ASSESSMENT OF VERTEBRATE SPECIES RICHNESS AND THEIR HABITATS OF PORTIONS OF FARM DE ROODEPOORT 435 IS, ERMELO DISTRICT

by

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Commissioned by Limosella on behalf of Centaur De Roodepoort (Pty) Ltd

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Declaration of Professional Standing and Independence:

We,

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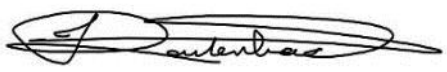
Jacobus Casparus Petrus van Wyk (SACNASP # 400062/09)
declare that we:

- 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 "Assessment of Vertebrate Species Richness and their Habitats of Portions of Farm De Roodepoort 435 IS, Ermelo District", 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 A.E. Mckechnie

Disclaimer:

Even though every care is taken to ensure the accuracy of this report, faunal and environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are made, to some extent, on reasonable and informed assumptions built on *bona fide* information sources, as well as deductive reasoning. A more factual report, based on field collecting and observations, can only be derived over several years and seasons of research, 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 therefore not accept responsibility for conclusions and mitigation measures, made in good faith, based on own databases, and 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 accepting this document, indemnifies the authors against all actions, claims, demands, losses, liabilities, costs, damages and expenses that arise from or in connection with services rendered, directly or indirectly, by the authors and use of this document. This report should therefore be viewed and acted upon with these limitations in mind.

EXECUTIVE SUMMARY

General: Three of the four major vertebrate habitat types are present, are sensitive and of good quality. Ecologically, the terrestrial habitat quality has been disturbed in some areas by livestock grazing, wire fences, a few gravel roads and monocultures. The study site falls in the Soweto Highveld Grassland (Gm 8) that has *Endangered* status and Amersfoort Highveld Clay Grassland (Gm 13) with a *Vulnerable* status. However most of the Amersfoort Highveld Clay Grassland is already disturbed by maize and soya fields.

Indigenous grasslands provide important ecological services like promoting water quality, quantity and sustainability, sediment control, floral (seed, pollination) and faunal (food, rest, breeding, connectivity) support.

The Ermelo district is water rich with many streams, dams and wetlands. All these water bodies are recognized as sensitive; there are sensitive wetland areas near the proposed mine that will require caution. In terms of the National Water Act, all wetlands in and around the study area must be considered as ecologically sensitive. The study site contains part of a water catchment area that, as an ecological mechanism, is very important. The drainage lines as well as their buffer zones should be considered as ecologically highly sensitive. The normal 100 meters buffer zone outside the riparian zone applies since the development will be outside the urban edge.

The mining operation will be underground and compared to opencast mining environmental damage will be significantly less.

The mine complex will reportedly be 130 hectares in extent and will displace maize and soya bean fields as well as a portion of primary grass between the fields and the railway lines to the south. Constructing an underground mine on the fields has no environmental conservation impact; former destruction has been comprehensive. However, destroying primary Soweto Highveld Grassland cannot be sanctioned without at least an offer of offset measures, especially since the coal mine industry's idea of rehabilitation is not always commensurate with that of ecologists. In this instance the grassland conservation status is rated as ***Medium-High,*** *i.e. Land where sections are disturbed but that is still ecologically sensitive to development/disturbance*. (See Sections 6.4 and 8.1 – Assessment Criteria to express conservation status). The impact scores of the mine development will be 60 and 36 respectively for the grassland and the cropland (See Sections 6.5 and 8.2).

The confirmed presence of three red-listed bird species, likely presence of two additional species, likely presence of one MPTA-listed species, plus the location of the site within an IBA, collectively calls for the sensitivity of the site to be considered Medium-High from an avifaunal perspective. The contribution of proposed development to cumulative avian habitat loss in the Amersfoort-Bethal-Carolina IBA also cannot be ignored. Although the surface infrastructure of the proposed mine will largely be restricted to areas that are currently under agriculture, the wider impacts of the mining activities on avifauna at the site must be carefully considered. For instance, one factor that should be considered is the potential for negative impacts over a larger area of the IBA through pollution

associated with construction and/or mining activities; the possibility exists, for instance, that injudicious use of toxic chemicals at the site could reach areas nearby wetlands via run-off and/or groundwater. For this reason, the location of this site within the IBA must be borne in mind when assessing the impacts of the construction and operational phases of this project.

The onus therefore rest on the Mpumalanga Nature Conservation Department to decide the way forward, especially since the grassland to-be-affected by the development coincide with a small patch of CBA irreplaceable patch in the Mpumalanga Biodiversity Plan (Figure 8).

The footprint of the mining operation will displace all vertebrates (including Red Data species that may occur or occasionally visit the site *per se*). This, however, does not place additional survival pressure on any species given the extensive rural nature of the district.

No views are offered regarding the indirect effect of mining, such as dust, noise, poaching or aesthetics. Neither does this investigation address the agricultural value of the land to be compromised by the mine development.

1 INTRODUCTION

Primarily this report focuses on the reigning status of threatened and sensitive vertebrates likely to occur on the proposed development site, and whose conservation status should be considered in the decision-making process. The report also remarks on sensitive ecosystems and/or services. In addition, special attention is paid to the qualitative and quantitative habitat conditions for Red Data species deemed present on the site and mitigation measures to ameliorate the effect of the proposed development. The secondary objective of the investigation is to compile a complete list of vertebrate species richness of the study area. The predicted impact of the development on species richness and habitat quality is discussed.

2 ASSIGNMENT – Protocol

This assignment is in accordance with the 2014 Environmental Impact Assessment (EIA) Regulations No. R. 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 scholarly report of the vertebrate fauna and habitats of the site, with emphasis on Red Data species and any critical ecosystems that may occur on the site. In order to compile this information, we had to define the extent and conservation condition of the major habitat types, and to test the environmental feasibility of these locations:

2.1 Initial preparations:

Obtain all relevant maps and information on the natural and disturbed environments of the area under scrutiny, including on Red Data vertebrate species that may occur within the area to be affected.

2.2 Faunal assessment

- Compile lists of the vertebrates that can be expected in the area and highlight Red Data species.
- Assess the quantitative and qualitative condition of suitable habitat for the Red-listed vertebrates that may occur in the area.
- Express an opinion pertaining to the conservation status of the Red Data species and their habitats.

2.3 General

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

3 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.

3.1 Background: Ecological impacts of coal mining

"Coal mining is one of the core industries that contribute to the economic development of a country but deteriorate the environment" (Tiwary 2001). Coal mines and their associated infrastructure generate a wide variety of potential environmental impacts during the construction, operational and decommissioning phases. The nature and severity of these

impacts depend to a large extent on the extent of mining operations, as well as the pre-mining state of a site. In broad terms, the potential environmental impacts of coal mines fall into the following categories:

- ***Topography***
  Large coal mines can cause extensive alterations to landscapes – in extreme cases the crests of entire mountains can be removed. Such large-scale landscape alterations, in addition to negatively affecting aesthetics of landscapes, can significantly affect drainage and water run-off patterns.

- ***Soil***
  Topsoil is a vital biological resource since it provides a habitat for vegetation and fossorial organisms. In addition, topsoil and the vegetation it hosts stabilizes underlying layers, and removal of topsoil and the associated vegetation can trigger significant erosion, particularly on slopes. The process of mining increases rates of erosion, by exposing underlying layers to rain and weather, and the removal of topsoil makes land unsuitable for natural vegetation or agriculture. Coal mining generates various wastes, many of which can pollute soil and potentially make it unsuitable for agricultural activities /rehabilitation post-decommissioning.

- ***Animals and plants***
  Coal mining activities and associated infrastructure affect plant and animal activities in a wide variety of ways, besides issues related to the impacts associated with soil interference, water and air pollution. Large areas are often cleared for mining, resulting in significant loss of habitat. Increased human pressure associated with mine personnel may affect animals directly through them being killed when they enter buildings, etc, as well as through activities such as poaching. Moreover, many components of the infrastructure associated with coal mines, such as powerlines, roads, bridges and so forth have the potential to generate significant negative impacts. Human activities can also result in the establishment of populations of invasive species, such as rats and plants used in artificial wetlands for treating effluent.

- ***Water***
  Pollution of surface and ground water – many of the most severe negative impacts of coal mining are manifested via pollution of surface and ground water. Pollution can affect areas far away from mines because pollutants are transported in streams and rivers, as well as in subterranean aquifers. Coal mines can cause water pollution in several ways (from Tiwary 2001):

1) Drainage from mining sites – mines typical involve water influxes from rain or interception of ground water flows. In most cases, much of this water is pumped out. Mine drainage may contain a variety of pollutants, including particulates, oil and grease, and in some instances undetonated explosives. In addition, the composition of mine drainage is strongly dependent on the chemical properties of the coal – a high sulphur content in the form of pyrites can cause mine water to be highly acidic. Tiwary (2001) found that water becomes acidic when sulphur content (in the form of pyrites) is 1-5 %. Acid mine drainage (AMD) can cause considerable downstream pollution, often characterised by a yellowish precipitate on the bottom of streams. AMD arises when sulphur-bearing minerals (e.g., pyrites) are oxidised, and can occur in dumps and stockpiles, as well as in opencast mines when seeping

groundwater or rain comes into contact with coal seams. The negative impacts of AMD are severe, and extend far beyond a mine. A study of AMD in Indian coal mines recorded run-off pH as low as 1.53 at some sites (Tiwary 2001). In addition, AMD is usually associated with high loading of metals such as iron and manganese.

2) Sediment run-off – rainfall can cause significant amounts of run-off from coal stockpiles and overburden/topsoil dumps, and pollutants can leach out from these materials. This problem is exacerbated by the highly erode-able nature of overburden/topsoil dumps.
3) Oil/fuel spillages – mining activities typically require large amounts of fuel to power vehicles and generators, and spillages are inevitable. In addition, mine workshops use large quantities of oil and other chemicals, and effluents entering local water systems during activities such as washing machinery can cause significant pollution.
4) Leaching of pollutants from overburden dumps – toxic substances present in overburden dumps can be leached in groundwater during rainfall. In addition, high pyrite content in overburden dumps can mean that water leaching through becomes acidic.
5) Sewage effluent – water used for domestic and sanitary purposes on site can pollute surface or ground water if not treated correctly.

- ***Air quality***
  Dust generated directly through mining activities, or indirectly by increased erosion, can significantly reduce air quality in the areas surrounding a coal mine. In addition, vehicle emissions also contribute to reduced air quality. In the case of very large scale mining operations, air pollution can also lead to acid rain.

- ***Noise***
  Mining involves various activities that create significant amounts of noise (e.g., blasting), and which cause noise pollution in the area surrounding a mine.

4 SCOPE AND OBJECTIVES OF THE STUDY

- To define and describe vertebrate habitat types identified on the site;
- To qualitatively and quantitatively assess the significance of vertebrate habitat components and their current general conservation status;
- To identify and comment on ecologically sensitive areas;
- To comment on connectivity;
- To provide a list of mammals, birds, reptiles and frogs that occur or might occur on site, and to identify species of conservation importance (Red Data species);
- To highlight potential impacts of the proposed development on the vertebrate species richness of the study site;
- To provide management recommendations that mitigate negative and enhance positive impacts, should the proposed development be approved, and
- To calculate and comment on significance ratings for the proposed development.

5 STUDY AREA

Most of the underground mine and complex will be developed on maize and soya fields as well as on a portion of grassland between the fields and the railway line (Figures 8, 16 and 17). This development will be above underground coal reserves (Figures 1 and 2).

Current land-use comprises of maize and soya fields on arable soils (Figures 7, 8, 16, 20 and 21) and grazing cattle on grasslands defined as Amersfoort Highveld Clay and Soweto Highveld Grassland vegetation units as defined by Mucina and Rutherford (2006) (Figure 11). It is clear that range management of grassy plains is practiced since nowhere overgrazing was recorded (Figures 9, 11, 12, 13, 15, 17, 19 and 26); generally grasslands are in a good conservation stasis. A grassy plain is being re- established on old fields (Figure 26).

The topography is typically gently undulating grassy plains of the Highveld interior (Figures 11 and 13). The higher elevations of these grassy plains consist of rocky ridges providing good rupiculous habitat (Figures 12, 19, 22, 23 and 24) and that correlate strongly with Significant and Irreplaceable areas highlighted by the Mpumalanga CBA maps (Figures 7 and 8).

A salient feature of the study site is that it is water rich; various drainage lines are dammed and runoff water accumulates and drains into the Klein Drinkwater Spruit and its tributaries (Figures 6, 13, 14, 18, 19 and 23). A number of small pans are present (Figure 10).

Ecologically the substrates present itself as clayey in the Amersfoort Highveld Clay Grassland vegetation unit and a lighter, sandy soil in the Soweto Highveld Grassland (Figures 4 and 5). Termitaria are an ecological resource, inter alia serve as refuge for small vertebrates, and are scarce.

The ridges carry to a lesser or greater degree shrubs, but these do not qualify as arboreal habitat for vertebrates (Figures 22 and 24). Stands of exotic trees (particularly *Eucalyptus*) dot the landscape (Figures 9, 11, 12, 19 and 22).

A deep dolerite quarry has been excavated on the summit of the ridge located on Restant 6 (Figure 25).

No caves providing for the exacting requirements of cave-dwelling bats were recorded.
Excluding the maize and soya bean fields, conservation condition is ranked as good.

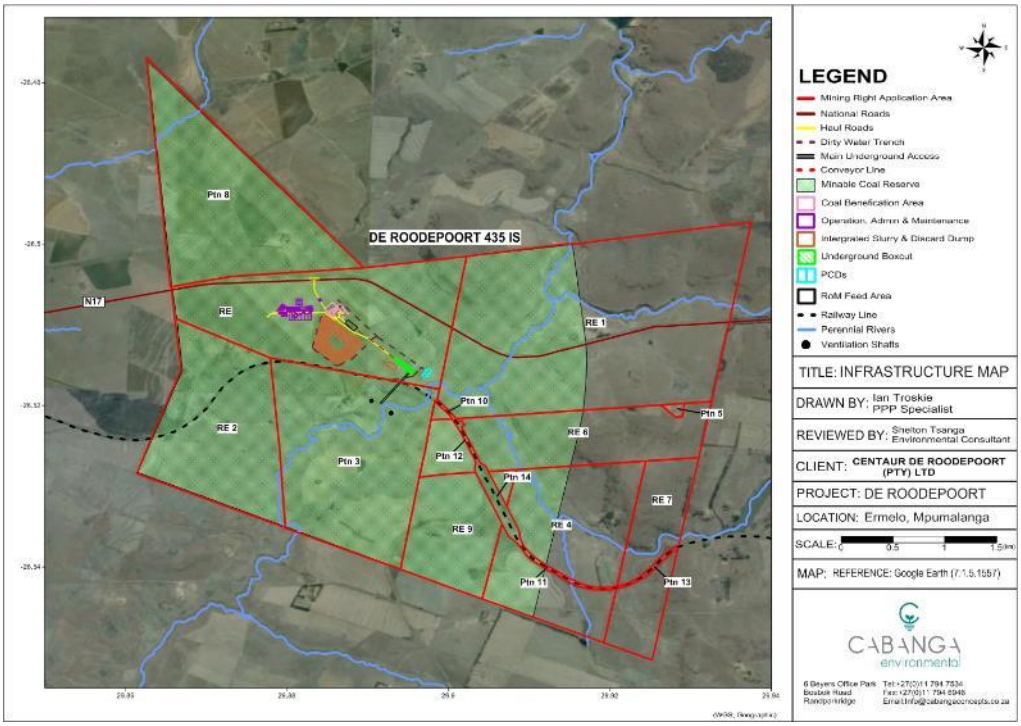


Figure 1: The various Portions and Restants of the Farm De Roodepoort 435 IS that collectively comprise the study area. Note the absence of underground coal reserves to the east.

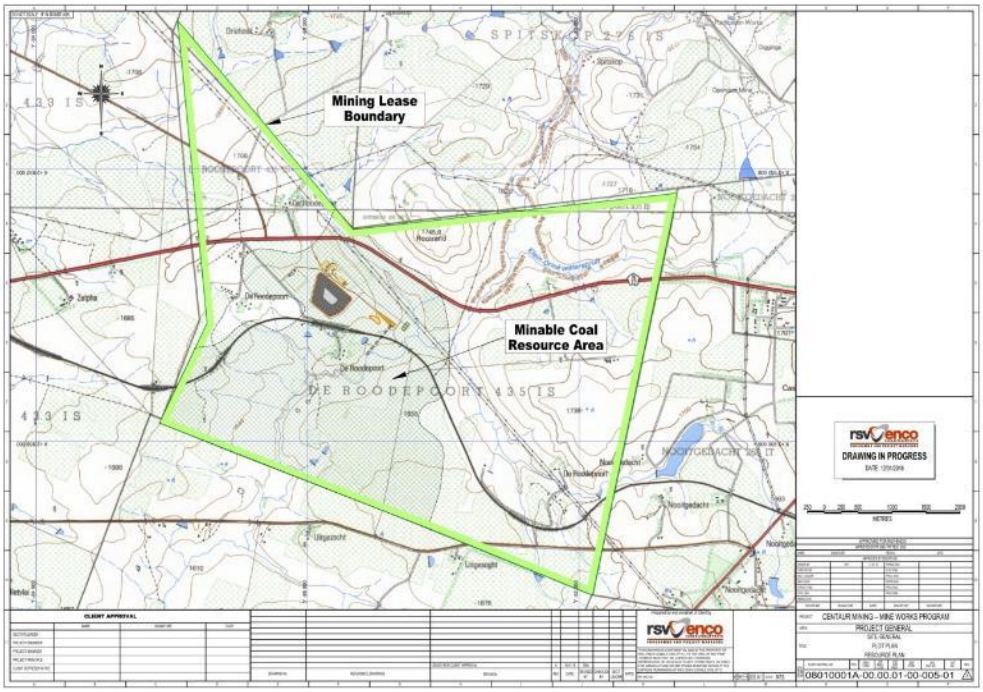


Figure 2: **The coal mine compound on the southern part of Portion RE. The minable coal resource area targeted is illustrated. The mine compound will be *ca.* 130 hectares in extent.**

Figure 3: **This image portrays an earlier consideration that has since been scrapped.**

Figure 4: Vegetation units as defined by Mucina and Rutherford (2006).

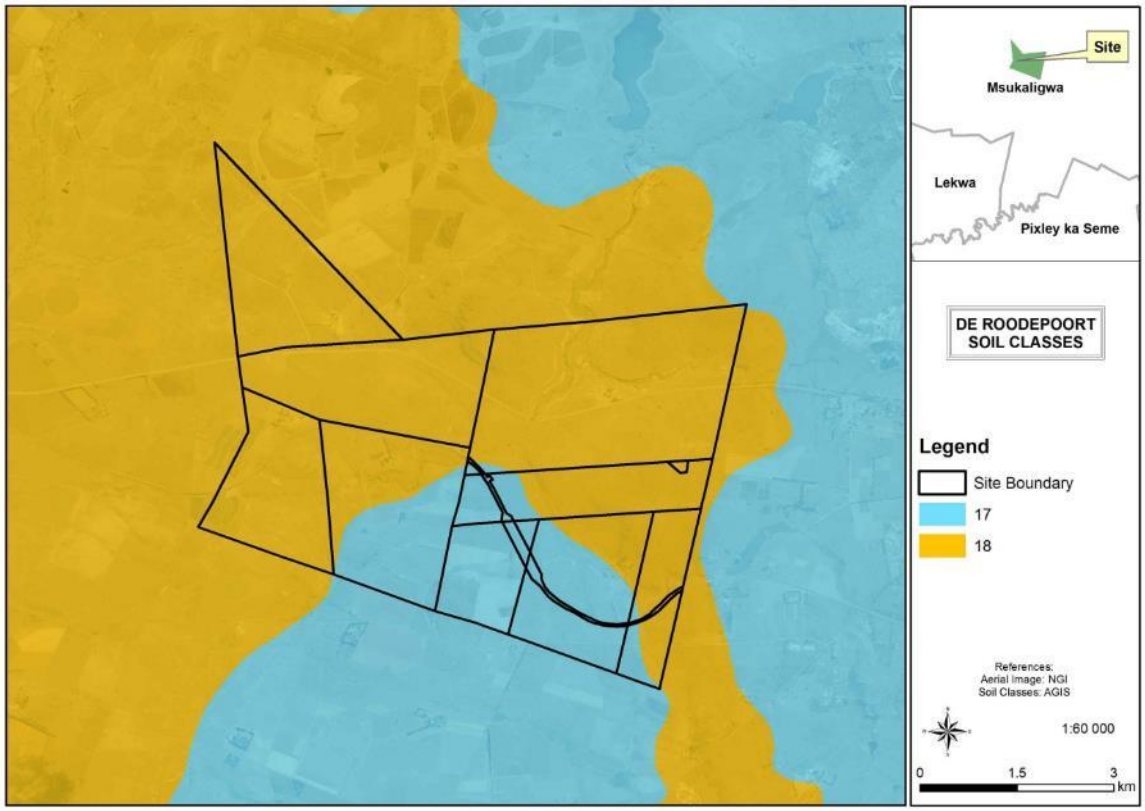


Figure 5: Soil types. Note that soil types and vegetation units (Figure 4) are spatially closely related.

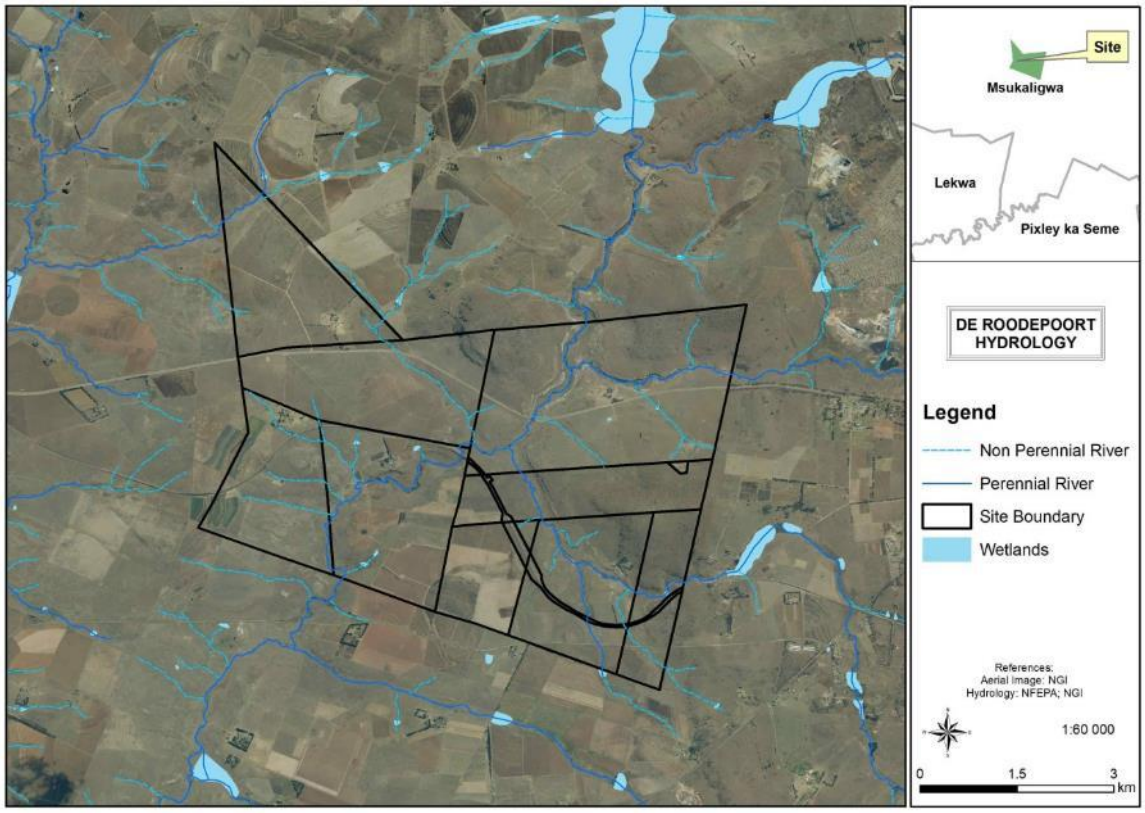


Figure 6: **The district is water rich, and on the site itself the Klein Drinkwater Spruit and tribuataries prevail.**

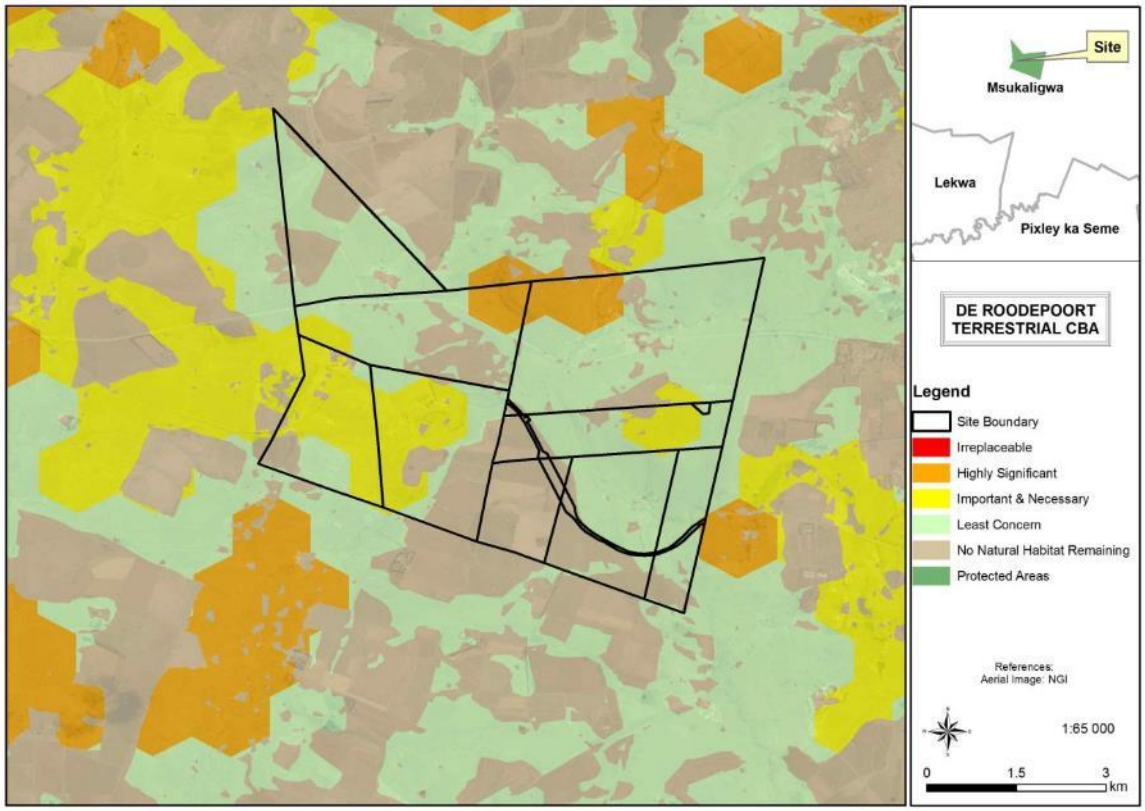


Figure 7: Critical Biodiversity Areas. The development will be on an area of Least Concern.

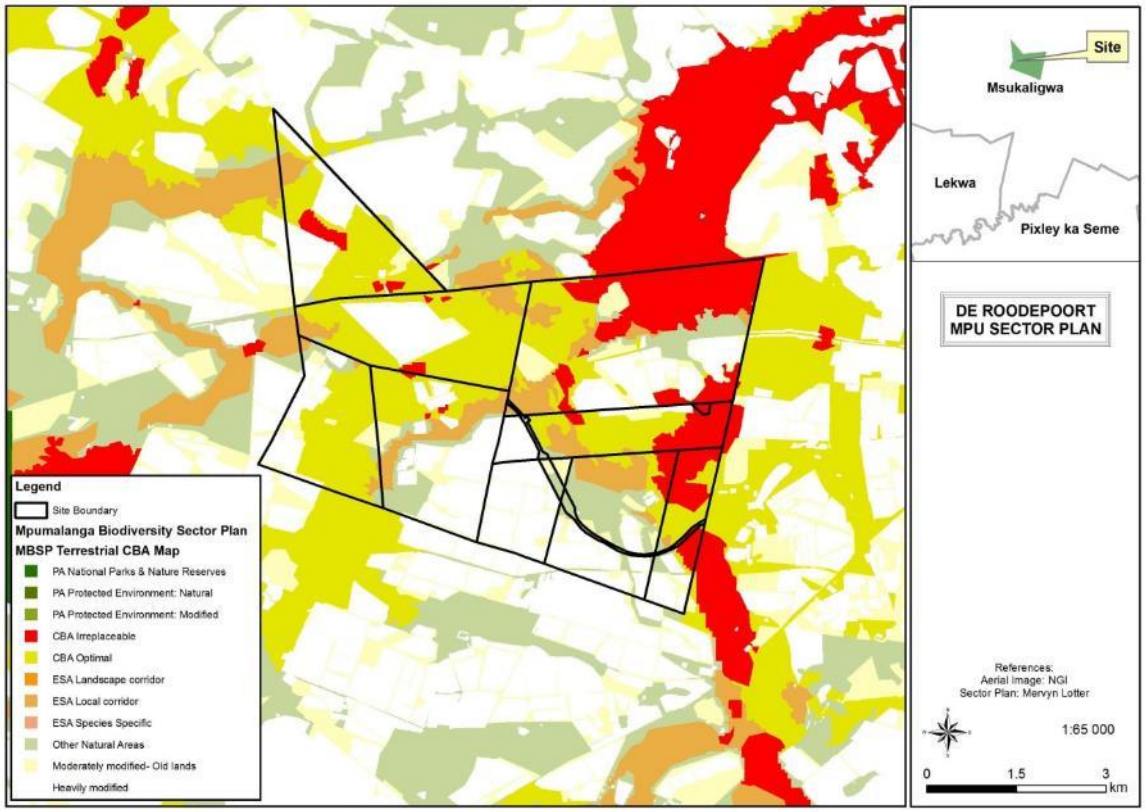


Figure 8: Mpumalanga Biodiversity Sector Plan. The development will be on Heavily Modified area (soya and maize fields).

Figure 9: An easterly view taken from the Tafelkop Road over recently grazed primary grassland of Portion 8 of the Farm De Roodepoort 435 IS.

Figure 10: A small pan on the northern part of Portion 8 of the study site bordering the Tafelkop Road. The district is water rich and apart from the Klein Drinkwater Spruit and tributaries, several pans and dams are present.

Figure 11: Some of the soils of the gently undulating Highveld plains are unsuitable for tilling and grasslands are used for raising cattle, such as on Portion 8.

Figure 12: Typical Highveld grassland with low ridges presenting rocky outcrops for rupiculous vertebrates, such as Spitskop straddling Portion 8 portrayed here. Note the *Eucalyptus* plantation to the left.

Figure 13: A typical vista of the site and district: photographed from the base of Spitskop on Portion 8, with grassland in the foreground, the N17 and roadside electrical lines, a manmade pond to the right, ESKOM high tension lines, the railway line crossing the Klein Drinkwater Spruit depression and fields in the distance.

Figure 14: Seasonal drainage line on Portion 8 north of the N17. Wetland vegetation is visible to the near-right area in the image.

Figure 15: Dense stands of tambooki grass flourishing in road servitudes provide excellent habitat for terrestrial small mammals.

Figure 16: A north-westerly view over soya fields and beyond that is maize fields. The mine compound will be constructed on these fields on Portion 8.

Figure 17: A northerly view of a portion of grazed grassland between the railway line and the planned dump site for mined debris scheduled to be made on Portion 8.

Figure 18: The south-westerly flowing Klein Drinkwater Spruit under the railway bridge on Portion 3.

Figure 19: A northerly view from the railway line on Restant 4 over a grassy plain sloping down to the Klein Drinkwater Spruit and the N17.

Figure 20: North-westerly view over soy fields on Portion 3, towards the proposed mine compound beyond the railway line.

Figure 21: A north-easterly view over a maize field on Restant 9.

Figure 22: A southerly view over a rocky ridge photographed from just north of the railway line on Portion 13 and near the eastern boundary of the study site, and outside the underground coal reserves areas (See Figure 1).

Figure 23: A northerly view from the N17 of Restant 1 over the Klein Drinkwater Spruit canyon and a rocky ridge beyond. The portrayed area is outside the underground coal reserves areas (See Figure 1).

Figure 24: A southerly view over a rocky ridge on Restant 6 south of the N17. The portrayed area is outside the underground coal reserves areas (See Figure 1).

Figure 25: A dolerite quarry on the summit of the ridge portrayed in Figure 24.

Figure 26: Disturbed grassland on Portion 10 between the N17 and the railway line.

6 METHODS

Acocks (1988), Mucina and Rutherford (2006), Low & Rebelo (1996), Knobel and Bredenkamp (2006), 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 mammal distribution.

The local occurrences of mammals are, on the other hand, closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupicolous (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.

Three criteria were used to gauge the probability of occurrences of vertebrate species on the study site. These include known distribution ranges, habitat preferences and the qualitative and quantitative presence and extent of suitable habitats on site:

- *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.
- *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.

6.1 Field Survey

During the site visit, mammals, birds, reptiles and frogs were identified by visual sightings through random transect walks and patrolling with a vehicle. No trapping or mist netting 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, birds by their calls, old nests, moulted feathers, spoor, droppings and food remains, and herpetofauna by their calls.

6.2 Desktop Survey

As many mammals and herpetofauna are either secretive, nocturnal, hibernators and/or seasonal, and whereas some birds are seasonal migrators, distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of such 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.

6.3 Taxon-specific Requirements

Mammals: During the visit the site was surveyed and assessed for the potential occurrence of Red Data and/or wetland-associated species such 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*), members 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.

Birds: Birds occurring at the site of the proposed mine were assessed in several steps, as detailed below. Red-listed species were identified using the recent (2015) Red Data Book for South Africa, Lesotho and Swaziland (Taylor et al. 2015).

Prior to the site visit, a desktop study was undertaken in which bird species that potentially occur at the site and in the surrounding areas were identified using data from the first and second South African Bird Atlas Projects (SABAP 1 and 2). SABAP 2 data are based on records for pentads (i.e., 5' X 5'), where SABAP 1 data were based on quarter-degree grid cells (i.e., 15' X 15'). A list of species potentially occurring at the site was developed for the SABAP 2 pentad within which the site falls (2630_2950), as well as all eight adjacent pentads (i.e., nine pentads in total). This species list is thus based on an area much larger than the actual development site – approximately 700 square kilometers (28 km north-south X 25 km east-west, Figure 1). This approach is adopted to ensure that all species potentially occurring at the site, whether resident, nomadic, or migratory, are identified.

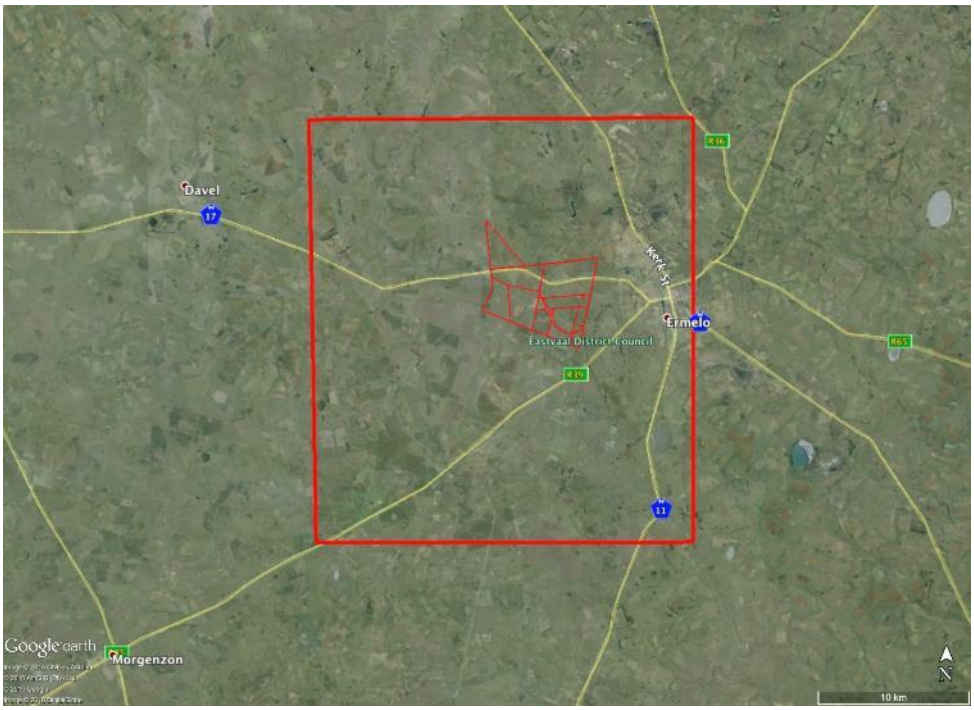


Figure 27. Approximate extent of area included (red square) when generating the list of birds potentially occurring at the site (outlines of properties shown in centre of square). Image courtesy of Google Earth.

A site visit took place on 2-3 April 2016, with a total of approximately 12 hours spent on site. The weather during the visit was warm, clear and with little wind. During the site visits, birds occurring at the site were identified by walking transects, and driving transects in surrounding areas. During walking transects, an observer with binoculars walked slowly through the site, identifying all birds encountered (seen or heard), identifying nests observed, and assessing the avian habitats present. The field survey included interviews with local land-owners, during which they were questioned regarding the presence of particular threatened bird species.

Bird species occurring at the site of the proposed project were intensively assessed during two days, and the possibility exists that rare species in the area were not encountered due to the short time spent on site. This constraint is partly offset by the incorporation of data from SABAP 2 and SABAP 1.

The behaviour and ecology of birds, like that of other organisms, is not completely predictable. The overall impacts of the proposed project can reliably be predicted on the basis of impacts observed elsewhere, but it is important to appreciate that specific, and sometimes subtle, local factors can modify interactions between birds and human activities.

Herpetofauna: During the visit, the site was surveyed and assessed for the potential occurrence of South African Red Data species in Mpumalanga (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).

Two other herpetofauna species, whose current status in South Africa is Least Concern, but which Mpumalanga Province have concern about, were also taken into consideration, such as the Spotted Harlequin Snake (Homoroselaps lacteus) and Many-Spotted Snake (Amplorhinus mutimaculatus).

6.4 Assessment criteria

The conservation status of habitats within the study site can be 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 development with little to no impact on the habitats or fauna.

These correlate with the significance ratings for the development as discussed in Section 6.5, and are tabulated as follows:

RANKING	65-100	64-36	35-16	15-5	1-4
SIGNIFICANCE	Very High	High	Moderate	Low	Minor
CONSERVATION STATUS	High	Medium-high	Medium	Medium-low	Low

6.5 Impact Assessment Criteria

In order to quantitatively express the projected impact of a development, somewhat subjective weighted values of 0-5 are deployed, as tabulated below. This technique is a useful tool to compare impacts on locations under consideration for development. The environmental significance of a development is then calculated using the following formula, which allows the development to be assessed more objectively:

Significance (Consequence) = (Magnitude + Reversibility + Extent + Duration) X Probability.

Significance values depicting reigning environmental conditions at proposed development sites.

SIGNIFICANCE RANKING MATRIX

RANKING	MAGNITUDE	REVERSIBILITY	EXTENT	DURATION	PROBABILITY
5	Very high/ don't know	Irreversible	International	Permanent	Certain/inevitable
4	High		National	Long term (impact ceases after operational life of asset	Almost certain
3	Moderate	Reversibility with human intervention	Provincial	Medium term (6-15 years)	Can occur
2	Low		Local	Short term (0 - 5 years)	Unusual but possible
1	Minor	Completely reversible	Site bound	Immediate	Extremely remote
0	None		None		None

- The **Magnitude** of the impact: This will be quantified as either:
  - Low: Will cause a low impact on the environment;
  - Moderate: Will result in the process continuing but in a controllable manner;
  - High: Will alter processes to the extent that they temporarily cease; and
  - Very High: Will result in complete destruction and permanent cessation of processes.
- **Reversibility/ Replaceability:** The degree at which the impact can be reversed or the lost resource replaced**.**
- **The Extent of the impact**: This criterion expresses the spatial extent of the impact.
- **The Duration (or Exposure)**: wherein it will be indicated whether:
  - The impact will be immediate;
  - The impact will be of a short tem (Between 0-5 years);
  - The impact will be of medium term (between 5-15 years);

- The impact will be long term (15 and more years); and
- The impact will be permanent.

- **The Probability:** which shall describe the likelihood of impact occurring and will be rated as follows:
- Extremely remote: Which indicates that the impact will probably not happen;
- Unusual but Possible: Distinct possibility of occurrence;
- Can Occur: there is a possibility of occurrence;
- Almost Certain: Most likely to occur; and
- Certain/ Inevitable: Impact will occur despite any preventative measures put in place.

Derived values are then translated as being in the significance range of from Very High to Minor.

RANKING	65-100	64-36	35-16	15-5	1-4
SIGNIFICANCE	Very High	High	Moderate	Low	Minor

- Very high environmental significance 65-100 points
- High environmental significance 64-36 points
- Moderate environmental significance 35-16 points
- Low environmental significance 15-5 points
- Minor environmental significance 4-1 points

Depending on the nature of the proposed development, significance rankings may be calculated Without Mitigation Measures (WOMM) and With Mitigation Measures (WMM) to illustrate the predicted effectiveness of proposed mitigation measures.

7 RESULTS

A site visit by a botanist, mammologist, ornithologist and herpetologist was conducted on 1 - 3 April 2016. The days were mild and sunny with a light wind, and there had been some rain recently but less than expected overall. A wetland specialist will also visit the site later.

7.1 MAMMALS

7.1.1 Mammal Habitat Assessment

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

The local occurrences of mammals 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 mammal species by evaluating the habitat types within the context of global distribution ranges.

Three of the major habitat types are represented on the study site, i.e. terrestrial, rupiculous and wetlands. Apart from shrubs on the rocky ridges, indigenous trees are absent and even exotics are scarce; an arboreal habitat is thus functionally absent, which is indeed a general characteristic of a typical Soweto and Amersfoort Highveld Clay Grassland vegetation units.

The terrestrial habitat of rolling grassland plains is by far the most extensive (Figures 11 and 12). The site visit was conducted during late-summer and generally the grass cover was growing vigorously and is well preserved in places (Figure 19), but is elsewhere heavily grazed (Figure 9) (as such transforming natural grassland into a near-hostile environment for terrestrial mammals). Generally the conservation condition of grasslands is rated as very good, and even secondary grasslands (Figure 26) provide good habitat conditions for terrestrial small mammals. It is obvious that veld fires are avoided and as result basal cover offers year-round refuge and nourishment to the extent that the presence of the 'Endangered' white-tailed mouse is most likely (Table 1).

Generally the substrate consists of a reddish-brown soil (in places containing gravel) predominantly in the Soweto Highveld Grassland portion. Clayey soils support Amersfoort Highveld Clay Grassland. Heavy clay prevails along the streams. Arable soils have been tilled, and on sub-optimal soils natural vegetation is retained for grazing cattle. A low incidence of termitaria has been recorded. Some small vertebrates (viz. pygmy mice, dwarf shrews) have a penchant to use moribund termitaria as refuges; hence these structures can be taken as suggesting the presence of these species.

The habitat conditions of rocky outcrops are ranked as excellent and overlap with Highly Significant / Important and Necessary Mpumalanga CBA Areas (Figure 7) and CBA Irreplaceable CBA area (Figure 8).

The drainage lines, the Klein Drinkwater Spruit and tributaries, natural pans and even manmade dams constitute sensitive habitat, even though the spruit is heavily polluted by leakages from the upstream waste water treatment facility. Wetland vegetation in riparian zones is good and provide good habitat for moisture-reliant small mammals such as vlei rats and shrews. In fact, rank vegetation in riparian zones is suitably preserved and allows for the presence of African marsh rats (Table 1).

7.1.2 Observed and Expected Mammal Species Richness

Discerning mammals narrowly dependent on arboreal habitat have *a priori* been omitted from the list of possible occurrences since this habitat is absent.

A prevailing perception gained during the site visit is that mammal populations should be healthy and that refuge and sustenance are available year-round in the absence of veld fires.

Large mammals (such elephants, buffaloes, black wildebeests, red hartebeests, white rhinos, lions, spotted hyenas and others) have long since been extirpated for sport and later

to favour grazing and growing crops. Later some medium-sized mammals were hunted out or coincidentally displaced, in particular baboons and monkeys. By-and-large a surprising number of herbivores and carnivores persisted (Table 1) in the rural and relatively unaltered district.

It is concluded that 67 species of mammals are still part of the present-day mammal species assemblage. The occurrence of 25 species was confirmed (Table 2). No re-introductions were done on-site, although owners of a game-fenced small property to the south introduced a number of exotic mammals.

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), and to a lesser extent their reticent and cryptic nature (scrub hares, genets and mongooses).

As a precautionary measure pygmy mice and dwarf shrews are included in the list of occurrences. These species have a penchant to use moribund termitaria as refuges and are herein assumed to be residents even though termitaria are scarce (Figure 31). The termite mound pictured in Figure 31 was damaged by aardvark preying to the extent that it died. Cape mole rats were recorded from sandy areas, whereas the ubiquitous African mole rat has established colonies in a variety of soil types.

It is most likely that the semi-aquatic vegetation along the watercourses will harbour vlei rats and the listed shrews, -both taxa having strong survival traits bar their narrow dependence on wetland habitat. In view of the good conservation health of the study area African marsh rats are considered as an occupant. The lack of permanent deep water obviates the presence of otter species, marsh mongooses and quite likely white-tailed mongooses.

Kudu, mountain reedbuck, grey rhebuck, duikers, steenbok, black-backed jackals, leopards, caracal, serval, aardwolves and brown hyenas still occur in the district and can be expected to at least occasionally venture onto the site.

In spite of their vulnerability to interference by humans and their pets, the extensive nature of the site and adjoining district prompt the inclusion of hedgehogs as likely occupants.

The listed free-tailed bat and the three vespertilionid bats showed remarkable adaptability by expanding their distributional ranges and population numbers significantly by capitalizing on the roosting opportunities offered by manmade structures on the Highveld; in this instance in the houses on the site and in the vicinity. Versper 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. Free-tailed bats are likewise partial to narrow-entrance roosts provided by buildings; in some instances roost occupation could numerically reach epidemic proportions. The study site offers no caves or mine adits answering to the exacting roosting requirements of cave-dwelling bats (Hipposideridae, Rhinolophidae, Nycteridae), but it is likely that they have roosts on the site in old buildings or elsewhere and at times

commute to hawk for invertebrates rising over the streams, dams and wetlands during summer sunsets. It can be expected that the watercourses, dams and pans are an excellent source of insects that rise in swarms at summer sunsets and function as feeding patches for hawking vesper bats.

African wild cats are likely inhabitants of the site, but they are inclined to interbreed with domestic cats and it is more likely that crossbred offspring persist. The two genet species and the two meerkats all have wide habitat tolerances, and that coupled to their catholic diets and reticent habits render them persistent carnivores, even close to human settlements.

The species richness is low for such an extensive area. That is ascribed to the fact that Highveld grasslands does not have the species richness of savannahs, and also since an important habitat type is absent (arboreal) and another modest and only weakly developed (wetland). The overall quality of conservation is largely ranked as good.

Table 1: 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 Macroscelididae	
	Family Macroscelididae	
*	*Elephantulus myurus*	Eastern rock elephant shrew
	Order Tubulidentata	
	Family Orycteropodidae	
√	*Orycteropus afer*	Aardvark
	Order Hyracoidea	
	Family Procaviidae	
√	*Procavia capensis*	Rock dassie
	Order Lagomorpha	
	Family Leporidae	
√	*Lepus saxatilis*	Scrub hare
√	*Pronolagus randensis*	Jameson's red rock rabbit
	Order Rodentia	
	Family Bathyergidae	
*	*Cryptomys hottentotus*	African mole rat
√	*Georychus capensis*	Cape mole rat
	Family Hystricidae	
√	*Hystrix africaeaustralis*	Cape porcupine
	Family Tryonomyidae	
*	*Thryonomys swinderianus*	Greater cane rat
	Family Pedetidae	
?	*Pedetes capensis*	Springhare
	Family Myoxidae	
DD?	*Graphiurus platyops*	Rock dormouse
	Family Muridae	

	SCIENTIFIC NAME	ENGLISH NAME
*	*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
√	*Aethomys namaquensis*	Namaqua rock mouse
*	*Otomys angoniensis*	Angoni vlei rat
*	*Otomys irroratus*	Vlei rat
*	*Gerbilliscus brantsii*	Highveld gerbil
En?	*Mystromys albicaudatus*	White-tailed mouse
*	*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?	*Myosorex varius*	Forest shrew
DD?	*Suncus lixus*	Greater dwarf shrew
DD*	*Crocidura mariquensis*	Swamp musk shrew
DD*	*Crocidura fuscomurina*	Tiny musk shrew
DD*	*Crocidura cyanea*	Reddish-grey musk shrew
DD*	*Crocidura silacea*	Lesser grey-brown 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	
√	*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
NT?	*Rhinolophus darlingi*	Darling's horseshoe bat
	Family Hipposideridae	
DD?	*Hipposideros caffer*	Sundevall's roundleaf bat
	Order Carnivora	
	Family Hyaenidae	
?	*Proteles cristatus*	Aardwolf

	SCIENTIFIC NAME	ENGLISH NAME
NT?	*Parahyaena brunnea*	Brown hyena
	Family Felidae	
√	*Panthera pardus*	Leopard
√	*Caracal caracal*	Caracal
√	*Felis silvestris*	African wild cat
√	*Leptailurus serval*	Serval
	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 Perissodactyla	
	Order Suiformes	
	Family Suidae	
√	*Potamochoerus larvatus*	Bushpig
√	*Phacochoerus africanus*	Common warthog
	Order Ruminanta	
	Family Bovidae	
√	*Tragelaphus strepsiceros*	Kudu
√	*Sylvicapra grimmia*	Common duiker
√	*Redunca fulvorufula*	Mountain reedbuck
√	*Pelea capreolus*	Grey rhebuck
√	*Antidorcas marsupialis*	Springbok
√	*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.

Table 2: Mammal species positively confirmed from the study site, observed indicators and habitat.

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
O. afer	Aardvark	Burrow	Sandy soil
P. capensis	Rock dassie	Sight record	Rocky ridges
L. saxatilis	Scrub hare	Faecal pellets	Short grass
C. hottentotus	African mole rat	Tunnel system	Universal
G. capensis	Cape mole rat	Tunnel system	Softer soils
H. africaeaustralis	Cape porcupine	Reported by residents	Universal
A. frontalis	S.A. hedgehog	Reported by residents	Good cover
P. pardus	Leopard	Reported by residents	Universal
C. caracal	Caracal	Reported by residents	Universal
F. silvestris	African wild cat	Reported by residents	Universal
L. serval	Serval	Reported by residents	Universal
G. genetta	Small-spotted genet	Reported by residents	Drier aspects
G. tigrina	SA large-spotted genet	Reported by residents	Close to water
C. penicillata	Yellow mongoose	Sight record	Good cover
G. sanguinea	Slender mongoose	Reported by residents	Good cover
A. paludinosus	Marsh mongoose	Reported by residents	Riparian zones
C. mesomelas	Black-backed jackal	Reported by residents	Universal
P. larvatus	Bushpig	Reported by residents	Universal
P. africanus	Common warthog	Reported by residents	Universal
T. strepsiceros	Kudu	Reported by residents	Universal
S. grimmia	Common duiker	Reported by residents	Grasslands
R. fulvorufula	Mountain reedbuck	Reported by residents	Mountainous
P. capreolus	Grey rhebuck	Reported by residents	Mountainous
A. marsupialis	Springbok	Reported by residents	Grassy plains
R. campestris	Steenbok	Reported by residents	Grasslands

No less than 25 species confirmed to be residents in and near the site is to be expected given the extensive character of the site and surrounding areas, the largely undisturbed condition of grassy plains and especially of the wooded ridges, and the excellent connectivity available in the district. This is indicative of the high conservation ranking of the properties. None of the species have been re-introduced. Not all species are permanent inhabitants but intermittently wander onto the site (viz. leopard, caracal, kudu).

7.1.3 Red Listed Mammal Species Identified:

-By the Scientific Community (Friedman and Daly (editors) 2004)

The rock dormouse, seven shrew species and African weasel cited as 'Data Deficient' in Table 1 are not necessarily endangered. These small mammals have not been adequately studied to provide quantitative field data to accurately assign to a conservation ranking. As

a precaution they are thus considered as 'Data Deficient'. Shrews, to a lesser extent rock dormouse (which is partially insectivorous) as well as the African 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 are obtained with drift fences and pitfalls and that 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.

The African marsh rat ('Near Threatened') and white-tailed rat ('Endangered') are both discerning rodents reliant on prerequisite pristine habitats. They have become endangered as result of habitat decline, respectively of rank riparian zone wetland vegetation and primary grassland.

Cave-dwelling bats 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 often be 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.

Considering the good conservation character of the site and adjoining farms, it is submitted that the Red Data species mentioned here are not under survival pressure.

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

-By the IUCN Red Data List

The compilation of Red Data mammals (Friedman and Daly (editors) 2004) is in fact a contribution to the IUCN initiative. Opinions expressed therein are elucidated above.

-By the Biodiversity Act No 10 of 2004

Protected Species: African 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
Mountain reedbuck - Redunca fulvorufula
Steenbok - Raphicerus campestris
Grey rhebuck - *Pelea capreolus*

Schedule 3: Ordinary Game

Scrub hare - Lepus saxatilis
Jameson's rock rabbit - *Pronolagus randensis*
Kudu - Tragelaphus strepsiceros
Grey duiker - Sylvicapra grimmia
Springbok - Antidorcas marsupialis

Schedule 4: Protected Wild Animals

Leopard - Panthera pardus

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

Rock dassie - Procavia capensis
Yellow mongoose - Cynictis penicillata
Slender mongoose - *Galerella sanguinea*
White-tailed mongoose - *Ichneumia albicauda*
Marsh mongoose - Atilax paludinosus
Serval - Leptailurus serval
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*
Caracal - Caracal caracal
Bush pig - Potamochoerus larvatus

-Endemism:

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

7.2 AVIFAUNA

7.2.1 Bird Habitat Assessment

The site of the proposed development falls within an Important Bird and Biodiversity Area (IBA), specifically the Amersfoort-Bethal-Carolina IBA (Marnewick et al. 2015). The designation of this IBA is based on the presence of the around 10 % of the global population of the globally threatened Botha's Lark, as well as the globally threatened Blue Crane, Southern Bald Ibis, Black Harrier, Blue Korhaan, Black-winged Pratincole, Secretarybird, Martial Eagle and Denham's Bustard (Marnewick et al. 2015). Regionally threatened species present in the IBA are African Grass Owl, White-bellied Korhaan and Lanner Falcon (Marnewick et al. 2015).

7.2.2 Avian habitats

Avian habitats at the site of the proposed development can be broadly categorized as follows:

- Agriculture – large parts of the site are under maize and soya (Figures 16, 20). There are also a number of farmhouses with associated stands of trees such as eucalypts.

- Grasslands – most of the natural habitats at the site consist of Highveld grasslands (Figures 9, 12, 13, 14, 15, 17, 19, 26). These vary in their substrate, and include rocky areas (Figures 22, 24). The grassland also varies in grazing intensity, from comparatively heavily grazed to relatively pristine. Several parts of the site have exotic firethorn trees (*Pyracantha*) growing, which in at least once instance is used as a nesting site by a threatened bird species (see below).

- Aquatic and riparian habitats. Several streams flow through the property, most notably the heavily polluted Klein Drinkwaterspruit. There are a variety of aquatic and riparian habitats associated with the watercourses, and several small dams. In some areas, the stream flows below cliffs, with a number of large exotic tree species lining the watercourse. There are also several small wetlands (Figures 10, 13, 18, 35, 36).

7.2.3 Avifauna

The grassland habitats at the site hold a variety of species, including Ant-eating Chat, Bokmakierie, Zitting Cisticola, Amur Falcon, Southern Bald Ibis, Black-shouldered Kite, Cape Longclaw, African Pipit, Quailfinch, Pied Starling, African Stonechat, Malachite Sunbird, Secretarybird, Pin-tailed Whydah and Long-tailed Widowbird. A number of additional species are added on account of the aquatic habitats, including Levaillant's Cisticola, Reed Cormorant, African Darter, Yellow-billed Duck, Spurwing Goose, Little Grebe, and (somewhat surprisingly given the highly polluted nature of the Klein Drinkwaterspruit) African Black Duck.

A total of 72 species were confirmed to be present at the site, and the occurrence of an additional 31 species is considered likely (Table 1). These include a number of red-listed species (Table 2), which are discussed individually below.

Table 3. Bird species recorded in the area considered for the desktop survey (SABAP 2 pentad 2540_3000 plus eight adjacent pentads – see Figure 1). The current (2015) status of each red-listed species is provided (NT = Near Threatened; VU = Vulnerable; EN = Endangered; CR = Critically Endangered), and the likelihood of each species occurring at the site is rated as confirmed, high, medium or low.

English name	Scientific name	IUCN Red Data Status	Likelihood of occurrence
Apalis, Bar-throated	*Apalis thoracica*		Low
Avocet, Pied	*Recurvirostra avosetta*		Low
Barbet, Acacia Pied	*Tricholaema leucomelas*		Low
Barbet, Black-collared	*Lybius torquatus*		Confirmed

English name	Scientific name	IUCN Red Data Status	Likelihood of occurrence
Barbet, Crested	*Trachyphonus vaillantii*		High
Bishop, Southern Red	*Euplectes orix*		Confirmed
Bishop, Yellow	*Euplectes capensis*		Medium
Bishop, Yellow-crowned	*Euplectes afer*		Confirmed
Bittern, Little	*Ixobrychus minutus*		Low
Bokmakierie	*Telophorus zeylonus*		Confirmed
Boubou, Southern	*Laniarius ferrugineus*		Low
Bulbul, Dark-capped	*Pycnonotus tricolor*		Confirmed
Bunting, Cape	*Emberiza capensis*		Low
Bunting, Cinnamon-breasted	*Emberiza tahapisi*		Low
Bunting, Golden-breasted	*Emberiza flaviventris*		Low
Bush-shrike, Olive	*Telophorus olivaceus*		Low
Bustard, Denham's	*Neotis denhami*	VU	Medium
Buzzard, Jackal	*Buteo rufofuscus*		Low
Buzzard, Steppe	*Buteo vulpinus*		High
Canary, Black-throated	*Crithagra atrogularis*		High
Canary, Cape	*Serinus canicollis*		High
Canary, Yellow	*Crithagra flaviventris*		Low
Canary, Yellow-fronted	*Crithagra mozambicus*		High
Chat, Anteating	*Myrmecocichla formicivora*		Confirmed
Chat, Familiar	*Cercomela familiaris*		Medium
Cisticola, Cloud	*Cisticola textrix*		High
Cisticola, Levaillant's	*Cisticola tinniens*		Confirmed
Cisticola, Pale-crowned	*Cisticola cinnamomeus*		Medium
Cisticola, Wailing	*Cisticola lais*		Low
Cisticola, Wing-snapping	*Cisticola ayresii*		Medium
Cisticola, Zitting	*Cisticola juncidis*		Confirmed
Cliff-chat, Mocking	*Thamnolaea cinnamomeiventris*		Medium
Cliff-swallow, South African	*Hirundo spilodera*		High
Coot, Red-knobbed	*Fulica cristata*		Confirmed
Cormorant, Reed	*Phalacrocorax africanus*		Confirmed
Cormorant, White-breasted	*Phalacrocorax carbo*		Medium
Crake, Black	*Amaurornis flavirostris*		Medium
Crane, Blue	*Anthropoides paradiseus*	NT	Medium
Crane, Grey Crowned	*Balearica regulorum*	EN	Medium
Crow, Cape	*Corvus capensis*		Low
Crow, Pied	*Corvus albus*		Confirmed
Cuckoo, Diderick	*Chrysococcyx caprius*		High
Cuckoo, Red-chested	*Cuculus solitarius*		Low
Darter, African	*Anhinga rufa*		Confirmed

English name	Scientific name	IUCN Red Data Status	Likelihood of occurrence
Dove, Laughing	*Streptopelia senegalensis*		Confirmed
Dove, Namaqua	*Oena capensis*		Medium
Dove, Red-eyed	*Streptopelia semitorquata*		Confirmed
Dove, Rock	*Columba livia*		Confirmed
Drongo, Fork-tailed	*Dicrurus adsimilis*		Low
Duck, African Black	*Anas sparsa*		Confirmed
Duck, Maccoa	*Oxyura maccoa*	NT	Low
Duck, White-backed	*Thalassornis leuconotus*		Medium
Duck, White-faced	*Dendrocygna viduata*		Medium
Duck, Yellow-billed	*Anas undulata*		Confirmed
Eagle, Booted	*Aquila pennatus*		Low
Eagle-owl, Cape	*Bubo capensis*		Medium
Eagle-owl, Spotted	*Bubo africanus*		High
Egret, Cattle	*Bubulcus ibis*		Confirmed
Egret, Great	*Egretta alba*		High
Egret, Little	*Egretta garzetta*		Confirmed
Egret, Yellow-billed	*Egretta intermedia*		Confirmed
Falcon, Amur	*Falco amurensis*		Confirmed
Falcon, Lanner	*Falco biarmicus*	VU	Medium
Finch, Red-headed	*Amadina erythrocephala*		Low
Fiscal, Common (Southern)	*Lanius collaris*		Confirmed
Fish-eagle, African	*Haliaeetus vocifer*		Medium
Flamingo, Greater	*Phoenicopterus ruber*	NT	Medium
Flamingo, Lesser	*Phoenicopterus minor*	NT	Medium
Flycatcher, Fairy	*Stenostira scita*		Low
Flycatcher, Fiscal	*Sigelus silens*		High
Flycatcher, Spotted	*Muscicapa striata*		Low
Francolin, Grey-winged	*Scleroptila africanus*		Medium
Francolin, Red-winged	*Scleroptila levaillantii*		Medium
Goose, Egyptian	*Alopochen aegyptiacus*		Confirmed
Goose, Spur-winged	*Plectropterus gambensis*		Confirmed
Grass-owl, African	*Tyto capensis*	VU	High
Grassbird, Cape	*Sphenoeacus afer*		Low
Grebe, Black-necked	*Podiceps nigricollis*		Medium
Grebe, Great Crested	*Podiceps cristatus*		Medium
Grebe, Little	*Tachybaptus ruficollis*		Confirmed
Greenshank, Common	*Tringa nebularia*		Medium
Guineafowl, Helmeted	*Numida meleagris*		Confirmed
Gull, Grey-headed	*Larus cirrocephalus*		Medium
Hamerkop, Hamerkop	*Scopus umbretta*		High
Harrier, Montagu's	*Circus pygargus*		Medium

English name	Scientific name	IUCN Red Data Status	Likelihood of occurrence
Hawk-eagle, Ayres's	*Aquila ayresii*		Low
Heron, Black	*Egretta ardesiaca*		Low
Heron, Black-headed	*Ardea melanocephala*		Confirmed
Heron, Goliath	*Ardea goliath*		Low
Heron, Green-backed	*Butorides striata*		Low
Heron, Grey	*Ardea cinerea*		Confirmed
Heron, Purple	*Ardea purpurea*		Medium
Honeybird, Brown-backed	*Prodotiscus regulus*		Low
Honeyguide, Lesser	*Indicator minor*		Low
Hoopoe, African	*Upupa africana*		High
House-martin, Common	*Delichon urbicum*		Confirmed
Ibis, African Sacred	*Threskiornis aethiopicus*		Confirmed
Ibis, Glossy	*Plegadis falcinellus*		Medium
Ibis, Hadeda	*Bostrychia hagedash*		Confirmed
Ibis, Southern Bald	*Geronticus calvus*	VU	Confirmed
Jacana, African	*Actophilornis africanus*		Low
Kestrel, Greater	*Falco rupicoloides*		Medium
Kestrel, Lesser	*Falco naumanni*		Medium
Kestrel, Rock	*Falco rupicolus*		Medium
Kingfisher, Giant	*Megaceryle maximus*		Low
Kingfisher, Half-collared	*Alcedo semitorquata*	NT	Low
Kingfisher, Malachite	*Alcedo cristata*		Low
Kingfisher, Pied	*Ceryle rudis*		Medium
Kite, Black-shouldered	*Elanus caeruleus*		Confirmed
Kite, Yellow-billed	*Milvus aegyptius*		Medium
Korhaan, Blue	*Eupodotis caerulescens*		High
Korhaan, White-bellied	*Eupodotis senegalensis*	VU	Confirmed
Lapwing, African Wattled	*Vanellus senegallus*		Medium
Lapwing, Blacksmith	*Vanellus armatus*		Confirmed
Lapwing, Crowned	*Vanellus coronatus*		Confirmed
Lark, Botha's	*Spizocorys fringillaris*	EN	Medium
Lark, Eastern Clapper	*Mirafra fasciolata*		Medium
Lark, Eastern Long-billed	*Certhilauda semitorquata*		Low
Lark, Red-capped	*Calandrella cinerea*		Medium
Lark, Rufous-naped	*Mirafra africana*		Medium
Lark, Spike-heeled	*Chersomanes albofasciata*		High
Longclaw, Cape	*Macronyx capensis*		Confirmed
Mannikin, Bronze	*Spermestes cucullatus*		Low
Marsh-harrier, African	*Circus ranivorus*	EN	Low
Martin, Banded	*Riparia cincta*		High
Martin, Brown-throated	*Riparia paludicola*		Confirmed

English name	Scientific name	IUCN Red Data Status	Likelihood of occurrence
Martin, Rock	*Hirundo fuligula*		High
Martin, Sand	*Riparia riparia*		Medium
Masked-weaver, Southern	*Ploceus velatus*		Confirmed
Moorhen, Common	*Gallinula chloropus*		Confirmed
Mousebird, Red-faced	*Urocolius indicus*		High
Mousebird, Speckled	*Colius striatus*		Confirmed
Myna, Common	*Acridotheres tristis*		Confirmed
Neddicky, Neddicky	*Cisticola fulvicapilla*		Confirmed
Night-Heron, Black-crowned	*Nycticorax nycticorax*		Medium
Oriole, Black-headed	*Oriolus larvatus*		Medium
Ostrich, Common	*Struthio camelus*		Low
Owl, Barn	*Tyto alba*		Confirmed
Owl, Marsh	*Asio capensis*		Medium
Painted-snipe, Greater	*Rostratula benghalensis*	NT	Low
Palm-swift, African	*Cypsiurus parvus*		Confirmed
Paradise-flycatcher, African	*Terpsiphone viridis*		Low
Pigeon, Speckled	*Columba guinea*		Confirmed
Pipit, African	*Anthus cinnamomeus*		Confirmed
Pipit, Buffy	*Anthus vaalensis*		Low
Plover, Common Ringed	*Charadrius hiaticula*		Low
Plover, Kittlitz's	*Charadrius pecuarius*		Low
Plover, Three-banded	*Charadrius tricollaris*		Low
Pochard, Southern	*Netta erythrophthalma*		Medium
Pratincole, Black-winged	*Glareola nordmanni*	NT	Medium
Prinia, Black-chested	*Prinia flavicans*		Confirmed
Prinia, Drakensberg	*Prinia hypoxantha*		High
Prinia, Karoo	*Prinia maculosa*		Low
Prinia, Tawny-flanked	*Prinia subflava*		High
Quail, Common	*Coturnix coturnix*		Medium
Quailfinch, African	*Ortygospiza atricollis*		Confirmed
Quelea, Red-billed	*Quelea quelea*		Confirmed
Reed-warbler, African	*Acrocephalus baeticatus*		Medium
Robin-chat, Cape	*Cossypha caffra*		Confirmed
Rock-thrush, Cape	*Monticola rupestris*		Medium
Rock-thrush, Sentinel	*Monticola explorator*		Low
Roller, European	*Coracias garrulus*	NT	Low
Roller, Lilac-breasted	*Coracias caudatus*		Low
Ruff, Ruff	*Philomachus pugnax*		Low
Rush-warbler, Little	*Bradypterus baboecala*		Medium
Sandpiper, Common	*Actitis hypoleucos*		High
Sandpiper, Curlew	*Calidris ferruginea*		Medium

English name	Scientific name	IUCN Red Data Status	Likelihood of occurrence
Sandpiper, Marsh	*Tringa stagnatilis*		Medium
Sandpiper, Wood	*Tringa glareola*		Medium
Secretarybird	*Sagittarius serpentarius*	VU	Confirmed
Seedeater, Streaky-headed	*Crithagra gularis*		Low
Shelduck, South African	*Tadorna cana*		Low
Shoveler, Cape	*Anas smithii*		Medium
Snipe, African	*Gallinago nigripennis*		Medium
Sparrow, Cape	*Passer melanurus*		Confirmed
Sparrow, House	*Passer domesticus*		Confirmed
Sparrow, Southern Grey-headed	*Passer diffusus*		High
Sparrowhawk, Black	*Accipiter melanoleucus*		Medium
Sparrowhawk, Rufous-chested	*Accipiter rufiventris*		Low
Spoonbill, African	*Platalea alba*		Medium
Spurfowl, Swainson's	*Pternistis swainsonii*		Confirmed
Starling, Cape Glossy	*Lamprotornis nitens*		Medium
Starling, Pied	*Spreo bicolor*		Confirmed
Starling, Red-winged	*Onychognathus morio*		Confirmed
Starling, Wattled	*Creatophora cinerea*		Medium
Stilt, Black-winged	*Himantopus himantopus*		Medium
Stint, Little	*Calidris minuta*		Low
Stonechat, African	*Saxicola torquatus*		Confirmed
Stork, Abdim's	*Ciconia abdimii*	NT	Low
Stork, White	*Ciconia ciconia*		Medium
Stork, Yellow-billed	*Mycteria ibis*	EN	Low
Sunbird, Amethyst	*Chalcomitra amethystina*		High
Sunbird, Malachite	*Nectarinia famosa*		Confirmed
Swallow, Barn	*Hirundo rustica*		Confirmed
Swallow, Greater Striped	*Hirundo cucullata*		Confirmed
Swallow, White-throated	*Hirundo albigularis*		Confirmed
Swamp-warbler, Lesser	*Acrocephalus gracilirostris*		High
Swamphen, African Purple	*Porphyrio madagascariensis*		Medium
Swift, African Black	*Apus barbatus*		Medium
Swift, Horus	*Apus horus*		Low
Swift, Little	*Apus affinis*		Confirmed
Swift, White-rumped	*Apus caffer*		Confirmed
Teal, Cape	*Anas capensis*		Low
Teal, Hottentot	*Anas hottentota*		Low
Teal, Red-billed	*Anas erythrorhyncha*		Medium
Tern, Whiskered	*Chlidonias hybrida*		Medium

English name	Scientific name	IUCN Red Data Status	Likelihood of occurrence
Tern, White-winged	*Chlidonias leucopterus*		Low
Thick-knee, Spotted	*Burhinus capensis*		High
Thrush, Groundscraper	*Psophocichla litsipsirupa*		Low
Thrush, Karoo	*Turdus smithi*		High
Thrush, Kurrichane	*Turdus libonyanus*		Medium
Thrush, Olive	*Turdus olivaceus*		Low
Turtle-dove, Cape	*Streptopelia capicola*		Confirmed
Wagtail, Cape	*Motacilla capensis*		Confirmed
Warbler, Sedge	*Acrocephalus schoenobaenus*		Medium
Warbler, Willow	*Phylloscopus trochilus*		Medium
Waxbill, Common	*Estrilda astrild*		High
Waxbill, Orange-breasted	*Amandava subflava*		Low
Weaver, Cape	*Ploceus capensis*		Medium
Weaver, Village	*Ploceus cucullatus*		Low
Wheatear, Capped	*Oenanthe pileata*		Medium
Wheatear, Mountain	*Oenanthe monticola*		High
White-eye, Cape	*Zosterops virens*		Confirmed
Whydah, Pin-tailed	*Vidua macroura*		Confirmed
Widowbird, Fan-tailed	*Euplectes axillaris*		Confirmed
Widowbird, Long-tailed	*Euplectes progne*		Confirmed
Widowbird, Red-collared	*Euplectes ardens*		Confirmed
Widowbird, White-winged	*Euplectes albonotatus*		High
Wood-hoopoe, Green	*Phoeniculus purpureus*		Low
Woodpecker, Ground	*Geocolaptes olivaceus*		Low
Wryneck, Red-throated	*Jynx ruficollis*		High

7.2.4 Threatened Species

A total of 19 Near Threatened or Threatened bird species have been recorded in the area considered during the desktop survey (Table 2).

The presence of three red-listed species was confirmed during surveys and/or through discussion with land-owners: Secretarybird, Southern Bald Ibis and White-bellied Korhaan. Each of these is discussed in more detail below.

Secretarybird

Recently up-listed from *Near Threatened* to *Vulnerable*, the Secretarybird has undergone a population reduction of > 30 % in the last ten years (Retief 2015). The species is primarily threatened by loss of its grassland and savanna habitats driven by agriculture, urbanization, overgrazing and bush encroachment, with other threats including collision with power lines and wind farms (Retief 2015). Much of the grassland at the site of the proposed mine is suitable habitat for this species, and its presence at the site was confirmed. Moreover, the

species breeds at the site, with a farmer reporting a nest in a firethorn (*Pyracantha*) tree near the dam just south of the N17 highway (Figure 28).

Southern Bald Ibis

The *Vulnerable* Southern Bald Ibis was recorded at the site during the survey, and the regular presence of the species was confirmed through discussions with landowners. This southern African endemic occurs in mid- to high-altitude grasslands and breeds colonially on cliffs (Henderson 2015). The species is threatened by theft of eggs and young, poisoning and habitat destruction and transformation (Henderson 2015). The individuals seen at the site were flying overhead. In addition, two sites representing good breeding habitat for this cliff-nesting species occur at the site: the cliffs along the Klein Drinkwaterspruit just north of the N17 highway (Figures 33, 34), and the cliffs on the adjacent property due east of Spitskop (Figure 33).

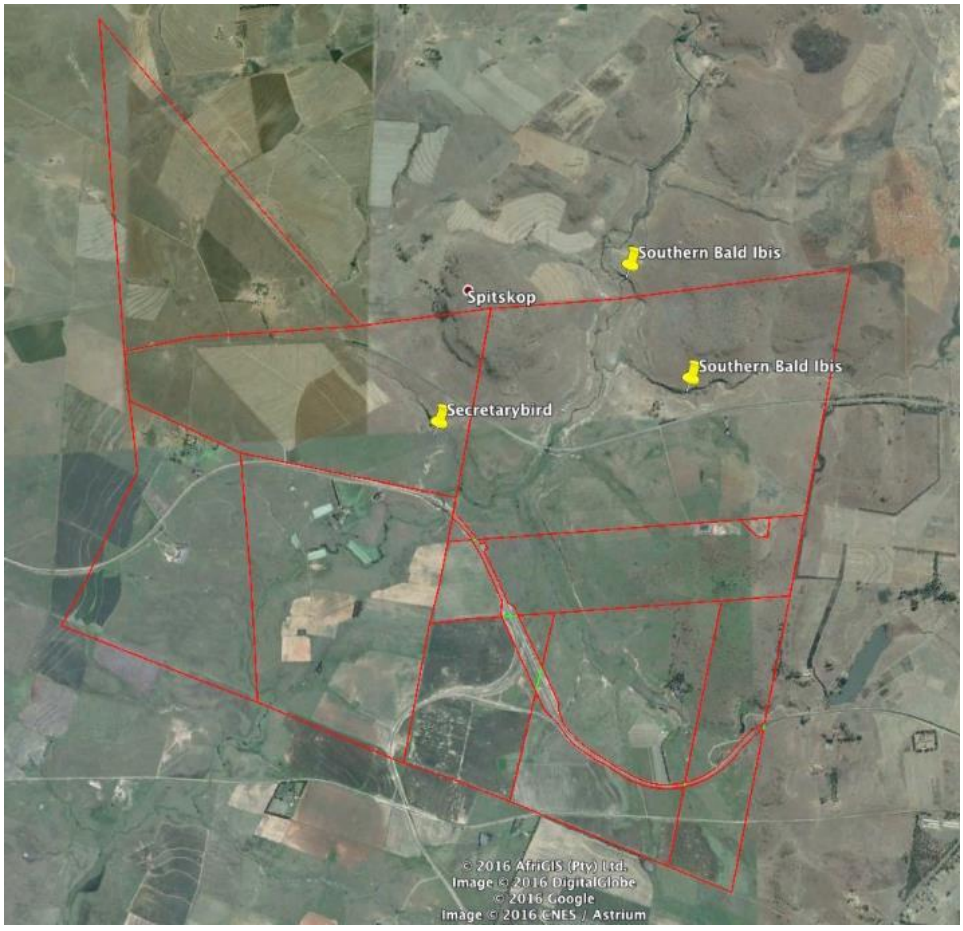


Figure 28: Approximate locations of Secretarybird nest, and two sites considered good nesting sites for Southern Bald Ibis. Image courtesy of Google Earth.

Figure 29: Cliffs representing potential nesting sites for Southern Bald Ibis

White-bellied (=Barrow's) Korhaan

The presence of the *Vulnerable* White-bellied Korhaan was confirmed during an interview with a landowner, and has been recorded in this pentad during SABAP 2. The species is considered *Vulnerable* on account of a population reduction of > 30% over the bird's last three generations, and is threatened primarily by habitat loss and degradation driven by agriculture and afforestation (du Plessis et al. 2015).

In addition to the above three species, the presence of African Grass-owl and Red-footed Falcon at the site is considered likely. The African Grass-owl is *Vulnerable*, and occurs in areas of long grass that may or may not be associated with wetlands (Whittington-Jones and Peacock 2015). Although the species has not been recorded in this area during SABAP 1 or 2, the grassland on the dolerite ridge immediately to the south of the quarry at 26°31'14"S 29°55'22"E is potential habitat (Figure 35). The primary threat faced by this species is loss of habitat, with losses of grasslands and wetlands to coal mining activities being among the most serious problems (Whittington-Jones and Peacock 2015). The Red-footed Falcon is Near Threatened, and is also likely to occur at the site periodically (Taylor 2015).

Another important red-listed species in this area is the *Endangered* Botha's Lark. The site of the proposed mine is located in the edge of this species' known distribution (Peacock 2015), and it has been recorded in the same quarter-degree square within which the site is located. This species is a habitat specialist, being confined to heavily grazed short natural upland grassland on plateaux and upper hill slopes (Peacock 2015). Nearly all of the grassland at the site is too tall for this species, although some of the more heavily grazed grassland patches (Figure 9) could conceivably approach habitat requirements for this species. Overall, however, the likelihood of this species occurring at this site is low.

Figure 30. **Tall grassland south of the dolerite quarry; this is possible habitat for African Grass-owl.**

Finally, Blue Korhaan is not red-listed regionally (Taylor et al. 2015), but is considered Vulnerable by the Mpumalanga Tourism and Parks Authority (MTPA). The likelihood of occurrence at the site for this species is considered high.

7.2.5 Overall sensitivity

The confirmed presence of three red-listed species, likely presence of two additional species, likely presence of one MPTA-listed species, plus the location of the site within an IBA, collectively calls for the sensitivity of the site to be considered medium-high from an avifaunal perspective. The contribution of proposed development to cumulative avian habitat loss in the Amersfoort-Bethal-Carolina IBA also cannot be ignored. Although the surface infrastructure of the proposed mine will largely be restricted to areas that are currently under agriculture, the wider impacts of the mining activities on avifauna at the site must be carefully considered. For instance, one factor that should be considered is the potential for negative impacts over a larger area of the IBA through pollution associated with construction and/or mining activities; the possibility exists, for instance, that injudicious use of toxic chemicals at the site could reach areas nearby wetlands via run-off and/or groundwater. For this reason, the location of this site within the IBA must be borne in mind when assessing the impacts of the construction and operational phases of this project.

Table 4. Red-listed species whose possible presence at the site of the proposed mine was evaluated during the assessment process.

Species	Scientific name	Red Data1	NEMBA2	Assessment of likelihood of presence at site
Stork, Yellow-billed	Mycteria ibis	EN		Unlikely. No suitable habitat – occurs in inland water bodies.
Stork, Abdim's	Ciconia abdimii	NT		Possible. Occurs in grasslands, woodlands and cultivated fields in rural areas.
Ibis, Southern Bald	Geronticus calvus	VU	VU	Present at site. See text for discussion.
Flamingo, Greater	Phoenicopterus ruber	NT		Unlikely. No suitable habitat – occurs in lakes and pans. Present approximately 30 km west of site.
Flamingo, Lesser	Phoenicopterus minor	NT		Unlikely. No suitable habitat – occurs in lakes and pans.
Duck, Maccoa	Oxyura maccoa	NT		Unlikely. Occurs in permanent standing water bodies such as large dams.
Secretarybird	Sagittarius serpentarius	VU		Present at site. See text for discussion
Falcon, Lanner	Falco biarmicus	VU		Possible.
Falcon, Red-footed	Falco vespertinus	NT		Likely.
Crane, Grey Crowned	Balearica regulorum	EN	EN	Possible. Occurs in undisturbed grassland and wetlands, cultivated fields
Crane, Blue	Anthropoides paradiseus	NT	EN	Possible. Occurs in undisturbed grassland and wetlands, cultivated fields.
Bustard, Denham's	Neotis denhami	VU	PR	Possible – occurs in grassland, often in rocky areas.
Korhaan, White-bellied	Eupodotis senegalensis	VU		Present at site. See text for discussion
Painted-snipe, Greater	Rostratula benghalensis	NT		Unlikely. Occurs in thick vegetation along the edges of water bodies.
Pratincole, Black-winged	Glareola nordmanni	NT		Possible. Occurs in open grassland, edges of pans and cultivated fields.

Species	Scientific name	Red Data1	NEMBA2	Assessment of likelihood of presence at site
Grass Owl, African	Tyto capensis	VU	VU	Likely.
Kingfisher, Half-collared	Alcedo semitorquata	NT		Unlikely. No suitable habitat – clear, vegetated fast-flowing streams.
Roller, European	Coracias garrulus	NT		Unlikely. No suitable habitat – open woodlands.
Lark, Botha's	Spizocorys fringillaris	EN		Possible. Some habitat that may approaching the requirements for this species.

1Current (2015) IUCN Red List Status for South Africa, Lesotho and Swaziland (Taylor et al. 2015). NT = Near Threatened; VU = Vulnerable; EN = Endangered; CR = Critically Endangered

2Indicates species listed as Protected ("PR"), Vulnerable ("VU"), Endangered ('EN") or Critically Endangered ("CR") in the National Environmental Management: Biodiversity Act, 2004 list of Threatened or Protected Species (2007 version

7.3 HERPETOFAUNA

The local occurrences 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.

7.3.1 Herpetofauna Habitat Assessment

From a herpetological habitat perspective it was established that three of the four major habitats are naturally present on the study site, namely terrestrial, rupiculous and wetland-associated vegetation cover.

Most of the study site consists of grassland. The natural grassland has been partially transformed for agricultural purposes like grazing and crop fields and by anthropogenic influences such as buildings, roads, fences and invasive plants. The study site is thus ecologically disturbed in some places. Very few moribund termitaria (Figure 27) were recorded on the study site. These structures are good indicators of the occurrence of small herpetofauna. Accordingly, it is estimated that the reptile and amphibian population densities for the study site is somewhat higher than it would be if these are absent. At the time of the site visit the basal cover was good despite grazing by live stock, and provides adequate cover for small terrestrial herpetofauna. The grasslands themselves have not been severely transformed; consequently prey is probably widely distributed so that foraging grounds would not need to be so extensive to support the different populations.

Figure 31: A moribund termitarium on the study site.

Some parts of the study site such as Spitskop (Figure 32), along the Klein Drinkwater Spruit (Figure 33) and south of the quarry on Restant 4, 6 and 7 (Figure 34) are sandstone or dolerite rocky outcrops that provide excellent rupiculous habitat. Due to the presence of

natural rupiculous habitat, some species like common girdled lizard, common crag lizard and rock agama were added to the species list (Table 5). There are several artificial surrogates for rupiculous habitat, such as buildings. Only common reptiles like the speckled rock skink will benefit from these structures.

Figure 32: Rupiculous habitat at Spitskop.

Figure 33: Rupiculous habitat along the Klein Drink Water Spruit.

Figure 34: Rupiculous habitat on Restant 6.

There are quite a few manmade dams (Figure 35) on the study site. Some of the dams are in drainage lines and hold water either temporarily (Figure 36) or permanently. The Klein Drinkwater Spruit flows through the study site, but is severely polluted by litter and raw sewage from Ermelo Town. Several almost pristine drainage lines flow into the Klein Drinkwater Spruit and these water sources would provide habitat for common water-dependent herpetofauna. All wetland forms enjoy statutory protection and are regarded as sensitive.

Figure 35: A manmade dam on the study site. Note the N17 Bridge in the background.

Figure 36: A temporary dam on the study site. Note part of Spitskop in the background

Along the rupiculous habitat indigenous trees like bushveld bluebush (*Diospyros lycioides*), spikethorn (*Gymnosporia buxifolia*), several *Searsia* species and white-stinkwood (*Celtis africana*) occurs. These indigenous trees are too few and arboreal habitat is therefore absent in a functional sense and 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 that provide shelter and food for some herpetofauna.

7.3.2 Observed and Expected Herpetofauna Species Richness

Of the 40 reptile species that may occur (Table 5), two were confirmed during site visits (Table 6) and of the possible 14 amphibian species that may occur on the study site (Table 5), one was confirmed during site visits (Table 6).

Fifty-four herpetofauna species are 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 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 7) are fairly common and widespread (viz. common house snake, mole snake, common egg eater, rinkhals, speckled rock skink, common platanna, striped stream frog, common river

frog, Boettger's caco, bubbling kassina, guttural toad and red toad). The relatively high species richness is due to the fair size of the study site and the three different habitat types occurring on the study site.

Table 5: Reptile and Amphibian diversity. The species observed or deduced to occupy the site. Species list and systematic arrangement and nomenclature according to Carruthers & Carruthers (1979), Branch (1998), Minter, *et.al* (2004), Alexander and Marais (2007), Koen (2007) Du Preez & Carruthers (2009) and Bates, *et.al* (2014).

	SCIENTIFIC NAME	ENGLISH NAME
	CLASS: REPTILIA	REPTILES
	Order:TESTUDINES	TORTOISES & TERRAPINS
*	*Pelomedusa subrufa*	Marsh Terrapin
	Order: SQUAMATA	SCALE-BEARING REPTILES
	Suborder:LACERTILIA	LIZARDS
	Family: Gekkonidae	Geckos
?***End***	*Lygodactylus ocellatus ocellatus*	Spotted Dwarf Gecko
?***End***	*Pachydactylus affinis*	Transvaal Gecko
?	*Pachydactylus capensis*	Cape Gecko
****N-End***	*Pachydactylus vansoni*	Van Son's Gecko
	Family: Lacertidae	Old World Lizards or Lacertids
****End***	*Nucras lalandii*	Delalande's Sandveld Lizard
?	*Nucras ornata*	Ornate Sandveld Lizard
?	*Pedioplanis lineoocellata lineoocellata*	Spotted Sand Lizard
	Family: Cordylidae	
?***NTEnd***	*Chamaesaura aenea*	Coppery Grass Lizard
√***N-End***	*Cordylus vittifer*	Common Girdled Lizard
?	*Pseudocordylus melanotus melanotus*	Common Crag Lizard
	Family: Gerrhosauridae	Plated Lizards
√	*Gerhosaurus flavigularis*	Yellow-Throated Plated Lizard
	Family: Scincidae	Skinks
?***End***	*Acontias breviceps*	Short-Headed Legless Skink
?***End***	*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
?***End***	*Scelotes mirus*	Montane Dwarf Burrowing Skink
	Family: Varanidae	Monitors
?	*Varanus niloticus*	Nile Monitor
	Family: Agamidae	Agamas
√***End***	*Agama aculeata distanti*	Eastern Ground Agama
√***N-End***	*Agama atra*	Southern Rock Agama
	Suborder: SERPENTES	SNAKES
	Family: Typhlopidae	Blind Snakes

	SCIENTIFIC NAME	ENGLISH NAME
***N-End**	*Afrotyphlops bibronii*	Bibron's Blind Snake
	Family: Leptotyphlopidae	Thread Snakes
√	*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
?**NTEnd**	*Homoroselaps dorsalis*	Striped Harlequin Snake
?**End**	*Homoroselaps lacteus*	Spotted Harlequin Snake
√	*Boaedon capensis*	Common House Snake
***End**	*Lamprophis aurora*	Aurora Snake
?**N-End**	*Lamprophis guttatus*	Spotted Rock Snake
?**End**	*Lycodonomorphus inornatus*	Olive Ground Snake
?**End**	*Lycodonomorphus laevissimus*	Dusky-Bellied Water Snake
√	*Lycodonomorphus rufulus*	Brown Water Snake
?	*Lycophidion capense capense*	Cape Wolf Snake
?	*Psammophis brevirostris*	Short-snouted Grass Snake
√**N-End**	*Psammophis crucifer*	Cross-Marked Grass Snake
√	*Psammophylax rhombeatus*	Spotted Grass Snake
? **N-End**	*Amplorhinus multimaculatus*	Many-Spotted Snake
√ **End**	*Duberria lutrix lutrix*	South African Slug-Eater
√	*Pseudaspis cana*	Mole Snake
	Family: Elapidae	Cobras, Mambas and Others
√ **N-End**	*Hemachatus haemachatus*	Rinkhals
?	*Elapsoidea sundevallii*	Sundevall's Garter Snake
	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
√	*Amietaophrynus gutturalis*	Guttural Toad
* **End**	*Amietaophrynus rangeri*	Raucous Toad
	Family: Hyperoliidae	Reed Frogs
√	*Kassina senegalesis*	Bubbling Kassina
√ **End**	*Semnodactylus wealii*	Rattling Frog
	Family: Breviceptidae	Rain Frogs
?	*Breviceps mossambicus*	Mozambique Rain frog
	Family: Phrynobatrachidae	Puddle Frog
?	*Phrynobatrachus natalensis*	Snoring Puddle Frog

	SCIENTIFIC NAME	ENGLISH NAME
	Family: Ptychadenidae	Grass Frogs
√	*Ptychadena porosissima*	Striped Grass Frog
	Family: Pyxicephalidae	
√	*Amietia angolensis*	Common River Frog
√ ***N-End***	*Amietia fuscigula*	Cape River Frog
√	*Strongylopus fasciatus*	Striped Stream Frog
√ ***End***	*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
?	*Tomopterna tandy*	Tandy's 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.
End –Endemic to Mpumalanga Province and South Africa (Minter, *et.al* 2004; Bates, *et.al* 2014)
N-End Near – Endemic to Mpumalanga Province and South Africa (Minter, *et.al* 2004; Bates, *et.al* 2014)

√ 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.

Table 6: Reptile and Amphibian species positively confirmed on the study site, observed indicators and habitat.

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
Trachylepis punctatissima	Speckled Rock Skink	Sight record	Individuals on man-made rupiculous habitat.
Lygodactylus capensis capensis	Common Dwarf Gecko	Sight record	A few individuals Individuals on man-made rupiculous habitat.
Strongylopus fasciatusi	Striped Stream Frog	Vocalisation	Permanent water bodies

All three species in Table 8 should be abundant on the study site and elsewhere in its range.

7.3.3 Red Data Listed Herpetofauna identified

-By the Scientific Community

The study site falls outside the natural range of plain stream frog, spotted shovel-nosed frog, whistling rain frog, large-scaled grass lizard, giant dragon lizard, Fitzsimons' flat lizard, Breyer's long-tailed seps, Southern African python and the Nile crocodile. None of these species should occur on the study site.

The striped harlequin snake has not been recorded on the two quarter degree squares (TVL Museum Records or Ditsong Museum of Natural History), but the Mpumalanga Tourism and Parks Agency has a record of this snake on the quarter degree square 2629BD. Very few moribund termitaria, where this species is most likely to be found, are present on the study site. It is very difficult to confirm whether this cryptic snake is present on any study site, but there is a small chance this species could occur on this particular study site.

The coppery grass lizard has not been recorded on the two quarter degree squares (TVL Museum Records or Ditsong Museum of Natural History) but the study site has suitable habitat for the coppery grass lizard and there is a possibility that this species may be present on the site.

The distribution records for the giant bullfrog are extremely patchy for Mpumalanga Province, with only a few localities (Du Preez & Cook, 2004). Potential breeding sites for the giant bullfrog are present on 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 9cm 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).

Many parts of the study site consist of sandy soil and are very suitable as a dispersal area, 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.

The study site contains barriers which might obstruct giant bullfrog movement. The busy N17 highway bisects the study site and acts as dispersal barrier.

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.

There is a small chance that two snakes of the Mpumalanga Province may occur on or near the study site. The spotted harlequin snake has been recorded in quarter degree square 2629BD (Mpumalanga Tourism and Parks Agency Records). This species is usually found in deserted termite mounds or under rocks (Alexander & Marias, 2007). These types of

micro habitats are not abundant on the study site but do occur in some places. The many-spotted snake has been recorded on this quarter degree square 2629DB (Mpumalanga Tourism and Parks Agency Records). This secretive snake forages for frogs, lizards and rodents in reed beds and waterside vegetation (Branch, 1998 and Alexander & Marias, 2007). Potential habitat for this snake species is wetland-associated vegetation cover at the water edge. If the water bodies with their buffer habitat are protected, this species should coincidentally be protected.

-By the Biodiversity Act No 10 of 2004
Protected Species: Giant bullfrog.

-By the Mpumalanga Nature Conservation Act no. 10 of 1998
Schedule 2: Protected Game

Bullfrog – Pyxicephalus adspersus

All species of reptiles (Class Reptilia) excluding water leguan (*Varanus nilotica*), rock leguan (*Varanius exanthematicus*) and all species of snakes (Sub Order Serpentes)

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

Water leguan (*Varanus nilotica*), rock leguan (*Varanius exanthematicus*) and all species of snakes (Sub Order Serpentes)

Schedule 8: Problem Animals

All species of exotic tortoises, turtles and terrapins (Order Chelonia)

-Endemism:
See Table 5 above.

8 FINDINGS AND POTENTIAL IMPLICATIONS

8.1 Assessment criteria

The underground mine and compound will be mostly sited on maize and soya fields and as such their conservation status is rated as zero. However, the grassland section between the to-be-affected fields and the railways lines (Figure 16) is in fact primary grassland (and therefore good habitat). In the latter instance the conservation status is rated as **Medium-*High,*** *i.e. Land where sections are disturbed but that is still ecologically sensitive to development/disturbance*. (See Section 6.4 – Assessment Criteria to express conservation status). In fact, a portion of the grassland to be affected by the planned development is considered as 'CBA Irreplaceable' in the Mpumalanga Biodiversity Sector Plan (Figures 8 and 17). As prime habitat, this portion is rated high, but spatially the number of individuals it supports is modest, if not negligible.

8.2 Impact assessment derived values

The numerical impact values of the proposed mine for vertebrates yield the following totals for the grassland habitat and the maize / soya fields, given the projected impacts of the development and as per the assessment criteria discussed in Section 6.5 above.

Habitat	Magnitude	Reversibility	Extent	Duration	Probability	Significance	Confidence
Grassland	4	3	2	4	4	56	High
Cropland	0	3	1	4	4	32	Moderate

Significance values are expressed as

RANKING	**65-100**	**64-36**	**35-16**	**15-5**	**1-4**
SIGNIFICANCE	**Very High**	**High**	**Moderate**	**Low**	**Minor**

The numerical significance value for the grassland falls within the High Environmental Significance class and for the cropland in the Moderate Significance class. The loss of the fields would have little significance if it were not for the fact that the reversibility is rated as 3 (possible with human intervention), the duration of the impact is 4 (15 years or longer) and probability a 4 (likely).

The respective portions have "High" and "Moderate" values and are rated so because the nature of the development is essentially highly intrusive, cosmetically reversible but at high cost, virtually permanent and with a high probability of the intrusive event occurring.

8.3 Overall Impact Impressions

Species richness: The proposed development will definitely transform the fields and the existing habitats on the targeted terrain.
Threatened species: No threatened species are expected to be fatally impacted by the proposed development since their survival potential will be accommodated in the rest of the extensive natural areas of properties taken into consideration.
Sensitive areas: A small portion of the grassland to be affected is earmarked as 'CBA Irreplaceable' in the Mpumalanga Biodiversity Sector Plan (Figure 8). The development is a distance from water courses and the risk of contamination is proportionately small.
Habitat(s) quality and extent: The fields have no (or very little) potential to support vertebrates. However, the small portion of prime grassland will be destroyed.
Impact on species richness and conservation: Relative to the extensive countryside the development will not have a significant negative impact. However, this remark does not cover indirect impacts such as noise, dust, poaching, aesthetics etc.
Connectivity: Connectivity is presently partially curtailed by the railway lines. The mine territory will further impair connectivity in an east-west direction.
Management recommendations: See Section 9: 'Environmental Risks, Their Assessment and Proposed Mitigations'.
General: Nil.

8.4 Assessment of alternative sites

No alternative sites were presented for assessment, apart from possible but unspecified small changes in the exact route of the road.

9 ENVIRONMENTAL RISKS, THEIR ASSESSMENT AND PROPOSED MITIGATIONS

Spatially the development will be ca. 130 hectares and this is reflected in the estimated impacts.

Mitigation is arranged in graded steps, and the lowest level should be applied. The phases are:

1. Planning to avoid or minimise ecosystem loss(es) at acceptable levels.
2. Minimising impacts during the construction phase.
3. Rehabilitation to the 'pre-development' condition wherever possible during the construction/operation phases and especially upon cessation of the activity.
4. Offset of significant residual damaging impacts.

Projected impacts (irrespective on where the development will be sited) are divided into three succeeding phases, i.e. Planning, Construction and Operational.

9.1 Planning and Environmental Planning

9.1.1 EMP and ROD

It should be a contractual requirement to develop and implement a Record of Decision (ROD) and an Environmental Management Plan (EMP). The EMP must include detailed plans for management of runoff and underground seepage given the proposed nature of the development.

9.1.2 Roads, water and staff facilities.

These will require careful consideration, especially in view of the extent and duration of the construction phase of the development.

9.1.3 Wetlands.

The development will not be near wetlands. Runoff contaminants should nevertheless be curtailed.

9.2 Construction Phase

9.2.1 Destruction of natural habitat

Due to the nature of construction for such a development, much of the existing natural habitat will be destroyed even with mitigation along the verges. Whereas most of the development area is currently used for agriculture and hence will not represent significant loss of vertebrate habitats, the mine components located partly or wholly in areas that currently consist of grassland are more problematic. The development will include the discards dump, overland conveyor, boxcut, hards stockpile and pollution control dam. The footprint of this impact will presumably be greater than the area occupied by the development itself, on account of additional areas cleared for access, vehicle parking, construction activities and housing construction workers. Heavy motor vehicle usage over the study site will expose the soils on the site to erosion and compaction.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Destruction of natural habitat	Whole site	Site	Near permanent	High	Definite	High	Low	High

Mitigating Measures:

1. The spatial extent of construction activities must be minimized, and as far as possible restricted to the areas on which buildings, roads etc. will actually be located. Particular care must be taken to minimize activities in the areas of natural grasslands adjacent to the agricultural fields.
2. If the giant bullfrog, coppery grass lizard, striped harlequin snake, or any herpetological species are encountered or exposed during the construction phase, they should be removed and relocated to natural areas in the vicinity. This remediation requires the employment of a herpetologist to oversee the removal of any herpetofauna during the initial ground clearing phase of construction (i.e. initial ground-breaking by earthmoving equipment). The contractor must ensure that no herpetofauna species are disturbed, trapped, hunted or killed during the construction phase. Any herpetofauna that are inadvertently killed during earthmoving operations should be preserved as museum voucher specimens. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
3. When holes or trenches are dug, construction must be completed as quickly as possible; otherwise such holes may act as death traps for herpetofauna.
4. Maintain the appropriate legislative buffers from all wetlands.

9.2.2 Destruction of sensitive vertebrate habitat

Construction will annihilate existing natural habitat i.e. the patch of CBA grassland. This will however not lead to certain species becoming rarer within regional context.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Destruction of sensitive vegetation types and plants species	CBA patch of grassland	Local	Near permanent	High	Definite	High	Medium	High

Mitigating Measures

1. Ideally no construction should be allowed within sensitive habitat.
2. Sensitive habitat should be cordoned off to prevent access while construction takes place.

9.2.3 Loss of ecosystem function

Construction runs the risk of interfering with ecosystem function, such as reduction in water quality and dispersal, soil pollution or underground water contamination.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Destruction of natural habitat	Whole site	Local	Ongoing threat	High	Definite	High	Medium	High

Mitigating Measures

1. Restrict construction activities to the minimal areas within development site.
2. Cordon off sensitive habitat to restrict movement of construction vehicles and construction personnel.
3. The mine's influence should be exerted to retain the linear integrity, flow dynamics and water quality of the drainage lines and dams, and the quality of the Klein Drinkwater Spruit must be improved.

9.2.4 Loss of the ecological function of wetland

The mine will not be near a wetland or drainage line.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Not applicable	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Mitigating Measures

1. This report will definitely oppose development close to any drainage line.
2. Runoff and spillages of any noxious substance are to be contained and neutralized.

9.2.5 Exposure to erosion

Erosion of the soil surface due to increased runoff from the sealed road surfaces, causing exposed soil conditions where rainfall and high winds can accelerate mechanical erosion.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Exposure of the site to erosion.	Whole site	Local	Short term	High	Probable	Medium	Low	High

Mitigating Measures

1. Use a sequential construction strategy i.e. phasing the construction on the site and rehabilitating immediately after each phase.
2. Do not leave bare soil surfaces exposed to erosion for lengthy periods.
3. Implement sound storm water management measures.
4. Time construction to take place outside of the rainy season, thus reducing opportunities for erosion from rainfall events.

9.2.6 Poaching of wildlife in the vicinity

The site is vulnerable to hunting/trapping by construction workers. Harassing and hunting by construction workers could be expected.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Poaching of wildlife on and adjacent to the site	Whole site and adjacent areas	Site	Duration of mine life.	Medium	Probable	Medium	Low	High

Mitigating Measures

1. Education of the construction / mining staff about the value of wildlife and environmental sensitivity.
2. Restrict access to the suitable and sensitive habitats of faunal species.

3. Contractor / subcontractors must ensure that no animals are disturbed, trapped, hunted or killed during the construction phase.
4. Conservation-orientated clauses should be built into contracts for construction personnel and mining staff, complete with penalty clauses for non-compliance.

9.2.7 Disturbance associated with construction activities

The presence of vehicles and construction workers will cause disturbance to animals, with the movement and activities of personnel on site and the associated noise, pollution and litter all having a negative effect. A particular concern in this regard concerns the proximity of the mine to the area in which a secretarybird nest is located. Although this nest did not appear to be active during the site visit, it may well be used again by the birds in future, and it is very likely that the presence of the mine will result in their displacement from the site. It is unlikely that this can be avoided through mitigation.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Disturbance during construction	Whole site	Site	Duration of construction	High	Definite	Medium	Low	High

Mitigating Measures

1. Movement of construction vehicles and workers in the natural grasslands in the eastern part of the site must be minimized. In addition, workers must be instructed to minimize disturbance of birds at all times, and steps must be taken to ensure that no illegal hunting occurs.

9.2.8 Pollution associated with construction activities

Pollution associated with construction activities (e.g., fuel spills, use of cleaning chemicals) could have serious negative impacts on fauna if such chemicals were to enter the dams on the site, and/or make their way into the drainage lines and wetlands located immediately to the north or south of the site.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Pollution	Whole site	Local	Duration of construction	Medium	Medium	Medium	Low	HIgh

Mitigating Measures

1. Great care must be taken that no pollutants enter local water systems during the construction phase. Measures to rapidly deal with spills of fuel, cleaning chemicals or any other potential pollutants must be put in place before construction commences. Construction workers must be suitably trained to deal with any such spills.

9.2.9 Reversibility

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Rehabilitation	Whole site	Site	Permanent	Low	Definite	Medium	Low	High

Mitigating Measures

1. A mine and especially the dump are essentially permanent developments, with continual maintenance thereafter.

9.3 Operational Phase

9.3.1 Reduction of natural migratory and faunal dispersal routes.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Barrier across of grassland	Whole site	Site	Permanent	Gradual	Definite	High	Medium	High

Mitigating Measures

1. Ensure any crossing opportunities (viz. culverts, pipes and bridges) are designed to also facilitate small animal movements.

9.3.2 Possible increase in exotic vegetation

Exotic vegetation may be introduced to the environment via disturbance of the road verges or landscaping around the development.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Possible increase in exotic vegetation.	Site	Site	Permanent	Medium	Probable	High	Medium	High

Mitigating Measures

1. Implement a policy within the development that only indigenous plant species be used in the landscaping of the site.
2. Natural open spaces should be left in their undeveloped state for as long as possible, and any existing or new exotic vegetation that is present on the site should be removed and eradicated. This does not, however, apply to the *Pyracantha* trees, as they provide nesting sites for Secretarybirds and likely other species.

9.3.3 Displacement of indigenous faunal species

The development will transform the natural habitat of various faunal species. These species may no longer be able to find suitable habitat on the site, although most forms should be available on any undeveloped surrounding land. The access road itself could possibly lead to a modest decline in population numbers, but not to local extinction.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Reduction of indigenous faunal species	Site and surroundings	Local	Permanent	Low	Low	Medium	Low	High

Mitigating Measures

1. Maintenance of corridors (see 10.3.1 above) should minimise losses and assist with any subsequent recolonization of the site.

9.3.4 Increased amounts of surface water runoff

The increased amounts of surface water runoff from hard surfaces and especially the dump within the development may increase the chance of erosion and/or flash floods. With a

single rainfall event many litres of water are released. These waters are usually absorbed by the displaced grasslands and other vegetation.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Increased amounts of surface water runoff	Site and surroundings	Local	Permanent	Medium	Probable	Medium	Low	High

Mitigating Measures

1. Implement an ecologically sound storm water management plan, including where necessary dykes, retention ponds and artificial water sponges (wetlands).

9.3.5 Disturbances of fauna in nearby sensitive vegetation

Vehicle activity within the development and on the access road could disturb faunal species that depend on any natural, sensitive vegetation on either side of the site (if present).

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Disturbance of vertebrates in sensitive vegetation	Sensitive vegetation	Site and areas of physical influence	Permanent	Medium	Probable	Medium	Low	Medium

Mitigating Measures

1. A management plan to prevent maintenance workers from disturbing or harassing any animal.
2. Implement a monitoring programme to regularly assess the presence of faunal species within the sensitive vegetation, including road verges, in particular the grassland and drainage habitats.

9.3.6 Lighting

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Disturbance of nocturnal animals	Whole site	Site	Permanent	High	Definite	Medium	Low	High

Mitigating Measures

1. Vehicle headlight effects seem unavoidable, unless screened to shield their extent.
2. Any outside lighting, such as at junctions, sheds and head gear, should be designed to minimize impacts on fauna. All outside lighting should be directed away from sensitive surrounding areas. Fluorescent and mercury vapour lighting should be avoided and sodium vapour (yellow) lights should be used wherever possible.

9.3.7 Removal of exotic species, declared weeds and invader plants

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	

Mitigating Measures

1. Very few exotic species, weeds or invaders were observed on site, but their control should fall under that of alien species (see 10.3.2 above).

9.3.8 Management of waste products.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Fuel, oil or load spills	Whole site	Site	Duration of operational phase	High	Low	Medium	Low	High

Mitigating Measures

1. Given the nature of the development, special caution should be exercised to manage any risks arising from unexpected spills of potential toxic chemicals and prevent them from reaching surrounding habitats.

9.3.9 Air pollution

The proposed mine will result in a significant increase in air pollution at the site on account of windborne coal dust from stockpiles and the discard dump. This pollution will decrease the air quality in the surrounding area. In very windy weather, airborne dust could potentially increase the likelihood of avian collisions with the transmission powerlines that are located adjacent to the site of the proposed mine if the visibility for flying birds is reduced.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Air pollution	Whole site	Local	Duration of mining operations	Medium	High	Medium	Low	Medium

Mitigating Measures

1. Minimize air pollution, particularly windborne particles produced by the mining process, stockpile and discards dump. Shield stockpiles from predominant wind directions.
2. Vegetate areas and ensure continual capping and vegetation of the sides of the mine residue facility.
3. Regular spraying.
4. Continuously remove coal form site and reduce long-term stockpiling.
5. Clear coal spillages from site

9.3.10 Water pollution

The proposed mine will involve a variety of chemicals and waste products, many of which have the potential to severely pollute local water sources. These include accidental spillages of fuel, as well as the possibility of acid mine drainage. Birds in aquatic habitats at the site, as well as in areas downstream from the proposed mine, would be severely affected by any such pollution.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Water pollution	Beyond site	Local	Duration of mining operations	Medium	Medium	High	Low	Medium

Mitigating Measures

1. All necessary precautions must be put in place to prevent the mining operations leading

to pollution of local drainage lines and water bodies.

9.3.11 Power lines

Power lines linking the substation and mine buildings and other infrastructure will present collision and electrocution hazards to birds. Although these lines will presumably be small distribution lines and not large transmission lines, measures nevertheless need to be taken to reduce the likelihood of collisions and electrocutions.

Impact	Site	Extent	Duration	Intensity	Probability of occurrence/risk	Significance		Confidence
						WOMM	WMM	
Power lines	Power lines	Site	Duration of mining operations	Low	Medium	Medium	Low	Medium

Mitigating Measures

1. "Bird flappers" or double-loop flight diverters developed by the Eskom / Endangered Wildlife Trust (EWT) Strategic Partnership should be fitted to the line during initial construction. These devices must be attached to the centre 60% of the line between each pair of pylons, with the flappers 5 m apart in a staggered configuration. This requirement is not necessary for lines within 100 m of mine infrastructure, since birds are unlikely to be perching on lines in such close proximity to noisy mining operations.

10 LIMITATIONS, ASSUMPTIONS AND GAPS IN INFORMATION

The vertebrate team has sufficient experience and ample access to information sources to confidently compile lists of biota such as presented herein to support conclusions and suggested mitigation measures based on site visits. In instances where doubt exists, a species is assumed to be a possible occupant (viz. Red rock rabbits, pythons and bull frogs); -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 whether an intensive survey to augment this site visit will add significantly to the data base, and the additional costs are unlikely to warrant the effort.

11 CONCLUSION

General: Three of the four major vertebrate habitat types are present, are sensitive and of good quality. Ecologically, the terrestrial habitat quality has been disturbed in some areas by livestock grazing, wire fences, a few gravel roads and monocultures. The study site falls in the Soweto Highveld Grassland (Gm 8) that has *Endangered* status and Amersfoort Highveld Clay Grassland (Gm 13) with a *Vulnerable* status. However most of the Amersfoort Highveld Clay Grassland is already disturbed by maize and soya fields.

Indigenous grasslands provide important ecological services like promoting water quality, quantity and sustainability, sediment control, floral (seed, pollination) and faunal (food, rest, breeding, connectivity) support.

The Ermelo district is water rich with many streams, dams and wetlands. All these water bodies are recognized as sensitive; there are sensitive wetland areas near the proposed mine that will require caution. In terms of the National Water Act, all wetlands in and around the study area must be considered as ecologically sensitive. The study site contains part of a water catchment area that, as an ecological mechanism, is very important. The drainage lines as well as their buffer zones should be considered as ecologically highly sensitive. The normal 100 meters buffer zone outside the riparian zone applies since the development will be outside the urban edge.

The mining operation will be underground and compared to opencast mining environmental damage will be significantly less.

The mine complex will reportedly be 130 hectares in extent and will displace maize and soya bean fields as well as a portion of primary grass between the fields and the railway lines to the south. Constructing an underground mine on the fields has no environmental conservation impact; former destruction has been comprehensive. However, destroying primary Soweto Highveld Grassland cannot be sanctioned without at least an offer of offset measures, especially since the coal mine industry's idea of rehabilitation is not commensurate with that of ecologists. In this instance the grassland conservation status is rated as ***Medium-High,*** *i.e. Land where sections are disturbed but that is still ecologically sensitive to development/disturbance*. (See Sections 6.4 and 8.1 – Assessment Criteria to express conservation status). The impact scores of the mine development will be 60 and 36 respectively for the grassland and the cropland (See Sections 6.5 and 8.2).

The confirmed presence of three red-listed bird species, likely presence of two additional species, likely presence of one MPTA-listed species, plus the location of the site within an IBA, collectively calls for the sensitivity of the site to be considered Medium-High from an avifaunal perspective. The contribution of proposed development to cumulative avian habitat loss in the Amersfoort-Bethal-Carolina IBA also cannot be ignored. Although the surface infrastructure of the proposed mine will largely be restricted to areas that are currently under agriculture, the wider impacts of the mining activities on avifauna at the site must be carefully considered. For instance, one factor that should be considered is the potential for negative impacts over a larger area of the IBA through pollution associated with construction and/or mining activities; the possibility exists, for instance, that injudicious use of toxic chemicals at the site could reach areas nearby wetlands via run-off and/or groundwater. For this reason, the location of this site within the IBA must be borne in mind when assessing the impacts of the construction and operational phases of this project.

The onus therefore rest on the Mpumalanga Nature Conservation Department to decide the way forward, especially since the grassland to-be-affected coincide with a small patch of CBA irreplaceable patch in the Mpumalanga Biodiversity Plan (Figure 8).

The mining operation will displace all vertebrates (including Red Data species that may occur or occasionally visit). This, however, does not place additional survival pressure on any species given the extensive rural nature of the district.

No views are offered regarding the indirect effect of mining, such as dust, noise, poaching or aesthetics. Neither does this investigation address the agricultural value of the land to be compromised by the mine development.

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13 CURRICULUM VITAE

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; born Germiston, RSA
Nationality	South African
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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	Director: Planning, Northern Flagship Institute
Present Position	Consultant – Specialist, Environmental Impact Assessments (Applied research), Photographing microstock for four agencies
Qualifications	**B.Sc**. (UP) 1966, **T.H.E.D** (Pta TTC) 1967, **M.Sc.** (UP) 1971, **Ph.D**. (Un. Natal) 1971
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”.

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ACADEMIC QUALIFICATIONS

Ph.D. (Zoology), University of Natal, April 2002
M.Sc. *cum laude* (Zoology), University of Natal, April 1999
B.Sc. (Honours) *cum laude* (Zoology), University of Natal, April 1997
B.Sc. (Majors: Zoology and Botany), University of Natal, April 1996

PROFESSIONAL QUALIFICATIONS

Professional Natural Scientist (*Pr. Sci. Nat.*; Registration number: 400205/05), South African Council for Natural Scientific Professions

TECHNICAL REPORTS **[31 in total, only 10 most recent shown]**

McKechnie, A.E. 2013. *Specialist avifaunal assessment: proposed Frankfort Power Station.* Prepared for Rural Maintenance.

McKechnie, A.E. 2013. *Specialist avifaunal assessment: proposed MOGS oil storage facility, Saldanha Bay.* Prepared for Enviro-Insight.

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McKechnie, A.E. 2010. *Specialist survey report: assessment of impacts on birds, with particular reference to threatened and near threatened species: proposed subdivision of portion 39, Olifantsvlei 327 IQ, Gauteng*. Prepared for Prism EMS.

McKechnie, A.E. 2009. *Specialist survey report: assessment of impacts on birds, with particular reference to African Grass-owls, White-bellied Korhaans, African Finfoots and Half-collared Kingfishers:proposed residential development on portion 63, Rietvallei 180 IQ, Roodepoort, Gauteng*. Prepared for Prism EMS.

McKechnie, A.E. 2009. *Specialist survey report: Assessment of impacts on birds: proposed wind farm development on Burgershoop 107 and Elandspoort 99 HS, Mpumalanga.* Prepared for K2M Environmental.

Schwaibold, U., Alexander, G.J., **McKechnie, A.E.**, et al. 2009. *Monitoring recommendations for fauna: AngloGold Ashanti Vaal Reef and West Wits.* Prepared for AngloGold.

PEER-REVIEWED SCIENTIFIC PUBLICATIONS **[71 in total, only three most recent shown]**

Pietersen, D.W., Symes, C.T., Woodborne, S.W., **McKechnie, A.E.** and Jansen, R. (in press)

Diet and prey selectivity of the specialist myrmecophage, Temminck's ground pangolin (*Smutsia temminckii*). *Journal of Zoology*

Smit, B. and **McKechnie, A.E.** 2015. Water and energy fluxes during summer in an arid-zone passerine bird. *Ibis* 157(4): 774-786.

Whitfield, M.C., Smit, B., **McKechnie, A.E**. and Wolf, B.O. 2015. Avian thermoregulation in the heat: scaling of heat tolerance and evaporative cooling capacity in three southern African arid-zone passerines. *Journal of Experimental Biology* 218: 1705-1714.

ARTICLES IN SEMI-POPULAR MAGAZINES [73 in total, only three most recent shown]

McKechnie, A.E. 2016. Mercury rising - South Africa's national parks are getting warmer. *African Birdlife* in press.

McKechnie, A.E. 2016. Enormous, enigmatic, extinct – the elephant birds of Madagascar. *African Birdlife* in press.

Noakes, M.J. and **McKechnie, A.E.** 2015 Hot or not? Physiological variation in white-browed sparrow-weavers. *African Birdlife* September/October 2015: 12-13.

CONFERENCE PRESENTATIONS [110 in total, only plenary lectures shown]

McKechnie. A.E., Smit, B., Hockey, P.A.R. and Wolf, B.O. Taking the heat: climate change and desert birds. *At*: Frontiers in South African Ornithology, 15-16 March 2012, Port Elizabeth, South Africa.

McKechnie, A.E., Smit, B., Cory Toussaint, D., Boyles, J.G. and Wolf, B.O. Hot birds and bats: physiological approaches to predicting climate change impacts in small endotherms. *At:* Joint ZSSA and PARSA Conference, 10-13 July 2011, Stellenbosch, South Africa.

SCIENTIFIC AWARDS AND RECOGNITION [only last five years shown]

2013	Finalist: 2012/2013 NSTF/BHP Billiton Awards
2013	Exceptional Academic Achiever, University of Pretoria
2011	Founding Member, South Africa Young Academy of Science
2008-2012	Exceptional Young Researcher Award, University of Pretoria

STUDENT SUPERVISION

Current supervision: 4 PhD, 1 BSc(Hons); Current co-supervision: 3 PhD

Past supervision: 1 PhD, 10 MSc, 9 BSc (Hons); Past co-supervision: 1 PhD, 2 MSc, 3 BSc (Hons)

EDITORSHIP

Associate Editor: *Climate Change Responses*

Associate Editor: *Emu – Austral Ornithology*

Editorial Board: *Journal of Comparative Physiology* B

INVITED SEMINARS AND LECTURES [23 in total, only 3 most recent shown]

Mitrani Department for Desert Ecology, Ben-Gurion University of the Negev, Israel, August 2015.

School of Biological Sciences, University of Queensland, July 2015

Hawkesbury Institute for the Environment, University of Western Sydney, July 2015.

OTHER CONTRIBUTIONS

Scientific Advisor, *African Birdlife* magazine

Expert reviewer - South African National Standard SANS 10386 Annex C

Member, Research Ethics and Scientific Committee, National Zoological Gardens

Member, Steering Committee, Endangered Wildlife Trust Threatened Grassland Species Program
Council Member, Zoological Society of Southern Africa [2009-2013]

SOCIETY MEMBERSHIP

American Ornithologists' Union
Australia and New Zealand Society for Comparative Physiology and Biochemistry
Cooper Ornithological Society
International Ornithologists' Union
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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 >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.