Bird Impact Assessment Study

Braamhoek / Venus 400kV Transmission powerline, KwaZulu-Natal

Prepared by

Kevin McCann
Endangered Wildlife Trust

February 2005

BIRD IMPACT ASSESSMENT REPORT : Braamhoek - Venus 400 kV POWERLINE

1. Background

In December 2002, the Department of Environment Affairs and Tourism (DEAT) awarded Eskom environmental authorisation for the construction of the Braamhoek Pumped Storage Scheme in the Drakensberg on the provincial border between the Free State and KwaZulu-Natal. A condition (no. 6.2.37) of the authorisation is that Eskom undertakes "a comprehensive Environmental Impact Assessment for all access roads and power lines that connects the scheme to the national transmission grid".
Eskom Transmission is tasked with connecting the scheme to the National Grid, and has assumed responsibility for the EIA for the power lines. The extent of the development to effect this connection includes:

- The construction of a 400kV Transmission Substation, to be called the Braamhoek Substation, near the scheme,
- Provide an initial connection to the National Grid via a 'turn-in' from the nearby Majuba-Venus #2 400kV Transmission line,
- Ensure the reliability of the network by linking Braamhoek Substation directly to the Venus Substation near Estcourt with a new 400kV Transmission power line.

This report assesses the potential impacts on the avifaunal component in the study area of the Braamhoek substation, the "turn ins" from the nearby Majuba-Venus #2 400kV transmission power line, and the 400kV transmission power line between Braamhoek and Venus substations (assessing alternative routes).

1.1 Particulars of study area

Due to a growing demand for electricity during peak times of the day, Eskom Transmission have seen the need to upgrade its capacity and reliability of the National Grid during peak load periods. Eskom Transmission have therefore proposed the development and construction of a new 400kV transmission power line linking the Braamhoek substation at the Pump Storage Scheme near Besters to the Venus substation near Estcourt in northern KwaZulu-Natal.

Substation : Three alternative sites have been selected for the substation, although this assessment only looks at the preferred site, located closest to the lower dam site of the pump storage scheme (see Figure 1).

400kV power line routes (turn-ins and route between the Braamhoek and Vensus substation):
In terms of the assessment of environmental impacts of this new proposed 400kV power line, three alternative routes were selected. The alternative routes were as follows (see Figure 1 for details) :

Route Alternative 1 : most westerly route, following the Mersey – Venus 400kV power line from the Venus substation, and turning-in to the Braamhoek substation below the escarpment..
Route Alternative 2A : central route from the Venus substation, routing west of Ladysmith, parallel to the R103, crossing the Qedusizi Dam, routing west of Besters through to the Braamhoek substation.
Route Alternative 2B : central route following alternative 2A, but deviates behind the ridge at Grobbelaarskloof, rejoining the alternative 2A south of Ladysmith, then following the same route as alternative 2A.
Route Alternative 3 : from Venus substation, this alternative is routed parallel to the Mersey Venus #1 400kV power line, branching off to follow a 220kV power line east of Ladysmith, splitting again at Rietkuil, being routed east of Besters, around Mkutu ridge to the Braamhoek substation.

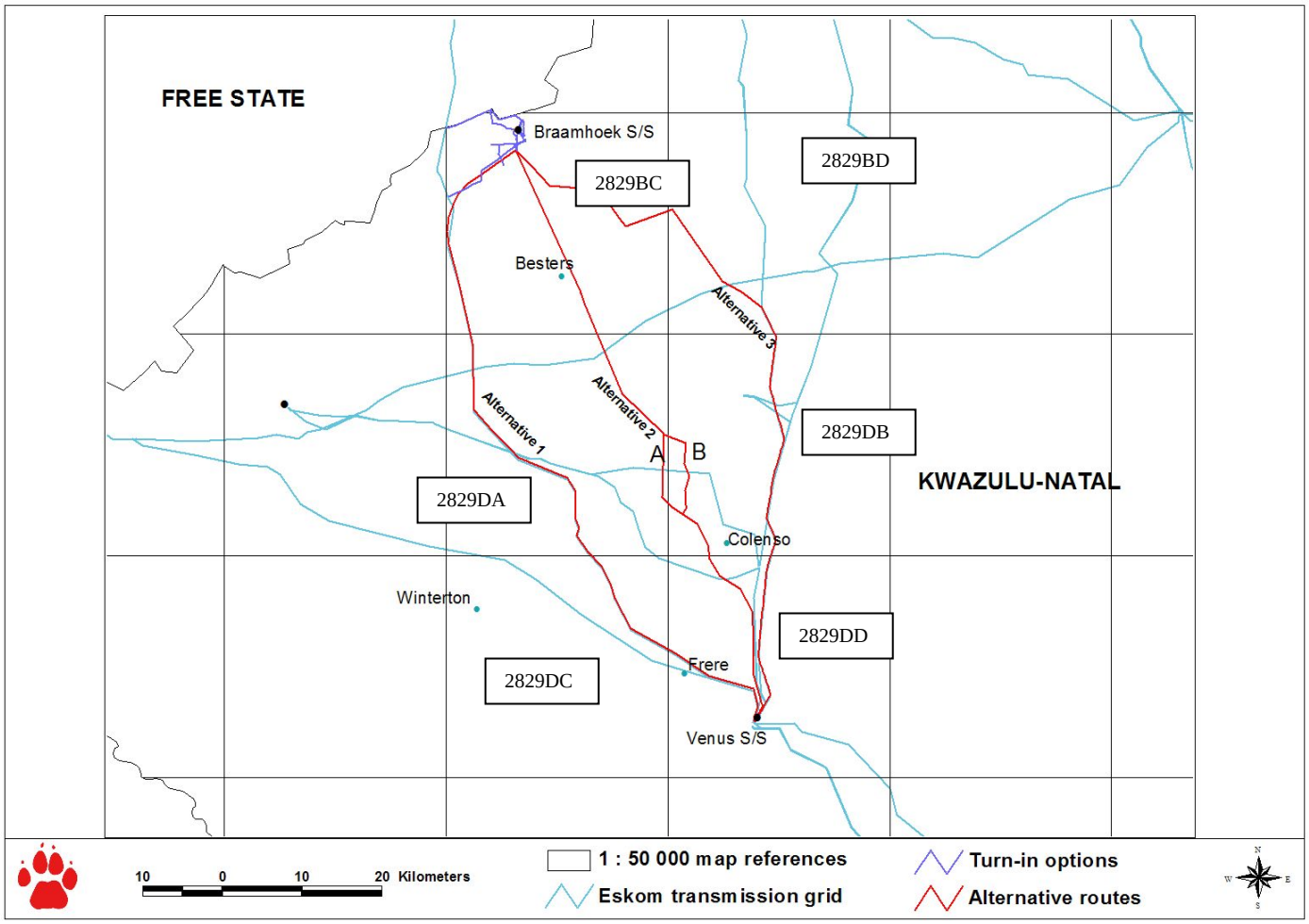

Figure 1: The study are for the Braamhoek – Venus 400 kV power line, showing the various routing options for this transmission power line, as well as the existing transmission grid.

1.2 Proposed structure types

The proposed Braamhoek – Venus 400 kV power line will be constructed using two tower types, the cross rope suspension tower (figure 2) along the majority of the route, with the self-supporting towers (Figure 3) used at bends or strengthening points.

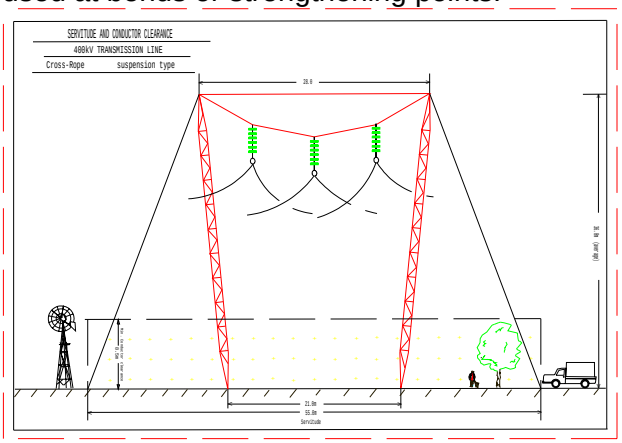

Figure 2: Cross-rope suspension tower structure

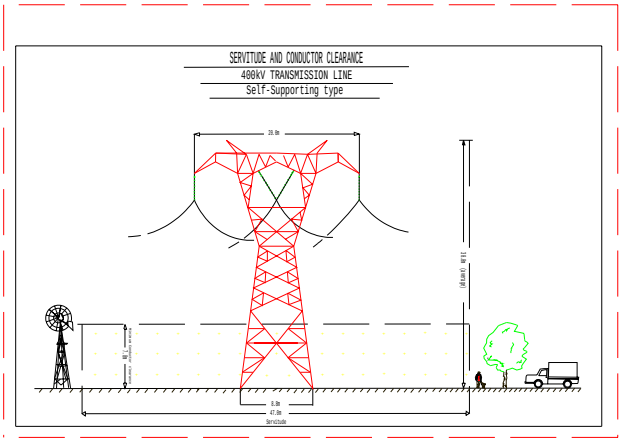

Figure 3: Self-supporting tower

The type and design of the towers used in a transmission power line are important in bird interactions and particular designs can even be used as a form of mitigation. Details and discussion of the line design and the use of the above mentioned structures will be made later in the document.

2 Description of typical impacts of powerlines on birds

2.1 Characteristics

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 power lines. (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs & Ledger 1986a; Hobbs & Ledger 1986b; 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, and disturbance and habitat destruction during construction and maintenance activities.

- Electrocutions: Large birds of prey are the most commonly electrocuted on power lines. The large transmission lines from 220 kV to 765 kV structures are usually not a threat to large raptors, because the pylons are designed in such a manner that the birds do not perch in close proximity to the potentially lethal conductors. In fact, these power lines 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 (van Rooyen, pers.obs). Cape Griffons have also taken to roosting on power lines in certain areas in large numbers, while Lappet-faced Vultures are increasingly using power lines as roosts, especially in the Northern Cape (van Rooyen, pers.obs.).

- Collisions: Up to 1996, it was generally believed that collisions are not a major problem in South Africa, with the exception of the three crane species. This may have been the case because collisions with power lines are seldom recorded through Eskom's internal systems, as it seldom impacts on the electricity supply. However, a disturbing new picture has since started to emerge from data gathered since 1996, pointing to the fact that collisions are indeed a major cause of unnatural mortality for several threatened bird species (van Rooyen 1999). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. These species are mostly heavy-bodied birds with limited manoeuvrability, which make it very difficult for them to take the necessary evasive action to avoid colliding with power lines.

- Bird Streamers: The theory that birds can cause flashovers through long streams of excreta, called streamers, has been postulated since the early 1920's. It has only really been investigated in the past decade, with Florida Power & Light in the USA and Eskom in South Africa being the pioneers in this field. It is now widely accepted within Eskom that bird streamers are a major cause of faults on the transmission network, and a national programme to eliminate this cause of faulting commenced in 2000. In the case of a bird streamer induced fault, the fault normally initiates on the live hardware and it propagates vertically towards the tower. The fault appears to flash across the air gap and does not follow an insulator creepage path as observed on pollution faults. (See Taylor 1999 for an exhaustive analysis of the propagation characteristics of the bird streamer mechanism). Bird streamer faults generally follow a highly distinctive bimodal, temporal pattern with peaks usually occurring early evening between 18h00 and 23h00 and again in the morning, between 04h00 and 08h00 (Taylor *et al.* 1999). A possible explanation for this lies in the natural foraging behaviour of birds, in that they tend to forage away from the line in daytime, returning early evening to roost until the next morning. More research is

needed to explain the early evening-early morning peaks in faults, but it could be related to metabolism of the birds. Streamer activity certainly increases from about 30 minutes before dawn, as the birds start to wake up (van Rooyen 2001).

- Bird pollution: Bird pollution is a form of pre-deposit pollution. In very simplified terms, a flashover occurs when an insulator string gets coated with pollutant, which compromises the insulation properties of the string. When the pollutant is wetted, the coating becomes conductive, insulation breakdown occurs and a flashover results.

- Bird nesting: There are a variety of reasons why birds sometimes breed on electricity structures including: lack of alternative nesting sites such as trees and cliffs; electricity structures offer a safe and sturdy platform for birds to build their nests. Large birds such as eagles and vultures use large sticks to build their nests. These sticks can exceed 1 metre in length in the case of large species like Black Eagles and Martial Eagles and it sometimes happens that large sticks protrude below the nest. These sticks can constitute an air gap intrusion between the conductor and the earthed structure, which causes a flashover during wet conditions. Crows often incorporate wire and other conductive material into their nests. This could constitute a flashover risk if it protrudes into the air gap, or when a bird arrives with a piece of wire in its bill and flies through the air gap. Pieces of rope and baling twine also get woven into crows' nests. When the rope or twine gets wet, it becomes conductive and causes flashovers in the manner described above. It was recently discovered that nest building crows may also cause flashovers when they fly into the air gap with pieces of wire in their bills. When nests cause flashovers, the nesting material may catch fire. This in turn can lead to equipment damage or a general veld fire. Apart from the cost of replacing damaged equipment, the resultant veld fire can lead to claims for damages from landowners.

- Habitat destruction and disturbance: During the construction phase and maintenance of power lines, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of servitudes. In areas with extensive wetlands, access roads can cause extensive damage through erosion. 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, both through alteration of habitat and disturbance caused by human activity.

2.2 Predictive methods

In predicting the impacts of a proposed power line on birds, a combination of science, field experience and common sense is required.

The methodology used to predict impacts in the current study was as follows:

- A map of the study area was obtained from PBA International (SA) showing existing power lines, roads, railways, dams, rivers, urban areas.
- The relevant wetlands and grasslands of KwaZulu-Natal, and specifically those for the study area were obtained from the Strategic Environmental Assessment project for KwaZulu-Natal, coordinated by KwaZulu-Natal Wildlife (Goodman 2000).
- Data on bird species lists, breeding species and seasonal reporting rates were obtained for all bird species for the relevant quarter degree grid squares from the Southern African Bird Atlas Project

(Harrison *et al.* 1997). It included the following quarter degree squares: 2829 BC, BD, DA, DB, DC, DD, and were obtained from the Avian Demography Unit at University of Cape Town.

- Specific threatened bird species data was obtained from the Strategic Environmental Assessment project for KwaZulu-Natal, coordinated by KwaZulu-Natal Wildlife (Goodman 2000), for the purpose of identifying sensitive bird areas within the study area.
- The National Landcover database was used for assessing the land-use patterns within the study area (CSIR – NLC Project 1999).
- The area was visited for two days during January 2005 to obtain a first-hand perspective of the proposed routes and birdlife.
- The impacts were predicted on the basis of ten years of experience in gathering and analysing data on wildlife impacts with power lines throughout South Africa, supplemented with local knowledge and first hand data.

Therefore, the criteria / aspects used to assess the avifaunal impacts from the substation, Braamhoek – Venus 400kV power line, and the Majuba – Venus 400kV turn-ins include :

- Relevant bird population densities, roost sites, feeding sites, flight paths both current and historic (where possible);
- Topography and vegetation type;
- Land use and agricultural practice;
- Power line position; design; length; historic performance (as far as possible).

The following issues have therefore been identified as important to address in the avifaunal impact study :

- The location of the substation;
- The presence of important bird species / habitats at the substation site;
- The collision risk to threatened bird species of the turn-ins and the 400kV powerline between Braamkhoek and Venus substations;
- The electrocution risk of the turn-ins and the 400kV powerline between Braamkhoek and Venus substations;
- The bird streamer / pollution risk of the turn-ins and the 400kV powerline between Braamkhoek and Venus substations;

3 Criteria against which expected impacts are evaluated

The following table summarises the information used in the impact tables to assess the potential impacts.

Table 1 : The assessment criteria used for the impact table analysis.

Nature of the impact	Description of impact
Extent of the impact	Describe whether the impact will be : local extending only as far as the development site; or limited to the site and immediate surroundings; or will have an impact on the region, or will have an impact on a national scale or across international borders
Duration of the impact	• Short term (0-5 years) • Medium term (5-15 years) • Long term (16-30 years) • Permanent

Intensity	The specialist should establish whether the impact is destructive or benign and should be qualified as low, medium or high. The specialist study must attempt to quantify the magnitude of the impacts and outline the rationale used.
Probability of occurrence	• 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
Status of the impact	The specialist should determine whether the impacts are negative, positive or neutral ("cost – benefit" analysis). The impacts are to be assessed in terms of their effect on the project and the environment. For example, an impact that is positive for the proposed development may be negative for the environment. It is important that this distinction is made in the analysis.
Accumulative impact	Consideration must be given to the extent of any accumulative impact that may occur due to the proposed development. Such impacts must be evaluated with an assessment of similar developments already in the environment. Such impacts will be either positive or negative, and will be graded as being of negligible, low, medium or high impact.
Degree of significance / confidence	**No significance**: the impacts do not influence the proposed development and/or environment in any way. **Low significance**: the impacts will have a minor influence on the proposed development and/or environment. These impacts require some attention to modification of the project design where possible, or alternative mitigation. **Moderate significance**: the impacts will have a moderate influence on the proposed development and/or environment. The impact can be ameliorated by a modification in the project design or implementation of effective mitigation measures. **High significance**: the impacts will have a major influence on the proposed development and/or environment. The impacts could have the "no-go" implication on portions of the development regardless of any mitigation measures that could be implemented.

4 Evaluation of expected impacts from the Braamhoek substation, the Braamhoek - Venus 400kV power line and the 400kV turn-ins on sensitive bird species

Generally speaking, it is unavoidable that birds get killed through interaction with infrastructure, including power lines, despite the best possible mitigation measures. It is therefore important to direct risk assessments and mitigation efforts towards species that have a high biological or social significance, in order to achieve maximum results with the available resources at hand. 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 cannot be accounted for in a pure scientific approach.

In accordance with this principle, the risk assessment is primarily aimed at assessing the potential threat to threatened bird species (biological significance) that occur or potentially occur along the proposed power line routes, as well as the importance of a reliable power supply to the customer.

4.1 Bird Species Diversity within the Study Area

The impacts that are expected with a proposed new power line depend on the bird species present. Bird species, based on their physical structure, behaviour and habitat requirements, will be susceptible to different impacts. For example, birds that perch on structures are more prone to electrocutions, while waterfowl which fly in large flocks along rivers or wetlands as flight paths are more prone to collisions. Table 2 shows the numbers of bird species present in the study area, based on data from the SABAP (Harrison *et al.* 1997) for each 1 : 50 000 map in the study area.

Table 2 : An assessment of the number of bird species present in the study area per 1 : 50 000 map reference (according to the South African Bird Atlas Project).

	No. species in grid square	No. Red Data species	No. Species interacting with powerlines	No. Red Data Species that interact with powerlines
2829 BC	176	11	44	10
2829 BD	271	19	70	14
2829 DA	287	20	68	15
2829 DB	263	18	71	14
2829 DC	257	21	65	16
2829 DD	296	23	73	16
Total	296	23	73	16

Table 3 shows a more detailed breakdown of the individual species that were identified as being present in the study area, showing their susceptibility to different types of impacts.

Table 3 : Details of the key individual bird species present in the study area that interaction with power lines, showing its respective red data category, its typical powerline interaction method (C = collision, E = electrocution, BS / P = bird streamer / pollution) – see Appendix 1 for the entire list of bird species.

Species	**Species type**	**Red Data category**	**Powerline Impact**		
			C	E	BS / P
Whitebreasted Cormorant	Waterbird		✓		
Reed Cormorant	Waterbird		✓		

Darter	Waterbird		✓		
Grey Heron	Waterbird		✓	✓	✓
Blackheaded Heron	Terrestrial		✓	✓	✓
Purple Heron	Waterbird		✓		
Goliath Heron	Waterbird		✓		
Great White Egret	Waterbird		✓		✓
Yellowbilled Egret	Waterbird		✓		✓
Little Egret	Waterbird		✓		
Cattle Egret	Terrestrial		✓		
Hamerkop	Waterbird		✓	✓	
White Stork	Terrestrial		✓	✓	✓
Black Stork	Terrestrial	Near Threatened	✓	✓	✓
Yellow-billed Stork	Waterbird	Near Threatened	✓	✓	✓
Greater Flamingo	Waterbird	Near Threatened	✓		✓
Sacred Ibis	Terrestrial		✓	✓	✓
Hadeda Ibis	Terrestrial		✓	✓	✓
Glossy Ibis	Terrestrial		✓	✓	✓
Bald Ibis	Terrestrial	Vulnerable	✓	✓	✓
African Spoonbill	Waterbird		✓		
Whitefaced Duck	Waterbird		✓		
Whitebacked Duck	Waterbird		✓		
African Black Duck	Waterbird		✓		
Yellowbilled Duck	Waterbird		✓		
SA Shelduck	Waterbird		✓		
Cape Shoveller	Waterbird		✓		
Knobbilled Duck	Waterbird		✓		
Egyptian Goose	Waterbird		✓		✓
Spurwing Goose	Waterbird		✓		✓
Secretary Bird	Terrestrial	Near Threatened	✓		
Cape Griffon	Raptor	Vulnerable	✓	✓	✓
Martial Eagle	Raptor	Vulnerable	✓	✓	✓
Black Eagle	Raptor		✓	✓	
Wahlbergs Eagle	Raptor			✓	
Crowned Eagle	Raptor			✓	
Long Crested Eagle	Raptor			✓	✓
Brown Snake Eagle	Raptor			✓	✓
African Fish Eagle	Raptor		✓	✓	
Jackal Buzzard	Raptor			✓	✓
Steppe Buzzard	Raptor		✓	✓	
African Goshawk	Raptor		✓		
Gymnogene	Raptor			✓	
Lanner Falcon	Raptor	Near Threatened		✓	
Yellow-billed Kite	Raptor		✓	✓	
Black Shouldered Kite	Raptor			✓	
Rock Kestrel	Raptor		✓	✓	
Lesser Kestrel	Raptor	Vulnerable		✓	
Eastern Redfooted Kestrel	Raptor			✓	
Greater Kestrel	Raptor		✓		
Barn Owl	Raptor			✓	

Grass Owl	Raptor	Vulnerable		✓	
Marsh Owl	Raptor			✓	
Cape Eagle Owl	Raptor			✓	
Spotted Eagle Owl	Raptor			✓	
Ground Hornbill	Terrestrial	Vulnerable	✓		
Shelley's Francolin	Terrestrial		✓		
Redwing Francolin	Terrestrial		✓		
Natal Francolin	Terrestrial		✓		
Rednecked Francolin	Terrestrial		✓		
Swainson Francolin	Terrestrial		✓		
Helmeted Guineafowl	Terrestrial		✓	✓	✓
Blue Crane	Terrestrial	Vulnerable	✓		
Grey Crowned Crane	Waterbird	Vulnerable	✓	✓	✓
Denims Bustard	Terrestrial	Vulnerable	✓		
Whitebellied Korhaan	Terrestrial	Vulnerable	✓		
Blue Korhaan	Terrestrial	Near Threatened	✓		
Black Crow	Terrestrial			✓	✓
Pied Crow	Terrestrial			✓	✓
White Necked Raven	Terrestrial			✓	✓

Important Note :
Table 2 and 3 shows that there exist bird species which can interact with power lines from a collision, electrocution and bird streamer and pollution point of view throughout the study area. Due to the type of power line being proposed, a 400kV power line using the cross rope suspension towers (only self-supporting structures at the bends), the threat of direct electrocutions becomes negligible (see Figure 4 below). The assessment will therefore focus on the avifaunal collision issue (route selection), as well as the potential for bird streamer / pollution impacts from birds perching on the self-supporting towers (potential supply issues).

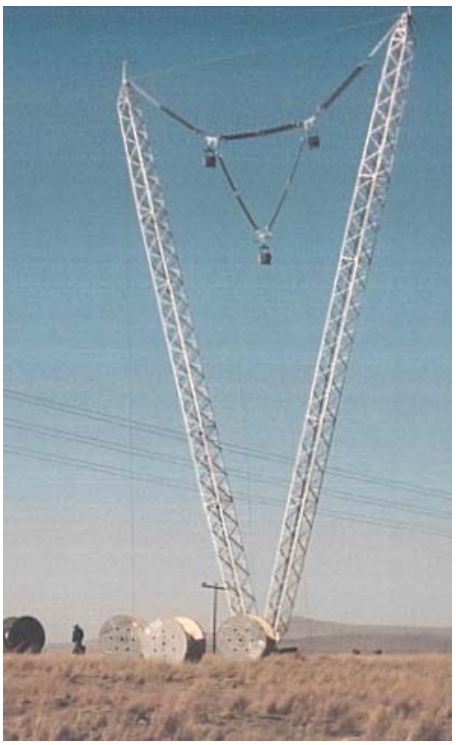

Figure 4: Photo of a cross rope suspension tower indicating the wide spaces between conductors, resulting in a negligible impact from an electrocution point of view.

4.2 Habitat, land-use and topography impact issues

The following bird micro-habitats have been identified in the study area, which influence the distribution of bird species and therefore influence the selection of the appropriate power line route:

- Riverine Habitat: Most rivers in southern Africa are in the east and extreme south, in the higher rainfall areas. Thirteen species of water bird are mostly restricted to riverine habitat in southern Africa. The map distribution of these species correlates with the river courses in southern Africa. The proposed Braamhoek - Venus line crosses a number of rivers, the most notable of which is the Tugela River. Species relevant to this study, are those associated with water, such as the herons, cormorants, storks.

- Wetland Habitat: Wetlands are characterized by slow flowing water and tall emergent vegetation, and provide habitat for many waterbirds. The most significant are the Wattled Crane, Grey Crowned Crane and White-winged Flufftail. The Grey Crowned Cranes is the most notable species in the study area. Wetland habitats have undergone dramatic transformation over the past decade, resulting in many of the species dependent on these ecosystems also be threatened.

- Grassland Habitat: The dominant plants in this biome are grass species, with geophytes and herbs also well represented. Grasslands are maintained mainly by a combination of the following factors: relatively high summer rainfall; frequent fires; frost and grazing. These factors preclude the growth of trees and shrubs. This biome has been largely transformed in South Africa through various land uses such as afforestation and crop cultivation.

- Indigenous forest Habitat: These patches of forest occur on the escarpment between KwaZulu-Natal and the Free State provinces, generally south facing where they are protected from grassland fires. These ecosystems have a unique set of bird species which specialise in these habitats.

- Dam Habitat: Many thousands of earthen and other dams exist in the southern African landscape. The construction of these dams has probably resulted in a range expansion for many water bird species that were formerly restricted to areas of higher rainfall. Whilst dams have altered flow patterns of streams and rivers, and affected many bird species detrimentally, a number of species have benefited from their construction. These include the African Fish Eagle, pelicans, darters and cormorants. Many species from these families occur in this study area.

- Arable lands: Arable or cultivated land represents a significant feeding area for many bird species in any landscape. Through opening up the soil surface, land preparation makes many insects, seeds, bulbs and other food sources suddenly accessible to birds and other predators; the crop or pasture plants cultivated are often eaten themselves by birds, or attract insects which are in turn eaten by birds; during the dry season arable lands often represent the only green or attractive food sources in an otherwise dry landscape. Species relevant to this study that utilize arable lands, are the White Stork, Blue Crane, and Grey Crowned Crane.

- Escarpment areas: The mountainous areas along the route represent a very distinct habitat type. This is most likely to be used by species such as the Cape Griffon Vulture, various raptors, Black Stork, Bald Ibis.

- Woodland: Arid woodland is composed of predominantly fine-leaved species on rich soils, normally dominated by *Acacia* species. Arid woodland occurs where there is varied, intermediate rainfall with hot, wet summers and cool, dry winters. Bird species that are relevant to this study and frequent woodland areas are: Wahlberg's, Booted, Martial Eagles, Cape Vulture, and Secretarybird.

4.3.1 Braamhoek substation

The location of the proposed Braamhoek substation is shown in Figure 5. A site inspection carried out on 14 January 2005 indicated no significant impacts to the bird population in the area, with the size of the potential substation resulting in very limited habitat alteration at the site. Therefore, no significant impacts are expected regarding the siting of the proposed Braamhoek substation.

Figure 5: Photo of the proposed site for the Braamhoek substation (indicated by the yellow arrow), adjacent to a drainage stream, choked with wattle.

4.3.2 Bird species impacts from the Braamhoek – Venus 400kV powerline route -

Table 3 and Appendix 2 show the avifaunal diversity within the study area, indicating the Red Data species present and the presence of species which interact with power lines. Because of the broad distribution of these species across the study area, route selection is difficult based solely on the presence of bird species sensitive to power line interactions. However, what it does indicate is that in determining the appropriate route for the power lines, the issues of avifaunal collisions, electrocutions and bird streamer mechanisms MUST be taken into consideration.

Figure 6 shows the routing of the different options, overlaid with the important bird areas for the study area, with the red areas indicating highly significant areas for birds and green areas of some to minimal importance (according to the Ezemvelo KZN Wildlife SEA). See Table 5 for the comparisons between the different route options. Note that this includes all bird species, and not just those that interaction with power lines.

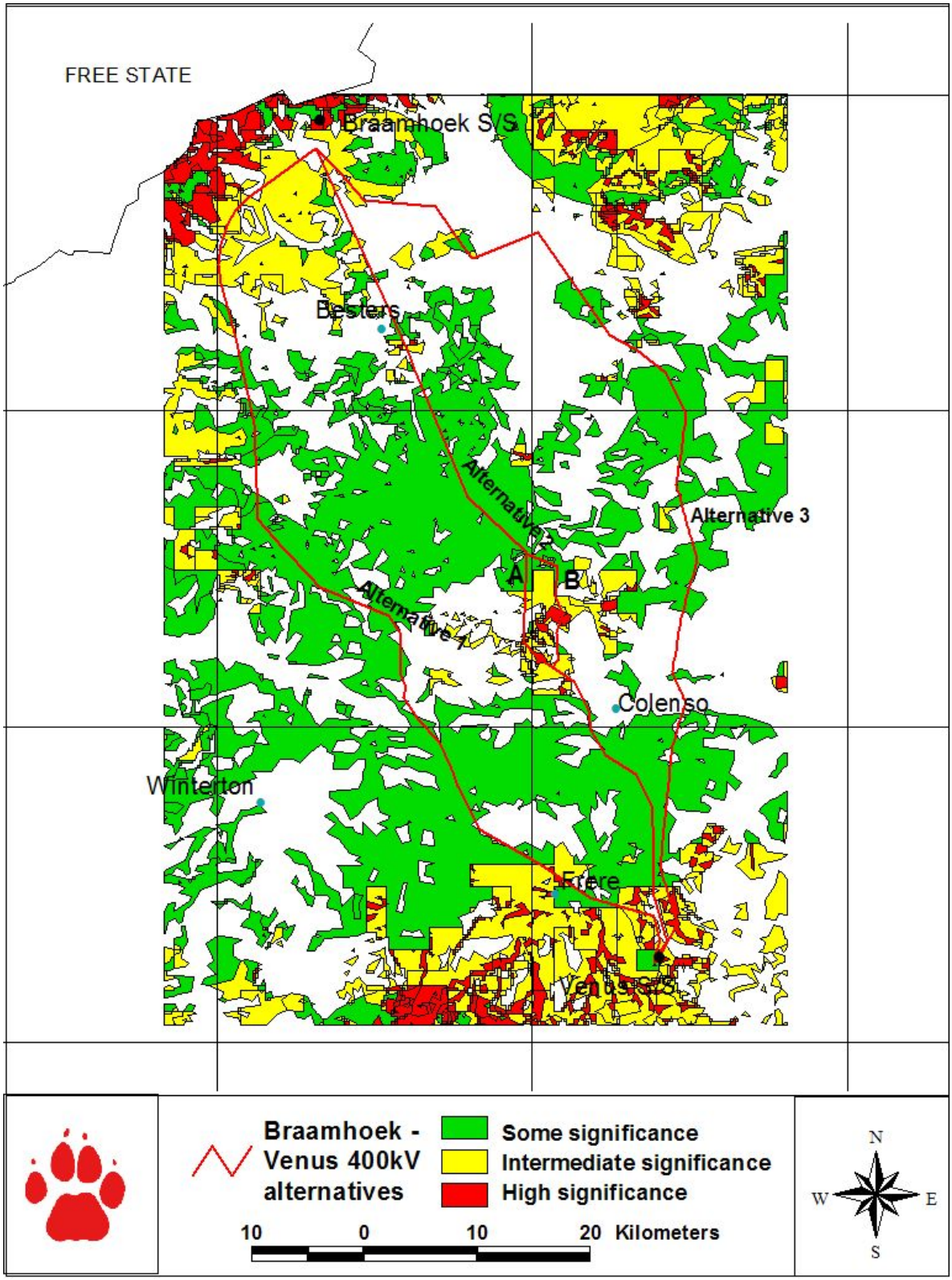

Figure 6: Map show the 400kV power line route options in relation to the important bird areas of the study area.

4.3.2.1 Collision hazard to bird species in the study area

It is an accepted fact that several bird species, mainly large terrestrial bird species (e.g. Secretary Birds, bustards, cranes, storks, etc.), are highly prone to colliding with the conductors of distribution power lines and the conductors or earth wires of transmission power lines (Anderson 2003). During the planning phase of new power line developments, potential collision “hot spots” (Anderson 2003) should be taken into account. These include flight paths (often flat and open areas, or depressions in the terrain), proximity to wetlands and agricultural areas, preferred feeding areas, and conservation areas. It may also be wise to group powerlines in a common corridor, which will increase their visibility. Separated powerlines force birds to make repeated avoidance manoeuvres to avoid the wires, thus increasing the collision risk.

An assessment of the study area was performed in order to determine the collision “hot spots” areas, which included open grasslands (see Figure 7), wetland crossings, proximity to dams and agricultural lands (see Figure 9) and river crossings. These areas were combined to form a collision sensitive area. Areas parallel to existing powerlines (see Figure 10) and next to major roads are accepted as areas of reduced collision potential as the existing power lines screen the new power line against further collisions, while roads act as natural forms of disturbance to bird species, thereby avoiding these areas. Therefore, these areas where excluded from the collision sensitivity areas, giving an overall collision hot spot map, shown in Figure 8.

Figure 7: Areas of open natural grassland result in a high collision potential for many large terrestrial bird species.

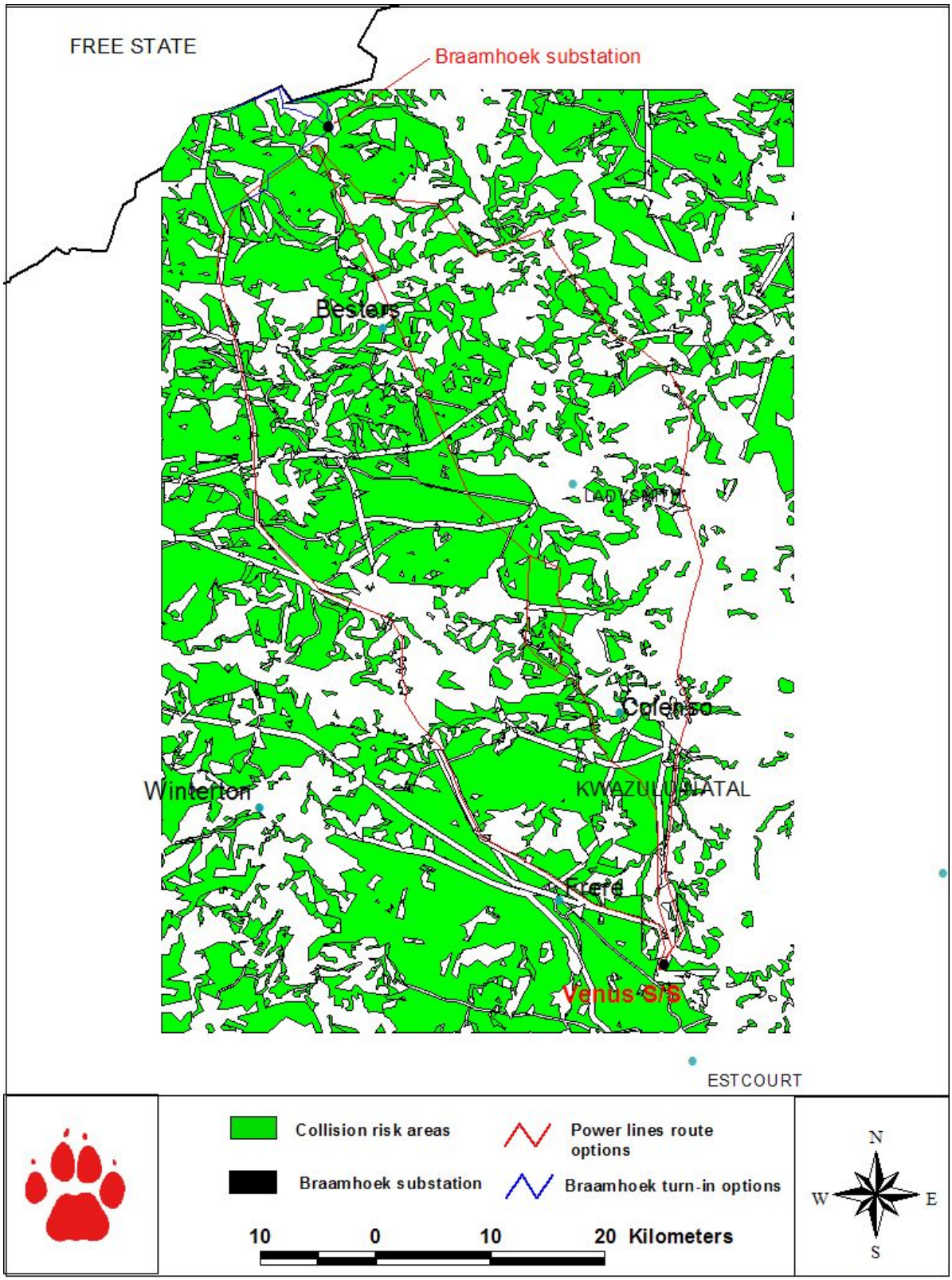

Figure 8: Map showing the location of collision sensitive areas and the routing of the different alternatives in relation to these collision areas.

Figure 9: Photo show areas of high collision hazard, close to farm dams and agricultural lands.

Figure 10: Photo showing the location of similar size power lines parallel to each other, thereby reducing the collision potential by keeping the disturbance in a single corridor.

Table 5 and Figure 8 indicate that both alternative routes 1 and 3 are routed through the least area of collision sensitivity, with alternative 1 being the preferred option from the collision point of view. The main reason for these two alternative routes coming out as the favour routes is due to the fact that they are routed parallel to existing 400kV power lines, which significantly reduces the risk of bird collisions.

4.3.2.2 Electrocutions

Predictably, there have been no recorded bird mortalities through electrocution on a 400kV power line in the past. Clearances between live hardware are too large on a 400kV line for electrocution to be possible through any mechanism other than that of bird streamers (see below). Therefore, the electrocution hazard was not considered in assessing the route selection.

4.3.2.3 Bird Streamer mechanism

There are two broad groupings amongst the species seen in the study area. The first group, which includes the cormorants, darter, herons, storks and some ibises (see Figure 12) are all very closely associated with water bodies. All areas close to open water were therefore considered to be of high importance. The second group includes the Cape Griffon Vulture, eagles and buzzards. The eagles and buzzards typically favour undulating topography where air currents enable easier soaring whilst they hunt. The only eagle with a relatively high report rate in this study area is the Black Eagle, which typically favours rocky ridges and kopjes. Faulting caused by eagles has been shown in other studies (van Rooyen & Smallie 2003) to generally occur close to eagle nests. No eagle nests were observed on any of the existing power lines in this study area.

The reporting rates of the first group of species (herons, cormorants, storks, ibises etc) are relatively high and are therefore expected to play a significant role in the bird streamer mechanism, and therefore in the overall performance of the power line. However, these species occur at relatively uniform densities throughout the study area (see Table 4), and are therefore unlikely to influence significantly the selection of a particular route.

Table 4: The relative densities of 5 different bird species (as shown by reporting rates – Harrison *et al.* 1997) according to the South African Bird Atlas Project, indicating the uniform nature of their densities throughout the study area.

	Hadeda Ibis	Sacred Ibis	Reed Cormorant	Grey Heron	White Stork
2829 BC	0.6000	0.5500	0.4500	0.3000	0.1000
2829 BD	0.8793	0.8621	0.8966	0.7069	0.1552
2829 DA	0.8000	0.4690	0.5103	0.5379	0.1103
2829 DB	0.8841	0.6707	0.5610	0.7195	0.1037
2829 DC	.7255	0.6928	0.4641	0.4052	0.1895
2829 DD	0.8490	0.5625	0.5156	0.6354	0.2188

The vultures and raptors on the other hand occur at far lower relative densities than the first group, except for the Cape Griffon Vulture, which is fairly abundant in the study area. This species breeds on the Drakensberg mountains and forages extensively off the berg into the study area. Route alternative 1 would have the highest impact in terms of the bird streamer mechanism from Cape Griffon Vultures due to the fact it is located closer to the Drakensberg Mountains, where the vultures (Cape Griffons) breed, coming off the berg to forage. The remaining alternatives have similar impact ratings, with alternative 3 having the lowest impact rating (see Figure 11 and Table 5).

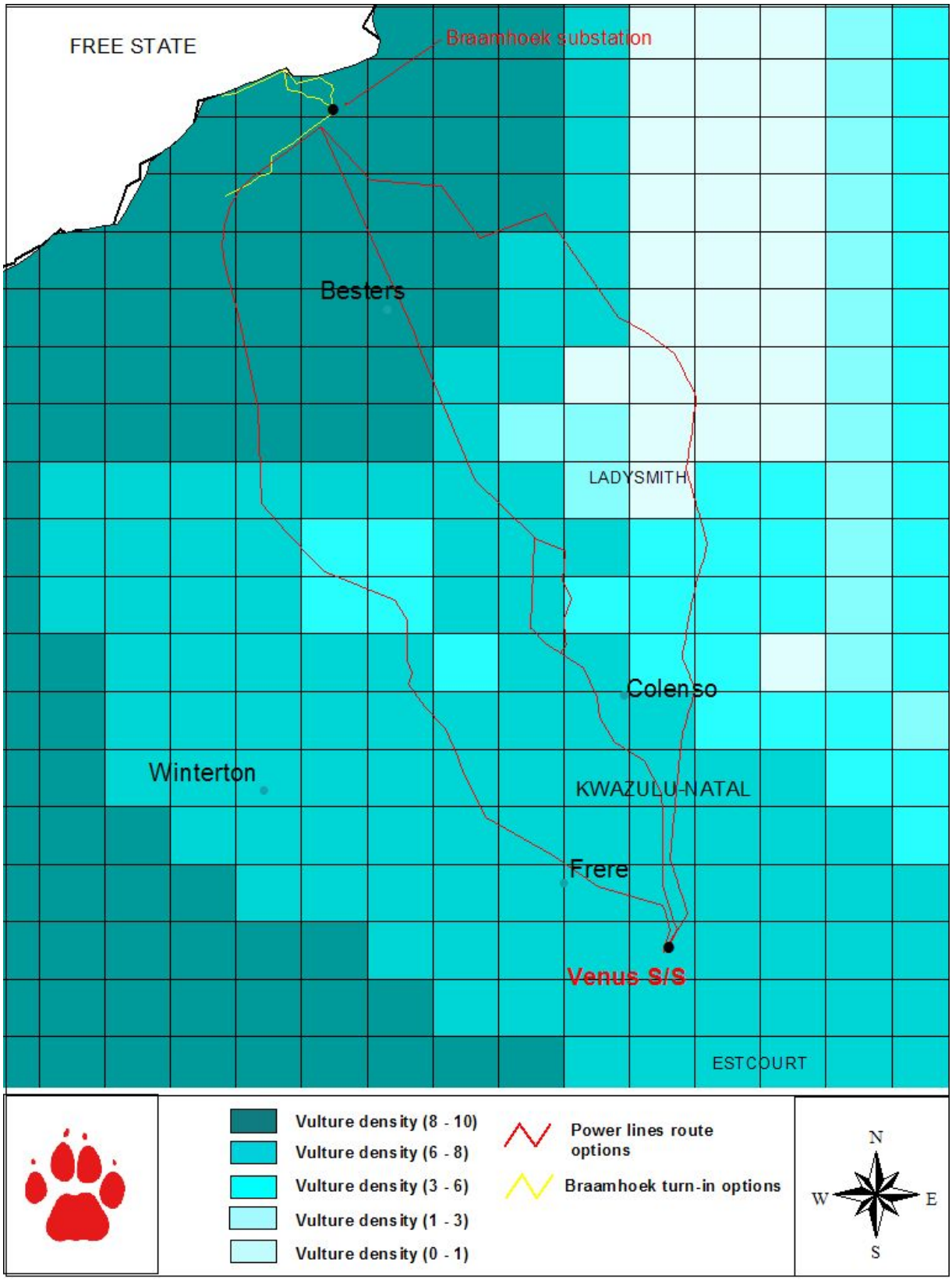

Figure 11 : Map showing the relative densities of Cape Griffons in the study area, as determined through the location of breeding colonies, vulture restaurants and roost sites (see van Rooyen & Piper 2004).

Figure 12: Photo showing Hadeda Ibises perched on a self-supporting 275kV power line tower, having the potential to cause bird streamer faults on the central phase.

4.3.3 400kV power line turn-ins from the Majuba – Venus #2 power line

Figure 13 indicates the 3 route options for the 400kV power line turn-in from the Majuba – Venus 400kV power line, in relation to the areas of importance for bird species in the study area (according to the Ezemvelo KZN Wildlife SEA).

Due to the same information described above for the electrocution and bird streamer impact, these 2 issues are insignificant in assessing the alternative routing for the 400kV turn-ins. The major consideration in terms of bird impacts is from the collision risk.

The distinction in bird species impacts for the turn-in options is between Option 1 which is routed below the escarpment and Options 2 and 3 which are routed along the top of the escarpment. None of these routes can be mitigated by routing it parallel to an existing power line as it will be a new route through open habitats. The entire area of all three options is open natural grassland, with very few alternative habitat types, i.e. an area with a high collision potential.

Both Option 2 and 3, routed along the top of the escarpment are expected to have a much higher collision risk than Option 1 for two reasons :

- The exposed nature of the power line at the edge of the escarpment, and the behaviour of bird species to move off the escarpment seasonally, dramatically increased the potential collision risk (see Figure 15).
- An historic Grey Crowned Crane collision incident took place on the top of the escarpment in a very exposed area (see Figure 14). In addition, a pair of Grey Crowned Crane was seen in a pan adjacent to the proposed Option 2 and 3 routes.

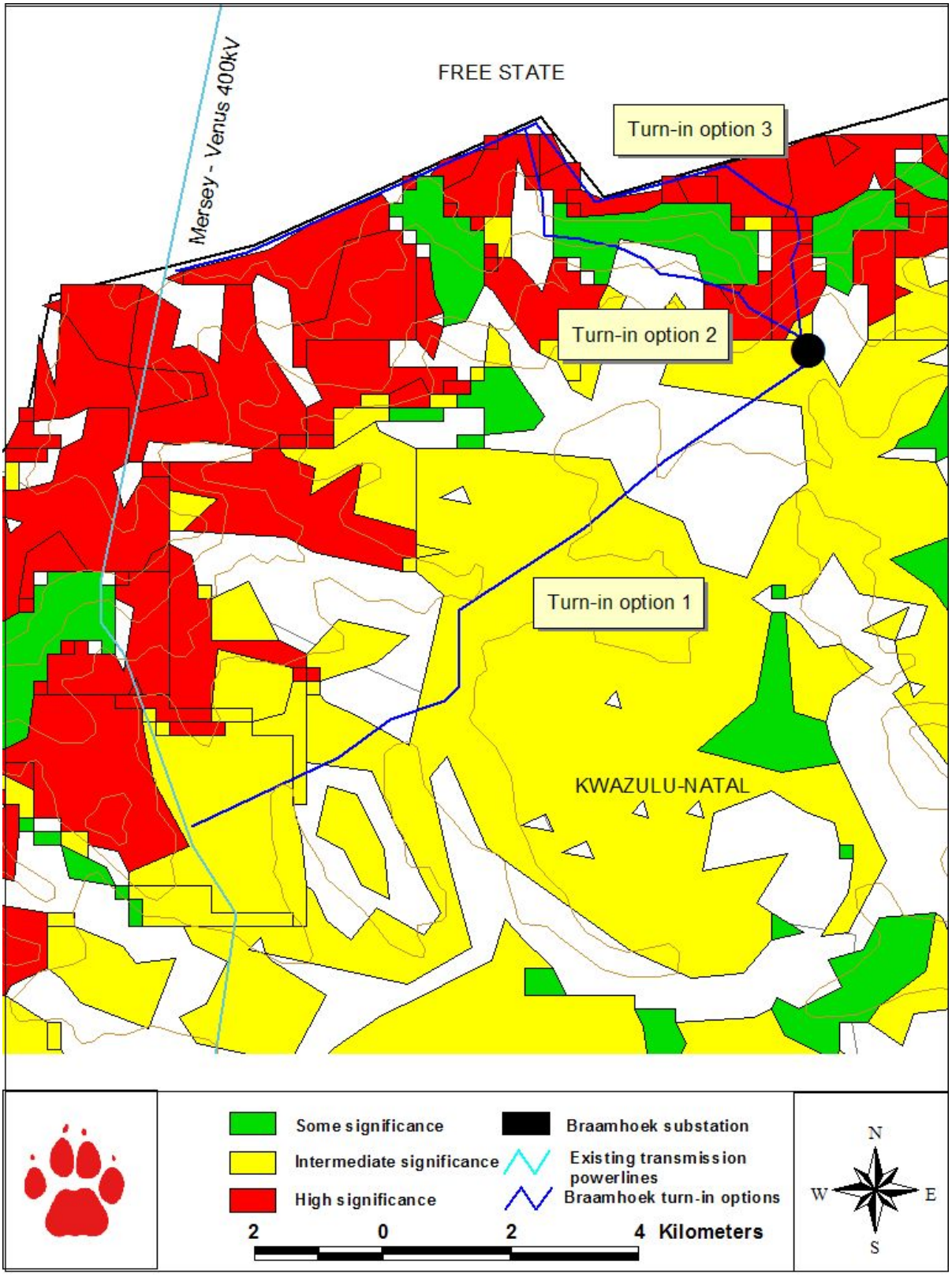

Figure 13: Map showing the location of the three 400kV turn-in route options from the Majuba – Venus 400kV power line.

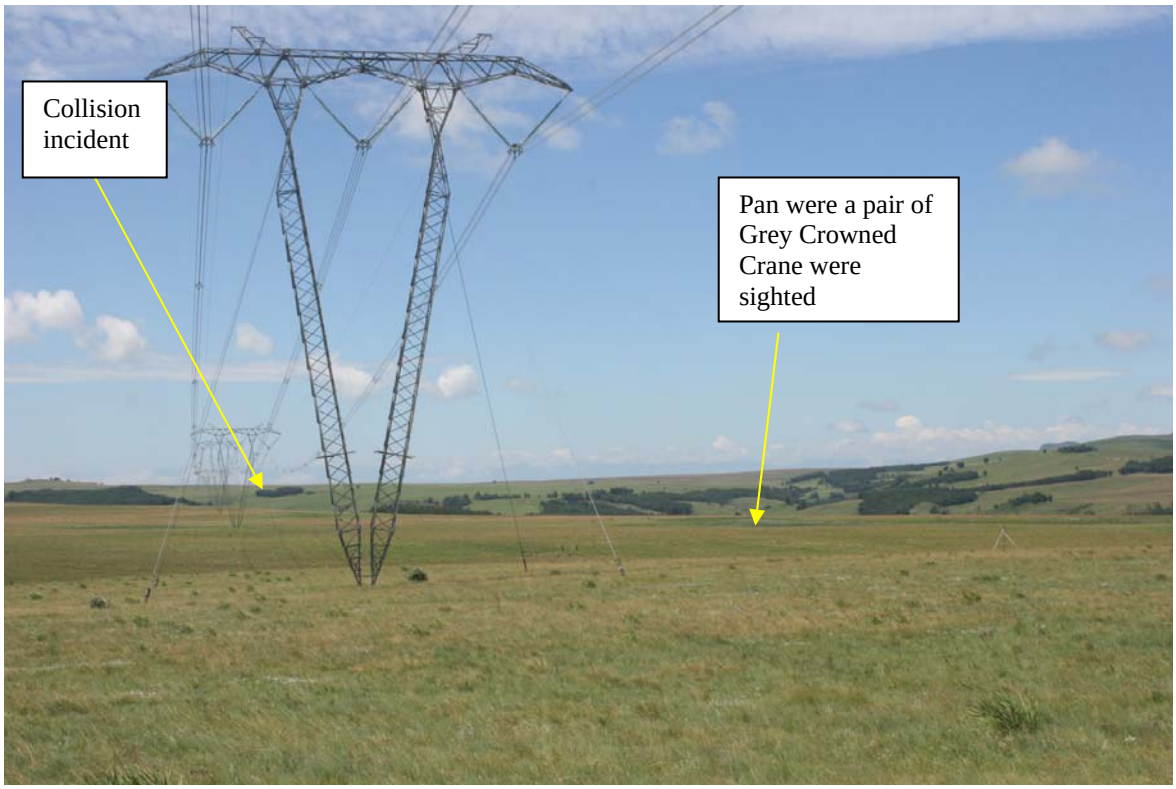

Figure 14: Photo of the Majuba – Venus- # 2 400kV power line, where turn-in Options 2 and 3 will tee-off. This photo also indicates the location of an historic Grey Crowned Crane collision on this power line.

Figure 15: Photo taken from the top of the escarpment towards KwaZulu-Natal, indicating the highly exposed nature of the terrain, resulting in an unacceptable collision risk potential.

Therefore, route Options 2 and 3 are classed as having an unacceptable collision risk potential and are classed as “no-go” options. Route Option 1 is viewed as an acceptable option as it is routed through less important bird habitats, below the escarpment where the collision risk is lower. The added advantage of this route, together with the preferred Braamhoek – Venus 400kV power line route is that all these power lines can be routed in a single disturbance corridor.

5 Recommended substation location and routes for the Braamhoek – Venus 400kV power line and the turn-in power line from the Majuba – Venus 400kV power line

5.1 Substation location

Due to the low significance of the site for bird species, no significant impacts are expected.

5.2 Braamhoek – Venus 400kV and Majuba – Venus 400kV turn-in power lines

After field assessment of the study area, the following have been identified as the specific impact issues :

- Open grassland areas where the collision hazard is high (collision susceptible species have been identified as present in the area, see Table 3). Areas of power line routed parallel to an existing power line would reduce the collision hazard considerably, to an acceptable level, while new power lines routed through open habitats with no other power lines would pose a significant hazard to bird species susceptible to collisions. Therefore, alternatives 1 and 3 are the preferred routes (see Table 5).
- River and wetland crossings are high collision risk areas as these are often used as flight paths for waterbirds. Areas where the powerline is routed parallel to rivers may also increase the interaction of waterbirds. Alternative 1 has fewer river and wetland crossings than the other options (see Table 5).
- The close proximity of the powerline route to a large dam, and in particular crossing a large dam, would pose a significant collision hazard to bird species as these areas are often used as a roost site for waterbirds as well as terrestrial bird species. These birds often leave the roost site at first light and return at dusk, when low light conditions prevail, making the routing of the powerline of the utmost importance. Therefore, alternatives 2A and 2B which cross the proposed dam outside Ladysmith would be an unacceptable collision risk.
- Powerlines routed through agricultural lands would result in a high collision hazard risk for certain species which would be abundant in these habitats. However, this is of low priority as most species resulting in powerline interactions are highly ubiquitous species (e.g. Spurwing goose, Egyptian goose), which have relatively low biological significance.
- Areas of bird species sensitivity were identified through the KZN Wildlife’s SEA, where species may be present which do not necessarily interact with the constructed powerline, but are vulnerable to negative interactions through breeding disturbance and hunting.
- Despite the fact that the electrocution hazard has be discounted due to the tower structure types, bird species which perch on the self-supporting tower may still cause pollution and bird streamer effects, resulting in poor supply. Cross-rope suspension towers do not allow birds to perch on the structures thereby effectively eliminating this impact. Mitigation measures to reduce the bird streamer impact are available and highly effect, thereby negating this as an influencing factor. However, without mitigation alternative 1 is likely to have a slightly higher bird streamer impact than the other alternatives.

A summary of all the potential impacts expected for each of the alternative routes for the Braamhoek - Venus 400kV power line are shown in Table 5.

Table 5: A summary of the overall bird impacts of each alternative route for the new 400kV power line.

		Alternative 1	Alternative 2A	Alternative 2B	Alternative 3
Bird Species					
Total number of bird species		296	296	296	296
Number of Red Data species		23	23	23	23
Number of powerline species		73	73	73	73
Number of Powerline Red Data species		16	16	16	16
Distance Through bird hotspots (Fig. 6 - E KZN W)	Some	46.1km	38.4km	40.2km	33.6km
	Medium	20.5km	12.9km	10.1km	9.4km
	High	1.5km	1.3km	2.0km	2.5km
Distance through collision hot spot areas (Fig. 8)		11.6km	47.1km	48.2km	16.2km
Distance through vulture density grid	0 – 1	0	0	0	18.2km
	1 – 3	0	0	0	0
	3 – 6	11.5km	0	3.5km	16.2km
	6 – 8	45.0km	54.5km	51.8km	31.6km
	8 – 10	34.4km	25.6km	25.6km	25.7km
Habitat / topography					
Distance through open grassland		57.8km	47.2km	48.5km	22.1km
Number of river crossings		1	5	5	4
Number of wetland crossings		21	22	20	29
Power Line Design / Route					
Distance not parallel to existing power line		11.9 km	51.5 km	45.8 km	40.6 km
% parallel to power line		86.8%	35.6%	43.2%	56.4%
Total route length		90.0 km	80.0 km	80.7 km	93.1 km

Therefore, either alternative 1 or 3 are the preferred option, with alternative 1 having a shorter distance of new powerline, and thereby a lower collision risk potential. In addition to this, with the preferred option for the Majuba – Venus 400kV turn-ins, this section of new power line will be routed parallel to an existing 400kV, thereby being routed parallel to an existing power line of similar height along its entire route and therefore eliminating the collision risk (with the appropriate mitigation measures implemented, i.e. an appropriate marking device at critical areas).

Therefore the preferred routes for the 400kV power lines are as follows :

- Braamhoek – Venus 400kV power line – alternative 1
- Majuba – Venus 400kV turn-in – option 1

The relative impact tables for the preferred substation site, the Braamhoek – Venus 400kV power line and the Majuba – Venus 400kV power line turn-in are shown below.

6. Impact Assessment on the preferred Braamhoek substation site, the 400kV power line route between the Braamhoek and Venus substations, and the 400kV turn-ins.

The issues assessed are as follows :

Braamhoek substation :-

- Impact of the construction and operation activities on the bird species at the development site (Impact table 1).

Braamhoek – Venus 400kV power line, including the turn-in from the Majuba – Venus 400kV power line :-

- Impact of fire on the avifauna, i.e. how people's activities in the area, both local people and the construction crew causing fires would impact on the breeding attempts of threatened species, as well as how this burning of grasslands would affect the foraging habitat quality (Impact table 2
- Impact of access roads (erosion) on the wetland resources in the study area (Impact table 3).
- Impact of disturbance (including hunting and poaching) from the construction crew on Red Data species which breed in the area (Impact table 4).
- Impact of collisions of birds with the power line (Impact table 5).
- Impact of the Bird Streamer mechanism on birds and the electricity infrastructure (Impact table 6).
- Impact of the proposed power line on the conservation areas of the region (in this case the avifaunal hotspot areas identified by Ezemvelo KZN Wildlife), (Impact table 7).

Impact Table 1

Theme	**Avifauna – substation construction and operation**	
Nature of impact	***The impact of construction and siting of the Braamhoek substation (disturbance of breeding species, affecting foraging habitats) on Red Data bird species***	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings	Site and immediate surroundings
Duration of impact	Short term – during construction phase	Long term – will permanently remove an area of grassland for use by bird species
Intensity	High	Low
Probability of occurrence	Probable	Improbable
Status of the impact	Project – neutral, environment – negative	Project – neutral, environment – negative
Accumulative Impact	Low	Low
Level of significance	**Low**	**No significance**
Mitigation measures	N/A	N/A
Level of significance after mitigation	**Low**	**No significance**
EMP requirements	Construction crews must avoid disturbance to the patches of indigenous forest nearby, especially in terms of removing tress for fire wood.	N/A
Discussion The substation is being constructed in an area of low bird species importance. The nature of the activity will be localised and is unlikely to impact on any significant bird species.		

Impact Table 2

Theme	**Avifauna - Impact of fire on Avifauna**	
Nature of impact	***The impact of fire (disturbance of breeding species, affecting foraging habitats) on Red Data bird species with the Braamhoek - Venus 400kV powerline, for the preferred alternative 1* and the Majuba – Venus 400kV turn-in***	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings	Site and immediate surroundings
Duration of impact	Short term – affects breeding attempt or habitat quality of that season	Short term – affects breeding attempt or habitat quality of that season
Intensity	Low	Low
Probability of occurrence	Probable	Improbable
Status of the impact	Project – neutral, environment – negative and positive **	Project – neutral, environment – negative and positive **
Accumulative Impact	Low	Low
Level of significance	**No significance *****	**No significance *****
Mitigation measures	N/A	N/A
Level of significance after mitigation	**No significance *****	**No significance *****
EMP requirements	Construction crews should be prevented from lighting fires in the grassland areas.	N/A
Discussion This powerline is being constructed where a 400 kV powerlines already exists, presumably with an existing burning programme. It is unlikely that the current burning pattern will change dramatically due to the existing intensive use of fire in the area for agriculture management and cattle grazing.		

* - This should predominantly affect open grassland dwelling species where fire could potentially destroy nests or affect breeding attempts. There exists large areas of open grassland along the route, thereby making this an important impacts consideration.
** - The impact on the environment could be negative (inappropriate burning in the incorrect season which could impact breeding attempts or could negatively impact habitat quality) or it could be positive (where burning at the correct time, i.e. late winter, could improve foraging habitat for example for Bald Ibis)
*** - The level of significance is rated as “no significance” due to the fact that these species are already encountering extensive burning each year, which is unlikely to change with the construction of this powerline; for this reason the level of significance before and after mitigation is NO SIGNIFICANCE.

Impact Table 3

Theme	**EROSION - Impact on Avifauna (habitat)**	
Nature of impact	***The impact on wetlands (an important bird species habitat) through access and access roads in constructing the 400kV powerline – preferred alternative 1 and the Majuba – Venus 400kV turn-in***	
Stage	Construction and Decommissioning	Operation
Extent of impact	Regional *	N/A
Duration of impact	Medium term	N/A
Intensity	High	N/A
Probability of occurrence	Definite	N/A
Status of the impact	Environment - Negative	N/A
Accumulative Impact	High	N/A
Level of significance	**Medium**	N/A
Mitigation measures	• Identify all wetlands along selected route • Wetlands should be avoided in planning access roads for construction **	N/A
Level of significance after mitigation	**Low *** **	N/A
EMP requirements	• Wetlands should be avoided in planning access roads for construction • Any damage to wetlands must be rehabilitated before the site is abandoned	N/A

Discussion

Wetlands are highly sensitive habitats being home to a group of highly specialized species, particularly bird species. More than 50% of KwaZulu-Natal's wetlands have been lost over the past 3 decades through draining, damming and road construction. Gaining access to construct this proposed powerline has the potential to impact heavily the wetlands in this study area. These wetlands must be avoided as it is unacceptable to route roads through wetlands.

* - Wetlands impacted at one point in the catchment very often influence the wetlands further down in the catchment, particularly through erosion and siltation
** - **WETLANDS MUST AT ALL COSTS BE AVOIDED** when planning the access roads for the construction teams
*** - The level of significance after mitigation is classed as Low as this power line will be routed parallel to an existing 400kV power line, which already has an access road, thereby reducing the need for new access roads. The area of concern is the turn-in from the Majuba – Venus 400kV power line where new roads accesses will be required - the placement of access road must be strictly controlled in the EMP

Impact Table 4

Theme	**NATURAL ENVIRONMENT / CONSTRUCTION ACTIVITIES – Disturbance Impact on Avifauna**	
Nature of impact	***The disturbance impact (disturbance of breeding species through any activity, including poaching) on Red Data bird species with the 400kV powerline, for the preferred alternative 1 and the Majuba – Venus 400kV turn-in***	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings	N/A
Duration of impact	Short term	N/A
Intensity	Medium*	N/A
Probability of occurrence	Probable	N/A
Status of the impact	Project – neutral, environment – negative	N/A
Accumulative Impact	Low	N/A
Level of significance	**Medium ***	N/A
Mitigation measures	Inform contractor / manager and staff of this impact (awareness)	N/A
Level of significance after mitigation	**Medium ****	N/A
EMP requirements	• Regulations laid done by Eskom to the contractor preventing any disturbance of breeding species, particularly Red Data species • Regular monitoring of the staff by contractor / manager	N/A
Discussion Construction activities, and the presence of staff on site leads to the potential impact or disturbance of Red Data breeding species, particularly in the open grasslands and near rivers and wetlands. Due to the presence of several red data species which breed in the study area in the open grasslands, there is likely to be an impact on these species, such as Blue Cranes, Black Stork, Grey Crowned Crane and Denim's Bustard. It is important for Eskom to include in their agreement with the construction contractor to prevent any disturbance occurring from the construction crews.		

* - The Intensity and level of significance are rated as Medium due to the moderate level of breeding Red Data species, with Bald Ibis, Black Stork, Blue Crane, Grey Crowned Crane and Martial Eagles having been recorded breeding in the relevant 1 : 50 000 grid squares

** - The only form of mitigation is awareness of contractor staff. From past experience, simple awareness of an issue such as this does not changes people's attitude and therefore would not change the level of significance after mitigation.

Impact Table 5

Theme	**NATURAL ENVIRONMENT - Impact on Avifauna**	
Nature of impact	***The collision of certain bird species (including Red Data species) with the proposed 400kV powerline – alternative 1 and the Majuba – Venus 400kV turn-in***	
Stage	Construction and Decommissioning	Operation
Extent of impact	N/A	Local
Duration of impact	N/A	Long term *
Intensity	N/A	Low
Probability of occurrence	N/A	Probable **
Status of the impact	N/A	Project – neutral, Environment - negative
Accumulative Impact	N/A	Negligible
Level of significance	N/A	**Low ****
Mitigation measures	N/A	• Route powerline parallel to existing Majuba - Venus 400 kV power line, towers of similar height • Fit an appropriate marking device to the power line in areas of open grassland, river and wetland crossings and where the line passes dams (see mitigation section for details)
Level of significance after mitigation	N/A	**No significance**
EMP requirements	N/A	• Fit an appropriate marking device to appropriate sections of powerline
Discussion The collision hazard to birds is highly significant, although along route B the severity of the impact can be dramatically reduced by routing the powerline parallel to an existing powerline, thereby keeping the disturbance in one corridor and by making the line more visible to birds by marking it with Bird Flight Diverters at specific areas along the route, mostly as a safe guard in particularly sensitive areas.		

* - as long as powerline is in use, up until it is decommissioned and removed

** - taken from van Rooyen & Smallie 2004 : “During June and July 2004, the collision risk posed to large terrestrial birds, by the Majuba-Venus 2 line was assessed, through driving the entire line, tower to tower where possible, and conducting a detailed field investigation. At the same time, the risk posed by birds to the performance of this line was assessed. A total of 142 spans of the line were identified for marking with a suitable bird flight diverter device. These spans were mainly across or adjacent to arable lands, wetlands, river crossings, and valley crossings. Several major collision “hot spots” were identified and have been highlighted for urgent attention. Specific guidelines for the installation of the bird flight diverter devices will depend on the device decided upon. Various devices are currently being tested and evaluated by Eskom in collaboration with EWT”.

Impact Table 6

Theme	**NATURAL ENVIRONMENT - Impact on Avifauna**	
Nature of impact	***The impact of the Bird Streamer mechanism on certain bird species (including Red Data species) and with the 400kV powerline – alternative 1 and the Majuba – Venus 400kV turn-in***	
Stage	Construction and Decommissioning	Operation
Extent of impact	N/A	Regional *
Duration of impact	N/A	Permanent
Intensity	N/A	Medium
Probability of occurrence	N/A	Highly Probable
Status of the impact	N/A	Project / Environment - Negative
Accumulative Impact	N/A	Medium
Level of significance	N/A	**Medium ****
Mitigation measures	N/A	• Construct 400kV powerline using cross-rope suspension towers as these prevent birds perching on towers • Fit PVC "Bird Guards" above all insulators / conductors on all self-supporting towers at bends or stabilizing points
Level of significance after mitigation	N/A	**No significance *****
EMP requirements	N/A	• Fit PVC "Bird Guards" above all insulators / conductors on all self-supporting towers
Discussion The bird streamer mechanism is caused by birds perching above insulators / conductors and excreting onto this infrastructure or into the air-gap thereby causing faulting. The mitigation available for reducing this impact to both the birds (which often get electrocuted in the process) and the electricity infrastructure is highly effective. The main aim of the mitigation is to keep the birds from perching directly above the insulators / conductors. Therefore, the cross-rope suspension towers make perching difficult for birds, while the self-supporting towers, which are favourite perching structures for birds, need to be fitted with PVC "Bird Guards". These devices have proven to be extremely effective in reducing the bird streamer mechanism on transmission powerlines.		

* - this will have a regional impact as faulting on transmission powerlines can impact the larger electricity network

** - Taken from van Rooyen & Smallie 2004 : "A total of 59 faults have been recorded on Majuba-Venus 2 from January 1996 to present. Of these, in 6 cases the reason for the fault was unknown, and in 10 cases the reason was determined to be birds. It is clear then that a maximum of 27% (16 of 59) of the total faults in the past 7 years could be assigned to birds, even if the unknown faults are included. As can be seen, the actual tower that the fault occurred at was not identified in any of the 16 faults. The phase that the fault occurred on was determined in only 3 of the 16 faults. It can be determined that only two of the 16 faults occurred during the day. The remainder are during the night, evening, or early morning. This corresponds with the patterns expected from streamer induced faulting, as the birds are roosting on the towers during the night.

*** - The level of significance will be reduced to "No significance" by fitting Bird guards to self-supporting structures as they have proven exceptionally effective in preventing the bird streamer mechanism (Pers. comm. – Hein Vosloo, Eskom Transmission)

Impact Table 7

Theme	**NATURAL ENVIRONMENT - Impact on Conservation Areas (for Avifauna) ***	
Nature of impact	***The impact on areas identified by KZN Wildlife as bird sensitive areas, for alternative 1 and the Majuba – Venus 400kV turn-in***	
Stage	Construction and Decommissioning	Operation
Extent of impact	Local	Local
Duration of impact	Short term	Long term
Intensity	Low	Low
Probability of occurrence	Improbable	Improbable
Status of the impact	Project – neutral, Environment -negative	Project – neutral, Environment - negative
Accumulative Impact	Low	Low
Level of significance	**Low**	**No significance**
Mitigation measures	None	None
Level of significance after mitigation	**Low**	**No significance**
EMP requirements	• None	None
Discussion Construction activities, and the presence of staff on site, and any future maintenance activities leads to the potential impact or disturbance of Red Data species, particularly in the open grasslands and near rivers and wetlands. Due to there being relatively few important areas, only close to the Venus substation and around the Braamhoek substation, the likelihood of this occurring is very low and the impact should be low to negligible.		

* - note that these impacts are on species which to do necessarily interact with powerlines, but are within the set of threatened species identified by Ezemvelo KZN Wildlife as priority avifaunal species in the province – these could potentially be impacted by the actual human and construction activities, including maintenance activities.

Table 6 shows the summary of the impact ratings for the Braamhoek substation, the Braamhoek – Venus 400kV powerline and the Majuba – Venus #2 400kV turn-ins.

Table 6: Summary of impact levels for the preferred substation site and Braamhoek – Venus 400kV power line, including the turn-in from the Majuba – Venus 400kV line, before and after mitigation.

ISSUE	Nature of Impact	**Route A**	
		Before Mitigation	After Mitigation
A. Braamhoek substation			
Avifauna – substation	Impact on bird species	Construction – **Low**	Construction - **Low**
		Operation – **No significance**	Operation – **No significance**
B. Braamhoek – Venus 400kV power line, including the turn-in			
Avifauna	Impact of fire on birds	Construction – **No significance**	Construction – **No significance**
		Operation – **No significance**	Operation – **No significance**
Erosion – impact on bird habitats	Impact on wetlands	Construction - **Medium**	Construction – **Low**
Natural Environment / Construction Activities	Disturbance on breeding species, including poaching	Construction – **Medium**	Construction – **Medium**
Natural Environment	Bird collisions	Operation - **Low**	Operation – **No significance**
Natural Environment	Bird Streamer mechanism	Operation - **Medium**	Operation – **No significance**
Natural Environment	Impact on bird sensitive areas	Construction – **Low**	Construction - **Low**
		Operation – **no significance**	Operation – **no significance**

7 Recommendations

7.1 Preferred route options

The preferred route option for the Braamhoek – Venus 400kV power line, including the turn-ins from the Majuba – Venus 400kV power line is shown in Figure 16.

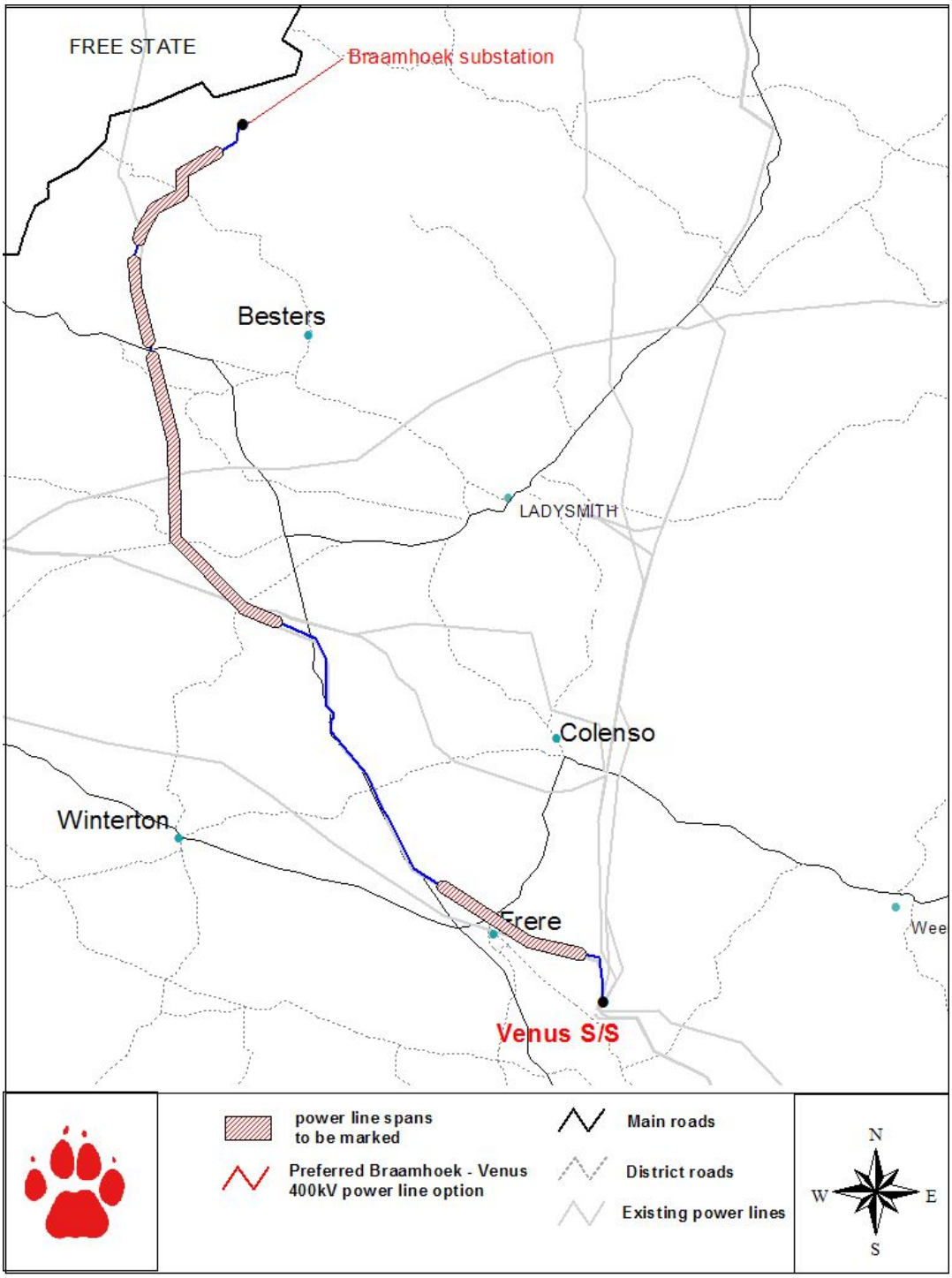

Figure 16: Map showing the location of the preferred 400kV power line route from Venus substation to the Braamhoek substation.

7.2 Recommended Mitigation of Avifaunal Impacts

- Preventing Wetland degradation
  Wetlands are highly sensitive systems and must be avoided at all times during the construction of this power line. Wetlands will be encountered along the length of the preferred route. Wetlands of all types must be identified prior to construction activities and must be highlighted as "no go" areas for construction activities. Planning of construction activities should prevent any access roads impacting on wetlands. Any damage to wetlands must be rehabilitated to their prior condition.

- Preventing Bird Collisions
  - The route identified in Figure 16 is recommended on the basis of it reducing the collision risk to acceptable levels. The most important aspect of this route is that it is routed parallel to an existing 400kV power line with towers of similar height. This method of running power lines parallel is known to significantly reduce bird collisions to acceptable levels.
  - Despite this fact, Figure 16 indicates ***the sections of powerline which must be marked with an appropriate marking device*** (line to be marked wherever it passes through open grassland areas, river crossings, wetland crossings, sections of powerline routed parallel to major rivers, powerline sections routed past dams, and powerline sections routed through agricultural lands).

- Preventing the Bird Streamer Mechanism
  All self-supporting pylon structures must be fitted with PVC "Bird Guards" above the insulators / conductors so as to prevent bird streamer mechanisms (see Figure 17).

Figure 17: Photos showing the fitting of "Bird Guards" to the self-supporting tower structures.

- Preventing any hunting / poaching or disturbance of breeding birds in the following areas
  Specific priority is placed on certain areas along the route where any hunting, poaching or disturbance of birds should not be tolerated. These areas correspond to the areas that require marking (see Figure 16), which correspond to areas of open grassland and dam and river crossings where sensitive bird species are likely to occur. In general, the contractor and staff must not interference with bird species anywhere along the route during construction.

References

ANDERSON, M.D. 2003. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Unpublished report to Eskom.

BARNES, K.N. (ed.) 2000. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

HARRISON, J.A., ALLAN, D.G., UNDERHILL, L.G., HERREMANS, M., TREE, A.J., PARKER, V & BROWN, C.J. (eds). 1997. The atlas of southern African birds. Vol. 1&2. BirdLife South Africa, Johannesburg.

HOBBS, J.C.A. & LEDGER J.A. 1986a. The Environmental Impact of Linear Developments; Powerlines and Avifauna. Third International Conference on Environmental Quality and Ecosystem Stability. Israel, June 1986.

GOODMAN, P. (Ed). 2000. Determining the conservation value of land in KwaZulu-Natal. SEA Report, KwaZulu-Natal Wildlife.

HOBBS, J.C.A. & LEDGER J.A. 1986b. Powerlines, Birdlife and the Golden Mean. Fauna and Flora 44:23-27.

KRUGER, R. & VAN ROOYEN, C.S. 1998. Evaluating the risk that existing powerlines pose to large raptors by using risk assessment methodology: the Molopo Case Study. 5th World Conference on Birds of Prey and Owls: 4 - 8 August 1998. Midrand, South Africa.

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

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

LEDGER, J.A. & ANNEGARN H.J. 1981. Electrocution Hazards to the Cape Vulture *(Gyps coprotheres)* in South Africa. Biological Conservation 20:15-24.

LEDGER, J.A. 1984. Engineering Solutions to the Problem of Vulture Electrocutions on Electricity Towers. The Certificated Engineer 57:92-95.

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

VAN ROOYEN, C.S. & LEDGER, J.A. 1999. Birds and utility structures: Developments in southern Africa. Pp 205-230 in Ferrer, M. & G..F.M. Janns. (eds.) Birds and Powerlines. Quercus, Madrid, Spain. 238pp.

VAN ROOYEN, C.S. 1998. Raptor mortality on powerlines in South Africa. 5th World Conference on Birds of Prey and Owls: 4 - 8 August 1998. Midrand, South Africa.

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

VAN ROOYEN, C.S. 2000. An overview of Vulture Electrocutions in South Africa. Vulture News 43: 5-22. Vulture Study Group, Johannesburg, South Africa.

VAN ROOYEN, C.S. & SMALLIE J. 2004. Risk assessment of bird interactions with the Majuba – Venus #2 400kV transmission power line. Unpublished Report, Endangered Wildlife Trust.

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

VERDOORN, G.H. 1996. Mortality of Cape Griffons *Gyps coprotheres* and African Whitebacked Vultures *Pseudogyps africanus* on 88kV and 132kV powerlines in Western Transvaal, South Africa, and mitigation measures to prevent future problems. 2nd International Conference on Raptors: 2-5 October 1996. Urbino, Italy.

APPENDIX 1

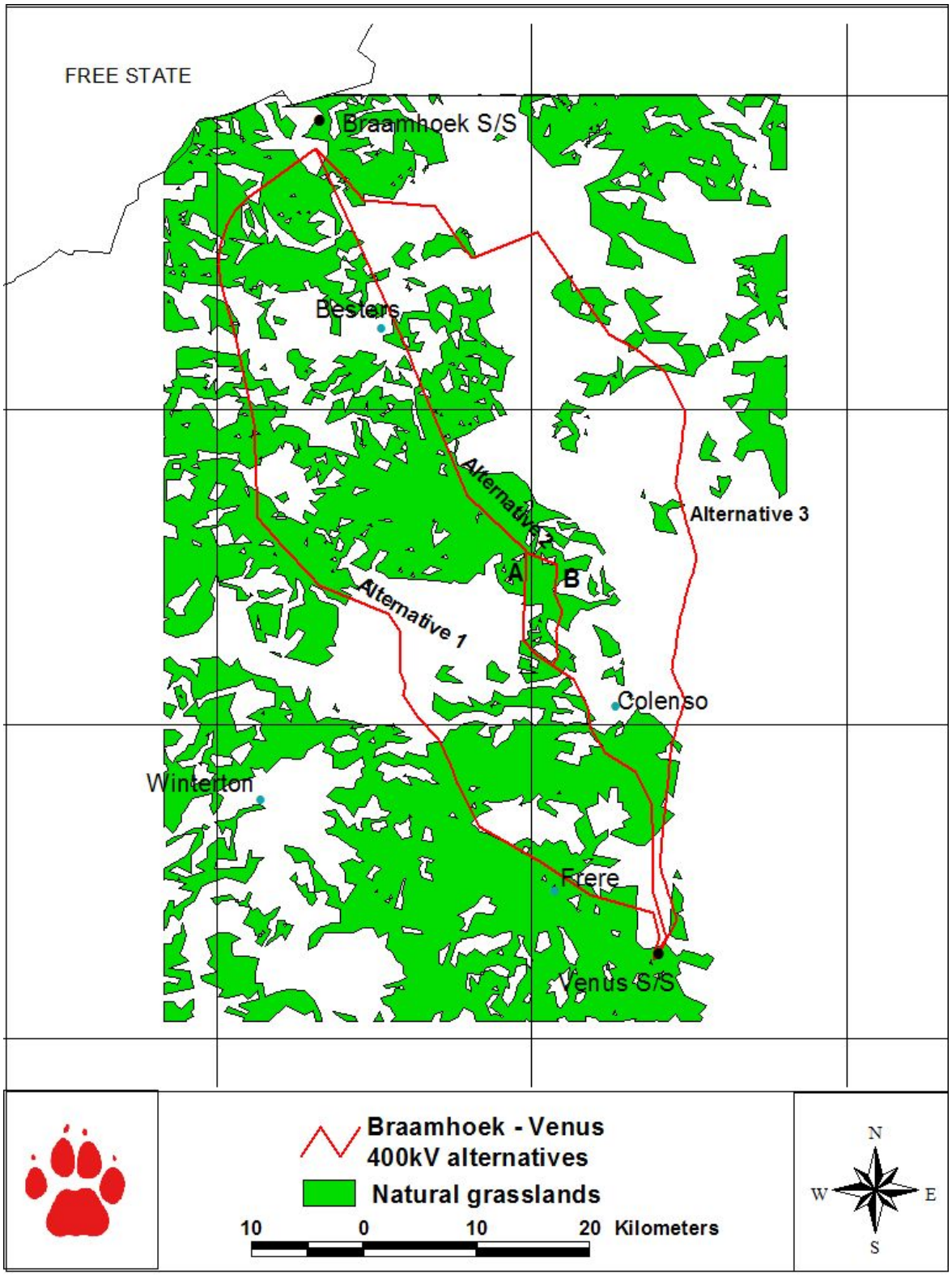

Figure 18: Map showing the Braamhoek – Venus 400kV power line options in relation to the open natural grasslands within the study area.

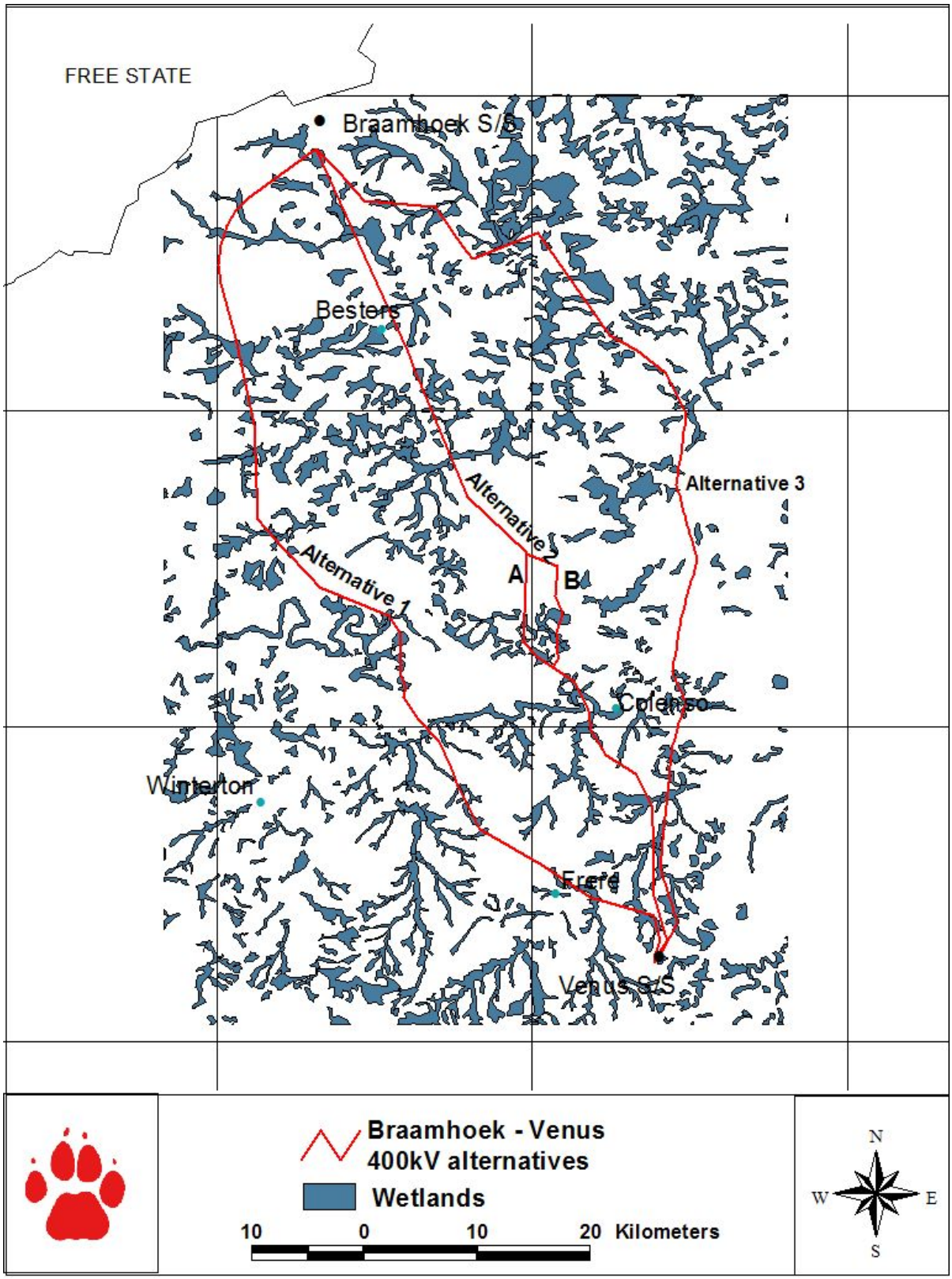

Figure 19: Map showing the Braamhoek – Venus 400kV power line options in relation to the wetlands within the study area.

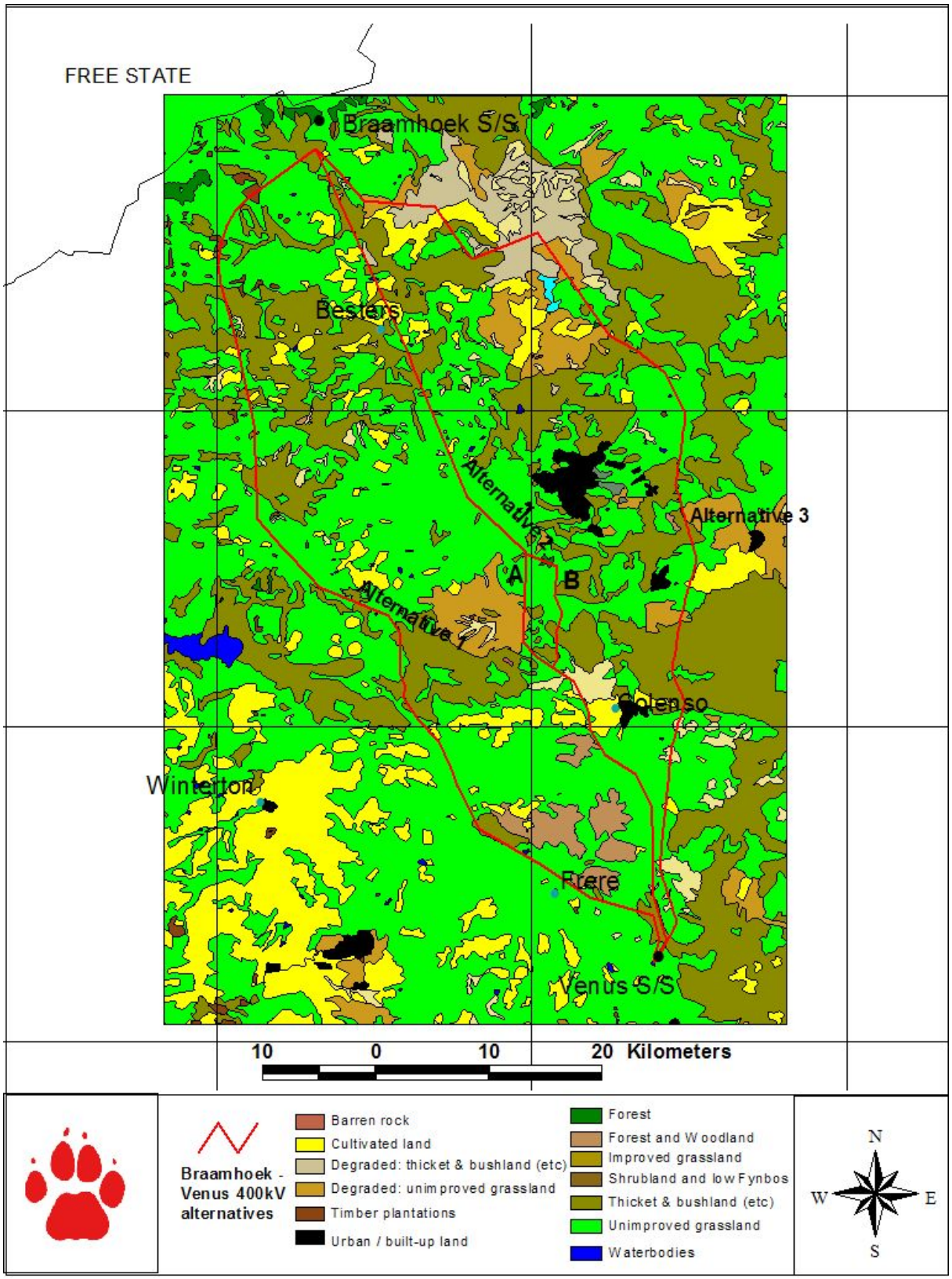

Figure 20: Map showing the Braamhoek – Venus 400kV power line options in relation to the land-use patterns within the study area.

APPENDIX 2

Number of cards per month :

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
14	9	13	11	10	14	10	8	19	9	15	13	145

Number of species present :

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
197	173	163	170	156	160	143	132	184	178	199	215	287

Number of species breeding :

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
16	4	2	4	1	2	1	4	13	14	23	25	62

		All Records				Breeding Records		
		JFMAMJ	JASOND	%	N	JFMAMJ	JASOND	N
DABCHICK	008	314313	662436	34	49	******	*****9	1
WHITBRST CORMORANT	055	1*2234	514121	23	33	******	******	0
REED CORMORANT	058	445676	464845	51	74	******	******	0
DARTER	060	133575	352231	32	46	******	******	0
GREY HERON	062	475575	565953	54	78	******	******	0
BLACKHEADED HERON	063	364564	557758	54	78	******	******	0
GOLIATH HERON	064	******	**1***	1	2	******	******	0
PURPLE HERON	065	1*****	***2**	2	3	******	******	0
GREAT WHITE EGRET	066	121***	111212	10	14	******	******	0
LITTLE EGRET	067	1*2*11	***21*	6	8	******	******	0
CATTLE EGRET	071	786676	568988	72	104	******	******	0
HAMERKOP	081	342452	1*2434	28	41	******	******	0
WHITE STORK	083	1241*1	****12	11	16	******	******	0
BLACK STORK NT	084	****1*	***2*1	3	4	******	******	0
YELLOWBILL STORK NT	090	*****1	******	1	1	******	******	0
SACRED IBIS	091	335754	466742	47	68	******	******	0
HADEDA IBIS	094	986888	969888	80	116	******	******	0
AFRICAN SPOONBILL	095	**4354	451632	28	41	******	******	0
LESSER FLAMINGO NT	097	******	****1*	1	1	******	******	0
WHITEFACED DUCK	099	642524	445425	40	58	******	******	0
FULVOUS DUCK	100	**1***	******	1	1	******	******	0
WHITEBACKED DUCK	101	******	*****1	1	1	******	******	0
EGYPTIAN GOOSE	102	475798	898877	70	102	9*****	******	1
S AFRICAN SHELDUCK	103	1*1313	2***11	10	14	******	******	0
YELLOWBILLED DUCK	104	444476	456455	50	72	*****9	******	1
AFRICAN BLACK DUCK	105	222544	411324	28	40	******	******	0
HOTTENTOT TEAL	107	******	*****1	1	1	******	******	0
REDBILLED TEAL	108	**111*	2*1*1*	5	7	******	******	0
CAPE SHOVELLER	112	***1*1	4*1**1	6	8	******	******	0
SOUTHERN POCHARD	113	1*****	**1111	3	5	******	******	0
KNOBBILLED DUCK	115	***211	**1**1	4	6	******	******	0
SPURWINGED GOOSE	116	322574	346445	42	61	******	******	0
SECRETARYBIRD NT	118	1**222	1*2111	11	16	******	******	0
BEARDED VULTURE E	119	******	**1***	1	1	******	******	0
CAPE VULTURE V	122	112343	534422	29	42	******	******	0
YLWBLD/BLACK KITE	126	1*****	**1*1*	3	5	******	******	0
BLACKSHOULDRD KITE	127	995588	567887	72	104	******	******	0
CUCKOO HAWK	128	******	***1**	1	1	******	******	0

BLACK EAGLE	131	***1** 111***	3	4	****** ******	0
WAHLBERG EAGLE	135	**11** **1*11	4	6	****** ******	0
BOOTED EAGLE	136	1***** ******	1	1	****** ******	0
MARTIAL EAGLE V	140	11*11* ***1*1	5	7	9***** ******	1
BROWN SNAKE EAGLE	142	****** **1**1	1	2	****** ******	0
AFRICAN FISH EAGLE	148	1**131 **1331	12	17	****** ******	0
STEPPE BUZZARD	149	674*1* ***356	26	38	****** ******	0
JACKAL BUZZARD	152	11**2* ***112	6	8	****** ******	0
LITTLE SPARROWHAWK	157	****** *****1	1	1	****** ******	0
AFRICAN GOSHAWK	160	****1* ******	1	1	****** ******	0
GABAR GOSHAWK	161	*114*1 1*3*31	12	18	****** ******	0
AFR MARSH HARRIER V	165	***11* 1*11*2	6	8	****** ******	0
GYMNOGENE	169	*1**2* *1*112	6	8	****** ******	0
PEREGRINE FALCON NT	171	***1** ******	1	1	****** ******	0
LANNER FALCON NT	172	12*121 **2212	11	16	****9* ******	1
HOBBY FALCON	173	*1**** ******	1	1	****** ******	0
E REDFOOTD KESTREL	180	8871** ****39	32	46	****** ******	0
ROCK KESTREL	181	473311 131242	26	37	****** ******	0
LESSER KESTREL V	183	243*** ****25	14	20	****** ******	0
COQUI FRANCOLIN	188	*****1 ******	1	1	****** ******	0
SHELLEY FRANCOLIN	191	132112 211212	16	23	****** ******	0
REDWING FRANCOLIN	192	****** **1***	1	1	****** ******	0
NATAL FRANCOLIN	196	122431 *12221	18	26	****** ******	0
REDNECKD FRANCOLIN	198	*1**** **1***	1	2	****** ******	0
SWAINSON FRANCOLIN	199	415534 133254	33	48	****** ******	0
COMMON QUAIL	200	1**11* **1*11	6	8	****** ******	0
HELMETD GUINEAFOWL	203	984566 688998	74	108	33**** *****3	3
KRRCHN BUTTONQUAIL	205	*1**** ***1**	1	2	****** ******	0
BLUE CRANE V	208	121332 214222	21	31	****** ******	0
CROWNED CRANE V	209	1**2*1 1321*2	10	14	****** ******	0
PURPLE GALLINULE	223	****** ***1**	1	1	****** ******	0
MOORHEN	226	***1*1 *11111	5	7	****** ******	0
REDKNOBBED COOT	228	645445 665747	52	75	****** 37****	3
WHITEBELLD KORHAAN V	233	12*141 1*2122	14	21	****** ******	0
BLUE KORHAAN NT	234	****** **1**2	2	3	****** *****9	1
KITTLITZ'S PLOVER	248	****** **1***	1	1	****** ******	0
THREEBANDED PLOVER	249	1*2122 243121	17	25	****** **9***	1
CROWNED PLOVER	255	12*233 252*21	18	26	****** **9***	1
BLCKWNGD PLOVER NT	257	1***** ******	1	1	****** ******	0
BLACKSMITH PLOVER	258	532678 696655	57	83	****** ****9*	1
WATTLED PLOVER	260	1*1*** ***111	3	5	****** ******	0
COMMON SANDPIPER	264	532211 *13243	25	36	****** ******	0
WOOD SANDPIPER	266	1***** ****12	3	5	****** ******	0
GREENSHANK	270	1***** *12*11	5	7	****** ******	0
RUFF	284	****** ****1*	1	1	****** ******	0
ETHIOPIAN SNIPE	286	*****1 1****1	2	3	****** ******	0
SPOTTED DIKKOP	297	22*321 *32233	19	28	****** ******	0
WATER DIKKOP	298	*****1 1***1*	3	4	****** ******	0
GREYHEADED GULL	315	****** **1*1*	1	2	****** ******	0
WHISKERED TERN	338	1***** ******	1	1	****** ******	0
FERAL PIGEON	348	**2*11 *11**2	7	10	****** ******	0
ROCK PIGEON	349	123434 754643	38	55	****** ******	0
REDEYED DOVE	352	364475 786755	52	75	****** ******	0
CAPE TURTLE DOVE	354	875779 887776	72	104	****** ******	0
LAUGHING DOVE	355	889889 888888	82	119	****** ******	0
NAMAQUA DOVE	356	1123*1 212412	16	23	****** ******	0
GREENSPOTTED DOVE	358	**1*1* *1*1**	3	4	****** ******	0

EUROPEAN CUCKOO	374	****** *****1	1	1	****** ******	0
AFRICAN CUCKOO	375	1***** *****2	2	3	****** ******	0
REDCHESTED CUCKOO	377	42**** ***778	24	35	*9**** ******	1
BLACK CUCKOO	378	2*2*** ***253	12	18	****** ******	0
GRT SPOTTD CUCKOO	380	1***** ***122	6	9	****** ******	0
STRIPED CUCKOO	381	****** ****1*	1	2	****** ******	0
JACOBIN CUCKOO	382	*21*** ****11	3	5	****** ******	0
KLAAS'S CUCKOO	385	21**** 1*1234	12	17	****** ******	0
DIEDERIK CUCKOO	386	7621** **1479	32	47	****** *****9	1
BURCHELL'S COUCAL	391	****** **1***	1	1	****** ******	0
BARN OWL	392	*1**1* 2**1*1	4	6	****** ******	0
GRASS OWL V	393	***111 1*****	3	4	****** ******	0
WOOD OWL	394	****** **1***	1	1	****** ******	0
MARSH OWL	395	*****1 2***11	4	6	****** ******	0
SCOPS OWL	396	***1** ******	1	1	****** ******	0
SPOTTED EAGLE OWL	401	13131* 2**112	10	15	9***** ******	1
FIERYNCK NIGHTJAR	405	*1**** 1*11**	3	5	****** ******	0
BLACK SWIFT	412	131331 **3122	18	26	****** ******	0
WHITERUMPED SWIFT	415	4322** **1135	19	27	****** ****9*	1
HORUS SWIFT	416	**11** *****1	2	3	****** ******	0
LITTLE SWIFT	417	123311 112316	21	31	****** ***5*5	2
ALPINE SWIFT	418	33122* **3445	23	34	****** ******	0
PALM SWIFT	421	*1*1** ***1*1	3	4	****** ******	0
SPECKLED MOUSEBIRD	424	2124*3 311352	23	34	****** ******	0
REDFACED MOUSEBIRD	426	332412 455854	38	55	****** ******	0
PIED KINGFISHER	428	112575 343432	32	47	****** ******	0
GIANT KINGFISHER	429	122432 1**113	17	25	****** ******	0
MLCHITE KINGFISHER	431	3***12 111222	13	19	****** ******	0
BRWNHD KINGFISHER	435	462658 663455	50	72	****** ******	0
LITTLE BEE-EATER	444	*****1 ***1**	1	2	****** ******	0
EUROPEAN ROLLER	446	1***1* *****2	3	5	****** ******	0
HOOPOE	451	432634 666856	48	70	****** ***9**	1
REDBLLD WOODHOOPOE	452	475532 332623	34	49	****** ******	0
SMTRBLD WOODHOOPOE	454	333333 453744	36	52	****** ******	0
GROUND HORNBILL V	463	****** ****1*	1	1	****** ******	0
BLACKCOLLRD BARBET	464	234554 465734	42	61	****** ******	0
PIED BARBET	465	464466 486745	50	73	****** ******	0
CRESTED BARBET	473	462434 564835	43	62	****** ******	0
GREATER HONEYGUIDE	474	****** 1*****	1	1	****** ******	0
LESSER HONEYGUIDE	476	****** *1*11*	2	3	****** ******	0
SHRPBLD HONEYGUIDE	478	**1*** ****21	3	5	****** ******	0
GROUND WOODPECKER	480	***1** ******	1	1	****** ******	0
GLDNTLD WOODPECKER	483	12**21 1*1222	12	17	****** ******	0
CARDINL WOODPECKER	486	332235 484434	37	53	*****9 ******	1
BEARDED WOODPECKER	487	*1*21* *****1	3	5	****** ******	0
OLIVE WOODPECKER	488	****1* ******	1	1	****** ******	0
REDTHROATD WRYNECK	489	1****1 **1231	8	12	****** ******	0
MELODIOUS LARK NT	492	1***** *1***1	2	3	****** ******	0
RUFOUSNAPED LARK	494	573434 236758	47	68	****** ******	0
SABOTA LARK	498	1222*2 433*31	19	28	****** ******	0
LONGBILLED LARK	500	1***** **111*	3	4	****** ******	0
SPIKEHEELED LARK	506	11*111 ******	4	6	****** ******	0
REDCAPPED LARK	507	*211** **2*4*	9	13	****** ******	0
EUROPEAN SWALLOW	518	99631* **1157	35	51	****** ******	0
WHITETHRTD SWALLOW	520	5853** *44243	31	45	****** ******	0
GRTR STRPD SWALLOW	526	6654** **2367	34	49	****** ****55	2
LSR STRIPD SWALLOW	527	87551* 144877	48	70	****** ***262	5

SA CLIFF SWALLOW	528	12422*	*12135	19	28	******	*****9	2
ROCK MARTIN	529	132121	212*32	17	24	******	******	0
HOUSE MARTIN	530	12*1**	****1*	4	6	******	******	0
SAND MARTIN	532	12****	***11*	4	6	******	******	0
BROWNTHRTED MARTIN	533	1*1423	314111	19	28	******	******	0
BANDED MARTIN	534	1*12**	******	3	5	******	******	0
BLK SAWWNG SWALLOW	536	1*****	***1**	1	2	******	******	0
BLACK CUCKOOSHRIKE	538	11****	****12	5	7	******	******	0
FORKTAILED DRONGO	541	698889	788978	80	116	5*****	*****5	2
BLACKHEADED ORIOLE	545	1***2*	1**11*	4	6	******	******	0
BLACK CROW	547	997976	698786	77	111	******	**9***	3
PIED CROW	548	998999	999999	96	139	******	**9***	1
WHITENECKED RAVEN	550	*42131	1*1***	10	15	******	******	0
SOUTHERN BLACK TIT	554	132231	*34433	25	36	******	******	0
ARROWMARKD BABBLER	560	534224	432333	31	45	******	******	0
BLACKEYED BULBUL	568	585678	766967	66	96	******	***55*	2
SOMBRE BULBUL	572	1*1*1*	***1**	3	4	******	******	0
KURRICHANE THRUSH	576	1*2113	252423	21	31	******	******	0
OLIVE THRUSH	577	*****1	*1****	1	2	******	******	0
GRNDSCRAPER THRUSH	580	462544	455735	44	64	3*****	**33*3	4
CAPE ROCK THRUSH	581	1*11*1	**1*1*	4	6	******	******	0
SENTNL ROCK THRUSH	582	******	****1*	1	1	******	******	0
MOUNTAIN CHAT	586	1*1*31	2*1121	10	14	******	******	0
BUFFSTREAKED CHAT	588	122111	**1***	6	9	******	******	0
FAMILIAR CHAT	589	464555	665755	51	74	******	**3313	7
MOCKING CHAT	593	1*2334	453435	30	43	******	******	0
ANTEATING CHAT	595	132243	354112	27	39	******	******	0
STONECHAT	596	11*645	765*12	30	44	******	******	0
CHORISTER ROBIN	598	******	*****1	1	1	******	******	0
CAPE ROBIN	601	443576	765865	55	80	5*****	****5*	2
WHITETHROATD ROBIN	602	*112**	2*2132	12	17	******	****9*	1
WHITEBROWED ROBIN	613	432545	665445	43	63	******	***5*5	2
TITBABBLER	621	332223	534742	33	48	5*****	****5*	2
ICTERINE WARBLER	625	11****	******	1	2	******	******	0
AFR MARSH WARBLER	631	1*****	***1*1	3	4	******	******	0
ERPN MARSH WARBLER	633	**1***	******	1	1	******	******	0
CAPE REED WARBLER	635	111***	*11*1*	5	7	******	******	0
YELLOW WARBLER	637	******	**1***	1	1	******	******	0
AFR SEDGE WARBLER	638	1*****	******	1	1	******	******	0
BROADTAILD WARBLER NT	642	***1**	******	1	1	******	******	0
WILLOW WARBLER	643	121***	****12	7	10	******	******	0
LONGBILLED CROMBEC	651	132433	353343	30	43	******	******	0
BLEATING WARBLER	657	*1**1*	***11*	3	4	******	******	0
GRASSBIRD	661	232*11	212132	18	26	5*****	*****5	2
FANTAILD CISTICOLA	664	441111	1*1*34	18	26	******	*****9	1
CLOUD CISTICOLA	666	11****	****11	3	5	******	******	0
AYRES' CISTICOLA	667	11****	*****2	3	5	******	*****9	1
WAILING CISTICOLA	670	122**1	*****1	5	7	******	******	0
RATTLING CISTICOLA	672	******	**111*	2	3	******	******	0
LEVAILNT CISTICOLA	677	332211	2*4112	20	29	******	******	0
CROAKING CISTICOLA	678	13*1**	**11*1	6	8	******	******	0
LAZY CISTICOLA	679	22*111	**2112	12	18	*9****	******	1
NEDDICKY	681	242224	453624	32	46	******	****9*	1
TAWNYFLANKD PRINIA	683	232455	365854	43	62	******	******	0
SPOTTED PRINIA	686	*****1	****12	3	4	******	******	0
SPOTTED FLYCATCHER	689	473***	****25	17	25	******	******	0
DUSKY FLYCATCHER	690	1111**	**1112	6	9	******	******	0

BLACK FLYCATCHER	694	114322	252232	25	36	****** ******	0
FISCAL FLYCATCHER	698	465676	686868	61	89	3***** **2222	6
CAPE BATIS	700	**1*** ******		1	1	****** ******	0
CHINSPOT BATIS	701	474566	686735	54	78	****** ******	0
FAIRY FLYCATCHER	706	***324	332**1	14	20	****** ******	0
PARADSE FLYCATCHER	710	5632**	**1767	30	43	3***** ***35*	4
AFR PIED WAGTAIL	711	112224	352232	23	34	****** ******	0
CAPE WAGTAIL	713	594978	587978	70	102	****** ******	0
RICHARD'S PIPIT	716	333444	445455	41	60	****** **9***	1
LONGBILLED PIPIT	717	*1**11	112111	9	13	****** ******	0
PLAINBACKED PIPIT	718	*1***1	**1***	3	4	****** ******	0
BUFFY PIPIT	719	******	*****1	1	1	****** ******	0
BUSHVELD PIPIT	723	******	*****1	1	1	****** ******	0
ORNGTHRTD LONGCLAW	727	162334	3*3235	30	43	****** ******	0
FISCAL SHRIKE	732	888678	898888	78	113	****** **9***	1
REDBACKED SHRIKE	733	111***	****1*	4	6	****** ******	0
SOUTHERN BOUBOU	736	442433	666654	43	63	****** ******	0
PUFFBACK	740	**1*1*	***411	6	8	****** ******	0
BRUBRU	741	242554	765844	45	65	****** ******	0
THREESTRKD TCHAGRA	743	******	*****1	1	1	****** ******	0
BLCKCROWND TCHAGRA	744	665558	766846	60	87	****** ******	0
BOKMAKIERIE	746	*2*11*	1*1312	8	12	****** ******	0
ORNGBR BUSH SHRIKE	748	1*22*1	*111*2	9	13	****** ******	0
OLIVE BUSH SHRIKE	750	******	*****1	1	1	****** ******	0
GREYHD BUSH SHRIKE	751	******	**1***	1	1	****** ******	0
INDIAN MYNA	758	23*121	152745	26	38	****** ****9*	1
PIED STARLING	759	132455	355464	39	57	****** ******	0
WATTLED STARLING	760	******	**1***	1	2	****** ******	0
PLUMCOLRD STARLING	761	4112**	***354	17	24	****** ******	0
GLOSSY STARLING	764	664577	666978	63	92	****** ******	0
REDWINGED STARLING	769	222324	665665	42	61	9***** ******	1
REDBILLED OXPECKER NT	772	******	***1**	1	1	****** ******	0
GURNEY'S SUGARBIRD	774	*****1	1*****	1	2	****** ******	0
MALACHITE SUNBIRD	775	***121	5651*1	17	25	****** ******	0
LSR DBLCLR SUNBIRD	783	***1**	******	1	1	****** ******	0
GTR DBLCLR SUNBIRD	785	111122	611111	15	22	****** ***9**	1
WHITEBELLD SUNBIRD	787	422434	786877	51	74	****** ****9*	1
BLACK SUNBIRD	792	232214	754657	39	57	****** ***9**	1
CAPE WHITE-EYE	796	662544	685967	53	77	****** ****9*	1
WTBR SPARROWWEAVER	799	**1***	111***	3	5	****** ******	0
HOUSE SPARROW	801	442445	554668	48	69	***3** ****33	3
CAPE SPARROW	803	313423	232234	27	39	****** **9***	1
GREYHEADED SPARROW	804	575565	785768	59	85	4**2** *2***2	5
YELLWTHRTD SPARROW	805	12**12	1*2212	12	17	****** ****9*	1
SPECTACLED WEAVER	810	1*****	*11*12	4	6	****** ******	0
SPOTTEDBCKD WEAVER	811	1*2**1	**2213	11	16	2***** ***225	6
CAPE WEAVER	813	121111	353431	19	28	****** *333**	3
MASKED WEAVER	814	662212	685968	48	69	2X**** *12212	23
REDBILLED QUELEA	821	1221*1	142232	17	25	****** ******	0
RED BISHOP	824	695534	443689	54	78	1***** ****36	7
GOLDEN BISHOP	826	221***	****24	10	14	****** *****9	2
YELLOWRUMPED WIDOW	827	******	1****1	1	2	****** ******	0
REDSHOULDERD WIDOW	828	2422*1	1*2244	21	31	****** ******	0
WHITEWINGED WIDOW	829	674111	134478	39	57	****** ****55	2
REDCOLLARED WIDOW	831	432**1	***145	17	24	****** *****9	1
LONGTAILED WIDOW	832	884542	346767	54	78	****** ****9*	1
MELBA FINCH	834	******	***1**	1	1	****** ******	0

BLUEBLLD FIREFINCH	840	21*2*1	*1*121	10	14	****** ******	0
BLUE WAXBILL	844	898888	797978	79	115	****** ******	0
COMMON WAXBILL	846	312422	2*2233	23	33	****** ******	0
SWEE WAXBILL	850	1***1*	1*****	2	3	****** ******	0
QUAIL FINCH	852	331112	113*13	18	26	****** ******	0
ORNGEBRSTD WAXBILL	854	11*1**	****22	6	9	****** ******	0
REDHEADED FINCH	856	111223	1322*1	14	21	****** **9***	1
BRONZE MANNIKIN	857	444525	344755	43	62	**55** ******	2
PINTAILED WHYDAH	860	695322	*33468	43	63	****** *****9	2
PARADISE WHYDAH	862	******	*****1	1	1	****** ******	0
BLACK WIDOWFINCH	864	1211*1	****21	7	10	****** ******	0
YELLOWEYE CANARY	869	475666	584858	58	84	**33** ****3*	3
BLACKTHRTED CANARY	870	312221	**1212	15	22	****** ******	0
CAPE CANARY	872	11***1	113*32	14	20	****** ******	0
BULLY CANARY	877	*1**11	*11*11	5	7	****** ******	0
STREAKYHDED CANARY	881	321444	443154	32	46	****** ******	0
GOLDNBRSTD BUNTING	884	262345	643855	42	61	****** ******	0
CAPE BUNTING	885	1**111	11**11	6	9	****** ******	0
ROCK BUNTING	886	444712	*12235	31	45	****** ******	0
R126 YLLWBLL KITE	888	662***	*35768	35	51	****** ******	0
R126 BLACK KITE	889	1*****	***1*2	3	5	****** ******	0