STRATEGIC ENVIRONMENTAL ASSESSMENT FOR EXPANSION OF ELECTRICITY GRID INFRASTRUCTURE IN SOUTH AFRICA

Biodiversity and Ecological Impacts - Avifauna

STRATEGIC ENVIRONMENTAL ASSESSMENT FOR THE EXPANSION OF ELECTRICITY GRID INFRASTRUCTURE IN SOUTH AFRICA

Draft v3 Specialist Assessment Report for Stakeholder Review

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ABBREVIATIONS AND ACRONYMS

BFD	Bird Flight Diverter
BLSA	Birdlife South Africa
CR	Critically Endangered
ECO	Environmental Control Officer
EGI	Electricity Grid Infrastructure
EN	Endangered
EWT	Endangered Wildlife Trust
IBA	Important Bird Area
IFC	International Finance Corporation
LED	Light Emitting Diode
NMU	Nelson Mandela University
NT	Near threatened
QDGC	Quarter Degree Grid Cell
SABAP1	Southern African Bird Atlas Project 1
SABAP2	Southern African Bird Atlas Project 2
SANBI	South African National Biodiversity Institute
SEA	Strategic Environmental Assessment
VU	Vulnerable

1 SUMMARY

The table below provides a summary of the most important findings of the study, as well as an overall suitability rating for each Expanded EGI Corridor.

Corridor	Overall Suitability	Comment
Expanded Western Corridor	Moderate suitability for power line infrastructure development. Abundance of High Sensitivity areas is due to the overall very low human population, with most of the natural habitat relatively untransformed. This, coupled with the occurrence of several high-risk species has resulted in the majority of the habitat receiving a High Sensitivity rating.	Key issues are the following: • Greater Flamingo collisions at waterbodies. • Kori Bustard collisions in the Nama and Succulent Karoo. • Black Stork collisions and displacement at waterbodies, drainage lines and cliffs. • Blue Crane collisions at cultivated commercial fields and waterbodies. • Great White Pelican collisions at waterbodies and along the coast. • Lesser Flamingo collisions at waterbodies and along the coast. • Ludwig's Bustard collisions in the Nama and Succulent Karoo. • Martial Eagle electrocutions and displacement of breeding birds on transmission lines in the Nama and Succulent Karoo. • Secretary bird collisions in the Nama and Succulent Karoo. • Verreaux's Eagle electrocutions, collisions and displacement of breeding birds at cliff sites throughout the corridor. • Caspian Tern collision at large waterbodies throughout the corridor.
Expanded Eastern Corridor	Moderate suitability for power line infrastructure development. The dense human population has resulted in large-scale transformation of the natural habitat, resulting in large sections of the corridor rated as Low Sensitivity. However, the remaining natural areas support a wide variety of power line sensitive Red Data species, resulting in many areas being rated as High or Very High.	Key issues are the following: • African Marsh-harrier collisions throughout the corridor. • Southern Ground Hornbill collisions, electrocutions and displacement throughout the corridor. • Black Stork collisions and displacement at waterbodies, cliffs and drainage lines throughout the corridor. • Blue Crane collisions and disturbance of breeding birds in grassland and wetland areas in Grassland. • Cape Vulture electrocutions, disturbance at breeding colonies and roosts throughout the corridor. Collisions and electrocutions at vulture restaurants. • Denham's Bustard collisions in grassland areas throughout the corridor. • Great White Pelican and Pink-backed Pelican collisions and displacement at waterbodies in Indian Ocean Coastal Belt. • Greater and Lesser Flamingo collisions at waterbodies throughout the corridor. • Grey Crowned Crane collisions at wetlands and cultivated commercial fields in Grassland and Indian Ocean Coastal Belt. Displacement of breeding birds in wetlands in Grassland and Indian Ocean Coastal Belt. • Secretarybird collisions throughout the corridor except Indian Ocean Coastal Belt.

Corridor	Overall Suitability	Comment
		• Verreaux's Eagle electrocutions, collisions and displacement of breeding birds at cliff sites. • Wattled Crane collisions and displacement at wetlands in Grassland. • Southern Bald Ibis collision and displacement at cliffs in Grassland. • Blue Swallow displacement due to habitat destruction in the KwaZulu – Natal mistbelt in the Grassland biome. • Displacement due to disturbance and habitat destruction at nest localities of Bateleur, Lappet-faced Vulture, Marabou Stork, Martial Eagle, Secretarybird, Tawny Eagle, Southern, White-backed Vulture, Hooded Vulture and White-headed Vulture in Savannah, African Crowned Eagle and Banded Snake-Eagle in Forest, and Pel's Fishing Owl at rivers and waterbodies in the northern part of the corridor. • Saddle-billed Stork and Yellow-billed Stork collisions at waterbodies in Savanna.

2 INTRODUCTION

The most prominent direct negative impact on birds by electricity infrastructure in South Africa are mortality through electrocution and collisions (Ledger and Annegarn, 1981; Ledger, 1983; Ledger, 1984; Hobbs and Ledger, 1986a; Hobbs and Ledger, 1986b; Ledger, et al., 1992; Verdoorn, 1996; Kruger and Van Rooyen, 1998; Van Rooyen, 1998; Kruger, 1999; Van Rooyen, 1999; Van Rooyen, 2000; Van Rooyen, 2007; Lehman et al*.,* 2007; Jenkins et al., 2010; Shaw, 2013).

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. The electrocution risk is largely determined by the pole/tower design (APLIC, 1996). In South Africa, large raptors and particularly vultures, are most prone to electrocution on electricity infrastructure (Ledger and Annegarn, 1981; Ledger, 1984; Verdoorn, 1996; Van Rooyen, 1998; Kruger et al., 2004; Boshoff et al., 2011).

Collision mortality is probably the biggest threat posed by transmission lines to birds in South Africa (Van Rooyen, 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds (Jenkins et al., 2010). These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (Van Rooyen, 2004). Shaw (2013: 3 - 4) 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, 2012). 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 lower-resolution, and often restricted, forward vision that is useful to detect obstacles (Martin & Shaw, 2010; Martin, 2011; Martin et al., 2012). Behaviour is important, with birds flying in flocks, at low levels and in crepuscular or nocturnal conditions at higher risk of collision (Bevanger, 1994). Experience affects risk, with migratory and nomadic species that spend much of their time in unfamiliar locations also expected to collide more often (Anderson, 1978; Anderson, 2002). Juvenile birds have often been reported as being more collision-prone than adults (e.g. Brown et al., 1987; Henderson et al., 1996).*

Topography and weather conditions affect how birds use the landscape. Power lines in sensitive bird areas (e.g. those that separate feeding and roosting areas, or cross flyways) can be very dangerous (APLIC, 2012; 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, 2012).

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; Alonso et al., 1994a; Bevanger 1994)."

From incidental record keeping by the Endangered Wildlife Trust (EWT), it is possible to give a measure of what species are generally susceptible to power line collisions in South Africa (see Figure 1). This list is far from comprehensive as only a fraction of mortalities are ever reported (Kruger, 1999; Shaw, 2013).

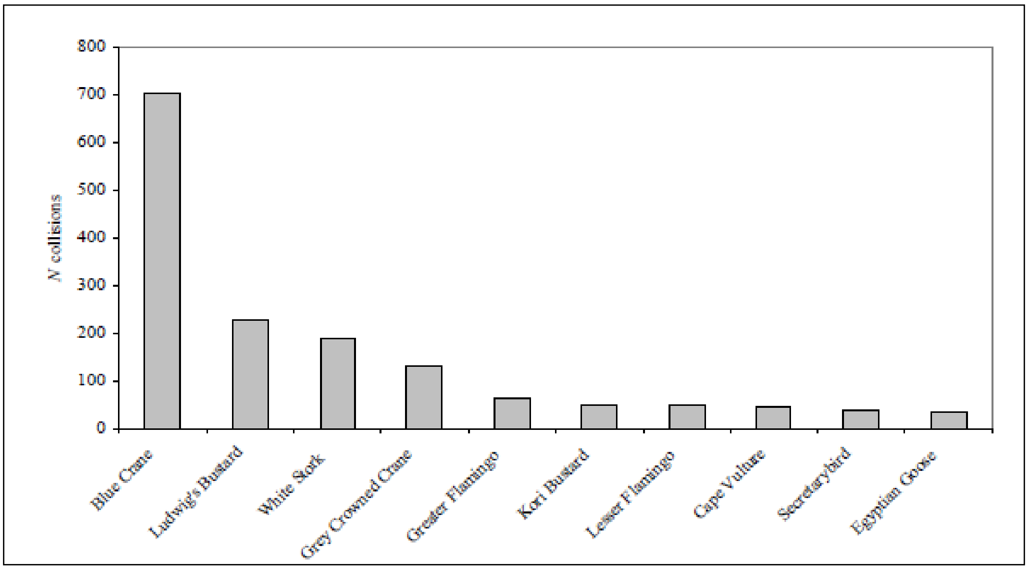

Figure 1: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2008 (Jenkins et al., 2010).

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

Despite doubts about the efficacy of line marking to reduce the collision risk for bustards (Jenkins et al*.,* 2010; Martin et al*.,* 2010), there are numerous studies which prove that marking a line with PVC spiral type Bird Flight Diverters (BFDs) generally reduce mortality rates (e.g. Sporer et al*.,* 2013; Barrientos et al*.,* 2011; Jenkins et al*.,* 2010; Alonso & Alonso, 1999; Koops & De Jong, 1982), also to some extent for bustards (Barrientos et al*.,* 2012; Hoogstad, 2015 pers.comm). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Barrientos et al*.* (2011) reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease of 55–94% in bird collisions. Koops and De Jong (1982) found that the spacing of the BFDs were critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5 metres, whereas using the same devices at 10 metre intervals only reduces the mortality by 57%. Barrientos et al*.* (2012) found that larger BFDs were more effective in reducing Great Bustard collisions than smaller ones. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin et al*.* 2010).

During the construction and maintenance of power lines and substations, some habitat destruction and transformation inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the levelling of substation yards. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line, which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through transformation of habitat, which could result in temporary or permanent displacement.

Apart from direct habitat destruction, the above-mentioned construction and maintenance activities also impact on birds through disturbance, particularly during breeding activities. Disturbance of breeding individuals could lead to breeding failure through abandonment of the nest or through exposing the eggs and nestlings to predation when the adult birds temporarily leave the nest area (Hockin et al*.,* 1992).

3 PROJECT SCOPE AND TERMS OF REFERENCE

The terms of reference for this report are as follows:

- Review of existing literature to compile a baseline description applicable to each proposed Expanded Electricity Grid Infrastructure (EGI) corridor;
- Compilation of a shortlist of bird species that are sensitive to power lines that are likely to occur in each corridor;

- Identification of avifaunal sensitivity features (e.g. habitat classes, roosts and colonies etc.) within each corridor;
- Development of an approach for classing each sensitivity feature in each corridor according to a four-tiered sensitivity rating system i.e. Very High, High, Medium or Low;
- Assessment of the proposed corridor in terms of the potential impacts associated with the construction and operation of power lines on priority species and their habitats;
- Description of proposed management actions to enhance benefits and avoid/reduce/offset negative impacts in each corridor;
- Based on the findings of the assessment, the compilation of a four-tiered sensitivity map related to potential impact on avifauna in each corridor;
- Provision of input into the pre-construction site specific environmental assessment protocol (Decision-Making Tools) for each corridor i.e. the additional information and level of assessment which is required in each sensitivity category before an authorisation (or similar) with respect to avifauna should be considered.

4 APPROACH AND METHODOLOGY

4.1 Study Methodology

Below is a summary of the methods followed to compile the report.

- The Southern African Bird Atlas 2 (SABAP2) data was obtained from the Animal Demography Unit at the University of Cape Town for each pentad in each corridor. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8km × 7.6km.

- Due to the large number of pentads (n = 1372), the pentads were consolidated into Quarter Degree Grid Cells (QDGC). A QDGC is the equivalent of a 1:50 000 topographical map and covers an area of 15 minutes of latitude by 15 minutes of longitude (25km x 27.4km) or approximately 640 square kilometres. From this a consolidated species list was compiled for each biome in each corridor by pooling all the data for the QDGCs which overlapped with a specific biome within a corridor. The total number of QDGCs for both corridors amounted to 175.

- All avifaunal species that could potentially be impacted by electricity infrastructure were identified for each biome within each corridor using the SABAP2 data as the main source of information. Where there was no SABAP2 data available (n = 2), data from the Southern African Bird Atlas 1 (SABAP1) was used.

- The list of avifaunal species was refined to a list of power line sensitive Red Data priority species for each biome within each corridor. The list was compiled by using the following criteria:
    - Electrocution and collision: Morphology, behaviour, habitat, historical records;
    - Displacement of breeding individuals: Habitat; and
    - SABAP2 reporting rate: A reporting rate of 5% or higher for the species in the biome.

- Bird habitat classes and key sensitivity features were identified for each biome within each corridor (see 4.2.and 7.1 below for a complete list of data sources and sensitivity features).

- The potential negative impacts on avifauna by the electricity grid was identified as:
    - Electrocutions[1];
    - Collisions; and
    - Displacement of breeding individuals

- The probability of the respective impacts occurring in a habitat class was rated for each priority species to arrive at a **species-specific probability score** for each impact, within each habitat class, within each biome, within each corridor. Probabilities for the respective impacts occurring were rated according to the below scale:

[1] The Eskom Land and Biodiversity Standard (2016) states that "all designs of new power lines and supporting infrastructure for power generation must be evaluated for the risk it could pose to wildlife and no design which has a high risk, or a record of it causing mortalities to wildlife, shall be used." However, it was assumed that Eskom might not be the only entity building power lines in future; therefore, it cannot automatically be assumed that all future distribution pole designs will be electrocution friendly.

- 0 = the impact is highly unlikely to occur
- 1 = the impact is unlikely to occur
- 2 = the impact could possibly occur
- 3 = the impact will most likely occur

- The species-specific probability score was multiplied by a weighted Red Data status score for each priority species to arrive at a **species-specific habitat sensitivity score** for each species, for each habitat class, within each biome, within each corridor. The Red Data status were assigned weighted scores according to the below scale:
    - Near threatened = 2
    - Vulnerable = 4
    - Endangered = 8
    - Critically endangered = 16

- An **aggregated habitat sensitivity score** for each habitat class within each biome, within each corridor was calculated by summing the species-specific probability scores for that particular habitat class:
    - Low = 0
    - Medium = 1 - 177
    - High = 178 - 354
    - Very High = 355 - 532

- A four-tiered consolidated sensitivity map of all habitat classes indicating their spatial extent in each of the corridors was developed with GIS, using the habitat sensitivity scores of the various habitat classes. The sensitivity ratings were illustrated according to the following classification scheme: Dark Red/Very High, Red/High, Orange/Medium, Green/Low.

- A number of key sensitivity features not related to habitat classes were buffered and allocated a default Dark Red/Very High sensitivity rating (e.g. vulture colonies, Black Stork nests, vulture restaurants etc.).

- Recommendations were compiled for each corridor on what assessments need to be undertaken in each of the sensitivity classes which will be incorporated into the Decision-Making Tools.

4.2 Data Sources

Table 1 presents a detailed list and description of all data sources on which the assessment is based, and from which sensitive features/criteria are extracted.

Table 1: Data sources on which the avifauna assessment is based.

Data title	Source and date of publication	Data Description
The Southern African Bird Atlas 1 (SABAP1)	Animal Demography Unit, University of Cape Town, 1997.	The Southern African Bird Atlas Project (SABAP) was conducted between 1987 and 1991.Because a new bird atlas was started in southern Africa in 2007, the earlier project is now referred to as SABAP1. SABAP1 covered six countries: Botswana, Lesotho, Namibia, South Africa, Swaziland and Zimbabwe. At the time, Mozambique was engulfed in a civil war, and had to be excluded. The resolution for SABAP1 was the quarter degree grid cell (QDGC), 15 minutes of latitude by 15 minutes of longitude, 27.4 km north-south and about 25 km east-west, an area of about 700 km². Fieldwork was conducted mainly in the five-year period 1987–1991, but the project coordinators included all suitable data collected from 1980–1987. In some areas, particularly those that were remote and inaccessible, data collection continued until 1993.

Data title	Source and date of publication	Data Description
		Fieldwork was undertaken mainly by birders, and most of it was done on a volunteer basis. Fieldwork consisted of compiling bird lists for the QDGCs. All the checklists were fully captured into a database. The final dataset consisted of 147 605 checklists, containing a total of 7.3 million records of bird distribution. Of the total 3973 QDGCs, only 88 had no checklists (2.2% of the total).
The Southern African Bird Atlas 2 (SABAP2)	Animal Demography Unit, University of Cape Town, 1 July 2007 to present, ongoing. Accessed in February 2018.	SABAP2 is the follow-up project to the Southern African Bird Atlas Project (for which the acronym was SABAP, and which is now referred to as SABAP1). This first bird atlas project took place from 1987-1991. The second bird atlas project started on 1 July 2007 and plans to run indefinitely. The current project is a joint venture between the Animal Demography Unit at the University of Cape Town, BirdLife South Africa (BLSA) and the South African National Biodiversity Institute (SANBI). The project aims to map the distribution and relative abundance of birds in southern Africa and the atlas area includes South Africa, Lesotho and Swaziland. SABAP2 was launched in Namibia in May 2012. The field work for this project is done by more than one thousand five hundred volunteers. The unit of data collection is the pentad, five minutes of latitude by five minutes of longitude, squares with sides of roughly 9km. At the end of June 2017, the SABAP2 database contained more than 189,000 checklists. The milestone of 10 million records of bird distribution in the SABAP2 database was less than 300,000 records away. Nine million records were reached on 29 December 2016, eight months after reaching 8 million on 14 April 2016, which in turn was eight months after reaching seven million on 22 August 2015, and 10 months after the six million record milestone. More than 78% of the original SABAP2 atlas area (i.e. South Africa, Lesotho and Swaziland) has at least one checklist at this stage in the project's development. More than 36% of pentads have four or more lists.
2013 - 2014 South African National Land-Cover Dataset	DEA, February 2015 (https://egis.environment.gov.za/)	The 2013-14 South African National Land-cover dataset produced by GEOTERRAIMAGE as a commercial data product has been generated from digital, multi-seasonal Landsat 8 multispectral imagery, acquired between April 2013 and March 2014. The data set was procured by the Department of Environmental Affairs for public use. In excess of 600 Landsat images were used to generate the land-cover information, based on an average of 8 different seasonal image acquisition dates, within each of the 76 x image frames required to cover South Africa. The land-cover dataset, which covers the whole of South Africa, is presented in a map-corrected, raster format, based on 30x30m cells equivalent to the image resolution of the source Landsat 8 multi-spectral imagery. The dataset contains 72 x land cover / use information classes, covering a wide range of natural and man-made landscape characteristics. Each data cell contains a single code representing the dominant land-cover class (by area) within that 30x30m unit, as determined from

Data title	Source and date of publication	Data Description
		analysis of the multi-date imagery acquired over that image frame. The original land-cover dataset was processed in UTM (north) / WGS84 map projection format based on the Landsat 8 standard map projection format as provided by the USGS3. The final product is available in UTM35 (north) and (south), WGS84 map projections and Geographic Coordinates, WGS84.
The biomes of South Africa as contained in the National Vegetation Map of South Africa (2012)	The Vegetation Map of South Africa, Lesotho and Swaziland by Mucina and Rutherford (eds.), 2006, with the spatial product updated in 2012.	The descriptions of vegetation types are given for each biome and include a general introduction to each biome, details about how each vegetation type relates to previously published vegetation maps, distribution, vegetation and landscape features, geology and soils, climate, important taxa, biogeographically important taxa, endemic taxa, conservation, and remarks.
The crane, raptor and vulture nest databases of the Endangered Wildlife Trust (EWT)	Endangered Wildlife Trust accessed February 2018	Data on crane, vulture and raptor nests collected by the various programmes of the EWT. Absence of records does not imply absence of the species within an area, but simply that this area may not have been sampled. All recorded nesting sites were included, no verification of current status of nests were conducted.
National vulture restaurant database	VulPro, March 2017 http://www.vulpro.com/	The register contains a georeferenced list of vulture restaurants throughout South Africa as compiled by Vulpro. All recorded vulture restaurants were included; no verification of current status of vulture restaurants was conducted.
List of eagle nests on Eskom transmission lines in the Karoo	Endangered Wildlife Trust, 2006	The dataset contains a georeferenced list of Tawny Eagle, Martial Eagle and Verreaux's Eagle nests on transmission lines in the Karoo as at 2006. All recorded nesting sites were included, no verification of current status of nests were conducted.
Information on the locality of Red Data nests	Unpublished data from pre-construction monitoring at renewable energy projects from 2010 - 2018, obtained from various avifaunal specialists.	Nests of various raptors, including Verreaux's Eagle, Martial Eagle, Tawny Eagle, African Crowned Eagle, Wattled Crane, White-backed Vulture collected in the course of pre-construction monitoring at proposed renewable energy projects in the Western, Northern, and Eastern Cape, and KZN.
The national register of Cape Vulture colonies	VulPro, Endangered Wildlife Trust, NMMU 2018	The dataset contains a georeferenced list of Cape Vulture breeding and roosting colonies.
A map of Blue Swallow breeding areas	Ezemvelo KZN Wildlife, March 2018	The KZN Mistbelt Grassland Important Bird Area (IBA) which incorporates all the known patches of grassland where Blue Swallows are known to nest and forage, plus additional nests sites outside the IBA. No verification of current status of nests was conducted.
Information on potential nesting areas of Southern Ground Hornbills.	Mabula Ground Hornbill Project, March 2018.	The data consists of a list of pentads where the species was sighted in Kwa-Zulu-Natal. Data was provided in pentad format. The assumption was made that the species would be breeding within the pentad.
Information on various Red Data species nests obtained from the Strategic Environmental Assessment for Wind and Solar Photovoltaic Energy in South Africa.	CSIR, 2015	The data comprise nest localities of Black Harrier, Martial Eagle, Verreaux's Eagle, Blue Crane, Lanner Falcon, in the solar and wind focus areas which overlaps with the corridors.

Data title	Source and date of publication	Data Description
Information on the localities of Southern Bald Ibis breeding colonies.	BLSA 2015. Nest localities of Southern Bald Ibis. https://www.birdlife.org.za/	The data comprises nest localities of Southern Bald Ibis collected by Dr Kate Henderson as part of her PhD studies.
Nests localities of various Red Data species.	Ezemvelo KZN Wildlife 2018	Nests localities of Bateleur, Black Stork, African Crowned Eagle, Lappet-faced Vulture, Marabou Stork, Martial Eagle, Secretarybird, Tawny Eagle, White-backed Vulture and White-headed Vulture.
Potential Bush Blackcap, Spotted Ground-Thrush and Orange Ground-Thrush breeding habitat.	BLSA. 2018a. A list of potential Bush Blackcap, Spotted Ground-Thrush and Orange Ground-Thrush breeding habitat. https://www.birdlife.org.za/.	The results of a modelling exercise undertaken by BirdLife South Africa to identify critical breeding habitat for three key forest – dwelling Red Data species.
Yellow-breasted Pipit core distribution	BLSA. 2018b. Yellow-breasted Pipit core distribution mapping. https://www.birdlife.org.za/.	Map of core distribution/breeding areas based on the modelling of key aspects of the species' biology.
Rudd's Lark core distribution	BLSA. 2018c. Rudd's Lark core distribution mapping. https://www.birdlife.org.za/.	Map of core distribution/breeding areas based on the modelling of key aspects of the species' biology.
Botha's Lark core distribution	BLSA. 2018d. Botha's Lark core distribution mapping. https://www.birdlife.org.za/.	Map of core distribution/breeding areas based on the modelling of key aspects of the species' biology.
White-winged Flufftail confirmed sightings 2000 – 2014	BLSA. 2014. White-winged Flufftail confirmed sightings 2000 – 2014. https://www.birdlife.org.za/.	A list of wetlands where this Critically Endangered (CR) species has been recorded in South Africa which includes the locality where the first breeding for the region has recently been confirmed.

4.3 Assumptions and Limitations

4.3.1 Assumptions

- It is assumed that the data layers used are reasonably accurate. Field verification will have to take place on a site by site basis linked to development proposals.

4.3.2 Limitations

- Due to the relatively coarse resolution of a QDGC (25 x 27.4km) sometimes species were recorded within a QDGC which contains more than one biome, some of which it is unlikely to occur in. In such an instance professional judgment was used to assess the potential for a species to occur in a given habitat and it was taken into account in the risk rating process.
- Only existing published and unpublished datasets were used with limited desktop verification.
- Some avifaunal specialist did not respond to data requests.
- The recommendations put forward here should be seen as generic and not replacing the project-specific recommendations which will be generated at the EIA level for an individual project.
- Due to the wide scope of the assessment, it is not possible to determine limits of acceptable change with a great deal of accuracy for each species in each corridor. For that, accurate data on population figures is required, as well as comprehensive data on the biology of each species, in order to model the effect of the envisaged impacts on the population. Information on that level is lacking for the majority of the species. Modelling impact at population level is a complicated process which falls outside the scope of this project.

The potential impact of power line developments on avifauna in South Africa is relatively well studied, but important information is still lacking.

Areas where the lack of knowledge is a constraint are the following:

- It is unclear how some Red Data species will react to the disturbance associated with the construction of power lines - more scientifically verifiable knowledge of the disturbance thresholds of these species would improve predictive capabilities.
- The actual mortality of power line sensitive Red Data species will always remain unknown. The impact of mortality on these populations is therefore difficult to assess, and needs to be deduced from the available, incomplete data currently available.
- Published, scientifically verified results from the experiments performed by the EWT to test the efficacy of Bird Flappers to prevent collision mortality is eagerly awaited.

4.4 Relevant Regulatory Instruments

Table 2 presents a detailed list and description of relevant regulatory instruments associated with the field of expertise at international, national scale, as well as provincial scale.

Table 2: International, national and provincial regulatory instruments relevant to avifauna.

Instrument	Key objective
International Instrument	
Ramsar Convention (The Convention of Wetlands of International Importance (1971 and amendments)	Protection and conservation of wetlands, particularly those of importance to waterfowl and waterfowl habitat.
Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)	Aims to conserve terrestrial, marine and avian migratory species throughout their range.
The Agreement on the Conservation of African- Eurasian Migratory Waterbirds, or African- Eurasian Waterbird Agreement (AEWA)	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.
International Finance Corporation (IFC) Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	To protect and conserve biodiversity. To maintain the benefits from ecosystem services. To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.
Convention on Biological Diversity (1993) including the CBD's Strategic Plan for Biodiversity 2011–2020 and the Aichi Biodiversity Targets	The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.
National Instrument	
National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)	The National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. Activity 12 in Listing Notice 3 (Government Notice R324 of 7 April 2017).relates to the clearance of 300 m^2 or more of vegetation, within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004.
National Environmental Management: Protected Areas Act, 2003. (Act 57 of 2003)	To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for

Instrument	Key objective
	intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.
National Environmental Management Act,1998 (Act 107 of 1998)	Promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development;
Environment Conservation Act, 1989 (Act 73 of 1989)	To provide for the effective protection and controlled utilization of the environment and for matters incidental thereto.
National Water Act, 1998 (Act 36 of 1998)	Part 3, The Reserve: The ecological reserve relates to the water required to protect the aquatic ecosystems of the water resource.
Provincial Instrument	
KwaZulu Nature Conservation Act, 1992 (Act 29 of 1992) still in force	Provides for the protection of fauna and flora in those areas that formed part of the former KwaZulu.
Mpumalanga Nature Conservation Act Of 1998.	Provides for the protection of fauna and flora in the Mpumalanga Province.
Natal Nature Conservation Ordinance 15 of 1974 (still in force)	Provides for the protection of fauna and flora in those areas that form part of the former Natal province.
Western Cape Nature Conservation Board Act, 1998 (Act 15 of 1998)	To provide for the establishment, powers, functions and funding of the Western Cape Nature Conservation Board and the establishment, funding a control of a Western Cape Nature Conservation Fund, and to provide for matters incidental thereto. The object of the board shall be, (a) promote and ensure nature conservation and related matter in the Province.
Western Cape Nature Conservation Laws Amendment Act, 2000 (Act 3 of 2000)	To provide for the amendment of various laws on nature conservation in order to transfer the administration of the provisions of those laws to the Western Cape Nature Conservation Board; to amend the Western Cape Nature Conservation Board Act, 1998 to provide for a new definition of Department and the deletion of a definition; to provide for an increase in the number of members of the Board; to provide for additional powers of the Board; to amend the provisions regarding the appointment and secondment of persons to the Board; and to provide for matters incidental thereto.
Northern Cape Nature Conservation Act, 2009 (Act 10 of 2009)	To provide for the sustainable utilization of wild animals, aquatic biota and plants: to provide for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; to provide for offences and penalties for contravention of the Act: to provide for the issuing of permits and other authorisations: and provide for the matter connected therewith.
Cape Nature Conservation Ordinance, No. 19 of 1974 (still in force)	Provides for the protection of fauna and flora in parts of the North-West Province and the Eastern Cape (former Cape Province).

5 IMPACT CHARACTERISATION

The impacts of power lines on birds can be summarised as follows:

- Electrocution: This happens when a large bird makes contact with two live components simultaneously, or a live and earthed component. This results in a short circuit as a result of which the bird is electrocuted. Electrocution risk is a function of the pole configuration and the size of the bird. In South Africa, large raptors and vultures are most vulnerable to electrocutions, on voltages of 11kV up to 132kV (Van Rooyen 1998).
- Collisions: In this instance, injury or death of the bird is caused by the bird colliding at high speed with the power line infrastructure, usually the earthwire of transmission and sub-transmission lines (>66kV), or the conductors themselves in the case of reticulation lines (11 – 33kV). In South Africa, most heavily impacted upon are bustards, storks, cranes and various species of waterbirds (Jenkins et al. 2010).

- Displacement due to habitat destruction: During the construction and maintenance of power lines and substations, some habitat destruction and transformation inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the levelling of substation yards. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through transformation of habitat, which could result in temporary or permanent displacement.
- Displacement due to disturbance: Apart from direct habitat destruction, the above-mentioned construction and maintenance activities also impact on birds through disturbance, particularly during breeding activities. Disturbance of breeding individuals could lead to breeding failure through abandonment of the nest or through exposing the eggs and nestlings to predation when the adult birds temporarily leave the nest area.

Please see Section 1: Introduction for a detailed discussion of the impacts listed above.

6 CORRIDORS DESCRIPTION

The point of departure was the delineation of the corridor according to biomes present in the corridor, and then extracting the power line sensitive Red Data species recorded by SABAP 2 within that biome[2]. It is generally accepted that vegetation structure, rather than the actual plant species, influences bird species distribution and abundance (Harrison et al., 1997). The description of the biomes largely follows the classification system used in the Atlas of Southern African Birds (SABAP1)) (Harrison et al. (1997) supplemented with material from Mucina and Rutherford (2006). The criteria used by the SABAP1 authors to amalgamate botanically defined vegetation units, or to keep them separate were: (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations.

The biome descriptions used in in this report are as follows:

- Fynbos: Fynbos is dominated by low shrubs and has two major vegetation divisions: fynbos proper characterised by restioid, ericoid and proteoid components; and renosterveld, dominated by *Asteraceae*, specifically Renosterbos *Elytropappus rhinocerotis*, with geophytes and some grasses.
- Succulent Karoo: The Succulent Karoo falls within the winter rain-fall region in the far west, and is characterised by succulent shrubs, particularly *Mesembryanthemaceae* and a particular paucity of grass cover and trees, except in the Little Karoo of the Western Cape Province, where tree cover is relatively well developed.
- Nama Karoo: The Nama Karoo vegetation largely comprises low shrubs and grasses; peak rainfall occurs in summer. Trees, e.g. *Vachellia karoo* and aline species such as Mesquite *Prosopis glandulosa* are mainly restricted to water courses where fairly luxuriant stands can develop especially in the Eastern Cape Province, and along the Orange River. In comparison to the Succulent Karoo, the Nama Karoo has a higher proportion of grass and tree cover.
- Savanna: Savanna is defined here as having a grassy understorey and a distinct woody upper storey of trees and tall shrubs. Tree cover can range from sparse to almost closed-canopy cover. The relatively arid fine-leaved, typically *Vachellia*-dominated woodland types typically occur in the drier western regions, while the mesic, pre-dominantly broadleaved woodlands typically occur in the wetter eastern regions.
- Forest: Consists of coastal and Afro-montane forest. The tree canopy cover in forests are continuous and mainly comprises evergreen tree species. Below the canopy, vegetation is multi-layered. The tall, dense trees result in little ground vegetation and a thick leaf litter. Forests only occur in frost-free regions with relatively high rainfall and protected from fires.

[2] It should be noted that due to the relatively coarse resolution of a QDGC (25 x 27.4km) sometimes species were recorded within a QDGC which contains more than one biome, some of which it is unlikely to occur in. In such an instance professional judgment was used to assess the potential for a species to occur in a given habitat and was taken into account in the risk rating process.

- Grassland: The dominant vegetation comprises grasses, with geophytes and herbs also well-represented. These grasslands are maintained largely by a combination of relatively high summer rainfall, frequent fires, frost and grazing, which preclude the presence of shrubs and trees. Sweet grasslands are fond in lower rainfall areas, are taller and less dense, have a lower fibre content and retain nutrients in the leaves during winter. Sour grasslands occur in higher rainfall regions and are characterized by being shorter and denser in structure, having a high fibre content and a tendency to withdraw nutrients to the roots during winter.
- Desert: The dominant vegetation comprises grassland dominated by “white grasses”, some spinescent (*Stipograstis* species) on flats with additional shrubs and herbs in the drainage lines or on more gravelly or loamy soil next to mountains. Hills and mountains are dominated by bare outcrops with very sparse shrubby vegetation in crevices, sometimes with localised grassland areas.
- Indian Ocean Coastal Belt/East Coast Littoral: This is a mosaic of coastal forest, sand forest, coastal thicket, coastal grasslands and mangroves. It is typically moist and tropical to sub-tropical.
- Azonal vegetation: This refers to distinctive vegetation types not restricted to a specific biome but occurring across several biomes. In azonal vegetation special substrate (special soil types or bedrocks) and/or hydrogeological conditions (waterlogging, flooding, tidal influence) exert an overriding influence on floristic composition, structure and dynamics over macroclimate. Azonal vegetation are mostly found in freshwater wetlands, alluvial zones, salt pans, estuaries, seashores, and dunes.

Figure 2 provides an overview of the various biomes within South Africa, as well as the proposed Expanded EGI corridors (and the gazetted EGI corridors).

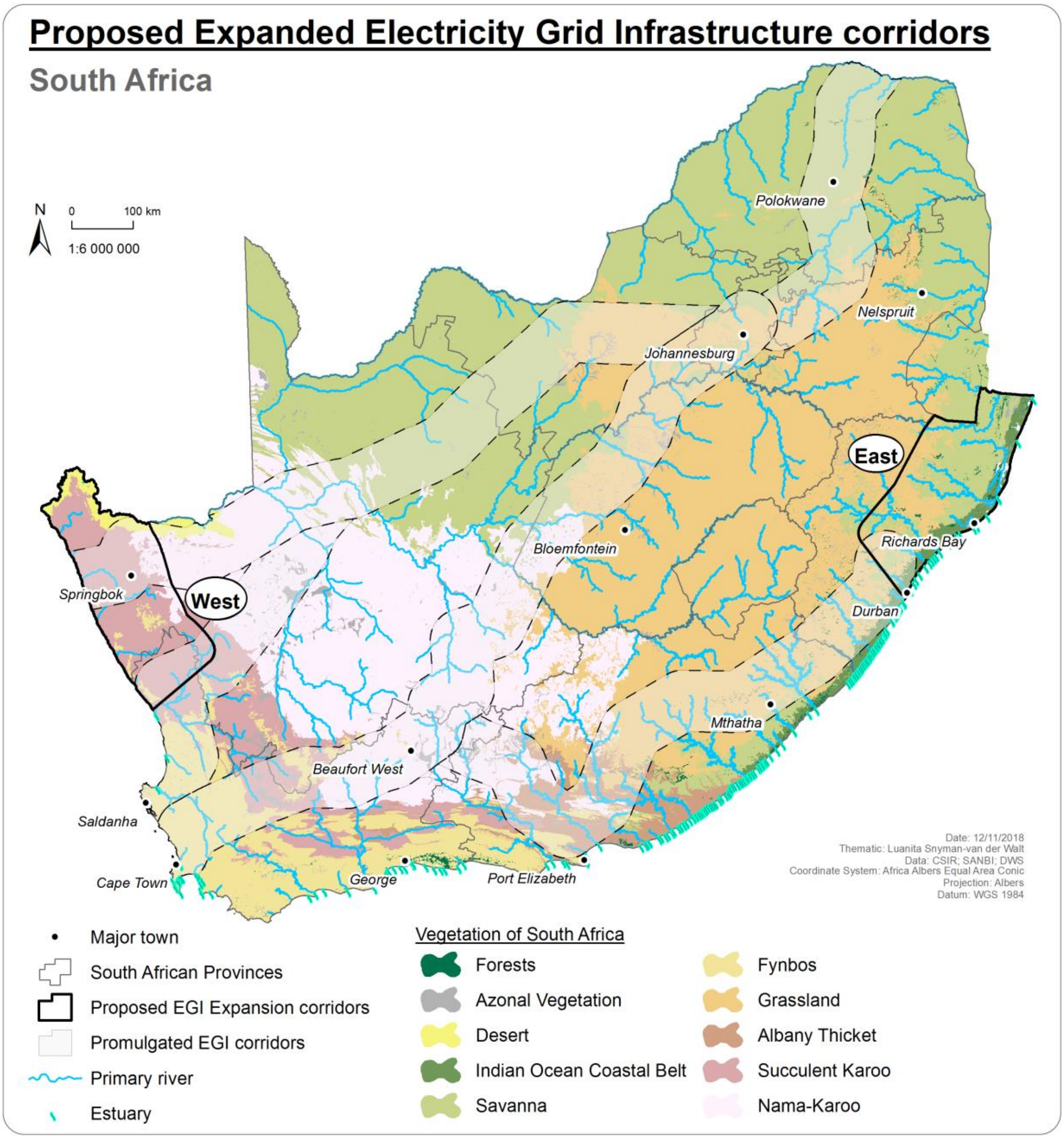

Figure 2: Overview of the Biomes within South Africa and the Proposed Expanded EGI Corridors

Table 3: Environmental description of the proposed EGI extended corridors.

Corridor	Brief description
Expanded Western Corridor	The Expanded Western Corridor contains 4 biomes, as well as Azonal vegetation. These are: • Desert • Fynbos • Nama-Karoo • Succulent Karoo The following power line sensitive Red Data species were identified and rated for potential impacts in each biome, extracted from a total of 90 QDGCs. NT = Near threatened VU = Vulnerable EN = Endangered CR = Critically Endangered

Species	Status	Fynbos	Succulent Karoo	Nama Karoo	Desert	Azonal
African Marsh-Harrier	EN	x				x
Black Harrier	EN	x	x	x	x	
Black Stork	VU	x	x	x	x	x
Blue Crane	NT	x	x			x
Caspian Tern	VU					x
Greater Flamingo	NT	x	x	x	x	x
Karoo Korhaan	NT	x	x	x	x	
Lanner Falcon	VU	x	x	x	x	x
Lesser Flamingo	NT	x	x	x	x	x
Ludwig's Bustard	EN	x	x	x	x	
Maccoa Duck	NT					x
Martial Eagle	EN	x	x	x	x	
Secretarybird	NT	x	x	x		
Southern Black Korhaan	VU	x	x			
Verreaux's Eagle	VU	x	x	x	x	
Great White Pelican	VU					x
Kori Bustard	NT		x			

Corridor	Brief description

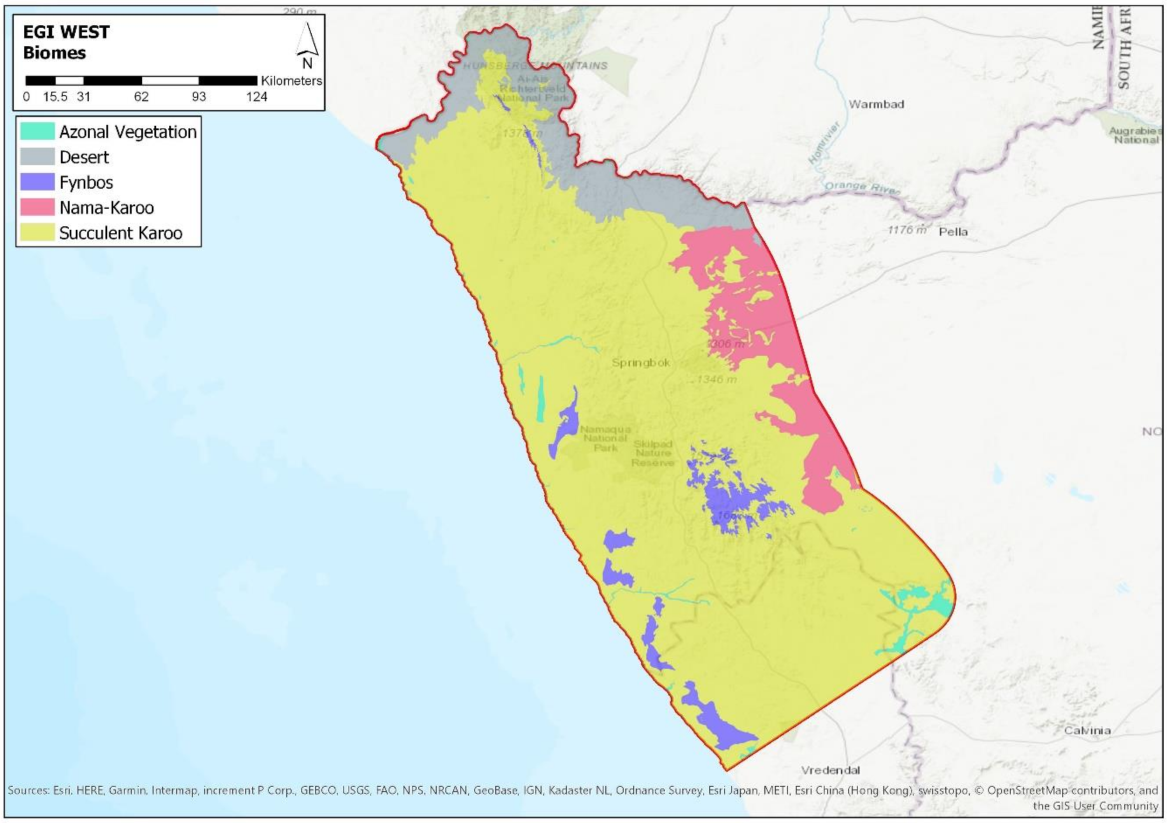

Figure 3: Biomes of the Expanded Western EGI Corridor.

Corridor	Brief description
Expanded Eastern Corridor	*The Expanded Eastern Corridor contains four biomes, as well as Azonal vegetation. These are* • Forests • Grassland • Indian Ocean Coastal Belt • Savanna *The following power line sensitive Red Data species were identified and rated for potential impacts in each biome, extracted from a total of 85 QDGCs.* *NT = Near threatened* *VU = Vulnerable* *EN = Endangered* *CR = Critically Endangered*

Species	Status	Savanna	Grassland	Forest	Indian Ocean Coastal Belt	Azonal
African Marsh-Harrier	EN	x	x		x	x
Abdim's Stork	NT		x			x
Black Harrier	EN		x			
Black Stork	VU	x	x		x	x
Cape Parrot	EN			x		
Caspian Tern	VU					x
Greater Flamingo	NT				x	x
Lanner Falcon	VU	x	x	x	x	x
Lesser Flamingo	NT				x	x
Maccoa Duck	NT					x
Martial Eagle	EN	x	x		x	
Secretarybird	NT	x	x			
Lappet-faced Vulture	EN	x				
Verreaux's Eagle	VU	x	x			
Marabou Stork	NT	x			x	x
Denham's Bustard	VU		x		x	
Pink-backed Pelican	VU					x
Saddle-billed Stork	EN					x
Southern Bald Ibis	VU		x			
Burchell's Courser	VU		x			
Cape Vulture	EN	x				
Southern Ground-Hornbill	EN	x			x	
Tawny Eagle	EN	x				
Wattled Crane	CR		x			x
African Grass-Owl	VU		x			x
Grey Crowned Crane	EN		x		x	x
White-bellied Korhaan	VU	x	x		x	
White-backed Vulture	CR	x				
Yellow-billed Stork	EN					x
African Crowned Eagle	VU			x		
African Finfoot	VU					x
African Pygmy-Goose	VU					x
Bateleur	EN	x				
Great White Pelican	VU					x
Hooded Vulture	CR	x				
Pel's Fishing-Owl	EN					x

Corridor	Brief description

Southern Banded Snake-Eagle	CR				x	
White-headed Vulture	CR	x				
White-backed Night-Heron	VU					x
Black-rumped Buttonquail	EN		x			
Orange Ground-thrush	NT					
Spotted Ground-thrush	EN			x		

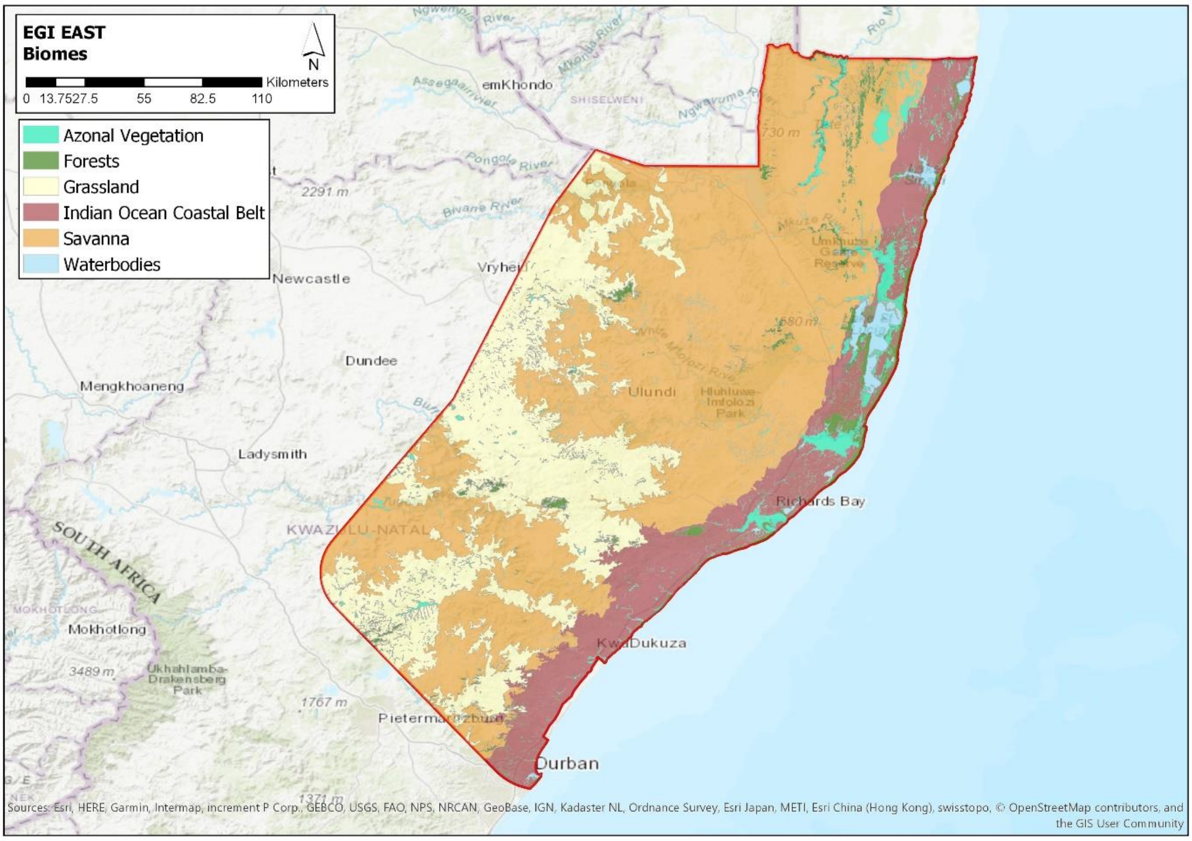

Figure 4: Biomes of the Expanded Eastern EGI Corridor.

7 FEATURE SENSITIVITY MAPPING

7.1 Identification of feature sensitivity criteria

Table 4: Description and sources of data used for the avifauna sensitivity analysis.

Sensitivity Feature Class (Habitat class)	Data Source + Date of Publications	Data Description, Preparation and Processing	Relevant Corridors Phases
Wetlands and waterbodies: Water permanent	South African National Land-Cover Dataset, 2015	Areas of open, surface water, that are detectable on all image dates used in the Landsat 8 based water modelling processes. Permanent water extent typically refers to the minimum water extent, which occurs throughout the 2013-14 assessment period. Includes both natural and man-made water features.	West and East
Wetlands and waterbodies: Water seasonal	South African National Land-Cover Dataset, 2015	Areas of open, surface water, that are detectable on one or more, but not all image dates used in the Landsat 8 based water modelling processes. Seasonal water extent typically refers to the maximum water extent, which may only occur for a limited time within the 2013-14 assessment period. Includes both natural and man-made water features.	West and East
Wetlands and waterbodies: Wetlands	South African National Land-Cover Dataset, 2015	Wetland areas that are primarily vegetated on a seasonal or permanent basis. Defined on the basis of seasonal image identifiable surface vegetation patterns (not subsurface soil characteristics. The vegetation can be either rooted or floating. Wetlands may be either daily (i.e. coastal), temporarily, seasonal or permanently wet and/or saturated. Vegetation is predominately herbaceous. Includes but not limited to wetlands associated with seeps/springs, marshes, floodplains, lakes/pans, swamps, estuaries, and some riparian areas. Wetlands associated with riparian zones represent image identified vegetation along the edges of watercourses that show similar spectral characteristics to nearby wetland vegetation. Excludes Mangrove swamps. Permanent or seasonal open water areas within the wetlands are classified separately. Seasonal wetland occurrences within commercially cultivated field boundaries are not shown, although they have been retained within subsistence level cultivation fields.	West and East
Indigenous Forest	South African National Land-Cover Dataset, 2015	Natural / semi-natural indigenous forest, dominated by tall trees, where tree canopy heights are typically > ± 5m and tree canopy densities are typically > ± 75 %, often with multiple understory vegetation canopies.	East
Thicket/dense bush	South African National Land-Cover Dataset, 2015	Natural / semi-natural tree and / or bush dominated areas, where typically canopy heights are between 2 - 5 m, and canopy density is typically > ± 75%, but may	West and East

Sensitivity Feature Class (Habitat class)	Data Source + Date of Publications	Data Description, Preparation and Processing	Relevant Corridors Phases
		include localised sparser areas down to ± 60%. Includes dense bush, thicket, closed woodland, tall, dense shrubs, scrub forest and mangrove swamps. Can include self-seeded bush encroachment areas if sufficient canopy density.	
Woodland/open bush	South African National Land-Cover Dataset, 2015	Natural / semi-natural tree and / or bush dominated areas, where typically canopy heights are between ± 2 - 5 m, and canopy densities typically between 40 - 75%, but may include localised sparser areas down to ± 15 - 20 %. Includes sparse – open bushland and woodland, including transitional wooded grassland areas. Can include self-seeded bush encroachment areas if canopy density is within indicated range. In the arid western regions (i.e. Northern Cape), this cover class may be associated with a transitional bush / shrub cover that is lower than typical Open Bush / Woodland cover but higher and/or more dense than typical Low Shrub cover.	West and East
Grassland	South African National Land-Cover Dataset, 2015	Natural / semi-natural grass dominated areas, where typically the tree and / or bush canopy densities are typically < ± 20 % but may include localised denser areas up to ± 40 %, (regardless of canopy heights). Includes open grassland, and sparse bushland and woodland areas, including transitional wooded grasslands. May include planted pasture (i.e. grazing) if not irrigated. Irrigated pastures will typically be classified as cultivated, and urban parks and golf courses etc under urban.	West and East
Shrubland fynbos	South African National Land-Cover Dataset, 2015	Natural / semi-natural low shrub dominated areas, typically with < ± 2m canopy height, specifically associated with the Fynbos Biome. Includes a range of canopy densities encompassing sparse to dense canopy covers. Very sparse covers may be associated with the bare ground class. Note that taller tree / bush / shrub communities within this vegetation type are typically classified separately as one of the other tree or bush dominated cover classes.	West
Low shrubland	South African National Land-Cover Dataset, 2015	Natural / semi-natural low shrub dominated areas, typically with ≤ 2m canopy height. Includes a range of canopy densities encompassing sparse to dense canopy covers. Very sparse covers may be associated with the bare ground class. Typically associated with low, woody shrub, karoo-type vegetation communities, although can also represent locally degraded vegetation areas where there is a significantly reduced vegetation cover in comparison to surrounding, less impacted vegetation cover, including long-term wildfire scars in some mountainous areas in the western Cape. Note that taller tree / bush / shrub communities within this vegetation type are typically classified separately as one of the other tree or bush dominated cover classes.	West and East
Cultivated commercial fields rainfed	South African National Land-Cover Dataset, 2015	Cultivated lands used primarily for the production of rain-fed, annual crops for commercial markets. Typically represented by large field units, often in dense local or regional clusters. In most cases the defined cultivated extent represents the	West and East

Sensitivity Feature Class (Habitat class)	Data Source + Date of Publications	Data Description, Preparation and Processing	Relevant Corridors Phases
		actual cultivated or potentially extent.	
Cultivated commercial pivots	South African National Land-Cover Dataset, 2015	Cultivated lands used primarily for the production of centre pivot irrigated, annual crops for commercial markets. In most cases the defined cultivated extent represents the actual cultivated or potentially extent.	West and East
Cultivate orchards and vines	South African National Land-Cover Dataset, 2015	Cultivated lands used primarily for the production of both rain-fed and irrigated permanent crops for commercial markets. Includes both tree, shrub and non-woody crops, such as citrus, tea, coffee, grapes, lavender and pineapples etc. In most cases the defined cultivated extent represents the actual cultivated or potentially extent.	West and East
Cultivated subsistence	South African National Land-Cover Dataset, 2015	Cultivated lands used primarily for the production of rain-fed, annual crops for local markets and / or home use. Typically represented by small field units, often in dense local or regional clusters. The defined area may include intra-field areas of non-cultivated land, which may be degraded or use-impacted, if the individual field units are too small to be defined as separate features.	West and East
Cultivated sugar cane	South African National Land-Cover Dataset, 2015	Commercial, pivot irrigated fields that appear to be used continuously for growing sugarcane on the majority of multi-date Landsat images used in the 2013-14 analysis period. Also includes commercial and semi-commercial / emerging farmer status, non-pivot fields that appear to be used continuously for growing sugarcane on the majority of multi-date Landsat images used in the 2013-14 analysis period.	East
Plantations	South African National Land-Cover Dataset, 2015	Planted forestry plantations used for growing commercial timber tree species. The class represents mature tree stands which have approximately 70% or greater tree canopy closure (regardless of canopy height), on all the multi-date Landsat images in the 2013-14 analysis period. The class includes spatially smaller woodlots and windbreaks with the same cover characteristics. It also includes young tree stands that have approximately 40 - 70% tree canopy closure (regardless of canopy height), clear-felled stands and spatially smaller woodlots and windbreaks with the same cover characteristics.	West and East
Industrial	South African National Land-Cover Dataset, 2015	Mining activity footprint, based on pure, non-vegetated, bare ground surfaces. Includes extraction pits, tailings, waste dumps and associated surface infrastructure such as roads and buildings (unless otherwise indicated), for both active and abandoned mining activities. Class may include open cast pits, sand mines, quarries and borrow pits etc. also includes mining activity footprint, based on semi-bare ground surfaces, which may be sparsely vegetated. Includes extraction pits, tailings, waste dumps and associated surface infrastructure such as roads and buildings (unless otherwise indicated) and surrounding dust-impacted areas, for both active and abandoned mining activities. Water bodies inside mining areas which represent	West and East

Sensitivity Feature Class (Habitat class)	Data Source + Date of Publications	Data Description, Preparation and Processing	Relevant Corridors Phases
		permanent and non-permanent water extents are also included. Areas containing buildings and large surface infrastructure associated with the extraction, processing or administration of the associated mining area are also included.	
Bare	South African National Land-Cover Dataset, 2015	Non-vegetated donga and gully features, typically associated with significant natural or man-induced erosion activities along or in association with stream and flow lines. The mapped extent of the dongas and gullies is represented by bare ground conditions in all or the majority of the multi-date Landsat images used in the land-cover modelling. Note that these erosion features are significantly better represented both spatially and numerically in the wetter, more lush regions of the country where the non-vegetated erosion surface is significantly different from the surrounding vegetation cover (i.e. bushveld and grassland regions). In general, sparsely vegetated sheet eroded areas and degraded areas with significantly reduced local vegetation cover are not included in this class but will be represented by local areas of low shrub or bare ground. Also included are bare, non-vegetated ground, with little or very sparse vegetation cover (i.e. typically < ± 5 - 10 % vegetation cover), occurring as a result of either natural or man-induced processes. Includes but not limited to natural rock exposures, dry river beds, dry pans, coastal dunes and beaches, sand and rocky desert areas, very sparse low shrublands and grasslands, surface (sheet) erosion areas, severely degraded areas, and major road networks etc. May also include long-term wildfire scars in some mountainous areas in the Western Cape.	West and East
Urban	South African National Land-Cover Dataset, 2015	Areas containing the following: • high density buildings and other built-up structures associated with mainly non-residential, commercial, administrative, health, religious or transport (i.e. train station) activities; • buildings and other built-up structures associated with mainly non-residential, industrial and manufacturing activities, including power stations; • high density buildings and other built-up structures typically associated with informal, often non-regulated, residential housing; • variable density buildings and other built-up structures typically associated with formal, regulated, residential housing; • buildings, other built-up structures and open sports areas typically areas associated with schools and school sports grounds. • Areas containing a low density mix of buildings, other built-up structures within open areas, which may or may not be cultivated, that are representative of both formally declared agricultural holdings, and similar small holdings / small farms,	West and East

Sensitivity Feature Class (Habitat class)	Data Source + Date of Publications	Data Description, Preparation and Processing	Relevant Corridors Phases
		typically located on the periphery of urban areas. • Areas containing a low density mix of buildings, other built-up structures associated with golf courses. The class includes both residential golf estates and non-residential golf courses, and typically represents the border extent of the entire estate or course. • Areas containing high density buildings and other built-up structures typically associated with formal, regulated, residential housing associated with townships and "RDP" type housing developments. • Areas containing variable density structures typically associated with rural villages, including both traditional and modern building formats. • Areas containing variable densities of buildings other built-up structures, or no structures at all, that are not clearly identifiable as one of the other Built-Up classes. May include runways, major infrastructure development sites, holiday chalets, roads, car parks, cemeteries etc.	
Drainage lines	National Freshwater Ecosystem Priority Areas Project (NFEPA), 2011	The National Freshwater Ecosystem Priority Areas (NFEPA) project identifies a national network of freshwater priorities for conservation and explores institutional mechanisms for their implementation.	West and East
Nest sites, roosts and colonies of Red Data species	• The crane and raptor nest databases of the Endangered Wildlife Trust (EWT); 2018	• Nest sites of Martial Eagle, Verreaux's Eagle, Tawny Eagle, Bateleur, White-backed Vulture, Lappet-faced Vulture, Black Harrier, Lanner Falcon, Blue Crane, Wattled Crane, Grey Crowned Crane.	East
	• The Endangered Wildlife Trust's database of eagles nesting on transmission lines in the Karoo; 2006	• Martial Eagle, Verreaux's Eagle and Tawny Eagle nests on transmission lines in the Karoo.	West
	• A map of Blue Swallow breeding areas obtained from Ezemvelo KZN Wildlife; 2018	• Blue Swallow breeding areas in KwaZulu-Natal	East
	• Information on the locality of various Red Data raptor nests. Received from various avifaunal specialists working on renewable energy projects, 2010 – 2018.	• Nest localities of Martial Eagle, African Crowned Eagle, Verreaux's Eagle, Tawny Eagle, White-backed Vulture, Black Harrier and Wattled Crane at renewable energy development sites.	West and East
	• Information on potential nesting areas of Southern Ground Hornbills, Mabula Ground Hornbill Project, 2018.	• Potential nest areas of Southern Ground Hornbill.	East
	• Information on various Red Data species nests and vulture colonies obtained from the Strategic Environmental Assessment for Wind and Solar Photovoltaic Energy in South Africa, 2015.	• The data comprise nest localities of Black Harrier, Martial Eagle, Verreaux's Eagle, Blue Crane, Lanner Falcon, in solar and wind focus areas.	West
	• Information on the locality of Southern Bald Ibis		

Sensitivity Feature Class (Habitat class)	Data Source + Date of Publications	Data Description, Preparation and Processing	Relevant Corridors Phases
	breeding colonies, BLSA, 2015.	• Information from Dr. Kate Henderson's PhD on the locality of Southern Bald Ibis roost and colonies.	East
	• National vulture restaurant database obtained from VulPro in March 2017	• The best currently available data on the location of vulture restaurants.	East
	• The register of Cape Vulture colonies obtained from VulPro, NMMU and Ezemvelo KZN Wildlife, 2018	• The best currently available data on the location of Cape Vulture colonies.	East
	• Information on various Red Data species nests obtained from Ezemvelo KZN Wildlife, 2018.	• Nests localities of Bateleur, Black Stork, African Crowned Eagle, Lappet-faced Vulture, Marabou Stork, Martial Eagle, Secretarybird, Tawny Eagle, White-backed Vulture and White-headed Vulture.	East

Below are all feature types considered in the sensitivity analysis and the rating given to each feature and buffered area, where applicable (Table 5). Details on each individual feature ratings are available on request in spreadsheet format. An example of how it was calculated is included as Appendix 1.

Table 5: Avifauna sensitivity features and ratings.

Corridor	Biome	Feature Class	Feature Class Sensitivity	Buffer Distance Sensitivity
Expanded Western Corridor	Azonal Vegetation	Bare	Medium	
		Cliffs (1km buffer)	Medium	1km
		Cultivated commercial fields rainfed	Medium	
		Cultivated vines	Medium	
		Drainage lines	Medium	
		Grassland	Medium	
		Industrial	Low	
		Low shrubland	Medium	
		Plantations	Medium	
		Shrubland fynbos	Medium	
		Thicket /Dense bush	Medium	
		Urban (500m buffer)	Low	500m
		Wetlands and waterbodies (500m buffer)	Medium	500m
		Woodland/Open bush	Medium	
	Desert	Bare	Medium	
		Cliffs (1km buffer)	Medium	1km
		Cultivated commercial fields rainfed	Medium	
		Cultivated commercial pivots	Medium	
		Cultivated orchards	Medium	
		Cultivated vines	Medium	
		Drainage lines	Medium	
		Grassland	High	
		Industrial	Low	
		Low shrubland	High	
		Shrubland fynbos	High	
		Thicket /Dense bush	Medium	
		Urban (500m buffer)	Low	500m
		Wetlands and waterbodies (500m buffer)	Medium	500m
		Woodland/Open bush	Medium	
	Fynbos	Bare	Medium	
		Cliffs (1km buffer)	Medium	1km
		Cultivated commercial fields rainfed	Medium	
		Cultivated subsistence	Medium	
		Drainage lines	Medium	
		Grassland	Medium	
		Industrial	Low	
		Low shrubland	Medium	
		Shrubland fynbos	Medium	
		Thicket /Dense bush	Medium	
		Urban (500m buffer)	Low	500m
		Wetlands and waterbodies (500m buffer)	Medium	500m
		Woodland/Open bush	Medium	
	Nama-Karoo	Bare	Medium	
		Cliffs (1km buffer)	Medium	1km
		Drainage lines	Medium	
		Grassland	High	
		Industrial	Low	
		Low shrubland	High	
		Shrubland fynbos	High	

Corridor	Biome	Feature Class	Feature Class Sensitivity	Buffer Distance Sensitivity
		Thicket /Dense bush	Medium	
		Wetlands and waterbodies (500m buffer)	Medium	500m
		Woodland/Open bush	Medium	
	Succulent Karoo	Bare	Medium	
		Cliffs (1km buffer)	Medium	1km
		Cultivated commercial fields rainfed	Medium	
		Cultivated commercial pivots	Medium	
		Cultivated subsistence	Medium	
		Cultivated vines	Medium	
		Drainage lines	Medium	
		Grassland	High	
		Industrial	Low	
		Low shrubland	High	
		Plantations	Medium	
		Shrubland fynbos	High	
		Thicket /Dense bush	Medium	
		Urban (500m buffer)	Low	500m
		Wetlands and waterbodies (500m buffer)	Medium	
		Woodland/Open bush	Medium	
Expanded Eastern Corridor	Azonal Vegetation	Bare	Medium	
		Cliffs (1km buffer)	Medium	1km
		Cultivated commercial fields rainfed	Medium	
		Cultivated commercial pivots	Medium	
		Cultivated orchards	Medium	
		Cultivated subsistence	Medium	
		Cultivated sugar cane	Medium	
		Drainage lines	High	
		Grassland	Medium	
		Indigenous Forest	Medium	
		Industrial	Low	
		Low shrubland	Medium	
		Plantations	Medium	
		Thicket /Dense bush	Medium	
		Urban (500m buffer)	Low	500m
		Wetlands and waterbodies (500m buffer)	Very high	500m
		Woodland/Open bush	High	
	Forests	Bare	Medium	
		Cliffs (1km buffer)	Medium	1km
		Cultivated commercial fields rainfed	Medium	
		Cultivated orchards	Medium	
		Cultivated subsistence	Medium	
		Cultivated sugar cane	Medium	
		Drainage lines	Medium	
		Grassland	Medium	
		Indigenous Forest	Medium	
		Industrial	Low	
		Low shrubland	Medium	
		Plantations	Medium	
		Thicket /Dense bush	Medium	
		Urban (500m buffer)	Low	500m
		Wetlands and waterbodies (500m buffer)	Medium	500m
		Woodland/Open bush	Medium	
	Grassland	Bare	Medium	
		Cliffs (1km buffer)	Medium	1km
		Cultivated commercial fields rainfed	Medium	

Corridor	Biome	Feature Class	Feature Class Sensitivity	Buffer Distance Sensitivity
		Cultivated commercial pivots	Medium	
		Cultivated orchards	Medium	
		Cultivated subsistence	Medium	
		Cultivated sugar cane	Medium	
		Drainage lines	Medium	
		Grassland	High	
		Indigenous Forest	Medium	
		Industrial	Low	
		Low shrubland	Medium	
		Plantations	Medium	
		Thicket /Dense bush	Medium	
		Urban (500m buffer)	Low	500m
		Wetlands and waterbodies (500m buffer)	High	500m
		Woodland/Open bush	High	
	Indian Ocean Coastal Belt	Bare	Medium	
		Cliffs (1km buffer)	Medium	1km
		Cultivated commercial fields rainfed	Medium	
		Cultivated orchards	Medium	
		Cultivated subsistence	Medium	
		Cultivated sugar cane	Medium	
		Drainage lines	Medium	
		Grassland	Medium	
		Indigenous Forest	Medium	
		Industrial	Low	
		Low shrubland	Medium	
		Plantations	Medium	
		Thicket /Dense bush	Medium	
		Urban (500m buffer)	Low	500m
		Wetlands and waterbodies (500m buffer)	High	500m
		Woodland/Open bush	High	
	Savanna	Bare	Medium	
		Cliffs (1km buffer)	Medium	1km
		Cultivated commercial fields rainfed	Medium	
		Cultivated commercial pivots	Medium	
		Cultivated orchards	Medium	
		Cultivated subsistence	Medium	
		Cultivated sugar cane	Medium	
		Drainage lines	High	
		Grassland	High	
		Indigenous Forest	Medium	
		Industrial	Low	
		Low shrubland	Medium	
		Plantations	Medium	
		Thicket /Dense bush	Medium	
		Urban (500m buffer)	Low	500m
		Wetlands and waterbodies (500m buffer)	High	500m
		Woodland/Open bush	Very high	
All phases	Key sensitivity features	Nest sites of Red Data species	Very high	2.5km
		Cape Vulture colonies and vulture restaurants	Very high	5km

1

7.2 Feature maps

7.2.1 Expanded Western Corridor

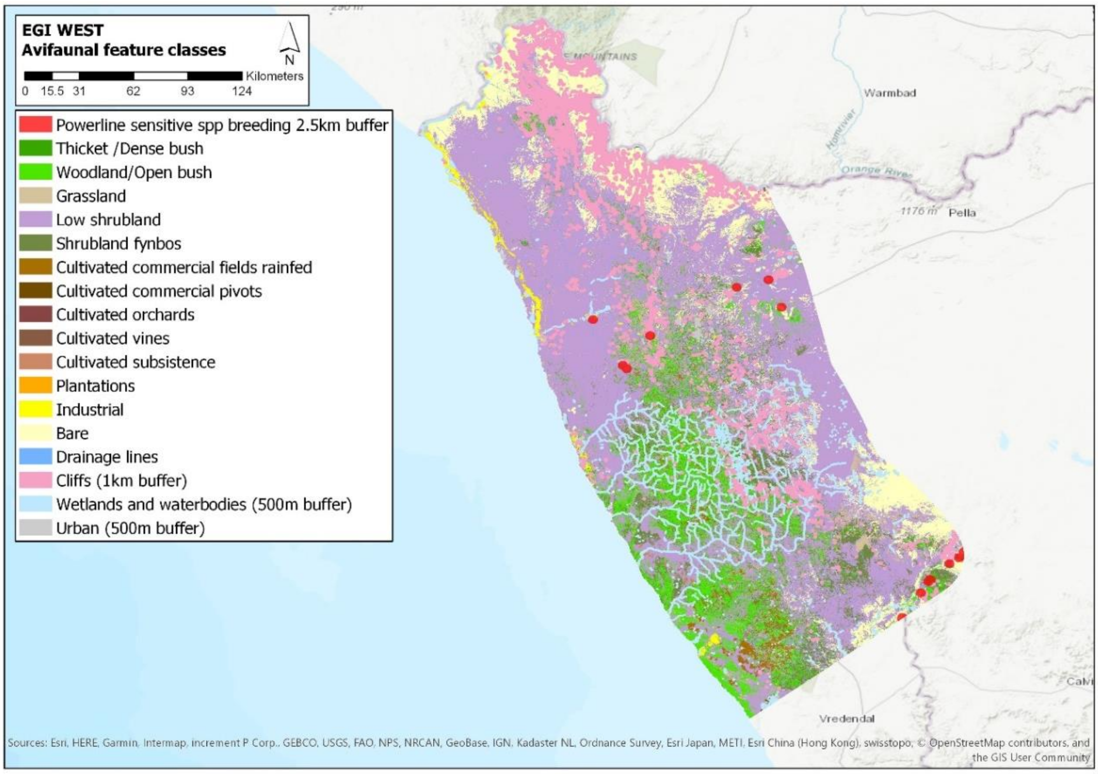

Figure 5: Sensitive environmental features of importance to avifauna in the Expanded Western Corridor.

7.2.2 Expanded Eastern Corridor

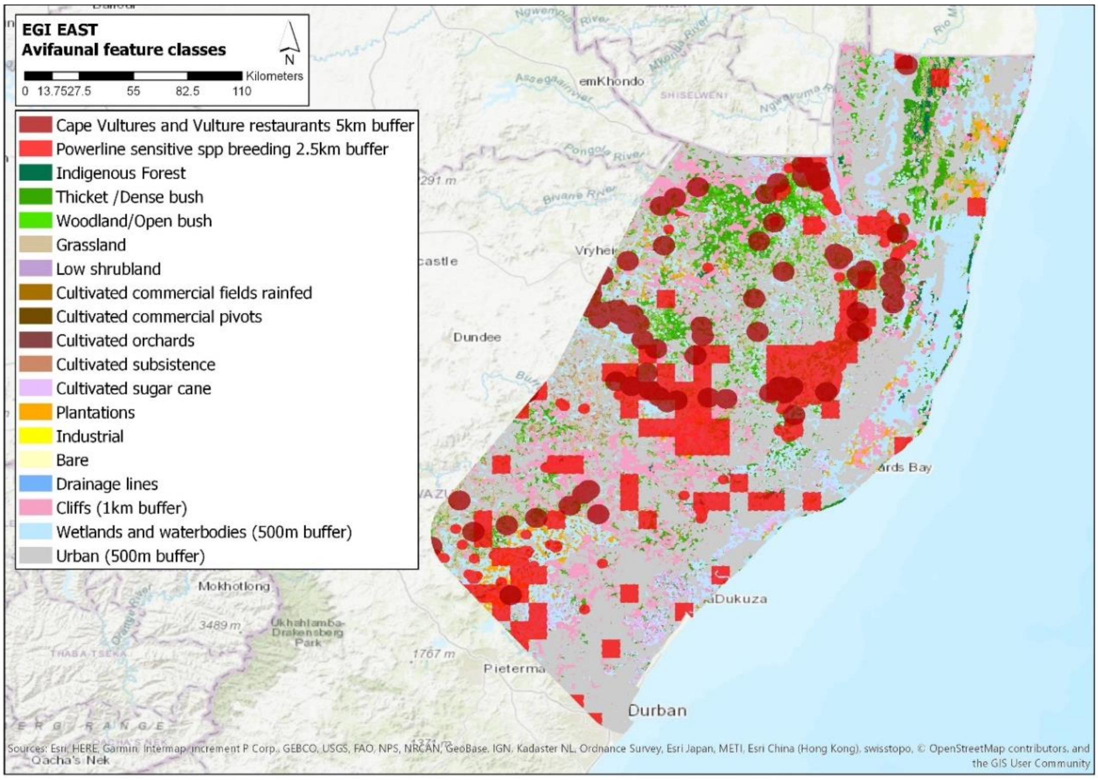

Figure 6: Sensitive environmental features of importance to avifauna in the Expanded Eastern Corridor.

8 FOUR- TIER SENSITIVITY MAPPING

The relative sensitivity mapping will follow a four tier sensitivity classes approach with:

- Dark Red: Very High Sensitivity
- Red: High Sensitivity,
- Orange: Medium Sensitivity
- Green: Low Sensitivity

8.1 Four Tier sensitivity maps

8.1.1 Expanded Western Corridor

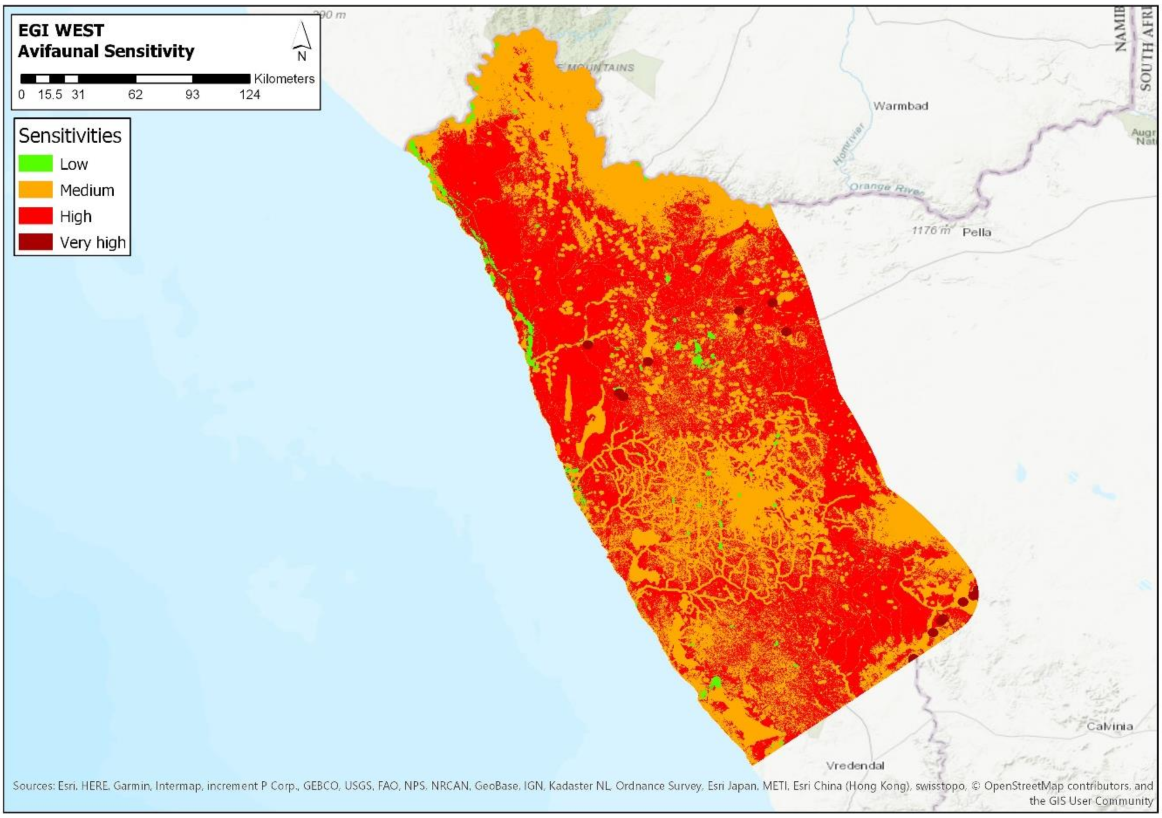

Figure 7: Avifauna sensitivity map for the Expanded Western Corridor.

8.1.2 Expanded Eastern Corridor

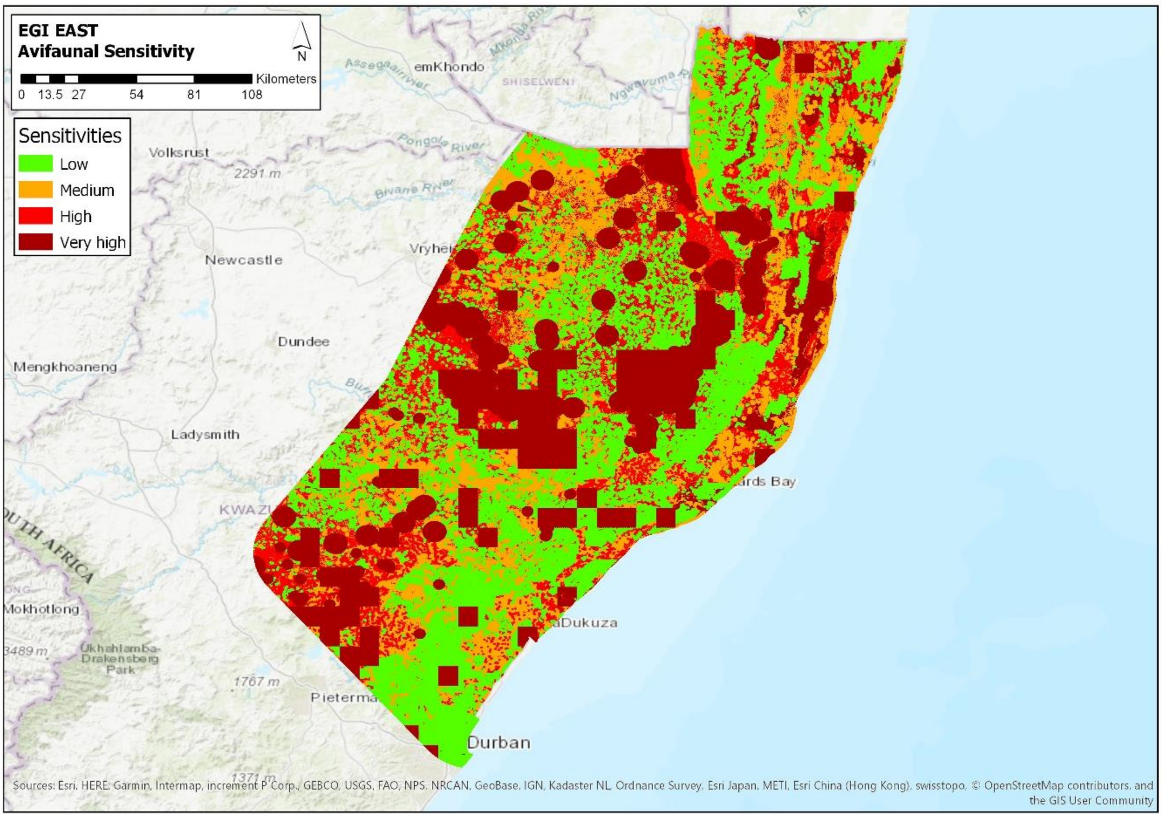

Figure 8: Avifauna sensitivity map for the Expanded Eastern Corridor.

9 KEY POTENTIAL IMPACTS AND MITIGATION

Table 6: Key potential impacts on avifauna associated with the development of EGI, and suggested mitigation measures.

Corridor	Key Impacts	Site Specific Descriptions	Possible Effect	Mitigation
Expanded Western Corridor	• Mortality of power line sensitive Red Data species through collisions • Mortality of power line sensitive Red Data species through electrocutions • Displacement of Red Data species due to habitat destruction and disturbance	Greater Flamingo collisions at waterbodies.	Multiple casualties could destabilise the population.	Avoid routing power lines within 500 m of the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines at waterbodies with nocturnal light emitting diode (LED) mitigation devices.
		Kori Bustard collisions in the Nama and Succulent Karoo.	Multiple casualties could destabilise the population and result in a negative population growth (Shaw, 2013).	Mark power lines with BFDs.
		Black Stork collisions and displacement at waterbodies, drainage lines and cliffs.	Multiple casualties could destabilise the population.	Avoid routing power lines within 500 m of the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines at waterbodies and across drainage lines with BFDs. Search suitable cliffs for nest sites and buffer nests by 2.5 km. Should the full extent of the buffering not be practically possible it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the Environmental Control Officer (ECO). An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain, if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.
		Blue Crane collisions at cultivated commercial fields and waterbodies.	Multiple casualties could destabilise the population and result in a negative population growth (Shaw et al. 2010)	Avoid routing power lines within 500 m of the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines at waterbodies with nocturnal LED mitigation devices. Buffer all nests by 2.5 km. Should the full extent of the buffering not be practically possible it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the ECO. An

Corridor	Key Impacts	Site Specific Descriptions	Possible Effect	Mitigation
				effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.
		Great White Pelican collisions at waterbodies and along the coast	Multiple casualties could destabilise the population.	Avoid routing power lines within 500 m of the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines at waterbodies with BFD.
		Lesser Flamingo collisions at waterbodies and along the coast.	Multiple casualties could destabilise the population.	Avoid routing power lines within 500 m of the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines at waterbodies with nocturnal LED mitigation devices.
		Ludwig's Bustard collisions in the Nama and Succulent Karoo.	Multiple casualties could destabilise the population and result in a negative population growth (Shaw 2013).	Mark power lines with BFDs.
		Martial Eagle electrocutions and displacement of breeding birds on transmission lines in the Nama and Succulent Karoo.	Multiple casualties and disturbance of breeding birds could destabilise the population.	Use only bird-friendly power line designs. Investigate all suitable transmission and sub-transmission lines (≤66kV) for nests and buffer by 2.5 km. Should the full extent of the buffering not be practically possible it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the ECO. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.
		Secretary bird collisions in the Nama and Succulent Karoo.	Multiple casualties could destabilise the population.	Mark power lines with BFDs
		Verreaux's Eagle electrocutions, collisions and displacement of breeding birds at cliff sites throughout the corridor.	Multiple casualties could destabilise the population. The species upgraded from not threatened to vulnerable in the	Use only bird-friendly power line designs. Investigate all suitable cliff sites for nests and buffer by 2.5 km. Should the full extent of the buffering not be practically possible it would require management of the potential impacts on the breeding birds

Corridor	Key Impacts	Site Specific Descriptions	Possible Effect	Mitigation
			2014 national Red Data list.	once construction commences, which would necessitate the involvement of the avifaunal specialist and the ECO. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.
		Caspian Tern collision at large waterbodies throughout the corridor.	Multiple casualties could destabilise the population.	Mark power lines with BFDs.
Expanded Eastern Corridor	• Mortality of power line sensitive Red Data species through collisions • Mortality of power line sensitive Red Data species through electrocutions • Displacement of Red Data species due to habitat destruction and disturbance	African Marsh-harrier collisions throughout the corridor.	Multiple casualties could destabilise the population.	Avoid routing power lines within 500 m of the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines with BFD's
		Southern Ground Hornbill collisions, electrocutions and displacement throughout the corridor.	Multiple casualties and displacement of breeding birds could destabilise the population.	Use only bird-friendly power line designs. Buffer all nests by 2.5 km. Should the full extent of the buffering not be practically possible it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the ECO. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.
		Black Stork collisions and displacement at waterbodies, cliffs and drainage lines throughout the corridor.	Multiple casualties could destabilise the population.	Avoid routing power lines within 500 m of the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines at waterbodies and across drainage lines with BFDs. Search cliff areas for nest sites and buffer these by 2.5 km. Should the full extent of the buffering not be practically possible it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the ECO. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will

Corridor	Key Impacts	Site Specific Descriptions	Possible Effect	Mitigation
				enable him/her to ascertain if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.
		Blue Crane collisions and disturbance of breeding birds in grassland and wetland areas in Grassland.	Multiple casualties could destabilise the population and result in a negative population growth (Shaw et al. 2010)	Avoid routing power lines within 500 m of the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines at waterbodies with nocturnal LED mitigation devices. Buffer nest sites by 2.5 km. Should the full extent of the buffering not be practically possible it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the ECO. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.
		Cape Vulture electrocutions, disturbance at breeding colonies and roosts throughout the corridor. Collisions and electrocutions at vulture restaurants.	Multiple casualties and disturbance of breeding birds could destabilise the population and lead to population decline.	Use only bird-friendly designs. Buffer breeding colonies and vulture restaurants by 5 km. Should the full extent of the buffering at vulture restaurants and breeding colonies not be practically possible, the areas must be thoroughly investigated by an avifaunal specialist and those power lines that could pose a collision threat to vultures must be identified and marked with BFDs. In addition, it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the ECO. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.
		Denham's Bustard collisions in grassland areas throughout the corridor.	Multiple casualties could destabilise the population.	Mark power lines with BFDs

Corridor	Key Impacts	Site Specific Descriptions	Possible Effect	Mitigation
		Great White Pelican and Pink-backed Pelican collisions and displacement at waterbodies in Indian Ocean Coastal Belt.	Multiple casualties could destabilise the population.	Avoid routing power lines within 500 m of the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines at waterbodies BFDs.
		Greater and Lesser Flamingo collisions at waterbodies throughout the corridor.	Multiple casualties could destabilise the population.	Avoid routing power lines within 500 m of the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines at waterbodies with nocturnal LED mitigation devices.
		Grey Crowned Crane collisions at wetlands and cultivated commercial fields in Grassland and Indian Ocean Coastal Belt. Displacement of breeding birds in wetlands in Grassland and Indian Ocean Coastal Belt.	Multiple casualties could destabilise the population.	Avoid routing power lines within 500 m of the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines at waterbodies with nocturnal LED mitigation devices. Buffer all nests by 2.5 km. Should the full extent of the buffering not be practically possible it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the ECO. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.
		Secretarybird collisions throughout the corridor except Indian Ocean Coastal Belt.	Multiple casualties could destabilise the population.	Mark power lines with BFDs
		Verreaux's Eagle electrocutions, collisions and displacement of breeding birds at cliff sites.	Multiple casualties could destabilise the population.	Use only bird-friendly power line designs. Investigate all suitable cliff sites for nests and buffer by 2.5 km. Should the full extent of the buffering not be practically possible it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the ECO. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.

Corridor	Key Impacts	Site Specific Descriptions	Possible Effect	Mitigation
		Wattled Crane collisions and displacement at wetlands in Grassland.	Multiple casualties could destabilise the population.	Avoid routing power lines within 500 m of the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines at waterbodies with nocturnal LED mitigation devices. Buffer all nests by 2.5 km. Should the full extent of the buffering not be practically possible it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the ECO. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.
		Southern Bald Ibis collision and displacement at cliffs in Grassland.	Multiple casualties could destabilise the population.	Investigate all suitable cliff sites for nests and buffer all nests by 2.5 km. Should the full extent of the buffering not be practically possible it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the ECO. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.
		Blue Swallow displacement due to habitat destruction in the KwaZulu–Natal mistbelt in the Grassland biome.	Habitat destruction, especially the destruction of suitable nest holes could destabilise the population and contribute to the negative population growth.	Buffer all known Blue Swallow breeding habitat by 2.5 km. Should the full extent of the buffering not be practically possible, a thorough investigation must be conducted by a suitably experienced avifaunal specialist with experience of Blue Swallows to identify any potential nesting holes, which must then be appropriately buffered, in consultation with EKZN Wildlife and BLSA to prevent destruction of the nest holes.
		Displacement due to disturbance and habitat destruction at nest localities of Bateleur, Lappet-faced Vulture, Marabou Stork,	Disturbance of breeding birds could lead to temporary or even permanent abandonment of breeding efforts. Destruction	Buffer all nests by 2.5 km. Should the full extent of the buffering not be practically possible it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the

Corridor	Key Impacts	Site Specific Descriptions	Possible Effect	Mitigation
		Martial Eagle, Secretarybird, Tawny Eagle, Southern, White-backed Vulture, Hooded Vulture and White-headed Vulture in Savannah, African Crowned Eagle and Banded Snake-Eagle in Forest, and Pel's Fishing Owl at rivers and waterbodies in the northern part of the corridor.	of nesting trees could displace birds from the area.	avifaunal specialist and the ECO. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain if, when and where breeding birds could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle.
		Saddle-billed Stork and Yellow-billed Stork collisions at waterbodies in Savanna.	Multiple casualties could destabilise the population.	Avoid routing power lines within 500 m from the edge of waterbodies found to be suitable for the species, and if unavoidable, mark power lines at waterbodies with BFDs

10 BEST PRACTICE GUIDELINES AND MONITORING REQUIREMENTS

10.1 Planning phase

Table 7: Planning phase framework for the investigation, assessment and mitigation of EGI development on avifauna.

Stage	Activity summary	Activity	Suggested best practices for the assessment and mitigation of impacts on avifauna
Planning	• Identification of potential power line routes.	• Identification of technically feasible assessment corridor alternatives for assessment during the project specific assessment process.	• A suitably qualified avifaunal specialist should be appointed to conduct an avifaunal impact assessment study. The specialist should proceed as follows: ○ The centre line of each assessment corridor must be determined. ○ A 2km buffer zone must be drawn around the centre line of each assessment corridor. ○ The sum total area of each habitat sensitivity class in the assessment corridor must be calculated, based on the four-tier avifaunal sensitivity map. ○ The procedure to follow for the avifaunal assessment of each assessment corridor alternative must be determined, based on the majority sensitivity class in the corridor. Depending on the representation of sensitivity classes in the corridor, this may be a combination of procedures. • The specialist must make a recommendation on whether the power line may proceed or not, based on the anticipated impacts on Red Data avifauna, and must identify a preferred corridor which will have the least impact on Red Data avifauna, i.e. one which **avoids** Very High and High sensitive areas as much as possible. • If the power line project may proceed, the specialist must describe suitable mitigation measures to be implemented, based on the type of impacts that are foreseen and Red Data species to be impacted (see Section 9).

10.2 Construction phase

Table 8: Construction phase framework for the investigation, assessment and mitigation of EGI development on avifauna.

Stage	Activity summary	Activity	Suggested best practices for the assessment and mitigation of impacts on avifauna
Construction	Establishment of tower positions and vegetation clearing in the servitude.	• Access Negotiations • Tower Pegging • Vegetation clearing in servitude • New gate installation	If a feasible corridor alternative is identified and authorisation or similar is obtained to proceed with the project, the procedure is as follows: • Once the tower positions have been pegged, a walk-through should be conducted by a suitably qualified avifaunal specialist to identify all active Red Data nests in the servitude and immediately adjacent areas prior to the commencement of the servitude clearing. Due to the length of time between the authorisation (or similar) of the project and the commencement of construction activities, the nest surveys (if any) conducted during the planning phase will have to be repeated. This is usually only applicable in Very High and High sensitivity areas but depending on the circumstances of each project and the professional opinion of the specialist, this may have to be extended to Medium and Low sensitivity areas as well. The width of the corridor to be surveyed will be determined by the species which are likely to breed there. • Should such a nest be discovered, the avifaunal specialist should be provided with a work schedule which will enable him/her to ascertain, if, when and where the breeding birds could be impacted by the clearing activities. • During the walk-through, the specialist must also identify sections of line to be marked with BFDs.
	• Assembling of the power line	• Foundation nominations (for main structure and anchors) • Excavation of foundation • Foundation steelwork (reinforcing) • Foundation (concrete) pouring • Delivery of tower steelwork • Assembly team / Punching and painting • Erection • Stringing • Sag and tension	• If it has been established during the walk-through that a breeding pair of Red Data species could be displaced, appropriate management measures would need to be implemented, the nature of which will depend on the Red Data conservation status of the species and the location of the nest. Each case will have to be dealt with on an ad hoc basis but could include the following: • The eggs and/or chicks must be removed to a rehabilitation facility if the nest will be destroyed. • Construction activities must be timed to avoid the disturbance of the breeding birds during critical phases of the breeding cycle. • Activities must be restricted to the servitude width. • No access must be allowed to property/habitat beyond the servitude. • Maximum use must be made of existing access roads to prevent the unnecessary construction of new roads. • BFDs must be fitted to those sections of the line which were identified during the walk-through.
	• Rehabilitation	• Low vehicle and people intensity work	• Activities must be restricted to the servitude width. • No access must be allowed to property/habitat beyond the servitude.

Stage	Activity summary	Activity	Suggested best practices for the assessment and mitigation of impacts on avifauna
		• Seeding of the servitude • Ground application using all-terrain vehicles, agricultural equipment, seed drills etc. • Minimal people and equipment on site	• Maximum use must be made of existing access roads to prevent the unnecessary construction of new roads. • People and equipment must be restricted to a minimum to execute the on-site work. • A suitably qualified rehabilitation expert must be appointed to manage the process in order to recreate the natural environment as best as possible.

10.3 Operations phase

Table 9: Operations phase framework for the investigation, assessment and mitigation of EGI development on avifauna.

Stage	Activity Summary description	Activity	Suggested best practices for the assessment and mitigation of impacts on avifauna
Operations	Aerial and ground surveillance activities to: • identify any potential 3rd party incursions onto the servitude. • identify areas of servitude instability that could potentially affect the integrity of the power line. • to identify areas where there is potential surface erosion. • To inspect the electrical hardware.	• Aerial line patrol – varies in frequency depending on location • Walking/driving the power line servitude. Occurs typically at least once every 3 years in the case of transmission lines.	• If possible, patrols should be scheduled to occur outside of breeding window of Red Data species, especially large raptors breeding on transmission lines. • Once-off pass through should be planned vs. "in and out' to limit potential disturbance to birds.
Operations	The repair and maintenance of electrical hardware on the pylons.	• Cleaning of insulators • Replacement of faulty insulators • Removal/trimming of conductive nesting material which compromises electrical clearances. • Maintenance of access gates • Maintenance and repair of servitude track • Vegetation cutting in the servitude.	• If feasible, repairs should be scheduled outside the breeding window of Red Data species, especially large raptors breeding on the power line. • Temporary removal of a nestlings and/or eggs by a qualified expert for the duration of the repair activities might be necessary. • Problem nests to be relocated to a different location on the tower to prevent pollution of insulators and eliminate the risk of streamer faulting, through the use of nesting platforms.

10.4 Rehabilitation and post closure

Table 10: Rehabilitation and post closure framework for the investigation, assessment and mitigation of EGI development on avifauna.

Stage	Activity Summary description	Activity	Suggested best practices for the assessment and mitigation of impacts on avifauna
Decommissioning	Dismantling of power line	• Dismantling of the towers and the disposal or recycling of the material	• A walk-through should be conducted by a suitably qualified avifaunal specialist to identify all active Red Data nests in the servitude, including those on the pylons, and immediately adjacent areas prior to the commencement of the dismantling operations. • Should such a nest be discovered, the avifaunal specialist should be provided with a work schedule which will enable him/her to ascertain, if, when and where the breeding birds could be impacted by the dismantling operations. • If it has been established during the walk-through that a breeding pair of Red Data species will be displaced, appropriate management measures would need to be implemented, the nature of which will depend on the Red Data conservation status of the species and the location of the nest. Each case will have to be dealt with on an ad hoc basis but could include the following: ○ The eggs and/or chicks must be removed to a rehabilitation facility if the nest will be destroyed. ○ Dismantling activities must be timed to avoid the disturbance of the breeding birds during critical phases of the breeding cycle. • Activities must be restricted to the servitude width. • No access must be allowed to property/habitat beyond the servitude. • Maximum use must be made of existing access roads to prevent the unnecessary construction of new roads.

10.5 Monitoring requirements

Table 11: Avifauna monitoring requirements for EGI developments.

Stage	Activity Summary description	Activity	Suggested best practices for the assessment and mitigation of impacts on avifauna
Operations	None	• None	• Depending on the sensitivity of the power line, post-construction monitoring may be required for a specific period to assess the effectiveness of BFDs, and to identify additional sections of line to be fitted with BFDs.

11 CONCLUSIONS AND FURTHER RECOMMENDATIONS

In the terms of reference for this report received from the CSIR, it was specifically stated that the sensitivity delineation should be undertaken in the context of all EGI including transmission lines, distribution lines and substations. The implication of this was that electrocution as a source of mortality had to be taken into account in the risk assessment, because the vast majority of bird electrocutions happen on the smaller distribution structures, and not the large transmission structures (Lehman et al. 2007)[3]. It was assumed that future distribution infrastructure could potentially be a source of electrocution mortality. However, the Eskom Land and Biodiversity Standard (2016) states that “all designs of new power lines and supporting infrastructure for power generation must be evaluated for the risk it could pose to wildlife and no design which has a high risk, or a record of it causing mortalities to wildlife, shall be used.” It was further assumed that Eskom might not be the only entity building power lines in future; therefore it cannot automatically be assumed that all future distribution pole designs will be electrocution friendly. However, should this assumption be wrong, and Eskom continues to build the vast majority of future distribution lines, it could be argued that electrocution of birds has effectively been eliminated as a source of mortality on future distribution lines. It might therefore be a useful exercise to repeat this analysis without electrocution, as it may have a significant impact on the outcome of the analysis, in that it may reduce the risk rating of some of the habitat classes.

There are currently no accepted best practice guidelines for the investigation and assessment of potential impacts of electricity infrastructure on avifauna. The methods and level of investigation that is required are left up to the individual avifaunal specialist. There is a strong need for a set of best practice guidelines to be compiled to standardise methodology, along the lines of the best practice guidelines which was developed for the assessment of impacts of wind energy developments on avifauna[4].

It is understood that DEA are acting to reduce the assessment requirements for any EGI development inside of the expanded EGI corridors (once gazetted) from an EIA to a Basic Assessment (BA) or possibly to be exempted from environmental authorisation, provided that the Minimum Information Requirments or Standards and Generic EMPr (being compiled as part of this SEA) are complied with. This will be done by utilising provisions within NEMA. Currently the construction of facilities or infrastructure for transmission or distribution of electricity with a capacity >275KV outside of an urban area or industrial complexes requires a full EIA to be undertaken. However, Government Notice 113 in Government Gazette 41445 published on 16 February 2018 deals with the gazetting of the EGI corridors that were the subject of the 2016 EGI SEA, which specifies that development of this type within the gazetted corridors will no longer require a full EIA, but rather a BA. It is important to note that the level of investigation required for avifaunal impacts are not governed by the size of the line, because the impacts associated with power lines often have little to do with the size of the line, e.g. as pointed out above, distribution lines are far more dangerous from an electrocution perspective than transmission lines. Whether the avifaunal investigations form part of an EIA or a BA is irrelevant for the avifaunal investigation process. The minimum standards of the latter are determined by the envisaged impacts, not the legal process. Even though the present report does not offer many immediate opportunities to directly streamline the development authorisation process, the findings still have considerable worth for both DEA and the industry. By highlighting and mapping the avian sensitivities within each corridor at this scoping level, the SEA offers developers early clarity on the bird-related obstacles they are likely to encounter at any given location within each of the corridors. Hence there is greater certainty in pursuing development options, and less likelihood of unexpected and costly delays. The value of this indirect streamlining function should not be underestimated.

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[4] See Jenkins A R; Van Rooyen C S; Smallie J J; Anderson M D & Smit H A. 2011. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.

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Appendix 1: Example of a ratings table to calculate the sensitivity scores of the habitat classes

mes	_Habitat	ck Harrier elec	ck Harrier coll	ck Harrier disp	ck Harrier sum	ck Harrier RDs	ck Harrier score	ck Stork elec	ck Stork coll	ck Stork disp	ck Stork sum	ck Stork RDs	ck Stork score	e Crane elec	e Crane coll	e Crane disp	e Crane sum	e Crane RDs	e Crane score	ipian Tern elec	ipian Tern coll	ipian Tern disp	ipian Tern sum	ipian Tern RDs	ipian Tern score	at White Pelican elec	at White Pelican coll	at White Pelican disp	at White Pelican sum	at White Pelican RDs	at White Pelican score	ater Flamingo elec	ater Flamingo coll	ater Flamingo disp	ater Flamingo sum	ater Flamingo RDs	ater Flamingo score	oo Korhaan elec	oo Korhaan coll	oo Korhaan disp	oo Korhaan sum	oo Korhaan RDs	oo Korhaan score
Nama-Karoo	Bare				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Nama-Karoo	Cliffs (1km buffer)				0	8	0	2	2	2	6	4	24				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Nama-Karoo	Drainage lines				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Nama-Karoo	Grassland		2	2	4	8	32				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0		2	2	4	2	8
Nama-Karoo	Industrial				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Nama-Karoo	Low shrubland		2	2	4	8	32				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0		2	2	4	2	8
Nama-Karoo	Shrubland fynbos		2	2	4	8	32				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0		2	2	4	2	8
Nama-Karoo	Thicket /Dense bush				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Nama-Karoo	Wetlands and waterbodies (500m buffer)				0	8	0	2	2	2	6	4	24				0	2	0		2	1	3	4	12				0	4	0		2	2	4	2	8				0	2	0
Nama-Karoo	Woodland/Open bush				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Succulent Karoo	Bare				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Succulent Karoo	Cliffs (1km buffer)				0	8	0	2	2	2	6	4	24				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Succulent Karoo	Cultivated commercial fields rainfed				0	8	0				0	4	0		2	2	4	2	8				0	4	0				0	4	0				0	2	0				0	2	0
Succulent Karoo	Cultivated commercial pivots				0	8	0				0	4	0		2	2	4	2	8				0	4	0				0	4	0				0	2	0				0	2	0
Succulent Karoo	Cultivated subsistence				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Succulent Karoo	Cultivated vines				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Succulent Karoo	Drainage lines				0	8	0	2	2	2	6	4	24				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Succulent Karoo	Grassland		2	2	4	8	32				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0		2	2	4	2	8
Succulent Karoo	Industrial				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Succulent Karoo	Low shrubland		2	2	4	8	32				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0		2	2	4	2	8
Succulent Karoo	Plantations				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Succulent Karoo	Shrubland fynbos		2	2	4	8	32				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0		2	2	4	2	8
Succulent Karoo	Thicket /Dense bush				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Succulent Karoo	Urban (500m buffer)				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0
Succulent Karoo	Wetlands and waterbodies (500m buffer)				0	8	0	2	2	2	6	4	24		2	2	4	2	8		2	1	3	4	12				0	4	0		2	2	4	2	8				0	2	0
Succulent Karoo	Woodland/Open bush				0	8	0				0	4	0				0	2	0				0	4	0				0	4	0				0	2	0				0	2	0

The table above is an excerpt of the ratings table for the Expanded Western Corridor to serve as an illustration of how the ratings were calculated.

elec = electrocution
coll = collision
disp = displacement
RD's = Red Data scores

The probability of the respective impacts occurring in a habitat class was rated for each priority species to arrive at a species-specific probability score for each impact, within each habitat class, within each biome, within each corridor. Probabilities for the respective impacts occurring were rated according to the below scale:

- 0 = the impact is highly unlikely to occur
- 1 = the impact is unlikely to occur
- 2 = the impact could possibly occur
- 3 = the impact will most likely occur