CONSTRUCTION OF A 400 KV BY-PASS LINE, APPROXIMATELY 10 KM IN LENGTH, ON THE BRAVO – VULCAN (WITBANK) LINE TO BY-PASS DUVHA (Bravo 5). DEA Ref No - 12/12/20/1097

by

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Declaration of Professional Standing and Independence:

We,

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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 a 400 Kv By-Pass Line, Approximately 10km in Length, on the Bravo – Vulcan (Witbank) Line to By-Pass Duvha (Bravo 5). DEA Ref No - 12/12/20/1097” 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 assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are to some extent made on reasonable and informed assumptions built on *bone fide* information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and animal migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. The vertebrate team can thus not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. Although the authors exercised due care and diligence in rendering services and preparing documents, they accept no liability, and the client, by receiving this document, indemnifies the authors against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the authors and by the use of this document. This report should therefore be viewed and acted upon with these limitations in mind.

ABSTRACT

The site (as depicted in Figures 1- 8) has been entirely transformed into an industrial facility with a high security profile and strict measures to manage risks such as fire or unauthorized entrance. The latter takes precedence over nature preservation.

The conservation status of the site is rated as **Low**: i.e. *Land that has little conservation value and that could be considered for developed with little to no impact on the habitats or vertebrates.*

The impact of the constructing a 400kV by-pass within the Duvha compound and outside it in incoming and outgoing servitudes is calculated to be 'Moderate'. This ranking is boosted by the high "Definite" values that in a sense overly emphasize the actual impact on terrestrial vertebrates and their habitats.

No reasonable objection can be raised should intended bypass alterations are constructed.

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 diversity scan on the site proposed for the Bravo 5 powerline route. 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 vertebrates that can be expected in the area.
Identify the Red Data species that occur (or may occur) on the site.
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 live-support products for plants, animals and humans. Environmental degradation ranges from mega-problems such as global warming, demand for power, land-use practices to 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, such as:

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.

3. PROJECT DESCRIPTION

Eskom has been experiencing a growing demand for electricity which increasing pressure on the current existing 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 5 component of the Bravo Integration Project.

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

4. SCOPE AND OBJECTIVES OF THE STUDY

- To qualitatively and quantitatively assess the significance of the habitat components and current general conservation status of the study site;
- Identify and comment on ecologically sensitive areas or ecological services;
- Comments on connectivity with natural vegetation and habitats on adjacent terrain;
- To provide a list of that occur or might occur, and to identify species of conservation importance;
- To highlight potential impacts of the proposed development on the mammals and their habitats of the study site;
- 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.

5. STUDY AREA

5.1 General

The Bravo 5 initiative is located east of Emahlahleni, Mpumalanga, partially in the vicinity and partially within the compound of the Duvha Power Station (Figure 1). The studied area includes a powerline that bypasses the Duvha Power Station and connects the line to the existing grid. The site lies immediately south of large slimes dams. The Olifants River lies to the west and the R575 lies to the east.

The Mpumalanga Biodiversity Conservation plan: Critical Biodiversity Areas (Terrestrial) Map show the line traversing primarily areas with no natural habitat remaining and a small section classified as Important and Necessary and Highly Significant on the southern extent (Figure 2).

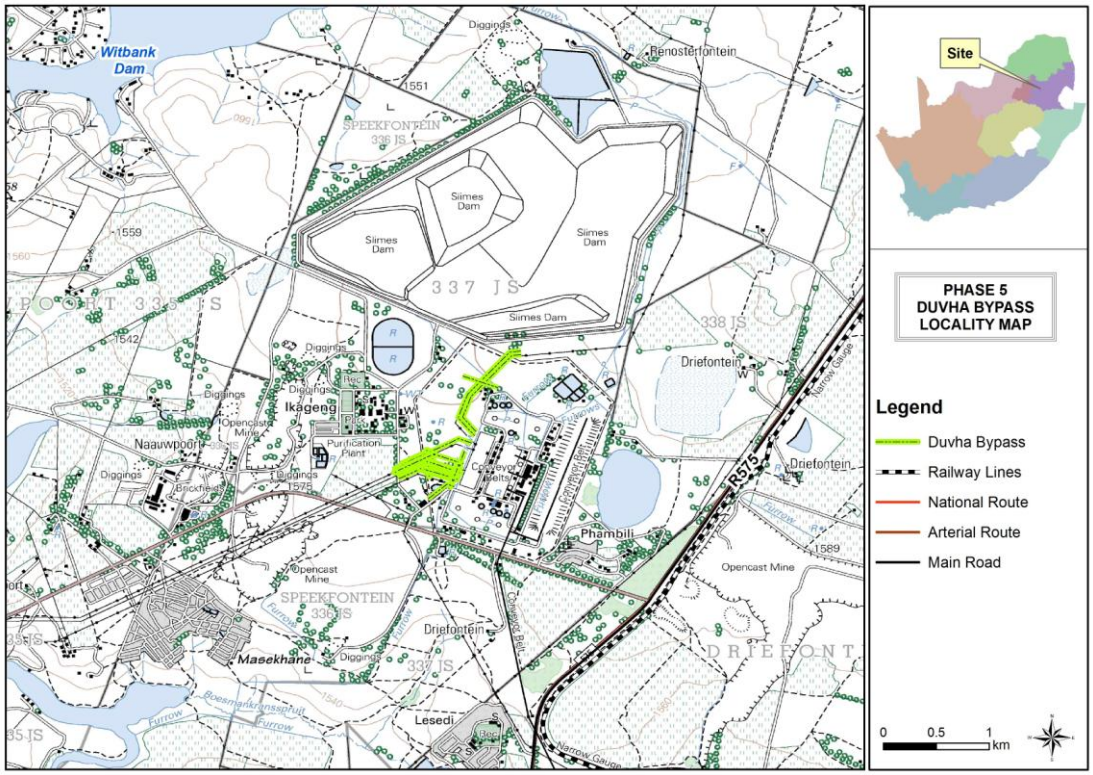

Figure 1: The location of the Bravo 5 powerline.

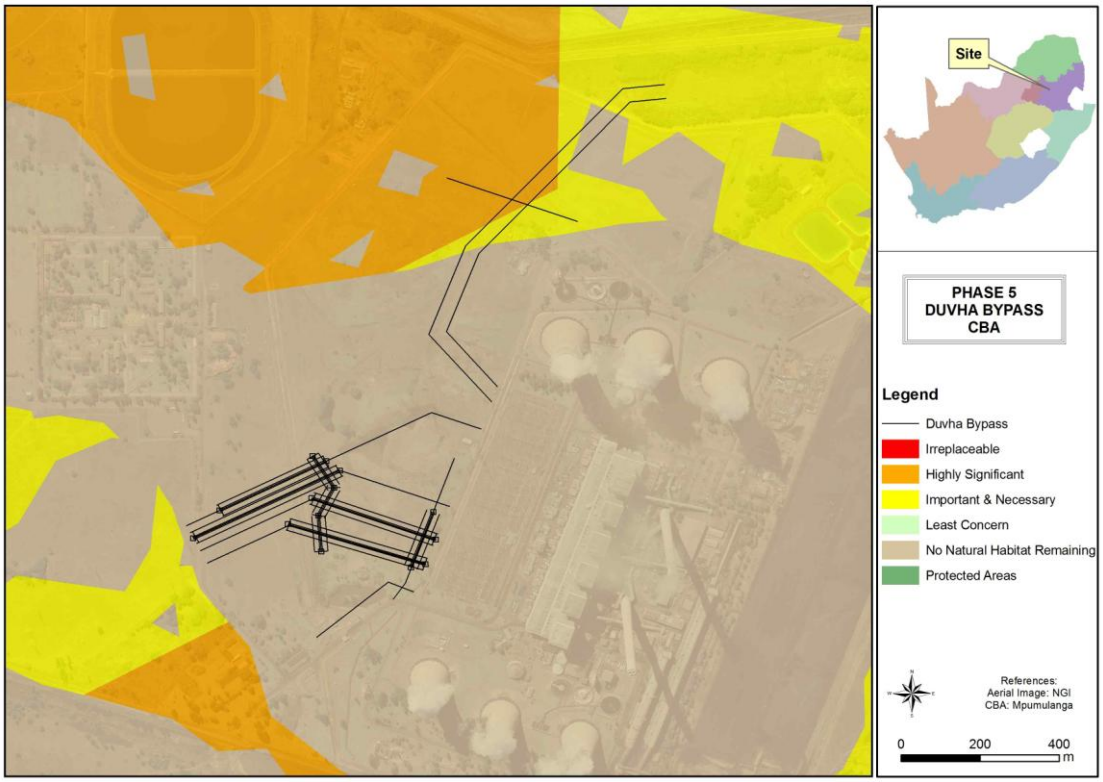

Figure 2: Conservation status of areas traversed by the proposed powerline as classified in the Mpumalanga regional datasets.

5.2 Vegetation Types

The study area falls within the Grassland Biome and at a higher resolution, the Rand Highveld Grassland vegetation unit to the south and Eastern Highveld Grassland vegetation unit to the north as classified by Mucina and Rutherford (2006) (Figure 3).

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

Figure 3: The vegetation classification for the proposed powerline.

5.3 Regional Hydrology

Wetland and river systems affected by the proposed powerline are discussed in detail in the accompanying wetland assessment report. In general, the study site falls within Quaternary Catchment B11G and drains towards the Olifants River. This site further falls within the DWS Olifants Water Management Area, nr 4. The NFEPA wetland layer shows several water bodies close to the proposed infrastructure, although they are not natural (Figure 4).

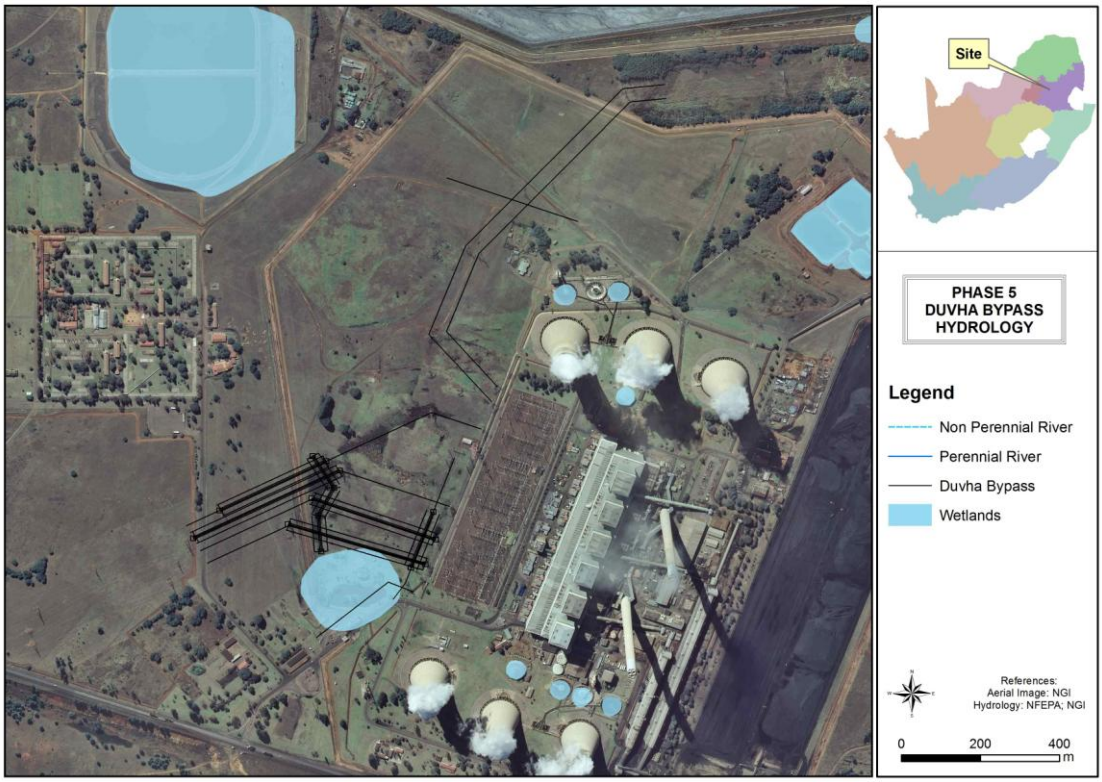

Figure 4: A hydrology map of the site and water features in the proximity of the powerline route.

5.4 Site Description

The relatively small study site comprises of the Duvha Power Station and surrounding land over which the incoming and outgoing lines traverse. Clearly the entire terrain has been cleared and levelled before construction commenced. During the operational phase of the station, regeneration of natural grass commenced and progressed to a relatively lush stand of mature secondary grass. Fires are obviously avoided. A small herd of zebra are kept in the compound but the grazing is not ideal for a species preferring short grass. The wetland north of the Duvha Station and the slimes dam is manmade when levelling of the construction site resulted in a depression.

Figure 5: A south-easterly view of the Duvha Power Station. The bypass construction will be within the secured compound of the station.

Figure 6: The entire compound of the Duvha Power Station is secured by a double mesh fence with barbed wire loops atop the outer, and an electrical fence in-between.

Figure 7: The two incoming lines from the north-east cross a manmade wetland between the Duvha perimeter to the right and a slimes dam visible to the left. See footprint in Figure 1.

Figure 8: The outgoing lines exiting to the south-west across cut grassland within and outside the Duvha security compound.

6. METHODS

6.1 Vertebrate Survey

A three-hour site visit was conducted on 23 May 2016, during which 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.

The 500 meters of adjoining properties was scanned for important fauna habitats.

6.2 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.

6.3 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 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 mammal 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.

6.4 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 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*).

6.5 Assessment criteria

Conservation status of habitats within 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.

6.6 Significance (Consequence) Rankings

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. In this instance the total impact of the entire proposed developments is simultaneously calculated. The derived numerical value of the environmental impact will be interpreted in relationship to other conditions and influences (viz. historical events).

- 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.

7. RESULTS

A site visit by a mammalogist and a botanist was conducted on 23 May 2016 from 09:00-11:30 hours. The day was warm and sunny with a light wind. The herpetologist made a desktop assessment based on the data garnered during the site visit and his contribution forms part of this report, that ideally should be considered together with the floral report.

7.1 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.

7.1.1 Mammal Habitat Assessment

Natural habitat has been entirely demolished when the terrain for the station was prepared for construction. Subsequently regeneration commenced and within the compound as well as under the incoming and outgoing lines a good stand of secondary grass developed that are regularly mowed. The twin security thick-gauge mesh-fences (Figure 6) were probably one of the first structures to be built with the likelihood that trapped mammals eventually perished. The fence bases are concreted and the mesh is so small that movement in and out of the compound is impossible for all animals bar the very smallest, such as pygmy mice. Wetland vegetation became established in the manmade wetland immediately north of the perimeter barrier, some of it aliens. Nevertheless, it is probable that some moisture-reliant small mammals invaded this habitat type.

The site is devoid of any indigenous trees (wattles are present), whereas moribund termitaria serving as refuge for dwarf shrews and pygmy mice were not recorded.

7.1.2 Observed and Expected Mammal Species Richness

Species adapted to rupiculous\ and arboreal habitats were *a priori* deleted from the list of occurrences (Table 2) since these were never available. Only 16 species are probable inhabitants of the area to be affected by the development, and most of them outside the perimeter fencing and are unable to pass through the fine mesh.

All of the species (Table 2) are common and widespread (viz. scrub hares, multimammate mice, pygmy mice, mongooses). These 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), and to a lesser extent their reticent and cryptic nature (viz. scrub hares 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 and will at time over fly the site. There are no caves or suitable structures answering to the exacting roosting requirements of cave-dwelling bats (Hipposideridae, Rhinolophidae, Nycteridae).

The species richness is low and is an artefact of unintended curbing species richness in order to clear the site, construct the power plant and thereafter secure it. The overall quality of conservation is ranked as zero considering the total devastation of environmental elements.

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 Lagomorpha	
	Family Leporidae	
*	*Lepus saxatilis*	Scrub hare
	Order Rodentia	
	Family Bathyergidae	
*	*Cryptomys hottentotus*	African mole rat
	Family Muridae	
?	*Rhabdomys pumilio*	Four-striped grass mouse
*	*Mus minutoides*	Pygmy mouse
*	*Mastomys natalensis*	Natal multimammate mouse
*	*Mastomys coucha*	Southern multimammate mouse
*	*Aethomys ineptus*	Tete veld rat
*	*Gerbilliscus brantsii*	Highveld gerbil
	Order Eulipotypha	
	Family Soricidae	
DD?	*Crocidura cyanea*	Reddish-grey musk shrew
DD?	*Crocidura hirta*	Lesser red musk shrew
	Order Chiroptera	
	Family Vespertilionidae	
√	*Neoromicia capensis*	Cape serotine bat
√	*Scotophilus dinganii*	African yellow house bat
√	*Scotophilus viridis*	Greenish yellow house bat
	Order Carnivora	

	Family Herpestidae	
√	*Cynictis penicillata*	Yellow mongoose
√	*Galerella sanguinea*	Slender mongoose
	Order Perissodactyla	
	Family Equidae	
√	*Equus quagga*	Plains zebra

√ **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.

7.1.3 Red Listed Mammal Species Identified:

-By the Scientific Community

The two shrew species 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 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, they are furthermore not readily trapped with conventional bait or traps which may mean that their numbers are under-estimated. Good capture results obtained with drift fences and pitfalls support the latter statement.

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

Nil

-By the Mpumalanga Nature Conservation Act 10 of 1998.

Nil.

7.2 HERPETOFAUNA

In any local setting, the occurrence of reptiles and amphibians are closely dependent on four broadly defined habitat types, i.e. 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.

7.2.1 Herpetofauna Habitat Assessment

From a herpetological perspective it is concluded that two of the four major habitats are naturally present on or near the study site, namely terrestrial and wetland-associated vegetation cover. No moribund termitaria were recorded within the terrestrial habitat-type on the study site. These structures are good indicators of the occurrence of specific small herpetofauna. Accordingly, it is estimated that the reptile and amphibian population density for the study site is lower than normal. At the time of the site visit the basal cover was generally very poor in places and would not provide adequate cover for small terrestrial herpetofauna.

Arboreal habitat is absent from the site and due to this discerning species like flap-neck chameleons, tree agama and the spotted bush snake were omitted from the species list in Table 3. Due to the absence of indigenous or exotic trees there are no dead logs, which could provide shelter and food for some reptiles.

Natural rupiculous habitat was not present; consequently some species like common girdled lizard and rock agama were omitted from Table 3.

The wetland north of the Duvha Station and the slimes dam is manmade when levelling of the construction site resulted in a depression. As a consequence, habitat is available for temporary water-breeding frog species north of the study site. These may venture onto the site (but outside the perimeter fence) during very wet periods.

7.2.2 Observed and Expected Herpetofauna Species Richness

Forty-six herpetofauna species are recorded as potential residents of, or vagrants to the study site (31 reptiles and 15 amphibians) (Table 3). None were confirmed during site visits. Most of these species 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 species known to occur in South Africa (De Moor and Bruton, 1988; Picker and Griffiths, 2011) but, with only a few 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 3) are fairly common and widespread (viz. common house snake, mole snake, common egg eater, speckled rock skink, Boettger's caco, bubbling kassina and guttural toad and red toad). The relatively low species richness is due to the disturbed nature of the fairly small study site and only two different habitat types occurring on the study site (one peripherally).

Table 3: Reptile and Amphibian diversity. The species observed or deduced to occupy the site. Species list and 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
√	*Pachydactylus affinis*	Transvaal Gecko
*	*Pachydactylus capensis*	Cape Gecko

	SCIENTIFIC NAME	ENGLISH NAME
	Family:Lacertidae	Old World Lizards or Lacertids
?	*Nucras ornata*	Ornate Sandveld Lizard
	Family: Cordylidae	Cordylids
?**NT**	*Chamaesaura aenea*	Coppery Grass Lizard
	Family: Gerrhosauridae	Plated Lizards
?	*Gerhosaurus flavigularis*	Yellow-throated Plated Lizard
	Family: Scincidae	Skinks
?	*Acontias gracilicauda*	Thin Tailed Legless Skink
*	*Afroablepharus wahlbergii*	Wahlberg's Snake-Eyed Skink
√	*Trachylepis capensis*	Cape Skink
√	*Trachylepis punctatissima*	Speckled Rock Skink
?	*Trachylepis varia*	Variable Skink
	Family: Varanidae	Monitors
?	*Varanus albigularis albigularis*	Water Monitor
	Family: Agamidae	Agamas
√	*Agama aculeata distanti*	Eastern Ground Agama
	Suborder: SERPENTES	SNAKES
	Family: Typhlopidae	Blind Snakes
?	*Afrotyphlops bibronii*	Bibron's Blind Snake
	Family: Leptotyphlopidae	Thread Snakes
*	*Leptotyphlops distanti*	Distant's Thread Snake
	Family: Viperidae	Adders
*	*Bitis arietans*	Puff Adder
√	*Causus rhombeatus*	Rhombic Night Adder
	Family: Lamprophiidae	
?	*Aparallactus capensis*	Black-Headed Centipede Eater
?	*Atractaspis bibronii*	Bibron's Stiletto Snake
?**NT**	*Homoroselaps dorsalis*	Striped Harlequin Snake
√	*Boaedon capensis*	Common House Snake
?	*Lamprophis aurora*	Aurora House Snake
?	*Lycodonomorphus rufulus*	Brown Water Snake
?	*Psammophis brevirostris*	Short-Snouted Grass Snake
*	*Psammophylax rhombeatus 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*	Common or Rhombic Egg Eater
	CLASS: AMPHIBIA	AMPHIBIANS
	Order: ANURA	FROGS
	Family: Pipidae	Clawed Frogs
√	*Xenopus laevis*	Common Platanna
	Family: Bufonidae	Toads
√	*Amietaophrynus gutturalis*	Guttural Toad
*	*Amietaophrynus rangeri*	Rauccous Toad
*	*Schismaderma carens*	Red Toad
	Family: Hyperoliidae	Reed Frogs

	SCIENTIFIC NAME	ENGLISH NAME
*	*Kassina senegalesis*	Bubbling Kassina
?	*Semnodactylus weallii*	Rattling Frog
	Family: Phrynobatrachidae	Puddle Frog
?	*Phrynobatrachus natalensis*	Snoring Puddle Frog
	Family: Ptychadenidae	Grass Frogs
?	*Ptychadena porosissima*	Striped Grass Frog
	Family: Pyxicephalidae	
√	*Amietia angolensis*	Common 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.

7.2.3 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, Nile crocodile and Southern African python. These species should occur on the study site.

The coppery grass lizard has been recorded on a quarter degree square near the study site and therefore there is a possibility that this species may occur on or near the study site.

The striped harlequin snake has been recorded on a quarter degree square near the study site but moribund termitaria, where this species is most likely to be found, are absent from the study site. It is very difficult to confirm whether this cryptic snake is present on any study site, but there is a vsmall possibility that this species may occur on the study site.

There are only a few localities in Mpumalanga Province where giant bullfrogs were recorded (Du Preez & Cook, 2004), with only one near the study site. The buffer area north of the study site contains temporary wetlands, which are potential breeding places for giant bullfrogs. Giant bullfrogs prefer warm, stagnant water, which giant bullfrog tadpoles need for rapid development (Van Wyk, Kok & Du Preez, 1992). Bullfrog breeding sites are mostly temporary, in order to avoid predation from fish. Some of the wetlands on the study site have gentle slopes, which giant bullfrogs prefer. A gentle slope allows for shallow water (less than 10cm deep), which enables the female bullfrog to stand when she lays her eggs above the water surface for the male to fertilise. Many parts of the study site consist of sandy

soil and are very suitable as dispersal areas, which combine 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 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 of Least Concern in South Africa, although it is currently still a ToPS-listed species (Threatened or Protected Species).

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

-By the Mpumalanga Nature Conservation Act no. 10 of 1998

Schedule 2: Protected Game

Nil.

Bullfrog

All species of reptiles excluding the water leguan, rock leguan and all species of snakes

Schedule 3: Ordinary Game

Nil.

Schedule 4: Protected Wild Animals

Nil.

Schedule 5: Wild Animals to Which the Provisions of Section 33 Apply

Water leguan

Rock leguan

Schedule 6: Problem Animals

All species of exotic tortoises, turtles and terrapins

-Endemism:

None of the species purported to be residents of the study site and surrounding areas are endemic to Gauteng or Mpumalanga.

8. FINDINGS AND POTENTIAL IMPLICATIONS

8.1 Impact Assessment

The intended development will not result in a further loss of ecological sensitive and important habitat units (natural or manmade), 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.

Species richness: Has been reduced during the construction phase, but will not be further affected by the new development.

Endangered species: Will not be affected by the new development.

Sensitive species and/or areas (Conservation ranking): The site has been entirely transformed during the construction phase and will not be subjected to any rehabilitation efforts.
Habitat(s) quality and extent: Terrestrial habitat regenerated into a secondary condition and a wetland developed co-incidentally as result of site clearing and levelling. Neither will be altered.
Impact on species richness and conservation: The new development is not expected to further degrade either species richness or conservation.
Connectivity: The perimeter security fence is an exceptional barrier to connectivity, answering to its design objectives.
Management recommendation: Nil.
General: Nil.

8.2 Assessment criteria

The conservation impact on natural biota of the construction and operation of the Bravo 4 Powerline is rated to be **Low,** i.e. *"Land that has little conservation value and that could be considered for developed with little to no impact on the habitats or fauna".*

8.3 Impacts on mammals and herpetofauna

See Section 6.6 (Significance (Consequence) Rankings) for the procedure to calculate ranking values.

Table 4: Direct impact on terrestrial vertebrate communities.

Nature: At the commencement of construction the power plant was secured for a number of safety reasons. The precautions were intended to exclude humans without authorization from the site, but are equally effective against terrestrial vertebrate species. Zoologically the net effect is virtually a matter of what is outside, remains outside and what survived inside, remain inside

The development can be reversed with costly human intervention, and recovered materials can be recycled.

No further loss or even reduction of ecological resources is anticipated.

Mitigation the impacts is standard procedure for ESKOM developments, but in this instance mitigation is superfluous.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Definite	5	Definite	5
Duration	Short duration	1	Short duration	1
Extent	Local	1	Local	1
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**20**	**Moderate**	**20**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Most likely	5	Most likely	5
Duration	Long term	4	Long term	4
Extent	Local	1	Local	1
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**35**	**Moderate**	**35**
Status (positive or negative)	**Negative**		**Negative**	
Reversibility	High		High	
Irreplaceable loss of	None		None	

resources?		
Can impacts be mitigated?	No – redundant	
Mitigation: • The development will be on terrain that has previously been entirely transformed and managed for the purpose it was designed for. Nature preservation was not amenable to the objective and was thus not a consideration.		
Cumulative impacts: Former developments intentionally transformed a small portion of Highveld grassland to build and operate a high security and sensitive facility. The transformation was complete and no further damage to prime environmental assets can be inflicted and should be accepted as a *fete d'accomple.*		
Residual Risks: None anticipated.		

Table 5: Loss of faunal habitat and ecological structure.

Nature: The initial development transformed the campus and surrounds. In the interim a regeneration of secondary grassland developed inside the compound and at critical places is mowed to curb fire hazards. Away from the substation grass is grazed by zebras but few other (if any) herbivores.

The minimal loss of secondary habitat due to development can be reversed with costly human intervention. Leaving ecological succession to its own devices is not compliant with limiting fire hazards.

No irreplaceable loss of resources is anticipated.
Mitigating the impacts is standard procedure for ESKOM developments but in this instance is not attainable.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Definite	5	Definite	5
Duration	Short duration	1	Short duration	1
Extent	Local	1	Local	1
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**20**	**Moderate**	**20**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Definite	5	Definite	5
Duration	Long term	4	Long term	4
Extent	Local	1	Local	1
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**35**	**Moderate**	**35**
Status (positive or negative)	Negative		Negative	
Reversibility	High		High	
Irreplaceable loss of resources?	None		None	
Can impacts be mitigated?	No - redundant			

Mitigation: • None possible due to former blanket transformation. Secondary habitats evolved will not be affected.
Cumulative impacts: Expected to be none.
Residual Risks: None anticipated.

9. LIMITATIONS, ASSUMPTIONS AND GAPS IN INFORMATION

The vertebrate team has sufficient experience and ample access to information sources to confidently compile lists of biota (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); -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.

10. CONCLUSIONS

The site (as depicted in Figures 1- 8) has been entirely transformed into an industrial facility with a high security profile and strict measures to manage risks such as fire or unauthorized entrance. The latter takes precedence over nature preservation.

The conservation status of the site is rated as **Low**: i.e. *Land that has little conservation value and that could be considered for developed with little to no impact on the habitats or vertebrates.*

The impact of the constructing a 400kV by-pass within the Duvha compound and outside it in incoming and outgoing servitudes is calculated to be 'Moderate'. This ranking is boosted by the high "Definite" values that in a sense overly emphasize the actual impact on terrestrial vertebrates and their habitats.

No reasonable objection can be raised should intended bypass alterations are constructed.

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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:

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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 >260 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.