ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED MATIMBA-WITKOP NO. 2 400 kV TRANSMISSION LINE, NORTHERN PROVINCE

SPECIALIST STUDY – BIRD IMPACT ASSESSMENT

APPENDIX N

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1. BACKGROUND

1.1. Description of Typical Impacts of Powerlines on Birds

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds and other animals and birds colliding with powerlines (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs & Ledger 1986a; Hobbs & Ledger 1986b; Hobbs *et al.* 1990; Ledger 1992; Ledger *et al.* 1992; Verdoorn 1996; Kruger & Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000). Other problems are electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure (Van Rooyen, Vosloo & Harness 2002), and disturbance and habitat destruction during construction and maintenance activities.

The terms of reference for this study stipulated that the potential impacts of the powerline on birds should be investigated. Therefore attention will be focused on that aspect. Where applicable, reference will be made of the impacts of the birds on the proposed powerline.

1.2. Electrocutions

Large birds of prey are the most commonly electrocuted on powerlines. The large transmission lines from 275 kV to the 765 kV structures are generally not a threat to large raptors, because the pylons are designed in such a manner that the birds can not perch in close proximity the potentially lethal conductors. In fact, these powerlines have proved to be beneficial to birds such as Martial Eagles, Tawny Eagles, African Whitebacked Vultures, and even occasionally Black Eagles by providing safe nesting and roosting sites in areas where suitable natural alternatives are scarce (pers.obs). Cape Griffons have also taken to roosting on powerlines in certain areas in large numbers, while Lappetfaced Vultures are increasingly using powerlines as roosts, especially in the Northern Cape (pers.obs.). Electrocutions on large transmission structures are rare, although it may occasionally happen (M. Farinha, *pers. comm*), presumably *via* the bird streamer mechanism (Van Rooyen & Taylor 1999; Van Rooyen, Vosloo & Harness 2002). This is, however, very rare.

1.3. Collisions

Anderson (2001) summarises collisions as a source of avian mortality as follows:

"The collision of large terrestrial birds with the wires of utility structures, and especially powerlines, has been determined to be one of the most important mortality factors for this group of birds in South Africa (Herholdt 1988; Johnsgard 1991; Allan 1997). It is possible that the populations of two southern African endemic bird species, the Ludwig's Bustard *Neotis ludwigii* and Blue Crane *Anthropoides paradiseus*, may be in decline because of this single mortality factor (Anderson 2000; McCann 2000). The Ludwig's Bustard (Anderson 2000) and Blue Crane (McCann 2000) are both listed as "vulnerable" in The Eskom Red Data Book of Birds of South Africa, Lesotho & Swaziland (Barnes 2000) and it has been suggested that powerline collisions is one of the factors which is responsible for these birds' present precarious conservation status

Collisions with powerlines and especially overhead earth-wires have been documented as a source of mortality for a large number of avian species (e.g. Beaulaurier *et al*., 1982; Bevanger 1994, 1998). In southern Africa, this problem has until recently received only limited attention. Several studies however have identified bird collisions with powerlines as a potentially important mortality factor (for example, Brown & Lawson 1989; Longridge 1989). Ledger *et al* (1993), Ledger (1994) and Van Rooyen & Ledger (1999) have provided overviews of bird interactions with powerlines in South Africa. Bird collisions in this country have been mainly limited to Greater and Lesser Flamingos, various species of waterbirds (ducks, geese, and waders), Stanley's *Neotis denhami* and Ludwig's Bustards, White Storks *Ciconia ciconia*, and Wattled *Grus carunculatus,* Grey Crowned *Balearica regulorum* and Blue Cranes (for example, Jarvis 1974; Johnson 1984; Hobbs 1987; Longridge 1989; Van Rooyen & Ledger (1999)). Certain groups of birds are more susceptible to collisions, namely the species which are slow fliers and which have limited manoeuvrability (as a result of high wing loading) (Bevanger 1994). Birds which regularly fly between roosting and feeding grounds, undertake regular migratory or nomadic movements, fly in flocks, or fly during low-light conditions are also vulnerable. Other factors which can influence collision frequency include the age of the bird (younger birds are less experienced fliers), weather factors (decreased visibility, strong winds, etc.), terrain characteristics and powerline placement (lines that cross the flight paths of birds), powerline configuration (the larger structures are more hazardous), human activity (which may cause birds to panic and fly into the overhead lines), and familiarity of the birds with the area (therefore nomadic Ludwig's Bustards would be more susceptible) (Anderson 1978; APLIC 1994).

Although collision mortality rarely affects healthy populations with good reproductive success, collisions can be biologically significant to local populations (Beer & Ogilvie 1972) and endangered species (Thompson 1978; Faanes 1987). The loss of hundreds of Northern Black Korhaans *Eupodotis afraoides* due to powerline collisions would probably not affect the success of the total population of this species and would probably not be biologically significant, but if one Wattled Crane was killed due to a collision, that event could have an effect on the population that would be considered biologically significant. Biological significance is an important factor that should be considered when prioritising mitigation measures. Biological significance is the effect of collision mortality upon a bird population's ability to sustain or increase its numbers locally and throughout the range of the species.

1.4. Habitat Destruction and Disturbance

During the construction phase and maintenance of powerlines, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of servitudes. 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 minimise the risk of fire under the line which can result in electrical flashovers.

These activities could have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude, both through alteration of habitat and disturbance caused by human activity. Transmission lines have also become an important nesting substrate for several large raptors, including the threatened Martial Eagle (pers. obs.). These birds are highly susceptible to disturbance, and should this disturbance take place during a critical time in the breeding cycle e.g. when the eggs have not hatched or just prior to the chick fledging, it could terminate the breeding effort. This scenario could present itself where a new line is constructed next to an existing powerline containing active raptor nests.

2. PARTICULARS OF STRUCTURES AND STUDY AREA

2.1. Structures

The majority of the line will be built on cross-rope suspension structures. In areas where the line will cross broken ground and at turns, self supporting structures will be used.

2.2. Eastern Section of the Study Area

The study area falls within the Pietersburg Plateau. The original vegetation that prevailed in the area contained elements of arid woodland, moist woodland and sour grassland. The original vegetation cover has been extensively degraded by human activity, particularly bush clearing to make way for grazing, dry land cultivation and settlements, and erosion is also extensive in places. However, pockets of the original vegetation survive intact. The area is characterised by extensive electrical infrastructure development. The reason for this is that the Witkop-transmission substation is situated there, which serves as the central point for many high voltage lines running to and from it, resembling the centre of a spider web of electricity lines. The area also contains a reticulation substation with several reticulation lines emanating from there. The area has a high population density, with many smallholdings. The land cover is a patchwork of agricultural land, including several irrigated fields adjacent to the Witkop Substation, and degraded woodland.

The powerline corridor starts at Witkop Substation and follows the existing "highway" of powerlines consisting of the Witkop –Potgietersrus 132 kV, Warmbad-Witkop 400 kV, Matimba – Witkop 400 kV, Sandsloot-Witkop 132 kV, Witkop-Pietersburg No. 2 132 kV for approximately 5 km out of Witkop Substation in a westerly direction. The lines then diverge with the existing Witkop –Potgietersrus 132 kV, Warmbad-Witkop 400 kV, Sandsloot-Witkop 132 kV, and Witkop-Pietersburg No. 2 132 kV splitting away from the Matimba-Witkop 400 kV line. The study corridor follows the existing Matimba-Witkop 400 kV (see map 2: East) in a north-westerly direction through a patchwork of agricultural land, irrigated fields and degraded woodland, for about 15 km. The remainder of the proposed corridor that falls with in the area covered by Map 2: East falls within woodland bordered by densely populated, rural townships up to where the corridor splits in two near the Masebe Nature Reserve. Generally speaking, the area covered by Map: 2 East has been more extensively impacted by human activity than the area covered by Map 2: West.

2.3. Western Section of the Study Area

There are two potential corridors in the area covered by this map. Corridor 1 follows the existing Matimba-Witkop No. 1 400 kV Transmission line. Corridor 2 closely follows the existing road network. The area covered by this map is generally far less impacted by human activity than the area covered by Map 1: East. The dominant land use is commercial game farms and nature reserves e.g. the Waterberg Biosphere Reserve that contains the Masebe Nature Reserve and the Moepel Farms Nature Reserve. The habitat is generally intact, except for areas around human settlements where some subsistence farming is evident. The area is mostly savanna with a distinct grassy understorey and woody upperstorey of trees and tall shrubs. Elements of arid woodland (*Acacia* woodland on alluvial plains) and moist woodland (broadleaved woodland on higher slopes) are interwoven. Several large drainage lines cross through the area, including the Mokolo, Mogalakwena and Lephalala rivers. Intensive irrigation agricultural is maintained in a narrow strip along these rivers.

3. PREDICTIVE METHODS

In predicting impacts of a proposed powerline on birds, a combination of science and field experience is required.

3.1. Methodology

- Maps of the study area was obtained from Arivia.kom showing existing powerlines, roads, railways , dams, urban areas and the land cover of the study area as compiled by the CSIR (South African National Land-cover Database Project 1999). The maps were used in order to identify potential "hot-spots" along the corridors e.g. patches of undisturbed vegetation, river crossings, wetlands and dams and agricultural areas.
- Atlas of southern African Birds (ASAB) (Harrison *et. al.,* 1997) species lists of the quarter degree squares (or 1: 50 000 map units), within which the corridors are located were obtained from the Avian Demography Unit at University of Cape Town. The following squares were combined:
    - 2327DA DB DC DD combined;
    - 2328CA CB CC CD combined;
    - 2328DA DB DC DD combined;
    - 2329CA CB CC CD combined;
    - 2429AA AB combined
- The study area was visited to obtain a first-hand perspective of the proposed corridors. An attempt was made to travel both the alternative corridors as far as was practically possible, and to visit all potential hot-spots identified from the land cover maps.
- Interviews were conducted with Mr. Manie Farinha, local Eskom employee at Witkop Substation, to obtain information on bird behaviour in relation to existing powerlines in the area.

- The impacts were predicted on the basis of six years of experience in gathering and analysing data on wildlife impacts with powerlines throughout southern Africa (see van Rooyen & Ledger 1999 for an overview of methodology), supplemented with local knowledge and first hand data. Extensive use was made of personal experience of the bird life in the study area, with which the author is familiar with.

4. UNCERTAINTIES IN PREDICTING RESULTS

4.1. Confounding Factors

- The ASAB data covers the period 1986-1997. Bird distribution patterns fluctuate continuously according to availability of food and nesting substrate.
- Sources of error in the ASAB database.
  - Inadequate coverage of some areas
  - Errors in species identification during data capturing stage
  - Biases in the reporting process due to several factors

  (For a full discussion of potential inaccuracies in ASAB data, see Harrison *et. al.* 1997).
- Access to some of the corridors, especially the Southern Corridor, was limited as few access roads were available to inspect the area. In this instance, a general impression of the habitat was formed from whatever vantage points were available, supplemented with information from the land cover maps.

4.2. General Comment

Predictions are based on experience of these and similar species in different parts of South Africa. Birds are biological beings; therefore their behaviour can not be reduced to formulas that will hold true under all circumstances. However, powerline impacts can be predicted with a fair amount of certainty, based on experienced gained through the investigation of more than 300 localities in southern Africa where birds interacted with powerlines. The author is well acquainted with the study area and the species occurring there, therefore the predictions are made with a high level of confidence.

5. GAPS IN BASELINE DATA

- Little long term, verified data of species distribution on microhabitat level <u>along the proposed powerline corridors.</u>

- Little long term, verified data on impacts of existing transmission lines in the study area on birds.
- Inadequate data on microhabitat along some stretches of the corridors, due to inaccessibility. However, Mr. Manie Farinha from Eskom Transmission is intimately familiar with the area and provided invaluable inputs in this regard.

6. CRITERIA AGAINST WHICH EXPECTED IMPACTS ARE EVALUATED

Nature and status	Description of impact and status (negative, neutral, positive)
General susceptibility to expected impact	Very high, high, low, very low
Probability	• Improbable, where the possibility of the impact to materialise is very low • Probable, where there is a distinct possibility that the impact will occur • Highly probable, where it is most likely that the impact will occur • Definite, where the impact will definitely occur
Expected locality	Description of localities where impact is expected to occur
Frequency	Very high, high, low, very low
Timing	Time of day/year
Duration	• Short term (0-5 years) • Medium term (5-15 years) • Long term (for the life-time of the infrastructure)
Permanence	Permanent, semi-reversible or reversible
Extent	• Local (the site and immediate surroundings) • Regional • National • International
Significance	• Low, where it will not have an impact on the decision • Medium, where it should have an impact on the decision unless mitigated • High, where it will influence the decision regardless of possible mitigation

(Adapted from Guideline Document, EIA Regulations, Implementation of sections 21, 22 and 26 of the Environment Conservation Act, April 1998, DEAT)

7. EVALUATION OF EXPECTED IMPACTS ON IMPACT SENSITIVE SPECIES IN STUDY AREA

Generally speaking, it is unavoidable that birds get killed through interaction with infrastructure, including powerlines, despite the best possible mitigation measures. It is, therefore, important to direct risk assessments and mitigation efforts towards species that have a high biological significance, in order to achieve maximum results with the available resources at hand. However, a pure scientific approach would only consider the effects of deaths on the sustainability of the population, but society places other values on certain species, e.g. aesthetic or commercial, which can not be accounted for in a pure scientific approach, but can not be ignored either. In accordance with this principle, the risk assessment is primarily aimed at assessing the potential threat to Red Data species (biological significance), but in addition, more common species that are vulnerable to powerlines, that occur or potentially occur along the proposed powerline corridors, was also considered in the study, although in less detail.

For an evaluation of expected impacts see Annexures A, B and C.

8. CONCLUSIONS

8.1. Disturbance

There could be a short term, temporary disturbance impact during construction of the powerline on raptors and vultures breeding near the construction operations.

8.2. Electrocutions

Electrocutions are ruled out due to the large clearances between potentially lethal components, which make it impossible for any bird to bridge the air gap and cause an electrical short circuit.

8.3. Collisions

The study identified collisions as a potentially significant long term impact that the proposed powerlines could have on certain birds occurring within the study area. The most likely scenarios where collisions will occur are the following:

- Where vultures congregate at a carcass near the powerlines
- Where waterbirds fly down drainage lines and hit the line at river crossings
- At waterbodies where the line skirts or crosses the waterbody.
- Where White and Abdim's Storks congregate in large flocks in agricultural areas, irrigated crops and at veld fires.
- Near active raptor nests

8.4. Preferred Corridor

The Northern Corridor is the preferable corridor for the following reasons:

- It has fewer river crossings and dams which are collision hot-spots.
- It runs alongside existing roads for most of the way, eliminating the need for the construction of new access roads which means less habitat destruction.
- Generally speaking, the corridor runs through fewer game farming and conservation areas than the Southern corridor, where the existing impacts on the habitat is generally lower.

8.5. Extensions to the Matimba and Witkop Substations

No significant new impacts are expected to flow from these extensions, due to the heavy permanent impacts that are already evident in the area. It is highly unlikely that large, powerline sensitive species occur permanently in the area anymore.

9. RECOMMENDED MITIGATION MEASURES

9.1. River Crossings, Dams and Irrigated Crops

It is generally accepted that bird collisions can be reduced by marking the earthwire of a transmission line with suitable anti-collisions devices. In this instance, this measure should be implemented in the following areas:

- Corridor 1: Points 1, 2, 6 and 7 on Annexure C. The area and actual spans to be marked should be verified by the ornithological consultant.
- Corridor 2: Points 1, 3, 4, 5, 6 and 7 on Annexure C. The area and actual spans to be marked should be verified by the ornithological consultant.

9.2. Active Raptor Nests

Once the final route has been established, an ornithological survey should be conducted prior to the commencement of construction to identify raptor nests along the route. Appropriate action plans will then be formulated in consultation with the construction team to minimise the risk of disturbance to the birds. Once the line has been constructed, all spans running close to active raptor nests must be marked with anti-collision devices. The area and actual spans to be marked should be verified by the ornithological consultant.

9.3. Other Potential Problem Scenarios

Unfortunately, none of these can be effectively predicted due to the dynamic and unpredictable nature of these events:

- Collision risk where vultures congregate at a carcass near the powerlines
- Collision risk where storks congregate temporarily at veld fires

10. SUMMARY OF IMPACTS AND MITIGATION MEASURES

A summary table of impacts is included within Annexure D.

11. IMPACTS OF BIRDS ON THE PROPOSED POWERLINE

The line will be running through an area heavily populated with large perching birds. These birds will no doubt attempt to perch on the structures. The cross-rope suspension structures will prevent any large birds to perch for extended periods above the conductors, therefore the risk of streamer induced faulting will be minimum. However, all self supporting structures should get bird guards installed on critical areas to prevent streamer induced faulting.

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ANNEXURE A:

IMPACTS ON RED DATA SPECIES OCCURRING OR POTENTIALLY OCCURRING ALONG THE PROPOSED CORRIDORS

Species	Conservation status (Barnes 2000)	Nature of impact	General susceptibility to expected impacts	Probability	Expected locality	Frequency	Timing	Duration	Extent	Magn.
Whitebacked Night Heron	Vulnerable	• Collision with earthwire	Unknown. Active at night.	Not known.	Along heavily wooded riverbanks. Most likely along the Mokolo, Mogalakwena and Lephalala rivers.	Unknown	At night	Long term; Permanent	Local	Unknown
Black Stork	Near-threatened	• Collision with earthwire	Unknown. Its close relative, the White Stork is highly susceptible to collisions.	Probable.	The birds breed in montane habitat and frequent rivers and wetlands to feed. Could be encountered in the first 5km of the route in mountainous habitat. Most likely along the Mokolo, Mogalakwena and Lephalala and other watercourses, and in the vicinity of koppies and hills anywhere along the route.	Low	When flying up and down river courses	Long term; Permanent	Local	Medium
Marabou Stork	Near-threatened	• Collision with earthwire	Unknown, but probably high due to physical size and behaviour.	Probable	Occurs in low numbers throughout the study area. Numbers probable fluctuate according to availability of food.	Very low. The most likely areas would along river courses where the birds forage and roost.	During day	Long term; Permanent	Local	Medium
Saddlebilled Stork	Endangered	• Collision with earthwire	Unknown, but probably high due to physical size and behaviour.	Improbable. Vagrant to the area						

Species	**Conservation status (Barnes 2000)**	**Nature of impact**	**General susceptibility to expected impacts**	**Probability**	**Expected locality**	**Frequency**	**Timing**	**Duration**	**Extent**	**Magn.**
Greater Flamingo	Near-threatened	• Collision with earthwire	High	Improbable. Vagrant in area.						
Lesser Flamingo	Near-threatened	• Collision with earthwire	High	Improbable. Vagrant in area.						
Cape Griffon	Vulnerable	• Collision with earthwire	Collision medium	Probable	Anywhere along the route if the birds descend to a carcass.	Low	Througho ut the year	Long term; Permanent	Regiona l	Low. Collision risks are linked to random locality of carcasses
African Whitebacked Vulture	Vulnerable	• Collision with earthwire • Disturba nce of breeding pair during construct ion	Collision medium Disturbance high	Collision probable Disturbance highly probable if breeding near the construction activities	Anywhere along the route if the birds descend to a carcass, or breed near the line.	Low	Througho ut the year	Collision long term; permanent Disturbance short term, but could be permanent if the birds desert the nest.	Regiona l	Medium
Blackwinged Pratincole	Near threatened	• Collision with earthwire	? Probably low due to nimbleness	Improbable. Very low numbers in study area						

Species	Conservation status (Barnes 2000)	Nature of impact	General susceptibility to expected impacts	Probability	Expected locality	Frequency	Timing	Duration	Extent	Magn.
Secretarybird	Near-threatened	• Collision with earthwire • Disturbance of breeding pair during construction	High	Collision probable. It is a fairly common breeding resident and known to be vulnerable to collisions. Most at risk when flushed. Disturbance highly probable if breeding near the construction activities	Anywhere along the proposed routes in areas of natural vegetation especially lightly wooded grassland. Agricultural clearings surrounded by natural bush are favourite hunting ground. Likes to drink at waterholes and cattle reservoirs during the heat of the day.	Low. The birds generally occur single or in pairs. Wanders widely outside the breeding season.	Throughout the year	Collisions long term; permanent, although resident birds may with time learn to avoid the line. Disturbance short term only during construction	Local	Medium
Lappetfaced Vulture	Vulnerable	• Collision with earthwire • Disturbance of breeding pair during construction	Collision medium Disturbance high	Probable Disturbance highly probable if breeding near the construction activities	Anywhere along the route if the birds descend to a carcass.	Low	Through-out the year	Collision long term; permanent Disturbance short term, but could be permanent if the birds desert the nest.	Regional	Medium

Species	Conservation status (Barnes 2000)	Nature of impact	General susceptibility to expected impacts	Probability	Expected locality	Frequency	Timing	Duration	Extent	Magn.
Tawny Eagle	Vulnerable	• Collision with earthwire • Disturbance of breeding pair during construction	Collision low Disturbance high	Probable Disturbance highly probable if breeding near the construction activities	Tawny Eagles are extremely rare outside large game reserves and are thinly distributed throughout the corridor.	Low	Throughout the year	Collision long term; permanent Disturbance short term, but could be permanent if the birds desert the nest.	Regional	Medium
Martial Eagle	Vulnerable	• Collision with earthwire • Disturbance of breeding pair during construction	Collision low.	Probable Disturbance highly probable if breeding near the construction activities	Martial Eagles have very large territories, while immature birds wander widely. It is highly likely that the study area forms part of several Martial Eagle pair territories Could occur anywhere along the route.	Low.	Throughout the year	Collision long term; permanent Disturbance short term, but could be permanent if the birds desert the nest.	Regional	Medium
Bateleur	Vulnerable	• Collision with earthwire	High. Often flies low and fast.	Improbable due to low numbers in study area.						
Lanner Falcon		• Collision with earthwire	Low	Improbable. Collision risk improbable as birds are very						

				nimble.						

Species	Conservation status (Barnes 2000)	Nature of impact	General susceptibility to expected impacts	Probability	Expected locality	Frequency	Timing	Duration	Extent	Magn.
Lesser Kestrel	Vulnerable	• Collision with earthwire	Very low.	Improbable. Vagrant to area.						
Blue Crane	Vulnerable	• Collision with earthwire • Disturbance during construction	High	Improbable. Very low numbers in study area and corridors do not cross suitable habitat.	Could potentially occur along all the routes where tall sour grass prevails. Most likely on the Pietersburg Plateau and on the Waterberg Plateau.					
African Finfoot	Vulnerable	• Collision with earthwire • Disturbance during construction	Collision low Disturbance high	Collision improbable Disturbance probable	Occurs along quiet watercourses with extensive vegetation and overhanging branches. Most likely along the Mokolo, Mogalakwena and Lephalala.	Low	During construction periods	Short term; Temporary	Local	Low. Impact is not permanent.
Stanley's Bustard	Vulnerable	• Collision with earthwire	High	Improbable. Very low numbers in study area and corridors do not cross suitable habitat.	Could potentially occur along all the routes where tall sour grass prevails. Most likely on the Pietersburg Plateau and on the Waterberg Plateau.					
Halfcollared Kingfisher	Near threatened	• None								

Species	Conservation status (Barnes 2000)	Nature of impact	General susceptibility to expected impacts	Probability	Expected locality	Frequency	Timing	Duration	Extent	Magn.
Kori Bustard	Vulnerable	• Collision with earthwire	High	Probable	Anywhere along the route in lightly wooded savanna, but more in the west.	Low due to low numbers	Througho ut the year	Long term; Permanent	Local	Low. Although mortality will be biologicall y significant , collisions can not be predicted
Melodious Lark	Near-threatened	• Disturba nce during construct ion	?	Improbable. Very low numbers in study area due to unsuitable habitat						
Whitebellied Korhaan	Vulnerable	• Collision with earthwire • Disturba nce during construc-tion	Collision low Disturbance high	Collision improbable, unless flushed. Do not regularly fly long distances like the larger bustards. Temporary disturbance probable in areas of tall grass	Could potentially occur along all the routes where tall sour grass prevails. Most likely on the Pietersburg Plateau and on the Waterberg Plateau.	Once-off during construction phase	Througho ut the year	Short term (during construction phase)	Local	Low

ANNEXURE B:
POTENTIAL IMPACTS ON NON-RED DATA SPECIES RECORDED IN THE STUDY AREA

Species	Nature of impact and probability of occurring	Locality
Large raptors: • Black Eagle • Steppe Eagle • Wahlberg's Eagle • African Hawk Eagle • Brown Snake Eagle • Blackbreasted Snake Eagle • African Fish Eagle • Steppe Buzzard • Jackal Buzzard	All these species are potentially vulnerable to collisions with powerlines, although the risk decreases with the size of the bird. The probability is however low. Most at risk are African Fish Eagles flying up and down river courses, and raptors nesting near the proposed line. The latter could suffer from temporary disturbance during construction operations, and afterwards the young birds could be at risk of collisions. All the species are vulnerable to disturbance when breeding.	These species could be encountered in low numbers anywhere along the proposed corridors, but will be more common in the less disturbed areas, namely the area covered by Map 1 West.
Waterbirds • Whitebreasted Cormorant • Reed Cormorant Darter • Grey Heron • Blackheaded Heron • Goliath Heron • Purple Heron • Great White Egret • Little Egret • Yellowbilled Egret • Black Egret • Cattle Egret • Squacco Heron • Greenbacked Heron • Blackcrowned Night Heron • Little Bittern • Hamerkop • Whitefaced Duck • Fulvous Duck • Whitebacked Duck • Egyptian Goose • Yellowbilled Duck • African Black Duck • Cape Teal	All these species are potentially vulnerable to collisions with powerlines, although the risk normally decreases with the size of the bird.	These species could be encountered anywhere along the proposed corridors along watercourses, seasonal wetlands and at dams. Population numbers could vary hugely depending on the availability of seasonal wetlands. Potential collisions hot-spots that were identified during the study are numbered and indicated on the accompanying map annexure C.

Species	Nature of impact and probability of occurring	Locality
• Hottentot Teal • Redbilled Teal • Cape Shoveller • Southern Pochard • Knobbilled Duck • Spurwinged Goose • Purple Gallinule • Moorhen • Redknobbed Coot • African Jacana • Painted Snipe • Kittlitz's Plover • Threebanded Plover • Caspian Plover • Blacksmith Plover • Common Sandpiper • Wood Sandpiper • Marsh Sandpiper • Greenshank • Curlew Sandpiper • Little Stint • Ruff • Ethiopian Snipe • Blackwinged Stilt • Water Dikkop		
Storks, Ibises and Spoonbills • White Stork • Abdim's Stork • Yellowbilled Stork • Sacred Ibis • Glossy Ibis • Hadeda Ibis • African Spoonbill	These species are potentially vulnerable to collisions with powerlines.	These species could be encountered anywhere along the proposed corridors in suitable habitat, even close to human settlements. Collisions with the powerline are probable near agricultural areas, especially irrigated fields next to river courses, and at seasonal and permanent water bodies. Population numbers could vary hugely depending on the availability of food. Potential collisions hot-spots that were identified during the study are numbered and indicated on the accompanying map annexure C.

ANNEXURE C:

MAP OF STUDY AREA INDICATING POTENTIALLY SENSITIVE AREAS

ANNEXURE D:

SUMMARY OF POTENTIAL IMPACTS ON AVIFAUNA

Table 1: Collision with earthwire

Stage	Construction	Operational
Extent of impact	None	Local
Duration of impact	None	Permanent
Intensity	None	Low
Probability of occurrence	None	Probable
Status of the impact	Not applicable	Negative
Level of significance	None	Low to Medium
Mitigation measures	None	**River crossings, dams and irrigated crops** It is generally accepted that bird collisions can be reduced by marking the earthwire of a transmission line with suitable anti-collisions devices. In this instance, this measure should be implemented in the following areas: • Northern Corridor: Points 1; 2; 6; 7 on annexure C. The area and actual spans to be marked should be verified by the ornithological consultant. • Southern Corridor: Points 1; 3; 4; 5; 7 on annexure C. The area and actual spans to be marked should be verified by the ornithological consultant. The area and actual spans to be marked should be verified by the ornithological consultant. **Active raptor nests** Once the line has been constructed, all spans running close to active raptor nests must be marked with anti-collision devices. The area and actual spans to be marked should be verified by the ornithological consultant. **Other potential problem scenario's** Unfortunately, none of these can be effectively predicted due to the dynamic and unpredictable nature of these events:

Stage	Construction	Operational
		• Collision risk where vultures congregate at a carcass near the powerlines • Collision risk where storks congregate temporarily at veld fires
EMP requirements	None	None
Discussion The study identified collisions as a potentially significant long term impact that the proposed powerlines could have on certain birds occurring within the study area. The most likely scenarios where collisions will occur are the following: • Where vultures congregate at a carcass near the powerlines • Where waterbirds fly down drainage lines and hit the line at river crossings • At waterbodies and wetlands where the line skirts or crosses the waterbody or wetland. • Where White and Abdim's Storks congregate in large flocks in agricultural areas, irrigated crops and at veld fires. • Near active raptor nests		

Table 2: Disturbance

Stage	Construction	Operational
Extent of impact	Local	None
Duration of impact	Temporary but could be permanent	None
Intensity	Low	None
Probability of occurrence	Probable	None
Status of the impact	Negative	Not applicable
Level of significance	Medium	Not applicable
Mitigation measures	Once the final route has been established, an ornithological survey should be conducted prior to the commencement of construction to identify raptor nests along the route. Appropriate action plans will then be formulated in consultation with the construction team to minimise the risk of	None

Stage	Construction	Operational
	disturbance to breeding raptors.	
EMP requirements	None	None

Discussion

During the construction phase of powerlines, disturbance of wildlife takes place. This happens with the construction of access roads, the clearing of servitudes and the actual assembling of the towers. These activities could have an impact on birds, particularly raptors, breeding, foraging and roosting in or in close proximity of the servitude, both through alteration of habitat and disturbance caused by human activity. Raptors are highly susceptible to disturbance, and should this disturbance take place during a critical time in the breeding cycle e.g. when the eggs have not hatched or just prior to the chick fledging, it could terminate the breeding effort. It could even lead to permanent desertion of the nest. This scenario could present itself where a new line is constructed in an area containing active raptor nests.