

# AVIFAUNAL IMPACT ASSESSMENT

## Camden II Wind Energy Facility, Grid Connection and Battery Storage Facility Mpumalanga Province



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# EXECUTIVE SUMMARY

## 1 BACKGROUND

The proposed Camden Renewable Energy Complex (the 'Complex') is being developed by ENERTRAG South Africa (Pty) Ltd ("ENERTRAG" or "Developer") in the context of the Department of Mineral Resources and Energy's (DMRE) Integrated Resource Plan, and the Renewable Energy Independent Power Producer Procurement Programme (REIPPP).

The Complex can be divided into eight (8) Projects, namely:

- Camden I Wind Energy Facility (up to 200MW).
- Camden I Wind Grid Connection (up to 132kV).
- Camden up to 400kV Grid Connection and Collector substation.
- Camden I Solar up to 100MW.
- Camden I Solar up to 132kV Grid Connection.
- Camden Green Hydrogen and Ammonia Facility, including grid connection infrastructure and water pipeline.
- Camden II Wind Energy Facility (up to 200MW).
- Camden II Wind Energy Facility up to 132kV Grid Connection.

This impact report deals with the Camden II Wind Energy Facility (WEF), Battery Energy Storage System (BESS) and 132kV grid connection.

## 2 AVIFAUNA

The SABAP2 data indicates that a total of 234 bird species could potentially occur within the broader area – Appendix 1 provides a comprehensive list of all the species. Of these, 37 species are classified as wind priority species and 78 as powerline sensitive species. Of the 37 wind priority species, 16 are South African Red List species, and of the 78 powerline sensitive species, 15 are South African Red List species. Of the wind priority species, 25 are likely to occur regularly in the development area, and 55 powerline sensitive species are likely to occur regularly in the project area.

## 3 SUMMARY AND CONCLUSION

### 3.1 Wind Energy Facility

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

- Displacement 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 medium voltage overhead lines in the operational phase.
- Collisions with the medium voltage overhead lines in the operational phase.
- Displacement due to disturbance linked to dismantling activities in the decommissioning phase.

#### 3.1.1 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 following species could be impacted by disturbance during the construction phase African Grass Owl, Black-bellied Bustard, Blue Crane, Blue Korhaan, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Marsh Owl, Northern Black Korhaan, Spotted Eagle-Owl and White-bellied Bustard. The impact is rated as **moderate** pre-mitigation and will be reduced but remain at a **moderate** level post-mitigation.

### **3.1.2 Displacement of priority species due to habitat transformation in the construction phase**

The network of existing roads at the WEF has likely resulted in significant habitat fragmentation. This, together with the disturbance factor of the operating turbines, could have an effect on 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 following species are likely to be most affected by habitat transformation: African Grass Owl, Black-bellied Bustard, Black-winged Lapwing, Blue Crane, Blue Korhaan, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Marsh Owl, Northern Black Korhaan, Secretarybird and White-bellied Bustard. The impact is rated as **moderate** pre-mitigation and will be reduced but remain at a **moderate** level post-mitigation.

### **3.1.3 Collision mortality of priority species caused by the wind turbines in the operational phase**

The proposed Camden II Wind Energy Facility 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., bustards, cranes, flamingos, storks, Southern Bald Ibis and Secretarybird, although bustards and cranes generally seem to be not as vulnerable to turbine collisions as was originally anticipated (Ralston-Paton & Camagu 2019). Soaring priority species, i.e., species such as Cape Vulture and a variety of raptors, including several species of eagles, are highly vulnerable to the risk of collisions. The following priority species could be at risk of collisions with the turbines: Common Buzzard, Jackal Buzzard, Blue Crane, Brown Snake Eagle, Black-chested Snake Eagle, Long-crested Eagle, Martial Eagle, Peregrine Falcon, Lanner Falcon, Greater Flamingo, Lesser Flamingo, Montagu's Harrier, African Marsh Harrier, Black Harrier, African Harrier-Hawk, Cape Vulture, Secretarybird, Black-bellied Bustard, White-bellied Bustard, Denham's Bustard, Wattled Crane, Grey Crowned Crane, African Fish Eagle, Spotted Eagle-Owl, Amur Falcon, Grey-winged Francolin, Southern Bald Ibis, Black-winged Kite, Northern Black Korhaan, Blue Korhaan, Black-winged Lapwing, Western Osprey, Marsh Owl, African Grass Owl, Black Sparrowhawk and White Stork. The impact is rated as **moderate** pre-mitigation but should be reduced to a **low** level post-mitigation.

### **3.1.4 Electrocutation of priority species on the medium voltage overhead lines (if any) in the operational phase**



While the intention is to place the medium voltage reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the electrical infrastructure could potentially pose an electrocution risk to several power line sensitive species that could on occasion perch on these poles. In summary, the following priority species are potentially vulnerable to electrocution in this manner: African Fish Eagle, African Grass Owl, Amur Falcon, Black Sparrowhawk, Black-chested Snake Eagle, Black-headed Heron, Black-winged Kite, Brown Snake Eagle, Cape Crow, Cape Vulture, Common Buzzard, Hadada Ibis, Helmeted Guineafowl, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Peregrine Falcon, Pied Crow, Southern Bald Ibis, Spotted Eagle-Owl, Western Barn Owl, Western Osprey and Yellow-billed Kite. The impact is rated as **moderate** pre-mitigation but should be reduced to a **low** level post-mitigation.

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

While the intention is to place the medium voltage reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. These spans could pose a collision risk to virtually all powerline sensitive avifauna, depending on where those spans are located. Species potentially at risk are African Black Duck, African Darter, African Grass Owl, African Sacred Ibis, African Spoonbill, Black Heron, Black-bellied Bustard, Black-crowned Night Heron, Black-headed Heron, Black-necked Grebe, Blue Crane, Blue Korhaan, Blue-billed Teal, Cape Shoveler, Cape Teal, Cape Vulture, Denham's Bustard, Egyptian Goose, Fulvous Whistling Duck, Glossy Ibis, Goliath Heron, Great Egret, Greater Flamingo, Grey Crowned Crane, Grey Heron, Hadada Ibis, Hamerkop, Intermediate Egret, Lesser Flamingo, Little Egret, Little Grebe, Mallard, Marsh Owl, Northern Black Korhaan, Purple Heron, Red-billed Teal, Red-knobbed Coot, Reed Cormorant, Secretarybird, South African Shelduck, Southern Bald Ibis, Southern Pochard, Spotted Eagle-Owl, Spur-winged Goose, Squacco Heron, Wattled Crane, Western Barn Owl, Western Cattle Egret, White Stork, White-backed Duck, White-bellied Bustard, White-breasted Cormorant, White-faced Whistling Duck, Yellow-billed Duck. The impact is rated as **moderate** pre-mitigation but should be reduced to a **low** level post-mitigation.

### **3.1.6 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 **medium** pre-mitigation and it will decrease to **low** post-mitigation.

## **3.2 Battery Energy Storage Facility (BESS)**

The impact that is associated with the construction of the BESS is the potential displacement of priority avifauna due to disturbance associated with the construction and dismantling of the facility and habitat transformation in the footprint of the facility.

### **3.2.1 Displacement due to disturbance associated with the construction of the facility**

Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although in practice that can admittedly be challenging to implement. The priority species which are potentially most vulnerable to the impact of

displacement due to disturbance linked to the BESS are terrestrial species and owls. Priority species that could be most affected are the following: African Grass Owl, Black-bellied Bustard, Black-winged Lapwing, Blue Crane, Blue Korhaan, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Marsh Owl, Northern Black Korhaan, Secretarybird and White-bellied Bustard. The impact is rated as **low** pre- and post-mitigation.

### **3.2.2 Displacement due to habitat transformation associated with the construction of the facility**

These construction activities will impact on birds breeding, foraging and roosting in or in close proximity of the proposed facility through **transformation of habitat**, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the facility is unavoidable. The loss of habitat for priority species due to direct habitat transformation associated with the construction of the 5 ha proposed facility is likely to be relatively insignificant due to the relatively small size of the footprint (only 0.1% of the total project area, and 2.5% of the buildable area). The impact is rated as **low** pre-mitigation and it will decrease to **very low** post-mitigation.

### **3.2.3 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 BESS. The impact is rated as **low** pre-mitigation and it will decrease to **very low** post-mitigation.

## **3.3 The up to 132kV OHL**

The following potential impacts on powerline sensitive avifauna are associated with the construction and operation of the up to 132kV grid connection related to the Wind Energy Facility:

- Displacement due to disturbance associated with the construction of the proposed OHL and on-site substation.
- Displacement due to habitat transformation associated with the construction of the proposed OHL and on-site substation.
- Mortality due to electrocution on the proposed OHL infrastructure
- Mortality due to electrocution on the electrical infrastructure within the proposed on-site substation.
- Mortality due to collisions with the proposed OHL.
- Displacement due to disturbance associated with the dismantling of the proposed OHL and on-site substation.

### **3.3.1 Displacement due to disturbance associated with the construction of the proposed OHL and on-site substation.**

Construction activities could impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although this is often impractical to implement due to tight construction schedules. Powerline sensitive species which are potentially most vulnerable to displacement due to disturbance are mostly ground nesting species: African Grass Owl, Black-bellied Bustard, Blue Crane, Blue Korhaan, Denham's Bustard, Grey Crowned Crane, Helmeted Guineafowl, Marsh Owl, Northern Black Korhaan, Secretarybird, Spotted Eagle-Owl and White-bellied Bustard. The impact is rated as **moderate** pre-mitigation and it will decrease to **low** post-mitigation.

### **3.3.2 Displacement due to habitat transformation associated with the construction of the proposed OHL and on-site substation.**

During the construction of powerlines, service roads (jeep tracks), substations and other associated infrastructure, habitat destruction/transformation inevitably takes place. These activities could impact on birds breeding, foraging and roosting in or in close proximity of the proposed OHL grid connection through the transformation of habitat. Relevant to this development, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the on-site substation is unavoidable. In the case of the OHL, the direct habitat transformation is limited to the on-site substation and pole/tower footprints and the narrow access road/track under the proposed OHL. The loss of habitat in the substation footprint (2 ha) will be a relatively insignificant percentage of the habitat that regularly supports powerline sensitive species, and the resultant impact is likely to be fairly minimal. Powerline sensitive species which are potentially most vulnerable to displacement due to habitat transformation are mostly ground nesting species: African Grass Owl, Black-bellied Bustard, Blue Crane, Blue Korhaan, Denham's Bustard, Grey Crowned Crane, Helmeted Guineafowl, Marsh Owl, Northern Black Korhaan, Secretarybird, Spotted Eagle-Owl and, White-bellied Bustard. The impact is rated as **moderate** pre-mitigation and it will decrease to **low** post-mitigation.

### **3.3.3 Mortality of powerline sensitive avifauna due to electrocutions on the OHL**

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the voltage size of the proposed powerline and the pole/tower design. Should the proposed OHL be constructed using a 132kV tower specification, the electrocution impact for the majority of priority species will be negligible. The only priority species capable of bridging the clearance distances of an OHL constructed using this specification is the Cape Vulture, due to their size and gregarious nature. The impact is rated as **moderate** pre-mitigation and it will decrease to **low** post-mitigation.

### **3.3.4 Mortality of powerline sensitive avifauna due to electrocutions in the onsite substation**

Electrocutions within the proposed on-site substation are possible, however the likelihood of this impact on the more sensitive Species of Conservation Concern (SCC) is remote, as these species are unlikely to regularly utilise the infrastructure within the onsite substation station for perching or roosting. Powerline sensitive species that are more vulnerable to electrocutions are medium-sized raptors, corvids, owls and certain species of waterbirds. As far as the substation is concerned, the following species are potentially at risk of electrocution: African Fish Eagle, African Grass Owl, Amur Falcon, Black Sparrowhawk, Black-chested Snake Eagle, Black-headed Heron, Black-winged Kite, Brown Snake Eagle, Cape Crow, Cape Vulture, Common Buzzard, Hadada Ibis, Helmeted Guineafowl, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Peregrine Falcon, Pied Crow, Southern Bald Ibis, Spotted Eagle-Owl, Western Barn Owl, Western Osprey and Yellow-billed Kite. The impact is rated as **low** pre- and post-mitigation.

### **3.3.5 Mortality of powerline sensitive avifauna due to collisions with the OHL**

The up to 132kV OHL could pose a collision risk to virtually all powerline sensitive avifauna, depending on where the spans are located. Several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions, powerline configuration and visual capacity. Species potentially at risk are African Black Duck, African Darter, African Grass Owl, African Sacred Ibis, African Spoonbill, Black Heron, Black-bellied Bustard, Black-crowned Night Heron, Black-headed Heron, Black-necked Grebe, Blue Crane, Blue Korhaan, Blue-billed Teal, Cape Shoveler, Cape Teal, Cape Vulture, Denham's Bustard, Egyptian Goose, Fulvous Whistling Duck, Glossy Ibis, Goliath Heron, Great Egret, Greater Flamingo, Grey Crowned Crane, Grey Heron, Hadada Ibis, Hamerkop, Intermediate Egret, Lesser Flamingo, Little Egret, Little Grebe, Mallard, Marsh Owl, Northern Black Korhaan, Purple Heron, Red-billed Teal, Red-knobbed Coot, Reed Cormorant, Secretarybird, South African Shelduck, Southern Bald Ibis, Southern Pochard, Spotted Eagle-Owl, Spur-winged Goose, Squacco Heron, Wattled Crane, Western Barn Owl, Western Cattle Egret, White Stork, White-backed Duck, White-bellied Bustard, White-breasted Cormorant, White-faced Whistling Duck, Yellow-billed Duck. The impact is rated as **moderate** pre-mitigation and it will decrease to **low** post-mitigation.

### **3.3.6 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 OHL and onsite substation. The impact is rated as **medium** pre-mitigation and it will decrease to **low** post-mitigation.

## **3.4 Cumulative impacts**

### **3.4.1 Wind Energy Facility**

The proposed Camden II WEF will consist of up to 45 turbines in total. According to information that is available, the number of additional wind turbines that are planned within a 30km radius in broadly similar habitat around the proposed WEF is another (up to) 37 i.e. for the proposed Camden I WEF. If both the Camden I and Camden II projects are approved, a total of up to 82 turbines may be developed, of which the Camden I will contribute approximately 45%. As such, the WEFs' contribution to the total number of turbines, and by implication to the cumulative impact of all the planned turbines, is High, but could be reduced to Moderate with appropriate mitigation. The total area of similar habitat (excluding opencast mining and urban areas) available to birds in the 30km radius around the project area (including the project area) is approximately 4 258 km<sup>2</sup>. This translates into approximately 1

turbine/52km<sup>2</sup> 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, and the impact could be reduced if the recommended mitigation at the two Camden wind projects (suggested here and in association with the Camden I Wind Energy Facility avifaunal report by this author) is diligently implemented.

### **3.4.2 Up to 132kV OHL**

The combined length of the grid connections for the Camden I and II renewable energy projects listed above, and the 400kV OHL to Camden Power Station Substation, is approximately 26.4km. The proposed Camden II grid connection will be a maximum of 12.2km long. The existing high voltage lines in the 30km radius around the proposed Camden I WEF run into hundreds of kilometres (see Figure 12). The Camden II grid OHL contribution to the total length of high voltage lines within a 30km radius, and by implication to the cumulative impact of all the planned and existing high voltage lines, is thus **Low** in comparison. However, the density of planned and existing high voltage lines within a 30km radius, and by implication the cumulative impact on avifauna, is considered to be **Moderate**.

### **3.4.3 Battery Energy Storage Facility**

The BESS will transform an area of approximately 5 ha. Given the available habitat of approximately 4 258km<sup>2</sup> within a 30km radius around the project site, the cumulative impact of displacement and habitat transformation caused by the BESS is **Low** due to the small footprint.

## **4 CONCLUSION AND IMPACT STATEMENT**

### **4.1 Wind Energy Facility**

The proposed wind energy facility will have a moderate impact on priority avifauna which, in most instances, could be reduced to a low impact through appropriate mitigation, although some instances 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.

### **4.2 The up to 132kV OHL**

The proposed up to 132kV OHL will have a mostly impact on priority avifauna which, in all instances, could be reduced to a low impact through appropriate mitigation. No fatal flaws were discovered during the onsite investigations. The proposed development is therefore supported, provided the mitigation measures listed in this report are strictly implemented.

### **4.3 Battery Energy Storage Facility (BESS)**

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



## 5 ENVIRONMENTAL SENSITIVITIES

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

- A 100m **all infrastructure exclusion zone** must be implemented around drainage lines and associated wetlands (except essential road, pipeline and gridline crossings). Wetlands are important breeding, roosting and foraging habitat for a variety of SCC, most notably for African Grass Owl (SA status Vulnerable), Grey Crowned Crane (SA status Endangered) and African Marsh Harrier (SA status Endangered). Where unavoidable, road and grid line crossings across these features should be restricted to the immediate footprint of the infrastructure only.
- Development in the remaining **high sensitivity grassland must be limited as far as possible (limited infrastructure zone)**. 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 SCC. These include Blue Crane (SA status near-threatened), Blue Korhaan (Global status near -threatened), White-bellied Bustard (SA Status Vulnerable), Denham's Bustard (SA Status Vulnerable).

See Figure (i) for the avifaunal sensitivities identified from a wind energy perspective.

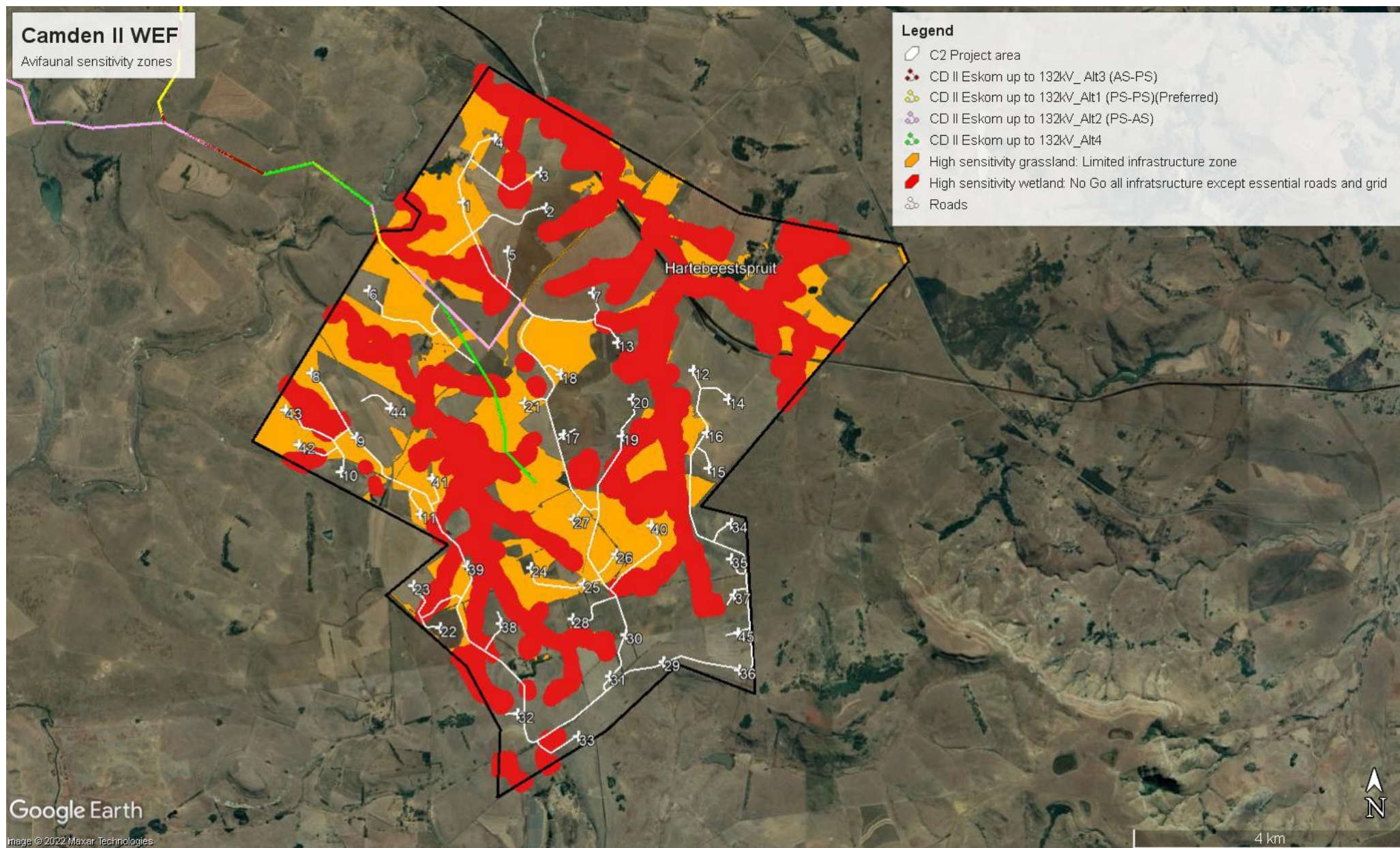


Figure (i): Proposed avifaunal exclusion zones at the Camden I Wind Energy Facility

# CONTENTS

<b>DETAILS OF THE SPECIALIST .....</b>	<b>13</b>
<b>1 INTRODUCTION.....</b>	<b>14</b>
<b>2 TERMS OF REFERENCE .....</b>	<b>19</b>
<b>3 OUTLINE OF METHODOLOGY AND INFORMATION REVIEWED .....</b>	<b>19</b>
<b>4 ASSUMPTIONS AND LIMITATIONS.....</b>	<b>21</b>
<b>5 LEGISLATIVE CONTEXT .....</b>	<b>21</b>
5.1 AGREEMENTS AND CONVENTIONS .....	21
5.2 NATIONAL LEGISLATION .....	22
5.3 PROVINCIAL LEGISLATION.....	23
<b>6 BASELINE ASSESSMENT .....</b>	<b>23</b>
6.1 IMPORTANT BIRD AREAS .....	23
6.2 DFFE NATIONAL SCREENING TOOL .....	24
6.3 PROTECTED AREAS.....	26
6.4 BIOMES AND VEGETATION TYPES.....	27
6.5 BIRD HABITAT.....	27
6.6 AVIFAUNA .....	36
<b>7 IMPACT ASSESSMENT.....</b>	<b>50</b>
7.1 COLLISION MORTALITY ON WIND TURBINES.....	51
7.2 DISPLACEMENT DUE TO DISTURBANCE.....	56
7.3 DISPLACEMENT DUE TO HABITAT LOSS.....	57
7.4 ELECTROCUTION ON THE MEDIUM VOLTAGE NETWORK .....	58
7.5 COLLISIONS WITH THE MEDIUM VOLTAGE NETWORK.....	58
<b>8 IMPACT RATING.....</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
8.1 IMPACT CRITERIA.....	<b>ERROR! BOOKMARK NOT DEFINED.</b>
8.2 IMPACT TABLES .....	<b>ERROR! BOOKMARK NOT DEFINED.</b>
8.3 CUMULATIVE IMPACTS .....	65
<b>9 MITIGATION MEASURES.....</b>	<b>69</b>
9.1 DESIGN PHASE .....	70
9.2 CONSTRUCTION PHASE.....	71
9.3 OPERATIONAL PHASE .....	71
9.4 DE-COMMISSIONING PHASE .....	72
<b>10 ENVIRONMENTAL SENSITIVITIES .....</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
<b>11 CONDITIONS FOR INCLUSION IN THE EMPR.....</b>	<b>75</b>
<b>12 ‘NO-GO’ ALTERNATIVE.....</b>	<b>75</b>
<b>13 SUMMARY AND CONCLUSION .....</b>	<b>75</b>
13.1 DISPLACEMENT OF PRIORITY SPECIES DUE TO DISTURBANCE LINKED TO CONSTRUCTION ACTIVITIES IN THE CONSTRUCTION PHASE.....	75
13.2 DISPLACEMENT DUE TO HABITAT TRANSFORMATION IN THE CONSTRUCTION PHASE .....	76
13.3 COLLISION MORTALITY CAUSED BY THE WIND TURBINES IN THE OPERATIONAL PHASE .....	76
13.4 ELECTROCUTION ON THE MEDIUM VOLTAGE OVERHEAD LINES (IF ANY) IN THE OPERATIONAL PHASE.....	76
13.5 COLLISIONS WITH THE MEDIUM VOLTAGE OVERHEAD LINES (IF ANY) IN THE OPERATIONAL PHASE .....	77
13.6 DISPLACEMENT OF PRIORITY SPECIES DUE TO DISTURBANCE LINKED TO DISMANTLING ACTIVITIES IN THE DECOMMISSIONING PHASE .....	77

13.7 CUMULATIVE IMPACTS .....	80
<b>14 CONCLUSION AND IMPACT STATEMENT .....</b>	<b>81</b>
<b>15 POST CONSTRUCTION PROGRAMME .....</b>	<b>82</b>
<b>16 REFERENCES.....</b>	<b>82</b>
<b>APPENDIX 1: SPECIES LIST.....</b>	<b>92</b>
<b>APPENDIX 2: HABITAT FEATURES AT THE DEVELOPMENT AREA .....</b>	<b>102</b>
<b>APPENDIX 3: PRE-CONSTRUCTION MONITORING .....</b>	<b>102</b>
<b>APPENDIX 4: FLIGHT MAPS.....</b>	<b>105</b>
<b>APPENDIX 5: ASSESSMENT CRITERIA .....</b>	<b>111</b>
<b>APPENDIX 6: ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR) .....</b>	<b>122</b>
<b>APPENDIX 7: POST-CONSTRUCTION MONITORING PLAN.....</b>	<b>130</b>



## **DETAILS OF THE SPECIALIST**

### **Chris van Rooyen (Bird Specialist)**

Chris has 25 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous power line and wind generation projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently (2016) accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

### **Albert Froneman (Bird and GIS Specialist)**

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

# 1 INTRODUCTION

The proposed Camden Renewable Energy Complex (the 'Complex') is being developed by ENERTRAG South Africa (Pty) Ltd ("ENERTRAG" or "Developer") in the context of the Department of Mineral Resources and Energy's (DMRE) Integrated Resource Plan, and the Renewable Energy Independent Power Producer Procurement Programme (REIPPP).

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## 1.1 Wind Energy Facility and Battery Energy Storage Facility

Table 1 summarises the main features of the proposed WEF, relevant to potential avifaunal impacts.

Table 1: Camden II Energy Facility summary

<b>Facility Name</b>	Camden II Wind Energy Facility
<b>Applicant</b>	Camden II Wind Energy Facility (RF) Propriety Limited
<b>Municipalities</b>	Msukaligwa Local Municipality of the Gert Sibande District Municipality
<b>Affected Farms<sup>1</sup></b>	As above
<b>Extent</b>	5000 ha
<b>Buildable area</b>	Approximately 200 ha, subject to finalization based on technical and environmental requirements
<b>Capacity</b>	Up to 200MW
<b>Number of turbines</b>	Up to 45
<b>Turbine hub height:</b>	Up to 200m
<b>Rotor Diameter:</b>	Up to 200m
<b>Foundation</b>	<ul style="list-style-type: none"><li>• Concrete foundations of approximately of 25m diameter x 4.5m deep will be required for each turbine, requiring approximately 2500m<sup>3</sup> concrete. Please note these dimensions may be larger as required by the geotechnical conditions.</li><li>• Concrete foundation will be constructed to support a mounting ring.</li></ul>
<b>O&amp;M building footprint:</b>	Located near the substation. Septic/conservancy tanks (operational phase) with portable toilets for construction phase. Typical areas include: <ul style="list-style-type: none"><li>- Operations building – 20m x 10m = 200m<sup>2</sup></li><li>- Workshop – 15m x 10m = 150m<sup>2</sup></li><li>- Stores - 15m x 10m = 150m<sup>2</sup></li></ul>
<b>Construction camp laydown</b>	Typical area 100m x 50m = 5000m <sup>2</sup> . Sewage: Septic/conservancy tanks and portable toilets.

<sup>1</sup> Based on the current conceptual layout.

<b>Temporary laydown or staging area:</b>	Typical area 220m x 100m = 22000m <sup>2</sup> . Laydown area could increase to 30000m <sup>2</sup> for concrete towers, should they be required.
<b>Cement batching plant (temporary):</b>	Gravel and sand will be stored in separate heaps whilst the cement will be contained in a silo.
<b>Internal Roads:</b>	Width of internal road – Between 5m and 6m. Length of internal road – Approximately 60km. Where required for turning circle/bypass areas, access or internal roads may be up to 20m to allow for larger component transport.
<b>Cables:</b>	The medium voltage collector system will comprise of cables up to and include 33kV that run underground, except where a technical assessment suggest that overhead lines are required, in the facility connecting the turbines to the onsite substation.
<b>IPP site substation and battery energy storage system (BESS):</b>	<p>Total footprint will be up to 6.5ha in extent (5ha for the BESS and 1.5ha for the IPP portion of the substation). The substation will consist of a high voltage substation yard to allow for multiple (up to) 132kV feeder bays and transformers, control building, telecommunication infrastructure, access roads, etc.</p> <p>The BESS storage capacity will be up to 200MW/800MWh with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers.</p>

## 1.2 Up to 132kV Grid Connection

It is proposed that Camden II Wind Energy Facility will connect to the nearby Camden Collector substation (which in turn will connect to the Camden Power Station), through an up to 132kV powerline (either single or double circuit) from the Camden II Wind Energy Facility grid connection substation portion and that of the Collector substation. The powerline will be maximum of 12.1km in length. The onsite grid connection substation will consist of high voltage substation yard to allow for multiple (up to) 132kV feeder bays and transformers, control building, telecommunication infrastructure, access roads, etc. The area for the onsite substation will be up to 1.5ha. The up to 132kV powerline and substation will have a 250m assessment corridor for purposes of micro-siting. This application includes the necessary up to 132kV voltage electrical components required for connection at the Collector Substation.

See Figures 1, 2 and 3 for a map of the development area

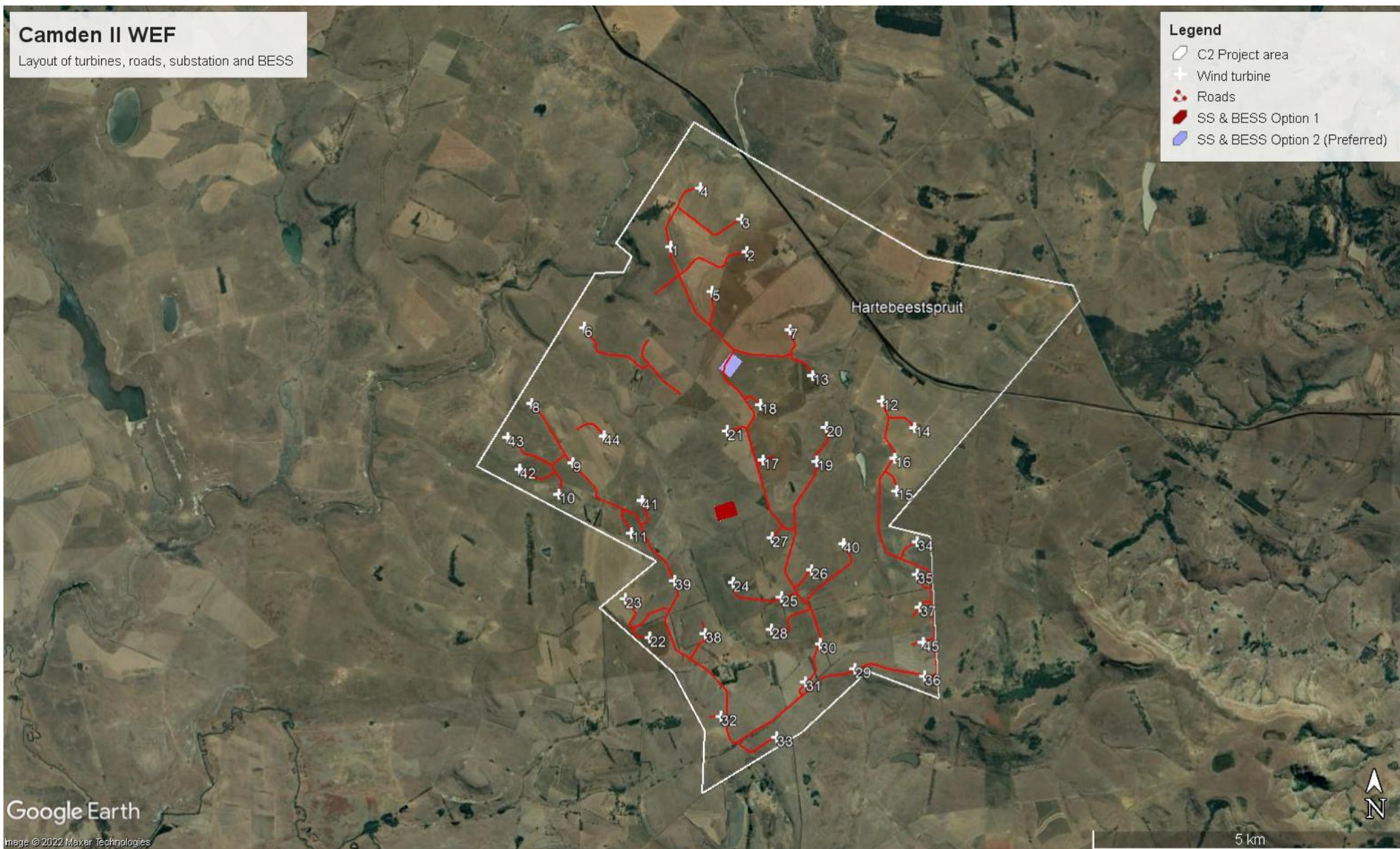


Figure 1: Proposed layout of the project area of the proposed Camden I WEF and BESS alternatives.



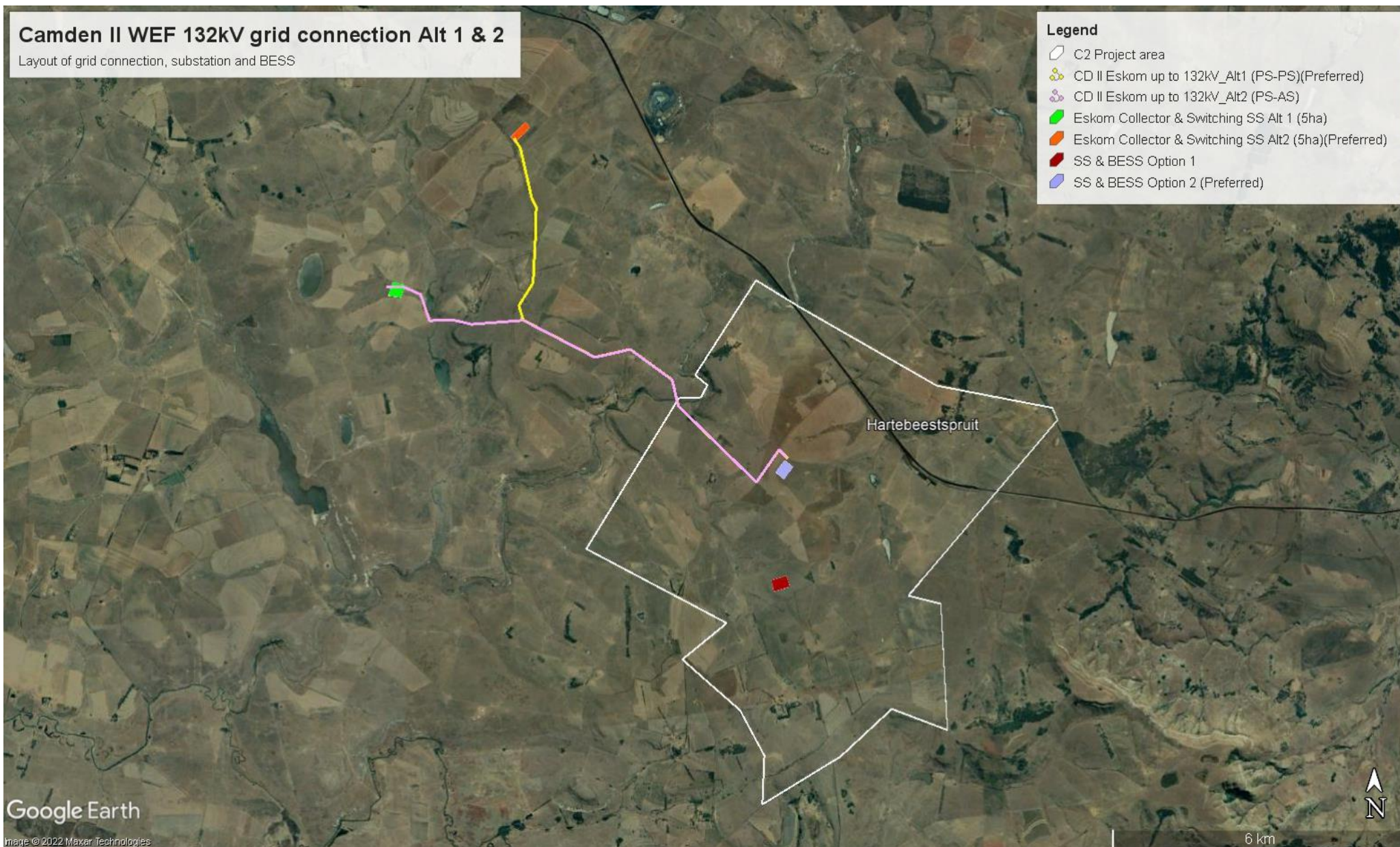


Figure 2: The lay-out of the proposed Camden I up to 132kV grid connection and Eskom collector & switching station.



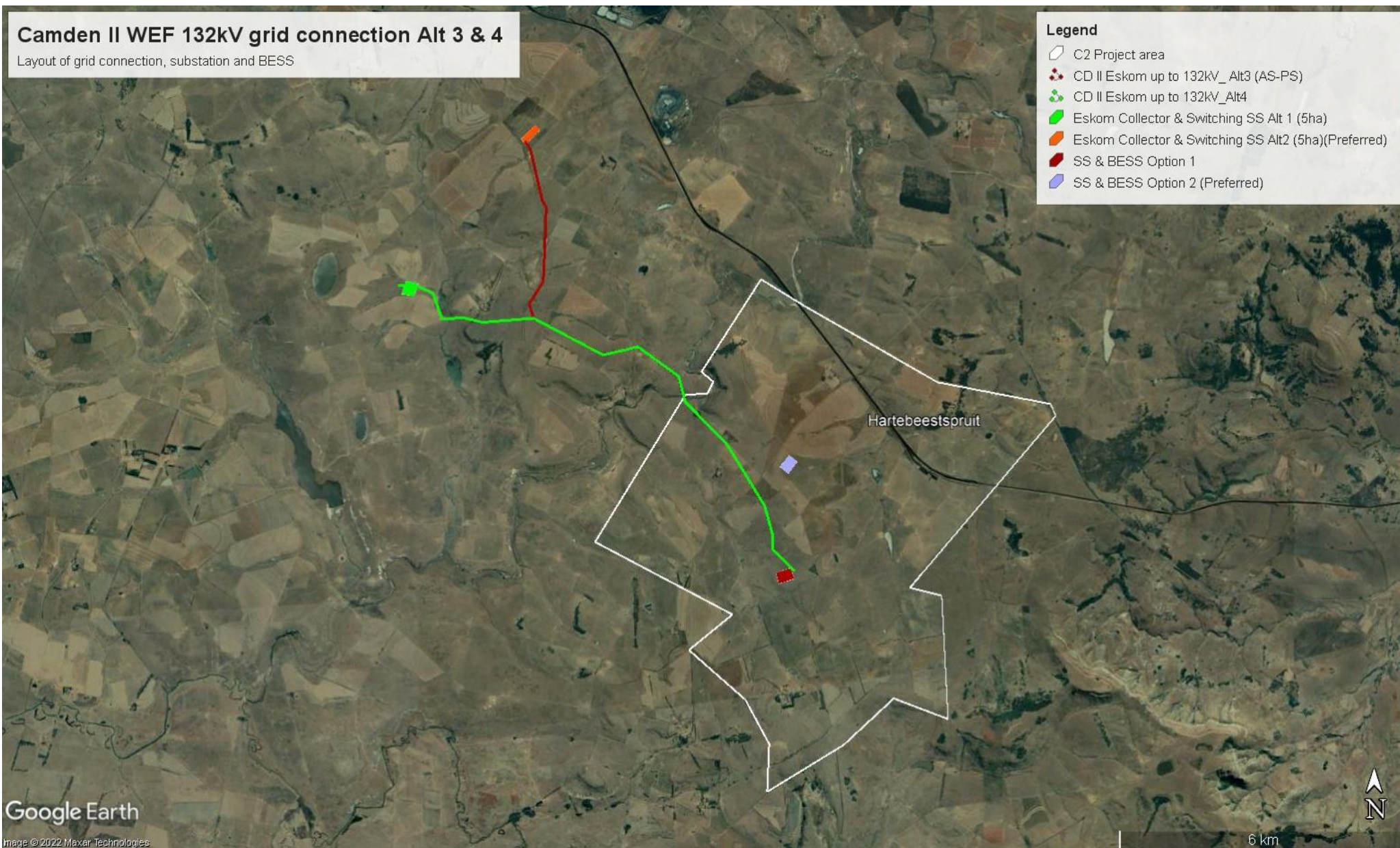


Figure 3: The lay-out of the proposed Camden I up to 132kV grid connection and Eskom collector & switching station.

## 2 TERMS OF REFERENCE & PROTOCOLS

### 2.1 Wind Energy Facility protocol

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).

### 2.2 Up to 132kV grid connection protocol

The Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species (Government Gazette No 43855, 30 October 2020).

The purpose of the specialist report is to determine the main issues and potential impacts of the proposed wind farm and grid connection, based by the on existing information and field assessments, according to the said protocols. In summary, the protocols require the following:

- 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, BESS and the up to 132kV grid connection.
- Identify potential sensitive environments and receptors that may be impacted on by the proposed wind farm, BESS and 132kV grid connection 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 of the WEF, BESS and up to 132kV grid connection.
- Identify avifaunal sensitivities, including 'No-Go' areas, where applicable.
- Recommend mitigation measures to reduce the impact of the expected impacts.
- Provide an impact statement on whether the projects should be approved or not.

## 3 OUTLINE OF METHODOLOGY AND INFORMATION REVIEWED

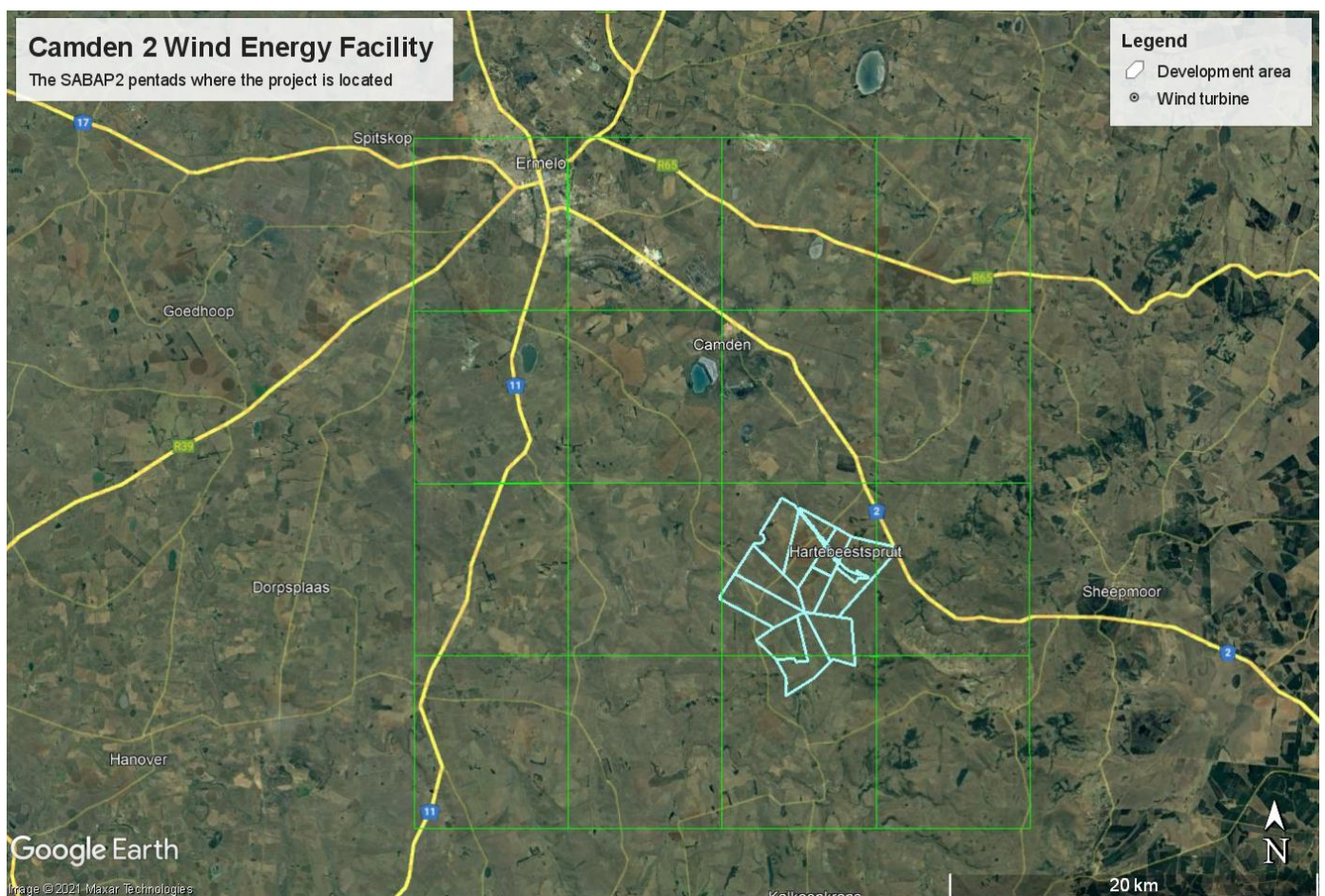
The following methods were employed to conduct this study:

- Priority species for wind development were identified from the updated list of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).
- 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.
- Bird distribution data from the Southern African Bird Atlas Project 2 (SABAP 2) was obtained (<http://sabap2.adu.org.za/>), in order to ascertain which species occur in the pentads where the proposed development is located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5' x 5'). Each pentad is approximately 8 x 7.6 km. To get a more representative impression of the birdlife, a consolidated data set was obtained for a total of 16 pentads some of which intersect and others that are near the development area, henceforth referred to as "the broader area" (see Figure 4Figure 5). The decision to include multiple pentads around the development area was to get a more representative picture of the bird abundance and variety in the region. The additional pentads and their data augment the bird distribution data. A total of 165 full protocol lists (i.e. bird listing surveys lasting a minimum of two hours each) and 227 ad hoc protocol lists (surveys lasting less than two hours but still yielding valuable data) have been completed to date for the 16 pentads where the development area is located. The SABAP2 data was therefore regarded as a reliable reflection of the avifauna



which occurs in the area, but the data was also supplemented by data collected during the site surveys and general knowledge of the area.

- A classification of the vegetation types in the development area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red List Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the latest (2021.3) IUCN Red List of Threatened Species (<http://www.iucnredlist.org/>).
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015; <http://www.birdlife.org.za/conservation/important-bird-areas>) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- Satellite imagery (Google Earth © 2022) was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- The South African National Biodiversity BGIS map viewer was used to determine the locality of the development areas relative to National Protected Areas.
- The DFFE National Screening Tool was used to determine the assigned avian sensitivity of the development areas.
- The South African National Biodiversity Institute (SANBI) guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa (2020) were consulted to assist with the interpretation of the Terrestrial Animal Species protocol.
- The main source of information on the avifaunal diversity and abundance at the project area is an integrated pre-construction monitoring programme which was implemented at the project area, covering all seven proposed sub projects of the Camden Renewable Energy Complex (See Appendix 3).



**Figure 4: Area covered by the four SABAP2 pentad grid cells (green squares).**



## 4 ASSUMPTIONS AND LIMITATIONS

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

- The SABAP2 dataset is a comprehensive dataset which provides a reasonably accurate snapshot of the avifauna which could occur at the proposed site. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, and the results of the pre-construction monitoring which was conducted over 12 months.
- Conclusions in this report are based on experience of these and similar species at wind farm developments in different parts of South Africa. However, bird behaviour can never be predicted with absolute certainty.
- To date, only one peer-reviewed scientific paper has been published on the impacts wind farms have on birds in South Africa (Perold *et al.* 2020). The precautionary principle was therefore applied throughout. The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle. The principle was implemented in an international treaty as early as the 1987 Montreal Protocol and, among other international treaties and declarations, is reflected in the 1992 Rio Declaration on Environment and Development. Principle 15 of the 1992 Rio Declaration states that: “in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation.”
- According to the specifications received from the proponent, the 33kV medium-voltage lines will be buried where practically feasible. It was therefore assumed that there could be 33kV overhead lines which could pose an electrocution risk to priority species.
- It is assumed that the up to 132kV overhead line will be built on poles/towers designed to 132kV specifications.

## 5 LEGISLATIVE CONTEXT

### 5.1 Agreements and conventions

Table 2 below lists agreements and conventions which South Africa is party to, and which are relevant to the conservation of avifauna<sup>2</sup>.

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

Convention name	Description	Geographic scope
African-Eurasian Waterbird Agreement (AEWA)	<p>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.</p> <p>Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.</p>	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	<p>The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives:</p> <p>The conservation of biological diversity</p> <p>The sustainable use of the components of biological diversity</p>	Global

<sup>2</sup> (BirdLife International (2021) Country profile: South Africa. Available from: [http://www.birdlife.org/datazone/country/south\\_africa](http://www.birdlife.org/datazone/country/south_africa). Checked: 2021-09-20).

	The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	Global
Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Global
Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia	The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate.	Regional

## 5.2 National legislation

### 5.2.1 Constitution of the Republic of South Africa, 1996

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

- (a) to an environment that is not harmful to their health or well-being; and
- (b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –
  - (i) prevent pollution and ecological degradation;
  - (ii) promote conservation; and
  - (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

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

The National Environmental Management Act 107 of 1998 (NEMA) creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out a number of guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated. NEMA also provides that a wide variety of listed developmental activities, which may significantly affect the environment, may be performed only after an environmental impact assessment has been done and authorization has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

**NEMA makes provision for the prescription of procedures for the assessment and minimum criteria for reporting on identified environmental themes (Sections 24(5)(a) and (h) and 44) when applying for environmental authorisation. In the case of wind energy developments, the Protocol for the specialist assessment and minimum report content requirements for environmental impacts on avifaunal species where the output is 20MW or more (Government Gazette No 43110, 20 March 2020) is applicable to the wind farm development. The Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal Species was published on 30 October 2020. This protocol applies also for the assessment of impacts caused by power lines and BESS on avifauna.**

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

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

## **5.3 Provincial Legislation**

The current legislation applicable to the conservation of fauna and flora in Mpumalanga is the Mpumalanga Nature Conservation Act 10 of 1998. It consolidated and amended the laws relating to nature conservation within the province and provides for matters connected therewith. All birds are classified as Protected Game (Section 4 (1) (b)), except those listed in Schedule 3, which are classified as Ordinary Game (Section 4 (1)(c)).

# **6 BASELINE ASSESSMENT**

## **6.1 Important Bird Areas**

The project site is located between two Important Bird Area (IBAs), overlapping slightly with one. The closest IBA to the project site is the Grasslands IBA SA020, which is located on the eastern border of the site, with one land parcel overlapping with the IBA. The Amersfoort-Bethal-Carolina SA018 is located 13km to the east of the site. The Chrissies Pans IBA SA019 is located 20km to the north-east of the site. Due to the close proximity of the site to the IBAs, it is possible that some highly mobile priority species which are also IBA trigger species, and which occur either permanently or sporadically in the IBAs, might be impacted by the project when they leave to forage or breed beyond the borders of the IBA. Species that were recorded in the broader area and fall within this category are the following:

- Secretarybird
- Pied Avocet
- Denham's Bustard
- Blue Crane
- Grey Crowned Crane
- Wattled Crane
- White-backed Duck
- Yellow-billed Duck
- Martial Eagle
- Lanner Falcon
- Greater Flamingo

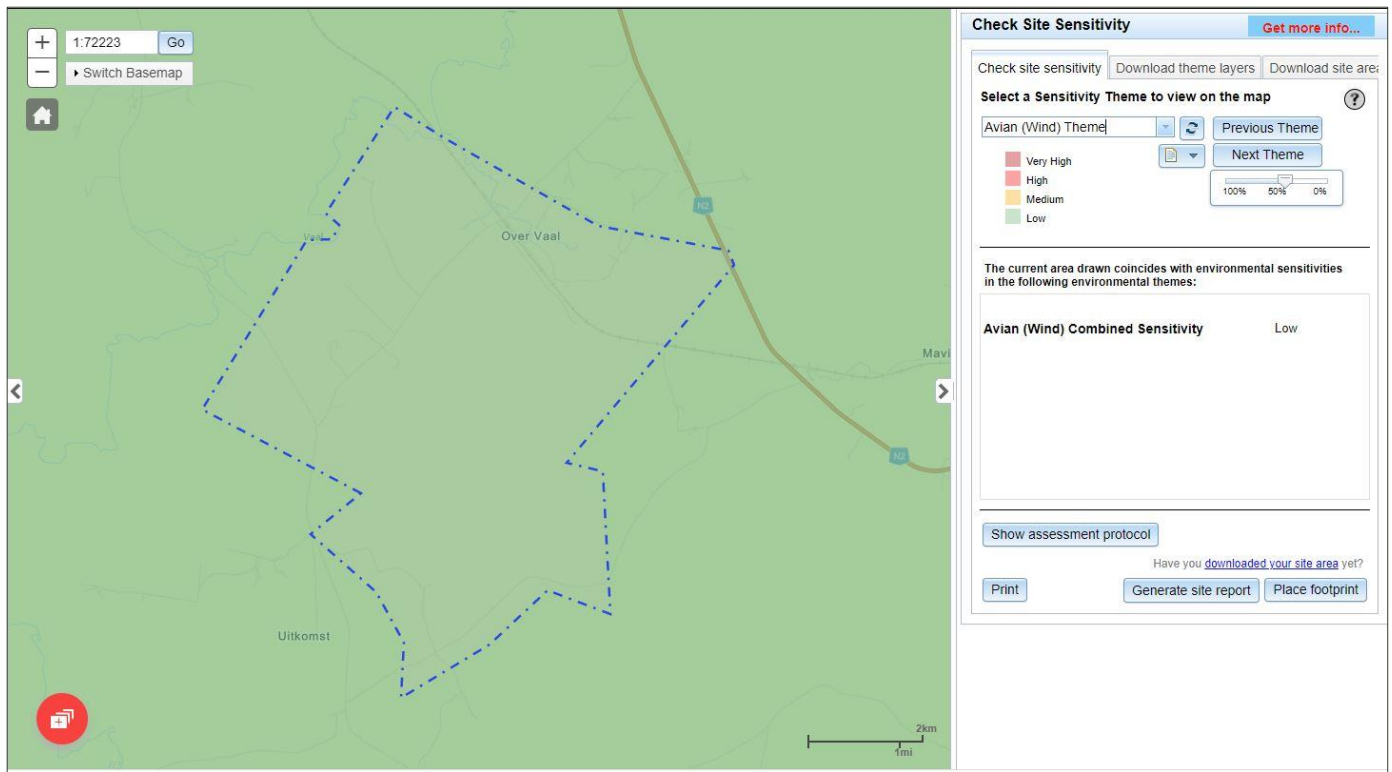
- Lesser Flamingo
- Black-necked Grebe
- Little Grebe
- African Marsh Harrier
- Black Harrier
- Southern Bald Ibis
- African Grass Owl
- Southern Pochard
- Cape Shoveler
- White-winged Tern

## 6.2 DFFE National Screening Tool

In the case of the Animal Species theme, relevant to the proposed grid connection and BESS, the project area is classified as **Medium to High** sensitivity, based on the potential presence of several species of conservation concern (SCC) namely Grey Crowned Crane (Globally and Regionally Endangered), Martial Eagle (Globally and Regionally Endangered), Southern Bald Ibis (Globally and Regionally Vulnerable), White-bellied Korhaan (Regionally Vulnerable), Secretarybird (Globally Endangered and Regionally Vulnerable) and Wattled Crane (Globally Vulnerable and Regionally Critically Endangered) (Figure 7). This classification was confirmed during the site surveys, based on the presence of recorded SCC, namely Secretarybird (Globally Endangered, Regionally Vulnerable) White-bellied Bustard (Regionally Vulnerable), Blue Crane (Globally Vulnerable, Regionally Near-threatened), Grey Crowned Crane (Globally and Regionally Endangered), Martial Eagle (Globally and Regionally Endangered), Lanner Falcon (Regionally Vulnerable), Greater Flamingo (Regionally Near-threatened), Lesser Flamingo (Globally and Regionally Near-threatened), Black Harrier (Regionally and Globally Endangered), Southern Bald Ibis (Regionally and Globally Vulnerable), Blue Korhaan (Globally Near-threatened), African Grass Owl (Regionally Vulnerable) and Cape Vulture (Globally Vulnerable and Regionally Endangered). This classification is applicable to the WEF, the up to 132kV grid connection, and the BESS.

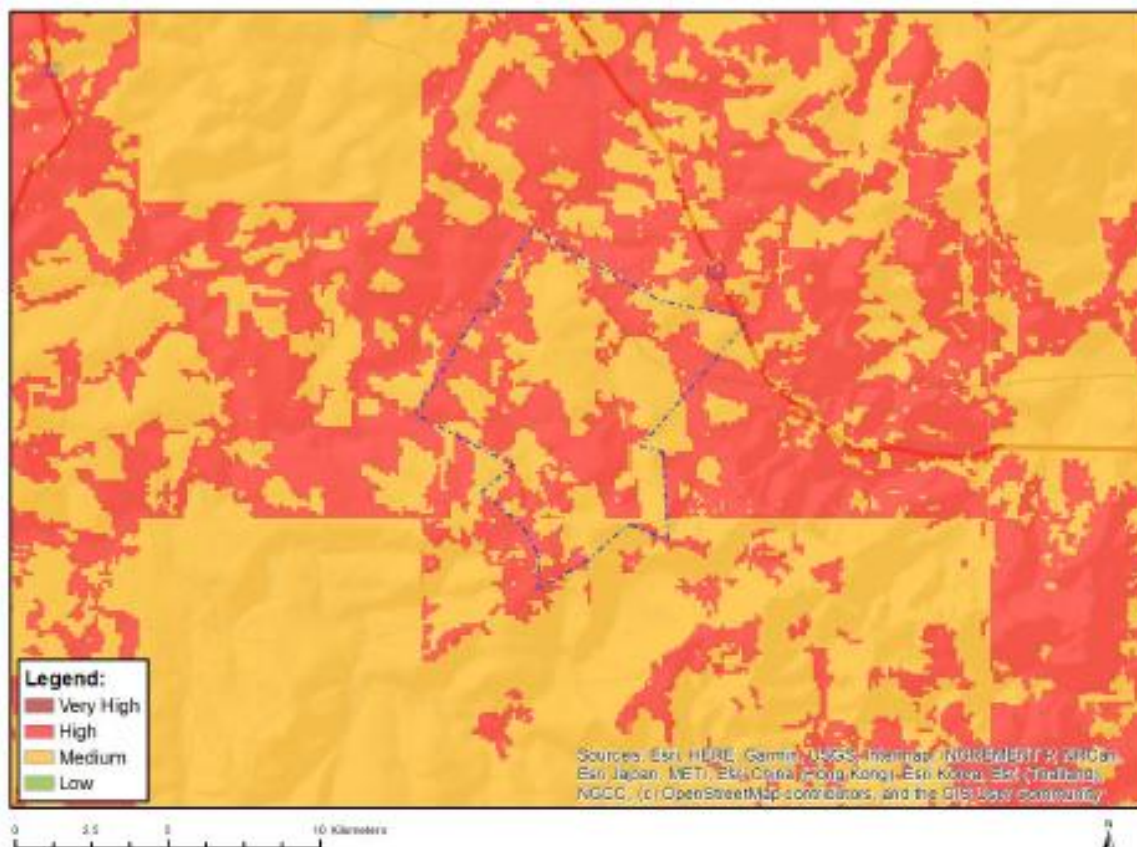
According to the DFFE national screening tool, the habitat within the project area is classified as **Low** sensitivity for birds according to the Avian Wind theme (see Figure 6). This classification for wind is not accurate as far as the impact of the proposed WEF is concerned, based on actual conditions recorded on the ground during the four seasons of pre-construction monitoring. The classification of the project area should be **High** based on the recorded presence of SCC in the project site.





**Figure 5: The National Web-Based Environmental Screening Tool map of the Camden I development area, indicating sensitivities for the Avian Wind theme. The classification of the wind energy facility should be changed to High sensitivity based on the presence of several species of conservation concern recorded at the project area.**

## MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at [eiadatarequests@sanbi.org.za](mailto: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-Neotis denhami
High	Aves-Polemaetus bellicosus
High	Aves-Geronticus calvus
High	Aves-Eupodotis senegalensis
Medium	Aves-Sagittarius serpentarius
Medium	Aves-Hydroprogne caspia
Medium	Aves-Neotis denhami
Medium	Aves-Balearica regulorum
Medium	Aves-Geronticus calvus

Medium	Aves-Eupodotis senegalensis
Medium	Aves-Grus carunculata
Medium	Aves-Tyto capensis
Medium	Mammalia-Crocidura maquassiensis
Medium	Mammalia-Ourebia ourebi ourebi

Figure 6: The National Web-Based Environmental Screening Tool map of the Camden II development area and immediate surrounding area, indicating sensitivities for the Animal Species theme. This classification is applicable to the WEF, the up to 132kV grid connection and the BESS.

## 6.3 Protected Areas

According to the South African Protected Areas database (SAPAD), the site borders on the Langcarel Private Nature Reserve, but does not actually overlap with it. From an avifaunal perspective the state of the habitat and land use is more important than the legal status, which has been surveyed and assessed for this assessment. The results provided are therefore applicable regardless of the legal status of the land parcels considered.

## 6.4 Biomes and vegetation types

The project area is situated in the Grassland Biome, in the Mesic Highveld Grassland Bioregion (Muchina & Rutherford 2006). Vegetation on site consists predominantly Amersfoort Highveld Clay Grassland and Eastern Highveld Grassland, which is comprised of undulating grassland plains, with small, scattered patches of dolerite outcrops in areas, low hills, and pan depressions. The vegetation is comprised of a short, closed grassland cover, largely dominated by a dense *Themeda triandra* sward, often severely grazed to form a short lawn (Mucina & Rutherford 2006).

Ermelo has a temperate climate. January is the warmest month with a maximum temperature of 24.4 C°. June and July are the coldest months, with a minimum temperature of 0.2 C°. The driest month is June with an average of 3 mm of precipitation. Most of the precipitation falls in December, averaging 151 mm. The average annual precipitation is around 756 mm (Climate – data.org 2021).

The topography in the project area is characterised by gentle undulating plains. The predominant land use for this area is livestock grazing with some crop farming, mostly maize, soya beans and pastures. The livestock in the project area is a combination of mostly sheep and cattle, with a few horses.

## 6.5 Bird habitat

Whilst much of the distribution and abundance of the bird species in the project area can be explained by the dominant biomes and vegetation types, it is also important to examine the modifications which have changed the natural landscape, and which may have an effect on the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types and are determined by a host of factors such as topography, land use and man-made infrastructure.

The following bird habitat classes were identified in the project area (see Appendix 2 for examples of the habitat classes):

### 6.5.1 Grassland

The majority of the habitat in the project area comprises grassland. The grassland varies from dense stands of relatively high grass to areas of heavily grazed short grass.

#### 6.5.1.1 Wind priority species

The wind priority species which could potentially use the grassland in the project area on a regular basis are the following:

- Secretarybird
- White-bellied Bustard
- Common Buzzard
- Jackal Buzzard
- Buff-streaked Chat
- Blue Crane
- Grey Crowned Crane

- Black-chested Snake Eagle
- Long-crested Eagle
- Spotted Eagle-Owl
- Amur Falcon
- Lanner Falcon
- Grey-winged Francolin
- African Harrier-Hawk
- Southern Bald Ibis
- Black-winged Kite
- Blue Korhaan
- Black-winged Lapwing
- African Grass Owl
- Marsh Owl
- Black Sparrowhawk
- White Stork

The wind priority species which could occasionally use the grassland in the project area are the following:

- Black-bellied Bustard
- Denham's Bustard
- Brown Snake Eagle
- Martial Eagle
- Peregrine Falcon
- African Marsh Harrier
- Black Harrier
- Montagu's Harrier
- Northern Black Korhaan
- Cape Vulture

#### **6.5.1.2 Powerline sensitive species**

The powerline sensitive species which could potentially use the grassland in the project area on a regular basis are the following:

- Secretarybird
- White-bellied Bustard
- Lanner Falcon
- Southern Bald Ibis
- African Grass Owl
- Blue Crane
- Blue Korhaan
- Grey Crowned Crane
- Common Buzzard
- Jackal Buzzard
- Cape Crow
- Pied Crow
- Black-chested Snake Eagle
- Long-crested Eagle
- Spotted Eagle-Owl



- Western Cattle Egret
- Amur Falcon
- Helmeted Guineafowl
- African Harrier-Hawk
- Black-headed Heron
- Hadada Ibis
- Black-winged Kite
- Marsh Owl
- Western Barn Owl
- White Stork

The powerline sensitive species which could occasionally use the grassland in the project area are the following:

- Denham's Bustard
- Martial Eagle
- Black Harrier
- Cape Vulture
- Black-bellied Bustard
- Brown Snake Eagle
- Peregrine Falcon
- Montagu's Harrier
- Yellow-billed Kite
- Northern Black Korhaan

#### **6.5.2 Drainage lines and wetlands**

There are several wetlands in the project area, most of which are associated with drainage lines. Wetlands are characterised by static or slow flowing water and are extensively covered by tall emergent wetland vegetation.

##### **6.5.2.1 Wind priority species**

The priority species which could potentially use the wetlands in the project area on a regular basis are the following:

- Blue Crane
- Grey Crowned Crane
- African Grass Owl
- Marsh Owl

The priority species which could occasionally use the wetlands in the project area are the following:

- African Marsh Harrier
- Montagu's Harrier
- Wattled Crane

##### **6.5.2.2 Powerline sensitive species**

The powerline sensitive species which could potentially use the wetlands in the project area on a regular basis are the following:

- African Grass Owl

- Blue Crane
- Grey Crowned Crane
- Hamerkop
- African Black Duck
- Great Egret
- Intermediate Egret
- Little Egret
- Glossy Ibis
- Hadada Ibis
- Marsh Owl

The powerline sensitive species which could occasionally use the wetlands in the project area are the following:

- African Marsh Harrier
- Wattled Crane

### **6.5.3 Agricultural lands**

The project site contains a patchwork of agricultural fields, where maize, soya beans and pastures are cultivated. Some fields are lying fallow or are in the process of being re-vegetated by grass.

#### **6.5.3.1 Wind priority species**

The priority species which could potentially use the agricultural fields in the project area on a regular basis are the following:

- Blue Crane
- Grey Crowned Crane
- Common Buzzard
- Spotted Eagle-Owl
- Amur Falcon
- Lanner Falcon
- Southern Bald Ibis
- Black-winged Kite

The priority species which could occasionally use the agricultural lands in the project area are the following:

- Peregrine Falcon
- African Marsh Harrier
- Montagu's Harrier
- Wattled Crane
- Black Harrier
- Black-bellied Bustard
- Denham's Bustard
- Brown Snake Eagle
- Martial Eagle
- Northern Black Korhaan
- Cape Vulture

#### **6.5.3.2 Powerline sensitive species**

The powerline sensitive species which could potentially use the agricultural fields in the project area on a regular basis are the following:

- Amur Falcon
- Blue Crane
- Egyptian Goose
- Grey Crowned Crane
- Helmeted Guineafowl
- Lanner Falcon
- Southern Bald Ibis
- Spur-winged Goose

The powerline sensitive species which could occasionally use the agricultural lands in the project area are the following:

- Black-bellied Bustard
- Brown Snake Eagle
- Cape Vulture
- Denham's Bustard
- Martial Eagle
- Montagu's Harrier
- Northern Black Korhaan
- Peregrine Falcon
- Wattled Crane
- Yellow-billed Kite

#### **6.5.4 Alien trees**

The development area contains few trees. Most trees are alien species, particularly Eucalyptus, Australian Acacia (Wattle), and Salix (Willow) species. Trees are often planted as wind breaks next to agricultural lands and around homesteads. Some of the drainage lines also have trees growing in them.

##### **6.5.4.1 Wind priority species**

The priority species which could potentially use the alien trees in the project area on a regular basis are the following:

- Grey Crowned Crane
- Common Buzzard
- Spotted Eagle-Owl
- Amur Falcon
- Lanner Falcon
- Southern Bald Ibis
- Black-winged Kite
- Jackal Buzzard
- Black-chested Snake Eagle
- Long-crested Eagle
- African Harrier-Hawk
- Black Sparrowhawk
- African Fish Eagle

The priority species which could occasionally use the alien trees in the project area are the following:

- Peregrine Falcon
- Brown Snake Eagle
- Martial Eagle
- Cape Vulture

#### **6.5.4.2 Powerline sensitive species**

The powerline sensitive species which could potentially use the alien trees in the project area on a regular basis are the following:

- African Darter
- African Fish Eagle
- African Harrier-Hawk
- African Sacred Ibis
- Amur Falcon
- Black Sparrowhawk
- Black-chested Snake Eagle
- Black-winged Kite
- Cape Crow
- Common Buzzard
- Grey Crowned Crane
- Hadada Ibis
- Helmeted Guineafowl
- Jackal Buzzard
- Lanner Falcon
- Long-crested Eagle
- Pied Crow
- Reed Cormorant
- Rock Kestrel
- Secretarybird
- Southern Bald Ibis
- Spotted Eagle-Owl
- Western Barn Owl
- Western Cattle Egret
- White-breasted Cormorant

The powerline sensitive species which could occasionally use the alien trees in the project area are the following:

- Brown Snake Eagle
- Cape Vulture
- Martial Eagle
- Peregrine Falcon
- Western Osprey
- Yellow-billed Kite

#### **6.5.5 Dams**

There are many ground dams at the project site, located in drainage lines.



#### 6.5.5.1 Wind priority species

The priority species which could potentially use the dams in the project area on a regular basis are the following:

- African Fish Eagle

The priority species which could occasionally use the dams and pans in the project area are the following:

- Western Osprey

#### 6.5.5.2 Powerline sensitive species

The powerline sensitive species which could potentially use the dams in the project area on a regular basis are the following:

- African Darter
- African Sacred Ibis
- African Swampphen
- Common Moorhen
- Egyptian Goose
- Great Egret
- Grey Heron
- Hamerkop
- Intermediate Egret
- Little Egret
- Little Grebe
- Purple Heron
- Red-billed Teal
- Red-knobbed Coot
- Reed Cormorant
- South African Shelduck
- Southern Pochard
- Spur-winged Goose
- White Stork
- White-breasted Cormorant

The priority species which could occasionally use the dams and pans in the project area are the following:

- Black Heron
- Black-crowned Night Heron
- Black-necked Grebe
- Blue-billed Teal
- Cape Teal
- Goliath Heron
- Mallard
- Squacco Heron
- Western Osprey

### 6.5.6 Pans

The project site contains only one medium-sized pan and a few small ones. These pans are a potential drawcard for many species. Lesser and Greater Flamingos could use these pans for foraging and roosting. Large raptors and vultures could use the pans for bathing and drinking, and Blue Cranes could roost there on occasion.

#### 6.5.6.1 Wind priority species

The wind priority species which could potentially use the pans in the project site on a regular basis are the following:

- Common Buzzard
- Jackal Buzzard
- Blue Crane
- Black-chested Snake Eagle
- Long-crested Eagle
- Lanner Falcon
- Greater Flamingo
- Lesser Flamingo
- African Harrier-Hawk

The priority species which could occasionally use the pans in the project site are the following:

- Brown Snake Eagle
- Martial Eagle
- Peregrine Falcon
- African Marsh Harrier
- Montagu's Harrier
- Black Harrier
- Cape Vulture
- Black-bellied Bustard
- Denham's Bustard
- Wattled Crane
- Northern Black Korhaan
- Western Osprey

#### 6.5.6.2 Powerline sensitive species

The powerline sensitive species which could potentially use the pans in the project area on a regular basis are the following:

- Black-chested Snake Eagle
- Blue Crane
- Egyptian Goose
- Greater Flamingo
- Grey Crowned Crane
- Hamerkop
- Lanner Falcon
- Lesser Flamingo
- Red-knobbed Coot
- Secretarybird

- South African Shelduck

The powerline sensitive species which could occasionally use the pans in the project area are the following:

- Brown Snake Eagle
- Cape Teal
- Cape Vulture
- Mallard
- Martial Eagle
- Peregrine Falcon
- Yellow-billed Kite

#### **6.5.7 High voltage lines**

The project area is transected by one high voltage line and two other high voltage lines run directly west within 2km of the project site all of which originate at the nearby Camden power station and substation. High voltage lines are used by a variety of avifauna for perching, roosting and in some cases, breeding. These include raptors, vultures, ibis and also cranes.

##### **6.5.7.1 Wind priority species**

The wind priority species which could potentially use the high voltage lines in the project area on a regular basis are the following:

- African Fish Eagle
- Amur Falcon
- Black-chested Snake Eagle
- Black-winged Kite
- Common Buzzard
- Grey Crowned Crane
- Lanner Falcon
- Long-crested Eagle
- Southern Bald Ibis

The wind priority species which could occasionally use the high voltage lines in the project area are the following:

- Brown Snake Eagle
- Cape Vulture
- Martial Eagle
- Peregrine Falcon

##### **6.5.7.2 Powerline sensitive species**

The powerline sensitive species which could potentially use the high voltage lines in the project area on a regular basis are the following:

- Amur Falcon
- Black-chested Snake Eagle
- Black-winged Kite
- Cape Crow



- Common Buzzard
- Jackal Buzzard
- Lanner Falcon
- Long-crested Eagle
- Pied Crow
- Rock Kestrel
- Southern Bald Ibis

The powerline sensitive species which could occasionally use the high voltage lines in the project area are the following:

- Brown Snake Eagle
- Cape Vulture
- Martial Eagle
- Peregrine Falcon
- Western Osprey

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

## **6.6 AVIFAUNA**

### **6.6.1 South African Bird Atlas Project 2**

The SABAP2 data indicates that a total of 234 bird species could potentially occur within the broader area – Appendix 1 provides a comprehensive list of all the species. Of these, 37 species are classified as wind priority species and 78 as powerline sensitive species. Of the 37 wind priority species, 16 are South African Red List species, and of the 78 powerline sensitive species, 15 are South African Red List species. Of the wind priority species, 25 are likely to occur regularly in the development area, and 55 powerline sensitive species are likely to occur regularly in the project area.

Table 3 and Table 4 list all the wind priority species and powerline sensitive species respectively that are likely to occur regularly and the possible impact on the respective species by the proposed wind farm (including the BESS) and 132kV grid connection. The following abbreviations and acronyms are used:

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

Table 3: Wind priority species potentially occurring at the project area.

Species name	Scientific name	SABAP2 reporting rate		Status			Recorded during monitoring	Likelihood of regular occurrence	Habitat						Impacts					
		Full protocol	Ad hoc protocol	Global status	Regional status	IBA trigger species			Grassland	Drainage lines & Wetlands	Alien trees	Pans	Agriculture	Dams	HV lines	Collision with turbines	Displacement - habitat transformation	Displacement - disturbance	Electrocution MV lines	Collision MV lines
African Fish Eagle	<i>Haliaeetus vocifer</i>	12.12	0.88	-	-		x	H			x			x	x	x			x	
African Grass Owl	<i>Tyto capensis</i>	2.42	0.00	-	VU	x	x	M	x	x						x	x	x	x	x
African Harrier-Hawk	<i>Polyboroides typus</i>	11.52	1.76	-	-		x	M	x		x	x				x			x	
African Marsh Harrier	<i>Circus ranivorus</i>	0.61	0.00	-	EN	x		L	x	x		x				x			x	
Amur Falcon	<i>Falco amurensis</i>	29.09	6.61	-	-		x	H	x		x		x		x	x				
Black Harrier	<i>Circus maurus</i>	0.00	0.88	EN	EN	x		L	x			x				x			x	
Black Sparrowhawk	<i>Accipiter melanoleucus</i>	12.12	0.88	-	-		x	M	x		x					x			x	
Black-bellied Bustard	<i>Lissotis melanogaster</i>	0.61	0.00	-	-			L	x							x	x	x		x
Black-chested Snake Eagle	<i>Circaetus pectoralis</i>	3.03	0.44	-	-		x	M	x		x	x			x	x			x	
Black-winged Kite	<i>Elanus caeruleus</i>	60.61	12.78	-	-		x	H	x		x		x		x	x			x	
Black-winged Lapwing	<i>Vanellus melanopterus</i>	14.55	0.00	-	-		x	H	x							x	x			
Blue Crane	<i>Grus paradisea</i>	11.52	0.44	VU	NT	x	x	H	x	x		x	x			x	x	x		x
Blue Korhaan	<i>Eupodotis caerulescens</i>	6.06	0.00	NT	LC	x	x	M	x							x	x	x		x
Brown Snake Eagle	<i>Circaetus cinereus</i>	1.82	0.00	-	-			L	x		x	x			x	x			x	
Buff-streaked Chat	<i>Campicoloides bifasciatus</i>	5.45	0.44	-	-	x		M	x								x	x		
Cape Vulture	<i>Gyps coprotheres</i>	0.00	0.00	EN	EN		x	L	x		x	x			x	x			x	x
Common Buzzard	<i>Buteo buteo</i>	27.88	9.25	-	-		x	H	x		x	x	x		x	x			x	
Denham's Bustard	<i>Neotis denhami</i>	1.82	0.00	NT	VU	x		L	x							x	x	x		x
Greater Flamingo	<i>Phoenicopterus roseus</i>	3.64	4.41	-	NT	x	x	M				x				x				x
Grey Crowned Crane	<i>Balearica regulorum</i>	5.45	0.00	EN	EN	x	x	M	x	x	x		x		x	x	x	x	x	x
Grey-winged Francolin	<i>Scleroptila afra</i>	27.27	2.20	-	-		x	H	x							x	x	x		
Jackal Buzzard	<i>Buteo rufofuscus</i>	19.39	2.20	-	-		x	H	x		x	x				x			x	
Lanner Falcon	<i>Falco biarmicus</i>	7.27	0.00	-	VU	x	x	M	x		x	x	x		x	x			x	
Lesser Flamingo	<i>Phoeniconaias minor</i>	3.64	1.32	NT	NT	x	x	M				x				x				x

Species name	Scientific name	SABAP2 reporting rate		Status			Recorded during monitoring	Likelihood of regular occurrence	Habitat						Impacts					
		Full protocol	Ad hoc protocol	Global status	Regional status	IBA trigger species			Grassland	Drainage lines & Wetlands	Alien trees	Pans	Agriculture	Dams	HV lines	Collision with turbines	Displacement - habitat transformation	Displacement - disturbance	Electrocution MV lines	Collision MV lines
Long-crested Eagle	<i>Lophaetus occipitalis</i>	6.67	9.25	-	-		x	M	x		x	x			x	x			x	
Marsh Owl	<i>Asio capensis</i>	5.45	0.44	-	-		x	H	x	x						x	x	x	x	x
Martial Eagle	<i>Polemaetus bellicosus</i>	2.42	0.00	EN	EN	x	x	L	x		x	x			x	x			x	
Montagu's Harrier	<i>Circus pygargus</i>	1.21	0.00	-	-			L	x	x		x				x			x	
Northern Black Korhaan	<i>Afrotis afraoides</i>	0.61	0.00	-	-			L	x							x	x	x		x
Peregrine Falcon	<i>Falco peregrinus</i>	1.21	0.00	-	-		x	L	x		x	x	x		x	x			x	
Secretarybird	<i>Sagittarius serpentarius</i>	13.33	0.00	EN	VU	x	x	H	x							x	x			x
Southern Bald Ibis	<i>Geronticus calvus</i>	23.03	3.08	VU	VU	x	x	H	x		x		x		x	x			x	x
Spotted Eagle-Owl	<i>Bubo africanus</i>	9.09	0.88	-	-		x	H	x		x		x			x		x	x	x
Wattled Crane	<i>Grus carunculata</i>	0.61	0.00	VU	CR	x		L		x						x				x
Western Osprey	<i>Pandion haliaetus</i>	0.61	0.00	-	-			L						x		x			x	
White Stork	<i>Ciconia ciconia</i>	7.27	1.32	-	-		x	M	x							x				x
White-bellied Bustard	<i>Eupodotis senegalensis</i>	7.88	0.00	-	VU	x	x	M	x							x	x	x		x



Table 4: Powerline sensitive species potentially occurring at the project area.

Species name	Scientific name	SABAP2 reporting rate		Status			Recorded during surveys	Likelihood of regular occurrence	Habitat							Impacts			
		SABAP2 full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate	Global status	Regional status	IBA trigger species			Grassland	Drainage lines and wetlands	Dams	Pans	Alien trees	HV lines	Agriculture	Collisions: Powerline	Displacement: Disturbance	Displacement: Habitat transformation	Electrocutions: Substation and MV lines
African Black Duck	<i>Anas sparsa</i>	11	0	-	-		x	H		x						x			
African Darter	<i>Anhinga rufa</i>	16	2.2	-	-		x	H			x		x			x			
African Fish Eagle	<i>Haliaeetus vocifer</i>	12	0.9	-	-		x	H					x						x
African Grass Owl	<i>Tyto capensis</i>	2.4	0	-	VU		x	M	x	x						x	x	x	x
African Harrier-Hawk	<i>Polyboroides typus</i>	12	1.8	-	-		x	M	x				x						
African Marsh Harrier	<i>Circus ranivorus</i>	0.6	0	-	EN			L		x									
African Sacred Ibis	<i>Threskiornis aethiopicus</i>	48	6.2	-	-		x	H			x		x			x			
African Spoonbill	<i>Platalea alba</i>	16	2.2	-	-		x	H								x			
African Swamphen	<i>Porphyrio madagascariensis</i>	6.1	2.2	-	-		x	M			x								
Amur Falcon	<i>Falco amurensis</i>	29	6.6	-	-		x	H	x				x	x	x				x
Black Harrier	<i>Circus maurus</i>	0	0.9	EN	EN			L	x										
Black Heron	<i>Egretta ardesiaca</i>	0.6	0	-	-			L			x					x			
Black Sparrowhawk	<i>Accipiter melanoleucus</i>	12	0.9	-	-		x	H					x						x
Black-bellied Bustard	<i>Lissotis melanogaster</i>	0.6	0	-	-			L	x						x	x	x	x	
Black-chested Snake Eagle	<i>Circaetus pectoralis</i>	3	0.4	-	-		x	M	x			x	x	x					x
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	0.6	0	-	-			L			x					x			
Black-headed Heron	<i>Ardea melanocephala</i>	52	4	-	-		x	H	x							x			x
Black-necked Grebe	<i>Podiceps nigricollis</i>	0.6	0.4	-	-			L			x					x			
Black-winged Kite	<i>Elanus caeruleus</i>	61	13	-	-		x	H	x				x	x					x
Blue Crane	<i>Grus paradisea</i>	12	0.4	VU	NT		x	H	x	x		x			x	x	x	x	
Blue Korhaan	<i>Eupodotis caerulea</i>	6.1	0	NT			x	H	x							x	x	x	
Blue-billed Teal	<i>Spatula hottentota</i>	1.2	0	-	-			L			x					x			
Brown Snake Eagle	<i>Circaetus cinereus</i>	1.8	0	-	-			L	x			x	x	x	x				x
Cape Crow	<i>Corvus capensis</i>	18	0.4	-	-		x	H	x				x	x					x
Cape Shoveler	<i>Spatula smithii</i>	19	0	-	-		x	H								x			
Cape Teal	<i>Anas capensis</i>	3	0	-	-		x	L			x	x				x			

Species name	Scientific name	SABAP2 reporting rate		Status			Recorded during surveys	Likelihood of regular occurrence	Habitat							Impacts			
		SABAP2 full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate	Global status	Regional status	IBA trigger species			Grassland	Drainage lines and wetlands	Dams	Pans	Alien trees	HV lines	Agriculture	Collisions: Powerline	Displacement: Disturbance	Displacement: Habitat transformation	Electrocutions: Substation and MV lines
Cape Vulture	<i>Gyps coprotheres</i>	0	0	EN	EN		x	L	x			x	x	x	x	x			x
Common Buzzard	<i>Buteo buteo</i>	28	9.3	-	-		x	H	x				x	x					x
Common Moorhen	<i>Gallinula chloropus</i>	33	1.8	-	-		x	H			x								
Denham's Bustard	<i>Neotis denhami</i>	1.8	0	NT	VU			L	x						x	x	x	x	
Egyptian Goose	<i>Alopochen aegyptiaca</i>	78	6.2	-	-		x	H			x	x			x	x			
Fulvous Whistling Duck	<i>Dendrocygna bicolor</i>	0	0.4	-	-			L								x			
Glossy Ibis	<i>Plegadis falcinellus</i>	4.2	1.8	-	-			M		x						x			
Goliath Heron	<i>Ardea goliath</i>	2.4	0	-	-			L			x					x			
Great Egret	<i>Ardea alba</i>	7.9	1.3	-	-			M		x	x					x			
Greater Flamingo	<i>Phoenicopterus roseus</i>	3.6	4.4	-	NT		x	M				x				x			
Grey Crowned Crane	<i>Balearica regulorum</i>	5.5	0	EN	EN		x	M	x	x		x	x		x	x	x	x	
Grey Heron	<i>Ardea cinerea</i>	25	3.5	-	-		x	H			x					x			
Hadada Ibis	<i>Bostrychia hagedash</i>	90	14	-	-		x	H	x	x			x			x			x
Hamerkop	<i>Scopus umbretta</i>	12	0	-	-		x	H		x	x	x				x			
Helmeted Guineafowl	<i>Numida meleagris</i>	49	3.1	-	-		x	H	x				x		x		x	x	x
Intermediate Egret	<i>Ardea intermedia</i>	14	1.8	-	-		x	H		x	x					x			
Jackal Buzzard	<i>Buteo rufofuscus</i>	19	2.2	-	-		x	H	x				x	x					x
Lanner Falcon	<i>Falco biarmicus</i>	7.3	0	-	VU		x	M	x			x	x	x	x				x
Lesser Flamingo	<i>Phoeniconaias minor</i>	3.6	1.3	NT	NT		x	M				x				x			
Little Egret	<i>Egretta garzetta</i>	4.2	1.3	-	-			H		x	x					x			
Little Grebe	<i>Tachybaptus ruficollis</i>	39	3.1	-	-		x	H			x					x			
Long-crested Eagle	<i>Lophaetus occipitalis</i>	6.7	9.3	-	-		x	M	x				x	x					x
Mallard	<i>Anas platyrhynchos</i>	0.6	0.4	-	-			L			x	x				x			
Marsh Owl	<i>Asio capensis</i>	5.5	0.4	-	-		x	M	x	x						x	x	x	x
Martial Eagle	<i>Polemaetus bellicosus</i>	2.4	0	EN	EN		x	L	x			x	x	x	x				x
Montagu's Harrier	<i>Circus pygargus</i>	1.2	0	-	-			L	x						x				
Northern Black Korhaan	<i>Afrotis afraoides</i>	0.6	0	-	-			L	x						x	x	x	x	
Peregrine Falcon	<i>Falco peregrinus</i>	1.2	0	-	-		x	L	x			x	x	x	x				x
Pied Crow	<i>Corvus albus</i>	12	3.5	-	-		x	H	x				x	x					x
Purple Heron	<i>Ardea purpurea</i>	4.2	0	-	-			M			x					x			

Species name	Scientific name	SABAP2 reporting rate		Status			Recorded during surveys	Likelihood of regular occurrence	Habitat							Impacts			
		SABAP2 full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate	Global status	Regional status	IBA trigger species			Grassland	Drainage lines and wetlands	Dams	Pans	Alien trees	HV lines	Agriculture	Collisions: Powerline	Displacement: Disturbance	Displacement: Habitat transformation	Electrocutions: Substation and MV lines
Red-billed Teal	<i>Anas erythrorhyncha</i>	17	1.3	-	-		x	H			x					x			
Red-knobbed Coot	<i>Fulica cristata</i>	58	4.8	-	-		x	H			x	x				x			
Reed Cormorant	<i>Microcarbo africanus</i>	64	4.8	-	-		x	H			x		x			x			
Rock Kestrel	<i>Falco rupicolus</i>	5.5	0.9	-	-		x	M					x	x					
Secretarybird	<i>Sagittarius serpentarius</i>	13	0	EN	VU		x	H	x			x	x			x	x	x	
South African Shelduck	<i>Tadorna cana</i>	30	3.5	-	-		x	H			x	x				x			
Southern Bald Ibis	<i>Geronticus calvus</i>	23	3.1	VU	VU		x	H	x				x	x	x	x			x
Southern Pochard	<i>Netta erythrophthalma</i>	9.1	0	-	-		x	M			x					x			
Spotted Eagle-Owl	<i>Bubo africanus</i>	9.1	0.9	-	-		x	M	x				x			x	x	x	x
Spur-winged Goose	<i>Plectropterus gambensis</i>	44	1.8	-	-		x	H			x				x	x			
Squacco Heron	<i>Ardeola ralloides</i>	1.2	0	-	-			L			x					x			
Wattled Crane	<i>Grus carunculata</i>	0.6	0	VU	CR			L		x					x	x			
Western Barn Owl	<i>Tyto alba</i>	3	0.4	-	-			M	x				x			x			x
Western Cattle Egret	<i>Bubulcus ibis</i>	45	12	-	-		x	H	x				x			x			
Western Osprey	<i>Pandion haliaetus</i>	0.6	0	-	-			L			x		x	x					x
White Stork	<i>Ciconia ciconia</i>	7.3	1.3	-	-		x	M	x		x					x			
White-backed Duck	<i>Thalassornis leuconotus</i>	6.7	0	-	-		x	M								x			
White-bellied Bustard	<i>Eupodotis senegalensis</i>	7.9	0	-	VU		x	M	x							x	x	x	
White-breasted Cormorant	<i>Phalacrocorax lucidus</i>	12	0.9	-	-		x	H			x		x			x			
White-faced Whistling Duck	<i>Dendrocygna viduata</i>	0.6	0	-	-			L								x			
Yellow-billed Duck	<i>Anas undulata</i>	62	4.4	-	-		x	H								x			
Yellow-billed Kite	<i>Milvus aegyptius</i>	2.4	0	-	-		x	L	x			x	x		x				x

## 6.6.2 Pre-construction monitoring

Table 55, and Figure 7 6 and 7 below present the results of the integrated pre-construction monitoring conducted at the Camden II project area and control area. Monitoring was conducted by means of drive transect counts, walk transect counts, vantage point watches, and focal point counts (see Appendix 3 for more detail on the methodology) as per the requirements of the latest avifaunal guideline at the time of writing. Monitoring was implemented in the following time slots, covering the original land parcels and subsequent extensions:

1. 26 July - 07 August 2020 (winter)
2. 16 September - 07 October and 05 November 2020 (spring)
3. 13 - 27 February 2021 (summer)
4. 18 - 21 March, 12 - 14 April, 03 - 13 May 2021 (autumn)
5. 26 July - 01 August 2021 (winter)
6. 31 August - 3 Sept 2021 (spring)

### 6.6.2.1 Transects

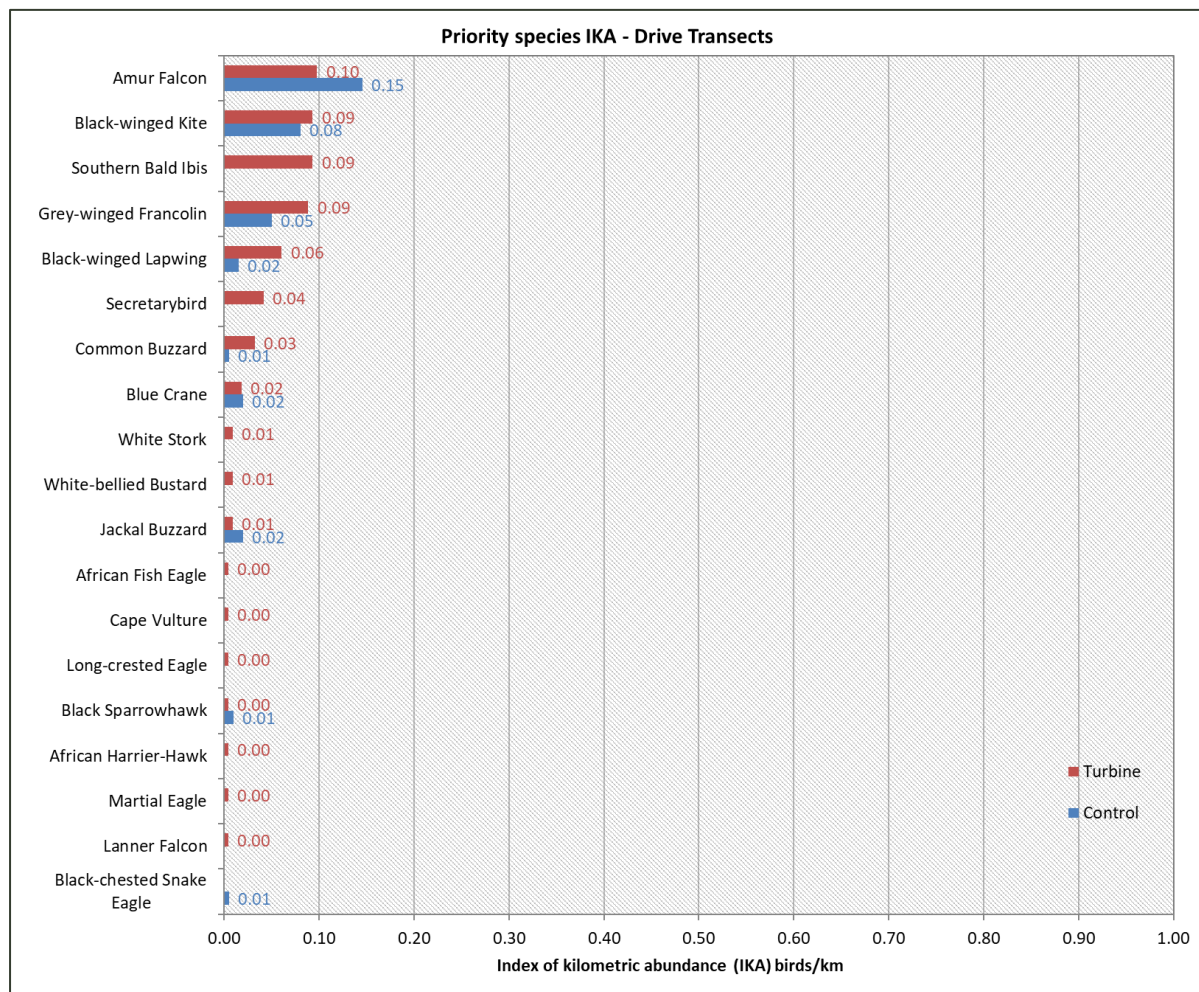
The results of the transect counts are tabled in Table 5 below:

**Table 5: The results of the transect counts**

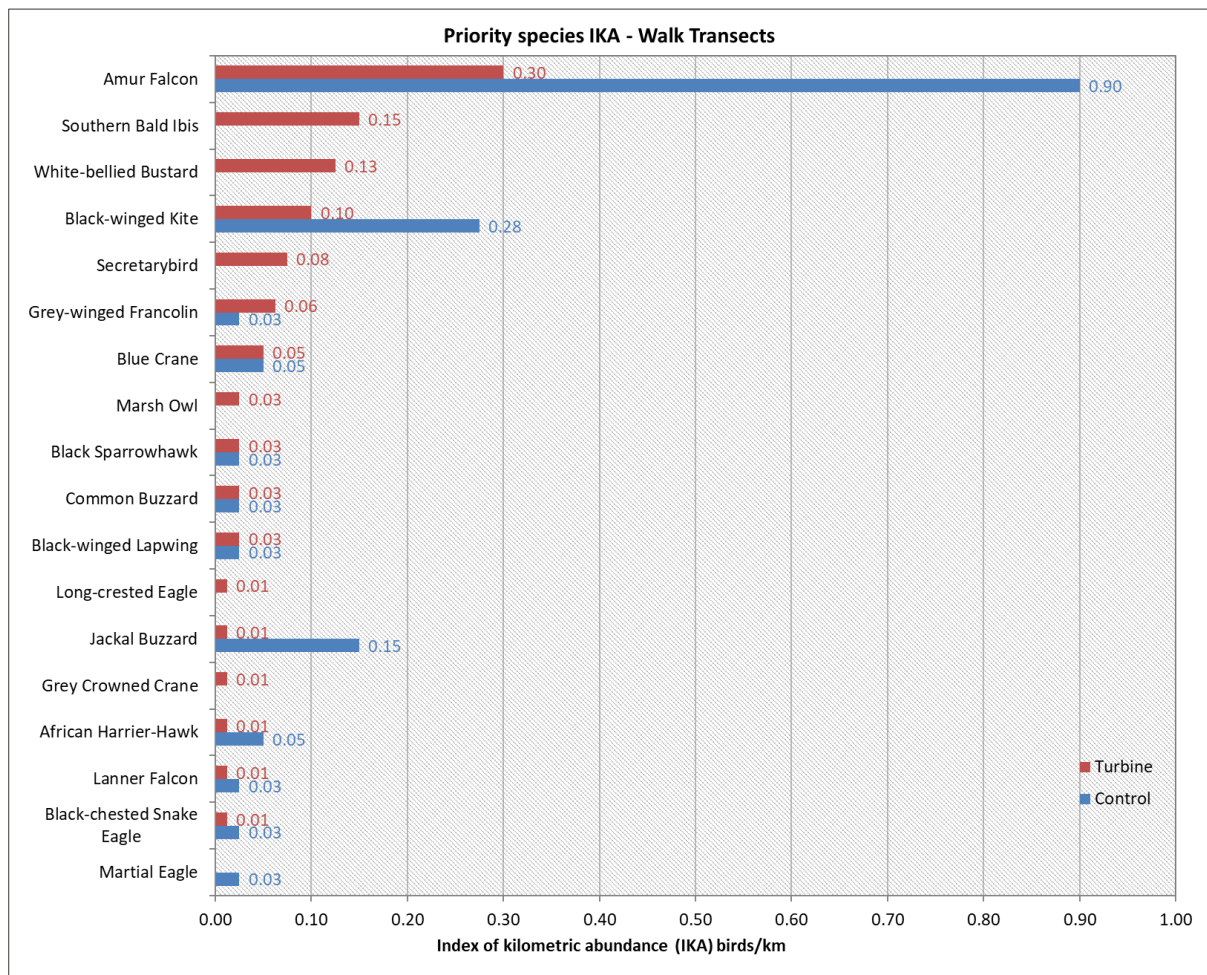
Turbine site	Number of records
<b>Species composition</b>	
All Species	142
Wind Priority Species (15%)	21
Non-Priority Species	121
<b>Total count</b>	
Drive transects	3039
Walk transects	3344
Total	6383
Control site	Number of records
<b>Species composition</b>	
All Species	123
Wind Priority Species (10%)	12
Non-Priority Species	111
<b>Total count</b>	
Drive transects	3536
Walk transects	2660
Total	6196



An Index of Kilometric Abundance (IKA = birds/km) was calculated for each wind priority species recorded during transects over all four seasons (see Figures 8 and 9 below).

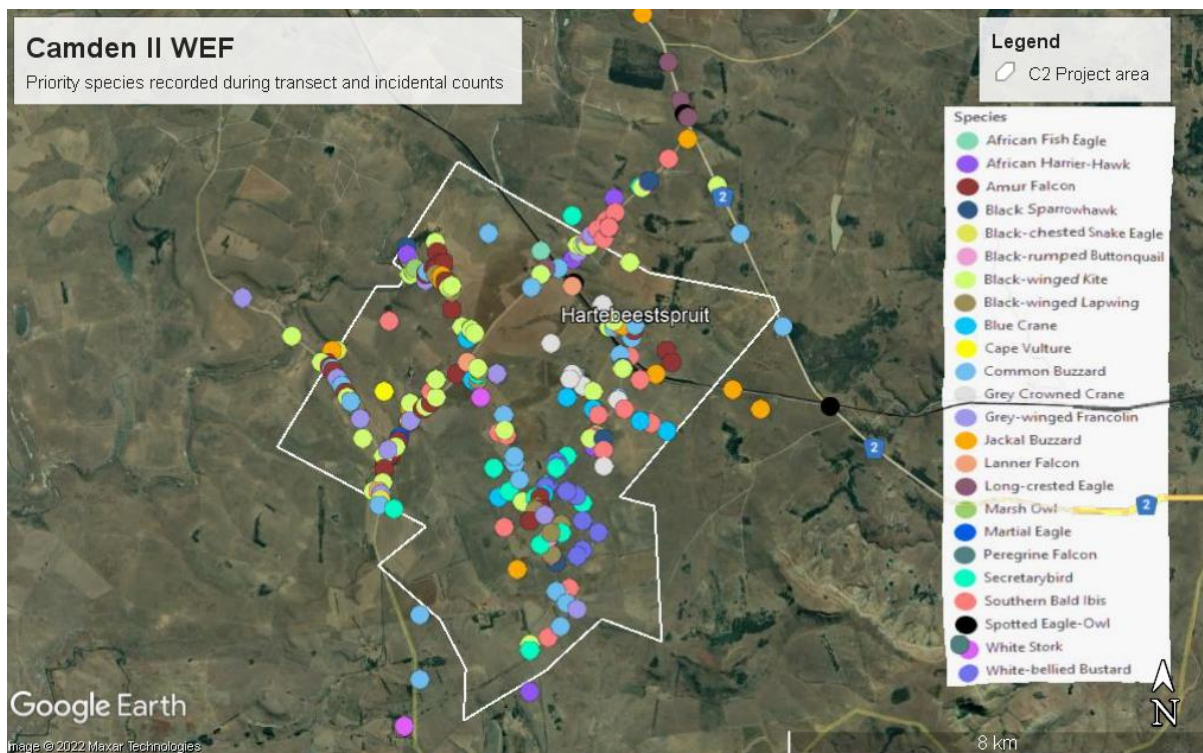


**Figure 7: Index of kilometric abundance of wind priority species recorded at the project area and control site through drive transect surveys over all four seasons.**



**Figure 8: Index of kilometric abundance of wind priority species recorded at the WEF through walk transect surveys over all four seasons.**

Figure 910 below shows the spatial distribution of the wind priority species recorded during transect counts and incidental sightings over all four seasons.



**Figure 9: The location of wind priority species recorded at the proposed WEF through transect counts and incidental sightings.**

#### 6.6.2.2 Focal points

A total of one potential focal point (FP) of bird activity was identified and monitored:

- FP1: A farm dam in a drainage line in the project area

A total of 276 birds were counted at the focal point over four seasons during four counts. The results of focal point counts are displayed in Table 6. SCC are indicated in red

**Table 6: Species recorded during focal points counts in the 12 months pre-construction monitoring period. Wind priority species are indicated with a (w). Powerline sensitive species are indicated with a (p). SCC are indicated in red.**

Focal point	Species
FP1: A farm dam in a drainage line in the project area	African Darter
	African Sacred Ibis (p)
	African Wattled Lapwing
	Black-headed Heron (p)
	Blacksmith Lapwing
	Brown-throated Martin
	Cape Longclaw
	Cape Shoveler
	Cape Wagtail
	Common Waxbill



	Egyptian Goose (p) Fan-tailed Widowbird Hadada Ibis (p) Hamerkop (p) Intermediate Egret (p) Levaillant's Cisticola Little Grebe (p) Long-tailed Widowbird Purple Heron (p) Red-knobbed Coot (p) Reed Cormorant (p) South African Shelduck (p) Southern Bald Ibis (p)(w) Southern Masked Weaver Southern Red Bishop Spur-winged Goose (w) Three-banded Plover Western Cattle Egret (p) Whiskered Tern White-throated Swallow Yellow-billed Duck (p) Yellow-crowned Bishop
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See Appendix 2 for the location of the focal points.

### 6.6.2.3 Incidental counts

Table 77 provides an overview of the incidental sightings of priority species during four surveys in the project area and immediate surroundings.

**Table 7: Incidental sightings of wind priority species made during 12 months pre-construction monitoring. SCC are indicated in red.**

Bird	Status	Survey 1	Survey 2	Survey 3	Survey V4	Survey V5	Survey V6	Total
African Fish Eagle		5	1	1	3			10
African Grass Owl	Regionally Vulnerable		1	1				2
African Harrier-Hawk		1		2				3
Amur Falcon				12				12
Black Sparrowhawk			3	3				6
Black-chested Snake Eagle				3				3
Black-rumped Buttonquail			1					1
Black-winged Kite		7	13	4	6	2	2	34
Black-winged Lapwing		1	1	1	2			5
Blue Crane	Regionally near-threatened	4	3	1				8
Blue Korhaan	Regionally Vulnerable		1					1
Common Buzzard			2	20	3			25



Greater Flamingo	Regionally near-threatened	2		1				3
Grey Crowned Crane	Globally and Regionally Endangered	3	3				4	10
Grey-winged Francolin		2	2	5	3			12
Jackal Buzzard		1	3	4	2		1	11
Lanner Falcon	Regionally Vulnerable			1				1
Lesser Flamingo	Globally and Regionally near-threatened	2		1				3
Long-crested Eagle		1		3	3			7
Marsh Owl		1		2				3
Martial Eagle	Globally and Regionally Endangered			1			1	2
Peregrine Falcon				1				1
Secretarybird	Regionally Vulnerable Globally Endangered	1	4	6	1			12
Southern Bald Ibis	Regionally Vulnerable	11	2	7		1	1	22
Spotted Eagle-Owl		1	2	4				7
White Stork				3				3
White-bellied Bustard	Regionally Vulnerable	2	4					6
Buff-streaked Chat					1			1
Brown Snake Eagle					1			1
Cape Vulture	Globally Vulnerable, Regionally Endangered				1			1

See Appendix 1 for a list of all species recorded during the pre-construction monitoring.

#### 6.6.2.4 Vantage point observations

A total of 192 hours of vantage point watches were completed at two vantage points in order to record flight patterns of priority species in the project area. In the sampling periods, the duration of priority species flights amounted to 25 hours, 58 minutes and 57 seconds. A total of 532 individual flights were recorded. The passage rate for priority species was 1.8 birds/hour. This amounts to approximately 23.6 birds per day.<sup>3</sup> See Figure 1011 below for the duration of flights for each priority species.<sup>4</sup>

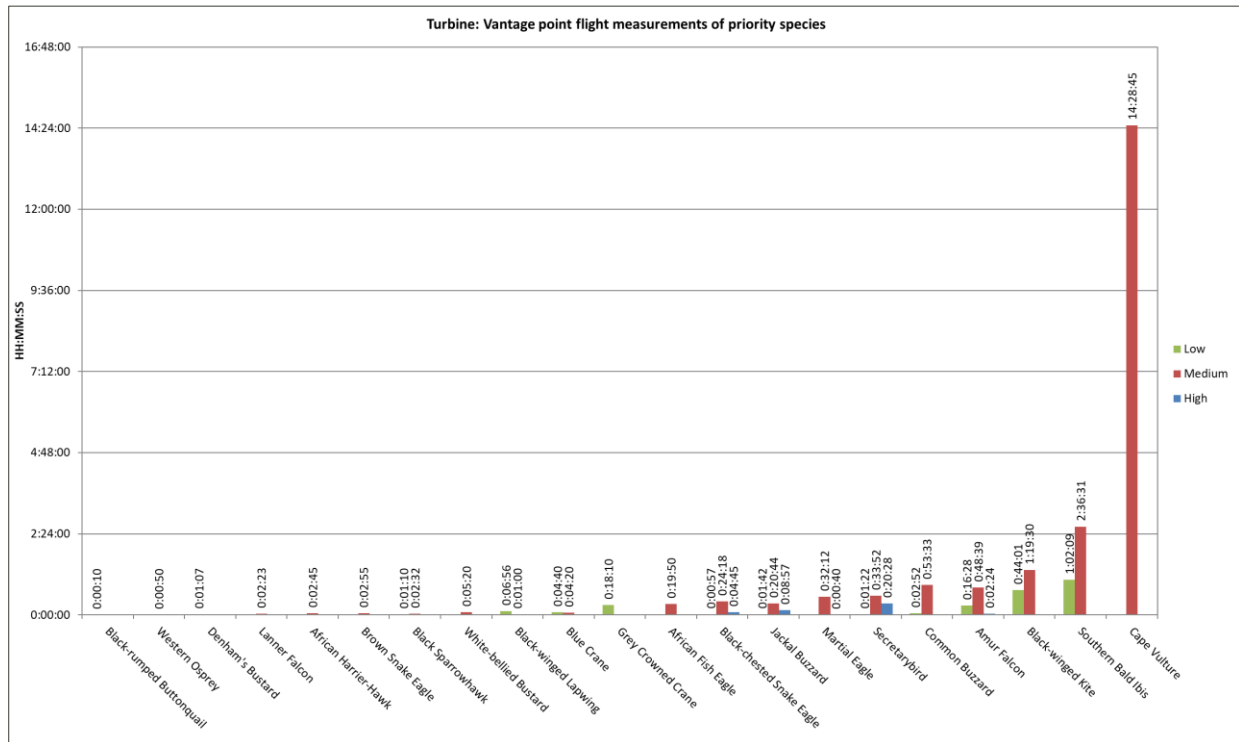


Figure 10: Flight times and altitude recorded for priority species

#### 6.6.2.5 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 taking into account 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.

<sup>3</sup> Assuming 13 hours daylight averaged over all four seasons.

<sup>4</sup> 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.

This was done in order to gain a rough indication of which species are likely to be most at risk of collision. The formula used is as follows<sup>5</sup>:

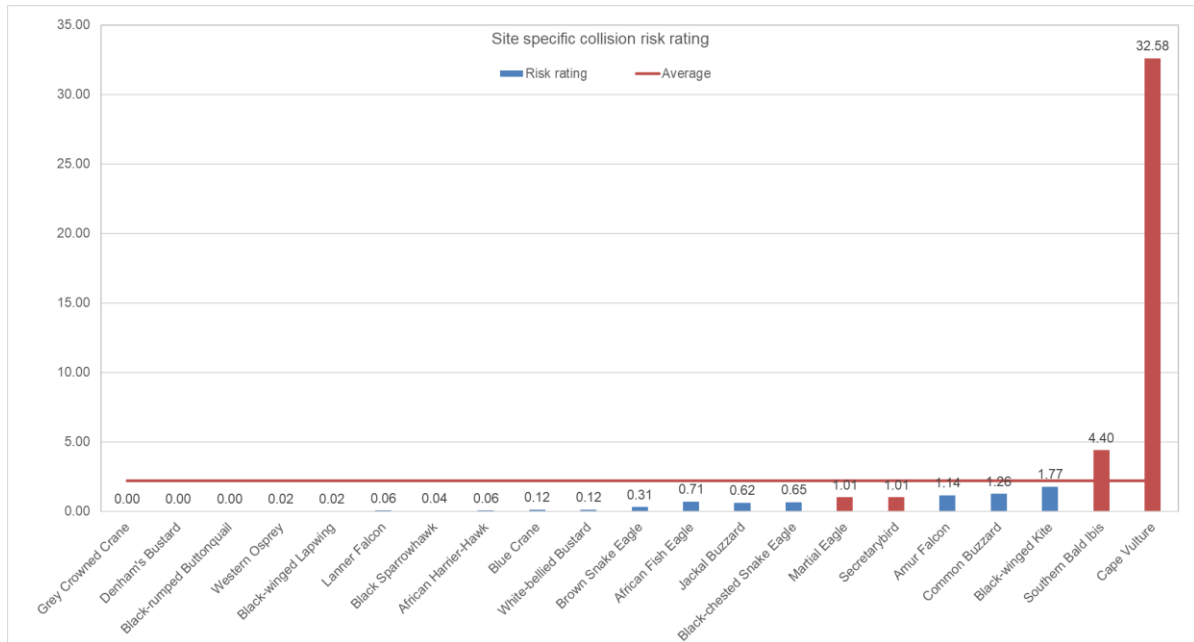
*Duration of rotor altitude flights x collision ratings in the Avian Wind Farm Sensitivity Map x number of turbines ÷ 100.*

The results are presented in Table 88 and Figure 1112 below.

**Table 8: Site specific collision risk rating**

Species	Duration of rotor altitude flights (hr)	Avian Wind Farm Sensitivity collision susceptibility rating	Site specific collision risk rating
Grey Crowned Crane	0.00	82	0.00
Denham's Bustard	0.00	85	0.00
Black-rumped Buttonquail	0.00	30	0.00
Western Osprey	0.00	85	0.02
Black-winged Lapwing	0.00	57	0.02
Lanner Falcon	0.00	85	0.06
Black Sparrowhawk	0.00	55	0.04
African Harrier-Hawk	0.00	65	0.06
Blue Crane	0.00	85	0.12
White-bellied Bustard	0.00	70	0.12
Brown Snake Eagle	0.01	80	0.31
African Fish Eagle	0.01	115	0.71
Jackal Buzzard	0.01	95	0.62
Black-chested Snake Eagle	0.02	85	0.65
Martial Eagle	0.02	100	1.01
Secretarybird	0.02	95	1.01
Amur Falcon	0.03	75	1.14
Common Buzzard	0.04	75	1.26
Black-winged Kite	0.07	57	1.77
Southern Bald Ibis	0.11	90	4.40
Cape Vulture	0.60	120	32.58
Average	0.05	80.29	2.18

<sup>5</sup> It is important to note that the formula does not incorporate avoidance behaviour. This may differ between species and may have a significant impact on the size of the risk associated with a specific species. It is generally assumed that 95-98% of bird flights will successfully avoid the turbines (SNH, 2010).



**Figure 11: Site specific collision risk rating for priority species. The red line indicates the average collision risk rating for priority species at the development site, based on recorded flight behaviour in four surveys. Species of conservation concern are indicated with red bars.**

#### 6.6.2.6 Spatial distribution of flights over the turbine area

Flight maps were prepared for the SCC with substantial flight activity, 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) taking into account the flight intensity i.e., the duration and distance of individual flight lines through a grid cell and the number of individual birds associated with each flight crossing the grid cell, in order to give an indication where the observed flight activity was most concentrated (see Appendix 4).

## 7 IMPACT ASSESSMENT

### 7.1 Wind Energy Facility

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

- Mortality of priority avifauna due to collisions with the wind turbines
- Displacement of priority avifauna due to disturbance during construction and operation of the wind farm
- Displacement of priority avifauna due to habitat change and loss at the wind farm
- 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



It should be noted that the assessment is made on the *status quo* as it is currently on site. The possible change in land use in the broader development site is not taken into account because the extent and nature of future developments (not only wind energy development) are unknown at this stage. It is possible that there could be changes in the foreseeable future in the form of mining.

### 7.1.1 Collision mortality on wind turbines<sup>6</sup>

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

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

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

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<sup>6</sup> 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.

#### 7.1.1.1 Species-specific factors

- Morphological features

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

*Information on the wing loading of the priority species potentially occurring regularly at the proposed Camden II 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 priority species that could potentially be vulnerable to wind turbine collisions due to morphological features (high wing loading) are bustards, cranes, flamingos and vultures, making them less manoeuvrable (Keskin *et al.* 2019).*

- Sensorial perception

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

*Some of the regularly occurring priority species at the proposed Camden II Wind Energy Facility have high resolution vision areas found in the lateral fields of view, rather than frontally, e.g., the vultures, bustards and cranes. The exceptions to this are the priority raptors which all have wider binocular fields, although as pointed out by Martin (2011, 2012), this does not necessarily result in these species being able to avoid obstacles better.*

- Phenology

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

*South Africa is at the end of the migration path for summer migrants; therefore, the phenomenon of migratory flyways where birds are concentrated in large numbers for a limited period of time, e.g. the African Rift Valley or Mediterranean Red Sea flyways, is not a feature of the national landscape. The migratory priority species which could occur at the proposed Camden II Wind Energy Facility with some regularity, e.g., White Stork, Amur Falcon and Common Buzzard will behave much the same as the resident birds once they arrive in the area. The same is valid for local migrants such as the Denham's Bustard, Lesser Flamingo and Greater Flamingo. It is expected that, for the period when they are present, these species will be exposed to the same risks as resident species.*

- Bird behaviour

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

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

denhami turbine fatalities have been reported to date, despite the species occurring at several wind farm sites.

*The priority species which could occur with some regularity at the proposed Camden II Wind Energy Facility can be classified as either terrestrial species, soaring species or occasional long-distance fliers. Terrestrial species spend most of the time foraging on the ground. They do not fly often and when they do, they generally fly for short distances at low to medium altitude. At the application site bustards and korhaans are included in this category. Occasional long-distance fliers generally behave as terrestrial species but can and do undertake long distance flights on occasion. Species in this category are White Stork, Denham's Bustard, Blue Crane, Grey Crowned Crane, Southern Bald Ibis, Secretarybird and Greater and Lesser Flamingo. Soaring species spend a significant time on the wing in a variety of flight modes including soaring, kiting, hovering, and gliding at medium to high altitudes. At the project site, these include all the raptors and vultures.*

- Avoidance behaviours

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

*It is anticipated that most birds at the proposed Camden II Wind Energy Facility will avoid the wind turbines, as is generally the case at all wind farms (SNH 2010). Exceptions already mentioned are raptors that engage in hunting which might serve to distract them and place them at risk of collision, birds engaged in display behaviour or inter- and intraspecific aggressive interaction. Complete macro-avoidance of the wind farm is unlikely for any of the priority species likely to occur at the proposed WEF.*

- Bird abundance

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



*The abundance of priority species at the proposed Camden II Wind Energy Facility will fluctuate depending on the season of the year. Greater numbers are expected during the rainy season, when foraging conditions are better and certain migratory species are present.*

#### 7.1.1.2 Site-specific factors

- Landscape features

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

*The project site does not contain many landscape features as it is situated on a slightly undulating plain.*

- Flight paths

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

*No specific flight paths have been identified.*

- Food availability

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

*The occurrence of Cape Vultures at the project site could be linked to the availability of food, while the agricultural activity is an attractant for Southern Bald Ibis.*

### 7.1.1.3 Summary of turbine collision risk

The proposed Camden II Wind Energy Facility 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., bustards, cranes, flamingos, storks, Southern Bald Ibis and Secretarybird, although bustards and cranes generally seem to be not as vulnerable to turbine collisions as was originally anticipated (Ralston-Paton & Camagu 2019). Soaring priority species, i.e., species such as Cape Vulture and a variety of raptors, including several species of eagles, are highly vulnerable to the risk of collisions. In summary, the following priority species could be at risk of collisions with the turbines: Common Buzzard, Jackal Buzzard, Blue Crane, Brown Snake Eagle, Black-chested Snake Eagle, Long-crested Eagle, Martial Eagle, Peregrine Falcon, Lanner Falcon, Greater Flamingo, Lesser Flamingo, Montagu's Harrier, African Marsh Harrier, Black Harrier, African Harrier-Hawk, Cape Vulture, Secretarybird, Black-bellied Bustard, White-bellied Bustard, Denham's Bustard, Wattled Crane, Grey Crowned Crane, African Fish Eagle, Spotted Eagle-Owl, Amur Falcon, Grey-winged Francolin, Southern Bald Ibis, Black-winged Kite, Northern Black Korhaan, Blue Korhaan, Black-winged Lapwing, Western Osprey, Marsh Owl, African Grass Owl, Black Sparrowhawk and White Stork.

### 7.1.2 Displacement due to disturbance

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

Unfortunately, few studies of displacement due to disturbance are conclusive, often because of the lack of before- and-after and control-impact (BACI) assessments. Indications are that Great Bustard *Otis tarda* could be displaced by wind farms up to one kilometre from the facility (Langgemach 2008). An Austrian study found displacement for Great Bustards up to 600m (Wurm & Kollar as quoted by Raab *et al.* 2009). However, there is also evidence to the contrary; information on Great Bustard received from Spain points to the possibility of continued use of leks at operational wind farms (Camiña 2012b). The same situation seems to prevail at wind farms in the Eastern Cape where Denham's Bustard are still using wind farm sites as leks.<sup>7</sup> Research on small grassland species in North America indicates that permanent displacement is uncommon and very species specific (e.g. see Stevens *et al.* 2013, Hale *et al.* 2014). There also seems to be little evidence for a persistent decline in passerine populations at wind farm sites in the UNITED KINGDOM (despite some evidence of turbine avoidance), with some species, including Skylark, showing increased populations after wind farm construction (see Pierce-Higgins *et al.* 2012). Populations of Thekla Lark *Galerida theklae* were found to be unaffected by wind farm developments in Southern Spain (see Farfan *et al.* 2009).

The consequences of displacement for breeding productivity and survival are crucial to whether or not there is likely to be a significant impact on population size. However, studies of the impact of wind farms on breeding birds are also largely inconclusive or suggest lower disturbance distances, though this

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<sup>7</sup> Personal communication by Wessel Rossouw, bird monitor based in Jeffreys Bay, from personal observations in the Kouga municipal area.

apparent lack of effect may be due to the high site fidelity and long life-span of the breeding species studied. This might mean that the true impacts of disturbance on breeding birds will only be evident in the longer term, when new recruits replace existing breeding birds. Few studies have considered the possibility of displacement for short-lived passerines (such as larks), although Leddy *et al.* (1999) found increased densities of breeding grassland passerines with increased distance from wind turbines, and higher densities in the reference area than within 80m of the turbines. A review of minimum avoidance distances of 11 breeding passerines were found to be generally <100m from a wind turbine ranging from 14 – 93m (Hötter *et al.* 2006). A comparative study of nine wind farms in Scotland (Pearce-Higgins *et al.* 2009) found unequivocal evidence of displacement: Seven of the 12 species studied exhibited significantly lower frequencies of occurrence close to the turbines, after accounting for habitat variation, with equivocal evidence of turbine avoidance in a further two. No species were more likely to occur close to the turbines. Levels of turbine avoidance suggest breeding bird densities may be reduced within a 500m buffer of the turbines by 15– 53%, with Common Buzzard *Buteo buteo*, Hen Harrier *Circus cyaneus*, Golden Plover *Pluvialis apricaria*, Snipe *Gallinago gallinago*, Curlew *Numenius arquata* and Wheatear *Oenanthe oenanthe* most affected. In a follow-up study, monitoring data from wind farms located on unenclosed upland habitats in the United Kingdom were collated to test whether breeding densities of upland birds were reduced as a result of wind farm construction or during wind farm operation. Red Grouse *Lagopus lagopus scoticus*, Snipe *Gallinago gallinago* and Curlew *Numenius arquata* breeding densities all declined on wind farms during construction. Red Grouse breeding densities recovered after construction, but Snipe and Curlew densities did not. Post-construction Curlew breeding densities on wind farms were also significantly lower than reference sites. Conversely, breeding densities of Skylark *Alauda arvensis* and Stonechat *Saxicola torquata* increased on wind farms during construction. Overall, there was little evidence for consistent post-construction population declines in any species, suggesting that wind farm construction can have greater impacts upon birds than wind farm operation (Pierce-Higgins *et al.* 2012).

*It is inevitable that a measure of displacement will take place for all priority species during the construction phase, due to the disturbance factor associated with the construction activities. This is likely to affect ground nesting species 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 WEF is operational, due to the disturbance factor of the operational turbines, and the habitat fragmentation. In summary, the following species could be impacted by disturbance during the construction phase: Blue Crane, Black-bellied Bustard, White-bellied Bustard, Denham's Bustard, Grey Crowned Crane, Spotted Eagle-Owl, Grey-winged Francolin, Northern Black Korhaan, Blue Korhaan, Marsh Owl and African Grass Owl.*

### 7.1.3 Displacement due to habitat loss

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

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

*The network of roads is likely to result in significant habitat fragmentation. This, together with the disturbance factor of the operating turbines, could have an effect on the density of several species, particularly larger terrestrial species which would utilise the remaining high quality grassland, wetlands and wetland fringes as breeding habitat. Given the conceptual turbine layout and associated road infrastructure, it is not expected that any priority species will be permanently displaced from the development site, but densities may be reduced. In summary, the following species are likely to be affected by habitat transformation: Blue Crane, Black-bellied Bustard, White-bellied Bustard, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Northern Black Korhaan, Blue Korhaan, Marsh Owl, African Grass Owl, Black-winged Lapwing and Secretarybird.*

#### **7.1.4 Electrocuton on the medium voltage network**

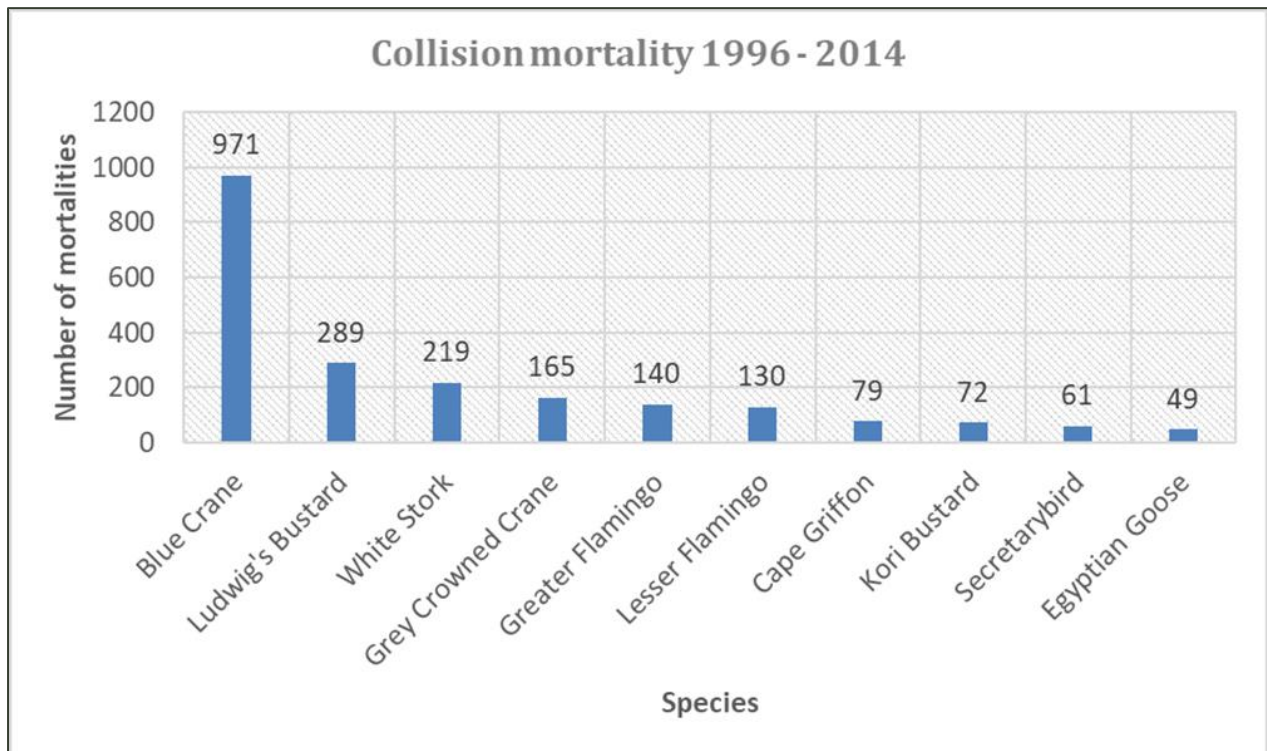
Electrocuton refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2000). The electrocuton risk is largely determined by the design of the electrical hardware.

While the intention is to place the medium voltage reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these instances, the electricity could potentially pose an electrocuton risk to several priority species that could on occasion perch on these poles. In summary, the following priority species are potentially vulnerable to electrocuton in this manner: Grey Crowned Crane, Marsh Owl, African Grass Owl, Spotted Eagle-Owl, Common Buzzard, Peregrine Falcon, Black Harrier, Jackal Buzzard, Brown Snake Eagle, Black-chested Snake Eagle, Long-crested Eagle, Martial Eagle, Lanner Falcon, Montagu's Harrier, African Marsh Harrier, African Harrier-Hawk, Cape Vulture, African Fish Eagle, Southern Bald Ibis, Black-winged Kite, Western Osprey and Black Sparrowhawk.

#### **7.1.5 Collisions with the medium voltage network**

Collisions are one of the biggest 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. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (Van Rooyen 2004, Anderson 2001).

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



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

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

Using a controlled experiment spanning a period of nearly eight years (2008 to 2016), the Endangered Wildlife Trust (EWT) and Eskom tested the effectiveness of two types of line markers in reducing power line collision mortalities of large birds on three 400kV transmission lines near Hydra substation in the Karoo. Marking was highly effective for Blue Cranes, with a 92% reduction in mortality, and large birds



in general with a 56% reduction in mortality, but not for bustards, including the endangered Ludwig's Bustard. The two different marking devices were approximately equally effective, namely spirals and bird flappers, they found no evidence supporting the preferential use of one type of marker over the other (Shaw et al. 2017).

Distribution lines i.e. 11kV to 88kV are often overlooked in collision studies, but given their far greater extent they can represent a serious source of mortality (Shaw et al. 2010a, 2010b).

*While the intention is to place the medium voltage reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. These spans could pose a collision risk to virtually all powerline sensitive avifauna, depending on where those spans are located. Species potentially at risk are African Black Duck, African Darter, African Grass Owl, African Sacred Ibis, African Spoonbill, Black Heron, Black-bellied Bustard, Black-crowned Night Heron, Black-headed Heron, Black-necked Grebe, Blue Crane, Blue Korhaan, Blue-billed Teal, Cape Shoveler, Cape Teal, Cape Vulture, Denham's Bustard, Egyptian Goose, Fulvous Whistling Duck, Glossy Ibis, Goliath Heron, Great Egret, Greater Flamingo, Grey Crowned Crane, Grey Heron, Hadada Ibis, Hamerkop, Intermediate Egret, Lesser Flamingo, Little Egret, Little Grebe, Mallard, Marsh Owl, Northern Black Korhaan, Purple Heron, Red-billed Teal, Red-knobbed Coot, Reed Cormorant, Secretarybird, South African Shelduck, Southern Bald Ibis, Southern Pochard, Spotted Eagle-Owl, Spur-winged Goose, Squacco Heron, Wattled Crane, Western Barn Owl, Western Cattle Egret, White Stork, White-backed Duck, White-bellied Bustard, White-breasted Cormorant, White-faced Whistling Duck, Yellow-billed Duck.*

## **7.2 Battery Energy Storage Facility (BESS)**

The impact that is associated with the construction of the BESS is the potential displacement of priority avifauna due to disturbance associated with the construction of the facility and habitat transformation in the footprint of the facility.

### **7.2.1 Displacement due to habitat destruction and disturbance**

During the construction of the BESS, habitat destruction/transformation will inevitably take place. The construction activities will constitute the following:

- Site clearance and preparation.
- Construction of the infrastructure related to the BESS.
- Transportation of personnel, construction material and equipment to the site, and personnel away from the site.
- Removal of vegetation for the proposed infrastructure line, stockpiling of topsoil and cleared vegetation.
- Excavations for infrastructure.

These activities will impact on birds breeding, foraging and roosting in or in close proximity of the proposed facility through **transformation of habitat**, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the facility is unavoidable. The loss of habitat for priority species due to direct habitat transformation associated with the construction of the 5 ha proposed facility is likely to be relatively insignificant due to the relatively small size of the footprint (only 0.07% of the total project area, and 2.5% of the buildable area).

Apart from direct habitat destruction, the above-mentioned activities also impact on birds through **disturbance**; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although in practice that can admittedly be challenging to implement.

*The priority species which are potentially most vulnerable to the impact of displacement due to disturbance and habitat transformation linked to the BESS are terrestrial species and owls. Priority species that could be affected are the following: African Grass Owl, Black-bellied Bustard, Black-winged Lapwing, Blue Crane, Blue Korhaan, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Marsh Owl, Northern Black Korhaan, Secretarybird and White-bellied Bustard.*

### 7.3 Up to 132kV overhead line (OHL)

The following potential impacts on powerline sensitive avifauna are associated with the construction and operation of the up to 132kV grid connection:

- Mortality due to electrocution on the proposed OHL infrastructure
- Mortality due to electrocution on the electrical infrastructure within the proposed on-site substation.
- Mortality due to collisions with the proposed OHL.
- Displacement due to disturbance associated with the construction of the proposed OHL and on-site substation.
- Displacement due to habitat transformation associated with the construction of the proposed OHL and on-site substation.

#### 7.3.1 Mortality of powerline sensitive avifauna due to electrocutions

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the voltage size of the proposed powerline and the pole/tower design. Should the proposed OHL be constructed using a 132kV tower specification, the electrocution impact for the majority of priority species will be negligible. The only priority species capable of bridging the clearance distances of an OHL constructed using this specification is the Cape Vulture, due to their size and gregarious nature.

Ordinarily, the construction of a single circuit powerline using the approved vulture friendly pole/tower design D-DT-7649 accordance with the Distribution Technical Bulletin titled *Refurbishment of 66/88kV line kite type frames with D-DT-7649 type top configuration - Reference Number 240-170000467* will eliminate the electrocution risk. The configuration of the insulators and the clearance distances between the live and earthed components on this structure can comfortably accommodate a perching vulture. However if the OHL will be built on lattice structures, it is imperative that there is a minimum clearance of 1.8m between the jumper cables and/or insulators and the horizontal earthed component on the lattice structure (pers.comm. Lourens Leeuwner - Eskom-EWT Strategic Partnership Manager). Additional mitigation in the form of insulating sleeves on jumper cables present on strain poles and

terminal poles is also recommended (if suitable insulation material is readily available), alternatively all jumper cables must be suspended below the crossarms.

Electrocutions within the proposed on-site substation are possible, however the likelihood of this impact on the more sensitive SCC is remote, as these species are unlikely to regularly utilise the infrastructure within the onsite substation station for perching or roosting. Species that are more vulnerable to this impact are medium-sized raptors, corvids, owls and certain species of waterbirds.

*It is assumed that the OHL will be built on 132kV pole/tower designs therefore the powerline sensitive species which is potentially vulnerable to electrocution on the actual towers/poles is Cape Vulture. As far as the substation is concerned, the following species are potentially at risk of electrocution: African Fish Eagle, African Grass Owl, Amur Falcon, Black Sparrowhawk, Black-chested Snake Eagle, Black-headed Heron, Black-winged Kite, Brown Snake Eagle, Cape Crow, Cape Vulture, Common Buzzard, Hadada Ibis, Helmeted Guineafowl, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Peregrine Falcon, Pied Crow, Southern Bald Ibis, Spotted Eagle-Owl, Western Barn Owl, Western Osprey and Yellow-billed Kite.*

### **7.3.2 Mortality of powerline sensitive avifauna due to collisions**

See also the discussion under 7.1.5.

In a PhD study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with transmission lines:

*“The collision risk posed by powerlines is complex and problems are often localised. While any bird flying near a powerline is at risk of collision, this risk varies greatly between different groups of birds, and depends on the interplay of a wide range of factors (APLIC 1994). Bevanger (1994) described these factors in four main groups – biological, topographical, meteorological and technical. Birds at highest risk are those that are both susceptible to collisions and frequently exposed to powerlines, with waterbirds, gamebirds, rails, cranes and bustards usually the most numerous reported victims (Bevanger 1998, Rubolini et al. 2005, Jenkins et al. 2010).*

*The proliferation of man-made structures in the landscape is relatively recent, and birds are not evolved to avoid them. Body size and morphology are key predictive factors of collision risk, with large-bodied birds with high wing loadings (the ratio of body weight to wing area) most at risk (Bevanger 1998, Janss 2000). These birds must fly fast to remain airborne, and do not have sufficient manoeuvrability to avoid unexpected obstacles. Vision is another key biological factor, with many collision-prone birds principally using lateral vision to navigate in flight, when it is the lower-resolution, and often restricted, forward vision that is useful to detect obstacles (Martin & Shaw 2010, Martin 2011, Martin et al. 2012). Behaviour is important, with birds flying in flocks, at low levels and in crepuscular or nocturnal conditions at higher risk of collision (Bevanger 1994). Experience affects risk, with migratory and nomadic species that spend much of their time in unfamiliar locations also expected to collide more often (Anderson 1978, Anderson 2002). Juvenile birds have often been reported as being more collision-prone than adults (e.g. Brown et al. 1987, Henderson et al. 1996).*

*Topography and weather conditions affect how birds use the landscape. Powerlines in sensitive bird areas (e.g. those that separate feeding and roosting areas, or cross flyways) can be very dangerous (APLIC 1994, Bevanger 1994). Lines crossing the prevailing wind conditions can pose a problem for*

large birds that use the wind to aid take-off and landing (Bevanger 1994). Inclement weather can disorient birds and reduce their flight altitude, and strong winds can result in birds colliding with powerlines that they can see but do not have enough flight control to avoid (Brown et al. 1987, APLIC 2012).

*The technical aspects of powerline design and siting also play a big part in collision risk. Grouping similar powerlines on a common servitude, or locating them along other features such as tree lines, are both approaches thought to reduce risk (Bevanger 1994). In general, low lines with short span lengths (i.e. the distance between two adjacent pylons) and flat conductor configurations are thought to be the least dangerous (Bevanger 1994, Jenkins et al. 2010). On many higher voltage lines, there is a thin earth (or ground) wire above the conductors, protecting the system from lightning strikes. Earth wires are widely accepted to cause the majority of collisions on powerlines with this configuration because they are difficult to see, and birds flaring to avoid hitting the conductors often put themselves directly in the path of these wires (Brown et al. 1987, Faanes 1987, Alonso et al. 1994a, Bevanger 1994)."*

Several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions and powerline configuration. An important additional factor that previously has received little attention is the visual capacity of birds; i.e. whether they are able to see obstacles such as powerlines, and whether they are looking ahead to see obstacles with enough time to avoid a collision. In addition to helping explain the susceptibility of some species to collision, this factor is key to planning effective mitigation measures. Recent research provides the first evidence that birds can render themselves blind in the direction of travel during flight through voluntary head movements (Martin & Shaw 2010). Visual fields were determined in three bird species representative of families known to be subject to high levels of mortality associated with powerlines i.e. Kori Bustard *Ardeotis kori*, Blue Crane and White Stork. In all species the frontal visual fields showed narrow and vertically long binocular fields typical of birds that take food items directly in the bill under visual guidance. However, these species differed markedly in the vertical extent of their binocular fields and in the extent of the blind areas which project above and below the binocular fields in the forward-facing hemisphere. The importance of these blind areas is that when in flight, head movements in the vertical plane (pitching the head to look downwards) will render the bird blind in the direction of travel. Such movements may frequently occur when birds are scanning below them (for foraging or roost sites, or for conspecifics). In bustards and cranes pitch movements of only 25° and 35°, respectively, are sufficient to render the birds blind in the direction of travel; in storks, head movements of 55° are necessary. That flying birds can render themselves blind in the direction of travel has not been previously recognised and has important implications for the effective mitigation of collisions with human artefacts including wind turbines and powerlines. These findings have applicability to species outside of these families especially raptors (*Accipitridae*) which are known to have small binocular fields and large blind areas similar to those of bustards and cranes, and are also known to be vulnerable to powerline collisions.

Despite doubts about the efficacy of line marking to reduce the collision risk for bustards (Jenkins et al. 2010; Martin et al. 2010), there are numerous studies which prove that marking a line with PVC spiral type Bird Flight Diverters (BFDs) generally reduce mortality rates (e.g. Bernardino et al. 2018; Sporer et al. 2013, Barrientos et al. 2011; Jenkins et al. 2010; Alonso & Alonso 1999; Koops & De Jong 1982), including to some extent for bustards (Barrientos et al. 2012; Hoogstad 2015 pers.comm). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Barrientos et al. (2011) reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of

flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease of 55–94% in bird mortalities. Kooops and De Jong (1982) found that the spacing of the BFDs was critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5m, whereas using the same devices at 10m intervals only reduces the mortality by 57%. Barrientos *et al.* (2012) found that larger BFDs were more effective in reducing Great Bustard collisions than smaller ones. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al.* 2010).

*The up to 132kV OHL could pose a collision risk to virtually all powerline sensitive avifauna, depending on where those spans are located. Species potentially at risk are African Black Duck, African Darter, African Grass Owl, African Sacred Ibis, African Spoonbill, Black Heron, Black-bellied Bustard, Black-crowned Night Heron, Black-headed Heron, Black-necked Grebe, Blue Crane, Blue Korhaan, Blue-billed Teal, Cape Shoveler, Cape Teal, Cape Vulture, Denham's Bustard, Egyptian Goose, Fulvous Whistling Duck, Glossy Ibis, Goliath Heron, Great Egret, Greater Flamingo, Grey Crowned Crane, Grey Heron, Hadada Ibis, Hamerkop, Intermediate Egret, Lesser Flamingo, Little Egret, Little Grebe, Mallard, Marsh Owl, Northern Black Korhaan, Purple Heron, Red-billed Teal, Red-knobbed Coot, Reed Cormorant, Secretarybird, South African Shelduck, Southern Bald Ibis, Southern Pochard, Spotted Eagle-Owl, Spur-winged Goose, Squacco Heron, Wattled Crane, Western Barn Owl, Western Cattle Egret, White Stork, White-backed Duck, White-bellied Bustard, White-breasted Cormorant, White-faced Whistling Duck, Yellow-billed Duck.*

### 7.3.3 Displacement due to habitat transformation

During the construction of powerlines, service roads (jeep tracks), substations and other associated infrastructure, habitat destruction/transformation inevitably takes place. These activities could impact on birds breeding, foraging and roosting in or in close proximity of the proposed OHL grid connection through the transformation of habitat. The construction activities will constitute the following:

- Site clearance and preparation;
- Excavations for infrastructure;
- Construction of the substation and grid connection infrastructure; and
- Transportation of personnel, construction material and equipment to the site, and personnel away from the site.

Relevant to this development, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the on-site substation is unavoidable. In the case of the OHL, the direct habitat transformation is limited to the on-site substation and pole/tower footprints and the narrow access road/track under the proposed OHL. The loss of habitat in the substation footprint (2 ha) will be a relatively insignificant percentage of the habitat that regularly supports powerline sensitive species and the resultant impact is likely to be fairly minimal.

*Powerline sensitive species which are potentially vulnerable to displacement due to habitat transformation are mostly ground nesting species: African Grass Owl, Black-bellied Bustard, Blue Crane, Blue Korhaan, Denham's Bustard, Grey Crowned Crane, Helmeted Guineafowl, Marsh Owl, Northern Black Korhaan, Secretarybird, Spotted Eagle-Owl and, White-bellied Bustard.*



### 7.3.4 Displacement due to disturbance

Apart from direct habitat destruction, the above-mentioned activities also impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although this is often impractical to implement due to tight construction schedules.

*Powerline sensitive species which are potentially vulnerable to displacement due to disturbance are mostly ground nesting species: African Grass Owl, Black-bellied Bustard, Blue Crane, Blue Korhaan, Denham's Bustard, Grey Crowned Crane, Helmeted Guineafowl, Marsh Owl, Northern Black Korhaan, Secretarybird, Spotted Eagle-Owl and White-bellied Bustard.*

## 8 IMPACT RATINGS

The impacts on avifauna of the proposed Camden II WEF, BESS and 132V OHL are rated according to the criteria set out below.

### 8.1 Determination of Significance of Impacts

The EIA Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation. The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects are reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considers direct<sup>8</sup>, indirect<sup>9</sup>, secondary<sup>10</sup> as well as cumulative<sup>11</sup> impacts.

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<sup>8</sup> Impacts that arise directly from activities that form an integral part of the Project.

<sup>9</sup> Impacts that arise indirectly from activities not explicitly forming part of the Project.

<sup>10</sup> Secondary or induced impacts caused by a change in the Project environment.

<sup>11</sup> Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.

A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact). The significance of environmental aspects is determined and ranked by considering the criteria<sup>12</sup> presented in Table 8.

**Table 9: Impact Assessment Criteria and Scoring System**

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
<b>Impact Magnitude (M)</b> 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
<b>Impact Extent (E)</b> 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
<b>Impact Reversibility (R)</b> 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: No possible despite action
<b>Impact Duration (D)</b> 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
<b>Probability of Occurrence (P)</b> The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
<b>Significance (S)</b> 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					
<b>Total Score</b>	<b>4 to 15</b>	<b>16 to 30</b>	<b>31 to 60</b>	<b>61 to 80</b>	<b>81 to 100</b>
<b>Environmental Significance Rating (Negative (-))</b>	Very low	Low	Moderate	High	Very High
<b>Environmental Significance Rating (Positive (+))</b>	Very low	Low	Moderate	High	Very High

## 8.2 Impact Assessments

### 8.2.1 Impact assessment tables

The impacts are summarised in table form are in Appendix 4.

### 8.3 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 in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

<sup>12</sup> The definitions given are for guidance only, and not all the definitions will apply to all the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

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:

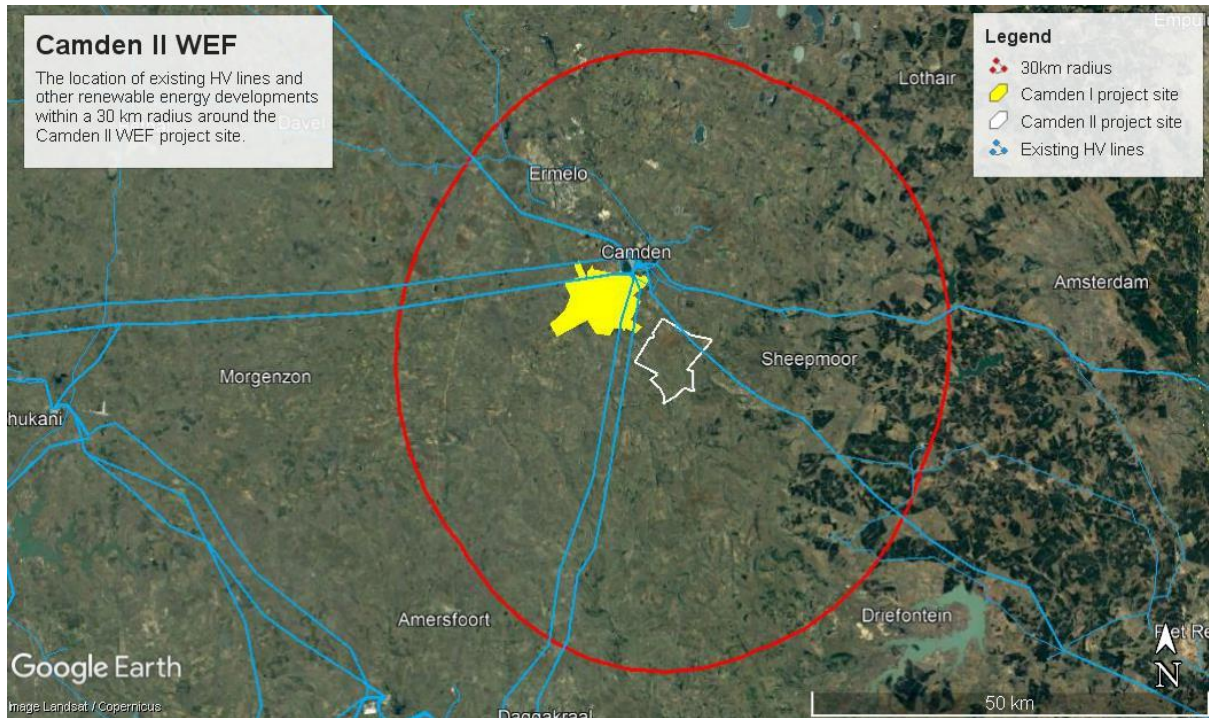
- Unacceptable risk
- Unacceptable loss
- Complete or whole-scale changes to the environment
- Unacceptable increase in impact

### 11.3.1 Wind Energy Facility

According to the official database of DFFE and other documents in the public domain, there are currently one additional planned renewable energy facility within a 30km radius around the proposed development, namely the Camden I Wind Energy Facility (up to 200MW)(see Figure 14).

The proposed Camden II WEF will consist of up to 45 turbines in total. According to information that is available, the number of additional wind turbines that are planned within a 30km radius in broadly similar habitat around the proposed WEF is another (up to) 37 i.e. for the proposed Camden I WEF. If both the Camden I and Camden II projects are approved, a total of up to 82 turbines may be developed, of which the Camden II will contribute approximately 54%. As such, the WEFs' contribution to the total number of turbines, and by implication to the cumulative impact of all the planned turbines, is **High**, but could be reduced to **Moderate** with appropriate mitigation.

The total area of similar habitat (excluding opencast mining and urban areas) available to birds in the 30km radius around the project area (including the project area) is approximately 4 258 km<sup>2</sup>. This translates into approximately 1 turbine/52km<sup>2</sup> 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**, and the impact could be reduced if the recommended mitigation at the two Camden wind projects is diligently implemented.



**Figure 13: Proposed renewable energy projects and existing HV lines within 30km of the proposed Camden II WEF (Source: DFFE database 2022 & WSP Environmental).**

### 11.3.2 Up to 132kV OHL

According to the official database of DFFE and other documents in the public domain, there is currently one additional planned renewable energy facility within a 30km radius around the proposed development, namely the Camden I Wind Energy Facility (see Figure 12) which will have a grid connection of maximum 5.3km in length. In addition, there will be a 400kV connection to the Camden Power Station Substation of maximum 8.9km. The maximum length of the Camden II OHL will be 12.2km.

The combined length of the grid connections for the Camden I and II renewable energy projects listed above, and the 400kV OHL to Camden Power Station Substation, is approximately 26.4km. The proposed Camden II grid connection will be a maximum of 12.2km long. The existing high voltage lines in the 30km radius around the proposed Camden I WEF run into hundreds of kilometres (see Figure 12). The Camden II grid OHL contribution to the total length of high voltage lines within a 30km radius, and by implication to the cumulative impact of all the planned and existing high voltage lines, is thus **Low** in comparison. However, the density of planned and existing high voltage lines within a 30km radius, and by implication the cumulative impact on avifauna, is considered to be **Moderate**.

### 11.3.3 Battery Energy Storage System

The BESS will transform an area of approximately 5 ha. Given the available habitat of approximately 4 258km<sup>2</sup> within a 30km radius around the project site, the cumulative impact of displacement and habitat transformation caused by the BESS is Low due to the small footprint.

## 9 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 proposed 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 15.



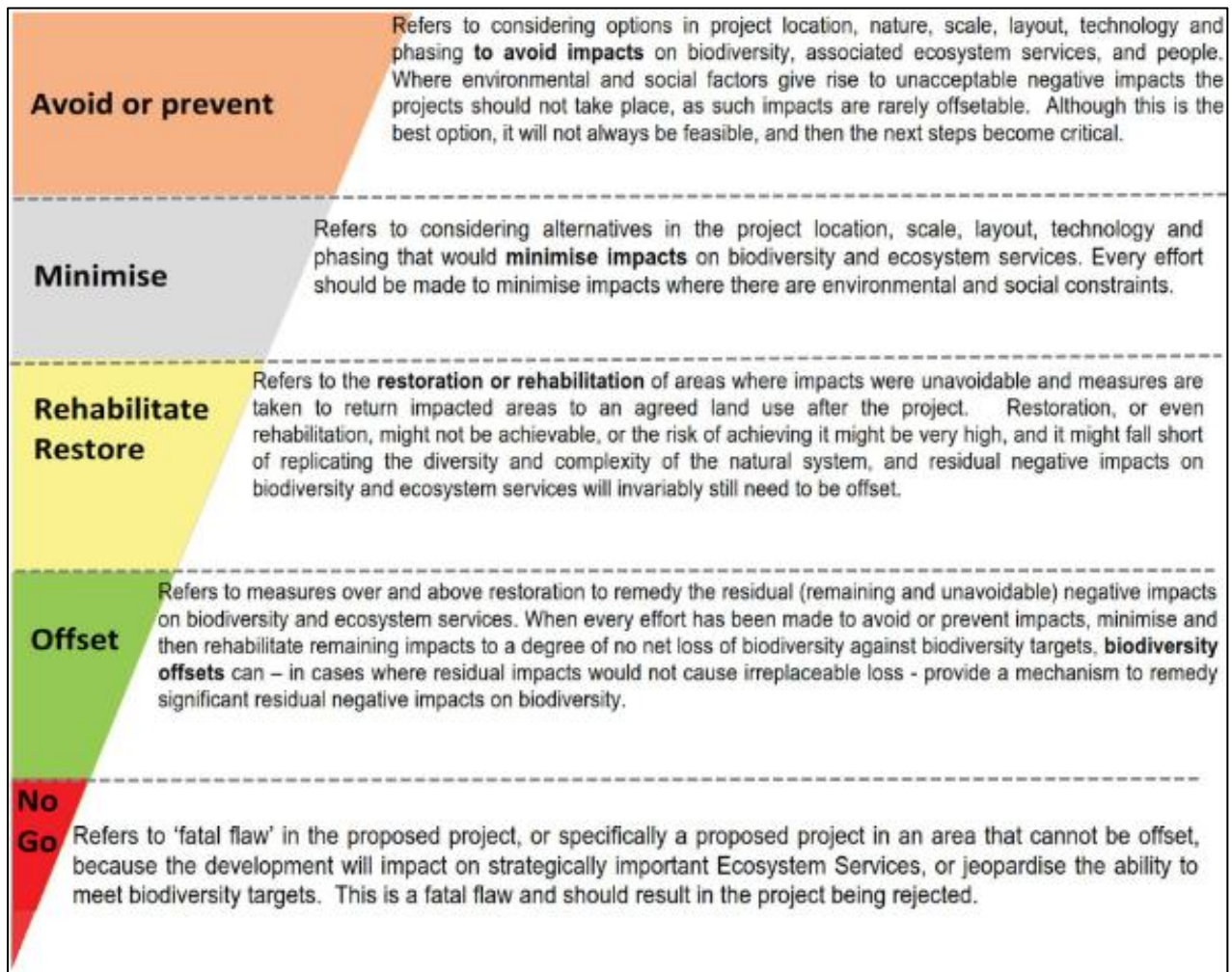


Figure 14: Mitigation Sequence/Hierarchy

## 9.1 Wind Energy Facility

The mitigation measures that are proposed for the wind energy facility are listed below.

### 9.1.1 Design Phase

- The medium voltage cable should be buried as far as possible. Overhead lines should only be considered if technical constraints to trenching are present.
- A bird-friendly pole design must be employed for all medium voltage overhead lines. The avifaunal specialist must approve the final design prior to construction commencing.
- Bird flight diverters should be installed on all overhead medium voltage power lines according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines).
- A 100m **all infrastructure exclusion zone** must be implemented around drainage lines and associated wetlands (except essential road, pipeline and gridline crossings). Wetlands are important breeding, roosting and foraging habitat for a variety of SCC, most notably for African Grass Owl (SA status Vulnerable), Grey Crowned Crane (SA status Endangered) and African Marsh Harrier (SA status Endangered). Where unavoidable, road and grid line crossings across these features should be restricted to the immediate footprint of the infrastructure only.

- Development in the remaining **high sensitivity grassland must be limited as far as possible (limited infrastructure zone)**. 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 SCC. These include Blue Crane (SA status near-threatened), Blue Korhaan (Global status near -threatened), White-bellied Bustard (SA Status Vulnerable), Denham's Bustard (SA Status Vulnerable).

### 9.1.2 Construction phase

- Conduct a pre-construction inspection to identify SCC 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.
- 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.

### 9.1.3 Operational phase

- The mitigation measures proposed by the vegetation specialist must be strictly enforced, including rehabilitation of disturbed areas.
- It is recommended that shutdown on demand (SDoD) is implemented at all turbines for a trial period of two years to monitor the frequency and duration of shutdown events. Based on the result of the trial period, the need for the continuation of the SDoD, or the implementation of other proven mitigation measures if available at the time, must be evaluated by the avifaunal specialist. The need for SDoD arises from the following circumstances:
  - The site is located between three IBAs. Due to the close proximity of the site to the IBAs, it is possible that some highly mobile priority species which are also IBA trigger species, and which occur either permanently or sporadically in the IBAs, might be at risk of collisions they leave to forage or breed beyond the borders of the IBA at the project site.
  - Cape Vultures have been recorded at the site. The species could occur sporadically, and they are highly vulnerable to turbine collisions.
  - The habitat at the site is used by a variety of Red List priority species. This includes not only natural grassland, but also agriculture e.g., Southern Bald Ibis forage extensively in agricultural fields.
- 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., if it exceeds the pre-determined threshold determined by the avifaunal specialist, additional measures will have to be implemented which could include shut down on demand or other proven measures.

#### 9.1.4 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 use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The mitigation measures proposed by the vegetation specialist must be strictly enforced, including rehabilitation of disturbed areas.

Figure 16 indicates the avifauna sensitivity zones identified in the course of the study, relevant to the wind energy facility.

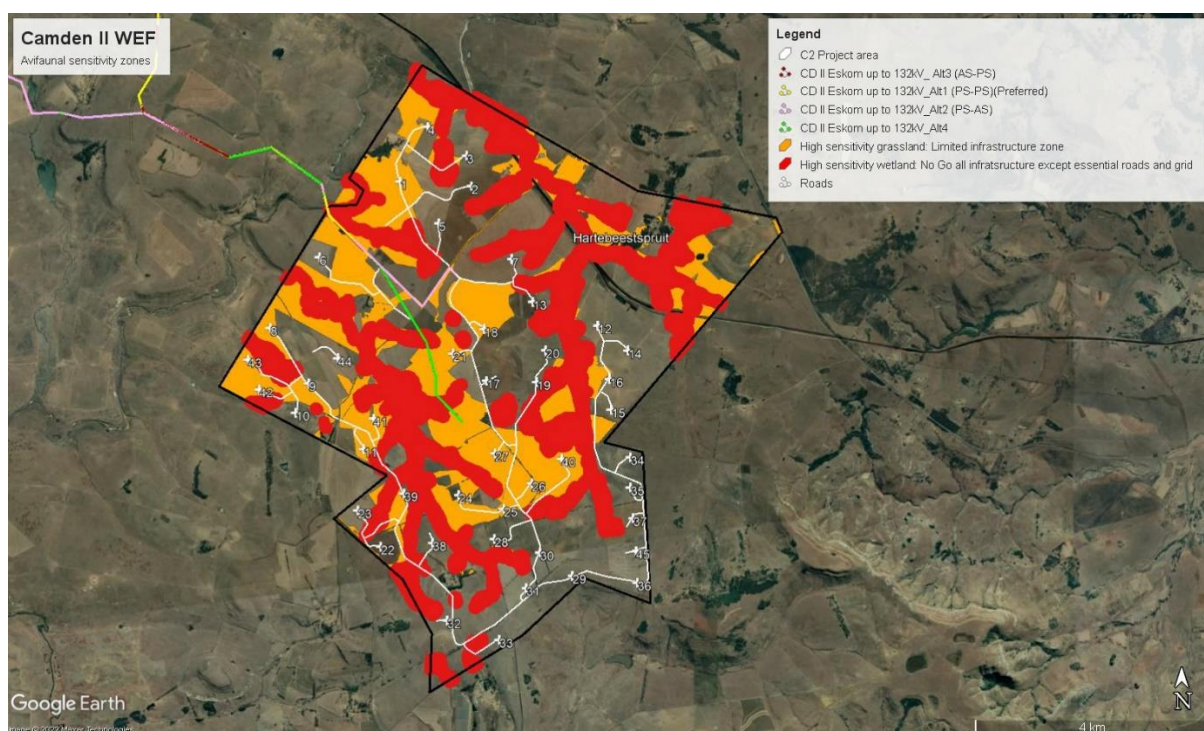


Figure 15: Avifaunal sensitivity zones

## 9.2 Battery Energy Storage Facility (BESS)

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

### 9.2.1 Design Phase

- None.

### 9.2.2 Construction phase

- Conduct a pre-construction inspection to identify SCC 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.
- 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.

### 9.2.3 Operational phase

- None.

### 9.2.4 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 and the construction of new roads should be kept to a minimum.
- The mitigation measures proposed by the vegetation specialist must be strictly enforced, including rehabilitation of disturbed areas.

## 9.3 Up to 132kV OHL

The mitigation measures that are proposed for the up to 132kV OHL are listed below.

### 9.3.1 Planning & Design phase

- If a steel monopole pole design is used, the approved vulture friendly pole/tower design D-DT-7649 in accordance with the Eskom Distribution Technical Bulletin titled *Refurbishment of 66/88kV line kite type frames with D-DT-7649 type top configuration - Reference Number 240-170000467* relating to bird friendly structures, must be used.
- If lattice type structures are used, it is imperative that a minimum vertical clearance of 1.8m is maintained between the jumper cables and/or insulator live ends, and the horizontal earthed components. Additional mitigation in the form of insulating sleeves on jumper cables present on strain poles and terminal poles is also recommended (if suitable insulation material is readily available), alternatively all jumper cables must be suspended below the crossarms.

### 9.3.2 Construction phase

- Conduct a pre-construction inspection (avifaunal walk-through) to identify SCC that may be breeding within the infrastructure footprints. If a nest is occupied, the avifaunal specialist must



consult with the contractor to find ways of minimising the potential disturbance to the breeding birds during the construction period.

- Bird Flight Diverters must be fitted to the entire OHL according to the applicable Eskom Engineering Instruction (*Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines*). These devices must be installed as soon as the conductors and earthwires are strung.
- Construction activity should be restricted to the immediate footprint of the infrastructure.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- Vegetation clearance should be limited to what is absolutely necessary.
- The mitigation measures proposed by the vegetation specialist must be strictly enforced.

### **9.3.3 Operational phase**

- No management actions are required for the operational phase

### **9.3.4 De-commissioning phase**

- Conduct an avifaunal inspection of the OHL prior to its decommissioning to identify nests on the poles/towers.
- 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 and the construction of new roads should be kept to a minimum.

## **10 PREFERRED ALTERNATIVE**

### **10.1 Wind energy facility**

Only one proposed wind turbine lay-out was provided for assessment. This layout has been refined to consider the specialist sensitivities as far as possible however, and adheres to the no-go zones requested in this report.

### **10.2 Battery Energy Storage System**

Alternative 1 and Alternative 2 two are both located in the same habitat type, namely high sensitivity grassland. Both alternatives will therefore have the same potential displacement impact on priority avifauna, therefore no preferred alternative can be selected. However, both options are acceptable, due to the low impact of the small footprint.



### 10.3 Up to 132kV OHL

Alternative 4 is the preferred alternative due to it being the shortest of all the alternatives. Alternative 2 is the least preferred alternative due to it being the longest and it runs mostly through high sensitivity grassland, and it crosses three drainage lines. However, all the alternatives can be mitigated to acceptable levels and therefore are considered suitable from an avifaunal perspective.

## 11 CONDITIONS FOR INCLUSION IN THE EMPr

Please see Appendix 6 for the monitoring requirements to be included in the EMPr for the WEF project.

## 12 'NO-GO' ALTERNATIVE

The 'no-go' alternative is the option of not constructing the Camden 1 WEF, BESS and up to 132kV OHL, where the *status quo* of the current status and/or activities on the project areas 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 areas. 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, bearing in mind that there have already been extensive impacts in the project area in the form of agriculture.

## 13 SUMMARY AND CONCLUSION

### 13.1 Wind Energy Facility

The proposed Camden 1 WEF will have several potential impacts on priority avifauna. These impacts are the following:

- Displacement 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 medium voltage overhead lines in the operational phase.
- Collisions with the medium voltage overhead lines in the operational phase.
- Displacement due to disturbance linked to dismantling activities in the decommissioning phase.

#### 13.1.1 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 following species could be impacted by disturbance during the construction phase African Grass Owl, Black-bellied Bustard, Blue Crane, Blue Korhaan, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Marsh Owl, Northern Black Korhaan, Spotted Eagle-Owl and White-bellied Bustard. The impact is rated as **moderate** pre-mitigation and will be reduced but remain at a **moderate** level post-mitigation.

#### **13.1.2 Displacement of priority species due to habitat transformation in the construction phase**

The network of existing roads at the WEF has likely resulted in significant habitat fragmentation. This, together with the disturbance factor of the operating turbines, could have an effect on 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 following species are likely to be most affected by habitat transformation: African Grass Owl, Black-bellied Bustard, Black-winged Lapwing, Blue Crane, Blue Korhaan, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Marsh Owl, Northern Black Korhaan, Secretarybird and White-bellied Bustard. The impact is rated as **moderate** pre-mitigation and will be reduced but remain at a **moderate** level post-mitigation.

#### **13.1.3 Collision mortality of priority species caused by the wind turbines in the operational phase**

The proposed Camden 1 Wind Energy Facility 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., bustards, cranes, flamingos, storks, Southern Bald Ibis and Secretarybird, although bustards and cranes generally seem to be not as vulnerable to turbine collisions as was originally anticipated (Ralston-Paton & Camagu 2019). Soaring priority species, i.e., species such as Cape Vulture and a variety of raptors, including several species of eagles, are highly vulnerable to the risk of collisions. The following priority species could be at risk of collisions with the turbines: Common Buzzard, Jackal Buzzard, Blue Crane, Brown Snake Eagle, Black-chested Snake Eagle, Long-crested Eagle, Martial Eagle, Peregrine Falcon, Lanner Falcon, Greater Flamingo, Lesser Flamingo, Montagu's Harrier, African Marsh Harrier, Black Harrier, African Harrier-Hawk, Cape Vulture, Secretarybird, Black-bellied Bustard, White-bellied Bustard, Denham's Bustard, Wattled Crane, Grey Crowned Crane, African Fish Eagle, Spotted Eagle-Owl, Amur Falcon, Grey-winged Francolin, Southern Bald Ibis, Black-winged Kite, Northern Black Korhaan, Blue Korhaan, Black-winged Lapwing, Western Osprey, Marsh Owl, African Grass Owl, Black Sparrowhawk and White Stork. The impact is rated as **moderate** pre-mitigation but should be reduced to a **low** level post-mitigation.

#### **13.1.4 Electrocutation of priority species on the medium voltage overhead lines (if any) in the operational phase**

While the intention is to place the medium voltage reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. In these

instances, the electrical infrastructure could potentially pose an electrocution risk to several power line sensitive species that could on occasion perch on these poles. In summary, the following priority species are potentially vulnerable to electrocution in this manner: African Fish Eagle, African Grass Owl, Amur Falcon, Black Sparrowhawk, Black-chested Snake Eagle, Black-headed Heron, Black-winged Kite, Brown Snake Eagle, Cape Crow, Cape Vulture, Common Buzzard, Hadada Ibis, Helmeted Guineafowl, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Peregrine Falcon, Pied Crow, Southern Bald Ibis, Spotted Eagle-Owl, Western Barn Owl, Western Osprey and Yellow-billed Kite. The impact is rated as **moderate** pre-mitigation but should be reduced to a **low** level post-mitigation.

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

While the intention is to place the medium voltage reticulation network underground where possible, there are areas where the lines might have to run above ground, for technical reasons. These spans could pose a collision risk to virtually all powerline sensitive avifauna, depending on where those spans are located. Species potentially at risk are African Black Duck, African Darter, African Grass Owl, African Sacred Ibis, African Spoonbill, Black Heron, Black-bellied Bustard, Black-crowned Night Heron, Black-headed Heron, Black-necked Grebe, Blue Crane, Blue Korhaan, Blue-billed Teal, Cape Shoveler, Cape Teal, Cape Vulture, Denham's Bustard, Egyptian Goose, Fulvous Whistling Duck, Glossy Ibis, Goliath Heron, Great Egret, Greater Flamingo, Grey Crowned Crane, Grey Heron, Hadada Ibis, Hamerkop, Intermediate Egret, Lesser Flamingo, Little Egret, Little Grebe, Mallard, Marsh Owl, Northern Black Korhaan, Purple Heron, Red-billed Teal, Red-knobbed Coot, Reed Cormorant, Secretarybird, South African Shelduck, Southern Bald Ibis, Southern Pochard, Spotted Eagle-Owl, Spur-winged Goose, Squacco Heron, Wattled Crane, Western Barn Owl, Western Cattle Egret, White Stork, White-backed Duck, White-bellied Bustard, White-breasted Cormorant, White-faced Whistling Duck, Yellow-billed Duck. The impact is rated as **moderate** pre-mitigation but should be reduced to a **low** level post-mitigation.

#### **13.1.6 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 **medium** pre-mitigation and it will decrease to **low** post-mitigation.

### **13.2 Battery Energy Storage Facility (BESS)**

The impact that is associated with the construction of the BESS is the potential displacement of priority avifauna due to disturbance associated with the construction and dismantling of the facility and habitat transformation in the footprint of the facility.

#### **13.2.1 Displacement due to disturbance associated with the construction of the facility**

Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timely identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although in practice that can admittedly be challenging to implement. The priority species which are potentially most vulnerable to the impact of

displacement due to disturbance linked to the BESS are terrestrial species and owls. Priority species that could be most affected are the following: African Grass Owl, Black-bellied Bustard, Black-winged Lapwing, Blue Crane, Blue Korhaan, Buff-streaked Chat, Denham's Bustard, Grey Crowned Crane, Grey-winged Francolin, Marsh Owl, Northern Black Korhaan, Secretarybird and White-bellied Bustard. The impact is rated as **low** pre- and post-mitigation.

#### **13.2.2 Displacement due to habitat transformation associated with the construction of the facility**

These construction activities will impact on birds breeding, foraging and roosting in or in close proximity of the proposed facility through **transformation of habitat**, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the facility is unavoidable. The loss of habitat for priority species due to direct habitat transformation associated with the construction of the 5 ha proposed facility is likely to be relatively insignificant due to the relatively small size of the footprint (only 0.07% of the total project area, and 2.5% of the buildable area). The impact is rated as **low** pre-mitigation and it will decrease to **very low** post-mitigation.

#### **13.2.3 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 BESS. The impact is rated as **low** pre-mitigation and it will decrease to **very low** post-mitigation.

### **13.3 The up to 132kV OHL**

The following potential impacts on powerline sensitive avifauna are associated with the construction and operation of the up to 132kV grid connection related to the Wind Energy Facility:

- Displacement due to disturbance associated with the construction of the proposed OHL and on-site substation.
- Displacement due to habitat transformation associated with the construction of the proposed OHL and on-site substation.
- Mortality due to electrocution on the proposed OHL infrastructure
- Mortality due to electrocution on the electrical infrastructure within the proposed on-site substation.
- Mortality due to collisions with the proposed OHL.
- Displacement due to disturbance associated with the dismantling of the proposed OHL and on-site substation.

#### **13.3.1 Displacement due to disturbance associated with the construction of the proposed OHL and on-site substation.**

Construction activities could impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timely identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although this is often impractical to implement due to tight construction schedules. Powerline sensitive species which are potentially most vulnerable to displacement due to disturbance are mostly ground nesting species: African Grass Owl, Black-bellied Bustard, Blue Crane, Blue Korhaan, Denham's Bustard, Grey Crowned Crane, Helmeted Guineafowl, Marsh Owl, Northern Black Korhaan, Secretarybird, Spotted Eagle-Owl and White-bellied Bustard. The impact is rated as **moderate** pre-mitigation and it will decrease to **low** post-mitigation.

#### **13.3.2 Displacement due to habitat transformation associated with the construction of the proposed OHL and on-site substation.**

During the construction of powerlines, service roads (jeep tracks), substations and other associated infrastructure, habitat destruction/transformation inevitably takes place. These activities could impact on birds breeding, foraging and roosting in or in close proximity of the proposed OHL grid connection through the transformation of habitat. Relevant to this development, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the on-site substation is unavoidable. In the case of the OHL, the direct habitat transformation is limited to the on-site substation and pole/tower footprints and the narrow access road/track under the proposed OHL. The loss of habitat in the substation footprint (2 ha) will be a relatively insignificant percentage of the habitat that regularly supports powerline sensitive species, and the resultant impact is likely to be fairly minimal. Powerline sensitive species which are potentially most vulnerable to displacement due to habitat transformation are mostly ground nesting species: African Grass Owl, Black-bellied Bustard, Blue Crane, Blue Korhaan, Denham's Bustard, Grey Crowned Crane, Helmeted Guineafowl, Marsh Owl, Northern Black Korhaan, Secretarybird, Spotted Eagle-Owl and, White-bellied Bustard. The impact is rated as **moderate** pre-mitigation and it will decrease to **low** post-mitigation.

#### **13.3.3 Mortality of powerline sensitive avifauna due to electrocutions on the OHL**

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the voltage size of the proposed powerline and the pole/tower design. Should the proposed OHL be constructed using a 132kV tower specification, the electrocution impact for the majority of priority species will be negligible. The only priority species capable of bridging the clearance distances of an OHL constructed using this specification is the Cape Vulture, due to their size and gregarious nature. The impact is rated as **moderate** pre-mitigation and it will decrease to **low** post-mitigation.

#### **13.3.4 Mortality of powerline sensitive avifauna due to electrocutions in the onsite substation**



Electrocutions within the proposed on-site substation are possible, however the likelihood of this impact on the more sensitive SCC is remote, as these species are unlikely to regularly utilise the infrastructure within the onsite substation station for perching or roosting. Powerline sensitive species that are more vulnerable to electrocutions are medium-sized raptors, corvids, owls and certain species of waterbirds. As far as the substation is concerned, the following species are potentially at risk of electrocution: African Fish Eagle, African Grass Owl, Amur Falcon, Black Sparrowhawk, Black-chested Snake Eagle, Black-headed Heron, Black-winged Kite, Brown Snake Eagle, Cape Crow, Cape Vulture, Common Buzzard, Hadada Ibis, Helmeted Guineafowl, Jackal Buzzard, Lanner Falcon, Long-crested Eagle, Marsh Owl, Martial Eagle, Peregrine Falcon, Pied Crow, Southern Bald Ibis, Spotted Eagle-Owl, Western Barn Owl, Western Osprey and Yellow-billed Kite. The impact is rated as **low** pre- and post-mitigation.

### 13.3.5 Mortality of powerline sensitive avifauna due to collisions with the OHL

The up to 132kV OHL could pose a collision risk to virtually all powerline sensitive avifauna, depending on where the spans are located. Several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions, powerline configuration and visual capacity. Species potentially at risk are African Black Duck, African Darter, African Grass Owl, African Sacred Ibis, African Spoonbill, Black Heron, Black-bellied Bustard, Black-crowned Night Heron, Black-headed Heron, Black-necked Grebe, Blue Crane, Blue Korhaan, Blue-billed Teal, Cape Shoveler, Cape Teal, Cape Vulture, Denham's Bustard, Egyptian Goose, Fulvous Whistling Duck, Glossy Ibis, Goliath Heron, Great Egret, Greater Flamingo, Grey Crowned Crane, Grey Heron, Hadada Ibis, Hamerkop, Intermediate Egret, Lesser Flamingo, Little Egret, Little Grebe, Mallard, Marsh Owl, Northern Black Korhaan, Purple Heron, Red-billed Teal, Red-knobbed Coot, Reed Cormorant, Secretarybird, South African Shelduck, Southern Bald Ibis, Southern Pochard, Spotted Eagle-Owl, Spur-winged Goose, Squacco Heron, Wattled Crane, Western Barn Owl, Western Cattle Egret, White Stork, White-backed Duck, White-bellied Bustard, White-breasted Cormorant, White-faced Whistling Duck, Yellow-billed Duck. The impact is rated as **moderate** pre-mitigation and it will decrease to **low** post-mitigation.

### 13.3.6 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 OHL and onsite substation. The impact is rated as **medium** pre-mitigation and it will decrease to **low** post-mitigation.

## 13.4 Cumulative impacts

### 16.4.1 Wind Energy Facility

The proposed Camden II WEF will consist of up to 45 turbines in total. According to information that is available, the number of additional wind turbines that are planned within a 30km radius in broadly similar habitat around the proposed WEF is another (up to) 37 i.e. for the proposed Camden II WEF. If both the Camden I and Camden II projects are approved, a total of up to 82 turbines may be developed, of which the Camden I will contribute approximately 45%. As such, the WEFs' contribution to the total number of turbines, and by implication to the cumulative impact of all the planned turbines, is **High**, but could be reduced to **Moderate** with appropriate mitigation. The total area of similar habitat (excluding opencast mining and urban areas) available to birds in the 30km radius around the project area (including the project area) is approximately 4 258 km<sup>2</sup>. This translates into approximately 1

turbine/52km<sup>2</sup> 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**, and the impact could be reduced if the recommended mitigation at the two Camden wind projects is diligently implemented.

#### **16.4.2 Up to 132kV OHL**

The combined length of the grid connections for the Camden I and II renewable energy projects listed above, and the 400kV OHL to Camden Power Station Substation, is approximately 26.4km. The proposed Camden I grid connection will be a maximum of 5.3km long. The existing high voltage lines in the 30km radius around the proposed Camden I WEF run into hundreds of kilometres (see Figure 12). The Camden I grid OHL contribution to the total length of high voltage lines within a 30km radius, and by implication to the cumulative impact of all the planned and existing high voltage lines, is thus **Low** in comparison. However, the density of planned and existing high voltage lines within a 30km radius, and by implication the cumulative impact on avifauna, is considered to be **Moderate**.

#### **16.4.3 Battery Energy Storage Facility**

The BESS will transform an area of approximately 5 ha. Given the available habitat of 4 258km<sup>2</sup> within a 30km radius around the project site, the cumulative impact of displacement and habitat transformation caused by the BESS is **Low** due to the small footprint.

## **14 CONCLUSION AND IMPACT STATEMENT**

### **14.1 Wind Energy Facility**

The proposed wind energy facility will have a moderate impact on priority avifauna which, in most instances, could be reduced to a low impact through appropriate mitigation, although some instances 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.

### **14.2 Battery Energy Storage Facility (BESS)**

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

### **14.3 The up to 132kV OHL**

The proposed up to 132kV OHL will have a mostly moderate impact on priority avifauna which, in all instances, could be reduced to a low impact through appropriate mitigation. No fatal flaws were

discovered during the onsite investigations. The proposed development is therefore supported, provided the mitigation measures listed in this report are strictly implemented.

## 15 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 for the WEF must be included as part of the bird specialist study. See Appendix 7 for a proposed programme for the WEF.

## 16 REFERENCES

- Allan, D. G., Harrison, J. A., Navarro, R., van Wilgen, B. W., & Thompson, M. W. (1997). The impact of commercial afforestation on bird populations in Mpumalanga Province, South Africa - insights from bird-atlas data. *Biological Conservation*, 79(2–3), 173–185.
- Alonso, J. A. and Alonso, J. C. 1999 Collision of birds with overhead transmission lines in Spain. Pp. 57–82 in Ferrer, M. and Janss, G. F. E., eds. *Birds and power lines: Collision, electrocution and breeding*. Madrid, Spain: Quercus.Google Scholar
- Amar, A., Buij, R., Suri, J., Sumasgutner, P., & Virani, M. Z. (2018). Conservation and ecology of African raptors. In *Birds of Prey* (pp. 419–455). Springer.
- Animal Demography Unit. 2022. The southern African Bird Atlas Project 2. University of Cape Town. <http://sabap2.adu.org.za>.
- Avian Power Line Interaction Committee (APLIC). 2012. *Mitigating Bird Collisions with Power Lines: The State of the Art in 2012*. Edison Electric Institute. Washington D.C.
- Band, W., Madders, M., Whitfield, D.P., 2007. Developing field and analytical methods to assess avian collision risk at wind farms. In: Lucas, M., Janss, G.F.E., Ferrer, M. (Eds.), *Birds and Wind Farms: Risk Assessment and Mitigation*. Quercus, Madrid, pp. 259–275.
- Barrientos R, Ponce C, Palacin C, Martín Ca, Martín B, et al. 2012. Wire marking results in a small but significant reduction in avian mortality at power lines: A BACI Designed Study. *PLoS ONE* 7(3): e32569. doi:10.1371/journal.pone.0032569.
- Barrientos, R., Alonso, J.C., Ponce, C., Palacín, C. 2011. Meta-Analysis of the effectiveness of marked wire in reducing avian collisions with power lines. *Conservation Biology* 25: 893–903.
- Barrientos, R., Ponce, C., Palacín, C., Martín, C. A., Martín, B., & Alonso, J. C. 2012. Wire marking results in a small but significant reduction in avian mortality at power lines: A baci designed study. *PLoS ONE*, 7(3). <https://doi.org/10.1371/journal.pone.0032569>
- Barrios, L., & Rodríguez, A. 2004. Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. *Journal of Applied Ecology*, 41(1), 72–81. <https://doi.org/10.1111/j.1365-2664.2004.00876.x>
- Beaulaurier, D.L. 1981. Mitigation of bird collisions with transmission lines. Bonneville Power Administration. U.S. Dept. of Energy.
- Bernardino, J., Bevanger, K., Barrientos, R., Dwyer, J.F. Marques, A.T., Martins, R.C., Shaw, J.M., Silva, J.P., Moreira, F. 2018. Bird collisions with power lines: State of the art and priority areas for research. <https://doi.org/10.1016/j.biocon.2018.02.029>. *Biological Conservation* 222 (2018) 1 – 13.

- Bernardino, J., Bispo, R., Costa, H., & Mascarenhas, M. (2013). Estimating bird and bat fatality at wind farms: A practical overview of estimators, their assumptions and limitations. *New Zealand Journal of Zoology*, 40(1), 63–74. <https://doi.org/10.1080/03014223.2012.758155>
- Bevanger, K. (1994). Bird interactions with utility structures: collision and electrocution, causes and mitigating measures. *Ibis*, 136(4), 412–425.
- Bidwell, M. T. (2004). Breeding habitat selection and reproductive success of Blue Cranes *Anthropoides paradiseus* in an agricultural landscape of the Western Cape, South Africa. In MSc (Conservation Biology) thesis, University of Cape Town.
- BirdLife International. (2022). IUCN Red List for birds. Downloaded from <http://www.birdlife.org> on 24/07/2021.
- Bright, J., Langston, R. H. W., Bullman, R., Evans, R. J., Gardner, S., Pearce-Higgins, J., & Wilson, E. (2006). Bird sensitivity map to provide locational guidance for onshore wind farms in Scotland. In RSPB Research Report (Vol. 20, Issue 20).
- Bright, J., Langston, R., Bullman, R., Evans, R., Gardner, S., & Pearce-Higgins, J. (2008). Map of bird sensitivities to wind farms in Scotland: A tool to aid planning and conservation. *Biological Conservation*, 141(9), 2342–2356. <https://doi.org/10.1016/j.biocon.2008.06.029>
- Calvert, A.M., Bishop, C.A., Elliot, R.D., Krebs, E.A., Kydd, T.M., Machtans, C.S., Robertson, G.J., 2013. A synthesis of human-related avian mortality in Canada. *Avian Conserv. Ecol.* 8 (2), 11.
- Camiña, A. 2012b. Email communication on 17 November 2012 to the author by Alvaro Camiña, Spanish ornithologist with decades of experience in avifaunal monitoring at wind farms in Spain.
- Campedelli, T., Londi, G., Cutini, S., Sorace, A., & Tellini Florenzano, G. (2014). Raptor displacement due to the construction of a wind farm: Preliminary results after the first 2 years since the construction. *Ethology Ecology and Evolution*, 26(4), 376–391. <https://doi.org/10.1080/03949370.2013.862305>
- Carrete, M., Sánchez-Zapata, J. A., Benítez, J. R., Lobón, M., & Donázar, J. A. (2009). Large scale risk-assessment of wind-farms on population viability of a globally endangered long-lived raptor. *Biological Conservation*, 142(12), 2954–2961. <https://doi.org/10.1016/j.biocon.2009.07.027>
- Carrete, M., Sánchez-Zapata, J. A., Benítez, J. R., Lobón, M., Montoya, F., & Donázar, J. A. (2012). Mortality at wind-farms is positively related to large-scale distribution and aggregation in griffon vultures. *Biological Conservation*, 145(1), 102–108. <https://doi.org/10.1016/j.biocon.2011.10.017>
- Cole, S. G., & Dahl, E. L. (2013). Compensating white-tailed eagle mortality at the Smøla wind-power plant using electrocution prevention measures. *Wildlife Society Bulletin*, 37(1), 84–93. <https://doi.org/10.1002/wsb.263>
- Cook, A. S. C. P., Humphreys, E. M., Bennet, F., Masden, E. A., & Burton, N. H. K. (2018). Quantifying avian avoidance of offshore wind turbines: Current evidence and key knowledge gaps. *Marine Environmental Research*, 140(June), 278–288. <https://doi.org/10.1016/j.marenvres.2018.06.017>
- Dahl, E. L., May, R., Hoel, P. L., Bevanger, K., Pedersen, H. C., Røskaft, E., & Stokke, B. G. (2013). White-tailed eagles (*Haliaeetus albicilla*) at the Smøla wind-power plant, central Norway, lack behavioral flight responses to wind turbines. *Wildlife Society Bulletin*, 37(1), 66–74. <https://doi.org/10.1002/wsb.258>

- De Lucas, M., Janss, G. F. E., Whitfield, D. P., & Ferrer, M. (2008). Collision fatality of raptors in wind farms does not depend on raptor abundance. *Journal of Applied Ecology*, 45(6), 1695–1703. <https://doi.org/10.1111/j.1365-2664.2008.01549.x>
- Desholm, M., & Kahlert, J. (2005). Avian collision risk at an offshore wind farm. *Biology Letters*, 1(3), 296–298. <https://doi.org/10.1098/rsbl.2005.0336>
- Dohm, R., Jennelle, C. S., Garvin, J. C., & Drake, D. (2019). A long-term assessment of raptor displacement at a wind farm. *Frontiers in Ecology and the Environment*, 17(8), 433–438. <https://doi.org/10.1002/fee.2089>
- Drewitt, A. L., & Langston, R. H. W. (2006). Assessing the impacts of wind farms on birds. *Ibis*, 148(SUPPL. 1), 29–42. <https://doi.org/10.1111/j.1474-919X.2006.00516.x>
- Drewitt, A. L., & Langston, R. H. W. (2008). Collision effects of wind-power generators and other obstacles on birds. *Annals of the New York Academy of Sciences*, 1134, 233–266. <https://doi.org/10.1196/annals.1439.015>
- Endangered Wildlife Trust. 2014. Central incident register for powerline incidents. Unpublished data.
- Erickson, W. P., Johnson, G. D., & David Jr, P. (2005). A summary and comparison of bird mortality from anthropogenic causes with an emphasis on collisions. In: Ralph, C. John; Rich, Terrell D., Editors 2005. *Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference*. 2002 March 20-24; Asilomar, California, Volume 2 Gen. Tech. Rep. PS, 191.
- Everaert, J. (2014). Collision risk and micro-avoidance rates of birds with wind turbines in Flanders. *Bird Study*, 61(2), 220–230. <https://doi.org/10.1080/00063657.2014.894492>
- Fahrig, L., Arroyo-Rodríguez, V., Bennett, J. R., Boucher-Lalonde, V., Cazetta, E., Currie, D. J., Eigenbrod, F., Ford, A. T., Harrison, S. P., Jaeger, J. A. G., Koper, N., Martin, A. E., Martin, J. L., Metzger, J. P., Morrison, P., Rhodes, J. R., Saunders, D. A., Simberloff, D., Smith, A. C., Watling, J. I. (2019). Is habitat fragmentation bad for biodiversity? *Biological Conservation*, 230, 179–186. <https://doi.org/10.1016/j.biocon.2018.12.026>
- Farfán, M. A., Vargas, J. M., Duarte, J., & Real, R. (2009). What is the impact of wind farms on birds? A case study in southern Spain. *Biodiversity and Conservation*, 18(14), 3743–3758. <https://doi.org/10.1007/s10531-009-9677-4>
- Ferrer, M., De Lucas, M., Janss, G. F. E., Casado, E., Muñoz, A. R., Bechard, M. J., & Calabuig, C. P. (2012). Weak relationship between risk assessment studies and recorded mortality in wind farms. *Journal of Applied Ecology*, 49(1), 38–46. <https://doi.org/10.1111/j.1365-2664.2011.02054.x>
- Fletcher, R. J., Didham, R. K., Banks-Leite, C., Barlow, J., Ewers, R. M., Rosindell, J., Holt, R. D., Gonzalez, A., Pardini, R., Damschen, E. I., Melo, F. P. L., Ries, L., Prevedello, J. A., Tscharntke, T., Laurance, W. F., Lovejoy, T., & Haddad, N. M. (2018). Is habitat fragmentation good for biodiversity? *Biological Conservation*, 226(July), 9–15. <https://doi.org/10.1016/j.biocon.2018.07.022>
- Fox, A. D., Desholm, M., Kahlert, J., Christensen, T. K., & Petersen, I. K. (2006). Information needs to support environmental impact assessment of the effects of European marine offshore wind farms on birds. *Ibis*, 148(SUPPL. 1), 129–144. <https://doi.org/10.1111/j.1474-919X.2006.00510.x>
- Frid, A., & Dill, L. (2002). Human-caused disturbance stimuli as a form of predation risk. *Ecology and Society*, 6(1). <https://doi.org/10.5751/es-00404-060111>



- Furness, R. W., Wade, H. M., & Masden, E. A. (2013). Assessing vulnerability of marine bird populations to offshore wind farms. *Journal of Environmental Management*, 119, 56–66. <https://doi.org/10.1016/j.jenvman.2013.01.025>
- Guichard, F. (2017). Recent advances in metacommunities and meta-ecosystem theories. *F1000Research*, 6(May), 1–8. <https://doi.org/10.12688/f1000research.10758.1>
- Haas, D., Nipkow, M., Fiedler, G., Handschuh, M., Schneider-Jacoby, M., & Schneider, R. (2006). Caution: Electrocution! NABU-German Society for Nature Conservation.
- Hale, A., Hatchett, E. S., Meyer, J. A., & Bennett, V. J. (2014). No evidence of displacement due to wind turbines in breeding grassland songbirds. *Condor*, 116(3), 472–482. <https://doi.org/10.1650/CONDOR-14-41.1>
- Harrison, J. A., Allan, D. G., Underhill, L. G., Herremans, M., Tree, A. J., Parker, V., & Brown, C. J. (Eds.). (1997). *The atlas of southern African birds. Vol. 2: Passerines*. BirdLife South Africa, Johannesburg, SA.
- Healy, S. D., & Braithwaite, V. A. (2010). The role of landmarks in small-and large-scale navigation.
- Herrera-Alsina, L., Villegas-Patraca, R., Eguiarte, L. E., & Arita, H. T. (2013). Bird communities and wind farms: A phylogenetic and morphological approach. *Biodiversity and Conservation*, 22(12), 2821–2836. <https://doi.org/10.1007/s10531-013-0557-6>
- Hobbs, J.C.A. & Ledger J.A. 1986a. The Environmental Impact of Linear Developments; Power lines and Avifauna. *Proceedings of the Third International Conference on Environmental Quality and Ecosystem Stability*. Israel, June 1986.
- Hobbs, J.C.A. & Ledger J.A. 1986b. Power lines, Birdlife and the Golden Mean. *Fauna and Flora*, 44:23-27.
- Hockey P.A.R., Dean W.R.J., and Ryan P.G. 2005. *Robert's Birds of Southern Africa*, seventh edition. Trustees of the John Voelcker Bird Book Fund, Cape Town.
- Hoover, S. L., & Morrison, M. L. (2005). Behavior of Red-Tailed Hawks in a Wind Turbine Development. *Journal of Wildlife Management*, 69(1), 150–159. [https://doi.org/10.2193/0022-541x\(2005\)069<0150:borhia>2.0.co;2](https://doi.org/10.2193/0022-541x(2005)069<0150:borhia>2.0.co;2)
- Hötter, H., Thomsen, K.-M., & Jeromin, H. (2006). Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. In Michael-Otto-Institut im NABU, Berghusen.
- Hull, C. L., Stark, E. M., Peruzzo, S., & Sims, C. C. (2013). Avian collisions at two wind farms in Tasmania, Australia: Taxonomic and ecological characteristics of colliders versus non-colliders. *New Zealand Journal of Zoology*, 40(1), 47–62. <https://doi.org/10.1080/03014223.2012.757243>
- Huso, M., Conkling, T., Dalthorp, D., Davis, M., Smith, H., Fesnock, A., & Katzner, T. (2021). Relative energy production determines effect of repowering on wildlife mortality at wind energy facilities. *Journal of Applied Ecology*, 58(6), 1284–1290. <https://doi.org/10.1111/1365-2664.13853>
- Huso, M., Dalthorp, D., Dail, D., & Madsen, L. (2015). Estimating wind-turbine-caused bird and bat fatality when zero carcasses are observed. *Ecological Applications*, 25(5), 1213–1225. <https://doi.org/10.1890/14-0764.1>
- Janss, G. F. E. (2000). Avian mortality from power lines: A morphologic approach of a species-specific mortality. *Biological Conservation*, 95(3), 353–359. [https://doi.org/10.1016/S0006-3207\(00\)00021-5](https://doi.org/10.1016/S0006-3207(00)00021-5)

- Jenkins, A. & Smallie, J. 2009. Terminal velocity: the end of the line for Ludwig's Bustard? *Africa Birds and Birding*. Vol 14, No 2.
- Jenkins, A., De Goede, J.H. & Van Rooyen, C.S. 2006. Improving the products of the Eskom Electric Eagle Project. Unpublished report to Eskom. Endangered Wildlife Trust.
- Jenkins, A., De Goede, K. H., Sebele, L., & Diamond, M. (2013). Brokering a settlement between eagles and industry: Sustainable management of large raptors nesting on power infrastructure. *Bird Conservation International*, 23(2), 232–246. <https://doi.org/10.1017/S0959270913000208>
- Jenkins, A., Ralston-Paton, S., & Smit-Robinson, H. A. (2017). Guidelines for Assessing and Monitoring the Impact of Solar Power Generating Facilities on Birds in Southern Africa. BirdLife South Africa.
- Jenkins, A., Smallie, J. J., & Diamond, M. (2010). Avian collisions with power lines: A global review of causes and mitigation with a South African perspective. *Bird Conservation International*, 20(3), 263–278. <https://doi.org/10.1017/S0959270910000122>
- Jenkins, A., van Rooyen, C. S., Smallie, J. J., Anderson, M. D., & Smit, A. H. (2015). Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Wildlife & Energy Programme of the Endangered Wildlife Trust & BirdLife South Africa.
- Jenkins, A.R., De Goede, J.H., Sebele, L. & Diamond, M. 2013. Brokering a settlement between eagles and industry: sustainable management of large raptors nesting on power infrastructure. *Bird Conservation International* 23: 232-246.
- Jenkins, A.R., Smallie, J.J. & Diamond, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. *Bird Conservation International* 20: 263-278.
- Katzner, T., Smith, B. W., Miller, T. A., Brandes, D., Cooper, J., Lanzone, M., Brauning, D., Farmer, C., Harding, S., Kramar, D. E., Koppie, C., Maisonneuve, C., Martell, M., Mojica, E. K., Todd, C., Tremblay, J. A., Wheeler, M., Brinker, D. F., Chubbs, T. E., ... Bildstein, K. L. (2012). Status, biology, and conservation priorities for North America's Eastern golden eagle (*Aquila chrysaetos*) population. *A United Kingdom*, 129(1), 168–176. <https://doi.org/10.1525/aUnited Kingdom.2011.11078>
- Keskin, G., Durmuş, S., Karakaya, M., & Özelmaz, Ü. (2019). Effects of wing loading on take-off and turning performance which is a decisive factor in the selection of resting location of the Great Bustard (*Otis tarda*). *Biyolojik Çeşitlilik ve Koruma*, 12(3), 28–32.
- Kitano, M., & Shiraki, S. (2013). Estimation of bird fatalities at wind farms with complex topography and vegetation in Hokkaido, Japan. *Wildlife Society Bulletin*, 37(1), 41–48. <https://doi.org/10.1002/wsb.255>
- Koops, F.B.J. & De Jong, J. 1982. Vermindering van draadslachtoffers door markering van hoogspanningsleidingen in de omgeving van Heerenveen. *Electrotechniek* 60 (12): 641 – 646.
- Krijgsveld, K. L., Akershoek, K., Schenk, F., Dijk, F., & Dirksen, S. (2009). Collision risk of birds with modern large wind turbines. *Ardea*, 97(3), 357–366. <https://doi.org/10.5253/078.097.0311>
- Kruger, R. & Van Rooyen, C.S. 1998. Evaluating the risk that existing power lines pose to large raptors by using risk assessment methodology: The Molopo Case Study. *Proceedings of the 5th World Conference on Birds of Prey and Owls*. August 4-8, 1998. Midrand, South Africa.

- Kruger, R. 1999. Towards solving raptor electrocutions on Eskom Distribution Structures in South Africa. Bloemfontein (South Africa): University of the Orange Free State. (M. Phil. Mini-thesis)
- Lane, S. J., Alonso, J. C., & Martín, C. A. (2001). Habitat preferences of great bustard *Otistarda* flocks in the arable steppes of central Spain: are potentially suitable areas unoccupied? *Journal of Applied Ecology*, 38(1), 193–203.
- Langgemach, T. (2008). Memorandum of Understanding for the Middle-European population of the Great Bustard, German National Report 2008. Landesumweltamt Brandenburg (Brandenburg State Office for Environment).
- Leddy, K. L., Higgins, K. F., & Naugle, D. E. (1999). Effects of wind turbines on upland nesting birds in Conservation Reserve Program grasslands. *The Wilson Bulletin*, 100–104.
- Ledger, J. 1983. Guidelines for Dealing with Bird Problems of Transmission Lines and Towers. Eskom Test and Research Division. (Technical Note TRR/N83/005).
- Ledger, J.A. & Annegarn H.J. 1981. Electrocution Hazards to the Cape Vulture (*Gyps coprotheres*) in South Africa. *Biological Conservation* 20:15-24.
- Ledger, J.A. 1984. Engineering Solutions to the Problem of Vulture Electrocutions on Electricity Towers. *The Certificated Engineer*, 57:92-95.
- Ledger, J.A., J.C.A. Hobbs & Smith T.V. 1992. Avian Interactions with Utility Structures: Southern African Experiences. Proceedings of the International Workshop on Avian Interactions with Utility Structures. Miami (Florida), Sept. 13-15, 1992. Electric Power Research Institute.
- Loss, S. R., Will, T., & Marra, P. P. (2014). Refining estimates of bird collision and electrocution mortality at power lines in the United States. *PLoS ONE*, 9(7), 26–28. <https://doi.org/10.1371/journal.pone.0101565>
- Marnewick, M. D., Retief, E. F., Theron, N. T., Wright, D. R., & Anderson, T. A. (2015). Important bird and biodiversity areas of South Africa. Johannesburg: BirdLife South Africa. <http://www.birdlife.org.za/conservation/importantbird-areas/documents-and-downloads>
- Marques, A., Batalha, H., Rodrigues, S., Costa, H., Pereira, M. J. R., Fonseca, C., Mascarenhas, M., & Bernardino, J. (2014). Understanding bird collisions at wind farms: An updated review on the causes and possible mitigation strategies. *Biological Conservation*, 179, 40–52. <https://doi.org/10.1016/j.biocon.2014.08.017>
- Marques, A., Santos, C. D., Hanssen, F., Muñoz, A. R., Onrubia, A., Wikelski, M., Moreira, F., Palmeirim, J. M., & Silva, J. P. (2020). Wind turbines cause functional habitat loss for migratory soaring birds. *Journal of Animal Ecology*, 89(1), 93–103. <https://doi.org/10.1111/1365-2656.12961>
- Martín, B., Perez-Bacalu, C., Onrubia, A., De Lucas, M., & Ferrer, M. (2018). Impact of wind farms on soaring bird populations at a migratory bottleneck. *European Journal of Wildlife Research*, 64(3). <https://doi.org/10.1007/s10344-018-1192-z>
- Martin, G. (2011). Understanding bird collisions with man-made objects: A sensory ecology approach. *Ibis*, 153(2), 239–254. <https://doi.org/10.1111/j.1474-919X.2011.01117.x>
- Martin, G., & Katzir, G. (1999). Visual fields in short-toed eagles, *Circetus gallicus* (Accipitridae), and the function of binocularity in birds. *Brain, Behavior and Evolution*, 53(2), 55–66.
- Martin, G., Portugal, S. J., & Murn, C. P. (2012). Visual fields, foraging and collision vulnerability in *Gyps* vultures. *Ibis*, 154(3), 626–631. <https://doi.org/10.1111/j.1474-919X.2012.01227.x>

- Martin, G., Shaw, J., Smallie J. & Diamond, M. 2010. Bird's eye view – How birds see is key to avoiding power line collisions. Eskom Research Report. Report Nr: RES/RR/09/31613.
- Martin, G., Shaw, J., Smallie, J., & Diamond, M. (2010). Bird's eye view—How birds see is key to avoiding power line collisions. Eskom Research Report. Report Nr: RES/RR/09/31613.
- May, R. (2015). A unifying framework for the underlying mechanisms of avian avoidance of wind turbines. *Biological Conservation*, 190, 179–187. <https://doi.org/10.1016/j.biocon.2015.06.004>
- May, R., Reitan, O., Bevanger, K., Lorentsen, S. H., & Nygård, T. (2015). Mitigating wind-turbine induced avian mortality: Sensory, aerodynamic and cognitive constraints and options. *Renewable and Sustainable Energy Reviews*, 42, 170–181. <https://doi.org/10.1016/j.rser.2014.10.002>
- McClure, C. J. W., Dunn, L., McCabe, J. D., Rolek, B. W., Botha, A., Virani, M. Z., Buij, R., & Katzner, T. E. (2021). Flight altitudes of raptors in southern Africa highlight vulnerability of threatened species to wind turbines. *Frontiers in Ecology and Evolution*, 9(October). <https://doi.org/10.3389/fevo.2021.667384>
- McGrady, M. J., Grant, J. R., Bainbridge, I. P., & McLeod, D. R. A. (2002). A model of Golden Eagle (*Aquila chrysaetos*) ranging behavior. *Journal of Raptor Research*, 36(1 SUPPL.), 62–69.
- Mclsaac, H. P. (2001). Raptor Acuity and Wind Turbine Blade Conspicuity. In *Proceedings of National Avian-Wind Power Planning Meeting IV* (ed. PNAWPPM-IV) (pp. 59–87). <https://doi.org/10.1111/j.1540-5915.1985.tb01681.x>
- McLeod, D. R. A., Whitfield, D. P., & McGrady, M. J. (2002). Improving prediction of Golden Eagle (*Aquila chrysaetos*) ranging in western Scotland using GIS and terrain modeling. *Journal of Raptor Research*, 36(1 SUPPL.), 70–77.
- Mitkus, M., Potier, S., Martin, G. R., Duriez, O., & Kelber, A. (2018). Raptor vision. In *Oxford research encyclopedia of neuroscience*.
- Mucina, L., & Rutherford, M. C. (Eds.). (2006). *The vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19, South African National Biodiversity Institute: Pretoria, South Africa.
- Mueller, T., & Fagan, W. F. (2008). Search and navigation in dynamic environments - From individual behaviors to population distributions. *Oikos*, 117(5), 654–664. <https://doi.org/10.1111/j.0030-1299.2008.16291.x>
- Murgatroyd, M., Bouten, W., & Amar, A. (2021). A predictive model for improving placement of wind turbines to minimise collision risk potential for a large soaring raptor. *Journal of Applied Ecology*, 58(4), 857–868. <https://doi.org/10.1111/1365-2664.13799>
- O'Rourke, C. T., Hall, M. I., Pitlik, T., & Fernández-Juricic, E. (2010). Hawk eyes I: Diurnal raptors differ in visual fields and degree of eye movement. *PLoS ONE*, 5(9), 1–8. <https://doi.org/10.1371/journal.pone.0012802>
- Osborn, R.G., Dieter, C.D., Higgins, K.F., Usgaard, R.E., 1998. Bird flight characteristics near wind turbines in Minnesota. *Am. Midl. Nat.* 139, 29–38.
- Päckert, M., Martens, J., Sun, Y. H., Severinghaus, L. L., Nazarenko, A. A., Ting, J., Töpfer, T., & Tietze, D. T. (2012). Horizontal and elevational phylogeographic patterns of Himalayan and Southeast Asian forest passerines (Aves: Passeriformes). *Journal of Biogeography*, 39(3), 556–573. <https://doi.org/10.1111/j.1365-2699.2011.02606.x>
- Pearce-Higgins, J., Stephen, L., Douse, A., & Langston, R. H. W. (2012). Greater impacts on bird populations during construction than subsequent operation: result of multi-site and multi-species analysis. *Journal of Applied Ecology*, 49, 394–396.

- Pearce-Higgins, J., Stephen, L., Langston, R. H. W., Bainbridge, I. P., & Bullman, R. (2009). The distribution of breeding birds around upland wind farms. *Journal of Applied Ecology*, 46(6), 1323–1331. <https://doi.org/10.1111/j.1365-2664.2009.01715.x>
- Perold, V., Ralston-Paton, S., & Ryan, P. (2020). On a collision course? The large diversity of birds killed by wind turbines in South Africa. *Ostrich*, 228–239. <https://doi.org/10.2989/00306525.2020.1770889>
- Plonczkier, P., & Simms, I. C. (2012). Radar monitoring of migrating pink-footed geese: Behavioural responses to offshore wind farm development. *Journal of Applied Ecology*, 49(5), 1187–1194. <https://doi.org/10.1111/j.1365-2664.2012.02181.x>
- Raab, R., Julius, E., Spakovszky, P., & Nagy, S. (2009). Guidelines for monitoring of population parameters of Great Bustard and of the effects of management measures. Prepared for the CMS Memorandum of Understanding on the Conservation and Management of the Middle-European Population of the Great Bustard. BirdLife International. Brussels.
- Raab, R., Spakovszky, P., Julius, E., Schütz, C., & Schulze, C. H. (2011). Effects of power lines on flight behaviour of the West-Pannonian Great Bustard *Otis tarda* population. *Bird Conservation International*, 21(2), 142–155. <https://doi.org/10.1017/S0959270910000432>
- Ralston-Paton, S., & Murgatroyd, M. (2021). Verreaux's Eagles and Wind Farms. Guidelines for impact assessment, monitoring and mitigation. BirdLife South Africa (II). BirdLife South Africa Johannesburg.
- Ralston-Patton, M., & Camagu, N. (2019). Birds and Renewable Energy Update for 2019. Birds and Renewable Energy Forum, 10 October 2019. BirdLife South Africa, Johannesburg, SA.
- Retief E. F., Diamond, M., Anderson, M. D., Smit, H. A., Jenkins, A. ., & Brooks, M. (2012). Avian Wind Farm Sensitivity Map. Birdlife South Africa. <http://www.birdlife.org.za/conservation/birds-and-wind-energy/windmap>
- Rutherford, M. C., Muncina, L., Lotter, M. C., Bredenkamp, G. J., Smit, J. H. L., Scott-Shaw, C. R., Hoare, D. B., Goodman, P. S., Bezuidenhout, H., Scott, L., Ellis, F., Powrie, L. W., Siebert, F., Mostert, T. H., Henning, B. J., Venter, C. E., Camp, G. T. C., Siebert, S. J., Matthews, W. S., Hunter, P. J. H. (2006). Savanna Biome - 9. In L. Mucina & M. C. Rutherford (Eds.), *The Vegetation of South Africa, Lesotho and Swaziland* (pp. 438–539). Strelitzia 19, South African National Biodiversity Institute: Pretoria, South Africa.
- Saidur, R., Rahim, N. A., Islam, M. R., & Solangi, K. H. (2011). Environmental impact of wind energy. *Renewable and Sustainable Energy Reviews*, 15(5), 2423–2430. <https://doi.org/10.1016/j.rser.2011.02.024>
- Santos, C. D., Marques, A. T., & May, R. (2020). Recovery of raptors from displacement by wind farms – a response. *Frontiers in Ecology and the Environment*, 18(3), 121–122. <https://doi.org/10.1002/fee.2180>
- Scottish Natural Heritage. (2010). Use of avoidance rates in the SNH wind farm collision risk model. In SNH Avoidance Rate Information & Guidance Note.
- Shaw, J. (2013). Power line collisions in the Karoo: Conserving Ludwig's Bustard. University of Cape Town.
- Shaw, J., Jenkins, A., Ryan, P., & Smallie, J. (2010). A preliminary survey of avian mortality on power lines in the Overberg, South Africa. *Ostrich*, 81(2), 109–113. <https://doi.org/10.2989/00306525.2010.488421>
- Shaw, J., Reid, T. A., Schutgens, M., Jenkins, A. R., & Ryan, P. G. (2018). High power line collision mortality of threatened bustards at a regional scale in the Karoo, South Africa. *Ibis*, 160(2), 431–446. <https://doi.org/10.1111/ibi.12553>



- Shaw, J., Van Den Merwe, R., & Van Den Merwe, E. (2015). Winter scavenging rates under power lines in the Karoo, South Africa. *African Journal of Wildlife Research*, 45(1), 122–126. <https://doi.org/10.3957/056.045.0112>
- Shaw, J.M. 2013. Power line collisions in the Karoo: Conserving Ludwig's Bustard. Unpublished PhD thesis. Percy FitzPatrick Institute of African Ornithology, Department of Biological Sciences, Faculty of Science University of Cape Town May 2013.
- Shaw, J.M., Jenkins, A.R., Ryan, P.G. And Smallie, J.J. 2010b. A preliminary survey of avian mortality on power lines in the Overberg, South Africa. *Ostrich* 81: 109-113.
- Shaw, J.M., Jenkins, A.R., Smallie, J.J. And Ryan, P.G. 2010a. Modelling power-line collision risk for the Blue Crane *Anthropoides paradiseus* in South Africa. *Ibis* 152: 590-599.
- Shaw, J.M., Pretorius, M.D., Gibbons, B., Mohale, O., Visagie, R., Leeuwner, J.L. & Ryan, P.G. 2017. The effectiveness of line markers in reducing powerline collisions of large terrestrial birds at De Aar, Northern Cape. Eskom Research, Testing and Development. Research Report. RES/RR/17/1939422.
- Simmons, R & Martins, M. 2016. Photographic record of a Martial Eagle killed at Jeffreys Bay wind farm. *Birds & Bats Unlimited*.
- Smallwood, K. S., & Karas, B. (2009). Avian and Bat Fatality Rates at Old-Generation and Repowered Wind Turbines in California. *Journal of Wildlife Management*, 73(7), 1062–1071. <https://doi.org/10.2193/2008-464>
- Smallwood, K. S., Rugge, L., & Morrison, M. L. (2009). Influence of Behavior on Bird Mortality in Wind Energy Developments. *Journal of Wildlife Management*, 73(7), 1082–1098. <https://doi.org/10.2193/2008-555>
- South African National Biodiversity Institute. (2018). The Vegetation Map of South Africa, Lesotho and Swaziland (L. Mucina, M. C. Rutherford, & L. W. Powrie (Eds.); Version 20). <http://bgis.sanbi.org/Projects/Detail/186>.
- South African National Biodiversity Institute (SANBI). 2020. Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa. South African National Biodiversity Institute, Pretoria. Version 1.2020.
- Sovacool, B. K. (2013). The avian benefits of wind energy: A 2009 update. *Renewable Energy*, 49, 19–24. <https://doi.org/10.1016/j.renene.2012.01.074>
- Sporer, M.K., Dwyer, J.F., Gerber, B.D, Harness, R.E, Pandey, A.K. 2013. Marking Power Lines to Reduce Avian Collisions Near the Audubon National Wildlife Refuge, North Dakota. *Wildlife Society Bulletin* 37(4):796–804; 2013; DOI: 10.1002/wsb.329
- Stevens, T. K., Hale, A. M., Karsten, K. B., & Bennett, V. J. (2013). An analysis of displacement from wind turbines in a wintering grassland bird community. *Biodiversity and Conservation*, 22(8), 1755–1767. <https://doi.org/10.1007/s10531-013-0510-8>
- Stienen, E. W. M., Courtens, W., Everaert, J., & Van De Walle, M. (2008). Sex-biased mortality of common terns in wind farm collisions. *The Condor*, 110(1), 154–157.
- Taylor, M.R., Peacock F, & Wanless R.W (eds.) 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg, South Africa.
- Thelander, C. G., Smallwood, K. S., & Rugge, L. (2003). Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area: Period of Performance, March 1998--December 2000. National Renewable Energy Lab., Golden, CO.(US).
- Thompson, M. (2019). South African national land-cover (SANLC) 2018. Department of Environmental Affairs, and Department of Rural Development and Land Reform, Pretoria, South Africa. [https://www.environment.gov.za/projectsprogrammes/egis\\_landcover\\_datasets](https://www.environment.gov.za/projectsprogrammes/egis_landcover_datasets)

- Van Rooyen, C. S. (2000). An overview of vulture electrocutions in South Africa. *Vulture News*, 43, 5–22.
- van Rooyen, C. S. (2004). The Management of Wildlife Interactions with overhead lines. In *The fundamentals and practice of Overhead Line Maintenance (132kV and above)*, (pp. 217–245). Eskom Technology, Services International, Johannesburg.
- Van Rooyen, C.S. & Ledger, J.A. 1999. Birds and utility structures: Developments in southern Africa. Pp 205-230, in Ferrer, M. & G.F.M. Janns. (eds.). *Birds and Power lines*. Quercus, Madrid (Spain). Pp 238.
- Van Rooyen, C.S. & Taylor, P.V. 1999. Bird Streamers as probable cause of electrocutions in South Africa. EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999. Charleston, South Carolina.
- Van Rooyen, C.S. 1998. Raptor mortality on power lines in South Africa. *Proceedings of the 5th World Conference on Birds of Prey and Owls*. Midrand (South Africa), Aug.4 – 8, 1998.
- Van Rooyen, C.S. 1999. An overview of the Eskom-EWT Strategic Partnership in South Africa. EPRI Workshop on Avian Interactions with Utility Structures Charleston (South Carolina), Dec. 2-3 1999.
- Van Rooyen, C.S. 2007. Eskom-EWT Strategic Partnership: Progress Report April-September 2007. Endangered Wildlife Trust, Johannesburg.
- Van Rooyen, C.S. Vosloo, H.F. & R.E. Harness. 2002. Eliminating bird streamers as a cause of faulting on transmission lines in South Africa. *Proceedings of the IEEE 46th Rural Electric Power Conference*. Colorado Springs (Colorado), May. 2002.
- Verdoorn, G.H. 1996. Mortality of Cape Griffons *Gyps coprotheres* and African Whitebacked Vultures *Pseudogyps africanus* on 88kV and 132kV power lines in Western Transvaal, South Africa, and mitigation measures to prevent future problems. *Proceedings of the 2nd International Conference on Raptors: Urbino (Italy)*, Oct. 2-5, 1996.
- Villegas-Patraca, R., Cabrera-Cruz, S. A., & Herrera-Alsina, L. (2014). Soaring migratory birds avoid wind farm in the isthmus of Tehuantepec, Southern Mexico. *PLoS ONE*, 9(3), 1–7. <https://doi.org/10.1371/journal.pone.0092462>
- Walker, D., McGrady, M., McCluskie, A., Madders, M., & McLeod, D. R. A. (2005). Resident Golden Eagle ranging behaviour before and after construction of a windfarm in Argyll. *Scottish Birds*, 25, 24.
- Wurm, H., & Kollar, H. P. (2000). Auswirkungen des Windparks Zurndorf auf die Population der Großtrappe (*Otis tarda* L.) auf der Parndorfer Platte. 2. Zwischenbericht.

## APPENDIX 1: SPECIES LISTS

Species list for the broader area	Taxonomic name	SABAP2 full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate	Global status	Regional status
Species name					
African Black Duck	<i>Anas sparsa</i>	10.9	0.0	-	-
African Black Swift	<i>Apus barbatus</i>	3.0	0.4	-	-
African Darter	<i>Anhinga rufa</i>	16.4	2.2	-	-
African Fish Eagle	<i>Haliaeetus vocifer</i>	12.1	0.9	-	-
African Grass Owl	<i>Tyto capensis</i>	2.4	0.0	-	VU
African Harrier-Hawk	<i>Polyboroides typus</i>	11.5	1.8	-	-
African Hoopoe	<i>Upupa africana</i>	12.7	0.9	-	-
African Jacana	<i>Actophilornis africanus</i>	1.8	1.3	-	-
African Marsh Harrier	<i>Circus ranivorus</i>	0.6	0.0	-	EN
African Palm Swift	<i>Cypsiurus parvus</i>	1.2	1.3	-	-
African Paradise Flycatcher	<i>Terpsiphone viridis</i>	4.8	0.0	-	-
African Pipit	<i>Anthus cinnamomeus</i>	74.5	8.4	-	-
African Rail	<i>Rallus caerulescens</i>	5.5	0.0	-	-
African Reed Warbler	<i>Acrocephalus baeticatus</i>	3.0	0.4	-	-
African Sacred Ibis	<i>Threskiornis aethiopicus</i>	47.9	6.2	-	-
African Snipe	<i>Gallinago nigripennis</i>	20.0	0.9	-	-
African Spoonbill	<i>Platalea alba</i>	16.4	2.2	-	-
African Stonechat	<i>Saxicola torquatus</i>	87.9	10.6	-	-
African Swampphen	<i>Porphyrio madagascariensis</i>	6.1	2.2	-	-
African Wattled Lapwing	<i>Vanellus senegallus</i>	23.0	0.4	-	-
African Yellow Warbler	<i>Iduna natalensis</i>	3.0	0.0	-	-
Amethyst Sunbird	<i>Chalcomitra amethystina</i>	11.5	0.4	-	-
Amur Falcon	<i>Falco amurensis</i>	29.1	6.6	-	-
Ant-eating Chat	<i>Myrmecocichla formicivora</i>	89.7	12.3	-	-
Banded Martin	<i>Riparia cincta</i>	42.4	3.1	-	-
Barn Swallow	<i>Hirundo rustica</i>	41.8	7.9	-	-
Bar-throated Apalis	<i>Apalis thoracica</i>	5.5	0.0	-	-
Black Crake	<i>Zapornia flavirostra</i>	9.1	0.0	-	-
Black Harrier	<i>Circus maurus</i>	0.0	0.9	EN	EN
Black Heron	<i>Egretta ardesiaca</i>	0.6	0.0	-	-
Black Sparrowhawk	<i>Accipiter melanoleucus</i>	12.1	0.9	-	-
Black-bellied Bustard	<i>Lissotis melanogaster</i>	0.6	0.0	-	-
Black-chested Prinia	<i>Prinia flavicans</i>	16.4	0.0	-	-
Black-chested Snake Eagle	<i>Circaetus pectoralis</i>	3.0	0.4	-	-
Black-collared Barbet	<i>Lybius torquatus</i>	28.5	0.9	-	-
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	0.6	0.0	-	-
Black-headed Heron	<i>Ardea melanocephala</i>	52.1	4.0	-	-
Black-headed Oriole	<i>Oriolus larvatus</i>	13.9	1.8	-	-
Black-necked Grebe	<i>Podiceps nigricollis</i>	0.6	0.4	-	-
Blacksmith Lapwing	<i>Vanellus armatus</i>	67.9	7.0	-	-
Black-throated Canary	<i>Criethra atrogularis</i>	67.9	2.2	-	-
Black-winged Kite	<i>Elanus caeruleus</i>	60.6	12.8	-	-
Black-winged Lapwing	<i>Vanellus melanopterus</i>	14.5	0.0	-	-
Black-winged Stilt	<i>Himantopus himantopus</i>	9.1	0.0	-	-
Blue Crane	<i>Grus paradisea</i>	11.5	0.4	VU	NT
Blue Korhaan	<i>Eupodotis caerulea</i>	6.1	0.0	NT	

Species list for the broader area	Taxonomic name	SABAP2 full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate	Global status	Regional status
Species name					
Blue-billed Teal	<i>Spatula hottentota</i>	1.2	0.0	-	-
Bokmakierie	<i>Telophorus zeylonus</i>	64.8	4.4	-	-
Brown Snake Eagle	<i>Circaetus cinereus</i>	1.8	0.0	-	-
Brown-throated Martin	<i>Riparia paludicola</i>	46.7	4.0	-	-
Buff-streaked Chat	<i>Campicoloides bifasciatus</i>	5.5	0.4	-	-
Cape Batis	<i>Batis capensis</i>	0.6	0.0	-	-
Cape Bunting	<i>Emberiza capensis</i>	13.9	0.4	-	-
Cape Canary	<i>Serinus canicollis</i>	75.2	7.0	-	-
Cape Crow	<i>Corvus capensis</i>	17.6	0.4	-	-
Cape Grassbird	<i>Sphenoeacus afer</i>	24.8	0.9	-	-
Cape Longclaw	<i>Macronyx capensis</i>	86.7	10.1	-	-
Cape Robin-Chat	<i>Cossypha caffra</i>	60.0	3.5	-	-
Cape Shoveler	<i>Spatula smithii</i>	18.8	0.0	-	-
Cape Sparrow	<i>Passer melanurus</i>	81.8	6.6	-	-
Cape Starling	<i>Lamprotornis nitens</i>	6.1	0.0	-	-
Cape Teal	<i>Anas capensis</i>	3.0	0.0	-	-
Cape Turtle Dove	<i>Streptopelia capicola</i>	92.1	23.8	-	-
Cape Vulture	<i>Gyps coprotheres</i>	0.0	0.0	EN	EN
Cape Wagtail	<i>Motacilla capensis</i>	78.2	3.5	-	-
Cape Weaver	<i>Ploceus capensis</i>	33.9	2.2	-	-
Cape White-eye	<i>Zosterops virens</i>	35.2	1.3	-	-
Capped Wheatear	<i>Oenanthe pileata</i>	10.3	0.0	-	-
Cardinal Woodpecker	<i>Dendropicos fuscescens</i>	9.1	1.3	-	-
Chorister Robin-Chat Robin-Chat	<i>Cossypha dichroa</i>	1.2	0.0	-	-
Cinnamon-breasted Bunting	<i>Emberiza tahapisi</i>	1.8	0.0	-	-
Cloud Cisticola	<i>Cisticola textrix</i>	7.9	0.9	-	-
Common Buttonquail	<i>Turnix sylvaticus</i>	0.6	0.0	-	-
Common Buzzard	<i>Buteo buteo</i>	27.9	9.3	-	-
Common Greenshank	<i>Tringa nebularia</i>	5.5	0.0	-	-
Common House Martin	<i>Delichon urbicum</i>	6.1	0.0	-	-
Common Moorhen	<i>Gallinula chloropus</i>	32.7	1.8	-	-
Common Myna	<i>Acridotheres tristis</i>	21.2	10.1	-	-
Common Ostrich	<i>Struthio camelus</i>	21.8	1.3	-	-
Common Quail	<i>Coturnix coturnix</i>	29.1	0.4	-	-
Common Sandpiper	<i>Actitis hypoleucos</i>	1.2	0.0	-	-
Common Waxbill	<i>Estrilda astrild</i>	52.7	3.5	-	-
Crested Barbet	<i>Trachyphonus vaillantii</i>	3.0	0.0	-	-
Crowned Lapwing	<i>Vanellus coronatus</i>	61.2	3.1	-	-
Cuckoo Finch	<i>Anomalospiza imberbis</i>	1.2	0.0	-	-
Dark-capped Bulbul	<i>Pycnonotus tricolor</i>	50.3	4.0	-	-
Denham's Bustard	<i>Neotis denhami</i>	1.8	0.0	NT	VU
Diederik Cuckoo	<i>Chrysococcyx caprius</i>	24.2	0.9	-	-
Domestic Duck	<i>Anas platyrhynchos domestica</i>	0.6	0.0	-	-
Drakensberg Prinia	<i>Prinia hypoxantha</i>	18.8	0.0	-	-
Eastern Clapper Lark	<i>Mirafra fasciolata</i>	6.7	0.0	-	-
Eastern Long-billed Lark	<i>Certhilauda semitorquata</i>	4.8	0.0	-	-
Egyptian Goose	<i>Alopochen aegyptiaca</i>	78.2	6.2	-	-

Species list for the broader area	Taxonomic name	SABAP2 full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate	Global status	Regional status
Species name					
European Bee-eater	<i>Merops apiaster</i>	0.6	0.0	-	-
Familiar Chat	<i>Oenanthe familiaris</i>	0.6	0.0	-	-
Fan-tailed Widowbird	<i>Euplectes axillaris</i>	39.4	3.1	-	-
Fiscal Flycatcher	<i>Melaenornis silens</i>	17.0	0.9	-	-
Fork-tailed Drongo	<i>Dicrurus adsimilis</i>	10.3	0.4	-	-
Fulvous Whistling Duck	<i>Dendrocygna bicolor</i>	0.0	0.4	-	-
Giant Kingfisher	<i>Megaceryle maxima</i>	4.8	0.0	-	-
Glossy Ibis	<i>Plegadis falcinellus</i>	4.2	1.8	-	-
Golden-breasted Bunting	<i>Emberiza flaviventris</i>	5.5	0.4	-	-
Goliath Heron	<i>Ardea goliath</i>	2.4	0.0	-	-
Great Egret	<i>Ardea alba</i>	7.9	1.3	-	-
Greater Flamingo	<i>Phoenicopterus roseus</i>	3.6	4.4	-	NT
Greater Striped Swallow	<i>Cecropis cucullata</i>	55.8	7.9	-	-
Green Wood Hoopoe	<i>Phoeniculus purpureus</i>	7.9	0.4	-	-
Grey Crowned Crane	<i>Balearica regulorum</i>	5.5	0.0	EN	EN
Grey Heron	<i>Ardea cinerea</i>	24.8	3.5	-	-
Grey-headed Gull	<i>Chroicocephalus cirrocephalus</i>	3.6	0.4	-	-
Grey-winged Francolin	<i>Scleroptila afra</i>	27.3	2.2	-	-
Groundscraper Thrush	<i>Turdus litsitsirupa</i>	0.6	0.0	-	-
Hadada Ibis	<i>Bostrychia hagedash</i>	89.7	13.7	-	-
Hamerkop	<i>Scopus umbretta</i>	11.5	0.0	-	-
Helmeted Guineafowl	<i>Numida meleagris</i>	49.1	3.1	-	-
Horus Swift	<i>Apus horus</i>	1.2	0.0	-	-
House Sparrow	<i>Passer domesticus</i>	20.0	9.3	-	-
Intermediate Egret	<i>Ardea intermedia</i>	13.9	1.8	-	-
Jackal Buzzard	<i>Buteo rufofuscus</i>	19.4	2.2	-	-
Karoo Thrush	<i>Turdus smithi</i>	5.5	0.0	-	-
Kittlitz's Plover	<i>Charadrius pecuarius</i>	7.3	0.4	-	-
Kurriehane Thrush	<i>Turdus libonyana</i>	8.5	0.4	-	-
Lanner Falcon	<i>Falco biarmicus</i>	7.3	0.0	-	VU
Laughing Dove	<i>Spilopelia senegalensis</i>	45.5	7.5	-	-
Lazy Cisticola	<i>Cisticola aberrans</i>	4.8	0.0	-	-
Lesser Flamingo	<i>Phoeniconaias minor</i>	3.6	1.3	NT	NT
Lesser Grey Shrike	<i>Lanius minor</i>	0.6	0.0	-	-
Lesser Honeyguide	<i>Indicator minor</i>	0.6	0.0	-	-
Lesser Moorhen	<i>Paragallinula angulata</i>	0.6	0.4	-	-
Lesser Striped Swallow	<i>Cecropis abyssinica</i>	0.6	1.3	-	-
Lesser Swamp Warbler	<i>Acrocephalus gracilirostris</i>	12.7	0.4	-	-
Levaillant's Cisticola	<i>Cisticola tinniens</i>	73.9	5.7	-	-
Little Egret	<i>Egretta garzetta</i>	4.2	1.3	-	-
Little Grebe	<i>Tachybaptus ruficollis</i>	38.8	3.1	-	-
Little Rush Warbler	<i>Bradypterus baboecala</i>	6.7	0.9	-	-
Little Stint	<i>Calidris minuta</i>	1.8	0.0	-	-
Little Swift	<i>Apus affinis</i>	16.4	4.8	-	-
Long-crested Eagle	<i>Lophaetus occipitalis</i>	6.7	9.3	-	-
Long-tailed Widowbird	<i>Euplectes progne</i>	84.8	15.4	-	-
Malachite Kingfisher	<i>Corythornis cristatus</i>	7.3	0.0	-	-
Malachite Sunbird	<i>Nectarinia famosa</i>	11.5	0.4	-	-

Species list for the broader area	Taxonomic name	SABAP2 full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate	Global status	Regional status
Species name					
Mallard	<i>Anas platyrhynchos</i>	0.6	0.4	-	-
Marsh Owl	<i>Asio capensis</i>	5.5	0.4	-	-
Martial Eagle	<i>Polemaetus bellicosus</i>	2.4	0.0	EN	EN
Montagu's Harrier	<i>Circus pygargus</i>	1.2	0.0	-	-
Mountain Wheatear	<i>Myrmecocichla monticola</i>	4.8	0.9	-	-
Namaqua Dove	<i>Oena capensis</i>	1.8	0.0	-	-
Neddicky	<i>Cisticola fulvicapilla</i>	7.9	0.0	-	-
Nicholson's Pipit	<i>Anthus nicholsoni</i>	1.8	0.4	-	-
Northern Black Korhaan	<i>Afrotis afraoides</i>	0.6	0.0	-	-
Olive Thrush	<i>Turdus olivaceus</i>	6.1	0.4	-	-
Olive Woodpecker	<i>Dendropicos griseocephalus</i>	3.0	0.0	-	-
Orange-breasted Waxbill	<i>Amandava subflava</i>	9.7	0.0	-	-
Pale-crowned Cisticola	<i>Cisticola cinnamomeus</i>	21.2	0.0	-	-
Peregrine Falcon	<i>Falco peregrinus</i>	1.2	0.0	-	-
Pied Avocet	<i>Recurvirostra avosetta</i>	4.8	0.0	-	-
Pied Crow	<i>Corvus albus</i>	11.5	3.5	-	-
Pied Kingfisher	<i>Ceryle rudis</i>	12.7	0.4	-	-
Pied Starling	<i>Lamprotornis bicolor</i>	55.2	11.5	-	-
Pin-tailed Whydah	<i>Vidua macroura</i>	44.8	2.6	-	-
Plain-backed Pipit	<i>Anthus leucophrys</i>	1.2	0.0	-	-
Purple Heron	<i>Ardea purpurea</i>	4.2	0.0	-	-
Quailfinch	<i>Ortygospiza atricollis</i>	47.9	1.8	-	-
Red-backed Shrike	<i>Lanius collurio</i>	0.6	0.0	-	-
Red-billed Quelea	<i>Quelea quelea</i>	38.8	1.8	-	-
Red-billed Teal	<i>Anas erythrorhyncha</i>	17.0	1.3	-	-
Red-capped Lark	<i>Calandrella cinerea</i>	56.4	2.2	-	-
Red-chested Cuckoo	<i>Cuculus solitarius</i>	4.8	0.4	-	-
Red-chested Flufftail	<i>Sarothrura rufa</i>	0.6	0.0	-	-
Red-collared Widowbird	<i>Euplectes ardens</i>	12.1	1.3	-	-
Red-eyed Dove	<i>Streptopelia semitorquata</i>	64.2	12.3	-	-
Red-faced Mousebird	<i>Urocolius indicus</i>	4.2	0.4	-	-
Red-headed Finch	<i>Amadina erythrocephala</i>	1.8	0.0	-	-
Red-knobbed Coot	<i>Fulica cristata</i>	58.2	4.8	-	-
Red-throated Wryneck	<i>Jynx ruficollis</i>	29.7	2.2	-	-
Red-winged Francolin	<i>Scleroptila levaillantii</i>	24.8	1.3	-	-
Red-winged Starling	<i>Onychognathus morio</i>	8.5	3.1	-	-
Reed Cormorant	<i>Microcarbo africanus</i>	63.6	4.8	-	-
Rock Dove	<i>Columba livia</i>	6.1	4.4	-	-
Rock Kestrel	<i>Falco rupicolus</i>	5.5	0.9	-	-
Rock Martin	<i>Ptyonoprogne fuligula</i>	13.9	1.8	-	-
Ruff	<i>Calidris pugnax</i>	1.8	0.4	-	-
Rufous-naped Lark	<i>Mirafr africana</i>	1.2	0.9	-	-
Sand Martin	<i>Riparia riparia</i>	1.2	0.4	-	-
Secretarybird	<i>Sagittarius serpentarius</i>	13.3	0.0	EN	VU
Sedge Warbler	<i>Acrocephalus schoenobaenus</i>	0.6	0.0	-	-
Sentinel Rock Thrush	<i>Monticola explorator</i>	2.4	0.0	NT	
South African Cliff Swallow	<i>Petrochelidon spilodera</i>	38.2	3.5	-	-
South African Shelduck	<i>Tadorna cana</i>	30.3	3.5	-	-



Species list for the broader area	Taxonomic name	SABAP2 full protocol reporting rate	SABAP2 Ad hoc protocol reporting rate	Global status	Regional status
Species name					
Southern Bald Ibis	<i>Geronticus calvus</i>	23.0	3.1	VU	VU
Southern Boubou	<i>Laniarius ferrugineus</i>	15.2	0.9	-	-
Southern Fiscal	<i>Lanius collaris</i>	92.1	15.4	-	-
Southern Grey-headed Sparrow	<i>Passer diffusus</i>	57.6	4.4	-	-
Southern Masked Weaver	<i>Ploceus velatus</i>	90.9	9.7	-	-
Southern Pochard	<i>Netta erythrophthalma</i>	9.1	0.0	-	-
Southern Red Bishop	<i>Euplectes orix</i>	84.2	12.3	-	-
Speckled Mousebird	<i>Colius striatus</i>	25.5	0.9	-	-
Speckled Pigeon	<i>Columba guinea</i>	67.3	13.2	-	-
Spike-heeled Lark	<i>Chersomanes albofasciata</i>	48.5	1.3	-	-
Spotted Eagle-Owl	<i>Bubo africanus</i>	9.1	0.9	-	-
Spotted Flycatcher	<i>Muscicapa striata</i>	4.2	0.4	-	-
Spotted Thick-knee	<i>Burhinus capensis</i>	9.1	0.0	-	-
Spur-winged Goose	<i>Plectropterus gambensis</i>	44.2	1.8	-	-
Squacco Heron	<i>Ardeola ralloides</i>	1.2	0.0	-	-
Streaky-headed Seedeater	<i>Crithagra gularis</i>	9.1	0.4	-	-
Swainson's Spurfowl	<i>Pternistis swainsonii</i>	61.2	2.6	-	-
Tawny-flanked Prinia	<i>Prinia subflava</i>	0.6	0.4	-	-
Temminck's Courser	<i>Cursorius temminckii</i>	1.8	0.0	-	-
Three-banded Plover	<i>Charadrius tricollaris</i>	35.2	0.9	-	-
Village Weaver	<i>Ploceus cucullatus</i>	4.2	0.0	-	-
Wailing Cisticola	<i>Cisticola lais</i>	9.1	0.0	-	-
Wattled Crane	<i>Grus carunculata</i>	0.6	0.0	VU	CR
Wattled Starling	<i>Creatophora cinerea</i>	0.6	0.0	-	-
Western Barn Owl	<i>Tyto alba</i>	3.0	0.4	-	-
Western Cattle Egret	<i>Bubulcus ibis</i>	44.8	12.3	-	-
Western Osprey	<i>Pandion haliaetus</i>	0.6	0.0	-	-
Whiskered Tern	<i>Chlidonias hybrida</i>	12.1	5.3	-	-
White Stork	<i>Ciconia ciconia</i>	7.3	1.3	-	-
White-backed Duck	<i>Thalassornis leuconotus</i>	6.7	0.0	-	-
White-bellied Bustard	<i>Eupodotis senegalensis</i>	7.9	0.0	-	VU
White-breasted Cormorant	<i>Phalacrocorax lucidus</i>	11.5	0.9	-	-
White-faced Whistling Duck	<i>Dendrocygna viduata</i>	0.6	0.0	-	-
White-rumped Swift	<i>Apus caffer</i>	30.3	4.0	-	-
White-throated Swallow	<i>Hirundo albigularis</i>	37.6	1.8	-	-
White-winged Tern	<i>Chlidonias leucopterus</i>	3.6	0.9	-	-
Willow Warbler	<i>Phylloscopus trochilus</i>	4.2	0.0	-	-
Wing-snapping Cisticola	<i>Cisticola ayresii</i>	45.5	6.2	-	-
Wood Sandpiper	<i>Tringa glareola</i>	6.1	0.0	-	-
Yellow Canary	<i>Crithagra flaviventris</i>	15.8	0.4	-	-
Yellow-billed Duck	<i>Anas undulata</i>	61.8	4.4	-	-
Yellow-billed Kite	<i>Milvus aegyptius</i>	2.4	0.0	-	-
Yellow-crowned Bishop	<i>Euplectes afer</i>	34.5	4.0	-	-
Yellow-fronted Canary	<i>Crithagra mozambica</i>	9.1	0.9	-	-
Zitting Cisticola	<i>Cisticola juncidis</i>	41.2	2.6	-	-

Species list for pre-construction surveys		WEF Transects	Control transects	Focal points	Incidental counts	WEF vantage points	Control vantage points
Priority species	Taxonomic name						
African Fish Eagle	<i>Haliaeetus vocifer</i>	*		*	*	*	
African Grass Owl	<i>Tyto capensis</i>				*		
African Harrier-Hawk	<i>Polyboroides typus</i>		*		*		*
Amur Falcon	<i>Falco amurensis</i>	*	*		*	*	*
Black Sparrowhawk	<i>Accipiter melanoleucus</i>	*	*		*	*	
Black-chested Snake Eagle	<i>Circaetus pectoralis</i>		*		*		*
Black-rumped Buttonquail	<i>Turnix nanus</i>				*		
Black-winged Kite	<i>Elanus caeruleus</i>	*	*		*	*	
Black-winged Lapwing	<i>Vanellus melanopterus</i>	*	*		*	*	*
Blue Crane	<i>Grus paradisea</i>	*	*		*	*	*
Blue Korhaan	<i>Eupodotis caerulescens</i>	*			*	*	
Brown Snake Eagle	<i>Circaetus cinereus</i>				*		
Buff-streaked Chat	<i>Campicoloides bifasciatus</i>				*		
Cape Vulture	<i>Gyps coprotheres</i>	*			*	*	*
Common Buzzard	<i>Buteo buteo</i>	*	*	*	*	*	*
Greater Flamingo	<i>Phoenicopterus roseus</i>			*	*		
Grey Crowned Crane	<i>Balearica regulorum</i>				*		
Grey-winged Francolin	<i>Scleroptila afra</i>	*	*		*	*	
Jackal Buzzard	<i>Buteo rufofuscus</i>		*		*	*	*
Lanner Falcon	<i>Falco biarmicus</i>	*	*		*	*	
Lesser Flamingo	<i>Phoeniconaias minor</i>			*	*		
Long-crested Eagle	<i>Lophaetus occipitalis</i>	*			*		
Marsh Owl	<i>Asio capensis</i>				*	*	
Martial Eagle	<i>Polemaetus bellicosus</i>		*		*		
Peregrine Falcon	<i>Falco peregrinus</i>				*		
Secretarybird	<i>Sagittarius serpentarius</i>	*			*	*	
Southern Bald Ibis	<i>Geronticus calvus</i>	*		*	*	*	
Spotted Eagle-Owl	<i>Bubo africanus</i>				*		
White Stork	<i>Ciconia ciconia</i>				*		
White-bellied Bustard	<i>Eupodotis senegalensis</i>				*		
<b>30</b>		<b>14</b>	<b>12</b>	<b>5</b>	<b>30</b>	<b>15</b>	<b>8</b>

Non-Priority Species	Taxonomic name	WEF Transects	Control transects	Focal points	Incidental counts
African Black Duck	<i>Anas sparsa</i>	*			
African Darter	<i>Anhinga rufa</i>	*	*	*	
African Hoopoe	<i>Upupa africana</i>		*		
African Pipit	<i>Anthus cinnamomeus</i>	*	*		
African Quail-Finch	<i>Ortygospiza atricollis</i>	*	*		
African Rail	<i>Rallus caerulescens</i>			*	
African Reed Warbler	<i>Acrocephalus baeticatus</i>	*			
African Sacred Ibis	<i>Threskiornis aethiopicus</i>	*	*	*	
African Snipe	<i>Gallinago nigripennis</i>	*	*		
African Spoonbill	<i>Platalea alba</i>	*	*	*	
African Stonechat	<i>Saxicola torquatus</i>	*	*		
African Swampphen	<i>Porphyrio madagascariensis</i>			*	
African Wattled Lapwing	<i>Vanellus senegallus</i>	*	*		
Ant-eating Chat	<i>Myrmecocichla formicivora</i>	*	*		
Banded Martin	<i>Riparia cincta</i>	*	*		
Barn Swallow	<i>Hirundo rustica</i>	*	*		
Black Crake	<i>Amauornis flavirostra</i>			*	
Black-chested Prinia	<i>Prinia flavicans</i>	*	*		
Black-collared Barbet	<i>Lybius torquatus</i>	*			
Black-headed Heron	<i>Ardea melanocephala</i>	*	*		
Black-headed Oriole	<i>Oriolus larvatus</i>		*		
Blacksmith Lapwing	<i>Vanellus armatus</i>	*	*	*	
Black-throated Canary	<i>Crithagra atrogularis</i>	*	*		
Black-winged Stilt	<i>Himantopus himantopus</i>		*	*	
Bokmakierie	<i>Telophorus zeylonus</i>	*	*		
Brown-throated Martin	<i>Riparia paludicola</i>	*	*	*	
Cape Bunting	<i>Emberiza capensis</i>		*		
Cape Canary	<i>Serinus canicollis</i>	*	*		
Cape Crow	<i>Corvus capensis</i>	*			
Cape Glossy Starling	<i>Lamprotornis nitens</i>	*			
Cape Grassbird	<i>Sphenoeacus afer</i>		*		
Cape Longclaw	<i>Macronyx capensis</i>	*	*		
Cape Robin-Chat	<i>Cossypha caffra</i>	*	*		
Cape Shoveler	<i>Lamprotornis nitens</i>	*	*	*	
Cape Sparrow	<i>Passer melanurus</i>	*	*		
Cape Teal	<i>Anas capensis</i>			*	
Cape Turtle Dove	<i>Streptopelia capicola</i>	*	*		
Cape Wagtail	<i>Motacilla capensis</i>	*	*	*	
Cape Weaver	<i>Ploceus capensis</i>	*	*	*	
Cape White-eye	<i>Zosterops virens</i>	*	*		
Capped Wheatear	<i>Oenanthe pileata</i>	*			

Non-Priority Species	Taxonomic name	WEF Transects	Control transects	Focal points	Incidental counts
Cardinal Woodpecker	<i>Dendropicos fuscescens</i>		*		
Chinspot Batis	<i>Batis molitor</i>		*		
Cloud Cisticola	<i>Cisticola textrix</i>	*	*		
Common Greenshank	<i>Tringa nebularia</i>		*	*	
Common Moorhen	<i>Gallinula chloropus</i>	*		*	
Common Myna	<i>Acridotheres tristis</i>	*	*		
Common Ostrich	<i>Struthio camelus</i>	*	*		
Common Quail	<i>Coturnix coturnix</i>	*	*		
Common Waxbill	<i>Estrilda astrild</i>	*	*	*	
Crowned Lapwing	<i>Vanellus coronatus</i>	*	*	*	
Dark-capped Bulbul	<i>Pycnonotus tricolor</i>	*	*		
Diederik Cuckoo	<i>Chrysococcyx caprius</i>	*	*		
Drakensberg Prinia	<i>Prinia hypoxantha</i>	*	*		
Eastern Clapper Lark	<i>Mirafr fasciolata</i>	*	*		
Eastern Long-billed Lark	<i>Certhilauda semitorquata</i>	*			
Egyptian Goose	<i>Alopochen aegyptiaca</i>	*	*	*	
Fan-tailed Widowbird	<i>Euplectes axillaris</i>	*	*		
Fiscal Flycatcher	<i>Melaenornis silens</i>	*	*		
Fork-tailed Drongo	<i>Dicrurus adsimilis</i>		*		
Giant Kingfisher	<i>Bostrychia hagedash</i>		*		
Greater Striped Swallow	<i>Cecropis cucullata</i>	*	*		
Grey Heron	<i>Ardea cinerea</i>	*	*	*	
Hadedda	<i>Bostrychia hagedash</i>	*	*		
Hamerkop	<i>Scopus umbretta</i>	*	*	*	
Helmeted Guineafowl	<i>Numida meleagris</i>	*	*		
Horus Swift	<i>Apus horus</i>		*		
House Sparrow	<i>Passer domesticus</i>	*			
Intermediate Egret	<i>Ardea intermedia</i>		*		
Kittlitz's Plover	<i>Charadrius pecuarius</i>	*	*	*	
Kurriehane Thrush	<i>Turdus libonyana</i>		*		
Laughing Dove	<i>Spilopelia senegalensis</i>	*	*		
Lazy Cisticola	<i>Cisticola aberrans</i>	*			
Lesser Moorhen	<i>Paragallinula angulata</i>		*		
Lesser Swamp Warbler	<i>Acrocephalus gracilirostris</i>	*		*	
Levaillant's Cisticola	<i>Cisticola tinniens</i>	*	*	*	
Little Grebe	<i>Tachybaptus ruficollis</i>	*	*	*	
Little Rush Warbler	<i>Bradypterus baboecala</i>			*	
Little Swift	<i>Apus affinis</i>	*	*		
Long-tailed Widowbird	<i>Euplectes progne</i>	*	*		
Malachite Kingfisher	<i>Corythornis cristatus</i>	*		*	
Mountain Wheatear	<i>Myrmecocichla monticola</i>	*			

Non-Priority Species	Taxonomic name	WEF Transects	Control transects	Focal points	Incidental counts
Namaqua Dove	<i>Oena capensis</i>		*		
Olive Woodpecker	<i>Dendropicos griseocephalus</i>	*			
Orange-breasted Waxbill	<i>Ortygospiza atricollis</i>	*			
Pale-crowned Cisticola	<i>Cisticola cinnamomeus</i>	*	*		
Pied Avocet	<i>Recurvirostra avosetta</i>			*	
Pied Crow	<i>Corvus albus</i>	*			
Pied Kingfisher	<i>Ceryle rudis</i>	*		*	
Pied Starling	<i>Lamprotornis bicolor</i>	*	*		
Pin-tailed Whydah	<i>Vidua macroura</i>	*	*		
Red-billed Quelea	<i>Quelea quelea</i>	*	*		
Red-billed Teal	<i>Anas erythrorhyncha</i>		*	*	
Red-capped Lark	<i>Calandrella cinerea</i>	*	*		
Red-chested Cuckoo	<i>Cuculus solitarius</i>	*			
Red-chested Flufftail	<i>Sarothrura rufa</i>	*			
Red-collared Widowbird	<i>Euplectes ardens</i>	*	*		
Red-eyed Dove	<i>Streptopelia capicola</i>	*	*		
Red-faced Mousebird	<i>Urocolius indicus</i>	*	*		
Red-knobbed Coot	<i>Fulica cristata</i>	*	*	*	
Red-throated Wryneck	<i>Jynx ruficollis</i>	*	*		
Red-winged Francolin	<i>Scleroptila levaillantii</i>	*	*		
Reed Cormorant	<i>Microcarbo africanus</i>	*	*	*	
Ring-necked Dove	#N/A		*		
Rock kestrel	<i>Falco rupicolus</i>				*
Rock Martin	<i>Ptyonoprogne fuligula</i>	*	*		
Sentinel Rock Thrush	<i>Monticola explorator</i>	*			
South African Cliff Swallow	<i>Petrochelidon spilodera</i>	*	*		
South African Shelduck	<i>Tadorna cana</i>	*	*	*	
Southern Boubou	<i>Laniarius ferrugineus</i>		*		
Southern Fiscal	<i>Lanius collaris</i>	*	*		
Southern Grey-headed Sparrow	<i>Passer diffusus</i>	*	*		
Southern Masked Weaver	<i>Ploceus velatus</i>	*	*	*	
Southern Pochard	<i>Netta erythrophthalma</i>	*			
Southern Red Bishop	<i>Euplectes orix</i>	*	*	*	
Speckled Mousebird	<i>Colius striatus</i>	*	*		
Speckled Pigeon	<i>Columba guinea</i>	*	*		
Spike-heeled Lark	<i>Chersomanes albobasata</i>	*	*		
Spotted Flycatcher	<i>Muscicapa striata</i>	*			
Spotted Thick-knee	<i>Burhinus capensis</i>		*		
Spur-winged Goose	<i>Plectropterus gambensis</i>	*	*	*	
Streaky-headed Seedeater	<i>Crithagra gularis</i>	*			
Swainson's Spurfowl	<i>Pternistis swainsonii</i>	*	*		

Non-Priority Species	Taxonomic name	WEF Transects	Control transects	Focal points	Incidental counts
Temminck's Courser	<i>Cursorius temminckii</i>	*			
Three-banded Plover	<i>Charadrius tricollaris</i>	*	*	*	
Wailing Cisticola	<i>Cisticola lais</i>	*	*		
Wattled Starling	<i>Creatophora cinerea</i>	*			
Western Cattle Egret	<i>Bubulcus ibis</i>	*	*	*	
Whiskered Tern	<i>Chlidonias hybrida</i>	*			
White-backed Duck	<i>Thalassornis leuconotus</i>	*			
White-breasted Cormorant	<i>Phalacrocorax lucidus</i>	*	*	*	
White-rumped Swift	<i>Apus caffer</i>	*	*		
White-throated Swallow	<i>Hirundo albigularis</i>	*	*		
White-winged Tern	<i>Chlidonias leucopterus</i>	*	*		
Willow Warbler	<i>Phylloscopus trochilus</i>		*		
Wing-snapping Cisticola	<i>Cisticola ayresii</i>	*	*		
Yellow Canary	<i>Crithagra flaviventris</i>	*	*		
Yellow-billed Duck	<i>Anas undulata</i>	*	*	*	
Yellow-billed Kite	<i>Milvus aegyptius</i>	*			
Yellow-crowned Bishop	<i>Euplectes afer</i>	*	*		
Yellow-fronted Canary	<i>Crithagra mozambica</i>	*			
Zitting Cisticola	<i>Cisticola juncidis</i>	*	*		
<b>142</b>	Subtotal	115	106	39	1
	Grand total	<b>129</b>	118	44	31



## APPENDIX 2: HABITAT FEATURES AT THE PROJECT AREA



Figure 1: High sensitivity natural grassland



Figure 2: An example of an earth dam



Figure 3: Agriculture



Figure 4: Drainage line (Vaal River)





Figure 5: Alien trees

## APPENDIX 3: PRE-CONSTRUCTION MONITORING

### 1. Objectives

The objective of the pre-construction monitoring at the proposed Camden II Wind Energy Facility (WEF) was to gather baseline data over a period of four seasons on the variety and abundance of avifauna at the project area.

### 2. Methods

One set of guidelines were applicable to these wind facilities:

- 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 which require environmental authorisation. The wind guidelines require a minimum of four site visits a year over a period of four seasons.

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

Monitoring surveys were conducted during the following periods:

1. 26 July - 07 August 2020 (winter)
2. 16 September - 07 October and 05 November 2020 (spring)
3. 13 - 27 February 2021 (summer)
4. 18 - 21 March, 12 - 14 April, 03 - 13 May 2021 (autumn)
5. 26 July - 01 August 2021 (winter)
6. 31 August - 3 Sept 2021 (spring)

Monitoring was conducted in the following manner:

- One drive transect was identified totalling 11.4km on the original development site and one drive transect in the control site with a total length of 10.5km. An additional drive transect of 7.33km was identified on the new land parcels that were added subsequent to the first two surveys.
- One monitor travelling slowly ( $\pm 10\text{km/h}$ ) in a vehicle recorded all birds on both sides of the transects. The observer stopped at regular intervals (every 500m) to scan the environment with binoculars. Drive transects were counted three times per sampling session.
- Two (2) walk transects of 1km each were identified at the original development site, and two at the control site. An additional two walk transects of 1km each were identified and the new land parcels that were added subsequent to the first two surveys. Walk transects were counted four (4) times per sampling season. All birds were recorded during walk transects.
- The following variables were recorded:
  - Species
  - Number of birds
  - Date

- Start time and end time
- Estimated distance from transect
- Wind direction
- Wind strength (estimated Beaufort scale)
- Weather (sunny; cloudy; partly cloudy; rain; mist)
- Temperature (cold; mild; warm; hot)
- Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground) and
- Co-ordinates (priority species only)

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

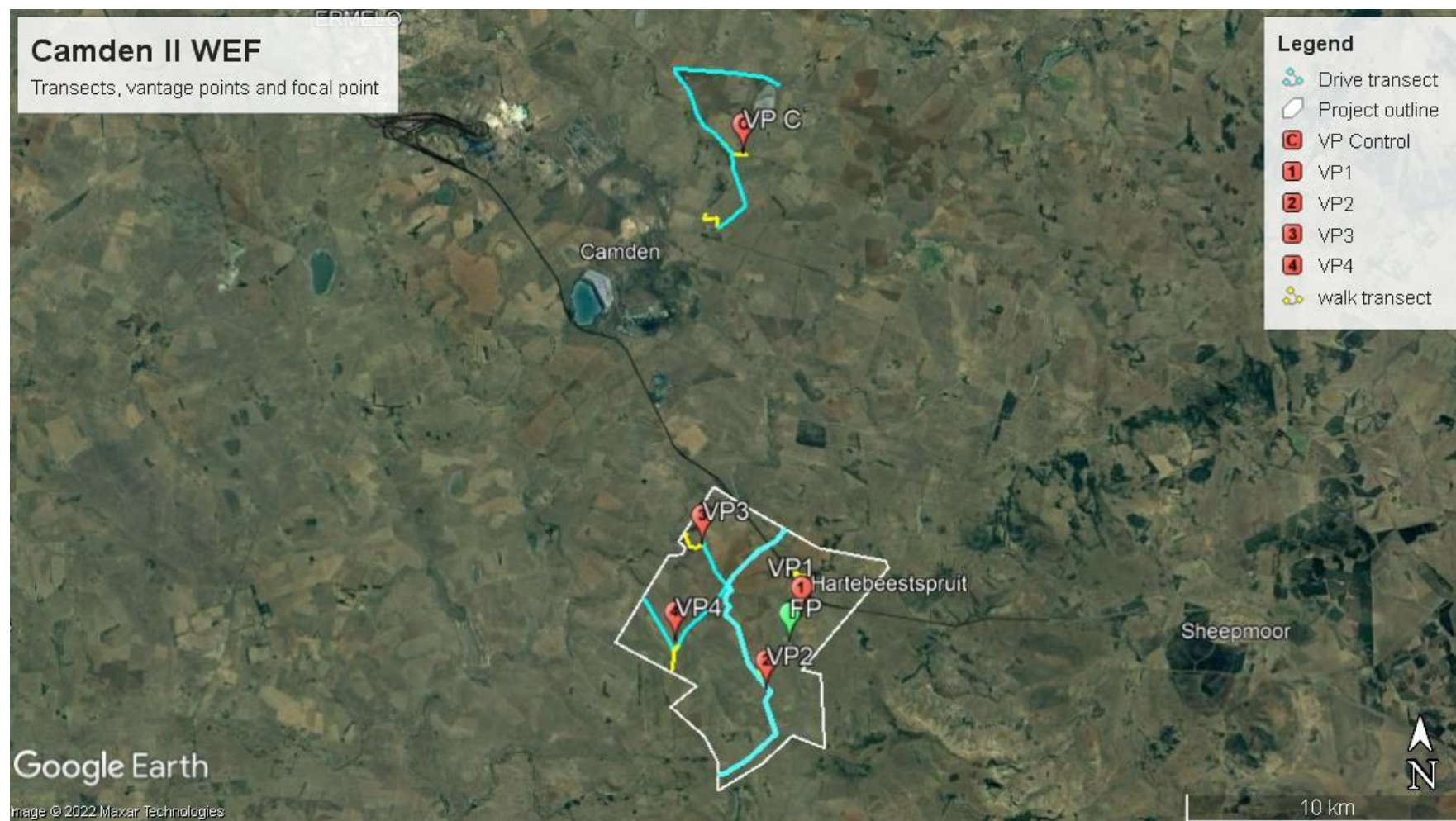
- Two vantage points (VPs) i.e. VP1 and VP2 were identified at the original development site from which the majority of the buildable area can be observed, to record the flight altitude and patterns of priority species. One VP was also identified on the control site. An additional two VPs i.e. VP3 and VP4 were identified on the new land parcels that were added subsequent to the first two surveys. The following variables were recorded for each flight:
  - Species
  - Number of birds
  - Date
  - Start time and end time
  - Wind direction
  - Wind strength (estimated Beaufort scale 1-7)
  - Weather (sunny; cloudy; partly cloudy; rain; mist)
  - Temperature (cold; mild; warm; hot)
  - Flight altitude (high i.e. above rotor height; medium i.e. at rotor height; low i.e. below rotor height)
  - Flight mode (soar; flap; glide; kite; hover) and
  - Flight time (in 15 second-intervals).

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

One potential focal point (FP) of bird activity was identified and monitored:

- FP1: A farm dam in a drainage line in the application site

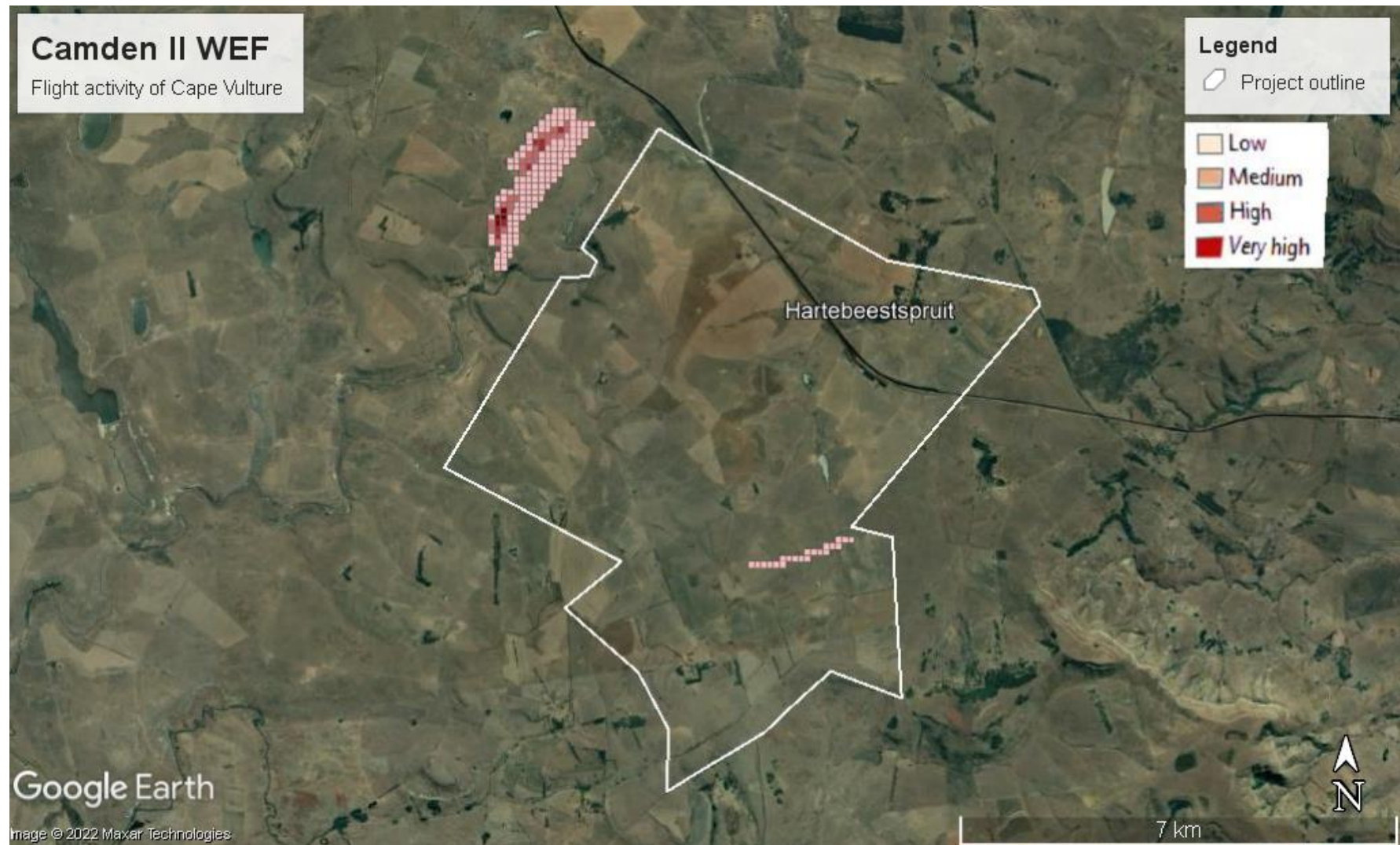
See Figure 1 for the location of the transects and VPs.



**Figure 1:** Area where monitoring was performed, with position of vantage points, focal points, drive transects and walk transects. The area to the north of the project area is the control area.

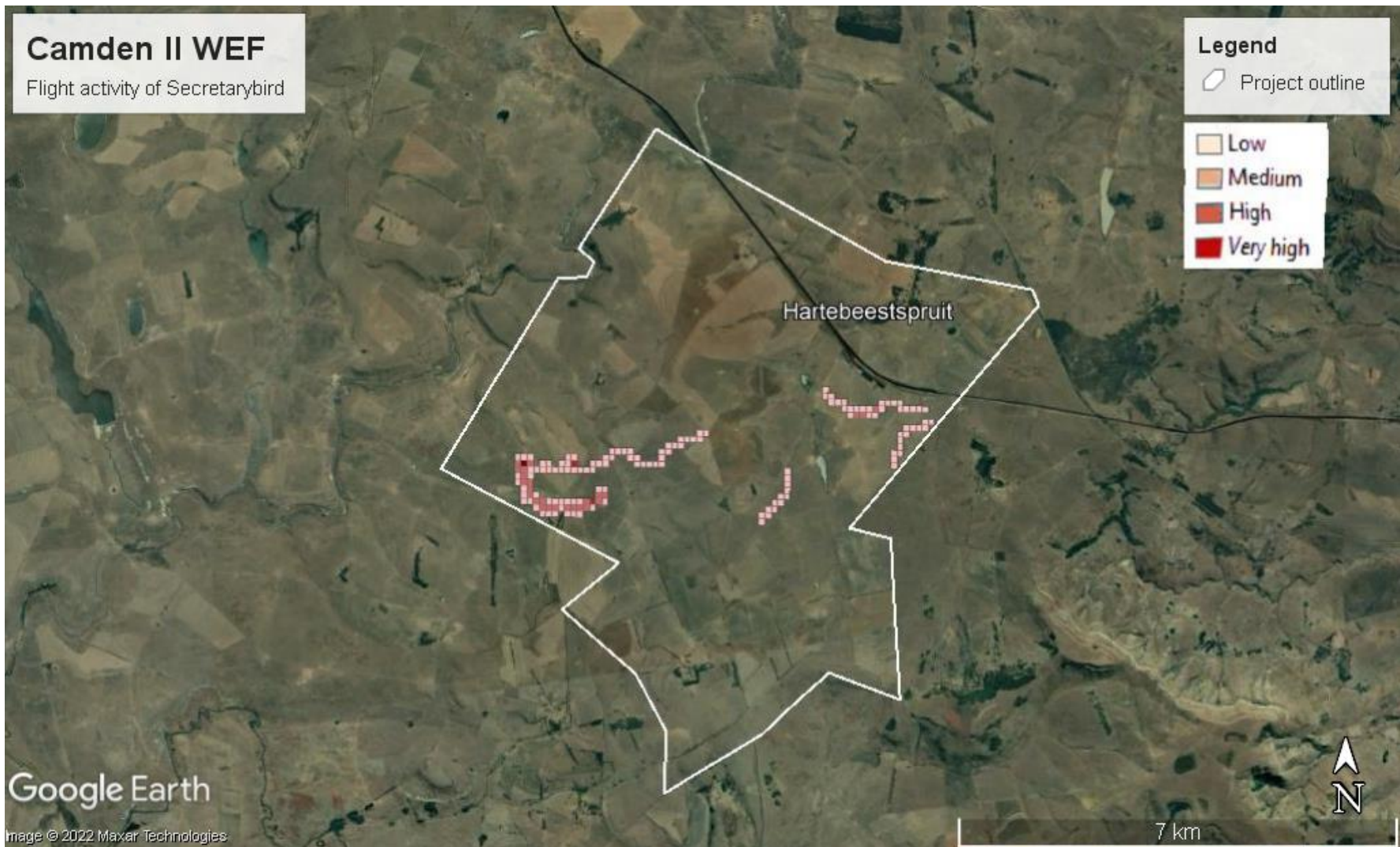


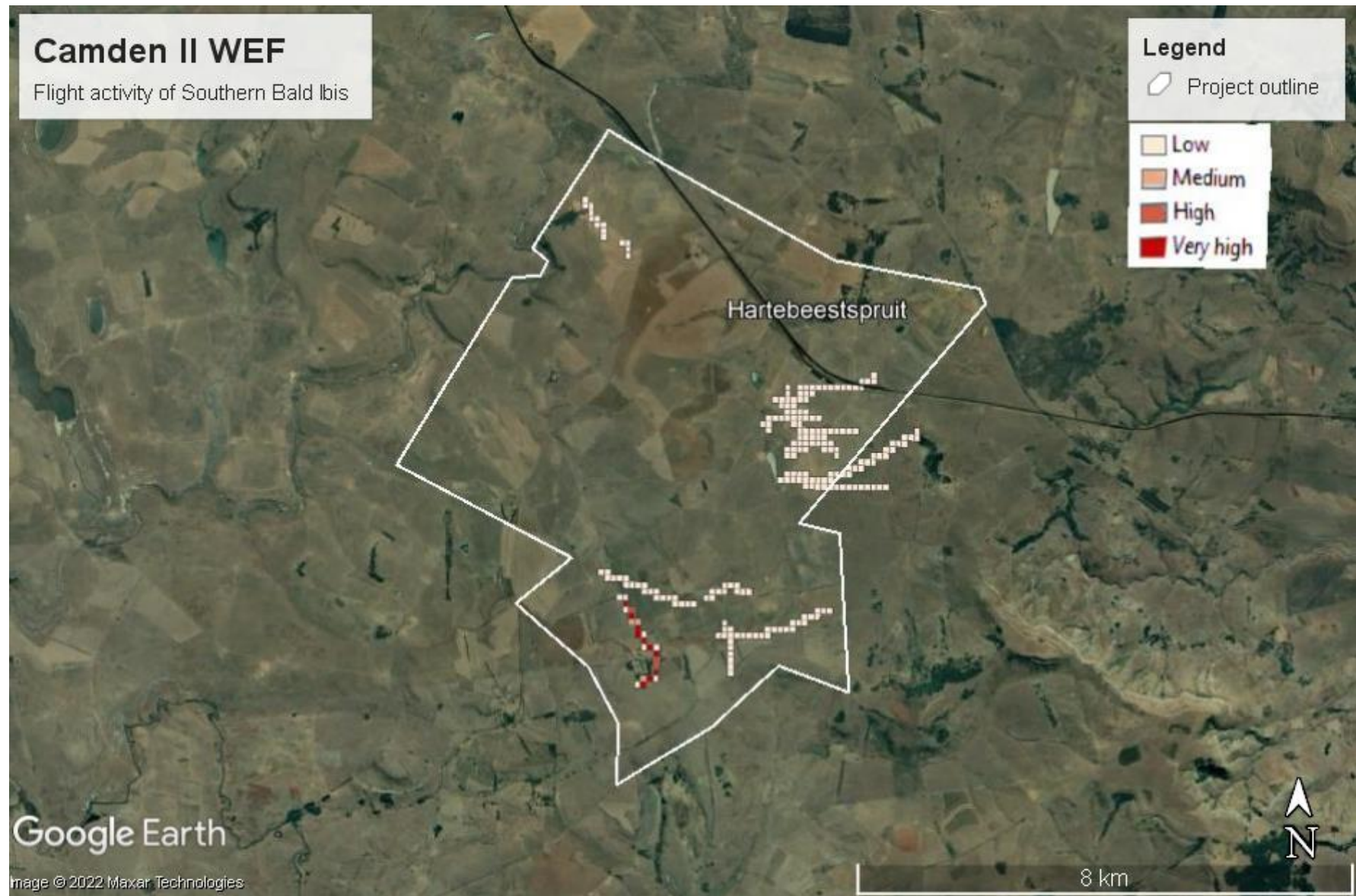
## APPENDIX 4: FLIGHT MAPS











## APPENDIX 5: IMPACT TABLES

**Project Name: Camden II WEF**

**Impact Assessment**

### CONSTRUCTION

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 1:	Displacement	Displacement of priority species due to disturbance associated with the construction of the wind turbines and associated infrastructure.	Construction	Negative	Moderate	4	2	4	2	5	60	N3	3	2	3	2	4	40	N3
Significance						N3 - Moderate							N3 - Moderate						
Impact 2:	Displacement	Displacement of priority species due to habitat transformation associated with the construction of the wind turbines and associated infrastructure.	Construction	Negative	Moderate	3	2	4	4	4	52	N3	3	2	3	4	3	36	N3
Significance						N3 - Moderate							N3 - Moderate						



**Project Name: Camden II WEF**

**Impact Assessment**

**OPERATIONAL**

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
<b>Impact 1:</b>	Mortality: Collision	Mortality of priority species due to collisions with the wind turbines	Operational	Negative	Moderate	4	3	4	4	4	60	N3	3	3	3	4	2	26	N2
Significance						N3 - Moderate							N2 - Low						
<b>Impact 2:</b>	Mortality: Collision	Mortality of priority species due to collisions with the medium voltage overhead power lines	Operational	Negative	Moderate	4	3	4	4	3	45	N3	3	3	3	4	2	26	N2
Significance						N3 - Moderate							N2 - Low						
<b>Impact 3:</b>	Mortality: Electrocution	Electrocution of priority species on the medium voltage infrastructure	Operational	Negative	High	4	3	4	4	4	60	N3	1	3	2	4	2	20	N2
Significance						N3 - Moderate							N2 - Low						



**Project Name: Camden II WEF**

**Impact Assessment**

**DECOMISSIONING**

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
Impact 1:	Displacement	Displacement of priority species due to disturbance associated with the dismantling of the wind turbines and associated infrastructure.	Construction	Negative	Moderate	4	2	3	2	4	44	N3	3	2	2	2	3	27	N2
Significance						N3 - Moderate							N2 - Low						

## Project Name: Camden II WEF

### Impact Assessment

#### CUMULATIVE

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
Impact 1:	Displacement	Displacement of priority species due to disturbance associated with the construction of the wind turbines and associated infrastructure.	Construction	Negative	Moderate	4	3	3	3	4	52	N3	3	3	3	2	3	33	N3
Significance						N3 - Moderate							N3 - Moderate						
Impact 2:	Displacement	Displacement of priority species due to habitat transformation associated with the construction of the wind turbines and associated infrastructure.	Construction	Negative	Moderate	3	3	4	4	4	56	N3	3	3	3	4	3	39	N3
Significance						N3 - Moderate							N3 - Moderate						
Impact 3:	Mortality: Collision	Mortality of priority species due to collisions with the wind turbines	Operational	Negative	Moderate	5	3	4	4	4	64	N4	4	3	3	4	3	42	N3
Significance						N4 - High							N3 - Moderate						
Impact 4:	Mortality: Collision	Mortality of priority species due to collisions with the medium voltage overhead power lines	Operational	Negative	Moderate	4	3	4	4	4	60	N3	3	3	3	4	4	52	N3
Significance						N3 - Moderate							N3 - Moderate						
Impact 5:	Mortality: Electrocution	Electrocution of priority species on the medium voltage infrastructure	Operational	Negative	High	5	3	4	4	4	64	N4	2	3	2	4	3	33	N3
Significance						N4 - High							N3 - Moderate						

## Project Name: Camden BESS

### Impact Assessment

#### CONSTRUCTION

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+)	E+	R+	D)x	P=	S	Rating	(M+)	E+	R+	D)x	P=	S	Rating
Impact 1:	Displacement	Displacement of priority species due to disturbance associated with the construction of the BESS	Construction	Negative	Moderate	2	1	1	2	3	18	N2	2	1	1	2	2	12	N1
Significance						N2 - Low							N1 - Very Low						
Impact 2:	Displacement	Displacement of priority species due to habitat transformation associated with the construction of the BESS	Construction	Negative	Moderate	2	1	5	4	2	24	N2	2	1	5	4	2	24	N2
Significance						N2 - Low							N2 - Low						

#### DECOMISSIONING

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+)	E+	R+	D)x	P=	S		(M+)	E+	R+	D)x	P=	S	
Impact 1:	Displacement	Displacement of priority species due to disturbance associated with the dismantling of the BESS	Construction	Negative	Moderate	2	1	1	2	3	18	N2	2	1	1	2	2	12	N1
Significance						N2 - Low							N1 - Very Low						

**Project Name: Camden BESS**

Impact Assessment

**CUMULATIVE**

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
<b>Impact 1:</b>	Displacement	Displacement of priority species due to disturbance associated with the construction of the BESS	Construction	Negative	Moderate	2	1	1	2	4	24	<b>N2</b>	2	1	1	2	3	18	<b>N2</b>
<b>Significance</b>						<b>N2 - Low</b>							<b>N2 - Low</b>						
<b>Impact 2:</b>	Displacement	Displacement of priority species due to habitat transformation associated with the construction of the BESS	Construction	Negative	Moderate	3	1	5	4	2	26	<b>N2</b>	3	1	5	4	2	26	<b>N2</b>
<b>Significance</b>						<b>N2 - Low</b>							<b>N2 - Low</b>						

**Project Name: Camden II Up to 132kV OHL**

**Impact Assessment**

**CONSTRUCTION**

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+)	E+	R+	D)x	P=	S	Rating	(M+)	E+	R+	D)x	P=	S	Rating
<b>Impact 1:</b>	Displacement	Displacement of priority species due to disturbance associated with construction of the on-site substation and up to 132kV overhead power line	Construction	Negative	Moderate	4	2	3	2	4	44	N3	3	2	3	2	3	30	N2
<b>Significance</b>						<b>N3 - Moderate</b>							<b>N2 - Low</b>						
<b>Impact 2:</b>	Displacement	Displacement of priority species due to habitat transformation associated with construction of the on-site substation and up to 132kV overhead power line	Construction	Negative	Moderate	2	2	3	2	4	36	N3	2	2	3	2	3	27	N2
<b>Significance</b>						<b>N3 - Moderate</b>							<b>N2 - Low</b>						



**Project Name: Camden II Up to 132kV OHL**

**Impact Assessment**

**OPERATION**

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation					S	Post-Mitigation							
						(M+	E+	R+	D)x	P=			(M+	E+	R+	D)x	P=	S	
Impact 1:	Mortality: Collision	Mortality of priority species due to collisions with the up to 132kV overhead power line	Operational	Negative	Moderate	5	3	3	4	4	60	N3	3	3	3	4	2	26	N2
Significance						N3 - Moderate						N2 - Low							
Impact 2:	Mortality: Electrocution	Electrocution of priority species on the on-site substation infrastructure	Operational	Negative	High	5	3	3	4	2	30	N2	1	2	3	4	2	20	N2
Significance						N2 - Low						N2 - Low							
Impact 3:	Mortality: Electrocution	Electrocution of priority species on the up to 132kV OHL	Operational	Negative	High	5	3	3	4	3	45	N3	1	2	3	4	2	20	N2
Significance						N3 - Moderate						N2 - Low							

**Project Name: Camden II Up to 132kV OHL**

Impact Assessment

**DECOMMISSIONING**

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
<b>Impact 1:</b>	Displacement	Displacement of priority species due to disturbance associated with decommissioning of the on-site substation and up to 132kV overhead power line	Decommissioning	Negative	Moderate	4	2	3	2	4	44	<b>N3</b>	3	2	3	2	2	20	<b>N2</b>
<b>Significance</b>						<b>N3 - Moderate</b>							<b>N2 - Low</b>						

**Project Name: Camden II Up to 132kV OHL**

**Impact Assessment**

**CUMULATIVE**

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+)	E+	R+	(D)±	P=	S		(M+)	E+	R+	(D)±	P=	S	
<b>Impact 1:</b>	Mortality: Collision	Powerline collision mortality of priority avifauna due to the construction of the overhead power line.	Cumulative	Negative	Moderate	2	2	2	4	3	30	<b>N2</b>	2	3	3	4	2	24	<b>N2</b>
<b>Significance</b>						<b>N2 - Low</b>							<b>N2 - Low</b>						
<b>Impact 2:</b>	Displacement	Displacement of priority avifauna due to disturbance and habitat transformation	Cumulative	Negative	Moderate	3	2	3	2	3	30	<b>N2</b>	3	2	3	2	2	20	<b>N2</b>
<b>Significance</b>						<b>N2 - Low</b>							<b>N2 - Low</b>						
<b>Impact 3:</b>	Mortality: Electrocutation	Mortality (electrocutation) of priority avifauna due to the construction of the on-site substation	Cumulative	Negative	High	3	3	3	4	2	26	<b>N2</b>	1	2	3	4	2	20	<b>N2</b>
<b>Significance</b>						<b>N2 - Low</b>							<b>N2 - Low</b>						

## APPENDIX 6: ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPr)

### 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	The results of the pre-construction monitoring must guide the lay-out of the turbines, especially as far as proposed no-turbine zones are concerned. No turbines must be constructed in the buffer zones which were identified based on the results of the pre-construction monitoring, with a specific view to limiting the risk of collisions to a variety of birds, including several Red Data species.	1. A 100m turbine exclusion zone must be implemented around wetlands and dams. Other infrastructure must be limited as far as possible to prevent displacement of African Grass Owl.	Once-off during the planning phase.	Project Developer
Avifauna: Mortality due to electrocution					
Electrocution of raptors on the internal medium voltage poles	Prevent electrocutions	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 as far as possible. 2. Consult with Avifaunal Specialist during the design phase of the overhead lines.	Once-off during the planning phase.	Project Developer

## EMPr 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.)	<p>A site-specific Construction EMPr (CEMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and must apply good environmental practice during construction. The CEMPr must specifically include the following:</p> <ol style="list-style-type: none"><li>1. No off-road driving.</li><li>2. Maximum use of existing roads.</li><li>3. Measures to control noise and dust according to latest best practice.</li><li>4. Restricted access to the rest of the property.</li><li>5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation and rehabilitation of the footprint.</li></ol>	<ol style="list-style-type: none"><li>1. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance.</li><li>2. Ensure that construction personnel are made aware of the impacts relating to off-road driving.</li><li>3. Construction access roads must be demarcated clearly. Undertake site inspections to verify.</li><li>4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance.</li><li>5. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.</li></ol>	<ol style="list-style-type: none"><li>1. Monthly</li><li>2. Monthly</li><li>3. Monthly</li><li>4. Monthly</li><li>5. Monthly</li></ol>	<ol style="list-style-type: none"><li>1. Contractor and ECO</li><li>2. Contractor and ECO</li><li>3. Contractor and ECO</li><li>4. Contractor and ECO</li><li>5. Contractor and ECO</li></ol>
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.	<ol style="list-style-type: none"><li>1. Develop a Habitat Rehabilitation Plan (HRP) and ensure that it is approved.</li><li>2. Monitor rehabilitation via site audits and site inspections to ensure compliance. Record and report any non-compliance.</li><li>3. Vehicle and pedestrian access to the site to be controlled and restricted to the facility footprint as much as possible to prevent unnecessary</li></ol>	<ol style="list-style-type: none"><li>1. All biodiversity recommendations regarding rehabilitation must be followed</li></ol>	<ol style="list-style-type: none"><li>1. Frequency as stated in the biodiversity rehabilitation plan</li></ol>	<ol style="list-style-type: none"><li>1. Developer</li><li>2. Contractor and ECO</li></ol>

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

## EMPr 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 <i>et al.</i> , 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 years of operation, and then repeated again in year 5, and again every five years thereafter for the operational lifetime of the facility.	1. Appoint Avifaunal Specialist to compile operational monitoring plan, including live bird monitoring and carcass searches. 2. Implement operational monitoring plan. 3. If estimated annual collision rates indicate unacceptable mortality levels of priority species, i.e., if it exceeds the pre-determined threshold determined by the avifaunal specialist, implement shut down on demand or other proven measures. 4. 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
Avifauna: Mortality due to collisions and electrocutions on the medium voltage 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	1. At least once every two months.	1. Operations Manager



Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
			recommended mitigation measures.		

## EMPr 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.	<p>A site-specific EMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the EMPr and must apply good environmental practice during construction. The EMPr must specifically include the following:</p> <ol style="list-style-type: none"><li>1. No off-road driving.</li><li>2. Maximum use of existing roads.</li><li>3. Measures to control noise and dust according to latest best practice.</li><li>4. Restricted access to the rest of the property.</li><li>5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint.</li></ol>	<ol style="list-style-type: none"><li>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.</li><li>2. Ensure that construction personnel are made aware of the impacts relating to off-road driving.</li><li>3. Access roads must be demarcated clearly. Undertake site inspections to verify.</li><li>4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance.</li><li>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.</li></ol>	<ol style="list-style-type: none"><li>1. Monthly</li><li>2. Monthly</li><li>3. Monthly</li><li>4. Monthly</li><li>5. monthly</li></ol>	<ol style="list-style-type: none"><li>1. O&amp;M Contractor and ECO</li><li>2. Contractor and ECO</li><li>3. Contractor and ECO</li><li>4. Contractor and ECO</li><li>5. Contractor and ECO</li></ol>

## Environmental Management Programme (EMPr): Up to 132kV overhead line

### Management Plan for the Planning and Design Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	Frequency	Responsibility
Mortality of avifauna, specifically Cape Vulture, due to electrocutions on the overhead powerline poles/towers	Reduction of avian electrocution mortality	<p>If a steel monopole pole design is used, the approved vulture friendly pole/tower design D-DT-7649 in accordance with the Eskom Distribution Technical Bulletin titled Refurbishment of 66/88kV line kite type frames with D-DT-7649 type top configuration - Reference Number 240-170000467 relating to bird friendly structures, must be used.</p> <p>If lattice type structures are used, it is imperative that a minimum vertical clearance of 1.8m is maintained between the jumper cables and/or insulator live ends, and the horizontal earthed components. Additional mitigation in the form of insulating sleeves on jumper cables present on strain poles and terminal poles is also recommended (if suitable insulation material is readily available), alternatively all jumper cables must be suspended below the crossarms.</p>	<ol style="list-style-type: none"> <li>Construct the powerline using a minimum vertical clearance of 1.8m between the jumper cables and/or insulators and the horizontal earthed component on the lattice structure.</li> <li>If possible, insulate jumper cables that may be present on strain and terminal poles/towers.</li> </ol> <p>Alternatively suspend all jumper cables below the crossarms</p>	Once-off	Contractor and ECO

## Management Plan for the Construction Phase

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 avifauna by ensuring that contractors are aware of the requirements of the Construction Environmental Management Programme (CEMPr.)	<p>Conduct a pre-construction inspection (avifaunal walk-through) of the final powerline alignment to identify priority species that may be breeding within the final footprint. If a SSC nest is occupied, the avifaunal specialist must consult with the contractor to find ways of minimising the potential disturbance to the breeding birds during the construction period.</p> <p>A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following:</p> <ol style="list-style-type: none"><li>1. No off-road driving;</li><li>2. Maximum use of existing roads, where possible;</li><li>3. Measures to control noise and dust according to latest best practice;</li><li>4. Restricted access to the rest of the property;</li><li>5. Strict application of all recommendations in the biodiversity specialist report pertaining to the limitation of the footprint.</li></ol>	<ol style="list-style-type: none"><li>1. Walk-through by avifaunal specialist</li><li>2. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance.</li><li>3. Ensure that construction personnel are made aware of the impacts relating to off-road driving.</li><li>4. Construction access roads must be demarcated clearly. Undertake site inspections to verify.</li><li>5. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance.</li><li>6. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.</li></ol>	<ol style="list-style-type: none"><li>1. Once-off</li><li>2. Monthly</li><li>3. Monthly</li><li>4. Monthly</li><li>5. Monthly</li></ol>	<ol style="list-style-type: none"><li>1. Avifaunal Specialist</li><li>2. Contractor and ECO</li><li>3. Contractor and ECO</li><li>4. Contractor and ECO</li><li>5. Contractor and ECO</li><li>6. Contractor and ECO</li></ol>
Avifauna: Mortality due to collision with the overhead powerline					
Mortality of avifauna due to collisions with the overhead powerline.	Reduction of avian collision mortality	Bird Flight Diverters must be fitted to the entire OHL according to the applicable Eskom Engineering Instruction (Eskom Unique Identifier 240 – 93563150: The utilisation of Bird Flight Diverters on Eskom Overhead Lines). These devices must be installed as soon as the conductors and earthwires are strung.	<ol style="list-style-type: none"><li>1. Fit Eskom approved Bird Flight Diverters on the entire length of line</li></ol>	<ol style="list-style-type: none"><li>1. Once-off</li></ol>	<ol style="list-style-type: none"><li>1. Contractor and ECO</li></ol>



## Management Plan for the Decommissioning Phase

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 decommissioning activities 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 Decommissioning EMPr.	<p>Conduct an avifaunal inspection of the OHL prior to its decommissioning to identify nests on the poles/towers. A site-specific Decommissioning EMPr (DEMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the DEMPr and should apply good environmental practice during decommissioning. The DEMPr must specifically include the following:</p> <p>1. No off-road driving;</p> <p>2. Maximum use of existing roads during the decommissioning phase and the construction of new roads should be kept to a minimum as far as practical;</p> <p>3. Measures to control noise and dust according to latest best practice;</p> <p>4. Restricted access to the rest of the property;</p> <p>5. Strict application of all recommendations in the botanical specialist report pertaining to the limitation of the footprint.</p>	<p>1. Implementation of the DEMPr. Oversee activities to ensure that the DEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance.</p> <p>2. Ensure that decommissioning personnel are made aware of the impacts relating to off-road driving.</p> <p>3. Access roads must be demarcated clearly. Undertake site inspections to verify.</p> <p>4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance.</p> <p>5. Ensure that the decommissioning area is demarcated clearly and that personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance.</p>	<p>1. Once-off</p> <p>2. On a daily basis</p> <p>3. Weekly</p> <p>4. Weekly</p> <p>5. Weekly</p> <p>6. Weekly</p>	<p>1. Contractor and ECO</p> <p>2. Contractor and ECO</p> <p>3. Contractor and ECO</p> <p>4. Contractor and ECO</p> <p>5. Contractor and ECO</p>

## Appendix 7: Post-construction monitoring plan

### 1 INTRODUCTION

The avifaunal post-construction monitoring at the proposed Camden II 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)<sup>13</sup>.

### 2 AIM OF POST-CONSTRUCTION MONITORING

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

- Confirm as far as possible what the actual impacts of each 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 each WEF changed?
- How has the number of birds and species composition changed?
- How have the movements of priority species changed?
- How has each WEF affected priority species' breeding success?
- How many birds collide with the turbines of each 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 each 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 facilities as they would

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<sup>13</sup> 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.



be over the lifespan of the facilities. Over time the habitat within each WEF may change, birds may become habituated to, or learn to avoid the facilities. 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 each 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 each 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 as part of the monitoring programme.

## **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 respective sites.
- 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 in order 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 sent to the specialist on a weekly basis:

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

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