



76 Valley View Road, Morningside, Durban, 4001  
PO Box 37069, Overport, Durban. 4067

Tel: +27 (0)31 3032835  
Fax: +27 (0)86 692 2547

## AVIFAUNAL IMPACT ASSESSMENT

PROPOSED DEVELOPMENT OF THE ESKOM AGULHAS 400/132KV 2X500 MVA TRANSMISSION  
SUBSTATION AND LOOP-IN LOOP-OUT LINES, SWELLENDAM LOCAL MUNICIPALITY, WESTERN CAPE  
PROVINCE

OCTOBER 2016



**Prepared by:**  
Afzelia Environmental Consultants  
P.O. Box 37069,  
Overport, 4067  
Tel: 031 303 2835  
Email: [info@afzelia.co.za](mailto:info@afzelia.co.za)

**Prepared for:**  
Nsovo Environmental Consulting  
Tel: 011 312 5153  
Fax: 086 602 8821  
Email: [beatrice@nsovo.co.za](mailto:beatrice@nsovo.co.za)

## Declaration

I, **Craig Widdows**, declare that -

- I act as the independent specialist in this application;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I will comply with the National Environmental Act (NEMA), regulations and all other applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; all the particulars furnished by me in this form are true and correct.

**Signature of the specialist:**



**Date: 06 October 2016**

<b>Specialist:</b>	Craig Widdows for Afzelia Environmental Consultants		
<b>Contact person:</b>	Dr. Craig Widdows		
<b>Qualification:</b>	PHD Ecology (UKZN)		
<b>Postal address:</b>	76 Valley View Road, Morningside		
<b>Postal code:</b>	4001	<b>Cell:</b>	083 7818 725
<b>Telephone:</b>	031 303 2835	<b>Fax:</b>	031 312 0896
<b>E-mail:</b>	Craig@afzelia.co.za		
<b>Professional affiliation(s) (if any)</b>	IAIAsa SACNASP <i>Pri.Sci.Nat</i> : Membership Number Pending		

*Although Afzelia Environmental Consultants (Pty) Ltd exercises due care and diligence in rendering services and preparing documents, the Consultants do not accept any liability, and the Client by receiving this document, indemnifies the Consultants (directors, managers, agents and employees) against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered directly or indirectly by the Consultants and by the use of the information contained in this document*

## Executive Summary

Afzelia Environmental Consultants (Pty) Ltd were appointed by Nsovo Environmental Consulting (Pty) Ltd to undertake an avifaunal impact assessment for the proposed construction of the Agulhas 400/132kV 2X500 MVA Transmission Substation and Loop-in Loop-out lines and associated 132 kV distribution power line. The study area is located 20km south west of the town of Swellendam within the Swellendam Local Municipality, Western Cape. The proposed project will form part of the Vryheid Network Strengthening project in order to increase the power output within the area. The establishment of the Agulhas Transmission Substation (TS) will assist in resolving the transmission capacity constraints at the Bacchus Substation and will play an important role in addressing the energy transmission issues within the Western Cape Municipality.

The primary aim of this assessment is to determine and assess the avifaunal communities associated with the study area and the sensitivity of the site from an avifaunal perspective. This will in turn provide valuable insight pertaining to the impacts of the substation on avian ecology within the study site.

A total of 216 bird species are predicted to occur with the 3420AB quarter degree grid square within which the proposed substation and associated power line will traverse (South African Bird Atlas Project 2), two of which are considered “Endangered”, three listed as “Vulnerable” and two are considered “Near Threatened” (Barnes 2014). Avian species likely to be impacted by the proposed substation and associated 132Kv loop-in loop-out lines include local populations of endemic passerine species (Agulhas Long-billed Lark), locally resident or transient raptors (Marial Eagle and Black Harrier) and large terrestrial birds (Denham’s Bustard, Blue Crane and Secretarybird). During the site visit 71 bird species were recorded within the greater study area including the Near Threatened Blue Crane (*Anthropoides paradiseus*) and Karoo Korhaan (*Eupodotis vigorsii*), the Vulnerable Denham’s Bustard (*Neotis denhami*), and the Endangered Black Harrier (*Circus maurus*). The avian composition was dominated by smaller passerine species including African Stonechat (*Saxicola torquatus*), Familiar Chat (*Cercomela familiaris*), Common Waxbill (*Estrilda astrild*), Cape Sparrow (*Passer melanurus*) and Southern Red Bishop’s (*Euplectes orix*).

The impacts associated with the proposed substation and 132kV power line project include:

- Destruction and alteration of avian habitats;
- Disturbance and displacement of bird species; and
- Collision and electrocution on associated overhead power lines.

Collisions with the earth wire is the main impact associated with the project. In order to mitigate this impact, it is imperative that earth wires crossing important avian habitats (agricultural lands, rivers, drainage lines and avian flyways) are fitted with anti-collision marking devices to increase the visibility of the power line and reduce likelihood of collisions. These must be Eskom approved anti-collision devices that are durable as the area is prone to strong winds. Further to this, electrocution of birds on the power line infrastructure also poses a risk to avifaunal species.

The construction of the proposed new Eskom Agulhas MVA transmission substation and associated power line at site alternative A and C are the most favourable sites from an avifaunal perspective. These sites will pose a limited threat to the birds occurring in the vicinity of the new infrastructure. This is largely due to the extensive impacts already evident at the sites (existing 400kV power line, transformed landscape and few suitable avian

micro-habitats) coupled with the short length (4.9km and 4.4km respectively) of the associated loop-in loop-out power line and 132kV distribution power line. The power line poses a moderate collision risk once the recommended mitigation measures are implemented. Given the relative homogeneity of the habitat within the study area as well as existing levels of disturbance (existing power line infrastructure, roads, urban development, agricultural practices), the proposed project is unlikely to have a significant, long-term impact on the local avifauna.

## **Table of Contents**

<b>1. INTRODUCTION .....</b>	<b>1</b>
<b>1.1 BACKGROUND AND LOCALITY OF THE ASSESSMENT .....</b>	<b>1</b>
<b>1.2 SCOPE OF WORK .....</b>	<b>1</b>
<b>1.3 INFORMATION SOURCES UTILISED.....</b>	<b>2</b>
<b>1.4 ASSUMPTIONS AND LIMITATIONS.....</b>	<b>2</b>
<b>2. METHODOLOGY .....</b>	<b>2</b>
<b>3. ASSESSMENT OF THE STUDY AREA .....</b>	<b>6</b>
<b>3.1 BASELINE BIOPHYSICAL CHARACTERISTICS.....</b>	<b>6</b>
<b>3.2 AVIAN MICRO-HABITATS .....</b>	<b>10</b>
<b>3.3 IMPORTANT BIRD AREAS (IBA) .....</b>	<b>13</b>
<b>4. AVIFAUNA SPECIES COMPOSITION.....</b>	<b>15</b>
<b>4.1 PREDICTED PRIORITY SPECIES .....</b>	<b>16</b>
<b>5. SENSITIVITY ASSESSMENT .....</b>	<b>20</b>
<b>6. COMPARISON OF SITE ALTERNATIVES .....</b>	<b>23</b>
<b>7. IMPACTS ASSOCIATED WITH THE SUBSTATION PROJECT .....</b>	<b>24</b>
<b>7.1 SIGNIFICANCE OF IDENTIFIED IMPACTS .....</b>	<b>24</b>
<b>7.2 CONSTRUCTION PHASE IMPACTS .....</b>	<b>26</b>
<b>7.3 OPERATIONAL PHASE IMPACTS .....</b>	<b>28</b>
<b>8. CONCLUSION .....</b>	<b>31</b>
<b>9. REFERENCES.....</b>	<b>32</b>

### List of Tables

Table 1. Red Listed bird species recorded in the 3420AB quarter degree square within which the proposed substation and loop in loop out lines are located .....	17
Table 2. Significance scoring used for each potential impact .....	25
Table 3. Impact assessment for the proposed substation and loop-in loop-out lines. ....	25

### List of Figures

Figure 1. Locality of proposed substation and associated infrastructure.....	4
Figure 2. Site description map of the proposed site alternatives.....	5
Figure 3. Vegetation type for the proposed study area .....	7
Figure 4. Important Bird Areas surrounding the study area .....	14
Figure 5. Sensitivity map of the study area .....	22
Figure 6. Technique and guideline for marking of the earth wire with bird flapper devices ( <i>Adapted from Vosloo et al. 2014</i> ). ....	30

### List of Photographs

Photograph 1. Overview of vegetation types and habitat structure located within the proposed study area and surrounds.....	9
Photograph 2. Agricultural land consisting of grazing land (A) and Canola plantations (B) that dominated the study area .....	11
Photograph 3. Several farm dams and riparian habitats identified within the study area. These areas are regarded as a sensitive avifaunal habitat as it provides suitable habitat for an abundance of species....	12
Photograph 4. Secretarybird ( <i>Sagittarius serpentarius</i> ) ( <i>Images extracted from Hockey et al. 2011</i> ).....	18
Photograph 5. Cape Vulture ( <i>Gyps coprotheres</i> ) (A) and Martial Eagle ( <i>Polemaetus bellicosus</i> ) (B). ( <i>Images extracted from Hockey et al. 2011</i> ). ....	19
Photograph 6. Black Harrier ( <i>Circus maurus</i> ) ( <i>Images extracted from Hockey et al. 2011</i> ). ....	19
Photograph 7. Denham's Bustard ( <i>Neotis denhami</i> ) (A) and Blue Crane ( <i>Anthropoides paradiseus</i> ) (B). ( <i>Images extracted from Hockey et al. 2011</i> ). ....	20
Photograph 8. Static Helical bird flight diverter and a mobile bird flapper device .....	30

# 1. INTRODUCTION

## 1.1 BACKGROUND AND LOCALITY OF THE ASSESSMENT

Afzelia Environmental Consultants (Pty) Ltd was appointed by Nsovo Environmental Consulting (Pty) Ltd to undertake an avifaunal impact assessment for the proposed Eskom Agulhas 400/132kv 2x500 MVA Transmission Substation and loop-in loop-out lines.

Eskom Holdings SOC Ltd is proposing the construction of the Agulhas 400/132kV Main Transmission Substation (MTS): the construction footprint of the development will be 600m x 600m. The project will include the construction of a 132kV distribution line that will connect to the existing and new substations.

The proposed development will form part of the Vryheid Network Strengthening project in order to increase the power output within the area. The establishment of the Agulhas Transmission substation will assist in resolving the transmission capacity constraints at Bacchus substation and will play an important role in addressing the energy transmission issues within the Western Cape Province.

The proposed project study area is located on the Leeuw Rivier 251 Portion 3 and Kluitjeskraal 256 Portions 2, 5 & RE within the Swellendam Local Municipality, Western Cape Province (**Figure 1**). The site is located approximately 20 km from Swellendam along the Nation Road (N2) and Regional Road (R319). There are four proposed site alternatives, Site A, C, F and G, all of which are situated within the quarter-degree square 3420AB (**Figure 2**).

Overhead power line infrastructure is known to negatively impact various avian species through direct mortality (collisions or electrocutions) of birds and indirectly through the removal of natural habitats. Interactions between birds and substation infrastructure is predicted to be less significant and impacts are likely to be indirect in nature due to habitat loss and disturbance.

## 1.2 SCOPE OF WORK

The primary aim of this avifaunal impact assessment report was to evaluate the study area and determine the area's avifaunal sensitivity. Sensitivity refers to an area's ability to provide suitable nesting and foraging habitat for both Red Listed species and non-Red Listed species. This aim was achieved through the following objectives:

- Site visit to identify important avian habitats within the study area as well as avian micro-habitats and species that will potentially use these ecological niches.
- A description of the current avifauna within the study area and the identification of Red Data species potentially affected by the proposed substation and associated power lines.
- Integration of the site data collected from avian atlases and counts within the area to develop a comprehensive avifaunal database likely to be present within the development footprint.
- Recommendations on which sites are preferable for the construction of the substation and associated loop-in loop-out lines. The most favourable site will have a limited impact on avifauna.

- Identify potential negative impacts on the avifaunal diversity and species composition within the study area and assess the significance of these impacts.
- To provide recommended mitigation measures for the potential impacts in order to reduce the significance of the impacts on avifauna.

### 1.3 INFORMATION SOURCES UTILISED

The avifaunal assessment made use of the following data sources:

- Bird distribution data of the Southern African Bird Atlas Project obtained from the Avian Demography Unit of the University of Cape Town, in order to ascertain species occurrence within the study area (Harrison et al. 1997).
- The conservation and endemic status of all bird species occurring within the quarter degree square determined with the use of The Eskom Red Data book of birds of South Africa, Lesotho and Swaziland (Taylor 2014) and BirdLife SA checklist of endemics and near-endemics.
- The Important Bird Areas (IBA) programme according to BirdLife South Africa was consulted.
- A classification of the vegetation types in the study area was obtained from Mucina & Rutherford (2006) and SANBI (2012).

### 1.4 ASSUMPTIONS AND LIMITATIONS

It is difficult to apply pure scientific methods within a natural environment without limitations, and project specific assumptions need to be made. The following constraints may have affected this assessment:

- The 3420AB quarter degree grid square, within which the project is located, is reasonably well covered by the South African Bird Atlas Project (SABAP2), with data recorded on 22-72 data cards. As a result, the species diversity and densities recorded by SABAP2 provide an accurate interpretation of the avifauna potentially occurring within the study area.
- Avian behaviour is relatively unpredictable and cannot be reduced to formulas that will hold true under all circumstances. However, power line impacts can be predicted with a fair amount of certainty due to the vast amount of data available in this regard.
- Although the predicted impacts are mostly concerned with Red Data species, the non-Red Data species will also benefit from the implementation of the proposed mitigation measures as they share the same habitat and affected by the same potential impacts.

## 2. METHODOLOGY

The methodology used to predict impacts of the proposed project are outlined below.

- The various data sets and scientific publications were collected and examined to determine the sensitive avian species impacted by this study.
- The data was examined to determine the richness and abundance of species which may be susceptible to impacts from the proposed project.
- The broader study area was visited during a four-day site visit of the proposed sites. All four sites were thoroughly traversed to obtain a first-hand perspective of the proposed project and birdlife, and to determine which avian micro-habitats are present within the study site. This involved traversing the broader study area, taking photographs, and walking certain accessible areas, to see as much as possible of the proposed substation sites and route options for the power line.
- A desk top examination of the site, using Google Earth imagery was done to compare the power line route options and substation site alternatives. This was confirmed during the site visit.
- Avian micro-habitats and sensitive habitats for avifaunal communities were identified and mapped.
- The impacts of the proposed project on the avifaunal populations were predicted by analysing data on wildlife impacts with power lines and associated substation infrastructure throughout southern Africa.

# Vryheid Network Strengthening - Swellendam Local Municipality, Ward 1 & 3, Western Cape Province

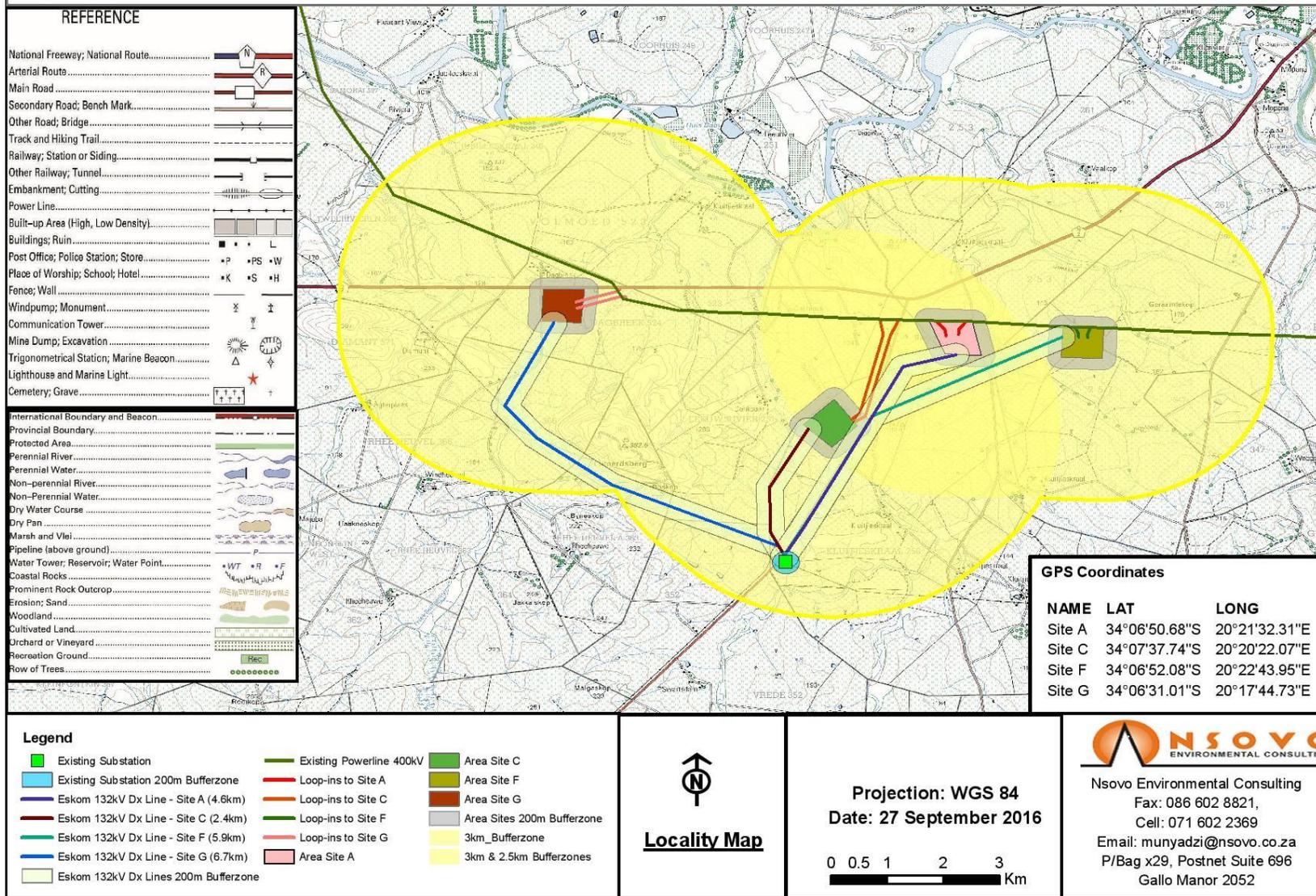


Figure 1. Locality of proposed substation and associated infrastructure

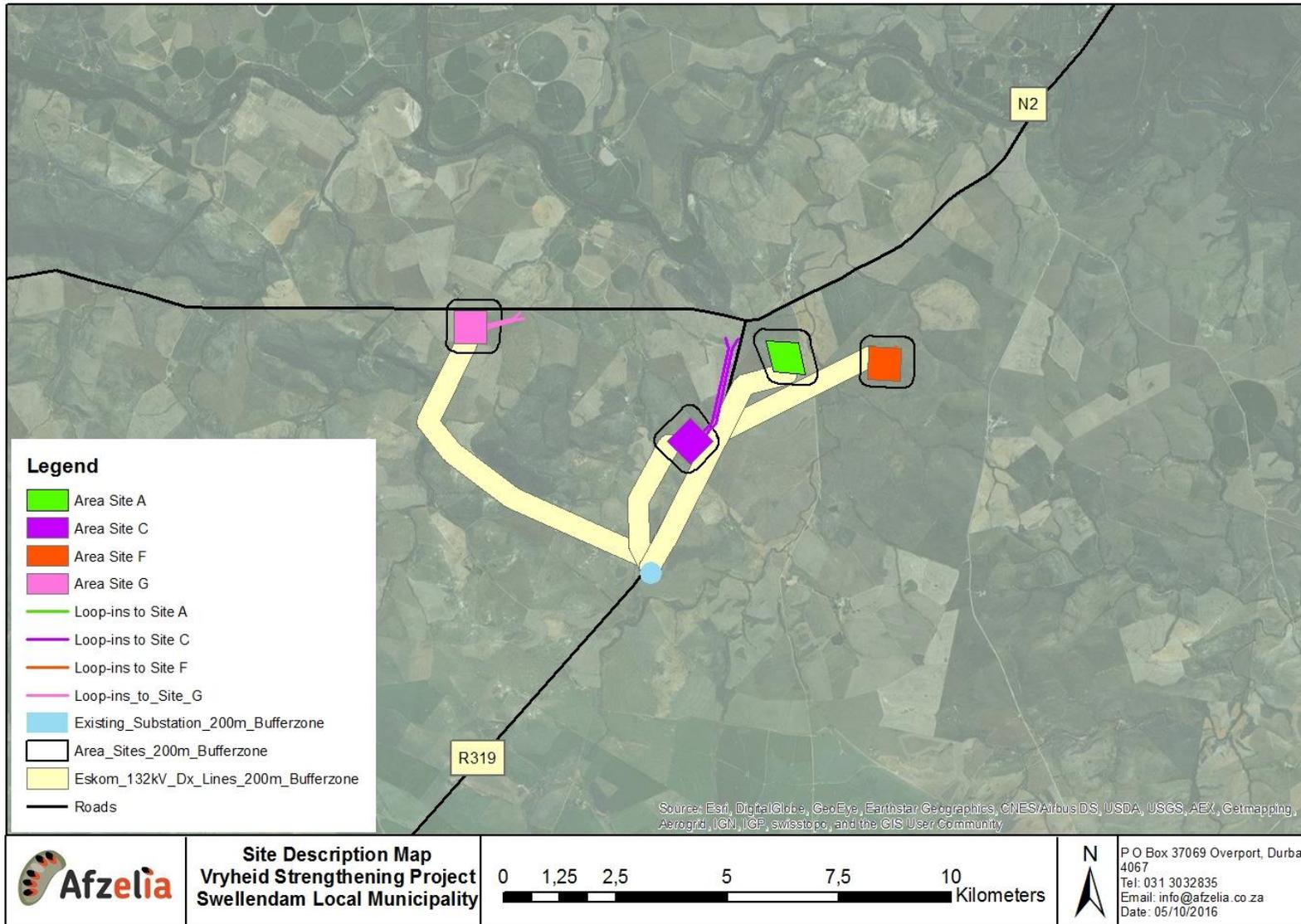


Figure 2. Site description map of the proposed site alternatives

### 3. ASSESSMENT OF THE STUDY AREA

#### 3.1 BASELINE BIOPHYSICAL CHARACTERISTICS

The Swellendam area is characterised by a winter rainfall pattern with some rain occurring in summer. The mean annual precipitation is approximately 462mm per year. It receives the lowest rainfall in June (23mm) and the highest in August (48mm). The average daily maximum temperatures range from 17.1 °C in July to 27.5 °C in January. The region is the coldest in July with minimum temperatures of 5.0 °C (Mucina and Rutherford 2006). First frosts are normally experienced after June and continue through to the beginning of September.

According to the National Vegetation Map (Mucina & Rutherford 2006 and SANBI, 2012) four vegetation types occur within the study area (**Figure 2**). North Sonderend Sandstone Fynbos occupies the north-west corner and central portions of the site while the Eastern Ruens Shale Renosterveld vegetation unit comprising the majority of the site. This vegetation type is characterised by moderately tall grassy shrubland dominated by Renosterbos. This vegetation type is considered critically endangered with at least 80% transformed mostly by cultivation and croplands (Mucina and Rutherford, 2006).

Small outcrops of Ruens Silcrete Renosterveld are located along the southern section of the larger study area and Cape Lowland Alluvial Vegetation traverses the eastern boundary and central section of the study area. Lowland Alluvial Vegetation was primarily confined with drainage lines and associated riparian zones. Within the site, these different vegetation types are structurally very similar and all consist of low shrubland species with varying degrees of graminoid, succulents, forbs and geophyte cover, depending on the aspect and landscape position.

The vast majority of the site has been transformed by intensive agriculture with all four site alternatives falling within agricultural cropland (**Figure 3**). There is remnant intact riparian vegetation along the drainage systems providing suitable habitat for nesting, foraging and roosting. The Bacchus-Proteus 400 kV line traverses through the northern portion of the study area and a substation is located to the south.

The main topographical unit within the proposed study area consists of moderately undulating hills and plains which are characteristic of the area. Major water courses in the study area include the Breede River located to the north of the proposed site alternatives (2km), and the smaller Kluitjieskraalrivier (0.8km) which drains southwards to the east of the proposed site alternatives.

Vegetation structure is considered more significant in determining avian species abundance and distribution than vegetation species composition (Harrison et al. 1997). As a result, the vegetation description within this assessment does not focus on the identification of floral species, but rather on vegetation structural units such as woodlands, riverine habitats or pans and wetlands.

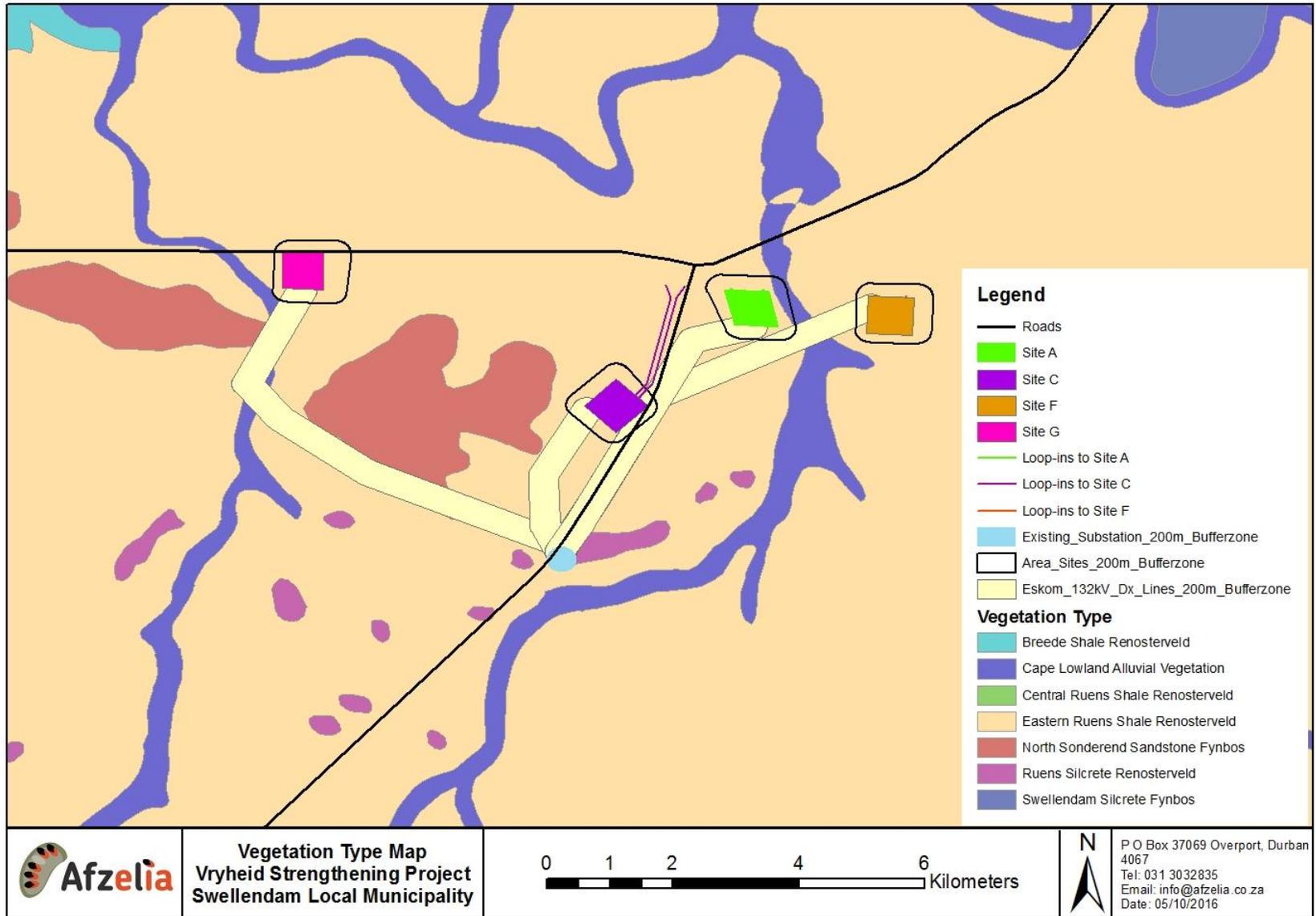


Figure 3. Vegetation type for the proposed study area





**Photograph 1. Overview of vegetation types and habitat structure located within the proposed study area and surrounds.**

## 3.2 AVIAN MICRO-HABITATS

Most of the abundance and distribution of avian species within the study area can be attributed to the vegetation types and bioregions. In determining the suitability of the study area for avian species, it is vital to examine the habitats available to these species. This will determine where the relevant species are most likely to occur within the study area. These micro-habitats do not necessarily correspond to vegetation types and are determined by a combination of vegetation type, topography, land use, food sources and other intrinsic factors.

Investigation of the study area revealed several avian micro-habitats. In each case, some of the species likely to make use of the various micro-habitats have been described. Despite this, due to their mobile nature, avian species will utilise almost any area in a given landscape from time to time.

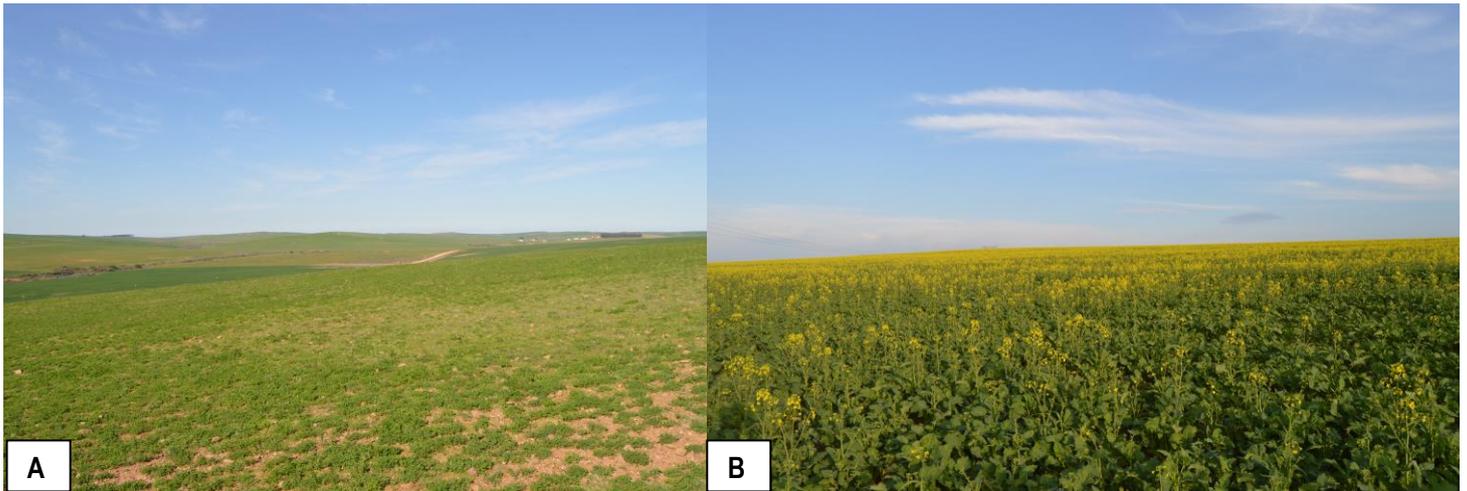
### Arable or cultivated landscape

Agricultural land is the dominant land cover and the most common micro-habitat within the study area (**Photograph 2**). Wheat and Canola (*Brassica napus L.*) are the dominant crops cultivated within the study area. This micro-habitat is characterised by a monoculture, within limited existing shrub and tree species (apart from adjacent drainage lines). Avifaunal species associated with this open micro-habitat are dominated by ground-dwelling species. Relevant avian species that will utilise this micro-habitat include Denham's Bustard (*Neotis denhami*), Blue Cranes (*Anthropoides paradiseus*) and various Heron species. In particular the White Stork (*Ciconia ciconia*) has a high affinity for arable land, with 80% of sightings in South Africa recorded within this habitat (Dean & Ryan 2005).

Farmland or cultivated land provides foraging opportunities for many bird species for the following reasons:

- i. Through the process of land preparation many insects, seeds, bulbs and other food sources become readily accessible to bird species;
- ii. The agricultural plants that are cultivated are often consumed by birds, or attract insects which are in turn consumed by birds; and
- iii. The use of agricultural lands as foraging sites is likely to fluctuate throughout the year. It is predicted that greater concentrations of birds will increase during spring when the fields are ploughed, and in late summer / autumn when the crops are harvested and the birds are attracted to feed on the residual grains.

Despite these benefits, active agricultural lands are not preferentially utilised by certain avian species due to the lack of vegetation cover and the regular disturbance experienced during the harvesting period. Areas where agricultural lands meet with natural shrublands has created a mosaic habitat merging the foraging advantages of the agricultural habitats and the protection of shrubland habitats.



**Photograph 2. Agricultural land consisting of grazing land (A) and Canola plantations (B) that dominated the study area**

The impacts associated with the substation and power line development within this micro-habitat are displacement of avian species due to habitat loss and disturbance as well as collisions with the associated power line (Denham's Bustard and Blue Crane).

#### Farm dams and drainage lines

The eastern section of the study area contains a series of farm dams (**Photograph 3**). These dams often hold large quantities of predictably available water. These water sources are often used by large flocks of granivorous bird species such as Cape Sparrow (*Passer melanurus*), Cape Canary (*Serinus canicollis*), Brimstone Canary (*Crithagra sulphurata*) and Southern Red Bishop's (*Euplectes orix*).

Drainage lines traverse the eastern and western boundaries of the study area (**Photograph 3**). Various species of water birds are mostly restricted to riverine habitat in Southern Africa. These drainage lines and associated riparian zones are important for Denham's Bustard as they provide foraging opportunities (invertebrates and small vertebrates). Furthermore, the riparian ecotone provides habitat for various species such as Kingfishers, Robin-Chats, Thrushes and Hammerkop (*Scopus umbretta*). Although the drainage lines within the area are negatively impacted due to the disturbance and encroachment from the croplands, they provide important corridors of natural vegetation, cover and nesting opportunities for many avian species within the largely agricultural landscape. They also represent an important flight path for many species.

The main impact associated with this habitat include habitat destruction, disturbance and collisions with the power line (larger species with low maneuverability).



**Photograph 3. Several farm dams and riparian habitats identified within the study area. These areas are regarded as a sensitive avifaunal habitat as it provides suitable habitat for an abundance of species**

#### Artificial micro-habitats

Artificial habitats are provided by the existing overhead power lines that traverse through the study area. The pylons are used by various species including raptors ((Jackal Buzzard (*Buteo rufofuscus*), Pale-chanting Goshawk (*Melierax canorus*) and Martial Eagles (*Polemaetus bellicosus*)) from which to hunt and to nest. Smaller raptor species such as Rock Kestrels and Black-shouldered Kites will also utilised power lines for perching. Therefore, power line infrastructure may benefit these species due to the limited occurrence of large trees from which to perch and hunt.

### 3.3 IMPORTANT BIRD AREAS (IBA)

The Important Bird Areas are identified as areas that are important for the long-term survival of threatened, restricted avian species.

All substation site alternatives fall within the Overberg Wheat-belt (SA115) Important Bird Area. The extent of the IBA is 603 540 ha and forms part of the Fynbos Biome. The landscape of the area consists of low lying hills and the natural Renoster vegetation in most areas has been replaced by cereal croplands and artificial pastures.

This IBA supports 304 bird species and hosts 30% of South Africa's Blue Crane (*Anthropoides paradiseus*) population as well as a large portion of the global range of the Agulhas Long-Billed Lark (*Certhilauda brevirostris*). The IBA also hosts large numbers of Denham's Bustard (*Neotis denhami*), White Stork (*Ciconia ciconia*) and Black Storks (*Ciconia nigra*).

IBA trigger species for this area include Cape Vulture (*Gyps coprotheres*), Blue Crane, Martial Eagle (*Polemateus bellicosus*), Black Harrier (*Circus maurus*), Denham's Bustard, Secretarybird (*Sagittarius serpentarius*) and Southern Black Korhaan (*Afrotis afra*).

The Langeberg Mountains (SA 113) is located approximately 5km north of the study area and a total of 206 bird species have been recorded within this area. IBA trigger species include Denham's Bustard, Martial Eagle, Black Harrier, Hottentot Buttonquail, Knysna Woodpecker and Knysna Warbler and Verreauxs' Eagle.

According to BirdLife South Africa, one-third of the 112 IBA's located within South Africa are under threat by alien invasive vegetation, habitat modification and agricultural expansion (Marnewick et al. 2015). It is important to include mitigation measures to ensure the development does not have a significant negative affect on protected avian species and source populations occurring within the IBA.

As the proposed study falls within the Overberg Wheat-belt (SA115) Important Bird Area and in close proximity to the Langeberg Mountains IBA, it is important to implement the outlined mitigation measures to ensure the development does not have a long term negative impact on protected bird species.

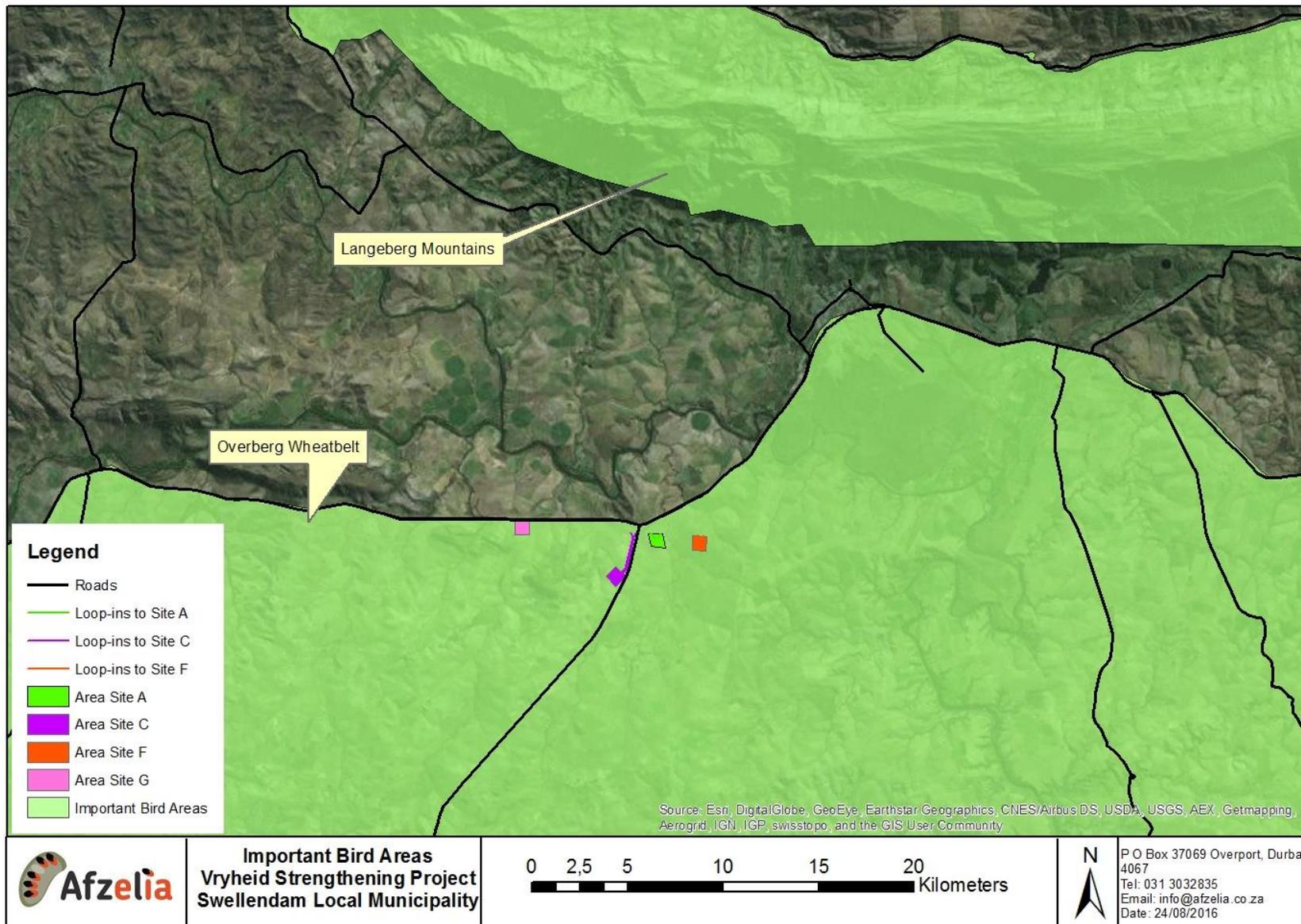


Figure 4. Important Bird Areas surrounding the study area

#### 4. AVIFAUNA SPECIES COMPOSITION

A total of 216 species are predicted to occur within the study area and wider impact zone (SABAP2), with six species (3%) classified as Red Data species (Barnes 2014). Furthermore, five species are southern African endemics and eleven are near-endemics. Reporting rates are an indication of the relative density of a species on the ground in that it reflects the number of times that a species was recorded relative to the total number of cards that were completed for the pentad<sup>1</sup>.

During the site visit a total of 71 bird species were recorded within the study area (**Appendix A**). This figure was much lower than the species rich area to the east of the site within the Bontobok National Park (219 species recorded).

The most commonly recorded species within the study sites were passerine species such as Waxbills, Sparrows and Canaries. Numerous species often associated with anthropogenically<sup>2</sup> modified landscapes were also recorded in close proximity to agricultural lands including Red-eyed Dove (*Streptopelia semitorquata*), Cape Sparrow (*Passer melanurus*), Pied Crow (*Corvus albus*) and Familiar Chat (*Cercomela familiaris*). The drainage lines micro-habitats were observed to have the highest abundance and species richness as opposed to the open agricultural landscape. Species identified within the drainage line habitat included Bokmakierie (*Telophorus zeylonus*), Cape Spurfowl (*Pternistis capensis*), Cape Teal (*Anas capensis*), and Malachite Sunbird (*Nectarinia famosa*). The agricultural land within the proposed site alternatives were fairly unproductive with a low avian species diversity and abundance. This habitat type was dominated by Common Fiscal (*Lanius collaris*), African Stonechat (*Saxicola torquatus*), Common Waxbill (*Estrilda astrild*), Cape Sparrow (*Passer melanurus*) and Southern Red Bishop (*Euplectes orix*). The Jackal Buzzard and Black Harrier were the only medium-large raptor species recorded during the site visit.

Endemism is the ecological status of a species that is unique to a defined geographic location and does not occur anywhere else in the world. Endemic avian species in most cases have a limited and restricted range (Klerk *et al.* 2002). The restricted range of these species makes them susceptible to population decline due to anthropogenic impacts encroaching on their specific habitat requirements. Endemic species recorded during the site visit included Cape Bulbul (*Pycnonotus capensis*) and Agulhas Long-billed Lark (*Certhilauda brevirostris*) and near-endemic species included Jackal Buzzard (*Buteo rufofuscus*), Fiscal Flycatcher (*Sigelus silens*) and Black Harrier (*Circus maurus*). Several endemic species whose distributions occur within the study area were identified during the site visit. Most of these species are not threatened and occur in other localities within the subregion.

The avifaunal species composition within the study area comprises of a variety of species that occur in numerous habitats and not exclusively within the study area. Despite this, various priority species were noted within the study area and the site from an avifaunal perspective is predicted to be of a moderate significance.

---

<sup>1</sup> A 5-minute X 5-minute coordinate grid super-imposed over the continent for spatial reference. One QDGC comprises of 9 pentads.

<sup>2</sup> A disturbance created as a result of human activities.

#### 4.1 PREDICTED PRIORITY SPECIES

**Table 1** provides a guideline of the Red Data species that could potentially be encountered anywhere within the pentad where suitable habitat is available, and should therefore not be used as a measure of actual densities within the study area. Report rates are the likelihood of a particular species occurring along any of the alignments/ substation sites represented as a percentage. Furthermore, it is also important to note that these species were recorded within the entire quarter degree square and may not have actually been recorded on the proposed site for the study. Species that are in bold were recorded during the site visit.

**Table 1. Red Listed bird species recorded in the 3420AB quarter degree square within which the proposed substation and loop in loop out lines are located**

NAME	CONSERVATION STATUS (2014)	HABITAT	LIKELIHOOD OF OCCURRENCE	HABITAT DESTRUCTION	DISTURBANCE	COLLISIONS WITH POWER LINE	ELECTROCUTION
SECRETARYBIRD <i>Sagittarius serpentarius</i>	VU	Open grassland with scattered shrubs	Low		X	X	
CAPE VULTURE <i>Gyps coprotheres</i>	EN	Grassland/Arid Savannah	Low			X	X
<b>KAROO KORHAAN</b> <i>Eupodotis vigorsii</i>	NT	Open Plains/Karoo Shrubland	Likely	X	X	X	
MARTIAL EAGLE <i>Polemaetus bellicosus</i>	VU	Woodland/Savannah	Low		X	X	X
<b>BLACK HARRIER</b> <i>Circus maurus</i>	EN	Fynbos shrubland and agricultural land	likely	X	X		
<b>BLUE CRANE</b> <i>Anthropoides paradiseus</i>	NT	Croplands, pastures cultivated lands. Wetlands and Grasslands	High		X	X	
<b>DENHAM'S BUSTARD</b> <i>Neotis denhami</i>	VU	Arable land/wetland	Highly likely	X	X	X	

\*NT= Near Threatened; VU=Vulnerable; EN= Endangered

### *Secretarybird*

Secretarybirds roost and nest in trees (optimal heights range from 4-15 metres) and areas with these breeding requirements are important for local populations (Herholdt and Anderson 2006). As the majority of the site has an absence of trees, apart from a series of drainage lines, this may account for the limited sightings of this species. Secretarybirds are also very sensitive to disturbances such as habitat degradation due to overgrazing and anthropogenic activities and they generally avoid these areas. As the study area falls within a highly disturbed agricultural landscape this may account for the low reporting rate of this species within this landscape. This species was not recorded during the site visit.



**Photograph 4. Secretarybird (*Sagittarius serpentarius*) (Images extracted from Hockey et al. 2011).**

### *Cape Vulture and Martial Eagle*

There were no sightings of the Cape Vulture and Martial Eagle during the site visit. The SABAP2 reporting rate for both species within the pentad was very low and this was further supported by the lack of suitable habitats. Furthermore, the availability of nest sites and suitable habitat is often a limiting factor for both species. *P. bellicosus* build their nests in large trees (ranging from 6-20 metres high) and the lack of large trees within the study area may account for the limited sightings of Martial Eagles. Both species also suffer from the direct (trapping and shooting) and indirect (poisoning) persecution by farmers (BirdLife International Factsheet 2010). As the study area falls within agricultural land these factors may account for the limited sightings within this landscape. There has been a decline in the population size and range of the Cape Vulture over the past decade (Jenkins, 2010).

The Cape Vulture is susceptible to mortalities associated with power line infrastructure (Collisions and electrocutions) and this has had a negative impact on the population dynamics. As power line infrastructure continue to expand into a variety of habitats within South Africa, it is likely to add further pressure to existing populations. Through the alteration of power line tower designs, electrocution risks have been reduced but mortalities resulting from collisions with power lines are still a cause for concern. Due to the limited length of the associated loop-in loop out lines, coupled with the study areas position in a largely cereal production dominated landscape, it is unlikely that regional populations of Cape Vulture and Martial Eagles will be impacted by the proposed project.



**Photograph 5. Cape Vulture (*Gyps coprotheres*) (A) and Martial Eagle (*Polemaetus bellicosus*) (B). (Images extracted from Hockey et al. 2011).**

*Black Harrier*

The Black Harrier is a ground nesting species and is expected to move through the study area. This species favours habitats close to water and damp vegetation close to pans. The Black Harrier was only recorded on the eastern boundary of the study area and the flight path was in the direction of the National Park. This area has large sections of natural Renosterveld vegetation. Although this species forages within agricultural landscapes they require untransformed Renosterveld habitat for breeding (BirdLife SA). This may account for the confined sightings within the area. The Black Harrier is considered prone to disturbance and displacement during the construction of phase of the project.



**Photograph 6. Black Harrier (*Circus maurus*) (Images extracted from Hockey et al. 2011).**

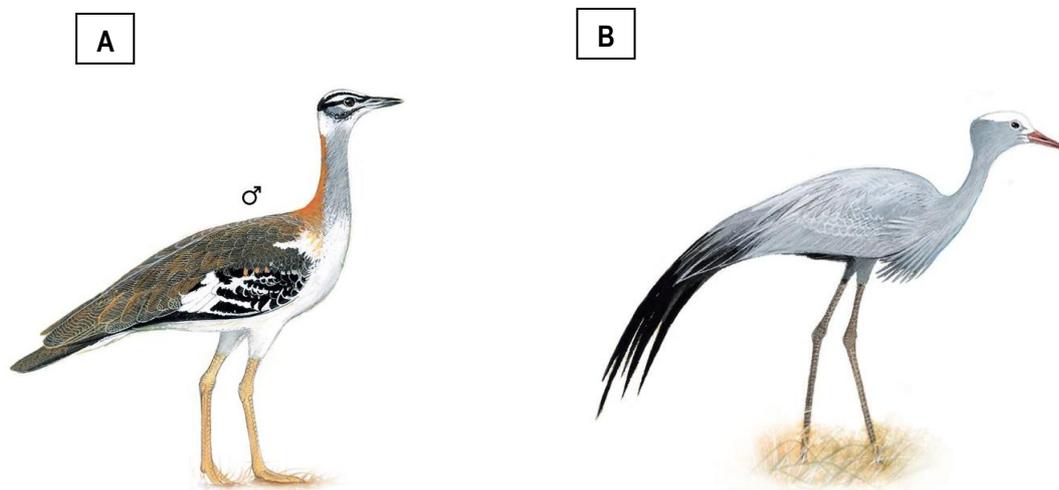
*Blue Crane and Denham's Bustard*

Blue Cranes and Denham's Bustard were recorded within the southern and eastern sections of the proposed study area. Both species are vulnerable to collisions with power lines (Allan 1996b). The existing 400kV power line is located within the northern section of the study area and may account for the limited sightings within its proximity. The core distribution of Blue Cranes in South Africa is located in croplands of the Western Cape and populations are increasing within the Swartland area (Young et al. 2003). The study area falls within the Overberg Wheat Belt and this Important Bird Area (IBA) contains 30% of South Africa's Blue Crane population.

This was confirmed during the site visit with groups of 20-30 individuals observed within the agricultural landscape.

Both species are susceptible to collisions with power lines due to their low mobility when in flight, inability to take evasive action (as stated previously with bustard species), and low altitude flight patterns when moving between feeding and breeding sites. A study conducted by Shaw et al. (2010) surveyed 199km of transmission and distribution power lines within the Overberg area. 54% of all avian carcasses found were Blue Crane and the study estimated 12% of the total Blue Crane population within the Overberg area could be killed annually by collisions with power lines (Shaw et al. 2010). This study also indicated that Denham's Bustard represented the second highest mortalities within the Overberg area, attributed to collisions with power line infrastructure.

Due to the large populations of both species coupled with their susceptibility to collisions with power lines, it is imperative that appropriate mitigation measures are implemented to lessen the impact of the 132kV loop-in loop-out line associated with the project.



**Photograph 7. Denham's Bustard (*Neotis denhami*) (A) and Blue Crane (*Anthropoides paradiseus*) (B). Images extracted from Hockey et al. 2011).**

Although this assessment focuses on Red Data bird species, other less threatened species will also potentially be affected by the proposed development. Mitigation measures proposed for Red Data species will therefore also serve to protect the more common species.

## 5. SENSITIVITY ASSESSMENT

There is a correlation between the presence of Red Listed and endemic species stated above and the availability of various habitats within the study area. These important avian habitats influence the occurrence of species within a landscape providing nesting, foraging and reproductive benefits. The integration of these micro-habitats with the ability of priority species to make use of these habitats within the study site, is pivotal in predicting the sensitivity of the study area.

A sensitivity map was compiled for the study area by making use of the results of the avifaunal micro-habitat assessment in order to identify specific habitats that are more closely associated with avian impacts than others.

A large portion of the study area has been assessed as being of Low and Medium sensitivity from an avifaunal perspective. The majority of the development footprint falls within the agricultural landscape unit and is considered to be of low ecological sensitivity as a result of the homogenous nature, which has severely transformed the ecological integrity of the area coupled with anthropogenic disturbance. This is not a unique habitat within the study area and populations of Blue Crane and Denham's Bustard that utilise this area will have alternative foraging sites. Development within this area could proceed with little risk of significant post-mitigation residual impact of protected avifaunal species, provided that stated mitigation measures are enforced.

Areas of moderate sensitivity were located within the study area and are associated with the relatively intact natural Renosterveld vegetation. This natural habitat includes rocky outcrops that provide important foraging and roosting requirements for avian species. It is important that these areas are protected from degradation.

High sensitivity avifaunal habitats are associated with the riparian habitat which traverse the study area. Although this contributes a small portion of the area, they are ecologically significant and represent an important habitat for avifaunal activity and attract many species. This is largely due to the intact nature of these drainage lines and riparian zones, allowing natural avian assemblages to persist within these areas. It will be important to maintain the connectivity of the drainage lines with the main system. Agricultural practices have encroached on this habitat but it is largely unaffected. It is important that this riparian habitat is protected from degradation. The protection of this habitat will provide an important ecological corridor and refuge for avifaunal species.

Due to the size of the development coupled with the degraded nature of the site alternatives and limited sensitive areas within the study area, avifaunal populations should not be significantly affected provided that mitigation measures are implemented and the substation sites occur within the low sensitive areas as originally indicated.

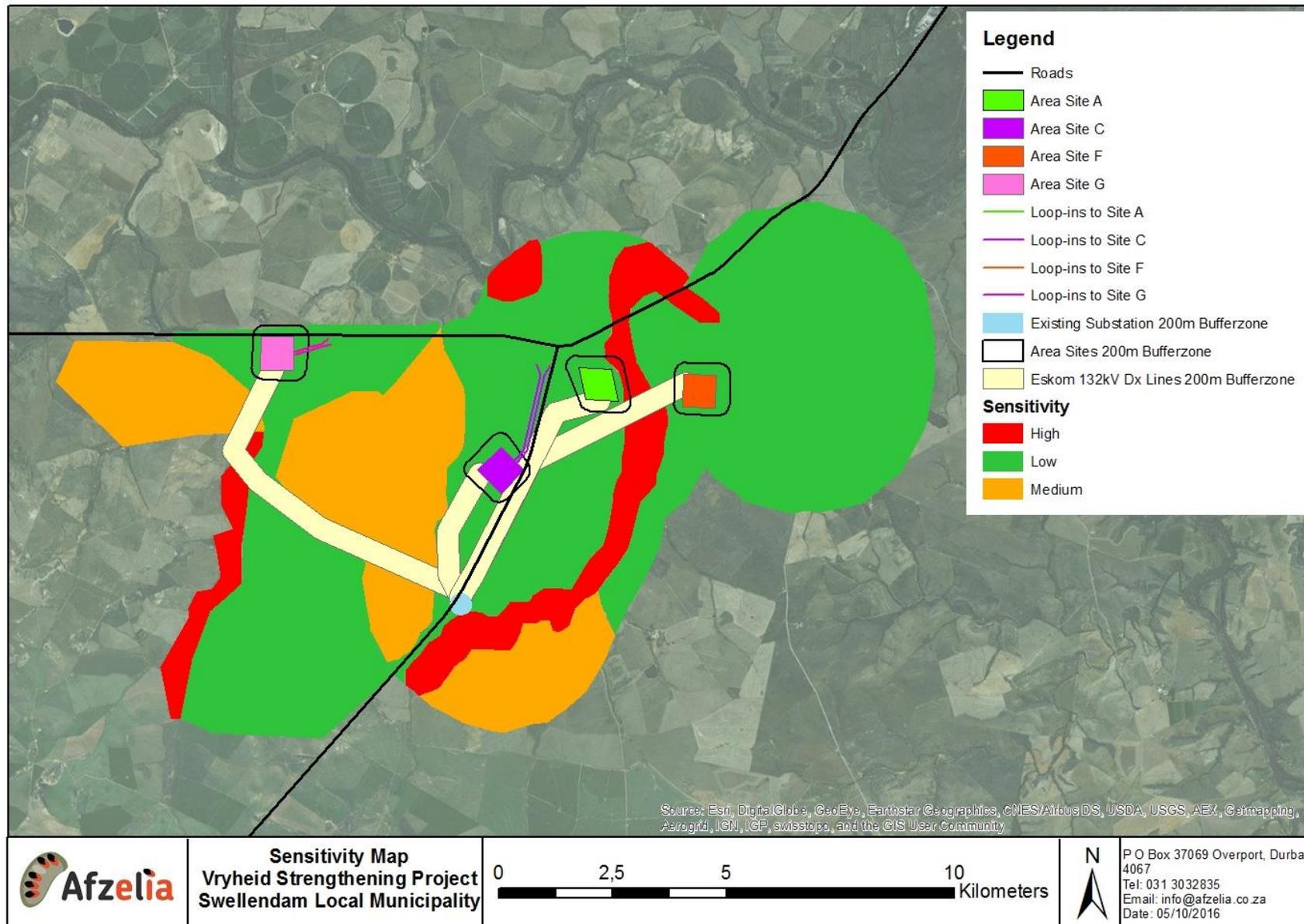


Figure 5. Sensitivity map of the study area

## 6. COMPARISON OF SITE ALTERNATIVES

### **Substation Site A:**

This is the northern substation site and is largely transformed and located next to the existing 400kV overhead power line and within close proximity to the National road (N2). The sum of impacts on avian species from the two power lines, within close proximity of one another, may be significantly lower than if these structures were separate in the landscape. The site is situated in old pasture land used for grazing and is in close proximity to human development. There are no sensitive micro-habitats within the site alternative and the site is likely to have low sensitivity for avifauna. Furthermore, the Loop-in loop-out line from the substation will be approximately 300m. The 132kV distribution power line associated with site A is 4.6km. Therefore, the total length of new power line infrastructure will be 4.9km.

### **Substation Site C:**

This is located to the west of substation Site A and is situated in old pasture land used for grazing. A farm dam micro-habitat is located within the vicinity of the site. This is the longest loop-in loop-out line and will be approximately 2039m from the substation. The 132 kV distribution power line associated with site C is 2.4km. Therefore, the total length of new power line infrastructure is 4.4km. This is the shortest line alternative. This short line alternative will pose a limited threat to the Blue Crane and Denham's Bustard population within the area, which have a high susceptibility to collision with overhead power lines in comparison to the other line alternatives.

### **Substation Site F:**

This site alternative is located on elevated landform to the east of site A. This is located within an agricultural area (Wheat production) and the existing 400kV power line and National road (N2) are located within close proximity of this site. A drainage line micro-habitat is located to the south west of the site. The loop-in loop-out line will be approximately 260m. The 132 kV distribution power line associated with site F is 5.9km. Therefore, the total length of new power line infrastructure is 6.16km. The longer power line associated with this site alternative poses an increased risk of collision to Blue Cranes and Denham's Bustard.

### **Substation Site G:**

This is the western most substation alternative. The site also falls within agricultural land (Canola cultivation) and is located adjacent to the N2. Blue Cranes were observed within close proximity to this site alternative. The loop-in loop-out line will be approximately 760m. The 132 kV distribution power line associated with site G is 6.7km. Therefore, the total length of new power line infrastructure is 7.46km. This is the longest line alternative and the longer power line associated with this site alternative poses an increased risk of collision to Blue Cranes and Denham's Bustard.

Due to the high levels of habitat transformation and disturbance levels substation site alternative A or C are preferable from an avifaunal perspective; they are unlikely to have a significant impact on avifaunal populations within the area. Both substation sites are also associated with the shortest distribution and loop-in loop-out power lines.

## 7. IMPACTS ASSOCIATED WITH THE SUBSTATION PROJECT

The implications of the proposed substation development and associated power line to resident avifaunal assemblages include:

- An area of approximately 600m x 600m of agricultural land will be altered and considered artificial, and largely unsuitable to avian species.
- During the construction phase, disturbance levels will be significantly higher in the immediate vicinity than previously. This disturbance will consist of machinery and vehicle disturbance as well as other construction activities.
- During the operational phase, there will be some vehicle activity resulting in disturbance, particularly within the road access corridor.
- Since the substation will include the loop-in loop-out overhead power lines, this will potentially pose a collision risk to avifauna, particularly heavier birds with low manoeuvrability (Bustard and Crane species).
- The substation infrastructure provides perching and nesting substrate for various avifauna, particularly crows and smaller species such as sparrows and starlings.
- There is a possibility that species such as crows/owls could be electrocuted on substation infrastructure.

### 7.1 SIGNIFICANCE OF IDENTIFIED IMPACTS

Significance scoring assesses and predicts the significance of environmental impacts through evaluation of the following factors; probability of the impact; duration of the impact; extent of the impact; and magnitude of the impact. The significance of environmental impacts is then assessed taking into account any proposed mitigations. The significance of the impact “without mitigation” is the prime determinant of the nature and degree of mitigation required. Each of the above impact factors have been used to assess each potential impact using ranking scales (**Table 2**).

Unknown parameters are given the highest score (5) as significance scoring follows the Precautionary Principle. The Precautionary Principle is based on the following statement: *When the information available to an evaluator is uncertain as to whether or not the impact of a proposed development on the environment will be adverse, the evaluator must accept as a matter of precaution, that the impact will be detrimental. It is a test to determine the acceptability of a proposed development. It enables the evaluator to determine whether enough information is available to ensure that a reliable decision can be made.*

**Table 2. Significance scoring used for each potential impact**

<b>Probability</b>	<b>Duration</b>
1 - very improbable	1 - very short duration (0-1years)
2 - improbable	2- short duration (2-5 years)
3 - probable	3 - medium term (5-15 years)
4 - highly probable	4 - long term (>15 years)
5 - definite	5 - permanent/unknown
<b>Extent</b>	<b>Magnitude</b>
1 - limited to the site	2 – minor
2 - limited to the local area	4 – low
3 - limited to the region	6 – moderate
4 - national	8 – high
5 - international	10 – very high

Significance Points = (Magnitude + Duration + Extent) x Probability.

The maximum value is 100 Significance Points.

Potential Environmental Impacts are rated as high, moderate or low significance as per the following:

<30 significance points = Low environmental significance

31-59 significance points = Moderate environmental significance

>60 significance points = High environmental significance

**Table 3. Impact assessment for the proposed substation and loop-in loop-out lines.**

<b>Impacts associated with the construction phase of the activities</b>										
Impact	Probability		Duration		Extent		Magnitude		Significance scoring without mitigation	Significance scoring with mitigation
	Without	With	Without	With	Without	With	Without	With		
<b>Construction Phase</b>										
Habitat Destruction	5	4	5	5	2	1	8	6	75 (high)	48 (moderate)
Disturbance to birds	5	4	2	2	2	1	6	4	50 (moderate)	28 (low)
<b>Operational Phase</b>										
Electrocution on substation infrastructure	2	1	5	5	1	1	4	2	20 (low)	8 (low)
Electrocution loop-in loop-out power line	3	2	4	4	2	2	6	4	36 (moderate)	20 (low)
Collisions with power line (Site A)	4	3	4	4	2	1	8	6	56 (moderate)	30 (moderate)

Collisions with power line (Site C)	4	3	4	4	2	1	8	6	56 (moderate)	30 (moderate)
Collisions with power line (Site F)	4	3	4	4	2	1	8	6	56 (moderate)	33 (moderate)
Collisions with power line (Site G)	4	3	4	4	2	1	8	6	56 (moderate)	33 (moderate)

## 7.2 CONSTRUCTION PHASE IMPACTS

### Habitat Destruction

During the construction phase and maintenance of substations and power lines, some habitat destruction and alteration will occur due to the clearing of servitudes and vegetation at the substation site. These activities have an impact on foraging, breeding and roosting ecology of avian species within the area through modification of habitat. The continual clearing of servitudes will have the effect of altering bird community structure along the length of the power line (Kind and Byers, 2002).

It is not envisaged that any Red Data species will be displaced by the habitat transformation that will take place as a result of the construction of the proposed substation. The impact on smaller, non-Red Data species that are potentially breeding in the area will be local in extent, in that it will not have a significant effect on regional or national populations.

The habitat is already largely transformed and fragmented by agricultural land. Furthermore, this is not a unique habitat within the landscape. The construction of the proposed transmission substation should therefore have a low displacement impact from an avifaunal perspective.

### Recommended Mitigation

- All construction and maintenance activities must be carried out according to the generally accepted environmental best practice and the temporal and spatial footprint of the development should be kept to a minimum. In particular, care must be taken in the vicinity of the drainage lines and existing roads must be used as much as possible for access during construction.
- The boundaries of the development footprint areas are to be clearly demarcated and it must be ensured that all activities remain within the demarcated footprint area. Special care must be taken in sensitive avifaunal micro-habitats such as drainage lines, pans and natural Renosterveld.
- Provide adequate briefing for site personnel.
- Any bird nests that are found during the construction period must be reported to the Environmental Control Officer (ECO).
- The above measures must be covered in a site specific EMP and controlled by an ECO.

## **Disturbance and displacement**

The disturbance of avifauna during the construction and operation of the substation will occur. This is an indirect impact that will affect the movement and distribution of avian species surrounding the power line corridor, particularly during the construction of the proposed project. The avoidance of these areas by avian species will impact the breeding and foraging characteristics of affected bird species. Species sensitive to disturbance are ground-nesting species resident within the development footprint. Disturbance can also influence the community structure of avifauna within close proximity to the development as certain species will be displaced and forced to find alternative territories. Avian species with small territories are particularly susceptible. Disturbance can also influence the community structure of avifauna within close proximity to the development as certain species will be displaced and forced to find alternative territories. Disturbance could have a negative impact on the breeding activities of various species, particularly if this occurs during a sensitive period in the breeding cycle.

Species of concern include Karoo Korhaan (*Eupodotis vigorsii*), Black Harrier (*Circus maurus*) and Blue Cranes (*Anthropoides paradiseus*). The Black Harrier often breed in damp vegetation in close proximity to wetlands or watercourses and Blue Cranes often breed on open ground near a water source (Hockey *et al.* 2006). These species will be sensitive to disturbance and habitat loss due to the construction of the proposed overhead power lines. Both the Black Harrier and Blue Cranes prefer habitats in close proximity to water sources (Hockey *et al.* 2006).

The proposed site alternatives are located within an agricultural habitat close to national and regional roads as well as the Vryheid Substation. Therefore, species within this landscape often experience disturbance. As a result, disturbance of birds by the proposed substation is anticipated to be of low significance as birds will move away from the area temporarily. The relatively small scale of the development (in relation to the large agricultural landscape) is unlikely to have a significant impact on avifauna. However, species are particularly sensitive to disturbance during the breeding season and this must be borne in mind during both the construction and operational (maintenance) phases.

## **Recommended Mitigation**

- Strict control must be maintained over all activities during construction, in line with an approved Construction EMPr.
- During Construction, if any of the Red Data species identified in this report are observed to be roosting and/or breeding in the vicinity, the ECO must be notified.
- The construction camps must be as close to the site as possible.
- Contractors and working staff should stay within the development footprint and movement outside these areas including avian micro-habitats must be restricted.
- Driving must take place on existing roads and a speed limit of 30km/h must be implemented on all roads running through the study area during all phases.

## 7.3 OPERATIONAL PHASE IMPACTS

### **Electrocution of birds on substation infrastructure**

Since there is live hardware in the substation yard, the potential exists for birds to bridge the gap between two phases or a phase and earth resulting in electrocution. However, very few electrocutions have been recorded on transmission substations. Species likely to be affected are crows and other species that are tolerant of disturbance. Small raptors such as Lanner Falcons are sometimes attracted into substation yards in pursuit of species nesting there such as sparrows and canaries.

The impact assessment found the impact of electrocution on substation infrastructure to be of low significance once mitigation in the form of bird friendly structures and bird deterrent measures have been put in place. Species likely to be affected are crows and other non-threatened species with the majority of threatened species (Denham's Bustard and Blue Cranes) avoiding the substation yard as they are sensitive to disturbances.

### **Recommended Mitigation**

- A "Bird Friendly" monopole structure, with a bird perch (as per standard Eskom guidelines) should be used for the tower structures.
- All relevant perching surfaces should be fitted with bird guards as deterrents

### **Electrocution of birds caused by the loop-in loop-out power line**

Electrocution<sup>3</sup> of birds on associated overhead power lines is an important cause of mortality for a variety of bird species particularly storks, cranes and raptors in South Africa (Van Rooyen & Ledger 1999). Electrocution occurs when a bird 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 risk of electrocution is influenced by the voltage and the design of the tower structure coupled with the size of the bird species. Large species such as Vultures and Eagles are large enough to bridge the gap between two live phases.

The impact of electrocution will be of high significance, and medium significance after the mitigation in the form of bird friendly structures.

### **Recommended Mitigation**

- A "Bird Friendly" monopole structure, with a bird perch (as per standard Eskom guidelines) should be used for the tower structures.
- All relevant perching surfaces should be fitted with bird guards and perch guards as deterrents (Hunting 2002). This must be conducted as per Eskom standard guidelines.
- Installation of artificial bird space perches and nesting platforms, at a safe distance from energised components (Goudie 2006; Prinsen et al. 2012).

---

<sup>3</sup> 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).

## **Collisions with the power line**

Collisions are the biggest single threat posed by overhead power lines to birds in southern Africa (van Rooyen 2004). Larger bird species such as bustards, storks, flamingos, cranes and raptors are highly susceptible to power line collisions (**Appendix 2**). These species often collide with the earth wire as it is not highly visible. These species are mostly heavy-bodied species with limited manoeuvrability and are not sufficiently mobile to take the necessary evasive action to avoid colliding with power lines (Anderson 2001; Van Rooyen 2004, Jenkins and Smallie 2009). This impact is further exacerbated as they tend to fly between foraging bouts and roosting sites within the elevation ranges of both high and low voltage power lines. Many of the collision sensitive species are considered threatened in southern Africa.

Areas that are regularly used by “collision prone” species for feeding, roosting or areas located along commonly used flight paths increases the risk of collisions. As a result, power line corridor selection is crucial in mitigating the negative impacts of this infrastructure of large avian species.

The Red Data species that are vulnerable to power line collisions are generally long living, slow reproducing species. Various species require specific conditions for breeding, resulting in limited successful breeding attempts. Due to these breeding requirements these species have not evolved to cope with high adult mortality. Therefore, regularly high adult mortality over prolonged periods could have a will have an effect on species population dynamics.

The potential collision of avian species with the power line earth wire is considered the most significant impact pertaining to avifauna within the project area. It is predicted that this impact will have a moderate negative impact prior to the implementation of mitigation measures. This is due to the presence of collision prone species including Denham’s Bustard and Blue Crane and to a lesser extent Karoo Korhaan. Both species mentioned have been recorded within the top ten avian species in South Africa prone to collisions with overhead powerlines. The impact assessment found this risk to be of medium significance. However, this is directly related to the length of the power line.

As would be expected the longer the power line, the higher the probability of larger birds colliding with the power line. This is compounded when the power line traverses important avifaunal micro-habitats and flight paths.

The impact assessment found the risk of collision with the power line at site alternative A and C to be of moderate significance after mitigation as these sites require the shortest power line (4.9km and 4.4km respectively) thus reducing the risk of collision. Site alternatives F and G require an overhead power line length approximately 6.16km and 7.46km respectively. The increased length coupled with the presence of Red Data species increases the impact of the proposed development. Furthermore, these site alternatives are in close proximity with important avifaunal micro-habitats (particularly the large drainage line), the disturbance and degradation of which will compound the negative impact on avifauna within the area.

## **Recommended Mitigation**

In order to mitigate for collision prone species, it is imperative that earth wires crossing important avian habitats are fitted with anti-collision marking devices to increase the visibility of the power line and reduce likelihood of collisions. These must be Eskom approved anti-collision devices that are durable as the area is prone to strong winds. Anti-collision devices must be installed as soon as the wires are strung.

EBM Flapper and the Tyco Flight Diverter are approved bird flight diverters which are currently used by Eskom (Transmission Bird Collision Guideline 2014; Distribution Technical Bulletin 2009).

The devices must be installed 5m apart and alternate between a light and dark colour in order to increase the visibility of the earth wires. Furthermore 100% of the identified spans must be marked with devices as collision probability is equally possible along the entire span (Shaw 2013). According to Shaw (2013), marking of only 60% of the line may divert collision prone species to the unmarked portions of the line.



Photograph 8. Static Helical bird flight diverter and a mobile bird flapper device

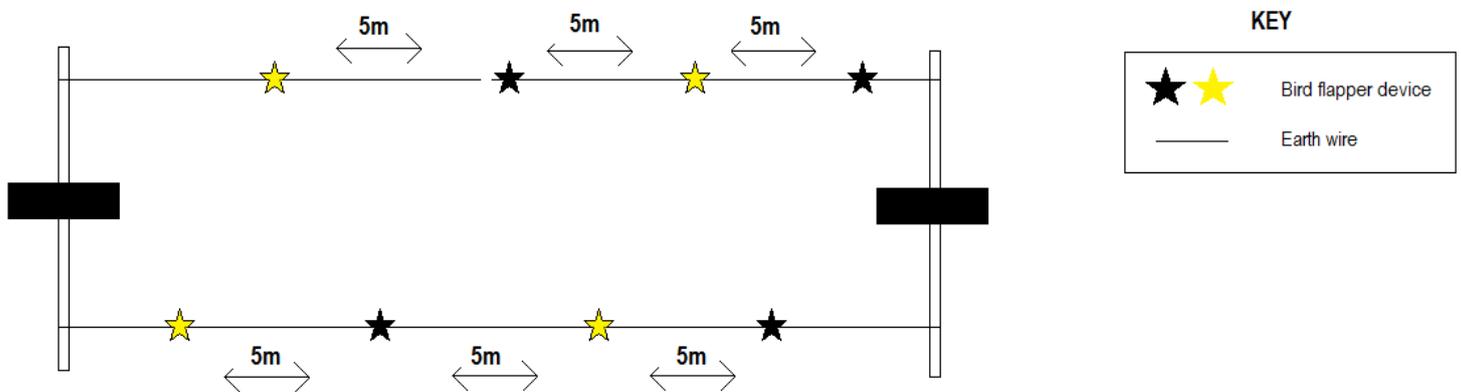


Figure 6. Technique and guideline for marking of the earth wire with bird flapper devices (Adapted from Vosloo et al. 2014).

## 8. CONCLUSION

As long as alternative A is chosen for the proposed construction of the new Eskom Agulhas 400/132kv 2x500 MVA Transmission Substation and Loop-in loop-out lines, only a limited threat to the birds occurring in the vicinity of the new infrastructure is likely to occur. This is largely due to the extensive impacts already evident at the site, the homogenous nature of the site and the shorter length of the proposed power line alternative. The impact of displacement due to habitat transformation will also only be low, and should only affect a few non-Red Data species at a local level. Furthermore, this site would require the shortest loop-in loop-out line from the substation reducing the risk of electrocution to avifaunal species and collisions with the power line.

Substation site A and C are the preferred sites for the proposed development from an avifaunal perspective. These sites are in close to the existing power line and other human development and as a result is already highly transformed. The sites have few micro-habitats within the area and will not have a negative impact on avian species richness and abundance due to habitat loss.

## 9. REFERENCES

- Anderson, M.D. 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Draft report to Eskom Resources and Strategy Division. Johannesburg. South Africa.
- Allan, D.G. 1996b. Population structure and breeding habits of the Blue Crane *Anthropoides paradiseus* in the Western Cape Province and Karoo, South Africa. In Beilfuss R et al. (eds), *The African Crane and Wetland Training Workshop*, Maun, Botswana, 1993. International Crane Foundation pp. 355-376.
- Barnes, K.N. (ed.) 2000. *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*. BirdLife South Africa: Johannesburg.
- Goudie, R.I., 2006. *Effects of powerlines on birds*. Harlequin Enterprises. St. John's, Newfoundland.
- Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tee, A.J., Parker, V., Brown, C.J (eds). 1997. *The atlas of southern African Birds*. Vol. 1 & 2. BirdLife South Africa: Johannesburg.
- Hunting, K., 2002. *A roadmap for PIER research on avian power line electrocution in California*. California Energy Commission, California.
- 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.
- King, D.I., Byers, B.E. 2002. An evaluation of power line rights-of-way as habitat for early-successional shrubland birds. *Wildlife Society Bulletin* 30: 868-874.
- Lehman, R.N., Kennedy, P.L. & Savidge, J.A. 2007. The state of the art in raptor electrocution research: a global review. *Biological Conservation* 136: 159-174.
- Marnewick MD, Retief EF, Theron NT, Wright DR, Anderson TA. 2015. *Important Bird and Biodiversity Areas of South Africa*. Johannesburg: BirdLife South Africa
- Martin, G.R., Shaw, J.M. 2010. Bird collisions with power lines: Failing to see the way ahead? *Biological Conservation*. 2695-2702
- Mucina, L., Rutherford, M.C. & Powrie, L.W. (eds) 2006. *Vegetation Map of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- Prinsen, H.A.M., Smallie, J.J., Boere, G.C., Pires, N. 2012. Guidelines on how to avoid or mitigate impact of electricity power grids on migratory birds in the African-Eurasian region. *Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) Conservation Guidelines No. 14*.
- Shaw, J.M., Jenkins, A.R., Smallie, J.J. & Ryan, P.G., 2010. Modelling power-line collision risk for the Blue Crane *Anthropoides paradiseus* in South Africa. *Ibis* 152: 590-599
- Van Rooyen, C.S. 2004a. The Management of Wildlife Interactions with overhead lines. In *The fundamentals and practice of Overhead Line Maintenance (132kV and above)*, pp217- 245. Eskom Technology, Services International, Johannesburg.

Vosloo, H.F., Cormack, R., Majola, W. 2014. Transmission Bird Collision Prevention Guideline. Eskom Transmission 1-11.

**Appendix 1.** List of bird species identified within the study area during the site visit.

COMMON NAME	SCIENTIFIC NAME	STATUS AND BIOLOGY	HABITAT
Karoo Prinia	<i>Prinia maculosa</i>	Near-Endemic	Fynbos, thickets, Karoo scrub
Pied Starling	<i>Spreo bicolor</i>	ESLS	Grassland and Karoo scrub
Black Harrier	<i>Circus maurus</i>	Vulnerable	Fynbos, Karoo scrub and agricultural land
African Sacred Ibis	<i>Threskiornis aethiopicus</i>	Common resident	Wetlands, fields and grasslands
African Pipit	<i>Anthus cinnamomeus</i>	Common resident and local nomad	Open grasslands and fields
Rock Kestrel	<i>Falco rupicolus</i>	Common resident and local nomad	Grassland, scrub and open woodland
Black-shouldered Kite	<i>Elanus caeruleus</i>	Common resident and local nomad	Savannah, grassland and agricultural areas
Cape Bulbul	<i>Pycnonotus capensis</i>	Endemic	Fynbos and coastal scrub
Jackal Buzzard	<i>Buteo rufofuscus</i>	Near-Endemic	Karoo scrub, grassland and agricultural land
Familiar Chat	<i>Cercomela familiaris</i>	Common resident and local nomad	Mountainous terrain and farmlands
Cape Spurfowl	<i>Pternistis capensis</i>	Near-Endemic	Lowland Fynbos, fields, riparian thickets
Helmeted Guineafowl	<i>Numida meleagris</i>	Common resident	Grassland, savannah and fields
Cape Grassbird	<i>Sphenoeacus afer</i>	Near-Endemic	Fynbos and rank grass (near water)
Blue Crane	<i>Anthropoides paradiseus</i>	Resident and local nomad	Agricultural lands
Common Fiscal	<i>Lanius collaris</i>	Common resident	Open habitats
Bokmakierie	<i>Telophorus zeylonus</i>	Common resident, shrublands and Strandveld	Shrublands, Strandveld and scrublands
Blacksmith Lapwing	<i>Vanellus armatus</i>	Common resident and nomad	Wetland margins, grasslands and fields
Speckled Pigeon	<i>Columba guinea</i>	Common resident	Rocky areas, fields and grasslands
Cape Turtle-dove	<i>Streptopelia capicola</i>	Abundant resident and nomad	Wide range of habitats, avoids forests
Laughing Dove	<i>Streptopelia senegalensis</i>	Abundant resident and nomad	Wide range of habitats, avoids forests
Cape Weaver	<i>Ploceus capensis</i>	Near-Endemic	Grassland and scrub
Red-capped Lark	<i>Calandrella cinerea</i>	Common resident, intra-African migrant	Grass areas and croplands

COMMON NAME	SCIENTIFIC NAME	STATUS AND BIOLOGY	HABITAT
Brown-throated Martin	<i>Riparia paludicola</i>	Common resident and Local migrant	Range of habitats, roosts in reeds
Pied Crow	<i>Corvus albus</i>	Common	Virtually all habitats
Cape Crow	<i>Corvus capensis</i>	Common	Cultivated fields and dry, desert regions
Streaky-headed Seedeater	<i>Crithagra gularis</i>	Common resident	Woodlands, thickets and dense scrub
Southern Boubou	<i>Laniarius ferrugineus</i>	Common resident	Forest edge, thickets and coastal scrub
Neddicky	<i>Cisticola fulvicapilla</i>	Common resident	Savannah and mountain Fynbos
Grey-backed Cisticola	<i>Cisticola subruficapilla</i>	Common resident	Lowland Fynbos and Karoo scrub
Cape Sparrow	<i>Passer melanurus</i>	Common resident in grasslands, fields and gardens	Grassland, fields and gardens
Cape Canary	<i>Serinus canicollis</i>	Common resident in Fynbos, grassland and coastal dunes	Fynbos, grassland and coastal dunes
Yellow canary	<i>Crithagra flaviventris</i>	Near-endemic	Karoo, coastal scrublands
Karoo Long-billed Lark	<i>Certhilauda subcoronata</i>	Common resident	Karoo scrub and grasslands
Little Grebe	<i>Tachybaptus ruficollis</i>	Common resident in freshwater bodies	freshwater bodies, dams, wetlands
African Darter	<i>Anhinga rufa</i>	Common resident	Lakes, dams and slow moving rivers
Grey Heron	<i>Ardea cinerea</i>	Common resident and local nomad	Pans and dams
Black-headed Heron	<i>Ardea melanocephala</i>	Common resident and local nomad	Grassland, fields and scrublands
Hamerkop	<i>Scopus umbretta</i>	Common resident	Lakes, dams, rivers and wetlands
Hadedda Ibis	<i>Bostrychia hagedash</i>	Common resident and nomad	Grassland, farmland and suburbia
Spur-winged Goose	<i>Plectropterus gambensis</i>	Common resident and local nomad	Wetlands and surrounding grasslands and fields
Egyptian Goose	<i>Alopochen aegyptiacus</i>	Common resident and local nomad	Wetlands and surrounding grasslands and fields
Cape Teal	<i>Anas capensis</i>	Locally common resident and nomad	Fresh or saline wetland systems
Peregrine Falcon	<i>Falco peregrinus</i>		
African Goshawk	<i>Accipiter tachiro</i>	Common resident	Woodlands, forests and wooded suburban areas

COMMON NAME	SCIENTIFIC NAME	STATUS AND BIOLOGY	HABITAT
Red-knobbed Coot	<i>Fulica cristata</i>	Common to abundant resident	Dams, lakes and slow flowing rivers
Denham's Bustard	<i>Neotis denhami</i>		Open grasslands and agricultural land
Karoo Korhaan	<i>Eupodotis vigorsii</i>	Endemic	Karoo scrub and open fields
Three-banded Plover	<i>Charadrius tricollaris</i>	Common resident	Fresh water bodies and wetland systems
White-rumped Swift	<i>Apus caffer</i>	Intra-African summer migrant	Open landscape near water bodies
Little Swift	<i>Apus affinis</i>	Common resident and partial migrant	Wide range of habitats
Speckled Mousebird	<i>Colius striatus</i>	Common resident and nomad	Thicket, riparian woodland and forest edges
African Hoopoe	<i>Upupa africana</i>	Common resident and local nomad	Savannah, woodlands and suburban gardens
African Stonechat	<i>Saxicola torquatus</i>	Common resident with winter movement patterns	Grasslands, fynbos and scrublands
Zitting Cisticola	<i>Cisticola juncidis</i>	Common resident	Grassland and fields
Cape Longclaw	<i>Macronyx capensis</i>	Endemic	Moist grasslands
Red-capped Lark	<i>Calandrella cinerea</i>	Common resident and intra-African migrant	Short grassy areas and croplands
Fork-tailed Drongo	<i>Dicrurus adsimilis</i>	Common resident	Savannah, plantations, suburbia
White-necked Raven	<i>Corvus albicollis</i>	Locally common resident	Wide variety of habitats
Cape Batis	<i>Batis capensis</i>	Endemic	Riparian thickets, woodlands and well wooded gardens
Fairy Flycatcher	<i>Stenostira scita</i>	Endemic	Karoo and migrates to Acacia savannah
Cape Wagtail	<i>Motacilla capensis</i>	Common resident	Wetlands and suburban gardens
Common Starling	<i>Sturnus vulgaris</i>	Common resident	Towns and farmlands
Red-winged Starling	<i>Onychognathus morio</i>	Common resident	Rocky ravines, cliffs and suburbia
Southern Red Bishop	<i>Euplectes orix</i>	Common, flock-feeding resident	Grassland, savannah and fields
Yellow Bishop	<i>Euplectes capensis</i>	Common resident	Damp, grassy areas
Swee Waxbill	<i>Coccygia melanotis</i>	Endemic	Forest edge, wooded areas and gardens
Common Waxbill	<i>Estrilda astrild</i>	Common resident	Reeds and scrubland near water

COMMON NAME	SCIENTIFIC NAME	STATUS AND BIOLOGY	HABITAT
Malachite Sunbird	<i>Nectarinia famosa</i>	Common resident and local migrant	Fynbos, grasslands and mountain scrub
Cape Canary	<i>Serinus canicollis</i>	Endemic	Fynbos, grasslands and gardens
Brimstone Canary	<i>Crithagra sulphuratus</i>	Common resident	Thickets and gardens
Cape Bunting	<i>Emberiza capensis</i>	Near-Endemic	Rocky hillslopes with bushes and shrubs
Cape White-eye	<i>Zosterops virens</i>	Endemic	Woodlands, thickets, plantations and gardens

\*ESLS- Endemic to South Africa, Lesotho and Swaziland

**Appendix 2.** Collision prone species in South Africa (Extracted from Jenkins *et al.* 2010).

