

**Route evaluation and Environmental Impact
Assessment (especially birds)
for the
132kV and 220kV Power Lines
Auas-Rehoboth and Auas-Windhhoek**

SPECIALIST CONTRIBUTION:

AVI-FAUNA

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1 INTRODUCTION

The aims of this study are to:

1. Review existing information on the avifauna and the environment through which the two proposed power lines (Auas-Windhoek and Auas-Rehoboth) will run;
2. Devise a sampling strategy to focus on the most sensitive areas and survey these areas for birds with a 25% coverage;
3. Attend meetings to discuss routes, alternatives and mitigation measures;
4. Provide a preliminary report with sensitive areas zoned;
5. Provide a full report by 18 November detailing the possible impacts on birds found along both proposed power lines.

This is the draft final report sent to Mike Everett 18 November 2005

Methods:

Prior to my field visits, bird atlas data collected at the quarter degree square (QDS) resolution, were accessed from the Namibian Avifaunal data base (Jarvis et al. 2001). Since I helped assemble this data base, I am familiar with some of this area just outside Windhoek. There I was the state ornithologist for the Ministry of Environment and Tourism for 13 years. Bird species lists and the relative abundance of each species was accessed for all the QDSs covering the intended route (2217CA, CB, CC and 2317AA). I also consulted vulture study group specialist Peter Bridgeford for information on nesting vultures and any mortalities due to power lines on the farms under study. I also spoke to Chris van Rooyen chief investigator for the South Africa Endangered Wildlife Trust on avian mortalities due to power lines. I asked him to review my recommendations and he gave very valuable additional advice. I focused on (i) species that are known to be susceptible to collisions with power lines (van Rooyen and Ledger 1999, van Rooyen 2000), (ii) raptors (birds of prey) that use and sometimes collide with power lines and (iii) red data species (Simmons & Brown 2005).

Maps of the proposed route were obtained from the office of Bridgit Roberts at the scale of 1:50 000, in addition to black and white aerial photos (same scale) with farm names and all present and proposed power lines marked thereon. I travelled around the area on 1, 2, 3 November 2005 especially in the vicinity of the Auas Game Lodge where present power lines cross the road and the Brack River. I made one trip to the Rehoboth end of the line. I was unable to visit the farmers to whom I spoke because of a Farmers Meeting on Thursday 3 November.

I interviewed five farmers by phone and followed up with simple questions by e-mail.

1.1 Assumptions and limitations:

This study relied on farmer interviews rather than site visits because of my limited time in Namibia and a farmers meeting that took place on the day set aside for site visits (farmers were not prepared to let me on their properties while they were not there). However, given that I have some experience of this area and because I have spoken to several farmers and other bird specialists with many years experience of power lines (Peter Bridgeford - Vulture



Study Group, Chris van Rooyen - EWT specialist in this field) I am confident that the conclusions are sound. It must be remembered that the avian data collected over about 15 years represents an averaged set of bird observations and important groups such as the raptors, vultures and wetland species will ebb and flow with environmental conditions. The power lines, however, are always there and will always impact the birds. Thus some existing ones should also be modified to avoid fatalities.

1.2 Description of avifauna, sensitive species and sensitive habitats and recorded impacts:

Of the 318 species of birds recorded in the area under investigation, 53 species of large wetland bird occur excluding wading birds such as stilts and avocets. A relatively large number of raptors (birds of prey) and vultures occur totalling 33 species. These species are highlighted because they are the most susceptible to collision and electrocution (van Rooyen 2000).

Large species - particularly the heavier **wetland species** - are more frequently killed by colliding with power lines than any other birds. These include storks, cranes, flamingos and the grassland bustards. Some migrate at night making them very susceptible (13 of 23 species recorded as mortalities - van Rooyen & Ledger 1999). All of these wetland species are found on the SABAP (Bird Atlas) lists for the area under investigation. Only the Kori Bustard of the three large bustards occurs here, however, and at low frequency (reporting rate 1% = once in 100 bird atlas cards). Thus the typically susceptible bustards are unlikely to be an issue to this area. According to the SABAP data there are 53 medium to large wetland species found in this area; most of these will be found on dams because natural wetlands and seeps are rare in the Khomas region. So the species that are at risk in this region would be the larger and commoner species. The two top contenders are White Pelican and Egyptian Goose. These are reported at a rate of 30% (of 100 atlas cards they were reported 30 times) and 36% respectively. True to this prediction both species have already been reported as killed on the existing power lines by the farmers on the Aus-Windhoek line. Birgitte (pers comm) of the Hohewarte farm reported an Egyptian Goose downed by overhead wires where the line crosses the Oliphants River in the last 3 years. Mrs Frower of Aris farm reported a Great White Pelican downed by flying into power lines on her farm that has 4 dams. Both birds died. The pelican is a *Vulnerable* Red-listed species in Namibia, the goose is not. These are frequently found commuting between coastal areas and productive farm dams and are probably the least manoeuvrable of all the species using the farm dams in the area. Given that they may use riverlines to navigate to farm dams, those power lines crossing the riverlines will be likely danger areas for these and other species.

Of the 33 raptors the two **vultures** are relatively common here and include the White-backed Vulture and Lappet-faced Vulture. Both are Red Data species - *Near Threatened* and *Vulnerable* respectively (Simmons & Brown 2005). Both breed and one has been recorded as killed by over head lines (below). These are the most susceptible species to collision and electrocution of all avian species occurring here.

There are two records of raptors/vultures killed on power lines in the area under investigation. The first was reported by on the farm Okatumba South when a Martial Eagle (Red Data category *Endangered*) was electrocuted and found hanging from power lines (Bridgeford & Hienrich unpubl data). The second was of a Lappet-faced Vulture that was found injured below a power-line on the farm Springbokvlei just east of the international airport.



The only other species that regularly impact power lines are sandgrouse that flock to waterholes in the evening and morning (Hockey et al 2005). None were reported by the farmers interviewed. This was not because they did not know them (Afrikaans = Keilkewyn, German = Namaflughuhn). Their relative abundance here is only 5% (Jarvis et al 2001) so they too are likely to be impacted at a very low level in this area.

Thus, in summary, there are three groups of species that are at potential risk to the newly proposed power-line - (i) larger wetland species that visit the farm dams that occur sparsely throughout the area under investigation (ii) large raptors that perch and may nest on pylons and (iii) vultures that may also perch, roost and nest on the lines. There is evidence that all groups *are already* being killed by the power lines currently in the area.

Therefore all (i) dams and (scarce) natural wetlands - including dry river beds that occasionally flood - are sensitive sites (ii) all vulture-friendly farms (usually conservancies where poisons are not used) are sensitive and (iii) cliff faces where larger raptors (e.g. Black Eagles) occur and build their nests are sensitive sites. Using these criteria the sites below are identified and ranked.

1.3 Rating and descriptions of sensitive areas and sites

The map below indicates areas that are sensitive enough to suggest an alteration of the configuration of the intended 220 kV line.

The first (**Note 1**) is the area just south of Windhoek city on the B1. Here the proposed power-line runs west of road alongside (<1 km from) the Regenstein Mountains. This is an area where slope-soaring raptors (e.g. Steppe Buzzards and Augur Buzzard) occur and is the site of a Black Eagle pair. An active nest is situated within 1 km of the line at approximately 22° 41.6'S, 17° 3.4'E. The pair was seen soaring just south of this area - over the intended route during my site visit. Given that the adults may hunt around the slopes and that young birds may be fledged here this is a highly sensitive area. The Black Eagle is a *Near-Threatened* Red data species in Namibia (Simmons & Brown 2005).

Note 2: The proposed power-line passes close to a large dam on Paulinehof and also diverges from an existing line as it nears the Auas substation. By altering the direction of the proposed line at the point 22° 38.5'S 17° 16.4'E, such that it parallels the existing line it will avoid the large dam and it make both lines more visible.

Note 3: The largest dam in the entire study area is found at the farm Nauaspoort 23° 3.4'S, 17° 13.0'E. The proposed power line runs close to this dam, which because of its size will attract numerous wetland species even when partly full. Straightening the configuration of



Of lower sensitivity are the following dry river beds and dams:

On the **Auas - Windhoek** line there are 3 wetlands (all dams) where the 220kV line passes within 1 km of the dam:

- Aris - 400 m [22o 42.5'S, 17o 05.9'E]
- Aris - 950 m [22o 43.1'S, 17o 06.8'E]
- Paulinehof - 550 m [22o 37.5 S, 17o 18.4 E] - mentioned above

There are **two river beds** that the intended 220kV line cross:

- Usib River on the Aris farm [22o 41.9' S, 17o 10.2E]
- Skaap River on the farm Waldeck [22o 39.8' S, 17o 14.5'E]

On the **Auas - Rehoboth** line there are 3 dams where the intended 132 kV line passes close to a dam:

- Hohewarte - 200 m [22o 39.3'S, 17o 21.5'E]
- Aus Game Lodge - 600 m [22o 47.7'S, 17o 19.8'E]
- Nauaspoort Dam - 2000 m (this is the largest dam in the study area and will likely attract many more birds).[23o 03.4'S, 17o 13.0'E] - mentioned above

There are **three river beds** which the intended 132 kV line crosses:

- Oliphants River on farm Hohewarte (twice crossing it) [22o 38.0'S, 17o 21.9'E]
[22o 39.4'S, 17o 21.6'E]
- Brack River on farm Tew - (Aus Game Lodge) [22o 46.9'S, 17o 20.4'E]
- Keiseb River on farm Onnaams - Koppies Kraal (twice crossing it close together)
[22o 56.2'S, 17o 17.4'E]

1.4 Potential Impacts:

Raptors and vultures often get electrocuted on lines because they breed on them and perch around them (6 of 23 species listed as killed on lines by van Rooyen & Ledger 1999). There are healthy populations of vultures in the farmlands south of the Auasberg and estimates of 50 -100 Whitebacked Vultures congregating at carcasses are given by some farmers (P Schaepe pers comm from Paulinehof). Nests have been reported by farmers and by local specialists from the VSG (P Bridgeford pers obs). Black (Verreaux's) Eagle, which are *Near-Threatened* in Namibia's Red Data book, is also commonly seen around the Regenstein mountains where they nest. Black Eagles, Martial Eagles and vultures are potential problems with power lines because (i) they perch and on and defecate over the insulators and cause flash-overs. This is presumed to occur when they defecate on the line reducing the resistance in the insulators and causing power to leak to earth. This momentarily disrupts the power supply. (ii) They nest on some pylons causing power failures and occasional fires (A Jenkins pers comm, van Rooyen 2000).





Photo 1: A young female Martial Eagle that was electrocuted and found below a transmission line in the N Cape South Africa. In this region Martials nest on the lines and this bird was killed in a fight with an adult male Martial. Pylons that prevent Red Data species such as these from perching or nesting are preferable to those encouraging them to perch or nest.

Figure 2: Photo of an female Martial Eagle

Photo 1 is an example of a juvenile female Martial Eagle that was electrocuted clutching a dead adult male Martial Eagle. The birds were found dead together below a pylon in the Northern Cape of South Africa (Simmons 2004).

Impacts on these species can be reduced by moving the intended line well away from all cliff edges and mountain sides. Particularly well used areas such as sites close to vulture restaurants (none reported in this area) should be monitored on a regular basis. It is widely recognised that the number of birds actually reported is a small proportion of those actually killed, because of a lack of daily surveys.

The design of the transmission towers is also very important - there are some designs that are presently killing raptors and vultures in this area and are known to kill birds either by electrocution or through collision.

Night-migrating birds such as flamingos have a greater chance of seeing clusters of lines or those with bird flappers than those without. So lines set close to cliff faces or other "backgrounds" often claim more lives than those on flat more open ground (van Rooyen 2000). However, the high earth wire present on many designs can kill even those species seeing clusters of the transmission cables, because they fly upwards when they see the cables.





Photo 2: These single structure pylons are relatively safe for vultures and eagles given their top perch bar (arrowed) that takes the birds away from the insulators. This design attracts Sociable Weavers (nest shown) as well as Buffalo Weavers but their nests are typically away from the insulators. Bird flappers should be put on this line (and the high earth wire) and other lines where they cross riverbeds.

I noted throughout this area that the Suspended Rope design (photo 3) does not attract any nests. Furthermore large raptors or vultures would find few suitable perching places on them. Thus they are preferable to other pylon designs.

Figure 3: Single structure pylons are safe for vultures





Figure 4: Photographic evidence - visual impact and electrocutions

Photo 3: The suspended rope designs are ideal for avoiding bird impacts and preventing large-nest species of birds from nesting on them. Note however, the visual impact of such lines against tourist-attracting landmarks such as the mountain range north of Rehoboth. Should they be set away from the roads to avoid visual impact on tourists?

1.5 Proposed mitigation measures:

- 1.5.1 The proposed power-line should pass > 1 km from all wetlands and dams. This will reduce the number of wetland birds (and other species coming to drink) from colliding with the line. All lines should preferably be routed on the *non*-mountain side to increase visibility to all species planning into, or taking off from, the wetland. Where the proposed line traverses conservancies with healthy populations of vultures an alternate route should be sought. These birds will collide with, or electrocute themselves on virtually any suspended transmission line design.





Photo 4: This vertical configuration pole was photographed running N-S in the farmland just North of Rehoboth.

It is a *lethal* structure for even small birds that perch on the top pole and stretch a wing over to the closest conductor. They are electrocuted because of this.

There are two solutions: (i) make a 50cm gap in the earth wire so that the earth connection is more difficult to make and (ii) increase the length of the top of the pole well above the conductor.

In this particular design the earth wire stops about 1.5m short of the top which may reduce but not eliminate electrocutions.

Figure 5: Lethal structure for birds

1.5.2 At the outset the pylon design should discourage vultures and raptors from perching on the pylon above the insulators. The new 132 kV pylon design (single steel structure) is unfortunately still electrocuting vultures (C van Rooyen pers comm). To mitigate this, these structures now come with an added perch on top of the pylon that takes perching birds away from the insulators (see arrow photo 2 above). These should be used *throughout* the area from Auas to Rehoboth on the 132 kV line because White-backed Vultures and Lappet-faced Vultures are found in these areas and are both Red Data species (Simmons & Brown 2005). It is known that by defecating in a long stream the birds bridge the gap between the conductor and the earth and electrocute them. Where birds are electrocuted in rich grassland areas, this can also cause veld fires if the bird carcass is still alight when it hits the ground (C van Rooyen pers comm). Some farmers have subsequently sued Eskom South Africa for damages arising from this.

1.5.3 The new lines should run close to existing lines (making both more visible) wherever this is feasible. Note especially the area within the farm Paulinehof where the proposed line diverges from the existing line at 22° 38.5'S 17° 16.4'E. A wetland (dam) also occurs in this area and by moving the line northwards NamPower can mitigate against wetland birds colliding with the power-line and make both lines more



visible by running the new one parallel to the existing line for ~5 km before heading it east to the Auas substation.

- 1.5.4 Where the power lines cross-larger rivers bird flappers should be suspended to increase line visibility. Wetland birds will tend to follow rivers searching for suitable habitat when the rivers flow or the dams fill. Flappers should be attached to the high earth wires as well.
- 1.5.5 Along the "Regenstein mountains" where the proposed line runs along the mountain slopes, it passes close to (< 1 km) of an active Black (Verreaux's) Eagle nest on the cliff. These are *Near-Threatened* Red Data species in Namibia. Since these birds use the slopes for soaring and hunting there is a strong chance that they or their offspring will collide with the poorly visible structures or transmission lines. This can be avoided by running the line to the east of the main road before 22° 40' S, to the east side of the main Windhoek-Rehoboth road. This will also have the effect of shortening the length of the line - a financial saving to NamPower. Wherever the line runs close to a mountain slope it should be placed at least 1 km from the closest cliff edge. This will reduce the chances that raptors will either collide with, perch on or build their nests on the pylons.
- 1.5.6 Visual Impact: aesthetically a line outlined against a set of mountains may spoil any potential view to visiting tourist. Therefore an obvious line should be set away from a road and not against a backdrop of mountains.
- 1.5.7 An alternate proposal to route the line to the north of the Auasberg was suggested by other consultants and I have evaluated this below based on its proximity to dams, riverbeds, cliff faces and vulture-friendly farms.



2 ALTERNATIVE ROUTE

I have taken a look at the suggested re-alignment to the north of the Auasberg Mountain and it has the following positive points:

(i) the northern route avoids the three dams and two riverbeds that were flagged as problems above;

(ii) it completely alleviates the need for the line to go anywhere near the Regenstein mountains where potential problems with breeding Black Eagles and slope-soaring raptors were identified as a problem;

(iii) the 50 - 100 White-backed Vultures that occur on the game farms and conservancies to the south of the Auasberg will be less impacted by a line on the north side because (a) they are less likely to occur there - it is more urbanized and there will be fewer appropriate food sources and (b) fewer appropriate trees for breeding in are likely to occur on the northern slopes than the southern slopes of a mountain (pers comm and from discussions with NBRI botanists).

If the line is set back at least 1 km from the escarpment areas of the Auasberg then I see no problem with slope-soaring raptors or vultures there.

I have looked for dams and riverlines in this area and assuming the line runs through the natural valley approximately 3 km north of the Auasberg mountain ridge then it will run within a km of four dams on the farms Finkenstein (3) and Voightland (1). It should ideally be routed about 1 km from each of these.



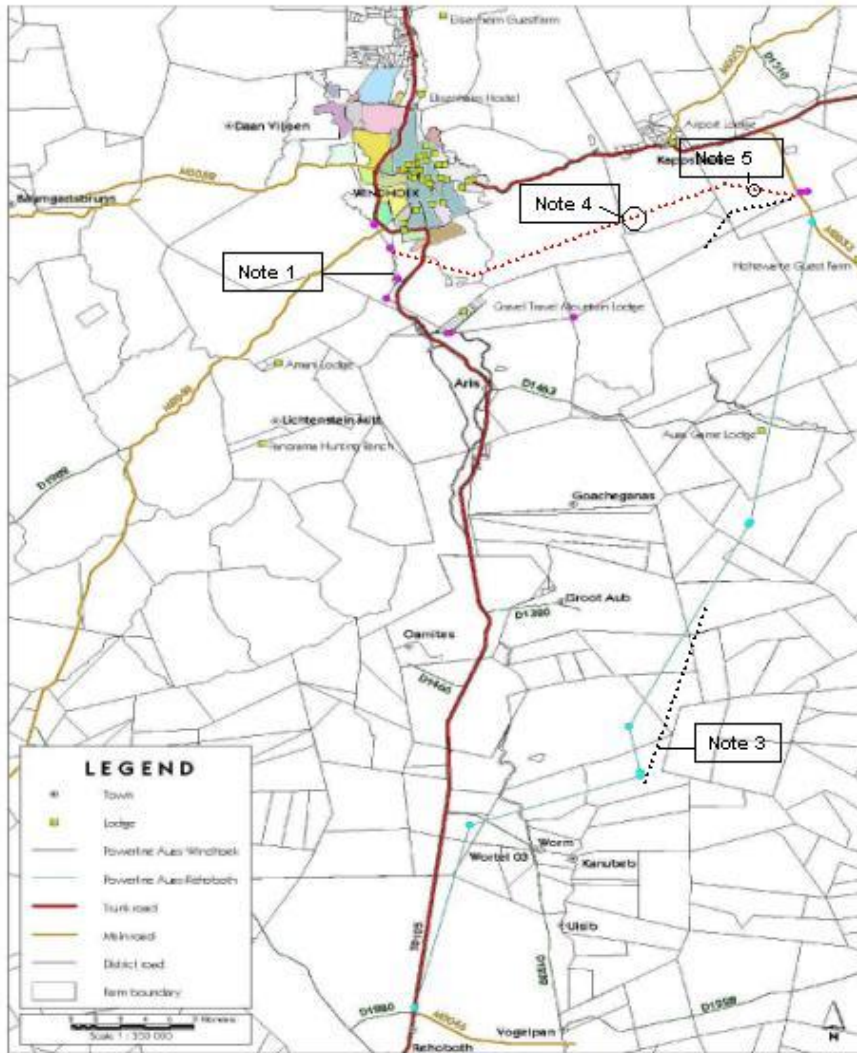


Figure 6: The red dotted line shows a possible route of the proposed 132kV line North rather than South of the Avasberg

Coordinates of these 4 dams are:

- 1) 22o 34.0'S, 17o 15.1'E [power-line within 200m]
- 2) 22o 34.6'S, 17o 16.5'E
- 3) 22o 34.9'S, 17o 19.5'E [line would pass over this dam] so it should be sent n of here
- 4) 22o 35.6'S, 17o 14.9'E [line within 300 m].

The most important areas of concern are noted "Note 4" and "Note 5". The first is an area where both a dam (1 - above) and a river occur on the farm Finkenstein. Bird flappers are advised for both and if the line can be routed 1 km north of the dam this is preferable. The second area of concern is Note 5 where a dam on the farm Voigtland occurs (4- above). A power-line already passes close to this dam and it recommended that the new line passes on the north side of this dam and bird flappers are put on the present line and the new line within the vicinity of this dam.

So there are many positive aspects to having a line to the north of the Avasberg, and I recommend this route above that which runs to the south of the Avasberg mountains. Note that Avis Dam [22o 34.7'S, 17o 07.9' E], as the largest permanent water body in the area should of course be given a very wide berth!



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APPENDIX 2(b)

Expert Advice



EXPERT ADVICE ON PROPOSED 132 kV DESIGN

Stephanie,

Thanks for Christian and Chris van Rooyen's detailed report on the new 132 kV pylons.

Attached below is the reaction I received from one of the USA's top experts on bird collisions with pylons.

His concerns can be summarised:

1. The number of guy wires appears to be excessive and these may need to be flagged in any areas which act as avian corridors.
2. The distance from the top of the pole to the closest conductor should be a minimum 150 cm (60 inches).

From the photographs it appears that this distance (judged from the height of the men standing at the base) from the top of the pole to the nearest conductor (my estimate is 1.0m), is less than the recommended distance.

From Chris van Rooyen and Christian's report they note that Martial Eagles have a wing span exceeding 2m. This is illustrated in the Photo 1 in my final report.

Both Rick Harness's recommendation (above) and the wing span of the largest raptors that will perch on the highest available perch (Martial with 2 m span) indicate that this is not a safe design for birds from an electrocution point of view. The number of guy wires reaching to approximately 10 m from ground level and the possible impact they will have on birds colliding with them suggests this is a poor design from both points of view. In game farming areas this may also affect more fleet footed mammals such as gemsbok and springbok, particularly after dark.

Recommendation: either

- (a) the pylon design must be changed for something more suitable i.e. a free standing structure not in need of guy wires or;
- (b) the top of the pole must be extended above the closest conductor by a minimum distance of 1.5 m and preferably 2.0 m; or
- (c) a small addition to the top of each pole preventing birds from perching on them, be added to all poles.

I do not recommend adding angle irons to accommodate one or two birds perching, as recommended by Boix-Hinzen and Van Rooyen (unpubl report with Enviro Dynamics 2004), because this encourages rather than discourages the use of these poles.



If the latter two options (b) or (c) are the only cost effective ones from NamPower's perspective, then the guy wires should be made more visible. This can be achieved either by painting them in a yellow and black chevron design or flagging them with a durable long lasting tape.

Any measures should be then monitored particularly in game farming areas where the threat of large mammal collision is greatest. Monitoring should be done on a regular basis (minimum is daily for a week during the 3 different seasons) either by the farmers or by Ministry of Environment staff in the area or as a UNAM or Polytechnic student project.

Stephanie I hope this is sufficient for your meeting tomorrow.

If you wish me to formally place this in my report please let me know.

Regards and best wishes

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