JUNE 2017

SHONGWENI SUBSTATION & THE ASSOCIATED HECTOR-SHONGWENI 275KV POWER LINES

AVIFAUNAL IMPACT ASSESSMENT REPORT

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PROFESSIONAL EXPERIENCE

Megan completed a Bachelor of Science degree in Environmental Management from the University of South Africa and has been involved in conservation for 18 years. She has ten years' experience in the field of bird interactions with electrical infrastructure (both linear and footprint) and during this time has completed specialist avifaunal impact assessments for over 80 projects. In various roles (including Programme Manager) with the Endangered Wildlife Trust's Wildlife & Energy Programme and the Programme's primary project (Eskom-EWT Partnership) from 2006 to 2013, Megan was responsible for assisting the energy industry and the national utility in minimising the negative impacts (associated with electrical infrastructure) on wildlife through the provision of strategic guidance, risk and impact assessments, training and research. Megan currently owns and manages *Feathers Environmental Services* and is tasked with providing strategic guidance to industry through the development of best practice procedures and guidelines, reviewing and commenting on methodologies, specialist studies and EIA reports for Renewable Energy projects as well as providing specialist avifaunal input into various developments including renewable energy facilities, power line, power station and substation infrastructure in addition to railway infrastructure and residential properties within South Africa and elsewhere within Africa. In addition, Megan has attended and presented at several conferences and facilitated workshops, as a subject expert, since 2007. Megan is a co-author of the *BirdLife South Africa / Endangered Wildlife Trust best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa* and the *Avian Wind Farm Sensitivity Map for South Africa* (2015) and played an instrumental role in facilitating the endorsement of these two products by the South African Wind Energy Association (SAWEA), IAIAsa (International Association for Impact Assessment South Africa) and Eskom. In 2011/2012, she chaired the Birds and Wind Energy Specialist Group in South Africa. From 2013 to 2015, Megan chaired the IUCN/SSC Crane Specialist Group's Crane and Powerline Network, a working group comprised of subject matter experts from across the world, working in partnership to share lessons, develop capacity, pool resources, and accelerate collective learning towards finding innovative solutions to mitigate this impact on threatened crane populations.

DECLARATION OF INDEPENDENCE

I, **Megan Diamond**, in my capacity as a specialist consultant, hereby declare that I:

* Act as an independent specialist to Nsovo Environmental Consulting for this project.
* Do not have any personal or financial interest in the project except for financial compensation for specialist investigations completed in a professional capacity as specified by the Amendment to Environmental Impact Assessment Regulations, 2017.
* Will not be affected by the outcome of the environmental process, of which this report forms part of.
* Do not have any influence over the decisions made by the governing authorities.
* Do not object to or endorse the proposed developments, but aim to present facts and our best scientific and professional opinion with regard to the impacts of the development.

* Undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Amendment to Environmental Impact Assessment Regulations, 2017.

INDEMNITY

* This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken.
* This report is based on a desktop investigation using the available information and data related to the site to be affected, a one-day site visit to the study area conducted on 19 April 2017 and 22 May 2017 in addition to a helicopter fly-over, conducted on 23 May 2017 (autumn surveys). No long-term investigation or monitoring has been conducted.
* The Precautionary Principle has been applied throughout this investigation.
* The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information at the time of study.
* Additional information may become known or available during a later stage of the process for which no allowance could have been made at the time of this report.
* The specialist investigator reserves the right to modify this report, recommendations and conclusions at any stage should additional information become available.
* Information, recommendations and conclusions in this report cannot be applied to any other area without proper investigation.
* This report, in its entirety or any portion thereof, may not be altered in any manner or form or for any purpose without the specific and written consent of the specialist investigator as specified above.
* Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.

29 June 2017

EXECUTIVE SUMMARY

In order to fulfil their mandate of providing a high-quality supply of electricity to support annual load growth and improve the operational flexibility of the existing network, Eskom Transmission proposes to construct two 275kV single circuit power lines (to be constructed with 400kV specifications), connecting the existing Hector Substation to the proposed Shongweni 500 MVA 400/132kV substation. The development of the proposed power lines will de-load the Hector-Klaarwater 275kV lines and the Klaarwater Substation. The project is located within the eThekwini Metropolitan Municipality in the KwaZulu Natal province.

A fairly wide diversity of species (346 species) could be found in the broader area within which the proposed study area is located based on existing data sources. The presence of these species in the broader area provides an indication of the diversity of species that could potentially occur within the areas earmarked for the proposed developments, particularly where pockets of natural vegetation/habitats persist. Of the 346 species, 22 of these are considered to be of conservation concern i.e. Red Data species. With the exception of African Crowned Eagle, Lanner Falcon, and Pink-backed Pelican, the majority of Red Data species (n=19) have been recorded in low numbers, with less than 30 individuals of each species being recorded over the ten-year survey period in the broader study area. The report rates for these species (and others) are significantly lower within the confines of the project boundary. The low report rates for these species could possibly be attributed to the fact that not all of the pentad grid cells have been surveyed equally and extensively, or perhaps more likely a result of the fairly high levels of disturbance caused by the surrounding land use practices. The significant disturbance and habitat loss experienced in the study area is undoubtedly displacing various birds that would, under optimum conditions, inhabit these areas.

The study area extends over five vegetation, two of which feature more prevalently, namely the Savanna biome, comprised of KwaZulu-Natal Sandstone Sourveld and the Grassland biome, comprised of Dry Coast Hinterland Grassland and Moist Coast Hinterland Grassland. The most sensitive of the micro habitats within the study areas are the rivers, wetlands, waterbodies and woodland vegetation which may provide foraging, roosting and breeding habitat for the waterbird, raptors and passerine species recorded in the area. Grassland areas may support the large terrestrial species which are vulnerable to collision with the power line earthwires and/or conductors. The likelihood of Red List avifaunal species frequenting the study area is considered to be low. As a result, the impacts of the proposed project could be more important for the more common bird species, which are generally more tolerant of human disturbance and hence more likely to regularly make use of this site. The habitat within which the proposed study area is located is low to moderately sensitive from a potential bird impact perspective.

Based on a qualitative and quantitative analysis **SUBSTATION SITE G** and **CORRIDOR 3** emerged as the preferred substation site and power line corridor respectively from a bird impact assessment perspective. Given the presence of existing habitat degradation and disturbance, it is anticipated that the proposed Shongweni substation

and Hector-Shongweni 275kV power line can be constructed within the study area with acceptable levels of impact on the resident avifauna subject to the following recommendations:

- Selecting Substation Site G and Corridor 3 for the proposed developments.
- An avifaunal walk-through of the final power line route must be conducted to identify Red List species that may be breeding within the power line corridor to ensure that the impacts to breeding species (if any) are adequately managed.
- High risk sections of power line must be identified by a qualified avifaunal specialist during the walk-through phase of the project, once the alignment has been finalized. Bird flight diverters must be installed on according to Eskom guidelines.
- 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 avifaunal species.
- Maximum use of existing access roads and the construction of new roads should be kept to a minimum.
- The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned.
- In addition to this, the normal suite of environmental good practices should be applied, such as ensuring strict control of staff, vehicles and machinery on site and limiting the creation of new roads as far as possible.

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1. INTRODUCTION

As the largest producer of electricity in South Africa, Eskom Holdings SOC (hereinafter referred to as Eskom) also transmits electricity via a transmission network, which supplies electricity at high voltages to a number of key customers and distributors. Significant lengths of new transmission power lines and their associated substations are being added to grid annually. These additions are mainly due to the major network reinforcements required for the supply to the key provinces, the integration of the new power stations and to support the increase in load demand of the customers, that are often located some distance away from the main load centres.

In order to fulfil their mandate of providing a high-quality supply of electricity to support annual load growth and improve the operational flexibility of the existing network, Eskom Transmission proposes to construct two 275kV single circuit power lines (to be constructed with 400kV specifications), connecting the existing Hector Substation to the proposed Shongweni 500 MVA 400/132kV Substation. The development of the proposed power lines will de-load the Hector-Klaarwater 275kV lines and the Klaarwater Substation. The project is located within the eThekwini Metropolitan Municipality in the KwaZulu Natal province (FIGURE 1).

The National Environmental Management Act (NEMA) (Act 107 of 1998) requires that an impact assessment be conducted for any development which could have a significant effect on the environment, with the objective to identify, predict and evaluate the actual and potential impacts of these activities on ecological systems; identify alternatives; and provide recommendations for mitigation to minimize the negative impacts. In order to meet the Environmental Impact Assessment requirements as outlined in Regulations 21-23 of the Environmental Impact Assessment Regulations GNR 982 of 2014, Eskom require detailed specialist studies that will document any potential fatal flaws and the impacts of the project and recommend measures to manage (maximise positive and minimise negative) and monitor those impacts. Eskom Transmission has appointed Nsovo Environmental Consulting as independent environmental assessment practitioners to manage the Environmental Impact Assessment process for the proposed development. Feathers Environmental Services was subsequently appointed to compile a specialist avifaunal assessment report (based on a desktop review, a site visit conducted on two separate occasions and a helicopter fly-over) which uses a set methodology and various data sets (discussed elsewhere) to determine which avian species regularly occur within the study area, the availability of bird micro habitats (i.e. avifaunal sensitive areas) and the possible impacts of the proposed development. In general terms, the impacts that could be associated with a project of this nature include: displacement of birds as a result of habitat loss and disturbance and collision with the overhead conductors and/or earth wires.

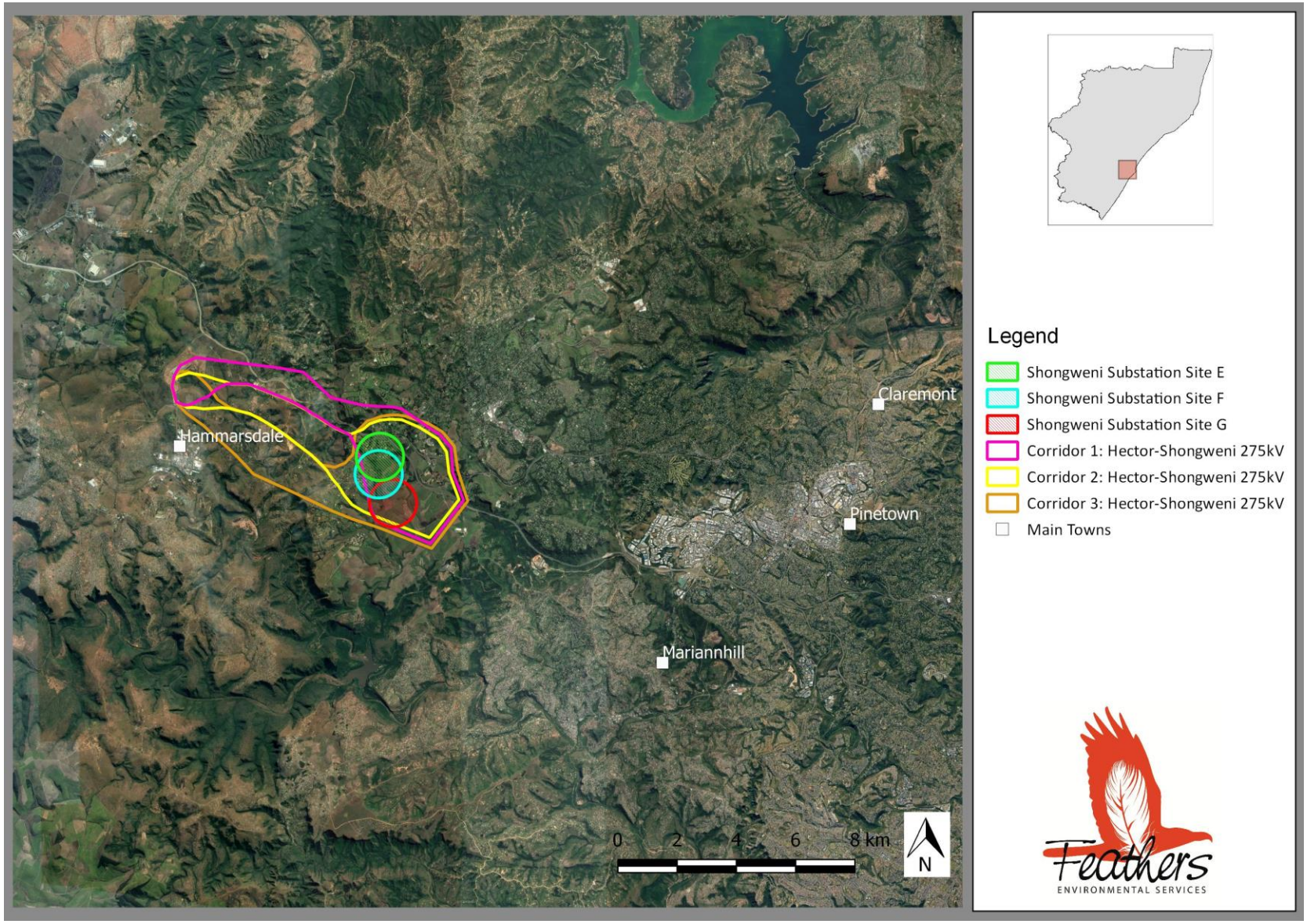

FIGURE 1: Geographical location of the proposed Shongweni substations sites and the associated Hector-Shongweni 275kV power line corridors.

2 RELEVANT LEGISLATION AND GUIDELINES

The following pieces of legislation are applicable to the proposed development:

2.1 THE CONVENTION ON BIOLOGICAL DIVERSITY

The Convention on Biological Diversity is an international convention (to which South Africa is a signatory) and represents a commitment to sustainable development. The Convention has three main objectives: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources (http://www.cbd.int/convention/guide/). Although the convention has not developed specific recommendations or guidelines pertaining to birds and railway infrastructure interactions and impacts, it does make provision (in a general policy guideline) for keeping and restoring biodiversity. In addition to this the CBD is an ardent supporter of thorough assessment procedures (Strategic Environmental Assessments (SEA) and Environmental Impact Assessments (EIA)) and requires that Parties apply these processes when planning activities that will have a biodiversity impact. An important principle encompassed by the CBD is the precautionary principle which essentially states that where serious threats to the environment exist, lack of full scientific certainty should not be used a reason for delaying management of these risks. The burden of proof that the impact will *not* occur lies with the proponent of the activity posing the threat. In addition, the Aichi Biodiversity Targets (CBD 2011) address several priority issues i.e. the loss of biodiversity and its causes; reducing direct pressure on biodiversity; safeguarding ecosystems, species and genetic diversity and participatory planning to enhance implementation of biodiversity conservation. Each of these is relevant in the case of energy infrastructure and bird conservation through all project phases from planning to the implementation of mitigation measures for existing developments.

2.2 THE CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) is an intergovernmental treaty and is the most appropriate instrument to deal with the conservation of terrestrial, aquatic and avian migratory species. The convention includes policy and guidelines with regards to the impacts associated with man-made infrastructure. CMS requires that Parties (South Africa is a signatory) take measures to avoid migratory species from becoming endangered (Art II, par. 1 and 2) and to make every effort to prevent the adverse effects of activities and obstacles that seriously impede or prevent the migration of migratory species (Art III, par. 4b and 4c). At CMS/CoP7 (2002) Res. 7.2 on Impact Assessment and Migratory Species was accepted, requesting Parties to apply appropriate SEA and EIA procedures for all proposed developments, including power lines. An agreement developed in the framework of CMS, in force since November 1999, brings the 119 Range States of the Africa Eurasian Waterbird Agreement (AEWA) region together in a common policy to protect migratory waterbirds that use the flyway from the Arctic to southern Africa.

2.3 THE AGREEMENT ON THE CONSERVATION OF AFRICAN-EURASIAN MIGRATORY WATER BIRDS

The Agreement on the Conservation of African-Eurasian Migratory Water birds (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. The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle, including many species of divers, grebes, pelicans, cormorants, herons, storks, rails, ibises, spoonbills, flamingos, ducks, swans, geese, cranes, waders, gulls, terns, tropic birds, auks, frigate birds and even the South African penguin. The core activities carried out under AEWA are described in its Action Plan, which is legally binding for all countries that have joined the Agreement. The AEWA Action Plan details the various measures to be undertaken by Contracting Parties (South Africa included) to guarantee the conservation of migratory waterbirds within their national boundaries. These include species and habitat protection and the management of human activities as well as legal and emergency measures.

2.4 THE NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT

The National Environmental Management: Biodiversity Act (No. 10 of 2004), (NEMBA) regulations on Threatened and Protected Species (TOPS) provides for the consolidation of biodiversity legislation through establishing national norms and standards for the management of biodiversity across all sectors and by different management authorities. The national Act and several sets of provincial conservation legislation provide for among other things, the management and conservation of South Africa's biodiversity; protection of species and ecosystems that necessitate national protection and the sustainable use of indigenous biological resources.

3 STUDY METHODOLOGY

3.1 TERMS OF REFERENCE

The avifaunal specialist has conducted this assessment according to the following terms of reference:

- Describe the current state of avifauna in the study area, outlining important characteristics which may be influenced by the proposed infrastructure or which may influence the proposed infrastructure during construction and operation.
- Identify Red Data and other power line sensitive (priority) species potentially affected by the proposed substation and associated power lines.
- Identify potential impacts (positive and negative, including cumulative impacts (if relevant) of the proposed development on avifauna during construction and operation.
- Rank and Identify the most suitable substation site and power line alternative for the proposed project.
- Assess the potential impact on the bird community according to the following criteria: magnitude; spatial scale; duration; reversibility; probability and significance.
- Provide a statement regarding the potential significance of the identified issues based on the evaluation of the impacts associated with the proposed development.
- Identify mitigation measures for enhancing benefits and avoiding or mitigating negative impacts and risks.
- Identify information gaps, limitations and additional information required.

» Identify and address any other aspects related to avifauna in the study area that should be incorporated into the reports.

3.2 METHODS

The following methodology was employed to compile this avifaunal assessment report:

* Various avifaunal data sets (listed below) were collected and examined to determine the location and abundance of sensitive Red Data (as well as non-Red Data) species that may be vulnerable to the impacts associated with the proposed substation and power lines construction and operational activities.
* Avifaunal sensitive areas within the study area, where the above impacts are likely to occur, were identified using various Geographic Information System (GIS) layers, Google Earth imagery and personal observations made during the site visits.
* The potential impacts of the proposed substation and power line construction and operational activities on the avifaunal community were predicted on the basis of experience in gathering and analysing data on avian impacts with various forms of linear infrastructure and developments in southern Africa since 2006 and supplemented with first hand data.
* Practical recommendations are made for the management and mitigation of potentially significant impacts.

3.3 DATA SOURCES USED

The following data sources and reports were used in varying levels of detail for this study:

* Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the Animal Demography Unit of the University of Cape Town, as a means to ascertain which species occur within the study area consisting of nine pentad grid cells within which the study areas are situated. Each pentad is approximately 8 × 7.6 km. Between 2007 and 2016, a total of 1477 full protocol cards (i.e. 1147 bird surveys lasting a minimum of two hours each) have been completed for the study area and its immediate surrounds. The relevant pentads within the study area include: 2940_3035; 2940_3040; 2940_3045; 2945_3035; 2945_3040; 2945_3045; 2950_3035; 2950_3040 and 2950_3045.
* The Southern African Bird Atlas Project 1 (Harrison *et al*, 1997) - Quarter Degree Squares 2930DC and 2930DD are relevant to this project.
* The Important Bird Areas (IBAs) report (Marnewick *et al*. 2015) was consulted to determine the location of the nearest IBAs and their importance for this study. There are no IBAs in the vicinity of the proposed development.
* The Coordinated Avifaunal Roadcount project (CAR – Young *et al*, 2003) data was consulted to obtain relevant data on large terrestrial bird report rates in the area. There are no CAR routes in the vicinity of the proposed development.
* The Co-ordinated Waterbird Count (CWAC – Taylor *et al*, 1999) data was consulted determine if large concentrations of water birds, associated with South African wetlands, may occur within the study area. There are no CWAC sites in the vicinity of the proposed development.

- The conservation status and endemism information of all bird species occurring in the aforementioned pentads was then determined with the use of the Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor et al. 2015) and the IUCN Red List of Threatened Species (http://www.iucnredlist.org/) and the most recent and comprehensive summary of southern African bird biology (Hockey et al. 2005).
- The latest vegetation classification described in the Vegetation Map of South Africa (South African National Biodiversity Institute, 2012 and Mucina & Rutherford, 2006) was consulted in order to determine which vegetation types occur on site.
- High resolution Google Earth ©2017 imagery was used to further examine the micro habitats within the study area.
- KMZ. shapefiles detailing the location of the proposed substation sites and power line corridor alternatives were provided by Nsovo Environmental Consulting.
- A field visit to the study area was conducted on 19 April 2017 in addition to a subsequent two-day site visit, conducted on 22-23 May 2017 (autumn surveys) to form a first-hand impression of the micro-habitat on site (FIGURE 1). This information, together with the SABAP2 data was used to compile a comprehensive list of species that could occur in the study area.
- Personal observations made during the aforementioned site visits to the study coupled with the author's experience gained from assessing various infrastructure development projects in the KwaZulu Natal region have been used to formulate a professional opinion of the species likely to occur in the study area and the likely impacts that the proposed development may have on the resident avifaunal community.

3.4 LIMITATIONS & ASSUMPTIONS

The author made the assumption that the sources of information used are reliable. However, it must be noted that there are limiting factors and these may potentially detract from the accuracy of the predicted results.

- The report is the result of a short-term study and is based on a site visit on two separate occasions in addition to a helicopter fly-over, to the proposed development area. No long-term monitoring was conducted by the avifaunal specialist; therefore, this assessment relies heavily upon secondary data sources with regards to bird abundances such as the SABAP1, SABAP2, IBA, CAR and CWAC projects. Although in some cases the data are more than two decades old, these comprehensive datasets provide a valuable baseline against which any changes in species presence, abundance, and distribution can be monitored. However, primary information on bird habitat was collected during the site visit and is used directly in determining which species of conservation importance are likely to occur where on site. Based on these findings, the specialist was able to assess the anticipated impacts and provide recommendations for mitigation.
- The site visits to the study area and the resultant observations were made in a single season (autumn), during which time various species may not have been present in the study area.

* The study area was defined by nine SABAP2 pentads. Although the proposed substation and associated power line alignments are located largely within a single pentad, a larger area is necessary to obtain a dataset that is comprehensive enough to ensure that reasonable conclusions about species diversity and densities, in a particular habitat type, can be drawn. Coverage by SABAP2 within the study area has been extensive with a total of 1477 full protocol data cards being completed for the broader study area and therefore the SABAP2 data is regarded as a reliable record of the avifauna likely to occur within the study area.
* Predictions in this study are based on experience of these and similar species in different parts of South Africa, through the authors' experience working in the avifaunal specialist field since 2006. However, bird behaviour can't be reduced to formulas that will hold true under all circumstances. It must also be noted that, it is often not possible to entirely eliminate the risk of the disturbance and displacement impacts associated with the activities proposed. Our best possible efforts can probably not ensure zero impact on birds. Studies such as this attempt to minimise the risk as far as possible, and although the impacts will be unavoidable, they are likely to be temporary.

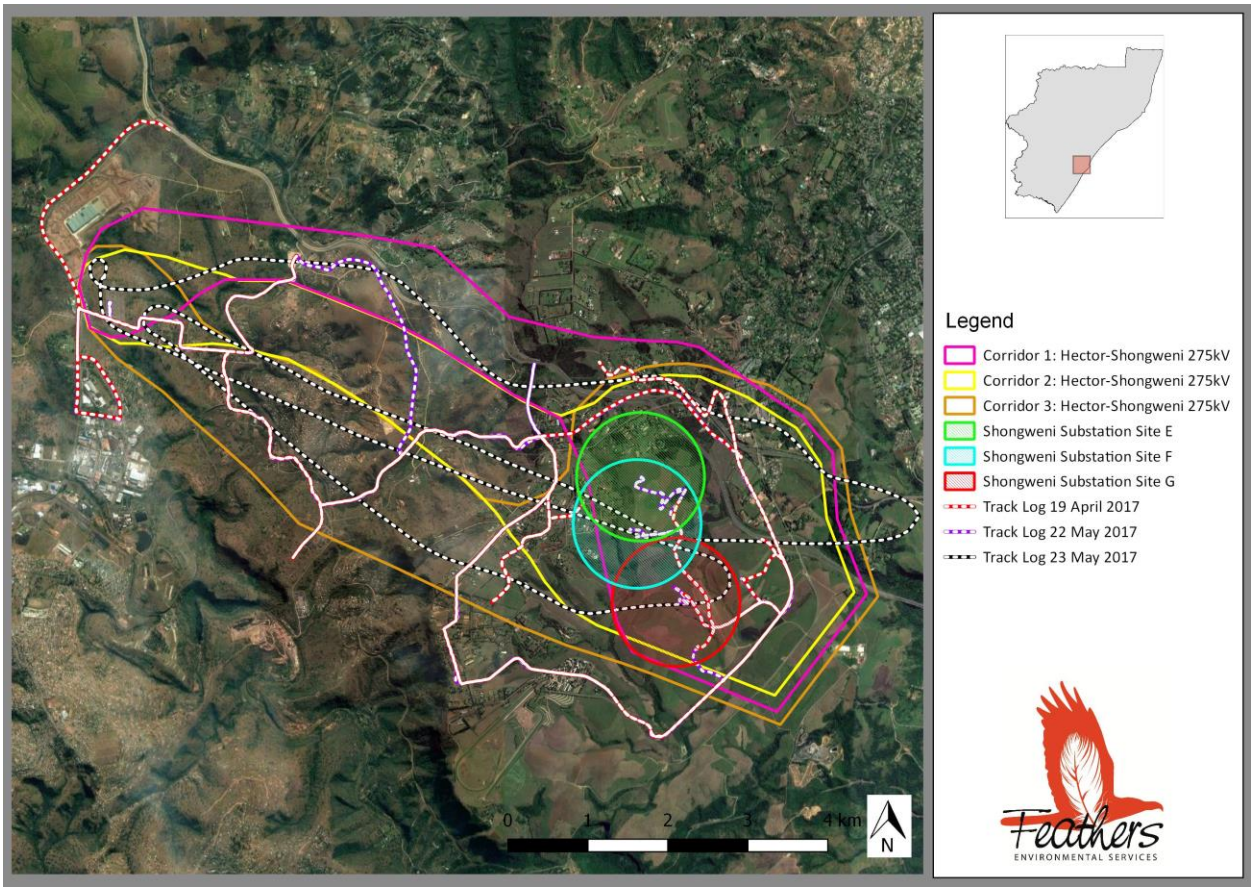

FIGURE 2: Regional map detailing the routes surveyed during the two site visits (19 April and 22 May 2017) and the helicopter fly-over conducted on 23 May 2017 of the study area.

4 DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 RELEVANT BIRD POPULATIONS

4.1.1. Important Bird Areas (IBA's)

Some sites are exceptionally important for maintaining the taxa dependent upon the habitats and ecosystems in which they occur. Vigorous protection of the most critical sites is one important approach to conservation. Many species may be effectively conserved by this means. Patterns of bird distribution are such that, in most cases, it is possible to select sites that support many species. These sites, carefully identified on the basis of the bird numbers and species complements they hold, are termed Important Bird Areas (IBAs). IBAs are selected such that, taken together, they form a network throughout the species' biogeographic distributions. IBAs are key sites for conservation – small enough to be conserved in their entirety and often already part of a protected-area network.

There are no IBA's within the immediate study area. The closest IBA to the proposed project (SA078 – KwaZulu Natal Mistbelt Grasslands) is located approximately 30km to the west (FIGURE 3). This IBA consists of a series of disconnected grassland patches on farms located in the KwaZulu-Natal Midlands (Marnewick et al, 2015) and has been declared an IBA based its breeding population of globally threatened Blue Swallows *Hirundo atrocaerulea.* In addition other, globally threatened species that occur in the IBA include Southern Bald Ibis *Geronticus calvus*, Martial Eagle *Polemaetus bellicosus*, Denham's Bustard *Neotis denhami*, Blue Crane *Anthropoides paradiseus*, Grey Crowned Crane *Balearica regulorum*, Southern Ground-Hornbill *Bucorvus leadbeateri*, Secretarybird *Sagittarius serpentarius* and Yellow-breasted Pipit *Anthus chloris*, African Marsh Harrier *Circus ranivorus*, Striped Flufftail *Sarothrura affinis* and African Grass Owl *Tyto capensis*. The distance of the IBA from the study area and the unlikely occurrence of the associated trigger species (only Southern Bald Ibis, Martial Eagle and African Marsh Harrier have been recorded in the study area in low number of between one and five individuals over a ten-year period) within the project boundary, means that the IBA will not have a significant impact on the establishment of the proposed Shongweni substation and the routing of the final Hector-Shongweni 275kV alignments and was therefore not used as a criterion to assess the anticipated impacts in the study area.

4.1.2. Coordinated Waterbird count (CWAC) data

The Animal Demography Unit (ADU) launched the Coordinated Waterbird Counts (CWAC) project in 1992 as part South Africa's commitment to International waterbird conservation. A CWAC site is any body of water, other than the oceans, which supports a significant number (set at approximately 500 individual waterbirds, irrespective of the number of species) of birds which use the site for feeding, and/or breeding and roosting (Young et al, 2003). This definition includes natural pans, vleis, marshes, lakes, rivers, as well as a range of man-made impoundments (i.e. sewage works). Currently the project regularly monitors over 400 wetlands around the country, and furthermore curates waterbird data for over 600 sites, providing much needed data for waterbird conservation

around the world. The presence of a CWAC site within the study area is an indication of a large number of water dependent species occurring there and the overall sensitivity of the area.

There are no CWAC sites within the immediate study area. Three CWAC sites are located approximately 20km east of the project boundary (FIGURE 3), two of which are associated with coastal 'wetlands' (Durban Bayhead NHS and Umgeni River Estuary) and the other a water treatment works (Northern Treatment Works). Given the distance from the study area and the relatively low numbers of waterbirds recorded at these locations, the aforementioned CWAC sites will not have a significant impact on the establishment of the proposed Shongweni substation and the routing of the final Hector-Shongweni 275kV alignments and was therefore not used as a criterion to assess the anticipated impacts in the study area.

4.2.3. Coordinated Avifaunal Road-count (CAR) data

Cranes, bustards, storks and other large birds that spend most of their time on the ground, need wide, open spaces and are certainly not restricted to protected areas. Agricultural habitats are used extensively for feeding, roosting and breeding, often because no natural, pristine habitats are available, and sometimes because the agricultural habitats are especially attractive to birds. Because of their size and conspicuous nature, these birds can be monitored using a relatively simple technique i.e. the road count. The Coordinated Avifaunal Roadcounts (CAR) project monitors the populations of 36 species of large terrestrial birds in agricultural habitats, in addition to gamebirds, raptors and corvids along 350 fixed routes covering over 19 000km (http://car.adu.org.za/). Although CAR road counts do not give an absolute count of the all the individuals in a population, they do provide a measure of relative abundance in a particular area.

There are no CAR routes within the confines of the study area; the closest CAR route (KM03) is located approximately 50km north-west of study area, near Howick. Despite the absence of CAR counts within the study area, it is important to note that several of the large terrestrial and raptor species that the CAR counts consider have been observed in the study area. These include i.e. Southern Bald Ibis, Helmeted Guineafowl *Numida meleagris*, Spur-winged Goose *Plectropterus gambensis*, Black-headed Heron *Ardea melanocephala*, Long-crested Eagle *Lophaetus occipitalis*, Steppe Buzzard *Buteo vulpinus* and Jackal Buzzard *Buteo rufofuscus* which are vulnerable to interactions with power line infrastructure.

4.1.4. South African Bird Atlas Project 2 Data (SABAP2)

A total of 346 bird species have been recorded within the relevant pentads during the SABAP2 atlassing period to date (APPENDIX 2). The presence of these species in the broader area provides an indication of the diversity of species that could potentially occur within the areas earmarked for the proposed developments, particularly where pockets of natural vegetation/habitats persist. Of the 346 species, 22 of these are considered to be of conservation concern (Red Data), according to the 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and

Swaziland (Taylor et al, 2015) and the IUCN Red List (2016). The White Stork *Ciconia ciconia*, which is not listed, but is protected internationally under the Bonn Convention on Migratory species, was also recorded.

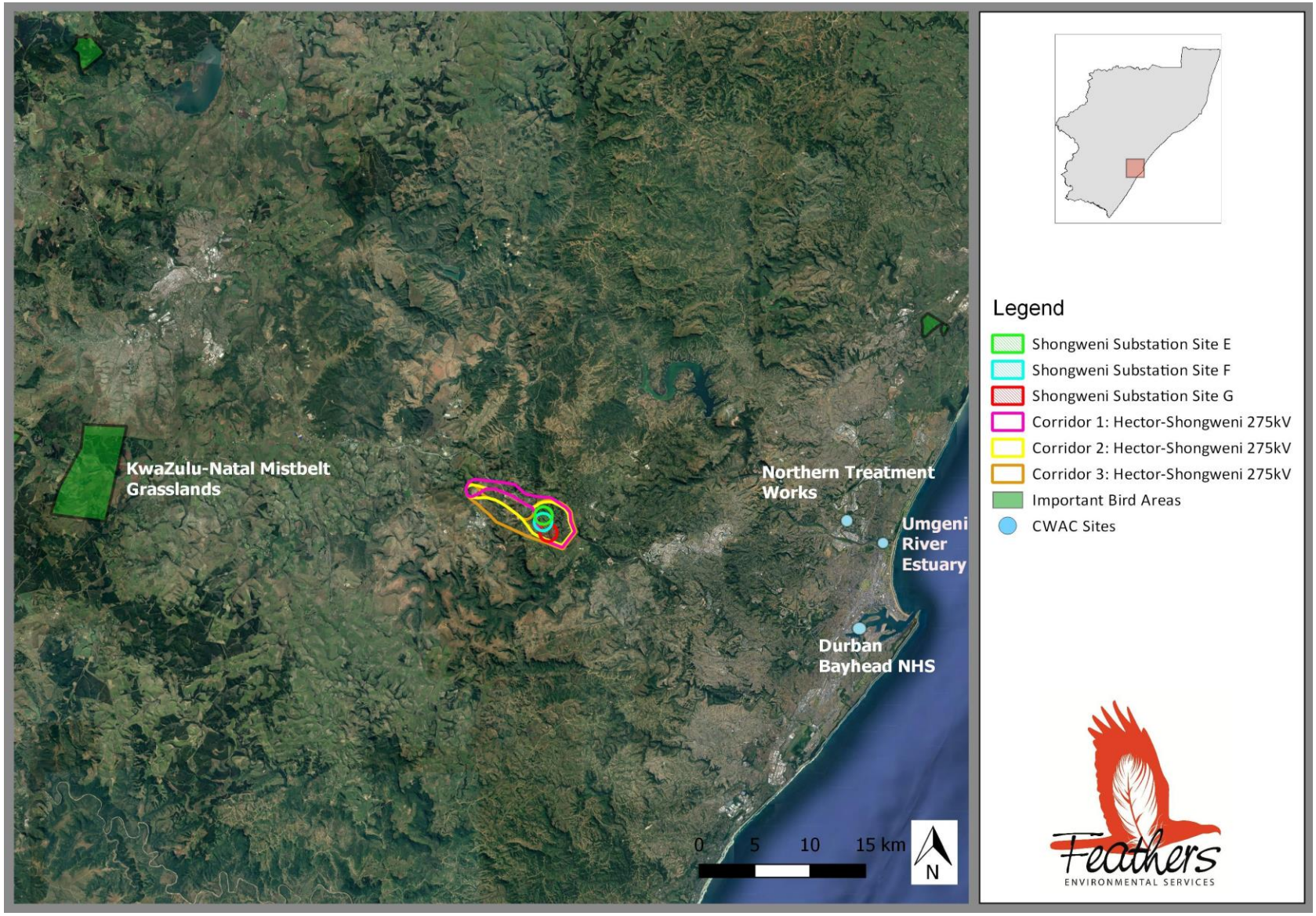

FIGURE 3: Regional map showing the study area in relation to the neighbouring Important Bird Areas (IBAs) and the Coordinated Waterbird Count sites.

With the exception of African Crowned Eagle *Stephanoaetus coronatus*, Lanner Falcon *Falco biarmicus*, and Pink-backed Pelican *Pelecanus rufescens*, the majority of Red Data species (n=19) have been recorded in low numbers, with less than 30 individuals being recorded over the ten-year survey period in the broader study area. The report rates for these species (and others) are significantly lower within the confines of the project boundary. The low report rates for these Red Data species can possibly be attributed to 1) the fact that not all of the nine pentad grid cells have been surveyed equally and extensively, or 2) a result of the fairly high levels of disturbance caused by the surrounding land use practices. The significant disturbance and habitat loss experienced in the study area has undoubtedly displaced many of the naturally occurring species, that under optimum conditions, would inhabit these areas. Although this report focuses on Red Data species, since the impacts associated with the construction and operation of the Shongweni substation and the 2 x Hector-Shongweni 275kV power lines are likely to be more biologically significant for these species, the impact on non-Red Data species is also assessed, albeit in less detail. Furthermore, much of the mitigation recommended for Red Data species will also protect non-Red Data species in the study area. The non-Red Data species that have been considered for this assessment include large eagles, buzzards, kestrels, herons, geese, ibis and various water bird species.

Each Red Data species' potential for occurring in a specific habitat class is indicated in TABLE 4.1, in addition to the type of impact that could potentially affect each species. It is important to note that birds can and will, by virtue of their mobility, utilise almost any areas in a landscape from time to time. However, the analysis in TABLE 4.1 represents each species' most preferred habitats. These locations are where most of the birds of that species will spend most of their time – so logically that is where potential impacts on those species will be most significant.

TABLE 4-1: Red Data species that could potentially occur in the study area

SPECIES (Taxonomic Name)	REGIONAL CONS. STATUS	GLOBAL CONS. STATUS	AV. REPORT RATE	NO. OF INDIVIDUALS	RIVERS	WATERBODIES	GRASSLAND	FOREST	WOODLAND	CULTIVATED LAND	COLLISION	DISPL. (HABITAT LOSS)	DISPL. (DISTURBANCE)
Blackcap, Bush *Lioptilus nigricapillus*	VU	NT	1.02	15	-	-	-	x	x	-	-	x	x
Broadbill, African *Smithornis capensis*	VU	LC	0.14	2	-	-	-	x	-	-	-	x	x
Buttonquail, Black-rumped *Turnix nanus*	VU	LC	0.07	1	-	-	x	-	-	x	-	-	-
Cormorant, Cape *Phalacrocorax capensis*	EN	EN	0.07	1	-	estuaries	-	-	-	-	-	-	-
Crane, Grey Crowned *Balearica regulorum*	EN	EN	0.27	4	-	x	x	-	open	x	x	-	x
Eagle, African Crowned *Stephanoaetus coronatus*	VU	NT	45.97	679	-	-	-	x	dense	-	x	x	x
Eagle, Martial *Polemaetus bellicosus*	EN	VU	1.56	23	-	-	-	edges	open	-	x	x	x
Eagle, Verreaux's *Aquila verreauxii*	VU	LC	1.29	19	-	-	-	-	-	-	x	-	-
Falcon, Lanner *Falco biarmicus*	VU	LC	13.00	192	-	-	x	-	open	x	x	-	x
Finfoot, African *Podica senegalensis*	VU	LC	0.07	1	x	x	-	-	-	-	-	-	-
Flamingo, Greater *Phoenicopterus ruber*	NT	LC	0.07	1	-	x	-	-	-	-	x	-	-
Ground-hornbill, Southern *Bucorvus leadbeateri*	EN	VU	0.07	1	-	-	x	-	x	-	x	-	-
Ground-thrush, Spotted *Zoothera guttata*	EN	EN	0.34	5	-	-	-	x	-	-	-	x	x
Ibis, Southern Bald *Geronticus calvus*	VU	VU	1.83	27	-	-	x	-	-	x	x	x	x
Kingfisher, Half-collared *Alcedo semitorquata*	NT	LC	0.47	7	x	-	-	-	-	-	-	x	x
Marsh-harrier, African Circus ranivorus	EN	LC	0.54	8	-	wetlands	-	-	-	-	x	x	x

SPECIES (Taxonomic Name)	REGIONAL CONS. STATUS	GLOBAL CONS. STATUS	AV. REPORT RATE	NO. OF INDIVIDUALS	RIVERS	WATERBODIES	GRASSLAND	FOREST	WOODLAND	CULTIVATED LAND	COLLISION	DISPL. (HABITAT LOSS)	DISPL. (DISTURBANCE)
Night-Heron, White-backed *Gorsachius leuconotus*	VU	LC	0.20	3	x	-	-	-	-	-	-	-	x
Pelican, Great White *Pelecanus onocrotalus*	VU	LC	0.07	1	-	x	-	-	-	-	x	-	-
Pelican, Pink-backed *Pelecanus rufescens*	VU	LC	5.01	74	x	x	-	-	-	-	x	-	x
Pygmy-Goose, African *Nettapus auritus*	VU	LC	0.68	10	-	x	-	-	-	-	x	x	x
Roller, European *Coracias garrulus*	NT	LC	0.41	6	-	-	-	-	open	-	-	x	x
Stork, Black *Ciconia nigra*	VU	LC	0.07	1	x	-	-	-	-	-	x	-	-
Stork, White *Ciconia ciconia*	BONN		0.74	11	-	-	x	-	-	x	x	-	x

CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near-threatened; LC = Least Concern;
BONN = Convention on the Conservation of Migratory Species of Wild Animals

4.2 BIRD HABITAT CLASSES

Vegetation is one of the primary factors determining bird species distribution and abundance in an area. The study area extends over five vegetation biomes (South African National Biodiversity Institute, 2012 and Mucina & Rutherford, 2006) two of which feature more prevalently, namely the Savanna biome, comprised of KwaZulu-Natal Sandstone Sourveld and the Grassland biome, comprised of Dry Coast Hinterland Grassland and Moist Coast Hinterland Grassland (TABLE 4.1).

TABLE 4-2: Total percentage of biome vegetation occurring in each power line corridor

BIOME	Substation E	Substation F	Substation G	Corridor 1	Corridor 2	Corridor 3
Savanna	97.23%	93.39%	97.16%	66.91%	64.73%	66.80%
Grassland	0.00%	0.00%	0.00%	31.00%	33.03%	30.06%
Forests	0.00%	0.00%	0.00%	1.42%	1.43%	2.31%
Azonal Vegetation	2.77%	6.61%	2.84%	0.95%	1.10%	0.81%
Indian Ocean Coastal Belt	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%

The following description of the vegetation on the site focuses on the vegetation structure and not species composition since it is widely accepted within ornithological circles that vegetation structure is more important in determining which bird species will occur there. From an avifaunal perspective, the Atlas of southern African Birds (SABAP1) recognises six primary vegetation divisions or biomes within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison et al. 1997). In addition to the description of vegetation, it is important to understand the habitats available to birds at a smaller spatial scale, i.e. micro habitats. Micro habitats are shaped by factors other than vegetation, such as topography, land use (SANBI, 2014), food sources and anthropogenic factors are critically important in mapping the site in terms of avifaunal sensitivity and ultimately informing the mitigation requirements.

Investigation of this study area revealed the following bird micro habitats, with APPENDIX 1 providing a photographic record of the bird habitats that occur within the study area:

4.2.1. Rivers

Most rivers in southern Africa are in the east and extreme south, in the higher rainfall areas. KwaZulu Natal is a water-rich province, comprised of over 18 000km of perennial and ephemeral rivers and 585 000ha of mapped freshwater wetlands. The river systems feed into 79 estuaries covering a mapped area of over 30 600ha (Rivers-Moore et al. 2007). These freshwater resources provide important corridors of microhabitat for waterbirds (13 of which are mostly restricted to riverine habitat in southern Africa) that will be regularly utilise rivers not only as a source of drinking water and food, but also for bathing and cover for skulking species. In addition, the thick riverine woodland with large shady riparian trees, offers important breeding substrate for a variety of birds, including raptors (Hockey *et al* 2005).

The Mhlatuzana and Wekeweke river systems feature within the study area (FIGURE 4 and APPENDIX 1 - FIGURE 1) and are traversed by all three of the proposed Hector-Shongweni 275kV power line corridors. Ordinarily, Red Data species that have been recorded in the broader study area that are likely to frequent rivers include Pink-backed Pelican, that will forage in rivers and often roost in tall trees in the riparian zone (Hockey *et al* 2005), while the thick riparian vegetation provides cover for shy species such as the African Finfoot *Podica senegalensis,* and Half-collared Kingfisher *Alcedo semitorquata*. However, it must be noted that although these species have been observed in the broader study area, they have not been recorded within the confines of the project boundary. This is likely a result of the poor quality of the Mhlatuzana and Wekeweke rivers in this area and the high levels of disturbance currently experienced in the study area. Therefore, the potential collision and displacement impacts as a result of habitat loss and disturbance associated with the construction and operation of the proposed Shongweni substation and the associated Hector-Shongweni 275kV power line are likely to be low.

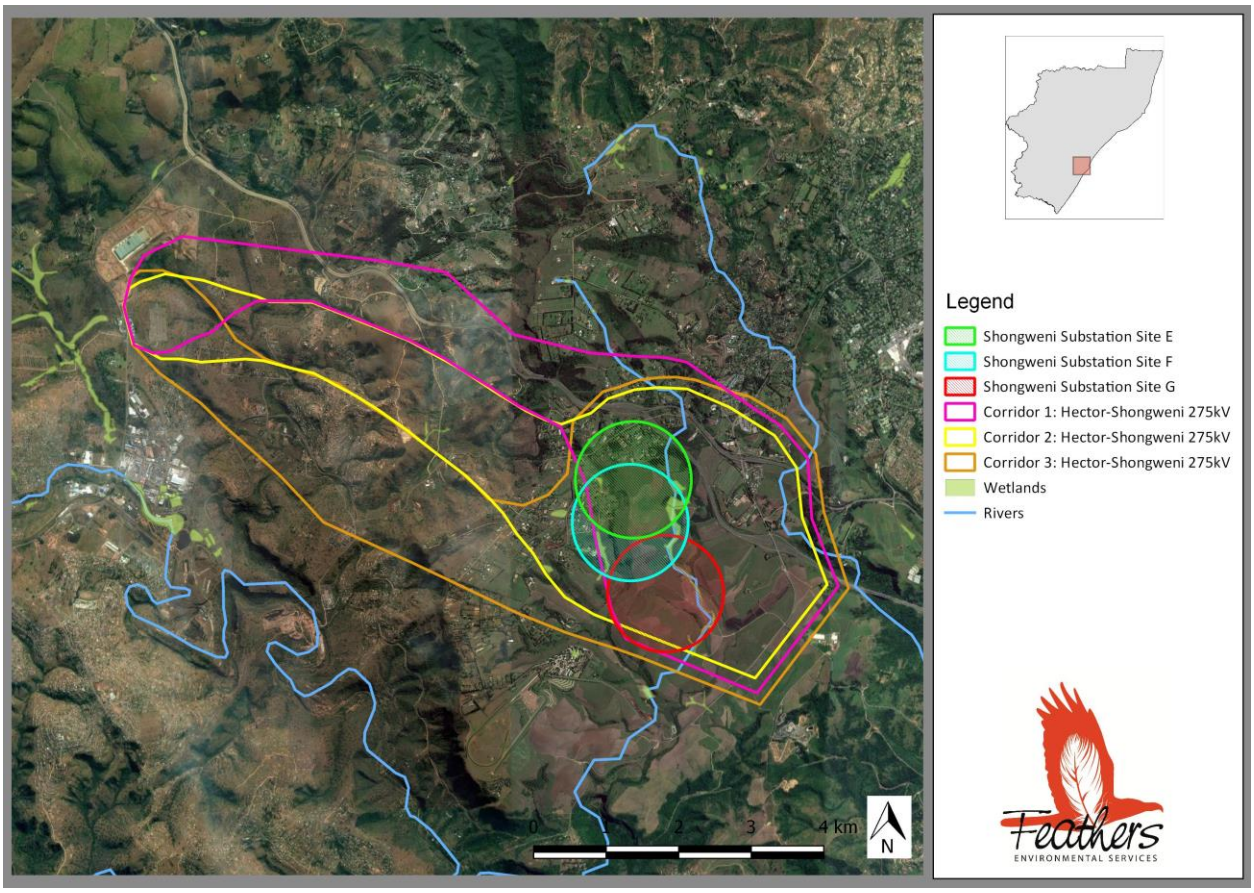

FIGURE 4. Regional map detailing the river systems, dams and wetlands that occur within the study area

4.2.2. Wetlands

Wetlands are characterized by slow flowing seasonal water (or permanently wet) and tall emergent vegetation (rooted or floating) and provide habitat for many water birds. The conservation status of many of the bird species that are dependent on wetlands reflects the critical status of wetlands worldwide, with many having already been

destroyed. There are examples of localized wetlands within the study area and (FIGURE 4 and APPENDIX 1 - FIGURE 2) and may represent attractive foraging habitat for the collision sensitive species such as Southern Bald Ibis (Young 2003). It is also the preferred roosting and foraging habitat for the African Marsh Harrier (Hockey *et al* 2005). Various common species i.e. ibis, herons and geese will also utilise wetlands for their foraging needs. Given their locations within the study area, and the low reporting rates for Southern Bald Ibis and African Marsh Harrier, construction and operational activities associated with the proposed substation and power line developments are unlikely to have a permanent negative impact on the wetlands and the bird communities that these may support.

4.2.3. Dams

Many thousands of earthen and other dams exist in the southern African landscape. Whilst dams have altered flow patterns of streams and rivers, and affected many bird species detrimentally, a number of species have benefited from their construction. The construction of these dams has probably resulted in a range expansion for many water bird species that were formerly restricted to areas of higher rainfall. Man-made impoundments (including irrigation ponds and sewage works), although artificial in nature, can be very important for variety of birds, particularly water birds. Apart from the water quality, the structure of the dam, and specifically the margins and the associated shoreline and vegetation, plays a big role in determining the species that will be attracted to the dam. Red Data species recorded in the study area by SABAP2 that are likely to be attracted to dams (FIGURE 4 and APPENDIX 1 - FIGURE 3) include Grey Crowned Crane, Great White Pelican *Pelecanus onocrotalus*, Pink-backed Pelican, African Pygmy-Goose *Nettapus auritus* and African Finfoot. Again, it must be noted that these species have not been recorded within the confines of the study area during the SABAP2 survey period. Common species in the study area that could use dams and dam edges include African Darter *Anhinga rufa*, Red-knobbed Coot *Fulica cristata,* Reed Cormorant *Phalacrocorax africanus,* White-breasted Cormorant *Phalacrocorax carbo*, various heron and duck species, Blacksmith Lapwing *Vanellus armatus,* African Sacred Ibis *Threskiornis aethiopicus* and Egyptian Goose *Alopochen aegyptiacus.* For these more common species that may utilize the dams and other waterbodies in the study area as roost sites, interaction with power lines may prove significant as they leave the roost in the early morning during low light conditions, and arrive at the roost in the late evening, again during low light conditions. During these conditions, the earth wires of power lines are almost invisible thereby increasing the chance of collision with the proposed Hector-Shongweni 275kV power lines.

4.2.4. Grassland

Of South Africa's 841 bird species, 350 occur in the Grassland Biome. This includes 29 species of conservation concern (i.e. those species declining in numbers), ten endemics, and as many as 40 specialist species that are exclusively dependent on grassland habitat. Although 30 percent of the study area is classed as grassland (FIGURE 5), large tracts within the proposed corridors have undergone significant transformation as a result of commercial cultivation, particularly sugarcane, urbanisation and pastoral activities. However, in those areas where grasslands persist (APPENDIX 1 - FIGURE 4) this habitat may attract Southern Bald Ibis, Lanner Falcon and White Stork that have been recorded in the study area. The species mentioned above, are vulnerable to interactions with electrical infrastructure in particular, collision with the overhead power line conductors and earthwires. Grasslands are also a favourite foraging area for game birds such as francolins and Helmeted Guineafowl. This in turn attracts large raptors e.g. Martial Eagle because of both the presence and accessibility of prey.

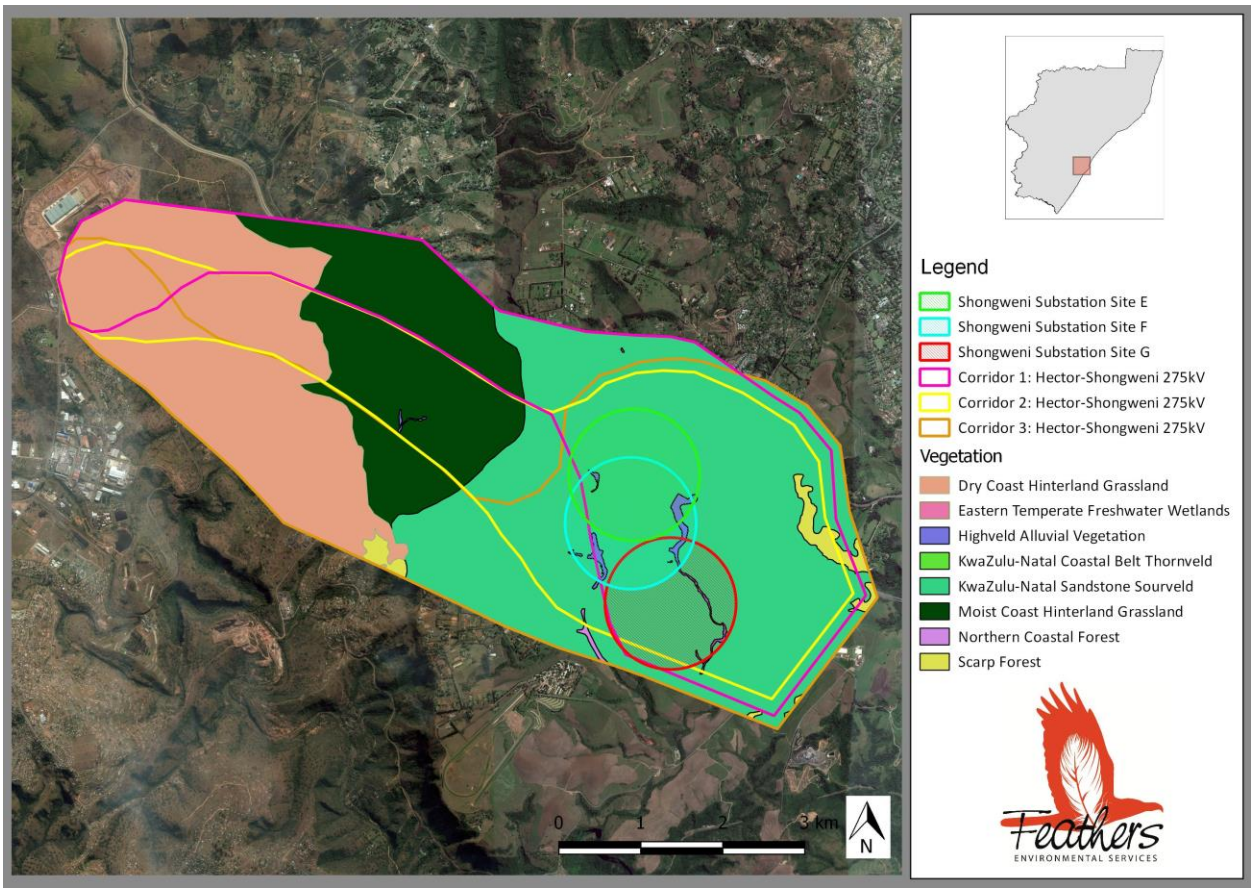

FIGURE 5. Regional map detailing the vegetation units that occur within the study area

4.2.5. Woodland

The woodland biome (FIGURE 5) contains a large variety of bird species (it is the most species-rich community in southern Africa) but very few bird species are restricted to this biome. It is also relatively well conserved compared to the grassland biome. Woodland is particularly rich in raptors, and forms the stronghold for Red Data species (recorded in the study area by SABAP2) such as Martial Eagle and Lanner Falcon. Apart from Red Data species, it also supports several non-Red Data raptor species, such as the Brown Snake-Eagle *Circaetus cinereus*, and a multitude of medium-sized raptors, for example the migratory Steppe Buzzard, African Harrier-Hawk (Gymnogene) *Polyboroides typus*, Jackal Buzzard, Wahlberg's Eagle *Aquila wahlbergi and* African Hawk-Eagle *Aquila spilogaster*. Relevant to this study, the state of the woodland varies from relatively intact (APPENDIX 1 - FIGURE 5 and 6) in places to a relatively poor state with evidence of heavy disturbance and habitat transformation evident near towns and settlements (APPENDIX 1 - FIGURE 10 and 11). As mentioned previously, the SABAP2 reporting rates for the Red Data birds potentially occurring in woodland habitat in the study area are low, indicating that human activity has impacted on the avifaunal community and that levels of disturbance are high.

4.2.6. Forest

A significantly smaller percentage of the study area is located within the Forest biome (FIGURE 5), specifically Scarp and Northern Coastal Forest. These pockets of indigenous forest could attract African Crowned Eagle, Bush Blackcap *Lioptilus nigricapillus*, African Broadbill *Smithornis capensis* and Spotted Ground-Thrush *Zoothera guttata*, however the reporting rates for these species are very low within the area earmarked for the proposed development, which is indicative of the levels of disturbance currently being experienced in the area.

4.2.7. Cultivated Lands

The ploughing of soil for crop production is often thought to be an improvement of the environment, but, in fact, this activity completely destroys the structure and species composition of the natural vegetation, thus causing irrevocable damage. These alterations have an enormous impact on the bird species that are dependent on the natural vegetation that they inhabit. The birds least likely to show the effects of these transformations are the small species which are able to persist in small, fragmented remnants of undisturbed habitat (Harrison *et al,* 1997). Larger species with large home ranges will most likely show disrupted patterns of distribution.

Conversely, agriculture may in fact cause some species to expand their distribution beyond the vegetation types in which they occurred naturally. There are examples of cultivated land within the study area, and these are draw cards for species such as Grey Crowned Crane, and a variety of non-Red Data species e.g. Hadeda Ibis *Bostrychia hagedash*, as the opening up the soil surface and land preparation makes many insects, seeds, bulbs and other food sources suddenly accessible to birds and other predators; and the crop or pasture plants cultivated are often eaten by birds, or attract insects and rodents which are in turn eaten by birds.

Relevant to this study, there are a few examples of communal/subsistence cultivated lands dotted throughout the study area (APPENDIX 1 - FIGURE 9). Commercial plantations, in the form of sugarcane and pine plantations, on the other hand, i.e. sugarcane and pine plantations are a prominent feature within the study area (APPENDIX 1 - FIGURE 7 and 8). These commercial plantations are regarded as sterile from a bird habitat point of view as the dense vegetation is often impenetrable, making foraging extremely difficult. Perhaps the only birds likely to be found utilizing these plantation areas are Black-headed Heron (especially after the sugar cane has been burned) and Long-crested Eagles that hunt on the periphery of both sugar cane and forest plantations, as well as the Woolly-necked Stork *Ciconia episcopus*, particularly in areas close to water.

4.2.8. Urban Areas

A large component of the study area is comprised of various degrees of urbanisation. These areas include surface infrastructure such as roads and buildings (APPENDIX 1 - FIGURE 10 and 11). Built-up areas generally are of little value to sensitive Red Data bird species due to their degraded nature and the associated disturbance factor, however one notable exception in this area is the African Crowned Eagle. With the abundant availability of prey and suitable nesting substrate (both indigenous forest and blue gum plantations) in the suburban areas, these

raptors are becoming urban exploiters. In addition, urban areas play an important role in providing safe refuge and foraging opportunities for small passerine species that have become common in urban environments.

5 GENERAL DESCRIPTION OF BIRD INTERACTIONS WITH ELECTRICAL INFRASTRUCURE

Poorly sited or designed facilities and infrastructure can negatively impact not only vulnerable species and habitats, but also entire ecological processes. The effects of any development 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 diversity of species present. With so many variables involved, the impacts of each development must be assessed individually. Each of these potential effects can interact, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss and disturbance causes a reduction in birds using an area which may then reduce the risk of collision). The principal areas of concern for Red Data species related to the proposed Shongweni substation and associated Hector-Shongweni 275kV power lines are:

* Displacement due to habitat loss in the physical infrastructure footprint;
* Displacement due to disturbance associated with construction and operation/maintenance; and
* Mortality due to collision with the earthwires and/or conductors of the transmission lines.

5.1 CONSTRUCTION PHASE

5.1.1. Displacement as a result of habitat loss or transformation

This impact is dependent on the location and the scale of the facility. Extensive areas of vegetation (habitat) are cleared to accommodate the considerable amount of infrastructure required, particular substation yards, reducing the amount of habitat available to birds for foraging, roosting and breeding (Smallie, 2013). The effect of the vegetation clearing is always more marked in woodland areas, where construction necessitates the removal of woody plants, and especially large trees. This development will undoubtedly destroy and modify a certain amount of habitat and is likely to impact the smaller passerine bird species with small home ranges as entire territories could be removed during construction activities.

Relevant to this assessment, the majority of the study area has been intensively transformed through urbanisation and commercial cultivation and therefore unlikely to support the sensitive Red Data species that have been recorded in the broader study area (TABLE 4.1). Natural habitats (i.e. rivers, wetlands, grassland and woodland) do persist in some parts of the study area and these may be transformed (or further transformed) during the course of the construction activities, which could in turn impact on birds using these habitats. It is also important to note that this impact may potentially have dire consequences for the smaller passerine species with small home ranges as entire territories could be removed during construction activities. Given that the areas earmarked for the proposed substation development are comprised almost entirely of sugarcane plantations the habitat transformation impacts will be of **LOW** significance from an avifaunal perspective. Although the footprint

size per tower is considerably smaller, the avifaunal habitats within the corridor are potentially more sensitive the impact is rated to be of **MEDIUM** significance for the proposed Hector-Shongweni 275kV power lines.

5.1.2. Displacement as a result of disturbance

Excavation and construction activities are a source of significant disturbance particularly as a result of the machinery and construction personnel that are present on site for the duration of the construction of the facility. For most bird species, construction activities are likely to be a cause of temporary disturbance and may impact on foraging, breeding and roosting behaviours or in more extreme cases, result in displacement from the site entirely.

The study area is already subjected to a fairly significant degree of disturbance due to the existing commercial cultivation and urban activities in the immediate vicinity of the substation sites and power line corridors. Based on the relatively small footprint and the location of the proposed substation sites and power line corridors, coupled with the low reporting rates for Red Data species recorded in the study area, the proposed development is unlikely to have any long-term, significant negative displacement impact on the local avifauna due to disturbance. The impact of disturbance is therefore likely to be **LOW** and temporary as far as Red Data species are concerned. If the power line is authorised, a detailed inspection of the authorised alignment would be required to establish if there are any breeding Red Data species that could be disturbed. In such an event, appropriate mitigation measures would need to be implemented (such as postponing the construction of the line to avoid peak breeding season).

5.2 OPERATIONAL PHASE

5.2.1. Mortality due to collision with the earth wire of the transmission line

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds and birds colliding with power lines (Ledger and Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs and Ledger 1986a; Hobbs and Ledger 1986b; Ledger, Hobbs and Smith, 1992; Verdoorn 1996; Kruger and Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000; Anderson 2001; Shaw 2013).

Collisions are the biggest single threat posed by power lines to birds in southern Africa (van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. These species are mostly heavy-bodied birds with limited maneuverability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). Unfortunately, many of the collision sensitive species are considered threatened in southern Africa. The Red Data species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. These species have not evolved to cope with high adult mortality, with the results that consistent high

adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term.

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

"The collision risk posed by power lines is complex and problems are often localised. While any bird flying near a power line 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 power lines, 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 low-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. Power lines 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 power lines that they can see but do not have enough flight control to avoid (Brown et al. 1987, APLIC 1994).

The technical aspects of power line design and siting also play a big part in collision risk. Grouping similar power lines 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 power lines 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, Bevanger 1994)."

A potential impact of the proposed Hector-Shongweni 275kV power lines is collisions with the earth wire and/or conductors present on the proposed power line infrastructure. Quantifying this impact in terms of the likely number of birds that will be impacted, is very difficult because such a huge number of variables play a role in determining the risk, for example weather, rainfall, wind, age, flocking behaviour, power line height, light conditions, topography, population density and so forth. However, from incidental record keeping by the Endangered Wildlife Trust: Wildlife & Energy Programme it is possible to give a measure of what species are likely to be impacted upon (see FIGURE 6 below - Jenkins et al. 2010). This only gives a measure of the general susceptibility of the species to power line collisions, and not an absolute measurement for any specific line.

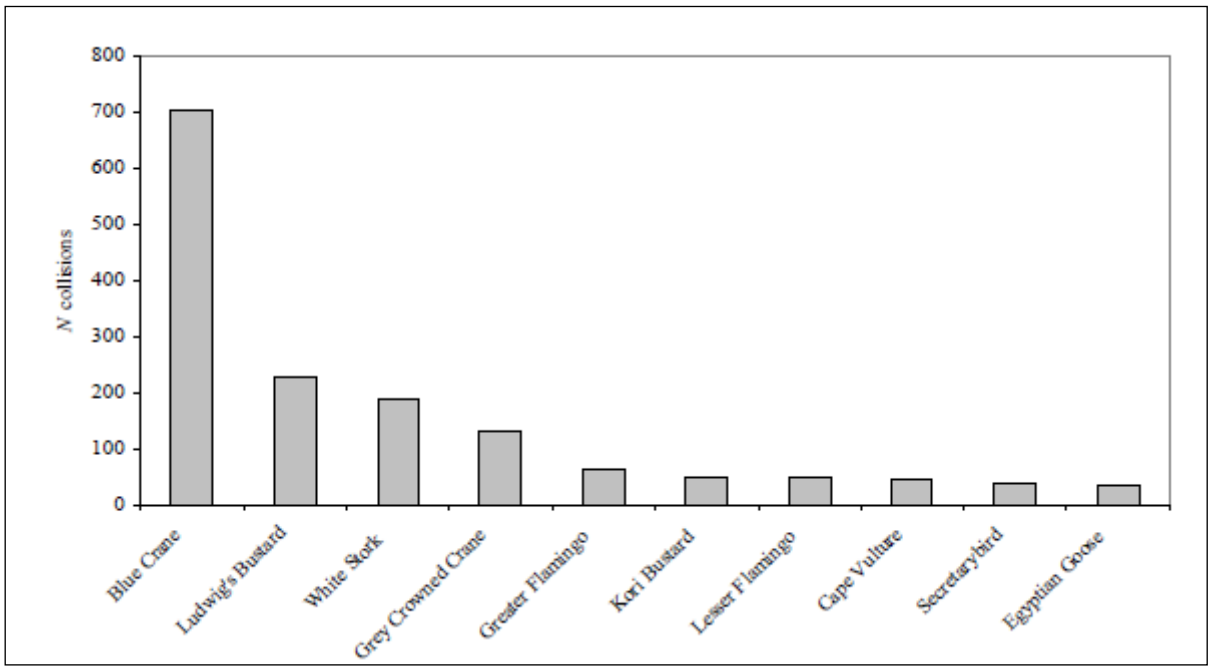

FIGURE 6: The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2007 (Jenkins et al. 2010)

Collision of large heavily-bodied Red Data species such as Southern Bald Ibis, various waterbird species and to a lesser extent raptors, is possible, particularly along sections of the proposed routes that traverse the open grassland and wetland areas and is therefore rated to be of **MEDIUM** significance. However, this rating can be reduced by selecting a corridor that poses the least risk to birds, avoiding key avifaunal habitat (i.e. rivers, dams, pans and wetlands) and where possible routing the proposed power lines alongside existing power line infrastructure in an effort to increase conductor visibility**.**

5.2.2. Mortality due to electrocution on the power line infrastructure and within the substation yard

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). Electrocution risk is strongly influenced by the power line voltage of the and design of the pole structure and mainly affects larger, perching species, such as vultures, eagles and storks, easily capable of spanning the spaces between energized components. Due to the large size of the clearances on most overhead lines of above 132kV, electrocutions are generally ruled out as even the largest birds cannot physically bridge the gap between dangerous components. It can be concluded that electrocutions on the proposed Hector-Shongweni 275kV power lines (to be constructed with 400kV specifications) will not be possible through conventional mechanisms and will therefore not be assessed in terms of its significance.

Electrocutions within the proposed Shongweni substation are possible, but should not affect the more sensitive Red Data bird species as these species are unlikely to use the infrastructure within the substation yards for perching or roosting. The risk of electrocution within the substation yard is therefore evaluated to be low. Since it is difficult to predict with any certainty where birds are likely to nest within the substation yard, coupled with the costs associated with insulating the entire substation, electrocutions will need to be mitigated using site-specific recommendations if and when they occur. Given the site-specific nature of this impact, it will not be assessed in terms of its significance.

6 SELECTION OF A PREFERRED SUBSTATION SITE AND POER LINE CORRIDOR

One of the objectives of this study is to determine the preferred substation site location and power line corridor in terms of impacts on power line sensitive Red Data avifauna.

The following factors were considered to arrive at a preferred substation site and corridor for the proposed Shongweni substation and Hector-Shongweni 275kV power lines, primarily using landcover data (SANBI, 2014) as the main source of data, supplemented with personal observations made during the site visit:

* *Rivers* - The study area contains several river systems which together with the surrounding riparian habitat could attract Red Data and several non-Red Data water dependent species which could potentially be impacted through collisions with the proposed power lines and disturbance during the construction of the proposed substation and power lines.

* *Waterbodies (wetlands and dams)* - Wetlands and dam edges are vitally important habitat for Red Data and non-Red Data water dependent species. Wetlands and dams were therefore treated as a risk increasing factor, both in terms of potential displacement of species due to habitat loss and/or disturbance, and potential collision risk.

- *Grassland* - Grassland habitat occurs in various forms within the study area i.e. natural grassland on hilltops, areas that are lightly wooded (savanna) and old agricultural clearings. Grasslands represent a significant feeding area for many bird species, of which many of the large terrestrial species are vulnerable to power line collisions. Grassland was treated as a risk increasing factor.

- *Woodland* - Although some natural woodland in the study area has been transformed by agricultural activities, pockets of relatively undisturbed woodland still remain in parts within the proposed power line corridors. Woodland is suitable for several Red Data species, particularly large raptors. This is due to the presence of a prey base and the presence of large trees for roosting and breeding purposes. Natural woodland was therefore treated as a risk increasing factor in terms of displacement through habitat loss and disturbance.

- *Cultivated land* - A large component of the study area is comprised of cultivated lands, mostly in the form of sugarcane and pine plantations, with smaller communal/subsistence cultivation occurring in smaller pockets within the sturdy area. From a habitat destruction and disturbance perspective, this represents a risk reducing factor as the natural woodland and grassland habitat has already been disturbed or destroyed completely, resulting in few power line sensitive Red Data utilising this habitat. However some Red Data species forage in cultivated lands and although this habitat is not as important as natural grassland, rivers and waterbodies, collision with the power lines could still occur.

- *High voltage power lines* - There are strong arguments for the fact that placing a new power line next to an existing power line reduces the risk of collisions to birds. The reasons for that are two-fold, namely it creates a more visible obstacle to birds and the resident birds, particularly breeding adults, which are accustomed to an obstacle in that geographic location and have learnt to avoid it (APLIC 2012; Sundar & Choudhury 2005). Other high voltage power lines running parallel to or within the proposed corridors were therefore treated as a risk reducing factor.

- *Urban* - These are obvious centres of human activity (towns, settlements and industrial activity) and are generally avoided by large power line sensitive species. The presence of towns, settlements and industrial activity is therefore a risk reducing factor.

The factors mentioned above were incorporated into a formula to arrive at a risk rating for each alignment. The formula was designed as follows:

- The number of river crossings within the corridor.
- The total surface area (hectares) of waterbodies within the corridor.
- The total surface area (hectares) of grassland within the corridor.
- The total surface area (hectares) of open indigenous forest within the corridor.
- The total surface area (hectares) of open woodland within the corridor.
- The total surface area (hectares) of dense woodland/thicket within the corridor.
- The total surface area (hectares) of commercial cultivated lands and plantations within the corridor.
- The total surface area (hectares) of subsistence cultivated lands

* The total surface area (hectares) of urban centres (towns, settlements & industry) within the corridor.
* The total length of existing high voltage power lines within the corridor.

TABLE 6-1: The results of the measurements for each factor at each substation site and within each power line corridor

FACTOR	Sub E	Sub F	Sub G	Corridor 1	Corridor 2	Corridor 3
River Crossings	0.00	0.00	0.00	1.00	1.00	1.00
Waterbodies (wetlands, dams, pans)	1.30	1.18	0.24	5.03	6.71	9.27
Grassland	5.91	4.49	1.89	172.50	203.16	252.07
Indigenous Forest	0.00	0.00	0.00	4.24	2.76	17.45
Woodland (open)	0.59	0.24	0.35	8.09	8.88	14.59
Thicket	39.70	31.43	11.70	291.32	292.69	433.01
Cultivated Land (commercial)	106.22	129.02	186.18	718.92	648.22	767.61
Cultivated Land (subsistence)	0.00	0.00	0.00	4.34	9.86	9.96
Urban	46.32	34.14	0.00	602.31	634.11	778.44
Existing TX Power Lines	0.00	0.00	0.00	1420.00	15094.00	37734.00

These factors do not have an equal impact on the size of the risk, therefore a weighting was assigned to each factor for each potential impact, based on the author's professional judgment on how important the factor is within the total equation, taking into account the avifaunal characteristics of the study area. The assigned weights (0 – 10) are tabled below:

TABLE 6-2: Weights assigned to risk factors.

FACTOR	Weighting	
	Displacement	Collisions
River Crossings	8	8
Waterbodies (wetlands, dams, pans)	8	10
Grassland	4	6
Indigenous Forest	8	2
Woodland (open)	4	4
Thicket	6	2
Cultivated Land (commercial)	-2	1
Cultivated Land (subsistence)	-1	2
Urban	-2	-1
Existing TX Power Lines	-1	-1

The risk score for a factor in each impact category was calculated as follows: total area of substation site or corridor within the risk factor x weighting. This calculation was done for each substation site and corridor. The

final risk rating in each impact category for a substation site and corridor was calculated as the sum of the risk scores of the individual factors ÷ 100. The overall risk rating for each corridor was calculated by summing the respective risk ratings for displacement and collisions for each power line corridor (see Tables 6-3 & 6-4 below).

TABLE 6-3: The final scores for the respective substation sites

FACTOR	DISPLACEMENT		
	Substation E	Substation F	Substation G
Waterbodies (wetlands, dams, pans)	10.40	9.44	1.92
Grassland	23.64	17.96	7.56
Woodland (open)	2.36	0.96	1.40
Thicket	238.20	188.58	70.20
Cultivated Land (commercial)	-212.44	-258.04	-372.36
Urban	-92.64	-68.28	0.00
OVERALL RATING (TOTAL ÷ 100)	-0.30	-1.09	-2.91

TABLE 6-4: The final scores for the respective corridors

FACTOR	DISPLACEMENT		
	Corridor 1	Corridor 2	Corridor 3
River Crossings	8.00	8.00	8.00
Waterbodies (wetlands, dams, pans)	40.24	53.68	74.16
Grassland	690.00	812.64	1512.42
Indigenous Forest	33.92	22.08	139.60
Woodland (open)	32.36	35.52	58.36
Thicket	1747.92	1756.14	2598.06
Cultivated Land (commercial)	-1437.84	-1296.44	-1535.22
Cultivated Land (subsistence)	-4.34	-9.86	-9.96
Urban	-1204.62	-1268.22	-1556.88
TOTAL DISPLACEMNT RATING	**-94.45**	**113.54**	**1288.54**
FACTOR	**COLLISIONS**		
	Corridor 1	**Corridor 2**	**Corridor 3**
River Crossings	8.00	8.00	8.00
Waterbodies (wetlands, dams, pans)	50.30	67.10	92.70
Grassland	103.50	1218.96	1512.42
Indigenous Forest	8.48	5.52	34.90
Woodland (open)	32.36	35.52	58.36
Thicket	582.64	585.38	866.02
Cultivated Land (commercial)	718.92	648.22	767.61

Cultivated Land (subsistence)	8.68	19.72	19.92
Urban	-602.31	-634.11	-778.44
Existing TX Power Lines	-1420.00	-15094.00	-37734.00
TOTAL COLLISION RATING	**-509.43**	**-13139.70**	**-35152.30**
OVERALL RATING (TOTAL ÷ 100)	**-6.04**	**-130.26**	**-338.64**

From the analysis above, the **SUBSTTION SITE G** and **CORRIDOR 3** emerged as the preferred substation site and power line corridor respectively from a bird impact assessment perspective.

7 ASSESSMENT OF EXPECTED IMPACTS

A quantitative methodology was used to describe, evaluate and rate the significance of the aforementioned impacts associated with the construction and operation the proposed developments at and within the **preferred substation and powerline locations.** This assessment is presented in tabular format below for both pre- and post-mitigation according to set criteria described in APPENDIX 3. The potential impacts of the Shongweni substation and the Hector-Shongweni 275kV power lines on the avifaunal community have been assessed separately given the characteristics of each development and nature of the avifaunal habitat present within each.

CONSTRUCTION PHASE									
Impact description	**Extent**	**Duration**	**Magnitude**	**Probability**	**Significance (pre-mitigation)**	**Significance (post-mitigation)**	**Reversibility**	**Mitigation**	**Confidence level**
IMPACT 1: Displacement of Red Data species as a result of habitat loss or transformation									
1.1 Avifaunal habitat is cleared to accommodate the Shongweni substation, reducing the amount of habitat available to birds for foraging, roosting and breeding	**Local (2)**	**Permanent (5)**	**Low (4)** since the natural vegetation present at all three substation sites are degraded to a fairly large extent and subject to significant existing disturbance. It is therefore unlikely to support the more sensitive Red Data species.	**Improbable (2)**	**Low (22)**	**Low (18)**	**Low**	The selection of **SUBSTATION SITE G** will reduce the significance of this impact. 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 Red Data species. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. The recommendations of the ecological and botanical specialist studies **must be strictly implemented**, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned.	**High**
1.2 Potential avifaunal habitat is cleared to	**Local (2)**	**Long term (4)**	**Low (4)** although the footprint size per tower is	**Probable (3)**	**Medium (30)**	**Low (16)**	**Medium**	The selection of **CORRIDOR 3** will reduce the significance of this impact.	**High**

accommodate the Hector-Shongweni 275kV power line towers and the 10m servitude for the stringing of the conductors reducing the amount of habitat available to birds for foraging, roosting and breeding			considerably smaller the avifaunal habitats within the corridor are potentially more sensitive					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 Red Data species. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. The recommendations of the ecological and botanical specialist studies **must be strictly implemented**, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned.	

CONSTRUCTION PHASE									
Impact description	**Extent**	**Duration**	**Magnitude**	**Probability**	**Significance (without**	**Significance (with**	**Reversibility**	**Mitigation**	**Confidence level**

					mitigation)	**mitigation)**			
IMPACT 2: Displacement of Red Data species as a result of disturbance									
2.1 Displacement as a result of disturbance associated with the construction of the Shongweni substation (i.e. noise and movement of construction and operational equipment and personnel) resulting in a negative direct impact on the resident avifauna.	**Local (2)**	**Short term (2)**	**Low (4)**	**Improbable (2)**	**Low (16**) the natural vegetation present at the proposed substation sites is degraded to a fairly large extent and subject to significant existing disturbance. It is therefore unlikely to support the more sensitive Red Data species.	**Low (12)**	**Medium**	The selection of **SUBSTATION SITE G** will reduce the significance of this impact. 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 Red Data species. Measures to control noise should be applied according to current best practice in the industry.	**High**
2.2 Displacement as a result of disturbance associated with the construction of the Hector-Shongweni	**Local (2)**	**Short term (2)**	**Moderate (4)**	**Probable (3)**	**Low (27)**	**Low (18)**	**Medium**	The selection of **CORRIDOR 3** will reduce the significance of this impact.	**High**

275kV power lines (i.e. noise and movement of construction and operational equipment and personnel) resulting in a negative direct impact on the resident avifauna.								An avifaunal walk-through of the final power line route must be conducted to identify Red Data species that may be breeding within the power line corridor to ensure that the impacts to breeding species (if any) are adequately managed 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 Red Data species. Measures to control noise should be applied according to current best practice in the industry.	

OPERATIONAL PHASE

Impact description	Extent	Duration	Magnitude	Probability	Significance (without mitigation)	Significance (with mitigation)	Reversibility	Mitigation	Confidence level
IMPACT 1: Mortality of Red Data species due to collision with the power line earth wire/conductors									
1.1 Collisions of Red Data avifauna with the earthwire of the Hector-Shongweni 275kV power lines, resulting in a negative direct mortality impact, particularly large terrestrial, waterbirds and to a lesser extent raptors.	**Local (2)**	**Long term (4)**	**Moderate (6)**	**Probable (3)**	**Medium (36)**	**Low (20)**	**High**	Every effort must be made to select a route that poses the least risk to birds, avoiding key avifaunal habitat (i.e. rivers, dams, pans and wetlands) and where possible routing the proposed power lines alongside existing power line infrastructure in an effort to increase conductor visibility. **The selection of CORRIDOR 3 will reduce the significance of this impact**. High risk sections of power line must be identified by a qualified avifaunal specialist during the walk-through phase of the project, once the alignment has been finalised. If power line marking is required, bird flight diverters must be installed on according to Eskom guidelines.	**High**

7 CONCLUSION & IMPACT STATEMENT

In conclusion, the habitat within which the proposed study areas are located is low to moderately sensitive from a potential bird impact perspective. In recent years, anthropogenic impacts, mostly in the form of cultivation and urbanisation have largely transformed the landscape resulting in a negative impact on avifaunal diversity and abundance with the study areas. This is reflected in the low reporting rates for Red Data species, which may also indicate that levels of disturbance are high. The construction of the proposed Shongweni substation and Hector-Shongweni 275kV power lines will result in various impacts of low to medium significance to the birds occurring in the vicinity of the new infrastructure, which can be reduced through the application of mitigation measures. Given the presence of existing habitat degradation and disturbance, it is anticipated that the proposed Shongweni substation and Hector-Shongweni 275kV power lines can be constructed within the study area with acceptable levels of impact on the resident avifauna subject to the following recommendations:

* Selecting Substation Site G and Corridor 3 for the proposed developments.
* An avifaunal walk-through of the final power line route must be conducted to identify Red Data species that may be breeding within the power line corridor to ensure that the impacts to breeding species (if any) are adequately managed.
* High risk sections of power line must be identified by a qualified avifaunal specialist during the walk-through phase of the project, once the alignment has been finalized. Bird flight diverters must be installed on according to Eskom guidelines.
* 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 avifaunal species.
* Maximum use of existing access roads and the construction of new roads should be kept to a minimum.
* The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned.
* In addition to this, the normal suite of environmental good practices should be applied, such as ensuring strict control of staff, vehicles and machinery on site and limiting the creation of new roads as far as possible.

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APPENDIX 1
AVIFAUNAL HABITAT OBSERVED WITHIN THE STUDY AREA

FIGURE 1: An example of a degraded river system in the study area

FIGURE 2: A wetland/flood plain associated with a river system

FIGURE 3: An example of a large dam within the study area.

FIGURE 4: Natural grassland habitat interspersed with small pockets of woodland on a hilltop

FIGURE 5: Open (savanna) woodland habitat.

FIGURE 6: Dense woodland habitat.

FIGURE 7: Sugarcane plantations dominate much of the areas earmarked for the substation development

FIGURE 8: Large stands of pine plantations

FIGURE 9: Example of subsistence agriculture

FIGURE 10: A well-established and affluent residential area

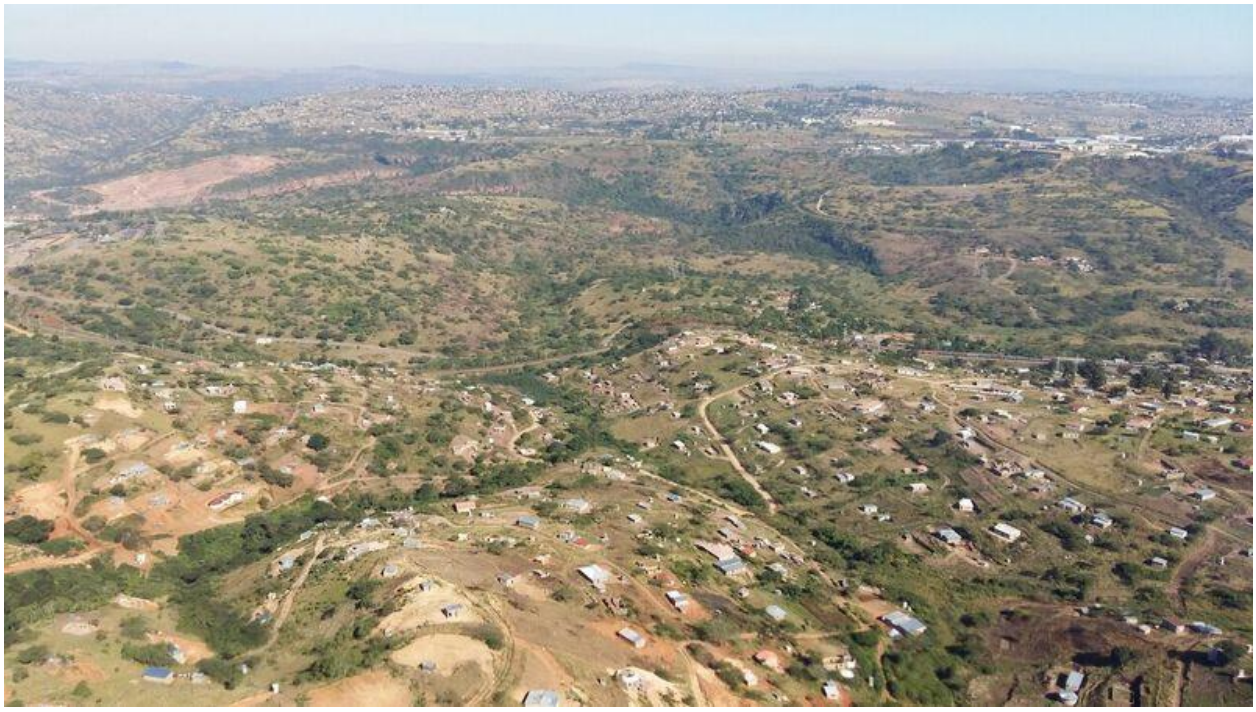

FIGURE 11: An example of a well-established village/settlement

APPENDIX 2

SOUTH AFRICAN BIRD ATLAS PROJECT DATA (SABAP 1 & 2) FOR THE PROPOSED PROJECT

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Apalis, Bar-throated	Apalis thoracica	68.72	1015				
Apalis, Yellow-breasted	Apalis flavida	1.96	29				
Barbet, Acacia Pied	Tricholaema leucomelas	0.14	2				
Barbet, Black-collared	Lybius torquatus	89.51	1322				
Barbet, Crested	Trachyphonus vaillantii	35.82	529				
Barbet, White-eared	Stactolaema leucotis	34.26	506				
Batis, Cape	Batis capensis	64.05	946				
Batis, Chinspot	Batis molitor	20.24	299				
Bee-eater, Little	Merops pusillus	5.15	76				
Bishop, Southern Red	Euplectes orix	49.22	727				
Bittern, Little	Ixobrychus minutus	0.68	10				
Blackcap, Bush	Lioptilus nigricapillus	1.02	15	VU	NT	Endemic	Endemic (SA, Lesotho, Swaziland)
Bokmakierie, Bokmakierie	Telophorus zeylonus	0.41	6				
Boubou, Southern	Laniarius ferrugineus	61.14	903				
Broadbill, African	Smithornis capensis	0.14	2	VU	LC		
Brownbul, Terrestrial	Phyllastrephus terrestris	48.48	716				
Brubru, Brubru	Nilaus afer	3.25	48				
Bulbul, Dark-capped	Pycnonotus tricolor	96.82	1430				
Bunting, Cinnamon-breasted	Emberiza tahapisi	0.14	2				
Bunting, Golden-breasted	Emberiza flaviventris	2.98	44				
Bush-shrike, Gorgeous	Telophorus quadricolor	6.57	97				
Bush-shrike, Grey-headed	Malaconotus blanchoti	43.60	644				
Bush-shrike, Olive	Telophorus olivaceus	12.19	180				
Bush-shrike, Orange-breasted	Telophorus sulfureopectus	24.31	359				
Buttonquail, Black-rumped	Turnix nanus	0.07	1	VU	LC		

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Buttonquail, Kurrichane	Turnix sylvaticus	0.41	6				
Buzzard, Jackal	Buteo rufofuscus	7.18	106			Endemic	Near Endemic
Buzzard, Steppe	Buteo vulpinus	21.06	311				
Camaroptera, Green-backed	Camaroptera brachyura	73.19	1081				
Canary, Brimstone	Crithagra sulphuratus	39.74	587				
Canary, Cape	Serinus canicollis	33.24	491				
Canary, Forest	Crithagra scotops	5.15	76			Endemic	Endemic (SA, Lesotho, Swaziland)
Canary, Yellow-fronted	Crithagra mozambicus	86.73	1281				
Chat, Familiar	Cercomela familiaris	48.14	711				
Cisticola, Croaking	Cisticola natalensis	23.36	345				
Cisticola, Lazy	Cisticola aberrans	17.47	258				
Cisticola, Levaillant's	Cisticola tinniens	33.04	488				
Cisticola, Pale-crowned	Cisticola cinnamomeus	0.54	8				
Cisticola, Rattling	Cisticola chiniana	13.88	205				
Cisticola, Red-faced	Cisticola erythrops	7.38	109				
Cisticola, Rufous-winged	Cisticola galactotes	0.20	3				
Cisticola, Wailing	Cisticola lais	0.27	4				
Cisticola, Wing-snapping	Cisticola ayresii	2.91	43				
Cisticola, Zitting	Cisticola juncidis	23.76	351				
Cliff-chat, Mocking	Thamnolaea cinnamomeiventris	9.88	146				
Coot, Red-knobbed	Fulica cristata	38.93	575				
Cormorant, Cape	Phalacrocorax capensis	0.07	1	EN	EN		
Cormorant, Reed	Phalacrocorax africanus	47.33	699				
Cormorant, White-breasted	Phalacrocorax carbo	17.13	253				
Coucal, Burchell's	Centropus burchellii	42.52	628			Near Endemic	
Courser, Bronze-winged	Rhinoptilus chalcopterus	0.07	1				
Crake, Baillon's	Porzana pusilla	0.07	1				

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Crake, Black	Amaurornis flavirostris	25.80	381				
Crane, Grey Crowned	Balearica regulorum	0.27	4	EN	EN		
Crested-flycatcher, Blue-mantled	Trochocercus cyanomelas	4.33	64				
Crombec, Long-billed	Sylvietta rufescens	0.68	10				
Crow, Cape	Corvus capensis	2.44	36				
Crow, Pied	Corvus albus	46.04	680				
Cuckoo, African Emerald	Chrysococcyx cupreus	20.18	298				
Cuckoo, Black	Cuculus clamosus	4.94	73				
Cuckoo, Common	Cuculus canorus	0.07	1				
Cuckoo, Diderick	Chrysococcyx caprius	34.53	510				
Cuckoo, Great Spotted	Clamator glandarius	0.07	1				
Cuckoo, Jacobin	Clamator jacobinus	0.41	6				
Cuckoo, Klaas's	Chrysococcyx klaas	32.09	474				
Cuckoo, Red-chested	Cuculus solitarius	29.11	430				
Cuckoo-shrike, Black	Campephaga flava	27.35	404				
Cuckoo-shrike, Grey	Coracina caesia	14.83	219				
Darter, African	Anhinga rufa	12.25	181				
Dove, Laughing	Streptopelia senegalensis	61.54	909				
Dove, Lemon	Aplopelia larvata	15.84	234				
Dove, Namaqua	Oena capensis	0.07	1				
Dove, Red-eyed	Streptopelia semitorquata	94.52	1396				
Dove, Rock	Columba livia	6.91	102				
Dove, Tambourine	Turtur tympanistria	48.41	715				
Drongo, Fork-tailed	Dicrurus adsimilis	90.79	1341				
Drongo, Square-tailed	Dicrurus ludwigii	41.16	608				
Duck, African Black	Anas sparsa	7.72	114				
Duck, Fulvous	Dendrocygna bicolor	0.34	5				

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Duck, Mallard	Anas platyrhynchos	0.14	2				
Duck, White-backed	Thalassornis leuconotus	0.95	14				
Duck, White-faced	Dendrocygna viduata	29.59	437				
Duck, Yellow-billed	Anas undulata	36.70	542				
Eagle, African Crowned	Stephanoaetus coronatus	45.97	679	VU	NT		
Eagle, Booted	Aquila pennatus	0.68	10				
Eagle, Long-crested	Lophaetus occipitalis	30.47	450				
Eagle, Martial	Polemaetus bellicosus	1.56	23	EN	VU		
Eagle, Verreaux's	Aquila verreauxii	1.29	19	VU	LC		
Eagle, Wahlberg's	Aquila wahlbergi	6.43	95				
Eagle-owl, Spotted	Bubo africanus	5.75	85				
Egret, Cattle	Bubulcus ibis	40.89	604				
Egret, Great	Egretta alba	1.83	27				
Egret, Little	Egretta garzetta	1.49	22				
Egret, Yellow-billed	Egretta intermedia	0.41	6				
Falcon, Amur	Falco amurensis	0.07	1				
Falcon, Lanner	Falco biarmicus	13.00	192	VU	LC		
Falcon, Peregrine	Falco peregrinus	1.49	22				
Finfoot, African	Podica senegalensis	0.07	1	VU	LC		
Firefinch, African	Lagonosticta rubricata	56.74	838				
Fiscal, Common (Southern)	Lanius collaris	80.57	1190				
Fish-eagle, African	Haliaeetus vocifer	19.97	295				
Flamingo, Greater	Phoenicopterus ruber	0.07	1	NT	LC		
Flufftail, Buff-spotted	Sarothrura elegans	6.43	95				
Flufftail, Red-chested	Sarothrura rufa	6.84	101				
Flycatcher, African Dusky	Muscicapa adusta	62.09	917				
Flycatcher, Ashy	Muscicapa caerulescens	22.21	328				

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Flycatcher, Fiscal	Sigelus silens	2.78	41			Endemic	Near Endemic
Flycatcher, Southern Black	Melaenornis pammelaina	79.55	1175				
Flycatcher, Spotted	Muscicapa striata	1.96	29				
Francolin, Red-winged	Scleroptila levaillantii	0.41	6				
Francolin, Shelley's	Scleroptila shelleyi	4.54	67				
Goose, Domestic	Anser anser	0.14	2				
Goose, Egyptian	Alopochen aegyptiacus	82.40	1217				
Goose, Spur-winged	Plectropterus gambensis	32.57	481				
Goshawk, African	Accipiter tachiro	36.02	532				
Goshawk, Gabar	Melierax gabar	0.88	13				
Grassbird, Cape	Sphenoeacus afer	37.58	555			Endemic	Near Endemic
Grebe, Little	Tachybaptus ruficollis	30.06	444				
Green-pigeon, African	Treron calvus	0.34	5				
Greenbul, Sombre	Andropadus importunus	85.44	1262				
Greenbul, Yellow-bellied	Chlorocichla flaviventris	0.68	10				
Greenshank, Common	Tringa nebularia	0.34	5				
Ground-hornbill, Southern	Bucorvus leadbeateri	0.07	1	EN	VU		
Ground-thrush, Spotted	Zoothera guttata	0.34	5	EN	EN		
Guineafowl, Crested	Guttera edouardi	0.14	2				
Guineafowl, Helmeted	Numida meleagris	21.46	317				
Hamerkop, Hamerkop	Scopus umbretta	33.65	497				
Harrier-Hawk, African	Polyboroides typus	24.10	356				
Hawk, African Cuckoo	Aviceda cuculoides	0.07	1				
Heron, Black	Egretta ardesiaca	0.07	1				
Heron, Black-headed	Ardea melanocephala	53.83	795				
Heron, Goliath	Ardea goliath	3.66	54				
Heron, Green-backed	Butorides striata	1.69	25				

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Heron, Grey	Ardea cinerea	18.14	268				
Heron, Purple	Ardea purpurea	5.89	87				
Heron, Squacco	Ardeola ralloides	0.27	4				
Honey-buzzard, European	Pernis apivorus	0.07	1				
Honeybird, Brown-backed	Prodotiscus regulus	12.39	183				
Honeyguide, Greater	Indicator indicator	0.95	14				
Honeyguide, Lesser	Indicator minor	19.97	295				
Honeyguide, Scaly-throated	Indicator variegatus	16.25	240				
Hoopoe, African	Upupa africana	31.14	460				
Hornbill, Crowned	Tockus alboterminatus	40.69	601				
Hornbill, Trumpeter	Bycanistes bucinator	53.42	789				
House-martin, Common	Delichon urbicum	0.68	10				
Ibis, African Sacred	Threskiornis aethiopicus	12.86	190				
Ibis, Glossy	Plegadis falcinellus	0.07	1				
Ibis, Hadeda	Bostrychia hagedash	96.21	1421				
Ibis, Southern Bald	Geronticus calvus	1.83	27	VU	VU		
Indigobird, Dusky	Vidua funerea	6.30	93				
Jacana, African	Actophilornis africanus	24.51	362				
Kestrel, Rock	Falco rupicolus	0.27	4				
Kingfisher, Brown-hooded	Halcyon albiventris	75.36	1113				
Kingfisher, Giant	Megaceryle maximus	9.95	147				
Kingfisher, Half-collared	Alcedo semitorquata	0.47	7	NT	LC		
Kingfisher, Malachite	Alcedo cristata	4.27	63				
Kingfisher, Pied	Ceryle rudis	5.42	80				
Kite, Black	Milvus migrans	0.20	3				
Kite, Black-shouldered	Elanus caeruleus	1.29	19				
Kite, Yellow-billed	Milvus aegyptius	55.52	820				

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Lapwing, Black-winged	Vanellus melanopterus	4.54	67				
Lapwing, Blacksmith	Vanellus armatus	44.96	664				
Lapwing, Crowned	Vanellus coronatus	2.10	31				
Lark, Red-capped	Calandrella cinerea	8.46	125				
Lark, Rufous-naped	Mirafra africana	48.00	709				
Longclaw, Cape	Macronyx capensis	9.34	138				
Longclaw, Yellow-throated	Macronyx croceus	45.90	678				
Malkoha, Green	Ceuthmochares australis	0.14	2				
Mannikin, Bronze	Spermestes cucullatus	84.77	1252				
Mannikin, Magpie	Spermestes fringilloides	0.61	9				
Mannikin, Red-backed	Spermestes bicolor	54.03	798				
Marsh-harrier, African	Circus ranivorus	0.54	8	EN	LC		
Martin, Banded	Riparia cincta	0.07	1				
Martin, Brown-throated	Riparia paludicola	10.49	155				
Martin, Rock	Hirundo fuligula	17.54	259				
Masked-weaver, Lesser	Ploceus intermedius	0.07	1				
Masked-weaver, Southern	Ploceus velatus	0.74	11				
Moorhen, Common	Gallinula chloropus	48.54	717				
Moorhen, Lesser	Gallinula angulata	0.14	2				
Mousebird, Red-faced	Urocolius indicus	1.56	23				
Mousebird, Speckled	Colius striatus	78.40	1158				
Myna, Common	Acridotheres tristis	68.38	1010				
Neddicky, Neddicky	Cisticola fulvicapilla	58.09	858				
Night-Heron, Black-crowned	Nycticorax nycticorax	0.07	1				
Night-Heron, White-backed	Gorsachius leuconotus	0.20	3	VU	LC		
Nightjar, European	Caprimulgus europaeus	0.07	1				
Nightjar, Fiery-necked	Caprimulgus pectoralis	16.99	251				

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Nightjar, Freckled	Caprimulgus tristigma	0.07	1				
Olive-pigeon, African	Columba arquatrix	22.07	326				
Openbill, African	Anastomus lamelligerus	0.54	8				
Oriole, Black-headed	Oriolus larvatus	85.10	1257				
Oriole, Eurasian Golden	Oriolus oriolus	0.07	1				
Osprey, Osprey	Pandion haliaetus	0.20	3				
Ostrich, Common	Struthio camelus	0.07	1				
Owl, Barn	Tyto alba	0.95	14				
Palm-swift, African	Cypsiurus parvus	44.14	652				
Paradise-flycatcher, African	Terpsiphone viridis	55.11	814				
Parakeet, Rose-ringed	Psittacula krameri	0.34	5				
Peacock, Common	Pavo cristatus	6.30	93				
Pelican, Great White	Pelecanus onocrotalus	0.07	1	VU	LC		
Pelican, Pink-backed	Pelecanus rufescens	5.01	74	VU	LC		
Petronia, Yellow-throated	Petronia superciliaris	4.74	70				
Pigeon, Speckled	Columba guinea	18.08	267				
Pipit, African	Anthus cinnamomeus	52.00	768				
Pipit, Buffy	Anthus vaalensis	0.14	2				
Pipit, Long-billed	Anthus similis	0.07	1				
Pipit, Plain-backed	Anthus leucophrys	15.30	226				
Pipit, Striped	Anthus lineiventris	1.83	27				
Plover, Common Ringed	Charadrius hiaticula	0.07	1				
Plover, Kittlitz's	Charadrius pecuarius	0.07	1				
Plover, Three-banded	Charadrius tricollaris	9.55	141				
Pochard, Southern	Netta erythrophthalma	0.27	4				
Prinia, Drakensberg	Prinia hypoxantha	0.20	3			Endemic	Endemic (SA, Lesotho, Swaziland)
Prinia, Tawny-flanked	Prinia subflava	82.80	1223				

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Puffback, Black-backed	Dryoscopus cubla	62.36	921				
Pygmy-Goose, African	Nettapus auritus	0.68	10	VU	LC		
Pygmy-Kingfisher, African	Ispidina picta	1.76	26				
Quail, Common	Coturnix coturnix	2.17	32				
Quailfinch, African	Ortygospiza atricollis	0.88	13				
Quelea, Red-billed	Quelea quelea	0.68	10				
Quelea, Red-headed	Quelea erythrops	0.07	1				
Rail, African	Rallus caerulescens	0.61	9				
Raven, White-necked	Corvus albicollis	43.26	639				
Reed-warbler, African	Acrocephalus baeticatus	3.45	51				
Reed-warbler, Great	Acrocephalus arundinaceus	0.20	3				
Robin, White-starred	Pogonocichla stellata	2.37	35				
Robin-chat, Cape	Cossypha caffra	78.61	1161				
Robin-chat, Chorister	Cossypha dichroa	1.83	27			Endemic	Endemic (SA, Lesotho, Swaziland)
Robin-chat, Red-capped	Cossypha natalensis	51.52	761				
Rock-thrush, Cape	Monticola rupestris	18.28	270			Endemic	Endemic (SA, Lesotho, Swaziland)
Rock-thrush, Sentinel	Monticola explorator	2.64	39			Endemic	Endemic (SA, Lesotho, Swaziland)
Roller, European	Coracias garrulus	0.41	6	NT	LC		
Ruff, Ruff	Philomachus pugnax	0.81	12				
Rush-warbler, Little	Bradypterus baboecala	53.96	797				
Sandpiper, Common	Actitis hypoleucos	1.76	26				
Sandpiper, Marsh	Tringa stagnatilis	0.07	1				
Sandpiper, Wood	Tringa glareola	1.35	20				
Saw-wing, Black (Southern race)	Psalidoprocne holomelaena	32.30	477				
Scimitarbill, Common	Rhinopomastus cyanomelas	0.34	5				
Scops-owl, Southern White-faced	Ptilopsus granti	0.41	6				
Scrub-robin, Brown	Cercotrichas signata	0.14	2			Endemic	Near Endemic

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Scrub-robin, White-browed	Cercotrichas leucophrys	43.26	639				
Seedeater, Streaky-headed	Crithagra gularis	51.59	762				
Shelduck, South African	Tadorna cana	0.34	5			Endemic	
Shoveler, Cape	Anas smithii	1.08	16			Near Endemic	
Shrike, Red-backed	Lanius collurio	1.08	16				
Snake-eagle, Black-chested	Circaetus pectoralis	0.14	2				
Snake-eagle, Brown	Circaetus cinereus	0.81	12				
Snipe, African	Gallinago nigripennis	0.34	5				
Sparrow, Cape	Passer melanurus	2.57	38				
Sparrow, House	Passer domesticus	62.09	917				
Sparrow, Southern Grey-headed	Passer diffusus	70.95	1048				
Sparrowhawk, Black	Accipiter melanoleucus	16.32	241				
Sparrowhawk, Little	Accipiter minullus	11.37	168				
Spoonbill, African	Platalea alba	2.17	32				
Spurfowl, Natal	Pternistis natalensis	54.64	807				
Spurfowl, Red-necked	Pternistis afer	0.07	1				
Starling, Black-bellied	Lamprotornis corruscus	61.00	901				
Starling, Cape Glossy	Lamprotornis nitens	44.28	654				
Starling, Common	Sturnus vulgaris	2.51	37				
Starling, Red-winged	Onychognathus morio	83.48	1233				
Starling, Violet-backed	Cinnyricinclus leucogaster	17.47	258				
Stilt, Black-winged	Himantopus himantopus	0.54	8				
Stint, Little	Calidris minuta	0.14	2				
Stonechat, African	Saxicola torquatus	55.38	818				
Stork, Black	Ciconia nigra	0.07	1	VU	LC		
Stork, White	Ciconia ciconia	0.74	11				
Stork, Woolly-necked	Ciconia episcopus	37.17	549				

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Sunbird, Amethyst	Chalcomitra amethystina	82.53	1219				
Sunbird, Collared	Hedydipna collaris	70.21	1037				
Sunbird, Greater Double-collared	Cinnyris afer	57.28	846			Endemic	Endemic (SA, Lesotho, Swaziland)
Sunbird, Grey	Cyanomitra veroxii	32.63	482				
Sunbird, Malachite	Nectarinia famosa	1.49	22				
Sunbird, Olive	Cyanomitra olivacea	71.63	1058				
Sunbird, Purple-banded	Cinnyris bifasciatus	2.17	32				
Sunbird, Scarlet-chested	Chalcomitra senegalensis	0.07	1				
Sunbird, Southern Double-collared	Cinnyris chalybeus	1.35	20			Endemic	Near Endemic
Sunbird, White-bellied	Cinnyris talatala	70.75	1045				
Swallow, Barn	Hirundo rustica	40.35	596				
Swallow, Greater Striped	Hirundo cucullata	21.67	320				
Swallow, Lesser Striped	Hirundo abyssinica	54.91	811				
Swallow, White-throated	Hirundo albigularis	12.59	186				
Swallow, Wire-tailed	Hirundo smithii	0.47	7				
Swamp-warbler, Lesser	Acrocephalus gracilirostris	13.88	205				
Swamphen, African Purple	Porphyrio madagascariensis	1.56	23				
Swift, African Black	Apus barbatus	29.18	431				
Swift, Alpine	Tachymarptis melba	3.18	47				
Swift, Common	Apus apus	1.29	19				
Swift, Horus	Apus horus	0.54	8				
Swift, Little	Apus affinis	26.88	397				
Swift, White-rumped	Apus caffer	34.39	508				
Tchagra, Black-crowned	Tchagra senegalus	8.53	126				
Tchagra, Southern	Tchagra tchagra	30.26	447			Endemic	Near Endemic
Teal, Cape	Anas capensis	0.07	1				
Teal, Hottentot	Anas hottentota	1.02	15				

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Teal, Red-billed	Anas erythrorhyncha	6.77	100				
Thick-knee, Spotted	Burhinus capensis	0.34	5				
Thick-knee, Water	Burhinus vermiculatus	1.56	23				
Thrush, Groundscraper	Psophocichla litsipsirupa	1.22	18				
Thrush, Kurrichane	Turdus libonyanus	25.05	370				
Thrush, Olive	Turdus olivaceus	62.97	930				
Tinkerbird, Red-fronted	Pogoniulus pusillus	11.37	168				
Tinkerbird, Yellow-rumped	Pogoniulus bilineatus	57.35	847				
Tit, Southern Black	Parus niger	69.13	1021				
Trogon, Narina	Apaloderma narina	19.03	281				
Turaco, Knysna	Tauraco corythaix	38.19	564			Endemic	Endemic (SA, Lesotho, Swaziland)
Turaco, Purple-crested	Gallirex porphyreolophus	82.19	1214				
Turtle-dove, Cape	Streptopelia capicola	10.90	161				
Twinspot, Green	Mandingoa nitidula	23.97	354				
Wagtail, African Pied	Motacilla aguimp	10.49	155				
Wagtail, Cape	Motacilla capensis	66.01	975				
Wagtail, Mountain	Motacilla clara	19.77	292				
Warbler, Barratt's	Bradypterus barratti	3.18	47			Endemic	Near Endemic
Warbler, Broad-tailed	Schoenicola brevirostris	1.56	23				
Warbler, Dark-capped Yellow	Chloropeta natalensis	16.45	243				
Warbler, Garden	Sylvia borin	1.02	15				
Warbler, Marsh	Acrocephalus palustris	4.47	66				
Warbler, Willow	Phylloscopus trochilus	8.94	132				
Waxbill, Blue	Uraeginthus angolensis	3.93	58				
Waxbill, Common	Estrilda astrild	40.83	603				
Waxbill, Grey	Estrilda perreini	7.45	110				
Waxbill, Orange-breasted	Amandava subflava	1.02	15				

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC Southern Africa	ENDEMIC South Africa
Waxbill, Swee	Coccopygia melanotis	2.71	40			Endemic	Near Endemic
Weaver, Cape	Ploceus capensis	10.16	150			Endemic	Near Endemic
Weaver, Dark-backed	Ploceus bicolor	42.32	625				
Weaver, Golden	Ploceus xanthops	11.24	166				
Weaver, Spectacled	Ploceus ocularis	82.53	1219				
Weaver, Thick-billed	Amblyospiza albifrons	50.85	751				
Weaver, Village	Ploceus cucullatus	91.88	1357				
Weaver, Yellow	Ploceus subaureus	10.29	152				
Wheatear, Capped	Oenanthe pileata	0.07	1				
White-eye, Cape	Zosterops virens	91.00	1344			Endemic	Near Endemic
Whydah, Pin-tailed	Vidua macroura	45.43	671				
Widowbird, Fan-tailed	Euplectes axillaris	54.71	808				
Widowbird, Long-tailed	Euplectes progne	0.34	5				
Widowbird, Red-collared	Euplectes ardens	32.30	477				
Widowbird, White-winged	Euplectes albonotatus	0.47	7				
Wood-dove, Emerald-spotted	Turtur chalcospilos	14.15	209				
Wood-hoopoe, Green	Phoeniculus purpureus	53.69	793				
Wood-owl, African	Strix woodfordii	7.11	105				
Woodland-warbler, Yellow-throated	Phylloscopus ruficapilla	18.35	271				
Woodpecker, Bearded	Dendropicos namaquus	8.53	126				
Woodpecker, Cardinal	Dendropicos fuscescens	28.30	418				
Woodpecker, Golden-tailed	Campethera abingoni	64.39	951				
Woodpecker, Olive	Dendropicos griseocephalus	20.79	307				
Wryneck, Red-throated	Jynx ruficollis	18.48	273				

APPENDIX 3
METHOD OF ASSESSING THE SIGNIFICANCE OF POTENTIAL ENVIRONMENTAL IMPACTS

The objective of the assessment of impacts is to identify and assess all the significant impacts that may arise as a result of the development of the proposed railway crossing loop extensions. The process of assessing the impacts of the project encompasses the following four activities:

* Identification and assessment of potential impacts
* Prediction of the nature, magnitude, extent and duration of potentially significant impacts
* Identification of mitigation measures that could be implemented to reduce the severity or significance of the impacts of the activity
* Evaluation of the significance of the impact after the mitigation measures have been implemented i.e. the significance of the residual impact.

In accordance with GNR 543, promulgated in terms of section 24 of the National Environmental Management Act, 1998 (Act 107 of 1998), specialists will be required to assess the significance of potential impacts in terms of the following criteria:

* Cumulative impacts
* Nature of the impact
* Extent of the impact
* Intensity of the impact
* Duration of the impact
* Probability of the impact occurring
* Impact non-reversibility
* Impact on irreplaceable resources
* Confidence level

Issues are assessed in terms of the following criteria:

* The nature, a description of what causes the effect, what will be affected and how it will be affected

* The physical extent, wherein it is indicated whether:

    1 - the impact will be limited to the site
    2 - the impact will be limited to the local area
    3 - the impact will be limited to the region
    4 - the impact will be national
    5 - the impact will be international

* The duration, wherein it is indicated whether the lifetime of the impact will be:

    1 - of a very short duration (0–1 years)
    2 - of a short duration (2-5 years)
    3 - medium-term (5–15 years)
    4 - long term (> 15 years)
    5 – permanent

* The magnitude of impact on ecological processes, quantified on a scale from 0-10, where a score is assigned:

  0 - small and will have no effect on the environment
  2 - minor and will not result in an impact on processes
  4 - low and will cause a slight impact on processes
  6 - moderate and will result in processes continuing but in a modified way
  8 - high (processes are altered to the extent that they temporarily cease)
  10 - very high and results in complete destruction of patterns and permanent cessation of processes

* The probability of occurrence, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale where:

  1 - very improbable (probably will not happen
  2 - improbable (some possibility, but low likelihood)
  3 - probable (distinct possibility)
  4 - highly probable (most likely)
  5 - definite (impact will occur regardless of any prevention measures)

* The significance, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.

* The status, which is described as either positive, negative or neutral.

* The degree to which the impact can be reversed.

* The degree to which the impact may cause irreplaceable loss of resources.

* The degree to which the impact can be mitigated.

The significance is determined by combining the criteria in the following formula:

S = (E + D + M) * P

The significance weightings for each potential impact are as follows:

< 30 points: LOW (i.e. where this impact would not have a direct influence on the decision to develop in the area);

30-60 points: MEDIUM (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated);

> 60 points: HIGH (i.e. where the impact must have an influence on the decision process to develop in the area).