CONSTRUCTION OF 2 X 400 KV LINES FROM KENDAL POWER STATION TO ZEUS SUBSTATION AND BRAVO POWER STATION TO ZEUS SUBSTATION (Bravo 4)
DEA Ref No - 12/12/20/1095

by I.L. RAUTENBACH, A.E. and J.C.P. VAN WYK

Commissioned by

Limosella Consulting
antoinette@limosella.co.za

Eco-Agent CC
PO Box 25533
Monument Park
0105
0825767046
012 3463180
Fax 012 4602525
March 2010

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Declaration of Professional Standing and Independence:

We,
Ignatius Lourens Rautenbach (SACNASP # 400300/05),
Jacobus Casparus Petrus van Wyk (SACNASP # 400062/09)

declare that we:

- hold higher degrees in the biological sciences, which allowed registration by S.A. Council for National Scientific Professions (SACNASP) as Professional Zoologists that sanction us to function independently as specialist scientific consultants;
- declare that as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003 this project was our own work from inception and reflects exclusively our observations and unbiased scientific interpretations, and executed to the best of our abilities;
- abide by the Code of Ethics of the SACNASP;
- are committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas we appreciate opportunities to learn through constructive criticism and debate, we reserve the right to form and hold our own opinions within the constraints of our training, experience and results and therefore will not submit willingly to the interests of other parties or change our statements to appease or unduly benefit them;
- are subcontracted as specialist consultants for the project "Construction of 2 X 400 KV Lines From Kendal Power Station to Zeus Substation and Bravo Power Station to Zeus Substation (Bravo 4) DEA Ref No - 12/12/20/1095" as described in this report;
- have no financial interest in the proposed development other than remuneration for the work performed;
- do not have, and will not have in the future, any vested or conflicting interests in the proposed development;
- undertake to disclose to the consultant and its client(s) as well as to the competent authority any material information that may have the potential to influence any decisions by the competent authority, as required in terms of the Environmental Impact Assessment Regulations 2006;
- reserve the right to only transfer our intellectual property contained in this report to the client(s), (party or company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, we recognise that written consent from the client will be required for any of us to release of any part of this report to third parties.
- In addition, remuneration for services provided by us is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorising this proposed project.

I.L. Rautenbach

J.C.P. van Wyk

Disclaimer:

Even though every care is taken to ensure the accuracy of this report, environmental assessm studies are limited in scope, time and budget. Discussions and proposed mitigations are to so extent made on reasonable and informed assumptions built on *bone fide* information sources, well as deductive reasoning. Deriving a 100% factual report based on field collecting a observations can only be done over several years and seasons to account for fluctuat environmental conditions and animal migrations. Since environmental impact studies deal v dynamic natural systems, additional information may come to light at a later stage. T vertebrate team can thus not accept responsibility for conclusions and mitigation measures ma n good faith based on own databases or on the information provided at the time of the directi Although the authors exercised due care and diligence in rendering services and prepar documents, they accept no liability, and the client, by receiving this document, indemnifies authors against all actions, claims, demands, losses, liabilities, costs, damages and expens arising from or in connection with services rendered, directly or indirectly by the authors and he use of this document. This report should therefore be viewed and acted upon with th imitations in mind.

ABSTRACT

The ca. 70km long Bravo 4 Powerline will traverse the Highveld grassland biome in a nort south axis between the Kendal Power Station to the Zeus Substation. Only terrestrial a wetland habitats are present. Roughly 60% of the terrain through which the line's servitude traverse comprises of maize fields, interspersed with grasslands on non-arable so Environmentally the maize fields are sterile entities for mammals, reptiles and amphibia The grasslands represent terrestrial habitat that have conservation status (and concomit habitat utility) ranging from unashamedly overgrazed to fairly a well preserved condition.

All streams and wetlands are red-flagged as sensitive, as per statutory prerequisites.

It is concluded that 40 species of mammals, 39 reptiles and 15 amphibians are likely to oc somewhere in the untransformed portions along of the servitude.

The line will not impact on its immediate environment since most of the terrain has alrea been transformed into maize fields, and furthermore since powerlines themselves are rat benign in spite of their formidable appearance. Mammals (bats excluded), reptiles and fr are terrestrial and thus not exposed to the risk of collisions with the wires or be electrocut The servitude has both a slight positive and negative impact. The natural vegetation along servitude will be manipulated towards rampant grassland by the removal of woody plants reduce the risk of 'hot' fires. Generally the grassland in the servitude comprises pri terrestrial habitat by providing refuge and nourishment for herbivorous vertebrates, ev hough it may be grazed by domestic stock. Grasslands along such a grassy servitude a serve as seedbeds and, when mowed (to further reduce fire risks) the cut grass is left and unctions as habitat and furthermore adds to the organic litter layer.

It is predicted that the powerline and its servitude will not impact on species richness and Red Data will be displaced. It should also be kept in mind that the Bravo 4 line will be along servitude of existing lines and environmental damage (as it may be) is to a large ext actored in the existing servitude.

The conservation status of the linear site is rated as **Medium-low** i.e. *Land on which sn sections could be considered for conservation but where the area in general has li conservation value* (See Section 5.5 – Assessment Criteria to express conservation status).

The impact of the Bravo 4 Powerline and its servitude is calculated to be 'Moderate'. T anking is boosted by the high Duration and Regional values and in a sense ove emphasizes the actual impact on terrestrial vertebrates and their habitats.

No reasonable objection can be raised to oppose the construction of the propos development.

1. ASSIGNMENT – Eco-Agent Protocol

Eco-Agent CC Ecological Consultants were appointed by Limosella Consultants on behalf of the Envirolution Consulting to undertake a mammal, reptile, and amphibian species richness and habitat conservation scan along the route decided on for the Bravo 4 powerline. An assessment of vegetation and birds are presented in separate reports. The quality of vertebrate habitats were assessed and used as a mechanism to deduce the likelihood of occurrences. This assignment is in accordance with the 2014 EIA Regulations (No.982, Department of Environmental Affairs and Tourism, 18 June 2010) emanating from Chapter 5 of the National Environmental Management Act, 2004 (Act No. 10 of 2004).

The assignment is interpreted as follows: Compile a study of the vertebrate fauna of the site, with emphasis on Red Data vertebrate species that occur or may occur on the site. In order to compile this, the following had to be done:

1.1 Initial preparations:

Obtain all relevant maps and information on the natural environment of the concerned area. This includes information on Red Data vertebrate species that may occur in the area.

1.2 Fauna assessment:

Compile lists of the terrestrial vertebrates that can be expected along the route and adjoining zones.
Identify the Red Data species that occur (or may occur) along the route.
Assess the quantitative and qualitative condition of suitable habitat for the Red-Listed vertebrates that may occur in the area.
Assess the likelihood of Red-Listed fauna being present on the study site.

1.3 General

Identify and describe particular ecologically sensitive areas.
Identify problem areas in need of special treatment or management, e.g. bush encroachment, erosion, water pollution, degraded areas, reclamation areas.
Make recommendations on aspects that should be monitored during development.
Calculate a significance rating for the proposed development.

2. RATIONALE

Environmental conservation is no longer the prerogative of vocal left-wing 1960s-style green activist NGOs. Instead it is now universally appreciated that a rapidly-growing and more demanding human population is continuing to place exponential stress on the Earth's resources with irredeemable costs to ecosystems. It is also recognized that ecosystems are in fact nature's 'engine room' to manufacture fundamental life-support products for plants, animals and humans. Environmental degradation ranges from mega-problems such as global warming, demand for power, land-use practices to smaller-scale issues such as indiscriminate use of household chemicals.

The new conservation awareness is settling at all levels ranging from consumers, school curricula, communities to governments. This new consciousness is typified by vigorous debate and empathy, and sometimes by decisiveness (viz. new legislation).

In South Africa a number of acts and regulations call developers (and by implication consumers), the scientific community and conservation agencies to task to minimise environmental impact. These include:

The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996),
The Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983),
The Environmental Conservation Act, 1989 (Act No. 73 of 1989),
The National Environment Management Act, 1998 (Act No. 107 of 1998) as amended in 2010,
The National Environmental Management Biodiversity Act, 2004. (Act 10 of 2004),
The National Environmental Management Biodiversity Act, 2004. (Act 10 of 2004), Draft List of Threatened Ecosystems. Government Gazette RSA Vol. 1477, 32689, Cape Town, 6 Nov 2009,
The National Environmental Management: Waste Act [NEM:WA] (Act 59 of 2008),
The National Forests Act, 2006 (Act 84 of 1998 as amended in 2006),
The National Heritage Resources Act, 1999 (Act No. 25 of 1999),
The National Environmental Management: Protected Areas Act (Act 57 0f 2003),
The Mineral and Petroleum Resources Development Act 28 of 2002,
The National Water Act, 1998 (Act No. 36 of 1998), and
The Environmental Impact Assessment Regulations Notice 733 of 2014.

The conduct of natural scientists is directed by The Natural Scientific Professions Act (Act 27 of 2003). Nowadays a development prerogative is to precede new constructions by a multidisciplinary environmental investigation to assess the conservation costs. This is to ensure that best conservation practices are applied during the planning, construction and operational phases of new developments.

2. PROJECT DESCRIPTION

Eskom experiences a growing demand for electricity. This places increasing pressure on the current power generation and transmission capacity. Eskom aims to improve the reliability of electricity supply to the country, and in particular to provide for the growth in electricity demand in the Gauteng and Mpumalanga provinces. To this end the Bravo Integration Project was launched. This project was broken down into smaller individual Environmental Impact Assessments for which alternatives were evaluated during a previous phase of the project (Table 1). Current assessments are evaluating the environmental impact of the final alignments, including tower positions.

This report addresses the Bravo 4 component of the Bravo Integration Project and focusses on mammals, reptiles and amphibians.

Table 1: Components of the Bravo Integration Project and associated activities

Line Name	Description of activities
Bravo 3	Construction of a new 400 kV line from Bravo power station to Lulamisa (Kyalami) substation
Bravo 4	Construction of 2 x 400 kV lines from Kendal power station to Zeus substation and Bravo power station to Zeus substation. These two lines will run parallel to each other
Bravo 5	Construction of a 400 kV by-pass line, approximately 10 km in length, on the Bravo – Vulcan (Witbank) line to by-pass Duvha
Kyalami – Midrand Strengthening	Comprising a Substation and three 400kv Transmission Lines of approximately 13 Km between existing Lulamisa Substation and proposed Kyalami Substation, Gauteng. A Substation and three 400kV Transmission Lines of approximately 13 Km between existing Lulamisa Substation and proposed Kyalami Substation, Gauteng

3. SCOPE AND OBJECTIVES OF THE STUDY

- To qualitatively and quantitatively assess the significance of the habitat components and current general conservation status along the route;
- Identify and comment on ecologically sensitive areas or ecological services;
- Comments on connectivity with natural vegetation and habitats on adjacent terrain;
- To provide lists of mammals, reptiles and frogs that occur or might occur, and to identify species of conservation importance;
- To highlight potential impacts of the proposed development on habitats along the route;
- To investigate the possibility of knock-on effects on the district as result of the development, and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.
- Calculate a significance rating for the proposed development.

4. STUDY AREA

4.1 General

Eskom propose to construct two new 400 kV power lines; one from Bravo to Zeus and the other one from the Kendal Power Station (near Ogies) to the Zeus substation (near Secunda), Mpumalanga. A section of existing line joins the Bravo substation to the new proposed kV line. These lines will run parallel to each other and will be approximately 90 km in length. The lines run south past the towns of Evander and Leandra for about 72 kilometres to the Zeus substation north of Standerton (Figures 1 and 2). The Land-Use is dominated by cultivated fields (maize), grazed grasslands, urban centres, coal mines and power stations (Figure 2).

The Mpumalanga Biodiversity Conservation Plan: Critical Biodiversity Areas (Terrestrial) Map shows the lines traversing areas with sensitivity scores ranging from Irreplaceable to No Habitat Remaining. The central section of the line crosses a large area classified as Highly Significant (Figure 3).

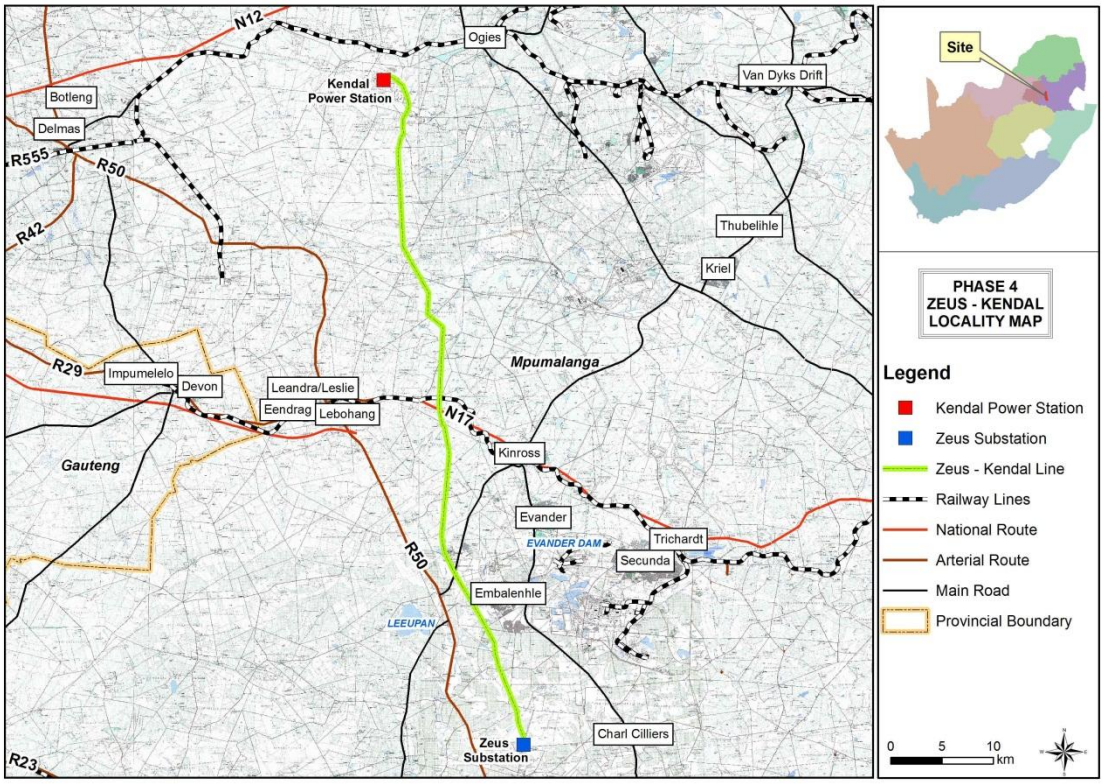

Figure 1: The location of the Bravo 4 powerline.

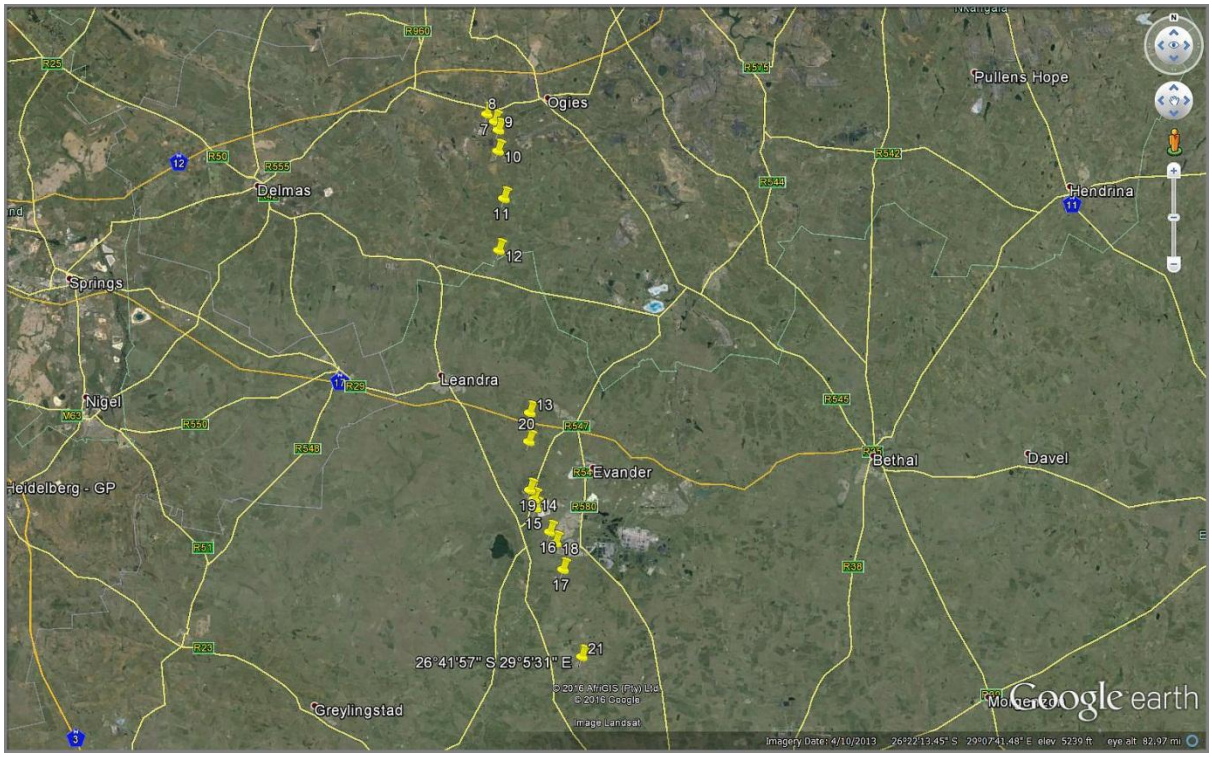

Figure 2: A satellite view of the route investigated, courtesy of Google Earth. The 15 yellow pins indicate sampling points, and numbering refers to Figures 7 – 20 where environmental conditions and spatial orientation at that location are presented.

4.2 Conservation Status

Conservation status as indicated by the Mpumalanga C-plan shows the proposed line crossing land classified mostly as 'No Natural Habitat Remaining', 'Least Concern', 'Highly Significant', and to a lesser extent 'Important and Necessary (Figure 3). The line will traverse part of the "Food Basket" region of South Africa and environmental displacement has largely been cause by tilling. National Biodiversity Assessment (SANBI, 2011) indicates the ecosystem of the area as 'Vulnerable' (Figure 4).

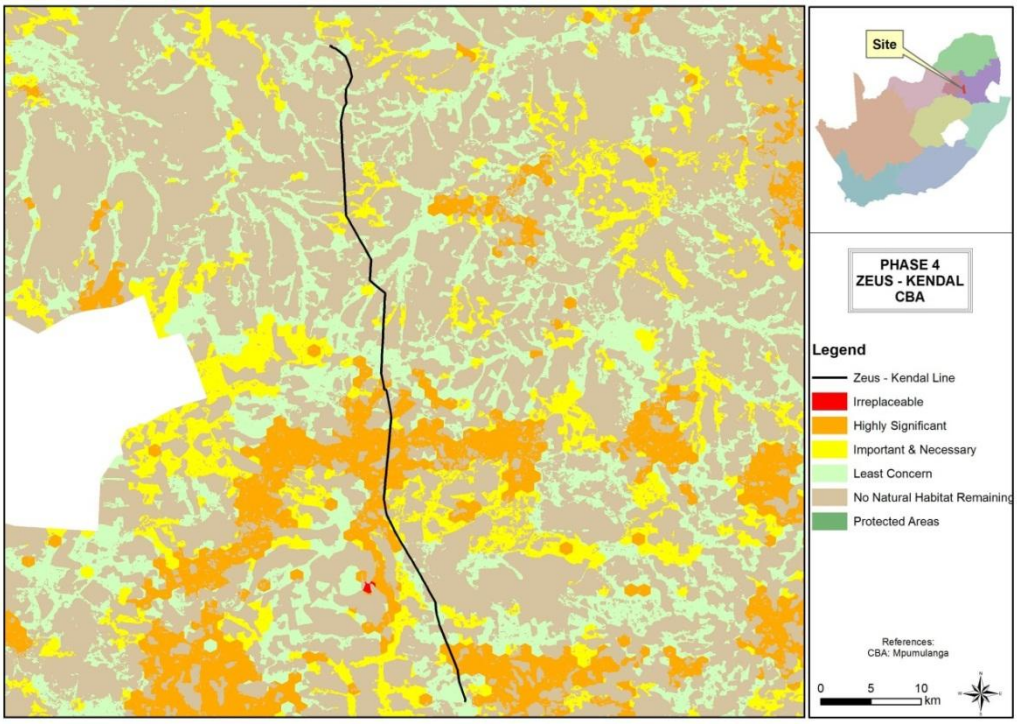

Figure 3: Conservation status of areas traversed by the proposed powerline as classified in the Mpumalanga regional dataset.

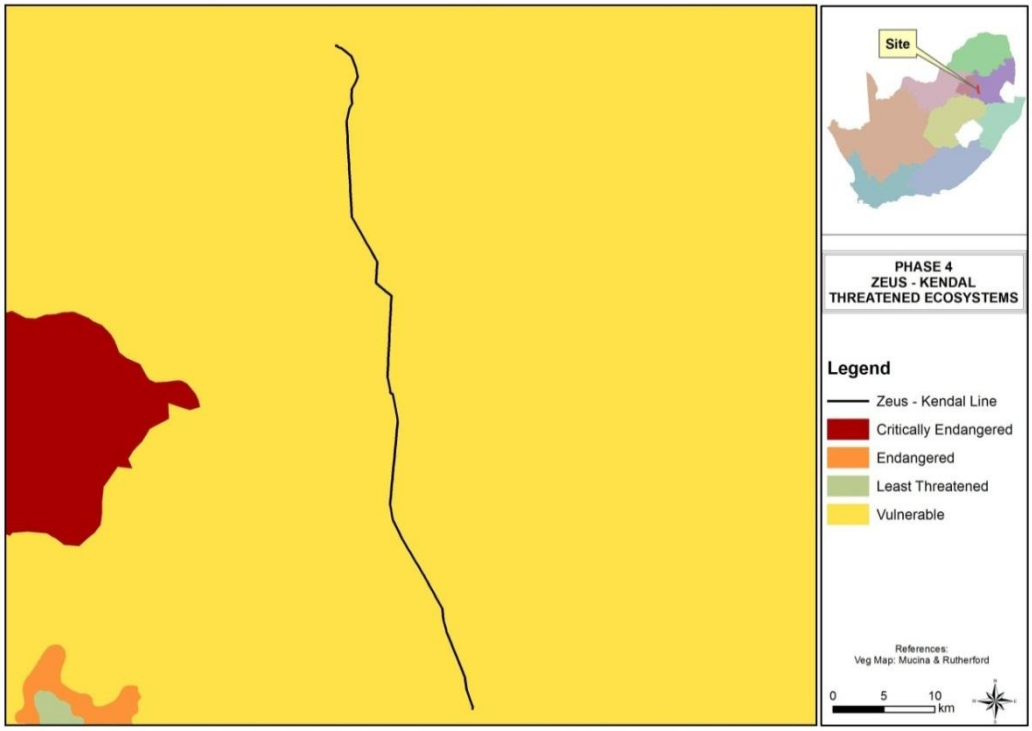

Figure 4: Threatened ecosystems as classified by the 2011 SANBI National Biodiversity Assessment.

4.3 Vegetation Types

The vegetation classification of South Africa (Mucina & Rutherford, 2006) classifies vegetation types crossed by the proposed lines as Eastern Highveld Grassland (sandy on Karoo sediments) and Soweto Highveld Grassland (fertile turf on dolerite) (Figure 5). Both these vegetation types are listed as Endangered based on their current conservation status (Mucina & Rutherford, 2006).

The accompanying floral report presents a more comprehensive overview of the site, incorporating all the elements underpinning the above-mentioned vegetation units.

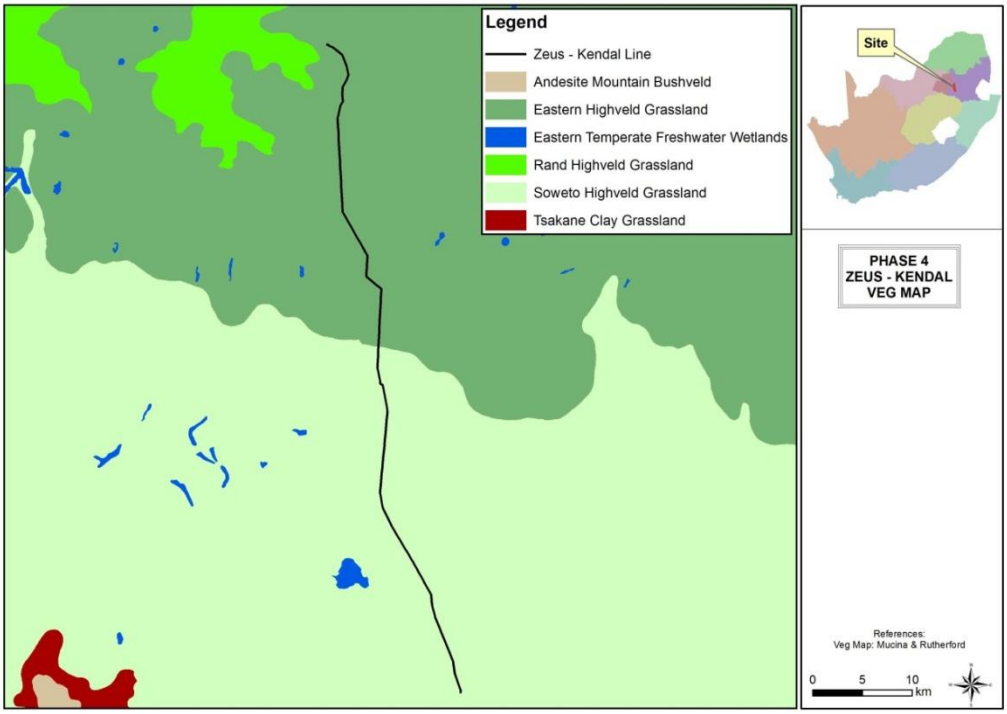

Figure 5: The vegetation classification along the proposed powerline.

4.3 Regional Hydrology

The study area falls within the Olifants River (Catchment B) and Vaal River (Catchment C). Quaternary Catchments relevant to the proposed lines are B20F, B20E, B11E, C12D and C12F. The main river in the northern section of the site is the Wilge River along with the Kromdraai Spruit and the Riet Spruit. All these watercourses drain primarily northwards towards the Olifants River. The southern section of the line drains into the Rolspruit and the Kaapspruit and eventually into the Vaal River. Several non-perennial streams and drainage lines also occur throughout the area, draining towards the main rivers (Figure 6).

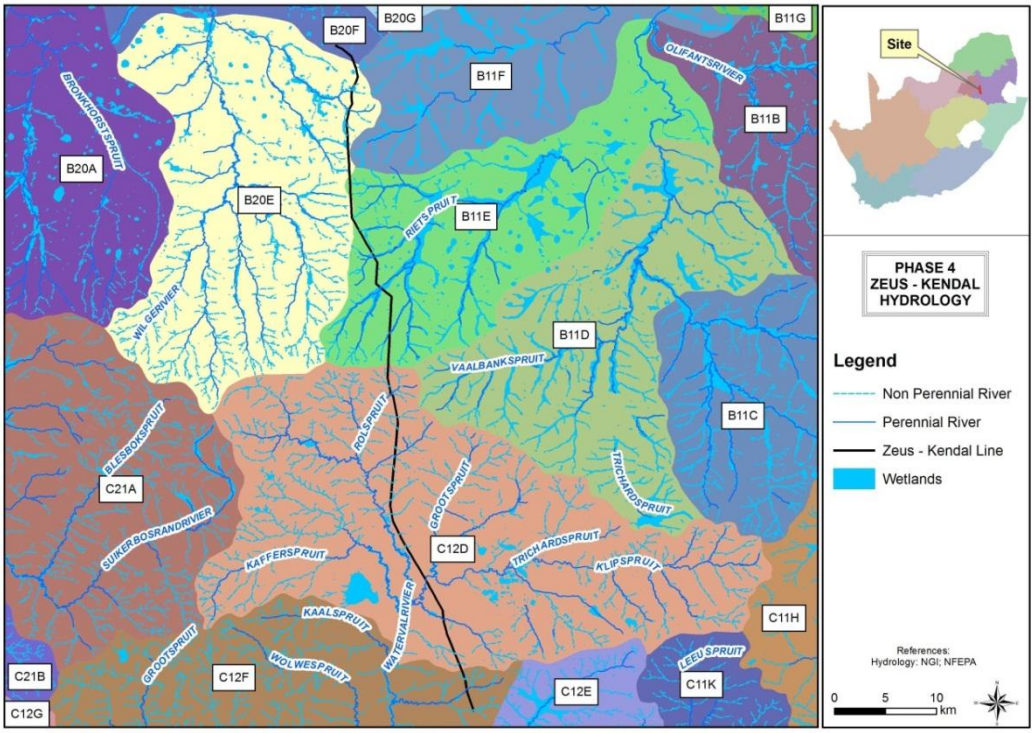

Figure 6: A hydrology map of the site and water features in the proximity of the powerline route.

Figure 7: The Kendall power station on the Mpumalanga Highveld Grassland biome between Delmas and Ogies.

Figure 8: Grassland directly east of the Kendal Power Station compound.

Figure 9: A westerly view over the major cause for environmental displacement – extensive maize production on all arable land, in this sandy loam on Karoo sediments. To terrestrial vertebrates maize fields are akin to sterile desert.

Figure 10: The valley floors of the undulating landscape form a network of drainage lines that flow into each other to form perennial streams supporting rank wetland vegetation, which in turn provide prerequisite habitat to discerning small mammals and amphibians.

Figure 11: The two predominant agricultural products of farmland along the Bravo 4 line. Tilling is responsible for environmental displacement and grazing could result in change and decline. However, managing range land often avoids fires that are conducive to ongoing habitat protection.

Figure 12: Grazing managed for optimal year-round beef production.

Figure 13: Mowed and harvested grass within the N17 servitude, with range land to the other side of the fence.

Figure 14: The undulating Highveld grassy plain typical of the interior.

Figure 15: The deeply incised tributary of the Rolspruit with under developed riparian zones.

Figure 16: The deeply incised Trichardspruit does not support well-developed wetland vegetation, and whatever there is will be over-utilized by grazing.

Figure 17: Grazing on turf just north of extensive maize fields. Here the new line will be to the east (right) in the servitude of the existing two lines pictured. There is less tilling in the clay soils of the southerly Soweto Highveld Grassland than on the northerly Eastern Highveld Grassland vegetation units.

Figure 18: Abused grassland just west of the Embalenhle Township. The conservation status such as this is contra-productive to optimal vertebrate species richness and population densities.

Figure 19: Extensive grassy plain in a rather transformed state just north of the site portrayed in Figure 18.

Figure 20: Note the black clayey nature of Soweto Highveld Grassland at this latitude.

Figure 21: The Zeus Substation in the Highveld Grassveld biome.

5. METHODS

5.1 Mammal, Reptile and Frog Survey

The ca. 70km length of the Bravo 4 route was travelled on 13 and 16 May 2016. During this exercise the observed and derived presence of mammals, reptiles and amphibians associated with the recognized habitat types of the study site, were recorded. This was done with due regard to the well recorded global distributions of Southern African vertebrates, coupled to the qualitative and quantitative nature of recognized habitats.

During the duration of the assessment, a global opinion of the conservation status of the entire route was developed in order to express it according to the descriptive ratings defined in Section 5.5 below. In order to enable us to develop the ability to calculate an impact rating of the powerline and servitude as described in Section5.6 below, 15 easily accessible sampling plots were selected and the coordinates taken with a Garmin Montana 650 were recorded, an e-image were made and notes regarding the environmental characteristic of the site were recorded. As part of the description of the study area these impressions are presented in Figures 7 to 21 above.

The 500 meters of adjoining properties was scanned for important fauna habitats or factors that may be affected by the new line and its servitude.

5.2 Field Survey

During the site visit vertebrates were identified by visual sightings through random transect walks and patrolling with a vehicle. No trapping was conducted, as the terms of reference did not require such intensive work. In addition, mammals were also identified by means of spoor, droppings, burrows or roosting sites. Locals were interviewed to confirm occurrences or absences of species.

Three criteria were used to gauge the probability of occurrence of vertebrate species on the study site. These include known distribution range, habitat preference and the qualitative and quantitative presence of suitable habitat.

5.3 Desktop Survey

As many vertebrates are either secretive, nocturnal, hibernators, migrators and/or seasonal, distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of these species based on authoritative tomes, scientific literature, field guides, atlases and data bases. This can be done with a high level of confidence irrespective of season. During the field work phase of the project, this derived list of occurrences is audited.

The probability of occurrences of terrestrial vertebrate species was based on their respective geographical distributional ranges and the suitability of on-site habitats. In other words, *high probability* would be applicable to a species with a distributional range overlying the study site as well as the presence of prime habitat occurring on the study site. Another consideration for inclusion in this category is the inclination of a species to be common, i.e. normally occurring at high population densities.

Medium probability pertains to a species with its distributional range peripherally overlapping the study site, or required habitat on the site being sub-optimal. The size of the site as it relates to its likelihood to sustain a viable breeding population, as well as its geographical isolation is also taken into consideration. Species categorized as medium normally do not occur at high population numbers, but cannot be deemed as rare.

A *low probability* of occurrence will mean that the species' distributional range is peripheral to the study site and habitat is sub-optimal. Furthermore, some mammals categorized as low are generally deemed to be rare.

5.4 Specific Requirements

Mammals: During the visit the site was surveyed and assessed for the potential occurrence of such Red Data and/or wetland-associated species as Juliana's golden mole (*Neamblosomus juliana*), Highveld golden mole (*Amblysomus septentrionalis*), Rough-haired golden mole (*Chrysospalax villosus*), African marsh rat (*Dasymys incomtus*), Angoni vlei rat (*Otomys angoniensis*), Vlei rat (*Otomys irroratus*), White-tailed rat (*Mystromys albicaudatus*), a member of shrews such as the Forest shrew (*Myosorex varius*), Southern African hedgehog *(Atelerix frontalis), a number of bats such as the* Short-eared trident bat (*Cloeotis percivali*), African clawless otter (*Aonyx capensis*), Spotted-necked otter (*Lutra maculicollis*), Marsh mongoose (*Atilax paludinosus*), Brown hyena (*Parahyaena brunnea*), etc.

Herpetofauna: During the visit, the site was surveyed and assessed for the potential occurrence of South African Red Data species in Gauteng and Mpumalanga Provinces (Minter, *et al*, 2004; Alexander & Marais, 2007; Du Preez & Carruthers, 2009 and Bates, *et al*, 2014), such as: Nile Crocodile (*Crocodylus niloticus*); Giant Bullfrog (*Pyxicephalus adspersus*); Plain Stream Frog (*Strongylopus wageri*); Spotted Shovel-Nosed Frog (*Hemisus guttatus*); Whistling Rain Frog (*Breviceps sopranus*); Coppery Grass Lizard (*Chamaeasaura aenea*); Large-Scaled Grass Lizard (*Chamaeasaura macrolepis);* Giant Dragon Lizard (*Smaug giganteus*); Fitzsimons' Flat Lizard (*Platysaurus orientalis fitzimonsi*); Breyer's Long-Tailed Seps (*Tetradactylus breyeri*); Striped Harlequin Snake (*Homoroselaps dorsalis*); and Southern African Python (*Python natalensis*).

5.5 Assessment criteria

Conservation status of habitats along the study site is subjectively assigned to one of five levels of sensitivity, i.e.

High: Ecologically sensitive and valuable land, with high species richness, sensitive ecosystems or Red Data species, that should be conserved and no development allowed.

Medium-high: Land where sections are disturbed but that is still ecologically sensitive to development/disturbance.

Medium: Land on which low-impact development with limited impact on the ecosystem could be considered, but where it is still recommended that certain portions of the natural habitat be maintained as open spaces.

Medium-low: Land on which small sections could be considered for conservation but where the area in general has little conservation value.

Low: Land that has little conservation value and that could be considered for developed with little to no impact on the habitats or fauna.

In some instances the Medium-high, Medium and Medium-high categories are lumped as of Medium Conservation sensitivity. This approach correlates highly with the empirical Significance ratings as defined below.

5.6 Significance (Consequence) Rankings

The quantitative methods to express an impact of an anticipated development all calculate their impact on pristine (or near-pristine) environmental conditions. Should the area under consideration has already been altered, the difference between the *status quo* and the final impact will be factored in.

The methods and format of the impact tables used in this report are in accordance to the requirements of the 2014 NEMA Regulations. This approach is more empirical and yields quantitative values ideal for comparative purposes.

» The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.

» The **probability (P)** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).

» The **duration (D)**, wherein it will be indicated whether:

∗ the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;

∗ the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;

∗ medium-term (5–15 years) – assigned a score of 3;

∗ long term (> 15 years) - assigned a score of 4; or

∗ permanent - assigned a score of 5;

» The **extent (E)**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):

» The **magnitude (M)**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

» the **significance (S)**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high;

- the significance rating is calculated by the following formula:

S (significance) = (D + E + M) x (P)

» the **status**, which will be described as either positive, negative or neutral.

» the degree to which the impact can be reversed.

» the degree to which the impact may cause irreplaceable loss of resources.

» the *degree* to which the impact can be *mitigated.*

The numerical value of the calculation is assigned to a significance category.

RANKING	65-100	64-36	35-16	15-5	1-4

SIGNIFICANCE	Very High	High	Moderate	Low	Minor

Impacts should be identified for the construction and operational phases of the proposed development. Proposed mitigation measures should be practical and feasible such that they can be realistically implemented by the applicant.

6. RESULTS

A site visit by a mammalogist and a botanist was conducted on 13 and 16 May 2016 from 09:00-16:30 hours. The days were mild and sunny with a light wind. The herpetologist made a desktop assessment based on the data set collated during the site visit that forms part of this report.

6.1 MAMMALS

Acocks (1988), Mucina and Rutherford (2006), Low & Rebelo (1996), Knobel and Bredenkamp (2006) and SANBI & DEAT (2009) discuss the distinguishing plant associations of the study area in broad terms. It should be acknowledged that botanical geographers have made immense strides in defining plant associations (particularly assemblages denoted as vegetation units or veld types), whereas this cannot be said of zoologists. The reason is that vertebrate distributions are not very dependent on the minutiae of plant associations. Rautenbach (1978 & 1982) found that mammal assemblages can at best be correlated with botanically defined biomes, such as those by Low and Rebelo (1996 & 1998), and latterly by Mucina and Rutherford (2006) as well Knobel and Bredenkamp (2006). Hence, although the former's work has been superseded by the work of the latter two, the definitions of biomes are similar and both remain valid for mammals and are therefore recognized as a reasonable determinant of mammalian distribution.

The local occurrences of mammals are, on the other hand, closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupiculous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of mammal species by evaluating the habitat types within the context of global distribution ranges.

6.1.1 Mammal Habitat Assessment

The route under investigation traverses rather uniform terrain and only two habitat types are present, namely predominantly terrestrial and to a lesser extent wetland (Figures 3 – 21). Of greater importance is that the land along the route has been extensively transformed by maize fields; as much as 60% of the land mass has long since been tilled and placed under cultivation. A mosaic of non-arable grassland patches and fields translated into fragmented distribution and laboured gene-flow through the impaired mechanism of connectivity. Grasslands are generally judged to be ecologically disturbed, in fact in places grasslands have been recklessly overgrazed (Figures 18 and 19). However, maximizing grazing includes a range management plan to exclude grass fires. Such an approach enhances species diversity and especially population densities. Most mammals do not breed during winter and population maxima drop during the passage of winter, but at least that phase in population dynamics are not exarcerbated by deprivation of refuge and nourishment as result of a grass fire.

6.1.2 Observed and Expected Mammal Species Richness

Species adapted to rupiculous and arboreal habitats were *a priori* deleted from the list (Table 1) since these were never available.

It is concluded that 40 species of mammals still manage to persist along the 70km farmland to be traversed by the Bravo 4 line. This is a rather high number for a site offering only two habitat types, but is an artefact of the extensive area.

Large mammals (such elephants, buffaloes, black wildebeests, red hartebeests, white rhinos, lions, leopards and others) have long since been extirpated for sport and later to favour grazing and growing crops. Later medium-sized mammals were hunted out or coincidentally displaced, in particular baboons, monkeys, warthogs and bush pigs. We have not come across any evidence that herbivores have been re-introduced.

Most of the species of the resident diversity (Table 1) are common and widespread (viz. scrub hares, multimammate mice, pygmy mice, genets, mongooses and others). Many of the species listed in Table 1 are robust (some with strong pioneering capabilities). The reason for their survival success is predominantly seated in their remarkable reproduction potential (viz. multimammate mice species capable of producing ca. 12 pups per litter at intervals of three weeks [r-selected]), and to a lesser extent their reticent and cryptic nature (scrub hares, genets and mongooses).

The listed vespertilionid bats showed remarkable adaptability by expanding their distributional ranges and population numbers significantly by capitalizing on the roosting opportunities offered by manmade structures; in this instance in the houses and structures in the vicinity. Vesper bats are more tolerant towards roost opportunities and it is more than likely that small colonies found roosting opportunities in the roofs of buildings near the study site. The study site offers no caves or suitable structures answering to the exacting roosting requirements of cave-dwelling bats (Hipposideridae, Rhinolophidae, Nycteridae), but it is likely that they have roosts elsewhere and at times commute to wetlands along the route to hawk for aerial invertebrates and feeding patches formed by insect swarms rising over water during summer sunsets.

It is deemed unlikely that otters persist (or ever occurred) in the larger streams (Figures 15 and 16) given their reliance on pristine streams.

Table 2: Mammal diversity. The species observed or deduced to occupy the site. (Systematics and taxonomy as proposed by Bronner et.al [2003], Skinner & Chimimba [2005], Apps [2012] and Stuart & Stuart [2015]).

	SCIENTIFIC NAME	ENGLISH NAME
	Order Afrosoricida	
	Order Tubulidentata	
	Family Orycteropodidae	
√	*Orycteropus afer*	Aardvark
	Order Lagomorpha	
	Family Leporidae	
√	*Lepus saxatilis*	Scrub hare
	Order Rodentia	
	Family Bathyergidae	
√	*Cryptomys hottentotus*	African mole rat
	Family Hystricidae	

√	*Hystrix africaeaustralis*	Cape porcupine
	Family Tryonomyidae	
√	*Thryonomys swinderianus*	Greater cane rat
	Family Pedetidae	
√	*Pedetes capensis*	Springhare
	Family Muridae	
√	*Rhabdomys pumilio*	Four-striped grass mouse
NT	*Dasymys incomtus*	African marsh rat
√	*Mus minutoides*	Pygmy mouse
√	*Mastomys natalensis*	Natal multimammate mouse
√	*Mastomys coucha*	Southern multimammate mouse
√	*Aethomys ineptus*	Tete veld rat
√	*Otomys angoniensis*	Angoni vlei rat
√	*Otomys irroratus*	Vlei rat
√	*Gerbilliscus brantsii*	Highveld gerbil
√	*Saccostomus campestris*	Pouched mouse
√	*Dendromus melanotis*	Grey pygmy climbing mouse
√	*Dendromus mesomelas*	Brants' climbing mouse
√	*Dendromus mystacalis*	Chestnut climbing mouse
	Order Eulipotypha	
	Family Soricidae	
DD	*Suncus lixus*	Greater dwarf shrew
DD	*Suncus infinitesimus*	Least dwarf shrew
DD	*Crocidura cyanea*	Reddish-grey musk shrew
DD	*Crocidura hirta*	Lesser red musk shrew
	Family Erinaceidae	
NT	*Atelerix frontalis*	Southern African hedgehog
	Order Chiroptera	
	Family Embalonuridae	
*	*Taphozous mauritianus*	Mauritian tomb bat
	Family Molossidae	
√	*Tadarida aegyptiaca*	Egyptian free-tailed bat
	Family Vespertilionidae	
NT	*Myotis welwitchii*	Welwitsch's hairy bat
NT	*Myotis tricolor*	Temminck's hairy bat
√	*Neoromicia capensis*	Cape serotine bat
√	*Scotophilus dinganii*	African yellow house bat
√	*Scotophilus viridis*	Greenish yellow house bat
	Family Nycteridae	
?	*Nycteris thebaica*	Egyptian slit-faced bat
	Family Rhinolophidae	
NT	*Rhinolophus clivosus*	Geoffroy's horseshoe bat
	Family Hipposideridae	
DD	*Hipposideros caffer*	Sundevall's roundleaf bat
	Order Carnivora	
	Family Hyaenidae	
√	*Proteles cristatus*	Aardwolf
NT	*Parahyaena brunnea*	Brown hyena
	Family Felidae	
?	*Caracal caracal*	Caracal
√	*Felis silvestris*	African wild cat
	Family Viverridae	

√	*Civettictis civetta*	African civet
√	*Genetta genetta*	Small-spotted genet
√	*Genetta tigrina*	SA large-spotted genet
	Family Herpestidae	
√	*Cynictis penicillata*	Yellow mongoose
√	*Galerella sanguinea*	Slender mongoose
√	*Ichneumia albicauda*	White-tailed mongoose
√	*Atilax paludinosus*	Marsh mongoose
	Family Canidae	
√	*Canis mesomelas*	Black-backed jackal
	Family Mustelidae	
DD	*Poecilogale albinucha*	African weasel
√	*Ictonyx striatus*	Striped polecat
	Order Ruminanta	
	Family Bovidae	
√	*Sylvicapra grimmia*	Common duiker
√	*Raphicerus campestris*	Steenbok

√ Definitely there or have a *high* probability to occur;
***** *Medium* probability to occur based on ecological and distributional parameters;
? *Low* probability to occur based on ecological and distributional parameters.

Red Data species rankings as defined in Friedmann and Daly's S.A. Red Data Book / IUCN (World Conservation Union) (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, LR/cd = Lower risk conservation dependent, LR/nt = Lower Risk near threatened, DD = Data Deficient. All other species are deemed of Least Concern.

6.1.3 Red Listed Mammal Species Identified:

-By the Scientific Community

The African marsh rat is narrowly dependent on rank semi-aquatic vegetation in riparian zones. This type of floral assemblage is almost always heavily grazed by cattle and thus reduced in effectiveness. However, it is contended that along the 70km trajectory some marsh rats survived.

The two musk shrew species (*Crocidura* spp.) the two dwarf shrews (*Suncus* spp.) as well as the African weasel (*Poecilogale*) cited as 'DD' in Table 1 are not necessarily endangered. These small mammals have not been adequately studied to provide quantitative field data for accurately assigning a conservation ranking. As a precaution, they are thus considered as 'Data Deficient'. Shrews and the weasel exist at the apex of the food pyramid, which means that their population numbers are inevitably significantly lower than that of similar-sized herbivorous mammals and especially of their smaller prey species. Because of the diet of these ferocious little insectivores / carnivores, they are furthermore not readily trapped with conventional bait or traps which may mean that their numbers are under-estimated. Good capture results for shrews obtained with drift fences and pitfalls support the latter statement.

Hedgehogs are 'Near Threatened' as result of interference by humans and their pets. Under natural conditions the passive defence mechanisms of these rather docile insectivores are sufficient to maintain breeding populations in a healthy condition. Considering the size of the district and connectivity in all directions it is reported that a small population of hedgehogs persist.

It is unclear why the two hairy bat species (*Myotis*) are regarded to be 'Near Threatened'. Cave-dwelling bats (*Rhinolophus*, *Nycteris* and *Hipposideros* spp.) are obligatory hibernators. In order to survive harsh Highveld winters in cold and moist overwintering caves, fat reserves are accumulated and used as 'fuel' when surviving at much-reduced physiological processes (one heart-beat per minute). Should hibernating bats be disturbed, they use fat reserves at an accelerated physiological rate in order to flee. It follows that should they are often disturbed while hibernating (such as by cave explorers), bats run out of fuel before the advent of summer and abundant invertebrate prey, and succumb from lack of 'fuel'.

Brown hyenas have been prosecuted to the point that they are deemed as "Near Threatened". It is amazing how the fallacy of brown hyenas is 'sheep killers' persist. Brown hyenas are known to range far and wide, and it must therefore be accepted that vagrants from the extensive district occasionally visit the study site.

No other Red Data or sensitive species are deemed present on the site, either since the site is too disturbed, falls outside the distributional ranges of some species, or does not offer suitable habitat(s).

-By the Biodiversity Act No 10 of 2004
Protected Species S.A. Hedgehog
Brown hyena

-By the Mpumalanga Nature Conservation Act no. 10 of 1998
Schedule 2: Protected Game
Hedgehog - Atelerix frontalis
Aardwolf - Proteles cristatus
Brown hyena - Parahyaena brunnea
Antbear - Orycteropus afer
Steenbok - Raphicerus campestris
Schedule 3: Ordinary Game
Scrub hare - Lepus saxatilis
Grey duiker - Sylvicapra grimmia
Schedule 5: Wild Animals to Which the Provisions of Section 33 Apply
Yellow mongoose - Cynictis penicillata
Slender mongoose - *Galerella sanguinea*
White-tailed mongoose - *Ichneumia albicauda*
Marsh mongoose - Atilax paludinosus
Civet - Civettictis civetta
Small-spotted genet - *Genetta genetta*
Large-spotted genet - *Genetta tigrina*
African wild cat - *Felis silvestris*
Schedule 8: Problem Animals
Black-backed jackal - *Canis mesomelas*

-Endemism:
None of the species purported to be residents of the study site and surrounding areas are endemic to Mpumalanga.

6.2 HERPETOFAUNA

Local presences of reptiles and amphibians are closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupiculous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of reptile and amphibian species by evaluating the habitat types within the context of global distribution ranges.

6.2.1. Herpetofauna Habitat Assessment

From a herpetological habitat perspective, it was established that two of the four major habitats are present along the Bravo 4 route, namely terrestrial and wetland-associated vegetation cover.

Most of the servitude consists of transformed grassland. The natural grassland was first transformed for agricultural purposes and some of it later by anthropogenic influences such as buildings, roads, fences and invasive plants. The study site is thus ecologically partly disturbed in many parts, otherwise even transformed. Moribund termitaria were recorded. These structures are good indicators of the occurrence of certain small herpetofaunal species. Accordingly, it is estimated that the reptile and amphibian population density for the linear study site is higher. At the time of the site visit the basal cover was good in grassveld portions and thus provides adequate cover for small terrestrial herpetofauna. Where grassveld was disturbed (such as overgrazing) prey is probably sparsely distributed, so foraging grounds would need to be fairly extensive to support the various populations of herpetofauna.

There are no areas of natural rupiculous habitat. Due to the absence of natural rupiculous habitat, some species like common girdled lizard and rock agama were omitted from the species list. However, there are plenty of artificial surrogates for rupiculous habitat, such as buildings, concrete fences and rubble dumps. Only common reptiles like the speckled rock skink benefit from these.

Noticeable absentees from the study site are indigenous trees. Arboreal habitat is therefore absent in a functional sense. Due to the absence of natural arboreal habitat, some species such as tree agamas and flap-neck chameleons were omitted from the species list. Most of the trees present on the study site are exotics. There are several dead logs, which provide shelter and food for some herpetofauna.

There are drainage lines, pans and manmade dams on or near the study site. Some of the dams are temporary and others are permanent. These water sources would provide habitat for common water-dependent herpetofauna. All wetlands are protected in Mpumalanga Province and are regarded as being sensitive.

6.2.2. Observed and Expected Herpetofauna Species Richness

Thirty-nine reptile species are likely to occur along the study site (Table 2) and a possibility of 15 amphibian species which may occur on the study site (Table 2).

The total of 54 herpetofauna species is recorded as potential occupants of the study site. Most of these are robust generalists with the ability to capitalise on disturbed environments. It should be noted that potential occurrence is interpreted as being possible over a period of time, as a result of expansions and contractions of population densities and ranges which stimulate migration.

The American red-eared terrapin (*Trachemys scripta elegans*) and the Brahminy blind snake (*Ramphotyphlops braminus*) are the only two feral reptile or amphibian species known to occur in South Africa (De Moor and Bruton, 1988; Picker and Griffiths, 2011), but with only a few recorded populations they are not expected to occur on this particular site.

The species assemblage is typical of what can be expected in extensive natural areas with sufficient habitat to sustain populations. Most of the species of the resident diversity (Table 2) are fairly common and widespread (viz. brown house snake, mole snake, common egg eater, rinkhals, speckled rock skink, common platanna, common river frog, Boettger's caco, bubbling kassina and guttural toad).

Table 3: Reptile and Amphibian diversity. The species observed or deduced to occupy the site. Systematic arrangement and nomenclature according to Branch (1998), Minter, *et.al* (2004), Alexander & Marais (2007), Du Preez & Carruthers (2009) and Bates *et.al* (2014)

	SCIENTIFIC NAME	ENGLISH NAME
	CLASS: REPTILIA	REPTILES
	Order: TESTUDINES	TORTOISES & TERRAPINS
	Family: Pelomedusidae	Side-necked Terrapins
?	*Pelomedusa subrufa*	Marsh Terrapin
	Order: SQUAMATA	SCALE-BEARING REPTILES
	Suborder:LACERTILIA	LIZARDS
	Family: Gekkonidae	Geckos
?	*Lygodactylus capensis capensis*	Common Dwarf Gecko
?	*Lygodactylus nigropunctatus*	Black-Spotted Dwarf Gecko
?	*Pachydactylus affinis*	Transvaal Gecko
/	*Pachydactylus capensis*	Cape Gecko
	Family: Lacertidae	Old World Lizards or Lacertids
?	*chnotropis capensis*	Ornate Rough-Scaled Lizard
?	*Nucras intertexta*	Spotted Sandveld Lizard
	Family: Cordylidae	
?NT	*Chamaesaura aenea*	Coppery Grass Lizard
?NT	*Chamaesaura macrolepis*	Large-Scaled Grass Lizard
	Family: Gerrhosauridae	Plated Lizards
?	*Gerhosaurus flavigularis*	Yellow-Throated Plated Lizard
	Family: Scincidae	Skinks
?	*Acontias gracilicauda*	Thin-Tailed Legless Skink
/	*Trachylepis capensis*	Cape Skink
/	*Trachylepis punctatissima*	Speckled Rock Skink
?	*Trachylepis varia*	Variable Skink
	Afroablepharus wahlbergii	Wahlberg's Snake-Eyed Skink
?	*Mochlus sundevallii sundevallii*	Sundevall's Writhing Skink
	Family: Agamidae	Agamas
/	*Agama aculeata distanti*	Eastern Ground Agama
	Family: Varanidae	Monitors
/	*Varanus niloticus*	Water Monitor
	Suborder: SERPENTES	SNAKES
	Family: Typhlopidae	Blind Snakes
	Afrotyphlops bibronii	Bibron's Blind Snake
?	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake

	SCIENTIFIC NAME	ENGLISH NAME
	Family: Leptotyphlopidae	Thread Snakes
?	*Leptotyphlops distanti*	Distant's Thread Snake
/	*Leptotyphlops scutifrons*	Peter's Thread Snake
	Family: Viperidae	Adders
/	*Bitis arietans arietans*	Puff Adder
	Causus rhombeatus	Rhombic Night Adder
	Family: Lamprophiidae	
/	*Aparallactus capensis*	Black-headed Centipede Eater
/	*Boaedon capensis*	Common House Snake
?	*Lamprophis aurora*	Aurora Snake
/	*Lycodonomorphus rufulus*	Brown Water Snake
?	*Lycophidion capense capense*	Cape Wolf Snake
/	*Psammophis brevirostris*	Short-snouted Grass Snake
/	*Psammophis crucifer*	Cross-Marked Grass Snake
?	*Psammophis subtaeniatus*	Western Yellow-Bellied Sand Snake
?	*Psammophis trinasalis*	Fork-Marked Sand Snake
	Psammophylax rhombeatus	Spotted Grass Snake
?	*Duberria lutrix lutrix*	South African Slug-Eater
/	*Pseudaspis cana*	Mole Snake
	Family: Elapidae	Cobras, Mambas and Others
/	*Hemachatus haemachatus*	Rinkhals
	Family: Colubridae	
/	*Crotaphopeltis hotamboeia*	Red-Lipped Snake
/	*Dasypeltis scabra*	Rhombic Egg Eater
	CLASS: AMPHIBIA	AMPHIBIANS
	Order: ANURA	FROGS
	Family: Pipidae	Clawed Frogs
/	*Xenopus laevis*	Common Platanna
	Family: Bufonidae	Toads
/	*Amietophrynus gutturalis*	Guttural Toad
	Amietophrynus rangeri	Raucous Toad
	Schismaderma carens	Red Toad
	Family: Hyperoliidae	Reed Frogs
/	*Kassina senegalesis*	Bubbling Kassina
	Family: Ptychadenidae	Grass Frogs
?	*Ptychadena porosissima*	Striped Grass Frog
	Family: Phrynobatrachidae	Puddle Frog
?	*Phrynobatrachus natalensis*	Snoring Puddle Frog
	Family: Pyxicephalidae	
/	*Amietia angolensis*	Common River Frog
	Amietia fuscigula	Cape River Frog
/	*Strongylopus fasciatus*	Striped Stream Frog
?	*Strongylopus grayii*	Clicking Stream Frog
/	*Cocosternum boettgeri*	Boettger's Caco or Common Caco
?**NT**	*Pyxicephalus adspersus*	Giant Bullfrog
/	*Tomopterna cryptotis*	Tremolo Sand Frog
/	*Tomopterna natalensis*	Natal Sand Frog

√ Definitely there or have a *high* probability of occurring;

* *Medium* probability of occurring based on ecological and distributional parameters;

? *Low* probability of occurring based on ecological and distributional parameters.

Red Data species rankings as defined in Branch, The Conservation Status of South Africa's threatened Reptiles': 89 – 103..In:- G.H.Verdoorn & J. le Roux (editors), 'The State of Southern Africa's Species (2002) and Minter, *et.al*, Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, NT = Near Threatened, DD = Data Deficient. All other species are deemed of Least Concern.

6.2.3. Red Data Listed Herpetofauna identified

-By the Scientific Community

The study site falls outside the natural range of the plain stream frog, spotted shovel-nosed frog, whistling rain frog; giant dragon lizard, Fitzsimons' flat lizard, Breyer's long-tailed seps, striped harlequin snake, Nile crocodile and Southern African python. These species should occur on the study site.

The coppery grass lizard has been recorded near a part of the study site and there are parts of the study site which consist of fairly pristine grassveld. Therefore there is a possibility that this species may occur on the study site.

The large-scaled grass lizard has been recorded near a small part of the study site. Therefore there is a small possibility that this species may occur along the study site.

Temporary pans occur on or near the servitude, but there are only a few localities in Mpumalanga Province where giant bullfrogs were recorded (Du Preez & Cook, 2004) and most are not near the study site.

Giant Bullfrogs require four types of habitat in order to survive under natural conditions: 1) breeding sites, 2) soils suitable for burrowing, 3) foraging grounds and 4) dispersal corridors (Carruthers, 2009). The study site to a greater or lesser degree provides all four of these habitats. Requirement 4, the dispersal corridors, plays an important part on the study site. Potential breeding sites for the giant bullfrog are present on or near the study site. These breeding sites are temporary, which bullfrogs prefer in order to avoid predation from fish. They also need water bodies of which at least one side has a very gentle slope. A gentle slope allows for shallow water (less than 10cm deep), which enables the female bullfrog to stand when she lays her eggs outside the water for the male to fertilise. Bullfrog tadpoles swim in schools and stay in the warm, shallow water during the day for rapid development (Van Wyk *et al*., 1992).

Some parts of the study site consist of sandy soil and are very suitable as a dispersal area for bullfrogs, which combines feeding and aestivation. It is essential that the soil be suitable for burrowing on a daily basis during the short activity period at the beginning of the rainy season and for deeper retreats during the resting periods. It is submitted that a small possibility exists that this species may occur on the study site.

It is important to note that in the latest literature (Measey (ed.) 2011 and Carruthers & Du Preez, 2011); the giant bullfrog's status has changed officially from Near Threatened (Minter *et al*, 2004) to Least Concern in South Africa.

Species with Mpumalanga Red Data status, like the striped harlequin snake (*Homoroselaps lacteus*) and many-spotted snake (*Amplorhinus multimacullatus*) do not occur on or near the study site.

7. FINDINGS AND POTENTIAL IMPLICATIONS

7.1 Impact Impressions

The extensive impact of growing crops has already reduced species richness *in situ* to zero. The disturbance of grazing on remaining patches of grassland varies from high to minimal.

The Bravo 4 line will not result in a further loss of ecological sensitive and important habitat units, ecosystem function (e.g. reduction in water quality, soil pollution), loss of mammal habitat, nor of loss/displacement of threatened or protected species. No sensitive ecological system or function is present.

All streams and wetlands are red-flagged as sensitive, as per statutory prerequisites.

Species richness: The *status quo* will not be altered during either the construction or especially the operational phases.
Endangered species: Ditto above.
Sensitive species and/or areas (Conservation ranking): Nil. The reality is that the footprint and/or effect of an imposing powerline are in fact ecologically remarkably light, particularly during the operational phase.
Habitat(s) quality and extent: Natural habitat may be affected during construction (especially compaction by vehicles), but can easily be rehabilitated, or can recover naturally over time.
Impact on species richness and conservation: Nil.
Connectivity: The Bravo 4 development will have no effect on connectivity during the operational stage, and very temporarily and very local during the construction phase.
Management recommendation: Nil.
General: Nil.

7.2 Assessment criteria

The conservation impact on natural biota of the construction and operation of the Bravo 4 Powerline is rated to be **Medium-low** i.e. *Land on which small sections could be considered for conservation but where the area in general has little conservation value* (See Section 5.5 – Assessment Criteria to express conservation status). This definition takes into account the generally disturbed state of the natural environment along the 70km length of the line, and the virtually benign affect an operational powerline has on the environment.

7.3 Impacts on mammals and herpetofauna

See Section 5.6 (Significance (Consequence) Rankings) for the procedure to calculate ranking values.

Table 4: Direct impact on terrestrial vertebrate communities

Nature: An ESKOM powerline is an imposing structure. However, its effect on terrestrial vertebrate species is limited to the collective surface area of four feet and anchor points typical of the more common towers (see the image on the cover page). This impact is no more than that of rocks or termitaria that may be present in the vicinity. The majority of mammals and all herpetofauna are terrestrial, and as such they are NOT prone to collisions or electrocution. Bats are indeed volant but they seldom hawk for prey at the average height of a powerline (30 meters) and have highly echolocation capabilities to navigate and avoid obstacles. The development can be reversed with human intervention, and recovered materials can be recycled. No irreplaceable loss or even reduction of ecological resources is anticipated. Mitigation the impacts is standard procedure for ESKOM developments.				
	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Most likely	4	Most likely	4
Duration	Short duration	2	Short duration	2
Extent	Regional	3	Regional	3
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**28**	**Moderate**	**28**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Most likely	4	Most likely	4
Duration	Long term	4	Long term	4
Extent	Regional	3	Regional	3
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**36**	**Moderate**	**36**
Status (positive or negative)	**Negative**		**Negative**	
Reversibility	High		High	
Irreplaceable loss of resources?	Low		Low	
Can impacts be mitigated?	Yes			

Mitigation: • A powerline *per se* is deemed harmless to terrestrial vertebrates, but the servitude will have an effect. • It must be noted that an ESKOM servitude act as a valuable conservation asset, such as *inter alia* a seedbank and often as prime habitat. • A powerline is normally reached by way of an access dirt tract along the servitude. It is important that this asset is managed to not cause erosion. • Woody plants are generally removed to reduce the impact of 'hot' fires. Since fires represent a catastrophic event for terrestrial vertebrates, this *modus operandus* is considered as positive. • Mature stands of grass develop and serve as excellent refuge and nourishment. However mature stands of grass are mowed to reduce the impact of accidental fires and this deprive most terrestrial vertebrates of refuge and nourishment. This cannot realistically be mitigated and must thus be left to the devices of ecological processes.
Cumulative impacts: Submitted to be initially minimal and thereafter stabilized, as the development will be relatively light and most fauna species have relatively high mobility or adaptivity. Impact to connectivity and ecological services will be insignificant, especially since mammals and herps adapt fast to low-key and consistent disturbances such as noise.
Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.

Table 5: Loss of faunal habitat and ecological structure

Nature: The physical structure of the development will not detract from optimizing habitat maintenance. The management of the servitude of the Bravo 4 Powerline may, however, result in negligible loss of pristine mammal, reptile and amphibian habitats, but this is counterbalanced by seasonal lush grass cover that are irregularly mowed to reduce the intensity of fires. It would appear that cut grass are left *in situ*, which will enhance the build-up of the surface detritus layer. Preservation of vegetation generally affects nutrient cycles, built-up of the organic litter layer and mostly results in habitat refuges.
The minimal loss of habitat due to development can be reversed with human intervention. However, leaving ecological succession to its own device will mostly result to lush basal cover.
No irreplaceable loss of resources is anticipated.
Mitigation the impacts is standard procedure for ESKOM developments.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Most likely	4	Most likely	4
Duration	Short duration	2	Short duration	2
Extent	Regional	3	Regional	3
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**28**	**Moderate**	**28**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Most likely	4	Most likely	4

Duration	Long term	4	Long term	4
Extent	Regional	3	Regional	3
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**36**	**Moderate**	**36**
Status (positive or negative)	Negative		Negative	
Reversibility	High		High	
Irreplaceable loss of resources?	Negligible		Negligible	
Can impacts be mitigated?	Yes			
Mitigation: • None other than the standard precautionary measures incorporated in ESKOM best-practice development protocol along a servitude. • It is strongly recommend that alien weeds are actively removed / destroyed. • It is suggested to leave cut grass in situ. This will ameliorate the habitat alteration by cutting a high stand of grass, will not detract from the maintenance of a seed bank, and will combat erosion. • ESKOM *modus operandus* for storm water management will suffice.				
Cumulative impacts: Expected to be minimal.				
Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.				

8. LIMITATIONS, ASSUMPTIONS AND GAPS IN INFORMATION

The vertebrate team has sufficient experience and ample access to information sources to confidently compile lists of mammals, reptiles and frogs (or in this instance detail the loss of species) to support conclusions and suggested mitigation measures based on a site visit. In instances where doubt exists, a species is assumed to be a possible occupant (viz. *Suncus* species or bullfrog); -this approach renders the conclusions to be robust. In instances where the possible occurrence has significant ecological implications, an intensive survey is recommended. In view of the latter, it is highly unlikely that an intensive survey will augment this site visit will add significantly to the data base, and the additional costs are unlikely to warrant the effort.

9. CONCLUSIONS

The ca. 70km long Bravo 4 Powerline will traverse the Highveld grassland biome in a north – south axis between the Kendal Power Station to the Zeus Substation. Only terrestrial and wetland habitats are present. Roughly 60% of the terrain through which the line's servitude will traverse comprises of maize fields, interspersed with grasslands on non-arable soils. Environmentally the maize fields are sterile entities for mammals, reptiles and amphibians. The grasslands represent terrestrial habitat that have conservation status (and concomitant habitat utility) ranging from unashamedly overgrazed to fairly a well preserved condition.

All streams and wetlands are red-flagged as sensitive, as per statutory prerequisites.

It is concluded that 40 species of mammals, 39 reptiles and 15 amphibians are likely to occur somewhere in the untransformed portions along of the servitude.

The line will not impact on its immediate environment since most of the terrain has already been transformed into maize fields, and furthermore since powerlines themselves are rather benign in spite of their formidable appearance. Mammals (bats excluded), reptiles and frogs are terrestrial and thus not exposed to the risk of collisions with the wires or be electrocuted. The servitude has both a slight positive and negative impact. The natural vegetation along the servitude will be manipulated towards rampant grassland by the removal of woody plants to reduce the risk of 'hot' fires. Generally the grassland in the servitude comprises prime terrestrial habitat by providing refuge and nourishment for herbivorous vertebrates, even though it may be grazed by domestic stock. Grasslands along such a grassy servitude also serve as seedbeds and, when mowed (to further reduce fire risks) the cut grass is left and still functions as habitat and furthermore adds to the organic litter layer.

It is predicted that the powerline and its servitude will not impact on species richness and no Red Data will be displaced. It should also be kept in mind that the Bravo 4 line will be along the servitude of existing lines and environmental damage (as it may be) is to a large extent factored in by the existing servitude.

The conservation status of the linear site is rated as **Medium-low** i.e. *Land on which small sections could be considered for conservation but where the area in general has little conservation value* (See Section 5.5 – Assessment Criteria to express conservation status).

The impact of the Bravo 4 Powerline and its servitude is calculated to be 'Moderate'. This ranking is boosted by the high Duration and Regional values and in a sense overly emphasizes the actual impact on terrestrial vertebrates and their habitats.

No reasonable objection can be raised to oppose the construction of the proposed development.

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APPENDIX A:

RÉSUMÉ

IGNATIUS LOURENS RAUTENBACH Ph.D., Prof. Nat. Sci.
Independent Environmental Consultant – MAMMALOGY.

Identity Number 421201 5012 00 5
Gender Male
Date of Birth 1 December 1942
Nationality South African
Home Languages Bilingual (English & Afrikaans)
Postal Address 45 Helgaard Street, Kilner Park, Pretoria, RSA 0186. Tel no +27 12 3334112, Cell +27 082 3351288. E-mail naasrauten@mweb.co.za
Former Position Retired Director: Planning, Northern Flagship Institute
Present Position Consultant – Specialist, Environmental Impact Assessments (Applied research), Photographing microstock for four agencies
Qualifications **B.Sc**. (UP), **T.H.E.D** (Pta TTC), **M.Sc.** (UP), **Ph.D**. (Un. Natal)
Professional Honours 1. Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400300/05
2. Fellow of the Photographic Society of South Africa
3. Master photographer at club level
4. Honorary life member of the S.A. Wildlife Management Association.
Notable Research Contribution In-depth survey of the Mammals of the Transvaal. 1982. 211pp. Ecoplan Monograph 1.
Notable Literary Contribution Rautenbach, Naas & Annalene Rautenbach. 2008. *Photography for Focused Beginners.* 302pp with 250 images. Green Door Studio, Pretoria.
Formal Courses Attended Computer Literacy, Project Management, Contract Design, Senior Management
Employment history
May 2001 - Present Self-employed, collaborator with Eco-Agent CC Ecological Consultants as well as Galago Environmental [environmental impact assessments], technical writing, and photography
April 1999 - August 2001 Director: Planning, Northern Flagship Institution
Jan 1991 - April 1999 Executive Director, Transvaal Museum
July 1967 - Dec 1990 Curator (in charge) of the Division of Mammalogy, Transvaal Museum. Promoted to Principal Scientist rank as of June 1985
March - June 1967 Research student at the Mammal Research Institute of the Zoology Department, University of Pretoria
July 1966, Nov l966 - Febr 1967 Member of the Smithsonian Institution's field teams collectively partaking in the 'African Mammal Project'
1966: Part-time research assistant to Prof. J. Meester, University of Pretoria
1962 - 1965 Temporary assistant during University holidays in the Nematology laboratories, Agricultural Technical Services
1991 - 2002 Founder member and non-executive director of the Board of Trustees of
1993 - 2001 Founder member and Trustee of the privatised Museums Pension Fund
1997 - 2001 Non-executive director of the Tswaing Section 21 Company

Professional Achievements
Managed a research institute of 125 members of staff. Solicited numerous grants totalling ≥ R1 000 000. Initiated and overseen building programmes of R30 million at the Transvaal Museum. Conceptualised and managed 12 display programmes.

Research: Author and co-author of 85 scientific publications re mammalogy in peer reviewed subject journals, 18 popular articles, 10 books, and >400 contractual EIA research reports. Extensive field work and laboratory experience in Africa, Europe, USA, Alaska, Brazil and Mexico. B -rated by FRD as scientist of international status 1983 – 1995.

Students: Additional to museum manager duties, **c**o-supervised 5 B.Sc. (Hons.), 2 M.Sc. and 2 Ph.D. students.

Public Recognition:
Public speaking *inter alia* Enrichment Lecturer on board the 6* *SS Silver Wind*, radio talks, TV appearances.

Hobbies
Technical writing, photography, field logistics, biological observations, wood working, cooking, designs.

Personal Evaluation
I am goal-orientated, expecting fellow workers and associates to share this trait. I am an extrovert, sensitive to amicable interpersonal relations. I have a wide interest span ranging from zoological consulting, photography, cooking, sport, news, gardening and out of necessity, DIY. To compensate for my less than perfect memory, I lead a structured and organised life to deal with the detail of a variety of interests. Often to the chagrin to people close to me, I have an inclination to "Think Out of the Box".

ABRIDGED CURRIVULUM VITAE VAN WYK:

JACOBUS CASPARUS PETRUS (JACO)

Identity number 680804 5041 08 4
Gender Male
Date of birth 4 August 1968
Nationality South African
Home languages Afrikaans, fluent in English
Postal address P.O. Box 25085, Monument Park, Pretoria, 0105.
Tel no +27 12 347 6502, Cell +27 82 410 8871
E-mail **jcpvanwyk@absamail.co.za**
Present position Co-Department Head, Environmental Education & Life Sciences, Hoërskool Waterkloof
Consultant Specialist Environmental Assessments, EIAs, writing, photo-recording
Qualifications **B.Sc**. (U.F.S.) **B.Sc. (Hon.)** (U.F.S.), **H.E.D** (U.F.S.), **M.Sc.** (U.F.S.)
Honours Foundation of Research Development bursary holder
Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400062/09
Notable Research Contribution In-depth field study of the giant bullfrog

Formal Courses Attended Outcomes Based Education, University of the South Africa (2002)
Introductory Evolution, University of the Witwatersrand (2008)
OBE, GET & FET training, 2002-2008, Education Department

Employment history
2000 – Present Co-Department Head for Environmental Education & Life Sciences, Hoërskool Waterkloof, Pretoria.
1995 - 1999 Teaching Biology (Grades 8 – 12) and Physics / Chemistry (Grades 8 – 9) at the Wilgerivier High School, Free State. Duties included teaching, mid-level management and administration.
July 1994 – Dec 1994 Teaching Botany practical tutorials to 1st year students at the Botany & Zoology Department of the Qwa-Qwa campus of the University of Free State, plant collecting, amphibian research
1993 - 1994 Mammal Research Institute (University of Pretoria) research associate on the Prince Edward Islands: topics field biology and population dynamics of invasive alien rodents, three indigenous seals, invertebrate assemblages, censussing king penguin chicks and lesser sheathbills, and marine pollution
1991 - 1993 Laboratory demonstrator for Zoological and Entomological practical tutorials, and caring for live research material, University of the Free State
1986 - 1990 Wildlife management and eco-guiding, Mt. Everest Game Farm, Harrismith
Professional Achievement **Research:** Author and co-author of 52 scientific publications in peer-reviewed and popular subject journals, and >60 contractual EIA research reports. Extensive field work and laboratory experience in Africa
Public Recognition: Public speaking *inter alia* radio talks, TV appearances
Hobbies: Popular writing, travel, marathon running, climbing (viz Kilimanjaro), photography, biological observations, public speaking.