JUNE 2017

INYANINGA SUBSTATION & ASSOCIATED INYANINGA-MBEWU 400KV POWER LINE

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 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 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; and a two-day site visit (helicopter fly-over) of the study area on 23-24 May 2017 (autumn survey). 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.

23 June 2017

EXECUTIVE SUMMARY

Load demands in the areas supplied by the existing Ottawa and Durban North substations, are set to double over the next 20-year period. 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 the Inyaninga 2 x 500 MVA 400/132 kV substation and its associated 400kV power line (approximately 100km in length), connecting the proposed Inyaninga substation to the Mbewu substation currently under construction. The project is located across various farms within the jurisdiction of eThekwini Metropolitan, Ilembe and Uthungulu District Municipalities in the KwaZulu Natal Province.

A fairly wide diversity of species (397 species) could be found in the broader area within which the proposed study area is located based on existing data sources. With the exception of Lanner Falcon *Falco biarmicus*, African Crowned Eagle *Stephanoaetus coronatus*, African Marsh-Harrier *Circus ranivorus* and Southern Bald Ibis *Geronticus calvus*, the majority of Red List species (n=29) have been recorded in less than ten of the 41 pentads that make up the study area. In addition, all 33 Red List species have been recorded in low numbers, with a maximum of 15 individual birds (Green Barbet *Stactolaema olivacea*) being recorded over the ten-year survey period. 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 six vegetation biomes, three of which feature more prevalently namely the Indian Ocean Coastal Belt (comprised of KwaZulu-Natal Coastal Belt Grassland, KwaZulu-Natal Coastal Belt Thornveld and Maputaland Coastal Belt), Savanna and Grassland biomes (Mucina & Rutherford, 2006). Grassland and woodland dominate the areas earmarked for the proposed substation and power line development. 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 areas are located is low to moderately sensitive from a potential bird impact perspective.

Based on a qualitative and quantitative analysis **SUBSTATION SITE INYA X3** and **CORRIDOR 2** 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 Inyaninga

substation and Inyaninga-Mbewu 400kV 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 InyaX3 and Corridor 2 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.

Load demands in the areas supplied by the existing Ottawa and Durban North substations, are set to double over the next 20-year period. 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 the Inyaninga 2 x 500 MVA 400/132kV substation and its associated 400kV power line (approximately 100km in length), connecting the proposed Inyaninga substation to the Mbewu substation currently under construction. The project is located across various farms within the jurisdiction of eThekwini Metropolitan, Ilembe and Uthungulu District Municipalities 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 and a two-day site visit) 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.

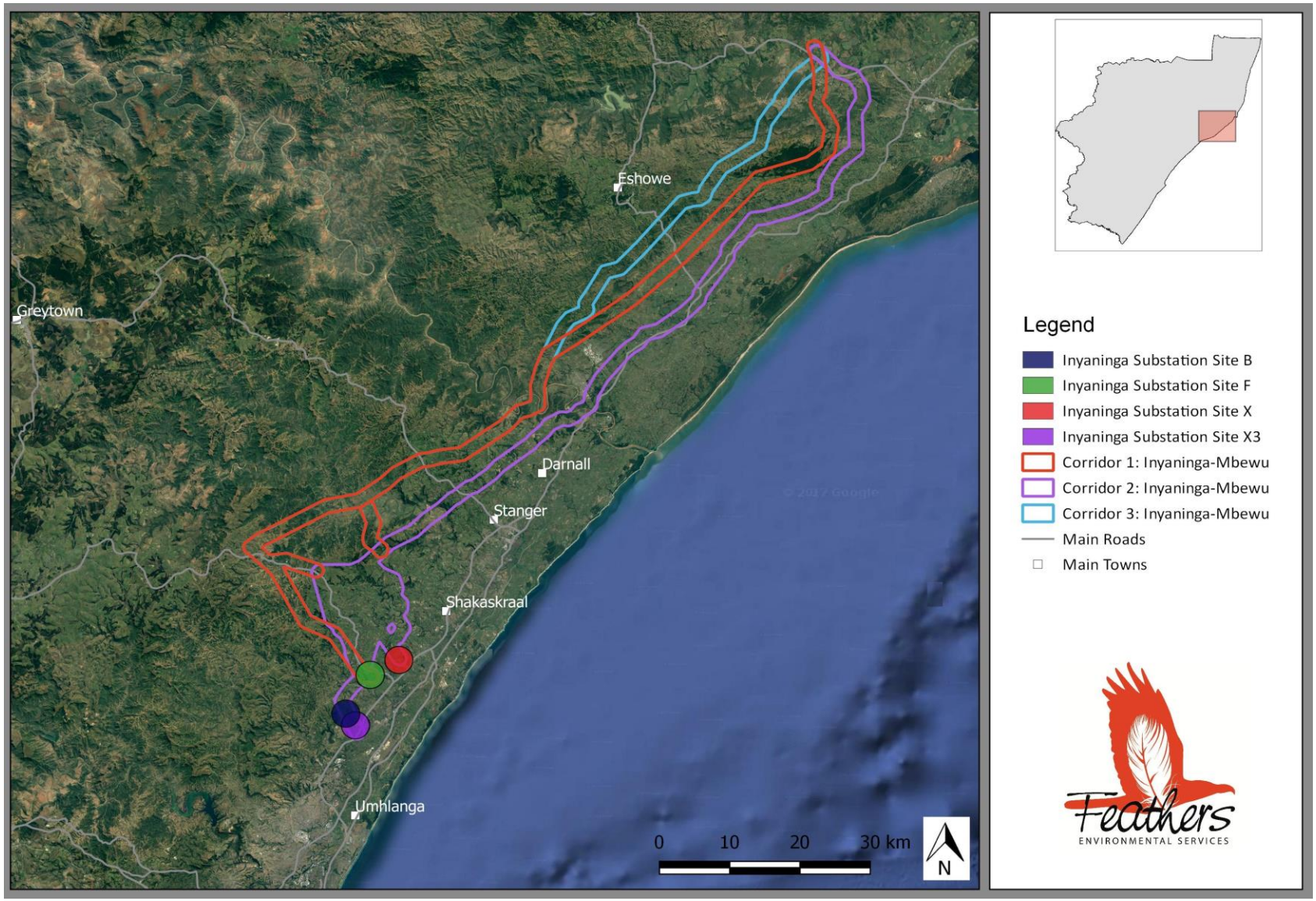

FIGURE 1: Geographical location of the study area, the proposed Inyaninga substations sites and the associated Inyaninga-Mbewu 400kV power line route alignments.

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 List 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 List (as well as non-Red List) 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 visit.
* 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 41 pentad grid cells within which the study areas are situated. Each pentad is approximately 8 × 7.6 km. Between 2007 and 2017, a total of 942 full protocol cards (i.e. 942 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: 2840_3140; 2840_3145; 2840_3150; 2845_3140; 2845_3145; 2845_3150; 2850_3130; 2850_3135; 2850_3140; 2850_3145; 2855_3125; 2855_3130; 2855_3135; 2855_3140; 2900_3120; 2900_3125; 2900_3130; 2900_3135; 2905_3120; 2905_3125; 2905_3130; 2910_3110; 2910_3115; 2910_3120; 2910_3125; 2915_3055; 2915_3100; 2915_3105. 2915_3110; 2915_3115; 2920_3055; 2920_3100; 2920_3105; 2920_3110; 2925_3055; 2925_3100; 2925_3105; 2930_3100; 2930_3105; 2935_3100 and 2935_3105.
* The Southern African Bird Atlas Project 1 (Harrison et al, 1997) - Quarter Degree Squares 2831CD; 2831DA; 2831DB; 2831DC; 2831DD; 2930BD; 2931AA; 2931AB; 2931AC; 2931AD; 2931BA and 2931CA 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. The Ngoye Forest Reserve (SA065) and Mount Moreland (SA123) IBAs are relevant to this project.

- 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. The Mandini Sewage Works and Sundumbili Sewage Works are most relevant to this study.
- 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 (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 site visit (helicopter fly-over) to the study area was conducted on 23-24 May 2017 (autumn survey) to form a first-hand impression of the micro-habitat on site. 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 (helicopter fly-over), comprised of two days, 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 41 SABAP2 pentads. Although the SABAP2 coverage of the study area appears to be extensive, with a total of 942 full protocol data cards being completed, 29 of the 41 pentads (70%) have been surveyed less than 20 times during the last ten years.
* 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.

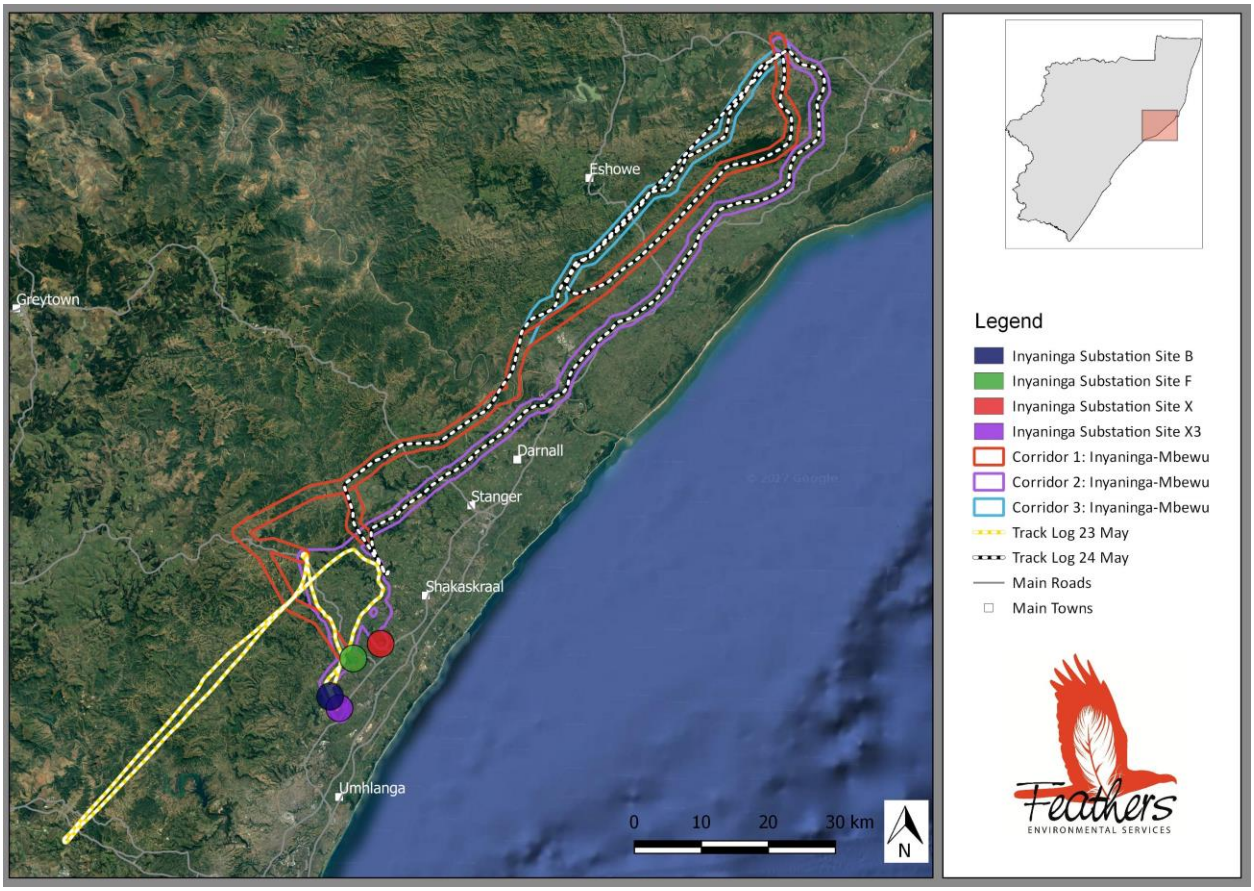

FIGURE 2: Regional map detailing the routes surveyed during the site visit (helicopter fly-over) to the study area conducted on 23-24 May 2017.

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. They are responsible for one (or more) of three factors:

- Hold significant numbers of one or more globally threatened species
- Are one of a set of sites that together hold a suite of restricted-range species or biome-restricted species
- Have exceptionally large numbers of migratory or congregatory species

There are six IBA's within 20kms of the proposed substations sites and power line corridors. The IBAs that are of most relevance to this study are the Ngoye Forest Reserve (SA065) and Mount Moreland (SA123), because of their proximity to the Corridors 1 and 3 and Inyaninga substation site InyaX3 respectively (FIGURE 3).

Ngoye Forest Reserve is located approximately 11km inland of Mtunzini and 20 km east of Eshowe. The reserve is drained by the Mhlatuzane River and its tributaries to the north and the tributaries of the Mlalazi River to the south. Large patches of grassland cover the open ridges of the reserve with bush clumps on rocky outcrops in the grassland. Some of the valleys are comprised of open woodland while the climax forest is characterised by a continuous canopy of large trees (30m in height) and poorly developed shrub and field layers. The reserve is the only forest patch in southern Africa that, due to the year-round availability of no fewer than eight species of fig species, holds and supports Green Barbet *Stactolaema olivacea*, one of the most range-restricted of all birds. In addition, other globally threatened species found within the forest include Spotted Ground Thrush *Zoothera guttata*, African Crowned Eagle *Stephanoaetus coronatus* and Southern Ground-hornbill *Bucorvus leadbeateri* and the regionally threatened Eastern Bronze-naped Pigeon *Columba delegorguei*. Populations of African Broadbill *Smithornis capensis*, Green Malkoha *Ceuthmochares australis*, White-eared Barbet *Stactolaema leucotis,* Scaly-throated Honeyguide *Indicator variegatus*, Olive Woodpecker *Dendropicos griseocephalus*, Red-backed Mannikin *Lonchura nigriceps*, Green Twinspot *Mandingoa nitidula*, Southern Tchagra *Tchagra tchagra*, Yellow-streaked Greenbul *Phyllastrephus flavostriatus*, Natal Spurfowl *Pternistis natalensis* and Forest Canary *Serinus scotops*, Grey Cuckooshrike *Coracina caesia*, Black-bellied Starling *Notopholia corrusca*, Chorister

Robin-Chat *Cossypha dichroa*, White-starred Robin *Pogonocichla stellata*, Brown Scrub Robin *Erythropygia signata* and Olive Bush-shrike *Chlorophoneus olivaceus* are common in the IBA (Marnewick et al. 2015).

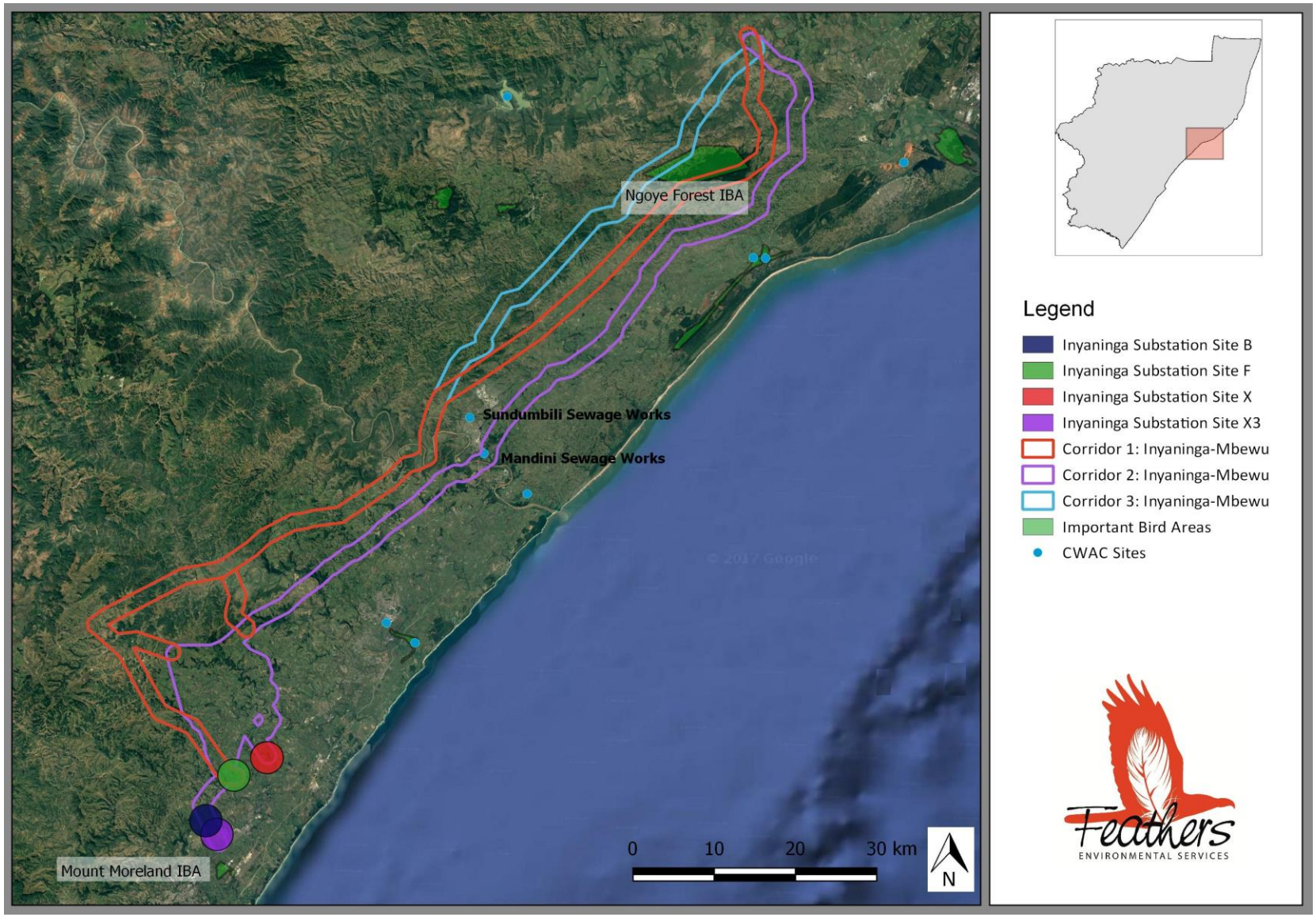

FIGURE 3: Regional map showing the study area in relation to the neighbouring Important Bird Areas (IBAs) and the Coordinated Waterbird Count sites.

The Mount Moreland IBA is located approximately 25km north of Durban, with King Shaka International Airport located 4km to the north and the N2 highway located alongside its eastern border. The area is heavily transformed and as a result little of the original grassland habitat remains. There are two wetlands in the lower-lying areas: Lake Victoria to the west of the Mount Moreland village and Froggy Pond to the east. The wetlands are dominated by *Phragmites* reedbeds and drain into the Umdloti River. The rest of the IBA is comprised of sugarcane farmlands that are the dominant feature of the surrounding landscape. The Lake Victoria and Froggy Pond wetlands support the largest single roost of Barn Swallows *Hirundo rustica* in South Africa, estimated to contain 3 million individuals. A resident population of African Marsh Harrier *Circus ranivorus* regularly hunt swallows as they come into reedbeds to roost. Similarly, both Lanner Falcon *Falco biarmicus* and Sooty Falcon *Falco concolor* have also been recorded hunting over the wetland (Marnewick et al. 2015).

The proximity of these IBAs provide an indication of the species that are likely to occur in similar habitats found within the study area. In particular, they highlight those species of conservation concern that are vulnerable to the displacement and collision impacts associated with the construction and operation of the proposed Inyaninga substation and the Inyaninga-Mbewu 400kV power line. It must be noted that the aforementioned IBAs are subject to various forms habitat transformation and existing disturbance. Cattle grazing, high fire frequencies, firewood and medicinal plant collection and the increase in homestead developments along the Ngoye reserve's boundary have adversely affected the avifaunal habitats and the species that these habitats support. Similarly, poor management practices and farming activities have largely altered the state of the Lake Victoria wetland. Although the key species within each of the IBAs has persisted despite the current displacement impacts as a result of habitat transformation and disturbance, any additional habitat loss or transformation in these areas may result in permanent displacement, which could have dire consequences for a range restricted species like the Green Barbet.

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.

Ten CWAC sites can be found within the immediate surrounds (in bird terms) of the study area. Eight of these are located some distance away, closer to the coastline. Relevant to this study, are the Mandini Sewage Works and Sundumbili Sewage Works, which are located in Corridor 2 and between Corridors 1 and 2 respectively (FIGURE 3). Unfortunately, very little data is available for both sites, with only five counts having been conducted at each location over a 23-year period. The Mandini Sewage Works shows no unusually large concentrations of any

species. Although the common duck species are numerous in summer, species diversity and bird numbers are low. Most of the water dependent species, resident in the area, prefer to utilise the Tugela River.

The Sundumbili Sewage Works has recorded twice the number of bird species counted at Mandini during the same period, but numbers of most species were low. Yellow-billed Stork *Mycteria ibis,* Purple Heron *Ardea purpurea*, African Fish-Eagle *Haliaeetus vocifer*, Black Crake *Amaurornis flavirostris*, three species of tern and three species of kingfisher have previously been recorded at the site. African Jacana *Actophilornis africanus* and Common Sandpiper *Actitis hypoleucos* were recorded in high number in summer 1995 and 1996 respectively. White-faced Duck *Dendrocygna viduata* counts are generally higher in winter.

Similarly, to IBAs, the proximity of these CWAC sites provide an indication of the waterbird species that are likely to occur in various wetland habitats within the study area. Given the size and nature of the CAWC sites (i.e. man-made impoundments) and the common species that frequent both locations, the displacement and collision impacts associated with the construction and operation of the proposed Inyaninga substation and the Inyaninga-Mbewu 400kV power line at these two sites are likely to be low. However, the impact of the proposed developments of the natural waterbodies (i.e. rivers, dams and wetlands) prevalent in the study area are likely to be of high significance.

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

A total of 397 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 397 species, 33 of these are considered to be of conservation concern (Red List), 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, which is not listed, but is protected internationally under the Bonn Convention on Migratory species, was also recorded.

With the exception of Lanner Falcon, African Crowned Eagle, African Marsh-Harrier and Southern Bald Ibis *Geronticus calvus*, the majority of Red List species (n=29) have been recorded in less than ten of the 41 pentads that make up the study area. In addition, each of the 33 Red List species have been recorded in low numbers, with a maximum of 15 individual birds (i.e. Green Barbet) being recorded over the ten-year survey period. The low report rates for these Red List species can possibly be attributed to 1) the fact that not all of the 41 pentad grid cells have been surveyed equally and extensively, with only ten pentads surveyed more than 20 times over the last decade, 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, particularly along Corridor 2 has undoubtedly displaced many of the naturally occurring species, that under optimum conditions, would inhabit these areas. Although this report focuses on Red List species, since the impacts associated with the construction and operation of the Inyaninga substation and the Inyaninga-Mbewu 400kV power line are likely to be more biologically significant for these species, the impact on non-Red List species is also assessed, albeit in less detail.

Furthermore, much of the mitigation recommended for Red List species will also protect non-Red List species in the study area. The non-Red List species that have been considered for this assessment include large eagles, buzzards, kestrels, herons, geese, ibis and various water bird species.

Each 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 List 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)
Barbet, Green *Stactolaema olivacea*	EN	LC	37.76	15.5	-	-	-	x	-	-	-	x	x
Blackcap, Bush *Lioptilus nigricapillus*	VU	NT	5.56	1.0	-	-	-	x	x	-	-	x	x
Cormorant, Cape *Phalacrocorax capensis*	EN	EN	3.85	1.0	-	estuaries	-	-	-	-	x	-	-
Crane, Grey Crowned *Balearica regulorum*	EN	EN	5.12	2.3	-	x	x	-	open	x	x	x	x
Eagle, African Crowned *Stephanoaetus coronatus*	VU	NT	11.46	3.4	-	-	-	x	dense	-	x	x	x
Eagle, Martial *Polemaetus bellicosus*	EN	VU	4.64	2.5	-	-	-	edges	open	-	x	x	x
Eagle, Tawny *Aquila rapax*	EN	LC	4.91	1.0	-	-	x	-	open	-	x	x	x
Eagle, Verreaux's *Aquila verreauxii*	VU	LC	15.38	2.0	-	-	-	-	-	-	x	-	-
Falcon, Lanner *Falco biarmicus*	VU	LC	13.73	2.9	-	-	x	-	open	x	x	-	x
Finfoot, African *Podica senegalensis*	VU	LC	2.88	1.0	x	x	-	-	-	-	-	x	x
Gannet, Cape *Morus capensis*	VU	VU	3.54	1.0	-	-	-	-	-	-	-	-	-
Ground-hornbill, Southern *Bucorvus leadbeateri*	EN	VU	18.33	7.7	-	-	x	-	x	-	x	x	x
Ground-thrush, Spotted *Zoothera guttata*	EN	EN	12.11	1.6	-	-	-	x	-	-	-	x	x
Ibis, Southern Bald *Geronticus calvus*	VU	VU	10.63	1.6	-	-	x	-	-	x	x	x	x
Jacana, Lesser *Microparra capensis*	VU	LC	4.23	1.5	-	x	-	-	-	-	-	x	x
Kingfisher, Half-collared *Alcedo semitorquata*	NT	LC	4.69	3.1	x	-	-	-	-	-	-	x	x
Marsh-harrier, African Circus ranivorus	EN	LC	8.58	3.1	-	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)
Nightjar, Swamp Caprimulgus natalensis	VU	LC	15.8	2.0	x	x	x	-	-	-	-	x	x
Oystercatcher, African Black Haematopus moquini	LC	NT	3.85	1.0	-	-	-	-	-	-	-	-	-
Painted-snipe, Greater *Rostratula benghalensis*	VU	LC	2.67	2.5	flood plains	x	-	-	-	-	-	x	x
Pelican, Great White *Pelecanus onocrotalus*	VU	LC	4.11	1.0	-	x	-	-	-	-	x	-	x
Pelican, Pink-backed *Pelecanus rufescens*	VU	LC	4.61	1.0	x	x	-	-	-	-	x	x	x
Pigeon, Eastern Bronze-naped *Columba delegorguei*	EN	LC	17.31	8.0	-	-	-	x	dense	-	-	x	x
Pipit, Short-tailed *Anthus brachyurus*	VU	LC	1.61	1.0	-	-	x	-	-	-	-	x	x
Pygmy-Goose, African *Nettapus auritus*	VU	LC	8.20	2.6	-	x	-	-	-	-	-	-	x
Roller, European *Coracias garrulus*	NT	LC	5.54	1.6	-	-	-	-	open	-	-	x	x
Sandpiper, Curlew *Calidris ferruginea*	LC	NT	12.17	12.5	-	wetlands	-	-	-	-	-	x	x
Secretarybird *Sagittarius serpentarius*	VU	VU	7.14	1.0	-	-	x	-	open	-	x	x	x
Snake-eagle, Southern Banded Circaetus fasciolatus	CR	NT	5.38	2.4	-	-	-	x	dense	-	x	x	x
Stork, Marabou *Leptoptilos crumeniferus*	NT	LC	4.17	1.0	x	x	x	-	open	-	x	x	x
Stork, Yellow-billed *Mycteria ibis*	EN	LC	4.23	1.0	x	x	-	-	-	-	x	x	x
Tern, Caspian *Sterna caspia*	VU	LC	3.22	1.0	-	x	-	-	-	-	-	-	-
Vulture, White-backed *Gyps africanus*	CR	CR	10.00	1.0	-	-	-	-	open	-	x	x	x
CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near-threatened; LC = Least Concern													

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 six vegetation biomes, three of which feature more prevalently, namely the Indian Ocean Coastal Belt (comprised of KwaZulu-Natal Coastal Belt Grassland, KwaZulu-Natal Coastal Belt Thornveld and Maputaland Coastal Belt), Savanna and Grassland biomes (Mucina & Rutherford, 2006). Grassland and woodland/thicket dominate the areas earmarked for the proposed substation and power line development (TABLE 4.1).

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

BIOME	Corridor 1	Corridor 2	Corridor 3
Indian Ocean Coastal Belt	57.64%	86.69%	51.30%
Savanna	26.48%	11.83%	32.77%
Grassland	12.95%	0.00%	13.39%
Forests	1.92%	0.71%	2.01%
Azonal Vegetation	0.96%	0.69%	0.44%
Waterbodies (Freshwater Lakes)	0.00%	0.09%	0.00%

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).

Several river systems feature prominently within the study area and include: Tongati; Mvoti; Zinkwazi; Thukela; Mkukuze; Mhlatuze; Mona; Mhlali; Nsuze, Nonoti; Nyoni; Matigulu; Nyezane, Mlalazi, KwaGugushe; Mhlatuzana and the Ntambanana (FIGURE 4 and APPENDIX 1 - FIGURE 1). Relevant to this study, the aforementioned rivers are all traversed by one or more of the proposed Inyaninga-Mbewu power line corridors. Red Data species that have been recorded in the study area and that are likely to frequent these rivers include Pink-backed Pelican *Pelecanus rufescens* in addition to Yellow-billed Stork and Marabou Stork *Leptoptilos crumeniferus,* that will forage in rivers and often roost in tall trees in the riparian zone (Hockey *et al* 2005). Thick riparian vegetation provides cover for shy species such as the African Finfoot *Podica senegalensis,* Swamp Nightjar *Caprimulgus natalensis* and Half-collared Kingfisher *Alcedo semitorquata*. Therefore, potential collision and displacement impacts as a result of habitat loss and disturbance associated with the construction and operation of the proposed Inyaninga-Mbewu 400kV power line are likely to be significant.

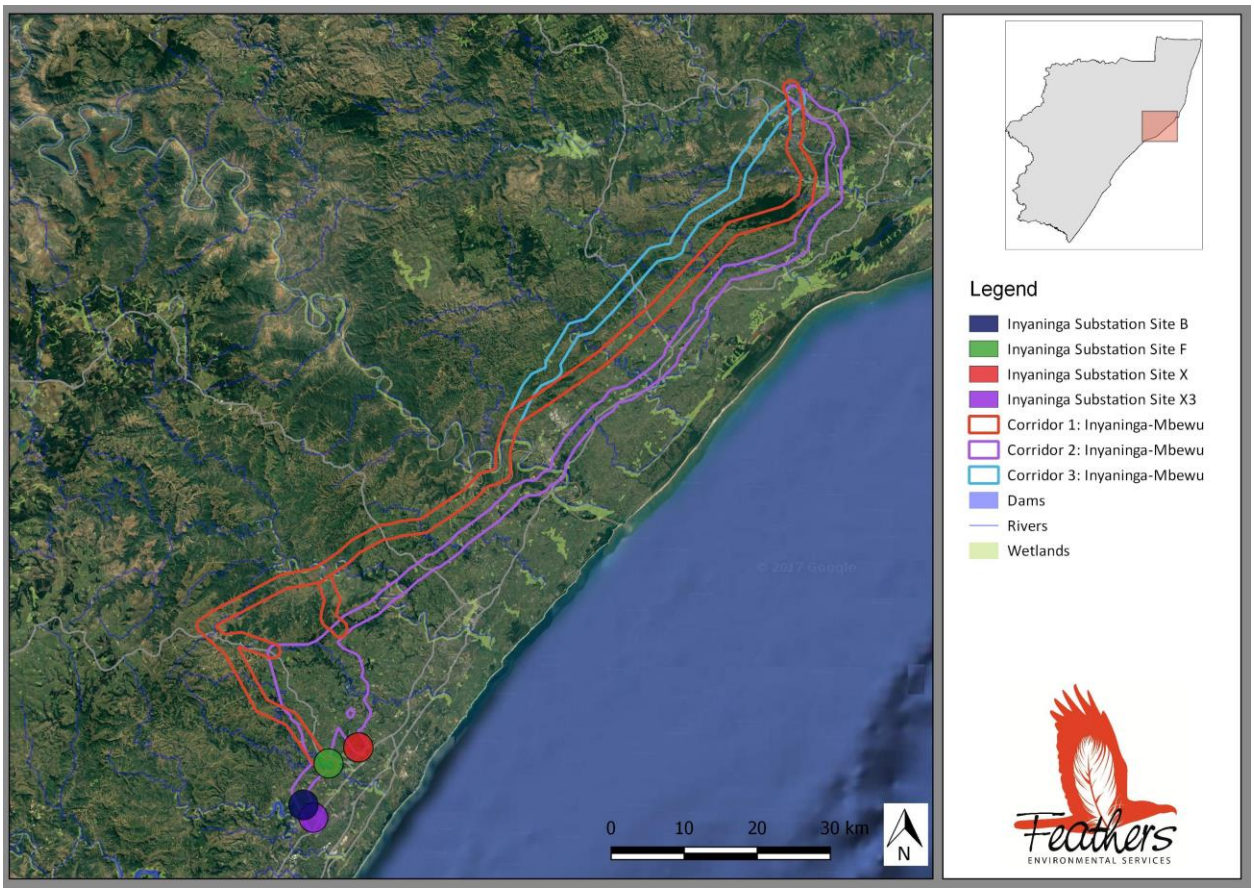

FIGURE 4. Regional map detailing the river systems, dams and wetlands that occur within the study area

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. Several, fairly extensive wetlands (mostly associated with the aforementioned river systems) occur within the study area and (FIGURE 4 and APPENDIX 1 - FIGURE 2) and will 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 the extensive nature of the wetlands and diversity of species that these habitats support, the construction and operational activities associated with the proposed Inyaninga-Mbewu 400kV power line are likely to result in significant displacement impacts if not appropriately mitigated.

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 List 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 *Balearica regulorum*, Yellow-billed Stork, Marabou Stork, Great White Pelican *Pelecanus onocrotalus*, Pink-backed Pelican, Caspian Tern *Sterna caspia*, African Pygmy-Goose *Nettapus auritus*, Greater Painted-Snipe *Rostratula benghalensis*, Swamp Nightjar, Lesser Jacana *Microparra capensis* and African Finfoot. Common species in the study area that could use dams and dam edges include African Darter *Anhinga rufa*, various heron and duck species, Blacksmith Lapwing *Vanellus armatus,* African Sacred Ibis *Threskiornis aethiopicus* and Egyptian Goose *Alopochen aegyptiacus.* For 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 Inyaninga-Mbewu 400kV power line.

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 between 50 and 80 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. However, in those areas where grasslands persist

(APPENDIX 1 - FIGURE 5) this habitat will typically attract Southern Bald Ibis, Grey Crowned Crane, Secretarybird *Sagittarius serpentarius,* Southern Ground-hornbill, Marabou Stork and White Stork *Ciconia ciconia.* All 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 *Numida meleagris*. This in turn attracts large raptors because of both the presence and accessibility of prey.

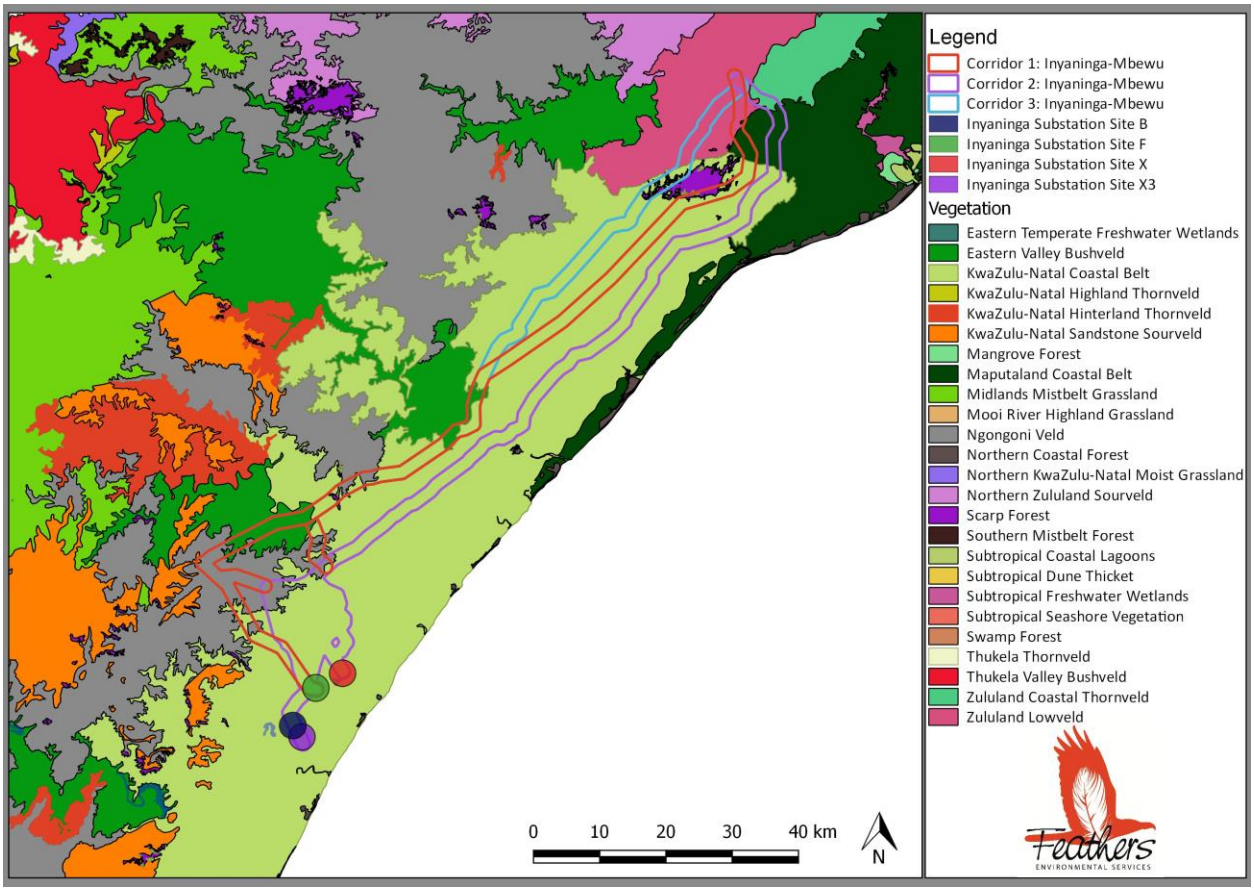

FIGURE 5. Regional map detailing the vegetation units that occur within the study area

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 List species (recorded in the study area by SABAP2) such as Martial Eagle *Polemaetus bellicosus*, Tawny Eagle *Aquila rapax*, Lanner Falcon, Marabou Stork, White-backed Vulture *Gyps africanus*, Secretarybird and European Roller *Coracias garrulus.* Apart from Red List species, it also supports several non-Red List raptor species, such as the Brown Snake-Eagle *Circaetus cinereus*, Black-chested Snake-Eagle *Circaetus pectoralis*, and a multitude of medium-sized raptors, for example the migratory Steppe Buzzard *Buteo vulpinus*, African Harrier-Hawk (Gymnogene)

Polyboroides typus, 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 6) in places to a relatively poor state with evidence of heavy disturbance and habitat transformation evident near towns and settlements (APPENDIX 1 - FIGURE 8). As mentioned previously, the SABAP2 reporting rates for the Red List 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 Forest. This vegetation type is found on slopes and in secluded valleys between the coast and the Mistbelt. A typical and conspicuous example of this forest type is the oNgoye Forest Reserve. This large remnant patch of coastal forest covering approximately 3900ha, supports the rare and endemic Green Barbet. It is also home to the Eastern Bronze-naped Pigeon and soaring raptors i.e. African Crowned Eagle, Black-chested Snake-Eagle, Yellow-billed Kite *Milvus aegyptius*, Jackal Buzzard *Buteo rufofuscus*, Steppe Buzzard, African Goshawk *Accipiter tachiro* and Black Sparrowhawk *Accipiter melanoleucus*. The reserve also holds extensive patches of grassland where Secretarybird and Southern Ground-hornbill can be found.

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, 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 cultivated lands dotted throughout the study area. There are however numerous examples of commercial plantations, i.e. sugarcane, banana and pine plantations are located within the study area, particularly Study Corridor 2 (APPENDIX 1 - FIGURE 6 and FIGURE 7). 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 the Kurrichane Buttonquail *Turnix sylvaticus*, Black-headed Heron *Ardea melanocephala*

(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, particularly in areas close to water.

4.2.8. Urban Areas

These areas include surface infrastructure such as roads and buildings (APPENDIX 1 - FIGURE 8). Built-up areas generally are of little value to sensitive Red List bird species due to their degraded nature and the associated disturbance factor. They do however 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 List species related to the proposed Inyaninga substation and associated Inyaninga-Mbewu 400kV power line 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, although sections of the study area have already been intensively transformed through urbanisation and cultivation, several river systems, wetlands and areas of natural woodland feature quite prominently within the study area (particularly power line corridors 1 and 3) that are likely to 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. The proposed development is likely to have habitat transformation impact of **MEDIUM** significance from an avifaunal perspective.

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 agricultural and urban activities in the immediate vicinity of the substation sites and within Corridor 2. Based on the relatively small footprint and the location of the of the proposed Inyaninga substation and low reporting rates for Red List 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 List species are concerned. However, based on the habitat availability within the proposed power line corridors, the displacement impact as a result of disturbance during the construction of the Inyaninga-Mbewu power line is likely to be of **MEDIUM** significance. If the power line is authorised, a detailed inspection of the authorised alignment would be required to establish if there are any breeding Red List 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 List 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 Inyaninga-Mbewu 400kV power line 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.

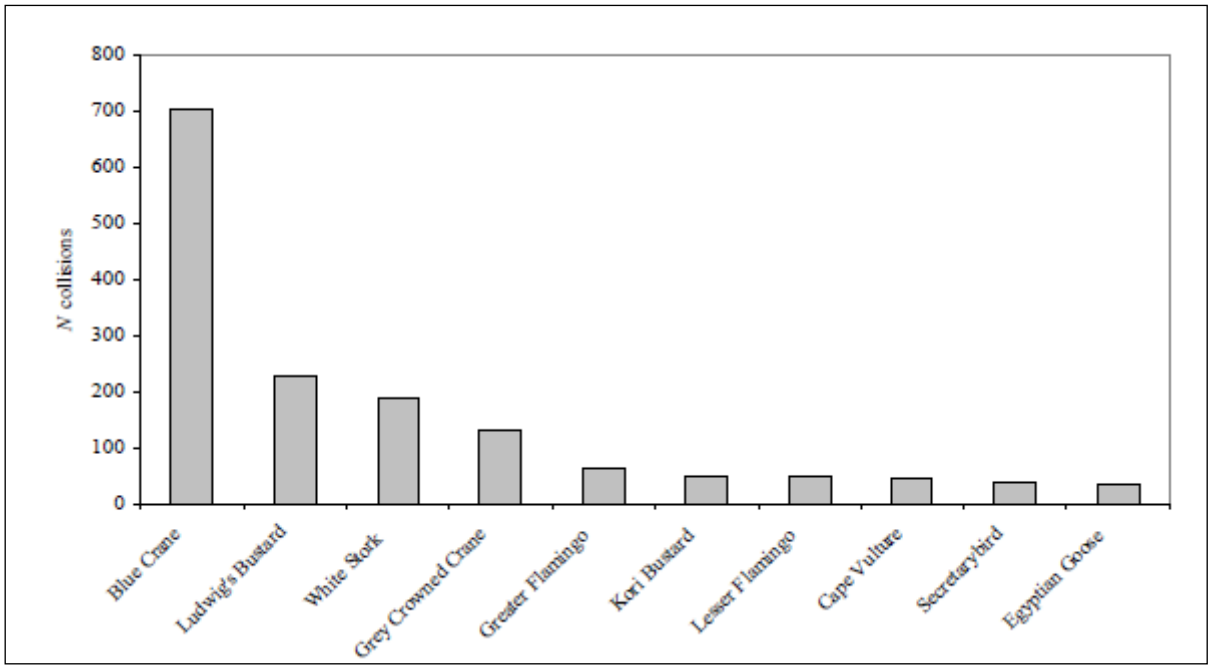

FIGURE 6: The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2007 (Jenkins et al. 2010)

Collision of large heavily-bodied Red List species such as Grey Crowned Crane, Secretarybird, Southern Bald Ibis, Southern Ground-hornbill, Great White Pelican, Pink-backed Pelican, Yellow-billed Stork and Marabou Stork in addition to 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 **HIGH** 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 Inyaninga-Mbewu 400kV power line will not be possible through conventional mechanisms and will therefore not be assessed in terms of its significance.

Electrocutions within the proposed Inyaninga substation are possible, but should not affect the more sensitive Red List 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 ALTERNATIVE

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.

6.1 COMPARRISON OF SUBSTATION ALTERNATIVES

The areas that have been delineated for the four Inyaninga substation sites (InyaB, InyaF, InyaX and InyaX3) occur within the same quarter degree square (Harrison *et al.* 1998) and within adjoining pentads. They are comprised of similar vegetation and micro habitat and are subjected to similar land use practices. All four sites are therefore likely to be identical in terms of species diversity and density too. With this in mind, the selection of a preferred substation site has been determined using observations (of available micro habitat, land use types and the location of the proposed substation site in relation to existing infrastructure) made during the field visit to the study area. Substation sites InyaB and InyaX3 are wholly transformed by sugarcane cultivation and are subject to fairly significant sources of existing disturbance from the neighbouring farmlands, residential areas and in the case

of InyaX3, the King Shaka International Airport. Substation site InyaX3 is located much closer to the airport and is likely to be within the impact zone for this facility and as a result likely to provide less favourable conditions for some of the more sensitive species. Similarly, substation site InyaF is also located between two residential areas and is largely comprised of sugarcane. However, pockets of indigenous riparian woodland, associated with the Tongati River set this site apart from the InyaB and InyaX3 substation sites to the south. Substation site InyaX lies to the north-east of substation site InyaF and is also comprised of sugarcane farmlands. The Dudley Pringle Dam, a natural lake, is a prominent feature within the area which is reported to support a diversity of bird species. The natural avifaunal habitats are under significant pressure in terms of fragmentation, transformation and permanent loss as a result agricultural and urban activities occurring in the area at present. Although enough land surface has been set aside within each of the proposed sites enabling micro-siting of the substation facility, thereby avoiding sensitive areas, every effort must be made to secure these natural habitats, no matter how small in extent, to ensure the density and diversity of the bird species that are attracted to and supported by these key habitats. It is on this basis that **substation site InyaX3 is recommended as the preferred Inyaninga substation alternative.**

6.2 COMPARRISON OF POWER LINE CORRIDOR ALTERNATIVES

The following factors were considered to arrive at a preferred corridor for the proposed Inyaninga-Mbewu 400kV power line, primarily using high resolution Google Earth imagery 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 List and several non-Red List water dependent species which could potentially be impacted through collisions with the proposed power line and disturbance during the construction of the proposed power line.

* *Waterbodies (wetlands and dams)* - Wetlands and dam edges are vitally important habitat for Red List and non-Red List 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, orchards and pine plantations with smaller communal/subsistence cultivated lands dotted throughout the landscape. 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 List species forage in cultivated lands and although this habitat is not as important as natural grassland, rivers and waterbodies, collision with the power line 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 within each corridor

FACTOR	Corridor 1	Corridor 2	Corridor 3
River Crossings	16	14	15
Waterbodies (wetlands, dams, pans)	347.45	322.50	309.70
Grassland	1108.70	581.50	1554.00
Indigenous Forest	657.10	84.90	647.50
Woodland (open)	565.40	291.70	700.90

Thicket	11175.20	8074.00	12949.40
Cultivated Land (commercial)	10053.50	21811.00	8350.70
Cultivated Land (subsistence)	2125.10	1231.30	1818.60
Urban	6815.80	3425.40	5647.30
Existing TX Power Lines	59.88	287.91	58.43

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	10
Waterbodies (wetlands, dams, pans)	8	10
Grassland	6	8
Indigenous Forest	10	2
Woodland (open)	6	6
Thicket	8	4
Cultivated Land (commercial)	-2	2
Cultivated Land (subsistence)	2	4
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 or length of corridor within the risk factor x weighting. This calculation was done for each corridor. The final risk rating in each impact category for an alignment was calculated as the sum of the risk scores of the individual factors ÷ 100. Finally, the overall risk rating for an alignment was calculated by summing the respective risk ratings for collisions and displacement for each alignment (see Table 6-3 below).

TABLE 6-3: The final scores for the respective alignments

FACTOR	DISPLACEMENT		
	Corridor 1	Corridor 2	Corridor 3
River Crossings	1.28	1.12	1.20
Waterbodies (wetlands, dams, pans)	27.80	25.80	24.78
Grassland	66.52	34.89	93.24
Indigenous Forest	65.71	8.49	64.75
Woodland (open)	33.92	17.50	42.05

Thicket	894.02	645.92	1035.95
Cultivated Land (commercial)	-201.07	-436.22	-167.01
Cultivated Land (subsistence)	42.50	24.63	36.37
Urban	-136.32	-68.51	-112.94
Existing TX Power Lines	-59.88	-287.91	-58.43
FACTOR	**COLLISIONS**		
	Corridor 1	**Corridor 2**	**Corridor 3**
River Crossings	1.6	1.4	1.5
Waterbodies (wetlands, dams, pans)	34.75	32.25	30.97
Grassland	88.70	46.52	124.32
Indigenous Forest	13.14	1.70	12.95
Woodland (open)	17.50	17.50	42.05
Thicket	447.01	322.96	517.98
Cultivated Land (commercial)	201.07	436.22	165.14
Cultivated Land (subsistence)	85.00	49.25	72.74
Urban	68.16	34.25	56.47
Existing TX Power Lines	-59.88	-287.91	-58.43
OVERALL RATING	**1631.53**	**619.85**	**1925.65**

From the analysis above, the **CORRIDOR 2** emerged as the preferred power line corridor alternative 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 Inyaninga substation and the Inyaninga-Mbewu 400kV power line 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 List species as a result of habitat loss or transformation									
1.1 Avifaunal habitat is cleared to accommodate the Inyaninga 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 four 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 List species.	**Highly Probable (4)**	**Medium (44)**	**Low (20)**	**Low**	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 List 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)**	**Moderate (6)** although the footprint size per tower is	**Probable (3)**	**Medium (36)**	**Low (18)**	**Medium**	The selection of **CORRIDOR 2** will reduce the significance of this impact.	**High**

accommodate the Inyaninga-Mbewu 400kV 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 List 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 mitigation)	Significance (with mitigation)	Reversibility	Mitigation	Confidence level
IMPACT 2: Displacement of Red List species as a result of disturbance									
2.1 Displacement as a result of disturbance associated with the construction of the Inyaninga 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 List species.	**Low (12)**	**Medium**	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 List 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 Inyaninga-Mbewu 400kV power line (i.e.	**Local (2)**	**Short term (4)**	**Moderate (6)**	**Probable (3)**	**Medium (36)**	**Medium (30)**	**Medium**	The selection of **CORRIDOR 2** will reduce the significance of this impact. An avifaunal walk-	**High**

noise and movement of construction and operational equipment and personnel) resulting in a negative direct impact on the resident avifauna.								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 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 List 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**	**Significance (with**	**Reversibility**	**Mitigation**	**Confidence level**

					mitigation)	**mitigation)**			
IMPACT 1: Mortality of Red List species due to collision with the power line earth wire/conductors									
1.1 Collisions of Red List avifauna with the earthwire of the Inyaninga-Mbewu 400kV power line**,** resulting in a negative direct mortality impact, particularly large terrestrial, waterbirds and to a lesser extent raptors.	**Local (2)**	**Long term (4)**	**High (8)**	**Probable (3)**	**Medium (42**)	**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 2 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 finalized. 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 List species, which may also indicate that levels of disturbance are high. The construction of the proposed Inyaninga substation and Inyaninga-Mbewu 400kV power line 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 Inyaninga substation and Inyaninga-Mbewu 400kV 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 InyaX3 and Corridor 2 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.

8 REFERENCES

Anderson, M.D. 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Draft report to Eskom Resources and Strategy Division. Johannesburg. South Africa.

Avian Power Line Interaction Committee (APLIC). 1994. Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute. Washington D.C.

Avian Power Line Interaction Committee (APLIC). 2012. Mitigating Bird Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute. Washington D.C.

Endangered Wildlife Trust – Wildlife & Energy Programme (EWT-WEP). 2013. Eskom-EWT Strategic Partnership Central Incident Register.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V and Brown, C.J. (eds). 1997. The atlas of southern African birds. Vol. 1&2. BirdLife South Africa: Johannesburg.

Hobbs, J.C.A. & Ledger J.A. 1986a. The Environmental Impact of Linear Developments; Power lines and Avifauna. (Third International Conference on Environmental Quality and Ecosystem Stability. Israel, June 1986).

Hobbs, J.C.A. & Ledger J.A. 1986b. "Power lines, Birdlife and the Golden Mean." Fauna and Flora, 44, pp 23-27.

Hockey, P.A.R, Dean, W.R.J and Ryan, P. 2005. Robert's birds of southern Africa (Vii) edition. The John Voelcker Bird Book Fund, Johannesburg.

Jenkins, A.R., Smallie, J.J. & Diamond, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. *Bird Conservation International* 20: 263-278

Kruger, R. & Van Rooyen, C.S. 1998. Evaluating the risk that existing power lines pose to large raptors by using risk assessment methodology: the Molopo Case Study. (5th World Conference on Birds of Prey and Owls: 4 - 8 August 1998. Midrand, South Africa.)

Kruger, R. 1999. Towards solving raptor electrocutions on Eskom Distribution Structures in South Africa. M. Phil. Mini-thesis. University of the Orange Free State. Bloemfontein. South Africa.

Ledger, J. 1983. Guidelines for Dealing with Bird Problems of Transmission Lines and Towers. Escom Test and Research Division Technical Note TRR/N83/005.

Ledger, J.A. & Annegarn H.J. 1981. "Electrocution Hazards to the Cape Vulture (Gyps coprotheres) in South Africa". Biological Conservation, 20, pp15-24.

Ledger, J.A. 1984. "Engineering Solutions to the problem of Vulture Electrocutions on Electricity Towers." The Certificated Engineer, 57, pp 92-95.

Ledger, J.A., J.C.A. Hobbs & Smith T.V. 1992. Avian Interactions with Utility Structures: Southern African Experiences. (Proceedings of the International Workshop on Avian Interactions with Utility Structures, Miami, Florida, 13-15 September 1992. Electric Power Research Institute.)

Marnewick, M.D., Retief E.F., Theron N.T., Wright D.R., Anderson T.A. 2015. Important Bird and Biodiversity Areas of South Africa. Johannesburg: BirdLife South Africa.

Martin, G.R., Shaw, J.M. 2010. Bird collisions with power lines: Failing to see the way ahead?. Biol. Conserv. (2010), doi:10.1016/j.biocon.2010.07.014.

Mucina. L. & Rutherford, M.C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Rivers-Moore, N.A., Goodman, P.S. and Nkosi, M.R. 2007. An assessment of the freshwater natural capital in KwaZulu-Natal for conservation planning.

Shaw, J.M. 2013. Power line collisions in the Karoo: Conserving Ludwig's Bustard. Unpublished PhD thesis. Percy FitzPatrick Institute of African Ornithology, Department of Biological Sciences, Faculty of Science University of Cape Town May 2013.

Smallie, J.J. 2013. Common bird interactions with wind and solar energy facilities. Unpublished WildSkies report.

Southern African Bird Atlas Project 2 (SABAP2). http://sabap2.adu.org.za. Accessed 7 June 2017.

Taylor, P.B., Navarro, R.A., Wren- Sargent, M., Harrison, J.A. & Kieswetter, S.L. 1999. TOTAL CWAC Report. Coordinated waterbird counts in South Africa, 1992-97. Avian Demography Unit, University of Cape Town.

Taylor, M.R., Peacock, F. and Wanless, R.M. (eds) 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

Van Rooyen, C.S. & Ledger, J.A. 1999. "Birds and utility structures: Developments in southern Africa" in Ferrer, M. & G..F.M. Janns. (eds.) Birds and Power lines. Quercus: Madrid, Spain, pp 205-230

Van Rooyen, C.S. 1998. Raptor mortality on power lines in South Africa. (5th World Conference on Birds of Prey and Owls: 4 - 8 August 1998. Midrand, South Africa.)

Van Rooyen, C.S. 1999**.** An overview of the Eskom - EWT Strategic Partnership in South Africa. (EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999, Charleston, South Carolina.)

Van Rooyen, C.S. 2000. "An overview of Vulture Electrocutions in South Africa." Vulture News, 43, pp 5-22. Vulture Study Group: Johannesburg, South Africa.

Van Rooyen, C.S. 2004a. The Management of Wildlife Interactions with overhead lines. In The fundamentals and practice of Overhead Line Maintenance (132kV and above), pp217-245. Eskom Technology, Services International, Johannesburg.

Van Rooyen, C.S. 2004b. Investigations into vulture electrocutions on the Edwardsdam-Mareetsane 88kV feeder, Unpublished report, Endangered Wildlife Trust, Johannesburg.

Van Rooyen, C.S. & Taylor, P.V. 1999. Bird Streamers as probable cause of electrocutions in South Africa. (EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999. Charleston, South Carolina)

Young, D.J., Harrison, J.A, Navarro, R.A., Anderson, M.A., & Colahan, B.D. (Eds). 2003. Big birds on farms: Mazda CAR Report 1993-2001. Avian Demography Unit: Cape Town.

APPENDIX 1
AVIFAUNAL HABITAT OBSERVED WITHIN THE STUDY AREA

FIGURE 1: An example of a typical large 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.

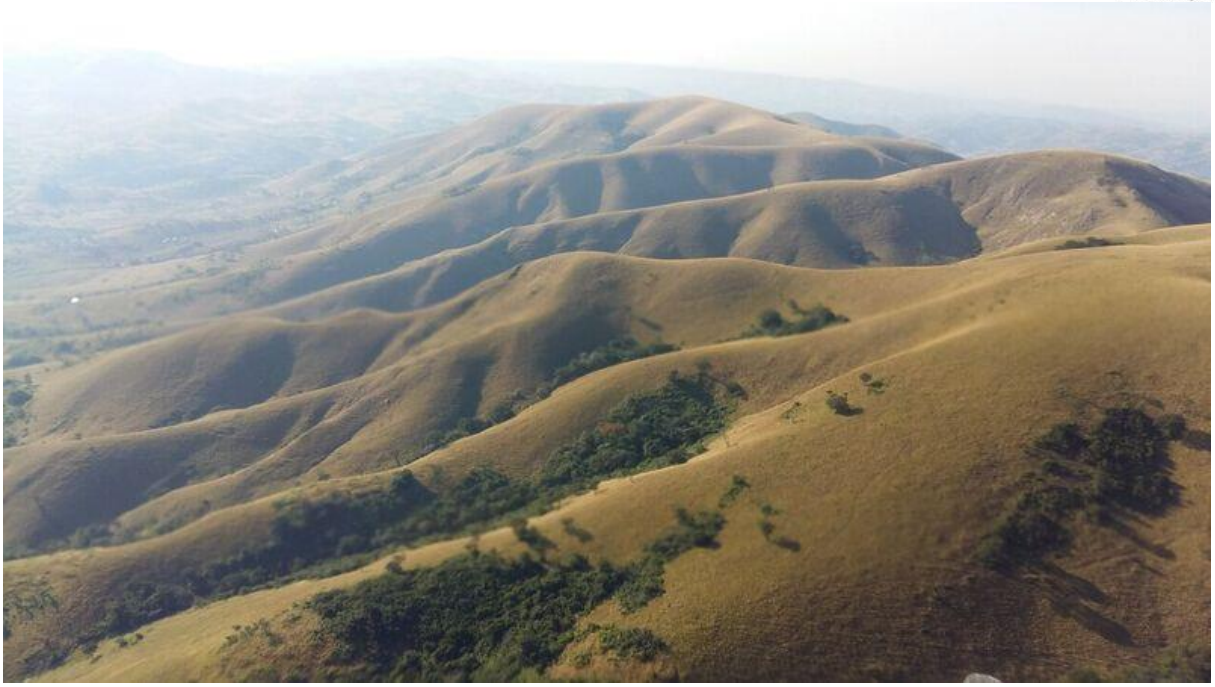

FIGURE 4: Natural grassland habitat interspersed with small pockets of woodland on hilltops

FIGURE 5: Dense woodland habitat.

FIGURE 6: Sugarcane plantations dominate much of the study area

FIGURE 7: Large stands of pine plantations

FIGURE 8: A well-established residential area

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 - South Africa	ENDEMIC - Southern Africa
Apalis, Bar-throated	Apalis thoracica	10.00	13				
Apalis, Rudd's	Apalis ruddi	23.53	4				Near Endemic
Apalis, Yellow-breasted	Apalis flavida	50.00	5				
Avocet, Pied	Recurvirostra avosetta	3.13	1				
Babbler, Arrow-marked	Turdoides jardineii	4.55	1				
Barbet, Acacia Pied	Tricholaema leucomelas	11.76	2				Near Endemic
Barbet, Black-collared	Lybius torquatus	80.00	8				
Barbet, Crested	Trachyphonus vaillantii	30.00	3				
Barbet, Green	Stactolaema olivacea	54.55	12	EN	LC		
Barbet, White-eared	Stactolaema leucotis	11.76	2				
Batis, Cape	Batis capensis	27.27	6				Near Endemic
Batis, Chinspot	Batis molitor	60.00	6				
Bee-eater, Blue-cheeked	Merops persicus	0.77	1				
Bee-eater, European	Merops apiaster	0.77	1				
Bee-eater, Little	Merops pusillus	20.00	2				
Bee-eater, White-fronted	Merops bullockoides	30.00	3				
Bishop, Southern Red	Euplectes orix	64.71	11				
Bittern, Little	Ixobrychus minutus	0.77	1				
Blackcap, Bush	Lioptilus nigricapillus	5.56	1	VU	NT	Endemic (SA, Lesotho, Swaziland)	Endemic
Bokmakierie, Bokmakierie	Telophorus zeylonus	0.77	1				Near Endemic
Boubou, Southern	Laniarius ferrugineus	50.00	5				Endemic
Brownbul, Terrestrial	Phyllastrephus terrestris	30.00	3				
Brubru, Brubru	Nilaus afer	10.00	1				
Bulbul, Dark-capped	Pycnonotus tricolor	100.00	10				
Bunting, Cinnamon-breasted	Emberiza tahapisi	10.00	1				
Bunting, Golden-breasted	Emberiza flaviventris	10.00	1				
Bush-shrike, Gorgeous	Telophorus quadricolor	70.00	7				
Bush-shrike, Grey-headed	Malaconotus blanchoti	23.53	4				
Bush-shrike, Olive	Telophorus olivaceus	1.54	2				Near Endemic
Bush-shrike, Orange-breasted	Telophorus sulfureopectus	40.00	4				
Bustard, Black-bellied	Lissotis melanogaster	15.38	2				
Buttonquail, Kurrichane	Turnix sylvaticus	10.00	1				
SPECIES	TAXONOMIC NAME	AV. REPORT	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC - South Africa	ENDEMIC - Southern Africa

		RATE					
Buzzard, Jackal	Buteo rufofuscus	5.88	1			Near Endemic	Endemic
Buzzard, Lizard	Kaupifalco monogrammicus	1.77	2				
Buzzard, Steppe	Buteo vulpinus	11.76	2				
Camaroptera, Green-backed	Camaroptera brachyura	60.00	6				
Camaroptera, Grey-backed	Camaroptera brevicaudata	1.75	1				
Canary, Brimstone	Crithagra sulphuratus	10.00	1				
Canary, Cape	Serinus canicollis	0.77	1				Endemic
Canary, Forest	Crithagra scotops	1.61	1			Endemic (SA, Lesotho, Swaziland)	Endemic
Canary, Yellow-fronted	Crithagra mozambicus	100.00	10				
Chat, Buff-streaked	Oenanthe bifasciata	16.67	1			Endemic (SA, Lesotho, Swaziland)	Endemic
Chat, Familiar	Cercomela familiaris	5.88	1				
Cisticola, Croaking	Cisticola natalensis	20.00	2				
Cisticola, Lazy	Cisticola aberrans	20.00	2				
Cisticola, Levaillant's	Cisticola tinniens	1.61	1				
Cisticola, Pale-crowned	Cisticola cinnamomeus	5.38	7				
Cisticola, Rattling	Cisticola chiniana	60.00	6				
Cisticola, Red-faced	Cisticola erythrops	17.65	3				
Cisticola, Rufous-winged	Cisticola galactotes	5.88	1				Near Endemic
Cisticola, Wailing	Cisticola lais	9.09	1				
Cisticola, Wing-snapping	Cisticola ayresii	0.77	1				
Cisticola, Zitting	Cisticola juncidis	70.00	7				
Cliff-chat, Mocking	Thamnolaea cinnamomeiventris	4.55	1				
Coot, Red-knobbed	Fulica cristata	2.31	3				
Cormorant, Cape	Phalacrocorax capensis	3.85	1	EN	EN		Breeding Endemic
Cormorant, Reed	Phalacrocorax africanus	40.00	4				
Cormorant, White-breasted	Phalacrocorax carbo	20.00	2				
Coucal, Black	Centropus grillii	12.50	1				
Coucal, Burchell's	Centropus burchellii	60.00	6				Near Endemic
Courser, Temminck's	Cursorius temminckii	5.38	7				
Crake, Black	Amaurornis flavirostris	10.00	1				
Crane, Grey Crowned	Balearica regulorum	2.31	3	EN	EN		
Crested-flycatcher, Blue-mantled	Trochocercus cyanomelas	18.18	4				
Crombec, Long-billed	Sylvietta rufescens	30.00	3				
Crow, Cape	Corvus capensis	10.00	1				
Crow, Pied	Corvus albus	80.00	8				
SPECIES	**TAXONOMIC NAME**	**AV. REPORT**	**NUMBER**	**REG. STATUS**	**GLOBAL STATUS**	**ENDEMIC - South Africa**	**ENDEMIC - Southern Africa**

		RATE					
Cuckoo, African Emerald	Chrysococcyx cupreus	10.00	1				
Cuckoo, Black	Cuculus clamosus	3.85	5				
Cuckoo, Diderick	Chrysococcyx caprius	41.18	7				
Cuckoo, Jacobin	Clamator jacobinus	0.77	1				
Cuckoo, Klaas's	Chrysococcyx klaas	10.00	1				
Cuckoo, Red-chested	Cuculus solitarius	10.00	1				
Cuckoo-shrike, Black	Campephaga flava	3.08	4				
Cuckoo-shrike, Grey	Coracina caesia	13.64	3				
Darter, African	Anhinga rufa	10.00	1				
Dove, Laughing	Streptopelia senegalensis	10.00	1				
Dove, Lemon	Aplopelia larvata	22.73	5				
Dove, Namaqua	Oena capensis	4.62	6				
Dove, Red-eyed	Streptopelia semitorquata	80.00	8				
Dove, Rock	Columba livia	13.85	18				
Dove, Tambourine	Turtur tympanistria	40.00	4				
Drongo, Fork-tailed	Dicrurus adsimilis	80.00	8				
Drongo, Square-tailed	Dicrurus ludwigii	2.31	3				
Duck, African Black	Anas sparsa	30.00	3				
Duck, Comb	Sarkidiornis melanotos	0.77	1				
Duck, Fulvous	Dendrocygna bicolor	1.54	2				
Duck, Mallard	Anas platyrhynchos	5.88	1				
Duck, White-backed	Thalassornis leuconotus	0.88	1				
Duck, White-faced	Dendrocygna viduata	20.00	2				
Duck, Yellow-billed	Anas undulata	2.31	3				
Eagle, African Crowned	Stephanoaetus coronatus	13.64	3	VU	NT		
Eagle, Booted	Aquila pennatus	10.00	1				
Eagle, Long-crested	Lophaetus occipitalis	5.88	1				
Eagle, Martial	Polemaetus bellicosus	1.61	1	EN	VU		
Eagle, Tawny	Aquila rapax	10.00	1	EN	LC		
Eagle, Verreaux's	Aquila verreauxii	15.38	2	VU	LC		
Eagle, Wahlberg's	Aquila wahlbergi	11.76	2				
Eagle-owl, Spotted	Bubo africanus	5.88	1				
Egret, Cattle	Bubulcus ibis	60.00	6				
Egret, Great	Egretta alba	2.31	3				
Egret, Little	Egretta garzetta	10.00	1				
SPECIES	**TAXONOMIC NAME**	**AV. REPORT**	**NUMBER**	**REG. STATUS**	**GLOBAL STATUS**	**ENDEMIC - South Africa**	**ENDEMIC - Southern Africa**

		RATE					
Egret, Yellow-billed	Egretta intermedia	1.54	2				
Falcon, Lanner	Falco biarmicus	10.00	1	VU	LC		
Falcon, Peregrine	Falco peregrinus	2.65	3				
Finch, Cuckoo	Anomalospiza imberbis	23.08	3				
Finfoot, African	Podica senegalensis	0.77	1	VU	LC		
Firefinch, African	Lagonosticta rubricata	10.00	1				
Firefinch, Red-billed	Lagonosticta senegala	17.65	3				
Fiscal, Common (Southern)	Lanius collaris	40.00	4				
Fish-eagle, African	Haliaeetus vocifer	20.00	2				
Flufftail, Buff-spotted	Sarothrura elegans	5.88	1				
Flufftail, Red-chested	Sarothrura rufa	3.45	1				
Flycatcher, African Dusky	Muscicapa adusta	30.00	3				
Flycatcher, Ashy	Muscicapa caerulescens	10.00	1				
Flycatcher, Fiscal	Sigelus silens	5.88	1			Near Endemic	Endemic
Flycatcher, Pale	Bradornis pallidus	0.77	1				
Flycatcher, Southern Black	Melaenornis pammelaina	50.00	5				
Flycatcher, Spotted	Muscicapa striata	10.00	1				
Francolin, Crested	Dendroperdix sephaena	10.00	1				
Francolin, Shelley's	Scleroptila shelleyi	3.51	2				
Gannet, Cape	Morus capensis	5.56	1	VU	VU		Breeding Endemic
Goose, Egyptian	Alopochen aegyptiacus	50.00	5				
Goose, Spur-winged	Plectropterus gambensis	20.00	2				
Goshawk, African	Accipiter tachiro	10.00	1				
Grassbird, Cape	Sphenoeacus afer	5.88	1			Near Endemic	Endemic
Grebe, Little	Tachybaptus ruficollis	30.00	3				
Greenbul, Sombre	Andropadus importunus	70.00	7				
Greenbul, Yellow-bellied	Chlorocichla flaviventris	40.00	4				
Greenbul, Yellow-streaked	Phyllastrephus flavostriatus	50.00	11				
Green-pigeon, African	Treron calvus	10.00	1				
Greenshank, Common	Tringa nebularia	10.00	13				
Ground-hornbill, Southern	Bucorvus leadbeateri	25.71	9	EN	VU		
Ground-thrush, Spotted	Zoothera guttata	27.27	6	EN	EN		
Guineafowl, Crested	Guttera edouardi	3.51	2				
Guineafowl, Helmeted	Numida meleagris	20.00	2				
Gull, Grey-headed	Larus cirrocephalus	6.25	1				
SPECIES	**TAXONOMIC NAME**	**AV. REPORT**	**NUMBER**	**REG. STATUS**	**GLOBAL STATUS**	**ENDEMIC - South Africa**	**ENDEMIC - Southern Africa**

		RATE					
Gull, Kelp	Larus dominicanus	6.25	1				
Hamerkop, Hamerkop	Scopus umbretta	30.00	3				
Harrier-Hawk, African	Polyboroides typus	19.23	25				
Hawk, African Cuckoo	Aviceda cuculoides	0.77	1				
Helmet-shrike, White-crested	Prionops plumatus	3.85	1				
Heron, Black	Egretta ardesiaca	0.77	1				
Heron, Black-headed	Ardea melanocephala	35.29	6				
Heron, Goliath	Ardea goliath	5.88	1				
Heron, Green-backed	Butorides striata	10.00	1				
Heron, Grey	Ardea cinerea	10.00	1				
Heron, Purple	Ardea purpurea	10.00	1				
Heron, Squacco	Ardeola ralloides	10.00	1				
Hobby, Eurasian	Falco subbuteo	1.52	1				
Honeybird, Brown-backed	Prodotiscus regulus	0.77	1				
Honey-buzzard, European	Pernis apivorus	1.61	1				
Honeyguide, Greater	Indicator indicator	4.62	6				
Honeyguide, Lesser	Indicator minor	8.46	11				
Honeyguide, Scaly-throated	Indicator variegatus	10.00	1				
Hoopoe, African	Upupa africana	23.53	4				
Hornbill, Crowned	Tockus alboterminatus	0.77	1				
Hornbill, Southern Yellow-billed	Tockus leucomelas	10.00	1				Near Endemic
Hornbill, Trumpeter	Bycanistes bucinator	5.88	1				
House-martin, Common	Delichon urbicum	3.08	4				
Ibis, African Sacred	Threskiornis aethiopicus	10.00	13				
Ibis, Glossy	Plegadis falcinellus	1.77	2				
Ibis, Hadeda	Bostrychia hagedash	80.00	8				
Ibis, Southern Bald	Geronticus calvus	5.88	1	VU	VU	Endemic (SA, Lesotho, Swaziland)	Endemic
Indigobird, Dusky	Vidua funerea	18.46	24				
Indigobird, Village	Vidua chalybeata	1.54	2				
Jacana, African	Actophilornis africanus	50.00	5				
Jacana, Lesser	Microparra capensis	0.77	1	VU	LC		
Kestrel, Rock	Falco rupicolus	7.69	1				
Kingfisher, Brown-hooded	Halcyon albiventris	90.00	9				
Kingfisher, Giant	Megaceryle maximus	5.38	7				
Kingfisher, Half-collared	Alcedo semitorquata	1.61	1	NT	LC		
SPECIES	**TAXONOMIC NAME**	**AV. REPORT**	**NUMBER**	**REG. STATUS**	**GLOBAL STATUS**	**ENDEMIC - South Africa**	**ENDEMIC - Southern Africa**

		RATE					
Kingfisher, Malachite	Alcedo cristata	20.00	2				
Kingfisher, Pied	Ceryle rudis	20.00	2				
Kingfisher, Striped	Halcyon chelicuti	0.77	1				
Kite, Black	Milvus migrans	1.77	2				
Kite, Black-shouldered	Elanus caeruleus	11.76	2				
Kite, Yellow-billed	Milvus aegyptius	20.00	2				
Lapwing, African Wattled	Vanellus senegallus	10.00	1				
Lapwing, Blacksmith	Vanellus armatus	10.00	1				
Lapwing, Black-winged	Vanellus melanopterus	33.85	44				
Lapwing, Crowned	Vanellus coronatus	10.00	1				
Lark, Flappet	Mirafra rufocinnamomea	0.77	1				
Lark, Red-capped	Calandrella cinerea	25.00	1				
Lark, Rufous-naped	Mirafra africana	20.00	2				
Lark, Sabota	Calendulauda sabota	5.88	1				Near Endemic
Longclaw, Cape	Macronyx capensis	5.88	1				Endemic
Longclaw, Yellow-throated	Macronyx croceus	10.00	1				
Malkoha, Green	Ceuthmochares australis	22.73	5				
Mannikin, Bronze	Spermestes cucullatus	60.00	6				
Mannikin, Magpie	Spermestes fringilloides	5.26	3				
Mannikin, Red-backed	Spermestes bicolor	10.00	1				
Marsh-harrier, African	Circus ranivorus	11.76	2	EN	LC		
Martin, Banded	Riparia cincta	7.69	1				
Martin, Brown-throated	Riparia paludicola	10.00	1				
Martin, Rock	Hirundo fuligula	5.88	1				
Martin, Sand	Riparia riparia	0.77	1				
Masked-weaver, Lesser	Ploceus intermedius	17.65	3				
Masked-weaver, Southern	Ploceus velatus	10.00	1				
Moorhen, Common	Gallinula chloropus	10.00	1				
Mousebird, Red-faced	Urocolius indicus	10.00	1				
Mousebird, Speckled	Colius striatus	50.00	5				
Myna, Common	Acridotheres tristis	10.00	1				
Neddicky, Neddicky	Cisticola fulvicapilla	10.00	1				
Nicator, Eastern	Nicator gularis	10.00	1				
Night-Heron, Black-crowned	Nycticorax nycticorax	0.77	1				
Nightjar, Fiery-necked	Caprimulgus pectoralis	5.88	1				
SPECIES	**TAXONOMIC NAME**	**AV. REPORT**	**NUMBER**	**REG. STATUS**	**GLOBAL STATUS**	**ENDEMIC - South Africa**	**ENDEMIC - Southern Africa**

		RATE					
Nightjar, Square-tailed	Caprimulgus fossii	0.77	1				
Nightjar, Swamp	Caprimulgus natalensis	15.38	2	VU	LC		
Olive-pigeon, African	Columba arquatrix	0.77	1				
Openbill, African	Anastomus lamelligerus	0.88	1				
Oriole, Black-headed	Oriolus larvatus	30.00	3				
Oriole, Eurasian Golden	Oriolus oriolus	1.52	1				
Osprey, Osprey	Pandion haliaetus	1.77	2				
Owl, Barn	Tyto alba	3.51	2				
Oystercatcher, African Black	Haematopus moquini	3.85	1	LC	NT		Breeding Endemic
Painted-snipe, Greater	Rostratula benghalensis	2.31	3	NT	LC		
Palm-swift, African	Cypsiurus parvus	30.00	3				
Paradise-flycatcher, African	Terpsiphone viridis	70.00	7				
Parakeet, Rose-ringed	Psittacula krameri	12.50	4				
Peacock, Common	Pavo cristatus	7.69	1				
Pelican, Great White	Pelecanus onocrotalus	0.77	1	VU	LC		
Pelican, Pink-backed	Pelecanus rufescens	7.69	1	VU	LC		
Petronia, Yellow-throated	Petronia superciliaris	10.00	1				
Pigeon, Eastern Bronze-naped	Columba delegorguei	13.64	3	EN	LC		
Pigeon, Speckled	Columba guinea	5.88	1				
Pipit, African	Anthus cinnamomeus	30.00	3				
Pipit, Buffy	Anthus vaalensis	1.61	1				
Pipit, Long-billed	Anthus similis	6.45	4				
Pipit, Plain-backed	Anthus leucophrys	4.55	1				
Pipit, Short-tailed	Anthus brachyurus	1.61	1	VU	LC		
Pipit, Striped	Anthus lineiventris	1.54	2				
Plover, Common Ringed	Charadrius hiaticula	21.54	28				
Plover, Grey	Pluvialis squatarola	5.88	1				
Plover, Kittlitz's	Charadrius pecuarius	80.77	105				
Plover, Three-banded	Charadrius tricollaris	20.00	2				
Plover, White-fronted	Charadrius marginatus	6.15	8				
Pochard, Southern	Netta erythrophthalma	6.67	1				
Pratincole, Collared	Glareola pratincola	5.88	1				
Prinia, Tawny-flanked	Prinia subflava	90.00	9				
Puffback, Black-backed	Dryoscopus cubla	60.00	6				
Pygmy-Goose, African	Nettapus auritus	1.54	2	VU	LC		
SPECIES	**TAXONOMIC NAME**	**AV. REPORT**	**NUMBER**	**REG. STATUS**	**GLOBAL STATUS**	**ENDEMIC - South Africa**	**ENDEMIC - Southern Africa**

		RATE					
Pygmy-Kingfisher, African	Ispidina picta	5.88	1				
Pytilia, Green-winged	Pytilia melba	4.55	1				
Quail, Common	Coturnix coturnix	0.88	1				
Quailfinch, African	Ortygospiza atricollis	0.88	1				
Quelea, Red-billed	Quelea quelea	17.65	3				
Quelea, Red-headed	Quelea erythrops	1.54	2				
Rail, African	Rallus caerulescens	5.56	1				
Raven, White-necked	Corvus albicollis	0.77	1				
Reed-warbler, African	Acrocephalus baeticatus	5.88	1				
Reed-warbler, Great	Acrocephalus arundinaceus	16.92	22				
Robin, White-starred	Pogonocichla stellata	18.18	4				
Robin-chat, Cape	Cossypha caffra	1.54	2				
Robin-chat, Chorister	Cossypha dichroa	36.36	8			Endemic (SA, Lesotho, Swaziland)	Endemic
Robin-chat, Red-capped	Cossypha natalensis	40.00	4				
Robin-chat, White-browed	Cossypha heuglini	4.62	6				
Robin-chat, White-throated	Cossypha humeralis	10.00	1				Endemic
Rock-thrush, Cape	Monticola rupestris	10.00	1			Endemic (SA, Lesotho, Swaziland)	
Rock-thrush, Sentinel	Monticola explorator	7.69	1			Endemic (SA, Lesotho, Swaziland)	Endemic
Roller, Broad-billed	Eurystomus glaucurus	7.69	1				
Roller, European	Coracias garrulus	10.00	1	LC	NT		
Ruff, Ruff	Philomachus pugnax	39.23	51				
Rush-warbler, Little	Bradypterus baboecala	10.00	1				
Sandpiper, Common	Actitis hypoleucos	17.65	3				
Sandpiper, Curlew	Calidris ferruginea	18.46	24	LC	NT		
Sandpiper, Green	Tringa ochropus	10.00	1				
Sandpiper, Marsh	Tringa stagnatilis	11.54	15				
Sandpiper, Terek	Xenus cinereus	1.52	1				
Sandpiper, Wood	Tringa glareola	50.00	65				
Saw-wing, Black (Southern race)	Psalidoprocne holomelaena	10.00	1				
Scimitarbill, Common	Rhinopomastus cyanomelas	10.00	1				
Scrub-robin, Brown	Cercotrichas signata	22.73	5			Near Endemic	Endemic
Scrub-robin, White-browed	Cercotrichas leucophrys	50.00	5				
Secretarybird, Secretarybird	Sagittarius serpentarius	7.14	1	VU	VU		
Seedeater, Streaky-headed	Crithagra gularis	1.61	1				
Shoveler, Cape	Anas smithii	3.45	1				Near Endemic
SPECIES	**TAXONOMIC NAME**	**AV. REPORT**	**NUMBER**	**REG. STATUS**	**GLOBAL STATUS**	**ENDEMIC - South Africa**	**ENDEMIC - Southern Africa**

		RATE					
Shrike, Red-backed	Lanius collurio	10.00	1				
Snake-eagle, Black-chested	Circaetus pectoralis	10.00	1				
Snake-eagle, Brown	Circaetus cinereus	10.00	1				
Snake-eagle, Southern Banded	Circaetus fasciolatus	0.88	1	NT	CR		
Snipe, African	Gallinago nigripennis	3.85	5				
Sparrow, House	Passer domesticus	40.00	4				
Sparrow, Southern Grey-headed	Passer diffusus	30.00	3				
Sparrowhawk, Black	Accipiter melanoleucus	6.15	8				
Sparrowhawk, Little	Accipiter minullus	1.54	2				
Spoonbill, African	Platalea alba	10.00	1				
Spurfowl, Natal	Pternistis natalensis	10.00	1				Near Endemic
Starling, Black-bellied	Lamprotornis corruscus	20.00	2				
Starling, Cape Glossy	Lamprotornis nitens	70.00	7				
Starling, Common	Sturnus vulgaris	7.14	1				
Starling, Red-winged	Onychognathus morio	20.00	2				
Starling, Violet-backed	Cinnyricinclus leucogaster	29.41	5				
Starling, Wattled	Creatophora cinerea	11.76	2				
Stilt, Black-winged	Himantopus himantopus	1.54	2				
Stint, Little	Calidris minuta	10.77	14				
Stonechat, African	Saxicola torquatus	50.00	5				
Stork, Marabou	Leptoptilos crumeniferus	4.17	1	NT	LC		
Stork, White	Ciconia ciconia	7.08	8				
Stork, Woolly-necked	Ciconia episcopus	20.00	2				
Stork, Yellow-billed	Mycteria ibis	0.77	1	EN	LC		
Sunbird, Amethyst	Chalcomitra amethystina	10.00	1				
Sunbird, Collared	Hedydipna collaris	20.00	2				
Sunbird, Greater Double-collared	Cinnyris afer	16.67	1			Endemic (SA, Lesotho, Swaziland)	Endemic
Sunbird, Grey	Cyanomitra veroxii	10.00	1				
Sunbird, Malachite	Nectarinia famosa	1.61	1				
Sunbird, Olive	Cyanomitra olivacea	10.00	1				
Sunbird, Purple-banded	Cinnyris bifasciatus	23.53	4				
Sunbird, Scarlet-chested	Chalcomitra senegalensis	41.18	7				
Sunbird, Southern Double-collared	Cinnyris chalybeus	4.17	1			Near Endemic	Endemic
Sunbird, White-bellied	Cinnyris talatala	70.00	7				
Swallow, Barn	Hirundo rustica	20.00	2				
SPECIES	**TAXONOMIC NAME**	**AV.**	**NUMBER**	**REG.**	**GLOBAL**	**ENDEMIC - South Africa**	**ENDEMIC - Southern**

		REPORT RATE		STATUS	STATUS		Africa
Swallow, Greater Striped	Hirundo cucullata	30.00	3				
Swallow, Grey-rumped	Pseudhirundo griseopyga	9.23	12				
Swallow, Lesser Striped	Hirundo abyssinica	30.00	3				
Swallow, Red-breasted	Hirundo semirufa	10.00	1				
Swallow, White-throated	Hirundo albigularis	5.88	1				
Swallow, Wire-tailed	Hirundo smithii	40.00	4				
Swamphen, African Purple	Porphyrio madagascariensis	41.18	7				
Swamp-warbler, Lesser	Acrocephalus gracilirostris	17.65	3				
Swift, African Black	Apus barbatus	3.85	5				
Swift, Alpine	Tachymarptis melba	2.86	1				
Swift, Common	Apus apus	7.69	1				
Swift, Horus	Apus horus	1.61	1				
Swift, Little	Apus affinis	10.00	1				
Swift, White-rumped	Apus caffer	10.00	1				
Tchagra, Black-crowned	Tchagra senegalus	50.00	5				
Tchagra, Brown-crowned	Tchagra australis	10.00	1				
Tchagra, Southern	Tchagra tchagra	1.61	1			Near Endemic	Endemic
Teal, Cape	Anas capensis	11.11	2				
Teal, Hottentot	Anas hottentota	0.88	1				
Teal, Red-billed	Anas erythrorhyncha	4.62	6				
Tern, Arctic	Sterna paradisaea	5.88	1				
Tern, Caspian	Sterna caspia	0.88	1	VU	LC		
Tern, Common	Sterna hirundo	5.88	1				
Tern, Little	Sterna albifrons	5.88	1				
Tern, Sandwich	Sterna sandvicensis	4.55	3				
Tern, Swift	Sterna bergii	0.77	1				
Tern, Whiskered	Chlidonias hybrida	0.88	1				
Tern, White-winged	Chlidonias leucopterus	3.45	1				
Thick-knee, Spotted	Burhinus capensis	3.85	5				
Thick-knee, Water	Burhinus vermiculatus	46.15	60				
Thrush, Groundscraper	Psophocichla litsipsirupa	3.13	1				
Thrush, Kurrichane	Turdus libonyanus	30.00	3				
Thrush, Olive	Turdus olivaceus	0.88	1				
Tinkerbird, Red-fronted	Pogoniulus pusillus	30.00	3				
Tinkerbird, Yellow-rumped	Pogoniulus bilineatus	30.00	3				
SPECIES	**TAXONOMIC NAME**	**AV.**	**NUMBER**	**REG.**	**GLOBAL**	**ENDEMIC - South Africa**	**ENDEMIC - Southern**

		REPORT RATE		STATUS	STATUS		Africa
Tit, Southern Black	Parus niger	40.00	4				
Tit-flycatcher, Grey	Myioparus plumbeus	10.00	1				
Trogon, Narina	Apaloderma narina	40.91	9				
Turaco, Knysna	Tauraco corythaix	3.85	1			Endemic (SA, Lesotho, Swaziland)	Endemic
Turaco, Purple-crested	Gallirex porphyreolophus	50.00	5				
Turnstone, Ruddy	Arenaria interpres	5.88	1				
Turtle-dove, Cape	Streptopelia capicola	20.00	2				
Twinspot, Green	Mandingoa nitidula	17.14	6				
Vulture, Palm-nut	Gypohierax angolensis	18.46	24				
Vulture, White-backed	Gyps africanus	10.00	1	CR	CR		
Wagtail, African Pied	Motacilla aguimp	10.00	1				
Wagtail, Cape	Motacilla capensis	30.00	3				
Wagtail, Mountain	Motacilla clara	9.09	2				
Warbler, Barratt's	Bradypterus barratti	1.61	1			Near Endemic	Endemic
Warbler, Broad-tailed	Schoenicola brevirostris	9.09	2				
Warbler, Dark-capped Yellow	Chloropeta natalensis	5.88	1				
Warbler, Garden	Sylvia borin	10.00	1				
Warbler, Marsh	Acrocephalus palustris	6.15	8				
Warbler, Sedge	Acrocephalus schoenobaenus	1.54	2				
Warbler, Willow	Phylloscopus trochilus	0.77	1				
Wattle-eye, Black-throated	Platysteira peltata	6.15	8				
Waxbill, Blue	Uraeginthus angolensis	20.00	2				
Waxbill, Common	Estrilda astrild	20.00	2				
Waxbill, Grey	Estrilda perreini	0.77	1				
Waxbill, Orange-breasted	Amandava subflava	0.77	1				
Waxbill, Swee	Coccopygia melanotis	3.08	4			Near Endemic	Endemic
Weaver, Cape	Ploceus capensis	1.61	1			Near Endemic	Endemic
Weaver, Dark-backed	Ploceus bicolor	20.00	2				
Weaver, Golden	Ploceus xanthops	1.75	1				
Weaver, Southern Brown-throated	Ploceus xanthopterus	0.77	1				
Weaver, Spectacled	Ploceus ocularis	60.00	6				
Weaver, Thick-billed	Amblyospiza albifrons	10.00	1				
Weaver, Village	Ploceus cucullatus	70.00	7				
Weaver, Yellow	Ploceus subaureus	10.00	1				
Whimbrel, Common	Numenius phaeopus	0.88	1				

SPECIES	TAXONOMIC NAME	AV. REPORT RATE	NUMBER	REG. STATUS	GLOBAL STATUS	ENDEMIC - South Africa	ENDEMIC - Southern Africa
White-eye, Cape	Zosterops virens	50.00	5			Near Endemic	Endemic
Whydah, Pin-tailed	Vidua macroura	40.00	4				
Widowbird, Fan-tailed	Euplectes axillaris	20.00	2				
Widowbird, Long-tailed	Euplectes progne	0.77	1				
Widowbird, Red-collared	Euplectes ardens	10.00	1				
Widowbird, White-winged	Euplectes albonotatus	4.62	6				
Wood-dove, Emerald-spotted	Turtur chalcospilos	60.00	6				
Wood-hoopoe, Green	Phoeniculus purpureus	30.00	3				
Woodland-warbler, Yellow-throated	Phylloscopus ruficapilla	1.61	1				
Wood-owl, African	Strix woodfordii	3.23	2				
Woodpecker, Bearded	Dendropicos namaquus	4.17	1				
Woodpecker, Cardinal	Dendropicos fuscescens	30.00	3				
Woodpecker, Golden-tailed	Campethera abingoni	20.00	2				
Woodpecker, Olive	Dendropicos griseocephalus	13.64	3				
Wryneck, Red-throated	Jynx ruficollis	0.77	1				

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).