Appendix E

Biodiversity

Informative/ Scoping Level Report: Ecological Assessment Of The Leeuwpan Colliery and Expansion, Delmas - Mpumalanga

Commissioned by

Groundwater Consulting Services Pty (Ltd)

Compiled by

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DRAFT

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1 EXECUTIVE SUMMARY

Groundwater Consulting Services (GCS) Pty (Ltd) appointed EkoInfo CC and its associates to assist them with the terrestrial flora and fauna studies at a brownfield mining area of Exxaro, referred to as Leeuwpan. This mining area is located east of the town of Delmas in Mpumalanga Province.

The Leeuwpan area covers approximately 3 518 ha, consisting of a mosaic of cultivated, forestry and primary natural vegetation. It is located within a threatened regional grassland unit, namely the Eastern Highveld Grassland (Endangered).

The team consists of the following team members with their responsibilities

1. Willem de Frey – GIS, Landscape Ecology & Vegetation Assessment
2. Lukas Niemand – Avifauna & Invertebrate Assessment
3. Luke Verburgt – Herpetofauna Assessment
4. Sam Laurence –Mammal Assessment

This document presents an update of the existing terrestrial ecological information for Leeuwpan Colliery and the areas targeted for expansion.

Vegetation ecological assessment

From the regional perspective, it is evident that the study area is located in a transformed and fragmented landscape. The area is not considered to be of conservation importance on a provincial scale even though it is located within a nationally threatened ecosystem. However, the remaining natural vegetation, especially terrerstrial grassland is important for the mine because it represents source area for future rehabilitation and restoration. The extent and distribution of the remaining terrestrial grassland, especially those located on good agricultural land, will be determined during the detail/ EIA phase. These areas will also be surveyed for the presence of threatened Red Data plants or for their suitability as habitat for threatened plants.

Avifauna and invertebrate ecological assessment

The information provided in this report forms part of a desktop study that was obtained from (1) relevant literature, (2) personal observations from similar habitat types in close proximity to the study site and during (3) an orientation site visit (18 - 19 July 2012). The desktop study will set a benchmark for baseline surveys that will form part of the Environmental Impact Assessment phase.

The following key considerations were identified and noted:

- A detailed description of methods that will be implemented to evaluate the bird and invertebrate diversity and abundance values on the study site;
- 121 bird species are expected to be present on the study area along with 18 threatened and near-threatened species;
- 83 bird species were recorded during an orientation site visit, including the following threatened species: Southern Bald Ibis (*Geronticus calvus*), African Marsh Harrier (*Circus ranivorus*) and Secretarybird (*Sagittarius serpentarius*);
- Various wetland features (unchannelled valley bottom wetlands and the floodplain of the Bronkhorstspruit) and primary grasslands were identified as important bird habitat;
- The rocky grasslands were identified as important invertebrate habitat. They may provide specialised habitat for key invertebrate guilds (pollinators);
- The study site provides potential habitat for the occurrence of the vulnerable Marsh Sylph (*Metisella meninx*) butterfly; and
- A number of potential impacts were listed in the main document.

Herpetofauna ecological assessment

- A scoping winter survey was performed for herpetofauna on the Leeuwpan mine site.

- As expected, no reptiles were observed during the survey and only one common amphibian species was heard calling.
- A good general understanding of the ecological processes and the current impacts on herpetofauna populations on the mine site was obtained during the scoping survey.
- Only a single herpetofauna species of conservation concern is expected to occur on the mine site namely the Giant Bullfrog (*Pyxicephalus adspersus*)
- The general methodology for the summer survey is discussed.

Mammal's ecological assessment

- 16 mammal species were recorded within the overall study footprint, including the project footprint and the immediately surrounding area.
- 2 red-data mammal species were confirmed within the study area, namely Brown Hyaena and Honey Badger.
- 1 TOPS protected species was recorded on site, namely the African clawless otter.
- Current impacts on the site include subsistence hunting with dogs (surrounding areas), impacts from livestock agriculture (overgrazing/trampling), impacts from mining activities, localised bush encroachment from alien/invasive species and impacts from crop agriculture.
- The winter study took place during a sub-optimal time of the year, and a follow up study is to take place over the summer wet-season period.
- In terms of total ecological sensitivity based on flora and fauna assessments on both a regional and local scale, it is evident that the habitat sites exhibits a mixture of mammalian sensitivities but the overall sensitivity appears to be low.
- Rocky primary grasslands may be of high sensitivity due to high structural complexity and strong species diversity.
- Drainage systems and wetland associated grasslands may be highly sensitive and have been prioritised for the primary study period.

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2 INTRODUCTION

Groundwater Consulting Services Pty (Ltd) appointed EkoInfo CC and its associates on behalf of Exxaro to assess the terrestrial flora and fauna for the Leeuwpan mining area situated on the farms Paardeplaat 380 and Paardeplaats 425 JT in the Province of Mpumalanga, near the town of Belfast (Figure 2 -1).

This version of the document concerns the scoping phase and aims to provide an overview of the existing information and additional information (Plan of Study for EIA) required during the Environmental Impact Assessment (EIA) phase. The scope of works listed below, where divided into two phases:'

1. A scoping phase consisting of a literature – and desktop review with a winter survey in July 2012, to assist with orientation and survey design for the EIA phase.
    a. The resolution of this phase is regional (1: 250 000 scale and smaller), effective pixel resolution 25 m or larger.
    b. Mainly qualitative data collected
2. An EIA phase consisting of detailed fieldwork as soon as sufficient rain had fallen and regrowth had occrued in October/ November 2012. On completion of the detail fieldwork, this document will be updated to reflect the results.
    a. The resolution of this phase is local (1: 10 000 or smaller), effective pixel resolution 10 m or larger.
    b. Both qualitative and quantitative data collected

2.1 Scope of work/ Terms of reference

In correspondence received and reflected in the appointment contract, the scope of work was as follows:

1. Flora Component
    a. Baseline flora assessment of the surface areas covered with natural vegetation area required. Large areas of the natural vegetation are already destroyed due to mining and farming activities such as cultivated lands, mining infrastructure such as roads, dams, plant, etc. The vegetation units included in Table 1 covers an area of approximately 1 014.46 ha. Detailed vegetation assessments are required for the Primary grassland, secondary / transformed grassland, wetland grassland plantations (which mainly consist of alien invasive / Category 2 / 3 declared invaders) and grassland scrub. An assessment with regards to Declared Category 1, 2 & 3 species must be included for the entire surface area, including areas with buildings such as mine offices, farm buildings etc).
    b. Provision must be made for two vegetation assessments
2. Fauna Component
    a. Mammals
        i. List of all potential mammals must be compiled by means of desktop study and all potential red data species must be highlighted with short habitat descriptions. The presence of these habitats and potential of identified red data species must be verified during the mammal assessment.
        ii. Detailed mammal survey must be conducted in order to record following:
            - All mammals encountered or noted during the surveys will be recorded;
            - Tracks and dung of mammals encountered during the survey will be, where possible, identified and recorded (if possible);
            - A list of the most prominent mammal species will be compiled;
            - A list of rare and endangered species encountered during the survey, as well as species listed according to the results of a desktop study but which were not recorded during the survey, will be compiled;
            - A list of protected species that occur on the potential list but not recorded during the site visits or surveys;
            - A list of exotic or introduced vertebrate species occurring on the property.
            - Provision must be made for night surveys as well in order to record nocturnal species as well
    b. Birds
        i. A complete list of bird species encountered within the surface boundaries of Exxaro Leeuwpan Coal and especially in natural undisturbed areas, wetlands,

pans, drainage channels and rehabilitated areas must be compiled. Interviews with farmers will need to be conducted in order to compile a species list of species recorded by farmers from time to time. The presence of potential red data and endemic birds and their preferred habitats must be compiled prior to the bird's survey. The potential of red data species and their preferred habitat, identified during a desktop study, must be verified during the bird's assessment.

ii. The following must be recorded during the bird survey:
- All birds encountered or noted during the surveys must be recorded;
- A list of the most prominent birds encountered and possible species that can be expected to be present;
- A list of rare and endangered species encountered during the survey;
- Possible migration species that are not on site during the survey must be assessed from literature surveys;
- A species list of all the birds that can possibly be present within the relevant grid in which the farms are situated must be compiled.

c. Invertebrates and Butterflies
- Evaluation and monitoring of invertebrate biodiversity must be included and must contain information on groups including ants, ground living beetles (Tenebrionidae and Carabidae), termites, leafhoppers, spiders, and scorpions as required by the Mpumalanga Tourism and Parks Agency minimum requirements. Methodology of how the field surveys will be conducted must be included.

d. Amphibians and Reptiles

i. The presence of amphibians and reptiles must be evaluated and all frogs and reptiles encountered must be recorded by means of a field survey. Night surveys on the frog species are required in areas accessible at night. A short description on the methodology that will be followed to record amphibians and reptiles must be included. Interviews with farmers must also be conducted in order to compile a species list of especially frogs and reptiles such as lizards, snakes and tortoises recorded by farmers from time to time. The following must be recorded during the survey:
- All frogs, snakes, lizards and tortoises encountered or noted during the surveys will be recorded;
- A list of the most prominent amphibian and reptile species will be compiled;
- A list of rare and endangered species encountered during the survey, as well as species

Environmental management requires an integrated and holistic approach, which relies on multi-disciplinary teams. For this study, the team consists of:

1. Willem de Frey, EkoInfo CC – Landscape Ecology & Vegetation in general (Appendix A)
2. Lukas Niemand, Pachnoda Consulting – Avifauna & Invertebrates (Appendix A)
3. Luke Verburgt, Enviro-Insight – Herpetofauna (Appendix A)
4. Sam Laurence, Enviro-Insight – Mammals, with specific emphasis on nocturnal animals and predators (Appendix A)

These professional scientists are registered with the South African Council for Natural Scientific Professions[1] (SACNASP) in their respective fields of expertise. In accordance with the requirements of SACNASP and the National Environmental Management Act's Environmental Management Regulations, they have an obligation to complete their tasks independent, professional and objective using the best available scientific knowledge and means available.

[1] http://www.sacnasp.org.za/

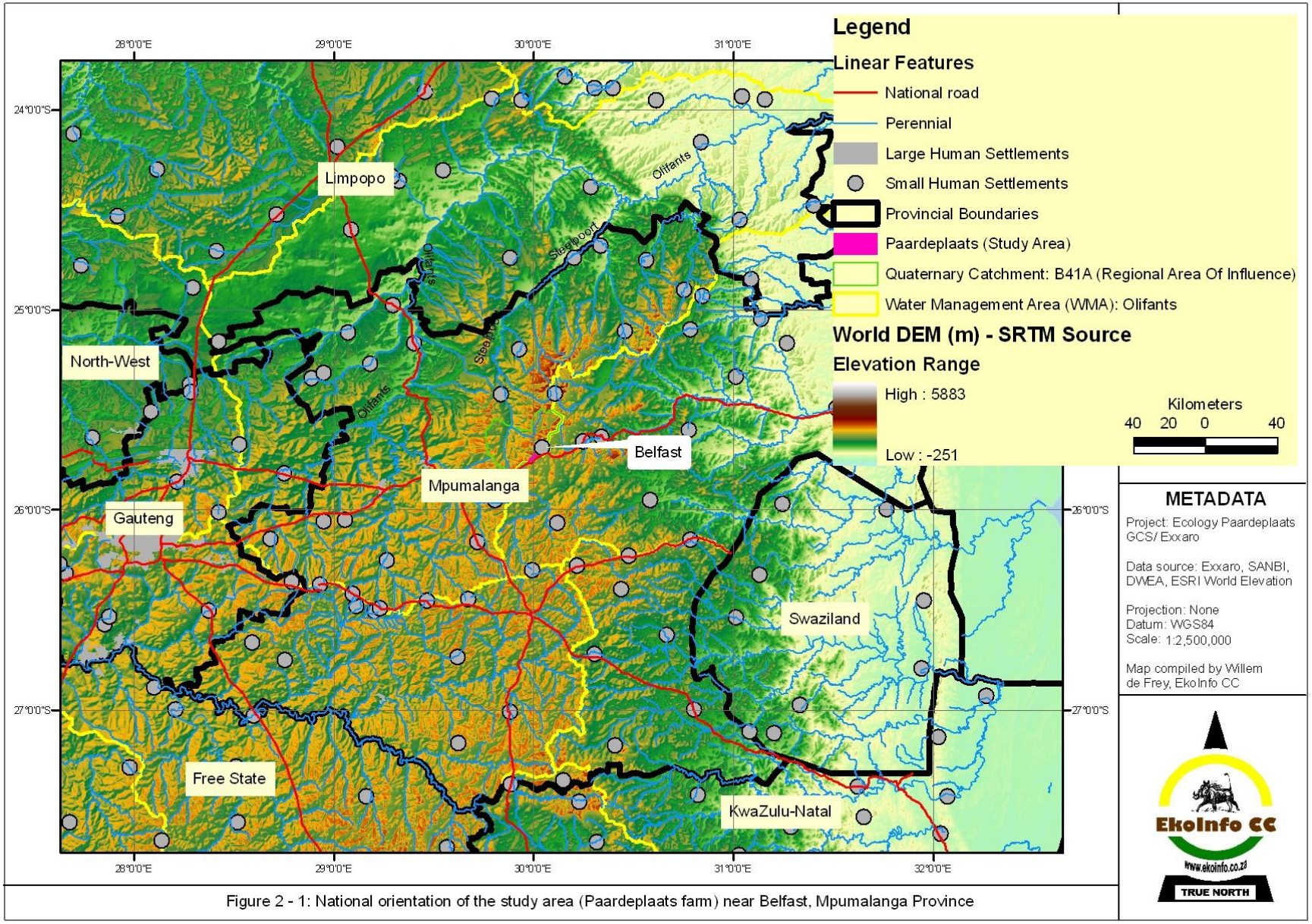

Figure 2 - 1: National orientation of the study area (Paardeplaats farm) near Belfast, Mpumalanga Province

3 STUDY AREA

3.1 Regional orientation

At a regional scale the study area is located within quaternary catchment B20A (Figure 3 - 1), which forms part of the Olifants Water Management Area (Figure 2 - 1). Quaternary catchment B20A represents the regional area of influence and the landscape in terms of landscape ecology (Turner, Gardner & O'Neill 2001, Wiens, Moss, Turner & Mladenoff 2006). Quaternary catchment B20A's extent covers approximately 57 428 ha or 574 km², of which the study area represents 6%.

3.2 Local orientation

At a local scale, the study area is located east of the town of Delmas (Figure 3-2). The study area consists of various properties (Goedgedacht 228, Welevreden 227, Witklip 229, Moabsvelden 248, Witklip 232, Wolvenfontein 244, Rietkuil 249, De Denne 256, Leeuwpan 246), which covers approximately 3 518 ha. Locally, it transects three (3) local watersheds which had been derived from the Shuttle's Digital Elevation Model (DEM), these three (3) local catchments cover approximately 22 361 ha (Table 3-1). The study area represents approximately 16 % of this local area of influence.

An environmental overview is provided to comprehend the mining activities influence on a regional scale/ landscape level.

3.3 Environmental Overview

An environmental overview is provided to assist in the determination of the environmental factors that influence the distribution of the vegetation and therefore habitats in the area.

A study focused only on the study area without taking into consideration the broad environment and adjacent land use, would be contrary to the goals of the National Environmental Management Act, 1998. Therefore the environmental overview was based on the quaternary catchment[2]. The quaternary catchment was selected, as it is the smallest unit for which biophysical data is available from DEAT's ENPAT series[3]. Quaternary catchment were used in the National Spatial Biodiversity Assessment rivers component to assess the status of rivers in South Africa and highlights the importance of quaternary catchments as a unit to measure the influence of human activities on water and the catchment areas they depend on (Nel *et al* 2004).

Quaternary catchment B20A in which the study area occurs is located in the Olifants River primary catchment. It forms part of the Olifants Water Management Area. According to the National Spatial Biodiversity Assessment 's[4] River component, between 75% and 95% of the Olifants Water Management Area's mainstem are critically endangered or endangered. Therefore conservation and restoration of drainage lines in this area should be a priority. **Quaternary catchment B20A is classified as having rehabilitation potential therefore the prevention of additional degradation should be a priority as well as the restoration and protection of remaining ecosystems whether terrestrial or aquatic.**

[2] **a catchment** is the area of land that drains water into a creek, lake, dam, groundwater aquifer, drain, estuary or wetland. Catchments collect water from where rain runs off. This includes your school and house roofs, roads, paddocks, forests and gardens (http://www.sa.waterwatch.org.au/dictiona.htm)
a catchment, in relation to a watercourse or watercourses or part of a watercourse, means the area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points (National Water Act of 1998, South African Government)

[3] National Department of Environmental Affairs and Tourism (DEAT)'s Environmental Potential Atlas (ENPAT) series

[4] NEL, J., MAREE, G., ROUX, D., MOOLMAN, J., KLEYNHANS, N., SILBERBAUER, M. & DRIVER, A. 2004. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 2: River Component. CSIR Report Number ENV-S-I-2004-063. Council for Scientific and Industrial Research, Stellenbosch.

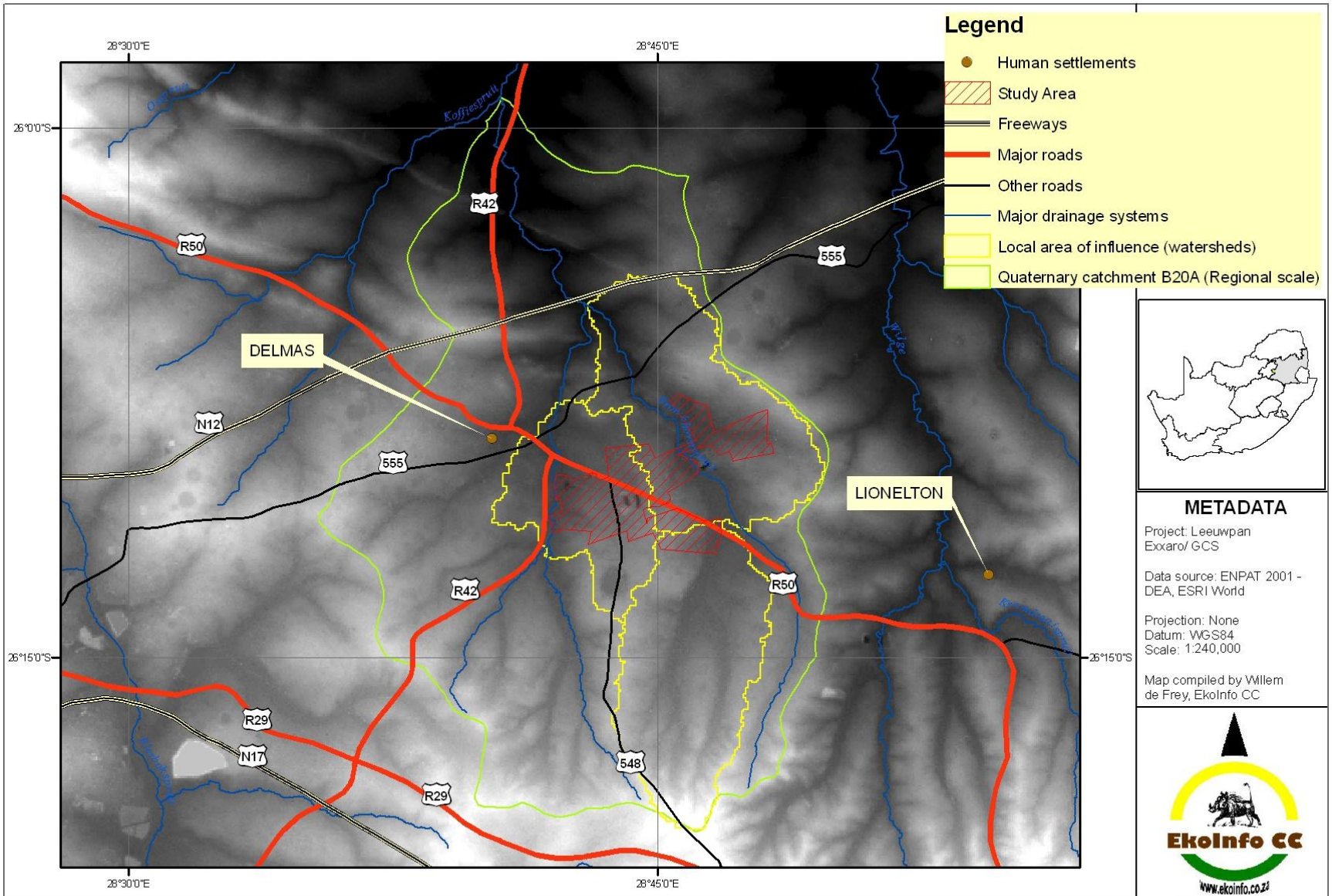

Figure 3 -1: Regional orientation of the study area (Leeuwpan Colliery) near Delmas, Mpumalanga

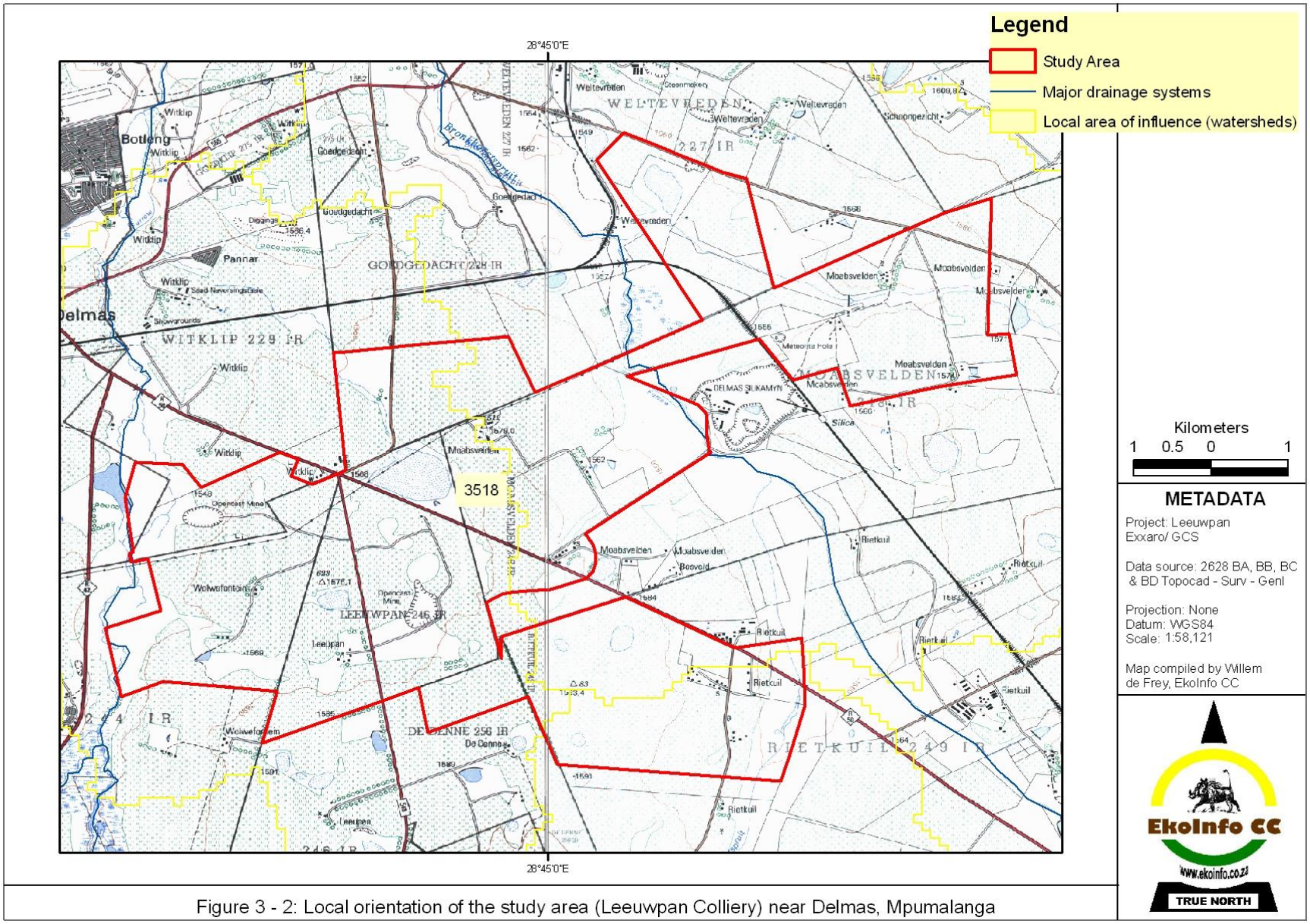

Figure 3 - 2: Local orientation of the study area (Leeuwpan Colliery) near Delmas, Mpumalanga

Table 3-1: Overview of the extent of the three local watersheds, which represent the local area of influence

Local watersheds	Surface area (ha)	% Cover
1	8915	40%
2	5255	23%
3	8191	37%
TOTALS	22361	100%
Study Area	3518	16%

3.3.1 Geology And Topography

The study area mainly overlay arenite (coarse sandstone), shale and coal (Figure 3-3.A). These lithological units represent sedimentary rocks. In high rainfall areas these rocks provide resistance against weathering due to the lack of minerals, while the igneous rock succumbs to chemical weathering (Read & Watson 1983; Strahler & Strahler 1987; Johnson, Anhaeusser & Thomas 2006). Dolomite occurs along the western boundary as well as towards the eastern boundary. Dolomite formations are often associated with aquifers and the formation of sinkholes. Exposure to acid mine drainage has to potential to increase the formation of sinkholes[5].

The landscape reflects this trend with the study area located within plains. The surface slopes and drains towards the north cutting through a landscape consisting of plains and hills (Figure 3-3.B).

It is expected that the weathering of the arenite and shale will result in the formation of sandy to sandy-loam soils within the flat area (slope less than 8%) of the study area. In these conditions rainfall tends to infiltrate rather than runoff, resulting in water moving within the soil profile.

3.3.2 Soil

The study area is associated with yellow-brown apedal soils; these soils in general represent soils with agricultural potential because the soils are well drained and aerated (Fey 2010) (Figure 3-3.C).

It is expected that the vegetation will reflect this variation in the soil conditions from coarse textured, well drained in the high lying areas, to fine textured and saturated in the low lying areas of the landscape.

3.3.3 Vegetation And Land Cover

The study area is located in the Grassland Biome of South Africa, across one regional vegetation unit, namely the Eastern Highveld Grassland (Figure 3-4.A) (Rutherford & Mucina 2006. This regional vegetation unit is classified as Endangered.

Regionally according to the 2000 land cover classification (Figure 3-4.B), only 46% of the landscape still represents natural vegetation (habitat), with only 54% being transformed (Table 3-2). This implies that most of the landscape is **poorly connected and fragmentation is a major issue** (Turner, Gardner & O'Neill 2001, Wiens, Moss, Turner & Mladenoff 2006).

3.3.4 Conservation status and local context

According to the Mpumalanga Parks Board Biodiversity Assessment (Figure 3-5.A) no habitat, which is of conservation priority (important and necessary, highly significant, irreplaceable, protected areas) to the province, is present within the study area (Table 3-3).

In terms of the latest nationally available land cover 2000 dataset (Figure 3-5.B), 33 % of the study area is considered to be natural and 67% is transformed (Table 3-4). This implies that within the study area **connectivity is an issue** as the threshold for connectivity is 25% or more transformation ((Turner, Gardner & O'Neill 2001, Wiens, Moss, Turner & Mladenoff 2006).

Therefore it can be concluded that based on the available small scale datasets, the study area **does not** represents an intact portion of an overall natural landscape. It is expected that the remaining natural flora and fauna at a local scale within the study area will reflect the disturbed and transformed state.

[5] www.earthlife.org.za/.../wp.../pdf16-Aug09draft-AMD-Fact-sheet-no1.pdf

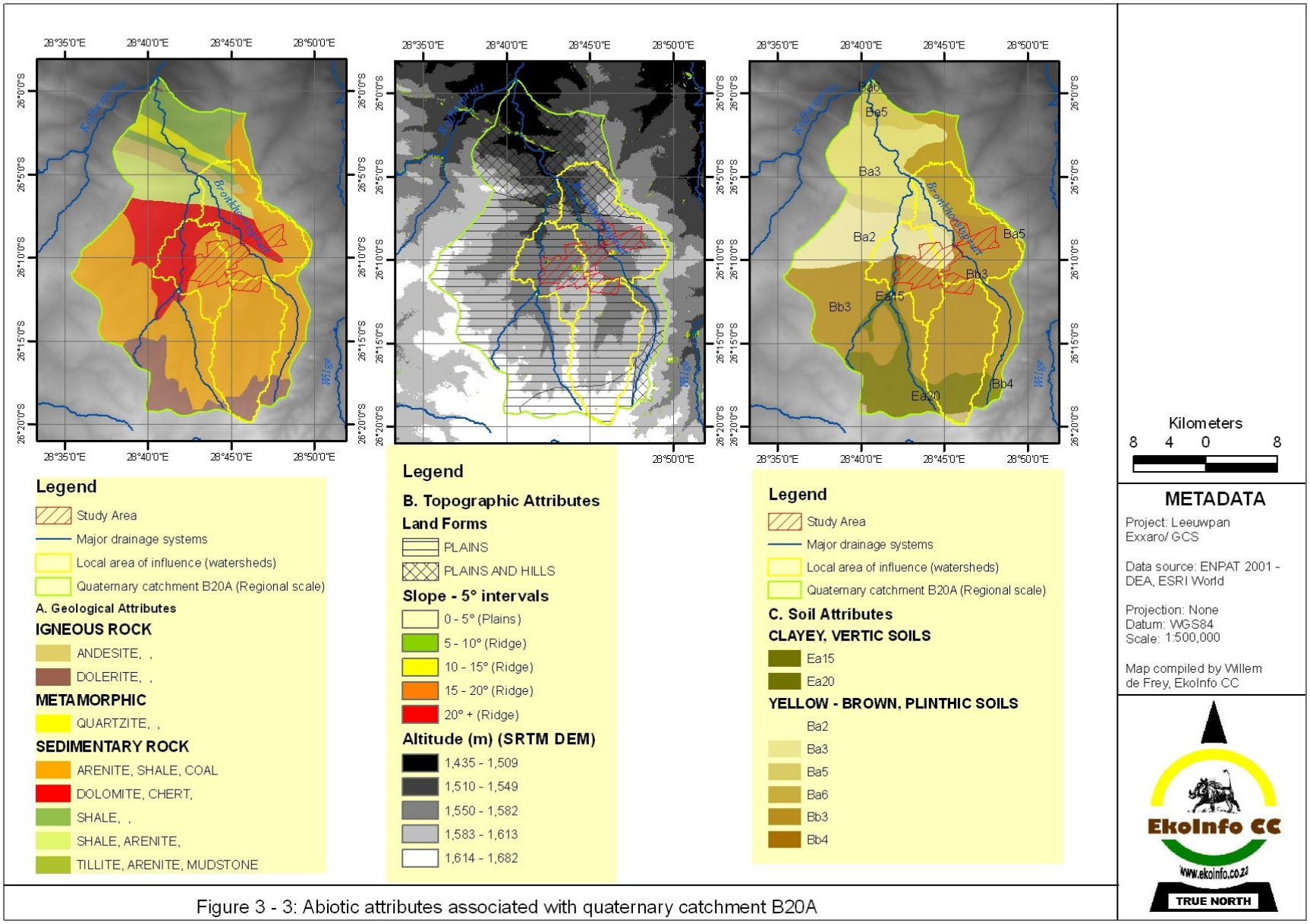

Figure 3 - 3: Abiotic attributes associated with quaternary catchment B20A

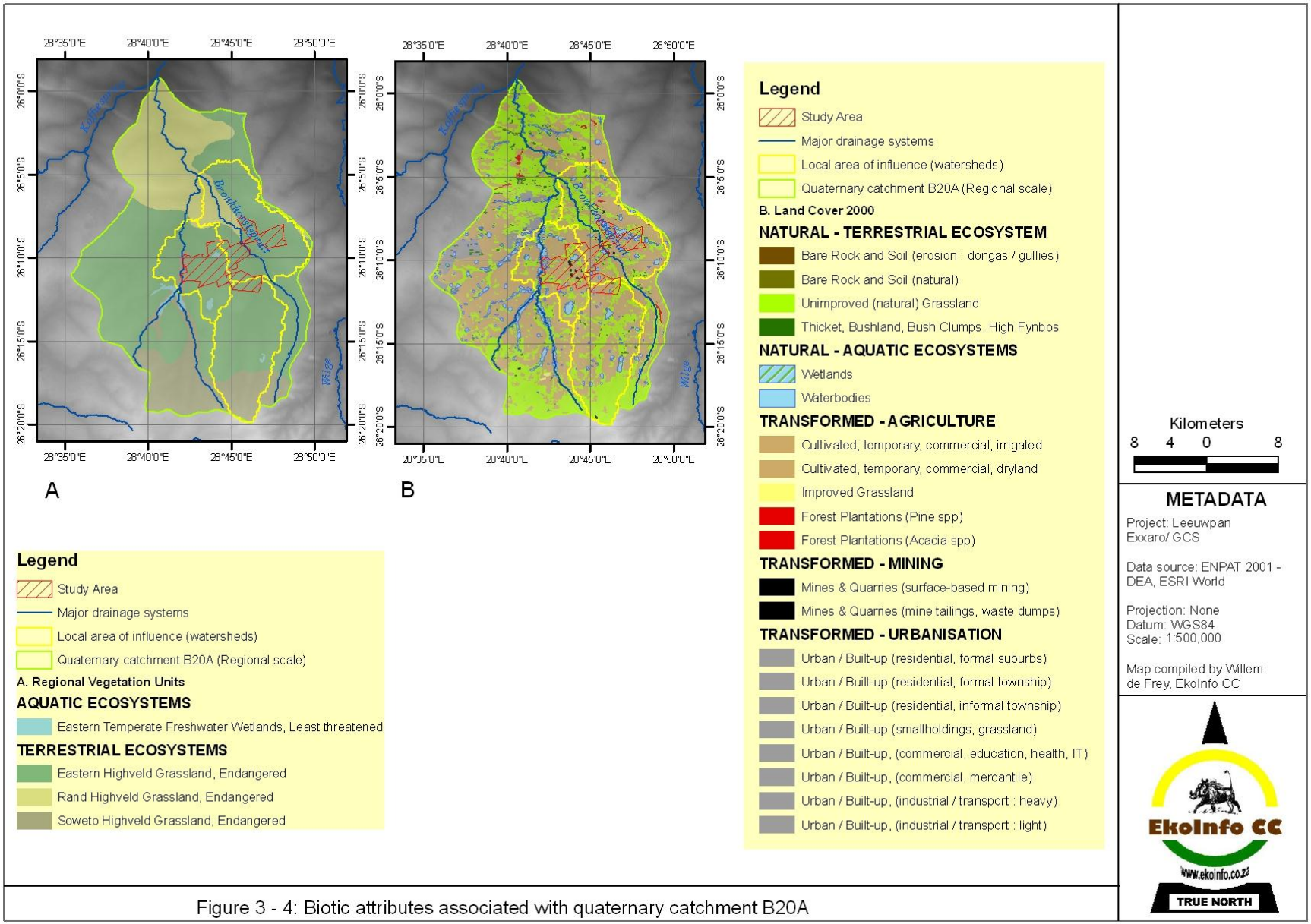

Figure 3 - 4: Biotic attributes associated with quaternary catchment B20A

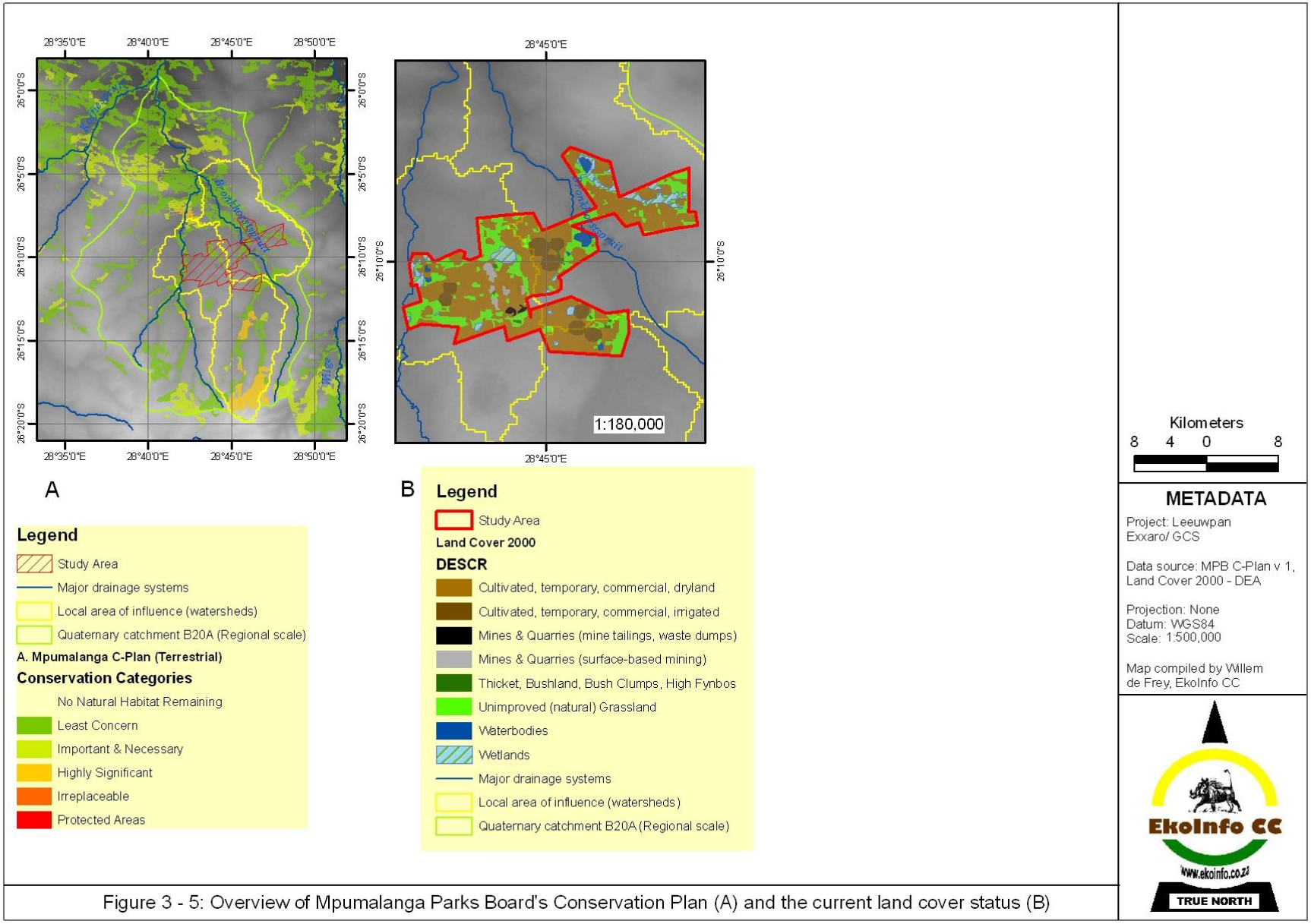

Figure 3 - 5: Overview of Mpumalanga Parks Board's Conservation Plan (A) and the current land cover status (B)

Table 3-2: Overview of the land cover categories present in quaternary catchment B20A, their derived ecological status and percentage cover.

Land Cover 2000 Categories	Surface area (ha)	% Cover	Derived Ecological Status	
			Natural	Transformed
Bare Rock and Soil (erosion : dongas / gullies)	35	0%	35	
Bare Rock and Soil (natural)	35	0%	35	
Cultivated, temporary, commercial, dryland	27123	47%		27123
Cultivated, temporary, commercial, irrigated	1701	3%		1701
Forest Plantations (Acacia spp)	6	0%		6
Forest Plantations (Pine spp)	218	0%		218
Improved Grassland	87	0%		87
Mines & Quarries (mine tailings, waste dumps)	14	0%		14
Mines & Quarries (surface-based mining)	90	0%		90
Thicket, Bushland, Bush Clumps, High Fynbos	884	2%	884	
Unimproved (natural) Grassland	22620	39%	22620	
Urban / Built-up (residential, formal suburbs)	155	0%		155
Urban / Built-up (residential, formal township)	297	1%		297
Urban / Built-up (residential, informal township)	45	0%		45
Urban / Built-up (smallholdings, grassland)	843	1%		843
Urban / Built-up, (commercial, education, health, IT)	35	0%		35
Urban / Built-up, (commercial, mercantile)	73	0%		73
Urban / Built-up, (industrial / transport : heavy)	26	0%		26
Urban / Built-up, (industrial / transport : light)	40	0%		40
Waterbodies	826	1%	826	
Wetlands	2275	4%	2275	
TOTALS	57428	100%	26676	30753
			46%	54%

Table 3-3: Overview of the Mpumalanga Province Conservation Plan categories present and their extent.

Mpumalanga Province Biodiversity Conservation Plan 2006	Surface area (ha)	% Cover
Least Concern	655	19%
No Natural Habitat Remaining	2862	81%
TOTALS	3518	100%

Table 3-4: Overview of the land cover 2000 categories present within the study area, their derived ecological status and percentage cover

Land cover 2000 categories	Surface area (ha)	% Cover	Derived Ecological Status		
			Aquatic	Natural	Transformed
Cultivated, temporary, commercial, dryland	2058	58%			2058
Cultivated, temporary, commercial, irrigated	240	7%			240
Mines & Quarries (mine tailings, waste dumps)	14	0%			14
Mines & Quarries (surface-based mining)	45	1%			45
Thicket, Bushland, Bush Clumps, High Fynbos	22	1%		22	
Unimproved (natural) Grassland	856	24%		856	
Waterbodies	66	2%	66		
Wetlands	217	6%	217		
TOTALS	3518	100%	283	878	2357
			8%	25%	67%

4 VEGETATION ECOLOGICAL ASSESSMENT

4.1 Introduction

EkoInfo CC was appointed to survey the remaining natural vegetation present within Leeuwpan Colliery and its proposed expansion areas.

The objectives of this section are in compliance with the National Environmental Management Biodiversity Act, 2004 to evaluate the ecosystem and species diversity present in the study area:

1. Determine the presence and extent of the remaining natural vegetation in the study area (ecosystem diversity).
2. Determine the presence or absence of species of concern – threatened, protected, medicinal and alien vegetation. (Species diversity).
3. Assess the ecological status and function of the remaining natural vegetation.
4. To assess the impact of the proposed mining activities on the remaining natural vegetation.
5. To provide mitigation measure to prevent or minimize the impact of the proposed mining activities on the remaining natural vegetation.

The contract specific objectives/ deliverables are as follow:

1. Results of desktop study, including descriptions of general vegetation types /veld types according to Low & Rebelo (1996) and Acocks (1988);
2. PRECIS List with all endemic and red data plant species, exotic and /or invader species, medicinal plants, protected species;
3. Vegetation classification, mapping of plant communities identified and the description thereof;
4. Species list for each plant community;
5. Dominant species for each plant community;
6. Invasive species (if present) for each plant community;
7. Exotic species (if present) for each plant community;
8. Rare or endangered species, as well as all protected plants (if present) for each plant community (according to the IUCN List, Mpumalanga Nature Conservation Act, NEMBA and Provincial and National legislation);
9. A species list for the entire area will be compiled for each of the above mentioned;
10. A list of endemic species (if present);
11. Ecological status;
12. Biodiversity, biodiversity rich areas and sensitive areas;

4.2 Method Statement

The ecological assessment of the remaining natural vegetation within the study area consisted of two components, namely a regional level, which concerns the current version of the document, and an EIA/ local component which concerns future versions of this document. The regional level focused on literature – and desktop review, while the EIA level will concern detail surveys during the optimal growing months from October/ November.

4.2.1 Literature And Desktop Review

The literature and desktop review made use of available scientific and popular literature, Internet sites and both large and small-scale Geographic Information System (GIS) data sets. The results of this component are mainly reflected in the Environmental Overview section of this report.

The literature review provided information on the national status of the remaining natural vegetation as well as the identity of species of concern such as threatened, protected, medicinal and alien plants.

The GIS datasets were used to determine the distribution and extent of ecological drivers such as geology, topography and soil. GIS packages applied were Idrisi Andes and SAGA for landscape analysis and modelling and ArcView 9.2 for data presentation.

4.3 Regional Context Results

This section represents the overall results from the literature and desktop review.

4.3.1 Ecosystem Diversity

The literature review indicated the presence of one regional vegetation unit within the study area, namely the **endangered Eastern Highveld Grassland**.

The available small-scale datasets (Land Cover 2000, Mpumalanga Conservation Plan) indicated that **less than** 67% of the study area represents natural vegetation. The species composition and presence of species of concern (Red Data, Protected, Medicinal and Alien invasive) within the remaining untransformed areas will be determined during the summer/ wet season survey in October/ November 2012.

4.3.2 Species Diversity

According to SANBI's records 5 296 plant species had been recorded within Mpumalanga Province, of which between 9 and 68 species had been recorded per the four topocadastral grids associated with the study area (Table 4 –1). Between these four topocadastral grids, a minimum of 147 species had been recorded, which represents 3% of all the species recorded within Mpumalanga Province.

A total of 112 species within Mpumalanga is classified as threatened (Vulnerable, Endangered and Critical Endangered) in terms of the IUCN Red Data criteria. Of the 112 species, 76 species (86%) are considered to be Vulnerable, 25 species (22%) are considered to be Endangered, and 11 species (10%) are considered to be Critical Endangered (Table 4-2). The 112 species represent 38 plant families of which the following the following seven (7) families contain more than 50% of the species (Table 4-3): Apocynaceae; Asphodelaceae; Fabaceae; Gesneriaceae; Iridaceae; Orchidaceae; Zamiaceae. A total of 72 genera represent the 112 threatened flora within Mpumalanga Province, of which the following 16 genera contains 50% of the species (Table 4-4): *Aloe; Asclepias; Asparagus; Brachystelma; Disa; Encephalartos; Erica; Gladiolus; Haworthia; Helichrysum; Pavetta; Protea; Streptocarpus; Thesium; Thorncroftia; Zantedeschia*.

Almost 80% of the threatened flora within Mpumalanga Province is associated with the herbaceous layer and mainly forbs (Table 4-5).

Using available environmental attributes (geology, soil, land forms, vegetation) associated with the threatened Red Data flora occurring in Mpumalanga, it was possible to create a profile.

The environmental attributes for the threatened Red Data flora were obtained from the South African National Biodiversity Institute (SANBI) and consisted of 1 123 records. From this information it was possible to compile a profile of the Mpumalanga threatened Red Data flora, **which indicates that they occur mainly between 1 000 and 2 000 metres above sea level, associated mainly with sandstone, on ridges, hills and mountains, where rocks occur, in well drained areas within the grassland.**

In terms of their habitait preferences there is a **high probability** (71%; Table 4-6)) that some of these species could occur here. The high level of transformation supports this statement because **habitat loss** is a significant contributor for the inclusion of species into the Red Data lists[6], and especially the threatened categories.

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[6] SANBI. 2012. Statistics: Red List of South African Plants version 2012.1. Downloaded from Redlist.sanbi.org on 2012/08/

Table 4-1: Overview of number of species recorded per topocadsastral grid associated with the study area (Source: PRECIS, SANBI)

Topocadastral Grid	No of species
2628BA	68
2628BB	44
2628BC	9
2628BD	40

Table 4-2: Overview of the number of threatened flora species per IUCN category within Mpumalanga Province

Threat status	No of species	% Frequency
Vulnerable	76	68%
Endangered	25	22%
Critical	11	10%
TOTALS	112	100%

Table 4-3: Overview of the families, which represent the 112 threatened flora species within Mpumalanga Province (SANBI 2009)

Family	No of species	% Frequency	Cumulative % Frequency
Apocynaceae	12	11%	11%
Zamiaceae	9	8%	19%
Asphodelaceae	9	8%	27%
Fabaceae	9	8%	35%
Orchidaceae	9	8%	43%
Gesneriaceae	6	5%	48%
Iridaceae	5	4%	53%
Asteraceae	4	4%	56%
Hyacinthaceae	4	4%	60%
Proteaceae	4	4%	63%
Amaryllidaceae	3	3%	66%
Lamiaceae	3	3%	69%
Mesembryanthemaceae	3	3%	71%
Rubiaceae	2	2%	73%
Anacardiaceae	2	2%	75%
Araceae	2	2%	77%
Asparagaceae	2	2%	79%
Ericaceae	2	2%	80%
Acanthaceae	2	2%	82%
Lobeliaceae	2	2%	84%
Canellaceae	1	1%	85%
Alliaceae	1	1%	86%
Woodsiaceae	1	1%	87%
Oxalidaceae	1	1%	88%
Apiaceae	1	1%	88%

Thymelaeaceae	1	1%	89%
Myricaceae	1	1%	90%
Passifloraceae	1	1%	91%
Crassulaceae	1	1%	92%
Santalaceae	1	1%	93%
Portulacaceae	1	1%	94%
Lauraceae	1	1%	95%
Orobanchaceae	1	1%	96%
Rosaceae	1	1%	96%
Ranunculaceae	1	1%	97%
Hypoxidaceae	1	1%	98%
Zingiberaceae	1	1%	99%
Scrophulariaceae	1	1%	100%
TOTALS	112	100%	

Table 4-4: Overview of the genera, which represent the 112 threatened flora species within Mpumalanga Province (SANBI 2009)

Genus	No of species	% Frequency	Cumulative % Frequency
Encephalartos	9	8%	8%
Aloe	7	6%	14%
Streptocarpus	6	5%	20%
Disa	5	4%	24%
Brachystelma	4	4%	28%
Protea	4	4%	31%
Helichrysum	3	3%	34%
Gladiolus	3	3%	37%
Asclepias	2	2%	38%
Asparagus	2	2%	40%
Erica	2	2%	42%
Haworthia	2	2%	44%
Zantedeschia	2	2%	46%
Pavetta	2	2%	47%
Thorncroftia	2	2%	49%
Thesium	1	1%	50%
Graderia	1	1%	51%
Siphonochilus	1	1%	52%
Dyschoriste	1	1%	53%
Drimiopsis	1	1%	54%
Syncolostemon	1	1%	54%
Delosperma	1	1%	55%
Cyrtanthus	1	1%	56%
Cyphia	1	1%	57%
Crotalaria	1	1%	58%
Crocosmia	1	1%	59%
Crassula	1	1%	60%
Clivia	1	1%	61%
Eriosema	1	1%	62%
Caesalpinia	1	1%	63%

Eucomis	1	1%	63%
Brachycorythis	1	1%	64%
Bowiea	1	1%	65%
Aspidonepsis	1	1%	66%
Aspidoglossum	1	1%	67%
Tulbaghia	1	1%	68%
Argyrolobium	1	1%	69%
Anacampseros	1	1%	70%
Warburgia	1	1%	71%
Alepidea	1	1%	71%
Adenium	1	1%	72%
Adenia	1	1%	73%
Ceropegia	1	1%	74%
Khadia	1	1%	75%
Pearsonia	1	1%	76%
Prunus	1	1%	77%
Pachycarpus	1	1%	78%
Ozoroa	1	1%	79%
Oxalis	1	1%	79%
Ocotea	1	1%	80%
Nerine	1	1%	81%
Morella	1	1%	82%
Monopsis	1	1%	83%
Miraglossum	1	1%	84%
Melanospermum	1	1%	85%
Lotononis	1	1%	86%
Searsia	1	1%	87%
Knowltonia	1	1%	87%
Platycoryne	1	1%	88%
Indigofera	1	1%	89%
Hypoxis	1	1%	90%
Hypodematium	1	1%	91%
Holothrix	1	1%	92%
Hesperantha	1	1%	93%
Rhynchosia	1	1%	94%
Schizochilus	1	1%	95%
Acacia	1	1%	96%
Gnidia	1	1%	96%
Sclerochiton	1	1%	97%
Gerbera	1	1%	98%
Frithia	1	1%	99%
Ledebouria	1	1%	100%
TOTALS	112	100%	

Table 4-5: Overview of the major growth forms associated with the 112 threatened flora species within Mpumalanga Province

Note: VU = Vulnerable, EN = Endangered, CR = Critical Endangered

Growth forms	No of species	Conservation Categories			Major Growth Forms			
					Herbs		Woody	Unknown
		VU	EN	CR	Graminoid	Forb		
[No lifeform defined]	2	1	1					2
Climber, geophyte, succulent	2	2				2		
Dwarf shrub	5	3	1	1		5		
Dwarf shrub, geophyte	1			1		1		
Dwarf shrub, herb	3	2	1			3		
Dwarf shrub, herb, succulent	1	1				1		
Dwarf shrub, shrub	2	2				2		
Dwarf shrub, succulent	2		1	1		2		
Epiphyte, herb, lithophyte	1	1				1		
Geophyte	8	8				8		
Geophyte, herb	16	9	4	3		16		
Geophyte, herb, succulent	3	3				3		
Geophyte, succulent	1	1				1		
Herb	19	15	4			19		
Herb, lithophyte	3	3				3		
Herb, parasite	1	1				1		
Herb, shrub	2	1	1			2		
Herb, succulent	11	9	1	1		11		
Scrambler	1		1			1		
Shrub	8	3	5				8	
Shrub, tree	7	2	2	3			7	
Succulent	7	5	1	1		7		
Tree	6	4	2				6	
TOTALS	112					89	21	2
						79%	19%	2%

Table 4-6: Probability for threatened Red Data flora to occur based on their habitat preference

Mpumalanga threatened Red Data flora habitat preferences	Present (1)/ Absent (0)	Motivation
Altitude: 1 000 – 2 000 m	1	Study area a1 550 m - Reference Figure 3 - 3.B
Sandstone	1	Arenite is coarse textured sandstone - Reference Figure 3-3.A
Ridges, hills, mountains	0	Regional scale plains present - Reference Figure 3-3.B
Surface rock	0.5	Surface rock generally present in steep areas (ridges) - Reference Figure 3-3.B
Well drained soils	0.75	Yellow-brown apedal soils (well-drained) dominate the land type - Reference Figure 3 - 3.C
Grassland	1	Located within the Eastern Highveld Grassland - Reference Figure 3-4.A
TOTALS	4.25	
Probability score (6 = 100%)	71%	
Probabilityscale	**Qualitative class**	
0 - 20	Very low	
20 - 40	Low	
40 - 60	Moderate	
60 - 80	High	
80 - 100	Very high	

4.4 Discussion

From the regional perspective, it is evident that the study area is located in a transformed and fragmented landscape. The area is not considered to be of conservation importance on a provincial scale even though it is located within a nationally threatened ecosystem. However, the remaining natural vegetation, especially terrerstrial grassland is important for the mine because it represents source area for future rehabilitation and restoration. The extent and distribution of the remaining terrestrial grassland, especially those located on good agricultural land, will be determined during the detail/ EIA phase. These areas will also be surveyed for the presence of threatened Red Data plants or for their suitability as habitat for threatened plants.

4.5 Plan of Study for EIA

During this component, existing information from previous EMPR's will be updated, with the latests information and maps (Figure 4 – 1). This area was covered during July 2012 as part of a orientation site visit, with the aim to identify remaining natural areas and the nature of alien invasive plants present.

4.5.1 Fieldwork

4.5.1.1 Ecosystem diversity

The Braun-Blanquet approach will be applied, which is basically the standard for phytosociological studies (plant description and mapping) in South Africa. The Braun-Blanquet plot method is the preferred sampling technique of the National Spatial Biodiversity Assessment team (Rouget *et al* 2004)

A minimum of 20 plots will be sampled during the October/ November 2012 based on available soil – and landscape information and physiognomic differences observed on large-scale aerial photographs and satellite imagery. The National Spatial Biodiversity Assessment team indicated that twenty (20) plots are the minimum number of plots, which can be included in the national biodiversity datasets (Rouget *et al* 2004). The random, *pro rata* placement of the sampling plots will be facilitated with the aid of a Geographic Information System (GIS). The co-ordinates of the plots will be exported to Mapsource and uploaded to a GARMIN Montana Global Positioning System (GPS) receiver for navigation in the field. Actual location in the field will be recorded within a 5 m accuracy interval.

At each plot, the following abiotic attributes will be documented:

1. Topography – altitude, terrain unit, percentage slope.
2. Soil – soil form, soil depth (mm), erosion, estimated percentage clay of A horizon.
3. Estimated percentage rock cover – gravel, small, medium, large.

The following overall vegetation characteristics will be documented:

1. Vegetation cover – total, trees, shrubs, herbs, open water, rock.
2. Estimated average height of trees, shrubs and herbs – highest and lowest categories.

A list of all species within an approximate 100m^2 area will be recorded in the following growth form categories: grasses, forbs and woody species. Cover abundance values will be estimated for each species within the plot. Unknown species or potential red data species will be identified using field guides (Van Oudtshoorn 1991, Van Wyk & Malan 1988), the University of Pretoria's herbarium and specialists from the National Botanical Institute.

The survey results will be entered into a relational database for record purposes and analysis of the abiotic and vegetation characteristics. The species data will be entered into TURBOVEG (Hennekens 1996) and analysed with Juice[7]. A vegetation map will be compiled/ refined, based on the results of the phytosociological table and boundaries of the homogenous units.

[7] http://www.sci.muni.cz/botany/juice/

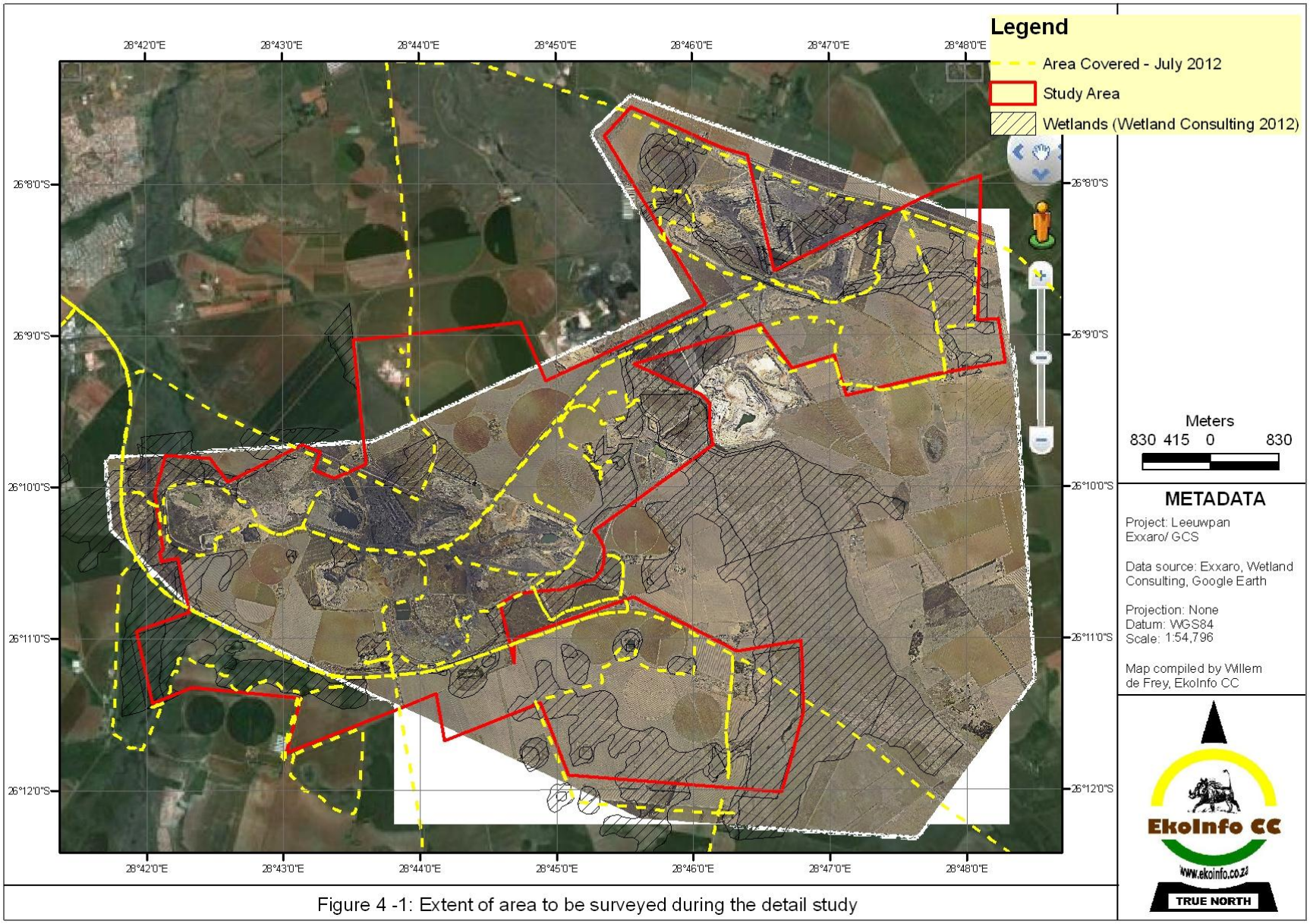


Figure 4 -1: Extent of area to be surveyed during the detail study

4.5.1.2 Species diversity

An identity kit will be compiled for each species listed as Red Data according to the February 2009 Red Data list from the South Africa National Biodiversity Institute (SANBI)[8]. The compilation of an identity kit involves a literature study to:

1. Determine habitat preferences.
2. Obtain a picture/ photo of the actual species or similar species.

Large-scale aerial photograph and available GIS data will be used to determine whether potential habitat occur in the study area. GIS datasets applied were:

1. Small scale – geology, pedology, terrain and vegetation.
2. Large scale – digital terrain models, soil survey.

During the site visit, the presence or absence of the actual Red Data species or potential habitat will be assessed.

4.5.2 Limitations And Assumptions

1. The Braun-Blanquet approach was developed to collect 95% of the species present within a plot, therefore the more plots surveyed the more comprehensive the species lists will be and the more detailed the vegetation description and mapping will be.
2. The following confidence levels are attributed to the species recorded: Families – 95%, Genera – 85% and Species – 75%.
3. Available regional land cover information was limited to the latest national dataset from 2000, it is expected that land cover changes occurred since 2000, mainly associated with urbanisation, mining and agriculture.
4. For many of the threatened plant species in South Africa no images are available to assist with field identification. Surveys done outside the optimal flowering period (November – March) further limit the probability of identifying these species.
5. The current scope of work does not require quantitative data with regards to population dynamics (density – species per ha, age structure), however this information is relevant with regards to rehabilitation and restoration planning.

[8] http://www.plantzafrica.com/frames/vegfram.htm

5 AVIFAUNA AND INVERTEBRATE ECOLOGICAL ASSESSMENT

5.1 Introduction

Pachnoda Consulting was contracted to provide an (1) avifaunal and (2) invertebrate survey of the proposed study site.

The main objectives of the study are to:

- describe the relevant baseline conditions relating to the avifaunal and invertebrate communities in study area;
- provide an inventory of communities/species/taxa confirmed in the area of investigation;
- describe the anticipated environmental impacts on the avifaunal and invertebrate communities during the life-cycle of the mining operation;
- describe how the negative environmental impacts as described above will be managed; and
- consider the cumulative impacts of the proposed development.

Specific tasks to be undertaken during the EIA assessment will include:

- Identify bird and specific invertebrate compositions on the study area and their association with particular habitats and/or plant communities;
- Provide an evaluation of their importance in a local, regional or national context, especially “rare” and/or threatened species;
- Identify areas or any species in the study area that are threatened or near-threatened (Red Data)t;
- Examine the ecological relationships/associations between recorded species and taxa, and the different habitat types in which they are found; and
- Identify any specific areas in the study area that may require special protective measures to avoid future degradation or environmental damage.

5.2 Method Statement & Plan of Study for the EIA

A two-phased approach will be implemented during the study. The first phase entails a literature review accompanied by an orientation site visit during the austral dry season (18-19 July 2012). The literature review and site orientation will set a benchmark for detailed studies that will form part of a summer baseline survey (during the EIA phase).

5.2.1 Avifauna

5.2.1.1 Literature and desktop survey

A desktop and literature review of the area under investigation was commissioned to collate as much information as possible prior to the summer baseline survey. The following literature were consulted:

- Hockey *et al.* (2005), Harrison *et al*. (1997) and del Hoyo *et al*. (1992-2011) were consulted for general information on the life history attributes of the relevant bird species;
- Barnes (1998) was consulted for information regarding the biogeographic affinities of selected bird species;
- The conservation status of bird species was categorised according to the IUCN Red List of threatened species (IUCN, 2012) and Barnes (2000);
- Distributional data was sourced from the South African Bird Atlas Project (SABAP1) and verified against Harrison *et al*. (1997) for species recorded from the quarter-degree grid cell (QDGC) 2628BA (Delmas) and 2628BB (Kendal). The SABAP1 data provides a “snapshot” of the abundance and composition of species recorded within a quarter degree grid cell (QDGC) which

was the sampling unit chosen. It should be noted that the atlas data makes use of reporting rates that were calculated from observer cards submitted by the public as well as citizen scientists. It therefore provides an indication of the thoroughness of which the QDGCs were surveyed between 1987 and 1991;

- Additional distributional data was also sourced from the SABAP2 database (http://www.sabap2.adu.org.za). Since bird distributions are dynamic (based on landscape changes such as fragmentation and climate change), SABAP2 was born (and launched in 2007) from SABAP1 with the main difference being that all sampling is done at a finer scale known as pentad grids (5 min lat x 5 min long, equating to 9 pentads within a QDGC). Therefore, the data is more site-specific, recent and more comparable with observations made during the site visit (due to increased standardisation of data collection); and
- The choice of scientific nomenclature, taxonomy and common names were recommended by the International Ornithological Committee (the IOC World Bird Names), unless otherwise specified (see www.worldbirdnames.org; Gill & Donsker, 2012). The nomenclatural sequence of Sibley & Ahlquist (1990) was adopted with slight modifications to the inferred phylogenies of the passerines due to the lack of robust taxonomic structure (Hockey *et al.,* 2005).

5.2.1.2 Point count surveys

A list of bird species detected on the study site will not suffice on its own when addressing environmental impacts. To describe the baseline conditions and dynamics relative to the avifaunal communities on the study site, it is necessary to obtain information on their distribution and abundance.

Therefore, bird data will be collected by means of *point counts* (Buckland *et al*., 1993). The data from the point counts will then be analysed to determine indicator species and to delineate the different communities present. The use of point counts is advantageous since it is the preferred method to use for cryptic or elusive species. In addition, it is the preferred method to line transect counts where access is problematic, or when the terrain appears to be complex. It is a good method to use, and very efficient for gathering a large amount of data in a short period of time (Sutherland, 2006).

At each point count the number of bird species seen will be recorded, as well as their respective abundances. Each point count will last approximately 10 minutes and will cover approximately 2 ha (Sutherland *et al*, 2004). To ensure the independence of observations, points will be at least 200 m apart. The data generated from the point counts will then be analysed according to Clarke & Warwick (1994) based on the computed percentage contribution (%) of each species including the consistency (calculated as the similarity coefficient/standard deviation) of its contribution. Hierarchical Agglomerative Clustering (a cluster analysis based group-average linkages; Clarke & Warwick 1994) will be performed on calculated Bray-Curtis coefficients derived from the data. A cluster analysis is used to assign associations between samples with the aim to objectively delineate groups or assemblages. Therefore, sampling entities that group together (being more similar) are believed to have similar compositions.

The species diversity of each community will be analysed by means of rarefaction, while richness measures (such as the total number of species recorded (S) and various diversity indices) will aim to compare the communities with each other. The advantage of rarefaction is that it adjusts the number of species expected from each sample if all were reduced to a standard size. The equitability of each species in each community will be presented by means of rank-abundance curves.

5.2.1.3 Construction of guild profiles

Bird guilds are a better alternative to species lists or inventories. The bird community on the study site represents a “guild profile”, consisting of an array of different feeding and nesting guilds, each represented by one or more species (Feinsinger, 2001). For example, a forest patch may have several species that are insectivorous, although they utilise different ways (e.g. gleaning, probing, hawking) at different strata (vertical levels) to obtain their prey. Hence, a forest patch with a high diversity of guilds is therefore often highly functional. Since richness values and species composition alone are not as good ecological indicators, the “guild profile” may be more sensitive to the effects of human-induced activities. The “guild profile” of each bird community will be analysed and interpreted (e.g. dominant guilds vs. “missing” guilds).

5.2.1.4 Additional methods to be applied

The following methods will be applied to augment the baseline avifaunal survey:

- Bird species will be identified, and where necessary, verified using Roberts Birds of Southern Africa, VIIth ed. (Hockey *et al*., 2005). The presence of bird species will also be verified by means of their calls and other signs such as nests, discarded egg shells (Tarboton, 2001) and feathers. Particular attention will be paid to suitable roosting, foraging and nesting habitat for threatened species, in particular the "vulnerable" African Grass Owl (*Tyto capensis*);
- The potential occurrence of elusive species will be verified by the playback of their respective calls;
- All areas consisting of suitable African Grass Owl (*Tyto capensis*) habitat will surveyed on foot by means of dragging a 60 m rope. Although seemingly unethical, rope-dragging is considered to be the most reliable and rapid method to establish the presence of Grass Owls when time is limited or when large areas of habitat are to be screened; and
- All observations will be processed for submission to the South African Bird Atlas Project (SABAP2).

5.2.2 Invertebrates

Surveys dealing with invertebrate groups impose significant problems especially when dealing with a huge global taxonomic impediment. Perhaps a better alternative in addressing developmental issues is to limit the number of taxa to a few species or target groups – often referred to as indicator groups. For example, data from field surveys aims at inquiring for signals or "thresholds" that will inform environmental changes at hand – e.g. changes to the abundance and distribution of target species or groups. Therefore, to address any question about the health or integrity of an ecosystem, a surrogate (or "shortcut") is needed, which in itself plays an integral part of the system. In addition, any responses reflected in the target group should also be reflected on other species forming part of the system.

For an indicator or target group/species to be successful, it should meet the following criteria (Feinsinger, 2001):

- It must be easy to sample objectively;
- It should be a group/species that can be sampled efficiently;
- The target group must provide large numbers per unit effort;
- Sampling should be cost-effective;
- The target group/species should be well-known (familiar);
- The scale at which the target group operates should correspond to the scale of the question raised (e.g. study site);
- The target group should be sensitive to factors of conservation concern;
- The target should respond consistently to environmental change over time and space, in either a similar or opposite direction;
- The target should be active at all seasons when sampling might occur; and
- The target should preferably be of interest to a wide spectrum of communities (e.g. the rural community).

For this assessment, it is believed that beetle diversities and butterfly richness could represent feasible target groups. Beetles (especially Scarab and Caraboid beetles) are often used as indicator groups reflecting rapid changes in above-ground landscapes (Hanski & Cambefort, 1991) and are particularly vulnerable to habitat change (Halffter *et al*., 1992). The order Coleoptera (beetles) it is the largest order of living organisms in the world. They vary greatly in size, form and more importantly, function. Therefore, systems with a high diversity of beetle families, are also likely to consist of a high guild membership and ecological integrity. Beetles are easy and relatively cheap to sample objectively by means of standard sampling methods.

Butterflies, like birds and mammals are charismatic and obvious in nature. They qualify as a valid target group, but seldom do so as a biodiversity indicator since their responses to habitat variables and human activities are complex (Feinsinger, 2001). The latter is partly explained by the difference in lifestyles and

resource requirements between larvae and adults. In addition, some species could be vagrant, which is sometimes difficult to distinguish from visiting species. However, butterflies willbe included in the study since they are one of the few insect groups that are globally assessed in terms of the IUCN criteria. They are widespread, relatively diverse and easy to identify in the field (being day-flying and conspicuous). Butterflies are also one of a few groups of invertebrates that are taxonomically well known and many species exhibit precise ecological requirements and are thus known to respond to particular changes in the environment (New, 1997). In conclusion, they are undoubtedly useful to include in habitat assessments conducted on a local spatial scale.

Main literature/resources will include:

- *Butterflies*: Henning *et al.* (2009) for the IUCN status of butterflies and Woodhall (2005) for information regarding the distribution patterns of butterfly species;
- *Scorpions*: All taxa collected will be identified by Mr Ian Engelbrecht (Gauteng Department of Agriculture and Rural Development) and Mr. Lorenzo Prendini (American Natural History Museum); and
- *Dung beetles*: Scholtz *et al*. (2009) will be consulted for general information and conservation of dung beetles while Davis *et al*. (2008) and Krell (1998) will provide identification keys.

5.2.2.1 Qualitative taxon-specific surveys

Diurnal butterflies (Families: Papilionidae & Hesperiidae)

Butterflies will be collected by means of active pursuit methods along random transect walks using a standard sweepnet. In addition, the occurrence of the vulnerable *Metisella meninx* (Marsh Sylph) butterfly will be verified in areas consisting of suitable habitat.

Scorpions

The presence of scorpion taxa will be verified by means of hand searching and rock lifting.

5.2.2.2 Invertebrates: Quantitative surveys

The objective of quantitative surveys is to evaluate the arthropod and Coleopteran diversity by comparing major habitat types (primary, secondary and rocky grassland) with each other.

Sweepnetting

Sweepnetting will be used to collect invertebrates from above-ground foliage pertaining to grassland seres. During sweepnetting the grassy layer will be brushed back and forth to dislodge invertebrates up to a height of 1 m above the ground. Each sweep sample consists of a linear transect of 100 sweeps each.

Pitfall trapping

Ideally, a total of 54 pitfall traps (depending on the habitat diversity) will be positioned within the major habitat types, consisting of three replicates of 6 buckets (2L) each. The buckets will be dug into the soil with the opening level with the soil surface. The traps will be left *in situ* for four weeks before removal.

Order-level and beetle family-level diversities will be calculated using the Shannon-Weaver index (H') (in Zilihona & Nummelin, 2001) and rarefaction, while Bray-Curtis similarity coefficients will be used to compare arthropod and beetle abundance distributions between the different habitat types. A cluster analysis based on Bray-Curtis similarity coefficients (Clarke & Warwick, 1994) will estimate the similarity of the taxa involved between the different habitat types.

5.2.3 Limitations And Assumptions

In order to obtain a comprehensive understanding of the dynamics of terrestrial communities, as well as the status of endemic, rare or threatened species in any area, faunal assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, due to time constraints such long-term studies are not feasible and more often based on instantaneous sampling bouts.

The invertebrate survey is planned to take place during the austral wet season after the area has received significant rains (e.g. preferably three weeks after the area has received at least 30 mm of precipitation).

5.3 Regional Results

5.3.1 Background: Ecosystem Diversity

The study site corresponds to the Grassland Biome and more particularly to the Mesic Grassland Bioregion as defined by Mucina & Rutherford (2006). The study site includes two ecological types known as (a) Soweto Highveld Grassland and (b) Eastern Highveld Grassland.

(a) Soweto Highveld Grassland: This grassland type is a short, dense grassland occurring on gently to moderately undulating landscapes.

Soweto Highveld Grassland is restricted to the provinces of Mpumalanga and Gauteng, and distributed in a broad band between Ermelo and Johannesburg in the north, and the Vaal River in the south. It also extends further westwards to Soweto and Randfontein.

Soweto Highveld Grassland is a threatened ("Endangered") vegetation type with only a few remaining patches of untransformed grassland being statutorily conserved. Large tracts are already transformed by cultivation, mining and urban development.

(b) Eastern Highveld Grassland: This grassland type is restricted to undulating plains and includes a number of low hills and pan depressions. The pan depressions are an important consideration since they provide critical important foraging habitat for two near-threatened flamingo species as well as a number of waterbird species.

The vegetation is short and dominated by graminoid species of the genera *Themeda, Aristida, Agrostis* and *Eragrostis*. Nearly 44 % of this grassland type is already transformed by cultivation, coal mining and the creation of artificial impoundments. Although the latter has contributed to the regional waterfowl diversity, severe transformation by opencast mining activities has led to the demise of the local biodiversity that historically occupied the area.

Despite the fact that the Highveld grasslands are poor in woody plant species and subsequently also in bird richness values, it is an important habitat for many terrestrial and cryptic bird species such as larks, pipits, korhaans and cisticolas. Nevertheless, the Mpumalanga grasslands are home to many endemic and threatened species, and are consistently under pressure from habitat destruction and fragmentation.

The study site is also represented by a number of habitat types, and each is believed to hold a different avifaunal and invertebrate community (Figure 5-1):

- *Grassland on waterlogged soils*: This habitat is essentially a wetland community that is concentrated on highly organic and waterlogged soils of the hillslope seep zones and unchannelled valley bottoms. The biodiversity and conservation value of these systems are a high priority since their linear configuration is expected to facilitate bird and invertebrate (e.g. pollinators) dispersal beyond the borders of the study site. Secondly, some parts are even considered as high conservation priorities that provide habitat for the African Grass-owl (*Tyto capensis*) and Marsh Sylph (*Metisella meninx*);
- *Endorheic pans*: These are ephemeral systems that tend to attract large numbers of bird species during unfavourable environmental conditions when nearby pans and dams are either non-

functional (dry) or lacking concentrated food resources. Furthermore, they are also the main breeding grounds for ducks and geese, and could be an important foraging habitat for flocks of Greater (*Phoenicopterus ruber*) and Lesser Flamingos (*P. minor*). Unfortunately many of the pans on the study site were converted to perennial irrigation dams. These are often less diverse in bird species;

- *Artificial impoundments* (dams): These are water bodies located within the linear alignments of seeps or streams, and function as storage water or reservoirs. Nevertheless, these areas have contributed to the colonisation and range expansion of many waterbird species that favours deep and open water habitat. Depending on their surface area, they often provide foraging habitat for wader and waterfowl species belonging to the Anatidae (ducks & geese), Podicipedidae (grebes), Ardeidae (herons), Phalacrocoracidae (cormorants), Threskiornithidae (ibises & spoonbills), Anhingidae (Darters) and lastly Palearctic migrant waders (especially Scolopacidae);
- *Primary and secondary grasslands*: Although highly fragmented, the open structure of these areas provide potential foraging habitat for many large-bodied terrestrial bird species pertaining to the families Oditidae (korhaans and bustards), Ardeidae (herons) and Sagittariidae (Secretarybird);
- *Rocky grassland*: This habitat is earmarked by grassland on rocky, shallow soils. It is predicted to be an important refuge for invertebrate species and likely to sustain high arthropod diversities due to the high spatial heterogeneities and niche sites.

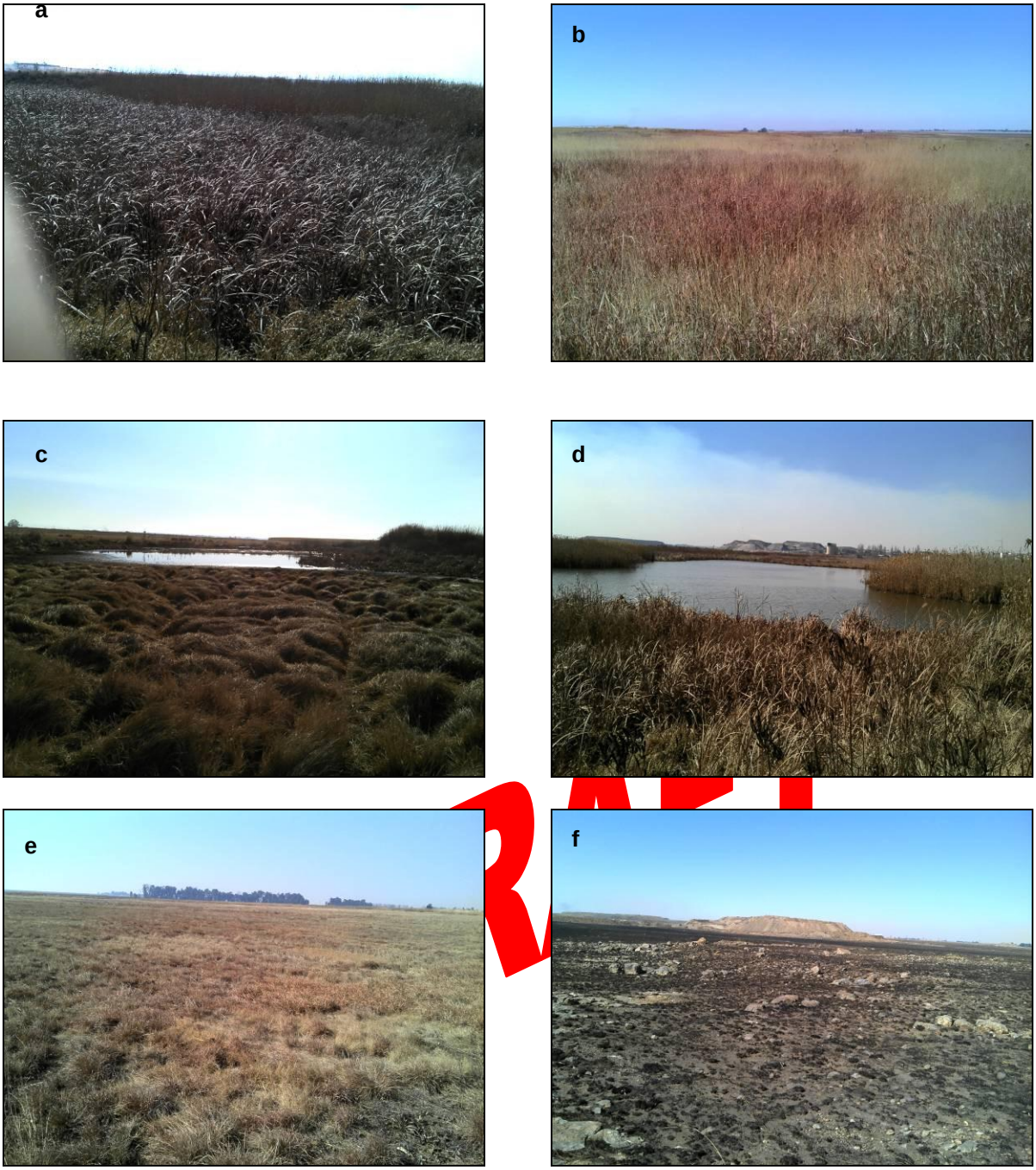


Figure 5-1: A collage of images illustrating some of the habitat variation on the study site: (a - b) Grassland on waterlogged soils dominated by (a) *Typha capensis* and (b) *Imperata cylindrica*; (c) a pan converted to an irrigation dam; (d) part of an artificial impoundment; (e) grazed grassland dominated by *Themeda triandra* and (f) burned rocky grassland.

5.3.2 Avifauna

5.3.2.1 Preliminary richness statistics

According to the pervious South African Bird Atlas Project (Harrison *et al*., 1997), an average of 196 bird species have been recorded in the region based on two quarter degree grid cells that are sympatric to the study site (2628BA = 191 spp. and 2628BB = 201 spp.). This equates to 21 % of the approximate 951

species listed for the southern African sub-region[9]. However, the SABAP2 database suggests that the study area is more likely to sustain an average 121 species[10] (www.sabap2.adu.org.za). On a national scale, the bird richness on the study site is predicted be moderate-high.

According to a recent site visit, the study site is represented by two distinct avifaunal assemblages consisting of (1) a community confined to the wetland features and (2) a community restricted to the grassland units. The former is dominated by the Red-knobbed Coot (*Fulica cristata*), Egyptian Goose (*Alopochen aegyptiaca*), Yellow-billed Egret (*Egretta intermedia*) and Blacksmith Lapwing (*Vanellus armatus*), and the latter by the African Pipit (*Anthus cinnamomeus*), Cape Longclaw (*Macronyx capensis*), Levaillant's Cisticola (*C. tinniens*) and Ploceid weavers (weavers and bishops).

5.3.2.2 Species of conservation concern

Table 5-1 provides an overview of threatened and near-threatened bird species recorded in the study area[11], as well as those previously recorded in area based on their known distribution range and the presence of suitable habitat. According to Table 5-1, a total of 18 species could occur on the study site.

Table 5-1: Threatened and near-threatened bird species that could utilise the study site based on their known distribution range and the presence of suitable habitat. Red list categories according to IUCN (2011)* and Barnes (2000)**.

Species	Global Conservation Status*	Red Data Status**	Recorded during SABAP1	Recorded during SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
Anthropoides paradiseus (Blue Crane)	Vulnerable	Vulnerable	Yes	No	Prefers open grasslands. Also forages in wetlands, pastures and agricultural land.	An irregular visitor on the study site. It is a regular (winter) visitor on the grasslands and cultivated fields south of the study site (Kinross – Devon area).
Circus macrourus (Pallid Harrier)	-	Near-threatened	No	No	Open grassland, valley bottom seeps and pastures.	An erratic (and unpredictable) summer visitor.
Circus maurus (Black Harrier)	Near-threatened	Near-threatened	Yes	No	Generally confined to the clay grasslands on the south-western part of Mpumalanga.	An uncommon winter visitor on the study site. It is a regular (winter) visitor on the grasslands and cultivated fields south-east of the study site (Kinross – Bethal area).
Circus ranivorus (African Marsh Harrier)	-	Vulnerable	Yes	Yes	Restricted to permanent wetlands with extensive reedbeds.	A regular foraging visitor to the extensive Bronkhorstspruit wetlands and associated floodplains.
Eupodotis	-	Vulnerable	Yes	No	Prefers transitional	Unlikely to occur.

[9] A geographical area south of the Cunene and Zambezi Rivers (includes Namibia, Botswana, Zimbabwe, southern Mozambique, South Africa, Swaziland and Lesotho).
[10] According to five pentad grid localities (range = 98 - 137 species).
[11] The study region has reference to an area that is larger than the study site itself. It incorporates external habitat types that are bordering the study site. Many bird species, especially large terrestrial species exhibit large home ranges and will move over large distances in search of food or mating partners. Therefore, the area of occupancy of some species is determined by changing environmental conditions.

Species	Global Conservation Status*	Red Data Status**	Recorded during SABAP1	Recorded during SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
senegalensis (White-bellied Korhaan)					habitat between grassland and savanna (e.g. Bankenveld).	
Eupodotis caerulescens (Blue Korhaan)	Near-threatened	Near-threatened	Yes	No	Prefers extensive open short grassland and cultivated land.	An uncommon foraging visitor on the study site.
Falco biarmicus (Lanner Falcon)	-	Near-threatened	No	No	Varied, but prefers to breed in mountainous areas	Possible occasional foraging visitor.
Falco naumanni (Lesser Kestrel)	Recently delisted	Vulnerable	Yes	No	Open grassland patches.	A fairly common summer visitor on the study site.
Falco vespertinus (Red-footed Falcon)	Near-threatened	-	Yes	No	Open arid savanna and grassland. Often joins flocks of Amur Falcons.	An irregular summer foraging visitor.
Glareola nordmanni (Black-winged Pratincole)	Near-threatened	Near-threatened	Yes	Yes	A species preferring extensive open grassland, usually near wetlands. Often forages over agricultural land and pastures.	A regular summer visitor in small numbers.
Geronticus calvus (Southern Bald Ibis)*	Vulnerable	Vulnerable	No	No	A species restricted to montane grassland (especially when burned) and breed/nest on steep cliffs.	A regular winter foraging visitor (small numbers only).
Mirafra cheniana (Melodious Lark)	Near-threatened	Near-threatened	No	Yes	A species with a preference for open dry "climax" *Themeda triandra* grassland or open primary grassland dominated by sour wiry grasses such as *Loudetia simplex, Tristachya rehmannii* and *Trachypogon spicatus* on well drained sandy substrates. Also secondary *Eragrostis*-dominated grassland.	Resident (breeding on southern part of the study site).
Mycteria ibis (Yellow-billed Stork)	-	Near-threatened	Yes	Yes	Prefers shoreline habitat bordering large impoundments and extensive wetland systems.	An uncommon foraging visitor on the study site (known to visit some of the large dams in the region).
Oxyura maccoa (Maccoa Duck)	Near-threatened	-	Yes	Yes	Large saline pans and shallow impoundments.	An uncommon resident; could be present on some of the larger pans and dams adjacent to the

Species	Global Conservation Status*	Red Data Status**	Recorded during SABAP1	Recorded during SABAP2	Preferred Habitat	Potential Likelihood of Occurrence
						study site.
Phoenicopterus minor (Lesser Flamingo)	Near-threatened	Near-threatened	Yes	Yes	Restricted to large alkaline pans and other inland water bodies.	An irregular visitor on the endorheic pans and large dams in the region.
Phoenicopterus ruber (Greater Flamingo)	-	Near-threatened	Yes	Yes	Restricted to large saline pans and other inland water bodies.	A regular visitor to the endorheic pans and dams in the region.
Sagittarius serpentarius (Secretarybird)	Vulnerable	Near-threatened	Yes	No	Prefers open grassland or lightly wooded habitat.	A regular foraging visitor.
Tyto capensis (African Grass-owl)	-	Vulnerable	No	Yes	Prefers rank moist grassland that borders drainage lines or wetlands.	A resident in areas with *Imperata cylindrica*. Occurs at low densities.

5.3.2.3 Orientation site visit

A total of 83 bird species were recorded during an orientation site visit (see Appendix C), which include the vulnerable Southern Bald Ibis (*Geronticus calvus*), African Marsh Harrier (*Circus ranivorus*) and Secretarybird (*Sagittarius serpentarius*). It is worth mentioning that 41 % of the observed species is represented by obligate and facultative aquatic species, thereby emphasising the contribution of the wetland features towards local bird diversity.

5.3.3 Invertebrates

The unchannelled valley bottom wetlands and hillslope seeps provide suitable habitat for the vulnerable Marsh Sylph (*Metisella meninx*) butterfly. *M. meninx* is an obligate wetland species and depends on the occurrence of *Leersia hexandra* (Rice Grass), its host plant, to sustain a viable population. The latter was found growing extensively, almost forming uniform stands, in many of the wetlands features. *M meninx* occupies wetlands in open grassland at altitudes of 1 400 to 1 700 m, often corresponding to the upper catchment regions of rivers and streams. The adults are on the wing from November to March (Henning *et al*., 2009).

5.3.4 Potential Ecological Importance of the area and Potential Impacts

1. A part of the study site coincides with the floodplain of the Bronkhorstspruit and an unnamed tributary (western part of the study site). These areas experience inundation on a seasonal basis, forming extensive shallow palustrine conditions which are often used as focal congregational habitat for waterfowl and wader species. Bird counts from a previous study has highlighted the avifaunal importance of these floodplains in providing habitat for up to ten species of Anatidae (ducks), two species of Laridae (gulls and terns), six scolopacid species (Palearctic waders) and large numbers of Black-winged Stilts (*Himantopus himantopus*). However, the study also mentioned the importance of these areas for Black-winged Stilt (*Himantopus himantopus*), Red-billed Teal (*Anas erythrorhyncha*), Comb Duck (*Sarkidiornis melanotos*; an uncommon species on the highveld) and Ruff (*Philomachus pugnax*). The latter was observed in large numbers with flocks numbering well over a 1 000 individuals.

2. The pans on the study site, including those adjacent to the study site, are all spatially interlinked with each other, and offer ephemeral foraging habitat for a variety of migratory and sedentary waterbird species. These are the only habitat to be utilised by the Yellow-billed Egret (*Egretta intermedia*).

3. The moist grassland seres along the hillslope seeps and some of the pans sustain remnant patches of *Imperata cylindrica*. These provide optimal roosting and breeding habitat for the threatened African Grass-owl (*Tyto capensis*). This species has been confirmed breeding on the southern part of the study site (2009, pers. obs.).

4. The grassland patches on the eastern section of the study site, in particular those with primary compositions, have the intrinsic potential to provide habitat for threatened and conservation important bird species, especially when burned (Southern Bald Ibis *Geronticus calvus* and Secretarybird *Sagittarius serpentarius*).

5. The rocky grasslands on the eastern part of the study site show high spatial heterogeneities contributing to a myriad of microhabitat types and niche space. These areas could support a high species richness of epigaeic invertebrate taxa and provide refugia for important invertebrate guilds (e.g. pollinators).

Potential Impacts

Based on the proposed mining operations, major impacts associated with the construction, operational and decommissioning phases will include:

- Long-term loss and displacement of waterbirds and grassland birds caused by mining activities;
- Indirect, long-term impacts associated with the acidification of soils and surface water (acid mine drainage), thereby affecting avifaunal reproduction and mortality, as well as accidental spillage of dirty/wastewater into nearby endorheic/wetland systems; and
- Possible skewed bird/invertebrate compositions due to the creation of artificial habitat (e.g. pollution control dams, voids).

However, the mining operations may also contribute to the following impacts that are potentially harmful (both directly and indirectly) to the local bird and invertebrate community:

- Increased settling of airborne pollutants (coal dust) and a decrease in resource utilisation (palatability) by primary invertebrate consumers (herbivores);
- Possible disruption of ecosystem service on primary grassland patches (e.g. potential loss of key pollinators);
- Increased fragmentation and loss of ecological connectivity (especially along drainage lines and rocky grassland); and
- Changes in bird and invertebrate community structure during rehabilitation events.

Please note that the proposed impacts have not been evaluated according to the EIA guidelines, and depending on the outcome of a baseline survey, it is possible that some of these impacts may be insignificant or irrelevant. They are mentioned here since they are commonly the result of opencast coal mining activities on the Highveld.

6 HERPETOFAUNA ECOLOGICAL ASSESSMENT

6.1 Introduction

Luke Verburgt (Enviro-Insight CC) was contracted to survey the reptiles and amphibians (hereafter collectively referred to as herpetofauna) within the Exxaro Leeuwpan mining area, near Delmas in the Mpumalanga province of South Africa.

The mining site is located East of Delmas at an elevation of approximately 1580 m a.s.l. and is predominantly characterized by the endangered Eastern Highveld Grassland vegetation type (Figure 6-1) (Mucina & Rutherford 2006).

The herpetofauna survey is divided into a winter- and summer survey. Because all herpetofauna are ectothermic and therefore require warm climatic conditions for general functioning, no herpetofauna are expected to be active during the winter months in this region of South Africa due to the cold temperatures. The winter survey therefore served as a reconnaissance visit with the following objectives:

- Evaluate existing habitat suitability for herpetofauna;
- Identify suitable sampling sites for the summer survey;
- Identify current potential threats to herpetofauna abundance and diversity;
- Predict the occurrence of herpetofauna species within the study area using desktop methods.

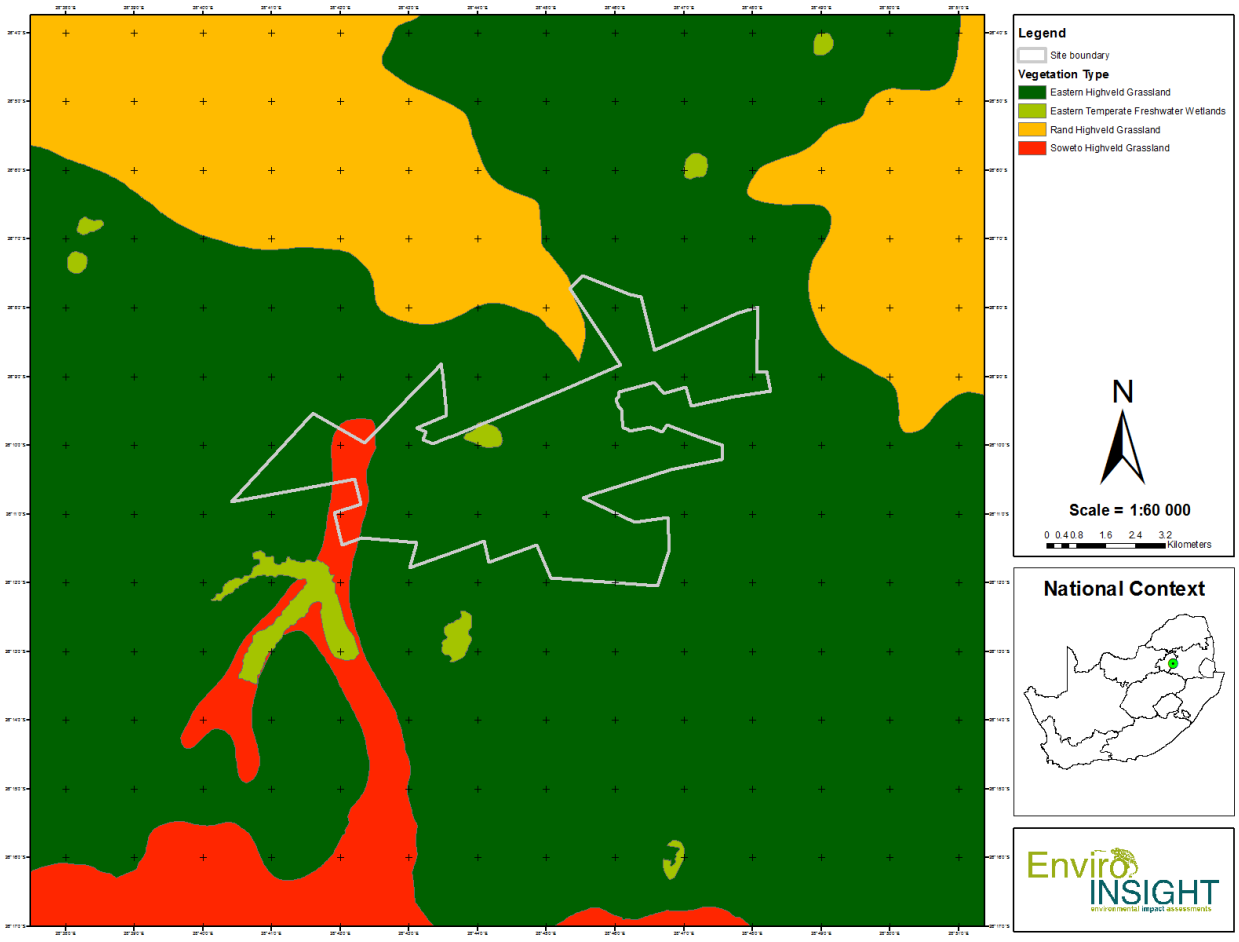


Figure 6-1: Vegetation types of the Leeuwpan mine site.

6.2 Method Statement

6.2.1 Site visit

A site visit was performed on 18 and 19 July 2012. An attempt was made to visit all habitats represented on the mine site as well as those surrounding the mine site. This was achieved by driving a vehicle and periodically stopping to take georeferenced photographs and make habitat specific notes.

6.2.2 Desktop Study

All available books providing information on distribution ranges and/or conservation status of South African herpetofauna were utilized to make predictions of occurrence in the area (see reference list). The South African red data book – Reptiles and amphibians (Branch 1988) is outdated and therefore the conservation status of the reptiles must be interpreted cautiously. The Southern African Reptile Conservation Assessment (SARCA 2012) is currently taking action to generate a new Red data book but is still in preparation. Nevertheless, the SARCA website (http://vmus.adu.org.za/) makes all information available to the public and this was utilized as the most current distribution authority for snakes and lizards. Reptile species nomenclature follows SARCA (2012). A complete guide to frogs of southern Africa (Du Preez & Carruthers 2009) was used as the primary identification guide and species nomenclature follows this reference. Online information was obtained from the Southern African Frog Atlas Project (SAFAP; http://vmus.adu.org.za/). The IUCN website (www.iucnredlist.org) was utilized to provide the most current account of the global conservation status of reptiles and amphibians while the National Environmental Management: Biodiversity Act (NEMBA 2004) was consulted for national conservation status. All reptile and amphibian species accounts recorded will be submitted to SARCA and SAFAP respectively.

6.2.3 Limitations And Assumptions

SARCA and SAFAP provide distribution data at the quarter degree square (QDS) resolution. Expected species lists may therefore represent an overestimation of the diversity expected as very specific habitat types may be required by a species which may be present in a QDS but not necessarily on the study site within the QDS. Conversely, many large areas in South Africa are poorly sampled for herpetofauna and expected species lists may therefore underestimate the species diversity. For this reason, the expected species list was drawn not only from the QDS's on which the study site resides (2628BA & 2628BB) but also from all of the 10 surrounding QDS's (2628BC, 2628BD, 2628AD, 2628AB, 2528DC, 2528DD, 2528CD, 2529CC, 2629AA, 2629AC). This increase the likelihood of obtaining a species list that suffers less from poor sampling in the area. However, it also artificially inflates the expected number of species because many different habitats in the surrounding QDS's may not be present on the study site. To counteract this, all possible attempts will be made to refine the expected species list based on species-specific habitat requirements and a deeper understanding of the habitat types and quality of the study site which will be obtained during the summer survey. Species that are unlikely to occur on the study site but that do occur in the surrounding QDS's will be removed from the expected species list and species with a high probability of occurrence on the study site will be added despite not being present in the study site QDS or the 10 surrounding QDS's.

6.3 Results

6.3.1 Site visit

The study site and the positions of the georeferenced photographs along with the GPS tracks are shown in Figure 6-2. A very large proportion of the site was effectively covered during this scoping survey. Thumbnail images of the georeferenced photographs taken are shown in Table 6-1. In general the study site and surrounding region showed a high level of habitat transformation due to the impacts of mining activities, crop agriculture, livestock grazing and uncontrolled fires. Any significant herpetofauna populations are expected to be confined to the drainage lines or the few rocky outcrops in the area.

As expected no reptiles were observed during the site visits. Only a single amphibian (*Amietia angolensis*) was heard calling intermittently at an artificial dam.

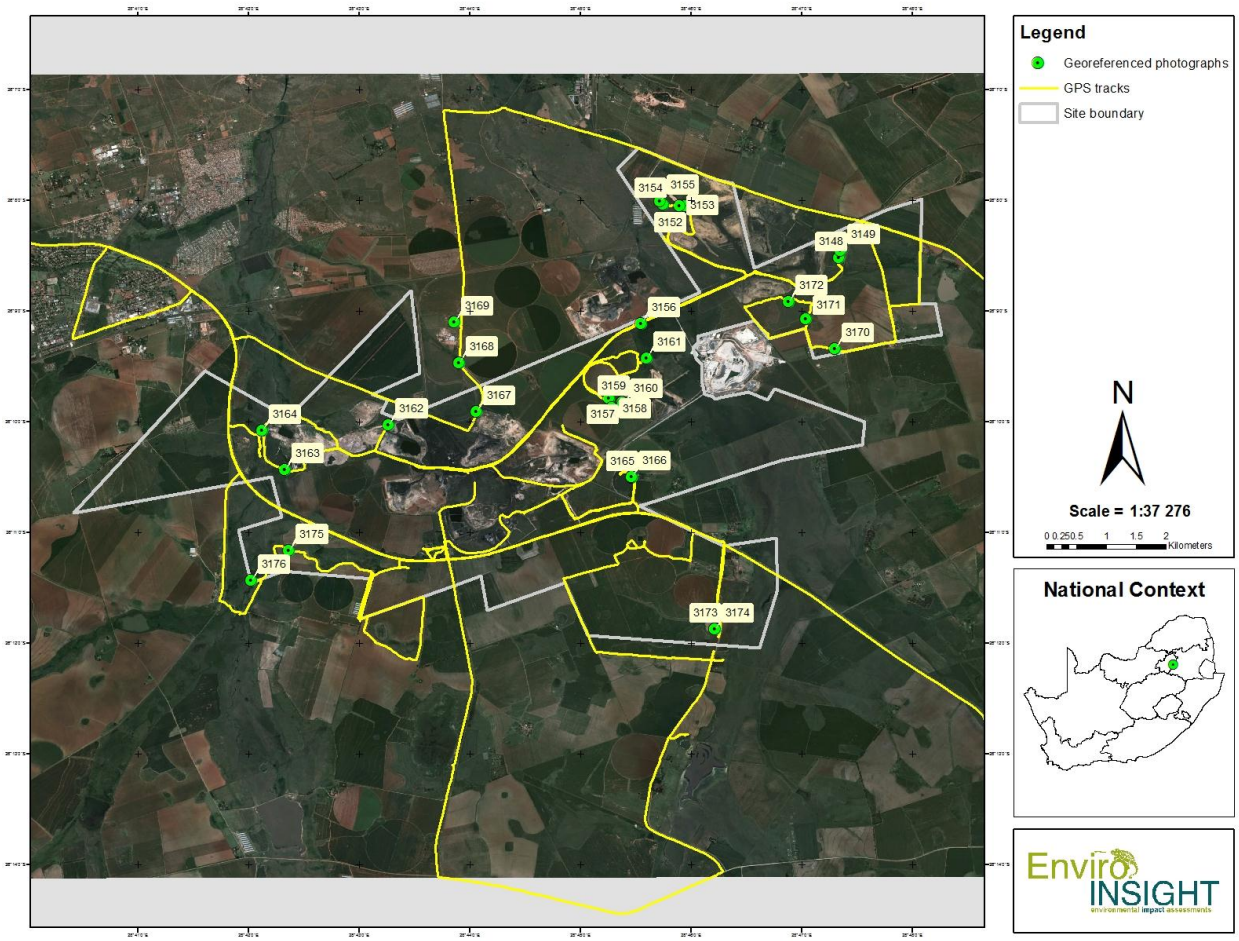
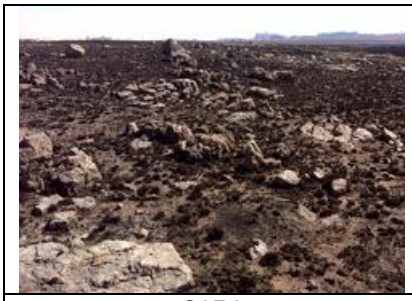


Figure 6-2: Coverage of the Leeuwpan mine site during the scoping winter survey. The GPS tracks (yellow) and the positions of the georeferenced photographs are shown. The numbers of the georeferenced photographs correspond to the photographs in Table 1.

Table 6-1: Georeferenced photographs taken during the scoping winter survey. The photograph numbers correspond to that shown in Figure 6-2.

		
3148	3149	3150
		
3151	3152	3153

		
3154	3155	3156
		
3157	3158	3159
		
3160	3161	3162
		
3163	3164	3165
		
3166	3167	3168

		
3169	3170	3171
		
3172	3173	3174
		
3175	3176	

6.3.2 Desktop Study

The reptile and amphibian species expected to occur on the mine site are shown in Table 6-2 and Table 6-3 respectively. Due to the severely transformed nature of the habitat on the mine site, these tables are an over-representation of what is actually likely to be found on the site. Only a single species of conservation concern is expected to occur on the study site namely the Giant Bullfrog (*Pyxicephalus adspersus*). NEMBA (2004) declares the giant bullfrog as "protected" and Du Preez & Carruthers (2009) list this species as "vulnerable". Therefore, any potential negative impact on the property that is likely to directly influence the above-mentioned species should be mitigated or prevented.

Table 6-2: Reptile species expected to occur on the Leeuwpan mining site.

Family	Scientific name	Common name	Atlas region endemic
Agamidae	*Agama aculeata distanti*	Distant's Ground Agama	x
Agamidae	*Agama atra*	Southern Rock Agama	
Amphisbaenidae	*Monopeltis infuscata*	Dusky Worm Lizard	
Atractaspididae	*Aparallactus capensis*	Black-headed Centipede-eater	
Atractaspididae	*Atractaspis bibronii*	Bibron's Stiletto Snake	
Atractaspididae	*Homoroselaps lacteus*	Spotted Harlequin Snake	x
Colubridae	*Boaedon capensis*	Brown House Snake	
Colubridae	*Crotaphopeltis hotamboeia*	Red-lipped Snake	
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater	
Colubridae	*Duberria lutrix*	South African Slug-eater	x
Colubridae	*Lamprophis aurora*	Aurora House Snake	x
Colubridae	*Lycodonomorphus inornatus*	Olive House Snake	x
Colubridae	*Lycodonomorphus rufulus*	Brown Water Snake	
Colubridae	*Lycophidion capense*	Cape Wolf Snake	
Colubridae	*Philothamnus hoplogaster*	South Eastern Green Snake	
Colubridae	*Philothamnus semivariegatus*	Spotted Bush Snake	
Colubridae	*Prosymna sundevallii*	Sundevall's Shovel-snout	

Colubridae	*Psammophis brevirostris*	Short-snouted Grass Snake	
Colubridae	*Psammophis crucifer*	Cross-marked Grass Snake	
Colubridae	*Psammophylax rhombeatus*	Spotted Grass Snake	
Colubridae	*Psammophylax tritaeniatus*	Striped Grass Snake	
Colubridae	*Pseudaspis cana*	Mole Snake	
Cordylidae	*Chamaesaura aenea*	Coppery Grass Lizard	x
Cordylidae	*Chamaesaura anguina*	Cape Grass Lizard	x
Cordylidae	*Chamaesaura macrolepis*	Large-scaled Grass Lizard	
Cordylidae	*Cordylus jonesii*	Jones' Girdled Lizard	
Cordylidae	*Cordylus vittifer*	Common Girdled Lizard	
Elapidae	*Elapsoidea sundevallii media*	Highveld Garter Snake	
Elapidae	*Hemachatus haemachatus*	Rinkhals	
Gekkonidae	*Hemidactylus mabouia*	Common Tropical House Gecko	
Gekkonidae	*Lygodactylus capensis*	Common Dwarf Gecko	
Gekkonidae	*Lygodactylus nigropunctatus*	Black-spotted Dwarf Gecko	x
Gekkonidae	*Pachydactylus affinis*	Transvaal Gecko	x
Gekkonidae	*Pachydactylus capensis*	Cape Gecko	
Gerrhosauridae	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	
Lacertidae	*Ichnotropis capensis*	Ornate Rough-scaled Lizard	
Lacertidae	*Nucras holubi*	Holub's Sandveld Lizard	
Lacertidae	*Nucras intertexta*	Spotted Sandveld Lizard	
Lacertidae	*Nucras lalandii*	Delalande's Sandveld Lizard	x
Lacertidae	*Pedioplanis burchelli*	Burchell's Sand Lizard	x
Lacertidae	*Pedioplanis lineoocellata*	Spotted Sand Lizard	
Leptotyphlopidae	*Leptotyphlops distanti*	Distant's Thread Snake	
Leptotyphlopidae	*Leptotyphlops incognitus*	Incognito Thread Snake	
Leptotyphlopidae	*Leptotyphlops scutifrons conjunctus*	Eastern Cape Thread Snake	
Leptotyphlopidae	*Leptotyphlops scutifrons*	Peters' Thread Snake	
Pelomedusidae	*Pelomedusa subrufa*	Marsh Terrapin	
Scincidae	*Acontias gracilicauda*	Thin-tailed Legless Skink	x
Scincidae	*Afroablepharus walbergii*	Wahlberg's Snake-eyed Skink	
Scincidae	*Mochlus sundevallii*	Sundevall's Writhing Skink	
Scincidae	*Trachylepis capensis*	Cape Skink	
Scincidae	*Trachylepis punctatissima*	Speckled Rock Skink	
Scincidae	*Trachylepis varia*	Variable Skink	
Typhlopidae	*Afrotyphlops bibronii*	Bibron's Blind Snake	
Typhlopidae	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	
Varanidae	*Varanus niloticus*	Water Monitor	
Viperidae	*Bitis arietans*	Puff Adder	
Viperidae	*Causus rhombeatus*	Rhombic Night Adder	

Table 6-3: Amphibian species expected to occur on the Leeuwpan mine site. Species marked in bold are of conservation concern.

Family	Scientific name	Common name
Bufonidae	*Amietophrynus garmani*	Eastern Olive Toad
Bufonidae	*Amietophrynus gutturalis*	Guttural Toad
Bufonidae	*Amietophrynus rangeri*	Racous Toad
Bufonidae	*Poyntonophrynus fenoulheti*	Northern Pygmy Toad
Bufonidae	*Schismaderma carens*	Red Toad
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina
Hyperoliidae	*Semnodactylus wealii*	Rattling Frog
Microhylidae	*Phrynomantis bifasciatus*	Banded Rubber Frog
Phrynobatrachidae	*Phrynobatrachus natalensis*	Common Puddle Frog
Pipidae	*Xenopus laevis*	African Clawed Frog
Ptychadenidae	*Ptychadena anchietae*	Plain Grass Frog
Ptychadenidae	*Ptychadena porosissima*	Striped Grass Frog
Pyxicephalidae	*Amietia angolensis*	Common River Frog
Pyxicephalidae	*Amietia fuscigula*	Cape River Frog
Pyxicephalidae	*Cacosternum boettgeri*	Common Caco
Pyxicephalidae	***Pyxicephalus adspersus***	**Giant Bullfrog**
Pyxicephalidae	*Strongylopus fasciatus*	Striped Stream Frog
Pyxicephalidae	*Strongylopus grayii*	Clicking Stream Frog
Pyxicephalidae	*Tomopterna cryptotis*	Tremolo Sand Frog
Pyxicephalidae	*Tomopterna natalensis*	Natal Sand Frog

6.3.3 Current threats to herpetofauna

Several current threats to the herpetofauna community in the region of the mine site were identified during the scoping study namely:

- Collisions with- or being run over by vehicles;
- Mining activities (clearing and fragmentation of habitat, pollution);
- Intensive cattle farming (trampling of vegetation, spreading of invasive plants);
- Crop agriculture;
- Encroachment of alien vegetation (Wattle, Pine, Bluegums).
- Uncontrolled burning.

6.4 Discussion

A relatively good initial understanding of the available habitat types, the general ecological processes and the main threats to herpetofauna was obtained during the winter scoping survey. During the summer survey a detailed study will be performed where an attempt will be made to understand herpetofauna species composition for each of the habitat types. This will allow for the generation of a sound environmental management plan to conserve the existing herpetofauna communities. The specific methods that will be adhered to for the summer survey are discussed below.

6.4.1 Survey timing

The Highveld region of South Africa exhibits strong seasonal variation in climate which greatly affects herpetofauna activity. It is therefore important to time the summer survey to coincide with the peak activity of herpetofauna. This peak in activity is usually observed for several days after heavy rains have fallen if the temperature rises appreciably and remains warm. The best chance of encountering such conditions is between October and December.

6.4.2 Survey duration

Herpetofauna are secretive and difficult to observe, especially snakes. Their movement habits are also notoriously unpredictable making it difficult to trap them effectively. The only way to counteract this is by increasing the trapping duration which increases the probability of trap success. It is therefore recommended that each funnel trap array (details section 6.4.3) be deployed for a minimum of 5 nights. Up to four trap arrays can be deployed and managed simultaneously.

6.4.3 Funnel Traps

Funnel trap drift fence arrays will placed within the selected areas where herpetofauna diversity is expected to be greatest within a particular habitat and where possible (depending on the soil conditions and slope). These sites will be finally selected through ground-truthing inspection at the initiation of the summer survey. Pitfall traps are very effective in trapping small reptiles, particularly lizards, small snakes and amphibians (Corn & Bury 1990; Branch 1998; Crosswhite *et. al*. 1999). The efficacy of pitfall trap arrays is increased by the addition of funnel traps along the drift fences (e.g. Masterson et. al. 2009). The funnel-trap drift fence arrays (Figure 6-3, designed by L. Verburgt) allow for the placement of traps where it is not possible to sink a 25 litre bucket (e.g. rocky or boggy ground) and provide greater trapping success (L. Verburgt, pers obs). Traps will be inspected daily in the morning and all captured specimens will be photographed and released away from the traps.

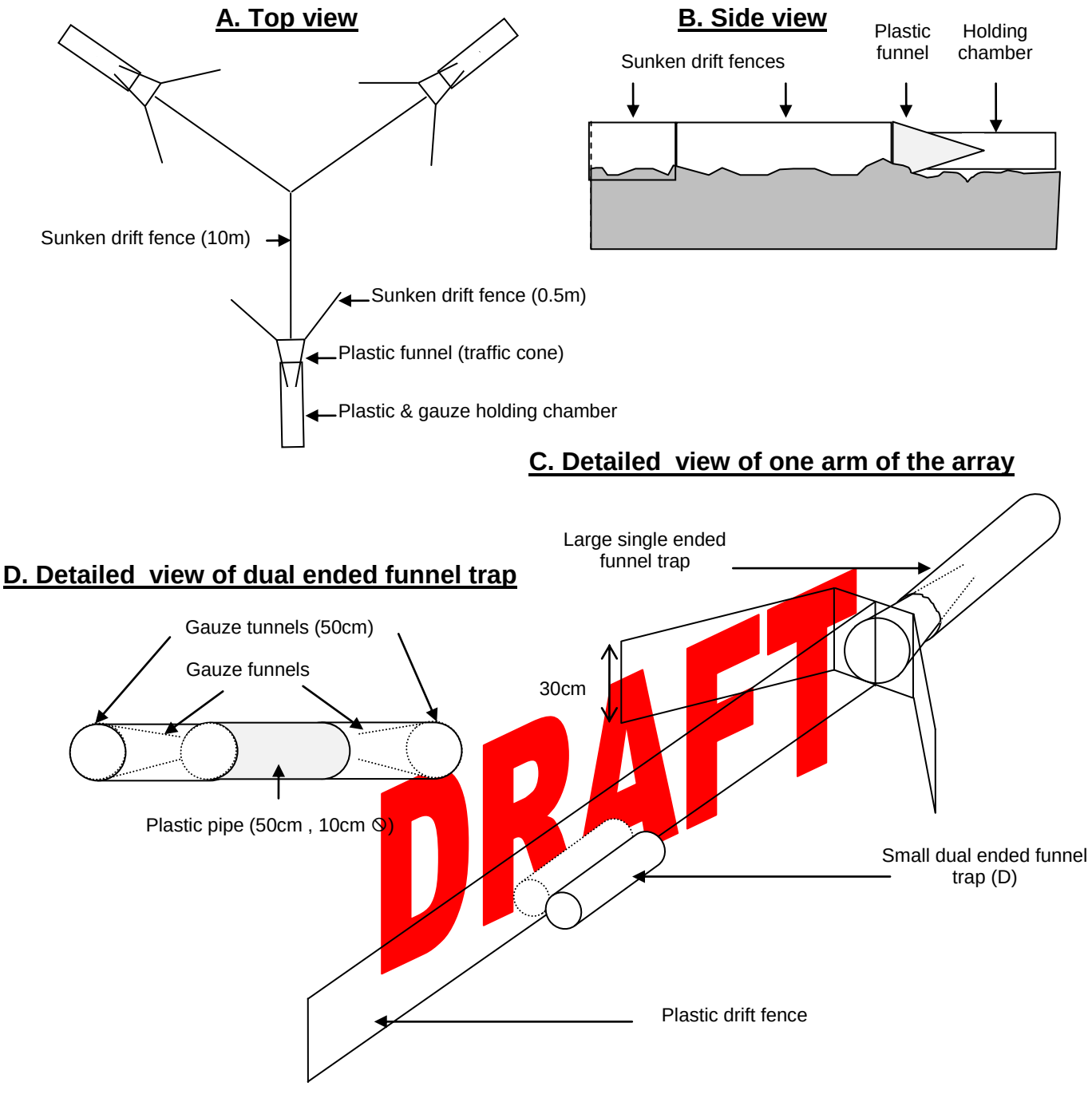


Figure 6-3: Funnel trap drift fence array used for the capture of reptiles during the survey. Funnel traps are constructed from metal gauze.

6.4.4 Active searching during point sampling

Reptiles will be searched for on foot within the study area during the day. Active searching for reptiles will involve:

- Photographing active reptiles from a distance with a telephoto lens;
- Lifting up and searching under debris or rocks (rocks will be returned to their original position);
- Excavation of suitable burrows that appear to be in use;

- Scanning for any signs of reptiles such as shed skins, the positive identification of which will be taken as an observation of that species;
- Catching any observed reptile by hand. All captured reptiles will be photographed and released unharmed.

Nocturnal snakes will be searched for by driving very slowly on the roads at night. Amphibians (frogs and toads) are nocturnal and will be searched for by torchlight at night along dam/pond edges and in wetland areas. Each amphibian species encountered at a particular site will be photographed. Positive identification of acoustic signals (males call to attract females) will also be used as a means of identifying amphibians. Acoustic signals will be recorded with high-precision recording equipment where possible and identification confirmed with existing recordings (Du Preez & Carruthers 2009). Remote sound recording equipment will be deployed at suitable sites for amphibians and will be set to record for 4 hours during each night. Recordings will be analyzed *post hoc* to identify any species calling that was not directly observed during active searching.

7 MAMMALS ECOLOGICAL ASSESSMENT

7.1 Introduction

South Africa has 506 recorded mammal species, which is considered to be an extremely high diversity both regionally and globally. For the purposes of the assessment, certain assumptions have to be made in order to provide focus for the study at hand. All marine based mammals (seals and fur seals) as well as aerial mammals (bats) were excluded from the study. In order to provide further focus to the study, the use of provincial and regional predictive analysis was further employed. Enviro-Insight was contracted to carry out a duel-season survey on the Leeuwpan coal mine extension, Delmas district, Mpumalanga South Africa. A site visit was carried out on the 19th and 20th of July, 2012. This represented the dry-season WINTER portion of the study. A follow up summer wet-season survey will be undertaken once conditions are more optimal for the full spectrum of survey methods. The terms of reference for the OVERALL mammalian study are listed below.

1. Determine the presence of the mammalian faunal species in need of national protection.
2. Determine the presence of alien faunal species posing a threat to indigenous mammalian faunal assemblages.
3. Assess the ecological status and function of the remaining mammalian faunal habitat.
4. To assess the impact of the proposed mining activities on the resident mammalian faunal population.
5. To provide mitigation measure to prevent or minimize the impact of the proposed mining activities on the resident mammalian faunal population.

The contract specific objectives/ deliverables are as follows:

1. Results of desktop study, including descriptions of faunal species potentially occurring on the study site based on known distributions and habitat requirements;
2. List of all Red-data species potentially occurring on the site;
3. Classification and mapping of potential faunal habitat ;
4. Species list of all faunal species recorded on site;
5. Dominant mammal species for each plant community;
6. Invasive species affecting the resident mammal faunal population;
7. Exotic species (if present) for each plant community;
8. A mammal species list for the entire area will be compiled for each of the above mentioned;
9. A list of endemic species (if present);
10. Ecological status of mammalian faunal habitats.
11. Identification of potentially sensitive areas in specific reference to faunal species;
12. Provision of all camera trap images, photographs and spoor identification for the resident mammalian faunal species on site;
13. The results of the mammal survey will be included as an appendix in the EIA.

7.2 Method Statement

7.2.1 Desktop Study

- Skinner and Chimimba (2007) was consulted for general information on the distribution and habitat requirements of mammal species;
- Liebenberg L. 2005 as well as Stuart and Stuart (1998) provided on site reference material to spoor and animal sign identifications;
- The conservation status of mammal species was acquired from the Endangered Wildlife Trust,2004, Red Data Book of the Mammals of South Africa and cross-referenced with Skinner and Chimimba (2007) and the IUCN.

The red-data categories have been defined by the IUCN as:

Critically Endangered (CR)
Critically Endangered refers to species facing immediate threat to extinction in the wild.

Endangered (EN)
Endangered species are those facing a very high risk of extinction in the wild within the foreseeable future.

Vulnerable (VU)
Vulnerable species are those facing a high risk of extinction in the wild in the medium-term.

Near Threatened (NT)
Those species which do not qualify for higher categories but which are at risk of becoming Vulnerable or Endangered in the future.

Data Deficient (DD)
Those species requiring more study in order to assign relevant conservation criteria.

***Lower Risk (LR)* - with two sub-categories**

LR-Least Concern (LC)
Those species whose population viability is not considered to be under immediate threat.

LR-Conservation Dependent (CD)
Those species not in immediate danger of extinction but do however rely on conservation measures in order to ensure population viability.

7.2.2 Likelihood of Occurrence

Even with a duel season sampling, there is a high likelihood that not all mammal species found within the study site will have been located during the survey. Therefore, a Likelihood of Occurrence and Special Consideration of importance must be applied to any potential omissions in the data set. For Likelihood of occurrence, a full summary of red-data mammals as well as other species of conservation concern is tabulated, with a simple likelihood applied. The likelihood was based on known distribution data, species-specific habitat requirements and local information. Categories used were Nil (no chance of occurrence), Low (low chance of species occurring on site), Medium (moderate chance of species occurring on site), High (very likely that species would occur on site) and Confirmed (species recorded on site). The relevant Species of Special, Consideration can then be addressed separately at the completion of the study, in context to the creation of the mining concession area and the effects on the species (both ecologically and spatially).

7.2.3 Field Study

The following methods are considered to be the standard operating procedure of Enviro-Insight CC for Mammal Surveys in Sub-Saharan Africa. Not all available methods were included in the winter dry-season mammal study (see limitations) but the summer wet-season method will be final and fully comprehensive. The study area as well as the camera trap locations is shown in Figure 7-1. A description of the methods is provided below.

Spoor tracking: Spoor tracking is considered to be the world's oldest science, enabling detailed sampling of mammalian species without the need for trapping or direct observation. All spoors, including footprints, den sites, burrows, hairs, scrapings and diggings was recorded and documented by detailed photography.

Camera trapping: The use of camera trapping has long been considered as a valuable ecological census tool in southern Africa. This method has been primarily used as a PASSIVE technique, which is confounded by the above influences, thereby creating a negative sample bias. This method can be strongly improved by increasing attention to camera site selection as well as the use of bait, i.e. ACTIVE sampling. The locations of the camera trap points are shown in Figure 7 - 2.

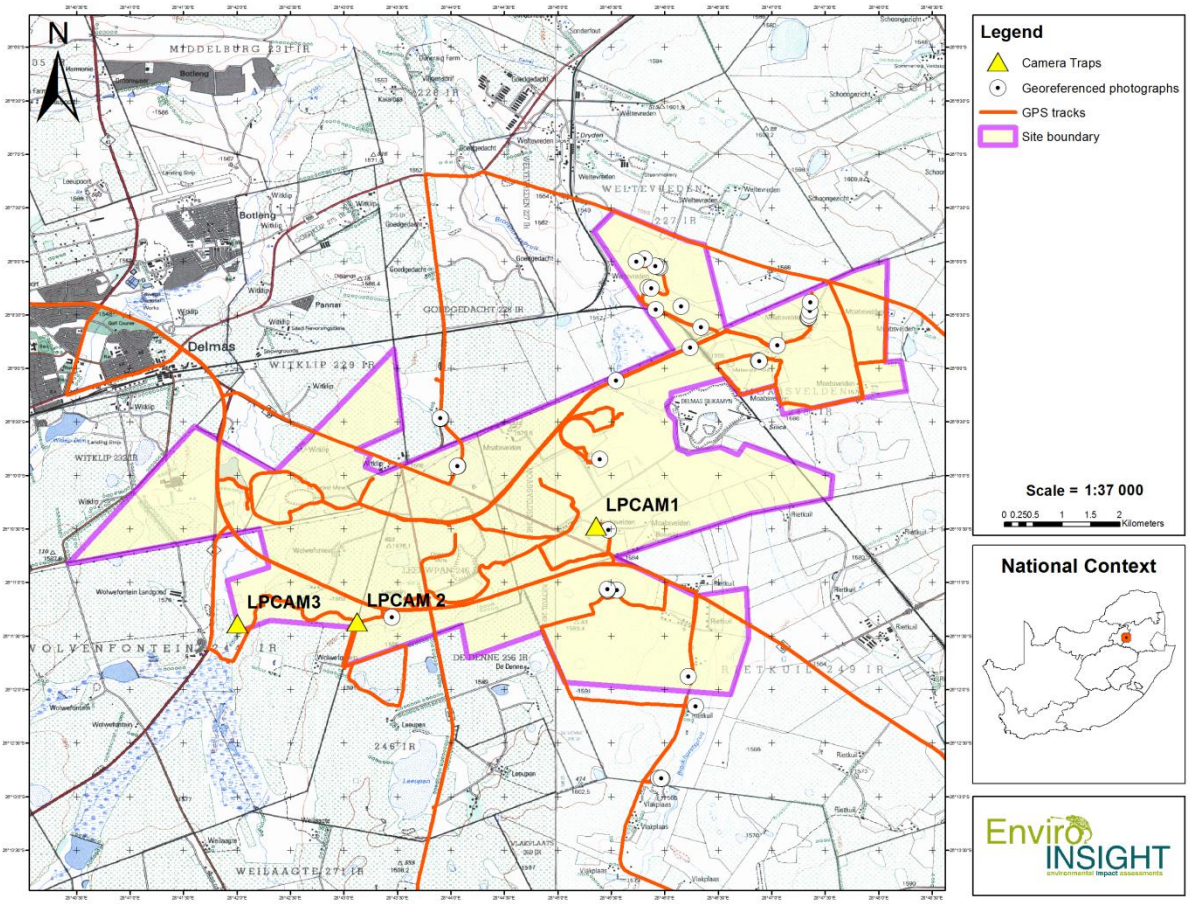


Figure 7-1: Coverage of the concession area, camera trap placement and Sherman trap line placement for the mammalian study.

An initial reconnaissance was carried out in the area before camera deployment, in order to determine the suitability of possible bait station locations. Bait stations are chosen based on available cover around the area, the location of the site on the properties and the presence of any promising signs (e.g. tracks, scats, tree scrapings) and the likelihood of possible habitat for important species.

Once suitable sites were located, the cameras were mounted and baits deployed. The baits used were mostly a combination of oil and fish remains. All bait used will be acquired locally. Figure 7-2 illustrates a typical camera station setup. Three cameras were deployed in the dry-season winter for a period of 25 nights. The total number of winter trap nights (25x3) totalled 75. However, the loss of a camera (and subsequent data requires adjustment of the total number of trap nights (25x2) which equals 50. This number will be combined with the total time for the summer survey to give the total sampling effort for camera surveys.

Cameras are set to record one images every time an animal enters the station (known as an event) followed by a 30 second video, which can record both the animals behaviour as well as eliminates much of the data loss which occurs when the animal is out of the camera range. After each trigger, there is a 1-minute delay between events. The initial bait station locations was chosen to cover as much of the study area as possible (especially with regards to habitat types as well as spatial representation).

It is imperative to note that a small number of cameras (e.g. 2 or 3) are wholly insufficient to sample an area of 1000 hectares or more. In order to account for the home range movements of animals, prevailing changes in weather conditions and the total area affected by the influence of the bait, areas should be saturated with bait stations. However, this approach was severely limited due to the lack of access to the

mine site area. Once suitable inductions have taken place (in the summer period), more cameras will be deployed and re-baited, providing much more robust data (from increased sampling effort).

Scat analysis: In addition to Sherman trapping, predator (owl, jackal, and domestic dog) scats were collected during the winter survey. These scats was examined for the presence of jawbones and teeth and then subsequently taken to the University of Pretoria for further identification.

Direct Observation: All mammals that are seen during the sampling period were noted and their geographic coordinates and the surrounding habitat recorded. Animals are usually encountered through driving, normal routine movement through the site, active searching of refugia and finally through spotlighting at night.

7.2.4 Limitations

There are a number of limitations that were experienced during the study period.

Trap Losses

During the study period, one camera trap was removed from its position in the eucalyptus stands. Such problems are axiomatic to studies in areas with high levels of human habitation. The summer survey will incorporate more of the mine site which is fenced from the general public and therefore, traps are less likely to be removed.

Limitations of Sherman trapping

As a rule, warm and wet conditions result in a basal layer optimal for foraging and cover from predators. A compromised basal layer can result in reduced animal activity. Furthermore, many mammals generally avoid exposure to low temperatures, as a lot of energy is required to maintain their body temperature (Schmidt-Nielsen 1995). Due to the fact that small mammals mostly forage at night and the temperatures at night will drop below 0°C, the conditions during the winter survey were considered to be sub-optimal. In addition, the strong dependence on moisture of some species (Skinner and Chimimba 2007) will also result in reduced activity patterns. As a result, Sherman trapping was not carried out during the winter

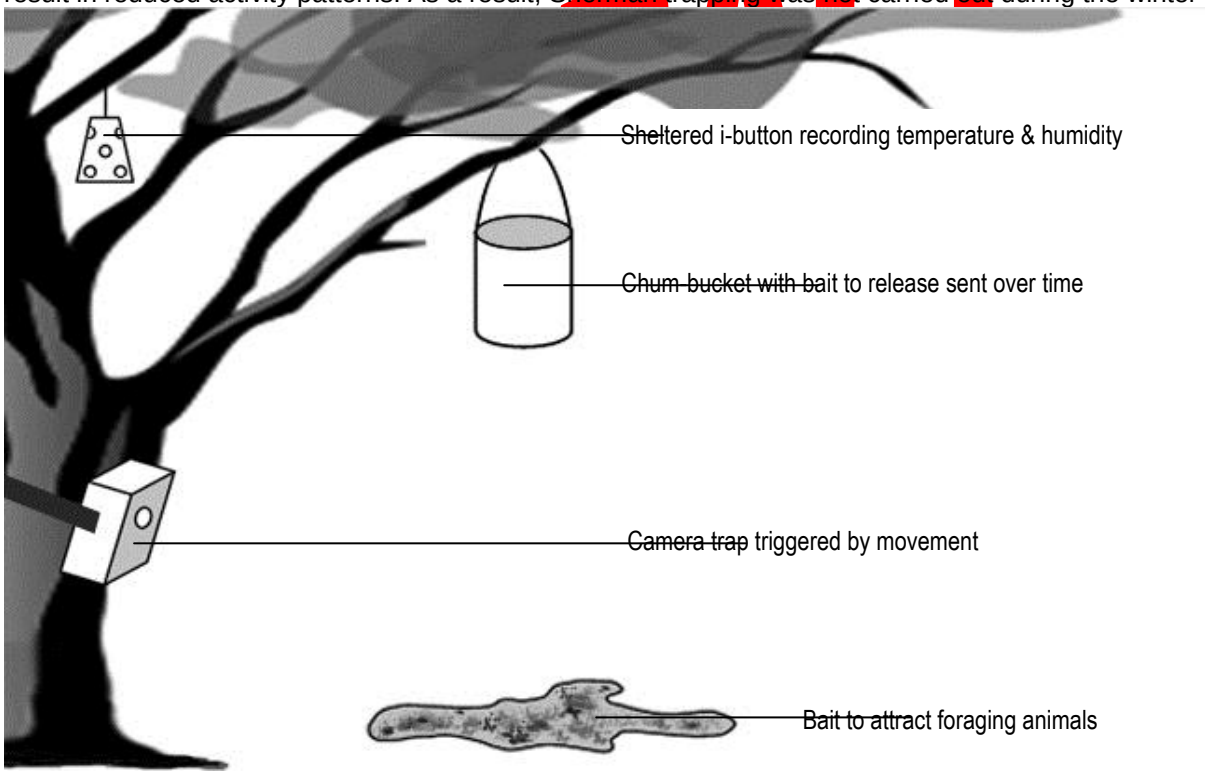


Figure 7-2: Camera trap setup design.

dry-season survey as small mammal trapping will be the primary focus of the summer wet-season sampling period.

Access to mine site

Due to Exxaro mine regulations, access to the mine site could not be achieved on a regular basis without an extensive induction process. It was therefore decided that the focus of the mammal sampling (camera traps and spoor tracking) would take place outside of the current mine concession area, with the summer-wet season sampling survey to take place across the entire concession.

7.3 Regional Results and Discussion

This section represents the overall results from the literature and desktop review as well as detail level assessments conducted during July (dry season).

In total, 16 mammal species were recorded during the two survey periods. The complete list of mammals is shown in Table 7-1. This represents strong preliminary evidence as to a significant mammal assemblage populating the study site. Due to the complexity and diversity of body sizes, ecology and movements of mammalian fauna, as well as the strong variation in sampling techniques used for each group, it is imperative that various aspects of the data be discussed in extended detail. Photographic evidence of mammal species taken on site is shown in photographic plate 7-1.

Table 7-1: Full list of mammal species acquired during the winter dry-season portion of the study

BIOLOGICAL NAME	ENGLISH NAME	EWT 2004 STATUS	TOPS	METHOD OF ACQUISITION	NOTES	LOCAL SENSITIVITY	REGIONAL SENSITIVITY
Atilax paludinosus	Water Mongoose	Least Concern	Nil	Camera trap	Common wetland resident	Low	Low
Aonyx capensis	African Clawless Otter	Least Concern	Yes	Camera trap	Common wetland resident	Low	Low
Canis mesomelas	Black-backed Jackal	Least Concern	Nil	Sighting	Common resident	Low	Low
Cryptomys hottentotus	Common Mole-rat	Least Concern	Nil	Burrows	Common resident	Moderate	Low
Cynictis penicillata	Yellow Mongoose	Least Concern	Nil	Sighting	Common resident	Low	Low
Galerella sanguinea	Slender Mongoose	Least Concern	Nil	Sighting	Common resident	Low	Low
Genetta genetta	Small-spotted Genet	Least Concern	Nil	Camera trap	Common resident	Low	Low
Hystrix africaeaustralis	Porcupine	Least Concern	Nil	Quills	Common resident	Low	Low
Leptailurus serval	Serval	Near Th ened	Nil	C p	Resident	Moderate	Moderate
Lepus saxatilis	Scrub Hare	Least Concern	Nil	Sighting	Common resident	Low	Low
Otomys irroratus	Vlei rat	Least Concern	Nil	Scat analysis /camera	Common resident	Low	Low
Mellivora capensis	Honey Badger	Near Th ed	Nil	Spoor	Common resident	Low	Low
Pedetes capensis	Springhare	Least Concern	Nil	Burrows	Common resident	Moderate	Low
Sylvicapra grimmia	Common Duiker	Least Concern	Nil	Spoor	Common resident	Low	Low
Total Number of Species	14	2	1				

7.3.1 Species of conservation concern

Two red-data species were located on the study site, which represent species of conservation concern. These species are discussed below.

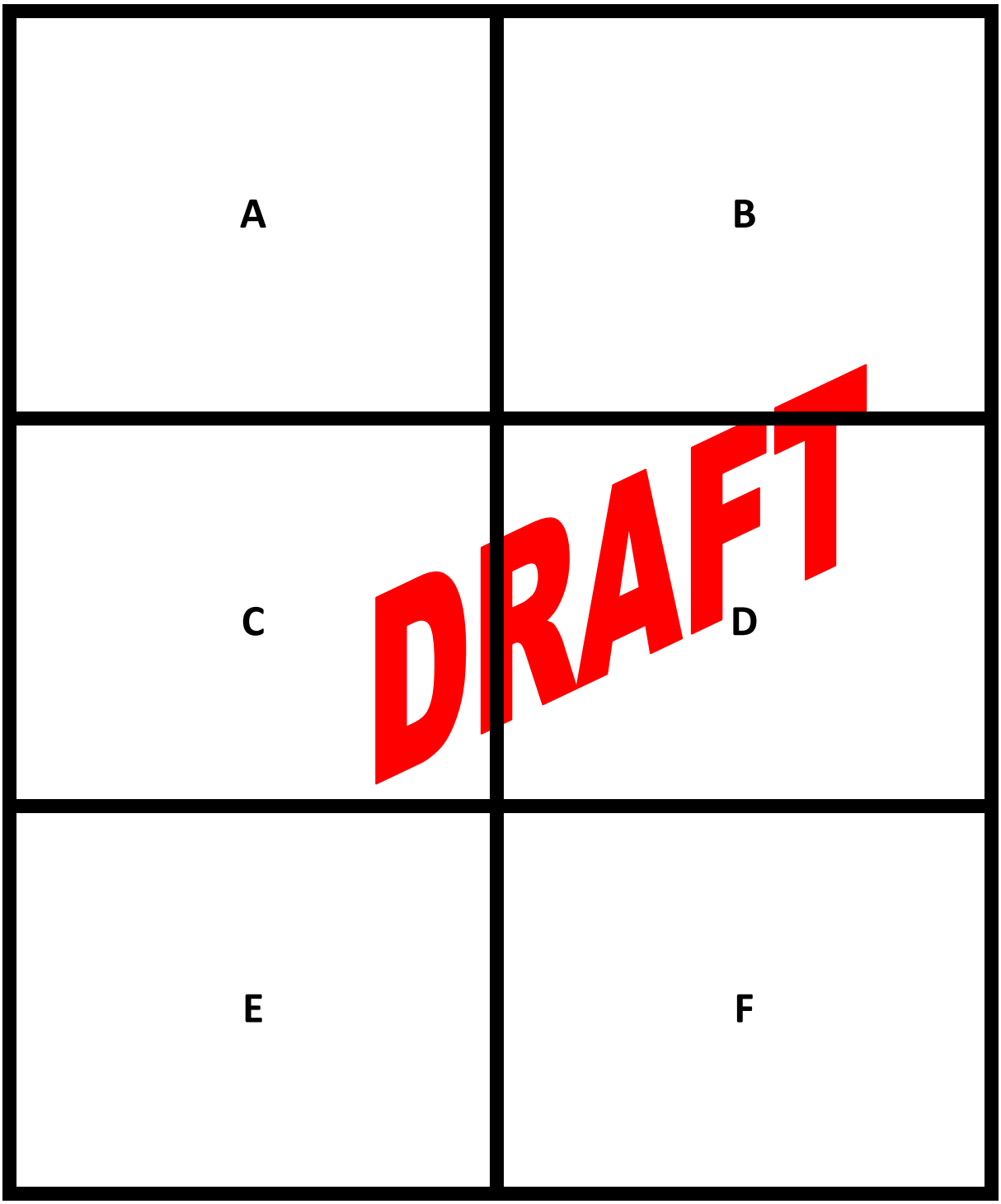
Serval: This species is listed as Near Threatened in South Africa. A serval was photographed very near to the drainage line, which is expected as the species forages on rodents which are often associated with wetland/drainage areas. The summer survey may reveal more about the prevailing serval population on site, as they may be transitory or indeed resident. Previous studies from the authour has shown the servals frequently make use of ridges, eucalyptus and wattle stands for refugia, emerging to forage along drainage areas, pans, wetlands and open grassland.

Honey Badger: This species is listed as Near Threatened in South Africa. Honey badger tracks were periodically encountered on road networks in the study area. The low frequency of tracks as well as the lack of camera trap evidence suggests that this species may only use the study area as a migratory

pathway between home ranges, rather than as a permanent core area, supporting viable populations. However, the summer study will provide more evidence as to the population status of not only honey badger, but other mesopredators found in the region.

7.3.2 Photographic evidence of mammals on site

Photographic evidence is a vital component of mammalian study results and the ordering of collage presented for photographic evidence is shown below.



The photographic evidence is presented in a quadrant, divided into A, B, C and D (E and F where applicable) in the exact order as shown above. Summaries of each Quadrant are presented below each collage.

Photo plate 7-1: Photographic evidence of Black backed jackal (dead specimen) on the study site

Photo plate 7-2: Photographic evidence of mammals on the study site

A) **Slender mongoose**
B) **African clawless otter**
C) **Water mongoose**
D) **Vlei rat**
E) **Large spotted genet**
F) **Serval**

7.3.3 Trade of Protected Species Act species of concern.

African clawless otter: This species is listed as CITES appendix 2 and is also TOPS (Trade of Protected Species Act) listed. In Mpumalanga, otters have previously been frequently recorded on wetlands within existing operational coal mines in the area. Despite the strong presence of human and mining activities, it appears to show strong populations throughout the area. Otters are persecuted in Mpumalanga Highveld regions, as they often come into direct conflict with the trout fishing industry. However, in the Delmas area, this recreational activity is not a direct threat. It is conceivable that large water bodies that exist within mine concession boundaries provide refuge from human persecution. The biggest threat to this species from mine activities will be contamination of food supplies by toxins and heavy metals in tailings dams, although to date, the exact effects are unknown.

7.3.4 Preliminary species trends

The species trends of the recorded mammals cannot accurately be predicted in such a short space of sampling time. However, due to the adequate spatial distribution of the sampling points, it is possible to ascertain some descriptive trends from the data. Descriptions of some of the more prevalent species observed on site are provided below.

Slender mongoose is an anthropogenic species which is often strongly associated with human activity. The high number of observations is expected. **Water mongooses** are also a highly synanthropic species but their presence will be limited to areas with ready access to wetlands/drainage lines.
Yellow mongoose is a common burrowing species which thrives, even in the presence of humans. The species frequently utilises cultivated lands where they are able to find excellent forage as well as optimal burrowing substrate. **Common duikers** will make use of plantation refugia during daylight hours and forage nocturnally. They are however, actively sought out by humans hunting with dogs in the area. The species is extremely common, even in disturbed areas exhibiting large degrees of human disturbance. **Black-backed jackal**s are an extremely common meso carnivore which exhibit highly generalist feeding habits. It is an anthropogenic species which is often strongly associated with human activity. Finally, scrub hares are a very common lagomorph which is also found in disturbed areas, sometimes in great numbers. Spoor of this species was located in all parts of the study area, and numerous sightings of the animal were recorded.

Representation of the trophic breakdown and description of the mammalian assemblages cannot be made until the study is complete. There has been almost no small mammal sampling and this must be carried out in order to complete a comprehensive data collection.

7.3.5 Method summary

As stated in the methodology section and in regards to data acquisition of mammals in the study area, a number of techniques stood out in regards to overall success. It must be noted that Nocturnal Surveys and Small Mammal Trapping have not been carried out and therefore represent a significant data gap. Figure 7-3 shows the number of species acquired for the full spectrum of sample techniques. As this is an organic document, based on an incomplete data set, the following summary will change after the wet-season survey.

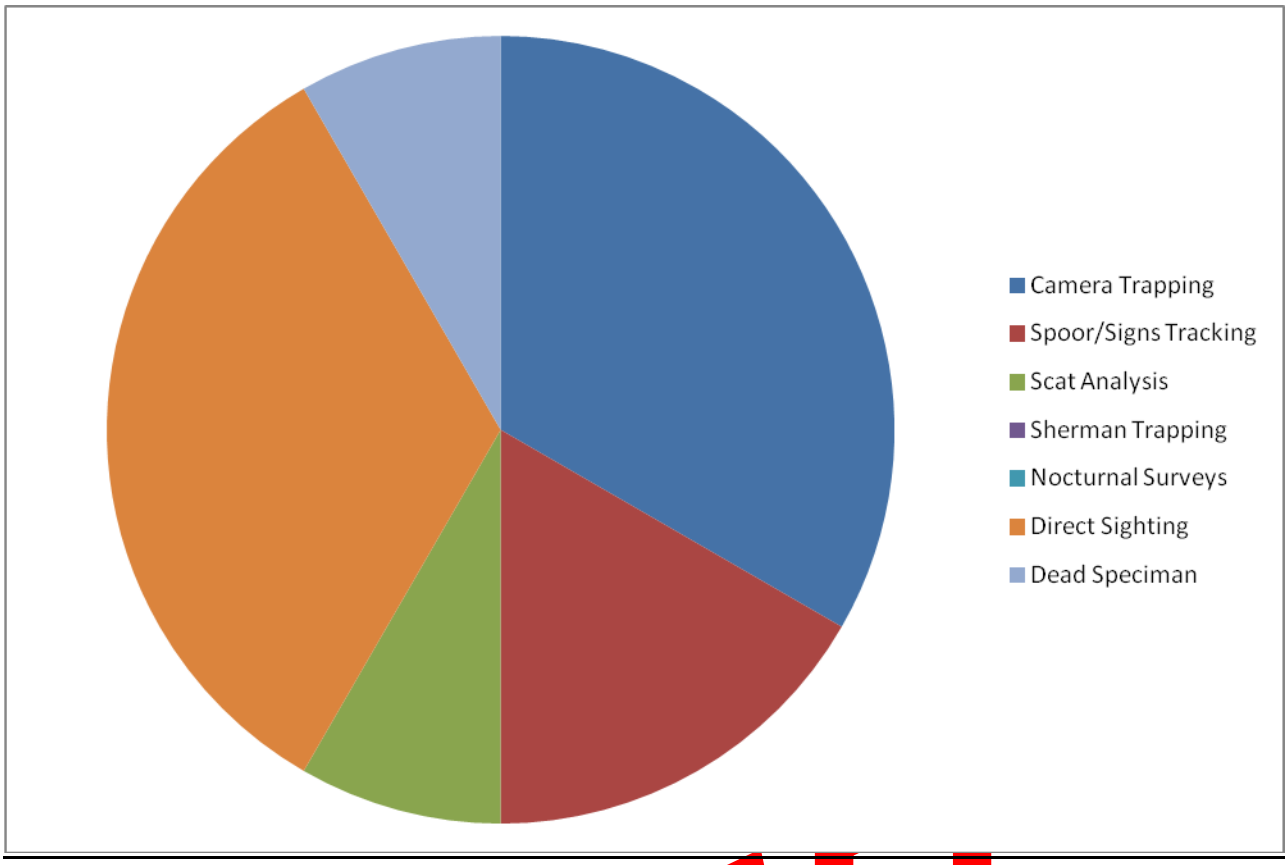


Figure 7-3: Frequency of success for mammalian sampling methods over the winter study period.

7.3.6 Likelihood of occurrence results

The full likelihood of occurrence results for the red-data species found in Mpumalanga is presented in Table 7-2. As the data set is so far, incomplete, it is important to treat this summary as an organic table which may be subject to change.

Table 7-2: likelihood of occurrence of red-data mammals for the study area

BIOLOGICAL NAME	ENGLISH NAME	RD	Likelihood	Notes
Acinonyx jubatus	Cheetah	VU	Nil	Outside distribution
Amblysomus hottentotus	Hottentot's Golden Mole	DD	Nil	Outside distribution
Amblysomus robustus	Robust Golden Mole	EN	Nil	Outside distribution
Amblysomus septentrionalis	Highveld Golden Mole	NT	Moderate	Rare resident
Atelerix frontalis	South African Hedgehog	NT	Moderate	Rare resident
Canis adustus	Side-striped Jackal	NT	Low	Outside distribution
Cercopithecus mitis	Samango Monkey	VU	Nil	Outside distribution
Cercopithecus mitis labiatus	Samango Monkey	EN	Nil	Outside distribution
Chrysospalax villosus	Rough-haired Golden Mole	CR	Low	Outside distribution
Crocidura cyanea	Reddish-grey Musk Shrew	DD	High	Possible wetland resident
Crocidura flavescens	Greater Musk Shrew	DD	Low	Rare
Crocidura fuscomurina	Tiny Musk Shrew	DD	Low	Rare
Crocidura hirta	Lesser Red Musk Shrew	DD	Low	Rare
Crocidura maquassiensis	Maquassie Musk Shrew	VU	Low	Rare
Crocidura mariquensis	Swamp Musk Shrew	DD	Low	Rare
Crocidura silacea	Lesser Grey-brown Musk Shrew	DD	Low	Rare
Crocuta crocuta	Spotted Hyaena	NT	Nil	Outside distribution
Damaliscus lunatus lunatus	Tsessebe	EN	Nil	Outside distribution
Dasymys incomtus	Water Rat	NT	Moderate	Possible wetland resident
Diceros bicornis minor	Black Rhinoceros	VU	Nil	Outside distribution
Elephantulus brachyrhynchus	Short-snouted Elephant-shrew	DD	Low	Low habitat potential
Grammomys dolichurus	Woodland Mouse	DD	Nil	Outside distribution
Graphiurus platyops	Rock Dormouse	DD	Low	Low habitat potential
Hippotragus equinus	Roan Antelope	VU	Nil	Outside distribution
Hippotragus niger niger	Sable Antelope	VU	Nil	Outside distribution
Hyaena brunnea	Brown Hyaena	NT	Moderate	Rare resident
Lemniscomys rosalia	Single-striped Mouse	DD	High	Common resident
Leptailurus serval	Serval	NT	Confirmed	Resident
Lutra maculicollis	Spotted-necked Otter	NT	Moderate	Possible wetland resident
Lycaon pictus	African Wild Dog	EN	Nil	Outside distribution
Manis temminckii	Pangolin	VU	Low	Low habitat potential
Mellivora capensis	Honey Badger	NT	Confirmed	Rare resident
Myosorex cafer	Dark-footed Forest Shrew	DD	Low	Rare
Myosorex varius	Forest Shrew	DD	High	Possible wetland resident
Mystromys albicaudatus	White-tailed Rat	EN	Low	Rare
Neamblysomus juliane	Juliana's Golden Mole	VU	Nil	Outside distribution
Otomys slogetti	Sloggett's Rat	DD	Nil	Outside distribution
Ourebia ourebi	Oribi	EN	Nil	Outside distribution
Panthera leo	Lion	VU	Nil	Outside distribution

Paracynictis selousi	Selous' Mongoose	DD	Nil	Outside distribution
Poecilogale albinucha	African Weasel	DD	Moderate	Rare
Raphicerus sharpei	Sharp's Grysbok	NT	Low	Outside distribution
Rhynchogale melleri	Meller's Mongoose	DD	Low	Outside distribution
Suncus infinitesimus	Least Dwarf Shrew	DD	Low	Rare
Suncus lixus	Greater Dwarf Shrew	DD	Low	Rare
Suncus varilla	Lesser Dwarf Shrew	DD	Moderate	Rare
Tatera leucogaster	Bushveld Gerbil	DD	High	Common resident

7.3.7 Ecosystem and mammalian species summary

According to Mucina and Rutherford (2006), the study area is located in the Grassland Biome of South Africa, across a single vegetation type, namely the Eastern Highveld Grassland. This regional vegetation unit is classed as Endangered, due to the low remaining pristine areas as well as the inherent sensitivity of the systems.

During the scoping study and from a mammalian perspective, the vegetation on the study site was divided into six main types, which are both listed and described below. These habitat types have been earmarked as priority areas for the primary survey in order to acquire an understanding of overall sensitivity of the area with regards to mammalian fauna. It must be noted that during the summer survey, certain sample bias can strongly influence the sampling results for sub-groups such as small mammals. For example, a wetland area with a strong structural complexity and species diversity may exhibit low trap success due to dust effects from the surrounding mine area.

Preliminary study areas:

- Wetland associated grasslands
- Rocky grasslands
- Artificial dams and associated vegetation
- Transformed grassland (Eucalyptus plantations)
- Current mining operations
- Cultivated areas

7.3.7.1 Wetland associated grasslands

These areas are considered to be habitat of high sensitivity. They provide excellent refugia and forage for small mammal species, which in turn form the basis for the trophic food chain. In any given area, these areas often comprise a very small percentage of the overall habitat in the study site, but are extremely important breeding and foraging sites for mammal species. The grasses in these habitats are often very dense and of high forage value which can have both positive and negative effects. Positive effects are from high structural complexity and strong foraging potential while negative effects come from invasive influences such as cattle grazing (and trampling) such areas.

7.3.7.2 Rocky grasslands

Rocky grasslands appear to occur at higher points in the landscape than wetland associated grassland areas. The grasslands are mixed with rocky refugia (which provide structural complexity) to provide a moderately to highly sensitive habitat, especially for small mammals. There appear to be no significant ridges within the study area, although some significant areas of rock grasslands were located.

7.3.7.3 Artificial dams and associated vegetation

Artificial dams have been created throughout the study area, either to supply water to mine activity or for surrounding agricultural practices. Often, these dams are linked to a drainage line system. The vegetation around these habitats is wetland associated and may include long grasses/reed structures as well as taller (often alien) trees. This provides structural complexity and potential breeding/foraging habitat for mammal species and requires more detailed assessment.

7.3.7.4 Transformed grassland (Eucalyptus plantations)

It is inherent to such areas to be of low sensitivity due to the species composition of the woody layer (*Eucalyptus spp. and Acacia mearnsii*) and levels of transformation. However, large charismatic species can be strongly prevalent in these systems throughout a given study area. It is feasible that the refugia potential of these areas is important on a regional context, providing day time cover from humans and feral predators. However, it must be noted that the use of bait within these areas can create a sample bias, especially for larger more mobile species.

7.3.7.5 Current mining operation areas (existing mine lands)

These areas exhibit some of the highest levels of disturbance within the study area due to almost complete transformation of the land as well as high levels of disturbances from mining activity such as noise, dust, road collisions and other physical disturbances. In other studies carried out in the province, it has been shown that despite the high levels of disturbances, some species will exist in association with this habitat type, and assessment on the Leeupan area must be carried out as a comparison.

7.3.7.6 Cultivated areas

In many mining areas (existing and proposed) livestock and crop agriculture will be carried out on areas within the concessions in order to maximise the landuse potential of the land. In the Leeupan area, surrounding lands (as well as lands directly within the mine area) have been allocated for farming of mealies, cattle as well as chickens. During the winter survey, the mealie fields had either been recently ploughed and sown, or were still tilled from the previous harvest. Previous studies from the author show that once crop yields establish beyond a certain height, they can provide valuable refugia areas for larger mammal species. In addition, the soft substrate is highly optimal for fossorial or burrowing species such as mole rats, mongooses, Suids and porcupines. Finally, due to the optimal substrate, these areas are ideal for spoor tracking assessments.

Photographic examples of the habitat types recorded on site are presented in Photographic Plate 7-3. It is vital to reiterate that the complete vegetation study has not been carried out as of yet, and mammalian assemblages must still be put into context with the actual vegetation units found within the mine concession.

Photo plate 7-3: Photographic examples of the habitat types recorded on site

A) Existing mine lands
B) Artificial dams and associated vegetation
C) Rocky grassland
D) Wetland associated grassland
E) Cultivated lands (pre seed)
F) Eucalyptus dominated areas

7.4 Discussion

- A strong mammalian assemblage is appears to be present within the study area. Sixteen mammal species were recorded within the study area, without intensive sampling, especially of small mammals.
- Two red-data species were located on site, namely serval and honey badger. Further wet-season survey work will clarify the ecological situation in regards to red-data mammals on site (status, habitat potential, frequency of records, regional importance etc).
- The wetland areas of the study site are the most ecologically important from a mammalian perspective. The wetland systems and associated drainage lines provide the basis for the trophic chain as well as essential movement corridors. In addition, the ridge areas shall fall under protection in any future management plans.
- A full, in season small mammal baseline needs to be carried out in all the representative habitats. This will provide adequate baseline data to be used for rehabilitation, as small mammals are excellent environmental indicators.

7.5 Plan of Study for EIA

The summer survey will be carried out at least two weeks after the onset of the first summer rains, preferably in middle to late November or afterwards.

Sherman trapping: During the summer wet-season survey period, small mammal trapping will represent a primary component of the sample methodology. Sherman traps (Figure 7-4) are too placed in trap lines of 15, within 5 sites in the study area for a period of 5 nights. The locations of the traplines will be decided during the study period but the placement will be designed to represent the five habitat types that can realistically be sampled (excluding the actual mining area). Bait used is a combination of peanut butter, sardines, vegetable oil and oats as recommended by Chimimba (pers.comm[12]). The use of Sherman traps to sample small mammal populations are necessary in order to comply with minimum sampling requirements for regional and international conservation authority standards.

There are various levels of information that may be obtained from the use of intensive small mammal Sherman trapping.

a) The diversity of the small mammals in the area can be used to indicate the impacts of mining disturbance. Assemblages can be directly compared to disturbance in order to indicate the effects of the activities on populations and diversity.
b) System health can be indicated by the average percentage trap success and/or species diversity for a given trap line.

Nocturnal assessments: This technique is an essential tool in mammalian sampling, simply because most of the target species only are active after dark. Each nocturnal survey lasts between two and three hours and three night drives should be carried out per season/sample period. Some animals may be located from vocalisations.

Herpetological arrays: The herpetological arrays that will be set up to capture amphibians and reptiles are also important sampling tools for small mammals. In areas such as Delmas, these traps are only effective in summer months when climatic conditions and basal coverage are optimal for herpetofaunal activity. Smaller mammal species that are foraging will often become trapped in the herpetological array,

[12] Professor Christian T Chimimba, Mammal Research Institute, University of Pretoria, South Africa.

in a form of passive capture. These data cannot be used in the overall small mammal assessment (more specifically trap success) but contribute to the overall species diversity results for a given area.

Figure 7-4: Sherman small mammal trap

Habitat assessment: Habitat assessment was based on a simple structural classification of the vegetation within the study site. Subsequently, a number of factors are then combined to provide a basic sensitivity rating to be used in mapping. The factors combined as the basis of habitat sensitivity are as follows:

Overall habitat potential: Relates to the ability of a given habitat to support a given mammalian species/group.

Refugia potential: The ability of a given habitat to fulfil shelter requirements of a given mammalian species/group.

Forage potential: The ability of a given habitat to fulfil food requirements of a given mammalian species/group.

Habitat connectivity: The ability of a given habitat to allow for migratory movement as well as genetic exchange, for a given mammalian species/group.

Overall Mammalian importance: The relevant importance of the sub-population of a given mammalian species/group in the context of the region/country and entire species/group community as a whole.

The sensitivity scale as shown in subsequent sensitivity mapping is described as follows:
High – RED

- Low levels of disturbance/transformation
- High forage potential

- Strong connectivity with other important habitats
- High refugia potential
- Relatively high structural diversity
- Relatively low resilience to environmental impacts
- Relatively high ecosystem uniqueness

Medium – YELLOW
- Relatively moderate levels of disturbance/transformation
- Moderate forage potential
- Moderate connectivity with other important habitats
- Moderate refugia potential
- Medium levels of structural diversity
- Relatively moderate resilience to environmental impacts

Low – GREEN
- Relatively high levels of disturbance/transformation
- Low to moderate forage potential
- Low to moderate connectivity with other important habitats
- Low to moderate refugia potential
- Low to medium levels of structural diversity
- Relatively high to moderate resilience to environmental impacts
- Low levels of regional uniqueness.

7.5.1 Discussion with local communities

Throughout southern Africa, the acquisition of local knowledge has proved to be a highly useful method for obtaining data. Basic questions were posed to local communities as to the mammalian assemblages within the project footprint, extent of subsistence hunting and current livestock practices. Interviews were facilitated through the use of field guides to avoid confusion between nomenclatures

7.5.2 Vegetation classification

A description of mammalian assemblages within the study area in context with the described vegetation units will be carried out once the botanical study is complete. Like many other aspects of biodiversity surveys, botanical assessments require the growing season (November to April) to accurately evaluate and classify the prevailing vegetation characteristics.

7.5.3 Impacts and Mitigation

Once the final data set has been obtained, it will be possible to create a an Impacts and Mitigatons summary, describing and quantifying the effects of the mine development (expansion) on the prevailing mammal assemblages within the study area. The impacts and mitigations are vital in driving the creation of the Environmental Management Plan and aiding in the reduction of the effects on regional and local mammal populations.

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9 APPENDIX A – TEAM MEMBERS: COMPANY PROFILE AND CV

Vegetation Ecological Assessment – Willem de Frey

Name of firm: EkoInfo cc Environmental and Wildlife Management Consultancy
Name of staff: WILLEM HENDRIK DE FREY
Profession: Environmental and Wildlife Management consultant
Years with firm: Since 1995
Nationality: RSA
Membership of professional societies:
The South African Council for Natural Scientific Professions (Reg no 400100/02)
Categories: Botanical Science and Ecological Science
Currently in the process of affiliating to:
South African Association of Botanist (SAAB)
Grassland Society of Southern Africa
South African Institute of Ecologist and Environmental Scientists (SAIE)

KEY QUALIFICATIONS:

Mr W de Frey has been involved in the discipline of ecology since 1989. During this period he prepared himself for a profession in environmental and wildlife management, by attending courses in chemistry, geology, pedology and statistics, while majoring in Botany and Zoology. His working knowledge was obtained while completing projects for his post-graduate studies in wildlife management in both the Savanna and Grassland Biomes. In addition to his academic publications, he has contributed to numerous reports regarding EMPR's, EIA's, vegetation - and soil surveys and monitoring since the registration of his own consultation close corporation in 1995. He is actively involved in the management and marketing of his close corporation while completing tasks in his field of expertise namely soil, vegetation science and Geographical Information Systems. Mr W de Frey is task orientated with consideration of people's needs and safety. He beliefs in a holistic approach to environmental and wildlife management and has therefore established a network with individuals in related fields. He is also assisting previously disadvantaged persons in establishing a presence in the environmental industry, namely Lordwick Makhura of Baagi Environmental Consultancy CC and a joint venture company Bonolo Biodiversity And Environmental Management consisting of Baagi Environmental Consultancy CC and Disa Mphago Community Helpers CC.

EDUCATION:

1992 BSc Botany & Zoology, University of Pretoria

Course	Content	Level
Chemistry	Organic and Inorganic chemistry	1st year
Geology	Introduction/ Geomorphology, Stratigraphy, Structural, Sedimentology Palaeontology, Crystallography	1st and 2nd year
Pedology	Introduction, soil classification, soil fertility, soil ecology, soil physics	1st and 2nd year
Botany	Morphology, Anatomy, Physiology, Taxonomy, Mycology, Ecology, Reproductive biology	1st, 2nd and 3rd year
Zoology	Taxonomy (Vertebrates and Invertebrates), Physiology (mainly vertebrates), Ecology (mainly vertebrates), Animal behaviour (mainly vertebrates)	1st, 2nd and 3rd year
Statistics	Sampling methods, Statistical Analysis, Probabilities	1st year

1993 BSc (Hons) (Cum laude) Wildlife Management, University of Pretoria
Dissertation: 'N HOLISTIESE EKOLOGIESE BENADERING TOT DIE DRAKRAGBEPALING VAN 'N GEMENGDE WILD- EN BEESBOERDERY IN DIE UBOMBO DISTRIK, MET ENKELE BESTUURS AANBEVELINGS, 1993
1999 MSc (Cum laude) Wildlife Management, University of Pretoria
Thesis: PHYTOSOCIOLOGY OF THE MPUMALANGA HIGH ALTITUDE GRASSLANDS, 1999

COURSES/ WORKSHOPS ATTENDED

1. Red List And Threatened Species Assessment Training Workshop, Hosted by the Conservation Breeding Specialist Group Southern Africa & Endangered Wildlife Trust, December 2003
2. National State of the Environment Workshop, Hosted by DEAT and SRK, ESKOM Convention Centre – November 2004
3. Gauteng Red Data Flora Workshop, Hosted by SANBI and GDACE – November 2005
4. Gauteng Flora Minimum Requirement Workshop, Hosted by GDACE Nature Conservation – August 2007

EMPLOYMENT RECORD:

1986 – 1987
5 Signals Regiment, SADF

1998 – 1993 – Partime
Council of Geoscience, Palaeontology Section
University of Pretoria, Botany Department
Academy of Marksmanship, Range Officer
U Huisoppasser, Own enterprise
1994 – 1995
University of Pretoria, Botany Department, Assistant researcher

1995 – present

EkoInfo cc Environmental and Wildlife Management Consultancy, Founding member and consultant

Overall EkoInfo CC's principal consultant completed or administrated more than 58 vegetation studies as part of Environmental Impact Assessments within all of South Africa's nine provinces and adjacent countries such as Botswana and Mozambique with a focus on either terrestrial vegetation and/ or wetlands. Some projects were on provincial level such as the Mpumalanga and Gauteng Degradation Projects coordinated by the Institute for Soil, Climate and Water and sponsored by National Department of Agriculture. The majority of projects were on local scale from 5 ha to 50 000 ha or more for local developers and corporate institutions (SASOL, Anglo Coal, BHP Billington, Ingwe Coal, Deneys Rietz Attorneys, ESKOM) facilitated independently or as a subcontractor/ specialist for the following institutions: Oryx Environmental CC, African EPA, Arcuss Gibb, Digby Wells and Associates, Nature and Business Alliance and Eyethu Engineers, Strategic Environmental Focus.

COMMUNITY SERVICE

1. Substitute lecture – 2nd & 3rd year Botany Practical (Vegetation Survey Methods), University of Pretoria -1994 & 1995
2. Guest lecture – Wetland Vegetation Communities (2nd year students), Department of Landscape Architecture, University of Pretoria – 1996 & 1997
3. Guest lecture – Principles of Ecology (1st year students), Department of Landscape Architecture, University of Pretoria – 2002
4. Guest lecture – Principles of vegetation survey and mapping for EIA's (3rd year students), Department of Landscape Architecture, University of Pretoria – 2003
5. Referee – ILASA Merits Awards (Environmental Planning), Institute for Landscape Architects of South Africa - 2003

LANGUAGES:

Language	Capability
English & Afrikaans	Speak, Read, Write - sufficient
Sepedi (Northern Sotho)	Speak, Read, Write – insufficient

Avifauna And Invertebrate Ecological Assessment – Lukas Niemand

CURRICULUM VITAE

Name:	**LUKAS JURIE NIEMAND**
Company:	Pachnoda Consulting cc (self-employed)
Date of Birth:	1974-03-12
Nationality:	South African
Languages:	English and Afrikaans

EDUCATIONAL QUALIFICATIONS

1992	Hoërskool Hartbeespoort, Hartbeespoort - Senior Certificate.
1996	University of Pretoria, Pretoria - B.Sc. (Zoology and Entomology).
1997	University of Pretoria, Pretoria - B.Sc. (Hons) (Entomology).
2001	University of Pretoria, Pretoria - M.Sc. (Restoration Ecology/Zoology).

MEMBERSHIP IN PROFESSIONAL SOCIETY

- Professional Natural Scientist (Pr. Sci. Nat.) (Reg. no. 400095/06)
- Entomological Society of Southern Africa
- Spider Club of South Africa
- BirdLife South Africa (former Ornithological Society of South Africa)
- Hartbeespoort Natural Heritage Society

EXPERIENCE

1. Ecological Assessments (Fauna, Flora and Red Data Scans, including both functional and compositional aspects):

- Belvedere Trust, Proposed retirement village on Amorosa Agricultural Holdings, Roodepoort, Gauteng (2004);
- City of Joburg Property Development Company, Proposed upgrade and development of the Orlando Dam Intersection, Soweto, Gauteng (2004);
- PDNA, Proposed NASREC development, Johannesburg, Gauteng (2004);

- 17 Shaft Conference and Education Centre, Proposed establishment of the Veteran's Heritage Education Centre, Crown Mines, Gauteng (2004);
- GAUTRANS, Proposed re-alignment of Road D781 and construction of a road bridge over the Rietvleispruit, Kempton Park, Gauteng (2004);
- Mr. N. Lang, Ecological Opinion on the proposed establishment of a township, Muldersdrift, Gauteng (2004);
- AGES, Proposed Equestrian Centre, Leeufontein 299 IR, Gauteng (2004);
- PDNA, Proposed new bridge and re-alignment of a portion of provincial road P101-2 (R51), Laversburg, Gauteng (2004);
- Blenneerville Investment (Pty) Ltd, Proposed construction of a residential and commercial development on of Paradiso Estate, Tweefontein 372 JR, Gauteng (2004);
- Les Roches (Pty) Ltd, Proposed zoning of holdings 1, 2 & 3 of Hyde Park Agricultural Holdings, Gauteng (2004);
- Transnet Limited, Terrestrial Faunal Ecological Opinion: Phase 1B expansion of the Sishen-Saldanha Iron ore export corridor, Saldanha Bay, Western Cape (2005);
- Celebration North Riding (Pty) Ltd, Proposed mixed land-use development, North Riding, Gauteng (2005);
- Wilderness Safaris, Proposed upgrade of the Manzengwenya Dive Camp, Greater St. Lucia Wetlands Park, KwaZulu-Natal (2005);
- Wilderness Safaris, Proposed upgrade of the Rocktail Bay Camp, Greater St. Lucia Wetlands Park, KwaZulu-Natal (2005);
- GAEA Projects, Corridor Assessment for the proposed Sibaya Precinct, KwaZulu-Natal (2005);
- Computer Domain Holdings (Pty) Ltd, Red Data Floral Scan on portion 3 of the farm Elandshoek, portions 12 & 27 of the farm Groot Suikerboschkop, and portions 5 & 10 of the farm Palmietfontein, Dullstroom (2005);
- Zong's Property Investments, Proposed establishment of a residential development on a portion of Pomona Estates Agricultural Holdings, Pomona, Gauteng (2005);
- GJ van Zyl Trust, Proposed development of a resort on the Farm Witpoort 216 JS, Mpumalanga (2005);
- Mr. Howard Walker, Proposed subdivision of the Farm Lunsklip 105 JT, and the Farm Morgenzon 122 JT, for the establishment of a private resort, Dullstroom, Mpumalanga (2005);
- Lavender Manor cc, Proposed establishment of a retail, commercial and Lavender Manor Township on part of farm Rietfontein 189 IQ, Muldersdrift, Gauteng (2005);
- Geo Pollution Technologies, Proposed establishment of a residential development: Noordwyk Ext 65 & 80 on Erand Agricultural Holdings, Midrand, Gauteng (2005);
- Mr. A. Le Roux, Proposed Cradle View Country Estate, Muldersdrift, Gauteng (2006);
- Viking Bay Development Company (Pty) Ltd, Proposed Viking Bay freshwater marina and hotel development, Vaal Dam, Gauteng (2006);

- Land for Africa (Pty) Ltd, Ecological Opinion for the proposed establishment of a residential township on holding 122 Erand Agricultural Holding Extension 1, Halfway House, Midrand, Gauteng (2006);
- Brickot Developments cc, Ecological opinion for the proposed Bethal Retirement Village on the remainder of portion 3 of the farm Mooifontein 108 IS, Bethal, Mpumalanga (2006);
- Brawild (Pty) Ltd, Red Data Scan for the proposed Annlin Ex 117, Pretoria, Gauteng (2006);
- Mbombela Local Municipality, Ecological Opinion for the proposed extension of the Lowveld Botanical Gardens, Nelspruit, Mpumalanga (2006);
- Natural Scientific Services cc, Botanical survey for the SASOL Mafutha coal project near Lephalale, Limpopo Province, RSA (2008);
- SRK Consulting, Ecological assessment on Vlakfontein area, NW of Ogies, Mpumalanga. Report compiled in association with EkoInfo (2009); and
- Aurecon, Desktop biodiversity assessment and wetland scan: upgrade of the River View waste water treatment works, eMalahleni, Mpumalanga province. Report compiled in association with Imperata Consulting (2009).

2. Mining and Industrial related projects:

- Lonmin Platinum (Western Platinum Limited), Ecological Assessment for the proposed MK3 Shaft Complex on the farm Wonderkop 400 JQ, Rustenburg, North West Province (2004);
- Impala Platinum Limited, Ecological Assessment for prospecting SEMPs on the farms Buffelshoek 386 KT, Kalkfontein 367 KT, Spitskop 333 KT, Steelpoortpark 366 Kt and Tweefontein 360 KT and Hackney 116 KT (all Sekhukhuneland), Mpumalanga and Limpopo Province (2004);
- Trans-Caledon Tunnel Authority (TCTA), Ecological Assessment for borrow pit SEMPs on the TCTA pipeline, Vaal Marina to Secunda (2005);
- Boynton Platinum (Pty) Ltd, Ecological Assessment for the proposed establishment of platinum mines on the farms Tuschenkomst 135 JP, Witkleifontein 136 JP and Ruighoek 169 JP, North West Province (2005);
- Impala Platinum Holdings, Ecological Assessment for prospecting SEMPs on the Impala Platinum Bafokeng Mining Complex, North West Province (2005);
- Ceramic Industries Limited, Ecological Assessment of the Rietspruit Clay Quarries, Vanderbijlpark, Gauteng (2005);
- Ekurhuleni Metropolitan Municipality, Ecological Assessment Report for the proposed GLB Landfill Site on the farm Zesfontein 27 IR, Benoni, Gauteng (peer reviewed, 2006);
- Ceramic Industries Limited, Ecological Assessment of the Leeukuil Clay Quarries, Vanderbijlpark, Gauteng (2006);
- Council for Geoscience, Habitat sensitivity assessment scoping report for Bon Accord quarry on a portion of the farm de Onderstepoort 300-JR, Tshwane, Gauteng (2007);
- Fraser Alexander, Biodiversity action plan for Lonmin Limpopo & Platinum, North West & Limpopo Province, RSA (2008-2009);

- Envirolution Consulting (Pty) Ltd., Ecological screening report and site selection process for an Eskom general landfill and hazardous waste storage facility near Lephalale, Limpopo Province, RSA (2009);
- Envirolution Consulting (Pty) Ltd., Ecological assessment for the proposed construction of an Eskom general landfill and hazardous waste storage facility at the Matimba Power Station, Limpopo Province, RSA (2009).

3. Avifaunal and Invertebrate Assessments:

- Lavender Manor cc, Red Data Bird Assessment for the proposed establishment of a retail, commercial and Lavender Manor Township on part of the farm Rietfontein 189 IQ, Muldersdrift, Gauteng (2004);
- Helga Schneider & Associates, Avifaunal & Invertebrate Red Data Assessment for the proposed rezoning & subdivision on Erf 6486 Orange Farm Ext 2, Johannesburg, Gauteng (2005);
- TOWNDEV, Avifaunal and Arachnid Assessment for the proposed subdivision of Grootfontein 349 JR, Rievlei Dam, Gauteng (2006);
- Prof. Van Rensburg, Red Data Invertebrate Scan for the proposed Rietvalleirand Extension 59, Gauteng (2006);
- Group Five Property Development, Invertebrate Assessment for the proposed Buccleuch Ex 1, Gauteng (2006);
- Zong's Property Investments, Avifaunal and *Metisella meninx* assessment for the establishment of a residential development on a portion of Pomona Estates Agricultural Holdings, Pomona, Gauteng (2006);
- Waterval Islamic Institute, Avifaunal and Invertebrate Assessment for the proposed Northern Golf Course Development, Midrand, Gauteng (2006);
- Ekurhuleni Metropolitan Municipality, Avifaunal & Invertebrate Red Data Assessment for the proposed low-cost housing development on Olifantsfontein 410 JR, Gauteng (2006);
- City of Tshwane Metropolitan Municipality, Invertebrate Red Data Scan for the proposed flood remediation and river upgrade at Soshanguve, Gauteng (2006);
- AGES, Invertebrate assessment for the proposed mining activities on the farm Thorncliffe 374 KT, Xstrata Eastern Mines, Mpumalanga (2007)
- AGES, Mammal and invertebrate assessment for the proposed Kalplats project, Stella, North West Province (2007)
- Exigent Engineering Consultants, Invertebrate assessment for the proposed Derdepoort X 11, Derdepoort, Gauteng (2007);
- Exigent Engineering Consultants, Invertebrate and Avifaunal scan for the proposed Cutty Sark hotel extension, Scottburgh, Kwazulu-Natal (2007);
- Strategic Environmental Focus, African Grass Owl assessment on the proposed Cradle View country estate on portion 60 of the farm Driefontein 179 IQ, Muldersdrift, Gauteng (2007);
- GEOLAB, Ecological assessment for the West Rand Gold Operations (WERGO) Witfontein tailings disposal facility, Mintails, Gauteng, RSA (2008);

- Coastal Environmental Services, Avifaunal Assessment for the proposed mining of heavy minerals at Port Durnford, KwaZulu-Natal (2008);
- SRK & Natural Scientific Services,cc, A feasibility study for the mining of coal north of the Limpopo Province. Avifaunal & invertebrate assessment, Rio Tinto Exploration, Limpopo Province, RSA (2009);
- Rural Maintenance, Invertebrate study for four mini-hydrological generation plants, Northern Malawi, Africa (2010);
- Impacto, An avifaunal study (Phase 1) for the proposed Mpanda Nkwua Dam on the Zambezi River, Mozambique, Tete Province (2010).

4. Other Assessments:

- Facilitation, project management and conduction of environmental scoping exercises, Environmental Impact Assessments, Environmental Management Plans, Feasibility Reports, for a range of projects and issues such as:
  - Housing Projects (West Rand Housing Projects) for the Gauteng Department of Housing;
  - Planning and facilitation of environmental awareness workshops (Winterveltd Workshops for the Department of Environmental Affairs and Tourism);
  - Compilation and evaluation of EIA reports and Environmental Management Plans (EMPs) for both the private and public sector (e.g. Scoping Report for the relocation of oxidation ponds for the Moqhaka Local Municipality and the installation of an underground additive tank for Sasol Oil (Pty) Ltd).
  - Urban Renewal Projects: Bekkersdal Urban Renewal Project and the Greater Evaton Urban Renewal Project for the Gauteng Department of Housing.
- Douglas Collieries (Inkwe Collieries), Biodiversity Assessment and database compilation of the Douglas Collieries (2005);
- Orion Group, Ecological Sensitivity Map for the proposed golf course and related facilities, Mont-Aux-Sources (2005);
- City of Joburg Property Development Company, Specialist *Lepidium mossii* assessment for the proposed upgrade and development of the Orlando Dam intersection, Soweto, Gauteng (2005).
- Johannesburg Roads Agency, Alien Eradication and Rehabilitation Programme for the proposed upgrade of 14th Avenue, Randburg, Gauteng (2006);
- City of Joburg Property Development Company, Ecological Management Plan for the Orlando Dam intersection, Soweto, Gauteng (2006);
- GJ van Zyl Trust, Alien Eradication Programme for the proposed development of a resort on the Farm Witpoort 216 JS, Mpumalanga (2006);
- GJ van Zyl Trust, Fire Management Plan for the proposed development of a resort on the Farm Witpoort 216 JS, Mpumalanga (2006);
- Khutala Collieries (Inkwe Collieries), Biodiversity Assessment and database compilation (2006)

- 5. Linear Assessments:

- Johannesburg Roads Agency, Ecological Assessment for the Proposed upgrade of 14th Avenue, Randburg, Gauteng (2004).
- Trans-Caledon Tunnel Authority (TCTA), Proposed Vaal River Eastern Subsytem Augmentation (VRESAP) pipeline from Vaal Marina to Secunda (2005);
- PBA International (in association with Bathusi EC), Ecological Scoping Report for the proposed Eskom Delta-Epsilon 765 kV Transmission lines (2007);
- Bohlweki Environmental (in association with Bathusi EC), Ecological Scoping Report for the proposed Eskom Malelane-Boulders 132 kV Distribution line (2007);
- Bohlweki Environmental (in association with Bathusi EC), Ecological Scoping Report for the proposed Eskom Marathon-Delta 132 kV Distribution line (2007);
- Strategic Environmental Focus, Avifaunal EIA Report for the proposed Eskom Hendrina-Prairie-Marathon 400 kV Transmission line, Mpumalanga (2007);
- Natural Scientific Services cc, Botanical survey for the proposed upgrade of the Transnet railway line between Hotazel, Northern Cape and the Port of Ngqura, Eastern Cape, RSA (2008);
- Envirolution Consulting (Pty) Ltd, Ecological Scoping Report for the proposed Eskom Apollo-Lepini 400kV transmission line (2009).

Additional Experience:

- Monitoring and evaluation of the rehabilitation programme for the mining company Richards Bay Minerals (RBM) with special reference to vegetation, bird, small mammal and millipede assemblages.
- Other responsibilities include assessment of the ecological standard operating procedures (SOP) according to RBM's environmental management programme in compliance with ISO 14001 environmental standards accreditation process.
- Participated in the annual relief programme on the S.A Agulhas voyage to Subantarctic Marion Island (Prins Edward group). Took part in the research to estimate the population dynamics and demography of the alien house mouse (*Mus musculus*) on the island (under supervision of the University of Pretoria).
- Participated in the preparation of a conservation management plan for a game and trout farm in conjunction with Mpumalanga Parks Board (in charge of the bird section) for the farm Nu-Scotland Bavaria.
- Lead a successful professional bird tour (party of 12) to the Eastern Zimbabwean highlands and adjacent Mashonaland Plato (10 days).
- Lead a successful professional bird tour (party of 9) to the Cape Peninsula, Karoo and West Coast (10 days).
- Lead a successful professional bird tour (party of 12) to the Swaziland and Northern Zululand (10 days).

- Lead a successful professional bird tour (party of 15) to the Namibia (10 days).
- Lead a successful professional bird tour (party of 14) to the Eastern Drakensberg and Lesotho (10 days).

Employment History:

March 2007 – Current: Self-employed (Pachnoda Consulting cc)

2004- January 2007: Strategic Environmental Focus (Pty) - Terrestrial Ecologist

2003 – 2004: Enviro-Afrik (Pty) Ltd– Environmental Consultant

2001 – 2003: University of Pretoria - Research Assistant

PUBLICATIONS:

- McEWAN, K.L., ALEXANDER, G.J., NIEMAND, L.J. & BREDIN, I.P. 2007. The effect of land transformation on diversity and abundance of reptiles. Paper presented at the 50th Anniversary Conference of the Zoological Society of Southern Africa.
- NIEMAND, L. 1997. Distribution and consumption of a rust fungus *Ravenelia macowaniana* by micro-lepidopteran larvae across an urban gradient: spatial autocorrelation and impact assessment. Hons publication, University of Pretoria, Pretoria
- NIEMAND, L. 2001. The contribution of the bird community of the regenerating coastal dunes at Richards Bay to regional diversity. MSc Thesis, University of Pretoria, Pretoria.
- VAN AARDE, R.J., WASSENAAR, T.D., NIEMAND, L., KNOWLES, T., FERREIRA, S. 2004. Coastal dune forest rehabilitation: a case study on small mammal and bird assemblages in northern KwaZulu-Natal, South Africa. In: Martínez, M.L. & Psuty, N. (Eds.) *Coastal sand dunes: Ecology and restoration*. Springer-Verlag, Heidelberg.
- VAN AARDE, R., DELPORT, J. & NIEMAND, L. 1999. Of frogs and men. *Mechanical Technology,* June: 32-33.
- VAN AARDE, R., DELPORT, J. & NIEMAND, L. 1999. Gone Frogging. *Getaway,* January: 80-83.

PRESENTATIONS:

- Co-presenter at the Wetland Training Course (30 July – 3 August 2007) entitled: “Wetland-associated fauna”. University of Pretoria, Pretoria.

Herpetofauna Ecological Assessment – Luke Verburgth

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LUKE VERBURGT

(M.Sc. Zoology)

Education

1994 **- Matriculation**
1999 **- B.Sc. Zoology**
2002 **- B.Sc. Zoology (Honours)** *cum laude*
2006 **- M.Sc. Zoology** *cum laude*
PhD Zoology in progress

Experience with reptiles and biosurveys

I have been collecting reptiles since I was a young boy. I have searched for and captured nearly all South African snake species and many lizard species, most of which I have kept and bred successfully in captivity.
I regularly do snake and reptile demonstrations for schools and other organizations (e.g. EWT, MENSA and FGASA trainees) and lecture at the University of Pretoria.
I have conducted many herpetofauna surveys since 2003 in Gauteng, Mpumalanga, Western Cape (Karoo), Northern Cape (Kalahari), Limpopo Provinces, Mozambique and Malawi. I am currently in the process of registering with the South African Council for Natural Scientific Professions (SACNASP).
I have recently started my own company which specializes in faunal surveys: Enviro-Insight CC: www.enviro-insight.co.za

Academic record

My academic profile and a full list of my publications (15) can be viewed here: http://www.up.ac.za/zoology/students.php?person=143

Society memberships

Herpetelogical Association of Africa - Member ID: **STU 334**
Animal Behavior Society – Member ID: **verburgt499**
The Mountain Club of South Africa ID: **MAG 458**

References

Please feel free to contact the following people for references:

- Prof. Andrew McKechnie (aemckechnie@zoology.up.ac.za)
- Prof. Sue Nicolson (snicolson@zoology.up.ac.za)
- Prof. JWH Ferguson (jwhferguson@zoology.up.ac.za)

Samuel Laurence - Curriculum Vitae

Personal Details

Date of Birth:	30 November 1979
Place of Birth:	London, United Kingdom
Nationality:	South African/Australian
ID No.:	7911305937089
Gender:	Male
Race:	Caucasian
Language Proficiency:	English/Afrikaans (understanding)

Career History

- 2009- Co-Founder of Enviro-Insight Consulting (CC), an Environmental Specialist Consultant company focusing on the application of the latest technology to facilitate environmental studies, census and assessments.
- 2008/2009 Snake Handling Demonstrator, Chameleon Village Reptile Centre
- 2009-Wildlife Chemical Immobilisation, Tamboti Animal Care Centre.
- 2003- 2008– Environmental Specialist Consultant (with specialisation in Carnivore Ecology and Ecological Management Plans), University of Pretoria, EKOINFO, EKOCHECK and AWE consulting, Specialising in carnivore census and monitoring, botany, small mammal trapping and reptile capture.
- 2006-2009-Lecturer, SAQA Assessor and Facilitator (FGASA Levels 1-2, Trails Guiding and Lodge Management)
- 2005-2006- Wildlife and University Technician, - University of Pretoria (Centre for Wildlife Management)
- 2006– Lion Research Field Researcher, Kruger National Park, Mpumalunga
- 2005-2006 – Field Guide, Ezemvelo Nature Reserve, Mpumalunga, under private contract in Kruger Park and Sabi Sands
- 2003-2005- Carnivore Researcher and Assistant Reserve Manager, Ezemvelo Nature Reserve, Mpumalunga
- 1998-2001 - Part time Tennis Coach Terry Morley's Tennis Tuition (Western Australia)
- 1997-1998- Scuba Schools International Open Water and Advanced Diver Qualification
- 2008- Advanced Snake and Reptile Handling- Chameleon Village Reptile Centre, NW Province.
- 2010- Training material and staff induction for Safety in Dangerous Game Areas, in conjunction with ESKOM and the Endangered Wildlife Trust (EWT).

Education and qualifications

- All Saints College, Perth Western Australia 1993-2002

  Matric Subjects –

  English

Geography
Biology
Physical Science
Mathematics

- Murdoch University, Perth, Western Australia 1998-2001
  Bachelor of Science Degree
  Majors - Conservation Biology
  Marine Biology

- University Of Pretoria 2002 – 2010

  Wildlife Management Honours (*Ecological Assessment and Management Plan of Varsvlei, Rooiwaal and Zandrivierspoort, Thabazimbi, Limpopo, RSA)*

- Wildlife Management Masters *Submitted* (*Ecological Niche Separation of Canis mesomelas, Panthera pardus and Parahyaena brunnea in the Grassland Biome, Mpumalunga, RSA*)

Recent projects pertinent to Environmental Impact Assessments (EIA)

- SUN CITY: Faunal Impact Assessment of the Proposed Golf Course, North West Province, RSA, 2007.
- PTM mining: Faunal Impact Assessment of proposed platinum mine, North West Province, RSA, 2007.
- JEFFARES and GREENE, Terrestrial Faunal Assessment of the inundation of 150 ha of land at Nacala Dam, Mozambique, 2009. Study including a full mammalian, herpetological and amphibian survey of the proposed inundation zone.
- LONMIN: Faunal Impact Assessment of proposed platinum mine, North West Province, RSA, 2008.
- NUCOAL: Faunal Impact Assessment of proposed platinum mine, North West Province, RSA, 2009.
- TRANSNET: Faunal Impact Assessment and Sensitivity Analysis of proposed railway, Richards Bay, KZN, RSA, 2010.

- ESKOM/ARCUS GIBB: Hydra-Perseus Environmental Management Plan and Walkdown, total distance 400km, Northern Cape, RSA, 2008.
- ESKOM: Spitzkop-Madupe Environmental Sensitivity Analysis and Walkdown, Section 1, total distance 69km, Limpopo Province, RSA. 2009.
- ESKOM: Spitzkop-Madupe Environmental Sensitivity Analysis and Walkdown, Section 2, total distance 170 km, Limpopo Province, RSA, 2009.

- SASOL: Environmental Impact Assessment, Proposed Pipeline, Mpumalunga, RSA, 2010.
- EKOINFO: Faunal Impact Assessment, Klipriviersberg Housing Development, Gauteng Province, RSA, 2008.
- ECOCHECK: Faunal Impact Assessment of proposed platinum mine, Selebi Pikwe, Botswana, 2008.
- AGES: Golden Mole and Wetland Assessment, Bronberg, Gauteng Province, 2010
- AGES: Curro School Python Scoping Analysis and Vegetation Functionality Analysis, Kameelsdrift, Gauteng Province, 2010.
- ENVIROAFRIK: Red Data Flora Identification and Relocation, Siyabuswa Municipality (D section), Mpumalunga, RSA, 2010.
- De Beers, Herpetological Survey, Benfontein, Dronfield, Rooipoort, Northern Cape Provinve, RSA, 2009/2010.
- IMPACTO: Full Mammal Imapact Assessment for the IMPANDA NKUA HYDROELECTRICAL DAM, Zambezi Valley, Mozambique. September 2010-Feb 2011.
- VALE: Mammal Monitoring, Vale Coal Mine, Tete, Mozambique. 2010-2011.

10 APPENDIX B – FLORA COMPONENT

To be populated during the EIA phase

11 APPENDIX C – AVIFAUNA AND INVERTEBRATES COMPONENT

11.1 Appendix C.1

A list of bird species observed during an orientation site (18-19 July 1012). # refers to IOC numbers and R6 to the old Roberts numbers. Scientific and colloquial names were used according to IOC World Bird Names (Gill & Donsker, 2012).

#	R6	Scientific Name	Colloquial Name
8	193	*Scleroptila levaillantoides*	Orange River Francolin
14	199	*Pternistis swainsonii*	Swainson's Spurfowl
20	203	*Numida meleagris*	Helmeted Guineafowl
22	99	*Dendrocygna viduata*	White-faced Duck
25	102	*Alopochen aegyptiaca*	Egyptian Goose
27	116	*Plectropterus gambensis*	Spur-winged Goose
31	105	*Anas sparsa*	African Black Duck
33	104	*Anas undulata*	Yellow-billed Duck
36	108	*Anas erythrorhyncha*	Red-billed Teal
68	464	*Lybius torquatus*	Black-collared Barbet
69	473	*Trachyphonus vaillantii*	Crested Barbet
98	429	*Megaceryle maximus*	Giant Kingfisher
99	428	*Ceryle rudis*	Pied Kingfisher
171	395	*Asio capensis*	Marsh Owl
179	348	*Columba livia*	Rock Dove
180	349	*Columba guinea*	Speckled Pigeon
185	355	*Streptopelia senegalensis*	Laughing Dove
187	354	*Streptopelia capicola*	Cape Turtle-Dove
188	352	*Streptopelia semitorquata*	Red-eyed Dove
192	356	*Oena capensis*	Namaqua Dove
224	226	*Gallinula chloropus*	Common Moorhen
226	228	*Fulica cristata*	Red-knobbed Coot
232	286	*Gallinago nigripennis*	African Snipe
241	270	*Tringa nebularia*	Common Greenshank
252	274	*Calidris minuta*	Little Stint
263	284	*Philomachus pugnax*	Ruff

#	R6	Scientific Name	Colloquial Name
272	297	*Burhinus capensis*	Spotted Thick-knee
275	295	*Himantopus himantopus*	Black-winged Stilt
291	258	*Vanellus armatus*	Blacksmith Lapwing
294	260	*Vanellus senegallus*	African Wattled Lapwing
297	255	*Vanellus coronatus*	Crowned Lapwing
316	315	*Larus cirrocephalus*	Grey-headed Gull
339	338	*Chlidonias hybrida*	Whiskered Tern
351	148	*Haliaeetus vocifer*	African Fish-Eagle
367	165	*Circus ranivorus*	African Marsh-Harrier
386	152	*Buteo rufofuscus*	Jackal Buzzard
398	118	*Sagittarius serpentarius*	Secretarybird
401	181	*Falco rupicolis*	Rock Kestrel
415	8	*Tachybaptus ruficollis*	Little Grebe
425	60	*Anhinga rufa*	African Darter
426	58	*Phalacrocorax africanus*	Reed Cormorant
435	68	*Egretta intermedia*	Yellow-billed Egret
436	66	*Egretta alba*	Great Egret
439	62	*Ardea cinerea*	Grey Heron
440	63	*Ardea melanocephala*	Black-headed Heron
441	64	*Ardea goliath*	Goliath Heron
443	71	*Bubulcus ibis*	Cattle Egret
447	74	*Butorides striata*	Green-backed Heron
453	81	*Scopus umbretta*	Hamerkop
457	94	*Bostrychia hagedash*	Hadeda Ibis
458	92	*Geronticus calvus*	Southern Bald Ibis
459	91	*Threskiornis aethiopicus*	African Sacred Ibis
571	548	*Corvus albus*	Pied Crow
576	732	*Lanius collaris*	Common Fiscal
594	533	*Riparia paludicola*	Brown-throated Martin
615	568	*Pycnonotus tricolor*	Dark-capped Bulbul
643	635	*Acrocephalus gracilirostris*	Lesser Swamp-Warbler
683	677	*Cisticola tinniens*	Levaillant's Cisticola
735	507	*Calandrella cinerea*	Red-capped Lark
737	508	*Spizocorys conirostris*	Pink-billed Lark
751		*Turdus smithi*	Karoo Thrush

#	R6	Scientific Name	Colloquial Name
767	601	*Cossypha caffra*	Cape Robin-Chat
782	596	*Saxicola torquatus*	African Stonechat
784	586	*Oenanthe monticola*	Mountain Wheatear
787	587	*Oenanthe pileata*	Capped Wheatear
793	595	*Myrmecocichla formicivora*	Anteating Chat
800	764	*Lamprotornis nitens*	Cape Glossy Starling
807	759	*Spreo bicolor*	Pied Starling
810	758	*Acridotheres tristis*	Common Myna
846	814	*Ploceus velatus*	Southern Masked-Weaver
854	821	*Quelea quelea*	Red-billed Quelea
855	826	*Euplectes afer*	Yellow-crowned Bishop
857	824	*Euplectes orix*	Southern Red Bishop
869	856	*Amadina erythrocephala*	Red-headed Finch
898	860	*Vidua macroura*	Pin-tailed Whydah
901	801	*Passer domesticus*	House Sparrow
903	803	*Passer melanurus*	Cape Sparrow
904	804	*Passer diffusus*	Southern Grey-headed Sparrow
908	713	*Motacilla capensis*	Cape Wagtail
915	727	*Macronyx capensis*	Cape Longclaw
920	716	*Anthus cinnamomeus*	African Pipit
923	719	*Anthus vaalensis*	Buffy Pipit
935	870	*Serinus atrogularis*	Black-throated Canary

12 APPENDIX D – HERPETOFAUNA COMPONENT

To be populated during the EIA phase

13 APPENDIX E – MAMMALS COMPONENT

To be populated during the EIA phase