Bird Impact Assessment Study

Kusile Railway Line and associated infrastructure

September 2009

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Executive summary

The proposed Kusile railway line project entails the construction of a railway line and associated infrastructure, for the transportation of sorbent from a commercial source north of Pretoria, and it comes off from the existing Pretoria-Witbank railway line, two kilometres north of the N4 highway, to Kusile Power Station, situated west of eMalahleni (Witbank) in Mpumalanga.

The potential impacts that the proposed development could have on bird life in the study area can be grouped as follows:

- Electrocution on the electrical infrastructure of the railway line;
- Collisions with the associated power lines;
- Collisions with the moving train;
- Disturbance due to the construction of the railway line and the operation of the train;
- Habitat destruction through the construction of the railway line and associated infrastructure.

A number of sensitive, Red Data species could potentially occur along any of the corridors, mostly in the remaining natural grassland, as well as along the wetlands and dams formed by the Wilge River and its tributaries. Red Data species most likely to be impacted by the proposed railway line and associated infrastructure are Blue Crane, Blue Korhaan, White-bellied Korhaan and Secretarybird (habitat destruction, power line collisions and disturbance) and African Grass-owl (habitat destruction, electrocutions and collisions with the train). The proposed corridors run through very similar habitat, which means that the potential bird impacts are likely to be similar in nature (but not in extent) along all the proposed corridors. Ideally, from a bird impact perspective, the preferred corridor would be one that strives to avoid natural grassland or wetlands, or alternatively, is situated within the zone of influence of factors that lessen the risk of interactions, for example within agricultural lands. Unfortunately, all the proposed corridors are largely situated in natural grassland, making none of them very desirable from a bird impact perspective. There is reason to believe that the impact of existing power lines may have been a major contributory factor to the perceived low density and/or absence of power line sensitive grassland species, especially Blue Cranes. .

RECOMMENDATIONS

Collisions with the proposed 88kV power line: The mitigation of bird impacts caused by power lines is, to a large extent, determined by the microhabitat within a zone of a hundred metres to about 1km on both sides of a line. This is particularly relevant as far as mitigation for bird collisions are concerned. Sensitive sections include dams, wetlands, drainage crossings and areas of natural grassland. Due to the fact that all the proposed power line alternative corridors run through sensitive habitat, it is recommended that the earth wire on the power line is marked with Bird Flight Diverters, alternating black and white, ten metres apart, on each earth wire.

Collisions with the moving train: Species at risk here are likely to be mostly owls, particularly the threatened African Grass-owl, as well as other, non-threatened species such as Spotted Eagle-Owl, Barn Owl and Marsh Owl (if the train operates at night or in dawn and dusk conditions). The obvious mitigating measure, to reduce the risk of this happening, would be to reduce the speed at which the train would be travelling. However, the slow maximum projected speed of 50km/h would in itself serve as a mitigating factor. No additional mitigation is therefore deemed necessary.

Disturbance during the construction and operation of the railway line: Very little can be done to mitigate for the inevitable impact on birds from the noise and movement associated with the construction and operation of the proposed railway line. In this respect the birds will benefit from any of the proposed mitigation measures aimed at reducing the noise associated with these activities, as recommended in the Noise Impact Study which is being undertaken as part of this EIA process. One measure that should be strictly enforced is to keep all activities restricted to the actual construction zone, and not allow any unnecessary movement outside of this zone. The latter should also apply to the construction of the proposed 88kv line.

Habitat destruction during the construction and operational activities associated with the railway line and associated infrastructure: It must be accepted that habitat destruction will inevitably take place in the railway servitude, through the construction of the railway line, service road and power lines. One way to limit the extent of this impact would be to restrict all activities to the actual construction zone, and not allow any unnecessary movement outside off this zone. Furthermore, in order to limit the overall impact of the development on the remaining grassland in the study area, the proponent is strongly urged to conserve the remaining grassland and wetland areas on its property as a form of off-set, to mitigate for the inevitable habitat destruction in the servitude. Given the rapid rate at which natural grassland in the Mpumalanga highveld is disappearing, this could be a valuable contribution towards the conservation of this very scarce natural resource, and would benefit at least the smaller grassland species currently (and potentially) occurring there. See also the proposed mitigation measures as detailed in the Ecological Impact Study which is being undertaken as part of this EIA process. As far as the construction of the 88kV line is concerned, all construction and maintenance activities should be undertaken in accordance with Eskom environmental best practice standards ((see in this respect the Eskom Environmental Procedure, EPC 32-96. All vehicle and pedestrian movement should be restricted to the actual construction site and, in the case of maintenance patrols, to the actual servitude.

Electrocutions: The electrical infrastructure associated with the railway line will pose a low risk of electrocution, but the possibility can not be entirely excluded as far as the 11kV structures are concerned. It is therefore recommended that the phase conductor is insulated for a distance of one metre on either side of the insulator for all three phase conductors to prevent any risk of phase-earth electrocution for species such as African Grass-owl, Marsh Owl, Barn Owl, Spotted Eagle-Owl and Black-shouldered Kite.

1 Background

1.1 Project background

The proposed Kusile railway line project entails the construction of a railway line and associated infrastructure, for the transportation of sorbent from a commercial source north of Pretoria, and it comes off from the existing Pretoria-Witbank railway line, two kilometres north of the N4 highway, to Kusile Power Station, situated west of eMalahleni (Witbank) in Mpumalanga.

The anticipated supplementary infrastructure includes:

- Electricity supply for both the construction and operational phases. This will entail construction of an 88kV or 132kV sub-transmission line as well as an 11kV power supply on top of the Overhead Traction Equipment (OHTE) mast.
- Sub-station(s);
- Maintenance road;
- Shunting yard; and
- Communication mast.

According to South African National Environmental Management Act 107 of 1998, regulations R387, an Environmental Impact Assessment (EIA) must be carried out in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA) EIA Regulations Government Notice R 387 – "the construction of a railway line". Zitholele Consulting, an independent consulting firm, was appointed to conduct the necessary EIA process on behalf of Eskom Holdings Ltd. The study area and proposed corridors are depicted in figure 1 below.

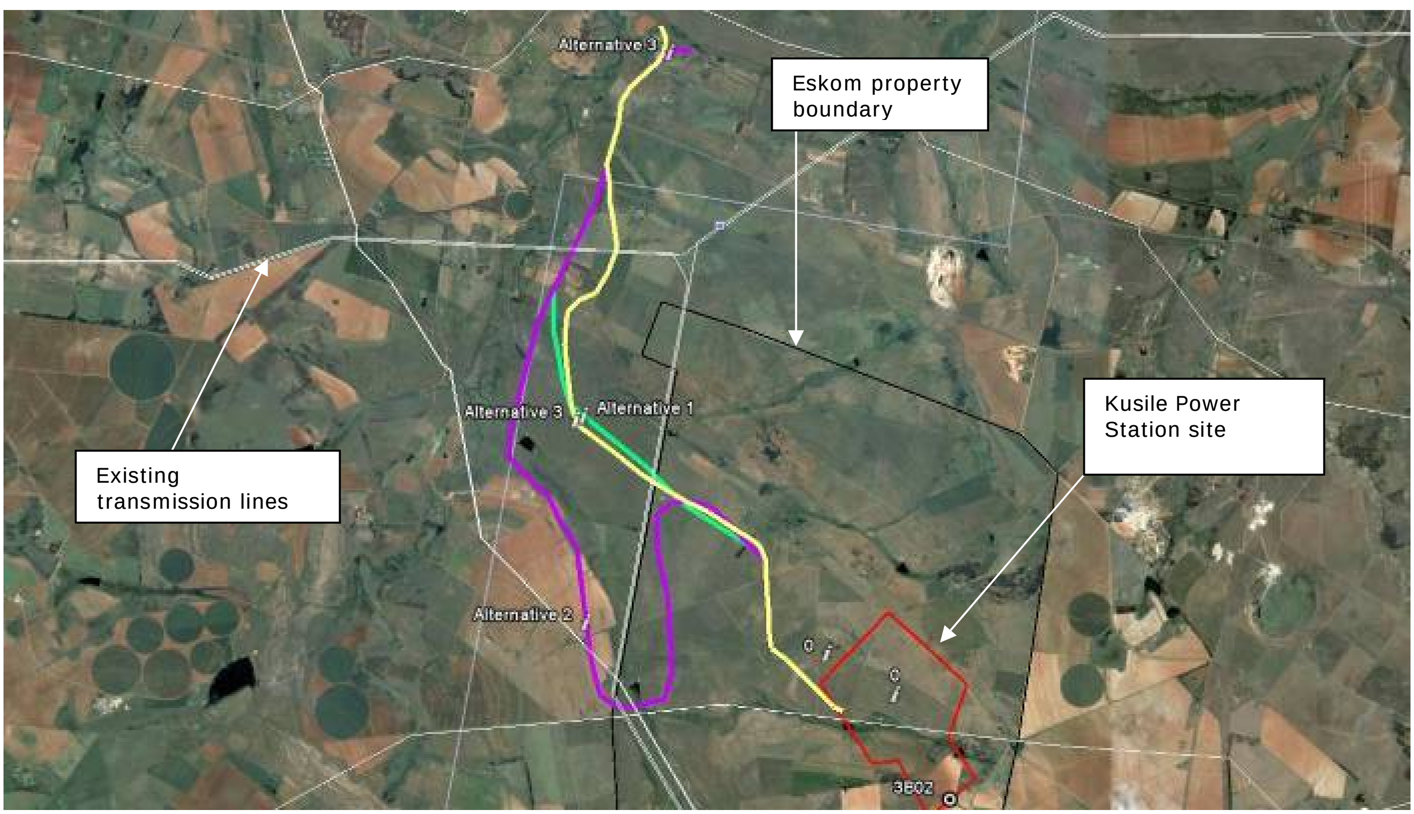


Figure 1: Study area with alternative railway corridors.

1.2 Scope of work

The brief for the report was as follows:
- provide a description of the study area pertaining to the specialist study;
- identify concerns and potential impacts;
- highlight sensitive and possible 'no-go' areas;
- identify a preferred alignment;
- provide an evaluation of the envisaged impacts on sensitive avifauna and
- suggest mitigation measures to reduce the impacts where necessary.

1.3 Description of potential impacts of railway lines and associated power lines on birds

The potential impacts that the proposed development could have on bird life in the study area can be grouped as follows:

- Electrocution on the electrical infrastructure of the railway line;
- Collisions with the associated power lines;
- Collisions with the moving train;
- Disturbance due to the construction of the railway line and the operation of the train;
- Habitat destruction through the construction of the railway line and associated infrastructure.

1.3.1 Electrocutions

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 Ssouthern 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, Anderson 2001). Other problems are electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure (Van Rooyen *et.al*. 2002), and disturbance and habitat destruction during construction and maintenance activities.

Large birds of prey are the most commonly electrocuted on power lines. The large transmission lines 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 the potentially lethal conductors. In fact, these power lines have proved to be beneficial to birds such as Martial Eagles *Polemaetus bellicosus*, Tawny Eagles *Aquila rapax*, White-backed Vultures *Gyps africanus*, and even occasionally Verreaux's Eagles *Aquila verreauxii* by providing safe nesting and roosting sites in areas where suitable natural alternatives are scarce (pers.obs). Cape Vultures *Gyps coprotheres* have also taken to roosting on power lines in certain areas in large numbers, while Lappet-faced Vultures *Torgos tracheliotis* are increasingly using power lines as roosts, especially in the Northern Cape (pers.obs.).

Unfortunately, the same can not be said of some of the smaller sub-transmission and reticulation lines of 11kV to 132kV, including designs associated with railway infrastructure (Van Rooyen 1998; 2000). Raptors and vultures instinctively seek out the highest vantage point as suitable perches from where they scan the surrounding area for prey or carrion. In flat, treeless habitats power pylons often provide ideal vantage points for this purpose. The vast majority of electrical structures were designed and constructed at a time when the awareness of the danger that they pose for raptors was very limited or totally absent. Depending on the design of the pole, a large raptor can potentially touch two live components or a live and earthed component simultaneously, almost inevitably resulting in instant electrocution and a concomitant disruption in the electrical supply (Van Rooyen 1998).

1.3.2 Collisions with the overhead lines

Anderson (2001) summarizes power line collisions as a source of avian mortality as follows:

"The collision of large terrestrial birds with the wires of utility structures, and especially power lines, 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 power line collisions is one of the factors which is responsible for these birds' present precarious conservation status.

Collisions with power lines 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 power lines 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 power lines 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 maneuverability (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 power line placement (lines that cross the flight paths of birds), power line configuration (the larger structures are more hazardous [for collisions, with electrocutions the opposite is the case]), 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 power line 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.

Unfortunately, many of the species that are collision sensitive are considered as threatened in Southern Africa. Of the five species most affected by transmission line collisions (Van Rooyen 2006) namely the Blue Crane, White Stork, Greater Flamingo *Phoenicopterus ruber*, Ludwig's Bustard and Cape Vulture, two are potentially present in this study area, namely the Blue Crane and the White Stork. It should be noted that these statistics are based on reported mortalities only; it has been proven that many mortalities go undetected (Bevanger 1999). In one instance, where bi-monthly monitoring did take place, a single 10km section of 132kV distribution line killed 59 Blue Cranes, 29 Ludwig's Bustard, and 13 White Storks during a three year period (EWT 2008). In 2004, fifty-four Blue Crane carcasses were discovered near Graaf-Reinet in the Northern Cape province under 3.7km of distribution line (EWT 2008).

The Red Data species that are vulnerable to power line collisions are often long-lived, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. A good example of this is the two flamingo species that occur in Southern Africa, which have hardly had any successful breeding attempts at Etosha Pan in Namibia for several decades. Another example is the Great White Pelican *Pelecanus onocrotalus* that only breeds successfully at Dassen Island in the Western Cape. These types of species (which include the Blue Crane, which is potentially present in the study area) have not evolved to cope with high adult mortality, with the results that consistent high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term. Many of the anthropogenic threats to these species are non-discriminatory as far as age is concerned (e.g. habitat destruction, poisonings, disturbance and power lines) and therefore contribute to adult mortality, and it is not known what the cumulative effect of these impacts could be over the long term.

From the figures quoted above, it is clear that power line collisions can be a major cause of avian mortality among power line sensitive species, especially Red Data species. Furthermore, the cumulative effects of power lines and other sources of unnatural mortality might only manifest itself decades later, when it might be too late to reverse the trend. It is therefore imperative to reduce any form of unnatural mortality in these species, regardless of how insignificant it might seem at present, especially in the case of regionally threatened species such as the Blue Crane in the present study area.

1.3.3 Habitat destruction

During the construction phase and maintenance of linear developments like railway and power lines, some habitat destruction and alteration inevitably takes place. This happens with the construction of service roads, and the clearing of servitudes. With power lines the 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 could have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude, through destruction of habitat. In this instance, a servitude with a minimum width of 31m will be totally transformed to accommodate the railway line and the service road. If, for example, the railway line and service road were to be constructed in a wetland, it could disrupt natural water flow patterns and impair the functioning of the wetland.

1.3.4 Disturbance

The noise and movement associated with construction activities and the noise of the train itself can potentially be highly disturbing to breeding birds. Many birds are highly susceptible to disturbance, and should this disturbance take place during a critical time in the breeding cycle, for example when the eggs have not hatched or just prior to the chick fledging, it could lead to temporary or permanent abandonment of the nest or premature fledging. In both instances, the consequences are almost invariably fatal for the eggs or the chicks. Such a sequence of events can have far reaching implications for certain large, rare species that only breed once a year or once every two years. Birds using the habitat adjacent to the transport corridor could be disturbed by construction activities and subsequent vehicle traffic along the corridor. However, some bird species can tolerate surprising high levels of disturbance if it is not coupled with intentional or unintentional harassment, for example bird collisions with aircrafts are a major safety risk on airports worldwide despite the continual noise and movement associated with large passenger jets. Bird will continue to forage undisturbed despite a large aircraft touching down within metres of them (pers. obs.). On the other hand, some species are exceptionally sensitive to disturbance and will readily abandon an area after the slightest disturbance. Blasting and rock drilling activities during the construction phase (if any), as well as the noise associated with the train, could have a long term impact on bird populations along certain sections of the route.

1.3.4 Collisions with the moving train

Mortality through collisions with fast moving vehicles is a common source of mortality among birds. Fences, fence posts and utility poles are common features of rural landscapes and are used extensively as perches for still-hunting by both diurnal and nocturnal raptors. The proximity of these perches to transport corridors is probably a further benefit as vehicles tend to flush rodents and insect prey. The corridors also create open areas for rodents and insects to cross, which deprive them of the necessary cover and makes them vulnerable to predation. All these factors combine to draw birds into the servitude and make them vulnerable to collisions with moving vehicles (Harrison *et.al.* 2002). For example, on a 30km stretch of highway near Nigel in Gauteng, 75 owls (mostly Barn Owls *Tyto alba* and Grass Owls *Tyto capensis*) were killed by traffic in a period of one month in 2002 (Raptor Conservation Group unp. data.). Judging from personal observation it seems that the birds are blinded by the headlights of an oncoming vehicle and adopt a freeze response, with fatal consequences. It is important to note that the railway in this instance is designed to operate at a maximum speed of 70km/h, which is considerably less than what vehicles usually travel on a highway.

Although most avian fatalities caused by vehicles occur on roadways, avian collisions also occur with trains (Spencer 1965) and airplanes. It is likely that train collisions also result in several thousand bird deaths annually in the United States (NWWC 2001).

1.4 Bird habitats in the study area

The study area falls in the following quarter degree square (1:50 000 map unit):

- 2528DD

Table 1 below indicates how the quarter degree square is divided in vegetation types, according to the classification of Harrison *et al* (1997) in the Atlas of Southern African Birds (the Bird Atlas). It is widely accepted that vegetation structure, rather than the actual plant species, influences bird species' distribution and abundance. Therefore, the vegetation description used in the Bird Atlas does not focus on lists of plant species, but rather on factors which are relevant to bird distribution. It is important to note that no new boundaries were created and use was made only of previously published data.

Table 1: Vegetation types in the study area (Harrison *et al* 1997)

Name	Sour Grasslands	Moist Woodland
2528DD	95%	5%

The dominant plants in the grassland 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 generally preclude the growth of trees and shrubs. This biome has been largely transformed through various land uses such as forestry and crop cultivation (Harrison *et al* 1997). Sour grassland generally occurs in the higher rainfall areas on leached soils and forms the dominant vegetation type in the study area. Many grassland bird species show a preference for sour grassland over sweet or mixed grasslands. The grassland biome is very important from a Red Data perspective, as it is the preferred habitat of several grassland "specialists" birds (see discussion of Grassland below). It has also been transformed to a large degree by intensive cultivation, which has placed it (and the species dependant on it) under severe pressure.

Woodland (or savanna) also occurs in the study area (marginally due to extensive clearing of woodland for agriculture) and it is defined as having a grassy under-storey and a distinct woody upper-storey of trees and tall shrubs (Harrison *et al.* 1997). Moist woodland comprises predominantly broadleaved, winter deciduous woodland. Soil types are varied but are generally nutrient poor. Savanna is relatively well conserved compared to grassland and contains a large variety of bird species (it is the most species-rich community in Ssouthern Africa) although very few bird species are restricted to this biome. The biome is particularly rich in large raptors, and forms the stronghold of Red Data species such as White-backed Vulture *Gyps africanus*, Martial Eagle *Polemaetus bellicosus*, Tawny Eagle *Aquila rapax*, and Lappet-faced Vulture *Torgos tracheliotis*. Apart from Red Data species, it also serves as the stronghold of several non-Red Data raptor species, such as the Brown Snake-Eagle *Circaetus cinereus*, Black-chested Snake-Eagle *Circaetus pectoralis*, and a multitude of medium-sized raptors for example the migratory Steppe Buzzard *Buteo vulpinus*, African Harrier- Hawk (Gymnogene) *Polyboroides typus*, Wahlberg's Eagle *Aquila wahlbergi* and African Hawk-Eagle *Aquila spilogaster*. Apart from raptors, woodland in its undisturbed state is suitable for a wide range of other power line sensitive birds, including the Kori Bustard *Ardeotis kori*.

In the study area natural woodland is virtually non-existent. The majority of the "woodland" in the area consists of invader species, particularly Eucalyptus and Australian *Acacia* species, of which substantial pockets are evident. Generally, the original woodland has been cleared to make way for agricultural activity and the absence of woodland in the study area is reflected in the bird species composition, with very few typical woodland species having been recorded in the study area during the Atlas period. Woodland species that may be attracted to the copses of alien trees in the study area are mainly raptors such as Black Sparrowhawk *Accipiter melanoleucus*, Ovambo Sparrowhawk *Accipiter ovampensis* and African Harrier-hawk *Polyboroides typus*.

Although much of the distribution and location of bird species within the study area can be explained by vegetation as discussed briefly above, it is necessary to look more closely at the smaller habitat niches available to birds, namely the microhabitats, in order to determine where the relevant species will most likely occur within the study area. These microhabitats do not always correspond to vegetation types and are determined by a combination of vegetation type, topography, land use, food sources and other factors.

The following distinct bird microhabitats were identified in the study area during the field visit in September 2009 (see **APPENDIX A** for examples of the microhabitats):

- Wetlands and dams: This habitat is represented in the study area by several man-made impoundments (dams), three of which occur in the immediate study area, as well as a few watercourses. The most important watercourse in the study area is the Wilge River and its tributaries. Amongst large terrestrial birds it is especially the three cranes species that depend on shallow, vegetated wetlands that are unpolluted and not excessively disturbed by live-stock and fire. The data from the Co-ordinated Road Count project (CAR) of the Avian Demography Unit shows that the wetlands in the Mpumalanga highveld are extensively used by Spurwing Goose *Plectropterus gambensis*, Black-headed Heron A*rdea melanocephala* and Grey Crowned Crane *Balearica regulorum*. Grey Crowned Cranes do not occur in the area anymore (Harrison *et.al.* 1997), not only because of habitat modification, but also because of disturbance and the proliferation of power lines which no doubt have taken their toll on birds over the years. The previous statement is admittedly speculative, but the sensitivity of cranes to human activity has been proven (Morrison 1998), as well as their vulnerability to power line collisions (Van Rooyen 2006). However, the dams, wetlands and associated floodplains in the study area are still suitable for other Red Data species such as African Marsh-harriers *Circus ranivorus* and African Grass-owl *Tyto capensis*. Non-threatened species that may from time to time occur on the wetlands, especially in quiet secluded areas of the dams in the study area, include Little Bittern *Ixobrychus minutus*, White-backed Duck *Thalassornis leuconotus*, African Rail *Rallus caerulescens*, Red-chested Flufftail *Sarothrura rufa*, Black Crake *Amaurornis flavirostris*, Common Moorhen *Gallinula chloropus*, African Purple Swamphen *Porphyrio madagascariensis*, Green-backed Heron *Butorides striata*, and various kingfishers (Marais & Peacock 2008). Open water may attract grebes, cormorants, darters and various species of ducks, as swell as Red-knobbed Coot *Fulica cristata*. Areas with reeds, sedges or grassy tangles are suitable for Orange-breasted Waxbill *Amandava subflava* and Common Waxbills *Estrilda astrild* and various warblers (Marais & Peacock 2008).

- Agriculture: Parts of the study area has been extensively transformed through dryland cultivation. The farm land in the study area is used for a variety of mixed farming practices. Grazing is developed in parallel with crop farming. The Mpumalanga highveld has summer rainfall; therefore intensive crop farming is practiced on a wide scale. Some of the maize lands are bordered by tracts of grassland ideal for grazing. Extensive areas stand under stubble during the winter and provide alternative grazing (Young *et.al.* 2003). Data from the CAR project indicates that agricultural land is used to a limited extent by large terrestrial birds in the Mpumalanga highveld (and presumably also in the similar eastern Gauteng highveld), as they prefer natural grassland. Fallow fields are used to a limited extent by Blue Cranes in summer, and pastures are used by Southern Bald Ibis *Geronticus calvus* (not recorded in the study area). Blue Cranes also use recently ploughed fields in winter (Young *et.al.* 2003). Indications are that Blue Korhaan *Eupodotis caerulescens* may also utilise agricultural fields to a limited extent (Young *et.al* 2003). A Red Data species that could also occur in this habitat from time to time is the Black-winged Partincole *Glareola nordmanni*. Overall though, agricultural lands are not as important for birds in the study area as natural grassland.
- Grassland: Large areas of untransformed natural grassland have remained in the study area, as well as abandoned lands that have reverted back to grassland. The CAR data indicate that natural grassland remains the preferred habitat of large terrestrial birds in the Mpumalanga highveld (Young *et.al*. 2003), and one can safely assume the same for similar habitat in Gauteng. Generally reporting rates for large terrestrial grassland species such as Blue Crane are low, which could be the result of the extensive fragmentation of natural grassland by agriculture, opencast mining and associated infrastructure, particularly power lines and roads. On the other hand, several typical grassland species were recorded in 2528DD by the Atlas Project, including White-bellied Korhaan *Eupodotis senegalensis*, Blue Korhaan *Eupodotis caerulescens,* Secretarybird *Sagittarius serpentarius* and Lesser Kestrel *Falco naumanni*. In 2008, a pair of Blue Cranes was recorded in natural grassland near the Kusile Power Station site, as well as Secretarybirds and White-bellied Korhaans (Konrad Kruger pers. comm.) Sadly, one of the Blue Cranes was found dead under a power line during a subsequent visit (Konrad Kruger pers.comm). It is important to note that while no records of African Grass-owl *Tyto capensis* were made by the Atlas project, the habitat at the site is very suitable for this species (as well as the non-threatened Marsh Owl *Asio capensis*) and it almost definitely occur in tall grassland patches on the fringes of wetlands and in shorter grass (40-50cm) in association with dried sedges (*Cyperus* sp.) which forms an impenetrable thicket which provide enough substrate for the African Grass-owls' characteristic "tunnels". Another Red Data species that could conceivably occur in the study area in the wetland habitat along the Wilge River is the African Marsh-harrier *Circus ranivorus*. Non-threatened species that may from time to time frequent the grassland habitat in the study area are Swainson's Spurfowl *Pternistis swainsonii*, African Pipit *Anthus cinnamomeus*, Cape Longclaw *Macronyx capensis*, Yellow-crowned Bishop *Euplectes afer*, several cisticola species, Rufous-naped Lark *Mirafra africana*, Spike-heeled Lark *Chersomanes albofasciata,* Long-tailed Widowbird *Euplectes progne* and Black-shouldered Kite *Elanus caeruleus* (Marais & Peacock 2008).

2 Sensitive bird species

Generally speaking, it is unavoidable that birds get killed through interaction with industrial infrastructure, including railway and 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 significance, in order to achieve maximum results with the available resources at hand.

In accordance with this principle, the risk assessment is primarily aimed at assessing the potential threat to Red Data species (see the concept of biological significance under 1.3.2). It is important to note though, that any proposed mitigation measures aimed at mitigation impacts on Red Data species will also benefit the non-threatened species.

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

- The Bird Atlas (Harrison *et.al.* 1997) species list for the relevant quarter degree square within which the study area is located was obtained from the South African National Biodiversity Institute (SANBI) website (http://www.birds.sanbi.org). This information was supplemented with information from the CAR Project, as well as other relevant literature.
- The study area was inspected with a vehicle and on foot to obtain first-hand perspectives of the proposed alternative routes, birdlife and bird habitats.
- High resolution Google Earth satellite imagery was used to delineate the different sensitivity zones in the study area for purposes of rating the different corridor options.
- The impacts were evaluated on the basis of experience by the author in gathering and analysing data on wildlife impacts with linear infrastructure throughout southern Africa since 1996 (see van Rooyen & Ledger 1999 for an overview of methodology), supplemented with first hand data obtained during the field visits.

The Red Data bird species that were recorded by the Bird Atlas project in the relevant quarter degree square is listed in Table 2 below. The square was not very well surveyed during the Bird Atlas period with only 47 cards completed – which may account for the somewhat inexplicable absence of species such as African Grass-owl and African Marsh-harrier, despite the presence of suitable habitat for both species. The reporting rates are an indication of densities on the ground – the number in the reporting rate column in Table 2 below represents the percentage of cards on which a species was recorded. With a few exceptions the reporting rates for Red Data species were generally low, indicating that the impacts on the habitat have been extensive, reducing many of the species to the status of vagrants, but this could also be partially due to inadequate coverage of the square.

Table 2: Red Data species recorded in 2528DD (Harrison *et.al* 1997)

Species	**Reporting rate %**	**Conservation status (Barnes 2000)**	**Habitat requirements (Barnes 2000; Hockey *et al* 2005; Harrison *et al* 1997; Young *et al* 2003; personal observations)**
BLUE KORHAAN *Eupodotis caerulescens*	2.1	near threatened	Grasslands, pastures and cultivated fields. **Vulnerable to power line collisions and disturbance**. Potentially vulnerable to railway line collisions due to its terrestrial nature.
BLACK-WINGED PRATINCOLE *Glareola nordmanni*	2.1	near threatened	Agricultural landscapes, ploughed lands. No interactions expected.

MELODIOUS LARK *Mirafra cheniana*	2.1	near threatened	Open climax *Themeda* grassland, pastures and fallow lands. **Vulnerable to habitat destruction and disturbance.**
SECRETARYBIRD *Sagittarius serpentarius*	4.3	near threatened	Prefer open grassland, densities low in maize growing areas. **Vulnerable to power line collisions**.
WHITE-BELLIED KORHAAN *Eupodotis senegalensis*	4.3	vulnerable	Often in the interface between grassland and savanna. Avoids severely grazed and recently burnt sites. Was recorded near Kusile Power Station site during field visits in 2008. **Vulnerable to power line collisions and disturbance**. Potentially vulnerable to railway line collisions due to its terrestrial nature.
LESSER KESTREL *Falco naumanni*	10.6	vulnerable	**No negative impacts expected from power line.** Small and nimble species, likely to use the power line as hunting perch.
BLUE CRANE *Anthropoides paradiseus*	6.4	vulnerable	Low reporting rate but can from time to time be present in the remaining grassland and wetlands. Was recorded near the Kusile Power Station site during field visits in 2008. **Vulnerable to power line collisions and disturbance**.

3 Discussion and evaluation of impacts

3.1 Electrocutions

Three power lines will be constructed. Two will be 88kV (or possibly 132kV). These power lines will be constructed on single steel pole structures (see figure 4 below). The other power supply will be an 11kV cross-arm arrangement on the OHTE mast (see figure 5). It is proposed that two new 88kV power lines be constructed that feed off of an existing 88kV power line towards two new substations which are proposed to be constructed adjacent to the railway track within the railway corridor.

Each of the three railway corridor alternatives would require two 88kV power lines and two substations (one located near Kusile Power Station and one half way between the Kusile Power Station and the existing Pretoria – Witbank railway) to electrify the railway. Therefore in addition to assessing the three railway alternative corridors, two power line corridors alternatives for each proposed power line are also being assessed (see figures 2 and 3 below).

3.1.1 88kV Power Line Corridor A

Power line corridor A is located approximately halfway between the Kusile Power Station construction site and the existing Pretoria – Witbank railway.

88kV Power Line – Alternative A-(a)

Alternative A-(a) starts at the existing 88kV power line and heads in a north easterly direction. The length of the alternative is dependent on which alternative railway corridor is approved, that is:

- Railway Alternative Corridor 1: The length of the proposed 88kV power line would be **1.68 km's** long.
- Railway Alternative Corridor 2: The length of the proposed 88kV power line would be **1.3 km's** long.
- Railway Alternative Corridor 3: The length of the proposed 88kV power line would be **1.92 km's** long.

This alternative crosses the Wilge River three times and an unnamed tributary once (four river crossings).

88kV Power Line – Alternative A-(b)

Alternative A-(b) also starts at the existing 88kV power line, however it starts approximately 240 metres south of alternative A-(a) and heads in a north easterly direction parallel to alternative A-(a). The length of the alternative is dependent on which alternative railway corridor is approved, that is:

- Railway Alternative Corridor 1: The length of the proposed 88kV power line would be **1.68 km's** long.
- Railway Alternative Corridor 2: The length of the proposed 88kV power line would be **1.17 km's** long.
- Railway Alternative Corridor 3: The length of the proposed 88kV power line would be **1.82 km's** long.

This alternative crosses the Wilge River once, the Klipfonteinspruit once and an unnamed tributary once (three river crossings).

3.1.2 88kV Power Line Corridor B

Power Line corridor B is located approximately to the immediate west of the Kusile Power Station construction site.

88kV Power Line – Alternative B-(a)

Alternative B-(a) starts at the existing 88kV power line and heads in a north easterly direction. The length of this alternative is not dependent on which alternative railway corridor is approved, as all three railway corridor alternatives merge towards the Kusile power station construction site. Therefore the length of this alternative is 2.37 km's.

This alternative crosses the Wilge River once and an unnamed tributary once.

88kV Power Line – Alternative B-(b)

Alternative B-(b) starts at the existing 88kV power line approximately 240 metres south of alternative B-(a) and heads in a north easterly direction parallel to alternative B(a). The length of this alternative is also not dependent on which alternative railway corridor is approved, for the same reason as alternative B- (a). This alternative is the same length as alternative B- (a) that is 2.37 km's and has the same river crossings as alternative B-(b).

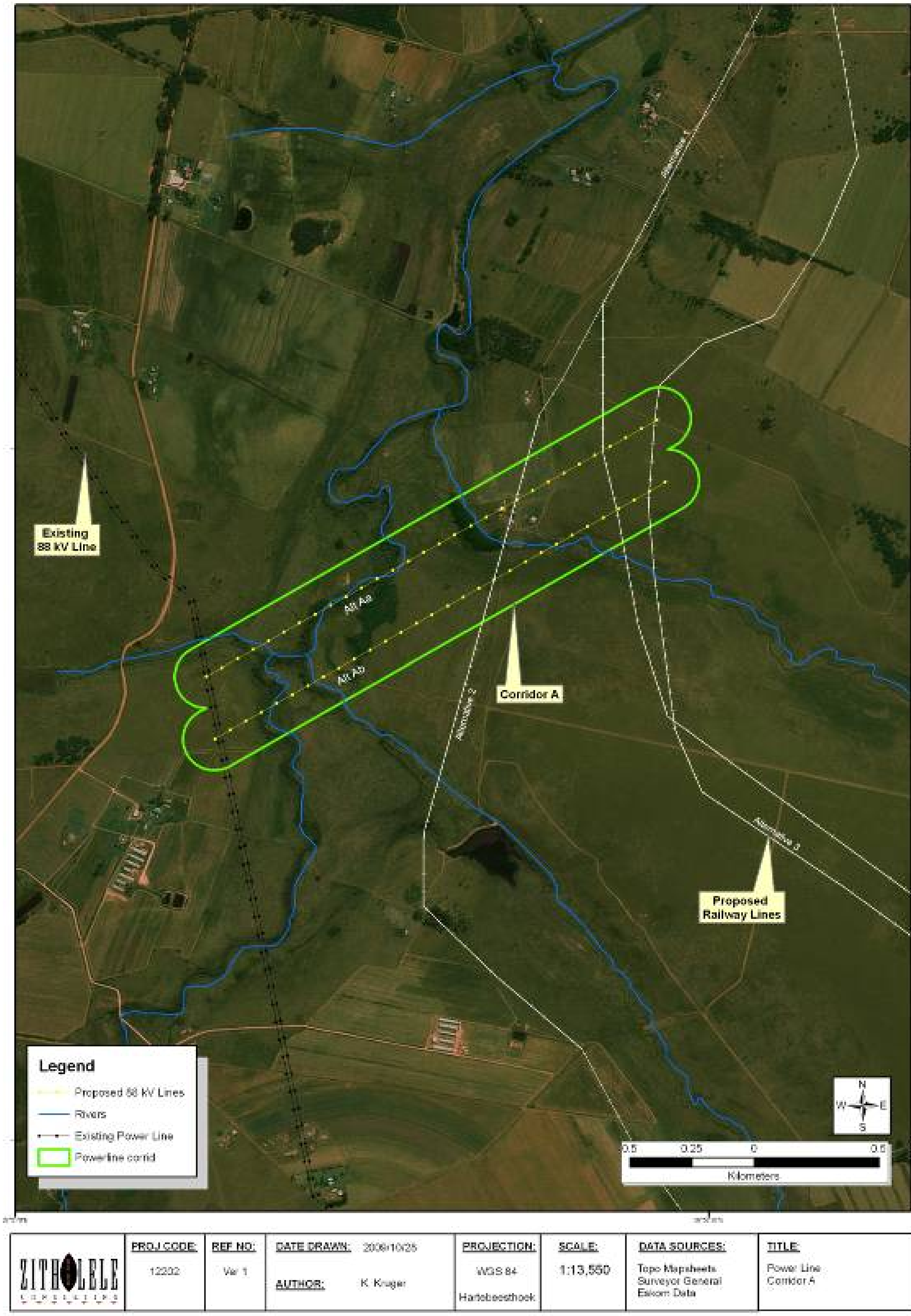


Figure 2: 88kV Power Line Corridor A

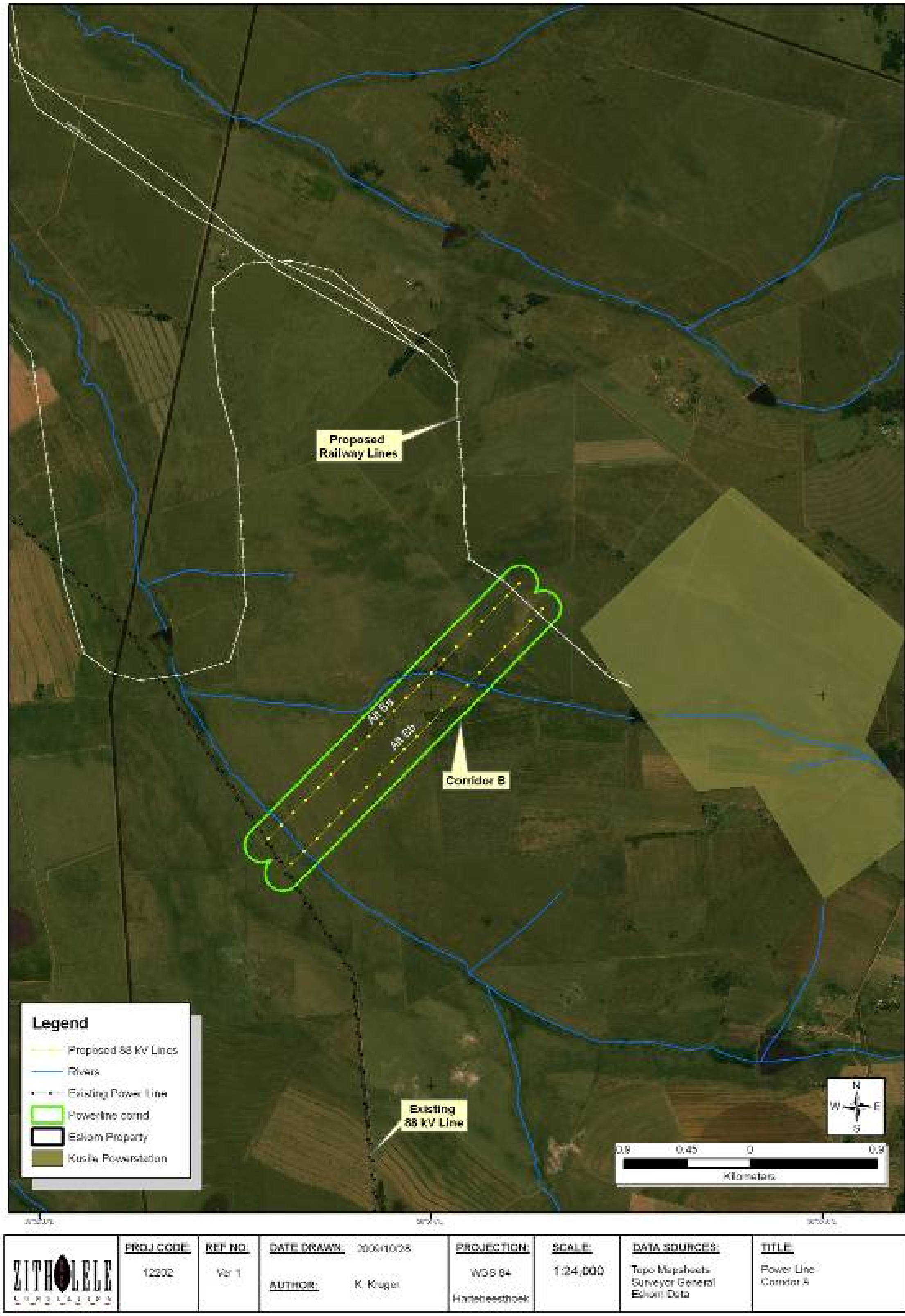


Figure 3: 88kV Power Line Corridor B

Figure 4: Single steel pole 88/132kV sub-transmission structure

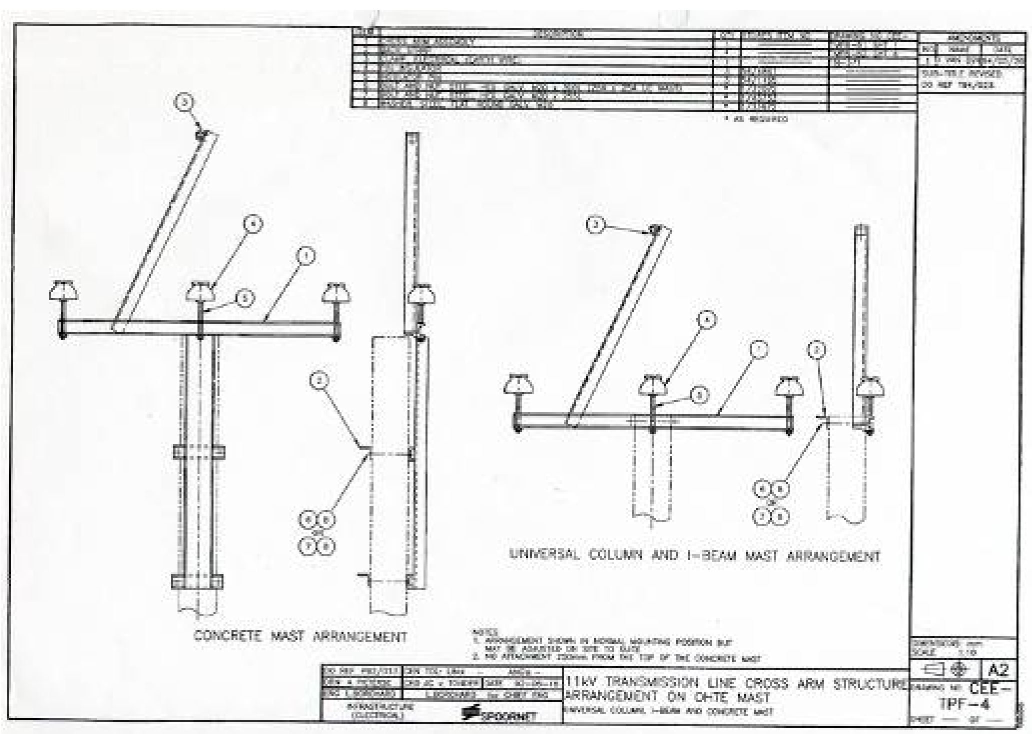


Figure 5: 11kV transmission line cross-arm structure on OHTE mast

The 88kV steel pole structure is not regarded as a high electrocution risk for birds. The only recorded avian electrocutions on this type of structure are Cape Vultures (not recorded in the study area), where several of these large birds attempted to perch together on the insulators (EWT 2008). Due to their large size and massive wingspans of up to 2.5m, they can bridge the distance between the live conductor and the earthed steel pole when attempting to perch on an insulator. None of the species that are likely to occur at the study area and perch on these poles should be at risk of electrocution e.g. Barn Owl *Tyto alba*, Spotted Eagle Owl *Bubo africanus* and Black-shouldered Kite *Elanus caeruleus*, as they will not be able to bridge the critical clearances between phase and earth. One possible exception is the Spur-winged Goose *Plectropterus gambensis*, but the existing transmission structures that run through the study area are likely to offer a more comfortable and therefore preferred perch to them.

The 11kV structures on the OTHE pose a more significant electrocution risk. The clearances on these structures are small and can be bridged by a medium-sized bird that perches on the steel cross-arm next to an insulator carrying a phase conductor, which could result in a phase-earth short circuit if the bird bridges the air gap between the phase conductor and the earthed cross-arm. Birds such as Barn Owls, Marsh Owls and Black-shouldered Kite may be tempted to perch on these structures to prey on rodents and other prey items in the servitude, and Pied Crows might also use these structures as look-outs to scavenge for train kills. All of these species might be exposed to phase-earth electrocution. One mitigating factor is the presence of the steel beam that supports the earth wire. Birds often prefer to perch on the highest point on a structure, and it is likely that the majority of birds will elect to perch on this beam or the earth wire itself, rather than on the cross-arm. Personal observations of birds using these structures tend to support this view.

In summary it can be concluded that the electrical infrastructure associated with the railway line will pose a low risk of electrocution, but that the possibility can not be entirely excluded as far as the 11kV structures are concerned.

3.2 Collisions

Bird collisions with the earth wire of the proposed 88kV line are a potential risk. This impact will most likely occur close to wetlands, where the line skirts a dam, where it crosses a drainage line or a flight path between dams, and in areas of natural grassland.

Species at risk of power line collisions are water birds of several species, particularly certain duck species, as they often fly in dim light conditions before dawn or after sunset (pers. obs). There are substantial numbers of non Red Data power line sensitive species that may occur in the study area due to the presence of dams and wetlands in the study area. Examples of birds that may be at risk of collisions are Little Grebe *Tachybaptus ruficollis* , cormorants, Red-billed Teal *Anas erythrorhyncha* and Southern Pochard *Netta erythrophthalma* Red-knobbed Coot *Fulica cristata*, Reed Cormorant *Phalacrocorax africanus*, Egyptian Goose *Alopochen aegyptiaca*, White-breasted Cormorant *Phalacrocorax lucidus*, Black-headed Heron *Ardea melanocephala*, Grey Heron *Ardea cinerea* and Yellow-billed Duck *Anas undulate*. These species (and many other non Red Data ducks, herons and waders) run the risk of collision with the proposed power 88 kV line. In addition, the chances of the occasional Blue Crane roosting in one of the dams cannot be excluded, which will put it at risk of collision if a power line is routed close to the dam.

Collision hazards also exist where the power line will cross natural grassland, as this is the preferred habitat of most of the remaining large terrestrial Red Data species, including the Blue Crane, Blue Korhaan, White-bellied Korhaan and Secretarybird in the Mpumalanga highveld. As mentioned earlier, the impacts on grassland and wetlands in the Mpumalanga highveld as a region have been severe, reducing most Red Data, large terrestrial species to vagrants. The dense grid of existing power lines that covers the whole of the Mpumalanga highveld may well have been a death trap for cranes, and the impact of these lines on the remaining Blue Cranes in the area can not be ascertained, but must almost certainly have been negative (see the discussion under 1.4 above). Large areas of what seems to be suitable grassland remain the study area, yet no cranes were observed. Given the extreme vulnerability of cranes to power lines, it is very likely that the power lines may have effectively sterilized large areas for these birds.

Collisions with the moving train could be a potential source of mortality too. Species at risk here are likely to be mostly owls (if the train operates at night, or at dawn or dusk), particularly the threatened African Grass-owl, as well as other, non-threatened species such as Spotted Eagle-Owl, Barn Owl and Marsh Owl. Owls are particularly vulnerable to nocturnal traffic – in a study conducted by Ansara (2004) a total of 554 owl mortalities were recorded on a 30km stretch of the N17 road on the eastern Gauteng highveld near Springs. The study's results showed an average casualty rate of 9.2 owls per year and consisted of the four species mentioned above, with the African Grass-owl being the second most recorded. One mitigating factor that will help to reduce the potential for collisions with the train, is the speed that the train will be traveling at. Ansara found that highway mortalities are directly proportional to the status of the road and therefore the speed of the traffic. However, the train was designed to operate at 70km/h. This is a considerably less than the average speed that motorists are driving on a busy highway, and should afford the birds more chance to take evasive action.

3.3 Habitat destruction

A degree of habitat destruction always exists when a linear infrastructure is constructed. In this instance, although sections of the study area have already been intensively transformed through agriculture, there are wetlands and large areas of natural grassland in the study area that could be damaged (or further damaged) in the course of construction activities, which could in turn impact on birds using these habitats. An example of Red Data species that could be impacted through the destruction of habitat is the African Grass-Owl, which is dependent on rank grassland on the fringes of wetlands, which might be damaged if the railway line and associated service road are constructed in this habitat. During the field visit, several areas of suitable habitat for this species were identified, mostly along drainage lines. The construction of the railway line and service road will also contribute to the fragmentation of the remaining natural grassland, which has negative implications for especially the larger species (e.g. White-bellied Korhaan) with larger territorial requirements. The footprint of the two substations that are planned is about 65m by 30m (just under 20 hectares each), and could, depending on where they will be situated, constitute an additional impact on the natural grassland habitat.

3.4 Disturbance

Disturbance of breeding birds in the natural grassland during construction operations and the operation of the railway line and associated infrastructure through the noise created by the train, is a distinct possibility. This could have an impact on Red Data species such as Blue Crane (should they still occur there – see discussion under 1.4 Bird Habitats in the study area), Blue Korhaan, White-bellied Korhaan and Melodious Lark. Such disturbance would be most harmful in summer which is the breeding season for the majority of birds. It is widely acknowledged that there is need to assess the influence of noise on animals, but overall, there has been relatively limited research undertaken in these fields; and the scientific evidence addressing the issue of human noise and wildlife is still rather meagre. In some cases one can observe, in others postulate, that the noise has the potential to cause injury, energy loss through movement away from noise source, decrease in food intake, habitat avoidance and abandonment, and reproductive loss. If birds are flushed by noise, eggs can be broken and young exposed to injury and predators. Very few studies in this field have designed experiments with a level of precision that can identify a threshold stimulus below which the target animal is unlikely to experience detrimental effects. Habituation to noise could enable animals to increase tolerance but, as with humans, anecdotal evidence of habituation is inadequate, and will need to be tested by appropriate studies. The influence of habituation, and overall tolerance to acoustic disturbance, are areas that require further investigation. There is still an absence of understanding how observed behavioral and physiological effects translate into ecological consequences for wildlife. One study that attempted to measure the effect of railway noise on birds is that of Waterman *et.al* (2004). In order to determine whether there is a disturbance factor, and in order to quantify the disturbance, the presence of 11 meadow bird species have been counted in 15 study areas near railroads in the Netherlands. A statistical relation has been developed between the noise load and the presence of birds. Some species appeared to be sensitive to the noise load. Quieter railway lines are showing fewer disturbances for these species than busier railway lines. The threshold noise level from which densities were affected varied little between species: Black-tailed Godwit *Limosa limosa* 45 dB(A), Skylark *Alauda arvensis* 42 dB(A) and Garganey *Anas querquedula* 49 dB(A). The uncertainty of these threshold levels are large, i.e. for Black-tailed Godwit the 90% confidence limits range from 30 to 57 dB(A). The eight other bird species studied, however, did not show a significant effect of the presence of the railway and its noise load (Waterman *et.al* 2004).

In the present study area, it can be reasonably inferred that sensitive species such as White-bellied Korhaan and Blue Crane (in the event of the latter still occurring there from time to time) will be affected by the noise (and the movement) of the train, whereas others, such as Black-shouldered Kite, Spotted Eagle Owl and Black-headed Heron will most likely habituate quickly to the noise of the train, given the fact that they are often observed foraging next to busy highways. It is a known fact that White-bellied Korhaan requires areas of suitable habitat well away from anthropogenic activities (high human densities). The White-bellied Korhaan is extremely sensitive to human intrusion and will promptly vacate areas when humans are detected, and may often flush away from human intrusion at distances of up to 1 km measured between the Korhaan individuals and the observer (Niemand 2009). Likewise, Morrison (1998) found that the probability of finding Blue Crane nests decrease as the number of roads in an area increase. She further found that Blue Cranes actively avoided tar and gravel roads, houses and areas of agricultural activity when selecting a nest site. It can therefore be postulated that the regular presence of railway traffic will most likely serve as a deterrent to the species.

3.5 Evaluation of impacts

An evaluation of the potential impacts on avifauna was conducted according to a set of criteria provided by Zitholele Consulting to the author as part of the sub consultant agreement. Details of the assessment methodology are available from Zitholele Consulting. Table 3 below provides a summary of the impacts describing the impact, significance, spatial scale, temporal scale, probability and rating.

Table 3: Impact rating table

Impact	**Significance**	**Spatial scale**	**Temporal scale**	**Probability**	**Rating**
Electrocutions	LOW	*Local*	Medium term	*Could happen*	
	2	***3***	**3**	***3***	**1.6**
Collisions with the 88kV power line	Moderate	*Local*	Medium term	*Could happen*	
	3	***3***	**3**	***3***	**1.8**
Collisions with the moving train	LOW	*Local*	Medium term	*Could happen*	
	2	***3***	**3**	***3***	**1.6**
Disturbance	HIGH	*Local*	Medium term	*Very likely*	
	4	***3***	**3**	***4***	**2.6**
Habitat destruction	HIGH	*Regional*	Permanent	*It is going to happen*	
	4	***4***	**5**	***5***	**4.3**

The impact risk is classified according to 5 classes as described in the table below.

Table 4: Impact risk classes

Impact	Rating	Impact Class	Description
Electrocutions	1.6	2	Low
Collisions with the 88kV power line	1.8	2	Low
Collisions with the moving train	1.6	2	Low
Disturbance	2.6	3	Moderate
Habitat destruction	4.3	5	Very high

4 Identifying a preferred corridor

One of the objectives of this study is to arrive at a preferred corridor for the proposed railway route and associated infrastructure in terms of impacts on avifauna. In order to achieve this, a formula was designed to assist in the identification of a preferred corridor. The following factors were incorporated in the formula to arrive at a preferred corridor, using high resolution Google Earth satellite imagery as the main source of data:

- Wetlands and dams: Wetlands and dams are always of particular importance for birds. The presence of wetlands and dams are an indicator of a higher collision, habitat destruction and disturbance risk.
- Natural grassland: According to Young *et.al*. (2003) the large terrestrial birds on the Mpumalanga highveld favour natural grassland habitat in contrast to agricultural landscapes. Natural grassland was therefore taken as a higher collision, disturbance and habitat destruction risk. Old lands that have reverted back to grassland were included in this category.
- Agricultural activity: This was taken as a risk reducing factor as the habitat transformation from natural grassland to monoculture crops has largely resulted in the sterilisation of the habitat for many grassland species.

The factors mentioned above were incorporated into the formula to arrive at a risk rating for each potential corridor. The formula was implemented as follows:

- Wetlands and dams: The length of corridor running within 250m of a dam or wetland was measured.
- The length of corridor running across agricultural lands was measured.
- The length of corridor running across natural grassland was measured.

Table 5: The results of the measurements for each alternative **railway corridor** (in km)

Factor	Alternative 1	Alternative 2	Alternative 3
Dams and wetlands	0.84	4.36	1
Agricultural activity	4.19	5.07	4.16
Grassland	8.07	10.56	8.05

Obviously all these factors do not have an equal impact on the size of the risk, therefore a weighting from -5 to 5 was assigned to each factor, based on the author's judgment on how important the factor is within the total equation.

The weights that were assigned are tabled below. Risk reducing factors were assigned a negative weight.

Table 6: Weighting of risk reducing factors

Factor	**Weighting**
Dams and wetlands	3
Agriculture	-3
Grassland	4

The final risk score for a **factor** was calculated as follows: measurements/counts x weighting. The final risk rating for a **corridor** was calculated as the sum the risk scores of the individual factors:

Table 7: The final scores for the respective railway line options

Factor	Alternative 1	Alternative 2	Alternative 3
Dams and wetlands	2.52	13.08	3
Agriculture	-12.57	-15.21	-12.48
Grassland	32.28	42.24	32.2
Total	**22.23**	**40.11**	**22.72**

From the analysis above it is clear that Alternative **1** and **3** are the **preferred railway corridors** from a bird interaction perspective as they obtained virtually identical scores. Alternative **2** is the **least preferred** alternative i.e. it holds the greatest risk of impacts to birds. It must be noted though that all the proposed corridors score high as far as crossing natural grasslands is concerned, which is less than ideal from a bird impact perspective.

The same exercise was performed for the alternative **power line corridors**, in order to arrive at a preferred corridor from a potential bird impact perspective.

Table 8: The results of the measurements for each alternative **powerline corridor** (in km)

Factor	Alternative A – (a)	Alternative A – (b)	Alternative B – (a)	Alternative B – (b)
Dams and wetlands	0.55	0.63	0.82	0.38
Agricultural activity	0	0	0	0
Grassland	1.17	1.34	1.48	1.93

Table 9: The final scores for the respective power line options

Factor	Alternative A – (a)	Alternative A – (b)	Alternative B – (a)	Alternative B – (b)
Dams and wetlands	1.65	1.89	2.46	1.14
Agriculture	0	0	0	0
Grassland	5.85	6.7	7.4	9.65
Total	**7.5**	**8.59**	**9.86**	**10.79**

From the analysis above it is clear that Alternatives **A – (a)** and **A – (b)** are the **preferred corridors** from a bird interaction perspective. Alternative **B-(b)** is the **least preferred** alternative i.e. it holds the greatest risk of impacts to birds. It must be noted though that all the proposed corridors score quite high as far as crossing natural grasslands is concerned, which is less than ideal from a bird impact perspective.

5 Conclusions

- A number of sensitive, Red Data species could potentially occur along any of the alternative railway and power line corridors, mostly in the remaining natural grassland, as well as along the wetlands and dams formed by the Wilge River and its tributaries.
- Red Data species that could be impacted by the proposed railway line and associated infrastructure are Blue Crane, Blue Korhaan, White-bellied Korhaan and Secretarybird (habitat destruction, power line collisions and disturbance) and African Grass-owl (habitat destruction, electrocutions and collisions with the train).
- The proposed corridors run through very similar habitat, which means that the potential bird impacts are likely to be similar in nature (but not in extent) along all the proposed corridors.
- Ideally, from a bird impact perspective, the preferred corridor would be one that strives to avoid natural grassland or wetlands, or alternatively, is situated within the zone of influence of factors that lessen the risk of interactions, for example within agricultural lands. Unfortunately, all the proposed alternative railway line and power line corridors are largely situated in natural grassland, making none of them very desirable from a bird impact perspective.
- The impact of existing power lines may have been a major contributory factor to the perceived low density and/or absence of power line sensitive grassland species, especially Blue Cranes.

6 Recommendations

6.1 Electrocutions

The electrical infrastructure associated with the railway line will pose a low risk of electrocution, but the possibility cannot be entirely excluded as far as the 11kV structures are concerned. It is therefore recommended that the phase conductor is insulated for a distance of one metre on either side of the insulator for all three phase conductors to prevent any risk of phase-earth electrocution for species such as African Grass-owl, Marsh Owl, Barn Owl, Spotted Eagle-Owl and Black-shouldered Kite.

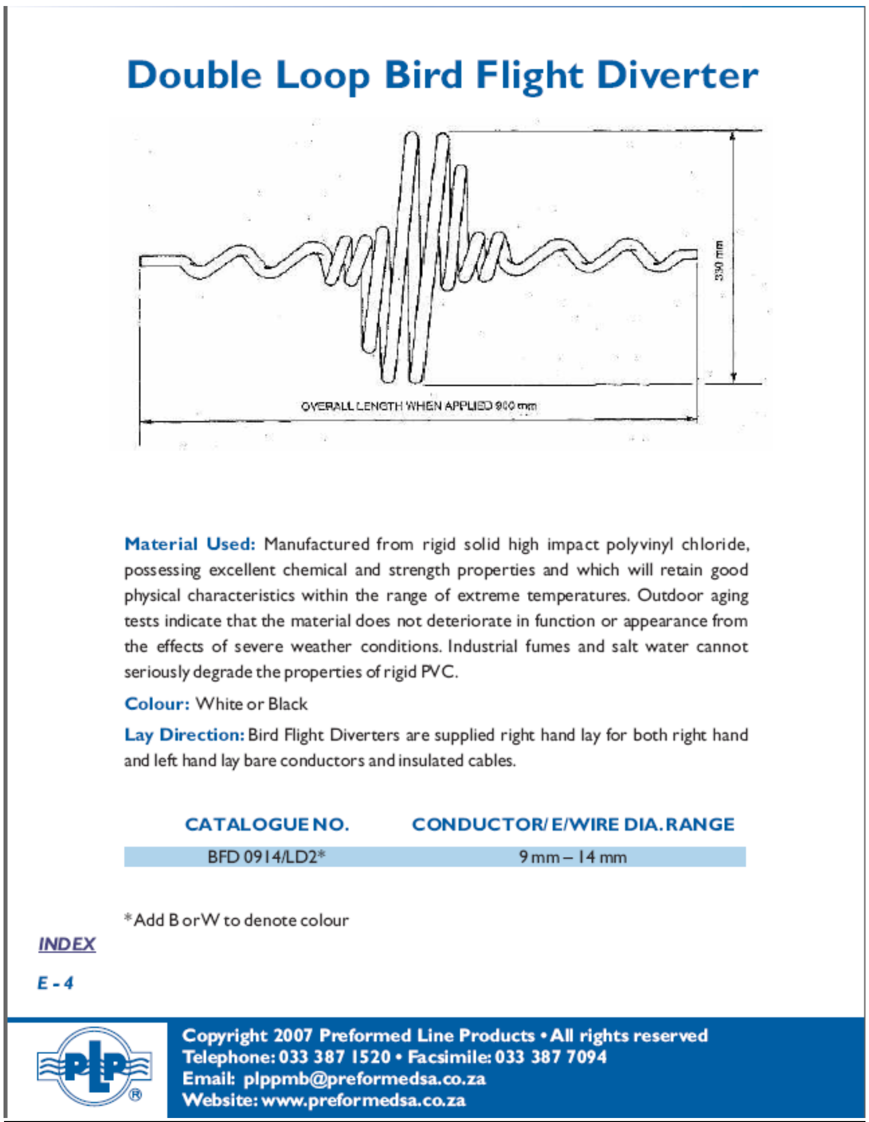
6.2 Collisions with the earth wire of the proposed 88kV line

It has been proven convincingly that the earth wire is the most hazardous obstacle for birds when crossing a power line (Meyer 1978; James & Haak 1979; Beaulaurier 1981; Faanes 1981). Quantifying this impact in terms of the likely number of birds that will be impacted, is very difficult because such a huge number of variables play a role in determining the risk, for example weather, rainfall, wind, age, flocking behaviour, power line height, light conditions, topography, population density and so forth (Bevanger 1999). However, it is possible to give a measure of what species are likely to be impacted upon, based on personal experience and existing literature. This only gives a measure of the general susceptibility of the species to power line collisions, and not an absolute measurement for this specific line.

Many studies have proven that marking the earth wire of a line with PVC spiral type **Bird Flight Diverters (BFD's**) can reduce the mortality rates by at least 60% (Alonso & Alonso 1999; Koops & De

Jong 1982). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Koops and De Jong (1982) found that the spacing of the spirals were critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5 metres, whereas using the same devices at 10 metre intervals only reduces the mortality by 57%. See Figure 6 for an example of an appropriate BFD that could be used for this purpose.

The mitigation of bird impacts caused by power lines is to a large extent determined by the microhabitat within a zone of a hundred metres to about 1km on both sides of the line. This is particularly relevant as far as mitigation for bird collisions are concerned. Sensitive sections include dams, wetlands, drainage crossings and areas of natural grassland Due to the fact that all the proposed power line alternative corridors run through sensitive habitat, it is recommended that the earth wire on the power line is marked with Bird Flight Diverters, alternating black and white, ten metres apart, on each earth wire.



Double Loop Bird Flight Diverter

330 mm

OVERALL LENGTH WHEN APPLIED 900 mm

Material Used: Manufactured from rigid solid high impact polyvinyl chloride, possessing excellent chemical and strength properties and which will retain good physical characteristics within the range of extreme temperatures. Outdoor aging tests indicate that the material does not deteriorate in function or appearance from the effects of severe weather conditions. Industrial fumes and salt water cannot seriously degrade the properties of rigid PVC.

Colour: White or Black

Lay Direction: Bird Flight Diverters are supplied right hand lay for both right hand and left hand lay bare conductors and insulated cables.

CATALOGUE NO.	CONDUCTOR/ E/WIRE DIA. RANGE
BFD 0914/LD2*	9 mm – 14 mm

*Add B or W to denote colour

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Telephone: 033 387 1520 • Facsimile: 033 387 7094
Email: plppmb@preformedsa.co.za
Website: www.preformedsa.co.za

Figure 6: Spiral type Bird Flight Diverter

6.3 Collisions with the moving train

Species at risk here are likely to be mostly owls, particularly the threatened African Grass-owl, as well as other, non-threatened species such as Spotted Eagle-Owl, Barn Owl and Marsh Owl. The obvious mitigating measure to reduce the risk of this happening would be to reduce the speed at which the train would be traveling. However, the slow maximum projected speed of 70km/h would in itself serve as a mitigating factor. No additional mitigation is therefore deemed necessary.

6.4 Disturbance during the construction and operation of the railway line

Very little can be done to mitigate for the inevitable impact on birds of the noise and movement associated with the construction and operation of the proposed railway line. In this respect the birds will benefit from any of the proposed mitigation measures aimed at reducing the noise associated with these activities, as recommended in the Noise Impact Study which is being undertaken as part of this EIA process. One measure that should be strictly enforced is to keep all activities restricted to the actual construction zone, and not allow any unnecessary movement outside this zone. The latter should also apply to the construction of the proposed 88kV line.

6.5 Habitat destruction during the construction and operational activities associated with the railway line and associated power lines

It must be accepted that habitat destruction will inevitably take place in the railway servitude, through the construction of the railway line and service road. One way to limit the extent of this impact would be to restrict all activities to the actual construction zone, and not allow any unnecessary movement outside of this zone. Furthermore, in order to limit the overall impact of the development on the remaining grassland in the study area, the proponent is strongly urged to conserve the remaining grassland and wetland areas on its property as a form of off-set, to mitigate for the inevitable habitat destruction in the servitude. Given the rapid rate at which natural grassland in the Mpumalanga highveld is disappearing, this could be a valuable contribution towards the conservation of this very scarce natural resource, and would benefit at least the smaller grassland species currently (and potentially) occurring there. See also the proposed mitigation measures as detailed in the Ecological Impact Study which is being undertaken as part of this EIA process.

As far as the construction of the 88kV line is concerned, all construction and maintenance activities should be undertaken in accordance with Eskom environmental best practice standards (see in this respect the Eskom Environmental Procedure, EPC 32-96). All vehicle and pedestrian movement should be restricted to the actual construction site and, in the case of maintenance patrols, to the actual servitude.

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