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ZITHOLELE CONSULTING (PTY) LTD

Vaalbank 88 Kv Powerline Project - Terrestrial Ecology Impact Assessment

Submitted to:
Zitholele Consulting (Pty) Ltd
P O Box 6002
Halfway House
1685

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REPORT

Golder Associates

Executive Summary

The study area is located approximately 3 km east of Sasolburg, in an area defined by the Central Free State Grassland vegetation type (Mucina & Rutherford's 2006). Owing primarily to agricultural activities, Mucina & Rutherford's (2004) list the Central Free State Grassland's as Vulnerable.

The study area consists of a mosaic of transformed land, semi-natural grassland and wetland habitats, with four vegetation communities being identified during the field survey, namely the Wetland/seep vegetation community, Eragrostis plana moist grassland; Cultivated land and Mixed grassland. Apart from areas of the cultivated land vegetation community, which have been completely transformed, disturbance levels in semi-natural and natural areas throughout the study area vary considerably. Sources of disturbance include overgrazing, ploughing, exotic species establishment, fragmentation from roads and farm fences, water impoundments, and mining and other anthropogenic activities.

Ecological functioning in these communities is thus generally considered medium. Despite this, Red data/protected flora species *Boophane disticha, Hypoxis hemerocallidea, Hypoxis acuminata* and *Eucomis autumnalis* have been recorded in the study area. The suitability of the Wetland/seep vegetation community, and parts of the Mixed grassland community to the south of the existing powerline as habitat for these and other Red data/protected flora species is considered high, while it is regarded as moderate for *Eragrostis plana* moist grassland, and Mixed grassland to the north of the existing powerline which is subject to heavier grazing pressure from game farm livestock.

A number of fauna species have been recorded in the study area. In general, these are common species that are not restricted in terms of habitat. Some recorded species as well as others that potentially occur in the study area are Red Data/protected species and are therefore of conservation concern. Accordingly, the conservation importance of mixed grassland to the south of the existing powerline and Wetland/seep vegetation are regarded as high and medium-high for *Eragrostis plana* moist grassland and Mixed grassland to the north of the existing powerline.

Construction of the powerline and switching station in semi-natural and natural areas will have direct negative ecological impacts, most notably potential collision risk to birds, and vegetation clearing during construction leading to habitat loss, degradation and fragmentation. Be that as it may, it is anticipated that provided the construction footprints in semi-natural and natural areas are kept to an absolute minimum, and that degraded sites are quickly and successfully rehabilitated, these negative ecological impacts can be appropriately reduced.

It is imperative that all areas designated for vegetation clearing or other construction related activities are searched for *Boophane disticha, Hypoxis hemerocallidea, Hypoxis acuminata* and *Eucomis autumnalis* and any other Red Data/protected species prior to construction; if found, these species should be relocated to a nearby site of similar habitat. A specific survey for African grass owl should also be conducted in areas of suitable habitat in the vicinity of the proposed route corridor. Other noted impacts include exotic species encroachment and dust generation. These impacts can similarly be mitigated through correct and active management.

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1.0 INTRODUCTION

Golder Associates (Golder) was appointed by Zitholele Consulting Pty Ltd. to conduct an ecological impact assessment of the site designated for proposed infrastructure associated with the Vaalbank - Makalu 88kV Powerline and Switching Station. The study focused on describing the ecological characteristics of the project area and its immediate surrounds (hereafter referred to as the study area), with a view to identifying and assessing possible negative ecological impacts resulting from the proposed project. This document presents the findings of the study.

2.0 OBJECTIVES

The objectives of the ecological assessment are to:

- Present a description of the study area's existing flora and fauna characteristics;
- Identify any habitats of concern, such as natural wetlands and other sensitive or important habitats;
- Determine what species of concern (Red Data and protected flora and fauna) potentially occur in the study area;
- Broadly identify and assess potential impacts of the proposed project on flora, fauna and ecosystem function; and
- Provide management recommendations to mitigate identified negative impacts.

3.0 APPROACH

The methodology used for this terrestrial ecological assessment comprises three components, namely a literature review, field programme and impact assessment. These are briefly summarised below (for a detailed methodology refer to Appendix A.

- Literature review – A literature review of reports, databases, guidelines and legislation relevant to the region was conducted to establish a historical description of the general ecological characteristics of the study area and broader landscape. Species lists of potential flora and fauna occurring on site, with specific emphasis on Red Data and protected species were compiled (refer to Appendix A for detailed methodology). The following frameworks were consulted with regard to potential species of concern:
  - International Union for the Conservation of Nature (IUCN) protected species lists (Status information sourced from IUCN (2011, internet), and SIBIS:SABIF(2009, internet);
  - National Environmental Management: Biodiversity Act Threatened or Protected Species List (NEMBA TOPS List) (2007);
  - National Forests Act (No. 84 of 1998), Listing No. 817, Schedule A; and
  - Free State Nature Conservation Ordinance (No. 8 of 1969).
- Field programme – The field programme was aimed at determining the on-site ecological characteristics and flora and fauna composition of the study area. Based on satellite imagery, vegetation communities within the study area were delineated. These vegetation communities were then sampled, by means of line and belt transects for flora. Fauna were sampled at specific sampling sites, by means of spot counts and active searches. Based on the findings of the field survey, the ecological functioning, suitability as habitat for Red Data and protected species and conservation importance of each vegetation community was determined (refer to Appendix A for detailed field methodology).

Impact assessment – With reference to the findings of the literature review and field study, potential negative environmental impacts associated with the proposed project were identified and assessed for significance. Based on the assessment, suitable mitigation measures have been recommended for inclusion into the

project's environmental management programme (EMP) (refer to Appendix A for impact assessment methodology).

4.0 EXISTING ECOLOGICAL CHARACTERISTICS

4.1 Site Location

The study area is located in Vaalbank; approximately 3 km east of Sasolburg, in the Free State Province (see Figure 1).

4.2 The Biophysical Environment

The study area is located in the grassland biome, which covers approximately 28% of South Africa and is the dominant biome on the central plateau and inland areas of the eastern subcontinent (Manning, 2009). Grasslands are typically situated in moist, summer rainfall regions, which experience between 400 mm and 2000 mm of rainfall per year. Vegetation consists of a dominant ground layer comprising grass and herbaceous perennials with little, to no woody plant species present.

According to Tainton (1999) the study area falls within 'climatic climax grassland'. As this description suggests, these areas are maintained in a grassland state by climatic conditions such as low rainfall and/or low temperatures. Based on Mucina & Rutherford's (2006) delineation of South Africa's vegetation, the study area contains elements of two vegetation types (see Figure 2), namely:

- Central Free State Grassland; and
- Andesite Mountain Bushveld.

The specific characteristics associated with these vegetation types are discussed in Section 4.2.1 and 4.2.2.

4.2.1 Central Free State Grassland

Distribution

The Central Free State Grassland vegetation type occurs in the Free State Province and marginally in the Gauteng Province - a broad zone from around Sasolburg in the north to Dewetsdorp in the south. Other major settlements located within this unit include Kroonstad, Ventersburg, Steynsrus, Winburg, Lindley and Edenville (Mucina & Rutherford, 2006).

Important Plant Taxa

Based on Mucina & Rutherford's (2006) vegetation classification, important plant taxa are those species that have a high abundance, a frequent occurrence (not being particularly abundant) or are prominent in the landscape within a particular vegetation type. They note the following species are important taxa in the Central Free State Grassland vegetation type:

Graminiodes: Grasses include *Brachiaria serrata, Cynodon dactylon, Cynodon hirsutus, Digitaria ternata, Elionurus muticus, Eragrostis chloromelas, Eragrostis patentipilosa, Eragrostis plana, Eragrostis racemosa, Heteropogon contortus, Hyparrhenia hirta, Microchloa caffra, Setaria sphacelata, Themeda triandra, Trachypogon spicatus, Abildgaardia ovata, Andropogon schirensis, Cymbopogon caesius, Diheteropogon amplectens, Melinis nerviglumis, Panicum gilvum* and *Setaria nigrirostris.*

Herbs: Herbs occurring in this vegetation type include *Acanthospermum australe, Ajuga ophrydis, Eriosema salignum, Euryops transvaalensis, Gerbera viridifolia, Helichrysum nudifolium, Helichrysum rugulosum, Hermannia depressa, Lotononis macrosepala, Nidorella hottentotica, Pentanisia prunelloides, Peucedanum afrum, Rotheca hirsuta, Selago paniculata, Senecio coronatus, Senecio inornatus, Sonchus nanus* and *Vernonia oligocephala.*

Geophytic and Semiparasitic Herbs: Geophytic herbs occurring in this vegetation type include *Aspidoglossum ovalifolium* and *Hypoxis rigidula,* while the semiparasitic herb *Striga asiatica* has also been noted.

Low Shrubs – Shrubs occurring in this vegetation type include *Anthospermum rigidum, Chaetacanthus setiger, Tephrosia capensis* and *Thesium impeditum.*

Conservation

This vegetation community is considered Vulnerable according to Mucina & Rutherford (2006). Although the conservation target for this vegetation type is 24%, only small portions are under statutory conservation or under protection in private nature reserves. Almost a quarter of the area has been transformed either for cultivation or by building of dams. No serious infestation by exotic flora has been observed in this vegetation type, but encroachment of dwarf Karoo shrubs becomes a problem in the degraded southern parts of this vegetation unit (Mucina & Rutherford, 2006).

4.2.2 Andesite Mountain Bushveld

Distribution

The Andesite Mountain Bushveld vegetation type occurs at an altitude of about 1 350 – 1 800 masl and is found in Gauteng, North-West, Mpumalanga and the Free State Provinces of South Africa. The vegetation conforms to a dense, medium-tall thorny bushveld with a well developed grass layer on hill slopes and some valleys with an undulating landscape (Mucina & Rutherford, 2006).

Important Plant Taxa

Mucina & Rutherford's (2006) note the following species as important taxa in the Andesite Mountain Bushveld vegetation type:

Small Trees: Trees occurring in this vegetation type include *Acacia caffra, Acacia karroo, Celtis africana, Protea caffra, Zanthoxylum capense* and *Ziziphus mucronata.*

Tall Shrubs: Shrubs include *Asparagus laricinus, Euclea crispa* subsp*. crispa, Rhus pyroides, Diospyros lycioides, Gymnosporia polyacantha, Lippia javanica and Rhamnus prinoides, Asparagus suaveolens, Rhus rigida, Teucrium trifidum, Isoglossa grantii* and *Rhoicissus tridentate.*

Graminoids: Grasses occurring in this vegetation type include *Eragrostis curvula, Hyparrhenia hirta, Setaria sphacelata, Themeda triandra, Cymbopogon pospischilii, Digitaria eriantha, Elionurus muticus, Eragrostis racemosa, Eragrostis superba* and *Panicum maximum.*

Herbs: Common herbs include *Commelina africana, Vernonia galpinii, Vernonia oligocephala* and *Aloe greatheadii* var. *davyana*

Conservation

This vegetation community is considered Least Threatened according to Mucina & Rutherford (2006). Although the conservation target for this vegetation type is 24%, only about 7% is statutorily conserved, mainly in the Suikerbosrand Nature Reserve and Magaliesberg area. Approximately 15% of Andesite Mountain Bushveld is already transformed by cultivation and urban development (Mucina & Rutherford, 2006).

4.3 Faunal Records

Golder Associates hold records of birds, mammals, herpetofauna and arthropods in the Study Area, gathered during field studies conducted for the adjacent/overlapping New Vaal Colliery (Golder Associates 2010, 2012).

Mammals

Mammal species recorded by Golder Associates during these surveys are shown in Table 1. None of the recorded species are listed as species of conservation concern by IUCN or NEMBA TOPS List. Refer to Appendix B for a list of mammals historically occurring in the study area.

Table 1: Mammal species previously recorded within the Study Area (Golder Associates 2010, 2012)

Species Name	Common Name	NEMBA TOPS List (2004)
Sylvicapra grimmia	Common duiker	-
Damasliscus pygargus phillipsi	Blesbok	-
Suricata suricatta	Suricate	-
Cynictis penicillata	Yellow mongoose	-
Atilax paludinosus	Water mongoose	-
Xerus inauris	Ground squirrel	-
Lepus saxatilis	Scrub hare	-
Crocidura cyanea	Reddish-grey musk shrew	-
Rhabdomys pumilio	Four-striped grass mouse	-
Mus musculus	House mouse	-
Mastomys spp.	Multimammate mouse	-
Otomys angoniensis	Angoni vlei rat	-

Birds

The majority of birds recorded during the 2012 and 2010 surveys are common and widespread species (Golder Associates 2012, 2010). Three Red Data/protected bird species were recorded during the surveys, summary details of these are provided in Table 2. Refer to Appendix C for a list of birds historically occurring in the study area.

Table 2: Bird species of conservation concern adjacent to the Study Area (Golder Associates 2010, 2012).

Species Name	Common Name	NEMBA TOPS List (2004)	IUCN Red Data List
Sagittarius serpentarius	Secretary bird	-	Vulnerable
Falco naumanni	Lesser kestrel	Vulnerable	Least concern
Tyto capensis	Grass owl	Vulnerable	Least concern

Herpetofauna

Five reptile and four amphibian species have been previously recorded in the the study area (Golder Associates, 2010). These are all common and widespread species and include the Puff adder (*Bitis arietans*), Striped skink (*Mabuya striata*), Cape skink, (*Mabuya capensis*), Red-lipped herald (*Crotaphopeltis hotamboeia*), Marsh terrapin (*Pelomedusa subrufa*), Guttural toad (*Bufo gutturalis*), Common platanna (*Xenopus laevis*), bubbling kassina (*Kassina senegalensis*) and Cape river frog (*Ametia fuscigula*). These are all common species with widespread distributions. Refer to Appendix D for a list of herpetofauna historically occurring in the study area.

Arthropoda

A total of eighteen arthropod taxa were recorded, in the study area, during the 2012 field survey (refer to Appendix E). These are all common and widespread species, mainly represented by the Order Lepidoptera.

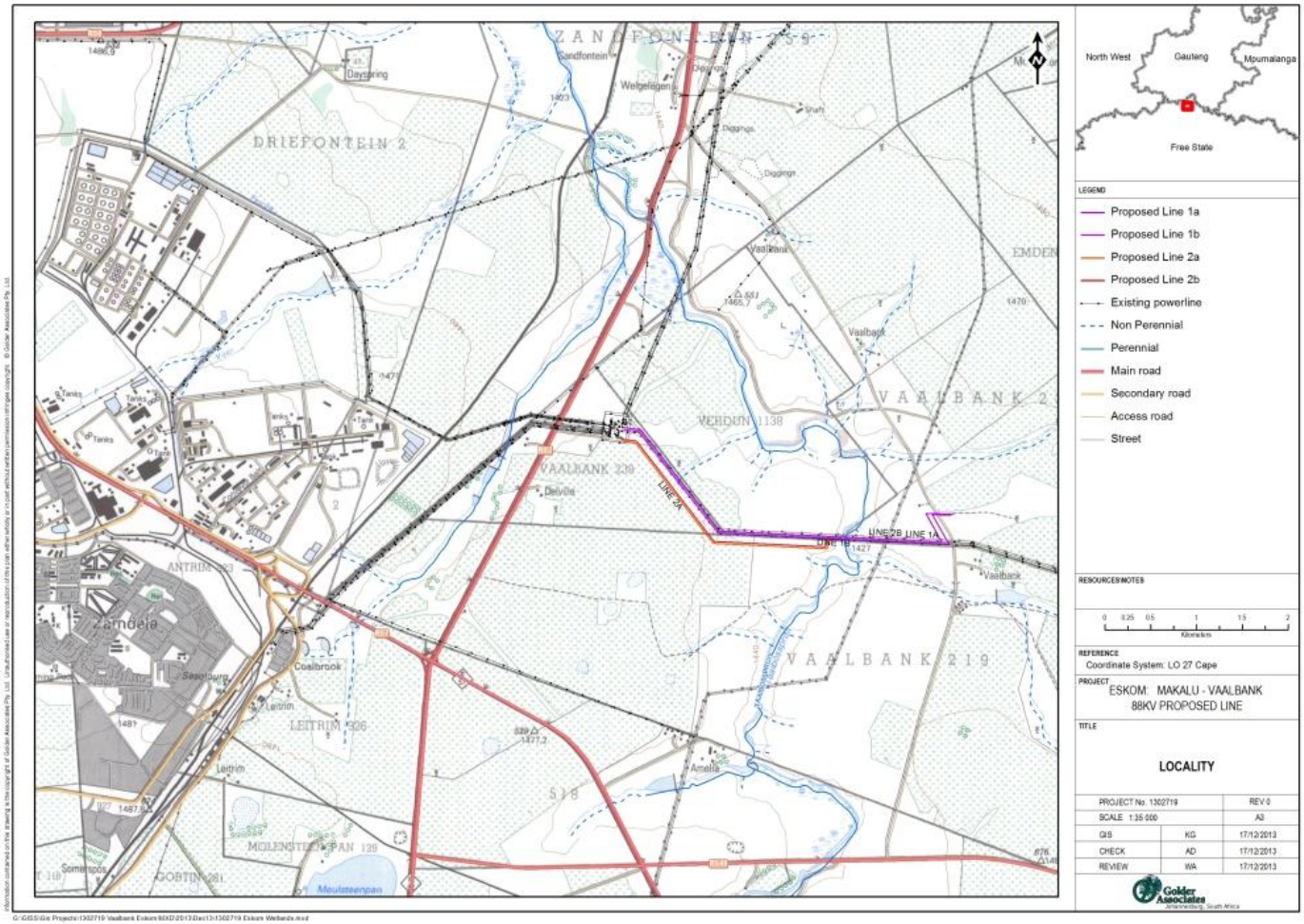

Figure 1: Regional locality of proposed Vaalbank – Makalu power line

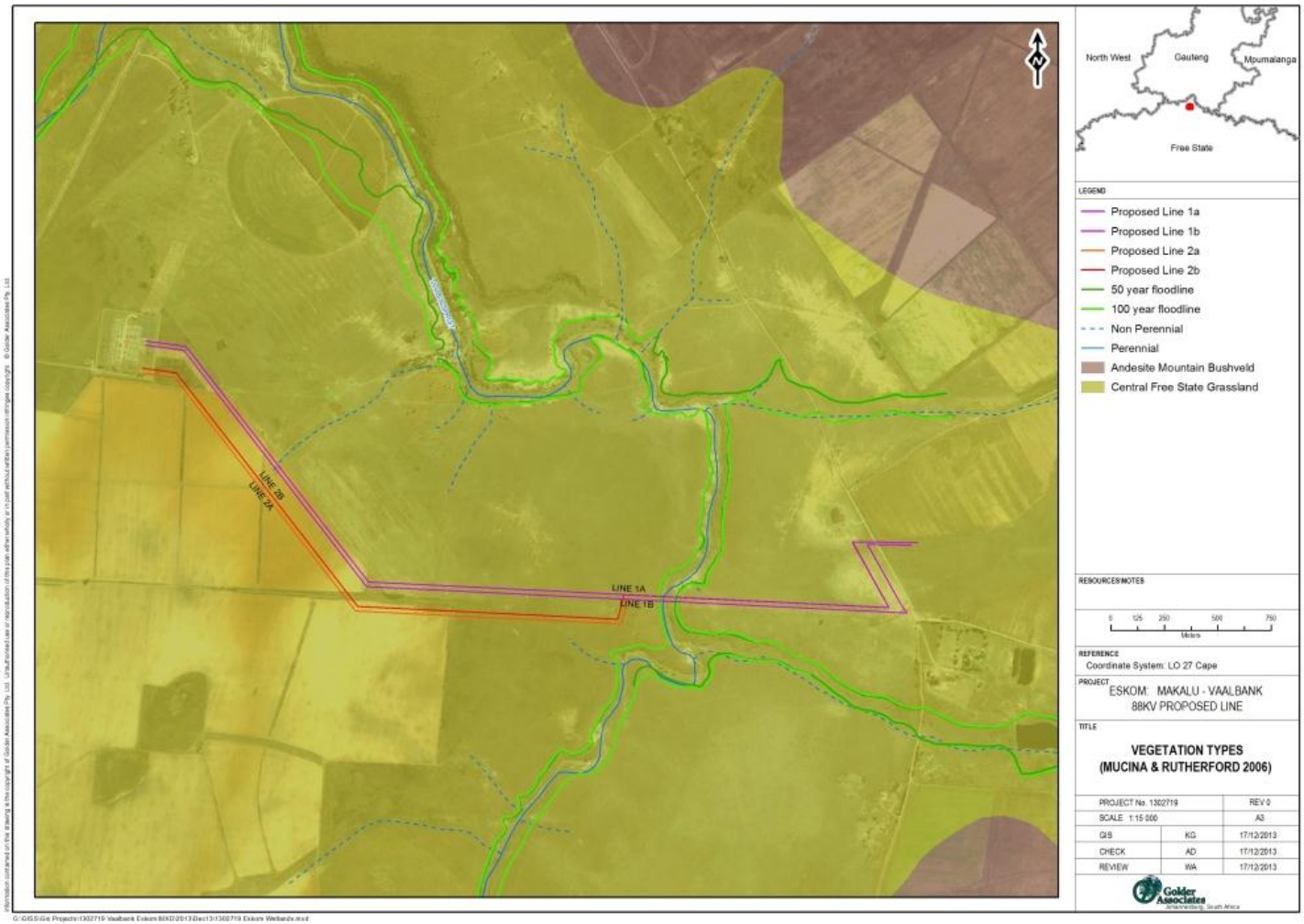

Figure 2: Location of the proposed Vaalbank – Makalu power line in relation to Mucina & Rutherford's (2006) vegetation types

5.0 RESULTS AND DISCUSSION

5.1 Flora Component

The study area consists of a mosaic of transformed land, semi-natural grassland and wetland/seep communities. Dominant transformation agents primarily include cultivation, mining and infrastructure development. Disturbance levels in non-transformed areas vary considerably depending on the nature of current and/or past perturbations.

Vegetation throughout the study area is dominated by grasses, forbs and herbs, as is typical of Central Free State Grassland. Woody species are confined mainly to exotics such as *Eucalyptus* and *Acacia* species which occur individually or in scattered pockets, and a few indigenous species. Refer to Appendix F for a list of species previously recorded in the relevant quarter degree squares according to the PRECIS database.

5.1.1 Vegetation communities

Four vegetation communities were identified during the site assessment (Figure 4). These were recognised based on physiognomy, moisture regime, and species composition and disturbance characteristics. Vegetation communities include:

- Wetland/seep vegetation community;
- *Eragrostis plana* moist grassland;
- Cultivated land; and
- Mixed grassland.

The characteristics of each vegetation community are discussed in the following sections.

5.1.1.1 Wetland/seep vegetation community

The hillslope seep zones of the study area are characterised by vegetation tolerant of high soil moisture levels and even complete saturation. These areas are generally used for grazing cattle or game, and are often disturbed through overgrazing. Moreover, certain wetland/seep areas have been degraded through ploughing and the establishment of artificial dams/weirs.

Within 500 m of the route corridor, areas of wetland/seep vegetation communities extend around hillslope seeps in the eastern area of the route corridor, and the vicinity of the Taaibosspruit crossing. Areas of permanent saturation at the edge of the Taaibosspruit channel are dominated by the reed *Phragmites australis.* The hillslope seep areas are characterised by sedges including *Cyperus rupestris, Cyperus sphaerocephalus, Kyllinga melanosperma* and *Kyllinga pulchella*, as well the grasses *Imperata cylindrica, Arundinella nepalensis, Andropogon appendiculatus* and *Setaria incrassata* were all recorded in seasonal and temporary saturation zones. Other common grass species recorded in this community include *Andropogon schirensis, Eragrostis trchophora, Eragrostis racemosa, Echinocloa colona, Sporobulus fimbriatus, Digitaria eriantha* and *Themeda triandra*.

A number of Red data / protected plant species were observed within these communities within 500m of the proposed route corridor; *Hypoxis hemerocallidea, Hypoxis acuminata, Boophane distichia*, and *Eucomis autumnalis* (Figure 3).

Common forbs include *Berkheya radula, Bidens pilosa*, Commelina africana var. krebsiana, Cyanotis speciosa, Senecio erubescens, Senecio inornatus, Trachyandra asperata, Tulbaghia acutiloba, Pseudognaphalium luteo-album*,* and *Verbena bonariensis*.*

* denotes exotic species

Hypoxis hemerocallidea

Hypoxis acuminata

Eucomis autumnalis

Boophane distichia

Figure 3: Red data/protected plant species observed within wetland/seep vegetation community

Sensitivity aspects

- Although often disturbed, wetland sites in the study area have an ecological functioning of medium;
- The suitability of this community for Red Data/protected species is considered high;
- The conservation importance of this community is considered high.

5.1.1.2 Eragrostis plana moist grassland

Eragrostis plana moist grasslands are commonly found in open areas with soil high moisture content. In the study area, these typically occur adjacent to wetlands, between cultivated fields, as well as in areas that show evidence of previous cultivation. Grazing by game appears to be the main land use of this vegetation type within the study area; therefore disturbance levels vary depending of usage.

Eragrostis species, most prominently *Eragrostis plana,* are often the most dominant flora species in this community. Other grasses recorded include *Chloris virgata, Cynodon dactylon, Eragrostis biflora, Eragrostis chloromelas, Eustachys paspaloides* and *Setaria sphacelata*. Forbs recorded include *Berkheya maritima, Berkheya setifera, Conyza bonariensis, Felicia mossamedensis, Gomphrena celosioides, Haplocarpha lyrata, Helichrysum rugulosum, Hibiscus trionum, Hypochaeris radicata*, Jamesbrittenia aurantiaca, Kyllinga erecta, Nidorella anomala, Schoenoplectus corymbosus* and *Senecio consanguineus.*

Sensitivity aspects

- Areas of *Eragrostis plana* moist grasslands are generally overgrazed and have an ecological functioning of medium;
- The suitability of this community for Red Data/protected species is considered moderate;
- The conservation importance of this community is considered medium-high.

5.1.1.3 Cultivated land

Large portions of the eastern extent of the study area are currently under cultivation. Currently cultivated lands have no natural vegetation remaining and are largely planted with soya bean (*Glycine max*) crop.

At the boundaries of this community, areas which have previously been cultivated but are currently left fallow are heavily disturbed and are colonised by a mixture of invasive, exotic plants, as well as pioneer and sub-climax indigenous species. Amongst these, common grasses noted include *Cynodon dactylon, Eragrostis curvula, Hyparrhenia hirta, Hyparrhenia dregeana, Melinis repens, Panicum repens and Urochloa mosambicensis.* Forb and herbs species include *Bidens pilosa*[*], *Conyza bonariensis*, Conyza canadensis*, Cosmos bipinnatus*, Cyperus esculentus*, Datura ferox*, Gomphocarpus fruticosa, Hypochaeris radicata*, Tagetes minuta*, Taraxacum officinale*, Tribulus terrestris and Verbena bonariensis*.*

Sensitivity aspects

- Due to the complete transformation of currently cultivated fields, and the highly disturbed nature of previously cultivated areas, these areas have negligible or low ecological functioning.
- No endemic, Red Data or protected species were recorded in the cultivated lands and the probability of such species occurring in this vegetation community is considered low.
- Accordingly, the conservation importance of cultivated land is considered low.

5.1.1.4 Mixed grassland vegetation community

The Mixed grassland vegetation community occurs in dry, flat or undulating sites in the study area that have not been transformed through cultivation. The grazing of cattle appears to be common in such areas, and disturbance levels range considerably, with species such as *Pseudognaphalium luteo-album, Seriphium plumosum* and *Verbena bonariensis* being particularly common in highly disturbed sites. Indigenous woody species observed in this community include *Rhus pyroides* and the dwarf trees *Ziziphus zeyheriana* and *Pygmaeothamnus zeyheri*. Within 500 m of the powerline, the area of mixed grassland immediately north of the existing powerline is well-grazed by game; however to the south of the game farm boundary the mixed grassland is less disturbed by grazing pressure and supports a greater diversity of flora species.

Grasses recorded in this community include *Arundinella nepalensis, Cymbopogon pospischilli, Elionurus muticus, Digitaria tricholaenoides, Melinis repens, Eragrostis curvula, Setaria sphacelata var. torta, Heteropogon contortus, Sporobolus africana, Themeda triandra* and *Digitaria sanguinalis.*

Forbs species recorded in this community include *Berkheya maritima, Bidens pilosa*, Cirsium vulgaris*, Commelina africana, Conyza bonariensis*, Hibiscus aethiopicus, Hibiscus microcarpus, Ledebouria sp., Pentzia piulifera, Protoasparagus laricinus, Pseudognaphalium luteo-album*, Senecio erubescens, Solanum panduriforme, Tagetes minuta, Tephrosia sp.,* and *Verbena bonariensis*.*

Sensitivity aspects

- Many areas comprising Mixed Grassland are disturbed and as such the overall ecological functioning of this community is considered medium.

[*] denotes exotic species

- One Red Data/protected species namely *Boophane disticha,* was recorded in this community. *Boophane disticha* is listed as Declining according to the IUCN and protected under Schedule 6 of the Free State Nature Conservation Ordinance (No. 8 of 1969).

The confirmed presence of *Boophane disticha* in the undisturbed mixed grassland to the south of the existing powerline, coupled with the fact that the Mixed Grassland vegetation community provides important semi-natural/natural grassland habitat for fauna within the study area renders the conservation importance of this area of the community high. Areas of mixed grassland to the north of the proposed powerline route, which form part of a game farm and are thus less likely to support Red Data / protected plant species due to grazing pressure, and considered to be of Medium-High conservation importance. Figure 6 illustrates conservation importance of the various communities across the study area.

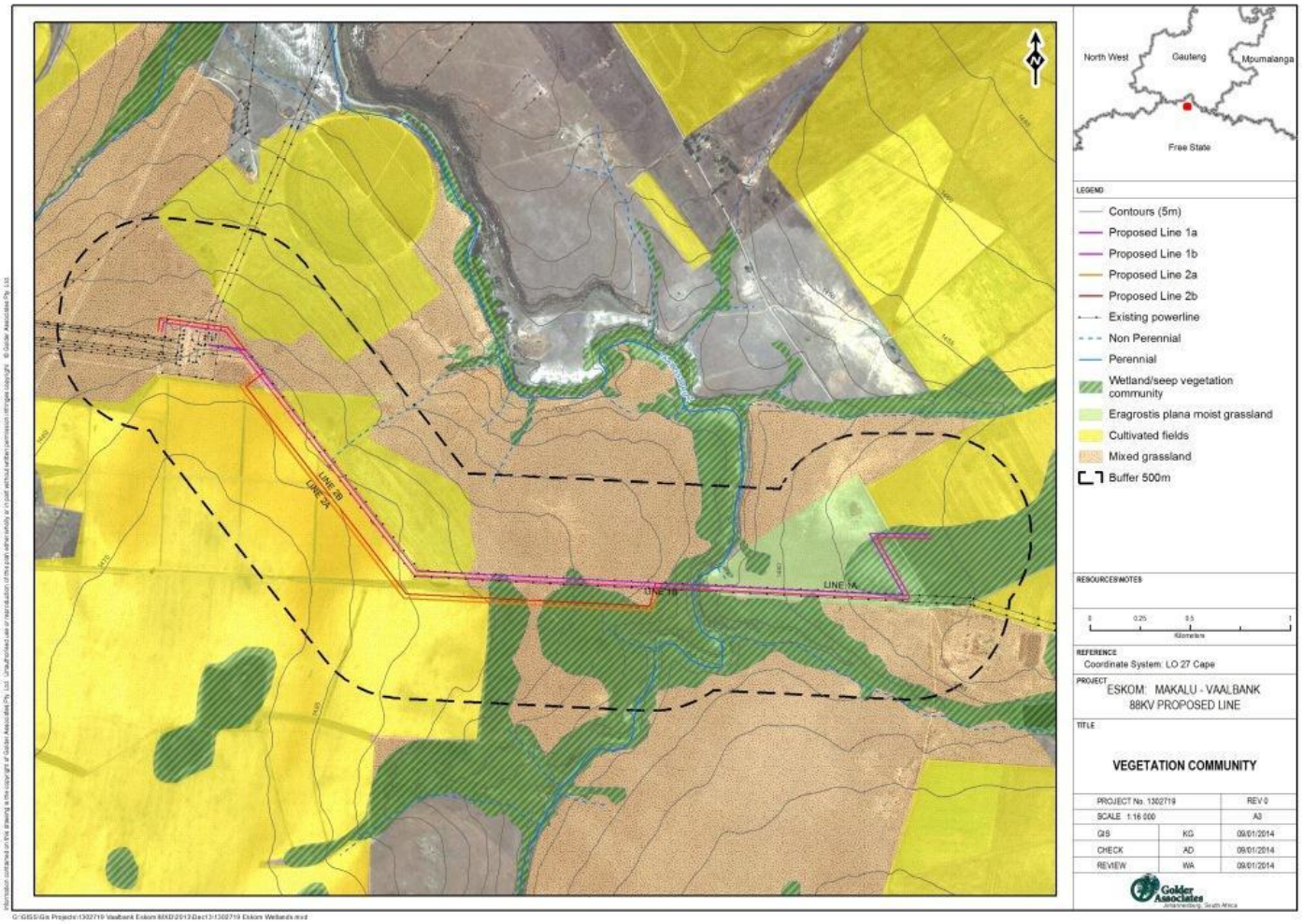

Figure 4: Vegetation communities recorded in study area in relation to proposed powerline

5.1.2 Red Data Flora Assessment

Red Data and/or protected species recorded within the study area during the Jan 2014 survey include *Boophane disticha* (Free State Nature Conservation Ordinance No. 8 of 1969), *Hypoxis hemerocallidea* and *Hypoxis acuminata* (listed as Least Concern by SANBI, 2005), and *Eucomis autumnalis* (listed as Declining by SANBI Red List, 2008).

Other Red Data plant species potentially occurring in the study area according to the South African Biodiversity Institute (SANBI) are listed in Table 3 . Considering that much of the area within 500m of the proposed powerline route consists of wetland/hillslope seepage areas and some relatively undisturbed moist grassland and mixed grassland, the probability of other Red Data/protected species occurring within the study area, and particularly in wetland areas, is considered medium.

Table 3: Red data flora species occurring in the grid square 2627DD

Family	Species Name	IUCN (2011) Status	Free State Nature Cons. Ordinance (No. 8 of 1969)
AMARYLLIDACEAE	*Crinum bulbispermum*	Declining	Protected
AMARYLLIDACEAE	*Alepidea attenuata*	Near threatened	Protected
APOCYNACEAE	*Brachystelma incanum*	Vulnerable	-
AQUIFOLIACEAE	*Stenostelma umbelluliferum*	Near threatened	-
ASPHODELACEAE	*Kniphofia typhoides*	Near threatened	Protected

5.1.3 Declared CARA Category 1, 2 and 3 Invasive Plants

The only current, active legislation concerning exotic and invasive species in South Africa forms part of the Conservation of Agricultural Resources Act (CARA) (No. 43 of 1983)[1] – specifically Regulations 15 and 16 which concern problem plants. Although the National Environmental Management: Biodiversity Act (NEMBA) (No. 10 of 2004) does include provision for exotic invasive species management, this legislation has yet to be finalised and remains in draft format (ARC, 2010, internet). Ten listed species have been recorded in the greater study area (Table 4); four of these were recorded within 500m of the proposed powerline route corridor.

Table 4: Declared CARA and NEMA listed species recorded in study area

Species name	Common name	CARA Category	NEMBA Category (proposed)	Present within 500 m of powerline
Opuntia ficus-indica	Sweet prickly pear	1	1b	
Verbena bonariensis	Purple top	-	1b	✓
Datura ferox	Large thorn-apple	1	1b	✓
Flaveria bidentis	Smelter's bush	-	1b	
Cirsium vulgaris	Spear thistle	1	1b	✓
Tamarix ramosissima	Pink tamarisk	1	1b	
Populus x canescens	Grey poplar	2	2	
Eucalyptus species	Gum trees	2	1b	
Gleditsia triacanthos	Honey locust	2	1b	
Acacia species	Wattles	2	2	✓

[1] CARA is currently (2011) in the process of being revised.

5.1.4 Floristic Sensitivity Analysis

Ecological Functioning

Much of the greater study area has been transformed or disturbed primarily through agricultural activities such as cultivation and livestock grazing, as well as infrastructure development, exotic species plantations and mining related operations. The area of mixed grassland and hillslope seeps to the south of the existing powerline, which is fenced off from the adjoining game farm, is relatively undisturbed by grazing pressure.

Ecological functioning therefore varies considerably across the study area. Highly transformed/disturbed areas such as the cultivated fields and developed sites (existing Makalu switching station) have a negligible to low ecological function. Semi-natural and natural sites in the study area are typically small, have been fragmented by roads, fences and cultivated fields, and are disturbed. As such, ecological functioning in these areas is generally considered medium (refer to Figure 5 for a map indicating ecological functioning of the study area).

Conservation Importance

Within the context of the surrounding landscape matrix, semi-natural and natural sites in the study area do provide important habitat for a variety of fauna and flora, some of which are Red Data and/or protected species. These include the plants *Boophane disticha, Hypoxis hemerocallidea, Hypoxis acuminata* and *Eucomis autumnalis*, as well as birds previously recorded in the study area such as African grass owl (*Tyto capensis*), lesser kestrel (*Falco naumanni*) and Secretarybird (*Sagittarius serpentarius*) (see Section 5.2.2). The conservation value of these areas is thus considered high. The conservation importance of transformed (i.e. soybean crop) or highly degraded areas is considered low, as these areas have negligible to low ecological function and are unlikely to possess fauna or flora species of concern (refer to Figure 6 for a map indicating conservation importance of the study area).

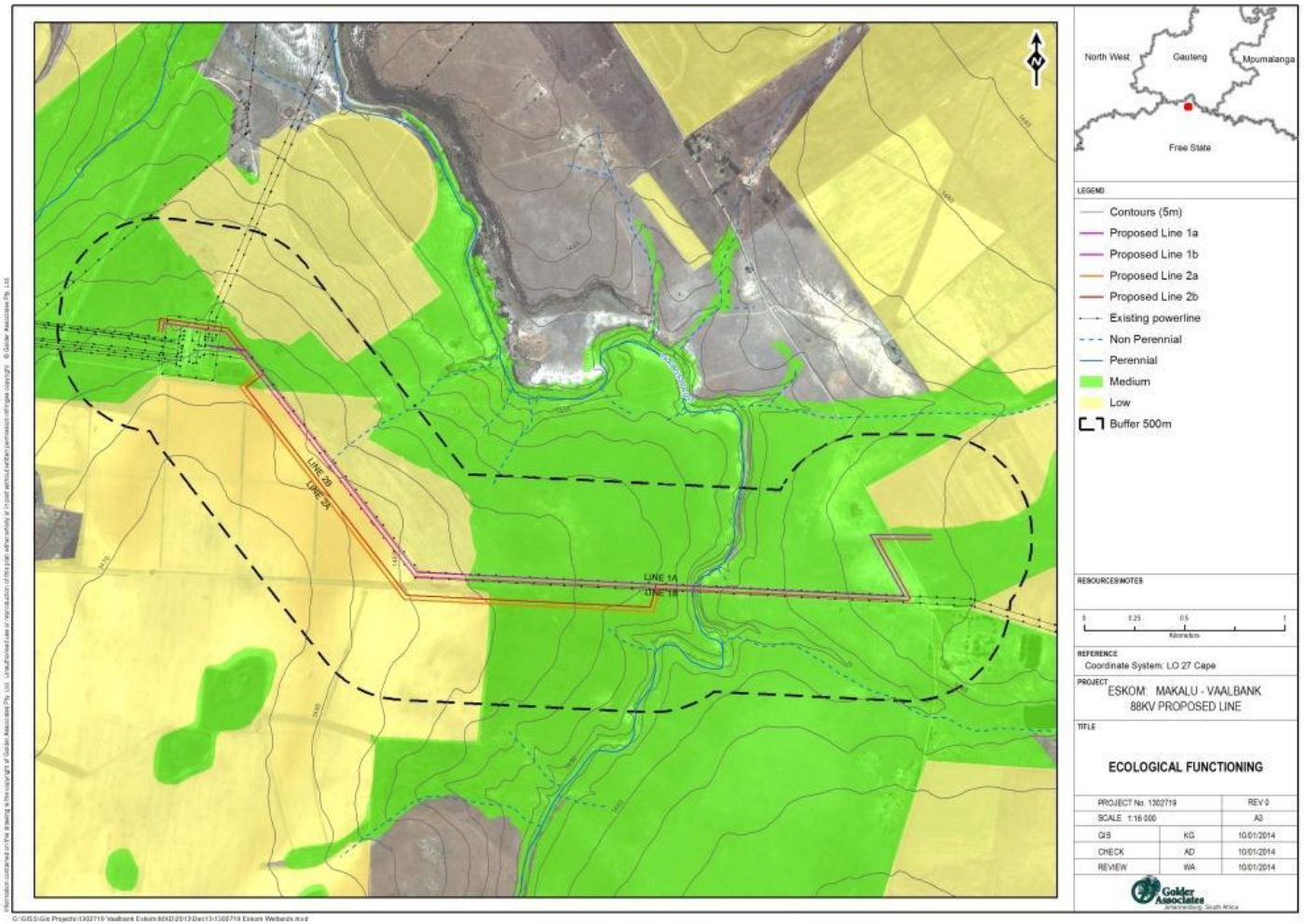

Figure 5: Ecological functioning of the study area

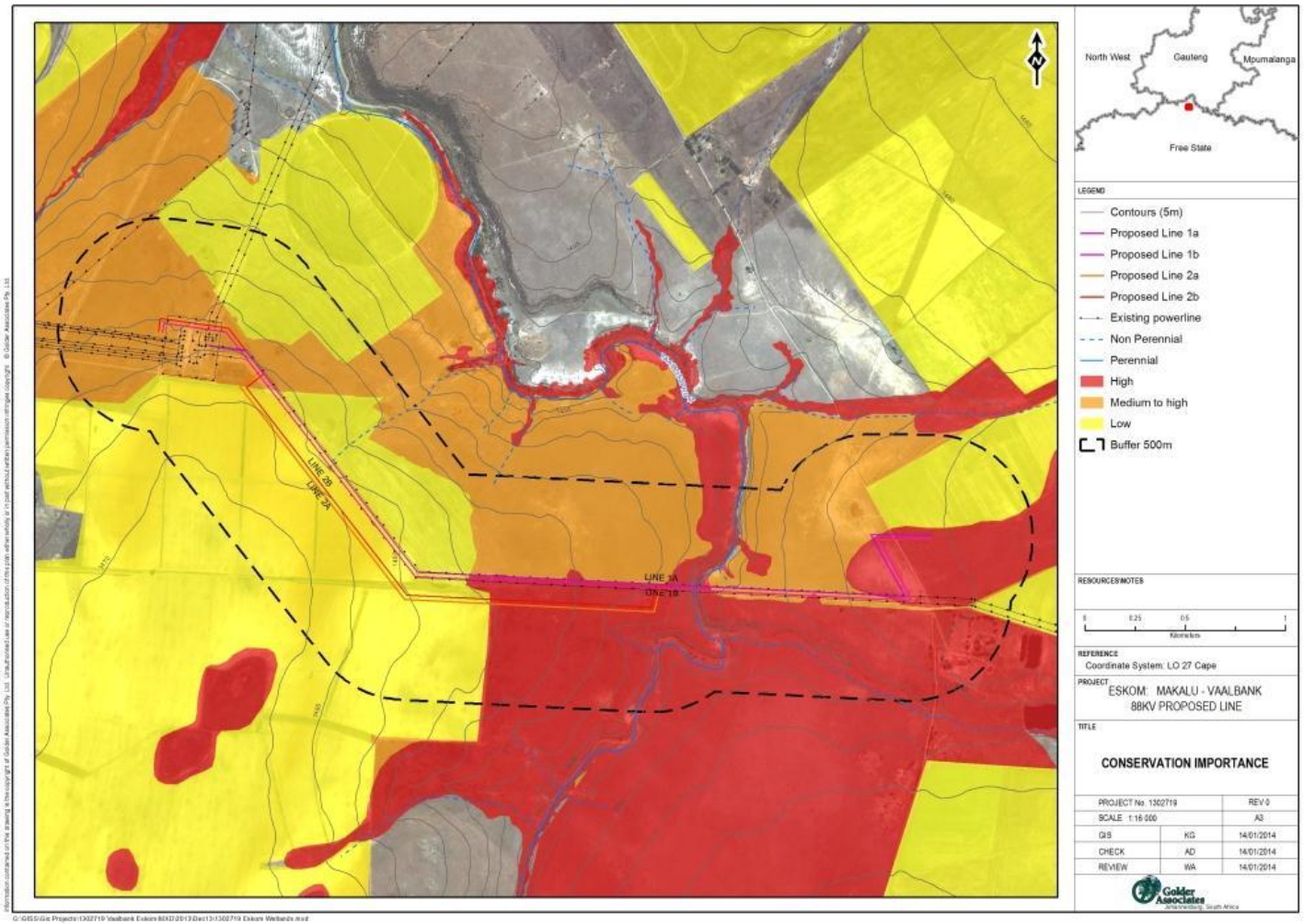

Figure 6: Conservation importance of the study area

5.2 Fauna Component

5.2.1 Mammals

Twelve mammal species have been recorded in the study area (Golder Associates, 2012, 2010), ref. Section 4.3. These were all common and widespread species. In addition, Southern African ground squirrell (*Xerus inauris*) was observed in the vicinity of the existing Makalu Substation during the January 2014 site visit.

Mammals historically recorded in the locality are listed in Appendix B. In addition, a number of Red Data and/or protected mammals potentially occur in the study area (Table 5). Given the types of habitat present and the degree of habitat disturbance and transformation, the probability of these species occurring in the study area is considered unlikely, but cannot be ruled out.

Table 5: Red Data and protected mammals potentially occurring in the study area

Species Name	Common Name	IUCN Status	NEMBA TOPS List (2004)	Probability of occurrence
Ourebia ourebi	Oribi	Endangered	Endangered	Low
Mystromys albicaudatis	White tailed rat	Endangered	-	Moderate
Damaliscus pygargus pygargus	Bontebok	Vulnerable	Vulnerable	Moderate
Laephotis wintoni	De Winton's long-eared bat	Vulnerable	-	Moderate
Rhinolophus denti	Dent's horseshoe bat	Near-Threatened	-	Moderate
Rhinolophus divosus	Geoffroy's horseshoe bat	Near-Threatened	-	Moderate
Cistugo lesueuri	Lesueur's wing-gland bat	Near-Threatened	-	Moderate
Miniopteris schreibersi	Schreiber's long-fingered bat	Near-Threatened	-	Moderate
Leptailurus serval	Serval	Near-Threatened	Protected	Moderate
Atelerix frontalis	South African hedgehog	Near-Threatened	-	High
Lutra maculicollis	Spotted necked otter	Near-Threatened	-	Moderate
Myotis tricolor	Temminck's hairy bat	Near-Threatened	-	Moderate
Otomys sloggetti	Sloggett's vlei rat	Near-Threatened	-	High

5.2.2 Birds

Twenty four bird species have been recorded in the study area (Golder 2010, 2012, 2014). The majority are common and widespread species. These include African spoonbill (*Platalea alba*), African fish eagle (*Haliaeetus vocifer*), Black-headed heron (*Ardea melanocephala*), Grey heron (*Ardea cinerea*), Golden bishop (*Euplectes afer*), Red bishop (*Euplectes orix*), Sacred ibis (*Threskiornis aethiopicus*), Helmeted guineafowl (*Numida meleagris*), Pin-tailed whydah (*Vidua macroura*), Long-tailed widow (*Euplectes progne*), Ostrich (*Struthio camelus*), Northern black korhaan (*Eupodotis afraoides*), Swainson's francolin (*Francolinus swainsonii*), White-browed sparrow-weaver (*Plocepasser mahali*), Marsh owl (*Asio capensis*), Laughing dove (*Streptopelia senegalensis*), Cape turtle dove (*Streptopelia capicola*), Cape Sparrow (*Passer melanurus*), Redbilled Quelea (*Quelea quelea*) and Masked Weaver (*Ploceus velatus*). Refer to Appendix C for a list of birds historically occurring in the study area.

Three Red Data/protected bird species have been recorded in the study area (Golder Associates 2010, 2012):

- **Secretarybird (*Sagittarius serpentarius*), Vulnerable (IUCN, 2013)** – Secretarybird (*Sagittarius serpentarius*) are large raptors which prey upon a variety of small mammals and reptiles that inhabit savanna and open grassland - the latter of which are found throughout the study area. In the 2012 survey an individual bird was observed foraging in the grasslands at the approximate location – 26°45.880S 27° 53 948E – approx. 6.5 km north of the proposed powerline route corridor;

- **Lesser kestrel (*Falco naumanni*), Vulnerable (NEMBA, 2007)** – These summer migrants are small raptors that favour open grassland and agricultural areas. During the 2012 survey one individual was recorded perched on a power line at the approximate location – 26° 51.059S 27° 56 599E – approx. 2km south of the proposed powerline route corridor; and
- **African Grass Owl (*Tyto capensis*), Vulnerable (NEMBA, 2007) –** African grass owl (*Tyto capensis*) are habitat specialists, favouring damp areas such as marshes, vleis and floodplains. This species was recorded in wetland adjacent to the Taaibosspruit during the 2010 study, and again in 2012 in a hillslope seep close to the confluence of the Taaibosspruit and Vaal rivers – approx. 8km northwest of the proposed route corridor. Suitable habitat for this species was observed to the south of the existing power line, within 500 m of the eastern part of the proposed route corridor.

Forty-five other Red Data/protected birds may potentially occur in the study area. These, along with their probability of occurrence, are listed in Table 6.

Table 6: Red Data and protected birds potentially occurring in the study area

Species Name	Common Name	IUCN Status	NEMBA TOPS List (2004)	Probability of occurrence
Alcedo semitorquata	Half-collared kingfisher	Near-threatened		Moderate
Anthropoides paradisea	Blue crane	Vulnerable	Endangered	Low
Aquila rapax	Tawny eagle	Vulnerable	Vulnerable	Moderate
Ardeotis kori	Kori bustard	Vulnerable	Vulnerable	Low
Balearica regulorum	Grey crowned crane	Vulnerable	Endangered	Low
Bucorvus leadbeateri	Southern ground-hornbill	Vulnerable	Protected	Low
Bugeranus carunculatus	Wattled crane	Critically Endangered	Critically Endangered	Low
Buphagus erythrorhynchus	Red-billed oxpecker	Near-threatened	-	Moderate
Charadrius pallidus	Chestnut-banded plover	Near-threatened	-	Moderate
Ciconia nigra	Black stork	Near-threatened	Vulnerable	Moderate
Circus macrourus	Pallid harrier	Near-threatened	-	Moderate
Circus maurus	Black harrier	Near-threatened	-	Moderate
Circus ranivorus	African marsh-harrier	Vulnerable	Protected	Moderate
Crex crex	Corn crake	Vulnerable	-	Moderate
Ephippiorhynchus senegalensis	Saddle-billed stork	Endangered	Endangered	Low
Eupodotis caerulescens	Blue korhaan	Near-threatened	Vulnerable	Moderate
Falco biarmicus	Lanner falcon	Near-threatened	-	Moderate
Falco naumanni	Lesser kestrel	Vulnerable	Vulnerable	Recorded
Falco peregrinus	Peregrine falcon	Near-threatened	-	Moderate
Geronticus calvus	Southern bald ibis	Vulnerable	Vulnerable	Moderate
Glareola nordmanni	Black-winged pratincole	Near-threatened	-	Moderate
Gypaetus barbatus	Bearded vulture	Endangered	Endangered	Low
Gyps africanus	African white-backed vulture	Vulnerable	Endangered	Low
Gyps coprotheres	Cape vulture	Vulnerable	Endangered	Low
Heteromirafra ruddi	Rudd's lark	Critically	-	Low

Species Name	Common Name	IUCN Status	NEMBA TOPS List (2004)	Probability of occurrence
		Endangered		
Hydroprogne caspia	Caspian tern	Near-threatened	-	Moderate
Leptoptilus crumeniferus	Marabou stork	Near-threatened	-	Low
Lioptilus nigricapillus	Bush blackcap	Near-threatened	-	Moderate
Mirafra chiniana	Melodious lark	Near-threatened	-	Moderate
Mirafra chuana	Short-clawed lark	Near-threatened	-	Moderate
Mycteria ibis	Yellow-billed stork	Near-threatened	-	Low
Neotis denhami	Stanley's bustard	Vulnerable	-	Low
Neotis ludwigii	Ludwig's bustard	Vulnerable	-	Low
Pelecanus onocrotalus	Great white pelican	Near-threatened	-	Low
Pelecanus rufescens	Pink-backed pelican	Vulnerable	Endangered	Low
Phoeniconaias minor	Lesser flamingo	Near-threatened	-	Low
Phoenicopterus ruber	Greater flamingo	Near-threatened	-	Low
Podica senegalensis	African finfoot	Vulnerable	-	Moderate
Polemaetus bellicosus	Martial eagle	Vulnerable	-	Low
Rostratula benghalensis	Greater painted-snipe	Near-threatened	-	Moderate
Sagittarius serpentarius	Secretarybird	Near-threatened	-	Recorded
Sarothrura affinis	Striped flufftail	Vulnerable	-	Moderate
Sarothrura ayresi	White-winged flufftail	Critically Endangered	-	Low
Spizocorys fringillaris	Botha's lark	Endangered	-	Moderate
Terathopius ecaudatus	Bateleur	Vulnerable	Vulnerable	Moderate
Torgos tracheliotus	Lappet-faced vulture	Vulnerable	Endangered	Low
Tyto capensis	African grass owl	Vulnerable	Vulnerable	Recorded
Vanellus melanopterus	Black-winged lapwing	Near-threatened	-	Moderate

5.2.3 Herpetofauna

Five reptile and four amphibian species have been recorded in the study area (Golder Associates, 2010). These are all common and widespread species and include the puff adder (*Bitis arietans*), striped skink (*Mabuya striata*), Cape skink, (*Mabuya capensis*), red-lipped herald (*Crotaphopeltis hotamboeia*), marsh terrapin (*Pelomedusa subrufa*), guttural toad (*Bufo gutturalis*), common platanna (*Xenopus laevis*), bubbling kassina (*Kassina senegalensis*) and Cape river frog (*Ametia fuscigula*). These are all common species with widespread distributions. No additional herpetofauna species were observed during the 2014 site visit. Refer to Appendix F for a list of herpetofauna historically occurring in the study area.

Four Red Data/protected species of herpetofauna potentially occur in the study area. These, along with their probability of occurrence, are listed in Table 7.

Table 7: Red Data and protected herpetofauna potentially occurring in the study area

Species Name	Common Name	IUCN (2011)Status	NEMBA TOPS List (2004)	Probability of occurrence
Cordylus giganteus	Sungazer	Vulnerable	Endangered	High

Species Name	Common Name	IUCN (2011)Status	NEMBA TOPS List (2004)	Probability of occurrence
Homoroselaps dorsalis	Striped Harlequin snake	Near-Threatened	-	High
Pyxicepahalus adspersus	Giant bullfrog	Near-Threatened	Protected	Moderate
Tetradactylus breyeri	Breyer's long-tailed seps	Vulnerable	-	Moderate

5.2.4 Arthropoda

A total of eighteen arthropod taxa were recorded in the study area during the 2012 field survey (Table 8). These are all common and widespread species, mainly represented by the Order Lepidoptera. Additional arthropod species recorded during the 2014 site visit include the scorpion *Uroplectes triangulifer* and an unidentified assassin bug from the family Reduviidae.

Table 8: Arthropoda recorded in the study area

Family	Species name
ARANEOMORPHAE	*Argiope flavipalpis*
MANTIDAE	*Epioscopomantis chalybea*
ACRIDIDAE	*Rhachitopis*
ACRIDIDAE	*Cyrtacanthacris aeruginosa*
BUTHIDAE	*Uroplectes triangulifer*
PROTONEURIDAE	-
LYCIDAE	*Lycus melanurus*
COCCONELLIDAE	*Micraspis striata*
COCCINELLIDAE	*Cheilomenes lunata*
CURCULIONIDAE	-
NYMPHALINAE	*Junonia octavia sesamus*
NYMPHALINAE	*Junonia hierta cebrene*
NYMPHALINAE	*Junonia orithya madagascariensis*
NYMPHALINAE	*Vanessa cardui*
DANAINAE	*Danaus chrysippus aegyptius*
PIERIDAE	*Eurema brigitta brigitta*
REDUVIIDAE	-
APIDAE	*Apis mellifera*
MEGACHILIDAE	*Coelioxys spp.*
TABANIDAE	*Haematopota*

Red data species that potentially occur in the study area are listed in Table 9. The probability of these occurring in the study area is considered moderate.

Table 9: Red Data arachnids potentially occurring in the study area

Family Name	Common Name	IUCN Status	Probability of occurrence
Ctenizidae (whole family)	Trapdoor spiders	Vulnerable	Moderate
Atypidae (whole family)	Purse Web spiders	Vulnerable	Moderate
Theraphosidae (whole family)	Baboon spiders	Vulnerable	Moderate

6.0 IMPACT ASSESSMENT

The aim of the impact assessment is to identify and assess specific impacts that the proposed project will have on species or sites of concern and on the general ecological functioning and integrity of the study area. Furthermore, the assessment aims to identify, and discuss suitable management measures to mitigate negative environmental impacts.

6.1 Identification of site related issues and concerns

The principle project-related concern is the collision risk that the powerlines may present to bird species; of secondary concern is the loss and disturbance of semi-natural and natural habitat from construction of the proposed switching station, powerlines and associated infrastructure, leading to a reduction in ecological functioning and biodiversity in the study area. The specific issues relating to these concerns are categorised and described as follows:

6.1.1 Collision Risk to birds

Powerlines present a collision risk to certain bird species. Birdlife South Africa has developed a list of priority bird species for which wind energy infrastructure (including power lines) present a particular risk (Retief et al., last updated Feb 2013). The risk to listed species is scored based on factors including the conservation status of the species, susceptibility to collisions based on structural factors, and susceptibility due to the behavioural characteristics of a particular species. The greater the score, the greater the risk; the highest possible score being 395 and the lowest 170.

Species that have been recorded by Golder Associates within the study area that feature on the list include Secretarybird, African grass-owl, and lesser kestrel. These, together with species that are potentially present in the study area, their conservation status, and their probability of presence are presented in Table 10. The table is ranked according to those species with the greatest priority score in terms of collision risk. Species that have been recorded, or have moderate probability of occurrence within the study area are highlighted.

Table 10: Bird species present/potentially present in study area, ranked by priority score

Species Name	**Common Name**	**IUCN Status**	**Species priority score**	**Probability of occurrence**
Gypaetus barbatus	Bearded vulture	Endangered	395	Low
Gyps coprotheres	Cape vulture	Vulnerable	385	Low
Bugeranus carunculatus	Wattled crane	Critically Endangered	349	Low
Geronticus calvus	Southern bald ibis	Vulnerable	330	Moderate
Polemaetus bellicosus	Martial eagle	Vulnerable	330	Low
Circus maurus	Black harrier	Near-threatened	325	Moderate
Anthropoides paradisea	Blue crane	Vulnerable	320	Low
Neotis ludwigii	Ludwig's bustard	Vulnerable	320	Low
Sagittarius serpentarius	Secretarybird	Near-threatened	320	Recorded
Ciconia nigra	Black stork	Near-threatened	310	Moderate
Pelecanus onocrotalus	Great white pelican	Near-threatened	310	Low
Circus ranivorus	African marsh-harrier	Vulnerable	300	Moderate
Pelecanus rufescens	Pink-backed pelican	Vulnerable	300	Low
Balearica regulorum	Grey crowned crane	Vulnerable	294	Low
Bucorvus leadbeateri	Southern ground-hornbill	Vulnerable	290	Low
Falco peregrinus	Peregrine falcon	Near-threatened	290	Moderate

Species Name	Common Name	IUCN Status	Species priority score	Probability of occurrence
Mycteria ibis	Yellow-billed stork	Near-threatened	290	Low
Phoeniconaias minor	Lesser flamingo	Near-threatened	290	Low
Phoenicopterus ruber	Greater flamingo	Near-threatened	290	Low
Tyto capensis	African grass owl	Vulnerable	289	Recorded
Falco naumanni	Lesser kestrel	Vulnerable	284	Recorded
Ardeotis kori	Kori bustard	Vulnerable	280	Low
Falco biarmicus	Lanner falcon	Near-threatened	280	Moderate
Gyps africanus	African white-backed vulture	Vulnerable	280	Low
Aquila rapax	Tawny eagle	Vulnerable	270	Moderate
Eupodotis caerulescens	Blue korhaan	Near-threatened	270	Moderate
Torgos tracheliotus	Lappet-faced vulture	Vulnerable	270	Low
Circus macrourus	Pallid harrier	Near-threatened	260	Moderate
Terathopius ecaudatus	Bateleur	Vulnerable	260	Moderate
Sarothrura ayresi	White-winged flufftail	Critically Endangered	250	Low
Spizocorys fringillaris	Botha's lark	Endangered	250	Moderate
Glareola nordmanni	Black-winged pratincole	Near-threatened	242	Moderate
Heteromirafra ruddi	Rudd's lark	Critically Endangered	240	Low
Leptoptilus crumeniferus	Marabou stork	Near-threatened	240	Low
Ephippiorhynchus senegalensis	Saddle-billed stork	Endangered	220	Low
Vanellus melanopterus	Black-winged lapwing	Near-threatened	184	Moderate
Mirafra chiniana	Melodious lark	Near-threatened	180	Moderate
Mirafra chuana	Short-clawed lark	Near-threatened	175	Moderate

The proposed powerline route will be located parallel to the existing powerline. Birds present in the study area may be habituated to the presence of the existing powerline; however the construction of additional powerlines in the area may present a cumulative impact in terms of collision risk. Suitable habitat for African grass owl is present within 500 m of the proposed powerline route.

6.1.2 Habitat loss and degradation associated with vegetation clearing

Habitat loss refers to the removal of natural habitat. In terrestrial ecosystems habitat loss occurs primarily through the clearing of indigenous vegetation or through the homogenisation of available habitat. This results not only in the immediate destruction of individual plants and some fauna species, but may also lead to a breakdown in ecosystem functioning and a contingent loss of biodiversity.

Habitat degradation refers to an extreme form of ecosystem disturbance. In such instances much of the original ecosystem processes have been disrupted and many of the original species have been excluded (Begon *et al*. 2002).

Although habitat loss and degradation are normally associated with the immediate vegetation clearing which precedes construction, the impacts can be long term, persisting throughout the operational and closure phases. In certain instances these impacts can be ameliorated by successful rehabilitation of the site.

6.1.3 Habitat fragmentation

Habitat fragmentation refers to the partitioning and breakup of natural habitat into smaller less viable habitat patches. In essence fragmentation leads to changes in habitat configuration which manifest as a decrease in patch size and an increase in patch number and isolation (Fahrig, 2003). These alterations change the ecological properties of remaining habitat which may affect species diversity and system function (Fahrig, 2003). Linear developments such as fences, pipelines, roads and conveyors are primary causes of habitat fragmentation.

In terms of ecological functioning, one of the primary outcomes of habitat fragmentation is an increase in habitat edge effects. Edge effect refers to changes in microclimate near the edge of habitat patches which not only reduce the effective size of viable, interior habitat, but may also create parameter conditions more conducive to predators, parasites and exotic species invasion (Begon *et al*. 2002). In addition, patch isolation can negatively affect the ability of fauna to disperse and move across the landscape thereby affecting fauna population abundance and distribution (Begon *et al*. 2002).

Habitat fragmentation initially occurs during vegetation clearing, but may persist throughout the remaining phases if linear barriers (e.g. fences conveyors and roads) are constructed.

6.1.4 Spillage of harmful or toxic substances

The spillage of harmful or toxic substances including diesel, oil, lubricants and bitumen may negatively impact upon fauna and flora in the study area. Direct pathways by which harmful or toxic substances are assimilated by biota include uptake by roots and/or leaf absorption in the case of plants, and direct ingestion or dermal absorption in the case of fauna. Indirect pathways include the ingestion of contaminated plants or animals by other herbivorous or predatory species. The consequences of contamination may include a reduction in fecundity[2], progressive weakening and often death.

The spillage of harmful toxic substances most commonly occurs during the construction phase of a project, yet will occur throughout all phases of the project if adequate management measures are not adhered to.

6.1.5 Sensory disturbances

Sensory disturbances typically include artificial lighting, noise and vibration associated with construction-related activities, and flood-lighting of buildings for security purposes.

Artificial lighting can result in the disruption of various ecological processes, most notably through its effect on animal behaviour. Longcore & Rich (2004) note that *inter alia* artificial light can alter reproductive behaviours, cause disorientation, hamper communication, affect nesting choices, disrupt competitive hierarchies and either increase or reduce predation success rates of various species. These impacts can all negatively affect fauna population dynamics.

Anthropogenic noise can be both distracting and physically harmful to fauna (Francis *et al.* 2009). Owing to their reliance on acoustic communication, birds are particular susceptible to elevated noise levels. Noise may disrupt communication and species interactions amongst birds leading to increased stress levels and ultimately, changes in bird species composition (Francis *et al.* 2009). Various other taxa that rely on acoustic communication including frogs, mammals and arthropods are similarly affected (Parris & Schneider, 2009). Moreover, noise may negatively affect the foraging success of species such as bats that rely on acoustic cues when hunting (Schaub *et al.* 2008).

Depending on whether the switching station will be lit at night during operation, sensory disturbances from noise and light may persist throughout all phases and will only cease upon final closure and rehabilitation.

6.1.6 Dust generation

The clearing of vegetation for construction, coupled with increased vehicular traffic and the establishment of top soil, overburden and waste stockpiles, will result in increased potential for dust entrainment.

[2] The number of offspring produced by an individual

Dust settling on plant material can affect photosynthesis, respiration, transpiration rates, and allow for the penetration of phototoxic gaseous pollutants into plant tissue (Farmer, 1993). These impacts can result in decreased plant productivity which may lead to alterations in plant community structure and consequent changes in herbivore diversity and abundance (Farmer, 1993).

Dust may also directly affect fauna. Arthropods exposed to dust for example, may be smothered by dust particles and/or have their chemical cues used for mating disrupted (Talley et al. 2006). Likewise, mammals exposed to coal dust have been observed to show abnormal respiratory afflictions (Borm & Tran, 2002).

Impacts from dust are likely to be most prevalent in the dry season, and during the construction phase of the proposed project, yet if not controlled may persist throughout all phases.

6.1.7 Increases in exotic and / or declared invader species

Clearing of natural vegetation may create conditions conducive to the establishment and colonisation of exotic and/or declared CARA Category 1, 2 & 3 invader plants. Most exotic, invasive species if left uncontrolled will suppress or replace indigenous plants leading to a concomitant reduction in fauna species diversity and abundance (Bromilow, 2010). Moreover, certain common invasive plants, such as the exotic *Acacias* (Wattle trees), are highly flammable and can increase the frequency and intensity of fires which may further alter ecosystem structure and functioning.

Facilitated by indigenous vegetation clearing, encroachment by exotic invasive species may initially occur during the construction phase. However, if not controlled, the scale and magnitude of infestation will rapidly increase and may persist for the entire lifecycle of the project.

6.1.8 Loss of species of conservation importance

The loss of species of conservation importance, and particulary Red Data and protected plant species, is most likely to occur during the initial vegetation clearing associated with the construction phase. Moreover, habitat loss, fragmentation and degradation may result in the populations of species of conservation importance becoming unsustainable, leading to local extinctions.

6.2 Recommended Mitigation Measures

6.2.1 Collision Risk to birds

A number of measures are recommended to address potential collision risk to bird species of concern:

- Given the presence of suitable habitat for African grass owl within 500 m of the proposed powerline, a targeted survey for this species should be undertaken prior to construction;
- Data on African grass owl presence should be incorporated into an overall conservation and management plan for this species. This plan should be compiled and implemented for the entire New Vaal Colliery Lifex mining rights area;
- Route powerline in parallel with existing powerline, and locate as close to the existing line as feasible;
- Bird diverters or ‘flappers’ incorporate reflectivity and glowing light to help birds to see powerlines and avoid collisions – these should be installed on all new powerlines being constructed;
- Post-construction monitoring surveys should be undertaken following construction to determine whether birds are colliding with/being electrocuted by powerlines, using established protocols (Jenkins et al., 2011); and
- Post-construction monitoring data should be periodically collated and analysed, and the findings integrated into the operational EMP and the broader mitigation scheme.

6.2.2 Habitat loss and degradation through vegetation clearing

The following management measures are recommended to mitigate habitat loss and degradation and associated impacts:

- Vegetation clearing should be restricted to the proposed switching station and pylon footprints, with no unnecessary clearing permitted outside of this area. Areas to be cleared, including construction sites and lay-down and vehicle turning points, should be taped off to prevent unnecessary disturbances;
- Removed topsoil should be stockpiled and used to rehabilitate disturbed areas;
- It is recommended that an environmental control officer (ECO) be appointed during construction to oversee the vegetation clearing process; and
- A suitable rehabilitation programme should be developed and implemented in all disturbed areas post construction. A suitably experienced person should be responsible for overseeing the rehabilitation programme.

6.2.3 Habitat fragmentation

In conjunction with the mitigation measures listed in Section 6.2.2 for habitat loss and degradation, the following additional measures are recommended to reduce the effects of habitat fragmentation:

- Where possible, the proposed linear infrastructure (powerline) should be aligned with existing linear infrastructure or routed through already transformed / degraded areas.
- Where it is necessary for linear infrastructure to be routed across important or sensitive habitats (e.g. wetlands), measures should be undertaken to:
  - Limit the footprint of areas to be excavated, and/or cleared of vegetation;
  - Route infrastructure across the narrowest portion of the sensitive habitat;
  - Prevent obstruction/disruption of surface or subterranean water flow; and
- Where possible, culverts should be installed at regular intervals along fences and access roads to allow fauna to move across these barriers.

6.2.4 Spillage of harmful or toxic substances

- All harmful or toxic substances kept on site should be stored in bunded areas, or in the correct manner as stipulated by the relevant Material Safety Data Sheets (MSDS);
- All vehicles and machinery should be adequately maintained to prevent the leakage of fuels and lubricants; and should be refuelled and stored in designated areas only;
- An emergency spillage containment plan should be developed and implemented to control for the spillage of harmful and toxic substances.

6.2.5 Sensory disturbances

Impacts related to noise and light pollution may be mitigated by:

- Lighting shields, directional lighting and low level lights should be implemented, where applicable; and
- Noise emanating from construction machinery and equipment should be kept to a minimum by the fitting of exhaust silencers and through the regular maintenance of construction vehicles; and
- Where possible, construction activities should be restricted to daylight hours.

6.2.6 Dust generation

The following methods can be used to prevent conditions conducive to dust generation and suppress dust should it occur:

- All topsoil stockpiles and cleared areas should be re-vegetated, covered or kept moist to prevent dust generation;
- Dust suppression through the use of water bowsers should be implemented on all exposed areas including roads, parking zones and lay down areas. Water spraying on high use roads should be prioritised; and
- All onsite traffic can be restricted to specific designated roads. Off-road travel can only be authorized on a case-by-case basis. Traffic speed can also be restricted to an appropriate level on all designated roads.

6.2.7 Establishment of exotic invasive plants

- An exotic species control programme, including monitoring, must be developed and implemented to reduce the encroachment of exotic invasive species; and
- It is recommended that the ECO be responsible for monitoring the nature and extent of on-site exotic, invasive plants.

6.2.8 Loss of species of conservation importance

Loss of species of conservation importance may be mitigated in the following ways:

- An ECO should be appointed during the construction phase to monitor for the presence of Red Data and protected flora and fauna in all areas where vegetation clearing and associated construction activities are to be undertaken.

Should such species be identified and require relocation, rescue permits should be obtained from the provincial authority, and suitable ex-situ, and/or in-situ conservation measures developed and implemented. Conservation measures must be approved by the provincial authority and overseen by the ECO

6.3 Impact Analysis

Potential negative impacts have been assessed using the impact assessment methodology detailed in Appendix A. The results are shown in Table 11 and discussed in Sections 6.2.1 though to 6.2.8.

Table 11: Ecological impact assessment summary

Impact	Phase	Impact before mitigation						Impact after mitigation					
		Probability	Scale	Duration	Magnitude	Total	Impact before mitigation	Probability	Scale	Duration	Magnitude	Total	Impact after mitigation
Collision risk to birds	Operational	3	1	4	10	45	Moderate	3	1	4	4	27	Low
Habitat loss and degradation through vegetation clearing	Construction Operational Closure	5	1	5	8	70	Moderate	5	1	4	6	55	Moderate
Habitat fragmentation through vegetation clearing and erection of linear infrastructure	Construction Operational	5	1	4	8	65	Moderate	5	1	4	6	55	Moderate
Spillage of harmful or toxic substances	Construction Operational Closure	4	1	2	6	36	Moderate	3	1	2	4	21	Low
Sensory disturbances of fauna populations from lighting and noise	Construction Operational Closure	4	1	2	6	36	Moderate	4	1	3	2	24	Low

Impact	Phase	Impact before mitigation						Impact after mitigation					
		Probability	Scale	Duration	Magnitude	Total	Impact before mitigation	Probability	Scale	Duration	Magnitude	Total	Impact after mitigation
Dust generation leading to habitat degradation	Construction Operational Closure	5	2	3	8	65	Moderate	4	1	3	6	40	Moderate
Increases in exotic and / or declared invader species	Construction Operational Closure	4	2	5	8	60	Moderate	3	1	4	4	27	Low
Loss of plant species of conservation importance	Construction Operational	4	1	5	10	64	Moderate	2	1	1	8	20	Low

7.0 DISCUSSION AND RECOMMENDATIONS

Based on Mucina & Rutherford's (2006) classification of South Africa's vegetation, the proposed powerline route corridor is located in an area dominated by the vegetation type Central Free State Grassland, which according to those authors, is regarded as vulnerable. Much of the study area has been either transformed or degraded largely through intensive crop production and other agricultural activities.

Areas of semi-natural and natural vegetation occur in small, often fragmented patches. These areas have generally been disturbed, largely through grazing of various intensities, and cannot be considered pristine habitats. Nevertheless, within the surrounding landscape matrix such areas are important ecologically, as they provide habitat for a variety of fauna and flora species, some of which are species of concern.

Species of concern recorded during the 2014 study, or that have previously been recorded in the study area include fauna such as the Grass owl (*Tyto capensis*), Lesser kestrel (*Falco naumanni*) and Secretarybird (*Sagittarius serpentarius*), as well as flora including *Boophane disticha, Hypoxis hemerocallidea, Hypoxis acuminata* and *Eucomis autumnalis*. Moreover, a number of other Red Data/protected species potentially occur in the study area.

Construction activities in semi-natural and natural areas will have direct negative ecological impacts, most notably vegetation clearing leading to habitat loss, degradation and fragmentation; and the powerlines when operational pose a collision risk to certain bird species that may be present in the area. This notwithstanding, provided the construction footprints in semi-natural and natural areas are kept to an absolute minimum, and that degraded sites are quickly and successfully rehabilitated, these negative ecological impacts can be appropriately reduced. Areas to be cleared should be searched for *Boophane disticha Hypoxis hemerocallidea, Hypoxis acuminata, Eucomis autumnalis* and any other Red Data/protected species prior to construction. If found these species should be relocated to a nearby site of similar habitat. A specific survey for African grass owl presence within 500 m of the proposed route corridor should also be conducted prior to construction, and the findings incorporated into a conservation management and monitoring plan for this species in the wider New Vaal mine rights area. Other noted impacts include *inter alia*, exotic species encroachment and dust generation. These impacts can similarly be mitigated through correct and active management.

It is recommended that the management measures stipulated in this report be included into the proposed projects official EMP and that these are assessed for efficacy during all phases of the project and adapted accordingly to ensure minimal disturbance of the study areas' ecology.

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GOLDER ASSOCIATES AFRICA (PTY) LTD.

Aisling Dower
Terrestrial Ecologist

Adrian Hudson
Senior Terrestrial Ecologist

AD/AH/ad

Reg. No. 2002/007104/07
Directors: SAP Brown, L Greyling, RGM Heath

https://afpws.golder.com/sites/p1302719vaalbankterrestrialstudy/reports/1302719-12577-1_terrestrial_assessment_final.docx

APPENDIX A

Methodology

Literature Review Component

Vegetation

Flora species lists for the grid squares 2628CA, 2727BB, 2627CB, 2627DD, 2628CC and 2728AA were obtained from the PRECIS (National Herbarium Pretoria Computer Information System) database. These were used to aid field sampling and to identify potential Red Data/protected species that may occur in the study area. Moreover, the Free State Nature Conservation Ordinance (No. 8 of 1969) was consulted for protected flora and fauna species. Mucina & Rutherford (2006) was consulted for an overview of the dominant vegetation types occurring in the area, as was the 2010 Golder New Vaal Colliery LifeX Baseline Terrestrial Ecology Assessment Report (No. 12111-9922-8), and the 2012 Golder New Vaal Colliery LifeX Terrestrial Ecology Impact Assessment Report (No.1302719-12577-1).

Mammals

A list of expected mammal species was compiled by consultation of a number of literature sources including Skinner & Smithers (1990), field guides including Stuart & Stuart (2007) the 2010 Golder New Vaal Colliery LifeX Baseline Terrestrial Ecology Assessment Report (No. 12111-9922-8), and the 2012 Golder New Vaal Colliery LifeX Terrestrial Ecology Impact Assessment Report (No.1302719-12577-1).

Birds

A list of expected bird species was compiled by consultation of a number of literature sources relevant to the study area, including the SANBI's SIBIS database (SIBIS: South African Biodiversity Information Facility, 2009, internet), Sinclair et al. (2002), the 2010 Golder New Vaal Colliery LifeX Baseline Terrestrial Ecology Assessment Report (No. 12111-9922-8), and the 2012 Golder New Vaal Colliery LifeX Terrestrial Ecology Impact Assessment Report (No.1302719-12577-1).

Reptiles

Expected reptile species lists were compiled by consultation of Branch (1994), Alexander and Marias (2010) the 2010 Golder New Vaal Colliery LifeX Baseline Terrestrial Ecology Assessment Report (No. 12111-9922-8), and the 2012 Golder New Vaal Colliery LifeX Terrestrial Ecology Impact Assessment Report (No.1302719-12577-1)..

Amphibians

Expected amphibian species lists were compiled by consultation of Carruthers (2001), Du Preez & Carruthers (2009), the 2010 Golder New Vaal Colliery LifeX Baseline Terrestrial Ecology Assessment Report (No. 12111-9922-8) and the 2012 Golder New Vaal Colliery LifeX Terrestrial Ecology Impact Assessment Report (No.1302719-12577-1).

Red Data and protected flora and fauna

In order to assess the Red Data and / or protected status of species in the study area, the following sources were reviewed:

- National Environmental Management: Biodiversity Act (No. 10 of 2004) – Lists of critically endangered, endangered, vulnerable and protected species (NEMBA TOPS List 2007);
- International Union for the Conservation of Nature (IUCN) Red List of Threatened Species (2011);
- Free State Nature Conservation Ordinance (No. 8 of 1969):
  - Schedule 1: Protected Game; and
  - Schedule 6: Protected Plants;

Field Sampling Methodology

Vegetation sampling

As a first approximation, plant communities were roughly delineated based on satellite imagery. The 2010 Golder New Vaal Colliery LifeX Baseline Terrestrial Ecology Assessment Report (No. 12111-9922-8) and the 2012 Golder New Vaal Colliery LifeX Terrestrial Ecology Impact Assessment Report (No.1302719-12577-1) were consulted in order to determine the general vegetation characteristics of the study area. In order to study the vegetation in greater detail, relevés for the field study were selected according to the vegetation characteristics identified. These were surveyed on January 9th 2014 (wet season survey). Relevé data was collected in the field by means of point transects (for species occurring in the herbaceous layer) and belt transects (for tree and shrub species).

Species that were not identified in the field were photographed for identification at a later stage by consulting additional literature sources. Identification of plant species was undertaken using Van Wyk & Van Wyk (1997), Van Wyk & Malan (1998), Gerber et al. (2004), Pooley (2005), Bromilow (2010), Schmidt et al. 2002, and Van Oudtshoorn (1999) where applicable.

Fauna surveys

Fauna observations were derived from the previous survey of the study area (Golder Associates, 2012). Additional records of any fauna species observed during the January 9th 2014 site visit are included in this report.

Mammals

Visual observations, surveys of tracks and signs, as well as anecdotal evidence provided by local residents and land users were used to record mammal species occurring on site. Stuart & Stuart (2007) was used to identify mammals observed in the study area.

Birds

Bird surveys were conducted by means of point counts of 15 min each (Bibby *et al*. 1998) at each of the fauna survey sites. During the survey, bird species were identified either visually or through bird calls. Where necessary, identifications were verified using Sinclair *et al*. (2002). Particular attention was paid to suitable roosting, foraging and nesting habitats for Red Data and protected species.

Reptiles

Active searching for reptile species was conducted at each of the fauna survey sites. Active searching was conducted on foot and included searching all suitable habitats (rocks, logs, artificial cover, leaf litter, artificial litter, bark), and scanning basking sites and places where specimens were likely to be found. Branch (1994) was used to identify observed reptile species.

Amphibians

Active searching for amphibian's species was conducted at each of the fauna survey sites. Active searching was conducted on foot and included searching all suitable habitats (leaf litter, artificial litter, bark, pools and streams etc.). Carruthers (2001) was used to identify any amphibians found in the study area.

Anthropoda

Active searching and sweep netting for arthropods were conducted at each of the fauna survey sites. Active searching was conducted on foot and included searching suitable habitats (rocks, logs, artificial cover, leaf litter, bark, leaf axils, etc), and scanning sites where specimens were likely to be found. Migdoll (1994), Filmer (1995), Leeming (2003), Leroy & Leroy (2003) and Picker *et al* (2004) were used to identify species where applicable. Identification was done to the lowest possible taxonomic level.

Floristic Sensitivities Analysis

Floristic sensitivity analysis was determined by subjectively assessing the ecological function and conservation importance of the vegetation, as defined in the below.

Rating of ecological function and conservation importance

	Ecological function	Conservation importance
High	Sensitive ecosystems with either low inherent resistance or resilience towards disturbance factors or highly dynamic systems considered to be stable and important for the maintenance of ecosystems integrity (e.g. pristine grasslands, pristine wetlands and pristine ridges).	Ecosystems with high species richness and usually provide suitable habitat for a number of threatened species. Usually termed 'no-go' areas and unsuitable for development, and should be protected.
Medium	Relatively important ecosystems at gradients of intermediate disturbances. An area may be considered of medium ecological function if it is directly adjacent to sensitive/pristine ecosystem.	Ecosystems with intermediate levels of species diversity without any threatened species. Low-density development may be allowed, provided the current species diversity is conserved.
Low	Degraded and highly disturbed systems with little or no ecological function.	Areas with little or no conservation potential and usually species poor (most species are usually exotic).

Red Data Assessment

Based on the potential Red Data species lists compiled during the literature review and on the findings of the field survey, the probability of occurrence of Red Data species in the study area were determined for each relevant taxon. The following parameters were used in the assessment:

Habitat requirements (HR): Most Red Data species have very specific habitat requirements and the presence of these habitat characteristics in the study area was evaluated.

Habitat status (HS): The status or ecological condition of available habitat in the area was assessed. Often a high level of habitat degradation prevalent in a specific habitat will negate the potential presence of Red Data species (this is especially evident in wetland habitats).

Habitat linkage (HL): Movement between areas for breeding and feeding forms an essential part of the existence of many species. Connectivity of the study area to surrounding habitat and the adequacy of these linkages are evaluated for the ecological functioning of Red Data species within the study area.

Probability of occurrence is presented in four categories, namely:

- Low;
- Medium;
- High; and
- Recorded.

Impact Assessment Methodology

Potential significance of impacts was based on occurrence and severity, which are further sub-divided as follows:

Occurrence		**Severity**	
Probability of occurrence	Duration of occurrence	Magnitude (severity) of impact	Scale / extent of impact

To assess each impact, the following four ranking scales are used:

PROBABILITY	DURATION
5 - Definite/don't know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (8-15 years)
2 - Low probability	2 - Short-term (0-7 years) (impact ceases after the operational life of the activity)
1 - Improbable	1 – Immediate
0 - None	
SCALE	**MAGNITUDE**
5 - International	10 - Very high/don't know
4 - National	8 - High
3 - Regional	6 - Moderate
2 - Local	4 - Low
1 - Site only	2 - Minor
0 - None	

The significance of the two aspects, occurrence and severity, is assessed using the following formula:

SP (significance points) = (magnitude + duration + scale) x probability

The maximum value is 150 significance points (SP). The impact significance points are assigned a rating of high, medium or low with respect to their environmental impact as follows:

SP >75	Indicates **high** environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 75	Indicates **moderate** environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates **low** environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that is likely to result in positive consequences/effects.

Potential impacts were assessed using the above calculation and rating system, and mitigation measures were proposed for all relevant project phases (construction to decommissioning).

APPENDIX B

Mammals historically/potentially occurring in the study area

Mammals

FAMILY	*BIOLOGICAL NAME*	COMMON NAME	PROBABILITY	RED DATA
CHRYSOCHLORIDAE (Golden Moles)	*Amblysomus septentrionalis*	Highveld Golden Mole	**2**	**NT**
MACROSCELIDIDAE (Sengis/Elephant Shrews)	*Elephantulus myurus*	Eastern Rock Sengi	**2**	**-**
ERINACEIDAE (Hedgehogs)	*Atelerix frontalis*	Southern African Hedgehog	**3**	**-**
SORICIDAE (Shrews)	*Crocidura mariquensis*	Swamp Musk Shrew	**2**	**-**
	Crocidura cyanea	Reddish-grey Musk Shrew	**3**	**-**
	Suncus varilla	Lesser Dwarf Shrew	**3**	**-**
NYCTERIDAE (Slit-faced Bats)	*Nycteris thebiaca*	Egyptian Slit-faced Bat	**1**	**-**
RHINOLOPHIDAE (Horseshoe Bats)	*Rhinolophus clivosus*	Geoffrey's Horseshoe Bat	**1**	**-**
	Rhinolophus darlingi	Darling's Horseshoe Bat	**1**	**-**
VESPERTILIONIDAE (Vesper Bats)	*Miniopterus schriebersii*	Schrieber's Long-fingered Bat	**1**	**-**
	Neoromicia capensis	Cape Serotine Bat	**1**	**-**
MOLOSSIDAE (Free-tailed Bats)	*Tadarida aegyptiaca*	Egyptian Free-tailed Bat	**1**	**-**
LEPORIDAE (Hares and Rabbits)	*Lepus capensis*	Cape Hare	**3**	**-**
	Lepus saxatillis	Scrub Hare	**3**	**-**
	Pronolagus rupestris	Smith's Red Rock Rabbit	**2**	**-**
SCIURIDAE (Squirrels)	*Xerus inauris*	Southern African Ground Squirrel	**2**	**-**
MYOXIDAE (Dormice)	*Graphiurus murinus*	Woodland Dormouse	**1**	**-**
PEDETIDAE (Springhares)	*Pedetes capensis*	Springhare	**2**	**-**
BATHYERGIDAE (Rodent Moles / Mole Rats)	*Cryptomys damarensis*	Damara Mole-rat	**2**	**-**
HYSTRICIDAE (Porcupine)	*Hystrix africaeaustralis*	Cape Porcupine	**3**	**-**
MURIDAE (Rats and Mice)	*Mystromys albicaudatus*	White-tailed Mouse	**1**	**EN**
	Steatomys krebsii	Krebb's Fat Mouse	**1**	**-**
	Tatera leucogaster	Bushveld Gerbil	**3**	**-**
	Tatera brantsii	Highveld Gerbil	**3**	**-**
	Michaelamys namaquensis	Namaqua Rock Mouse	**2**	**-**
	Aethomys silindensis	Silinda Rat	**1**	**-**
	Aethomys ineptus	Tete Veld Rat	**1**	**-**
	Rhabdomys pumilio	Four-striped Grass Mouse	**3**	**-**

FAMILY	*BIOLOGICAL NAME*	COMMON NAME	PROBABILITY	RED DATA
	Mus minutoides	Pygmy Mouse	**3**	**-**
	*Mus musculus**	House Mouse	**3**	**-**
	Mastomys natalensis	Natal Multimammate Mouse	**3**	**-**
	Mastomys coucha	Southern Multimammate Mouse	**3**	**-**
	*Rattus rattus**	House Rat	**3**	**-**
	Otomys angoniensis	Angoni Vlei Rat	**3**	**-**
	Otomys irroratus	Vlei Rat	**3**	**-**
CANIDAE (Foxes, Jackals, Wild Dog)	*Vulpes chama*	Cape Fox	**1**	**-**
	Otocyon megalotis	Bat-eared Fox	**1**	**-**
	Canis mesomelas	Black-backed Jackal	**3**	**-**
MUSTELIDAE (Otters, Badger, Weasel & Polecat)	*Aonyx capensis*	Cape Clawless Otter	**3**	**-**
	Lutra maculicollis	Spoted-necked Otter	**3**	**-**
	Poecilogale albinucha	African Striped Weasel	**2**	**-**
	Ictonyx striatus	Striped Polecat	**3**	**-**
HERPESTIDAE (Mongooses)	*Gallerella sanguinea*	Slender Mongoose	**2**	**-**
	Attilax paludinosus	Water (Marsh) Mongoose	**3**	**-**
	Helogale parvula	Dwarf Mongoose	**0**	**-**
	Ichneumia albicauda	White-tailed Mongoose	**3**	**-**
	Cynictis penicillata	Yellow Mongoose	**3**	**-**
	Suricata suricatta	Suricate (Meerkat)	**3**	**-**
VIVERRIDAE (Genets & Civets)	*Genetta genetta*	Small-spotted Genet	**2**	**-**
PROTELIDAE (Aardwolf)	*Proteles cristatus*	Aardwolf	**3**	**-**
FELIDAE (Cats)	*Felis silvestris lybica*	African Wild Cat	**3**	**-**
	Felis nigripes	Small Spotted Cat	**1**	**VU**
	Caracal caracal	Caracal	**1**	**-**
ORYCTEROPODIDAE (Aardvark)	*Orycteropus afer*	Aardvark	**3**	**-**
PROCAVIIDAE (Dassies / Hyrax)	*Procavia capensis*	Rock Dassie (Hyrax)	**1**	**-**
BOVIDAE (Buffalo & Antelopes)	*Dameliscus pygargus phillipsi*	Blesbok	**3**	**-**
	Raphicerus campestris	Steenbok	**3**	**-**

FAMILY	*BIOLOGICAL NAME*	COMMON NAME	PROBABILITY	RED DATA
	Sylvicapra grimmia	Common Duiker	**3**	**-**

IUCN status categories are: Endangered (EN), Vulnerable (VU) and Near Threatened (NT)

Probability of occurrence ratings:

1 = Low probability

2 = Moderate probability

3 = High probability

APPENDIX C

Birds historically/potentially occurring in the study area

Birds

Common Name	Biological Name	Red Data
Ostrich	*Struthio camelus*	-
Dabchick	*Tachybaptus ruficollis*	-
Pelican Pinkbacked	*Pelecanus rufescens*	VU
Cormorant Whitebreasted	*Phalacrocorax carbo*	-
Cormorant Reed	*Phalacrocorax africanus*	-
Darter	*Anhinga rufa*	-
Heron Grey	*Ardea cinerea*	-
Heron Blackheaded	*Ardea melanocephala*	-
Heron Goliath	*Ardea goliath*	-
Heron Purple	*Ardea purpurea*	-
Egret Great White	*Casmerodius albus*	-
Egret Little	*Egretta garzetta*	-
Egret Yellowbilled	*Mesophoyx intermedia*	-
Egret Black	*Egretta ardesiaca*	-
Egret Cattle	*Bubulcus ibis*	-
Heron Squacco	*Ardeola ralloides*	-
Heron Greenbacked	*Butorides striatus*	-
Heron Blackcrowned Night	*Nycticorax nycticorax*	-
Heron Whitebacked Night	*Gorsachius leuconotus*	VU
Bittern Little	*Ixobrychus minutus*	-
Bittern Dwarf	*Ixobrychus sturmii*	-
Hamerkop	*Scopus umbretta*	-
Stork White	*Ciconia ciconia*	-
Stork Black	*Ciconia nigra*	NT
Stork Abdim's	*Ciconia abdimii*	-
Stork Saddlebilled	*Ephippiorhynchus senegalensis*	NT
Stork Marabou	*Leptoptilos crumeniferus*	NT
Stork Yellowbilled	*Mycteria ibis*	NT
Ibis Sacred	*Threskiornis aethiopicus*	-
Ibis Glossy	*Plegadis falcinellus*	-
Ibis Hadeda	*Bostrychia hagedash*	-
Spoonbill African	*Platalea alba*	-
Flamingo Greater	*Phoenicopterus ruber*	NT
Flamingo Lesser	*Phoenicopterus minor*	NT
Duck Whitefaced	*Dendrocygna viduata*	-
Duck Fulvous	*Dendrocygna bicolor*	-
Duck Whitebacked	*Thalassornis leuconotus*	-
Goose Egyptian	*Alopochen aegyptiacus*	-

Common Name	Biological Name	Red Data
Duck Yellowbilled	*Anas undulata*	-
Duck African Black	*Anas sparsa*	-
Teal Cape	*Anas capensis*	-
Teal Hottentot	*Anas hottentota*	-
Teal Redbilled	*Anas erythrorhyncha*	-
Shoveller Cape	*Anas smithii*	-
Pochard Southern	*Netta erythrophthalma*	-
Duck Knobbilled	*Sarkidiornis melanotos*	-
Goose Spurwinged	*Plectropterus gambensis*	-
Duck Maccoa	*Oxyuramaccoa*	-
Secretarybird	*Sagittarius serpentarius*	NT
Vulture Cape	*Gyps coprotheres*	VU
Vulture Whitebacked	*Gyps africanus*	VU
Vulture Lappetfaced	*Torgos tracheliotus*	VU
Vulture Whiteheaded	*Trigonoceps occipitalis*	VU
Kite Black	*Milvus migrans*	-
Kite Yellowbilled	*Milvus aegyptius*	-
Kite Blackshouldered	*Elanus caeruleus*	-
Buzzard Honey	*Pernis apivorus*	-
Eagle Black	*Aquila verreauxii*	-
Eagle Tawny	*Aquila rapax*	VU
Eagle Steppe	*Aquila nipalensis*	-
Eagle Lesser Spotted	*Aquila pomarina*	-
Eagle Wahlberg's	*Aquila wahlbergi*	-
Eagle Booted	*Hieraaetus pennatus*	-
Eagle African Hawk	*Hieraaetus spilogaster*	-
Eagle Ayres'	*Hieraaetus ayresii*	NT
Eagle Martial	*Polemaetus bellicosus*	VU
Eagle Brown Snake	*Circaetus cinereus*	-
Eagle Blackbreasted Snake	*Circaetus pectoralis*	-
Bateleur	*Terathopius ecaudatus*	VU
Eagle African Fish	*Haliaeetus vocifer*	-
Buzzard Steppe	*Buteo buteo*	-
Buzzard Jackal	*Buteo rufofuscus*	-
Buzzard Lizard	*Kaupifalco monogrammicus*	-
Sparrowhawk Ovambo	*Accipiter ovampensis*	-
Sparrowhawk Little	*Accipiter minullus*	-
Sparrowhawk Black	*Accipiter melanoleucus*	-
Goshawk Little Banded	*Accipiter badius*	-

Common Name	Biological Name	Red Data
Goshawk Gabar	*Micronisus gabar*	-
Goshawk Pale Chanting	*Melierax canorus*	-
Goshawk Dark Chanting	*Melierax metabates*	-
Harrier Eurasian Marsh	*Circus aeruginosus*	-
Harrier Montagu's	*Circus pygargus*	-
Harrier Pallid	*Circus macrourus*	NT
Gymnogene	*Polyboroides typus*	-
Osprey	*Pandion haliaetus*	-
Falcon Peregrine	*Falco peregrinus*	NT
Falcon Lanner	*Falco biarmicus*	NT
Falcon Northern Hobby	*Falco subbuteo*	-
Kestrel Western Redfooted	*Falco vespertinus*	-
Kestrel Eastern Redfooted	*Falco amurensis*	-
KestrelRock	*Falcotin nunculus*	-
Kestrel Greater	*Falco rupicoloides*	-
Kestrel Lesser	*Falco naumanni*	VU
Francolin Coqui	*Francolinus coqui*	-
Francolin Crested	*Francolinus sephaena*	-
Francolin Natal	*Francolinus natalensis*	-
Francolin Swainson's	*Francolinus swainsonii*	-
Quail Common	*Coturnix coturnix*	-
Quail Harlequin	*Coturnix delegorguei*	-
Guineafowl Helmeted	*Numida meleagris*	-
Buttonquail Kurrichane	*Turnix sylvatica*	-
Crake African	*Crex egregia*	-
Crake Black	*Amaurornis flavirostris*	-
Flufftail Redchested	*Sarothrura rufa*	-
Moorhen Common	*Gallinula chloropus*	-
Moorhen Lesser	*Gallinula angulata*	-
Coot Redknobbed	*Fulica cristata*	-
Finfoot African	*Podica senegalensis*	VU
Bustard Kori	*Ardeotis kori*	VU
Korhaan Redcrested	*Eupodotis ruficrista*	-
Korhaan Whitewinged	*Eupodotis afraoides*	-
Jacana African	*Actophilornis africanus*	-
Snipe Painted	*Rostratula benghalensis*	NT
Plover Ringed	*Charadrius hiaticula*	-
Plover Kittlitz's	*Charadrius pecuarius*	-
Plover Threebanded	*Charadrius tricollaris*	-

Common Name	Biological Name	Red Data
Plover Caspian	*Charadrius asiaticus*	-
Plover Crowned	*Vanellus coronatus*	-
Plover Blacksmith	*Vanellus armatus*	-
Plover Wattled	*Vanellus senegallus*	-
Sandpiper Common	*Tringa hypoleucos*	-
Sandpiper Green	*Tringa ochropus*	-
Sandpiper Wood	*Tringa glareola*	-
Sandpiper Marsh	*Tringa stagnatilis*	-
Greenshank	*Tringa nebularia*	-
Sandpiper Curlew	*Calidris ferruginea*	-
Stint Little	*Calidris minuta*	-
Ruff	*Philomachus pugnax*	-
Snipe Ethiopian	*Gallinago nigripennis*	-
Avocet Pied	*Recurvirostra avosetta*	-
Stilt Blackwinged	*Himantopus himantopus*	-
Dikkop Spotted	*Burhinus capensis*	-
Dikkop Water	*Burhinus vermiculatus*	-
Courser Temminck's	*Cursorius temminckii*	-
Courser Threebanded	*Rhinoptilus cinctus*	-
Courser Bronzewinged	*Rhinoptilus chalcopterus*	-
Pratincole Blackwinged	*Glareola nordmanni*	NT
Gull Greyheaded	*Larus cirrocephalus*	-
Tern Whiskered	*Chlidonias hybridus*	-
Tern Whitewinged	*Chlidonias leucopterus*	-
Sandgrouse Burchell's	*Pterocles burchelli*	-
Sandgrouse Doublebanded	*Pterocles bicinctus*	-
Pigeon Feral	*Columba livia*	-
Pigeon Rock	*Columba guinea*	-
Dove Redeyed	*Streptopelia semitorquata*	-
Dove Cape Turtle	*Streptopelia capicola*	-
Dove Laughing	*Streptopelia senegalensis*	-
Dove Namaqua	*Oena capensis*	-
Dove Greenspotted	*Turtur chalcospilos*	-
Pigeon Green	*Treron calva*	-
Parrot Meyer's	*Poicephalus meyeri*	-
Lourie Grey	*Corythaixoides concolor*	-
Cuckoo Eurasian	*Cuculus canorus*	-
Cuckoo African	*Cuculus gularis*	-
Cuckoo Redchested	*Cuculus solitarius*	-

Common Name	Biological Name	Red Data
Cuckoo Black	*Cuculus clamosus*	-
Cuckoo Great Spotted	*Clamator glandarius*	-
Cuckoo Striped	*Oxylophus levaillantii*	-
Cuckoo Jacobin	*Oxylophus jacobinus*	-
Cuckoo Klaas's	*Chrysococcyx klaas*	-
Cuckoo Diederik	*Chrysococcyx caprius*	-
Coucal Burchell's	*Centropus burchellii*	-
Owl Barn	*Tyto alba*	-
Owl Grass	*Tyto capensis*	-
Owl Marsh	*Asio capensis*	-
Owl African Scops	*Otus senegalensis*	-
Owl Whitefaced	*Otus leucotis*	-
Owl Pearlspotted	*Glaucidium perlatum*	-
Owl Spotted Eagle	*Bubo africanus*	-
Owl Giant Eagle	*Bubo lacteus*	-
Nightjar Eurasian	*Caprimulgus europaeus*	-
Nightjar Fierynecked	*Caprimulgus pectoralis*	-
Nightjar Rufouscheeked	*Caprimulgus rufigena*	-
Nightjar Freckled	*Caprimulgus tristigma*	-
Swift Eurasian	*Apus apus*	-
Swift Black	*Apus barbatus*	-
Swift Whiterumped	*Apus caffer*	-
Swift Horus	*Apus horus*	-
Swift Little	*Apus affinis*	-
Swift Alpine	*Tachymarptis melba*	-
Swift Palm	*Cypsiurus parvus*	-
Mousebird Speckled	*Colius striatus*	-
Mousebird Whitebacked	*Colius colius*	-
Mousebird Redfaced	*Urocolius indicus*	-
Kingfisher Pied	*Ceryle rudis*	-
Kingfisher Giant	*Megaceryle maxima*	-
Kingfisher Halfcollared	*Alcedo semitorquata*	NT
Kingfisher Malachite	*Alcedo cristata*	-
Kingfisher Pygmy	*Ispidina picta*	-
Kingfisher Woodland	*Halcyon senegalensis*	-
Kingfisher Brownhooded	*Halcyon albiventris*	-
Kingfisher Greyhooded	*Halcyon leucocephala*	-
Kingfisher Striped	*Halcyon chelicuti*	-
Bee-eater Eurasian	*Merops apiaster*	-

Common Name	Biological Name	Red Data
Bee-eater Bluecheeked	*Merops persicus*	-
Bee-eater Carmine	*Merops nubicoides*	-
Bee-eater Whitefronted	*Merops bullockoides*	-
Bee-eater Little	*Merops pusillus*	-
Bee-eater Swallowtailed	*Merops hirundineus*	-
Roller Eurasian	*Coracias garrulus*	-
Roller Lilacbreasted	*Coracias caudata*	-
Roller Purple	*Coracias naevia*	-
Roller Broadbilled	*Eurystomus glaucurus*	-
HoopoeAfrican	*Upupa africana*	-
Woodhoopoe Redbilled	*Phoeniculus purpureus*	-
Woodhoopoe Scimitarbilled	*Rhinopomastus cyanomelas*	-
Hornbill Grey	*Tockus nasutus*	-
Hornbill Redbilled	*Tockus erythrorhynchus*	-
Hornbill Southern Yellowbilled	*Tockus leucomelas*	-
Hornbill Ground	*Bucorvus leadbeateri*	VU
Barbet Blackcollared	*Lybius torquatus*	-
Barbet Pied	*Tricholaema leucomelas*	-
Barbet Yellowfronted Tinker	*Pogoniulus chrysoconus*	-
Barbet Crested	*Trachyphonus vaillantii*	-
Honeyguide Greater	*Indicator indicator*	-
Honeyguide Lesser	*Indicator minor*	-
Honeyguide Sharpbilled	*Prodotiscus regulus*	-
Woodpecker Bennett's	*Campethera bennettii*	-
Woodpecker Goldentailed	*Campethera abingoni*	-
Woodpecker Cardinal	*Dendropicos fuscescens*	-
Woodpecker Bearded	*Thripias namaquus*	-
Wryneck Redthroated	*Jynx ruficollis*	-
Lark Monotonous	*Mirafra passerina*	-
Lark Rufousnaped	*Mirafra africana*	-
Lark Fawncoloured	*Mirafra africanoides*	-
Lark Sabota	*Mirafra sabota*	-
Lark Dusky	*Pinarocorys nigricans*	-
Lark Redcapped	*Calandrella cinerea*	-
Lark Pinkbilled	*Spizocorys conirostris*	-
Finchlark Chestnutbacked	*Eremopterix leucotis*	-
Finchlark Greybacked	*Eremopterix verticalis*	-
Swallow Eurasian	*Hirundo rustica*	-
Swallow Whitethroated	*Hirundo albigularis*	-

Common Name	Biological Name	Red Data
Swallow Pearlbreasted	*Hirundo dimidiata*	-
Swallow Redbreasted	*Hirundo semirufa*	-
Swallow Greater Striped	*Hirundo cucullata*	-
Swallow Lesser Striped	*Hirundo abyssinica*	-
Swallow South African Cliff	*Hirundo spilodera*	-
Martin Rock	*Hirundo fuligula*	-
Martin House	*Delichon urbica*	-
Martin Sand	*Riparia riparia*	-
Martin Brownthroated	*Riparia paludicola*	-
Martin Banded	*Riparia cincta*	-
Cuckooshrike Black	*Campephaga flava*	-
Drongo Forktailed	*Dicrurus adsimilis*	-
Oriole Eurasian Golden	*Oriolus oriolus*	-
Oriole Blackheaded	*Oriolus larvatus*	-
Crow Pied	*Corvus albus*	-
Tit Ashy	*Parus cinerascens*	-
Tit Southern Black	*Parus niger*	-
Tit Cape Penduline	*Anthoscopus minutus*	-
Tit Grey Penduline	*Anthoscopus caroli*	-
Babbler Arrowmarked	*Turdoides jardineii*	-
Babbler Pied	*Turdoides bicolor*	-
Bulbul Redeyed	*Pycnonotus nigricans*	-
Bulbul Blackeyed	*Pycnonotus barbatus*	-
Bulbul Terrestrial	*Phyllastrephus terrestris*	-
Thrush Kurrichane	*Turdus libonyanus*	-
Thrush Groundscraper	*Psophocichla litsitsirupa*	-
Chat Mountain	*Oenanthe monticola*	-
Wheatear Capped	*Oenanthe pileata*	-
Chat Familiar	*Cercomela familiaris*	-
Chat Mocking	*Thamnolaea cinnamomeiventris*	-
Chat Anteating	*Myrmecocichla formicivora*	-
Stonechat	*Saxicola torquata*	-
Robin Cape	*Cossypha caffra*	-
Robin Whitethroated	*Cossypha humeralis*	-
Robin Whitebrowed	*Cercotrichas leucophrys*	-
Robin Kalahari	*Cercotrichas paena*	-
Warbler Garden	*Sylvia bonn*	-
Whitethroat	*Sylvia communis*	-
Titbabbler	*Parisoma subcaeruleum*	-

Common Name	Biological Name	Red Data
Warbler Icterine	*Hippolais icterina*	-
Warbler Olivetree	*Hippolais olivetorum*	-
Warbler Great Reed	*Acrocephalus arundinaceus*	-
Warbler African Marsh	*Acrocephalus baeticatus*	-
Warbler Eurasian Marsh	*Acrocephalus palustris*	-
Warbler Eurasian Sedge	*Acrocephalus schoenobaenus*	-
Warbler Cape Reed	*Acrocephalus gracilirostris*	-
Warbler African Sedge	*Bradypterus baboecala*	-
Warbler Willow	*Phylloscopus trochilus*	-
Apalis Barthroated	*Apalis thoracica*	-
Crombec Longbilled	*Sylvietta rufescens*	-
Eremomela Yellowbellied	*Eremomela icteropygialis*	-
Eremomela Burnt-necked	*Eremomela usticollis*	-
Warbler Greybacked Bleating	*Camaroptera brevicaudata*	-
Warbler Barred	*Calamonastes fasciolatus*	-
Cisticola Fantailed	*Cisticola juncidis*	-
Cisticola Desert	*Cisticola aridulus*	-
Cisticola Tinkling	*Cisticola rufilatus*	-
Cisticola Rattling	*Cisticola chinianus*	-
Cisticola Levaillant's	*Cisticola tinniens*	-
Cisticola Lazy	*Cisticola aberrans*	-
Neddicky	*Cisticola fulvicapillus*	-
Prinia Tawnyflanked	*Prinia subflava*	-
Prinia Blackchested	*Prinia flavicans*	-
Flycatcher Spotted	*Muscicapa striata*	-
Flycatcher Bluegrey	*Muscicapa caerulescens*	-
Flycatcher Fantailed	*Myioparus plumbeus*	-
Flycatcher Black	*Melaenornis pammelaina*	-
Flycatcher Marico	*Bradornis mariquensis*	-
Flycatcher Pallid	*Bradornis pallidus*	-
Flycatcher Fiscal	*Sigelus silens*	-
Batis Chinspot	*Batis molitor*	-
Flycatcher Fairy	*Stenostira scita*	-
Flycatcher Paradise	*Terpsiphone viridis*	-
Wagtail African Pied	*Motacilla aguimp*	-
Wagtail Cape	*Motacilla capensis*	-
Wagtail Yellow	*Motacilla flava*	-
Pipit Grassveld	*Anthus cinnamomeus*	-
Pipit Longbilled	*Anthus similis*	-

Common Name	Biological Name	Red Data
Pipit Plainbacked	*Anthus leucophrys*	-
Pipit Buffy	*Anthus vaalensis*	-
Pipit Striped	*Anthus lineiventris*	-
Pipit Tree	*Anthus trivialis*	-
Pipit Bushveld	*Anthus caffer*	-
ShrikeLesserGrey	*Lanius minor*	-
Shrike Fiscal	*Lanius collaris*	-
Shrike Redbacked	*Lanius collurio*	-
Shrike Longtailed	*Corvinella melanoleuca*	-
Boubou Southern	*Laniarius ferrugineus*	-
Boubou Tropical	*Laniarius aethiopicus*	-
Boubou Crimsonbreasted	*Laniarius atrococcineus*	-
Puffback	*Dryoscopus cubla*	-
Brubru	*Nilaus afer*	-
Tchagra Threestreaked	*Tchagra australis*	-
Tchagra Blackcrowned	*Tchagra senegala*	-
Shrike Orangebreasted Bush	*Telophorus sulfureopectus*	-
Shrike Greyheaded Bush	*Malaconotus blanchoti*	-
Helmetshrike White	*Prionops plumatus*	-
Shrike Whitecrowned	*Eurocephalus anguitimens*	-
Starling Wattled	*Creatophora cinerea*	-
Starling Plumcoloured	*Cinnyricinclus leucogaster*	-
Starling Burchell's	*Lamprotornis australis*	-
Starling Longtailed	*Lamprotornis mevesii*	-
Starling Glossy	*Lamprotornis nitens*	-
Starling Greater Blue-eared	*Lamprotornis chalybaeus*	-
Starling Redwinged	*Onychognathus mono*	-
Oxpecker Redbilled	*Buphagus erythrorhynchus*	NT
Sunbird Marico	*Nectarinia mariquensis*	-
Sunbird Greater Doublecollared	*Nectarinia afra*	-
Sunbird Whitebellied	*Nectarinia talatala*	-
Sunbird Black	*Nectarinia amethystina*	-
White-eye Cape	*Zosterops pallidus*	-
Weaver Redbilled Buffalo	*Bubalornis niger*	-
Sparrowweaver Whitebrowed	*Plocepasser mahali*	-
Sparrow House	*Passer domesticus*	-
Sparrow Great	*Passer motitensis*	-
Sparrow Cape	*Passer melanurus*	-
Sparrow Southern Greyheaded	*Passer diffusus*	-

Common Name	Biological Name	Red Data
Sparrow Yellowthroated	*Petronia superciliaris*	-
Finch Scalyfeathered	*Sporopipes squamifrons*	-
Weaver Spectacled	*Ploceus ocularis*	-
Weaver Spottedbacked	*Ploceus cucullatus*	-
Weaver Cape	*Ploceuscapensis*	-
Weaver Masked	*Ploceusvelatus*	-
Weaver Lesser Masked	*Ploceus intermedius*	-
Weaver Redheaded	*Anaplectes rubriceps*	-
Finch Cuckoofinch	*Anomalospiza imberbis*	-
Quelea Redbilled	*Quelea quelea*	-
Bishop Red	*Euplectes orix*	-
Bishop Golden	*Euplectes afer*	-
Widow Whitewinged	*Euplectes albonotatus*	-
Widow Redcollared	*Euplectes ardens*	-
Finch Melba	*Pytilia melba*	-
Firefinch Jameson's	*Lagonosticta rhodopareia*	-
Firefinch Redbilled	*Lagonosticta senegala*	-
Waxbill Blue	*Uraeginthus angolensis*	-
Waxbill Violet-eared	*Uraeginthus granatinus*	-

IUCN status categories are: Endangered (EN), Vulnerable (VU) and Near Threatened (NT)

APPENDIX D

Herpetofauna historically/potentially occurring in the study area

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Reptiles

BIOLOGICAL NAME	COMMON NAME	Red Data
Acontias gracilicauda	Thin-tailed Legless Skink	-
Agama aculeata	Ground Agama	-
Agama atra	Southern Rock Agama	-
Aparallactus capensis	Cape Centipede Eater	-
Bitis arietans	Puff Adder	-
Causus rhombeatus	Common or Rhombic Night Adder	-
Cordylus vittifer	Transvaal Girdled Lizard	-
Cordylus giganteus	Giant Girdled Lizard or Sungazer	Vulnerable
Crotaphopeltis hotamboeia	Herald or Red-lipped Snake	-
Dasypeltis scabra	Common or Rhombic Egg Eater	-
Duberria lutrix	Common Slug Eater	-
Elapsoidea sunderwallii	Sundevall's Garter Snake	-
Gerrhosaurus flavigularis	Yellow-throated Plated Lizard	-
Hemachatus heamachatus	Rinkhals	-
Homoreselaps dorsalis	Striped Harlequin Snake	Near-threatened
Homoroselaps lacteus	Spotted Harlequin Snake	-
Ichnotropis squamulosa	Common Rough-scaled Lizard	-
Lamprophis aurora	Aurora House Snake	-
Lamprophis fuliginosus	Brown House Snake	-
Leptotyphlops conjunctus	Cape Thread Snake	-
Leptotyphlops scutifrons	Peter's Thread Snake	-
Lycodonomorphus leleupi	Mulanje Water Snake	-
Lycophidion capense	Cape Wolf Snake	-
Mabuya capensis	Cape Skink	-
Mabuya striata	Striped Skink	-
Mabuya varia	Variable Skink	-
Nucras lalandii	Delalande's Sandveld Lizard	-
Pachydactylus capensis	Cape Gecko	-
Pedioplanis lineoocellata	Spotted Sand Lizard	-
Pelomedusa subrufa	Marsh or Helmeted Terrapin	-
Prosymna sundevali	Sundevall's Shovel-snout	-
Psammophis crucifer	Cross-marked or Montane Grass Snake	-
Psammophis brevirostris	Leopard Grass Snake	-
Psammophylax rhombeatus	Spotted or Rhombic Skaapsteker	-
Psammophylax tritaeniatus	Striped Skaapsteker	-
Pseudoaspis cana	Mole Snake	-
Rhino lalandei	Delalande's Beaked blind snake	-
Tetradactylus breyeri	Breyer's Long-tailed Seps	Vulnerable
Typhlops bibronii	Bibron's Blind Snake	-
Varanus albigularis	Rock or White-throated Monitor	-
Varanus niloticus	Nile or Water Monitor	-

Source: Branch (1994)

Amphibians

SPECIES	Common Name	Red Data Status
Afrana angolensis	Common river frog	-
Afrana fuscigula	Cape river frog	-
Bufo gutturalis	Guttural toad	-
Bufo rangeri	Raucous toad	-
Bufo vertebralis	Souther pygmy frog	-
Cacosternum boettgeri	Comon caco	-
Kassina senegalensis	Bubbling kassina	-
Phrynobatrachus natalensis	Snoring puddle frog	-
Pyxicephalus adspersus	Giant bullfrog	Near Threatened
Schismaderma carens	Red toad	-
Strongylopus fasciatus	Striped stream frog	-
Tomopterna cryptotus	Tremolo sand frog	-
Tomopterna natalensis	Natal sand frog	-
Xenopus laevis	Common platanna	-

Source: Carruthers (2001)

APPENDIX E

Arthropod taxa previously recorded in Study Area

Arthropoda recorded in the study area (Golder Associates, 2012)

Family	Species name
ARANEOMORPHAE	*Argiope flavipalpis*
MANTIDAE	*Epioscopomantis chalybea*
ACRIDIDAE	*Rhachitopis*
ACRIDIDAE	*Cyrtacanthacris aeruginosa*
PROTONEURIDAE	-
LYCIDAE	*Lycus melanurus*
COCCONELLIDAE	*Micraspis striata*
COCCINELLIDAE	*Cheilomenes lunata*
CURCULIONIDAE	-
NYMPHALINAE	*Junonia octavia sesamus*
NYMPHALINAE	*Junonia hierta cebrene*
NYMPHALINAE	*Junonia orithya madagascariensis*
NYMPHALINAE	*Vanessa cardui*
DANAINAE	*Danaus chrysippus aegyptius*
PIERIDAE	*Eurema brigitta brigitta*
APIDAE	*Apis mellifera*
MEGACHILIDAE	*Coelioxys spp.*
TABANIDAE	*Haematopota*

APPENDIX F

Flora Species recorded during the 2014 Survey

July 2014
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Plant species recorded during 2014 survey

Family	*Species Name*
AMARANTHACEAE	*Achyranthes aspera*
AMARANTHACEAE	*Gomphrena celosioides*
AMARYLLIDACEAE	*Boophane disticha*
ANACARDIACEAE	*Rhus pyroides*
ANTHERACEAE	*Anthericum cooperi*

APPENDIX G

Plant species previously recorded in the grid square 2627DD (PRECIS)

July 2014
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Family	*Species*	Threat status
ACANTHACEAE	*Chaetacanthus setiger (Pers.) Lindl.*	LC
ACANTHACEAE	*Crabbea acaulis N.E.Br.*	LC
ACANTHACEAE	*Crabbea hirsuta Harv.*	LC
ALISMATACEAE	*Alisma plantago-aquatica L.*	Not Evaluated
ALLIACEAE	*Tulbaghia leucantha Baker*	LC
AMARANTHACEAE	*Achyranthes aspera L. var. aspera*	Not Evaluated
AMARANTHACEAE	*Achyranthes aspera L. var. sicula L.*	Not Evaluated
AMARANTHACEAE	*Gomphrena celosioides Mart.*	Not Evaluated
AMARANTHACEAE	*Guilleminea densa (Willd. ex Roem. & Schult.) Moq.*	Not Evaluated
AMARANTHACEAE	*Hermbstaedtia odorata (Burch.) T.Cooke var. aurantiaca (Suess.) C.C.Towns.*	LC
AMARANTHACEAE	*Hermbstaedtia odorata (Burch.) T.Cooke var. odorata*	LC
AMARYLLIDACEAE	*Ammocharis coranica (Ker Gawl.) Herb.*	LC
AMARYLLIDACEAE	*Crinum bulbispermum (Burm.f.) Milne-Redh. & Schweick.*	Declining
AMARYLLIDACEAE	*Cyrtanthus breviflorus Harv.*	LC
AMARYLLIDACEAE	*Haemanthus montanus Baker*	LC
ANACARDIACEAE	*Searsia lancea (L.f.) F.A.Barkley*	LC
ANACARDIACEAE	*Searsia pyroides (Burch.) Moffett var. gracilis (Engl.) Moffett*	LC
ANACARDIACEAE	*Searsia pyroides (Burch.) Moffett var. pyroides*	LC
ANTHERICACEAE	*Chlorophytum cooperi (Baker) Nordal*	LC
ANTHERICACEAE	*Chlorophytum fasciculatum (Baker) Kativu*	LC
APIACEAE	*Afrosciadium magalismontanum (Sond.) P.J.D.Winter*	LC
APIACEAE	*Alepidea attenuata Weim.*	NT
APIACEAE	*Berula thunbergii (DC.) H.Wolff*	LC
APIACEAE	*Centella asiatica (L.) Urb.*	LC
APIACEAE	*Cyclospermum leptophyllum (Pers.) Sprague ex Britton & P.Wilson*	Not Evaluated
APIACEAE	*Deverra burchellii (DC.) Eckl. & Zeyh.*	LC
APOCYNACEAE	*Araujia sericifera Brot.*	Not Evaluated
APOCYNACEAE	*Asclepias gibba (E.Mey.) Schltr. var. gibba*	LC
APOCYNACEAE	*Asclepias gibba (E.Mey.) Schltr. var. media N.E.Br.*	LC
APOCYNACEAE	*Asclepias meyeriana (Schltr.) Schltr.*	LC
APOCYNACEAE	*Aspidoglossum interruptum (E.Mey.) Bullock*	LC
APOCYNACEAE	*Brachystelma incanum R.A.Dyer*	VU
APOCYNACEAE	*Cordylogyne globosa E.Mey.*	LC
APOCYNACEAE	*Gomphocarpus fruticosus (L.) Aiton f. subsp. fruticosus*	LC
APOCYNACEAE	*Pachycarpus schinzianus (Schltr.) N.E.Br.*	LC
APOCYNACEAE	*Pentarrhinum insipidum E.Mey.*	LC

Family	*Species*	Threat status
APOCYNACEAE	*Raphionacme hirsuta (E.Mey.) R.A.Dyer*	LC
APOCYNACEAE	*Raphionacme velutina Schltr.*	LC
APOCYNACEAE	*Riocreuxia polyantha Schltr.*	LC
APOCYNACEAE	*Schizoglossum nitidum Schltr.*	LC
APOCYNACEAE	*Stenostelma capense Schltr.*	LC
APOCYNACEAE	*Stenostelma umbelluliferum (Schltr.) S.P.Bester & Nicholas*	NT
APONOGETONACEAE	*Aponogeton junceus Lehm.*	LC
ASPARAGACEAE	*Asparagus cooperi Baker*	LC
ASPARAGACEAE	*Asparagus laricinus Burch.*	LC
ASPHODELACEAE	*Bulbine abyssinica A.Rich.*	LC
ASPHODELACEAE	*Bulbine favosa (Thunb.) Schult. & Schult.f*	LC
ASPHODELACEAE	*Bulbine narcissifolia Salm-Dyck*	LC
ASPHODELACEAE	*Chortolirion angolense (Baker) A.Berger*	LC
ASPHODELACEAE	*Kniphofia porphyrantha Baker*	LC
ASPHODELACEAE	*Kniphofia typhoides Codd*	NT
ASPHODELACEAE	*Trachyandra asperata Kunth var. asperata*	LC
ASPHODELACEAE	*Trachyandra asperata Kunth var. macowanii (Baker) Oberm.*	LC
ASPHODELACEAE	*Trachyandra asperata Kunth var. nataglencoensis (Kuntze) Oberm.*	LC
ASPHODELACEAE	*Trachyandra laxa (N.E.Br.) Oberm. var. laxa*	LC
ASPHODELACEAE	*Trachyandra saltii (Baker) Oberm. var. saltii*	LC
ASTERACEAE	*Arctotis arctotoides (L.f.) O.Hoffm.*	LC
ASTERACEAE	*Arctotis microcephala (DC.) Beauverd*	LC
ASTERACEAE	*Arctotis venusta Norl.*	LC
ASTERACEAE	*Berkheya pinnatifida (Thunb.) Thell. subsp. ingrata (Bolus) Roessler*	LC
ASTERACEAE	*Berkheya radula (Harv.) De Wild.*	LC
ASTERACEAE	*Chrysocoma obtusata (Thunb.) Ehr.Bayer*	LC
ASTERACEAE	*Cirsium vulgare (Savi) Ten.*	Not Evaluated
ASTERACEAE	*Cnicus benedictus L.*	Not Evaluated
ASTERACEAE	*Conyza bonariensis (L.) Cronquist*	Not Evaluated
ASTERACEAE	*Conyza canadensis (L.) Cronquist*	Not Evaluated
ASTERACEAE	*Conyza chilensis Spreng.*	Not Evaluated
ASTERACEAE	*Conyza podocephala DC.*	LC
ASTERACEAE	*Cotula anthemoides L.*	LC
ASTERACEAE	*Cotula microglossa (DC.) O.Hoffm. & Kuntze ex Kuntze*	LC
ASTERACEAE	*Denekia capensis Thunb.*	LC
ASTERACEAE	*Dicoma anomala Sond. subsp. anomala*	LC
ASTERACEAE	*Felicia fascicularis DC.*	LC

Family	*Species*	Threat status
ASTERACEAE	*Felicia muricata (Thunb.) Nees subsp. muricata*	LC
ASTERACEAE	*Flaveria bidentis (L.) Kuntze*	Not Evaluated
ASTERACEAE	*Gamochaeta subfalcata (Cabrera) Cabrera*	Not Evaluated
ASTERACEAE	*Gazania krebsiana Less. subsp. arctotoides (Less.) Roessler*	LC
ASTERACEAE	*Gazania krebsiana Less. subsp. krebsiana*	LC
ASTERACEAE	*Gazania krebsiana Less. subsp. serrulata (DC.) Roessler*	LC
ASTERACEAE	*Geigeria aspera Harv. var. aspera*	LC
ASTERACEAE	*Gerbera ambigua (Cass.) Sch.Bip.*	LC
ASTERACEAE	*Gnaphalium confine Harv.*	LC
ASTERACEAE	*Haplocarpha scaposa Harv.*	LC
ASTERACEAE	*Helichrysum argyrosphaerum DC.*	LC
ASTERACEAE	*Helichrysum caespititium (DC.) Harv.*	LC
ASTERACEAE	*Helichrysum callicomum Harv.*	LC
ASTERACEAE	*Helichrysum lineare DC.*	LC
ASTERACEAE	*Helichrysum nudifolium (L.) Less. var. nudifolium*	LC
ASTERACEAE	*Helichrysum paronychioides DC.*	LC
ASTERACEAE	*Helichrysum rugulosum Less.*	LC
ASTERACEAE	*Helichrysum subglomeratum Less.*	LC
ASTERACEAE	*Hypochaeris brasiliensis (Less.) Griseb.*	Not Evaluated
ASTERACEAE	*Hypochaeris microcephala (Sch.Bip.) Cabrera var. albiflora (Kuntze) Cabrera*	Not Evaluated
ASTERACEAE	*Hypochaeris radicata L.*	Not Evaluated
ASTERACEAE	*Litogyne gariepina (DC.) Anderb.*	LC
ASTERACEAE	*Nolletia ciliaris (DC.) Steetz*	LC
ASTERACEAE	*Osteospermum muricatum E.Mey. ex DC. subsp. muricatum*	LC
ASTERACEAE	*Pentzia globosa Less.*	LC
ASTERACEAE	*Platycarphella parvifolia (S.Moore) V.A.Funk & H.Rob.*	LC
ASTERACEAE	*Pseudognaphalium luteo-album (L.) Hilliard & B.L.Burtt*	
ASTERACEAE	*Pseudognaphalium oligandrum (DC.) Hilliard & B.L.Burtt*	LC
ASTERACEAE	*Schkuhria pinnata (Lam.) Kuntze ex Thell.*	Not Evaluated
ASTERACEAE	*Senecio consanguineus DC.*	LC
ASTERACEAE	*Senecio coronatus (Thunb.) Harv.*	LC
ASTERACEAE	*Senecio erubescens Aiton var. erubescens*	LC
ASTERACEAE	*Senecio gregatus Hilliard*	LC
ASTERACEAE	*Senecio harveianus MacOwan*	LC
ASTERACEAE	*Senecio inaequidens DC.*	LC
ASTERACEAE	*Senecio inornatus DC.*	LC

Family	*Species*	Threat status
ASTERACEAE	*Senecio laevigatus Thunb. var. laevigatus*	LC
ASTERACEAE	*Senecio polyodon DC. var. polyodon*	LC
ASTERACEAE	*Sonchus integrifolius Harv. var. integrifolius*	LC
ASTERACEAE	*Tolpis capensis (L.) Sch.Bip.*	LC
ASTERACEAE	*Tripteris aghillana DC. var. aghillana*	LC
ASTERACEAE	*Ursinia nana DC. subsp. leptophylla Prassler*	LC
ASTERACEAE	*Xanthium spinosum L.*	Not Evaluated
ASTERACEAE	*Xanthium strumarium L.*	Not Evaluated
AZOLLACEAE	*Azolla filiculoides Lam.*	Not Evaluated
BRASSICACEAE	*Coronopus integrifolius (DC.) Spreng.*	Not Evaluated
BRASSICACEAE	*Diplotaxis muralis (L.) DC.*	Not Evaluated
BRASSICACEAE	*Lepidium bonariense L.*	Not Evaluated
BRASSICACEAE	*Nasturtium officinale R.Br.*	Not Evaluated
BRASSICACEAE	*Raphanus raphanistrum L.*	Not Evaluated
BRASSICACEAE	*Rorippa fluviatilis (E.Mey. ex Sond.) Thell. var. caledonica (Sond.) Marais*	LC
BRYACEAE	*Bryum apiculatum Schwägr.*	
CAMPANULACEAE	*Wahlenbergia androsacea A.DC.*	LC
CAMPANULACEAE	*Wahlenbergia denticulata (Burch.) A.DC. var. transvaalensis (Adamson) W.G.Welman*	LC
CAMPANULACEAE	*Wahlenbergia undulata (L.f.) A.DC.*	LC
CAPPARACEAE	*Cleome maculata (Sond.) Szyszyl.*	LC
CAPPARACEAE	*Cleome monophylla L.*	LC
CAPPARACEAE	*Cleome rubella Burch.*	LC
CARYOPHYLLACEAE	*Cerastium arabidis E.Mey. ex Fenzl*	LC
CARYOPHYLLACEAE	*Corrigiola litoralis L. subsp. litoralis var. litoralis*	LC
CARYOPHYLLACEAE	*Dianthus basuticus Burtt Davy subsp. basuticus var. basuticus*	LC
CARYOPHYLLACEAE	*Pollichia campestris Aiton*	LC
CARYOPHYLLACEAE	*Silene burchellii Otth var. angustifolia Sond.*	Not Evaluated
CELASTRACEAE	*Gymnosporia buxifolia (L.) Szyszyl.*	LC
CELTIDACEAE	*Celtis africana Burm.f.*	LC
CHENOPODIACEAE	*Chenopodium album L.*	Not Evaluated
CHENOPODIACEAE	*Chenopodium carinatum R.Br.*	Not Evaluated
CHENOPODIACEAE	*Chenopodium giganteum D.Don*	Not Evaluated
COMMELINACEAE	*Commelina africana L. var. krebsiana (Kunth) C.B.Clarke*	LC
COMMELINACEAE	*Commelina benghalensis L.*	LC

Family	*Species*	Threat status
COMMELINACEAE	*Commelina livingstonii C.B.Clarke*	LC
COMMELINACEAE	*Cyanotis speciosa (L.f.) Hassk.*	LC
CONVOLVULACEAE	*Convolvulus sagittatus Thunb.*	LC
CONVOLVULACEAE	*Convolvulus thunbergii Roem. & Schult.*	LC
CONVOLVULACEAE	*Falkia oblonga Bernh. ex C.Krauss*	LC
CONVOLVULACEAE	*Ipomoea bathycolpos Hallier f.*	LC
CONVOLVULACEAE	*Ipomoea oenotheroides (L.f.) Raf. ex Hallier f.*	LC
CONVOLVULACEAE	*Ipomoea ommanneyi Rendle*	LC
CONVOLVULACEAE	*Merremia verecunda Rendle*	LC
CONVOLVULACEAE	*Seddera capensis (E.Mey. ex Choisy) Hallier f.*	LC
CRASSULACEAE	*Crassula campestris (Eckl. & Zeyh.) Endl. ex Walp.*	LC
CRASSULACEAE	*Crassula lanceolata (Eckl. & Zeyh.) Endl. ex Walp. subsp. lanceolata*	LC
CRASSULACEAE	*Crassula natans Thunb. var. natans*	LC
CRASSULACEAE	*Crassula vaillantii (Willd.) Roth*	Not Evaluated
CUCURBITACEAE	*Citrullus lanatus (Thunb.) Matsum. & Nakai*	LC
CYPERACEAE	*Ascolepis capensis (Kunth) Ridl.*	LC
CYPERACEAE	*Bulbostylis burchellii (Ficalho & Hiern) C.B.Clarke*	LC
CYPERACEAE	*Bulbostylis contexta (Nees) M.Bodard*	LC
CYPERACEAE	*Bulbostylis hispidula (Vahl) R.W.Haines subsp. pyriformis (Lye) R.W.Haines*	LC
CYPERACEAE	*Bulbostylis humilis (Kunth) C.B.Clarke*	LC
CYPERACEAE	*Carex glomerabilis V.I.Krecz.*	LC
CYPERACEAE	*Cyperus congestus Vahl*	LC
CYPERACEAE	*Cyperus difformis L.*	LC
CYPERACEAE	*Cyperus eragrostis Lam.*	Not Evaluated
CYPERACEAE	*Cyperus esculentus L. var. esculentus*	LC
CYPERACEAE	*Cyperus longus L. var. tenuiflorus (Rottb.) Boeck.*	LC
CYPERACEAE	*Cyperus margaritaceus Vahl var. margaritaceus*	LC
CYPERACEAE	*Cyperus marginatus Thunb.*	LC
CYPERACEAE	*Cyperus tenax Boeckeler*	LC
CYPERACEAE	*Cyperus usitatus Burch.*	LC
CYPERACEAE	*Eleocharis dregeana Steud.*	LC
CYPERACEAE	*Eleocharis limosa (Schrad.) Schult.*	LC
CYPERACEAE	*Ficinia gracilis Schrad.*	LC
CYPERACEAE	*Fuirena pubescens (Poir.) Kunth var. pubescens*	LC
CYPERACEAE	*Fuirena stricta Steud. var. stricta*	LC
CYPERACEAE	*Isolepis costata Hochst. ex A.Rich.*	LC
CYPERACEAE	*Kyllinga alba Nees*	LC

Family	*Species*	Threat status
CYPERACEAE	*Kyllinga erecta Schumach. var. erecta*	LC
CYPERACEAE	*Pycreus chrysanthus (Boeckeler) C.B.Clarke*	LC
CYPERACEAE	*Pycreus macranthus (Boeckeler) C.B.Clarke*	LC
CYPERACEAE	*Pycreus mundii Nees*	LC
CYPERACEAE	*Pycreus nitidus (Lam.) J.Raynal*	LC
CYPERACEAE	*Schoenoplectus decipiens (Nees) J.Raynal*	LC
CYPERACEAE	*Schoenoplectus muricinux (C.B.Clarke) J.Raynal*	LC
CYPERACEAE	*Schoenoplectus muriculatus (Kük.) Browning*	LC
CYPERACEAE	*Schoenoplectus pulchellus (Kunth) J.Raynal*	LC
CYPERACEAE	*Scirpoides burkei (C.B.Clarke) Goetgh., Muasya & D.A.Simpson*	LC
DIPSACACEAE	*Cephalaria pungens Szabó*	LC
DIPSACACEAE	*Scabiosa columbaria L.*	LC
EBENACEAE	*Diospyros austro-africana De Winter var. microphylla (Burch.) De Winter*	LC
EBENACEAE	*Diospyros lycioides Desf. subsp. lycioides*	LC
ELATINACEAE	*Bergia pentheriana Keissl.*	LC
EQUISETACEAE	*Equisetum ramosissimum Desf. subsp. ramosissimum*	LC
ERIOCAULACEAE	*Eriocaulon dregei Hochst.*	LC
ERIOSPERMACEAE	*Eriospermum flagelliforme (Baker) J.C.Manning*	LC
EUPHORBIACEAE	*Acalypha angustata Sond.*	LC
EUPHORBIACEAE	*Clutia pulchella L. var. pulchella*	LC

APPENDIX H

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Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Africa (Pty) Ltd.
PO Box 6001
Halfway House, 1685
Building 1 , Golder House, Magwa Crescent West
Maxwell Office Park, Waterfall City
Cnr Allandale Road and Maxwell Drive
Midrand
South Africa
T: [+27] (11) 254 4800

Golder Associates