FLORA AND FAUNA ASSESSMENT

FOR

BRAKFONTEIN

UNIVERSAL COAL

AUGUST 2012

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EXECUTIVE SUMMARY

The aim of this survey was to undertake a basic ecological assessment of the local flora and fauna in the study areas. The objective is to establish the significance of the impacts of the construction and operation of the proposed opencast mine and associated infrastructure on the fauna and flora. Recommendations will also be made for mitigation actions that may either enhance potential benefits or minimize harmful effects. In order to meet this objective the aforementioned flora and fauna surveys were conducted.

Flora

The primary land-use in the study areas was found to be agriculture however, the study area still consists of natural grassland that has not been affected by agriculture. These natural grassland areas are restricted to the vicinity of the drainage lines, and accompanying low lying valley bottom wetlands and hill slopes.

During the dry season field survey 80 plant species were recorded, the dry season is typically not ideal for a biodiversity surveys as most vegetation is dormant and thus many animal species are not active. It must also be noted that certain areas of the study area had been burnt prior to the dry season sampling taking place.

During the field surveys 69 plant species were recorded. The recorded grass species represented pioneer, subclimax and climax species and the areas were all in different states of succession, with some areas supporting climax species like *Themeda triandra* and *Brachiaria serrata* displaying more advanced stages of plant succession. The stages of succession of the various areas were dependent on the severity of disturbances such as ploughing and invasion of alien plant species.

Furthermore, the study area also supported alien invasive plant species, such as *Datura stramonium, Bidens Formosa* and *Tagetes minuta*. An eradication and control program is recommended for the construction and operational phases and rehabilitation efforts to ensure that the area becomes free of these alien invasive species. The tree component will, if uncontrolled, alter the landscape and introduce bush encroachment to the grasslands.

Fauna

The mammal species observed during the field work were very limited, this was expected as the animal diversity and richness is a function of the available habitat and the level of threats present. A Serval (*Leptailurus serval)*, a Red Data Status mammal considered to be Near Threatened, was sighted in the project area. The presence of both these factors was evident as far as animal numbers where concerned. Forty eight bird species were recorded.

The animal species that were observed in the project area are adaptable species and although they will move out of the area during construction of the power station, by increasing the natural flora diversity during rehabilitation, one will have a natural influx of these animals, with smaller animals such as insects moving into the area first, followed by birds, frogs and reptiles. During this dry season survey two amphibian species were observed.

Conclusion

From the investigations performed during this assessment it was found that misuse and degradation has taken place in the study area, predominantly from agricultural and mining activities. From a flora perspective the surrounding land use and management measures employed by land owners had a substantial impact on the species richness and abundance

in the study area. From a fauna perspective very few species were encountered, with no large mammal species encountered, mostly due to increased threats, and degraded and a shrinking habitat.

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1 INTRODUCTION

South Africa is an exceptionally diverse country, one of the most biologically diverse in the world. This is largely due to the species diversity and endemism of the vegetation. The major natural systems of the country have been classified in terms of the biome concept, based on dominant plant life forms, correlated with climatic variations. Biomes found in South Africa include desert, fynbos, succulent, Karoo, Nama Karoo, grassland, savanna, Albany thicket, forest and wetland vegetation (DEAT, 2005).

Although 5.4% of South Africa's land surface area is currently formally conserved through the system of national and provincial protected areas, the protected area network is skewed towards certain biomes such as savanna, leaving biomes such as grasslands, in which the area of interest is located, and Succulent Karoo under conserved (DEAT, 2005). Many of these areas overlap with areas of high population density, high agricultural potential, mineral deposits and scenic beauty important for tourism. This can lead to conflict regarding decisions over land use allocations. For this reason extensive consultation regarding land use changes is required and areas considered irreplaceable for biodiversity conservation and important for ecosystem services, need to be set aside.

In many areas, especially in terrestrial ecosystems, it is not the direct use of biological resources that is threatening their sustainability, but rather indirect pressures such as changing land use and associated clearing of natural vegetation and habitat fragmentation.

The National Biodiversity Implementation Plan sets out the strategic objectives, outcomes and activities identified during the National Biodiversity Strategy and Action Plan (NBSAP) process. It identifies the leading agents and key partners for implementing the activities (DEAT, 2005). The plan consists of a goal and five strategic objectives (Table 1-1).

Table 1-1: Goal and strategic objectives of the National Biodiversity Implementation Plan

GOAL	**Conserve and manage terrestrial and aquatic biodiversity to ensure sustainable and equitable benefits to the people of South Africa, now and in the future.**
STRATEGIC OBJECTIVE 1	**Policy framework for biodiversity management.**
STRATEGIC OBJECTIVE 2	**Institutional framework for biodiversity management.**
STRATEGIC OBJECTIVE 3	**Integrated management of terrestrial and aquatic ecosystems.**
STRATEGIC OBJECTIVE 4	**Sustainable use of biological resources.**
STRATEGIC OBJECTIVE 5	**A network of conservation areas to conserve representative samples.**

Under Strategic Objective 3 the various industries impacting on biodiversity are encouraged to develop and implement changes in operations procedures to minimise negative impacts on biodiversity and create sustainable practices. Industries mentioned include those related to agricultural, mining, forestry, fishing and property development. Under mining industries it states that relationships already exists between mining industry and biodiversity sectors and

that these relationships should be further developed. Funds set aside for rehabilitation should be utilised to mitigate negative impacts on biodiversity and important biodiversity areas should be set aside and managed. It also states that mines play an important role in maintenance of natural corridors. The overall statement drives home that biodiversity is the responsibility of the industry and that practices should be carried out in a way that is responsible, sustainable and preserves biodiversity of the area. It also states that rehabilitation efforts should consider biodiversity.

The focus of this study is for the above mentioned strategic objectives to be the backbone of the investigation. The primary objective of this investigation was to characterise the flora and fauna present and to investigate the potential impacts of the proposed project on the vegetation and animal life in the study area. Furthermore to suggest management measures that will mitigate the effects that construction and operation will have on the area.

2 TERMS OF REFERENCE

Digby Wells Environmental were commissioned by Universal Coal South Africa (Pty) Ltd as the ecological specialists to conduct baseline studies in order to assess the terrestrial ecosystems associated with the proposed Brakfontein mining operation. This specialist study in particular addresses the terrestrial ecosystem component and aimed to assess the current ecological state and functioning of the terrestrial ecosystem. Furthermore this study aims to suggest management measures that must be implemented by Brakfontein to achieve the strategy and goals.

1.1 Legislative requirements

This assessment was completed in accordance with the requirements of the following legislation:

Conservation of Agricultural Resources Act (Act No. 43 of 1983) (CARA)

According to the CARA, declared weeds and invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants which are prohibited and must be controlled.
- Category 2 plants (commercially used plants) that may be grown in demarcated areas providing that there is a permit and steps are taken to prevent their spread.
- Category 3 plants (ornamentally used plants) that may no longer be planted and of which existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands.

This Act is relevant to any weeds or invader plant species encountered on the study areas.

National Environmental Management Act (Act No. 108 of 1998) (NEMA)

The NEMA requires, *inter alia*, that:

- Development must be socially, environmentally, and economically sustainable;
- Disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied; and

- A risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions.

NEMA states that "…the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage."

A "risk averse cautious approach" has been taken with the delineation of the sensitive areas on each study area.

National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA)

In terms of NEMBA, a project developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area, such as Critical Biodiversity Areas (CBAs);
- Promoting the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity; and
- Limit further loss of biodiversity and conserve endangered ecosystems.

In terms of Section 57 of the NEMBA a person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7. The Minister may, by notice in the Gazette, prohibit the carrying out of any activity which is of a nature that may negatively impact on the survival of a listed threatened or protected species.

National Forests Act (Act No. 84 of 1998)

According to this Act, the Minister may declare a tree, group of trees, woodland or a species of tree as protected. The prohibitions provide that no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister.

The Act further prohibits the destruction of indigenous trees in any natural forest without a licence.
Any protected trees encountered on the study areas are protected within this Act.

Environment Conservation Act (Act No. 73 of 1989) (ECA)

The ECA states that development must be environmentally, socially and economically sustainable. Sustainable development requires the consideration of, *inter alia*, the following factors:

- That pollution and degradation of the environment is avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- That the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
- That the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; and

- That negative impacts on the environment and on peoples' environmental rights be anticipated and prevented, and where they cannot be altogether prevented are minimised and remedied.

All these factors were taken into account with the compilation of this report.

3 KNOWLEDGE GAPS

Currently this report consists only of a single dry season survey and a supplementary wet season survey will still be completed, should the EMP be approved.

4 STUDY AREA

The proposed project is located within the western margins of the Witbank Coalfields within the jurisdiction of the Victor Khanye Local Municipality, which is in Nkangala District Municipality in Mpumalanga Province. The site is located approximately 16km north-east of Delmas town, 14km and 17km north of Devon and Leandra respectively. The centre co-ordinate of the largest part of the project area is located at 28°51'39.698"E and 26°12'31.237"S (Figure 4-1).

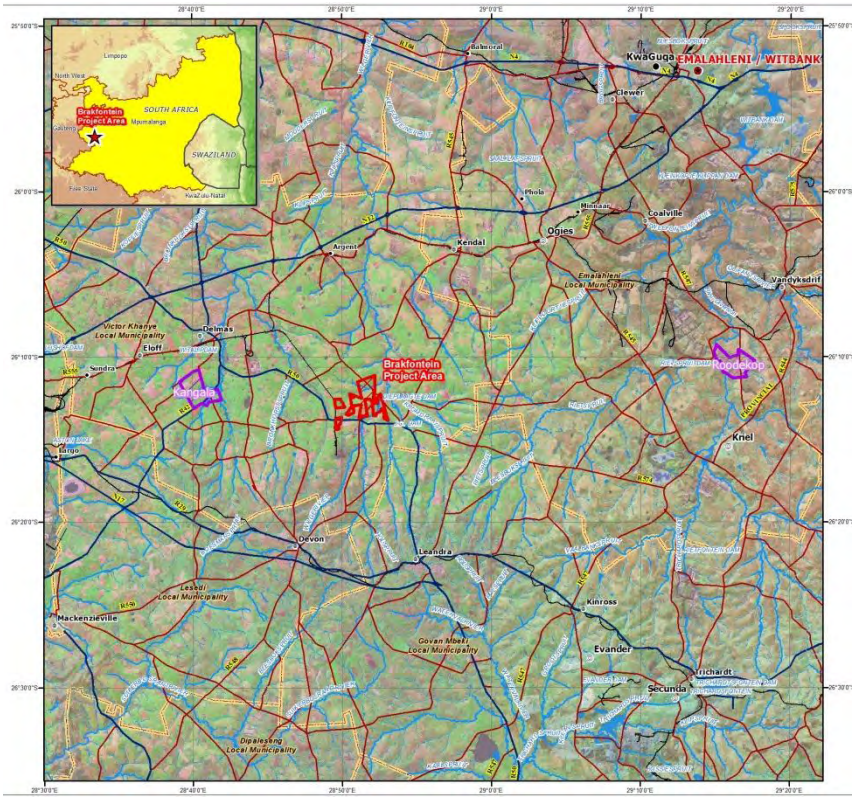

Figure 4-1: Regional setting

The classification of the vegetation types of South Africa by Mucina and Rutherford (2006) refers to the vegetation type as the Eastern Highveld Grassland (Gm12) and lists "North-eastern Sandy Highveld" (A57) and "Moist Sandy Highveld Grassland" (Type no. 38) as synonyms. Previously vegetation classification completed by Acocks (1988) and describes the area of interest as within the Bankenveld vegetation type (Type no. 61) of the grassland biome. Three variations are recognised, namely: the Central, Eastern and Western

Variations. The area of interest falls within the Eastern Variation which has sandy plains and is wetter than the Western Variation.

According to Ferrar and Lotter (2007), the Mpumalanga Province is categorised into 6 main areas of sensitivity, namely:

- Highly Significant;
- Important & Necessary;
- Irreplaceable;
- Least Concern;
- No Natural habitat Remaining; and
- Protected areas.

The study area falls within the classifications of Least Concern, No Natural Habitat Remaining and Important and Necessary (Table 4-1, Plan 3).

Table 4-1: Mpumalanga C-Plan

C-plan	Area (Ha)	Percentage (%)
Important and necessary	14.14	1.33
Least Concern	173.68	16.32
No Natural Habitat remaining	876.32	82.35

The layout of the terrain consisted of agricultural land specifically maize farming and natural grasslands in various ecological states, the degraded areas attributed to anthropogenic activities in the area. Un-channelled valley bottom wetland in the central eastern and western portion runs through the property, with hillslope seepages found on either sides of these.

5 EXPERTISE OF THE SPECIALIST

The Biodiversity specialist achieved a National Diploma in Nature Conservation, followed by a Bachelor of technology degree in Biodiversity Conservation at the Nelson Mandela Metropolitan University; and is an environmental consultant specialising in both terrestrial ecology and environmental management. Experience includes predominantly ecology field work such as flora and fauna surveys, biodiversity assessments, Biodiversity Action Plans, species relocation and environmental rehabilitation. Furthermore experience has been acquired in environmental Rehabilitation monitoring, Rehabilitation action plans, EIAs and Environmental Management Plans (EMP). Project experience includes various countries such as Botswana, Sierra Leone, Mali, Mozambique, Ghana, Democratic Republic of the Congo, Namibia and throughout South Africa.

6 AIMS AND OBJECTIVES

The aim of the study was to conduct an ecological state assessment of the terrestrial ecosystem associated with the study area. In order to achieve this aim, the following objectives were set:

- Determine and delineate (plant or animal species susceptible or vulnerable to activities or habitat alterations) plant and animal communities and habitat types that occur in the study area;
- Characterise the ecological state of the vegetation and/or habitat types by assessing the biophysical attributes of each;
- To determine if any plant or fauna species or assemblages will be directly impacted upon by the proposed project and associated activities and consequently, influence the design and layout of the proposed infrastructure as to have the least impact on the respective systems present in the study areas;
- Assess the significance of residual impacts that stem from the proposed activities that will be needed for the construction and operation of the opencast coal mine. These impacts include removal of vegetation and destruction of natural habitat utilised by fauna species; and
- Recommend measures to mitigate impacts on the ecological state of the project sites and surrounding areas

7 METHODOLOGY

7.1 Flora and fauna assessment

The diversity and concentrations of the flora component in conjunction with topographic features such as hills, valleys, streams and anthropogenic activities were used as the basis for delineating vegetation types or communities. According to Mucina and Rutherford (2006) “Vegetation mapping is a frequently used tool in nature and especially wildlife conservation practice in Southern Africa. Since successful, scientifically defendable management of conservation areas requires formulation and implementation of spatial management plans, vegetation has often been used to stratify land into management units”. The assumption is made that species of plants and animals are supported and are therefore reliant on features present within these vegetation types therefore the presence of a vegetation type could indicate the presence of species of plants and animals. The subsequent management prescriptions or objectives for the area of concern will concentrate on the vegetation units and their associated species and not purely on species alone, an ecosystem based approach.

A desktop study of the expected plant and animal species present within the study area was conducted prior to field work. This initial study meant that all flora and fauna components that were expected to be found were noted for reference during field work. The various areas proposed for development were accessed by means of dirt roads, tracks and existing cattle paths at various intervals. Sampling sites were distributed according to desktop study findings.

The flora study component initially consisted of the delineation of different communities at desktop level. Additional specialist study components associated with the identified vegetation communities included the identification of the following:

- Red data species;
- Medicinal species;
- Endemic species;

- Alien invasive species.

The fauna study component consisted of the identification of various faunal species as an indicator of the delineated vegetation communities and habitat features. These faunal species consisted of endemic, endangered and protect species. The special faunal components which were assessed for this study include:

- Mammals;
- Avifauna and;
- Herpetofauna (Reptiles and Amphibians).

All methods implemented during this study are based on accepted scientific investigative techniques/principles and were performed to acceptable standards and norms. The biodiversity survey took place during the dry season from the 11th to the 14th of June 2012.

7.2 Flora survey

A Braun-Blanquet method was used whereby vegetation is studied by means of aerial/satellite imagery based on physiognomic characteristics. Representative areas within the identified vegetation communities are then surveyed by means of line-point transects for grasses, sedges and forbs, as well as belt transects for shrubs and trees. Data obtained from these surveys are then subject to analysis to establish differences or similarities between observed communities and seasonal variation.

Vegetation communities were established during this dry season survey. This study identified all Red Data, protected and endemic species that could be present. Floristic sensitivity analysis was determined by subjectively assessing the ecological function and conservation importance of the vegetation, as defined in Table 7-1.

Table 7-1: The floristic sensitivity analysis through assessment of the ecological function and conservation importance.

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

7.3 Animal survey

Pertinent notes were made during the survey and desktop studies were also conducted for mammals, birds, reptile and frogs. All fauna species encountered on site were identified and recorded. The following methods were used during the survey:

7.3.1 Mammals

Visual sightings and ecological indications were used to identify the mammal inhabitants of the study area; this includes scats, tracks and habitat such as burrows and dens. Scat found was collected (if required), photographed on scale along with any tracks found and identified. For identification purposes a field guide Mammals of Southern Africa (Smithers, 2000) was used.

The following was recorded:

- All mammals encountered, noted or captured during the survey;
- Animals listed in previous studies;
- A list of the most prominent mammal species; and
- A list of threatened or protected species encountered during the survey.

Small mammal trapping was also applied by using Sherman traps. Sherman traps are collapsible traps (23 cm x 9 cm x 7.5 cm) which were baited and laid along transects. Areas where clear small mammal activity could be seen such as the presence of burrows were also used as sites for trapping. The traps were checked in the morning due to the fact that the small mammals are predominantly active at night. Captured animals were photographed and identified and released. Species of conservation concern and listed by the IUCN or by the South African Environmental legislation and Mpumalanga provincial as protected and endemic within the study area, took priority and the Red Data status identified and recorded.

7.3.2 Birds

The principal ornithological field survey technique used was transect surveys. Transect surveys were planned based on site representative of different avifauna habitat, such as bushveld, open areas and road reserves by simply following the linear project that transect over these habitat types. Transect procedures involve slow attentive walks along transects during which any bird seen or heard is identified and recorded, this was completed during diurnal and nocturnal surveys. Species observed during the vegetation transect surveys were also recorded.

The following was recorded:

- All birds encountered or noted during the survey; and
- A list of rare and endangered species encountered.

Where possible, visual identification was used to confirm calls. Bird species were confirmed using Sinclair *et al* (1997) and Roberts birds (2009).

7.3.3 Reptiles and Frogs

Herpetofauna include reptile and amphibian species. Direct/opportunistic observation was completed along trails or paths within the project area. Any herpetofauna species seen or heard along such paths or trails within the project area was identified and recorded. Another method used was refuge examinations using visual scanning of terrains to record smaller herpetofaunal species which often conceal themselves under rocks and in fallen logs, rotten tree stumps, under rocks, in leaf litter, rodent burrows, ponds, old termite mounds, etc. Branch (1996) and Carruthers (2011) was used to confirm identification where necessary.

7.3.4 Red Data faunal assessment

The following parameters were used to assess the Probability of Occurrence of each Red Data species:

- Habitat requirements (HR) – Most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics in the study area was evaluated.
- Habitat status (HS) – The status or ecological condition of available habitat in the area is assessed. Often a high level of habitat degradation prevalent in a specific habitat will negate the potential presence of Red Data species (this is especially evident in wetland habitats).
- Habitat linkage (HL) – Movement between areas for breeding and feeding forms an essential part of the existence of many species. Connectivity of the study area to surrounding habitat and the adequacy of these linkages are evaluated for the ecological functioning of Red Data species habitat within the study area.

Probability of occurrence is presented in four categories, namely:

- Low (will not occur);
- Medium (could possibly occur);
- High (most likely could occur); or
- Recorded (does occur on site).

The IUCN Red Data categories are defined as in Table 7-2 and it is used for the status identification of mammals, birds, reptiles and amphibians globally.

Table 7-2: Red Data Categories and description from IUCN (IUCN, 2010).

Category	Description
CRITICALLY ENDANGERED (CR)	A taxon is Critically Endangered when it is considered to be facing an extremely high risk of extinction in the wild
ENDANGERED (EN)	A taxon is Endangered when it is considered to be facing a very high risk of extinction in the wild
VULNERABLE (VU)	A taxon is Vulnerable when the best available evidence indicates it to be facing a high risk of extinction in the wild
NEAR THREATENED (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future
DATA DEFICIENT (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status
NOT EVALUATED (NE)	A taxon is Not Evaluated when it is has not yet been evaluated against the criteria

8 RESULTS AND DISCUSSIONS

8.1 Local Natural Environment

From the field survey conducted it was evident that the extent of the vegetation type, and its variances, that is described by Acocks (1988), Low and Rebello. (1996) and Mucina and Rutherford (eds) (2006), has declined to such an extent that only remnants remain in isolated pockets, where threats to it are minimised.

8.2 Habitat and Vegetation types

A total of six habitat units were delineated for the project area, topographic features and current land use were the primary considerations for the delineation of the various units (Table 8-1, Plan 4). These features included the location of the habitat type in the landscape, influence of available soil type, influence of available moisture, gradient and aspect and current land use practices. The above mentioned factors have an effect on the habitat type in isolation and in conjunction with each other.

The effects of the anthropogenic activities that were considered in assisting with the delineation of vegetative and/or habitat types included current and previous land use. Owing to the presence of extensive maize farming activities within the study area together with exotic tree areas and homesteads the natural landscape has been altered to such an extent that obvious divisions according to current and historical land use are noticeable. The buildings encountered in the study area were a small percentage (1%) and was not discussed as a separate vegetation unit. The pastures and grassland vegetation units are mapped together as the management of these areas is similar. The river and riparian vegetation type delineated utilising existing vegetation and topography, and not soil characteristics.

Below in Table 8-1, the habitat types identified during the survey are summarized into their individual attributes, as they were recorded they are, topographic setting and ecological functioning.

Table 8-1: Percentages and Hectares of each habitat type

Vegetative Unit	Size in ha (% of total)	Topographic Setting
Grassland	261.51 (25.58)	Hill slopes, Flats
Current cultivation	589.70 (57.69)	Hill slopes, Flats
Alien trees	17.17 (1.68)	Hill slopes, Flats
Pastures	68.97 (6.75)	Hill slopes, Flats
River/ Riparian	79.49 (7.87)	Riparian, bottom lands
Ridges	5.37 (0.52)	Hill slopes

8.2.1 Grassland

Mpumalanga falls within the Grassland Biome which has the highest biodiversity in South Africa after the Fynbos biome (Driver *et al*, 2004). Grasslands are dominated by a single layer of grasses and the amount of cover depends on rainfall and the degree of grazing. Trees are absent, except in a few localised habitats and geophytes are often abundant (Low & Rebelo, 1996). The grassland unit was identified as the original or primary vegetation type in the area as described by Mucina and Rutherford (2006). The grasslands have formed and are maintained as a result of natural factors such as fire and frost, both of which are

important in not allowing trees to start dominating the area, thereby creating a Savannah landscape.

The grassland habitat type identified at the project site was the remaining natural grassland (25 %) after the majority of the area was utilized for agricultural activities (58%) predominantly maize farming (Figure 8-1). The effects of the anthropogenic activities, in the form of declining and fragmented habitat, are a major threat to this grassland area. The grassland was encountered on relatively flat rolling hill slopes, with the majority of the very flat and agriculturally suitable areas used for maize farming. The sensitivity (Plan 4) was found to high and the grasslands are seen as important with regards to its biodiversity maintenance.

Figure 8-1: Grassland habitat type

From the data displayed in Figure 8-2 it is evident that the dominant growth forms encountered within this vegetation type is graminoids, followed by herbs and bulbs. Shrubs were in the minority with tree species not present at all. Figure 8-3 confirms that medicinal plants were more evident than the alien invasive species, suggesting that the negative impacts of the surrounding land use do have an effect on species composition within the natural areas.

From a grass succession perspective, climax and sub climax grass species were more prominent than pioneer species, indicating an established grass sword moving towards a climax state, from a successional aspect, but which also exhibits pioneer species that indicates disturbance is still playing a role within natural grasslands. This vegetation type plays a substantial role in ecosystems services, due to naturally occurring fauna species being reliant on the shelter food and general habitat available to them.

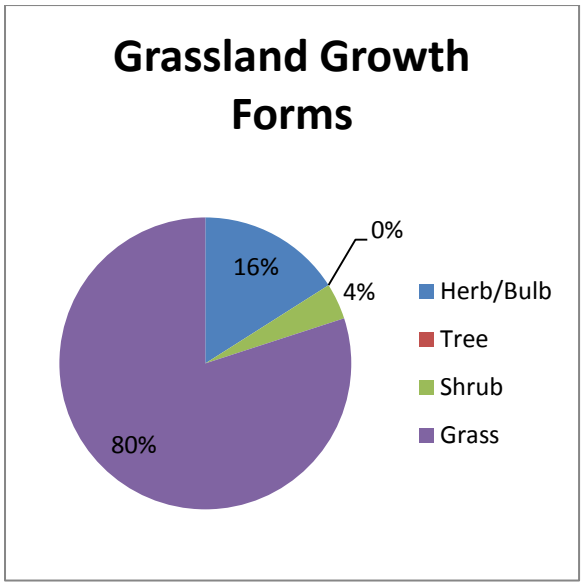

Figure 8-2: Grassland growth forms

8.2.2 Current cultivation

Areas that were found to be under current cultivation, accounts for approximately 58% of the study area, the majority of these are maize fields. The anthropogenic pressure that reduced the grassland has resulted in increased areas under current cultivation.

Areas of current cultivation were encountered on the areas with the least gradient, but also on the hill slopes where the gradient was no too aggressive Figure 8-3). Due primarily to the mono culture of maize plants, the ecological functioning of these areas was very low. This resulted in the ecological sensitivity being low.

Figure 8-3: Current maize cultivation

The vegetation type designated as current cultivated vegetation was, as expected dominated by the grass growth form, the dominating species of grass however is maize (*Zea maize*) plants. This indicates the dominant land use of these areas (Figure 8-3). As this survey was undertaken during the dry season, many of the maize fields were already harvested. Herbs and bulbs were found to be prominent on the periphery of this vegetation type, these were however pioneer weed species that thrive on open ground, which is created through ploughing. The shrub component falls within the same category, as they are also found on the edges of the plantations, and are also of a weedy nature. Medicinal plant species were more dominant that weed species, however certain weed species are also medicinal which could skew the data (Figure 8-4).

Climax grass species dominated the ecological services, specifically because of the maize plants. However sub climax grasses were also present and close behind the number of climax grasses. This vegetation type plays a small role in ecosystems services, however the large supply of food (maize) available, does contribute to the vegetation type being favoured by rodents, seed eating birds and reptiles that may prey on them.

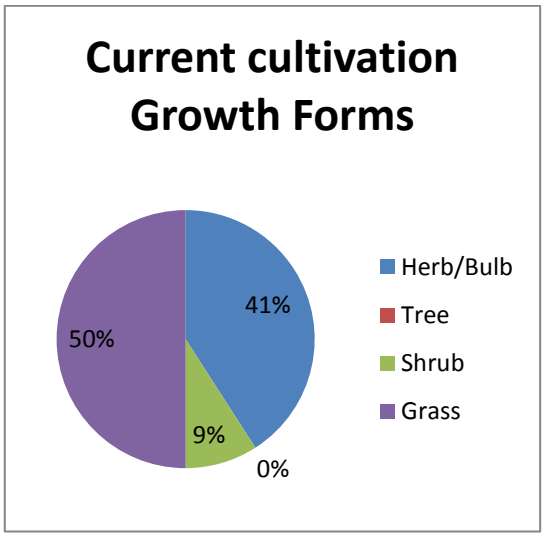

Figure 8-4: Cultivation growth forms

8.2.3 Alien trees

A small but prominent collection of alien invasive and exotic tree species were encountered throughout the project footprint, the dominant tree species found here were *Eucalyptus spp., Acacia spp., Populus spp*. and *Pinus spp* (Pine) (Figure 8-5). These tree species were either planted as windbreaks by local farmers, as is the case with Pine and *Eucalyptus spp*, or they were transported to the area via waterways such as *Populus spp*. The alien trees habitat type was further encountered on the hill slopes of rolling hills and flat areas between these hills.

These areas create a different micro habitat where tall tree cover shaded grassy areas. These areas were however very limited (1.6 %) and did not represent a significant amount of the vegetation habitats present.

Due to the effect of the alien invasive plant species that displaces indigenous flora the biodiversity maintenance of these areas was low. However remnants of indigenous vegetation still exist which, as mentioned, creates microhabitats.

Figure 8-5: Alien trees habitat type (*Populus x canescens*)

The alien trees vegetation type was encountered in isolated pockets within the study area, usually a specific pocket was dominated by one alien tree species. This vegetation type is the opposite of the grassland vegetation type and displays the growth forms that are not found within the Highveld grassland, as previously discussed, this is due to the natural occurring climatic events found here, events such as cold winter, frost and fire (Figure 8-6).

Areas where the effects of these events are diminished such as valleys or rocky areas, one could encounter trees. The large amount of grass species that was encountered was due to invasive grass species establishing themselves on the periphery of this vegetation type. Flora was almost entirely dominated by alien invasive and weed species, with very few climax and sub climax grasses found. Pioneer grass species was however prominent. This vegetation type plays a small role in ecosystems services, it does however contribute to available nesting sites for bird species.

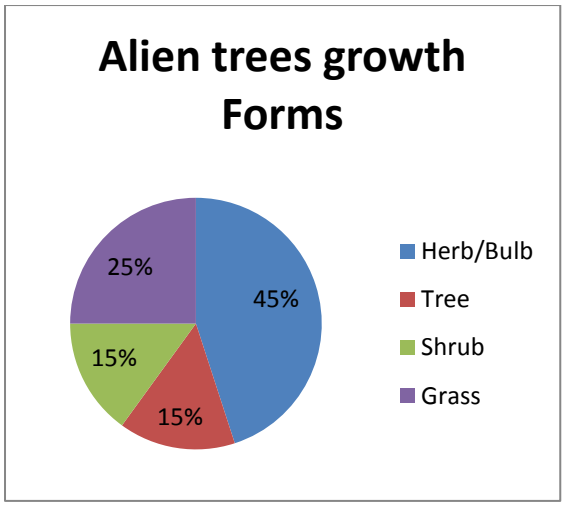

Figure 8-6: Alien trees growth forms

8.2.4 Pastures

Areas utilized as pastures were interspersed with the areas under current cultivation, this comes as no surprize as these farming practices are very often practiced concurrently. Evidence of cattle grazing in these areas was found.

Pasture areas together with cultivated areas are primarily responsible for declining natural habitat, which as discussed previously are Grassland. Pastures were encountered on the more flat areas and on the hill slopes where the gradient was gradual.

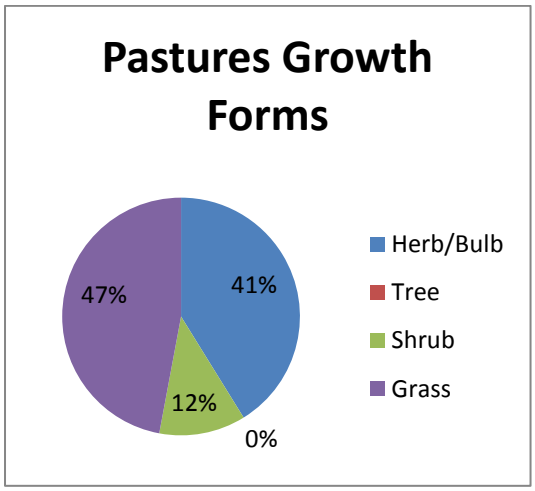

Figure 8-7: Pastures growth forms

In Figure 8-8, the dominant growth form was evident as being grass, however the majority of the grass species were in the pioneer and sub climax successional stages, indicating disturbance that prevent the grass sword attaining a climax status. The disturbance in this case appears to be grazing by cattle. No trees and only a few shrub species were encountered, once more the limiting climatic events (fire frost) have eliminated these growth forms. Medicinal plant species was scarce while alien invasive plants species was more prominent.

Figure 8-8: Pastures vegetation type

8.2.5 River and riparian

The River and riparian habitat type occurred on the eastern border (predominantly river) and the central and western (river and riparian) of the study site (Figure 8-9). Multiple small wetland systems were identified and are indicated on Plan 4. These areas were dominated by riparian vegetation that grows in seasonally to permanent wet soil. This habitat type covered 3.8 % of the study site and was located in a low lying riparian area.

Figure 8-9: River on the western border of the project area.

Growth forms that are not prominent in the other vegetation types almost dominated the riparian areas; sedges, reeds and ferns were well represented and grass species was found on the riverbanks, however they were not prominent within the permanently wet areas (Figure 8-10).

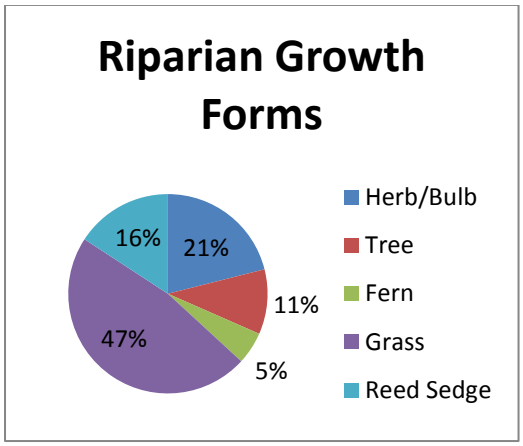

Figure 8-10: Riparian growth forms

Alien invasive or weed species were dominant within this habitat type, this was because of the high density of *Salix babylonica* (Weeping willow trees) on the river banks, while grass species specifically pioneer grasses also found regularly, seasonal burning could be the reason for this. Signs of seasonal burning were observed in the central grassland areas during dry season field work. This vegetation type supported the animal species because of shelter, food, water and general habitat of this kind is available to fauna species that are

specifically adapted to it. Amphibian species were only encountered within this vegetation type as were certain birds.

8.2.6 Rocky outcrops

Rocky outcrops are a sensitive landscape as determined by the MTPA, as per the minimum requirements set forth by Parks Board. Reasons for the protection of these outcrops are that they provide habitat for plant and animal species that is not impacted on by agriculture due to the unsuitable rocky nature of these outcrops for ploughing (Figure 8-11). Rocky outcrops accounted for .5% of the study area (Plan 4).

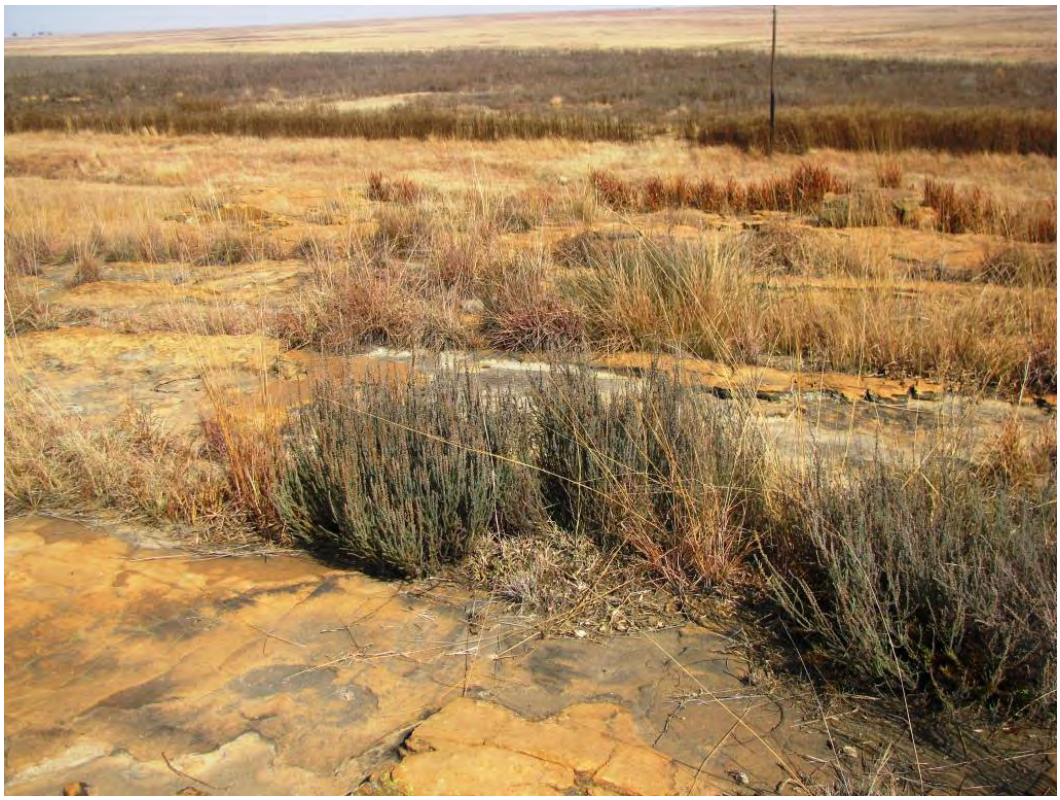

Figure 8-11: Rocky outcrops.

The rocky outcrops vegetation type was limited to the eastern banks of the river and riparian habitats. These areas were found to harbour a variety of growth forms, herbs, bulbs, sedges and reeds were well represented, with the reeds and sedges being found in areas where ground water surfaces on the exposed rocks. Trees were also encountered but one of these was an invasive species (*Salix babylonica*). From an ecological services point of view, medicinal species were prominent, but alien invasive species were also found. Grasses were found on the periphery of the rocky outcrops and these most often were grassland species pioneer subclimax and climax species were found in equal numbers.

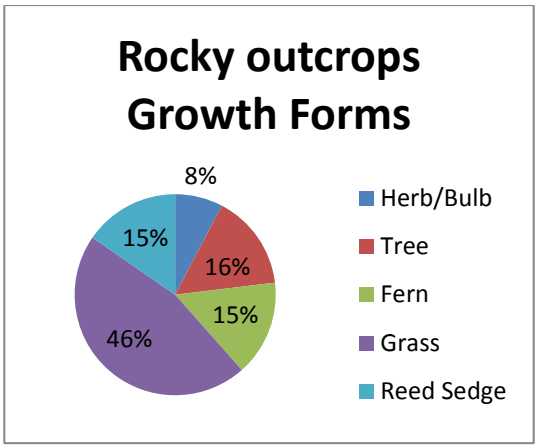

Figure 8-12: Rocky outcrops Growth form

8.3 Vegetation survey

The results of the dry season vegetation survey is summarised below. The study concentrated on the prevailing vegetation/habitat types that were observed and tentatively demarcated on aerial photographs. These vegetation types were subsequently field truthed by means of field work with the findings presented here.

8.3.1 Plant species recorded during the field surveys

During the field surveys, 78 plant species were recorded (Appendix A). These species included five tree, six shrub, one reed, two sedge, 34 grass and two herb or bulb species. From a grass perspective eight decreaser grasses were observed in the area. Seven grasses are Increaser I species, with six climax grasses occurring in the project area, these are known to occur in underutilised veld (van Oudtshoorn, 1999). Furthermore, twelve Increaser II grasses were recorded in the area, these species are abundant in over utilised veldt and therefore increase with excessive grazing. There was one Increaser III grasses species observed in the area.

Three grasses recorded in the area were exotics, weed or alien invasive (Table 8-2). During this dry season field survey it was found that a fire has moved through the area and burnt a substantial amount of the grassland and riparian vegetation types.

8.3.1.1 Red Data Plant Species

No red data listed plant species were encountered.

8.3.1.2 Exotic and Invasive Plant Species

The Conservation of Agricultural Resources Act regards weeds as alien plants, with no known useful economic purpose and as a result, should be eradicated. Invader plants, also considered by the Act, are also of alien origin but may serve useful purposes as ornamentals, as sources of timber, or may have other benefits. These plants need to be managed and prevented from spreading.

Category 1 plants are weeds that serve no useful economic purpose and possess characteristics that are harmful to humans, animals or the environment. These plants need to be eradicated using the control methods stipulated in regulation 15.D of the CARA. Category 2 plants are plants that are useful for commercial plant production purposes but are proven plant invaders under uncontrolled conditions outside demarcated areas. Category 3 plants are mainly used for ornamental purposes in demarcated areas but are

proven plant invaders under uncontrolled conditions outside demarcated areas. The planting of Category 2 and 3 plants should be confined to demarcated areas under controlled conditions of cultivation.

A total of 21 alien invasive, weed or exotic plant species were observed during the field survey (Table 8-2). Alien invasive species tend to out compete the indigenous vegetation, this is due to the fact that they are vigorous growers that are adaptable and able to invade a wide range of ecological niches (Bromilow, 2010). They are tough, can withstand unfavourable conditions and are easily dispersed. This is indicative of early stages of succession and although these species are invasive their use in aid of the prevention of erosion, is valuable. From the vegetation communities identified the alien trees, current cultivation and pastures were found to contain the highest number of alien invasive plant species. These are also the areas associated with the highest exposure to disturbances, and as mentioned previously, these plants are highly adaptable and do colonise open or disturbed areas, which are prevalent in the above mentioned communities.

Table 8-2: Alien invasive and Weed species recorded.

Scientific Name	Common Name	Ecological Status	Form	1	2	3	4	5	6
Bidens bipinnata		Alien Invasive	Herb	#	#	#	#		
Bidens formosa	Cosmos	Alien Invasive	Herb			#	#	#	
Conyza albida	Tall fleabane	Weed	Shrub			#	#		
Cortaderia selloana		Alien invasive	Grass		#	#	#		
Cyperus esculentus	Yellow Nut Sedge	Medicinal/Edible/Alien Invasive	Sedge	#				#	
Datura stramonium	Common Thorn Apple	Alien Invasive*	Herb		#				
Eucalyptus camaldulensis	Red River Gum	Alien Invasive**	Tree			#			
Gomphocarpus fruticosus	Milkweed	Exotic	Herb		#	#	#		
Gomphrena celosioides	Batchelor's Button	Exotic	Herb	#		#			
Paspalum dilatatum	Dallis Grass	Exotic	Grass	#					
Paspalum urvillei	Vasey Grass	Exotic	Grass	#					
Pennisetum clandestinum	Kikuyu Grass	Exotic	Grass						
Persicaria lapathifolia	Spotted Knotweed	Alien Invasive	Herb		#	#		#	
Populus x canescens	Grey popular/Cottonwood	Cat 2 Cara	Tree			#			
Richardia brasiliensis		Alien invasive	Herb	#		#			
Salix babylonica	Weeping willow	Cat 2 Cara	Tree					#	
Solanum incanum	Grey Bitter-apple	Medicinal Weed	Shrub		#	#			
Stoebe vulgaris	Bankrupt Bush	Weed	Shrub		#	#	#		
Tagetes minuta	Tall Khaki Weed	Alien Invasive	Herb				#		
Pinus patula	Patula pine	Alien invasive	Tree			#			

Verbena bonariensis	Tall Verbena	Alien invasive	Shrub							

Note: * - Category 1 plants according to CARA

** - Category 2 plants according to CARA

1- Grassland, 2- Current Cultivation, 3- Alien trees, 4- Pastures, 5- Riparian, 6- Rocky outcrops.

The presence of exotic invasive and weed plant species in an area is either an indication of recent disturbance where these species are pioneering re-establishment of plants, or misuse of an area where the natural plant species were selectively or completely removed possibly by livestock.

The presence or absence of these plants in a specific habitat type is therefore an indication of the ecological capacity and importance of that specific habitat type. Areas that contained high numbers of alien invasive and weed species are found not to support high numbers of animals as animals are not used to feeding on these plant species.

The majority of the exotic tree species encountered such as *Pinus patula, Populus x canescens* and *Eucalyptus camaldulensis* were planted by previous landowners for windbreaks around farm houses, this was evident in the location of most these trees. Habitat type 3 (Alien trees) (see Plan 4), indicates all the occurrences of alien tree clumps. The species *Populous x canescens* located on the eastern side of the central stream (Plan 4) is associated with riparian habitat types and reproduces vegetatively, therefore the removal of these trees are of importance to stop their spread.

8.3.1.3 Medicinal Plant Species

Medicinal plants are important to many people and are an important part of the South African cultural heritage (Van Wyk *et al*, 1997). Plants have been used traditionally for centuries to cure many ailments, as well as for cultural uses such as building material and for spiritual uses such as charms.

During the field work, 19 medicinal plants were observed by Digby Wells specialists (Table 8-3). Two of the most common species were *Haplocarpha scaposa* (False Gerbera) which is used in traditional medicine and *Tephrosia purpurea* (Silver Tephrosia) (Pooley 1998). The majority of the medicinal species were encountered within the natural grassland vegetation type with pastures areas also containing medicinal species.

Table 8-3: Medicinal plant species recorded.

Scientific Name	Common Name	Ecological Status	Form	1	2	3	4	5	6
Cyanotis speciosa	Doll's powderpuff	Medicinal/Charm	Herb	#					
Cyperus esculentus	Yellow Nut Sedge	Medicinal/Edible/Alien Invasive	Sedge	#				#	
Gazania krebsiana	Common Gazania	Medicinal	Herb	#			#		
Haplocarpha scaposa	False Gerbera	Medicinal	Herb	#		#			
Helichrysum acutatum		Medicinal	Herb	#					
Helichrysum nudifolium	Hottentot's Tea	Medicinal/Magical	Herb/Bulb	#					
Helichrysum		Medicinal/Magical	Bulb/Herb	#					

rugulosum									
Ledebouria ovatifolia		Medicinal	Bulb/Herb		#				
Pelargonium luridum	Stalk-flowered Pelargonium	Medicinal	Herb			#			
Persicaria serrulata	Knotweed/Snake Root	Medicinal	Herb						
Pollichia campestris	Waxberry	Edible/Medicinal	Shrub	#					
Polygala amatymbica	Dwarf Polygala	Medicinal	Herb	#					
Polygala hottentotta	Small Purple Broom	Medicinal	Herb/Bulb	#					
Scabiosa columbaria	Wild Scabiosa	Medicinal	Herb	#					
Searsia leptodictya	Mountain karee	Medicinal	Tree					#	#
Senecio erubescens		Medicinal	Herb	#					
Senecio inornatus		Medicinal	Herb		#				
Solanum incanum	Grey Bitter-apple	Medicinal Weed	Shrub		#	#			
Tephrosia purpurea	Silver Tephrosia	Medicinal	Herb				#		

Note:

1- Grassland, 2- Current Cultivation, 3- Alien trees, 4- Pastures, 5- Riparian, 6- Rocky outcrops.

The various components measured during the field survey all play a part in the health of the system currently present in the area of interest. From Table 8-4 it can be seen that the number of species, the medicinal plant species and the cultural (including magical) plant species are all more prominent in areas of less disturbance with exotic and weed species being more prominent within the areas of high disturbance or transformed areas, because of disturbance.

Table 8-4: Summary of the vegetation units

Vegetation Unit	Ha (Percentage)	No. of species	Red Data species	Medicinal plant	Cultural species	Alien, Weed, Exotics
Grassland	261.51 (25.58)	73	0	11	11	5
Current cultivation	589.70 (57.69)	22	0	3	3	7
Alien trees	17.17 (1.68)	20	0	3	3	12
Riparian	68.97 (6.75)	20	0	3	3	5
Pastures	79.49 (7.87)	17	0	2	2	7
Rocky outcrops	5.37 (0.52)	10	0	3	3	2

8.4 Animal Survey

8.4.1 Animal species of concern

From the desktop work conducted for the project area the species listed in Table 8-5 was identified as possibly occurring within the QDS grids within which the study area falls.

Table 8-5: Potential Red Data animal species

Species Name	Common Name	Status	Likelihood
Georychus capensis yatesi	Cape mole rat	EN	Medium
Chlorotalpa sclateri montana	Sclater's golden mole	CR	Medium
Amblysomus septentrionalis	Highveld golden mole	VU	Medium
Chrysospalax villosus rufopallidus	Rough-haired golden mole	CR	Medium
Chrysospalax villosus rufus	Rough-haired golden mole	EN	Medium
Neamblysomus julianae	Juliana's golden mole	EN	Medium
Amblysomus robustus	Robust golden mole	VU	Medium
Amblysomus hottentotus meesteri	Meester's golden mole	VU	Medium
Otomys laminatus	Laminate vlei rat	VU	Medium
Rhinolophus blasii empusa	Peak-saddle horseshoe bat	EN	Medium
Miniopterus fraterculus	Lesser long-fingered bat	VU	Medium
Myotis welwitschii	Welwitsch's hairy bat	EN	Medium
Cloeotis percivali australis	Short-eared trident bat	EN	Medium
Orycteropus afer	Antbear	NE	Medium
Ourebia ourebi	Oribi	VU	Medium
Poecilogale albinucha	African striped weasel	NE	Medium
Lycaon pictus	Wild dog	EN	Low
Manis temminckii	Pangolin	VU	Low
Proteles cristatus	Aardwolf	NE	Medium
Panthera pardus	African Leopard	NE	Low
Pronolagus crassicaudatus ruddi	Natal red rock rabbit	NE	Medium

8.4.1.1 Mammals

Actual sightings, spoor, calls, dung and nesting sites were used to establish the presence of animals on the proposed project site. The evidence of dung and spoor suggests that animals were present in the area although very few were recorded during the surveys. Sherman traps were placed close to fresh burrows for four days at four localities in an attempt to identify smaller mammals possibly present in the area. Table 8-6 lists all mammals observed during dry season survey, by Digby Wells specialists. The mammals recorded were found within a variety of the vegetation communities present.

Table 8-6: Mammal species

Common Name	Scientific Name	Red Data Status	Recorded	UNIT
Angoni Vlei Rat	*Otomys angoniensis*	Least concern	Locals	Grassland
Black backed jackal	*Canis mesomelas*	Least concern	Signs	Grassland
Common duiker	*Sylvicapra grimmia*	Least concern	Seen	Grassland
Common Molerat	*Cryptomys hottentotus*	Least concern	Locals	Grassland
Highveld Gerbil	*Tatera brantsi*	Least concern	Locals	Grassland
Porcupine	*Hystrix africaeaustralis*	Least concern	Locals	Grassland
Serval	*Leptailurus serval*	**Near Threatened**	Seen	Grassland
Steenbok	*Raphicerus campestris*	Least concern	Seen	Riparian
Water mongoose	*Atilax paludinosus*	Least concern	Signs	Riparian
Yellow mongoose	*Cynictis penicillata*	Least concern	Seen	Grassland

8.4.1.2 Birds

A total of 48 bird species were identified during the dry season survey (Appendix B). Most of these birds were observed in the vicinity of less disturbed areas. Many were also identified close to the dam on the south eastern corner of the project area, with birds regularly seen feeding on dried maize kernels on the edges of maize fields.

Red Data birds

No rare or endangered species were observed during the dry season survey. This does not mean that none occur here, but merely that none were recorded during this survey.

8.4.1.3 Reptiles and Amphibians

No reptiles were encountered during the dry season field survey. The herpetofauna of wetlands in general tends to be poor due to a paucity of habitat diversity. In addition they are difficult to see in a dense field layer and go into hiding on being disturbed. It is therefore difficult to assess their presence. The frequency of grass fires is detrimental to the existence of reptiles and amphibians not only directly, but also indirectly as they are exposed to predation following the removal of cover, which will result in reduced abundance and possibly in local extinctions of some species.

During the dry season studies the following amphibian species were encountered in the study area, these species were found in the vicinity of permanent water bodies and drainage lines (Table 8-7).

Table 8-7: Amphibian species encountered

Common name	IUCN Status	Habitat	Breeding sites
Guttural toad	Least Concern	Savanna	Semi-permanent water
		Grassland	Open pools
			Dams
			Streams
			Pans
Raucous Toad	Least Concern	Fynbos	Semi-permanent water
		Grassland	Permanent water
		Woodland	Rivers
			Streams
			Ponds

In addition to the amphibian species encountered it is considered likely that at least the Common River Frog *Afrana angolensis* will occur along the river margin while it is possible that the Transvaal Girdled Lizard *Cordylus vittifer* and Transvaal Thick-toed Gecko *Pachydactylus affinis* will occur among the rocky outcrops. This assumption is made because of the prevalence of these specie's preferred habitat types and associated services it provides to them.

9 FINDINGS

9.1 Vegetation

The grassland described after field work is one with various threats presently influencing the size and ecological functioning of it. The grassland is currently shrinking because of the anthropogenic threats that are present such as agriculture and mining, because of the shrinking grassland the influence of the edge effect is becoming more pronounced, whereby the area covered by the boundary or ecotone of the grassland is increasing in size.

This ecotone cannot be described as grassland because it contains elements of both the declining grassland and the advancing habitat type, be it maize field or disturbed areas. The other vegetation types present in the study area are a modified version of the original grassland vegetation type, after transformation. The introduction of exotic trees brought about the alien trees vegetation type, the introduction of maize (after grassland removal), brought about the current cultivation vegetation type.

9.2 Mammals

No Large and medium sized herbivores were encountered during the dry season field survey, this could be as a result of loss of habitat, informal hunting practiced on the study site. The very low numbers of actual wild animal sightings (small antelope species) confirmed this. The drainage lines present on site as well as the pans provide watering points for the existing wildlife, however only bird species were found to congregate in these areas. With the abundance of maize fields and the subsequent availability of food one can assume the presence of rodents. This and the presence of preferred habitat (reed beds and marshes) could indicate the reason for a small population of these animals surviving. The mammals present on the project site are a direct result of the number and severity of threats present. These threats include shrinking available habitat, hunting, lack of shelter and lack of space to accommodate viable populations. Due to the size and threats present in the area

no large herbivores will be able to return to the area, realistic expectations should be to conserve natural habitat.

9.3 Birds

During the dry season field excursions 48 bird species were observed, most of which were observed where maize harvesting have taken place on the property. Furthermore, most of the birds were either water birds (Egrets, Cormorants and Ducks) or seed eating birds (Quail, Doves and Guinea fowl), which is to be expected as the dominant land use in the area is maize farms which is a great source of food for seed eaters. The Marsh Owl (*Asio capensis)* was also encountered during night surveys.

Ecosystem services offered to bird species include shelter for bird species in the form of nesting sites within the trees of the alien tree vegetation type. Furthermore the grassland areas could offer space and materials for ground nesting birds to nest. As mentioned earlier the aquatic birds and seed eating birds were common on the property. The large contingent of seed eating birds was however due to the presence of two of the altered vegetation types, which was supplying the birds with food items in the form of seeds from the pastures and discarded maize in the agricultural fields. The alteration of the vegetation types by anthropogenic activities can therefore be altering the bird species composition of the study site.

The Marsh Owl is locally common in much of southern Africa where it is resident but with some local movements as a result of changing availability of food. This bird prefers open country between the coastal marshes and the savannah, inland marshes, moors and even the highlands up to 3 000m. It prefers areas of short vegetation with occasional patches of longer grass and is sometimes seen near human habitation. It is not found in forested areas.

The Marsh Owl is an opportunistic hunter with a varied diet and equally varied hunting methods. It will use perches such as tree stumps or fence posts when they are available but is equally adept at quartering the ground at a height of a few metres or dropping abruptly on its prey or even pursuing prey on foot. Its diet includes a wide variety of mammals from very small voles to medium-sized animals like hares. Small rodents and small birds make up the major part of its diet, but it will also take bats, birds, amphibians, reptiles and invertebrates such as scorpions, locusts and beetles.

The main threats it faces are bush fires, floods and habitat degradation by overgrazing and by the use of pesticides. It is also susceptible to road traffic and entanglement in barbed wire. Some nests are lost to predators.

It is generally seen singly or in pairs although, outside the breeding season, it may be in larger groups. Favoured roosts during the daylight hours are in hollows in long grass or similar vegetation - at night it is likely to be seen perched on a fence post or similar vantage point, keeping watch for potential prey. It tends to be quite aggressive in defence of its nest, but may, if the occasion demands, feign injury to distract a potential enemy.

The Marsh Owl is both monogamous and highly territorial. Where there is a colony, each territory can be as much as two square kilometres, although in areas of dense population and abundant food they may be as close as 75m apart. The male advertises his claimed territory by circling above it with much wing-clapping and croaking. This is continued by the pair as a courtship ritual. A depression in the ground amongst tall grass or weeds is lined with dry leaves towards the end of the wet season to form a nest. Vegetation is often pulled over the top of it as a canopy and alongside as an entrance tunnel. Between two and six eggs are laid with three being average, at intervals of two days. The female commences incubation with the first egg. Incubation lasts for 27 – 28 days. The chicks open their eyes at about seven days and by ten days the facial disc is clearly visible. The young leave the nest

and scatter into the vegetation from two weeks on. They make dancing motions and small calls to advertise their position to the adults, who bring them food. By 10 weeks they are fully feathered. Fledging commences at 29 - 35 days, but the young remain with their parents for some time before becoming totally independent.

9.4 Reptiles

The fact that no reptile species was encountered during the field surveys could be attributed to positioning of the study area in the landscape, with many agricultural activities surrounding the site, however the presence of the grasslands and riparian areas, and their accompanying rodent population suggests that certain reptile species such as snakes could be present.

9.5 Amphibians

The presence of amphibian species was investigated and two species were encountered, both of which can be expected to occur in the Mpumalanga grasslands. Because amphibians are ectothermic they are most active when their surrounding temperature stabilizes between 20˚C and 30˚C, which is why they hibernate in burrows or damp retreats during winter times when temperatures regularly fall below 20˚C (Du Preez and Caruthers 2009).

In summer rainfall areas breeding usually takes place after the first thunder storms. It therefore stands to reason that amphibian field surveys are most successful during the rainy season. With the available habitat present on the area of interest, it was expected to encounter amphibian species. However, after the dry season field visit it was evident that the threats present in the study area were having a serious effect on the population of amphibians. The biggest threat observed was habitat degradation through uncontrolled burning, this practice not only destroys the habitat (plants for shelter and food) but also directly kills the amphibians that cannot avoid the flames.

10 SUMMARY TABLE

10.1 Site-specific conservation value

The biodiversity conservation value of each vegetation unit in the study area was determined considering all the information collated during this study (Table 15-2). The following criteria were broadly taken into account in evaluating the importance of biodiversity of each vegetation unit:

- Ecological status of the vegetation unit (i.e. untransformed (primary) or transformed (secondary));
- Conservation status of vegetation type represented by each vegetation unit (after Mucina and Rutherford, 2007);
- Relative indigenous fauna and flora species richness of the vegetation units;
- Presence or habitat-derived probability of occurrence of Red Data or Protected fauna and flora species present in each vegetation unit;
- Presence of special (unique or restricted) habitats (such as ridge or hill);
- Presence of invasive alien species;
- Any other significant biodiversity features of the vegetation unit that may contribute to its conservation value.

Based on the above considerations, each vegetation unit was given a sensitivity/importance value of high, medium, low or negligible:

- The vegetation unit that have been more or less irreversibly transformed from their natural state have **negligible** value in terms of biodiversity conservation.
- The vegetation unit with a **low** sensitivity / importance are generally disturbed or transformed biotopes with little conservation value. The diversity of indigenous species is relatively low (compared to the natural untransformed habitats of the site) and the units are unlikely to support threatened/protected species. Future developments should, where possible, be planned within these areas, rather than in the medium or high conservation areas.
- Vegetation unit with a **moderate** sensitivity / importance are generally areas with some disturbance, but not as severe as for areas with a low sensitivity / importance. These are generally transformed habitats with good habitat potential or deteriorated untransformed habitats. The relative species richness of these units may also be lower than in those with high conservation value. No Red Data species have been identified/observed in this vegetation unit but there is still a moderate possibility that threatened/protected species may utilise the vegetation unit. Future alterations of these vegetation unit should be limited, but development in these areas is preferred above the areas with high conservation value.
- A vegetation unit with **high** sensitivity / importance is generally one that comprises untransformed biotopes where Red Data and protected species have been observed or where there is a high probability of such a species occurring. These vegetation units often consist of primary vegetation, rivers, streams and wetlands and are considered important even if they are disturbed. Mining and development should be limited and prevented as far as possible in these areas.

Threats to plant species and ecosystems create areas where alien and exotic plant species start to dominate the landscape. The below Table 10-1, displays the results obtained from all six habitat units. The results therefore identify and delineate the various vegetation and/or habitat types present within the study area, characterise the sensitivity (as per Table 7-1) of the vegetation and/or habitat types and describe the ecological state of the mammals, birds, amphibians and reptiles present.

Table 10-1: Summary table.

Vegetation type	Flora	Mammals	Birds	Amphibians	Reptiles	Sensitivity
Grassland	73	3	28	1	-	**High**
Current cultivation	22	4	16	-	-	Negligible
Alien trees	20	2	8	-	-	Low
Pastures	20	-	18	-	-	Medium
Riparian	17	2	12	1	-	**High**
Rocky outcrops	10	2	10	-	-	**High**

11 IMPACT ASSESSMENT

11.1 Construction Phase

During the construction phase the majority of the negative impacts are expected to occur.

Activity 1: Site clearing and topsoil removal

All vegetation communities, identified during field that are present within the proposed area of development and will be impacted on. Of concern is the natural areas as the existing vegetation (Grassland, rocky ridges and riparian areas) will be removed to facilitate the construction of mine and related infrastructure. This will include the continuous and complete removal of vegetation on the footprint of the actual pit. This activity is considered to be short term and will occur during the construction phase. The impact will be regional in extent with impacts likely to occur on site. The presence of sensitive habitats does however mean that destruction will be a regional loss of the habitat type. The severity of the impact was determined to be high.

The partial degradation of natural vegetation and habitat for animal life has already taken place within the surrounding environment due to current land use practices. The destruction of the areas with undisturbed natural grassland will result in the permanent reduction of natural habitat of reptiles, birds, frogs, insects and mammals present within the areas. The destruction of the rocky ridges habitat type will be of special concern as these are sensitive habitats. The grassland, rocky areas and riparian vegetation found offers habitat to certain birds, reptiles, frogs, insects and mammals that could be present. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be high.

Impact assessment:

Parameter	Description	Rating
Duration	Short term	5
Extent	Municipal area	4
Severity	Moderate	5
Likelihood	Certain	7
Significance	High	84%

Activity 3: Blasting and development of initial boxcut for mining

The blasting operations will scare off any remaining wildlife, of concern is the presence of the Marsh owl within the grassland vegetation type.

This activity is considered to be long term in duration as it will be required for the life of mine. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be medium high

Impact assessment:

Parameter	Description	Rating
Duration	Medium term	3

Extent	Site specific	2
Severity	Moderate	4
Likelihood	Certain	7
Significance	Medium - high	63%

11.2 Operational phase

Activity 6: Vehicular activity on haul roads, use of hall roads

The vehicular activity will result in the creation of soil based dust which will increase the deposits these materials on plant leaves, blocking stomata and inhibiting evapotranspiration. Natural dust will be created from use of the haul road and ash dust will be created during transport by haul trucks. This will impact on the vegetation health and availability as food items as well as inhibit the ability of the plants units to provide ecological services. This activity will also have a negative effect on animal species in the area, as they could be hit by vehicles. This activity is considered to be long term in duration as it will be required for the construction and operational phases. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be minor.

Impact assessment:

Parameter	Description	Rating
Duration	Long term	5
Extent	Site specific	2
Severity	Minor	2
Likelihood	Probable	4
Significance	Medium -high	63%

Activity 10: Concurrent replacement of overburden, topsoil and re-vegetation

This impact is negative. The replacement of overburden and topsoil throughout the operational phase may result in the reduction of available space for alien invasive species, soil erosion and soil compaction, associated with top soil storage areas. This activity will create favourable habitat for indigenous plant species, and promote rehabilitation efforts. This activity is considered to be medium in duration as it will be required for the operational phase as well as the decommissioning phase. The extent will be site specific with effects being on site. The severity of the impact was determined to be moderate.

Impact assessment:

Parameter	Description	Rating
Duration	Medium term	3
Extent	Site specific	2
Severity	Minor	1
Likelihood	Certain	5
Significance	Medium - high	53%

11.3 Decommissioning phase

Activity 11: Removal of all infrastructure.

The demolition and removal of infrastructure may result in impacts to vegetation, as large machinery is needed for removal of infrastructure. Of concern here is the destruction of vegetation, creation of favourable habitat for fast growing invasive species and ground compaction. Also of concern are the possible spillages from infrastructure holding hazardous material. These spillages and leaks may be considered for infrastructure such as sewerage and waste facilities, toxicant, pollutant and fuel storage infrastructure and general vehicle use. In the event that this infrastructure is not demolished properly and with caution, resulting spillages and leaks would impact on vegetation and soil quality. The demolition of infrastructure may require vehicles making use of non-designated areas, special care must be taken not to destroy rehabilitated areas. This activity is considered to be medium in duration as well as site specific in extent with impacts being on site. The severity of the impact was determined to be minor.

Impact assessment:

Parameter	Description	Rating
Duration	Medium term	3
Extent	Site specific	2
Severity	Minor	1
Likelihood	Certain	6
Significance	Medium	36%

Activity 12: Rehabilitation (spreading of soil, re-vegetation & profiling/contouring)

This impact is negative. The replacement of overburden and topsoil throughout the life of mine as well as the final replacement during the decommissioning phase may result in the restoration of the natural vegetation. This activity is considered to be medium in duration as it will be required for the decommissioning phase. The extent will be site specific with effects being on site. The severity of the impact was determined to be moderate.

Impact assessment:

Parameter	Description	Rating
Duration	Moderate-short term	3
Extent	Site specific	2
Severity	Moderate	1
Likelihood	Certain	6
Significance	Medium	36%

Activity 14: Environmental monitoring of decommissioning activities.

This activity is neutral, this activity will commence only after closure has taken place, furthermore this activity will be on-going after operations in the area has stopped.

Impact assessment:

Parameter	Description	Rating
Duration	Moderate-short term	3
Extent	Site specific	2
Severity	Moderate	1
Likelihood	Certain	6
Significance	Medium	36%

11.4 Post closure phase

Activity 16: Post-closure monitoring and rehabilitation.

This activity is neutral and will commence only after closure has taken place, furthermore this activity will be on-going after operations in the area has stopped.

Impact assessment:

Parameter	Description	Rating
Duration	Moderate-short term	3
Extent	Site specific	2
Severity	Moderate	1
Likelihood	Certain	6

Significance	Medium - high	36%

12 CUMULATIVE IMPLACTS

According to the Mpumalanga Biodiversity conservation plan handbook the Mpumalanga province is categorised in six biodiversity conservation categories for terrestrial ecosystems using systematic biodiversity planning methods. In Table 12-1 one can see the six categories and the relevant percentages of each one in the province. In Plan 3 a visual representation of the six categories show that the study area consists of three terrestrial categories, these are Important and necessary, Least concern and No habitat remaining, these categories make up the majority of the province. Furthermore, three riparian areas consisting of wetland vegetation (Ferrar and Lotter 2007), also exist on the area of interest.

The main threat to natural areas/biodiversity is the reduction of viable habitat, which can be contributed to the following, human settlement and urban development, mining, industry and manufacturing, energy, transport, agricultural activities and tourism and recreation (Ekurhuleni SoER 2003). All of the above with the possible exception of tourism and recreation are currently exerting pressure on the study area (area in general) by reducing the viable natural land. If the cumulative impacts of all the above mentioned seven threats are taken into account, the outcome is the percentages displayed in Table 12-1. The No natural habitat remaining is the category in which most threats can be categorised, and the transformation of the natural habitat from Protected areas to No natural Habitat remaining is driven by the seven threats.

Table 12-1: Terrestrial biodiversity conservation categories (Ferrar and Lotter 2007)

Category	Percentage
Protected areas	14.8% (10.4% KNP)
Irreplaceable	2.4%
Highly Significant	12.3%
Important and necessary	9.5%
Least concern	25.5%
No natural habitat remaining	35.8%

The reduction in natural habitat has taken place because of the current and continuing land use within the study area, which is agricultural, the change in land use from agricultural to mining will not have such a negative effect as changing land use from pastures to mining, for example. The main reason for this is the presence of natural habitat in pastures that could support fauna species.

Therefore the immediate and direct negative effect of this project on the natural environment is not seen as significant. However as illustrated previously the cumulative effects of threats in the general area and province is of serious concern and needs urgent attention. As this document only discusses the current project, mitigation measures suggested in this document is only relevant for this project.

It is imperative that the mitigation measures set forth in this document is strictly adhered to as to reduce the contribution this project could have to the Least concern, Important and necessary and No natural habitat remaining categories.

13 MITIGRATION MEASURES AND MANAGEMENT PLAN

Table 0-1: Management Plan

Activity	Objectives	Mitigation/Management measure	Frequency of mitigation	Legal Requirements	Recommended Action Plans	Timing of implementation	Responsible Person	Significance after Mitigation
CONSTRUCTION PHASE								
Site clearing and topsoil removal	Limit degradation and destruction of natural environment to designated project areas	Keep the footprint of the disturbed area to the minimum and designated areas only. Vegetate and wet open areas to limit erosion.	Daily	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Removal of lose sediment and rehabilitation of exposed areas	Construction and operational phases	Environmental Co-ordinator EPC contractor	Moderate alteration
	Restrict alien invasive plant recruitment	Removal of vegetation during construction and operation will be minimised to reduce the risk of open areas occurring.	Daily	Conservation of Agricultural resources Act (CARA), 1983 (Act no. 43 0f 1983)	Rehabilitation	Construction and operational phases	Environmental Co-ordinator EPC contractor	Moderate alteration
	Maintain top soil biological activity	Soils stockpiling without compaction to keep the seed bank viable if topsoil is replaced within a year	Daily	Conservation of Agricultural resources Act (CARA), 1983 (Act no. 43 0f 1983	Adhere to height specifications of stockpiles	Construction and operational phases	Environmental Co-ordinator EPC contractor	Minor
Construction of surface infrastructure	Limit areas suitable for alien invasive recruitment	Removal of vegetation during construction of infrastructure will be minimised to reduce the risk of open areas occurring.	Weekly	Conservation of Agricultural resources Act (CARA), 1983 (Act no. 43 0f 1983)	Rehabilitation	Construction and operational phases	Environmental Co-ordinator EPC contractor	Minor
	Limit the erosion potential of the site	Make use of permeable materials for pavements and walk-ways. Introduce a storm water management programme and create flower beds below the street level.	Monthly	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Removal of lose sediment and rehabilitation of exposed areas	Construction and operational phases	Environmental Co-ordinator EPC contractor	Minor
Blasting and development of initial boxcut for mining	Limit blasting destruction , noise and dust	Blasting to be conducted by professionally qualified contractors.	Daily	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)		Construction and operational phases	Environmental Co-ordinator EPC contractor	Minor
OPERATIONAL PHASE								
Vehicular activity on haul roads	Prevent excess dust creation that could inhibit plant growth.	Wetting of the haul road to suppress dust creation as well as cover haul trucks to prevent dust emissions during transport.	Weekly	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Continuous wetting of operating areas	Operational phase	Environmental Co-ordinator EPC contractor	Minor
Rehabilitation and revegetation	Reduce areas available for alien infestation	The footprint of the area disturbed by the mining operation will have natural vegetation restored.	Daily	Conservation of Agricultural resources Act (CARA), 1983 (Act no. 43 0f 1983)	Soils to be stockpiled and managed properly for rehabilitation	Operational phase	Environmental Co-ordinator EPC contractor	Serious (Positive)
DECOMMISSIONING PHASE								
Removal of infrastructure no longer required	Avoid spillage of hazardous materials, thereby protecting vegetation and soil.	The correct and careful handling of the infrastructure housing pollutants and toxicants to prevent spillages and leaks	Daily	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Continuous inspection and management of the removal process to detect issues.	Decommissioning phase	Environmental Co-ordinator	Minor
	Avoid destruction of vegetation, the creation of favourable habitat for fast growing invasive plants and ground compaction.	Vehicles to make use of existing roads and designated areas. Avoid rehabilitated and natural habitat areas as far as possible.	Daily	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Rehabilitation of impacted wetland areas	Decommissioning phase	Environmental Co-ordinator	Minor
Rehabilitation and re-vegetation	Restore natural vegetation	The footprint of the area disturbed by the mining operation will have topsoil and overburden replaced to restore the vegetation cover.	Daily	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Rehabilitation to represent original contours and topography	Decommissioning phase	Environmental Co-ordinator	Serious (Positive)
	Limit the erosion potential of exposed areas.	Exposed areas will be re-vegetated	Weekly	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Removal of excess sediment and low gradient rehabilitation where possible.	Decommissioning phase	Environmental Co-ordinator	Serious (Positive)
	Limit the erosion potential of exposed areas.	Exposed areas will be re-vegetated	Weekly	National Environmental Act (NEMA), 1998 (Act no. 107	Removal of excess sediment and low gradient	Decommissioning phase	Environmental Co-ordinator	Serious (Positive)

				0f 1998)	rehabilitation where possible. Use of recommended seed mix. Soil amelioration.			
	Restore water infiltration, and reduce surface water runoff	Re-vegetated areas will form seepage areas which will help aid infiltration.	Weekly	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Restore of wetland areas and low gradient rehabilitation to create seepage units.	Decommissioning phase	Environmental Co-ordinator	Serious (Positive)
POST CLOSURE PHASE								
Post-closure monitoring and rehabilitation	Monitor rehabilitation efforts	Ensure correct measures are employed for a variety of rehabilitation projects	Weekly	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)		Post Closure Phase	Environmental Co-ordinator	Serious (Positive)
	Direct rehabilitation efforts	Ensure correct measures are employed for a variety of rehabilitation projects	Weekly	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)		Post Closure Phase	Environmental Co-ordinator	Serious (Positive)
	Avoid erosion, alien invasive species establishment	Monitor rehab outcome to ensure open areas are eliminated.	Weekly	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)		Post Closure Phase	Environmental Co-ordinator	Serious (Positive)

14 MONITORING PROGRAMME

14.1 Location

During monitoring of the biological environment the direct and indirect effects of the infrastructure construction of the various phases can be measured. This can be accomplished through monitoring on various areas, more specifically on the construction areas, to measure direct effects, and monitoring within the vegetation communities to measure indirect effects. Three monitoring sites on construction sites areas and four sites per vegetation community will be sufficient. The vegetation communities that must be monitored are the grassland, riparian and wetland and the ridges.

14.2 Parameters

For monitoring purposes it is suggested that a flora and fauna survey be performed by qualified specialists, in order to determine if trends are emerging in the composition of the flora and fauna environment. Any data collected during these surveys could be compared to previous surveys. The following parameters must be monitored within each vegetation community.

Flora

- Species richness;
- Medicinal species;
- Alien invasive species;
- Red data and Protected plant species.

Fauna

- Mammals;
- Birds;
- Herpetofauna;
- Invertebrates.

14.3 Objectives

The objectives of the monitoring program will be to firstly document the current state of the biophysical environment, thereafter to compare this information with previous studies, that were completed prior to construction activities. A comparison between these two data sets will be used to identify trends, positive or negative, that are forming because of current construction or operational activities. With the information gathered, areas of concern can be identified and management plans can be implemented to rectify these. Of special concern will be alien invasive species control and eradication.

14.4 Key performance indicators

Certain key performance indicators will be used to gauge the response of the biophysical environment in relation to the construction and operational activities. These key performance indicators will include the general species richness and alien invasive plant infestations present within each vegetation community and close to construction areas.

14.5 Responsibility

Environmental Manager

14.6 Frequency

The frequency of these monitoring flora and fauna surveys must be every two seasons, or every two years.

14.7 Threshold or limits

Thresholds of potential concern will include the plant species richness of each vegetation community, if plant species richness decreases by 15% within the comparable same previous season then further studies are recommended to indicate what the exact reason is for the decrease in species richness, and to correct this as soon as possible.

The alien invasive plant species richness that is present within each plant community must not increase by more than 10%. The specific nature of the invasive plant species must also be a threshold, if highly aggressive invader species is encountered, then this must be of concern and rectified.

14.8 Corrective action

The management decisions made to accomplish certain goals, such as habitat management through minimising disturbance and eradicating alien invasive plant species, must be evaluated to ascertain if they are having the desired results. This is accomplished through monitoring as discussed previously, if this is not the case and the goals are not reached then adaptive management must take place where management plans or the implementation of these are adapted to suit specific situations better.

15 STUDY SUMMARY

The objectives that were initially set in order to accomplish the aim of the study are displayed in Table 15-1, as can be seen the status of these objectives indicate complete, and the relevant section within the report where they were completed are also given.

Table 15-1: Objectives status

Objectives	Status	Section
Delineate vegetation units	Completed	8.1 (Results sections)
Characterize flora present	Completed	8.3 (Results sections)
Characterize fauna present	Completed	8.4 (Results sections)
Identify threats to Biodiversity	Completed	1 (Introduction), 9 (Findings)

Taking into consideration the quality and quantity of available habitat, in conjunction with fauna and flora species found and described in the results section, the following **Error! eference source not found.**, indicates the importance of each habitat type to each measured attribute.

Table 15-2: Summarized conservation value of the Vegetation Units of the Brakfontein study area.

VEGETATION UNIT	BIODIVERSITY CONSERVATION VALUE			COMMENTS
	Botanical (vegetation)	Fauna (animals)	OVERALL	
Primary Grassland	High	High	**High**	Total recorded plant species richness of 74 species. Provides suitable habitats for approximately 172 terrestrial faunal species (4 frogs, 29 reptiles, 88 birds and 51 mammals).
Current Cultivation	Negligible	Low	**Low**	Plant species richness in this vegetation unit is negligible but it provides some suitable habitats for an approximate 50 terrestrial faunal species (2 reptiles, 38 birds and 10 mammals).
Alien Trees	Low to Negligible	Low	**Low**	Very low average plant species richness. Provides suitable habitats for approximately 64 terrestrial faunal species (6 reptiles, 46 birds and 12 mammals).
Pastures	Low to Moderate	Moderate	**Moderate**	Low total recorded plant species richness of 17. Suitable habitats are available for approximately 107 terrestrial faunal species (1 frog, 8 reptiles, 64 birds and 34 mammals).
River and Riparian	High	High	**High**	Total recorded plant species richness of 20 species. Suitable habitat available for approximately 136 terrestrial faunal species (9 frogs, 4 reptiles, 96 birds and 27 mammals) in the Riverine component and 162 (13 frogs, 10 reptiles, 104 birds and 35 mammals).
Rocky ridges	Very high	Moderate	**High**	Total recorded plant species richness of 11 species. Provides suitable habitat for approximately 81 terrestrial faunal species (20 reptiles, 38 birds and 23 mammals).

16 RECOMMENDATIONS AND KNOWLEDGE GAPS

The area of study presently consists of natural areas with high biodiversity conservation value (Table 10-1). Based on the findings of this assessment six distinct vegetation units were identified and delineated within the study area. These vegetation units were named as follows:

- Grassland;
- Current cultivation;
- Alien trees;
- Pastures;
- River/ Riparian;
- Ridges.

The study furthermore indicated that within the study area, there are three vegetation units with high biodiversity conservation value, namely Grassland, River and Riparian and Ridges. The biodiversity management actions of the proposed mine should be focussed on these vegetation units. These vegetation units also justify some effort in terms of biodiversity management on the proposed mine. The remainder of the vegetation units were classified as having low to negligible value in terms of biodiversity conservation. These vegetation units should be managed in such a way as to limit their impact on the vegetation units with high biodiversity conservation value.

Management actions are provided specifically for each of the vegetation units and the following general biodiversity management actions are recommended for the 3 high value units:

- Establishment of Core Biodiversity Management Areas (CBMA) within the study area (high biodiversity areas);
- Implement a long-term biodiversity monitoring program of core areas;
- Design a specialist alien plant monitoring plan;
- Design and implement a fire management plan;
- Promote sustainable use of natural resources within the area;
- Initiate Environmental Education Programmes;
- Conduct capacity building with respect to understanding biodiversity in the study area.

Due to the presence of various on-going human activities potentially posing a risk to the biodiversity aspects of each vegetation unit in the study area, it is suggested that an audit should be performed to determine exactly which anthropogenic stressors (dust, trace metals, gaseous emissions, etc.) are produced by the proposed mining operations, what the pathways may be and which species may act as receptors for these stressors. It is also strongly recommended that the management actions as stated in this report should be incorporated into the mine's EMP and considered for implementation in the study area.

17 CONCULSION

The area of study was found to be under pressure from surrounding land use, most notably mining and agriculture. Despite these threats it was found that the area of study provided an ecological service to the plant and animal species encountered during the field survey and possibly to the plant and animal species that were identified during the desktop survey.

The vegetation/habitat units identified were all responsible for varied degrees of natural to transformed habitat present, in turn this resulted in mosaic effect with regards to the vegetation which in turn has an effect on the animal species present. The combined effect of

the area that is under pressure and the different habitat types are reflected in the results of this study.

Few mammal species were found but this is only a reflection of species present on the specific days of study and not of species that are of a transient nature, therefore the population of animal species that the area supports could very possibly be larger than that which was encountered.

Furthermore, the animal species present are only the species adapted and associated with the limited habitat present, which can survive the anthropogenic pressure exerted on them. The habitat present on the project site is seen to be in an impacted state, due to reasons mentioned above. The result of this is the animal species present are a reflection of this impacted state and is therefore poor.

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Appendix A: Plant List

Scientific Name	Common Name	Ecological Status	Form	Grassland	Current cultivation	Alien trees	Pastures	Riparian	Rocky
Agrostis lachnantha	Bent grass	Pioneer Increaser 2	Grass	#			#		
Andropogon appendiculatus	Vlei Bluestem	Decreaser - Climax	Grass	#					
Andropogon huillensis	Large Silver Andropogon	Increaser 1 - Climax	Grass						
Andropogon eucomus	Snowflake grass	Increaser 2 - Subclimax	Grass	#		#	#	#	#
Argyrolobium stipulaceum			Herb	#					
Aristida adscensionis	Annual three awn	Pioneer Increaser 2	Grass		#				
Aristida congesta congesta	Tassel Tree-awn	Increaser 2 - Pioneer	Grass	#					
Bidens bipinnata		Alien Invasive	Herb	#	#	#	#		
Bidens formosa	Cosmos	Alien Invasive	Herb			#	#	#	
Brachiaria serrata	Velvet Signal Grass	Decreaser - Climax	Grass	#	#		#	#	
Chamaecrista comosa	Trailing dwarf cassia		Herb	#	#	#			
Conyza albida	Tall fleabane	Weed	Shrub			#	#		
Cortaderia selloana		Alien invasive	Grass		#	#	#		
Cyanotis speciosa	Doll's powderpuff	Medicinal/Charm	Herb	#					
Cymbopogon excavatus	Broad-leaved Turpentine Grass	Increaser 1 - Climax	Grass	#					
Cynodon dactylon	Couch Grass	Increaser 2 - Pioneer	Grass	#					
Cyperus esculentus	Yellow Nut Sedge	Medicinal/Edible/Alien Invasive	Sedge	#				#	#
Datura stramonium	Common Thorn Apple	Alien Invasive*	Herb		#				
Digitaria eriantha	Common Finger Grass	Decreaser - Climax	Grass	#	#			#	
Diheteropogon amplectens	Broad-leaved Bluestem	Decreaser - Climax	Grass	#					
Eragrostis curvula	Weepong Love Grass	Increaser 2 - Subclimax to climax	Grass						#
Eragrostis racemosa	Narrow Heart Love Grass	Increaser 2 - Subclimax	Grass	#					
Eucalyptus camaldulensis	Red River Gum	Alien Invasive**	Tree			#			
Gazania krebsiana	Common Gazania	Medicinal	Herb	#			#		
Geigeria burkei	Vermeersiektebossie	-	Herb	#			#		
Gomphocarpus fruticosus	Milkweed	Exotic	Herb		#	#	#		
Gomphrena celosioides	Batchelor's Button	Exotic	Herb	#		#			
Haplocarpha scaposa	False Gerbera	Medicinal	Herb	#		#			
Helichrysum acutatum		Medicinal	Herb	#					
Helichrysum nudifolium	Hottentot's Tea	Medicinal/Magical	Herb/Bulb	#					
Helichrysum rugulosum		Medicinal/Magical	Bulb/Herb	#					
Hemarthria altissima	Swamp couch	Decreaser - Climax	Grass				#	#	
Hermannia transvaalensis			Herb	#					
Heteropogon contortus	Spear Grass	Increaser 2 - Subclimax	Grass	#	#		#		
Hyparrhenia hirta	Common Thatching Grass	Increaser 1 - Subclimax to climax	Grass	#	#		#	#	#
Imperata cylindrica	Cotton Wool Grass	Increaser 1	Grass				#	#	
Kohautia virgata			Herb		#				
Ledebouria ovatifolia		Medicinal	Bulb/Herb		#				

Mariscus solidus			Sedge					#	
Mariscus congestus	Cultural		Herb					#	
Melenis nerviglumis	Bristle leaved red top	Climax Increaser 1	Grass			#		#	
Melinis repens	Natal Red Top	Increaser 2 - Pioneer to subclimax	Grass	#				#	
Paspalum dilatatum	Dallis Grass	Exotic	Grass	#					
Paspalum urvillei	Vasey Grass	Exotic	Grass	#					
Pelargonium luridum	Stalk-flowered Pelargonium	Medicinal	Herb			#			
Pennisetum clandestinum	Kikuyu Grass	Exotic	Grass						
Perotis patens	Cat's Tail	Increaser 2 - Pioneer to subclimax	Grass		#				
Persicaria lapathifolia	Spotted Knotweed	Alien Invasive	Herb		#	#		#	
Persicaria serrulata	Knotweed/Snake Root	Medicinal	Herb						
Phragmites australis	Common Reed	Decreaser	Grass						
Pogonarthria squarrosa	Herringbone Grass	Increaser 2 - Subclimax	Grass	#		#			
Pollichia campestris	Waxberry	Edible/Medicinal	Shrub	#				#	
Polygala amatymbica	Dwarf Polygala	Medicinal	Herb	#					
Polygala hottentotta	Small Purple Broom	Medicinal	Herb/Bulb	#					
Populus x canescens	Grey popular/Cottonwood	Cat 2 Cara	Tree			#			
Pteridium aquilinum	Bracken Fern		Fern					#	
Richardia brasiliensis		Alien invasive	Herb	#		#		#	#
Salix babylonica	Weeping willow	Cat 2 Cara	Tree					#	
Scabiosa columbaria	Wild Scabiosa	Medicinal	Herb	#					
Searsia leptodictya	Mountain karee	Medicinal	Tree					#	#
Sebaea grandis	Large-Flowered Sebaea	Charm	Herb		#				
Senecio erubescens		Medicinal	Herb	#					
Senecio inornatus		Medicinal	Herb		#				
Setaria sphacelata var. torta	Creeping Bristle Grass	Decreaser - Climax	Grass	#				#	#
Solanum incanum	Grey Bitter-apple	Medicinal Weed	Shrub		#	#			#
Sporobolus africanus	Ratstail dropseed	Subclimax increaser 3	Grass		#				#
Sporobolus fimbriatus	Dropseed grass	Climax decreaser	Grass						
Stoebe vulgaris	Bankrupt Bush	Weed	Shrub		#	#	#		
Tagetes minuta	Tall Khaki Weed	Alien Invasive	Herb				#		
Tephrosia purpurea	Silver Tephrosia	Medicinal	Herb				#		
Themeda triandra	Red Grass	Decreaser - Climax	Grass	#	#	#			
Trachypogon spicatus	Giant Spear Grass	Increaser 1 - Climax	Grass	#					
Trichoneura grandiglumis	Small Rolling Grass	Increaser 2 - Subclimax	Grass	#					
Tristachya leucothrix	Hairy Trident Grass	Increaser 1 - Climax	Grass		#				#
Zea mays		Edible	Grass		#				
Pinus patula	Patula pine	Alien invasive	Tree			#			
Typha capensis		Reed	Reed					#	#
Verbena bonariensis	Tall Verbena	Alien invasive	Shrub						

Appendix B: Bird list

Common Names	Scientific Names	Grassland	Cultivated	Alien trees	Pastures	Riparian	Rocky outcrops
African Darter	*Anhinga rufa*					#	
African Wattled Lapwing	*Vanellus senegallus*	#			#		
Barn Owl	*Tyto alba*			#			
Black Heron	*Egretta ardesiaca*					#	
Black-collared Barbet	*Lybius torquatus*						
Black-headed Heron	*Ardea melanocephala*					#	#
Black-shouldered Kite	*Elanus caeruleus*	#			#		#
Blacksmith Lapwing	*Vanellus armatus*	#			#		
Burchell's Coucal	*Centropus burchellii*			#			
Cape Sparrow	*Passer melanurus*		#				#
Cape Turtle-Dove	*Streptopelia capicola*		#				
Cape Wagtail	*Motacilla capensis*			#			
Cattle Egret	*Bubulcus ibis*		#		#		
Common Fiscal	*Lanius collaris*	#		#	#		
Common Moorhen	*Gallinula chloropus*						#
Common Myna	*Acridotheres tristis*		#				
Common Quail	*Coturnix coturnix*	#			#		
Common Ringed Plover	*Charadrius hiaticula*	#			#		
Common Sandpiper	*Actitis hypoleucos*					#	
Common Waxbill	*Estrilda astrild*	#					
Crested Barbet	*Trachyphonus vaillantii*						
Crowned Lapwing	*Vanellus coronatus*	#			#		
Dark-capped Bulbul	*Pycnonotus tricolor*	#		#	#	#	
Egyptian Goose	*Alopochen aegyptiaca*					#	#
Marsh Owl	*Asio capensis*		#		#		
Hadeda Ibis	*Bostrychia hagedash*	#	#				
Helmeted Guineafowl	*Numida meleagris*	#			#		
House Sparrow	*Passer domesticus*			#	#		
Laughing Dove	*Streptopelia senegalensis*	#	#				
Natal Spurfowl	*Pternistis natalensis*	#			#		
Pied Starling	*Spreo bicolor*	#	#				
Pin-tailed Whydah	*Vidua macroura*	#					
Purple Heron	*Ardea purpurea*	#				#	#
Red-billed Teal	*Anas erythrorhyncha*						
Red-capped Lark	*Calandrella cinerea*	#	#	#	#		
Red-eyed Dove	*Streptopelia semitorquata*	#	#				
Red-headed Finch	*Amadina erythrocephala*					#	

Red-knobbed Coot	*Fulica cristata*					#	#
Red-winged Starling	*Onychognathus morio*	#	#	#			
Reed Cormorant	*Phalacrocorax africanus*					#	#
Rock Dove	*Columba livia*	#					
Speckled Mousebird	*Colius striatus*			#			
Speckled Pigeon	*Columba guinea*	#	#				
Spotted Thick-knee	*Burhinus capensis*	#		#	#		
Spur-winged Goose	*Plectropterus gambensis*					#	
White-faced Duck	*Dendrocygna viduata*					#	#
Yellow Wagtail	*Motacilla flava*				#	#	
Yellow-billed Duck	*Anas undulata*					#	#

Appendix C: Maps and Plans