FLORA AND FAUNA ASSESSMENT

FOR

MINE AND RAILWAY LINE

WATERBERG DISTRICT

REPORT SUBMITTED TO:

RESGEN SOUTH AFRICA (PTY) LTD

BOIKARABELO COAL MINE

APRIL 2011

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EXECUTIVE SUMMARY

This document presents the findings of the fauna and flora study conducted on the farms Kalkpan 243 LQ, Kruishout 271 LQ, Zeekoevley 241 LQ, Vischpan 274 LQ, Witkopje 238 LQ, Draai om 244 LQ, Osorno 700 LQ and Kruispad 242 LQ where proposed mining infrastructure will be situated. The farms Kringgatspruit 318 LQ, Loopleegte 302 LQ, Zandbult 300 LQ, Steenbokpan 295 LQ, Grootswartbult 290, Vangpan 294 LQ and Bitterfontein 272 LQ are the parts of the project area earmarked for the construction of the railway leading to the main project area. The objectives of this survey were to characterise the fauna and flora environment present for each of the abovementioned farms. Thereafter, to establish the significance of the impact of the construction and operation phases associated with the proposed opencast mine, railway line and associated infrastructure on the fauna and flora in the area of interest and to investigate any potential threats to the proposed project. Furthermore, the possibility of the establishment of a carbon sequestration plan was investigated. In order to meet these objectives the aforementioned field survey was conducted.

Vegetation species composition and habitat diversity were assessed. The homogenous units identified were assessed for the presence of important plants (those with Red Data status, medicinal use, cultural use or declared weeds and invader species). The identification of these units led to the recognition of potentially important habitat types for discussion in the faunal survey. Potential areas of importance, such as those areas where Red Data species of both fauna and flora could occur, were identified and assessed. Wetland areas, including all pans, streams and smaller rivers, although dry, were noted and assessed.

The vegetation was found to be relatively uniform. Differing soil types due to altitude and water accumulation appear to be the dominant factors in determining the vegetation variation. Land use has a major influence on the state of the vegetation. Over utilisation primarily in the form of grazing by domestic livestock, and wild herbivores will manifest itself in the occurrence of bush encroachment.

From the results of the field survey of the vegetation, the following can be concluded:

1) The natural vegetation of the proposed area of development falls in the Savanna biome which is the largest Biome in southern Africa, occupying 46% of its area, and over one-third the area of South Africa. It is well developed over the lowveld and Kalahari of South Africa and is also the dominant vegetation in Botswana, Namibia and Zimbabwe (Rutherford & Westfall, 1986). The environmental factors delimiting the Savanna biome include the altitude (that ranges from sea level to 2000 m above sea level), the rainfall, which varies between 235 and 1 000 mm annually, frost, soil

and geology. Almost every major geological and soil type occurs within the savanna biome. The Savanna biome can therefore be considered as very complex. A major factor delimiting the biome is the lack of sufficient rainfall which prevents the upper layer from dominating, coupled with fires that prevent the tree layer from developing and grazing that keeps the grass sword in vigour. Summer rainfall is essential for the grass dominance, which, with its fine material, fuels near-annual fires, usually with less than 10% of plants, both in the grass and tree layer, killed by fire. Even with severe burning, most species can resprout from stem bases (Rutherford & Westfall 1986).

2) The proposed area of development falls within one vegetation types as described by White (1983), namely the South Zambezian undifferentiated woodland (unit 29d). The vegetation as described by White (1983) can be described as woodland, scrubveld or thickets.

3) The area of the proposed mine shows strong similarities to the Sweet Bushveld (Vegetation Type 17, Van Rooyen & Bredenkamp, 1996), the Arid Sweet Bushveld (Veld Type 14; Acocks, 1988) and the Limpopo Sweet bushveld as described by Mucina and Rutherford (2006). The Sweet Bushveld, Arid Sweet Bushveld and the Limpopo Sweet bushveld show similarities and correspond in vegetation composition, dominant trees and shrubs, climate and soils, therefore the description of Van Rooyen & Bredenkamp (in Low & Rebelo, 1996), Acocks (1988) and Mucina and Rutherford (2006) supports the findings in this report.

A total of 127 floral species were found during the field survey which included 26 purely medicinal plants of these one was magical (charm) plants and one of cultural value and two species with poisonous seeds, namely *Combretum apiculatum* and *Combretum erythrophyllum.* In addition to these medicinal species, two weed species with medicinal properties were also encountered.

The mammal species identified during the survey were for the most part bushveld species, with only their numbers affected by management decisions on various properties. Furthermore, management of the farms actively stocked a variety of mammals (possibly suited to other biomes) to populate the property, subsequently the field survey positively identified 22 mammal species that were present.

A total of 10 reptile species were recorded during the field survey, of which one, the Nile crocodile is designated as Vulnerable.

Frog species that were found totalled nine species, of which no Red data species were encountered.

During the field investigation the value of the general area as a carbon sink was investigated, furthermore the possibility of the current vegetation cover present acting as a carbon sink, was found to be of importance, however the actual positive effect with regards to carbon capture was found to be minimal.

In conclusion, the areas investigated were differentiated from one another primarily through management measures employed and availability of water. Through the construction of the mine and its associated infrastructure the management and water availability through change in land use will be affected to a large extent. However, following the prescribed guidelines and mitigation measures set forth in this document an attempt will be made to minimise the impacts.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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, in which the area of interest is located, leaving biomes such as grasslands 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 Limpopo Province is rich in biodiversity, this is commonly attributed to its bio-geographical location and diverse topography. Three centres of endemism occur within the province, the Drakensberg escarpment including Wolkberg, Sekhukhuneland and Soutpansberg, and according to Acocks (1974) there are 15 different veld types within the province.

There are currently 52 provincially protected areas in the province totalling 335 601 ha, which, excluding SANparks areas such as the Vembe Dongola, Marakele and Kruger National Park, account for 5.06 % of the total area of the province. The province has two established biosphere reserves, the Kruger to Canyons biosphere reserve and the Waterberg biosphere reserve. 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 primary objective of this investigation was to characterise the fauna and flora present and to investigate the potential impacts of the proposed project on the vegetation and animal life in the study area. Furthermore, the potential for carbon sequestration was investigated. These objectives were achieved by conducting an in-depth fauna and flora survey.

For the vegetation survey, sample plots within each farm boundary were assessed. This was achieved by identifying and recording plant species in the sample plots. The dominant species were noted and the presence of the following plants was established:

- Red Data status;
- Medicinal uses;

- Cultural uses;
- Declared weeds and invader species.

Species composition and habitat diversity were assessed. The homogenous vegetation units identified were assessed for the presence of the above-mentioned plants. The identification of these units leads to the recognition of potentially important habitat types for discussion in the faunal survey. Potential areas of importance, such as those areas where Red Data species of both fauna and flora could occur, were identified and assessed.

For the mammal survey the presence of mammals was evaluated by using non-destructive methods (live trapping) which included tracks, dung, habitat indicators and visual sighting of the animals themselves. Sightings were supplemented by means of live trapping of small sized mammal species with Sherman traps.

Visual observations of birds were conducted by using binoculars and identification was obtained from available field guides and text books. A complete list of bird species encountered within the boundaries of the relevant vegetation unit was be compiled.

Any signs of reptile activity were noted, this included shed skin, spoor and droppings. This technique was supplemented by non-lethal trapping by means of pitfall traps and drift fences.

Diurnal visual and audio observations supplemented by non-lethal trapping by means of pitfall traps and drift fences were used to identify amphibian species. Data was recorded in a notebook along with the time, date, habitat, weather conditions and a GPS location.

The possibility of creating an area where carbon sequestration takes place, within or outside the mine property will also be investigated.

2 TERMS OF REFERENCE

Digby Wells & Associates (DWA) was appointed as consultants to investigate the environmental aspects of the proposed Boikarabelo Coal mining operations on the farms Kalkpan 243 LQ, Kruishout 271 LQ, Zeekoevley 241 LQ, Vischpan 274 LQ, Witkopje 238 LQ, Draai om 244 LQ, Osorno 700 LQ and Kruispad 242 LQ and the proposed railway line on the farms Kringgatspruit 318 LQ, Loopleegte 302 LQ, Zandbult 300 LQ, Steenbokpan 295 LQ, Grootswartbult 290 LQ, Vangpan 294 LQ and Bitterfontein in the Waterberg district in the Limpopo Province.

This was achieved by compiling an Environmental Impact Assessment (EIA) & Environmental Management Plan (EMP), complying with Regulations 48, 50 and 51 of the government gazette No. 26275 for Boikarabelo Coal Mine project. An official site visit to the affected farms was conducted with Limpopo Economic Development Environment and Tourism (LEDET), Biodiversity department in order for Digby Wells specialists to gain an understanding of the department's specific requirements for this project.

The investigation focussed on the current state of the environment to record baseline information, from which conclusions can be drawn as to what impact the proposed mining development will have on the natural environment. The feasibility of carbon sequestration was also investigated.

This survey was completed in accordance with the following legislation:

- Section 21 of the Environment Conservation Act, 1989;
- Section 24 of the Constitution – Environment (Act 108 of 1996);
- Conservation of Agricultural Resources Act (CARA) no 43 of 1983;
- Section 5 of the National Environmental Management Act (Act 108 of 1998);
- National Environmental Management Biodiversity Act (NEMBA, Act 10 of 2004).

3 GAP ANALYSIS

As per the nature of vegetation and mammal surveying, representative samples are taken from the area of study, which represents the area in the literature produced. The representative samples presented here are an interim reflection of conditions and are not conclusive. Time constraints dictate the amount of time in the field, which translates into the amount of data that can be collected. The consultant strongly recommends that this document be read in conjunction with the Limpopo Environmental Management Act (Act No. 7 of 2003). Management plans must incorporate this document. Invertebrate studies were carried out only on desktop study level due to time constraints, the invertebrate findings are therefore of low confidence.

4 STUDY AREA

4.1 General Description

The project is located within the Waterberg coal field 75km north east of the town of Lephalale in the Limpopo Province. The project area falls within the Lephalale Local Municipality and the Waterberg magisterial district. The area of interest falls within the Savanna biome, or as it is also called the thornveld and broadleaved woodland, within the site boundaries the vegetation varies from open Xeric savanna of the high lying areas, to low lying riparian areas. The railroad study area is displayed in Appendix 4 and the mining area is displayed in Appendix 5.

4.2 Sensitive Landscapes and Areas of Conservation Importance

Officially protected areas as described by the IUCN (International Union for the Conservation of Nature), were not encountered during the surveys.

Areas that can be categorised as sensitive landscapes, which are therefore valuable to conservation efforts, are areas that currently support either sensitive species, or have the potential to support these species.

Identified areas of potential significance are those where the northern boundary of the proposed mine area follows the Limpopo River. These riparian zones give rise to different vegetation types due to the nature of the soil form and increased availability of water supply. Larger trees and denser vegetation tend to be found in these zones. These zones are important as they provide habitat for animal species and generally support abundant bird life.

4.3 Land use

The predominant present land use in the wider area is agriculture. Most farms are dominated by grazing as the most prominent land use specifically wild life and cattle. The area is well serviced by dirt roads as well as farm roads.

The direct impact of the dominant land use (game/cattle farming) in the general area is the fragmentation of the prevailing habitat into smaller bastions; this is also true as far as cattle farming is concerned. As all farms are fenced in, a smaller version of the dominant vegetation type is created, with a variety of large and medium sized mammal species associated with each fenced off area, this is a management decision. The indirect effect of the farming practices is therefore a differentiated animal assemblage present.

5 METHODOLOGY

5.1 Flora

5.1.1 Literature Study

During the literature study, the findings of White (1983), Low and Rebelo (1996), Acocks (1988), and Mucina and Rutherford (2006) were consulted and used as the basis of knowledge of the study area.

Protected trees occurring in the area, and listed by the National Forest Act, were noted. Furthermore, all specially protected (Schedule 12) species as listed by Limpopo Environmental Management Act (Act No. 7 of 2003), were noted.

The Limpopo Environmental Management Act (Act No. 7 of 2003), consists of schedules, each of which details a specific regulated topic. Of concern in this study is the following:

Schedule 1: Protected areas

Schedule 2: Specially protected wild animals

Schedule 3: Protected wild animals

Schedule 12: Protected plants

5.1.2 Field Survey

The fauna and flora field survey was conducted from the 25th to the 29th of January 2010, and the railroad study was completed from the 1st to the fourth of June 2010. Prior to the site visit the general area received the first of the seasonal summer rains, therefore the vegetation was in good condition. The exact position of each sample plot within the relevant stratification unit was chosen subjectively according to the methodology of the Zurich-Montpellier approach of phytosociology (Braun-Blanquet 1964). The Braun-Blanquette (BB) sampling method (Mueller-Dombois & Ellenberg 1974) has been successfully applied in other phytosociological studies in South African grasslands (e.g. Bredenkamp 1982, Bezuidenhoudt & Bredenkamp 1990) and also in many other vegetation studies (Du Plessis 2001). This is a standardised method used for vegetation classification within South Africa. The following cover-abundance scale table (Table 5-1) was therefore used:

Table 5-1: Braun-Blanquet cover-abundance scale

Symbol	Qualitative Braun-Blanquet scale
r	One or few individual (rare) with less than 1% of total sample plot area
+	Occasional and less than 1% of total sample plot area
1	Abundant and with very low cover or less abundant, but with higher cover, 1-5% cover of total sample plot area
2a	Covering 5-12% of the sample plot area, irrespective of the number of individuals
2b	Covering 12-25% of the sample plot area, irrespective of the number of individuals
3	>25-50% cover of the total sample plot area, irrespective of the number of individuals
4	>50-75% cover of the total sample plot area, irrespective of the number of individuals
5	>75% cover of the total sample plot area, irrespective of the number of individuals

5.1.2.1 Dry season survey

At each sample site the characteristics of the vegetation were described. All plant species present were identified and listed. The dominant species were noted. All aspects of importance or of conservation value, such as wetland areas and rocky outcrops, if present, were noted. The density and general height of the vegetation was described. Notes were taken describing any evidence of previous and / or current management measures and land uses. This included noting any herds of domestic animals, cultivated fields nearby, and homestead areas nearby. Photographs were taken of representative sites.

5.2 Mammals

5.2.1 Literature Study

The Red Data Book of the Mammals of South Africa: A Conservation Assessment (Friedman, Yolan and Daly, 2004) and the Limpopo State of the Environment Report (LDFEC, 2004) was used to establish what species could potentially occur in the area of interest. This was done primarily with the use of distribution maps. Aspects such as habitat preferences and availability, land use and land management were taken into account as far as possible. Furthermore, all specially protected (Schedule 2) and protected species (Schedule 3) as listed by Limpopo Environmental Management Act (Act No. 7 of 2003), were noted.

5.2.2 Field Survey

All mammals that were seen during the field surveys were noted. Mammal sampling areas were chosen according to habitat types and signs of small mammal activity. Although not all mammals (predominantly small mammals) were recorded in areas not specific to the proposed development, the ability of these mammals to move between areas, means the likelihood of these species occurring in the area of concern is high.

5.3 Birds

5.3.1 Literature study

A literature study of Roberts (2005) and Barnes (2000) and the Limpopo State of the Environment Report (LDFEC, 2004) was conducted to identify bird species that could potentially occur in the area of interest. The information obtained from this study was then used in the field for identification purposes. Furthermore, all specially protected (Schedule 2) and protected species (Schedule 3) as listed by Limpopo Environmental Management Act (Act No. 7 of 2003), were noted.

5.3.2 Field survey

All bird species observed during the field investigations in the general area were noted, because of the transient nature of birds observations were not limited to sample sites.

Visual observations of birds were conducted by using binoculars and identification was obtained from available field guides and text books. A complete list of bird species encountered within the boundaries of the relevant vegetation unit was be compiled.

5.4 Reptiles

5.4.1 Literature Study

A list of reptiles that could potentially occur in the area of interest, based primarily on distribution maps (Branch 2001) and the Limpopo State of the Environment Report (LDFEC, 2004), was sourced. Furthermore, all specially protected (Schedule 2) and protected species (Schedule 3) as listed by Limpopo Environmental Management Act (Act No. 7 of 2003, were noted.

5.4.2 Field Survey

Any reptiles that were observed during the field surveys were identified and listed. Furthermore, any signs of reptile activity was noted, this included shed skin, spoor and

droppings. This active technique was supplemented by non lethal, passive trapping by means of pitfall traps and drift fences.

5.5 Frogs

5.5.1 Literature Study

A list of frogs and toads that could potentially occur in the area of interest, based primarily on distribution maps (Carruthers 2001) and the Limpopo State of the Environment Report (LDFEC, 2004), was sourced. The habitat preferences of each species have been included. Furthermore, all specially protected (Schedule 2) and protected species (Schedule 3) as listed by Limpopo Environmental Management Act (Act No. 7 of 2003), were noted.

5.5.2 Field Survey

Any amphibians that were observed during the field surveys were identified and listed.

Diurnal visual and audio observations supplemented by non lethal passive trapping by means of pitfall traps and drift fences were used. Data was recorded in a notebook along with the time, date, habitat, weather conditions and a GPS location

5.6 Terrestrial Macroinvertebrates

5.6.1 Literature Study

The invertebrate literature survey involved consulting the IUCN Red Data and CITES sites for listed animals that occur in South Africa. Unfortunately these sites do not always offer detailed distribution maps. Coupled with lack of information on many species (Data Deficient category), it is difficult to conclude, for certain, if these organisms occur in the particular region of South Africa relevant to this project.

5.6.2 Field Survey

During the field survey the vegetation, specifically the grass sward was found to be grazed, this was not ideal for invertebrate sampling as the sweep net action relies on standing vegetation. After a long dry season the beginning of the wet season provides relief for grazers and browsers alike, and they make good use of the first green shoots that appear after the first rain. This of course delays the arrival of the invertebrate population that depends on the new growth. Subsequently no invertebrate sampling was carried out.

5.7 Listed species

Listed species of fauna and flora are regarded as species whose representation in the wild, has declined to such an extent that drastic action is needed to ensure their survival. Under anthropogenic pressure the number of these species has reached levels where preservation management is needed, and conservation management will no longer be effective. The listing of these species under either IUCN or CITES, is regarded as a valuable starting point to initiate legally sanctioned management practices to bring the numbers of these species back to within acceptable numbers.

5.7.1 IUCN

The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on plants and animals that have been globally evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those plants and animals that are facing a higher risk of global extinction (i.e. those listed as Critically Endangered, Endangered and Vulnerable). The IUCN Red List also includes information on plants and animals that are categorized as Extinct or Extinct in the Wild; on taxa that cannot be evaluated because of insufficient information (i.e., are Data Deficient); and on plants and animals that are either close to meeting the threatened thresholds or that would be threatened were it not for an on-going taxon-specific conservation programme (i.e., are Near Threatened).

Plants and animals that have been evaluated to have a low risk of extinction are classified as Least Concern. (IUCN.org).

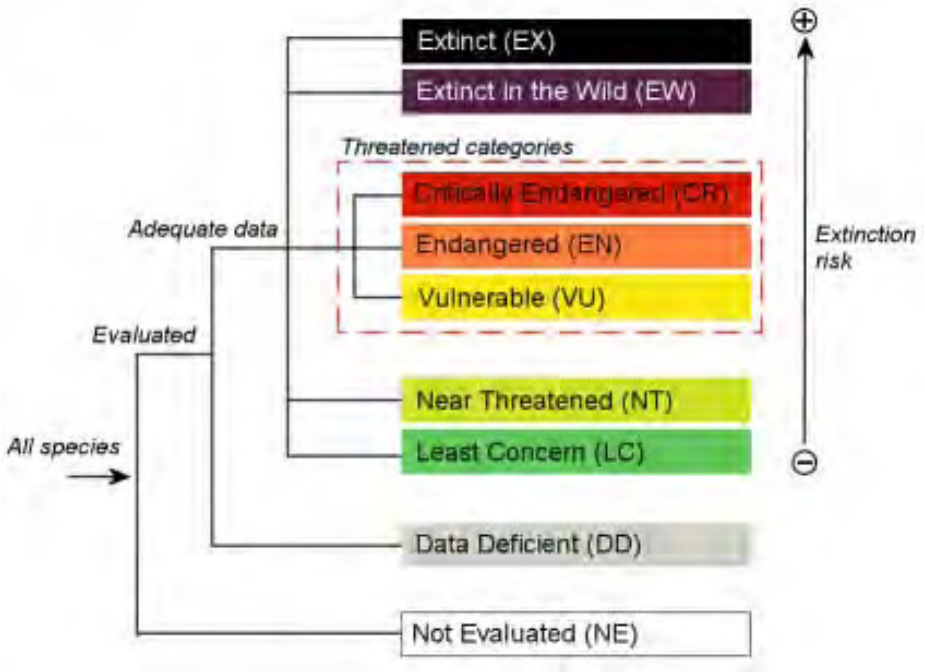

Figure 5-1: IUCN categories (IUCN.com)

For every Red Data species listed to occur within the project area, the Probability of Occurrence is established. The following parameters were used to assess the Probability of Occurrence:

- 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;

- Medium;

- High; or
- Recorded

5.7.2 CITES

CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival (CITES.org).

CITES works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species (CITES.org). Specimens are divided into the following appendices according to the restriction on trade.

Appendices I, II and III

- Appendix I include species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances.
- Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.
- Appendix III contains species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade. Changes to Appendix III follow a distinct procedure from changes to Appendices I and II, as each Party's is entitled to make unilateral amendments to it.

5.7.3 South African legislation

Of special concern during the field investigations were all protected trees listed by the South African National Forest act. Furthermore all specially protected (Schedule 2) and protected species (Schedule 3) as listed by Limpopo Environmental Management Act (Act No. 7 of 2003). Lastly, all, fauna and flora species, listed by the National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004).

5.8 Carbon sequestration

During the literature study, the possible feasibility of carbon sequestration during the Life of Mine (LOM) was investigated. Findings are represented on a sight specific manner taking into account the prevailing habitat of the area of concern as well as the type of development that will possibly take place.

6 RESULTS

The study area and the vegetation survey site positions are presented in Appendix 5.

6.1 Vegetation survey

6.1.1 General Description of the Vegetation

According to White (1983), the area of concern falls within the Kalahari thornveld and the transition to Zambezian broad-leaved woodland. This vegetation type is characterized by wooded grassland. Furthermore, the area falls on the transition between the Zambezian Regional Centre of Plant Endemism (also referred to as the Zambezian Region) and the Kalahari-Highveld Regional Transitional Zone as described by White (1983).

The area of the proposed development shows strong similarities to Vegetation Type 17, namely the Sweet Bushveld, as described by Van Rooyen & Bredenkamp (Low and Rebelo, 1996), the Arid Sweet Bushveld (Veld Type 14) as described by Acocks (1988) and the Limpopo sweet Bushveld according to Mucina and Rutherford (2006). The Sweet Bushveld, Arid Sweet Bushveld and Limpopo sweet bushveld show similarities and correspond in vegetation composition, dominant trees, shrubs, climate and soils. The Limpopo sweet bushveld vegetation in Limpopo represents 94.4% of the vegetation type's occurrence, 23% of it has been modified, furthermore, nationally as well as provincially 0.59% of it is officially protected

To the north of the Magaliesburg and the west of the Great Escarpment, stretches the savanna region that generally receives more rain than the Kalahari to its west and situated at higher altitudes and less tropical in character than the lowveld savanna that lies east of the Great Escarpment. This area is also referred to as the bushveld.

Official records and studies have in the past been conducted predominantly in nature reserves and game farms, leaving areas outside of these with little official data. However, five official major regions are present, three of which are represented in the study area.

Sweet Bushveld occurs on fertile soils in the dry and hot valleys of the Limpopo River and the thorny, small-leaved vegetation is dominated by *Acacia spp*. which increases to dense, impenetrable thickets at the expense of the grass layer when over utilised. Mixed Bushveld varies from short, dense bushveld to a rather open, tree savanna. On shallow, infertile soils the broad-leaved Red Bushwillow dominates, whereas on deeper, leached soils the Silver Clusterleaf becomes dominant. The Waterberg Moist Mountain Bushveld

is a typical example of moist, infertile savanna. Due to the high proportion of unpalatable grasses, the area has become known as sour bushveld.

The vegetation that characterizes this area has developed many survival strategies, including the ability to produce tannins that are triggered when the leaves are browsed, the production of toxic sap, the development of thorns or their adaptation to sourveld areas that is not generally favoured by grazers. The interaction of vegetation, fire and animals play important roles in maintaining savanna ecosystems.

Over time the savanna system and the antelope that inhabit it have co-evolved. Grasses, have become well adapted to defoliation, as much a defensive response to constant pressure by grazers as to the regular veld fires that pass through the savanna in the dry seasons. The success of grasses has been a constantly renewed vast reservoir of food upon which large herds of grazers flourish. The woody component is also constantly exploited by many browsers, and with so many herbivores present, the carnivore component of the complex ecological system also flourished.

The savanna biome is populated by a greater diversity of bird species than any other biome in South Africa. The presence of both woody plants and a well-developed herbaceous layer provides diverse sources of food and shelter for specialist and generalist bird species, including seed-eaters, insectivores and diurnal and nocturnal birds of prey abound.

Much of the area is used for game farming and big game hunting, indicating that utilization and conservation of an area are not mutually exclusive. The savanna biome is the core of the wildlife, ecotourism and meat-production industries. Threats include rapidly expanding development of settlements for impoverished human populations and the associated need for firewood and building materials, diminishing water supply, agriculture and over-grazing. The savanna of South Africa include numerous animal species; approximately 167 mammals (15% endemism), 532 birds (15% endemism), 161 reptiles (40% endemism), 57 amphibians (18% endemism) and an unknown number of invertebrates. “Flagship” species include the Starburst Horned Baboon Spider, ground Hornbill, Cape Griffon, Wild dog, Short-Eared Trident Bat and the White Rhinoceros (Knobel, 1999).

6.1.2 Description of the vegetation found during the field surveys

The area of interest consists of fourteen farm properties, all of which are separated from each other by means of game fencing and or roads. With the exception of the Haygon Safari’s properties (Kruispad, Osorno and Kalkpan) and the Exxaro owned properties (Witkopje and Draai om), all other properties are owned by different private individuals.

The motivation behind the ownership of the above mentioned farms differs from owner to owner, and so does the management of the farms. Management is a function of the desired outcome or goals for a property and these differ to a large extent. The areas of concern visited during the field surveys were found to be managed differently by the owners and this was reflected in the quantity and quality of various plant species encountered. Stocking rates of the properties were found to differ, and this in turn had an effect on the plant species present, and plant species absent.

In general the herbaceous component of the sampled area was sweetveld, consisting mostly of pioneer or sub-climax species and these were mostly increaser 2 species, which are grasses well known to be present in overgrazed veld. Increaser 2 species are opportunistic and tend to colonise an area that has been disturbed. They produce a lot of viable seed and can thus quickly establish on newly exposed ground. They are also more common in lower rainfall areas. Disturbances can be caused by overgrazing, road construction and homesteads, or excessive use of an area by livestock or wild ungulates and even the very dry hot summer conditions. These grasses have physiological adaptations which allow them to colonise cleared areas and they generally reproduce efficiently, eventually spreading over the whole disturbed area. Once these species have established themselves they create an environment suitable for other species, facilitating succession.

Furthermore the tree component encountered, varied between different degrees of bush encroachment to proper Savanna and mixed bushveld. Black thorn (*Acacia melifera)*, Simple leaf Rhigozum (*Rhigozum brevispinosum)* and Shepherds tree (*Boscia albitrunca),* were species found in many of the sample plots, on all eight main farms.

Some of the sample plots displayed a greater variety with regards to their woody or herbaceous layer, most notably areas in close proximity to riparian zones. These areas had notably higher clay content present in soil forms, and obvious signs of water accumulation during the wet season.

The vegetation supported by riparian environments, specifically on Osorno and Kruispad, differs from the surrounding vegetation. This is due to the increased availability of a water supply and different soil forms with a higher clay content and water holding capacity, as mentioned earlier. Larger trees tend to be found in these zones, Ana tree (*Faidherbia albida)* is one. Furthermore these zones are important as they provide habitat for animal species dependant on these conditions and generally support abundant bird life.

6.1.3 Plant species recorded during the field surveys

Using Fabian & Germishuizen (1997), Pooley (1998) and Van Wyk & Malan (1988) to identify the variety of herbaceous species present, the following observations were made. The high lying areas visited during the sampling were mostly found to have been overgrazed in the past, which has resulted in bush encroachment by most notably *Acacia melifera* (Black thorn). Furthermore, certain areas close to water sources specifically perennial and non-perennial pans and water troughs, suffered from the piosphere effect. Piospheres are the result of trampling and heavy use of veld around water points, with a diminishing grazing intensity with increasing distance from the water source (Tainton 1999).

High grazing pressure reduces the growth rate and reproductive potential of individual plants and so influences the competitive relations among the different species (Tainton, 1999). It was also observed that management efforts designed to reduce the effects of the encroachment resulted in large areas cleared of woody plant growth by mechanical means.

Skarpe (1990), cited in Tainton (1999), indicated that in non-grazed and moderately grazed areas shrub densities showed no consistent trend, but densities increased where grazing was heavy. Thereby supporting the conclusion reached in this section. Tree species whose abundance increased were shallow rooted tree species such as Black thorn (*Acacia mellifera)* and Velvet Raisin (*Grewia flava).* This suggests that the depletion of the grass layer removed competition for water between the tree and grass layer, resulting in accelerated bush encroachment.

The majority of grass species encountered were sub-climax increaser 2 or pioneer increaser 2 species and these are indicators of stressed veld, possibly due to overgrazing (Van Outdshoorn 1999). Decreaser species were also encountered but at far greater intervals.

The fact that in certain areas climax decreaser species were most often found only where grazing animals could not reach them i.e. under low growing thorn trees and dead branches, indicates that the specific stressor in this case was possibly overgrazing.

6.1.4 Primary mining area

Draai om

This farm is the eastern most area and only borders Witkopje farm on the western side. As per the mine plan no surface disturbance is planned for this farm. During field investigations it was found that the area was not used for any specific management orientated outcome. The only surface infrastructure was holding pens, and drinking

troughs, however it was unclear whether these were used for the release or capture of wild animals or shelter for domestic cattle or sheep, in the past. Four small seasonal pans were found, all four of which showed signs of wild ungulate utilisation through drinking and feeding.

Kruishout

This farm is under private management which is not commercially orientated. Kruishout is situated south of Kalkpan and east of Vischpan. The majority of the western side of this farm is earmarked to form part of the discard dump, according to the mine plan. The eastern side is divided by a railroad line that originates within Kalkpan. Three non-perennial pans were found on Kruishout, all of which showed signs of utilisation by wild ungulates. The vegetation of this farm is dominated by *Combretum apiculatum/Rhigozum brevispinosum* open woodland, which consists of two sub communities.

Community 1 consists of *Aristida congesta s. congesta/ Terminalia sericea* open woodland which occurs through the majority of the property. *Perotis patens* and *Pogonarthria squarrosa* dominated the grass sword in addition to *Aristida congesta s. congesta. Rhigozum brevispinosum* and *Dichrostachys cinerea* were the tree species found to be dominant in this community.

Community 2 consists of a *Grewia flava/ Digitaria eriantha* woodland and occurs to the east of the property. *Aristida adscensionis* and *Eragrostis biflora* together with *Digitaria eriantha* dominated the grass sword. *Acacia erioloba* and *Boscia albitrunca* dominated the tree component of this community.

Kalkpan

The farm Kalkpan is under the management of Haygon Safari's, a commercial endeavour of which Osorno and Kruispad also forms part of. This farm will be the sight of the most surface disturbance with mining associated infrastructure, the majority of the open cast pit, the majority of the discard dumps and a pollution control dam being situated here.

The area was dominated by a *Grewia flava/ Ximenia Americana* community woodland, covering most of the central, eastern and northern flat sandy areas. Here *Terminalia sericea* and *Acacia melifera* formed dense woodland with a grass sword comprising of *Schmidtia pappophoroides, Digitaria eriantha* and *Aristida congesta s. barbicollis.*

To the northwest a rocky sandstone ridge was a dominant landscape characteristic which gave rise to *Euclea undulata, Gardenia volkensii* community woodland,

interspersed with *Combretum apiculatum* and *Acacia fleckii*. The grass sword comprised of dominant species such as *Pogonarthria squarrosa* and *Eragrostis biflora.*

Vischpan

This is the southernmost farm and is located west of Kruishout, this farm is also privately owned, and used for commercial game farming. Only the north eastern corner of this farm will be disturbed by the discard dump situated on Kruishout. No surface infrastructure was observed as most of the buildings associated with this property are located south of the farm, on a different farm.

The northern boundary of this farm coincides with the edge of a floodplain associated with the Limpopo, this flood plain consists of neo cutanic soils in their formative stages.

The vegetation associated with this floodplain consists of *Geigeria burkei, Ximenia caffra* and *Blepharis subvolubilis,* open woodland with *Enneapogon cenchroides* and *Enneapogon scoparius* dominating the grass sword.

The central and southern and eastern part of the farm was dominated by a mixture of *Commiphora pyracanthoides, Aristida congesta s. congesta, Aristida congesta s. barbicollis*, *Acacia fleckii* and *Acacia mellifera.*

Zeekoevley

Centrally located to the west of Kalkpan and the east of Osorno, this farm is privately owned and caters for the hunters. Two surface water dams are planned for this farm, with further disturbance occurring on the eastern edge of the farm where the edges of two discard dumps from the adjoining properties spill over.

The Zeekoevley farm boundary encloses a floodplain that is fed by the Limpopo River from the north western side.

The central section of the farm is dominated by *Acacia karroo* and *Boscia foetida* community tree species in closed woodland with little grass cover on clay rich soils. *Aristida adscensionis* and *Schmidtia pappophoroides* were the dominant grass species in this community.

Urochloa mosambicensis and *Rhigozum brevispinosum* were present in this area but were much more prominent in the south east of the property. In this area open grassland community with a few small tree species were dominant. *Acacia senegal, Grewia flava Grewia flavescens* and *Boscia albitrunca* were dominant tree species, with *Brachiaria deflexa* and *Schmidtia pappophoroides* dominating the grass sword.

Osorno

Osorno is the most westerly located farm and together with Kruispad, is located on the banks of the Limpopo River to their west. The surface infrastructure planned for this specific farm is a pollution control dam located centrally. The northern part of Osorno is dominated by agricultural lands.

Kruispad

Kruispad is owned by Haygon Safari's, it lies to the south of Osorno, and no infrastructure will be built here.

The riverine vegetation encountered here was of good quality, containing well established trees, in combination with good ground cover by grass species. A very prominent tree species, *Faidherbia albida*, was encountered along the length of the river banks.

6.1.5 Railway line

The proposed railway line affects seven farm properties which are the farms Kringgatspruit 318 LQ, Loopleegte 302 LQ, Zandbult 300 LQ, Steenbokpan 295 LQ, Grootswartbult 290 LQ, Vangpan 294 LQ and Bitterfontein. Certain properties such as Bitterfontein and Steenbokpan will be crossed by the line, with others such as Loopleegte and Zandbult only affected by the line running adjacent to the current fence line (Appendix 4).

Kringgatspruit

The positioning of the proposed rail line on this farm will affect the area on the northern boundary and will coincide with the road reserve.

The project area of comprised of a well-developed grass layer, dominated by *Bothriochloa radicans, Brachiaria deflexa, Digitaria eriantha, Eragrostis biflora* and *Urochloa mosambicensis*.

The tree layer was also well developed but not dominating, *Acacia tortilis, Combretum apiculatum, Acacia erioloba, Grewia flavescens* and *Terminalia sericea* were found to be prominant.

The herb layer was under developed, with *Tephrosia purpurea* being dominant, most probably due to most of the survey sites being located close to the boundary fence, therefore being disturbed to an extent.

Loopleegte

The positioning of the proposed rail line on this farm will affect the area on the northern boundary and will coincide with the road reserve.

The grass layer encountered in the project area of this farm was relatively well developed without being domineering. The fact that the area surveyed was in close proximity to the road reserve and a boundary fence road, meant that the grass layer contained pioneer species associated with disturbed areas. *Aristida adscensionis* and *Aristida congesta s. barbicollis, Melinis repens* and *Enneapogon cenchroides* were dominanant grass species.

The tree component was found to be dominated by *Acacia tortilis, Grewia flavescens, Ziziphus mucronata* and *Combretum imberbe.* Many trees were found to be cut back to accommodate the boundary fence road.

Vangpan

The positioning of the proposed rail line on this farm will affect the area on the northern boundary, this will coincide with the road reserve.

The study area on this farm displayed a good grass layer, however open patches devoid of vegetation was observed and indicated possible over grazing. The grass layer was dominated by *Aristida congesta s. barbicollis, Aristida congesta s. congesta, Digitaria eriantha, Enneapogon cenchroides, Melinis repens* and *Pogonarthria squarrosa*.

The tree layer displayed typical savannah species and moderate densities, with the exception of *Terminalia sericea* (Silver Cluster leaf) that formed stands in areas. Tree species that characterised this area was *Acacia erioloba, Combretum hereroense, Commiphora pyracanthoides, Grewia flavescens Peltophorum africanum* and *Rhus pyroides*.

Zandbult

The positioning of the proposed rail line on this farm will affect the area on the northern boundary and will coincide with the road reserve.

The grass layer of the survey site was dominated by Perotis patens, *Aristida congesta s. congesta, Digitaria eriantha* and *Enneapogon cenchroides.* It was once more well developed but not domineering.

The tree layer was dominated by *Peltophorum africanum*, *Commiphora pyracanthoides, Acacia totillis, Dichrostachys cinerea, Terminalia sericea* and *Euclea undulate.*

Steenbokpan

The central southern boundary is where the proposed line will enter this farm, from here it will cross the farm to where it exits the farm in the north western corner.

The study area on this farm displayed a good grass layer, however an open field was encountered where the vegetation was observed to be grass dominated and indicated possible grazing. The grass layer was dominated by *Aristida congesta s. barbicollis, Aristida congesta s. congesta, Digitaria eriantha, Enneapogon cenchroides, Melinis repens, Aristida stipatata* and *Pogonarthria squarrosa*.

The tree layer displayed typical savannah species and moderate densities, these included *Acacia nigrescens, Combretum apiculatum*, *Acacia erioloba, Commiphora pyracanthoides, Grewia flavescens Peltophorum africanum, Boscia albitrunca* and *Rhus pyroides*. The open field consisted of small *Dichrostachys cinerea* and *Acacia totillis* tree species.

Grootswartbult

The proposed rail line will enter this farm on the south eastern corner and follow the boundary to the north western boundary point.

This property is removed from the tarred road and can only be accessed via a gravel road that runs through the breadth of the property. The following plant species dominated the survey area.

The grass layer, *Aristida congesta s. barbicollis, Digitaria eriantha, Eragrostis curvula, Aristida congesta s. congesta, Urochloa mosambicensis* and *Perotis patens*.

Tree layer, *Combretum hereroense, Commiphora pyracanthoides, Acacia nigrescens, Dichrostachys cinerea, Acacia mellifera* and *Euclea undulata.*

Bitterfontein

The proposed rail line will enter this farm property on the south eastern corner and move north to where it enters the farm Kruishout.

The grass layer encountered in the project area of this farm was relatively well developed without being domineering. The fact that the rail line cuts across the farm, and not only skirts the boundary, means that the vegetation encountered will consist of many more savannah species. *Digitaria eriantha, Pogonarthria squarrosa, Melinis repens* and *Schmidtia pappophoroides* were dominanant grass species.

The tree component was found to be dominated by *Acacia tortilis, Combretum apiculatum, Ziziphus mucronata, Acacia nigrescens* and *Combretum imberbe.*

6.1.6 Regional communities

The assemblages of plants that form plant communities are not only influenced by the specific management measures employed on a property but a combination of management topographical features, water availability (presence or absence) and level of utilisation. The following plant communities are not confined to the farm boundaries but stretch across the entire project area and are illustrated in Appendix 6.

Community 1

This community occurs on low lying areas and is characterised by vegetation occurring on central and northern Zeekoevley which is dominated by *Acacia karroo* and *Boscia foetida* community tree species in closed woodland with little grass cover on clay rich soils. *Aristida adscensionis* and *Schmidtia pappophoroides* were the dominant grass species in this community.

Community 2

Occuring on the outer edges of community 1 this community is more grass rich with fewer trees, mostly *Boscia foetida.* In this area open grassland community with a few small tree species were dominant. *Acacia senegal, Grewia flava Grewia flavescens* and *Boscia albitrunca* were dominant tree species, with *Brachiaria deflexa* and *Schmidtia pappophoroides* dominating the grass sword.

Community 3

This community occurs to the northwest where a rocky sandstone ridge dominates the landscape. It is this characteristic which gave rise to *Euclea undulata, Gardenia volkensii* community woodland, interspersed with *Combretum apiculatum* and *Acacia fleckii*. The grass sword comprised of dominant species such as *Pogonarthria squarrosa* and *Eragrostis biflora.*

Community 4

This community occurs on the northern border of the project site adjacent to the Limpopo River. It is a low lying community prone to flooding during the wet season

It is dominated by a low growing open Acacia woodland with a strong grass sword.

Community 5

This community borders community 4 to the south, here *Terminalia sericea* and *Acacia melifera* formed dense woodland with a grass sword comprising of *Schmidtia pappophoroides, Digitaria eriantha* and *Aristida congesta s. barbicollis* dominates the landscape.

Community 6

This community follows the lower lying banks of the Limpopo River, this community sonsists of predominantly riparian vegetation with large *Faidherbia albida* tree occurring throughout.

Community 7

This community is dominated by a *Grewia flava/ Ximenia Americana* community woodland, covering most of the central, eastern and northern flat sandy areas. Here *Terminalia sericea* and *Acacia melifera* formed dense woodland with a grass sword comprising of *Schmidtia pappophoroides, Digitaria eriantha* and *Aristida congesta s. barbicollis.*

Community 8

This community consists of old or recently planted or ploughed agricultural fields.

Community 9

This community was found on the farm Diepspruit, with dominant tree species being *Acacia tortillis* (Umbrella thorn), *Acacia karoo* (Sweet thorn), *Peltophorum africanum* (Weeping wattle), *Combretum apiculatum* (Red Bushwillow) and *Terminalia sericea* (Silver cluster leaf). The shrub component was dominated by *Euclea undulata* (Common guarrie), *Rhigozum brevispinosum* (Simple leaf Rhigozum), *Grewia flava* (Velvet Raisin) and *Dichrostachys cinerea* (Sickle bush) and the grass sword was dominated by *Schmidtia pappophoroides* (Sand Quick), *Perotis patens* (Cat's Tail), *Eragrosis pallens* (Broom love grass) and *Eragrostis nindensis* (Whether love grass).

6.1.7 Red Data plant species

On the farms Grootswartbult, Steenbokpan and Bitterfontein, the succulent *Aloe littoralis* was encountered, this species is designated as least concern by both the IUCN and the South African National Red data List and is a CITES app. 2 species (Figure 6-1). On the farm Zandbult the succulent *Taversia barklyi* was encountered, this species is designated as least concern by the South African National Red data List. The species *Adansonia digitata* was encountered on the farm Grootswartbult, this species is designated as least concern by the South African National Red data List.

The species *Boscia albitrunca* (Sheperds tree) is a nationally protected tree according to the National forest act of 1998 (Act 73 of 1998) and was encountered on Grootswartbult, Steenbokpan, Bitterfontein, Kalkpand, Kruishout and Zeekoeivlei. The species *Combretum imberbe* (Leadwood) was encountered on Vangpan, Bitterfontein, Loopleegte, Kalkpan, Kruishout and Zandbult it is designated as LC by the South African National Red data List.

The tree species *Sclerocarya birrea* (Marula) was encountered on Vangpan, Steenbokpan, Loopleegte and Kringgatspruit, and is nationally protected tree according to the National forest act of 1998 (Act 73 of 1998).

The tree species *Acacia erlioloba* is a nationally protected tree and was encountered on Grootswartbult, Steenbokpan, Bitterfontein, Kalkpan, Kruishout and Zeekoeivlei.

Table 6-1: Protected plant species on the railroad

Species name	Protected status	Growth form	V	K	Z	G	S	B	L
Acacia erioloba	Nationally forest act protected	Tree	2,3,4	2,3		1,2	1		1,2,3
Adansonia digitata	National red data list LC	Tree				2,3			
Aloe littoralis	National red data list, IUCN LC	Aloe				2,3	1	3	
Boscia albitrunca	National red data list LC	Tree				2,3		3	
Combretum imberbe	National red data list LC	Tree	2,3		2,3			3	1,3
Sclerocarya birrea	Nationally forest act protected	Tree	2,3	1,2,3				7	1,2
Taversia barklyi	National red data list LC	Succulent			2				

Note: V- Vangpan, K- Kringgatspruit, Z- Zandbult, G- Grootswartbult, S- Steenbokpan, B- Bitterfontein, L- Loopleegte

Table 6-2: Protected plant species on the mine area

Species name	Protected status	Growth form	A	B	C
Acacia erioloba	Nationally forest act protected	Tree		9,10,14	
Boscia albitrunca	National red data list LC	Tree	5	2,4,8,9	1,3,4,9,10
Combretum imberbe	National red data list LC	Tree			3, 9

Note: A- Kruishout, B- Zeekoevley, C - Kalkpan.

With the occurrence of many nationally protected plant species encountered during the field work it is strongly recommended that a management plan (Digby Wells) is followed for the legal management of these plants.

Figure 6-1: *Aloe litoralis*

6.1.8 Endemic plant species

No endemic plant species were recorded during the field surveys, however this by no means indicates their complete absence.

6.1.9 Exotic and invasive plant species

Among the alien invasive species encountered were *Capsella bursa-pastoris, Flaveria bidentis, Waltheria indica* and *Solanum panduriforme* (Bromilow 1995) (Table 6-3). These species were not encountered in large numbers and only sparsely distributed

single plants were found. In the vicinity of homesteads the occurrence and density of weed species were considerably higher than away from them. This could be indicative of the tendency of these species to colonise bare ground, something that is abundant around these areas.

Table 6-3: Invasive and Exotic plant species

Species	Ecological Status	Mine Farms								
		K1	V	K2	Z	K3	O	W	D	Railway
Aristida junciformis	Alien invasive							*	*	
Cyperus esculentus	Alien invasive		*							
Gomphrena celosioides	Exotic						*	*	*	
Opuntia ficus-indica	Alien invasive						*			L
Paspalum dilatatum	Exotic						*			
Sida cordifolia	Alien invasive						*	*	*	L
Solanum incanum	Weed			*				*	*	B
Solanum panduriforme	Weed	*	*	*	*	*	*			All
Tagetes minuta	Alien invasive			*			*			
Tribulus terrestris	Weed	*	*		*					
Capsella bursa-pastoris	Weed		*							

Note: K1-Kalkpan, K2- Kruishout, V-Vischpan, Z-Zeekoevley, K3-Kruispad, O-Osorno, W-Witkopje, D-Draai om,

Note: Railway key; K- Kringgatspruit, L- Loopleegte, Z- Zandbult, S- Steenbokpan, G-Grootswartbult, B- Bitterfontein, V- Vangpan.

6.1.10 Medicinal plant species

From the list of plant species identified during the field surveys (Appendix 1) there are 31 species (Table 6-4) officially recognised as having medicinal value, seven species are known for their cultural value. Medicinal plants are important to many people and have been used traditionally for centuries to cure many ailments. Plants have also been used traditionally for other cultural uses, such as building material, and for spiritual uses such as charms.

Table 6-4: Medicinal plant species recorded during the field surveys

	Farms	K1	V	K2	Z	K3	O	W	D	Railway
Species	**Growth form**									*
Acacia burkei	Tree		*							*

Acacia erioloba	Tree	*		*	*					*
Acacia karoo	Tree	*	*		*	*	*	*	*	*
Acacia tortilis	Tree	*	*	*	*					*
Albizia versicolor	Tree	*								
Ammocharis coranica	Shrub							*	*	
Boscia albitrunca	Tree			*						*
Cadaba aphylla	Shrub		*			*				*
Commelina africana	Herb						*			*
Cucumis zeyheri	Creeper									*
Cyanotis speciosa	Herb	*	*		*			*		*
Cyperus esculentus	Sedge		*							
Dichrostachys cinerea	Tree	*	*	*			*	*	*	*
Elephantorrhiza elephantina	Shrublet		*	*						*
Euclea divinorum	Tree								*	
Euclea undulata	Tree	*		*	*					*
Euphorbia ingens	Succulent						*			
Euphorbia tirucalli	Succulent							*		
Grewia flava	Tree	*	*	*	*		*	*	*	*
Grewia occidentalis	Shrub					*	*	*	*	*
Gymnosporea senegalensis	Shrub									*
Hibiscus trionum	Herb							*		
Lantana rugosa	Herb		*							
Ledebouria ovatifolia	Bulb/Herb		*							
Peltophorum africanum	Tree	*		*				*	*	*
Polygala amatymbica	Herb									*
Pseudognaphalium luteo-album	Herb					*	*			
Rhus pyroides	Tree		*			*	*	*		
Solanum incanum	Shrub							*	*	*
Solanum panduriforme	Shrub	*	*		*	*	*			*
Strychnos spinosa	Tree						*	*	*	
Tephrosia purpurea	Herb		*							
Terminalia sericea	Tree	*		*					*	*
Ximenia americana	Tree				*			*		*
Ximenia caffra	Shrub	*								*
Ziziphus mucronata	Tree					*		*		*

Note: K1-Kalkpan, K2- Kruishout, V-Vischpan, Z-Zeekoevley, K3-Kruispad, O-Osorno, W-Witkopje, D-Draai om.

Note: Railway key; K- Kringgatspruit, L- Loopleegte, Z- Zandbult, S- Steenbokpan, G-Grootswartbult, B- Bitterfontein, V- Vangpan.

6.2 Animal Survey

6.2.1 Mammals

6.2.1.1 Mammals observed and recorded in the area

During field investigations mammal species present within the area of concern were noted. The prominent relative abundance of wild ungulates and other mammals and the low abundance of large predators were obvious.

The specific management decision on these properties were to create a game ranch, by stocking the farm with wild herbivores, and small carnivores/scavengers. The direct effect of this is that intensive management has to be applied to control animal numbers, this is accomplished through hunting.

Table 6-5: Mammals recorded during the field surveys

		Farms	**K1**	**V**	**K2**	**Z**	**K3**	**O**	**W**	**D**	**S**	**R**
Species		**Common name**										
Acinonyx	*jubatus*	Cheetah										*
Aepyceros	*melampus*	Impala		*	*		*	*	*	*	*	*
Alcelaphus	*buselaphus*	Red Hartebeest		*								
Canis	*mesomelas*	Black-backed Jackal									*	*
Caracal	*caracal*	Caracal									*	*
Ceratotherium	*simum*	White Rhinoceros#		*								
Cercopithecus	*aethiops pygerythrus*	Vervet Monkey	*	*	*		*			*		
Connochaetes	*taurinus taurinus*	Blue Wildebeest		*				*			*	
Cynictis	*penicillata*	Yellow Mongoose									*	*
Damaliscus	*dorcas*	Blesbuck		*								
Equus	*burchellii*	Plains Zebra		*								
Girrafa	*camelopardalis*	Giraffe		*								
Hippotragus	*niger niger*	Sable Antelope#		*	*							
Hystrix	*africeaustralis*	Porcupine		*	*		*				*	*
Lepus	*saxatilis*	Scrub/Savannah Hare		*			*	*		*	*	
Mungos	*mungo*	Banded Mongoose	*	*			*					*
Oryx	*gazella*	Gemsbok		*								*
Papio	*ursinus*	Chacma Baboon									*	
Paraxerus	*cepapi*	Tree Squirrel		*							*	
Pedetes	*capensis*	Springhare										*
Phacochoerus	*africanus*	Warthog	*	*	*	*	*	*	*	*	*	*
Raphicerus	*campestris*	Steenbok#		*		*		*			*	*
Sylvicapra	*grimmia*	Grey /Common		*				*			*	*

		Duiker										
Syncerus	*caffer*	Cape Buffalo#	*	*								
Taurotragus	*oryx*	Eland		*								*
Tragelaphus	*strepsiceros*	Kudu		*	*		*	*	*		*	*
Tragelaphus	*angasi*	Nyala					*	*				
Xerus	*inauris*	Cape Ground Squirrel		*	*							*

Note: (#) denotes species protected within the Limpopo Province (Limpopo Environmental act of 2003)

Note: K1-Kalkpan, K2- Kruishout, V-Vischpan, Z-Zeekoevley, K3-Kruispad, O-Osorno, W-Witkopje, D-Draai om, S- Diepspruit, R – Railway section.

6.2.1.2 Red Data mammals

Near Threatened species with Red Data statuses was noted during the field survey and include the Sable Antelope (*Hippotragus niger niger*) and the Cheetah (*Acinonyx jubatus*). However previous studies in the area, on neighbouring farms identified the Honey Badger (*Mellivora capensis*) as being present, this mammal is also a Near Threatened species with Red Data status. The Sable is noted as a re-introduced species, but the cheetah and honey badger are naturally occurring. Herbivores are stocked on game farms but predatory animals such as cat species freely move around. These animals are actually regarded as a nuisance by the farmers due to the fact that they feed on the stocked herbivores, adding to their threatened status due to private handling, exporting and extermination of predatory animals, although they are protected by the IUCN, NEMBA, CITES and Limpopo legislation.

The remaining species all fall within the Lower Risk IUCN Red Data category, which describes species that do not qualify for the threatened categories. Species within this category are then either in the Least Concerned or Conservation Dependent sub categories. Lower Risk – Conservation Dependent species are species which may qualify for threatened categories if conservation efforts cease. The remaining species are Lower Risk – Least Concerned species, a category describing species that are under little or no threat.

6.2.2 Birds

The birds observed in the study area totalled 133 species. These included three Vulnerable and two Near Threatened species, the remaining species all fall within the Least Concerned IUCN categories and are not threatened species (Appendix 2). Birds observed outside the project area, yet within the general area, were also noted as the likelihood of these species occurring within the project area is high due to the transient nature of birds. The Red-billed Oxpecker (*Buphagus erythrorhynchus*) and the Yellow billed Stork (*Mycteria ibis*) are currently classified as Near threatened according to the IUCN, with the Kori Bustard (*Ardeotis kori*), White-backed Vulture *(Gyps africanus*) and the Cape Vulture (*Gyps coprotheres*) being designated as Vulnerable (Table 6-6).

Table 6-6: Red data birds observed

English Name	Scientific	General Status	IUCN
Kori Bustard	*Ardeotis kori*	R-R (Resident-Rare)	VU
Redbilled Oxpecker	*Buphagus erythrorhynchus*	R-C (Resident-common)	LC
Whitebacked Vulture	*Gyps africanus*	R-C (Resident-common)	VU
Cape vulture	*Gyps coprotheres*	R-R (Resident-Rare)	VU

Yellowbilled Stork	*Mycteria ibis*	NBM/R-LC (Non-Breeding migrant /Resident-Locally common)	NT

Note: VU – Vulnerable NT – Near Threatened

6.2.3 Reptiles

6.2.3.1 Reptile desktop study: Reptiles

All reptiles with distribution patterns across the area of interest are listed in the relevant desktop report for this project.

6.2.3.2 Reptiles observed and recorded in the area

The reptile species listed in Table 6-7 were all recorded during the field survey, confirming reports from local residents of their presence, the Nile crocodile was not personally seen but large drag marks on the muddy riverbanks, accompanied by crocodile tracks confirmed the presence of this reptile.

Table 6-7: Reptiles that were observed in the area of interest

Sub-order	Family	Species name	Common English name
Crocodylia	Amphisbaenidae	*Crocodylus niloticus*	Nile Crocodile
Sauria	Chamaeleonidae	*Chamaeleo dilepis*	Flap Neck Chameleon
Sauria	Cordylidae	*Platysaurus minor*	Waterberg flat lizard
Serpentes	Elapidae	*Dendroaspis polylepis*	Black Mamba
Scleroglossa	Gekkonidae	*Lygodactylus waterbergensis*	Waterberg dwarf gecko
Sauria	Lacertidae	*Heliobolus lugubris*	Bushveld Lizard
Sauria	Lacertidae	*Nucrus intertexta*	Spotted Sandveld Lizard
Pleurodira	Pelomedusidae	*Pelusios sinuatus*	Serrated Hinged Terrapin
Pleurodira	Pelomedusidae	*Pelomedusa subrufa*	Marsh Terrapin
Chelonia	Testudinid	*Psammobates oculiferus*	Kalahari Tent Tortoise
Chelonia	Testudinidae	*Geochelone pardalis*	Leopard Tortoise
Sauria	Varanidae	*Varanus niloticus*	Water Monitor
Sauria	Varanidae	*Varanus albigularis*	Rock Monitor

The majority of the reptiles expected to occur within the study area according to literature, especially snakes, are not expected to occur in areas where large scale game

farming has diminished the grass layer of the area on which these creatures depend for food sources such as rats and mice. This grass layer is essential for invertebrates and most rodents to survive; without this grass layer these fauna species do not have shelter or food. This will have a negative impact on their abundance.

6.2.3.3 Red Data reptiles

The Nile crocodile (*Crocodylus niloticus)* was the only reptile with Red Data status observed during the field surveys, the designation is Vulnerable. One species of reptile, the Southern African Python (*Python natalensis*) could potentially occur in the area of interest. This species is listed as Vulnerable. Two of the reptile species found on site is not listed under IUCN, however they are endemic to the Waterberg area. The Waterberg dwarf gecko (*Lygodactylus waterbergensis*) and the Waterberg Flat Lizard (*Platysaurus minor)* are reptile species that only occur within the Waterberg district, for this reason if there habitat is removed it would destroy the only section known as habitat and so impact the survival of the species. Rocky sandstone outcrops in savannah at altitudes of 900-2000 m are known to be utilized by these species as habitat. Although on site they were also found on artificial dam walls and other developments.

6.2.4 Frogs

6.2.4.1 Frogs recorded in the area

The distribution of frogs in the Savanna bushveld, is closely linked to their physiological adaptations to not only survive but thrive in certain climatic conditions. The summer rainfall gradient from the west (300 mm) of the Savanna range of South Africa to the east coast (1000 mm) provides a range of biotic and abiotic factors. These factors create niche differentiation to which different frog species are adapted. Owing to this, few frog species are distributed evenly across the region. In Table 6-8 all the frog species encountered during the field survey are listed, together with the habitat types they prefer, and are most likely to be found in.

Table 6-8: Frog and Toad species that were observed in the area of interest.

Family	Species	Common name	Likely habitat types
Bufonidae	*Bufo poweri*	Western Olive Toad	Banks of pans; river beds
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina	Inundated grasses; marshes, vleis, seepage points
Microhylidae	*Breviceps adspersus*	Bushveld Rain Frog	Open ground

Family	Species	Common name	Likely habitat types
Microhylidae	*Phrynomantis bifasciatus*	Banded Rubber Frog	Banks of pans
Ranidae	*Cacosternum boettgeri*	Common Caco	Inundated grasses; temporary pans & rain pools
Ranidae	*Chiromantis xerampelina*	Foam Nest Frog	Trees
Ranidae	*Ptychadena anchietae*	Plain Grass Frog	Inundated grasses
Ranidae	*Ptychadena mossambica*	Broad-Banded Grass Frog	Inundated grasses
Ranidae	*Tomopterna krugerensis*	Knocking Sand Frog	Banks of pans

6.2.4.2 Red Data frogs

No species of frogs with Red Data Status were observed during the field survey. However according to data obtained during the scoping report phase the Giant Bullfrog (*Pyxicephalus adspersus*) could occur in the area and is listed as Threatened. This species is expected to occur in open water.

6.2.5 Terrestrial invertebrates

6.2.5.1 Invertebrate desktop study

The literature survey indicated that three IUCN Red Data invertebrates (excluding Least Concerned category as these are not currently endangered) occur in South Africa (IUCN, 2006). These include five dragonflies (Odonata) and one millipede (Diplopoda) and have been listed with their Red Data status in Table 6-9. Their specific distributions are unknown and they may potentially not occur in the region of interest. Most species fall within the Data Deficient Red Data category, which lists animals that may be endangered but not enough information is known about them.

Table 6-9: IUCN Red Data invertebrates (excluding Least Concerned Category)

Class	Order	Family	Species	Red Data Status
Insecta	Odonata	Protoneuridae	*Elattonuera cellularis*	Data Deficient

Insecta	Odonata	Synlestidae	*Chlorolestes elegans*	Near Threatened
Myriapoda	Diplopoda	Spirostreptidae	*Doratogonus stephensi*	Data Deficient

6.2.5.2 Invertebrate field survey

No invertebrate field survey was conducted for reasons mentioned earlier.

6.2.5.3 Red Data terrestrial invertebrates

Butterflies and dragonflies are currently the main Red Data invertebrates due to the greater awareness of butterflies by the public and the fact they are caught for various collectors globally. Many Odonata species have been recognised as specialist habitat users and bio-indicators, hence the Red Data listing of some of these species.

During previous surveys nine butterfly species were collected in the general area and none were Red Data species.

7 CARBON SEQUESTRATION

7.1 Introduction

The carbon cycle is one of the major biogeochemical cycles because of its role in regulating the atmospheric concentration of carbon dioxide, which plays a critical role in controlling the Earth's climate. Together with other greenhouse gases such as water vapour, methane, nitrous oxide, ozone and halocarbons, it absorbs the radiation in the infrared wavelengths preventing the heat radiated from the earth's surface from escaping the atmosphere. As the concentration of these greenhouse gases increases, the amount of heat trapped in the atmosphere also increases, resulting in global warming. Over the past 150 years atmospheric concentrations of carbon dioxide have increased substantially from 266 parts per million to approximately 369 parts per million mainly as a result of the burning of fossil fuel and deforestation. The need to minimise the carbon released into the atmosphere is therefore of great importance (greencarbon.co.za, 2007).

There are 3 types of carbon sequestration:

1. Ocean sequestration where carbon is stored in oceans.

2. Geologic sequestration where carbon is stored in the pore spaces of geologic formations.

3. Terrestrial sequestration where carbon is stored in soils and vegetation. This one is our major natural carbon sink.

7.2 Vegetation and Global Warming

Vegetation plays an important role in the carbon cycle because it acts both as a sink and source of CO^2. Through the process of photosynthesis plants use light energy to reduce CO^2 to organic compounds. Hence when de-vegetated areas are re-vegetated, through natural regeneration or through human intervention, vegetation is a natural carbon sink. This carbon storage process enables vegetation to reduce atmospheric CO^2 concentrations and hence ameliorates global warming. Although plants naturally release carbon dioxide as a by-product of cellular metabolism and by the decomposition of organic material, these sources are not responsible for the observed increase in the carbon dioxide levels in the atmosphere over the past 150 years. However, when vegetation is cleared it acts as a human-induced source of carbon dioxide due to biomass burning, soil disturbance and the increased rate of decomposition (greencarbon.co.za, 2007).

In the context of vegetation the term carbon sequestration is the process of increasing the carbon content of vegetation carbon pools. The primary greenhouse gas, CO^2, is absorbed through the process of photosynthesis by the leaves of plants and the carbon atoms are used by plants to construct glucose and starches which in turn are the building blocks of biomass which, in the case of trees, are for example, roots, stems, branches and leaves. Oxygen molecules are released back into the atmosphere.

The major advantage of plants in a global warming context is that they absorb and store the carbon (C) element of the CO^2 greenhouse gas and thereby remove this greenhouse gas from the atmosphere. The result is that global warming is reduced through the growth of plants because they remove the CO^2 from the atmosphere where the CO^2 would otherwise have trapped atmospheric heat and increased the earth and atmospheric temperatures (greencarbon.co.za, 2007).

7.3 Kyoto Protocol

The Kyoto Protocol originated from the United Nations Framework Convention on Climate Change (UNFCCC), which was one of the initiatives of the 1992 Rio de Janeiro Earth Summit. In December 1997, the parties to the UNFCCC met in the City of Kyoto, Japan and adopted what has become known as the Kyoto Protocol. (greencarbon.co.za 2007)

The aim of the protocol is to reduce greenhouse gas emissions of industrialised countries by an average of 5.5 % below 1990 levels by the 2008 - 2012 commitment

period. The protocol has come into legal force on 16 February 2005. Obtaining greenhouse gas credits for Kyoto compliance may result in greenhouse gas trading. (greencarbon.co.za 2007).

For the client to enjoy the benefits of the Kyoto protocol, and not to fall foul of it, it must take into consideration that the construction of the various mining related infrastructure will permanently remove vegetation from certain areas. To aid management the characterisation of the farms into plant communities will allow for an estimation of what plant communities will be affected.

As described earlier the farms Kalkpan and Kruishout will be the location of most of the disturbance, the vegetation present on these farms will therefore be affected the most.

The communities present on these farms, among others, contributed to carbon sequestration through the process of photosynthesis whereby plants use light energy to reduce CO^2 to organic compounds. It therefore stands to reason the less vegetation is removed the more the capacity to reduce CO^2 to organic compounds is preserved.

It is however understood that placement of the mine infrastructure will be done, therefore mitigation measures set forth in this document will have to be adhered to.

8 DISCUSSION

The results obtained from the field study revealed natural habitat that has been greatly influenced by management decisions in the past. From data gathered it was obvious that the areas were stocked with ungulates, in certain circumstances overstocked, this was seen in the lack of available graze and the substantial bush encroachment that resulted from overstocking. The effect of overstocking reduces the vigour of plants by means of repeated defoliation of palatable species, thereby creating favourable habitat for bush encroaching species. Furthermore it also reduces the water infiltration capabilities of soil due to trampling, which indirectly affects plant growth.

Management decision for the farms required the artificial stocking of game for both hunting and game viewing purposes. The wild herbivore population cannot be seen as natural for the area, and can therefore not be indicative of high levels of biodiversity. Predatory animals on the other hand more freely between the farms and are naturally occurring. Not only is the Cheetah species naturally occurring, but they are a protected species on a provincial, national and global level. By removing habitat from this protected species will results in reduced habitat, food resources and other survival necessities. It is found that although the cheetah is protected, the implementation of this

legislation is enforced. This mammal will need to captured and relocated to a suitable habitat to ensure protection if the development should persist.

Although the railway will impact all fauna, it will predominantly impact the avifauna that occurs on the project area. Impacts include:

- Electrocution on the electrical infrastructure of the railway line;
- Collisions with the associated power lines;
- Collisions with the moving train;
- Disturbance due to the construction of the railway line and the operation of the train; and
- Habitat destruction through the construction of the railway line and associated infrastructure

This however will be further discussed in the impact assessment section. It must be noted that due to the fact that four IUCN Red Data species are found on site, the impact on avifauna will be high.

Management decision for the farms required the artificial stocking of game for both hunting and game viewing purposes. However no large predators were found to be present within the boundaries of the properties, specifically to protect the herbivore population. The wild herbivore population cannot be seen as natural for the area, and can therefore not be indicative of high levels of biodiversity.

Biodiversity offsets are considered as a ‘last resort’ option in a hierarchy of possible mitigation measures. That is, they are seen as an exceptional, rather than the usual form of mitigation. ‘Residual impacts’ are those impacts that remain once all proposed mitigation measures to avoid, reduce and repair/restore potential negative impacts have been taken into account. Offsets may be considered to compensate for those ‘residual’ biodiversity impacts resulting from proposed mine by securing priority habitat for biodiversity conservation at other locations.

Carbon sequestration, as discussed for this project can be accomplished by conserving habitat. This will have the added benefit of protecting animal species, which frequent these habitats.

9 CONCLUSION

9.1 General

From a floral perspective the natural habitat that exists on the area of concern is experiencing negative effects of overstocking; if the stressor (in this instance herbivores) is removed the recovery of the vegetation will be faster. After mining has started in the area, the vegetation that is undisturbed by mining will act as a refuge to floral species, and to a lesser extent to faunal species, protection of these areas from disturbance during mining is very important.

The large number of large herbivores present within the area of interest is of conservation importance and if the client wishes to purchase these animals with the land, re-location of these animals will have to be considered. For this reason a biodiversity offset area is an option to be considered. All large herbivores can be re-located to these areas where compensation for the destroyed natural habitat will be created. The possibility of conservancies is discussed under recommendations. Red Data species include the Honey Badger and Cheetah. Bird species however cannot be easily relocated, due to fact that they take flight; there are four IUCN species and they wells presented within the area. The vultures only feed within the project area; however the Kori bustard breeds within the project area.

9.2 Carbon sequestration

9.2.1 On site

As mentioned previously, there are three ways carbon can be stored, excluding atmospheric carbon, and the most prominent of these is terrestrial and vegetation sequestration. During field investigations it was found that the standing component of the vegetation present was extensive, therefore one can assume the amount of carbon stored within the standing vegetation is also substantial. Cutting and burning of this vegetation will release the stored carbon into the atmosphere, enlarging the carbon footprint of the responsible party. Not only is stored carbon released but the capability of this vegetation to capture and store more carbon is lost.

All survey sites located close to the Limpopo River contained a number of large *Faidherbia albida* trees, from the size of these trees one can assume their carbon storage capability must be very large. Areas not close to the Limpopo River were found to be suffering from bush encroachment, once again the carbon storage capability of this vegetation must be large.

The goals of the responsible party in this case must be firstly not to release more carbon into the atmosphere, and secondly to not lose the capability of further carbon storage. Both these goals can be attained by minimising the amount of standing vegetation removed and/or burned during construction and operational phase activities.

By increasing the standing vegetation in the project site, management will increase the capability of carbon sequestration by plants, if this option is taken into consideration, cognisance of provincial and national laws regarding plant/tree species must be taken. Areas that have been rehabbed by the client can be used to facilitate this. Furthermore, care must be taken not to modify the area in such a way that it does not resemble the remainder of the area.

Apart from the above mentioned actions the proposed mine must ensure that vehicles and machinery is in good working condition as to minimise CO^2 emissions.

9.2.2 Off site

The proposed mine will be extracting approximately 411 million tonnes of coal that is currently below ground. This coal will be sold to clients who in turn will burn this coal for energy creation, the amount of CO^2 that will potentially be released into the atmosphere by clients is massive and the proposed mine will have no control over this.

For this reason the recommendations contained within this report cannot be used as a carbon sequestration plan, as such a document will have to concentrate on much greater detail.

10 RECOMMENDATIONS

Before and during the construction phase an ecological audit must take place to ensure that there are no Red Data breeding sites, all burrowing animals have moved away from the disturbance and all fauna that might be harmed are relocated. Red Data species should be avoided where possible. If avoidance is not probable then relocation is obligatory. It is recommended that construction take place during the dry season (May to August), outside of the breeding timeframe of the Kori Bustard. Other mitigation measures can also be applied to prevent or reduce the impact on fauna, during the operational phase. The fact that natural habitat will be lost due to mining activities cannot be disputed, but opportunities to enhance the biodiversity in the area does exist. Firstly the remaining natural habitat must be managed to enhance its ecological integrity. On site monitoring must take place to identify negative trends in the ecosystem, adaptive management will then be applied to correct these negative trends, included here are bush encroachment and alien invasive plant species. Off-site this can be achieved through the establishment of conservancies in the surrounding area where sound

conservation values can be practiced and the biodiversity of the area conserved. On the conservancies the establishment of research facilities, subsidised by the mining company and operated by tertiary institutions must be investigated. By doing this the knowledge of the ecosystem will be enhanced through species and habitat level studies. The linking of these facilities to existing facilities must be researched in order to build partnerships and share information. The local inhabitant must form part of this initiative in order to address not only the biodiversity loss but also the loss of local knowledge.

The on-site effects that the mine and related infrastructure have on the flora of the area can be quantified with continuous monitoring of natural areas on the project site. Such a monitoring program must concentrate on the Red data species management, alien invasive species management, and bush encroachment management. The latter two being the major negative effects on flora apart from total removal. A monitoring program will include seasonal assessments to identify areas where intensive management in the form of bush and alien invasive clearing will have to be applied; furthermore the management of the red data species will have to take place. Follow up surveys of the identified problem areas will have to be conducted in order to adapt management plans to suit specific areas. Annual monitoring of the effects of the mine and its operations on fauna and flora in the general area must be conducted, this can be accomplished through information sharing with local land owners and surveys conducted on the surrounding farms. A preliminary timetable is supplied in Table 10-1.

The major management measure to be employed with regards to the Red data species will be exclusion of all activities within the buffer zone of 40 meters. The buffer zone prescribed was chosen after consideration was given to the distribution of the current populations of *Aloe littoralis*, which was positive as the plant is widespread in the xeric savanna woodland. Further consideration was given to the habitat/vegetation type that the plant prefers, which was also widespread and common. With regards to the remaining protected plant species encountered, specifically in the railway corridor farms, a separate management plan will have to be followed to manage these. Such a management plan will include the application of a permit, construction of a nursery and planting these plants in a designated off-set area.

Table 10-1: Monitoring times

Aspect	All Boikarabelo farms	Neighbouring farms/Railway farms
Fauna	Monitored annually	Monitored bi-annually
Flora	Monitored seasonally	Monitored bi-annually

The continued survival of plant species present depends on management actions that are implemented and not delivering the desired results being changed to suit the desired outcome.

The monitoring of the flora environment is completed by investigating its constituent components specifically the herb, grass shrub and tree layers. These components have differentiation within them and these are medicinal, endemic, alien invasive and weedy species. A monitoring program needs to evaluate the management actions on each of these components. The method of monitoring is the Braun Blanquet method, which is a specialised method designed specifically for vegetation survey/monitoring purposes.

- Monitoring must take place annually;
- Monitoring must be completed by qualified specialists;
- Adaptive management must applied;
- Monitoring during the wet season is essential; and
- Findings must be compared to previous years.

The alien vegetation monitoring will be of importance due to the threat posed by site clearance which provides open areas where alien invasive species could establish. Therefore the open areas created during the construction phase could persist during the operational phase, and thereby create areas where alien invasive species could establish.

The monitoring program will include an ecological audit. This audit will take place prior to any construction, to ensure all species that occur within the areas to be developed are relocated. This is due to the fact that burrowing animals might have young and for this reason will not move despite the disturbance. The ecological audit will continue during the construction phase daily to ensure disturbance to the natural environment is reduced and limited to demarcated areas. During the operational phase, assessments could be conducted every 6 months or annually determining the level of rehabilitation achieved and the current ecological state. Before the decommissioning phase a final survey could be conducted to determine how the environment can be improved based on the monitoring done over the life of the mine and facilitate in the final closing procedures, rehabilitation and management.

11 DESCRIPTION OF POTENTIAL IMPACTS

The following section describes the potential impacts that the proposed mining activities could have on the local fauna and flora. For more information on the proposed mine plan, please refer to the EIA. The activity numbers correspond with the listed activities in the EIA.

11.1 Construction phase

During the construction phase the majority of the negative impacts expected to occur with the construction of such a facility will occur.

Activity 2: Transport of construction material

This activity will be associated with all heavy duty transport of materials but will also include general operating of vehicles. It is likely that the increase in vehicle use will cause further damage (deterioration) to the informal roads which will result in further exposure of non-vegetated areas increasing the potential for erosion and sedimentation during rainfall periods. The increase in vehicle numbers will also increase the potential of spillages and leaks from operating vehicles which will have a negative impact on vegetation growth and even rehabilitation. Dust created during activity could have a detrimental effect on plant evapotranspiration. This activity is considered to be on-going through the life of mine and long term in duration and also local with regards to extent of impacts. The severity of the impact was determined to be moderate.

Impact assessment:

Parameter	**Description**	**Rating**
Duration	Long term	5
Extent	Local	2
Severity	Moderate	3
Likelihood	Probable	4
Significance	Medium - high	53%

Activity 3: Removal of Topsoil

The existing vegetation within the proposed area of development will be impacted on as the existing vegetation will be removed to facilitate the construction of mining related infrastructure which will include the railway line. This will include the continuous and complete removal of vegetation and soil as the opencast pit is excavated and rail line is built. Of specific concern is the Red Data plant species that were identified during the field work. The management of these plant species will begin before the construction phase with the application of permits from the Department of Agriculture, Forestry and Fisheries for the removal, destruction or cutting of these tree species. Such a permit will stipulate the actions and requirements that the mine and railway construction teams must adhere to. These activities or actions are considered to be medium term during life of mine as it will be required for the construction and operating phases of the mine and railway. 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, if proposed mitigation measures are carefully followed.

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 savanna will result in the permanent reduction of natural habitat of reptiles, birds, frogs, insects and mammals present within the areas. The savannah vegetation 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 serious.

Impact assessment:

Parameter	**Description**	**Rating**
Duration	Long term	5
Extent	Site specific	2
Severity	Serious	5
Likelihood	Certain	4
Significance	Medium-High	64%

Activity 5, 10: Construction of surface infrastructure

The construction of discard dumps, pollution control dams, offices, sewage treatment facility, rail spur facility for coal loading, and other infrastructure will increase the

favourable habitat for alien invasive plant species to establish themselves, primarily due to open/cleared ground being available to the very efficient establishment strategies of alien invasive plant species. The area designated for surface infrastructure will no longer allow for seepage of surface water into underground aquifers due to the hardening of surfaces. The infiltration will increase the surface water run-off, which in turn will increase erosion that will lead to loss of topsoil, which is detrimental to plant species.

This activity is considered to be short term in duration as well as local in extent. The severity of the impact was determined to be minor.

Impact assessment:

Parameter	**Description**	**Rating**
Duration	Short term	2
Extent	Site specific	2
Severity	Minor	2
Likelihood	Certain	5
Significance	Medium - low	40%

Activity 6: Stockpiling of soil and overburden from initial cuts

The establishment of the mining area by means of an initial boxcut will remove soil and vegetation. There will be a reduction in availability of soil for plant establishment, which will bring about a net loss of vegetation. 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.

The removal of topsoil and overburden will result in stockpiling of the material which will increase the potential of the stockpiles becoming eroded as a result of winds and rain moving across the areas. The removal of plants will negatively affect soil binding, and surface runoff.

Impact assessment:

Parameter	**Description**	**Rating**

Duration	Long term	5
Extent	Site specific	1
Severity	Minor	2
Likelihood	Probable	5
Significance	Medium - high	53%

Activity 7: Storage of hydrocarbon and explosives

The storage of fuel, lubricant and explosives will be required for the life of mine. Incorrect, inadequate or negligent storage of these materials may result in the potential pollution of surface water and top soil resources due to pollutant and toxicant spillages and leaks which may impact negatively on the water (drinking) and soil quality (plant growth) availability to plants and subsequently animals. Such spills will also negatively affect the ecological functioning of the systems. This activity is considered to be medium in duration as it will be required for the life of mine. The impact will be limited in extent. The severity of the impact was determined to have limited effects.

Impact assessment:

Parameter	**Description**	**Rating**
Duration	Long term	5
Extent	Site specific	2
Severity	Limited	1
Likelihood	Unlikely	3
Significance	Medium - low	32%

11.2 Operational phase

Activity 12: Overburden stockpiling

The removal of topsoil and overburden will result in stockpiling of the material which will increase the potential of the stockpiles becoming eroded as a result of winds and rain moving across the areas. The removal of plants will negatively affect soil binding, and surface runoff.

Impact assessment:

Parameter	**Description**	**Rating**
Duration	Long term	5
Extent	Site specific	2
Severity	Moderate	3
Likelihood	Certain	4
Significance	Medium - high	53%

Activity 13: Vehicular activity on haul roads, use of hall roads

The vehicular activity will result in the creation of soil based as well as coal 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 coal 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 is considered to be medium in duration as it will be required for the operational phase. 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	3

Likelihood	Probable	4
Significance	Medium -high	53%

Activity 23: Rehabilitation as mining progresses (where possible).

This may be considered to be a neutral impact if implemented properly. 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	Moderate-short term	3
Extent	Site specific	2
Severity	Moderate	3
Likelihood	Certain	5
Significance	Medium - high	53%

Activity 24: Railway line operation and rail loading loop.

This activity is considered to be negative in nature; coal will be loaded onto the railway line via overhead feeders on the rail loop. This activity holds potential for coal spillage which could potentially lead to contamination of surface water runoff. This will additionally affect plant growth and animal presence in the area in a negative way.

Impact assessment:

Parameter	Description	Rating
Duration	Long term	5
Extent	Site specific	2
Severity	Moderate	3
Likelihood	Certain	5
Significance	Medium - high	67%

11.3 Decommissioning

Activity 26: 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 invasives 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 short 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	Moderate-short term	3
Extent	Site specific	2
Severity	Moderate	3

Likelihood	Certain	5
Significance	Medium - high	53%

Activities 26, 27, 28, 29, 30, 31, 32: Final replacement of overburden and topsoil and re-vegetation.

This is considered to be a neutral impact if implemented properly. 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	3
Likelihood	Certain	6
Significance	Medium - high	64%

11.4 Post-closure phase

Activity 33: Post-closure monitoring and rehabilitation.

This activity is positive

Impact assessment:

Parameter	**Description**	**Rating**
Duration	Moderate-short term	3

Extent	Site specific	2
Severity	Moderate	3
Likelihood	Certain	5
Significance	Medium - high	53%

11.5 Railway development

11.5.1 Construction phase

Activity 2, 4: Transport of construction material, developing haul roads

This activity will be associated with all heavy duty transport of materials but will also include general operating of vehicles. The initial impact will result in the clearing of vegetation for the development of haul roads and so doing removing habitat possibilities for fauna. It is likely that the increase in vehicle use will cause further damage (deterioration) to the informal roads which will result in further exposure of non-vegetated areas increasing the potential for erosion and sedimentation during rainfall periods. The increase in vehicle numbers will also increase the potential of spillages and leaks from operating vehicles which will have a negative impact on vegetation growth and even rehabilitation. Dust created during activity could have a detrimental effect on plant evapotranspiration. Further impacts on fauna include collisions, harm to fauna species through vehicle activity and noise will disturb animal activity. Red Data species that occur on site are likely to be harmed and need to be relocated accordingly. The severity of the impact was determined to be serious, due to the presence of Red Data species.

Impact assessment:

Parameter	**Description**	**Rating**
Duration	Long term	5
Extent	Local	3
Severity	Moderate -high	4
Likelihood	Probable	4

Significance	Medium - high	64%

Activity 3: Removal of topsoil

The existing vegetation within the proposed area of development will be impacted as it will be removed to facilitate the construction of mining related infrastructure. This will include the continuous and complete removal of vegetation and soil as the opencast pit is excavated. This activity is considered to be medium term during life of mine as it will be required for the construction and operating phases of the mine.

Of specific concern is the Red Data plant species that were identified during the field work, along the railroad corridor. The management of these plant species will begin before the construction phase with the application of permits from the Department of Agriculture, Forestry and Fisheries for the removal, destruction or cutting of these tree species. Such a permit will stipulate the actions and requirements that the mine and railway construction teams must adhere to. These activities or actions are considered to be medium term during life of mine as it will be required for the construction and operating phases of the mine and railway. 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, if proposed mitigation measures are carefully followed.

The destruction of the areas with natural savanna will result in the permanent reduction of natural habitat of reptiles, birds, frogs, insects and mammals present within the areas. The grassland and surrounding vegetation offers habitat to certain birds, reptiles, frogs, insects and mammals that could be present, this includes habitat and feeding grounds for Red Data species. Although this impact is only on specific sites within the project area, it will still impact the ecology of the whole mining area. The severity of the impact was determined to be serious.

Impact assessment:

Parameter	**Description**	**Rating**
Duration	Long term	5
Extent	Site specific	2
Severity	Serious	5
Likelihood	Certain	4

Significance	Medium-High	64%

Activity 5: Construction infrastructure (substation for 20 MW and a railway line)

Although the railway will impact all fauna, it will predominantly impact the avifauna that occurs on the project area. Impacts include:

- Electrocution on the electrical infrastructure of the railway line;
- Collisions with the associated power lines;
- Collisions with the moving train;
- Disturbance due to the construction of the railway line and the operation of the train; and
- Habitat destruction through the construction of the railway line and associated infrastructure

Collisions with a moving train and the removal of habitat is also relevant for other fauna species. Because there are Red Data birds that occur within the area, it will mean the loss of species numbers for these threatened species. For this reason the impact significance is seen as high.

Impact Assessment:

Parameter	**Description**	**Rating**
Duration	Long term	5
Extent	National	5
Severity	Serious	5
Likelihood	Certain	4
Significance	High	80%

11.5.2 Operational phase

Activity 10: Removal of overburden, drilling and blasting

The removal of topsoil and overburden will result in stockpiling of the material which will increase the potential of the stockpiles becoming eroded as a result of winds and rain moving across the areas. The removal of plants will negatively affect soil binding, and surface runoff.

Impact assessment:

Parameter	**Description**	**Rating**
Duration	Long term	5
Extent	Site specific	2
Severity	Moderate	3
Likelihood	Certain	4
Significance	Medium - high	53%

Activity 12: Use and maintenance of haul roads and transportation of coal

The vehicular activity will result in the creation of soil based as well as coal 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 coal 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. Increase traffic can also cause increase fauna mortality, including that of Red Data species. This activity is considered to be medium in duration as it will be required for the operational phase. The severity of the impact was determined to be moderate.

Impact assessment:

Parameter	**Description**	**Rating**
Duration	Long term	5
Extent	Local	3

Severity	Medium-high	4
Likelihood	Probable	4
Significance	Medium -high	64%

Activity 22: Rehabilitation as mining progresses via backfilling of overburden

This may be considered to be a neutral impact if implemented properly. 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 in so doing increase habitat availability for fauna, 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	Moderate-short term	3
Extent	Site specific	2
Severity	Moderate	3
Likelihood	Certain	5
Significance	Medium - high	53%

11.5.3 Decommissioning phase

Activity 24: Removal of all infrastructure

The removal of infrastructure can lead to the local disturbance of fauna and flora. If building rubble is not disposed of correctly, this can also lead to pollution and a reduction in the ecological integrity that will inhibit rehabilitation efforts. Considering no mitigation is applied, the impact significance is identified as Medium low.

Impact Assessment

Parameter	Description	Rating
Duration	Long term	5
Extent	Site specific	2
Severity	Moderate-high	4
Likelihood	Probable	3
Significance	Medium - low	44%

Activity 25, 26, 27: Rehabilitation of void/spreading of topsoil/revegetation

This is considered to be a neutral impact if implemented properly. 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 and fauna. 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	3
Likelihood	Certain	6
Significance	Medium - high	64%

11.5.4 Post-closure phase

Activity 30: Post-closure monitoring and rehabilitation

This activity is positive. Monitoring of rehabilitation efforts can prevent environmental degradation and the maintenance of the ecological integrity. Ecological systems including fauna and flora will remain intact.

Impact assessment:

Parameter	Description	Rating
Duration	Moderate-short term	3
Extent	Local	3
Severity	Moderate	3
Likelihood	Certain	5
Significance	Medium - high	60%

11.6 Cumulative impacts

The cumulative effects of the planned mining infrastructure, in addition to the effect of the current land use practices, will greatly reduce the available graze and browse that wild herbivores need for survival. The ecosystem functioning and services that is currently produced in the area will be removed completely or reduced to a very small area, these include food and shelter for the animals. The footprint of the proposed opencast mining, discard dump, overburden dump, service water dams and railway will remove the ecosystem services on the associated farms. The areas that will be lost were shown to be under a certain amount of pressure at the time of the survey, most notably from insufficient management measures in terms of stocking rates. However a large number of wild herbivores was found to be reliant on the vegetation but they will however have to move away from the study site in search of food items. This is only relevant for introduced or re-introduced species. The remaining natural habitat on neighbouring farms can be assumed to be under the same type of management strategy as the farms assessed, purely because of the same farming method employed on all of them. The addition of animals that were reliant on the study area will further increase the pressure on these remaining areas including natural occurring predatory species. The effect on a local scale where neighbouring farms are being negatively influenced will only be visible after a few seasons when available habitat is reduced to such an extent that local fauna populations decrease including Red Data species numbers. Also a single change in land use will automatically reduce the surrounding ecological integrity and this can lead to more development to be authorised. This in turn will lead to

complete destruction of ecological systems, loss of habitat and loss of Red Data species. A large area will have to be conserved to ensure future habitat availability for species. Trans boundary impact will also occur due to species that will search for habitat and other resources.

12 MITIGATION MEASURES

Mitigation measure discussed here is aimed at impacts that arise from the activities described under section 11.

Table 12-1: Activities and mitigation measures

Activity	Objectives	Mitigation/Management measure	Frequency of mitigation	Legal Requirements	Recommended Action Plans	Timing of implementation	Responsible Person	Significance after Mitigation
CONSTRUCTION PHASE								
Traffic on site	Limit the footprint of the disturbed areas	Make use of existing roads and/or areas and roads designated for the mining operation	Weekly	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Rehabilitation	Construction, operational and decommissioning phases.	Environmental Co-ordinator	Minor
	Avoid impacts to vegetation and soil through spillages and leaks	Proper maintenance of operating vehicles and regular vehicle inspections.	Weekly	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Vehicle inspections	Construction, operational and decommissioning phases.	Environmental Co-ordinator	Minor
	Limit the negative effects of excessive dust	Remove lose earth from the road sides. Periodic spraying of roads with water or dust inhibitor.	Daily	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Rehabilitation	Construction, operational and decommissioning phases.	Environmental Co-ordinator	Minor
Storage of fuel, lubricant and explosives	Avoid impacts vegetation and soil by means of leaks and spillages.	The storage of materials and substances will be housed in suitable facilities. Management of these facilities will be ongoing and this will include regular inspections to detect faults/issues.	Weekly	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Possible removal and replacement of facilities, or repair of existing facilities.	Construction, operational and decommissioning phases.	Environmental Co-ordinator	Minor

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 stockpiles to limit erosion.	Daily	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Planting of indigenous plants will aid rehabilitation of exposed areas	Construction and operational phases	Environmental Co-ordinator	Moderate alteration
	Restrict alien invasive plant recruitment	Removal of vegetation during stripping and dump 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	Moderate alteration
	Retain biological properties of soil	Stockpile soil in the correct layers, avoid excessive height, and slope	Weekly	Conservation of Agricultural resources Act (CARA), 1983 (Act no. 43 0f 1983)	Adhere to best practice guidelines	Construction and operational phases	Environmental Co-ordinator	Moderate alteration
	Avoid destruction of Red Data plant species that were identified on site.	Consult with relevant authorities, and apply for the correct permit as per Authorities recommendations.	Daily	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Removal of protected plant species, for re-planting in offset area.	Construction and operational phases	Environmental Co-ordinator	Significant
Construction of surface infrastructure, including the rail siding	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	Minor
	Limit degradation and destruction of natural environment to designated project areas, avoiding buffer zone of red data plant species.	Keep the footprint of the disturbed area to the minimum and designated areas only, avoiding the red data plant species buffer zone	Weekly	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Planting of indigenous plants will aid rehabilitation of exposed areas. Fence the buffer zone.	Construction and operational phases	Environmental Co-ordinator	Moderate alteration

	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 lawns, and indigenous plant areas.	Monthly	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Planting of indigenous plants will aid rehabilitation of exposed areas.	Construction and operational phases	Environmental Co-ordinator	Minor
Establishment of initial boxcut	Removal of vegetation during boxcut construction will reduce available areas for plant recruitment.	The establishment of the boxcut is unavoidable, no mitigation is possible.	Daily	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Rehabilitation	Construction phase	Environmental Co-ordinator	Very significant
OPERATIONAL PHASE								
Topsoil and overburden removal and stockpiling	Limit destruction of exposed areas and stockpiles to designated areas.	Keep the footprint of the disturbed area to the minimum and designated areas only. Vegetate and wet stockpiles to limit erosion.	Daily	National Environmental Act (NEMA), 1998 (Act no. 107 0f 1998)	Planting of indigenous plants will aid rehabilitation of exposed areas	Construction and Operational phases	Environmental Co-ordinator	Moderate alteration
	Retain biological properties of soil	Stockpile soil in the correct layers, avoid excessive height, and slope	Weekly	Conservation of Agricultural resources Act (CARA), 1983 (Act no. 43 0f 1983)	Adhere to best practice guidelines	Construction and Operational phases	Environmental Co-ordinator	Moderate alteration
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	Minor
	Prevent injury or death of animal species	Adhere to speed limit	Daily		Construct speed humps, and speed limit signs	Construction and Operational phases	Environmental Co-ordinator	Minor

Replacement of overburden and topsoil 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	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)	Planting of indigenous plants will aid rehabilitation of exposed areas.	Operational phase	Environmental Co-ordinator	Serious (Positive)
	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)	Planting of indigenous plants will aid rehabilitation of exposed areas.	Operational phase	Environmental Co-ordinator	Serious (Positive)
Operation of substation and a railway line)	Limit collisions with the proposed power line	The mitigation of bird impacts caused by power lines is, to a large extent, determined by the microhabitat within a zone of a hundred metres to about 1km on both sides of a line. It is recommended that the earth wire on the power line is marked with Bird Flight Diverters, alternating black and white, ten metres apart, on each earth wire.	During construction and maintenance and inspection weekly	National Environmental Management: Biodiversity Act 10 of 2004 and protective legislation.	Maintenance and prevention	Construction and operational phase	Environmental Co-ordinator	Serious
	Limit collisions with the moving train	Species at risk here are likely to be mostly owls, particularly the threatened African Grass-owl, as well as vultures feeding off road kill. The mitigating would be to reduce	Throughout the operational phase	National Environmental Management: Biodiversity Act 10 of 2004 and protective legislation	Maintaining speed limits and enforcing it.	Operational phase	Environmental Co-ordinator	Serious

		the speed at a maximum projected speed of 50km/h.						
	Limit disturbance during the construction and operation of the railway line	Reduce noise impact were possible and remain within demarcated areas to reduce disturbance.	Throughout project life	National Environmental Management: Biodiversity Act 10 of 2004 and protective legislation	Monitoring of project activities	Construction and operational phase	Environmental Co-ordinator	Serious
	Habitat destruction during the construction and operational activities.	All activities should be limited to demarcated areas. Furthermore, in order to limit the overall impact of the development on the remaining habitat in the study area, the proponent is strongly urged to conserve the remaining natural areas on its property as a form of off-set, to mitigate for the inevitable habitat destruction in the servitude.	Throughout project life	National Environmental Management: Biodiversity Act 10 of 2004 and protective legislation	Monitoring of project activities and maintenance of conserved area.	Construction and operational phase	Environmental Co-ordinator	Serious
	Limit electrocutions	It is recommended that the phase conductor is insulated for a distance of one metre on either side of the insulator for all three phase conductors to prevent any risk of phase-earth electrocution for species. Electrocutions are identified as less likely in comparison to collisions	Throughout project life	National Environmental Management: Biodiversity Act 10 of 2004 and protective legislation	Maintenance and prevention	Construction and operational phase	Environmental Co-ordinator	Moderate

DECOMMISSIONING PHASE								
Demolition 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
Final replacement of overburden and topsoil followed by revegetation of disturbed areas.	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)	Planting of indigenous plants will aid rehabilitation of exposed areas.	Decommissioning phase	Environmental Co-ordinator	Serious (Positive)

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Appendix 1: Flora species

Scientific Name	**Common Name**	**Ecological Status**	**Form**
Acacia burkei	Black monkey thorn	Medicinal	Tree
Acacia erioloba	Camel thorn	Medicinal	Tree
Acacia erubescens	Blue thorn	-	Tree
Acacia fleckii	Plate thorn	-	Tree
Acacia karroo	Sweet thorn	Medicinal	Tree
Acacia mellifera	Black thorn	-	Tree
Acacia nigrescens	Knob thorn	-	Tree
Acacia senegal	Three hook thorn	--	Tree
Acacia tortilis	Umbrella thorn	Medicinal	Tree
Acrotome hispida	White cat's paws	-	Herb
Agapanthus species	-	-	Herb
Albizia versicolor	Large leaved fals thorn	Medicinal	Tree
Aloe littoralis	Mopane Aloe	National red data list LC	Aloe
Alloteropsis semialata	Black-seed grass	Increaser 1 - Climax	Shrub
Ammocharis coranica	Ground lilly	Medicinal	Shrub
Argemone species	-	-	Herb
Aristida adscensionis	Annual three awn	Pioneer Increaser 2	Grass
Aristida congesta s. barbicollis	Spreading three awn	Pioneer Increaser 2	Grass
Aristida congesta s. congesta	Tassel Tree-awn	Increaser 2 - Pioneer	Grass
Aristida diffusa	Iron Grass	Increaser 3 - Subclimax to climax	Grass
Aristida junciformis	Ngongoni Three-awn	Invasive	Grass
Aristida stipatata	Long awned grass	Pioneer Subclimax Increaser 2	Grass
Asparagus aethiopicus	-	-	Herb
Asparagus laricinus	Cluster leaved asparagus	Charm	Herb
Bauhinia galpinii	Pride of de kaap	-	Shrub
Blepharis subvolubilis	-	-	Herb
Boscia albitrunca	Shepherds tree	Medicinal Nat tree list	Tree
Boscia foetida	Stink bush	-	Tree
Bothriochloa radicans	Stinking grass	Subclimax Increaser 2	Grass
Brachiaria deflexa	False signal grass	Pioneer Increaser 2	Grass
Brachiaria serrata	Velvet Signal Grass	Decreaser - Climax	Grass
Cadaba aphylla	Leafless wormbush	Medicinal	Shrub
Capsella bursa-pastoris	-	Weed	Herb
Cenchrus ciliaris	Foxtail Buffalo grass	Subclimax climax Decreaser	Grass
Chamaecrista comosa	Trailing dwarf cassia		Herb
Chloris virgata	Feather top chloris	Pioneer increaser 2	Grass
Cleome angustifolia	Yellow Cleome	-	Herb
Combretum apiculatum	Red Bushwillow	-	Tree
Combretum imberbe	Leadwood	Medicinal #	Tree
Combretum molle	Velvet bushwillow	Traditional	Tree
Commelina africana	Yellow Commelina	Medicinal	Herb

Commiphora pyracanthoides	Common corkwood	-	Tree
Cucumis zeyheri	Wild cucumber	Medicinal	Herb
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
Dichrostachys cinerea	Sickle bush	Medicinal	Tree
Digitaria eriantha	Common Finger Grass	Decreaser - Climax	Grass
Digitaria velutina	Long plumed finger grass	Pioneer Subclimax Increaser 2	Grass
Dinebra retroflexa	Catstail vlei grass	Pioneer increaser 2	Grass
Dovyalis caffra	Kei apple	Edible fruit	Tree
Elephantorrhiza elephantina	Elephant's Root	Medicinal	Shrublet
Enneapogon cenchroides	Nine awned grass	Pioneer Subclimax Increaser 2	Grass
Enneapogon scoparius	Bottlebrush grass	Climax increaser 3	Grass
Eragrosis pallens	Broom love grass	Climax Inceaser 3	Grass
Eragrostis biflora	Shade eragrostis	Pioneer increaser 2	Grass
Eragrostis chloromelas	(Narrow) Curly Leaf	Increaser 2 - Subclimax to climax	Grass
Eragrostis cilianensis	Stink love grass	Pioneer increaser 2	Grass
Eragrostis gummiflua	Gum Grass	Increaser 2 - Subclimax	Grass
Eragrostis nindensis	Whether love grass	Subclimax Increaser 2	Grass
Eragrostis racemosa	Narrow Heart Love Grass	Increaser 2 - Subclimax	Grass
Euclea divinorum	Magic guarrie	Medicinal	Tree
Euclea species	-	-	Herb
Euclea undulata	Common guarrie	Medicinal	Tree
Euphorbia ingens	Common tree Euphorbia	Medicinal	Succulent
Euphorbia tirucalli	Rubber Euphorbia	Medicinal	Succulent
Evolvulus alsinoides	-	-	Herb
Felicia mossamedensis	Yellow felicia	-	Herb
Flaveria bidentis	-	-	Herb
Gardenia volkensii	Bushveld Gardenia	-	Shrub
Geigeria burkei	Vermeersiektebossie	-	Herb
Gomphrena celosioides	Batchelor's Button	Exotic	Herb
Grewia bicolor	Whit leaved raisin	Traditional	Shrub
Grewia flava	Velvet Raisin	Medicinal	Tree
Grewia flavescens	Sandpaper Raisin	-	Tree
Grewia occidentalis	Cross berry	Medicinal	Shrub
Gymnosporea senegalensis	Red Spike Thorn	Medicinal	Shrub
Gymnosporia buxifolia	Common spike thorn	-	Shrub
Helichrysum argyrosphaerum	Wild everlasting	-	Herb
Heliotropium steudneri	-	-	Herb
Heteropogon contortus	Spear Grass	Increaser 2 - Subclimax	Grass
Hibiscus trionum	Bladder Hibiscus	Medicinal	Herb
Hyparrhenia hirta	Common Thatching	Increaser 1 - Subclimax to climax	Grass

	Grass		
Indigofera hilaris	Red indigo bush	-	Herb
Indigofera species	-	-	Herb
Kyphocarpa angustifolia	-	-	Herb
Lantana rugosa	Birds Brandy	Medicinal	Herb
Ledebouria ovatifolia	-	Medicinal	Bulb/Herb
Lessertia miniata	-	-	Herb
Lessertia muricata	-	-	Herb
Mariscus congestus	Cultural	-	Herb
Melinis repens	Natal Red Top	Increaser 2 - Pioneer to subclimax	Grass
Opuntia ficus-indica	Sweet Prickly Pear	Alien Invasive ##	Tree/Shrub
Ozoroa paniculosa	Bushveld resin tree	-	Tree
Panicum maximum	Guinea grass	Subclimax, Climax, Decreaser	Grass
Paspalum dilatatum	Dallis Grass	Exotic	Grass
Peltophorum africanum	Weeping wattle	Medicinal	Tree
Perotis patens	Cat's Tail	Increaser 2 - Pioneer to subclimax	Grass
Phragmites australis	Common Reed	Decreaser	Grass
Pogonarthria squarrosa	Herringbone Grass	Increaser 2 - Subclimax	Grass
Polygala amatymbica	Dwarf Polygala	Medicinal	Herb
Pseudognaphalium luteo-album	Jersey Cudweed	Medicinal/Cultural	Herb
Rhigozum brevispinosum	Simple leaf Rhigozum	-	Small tree
Rhus pyroides	Common wild current	Medicinal	Tree
Sansevieria hyacinthoides	-	-	Herb
Schmidtia pappophoroides	Sand Quick	Subclimax Climax Decreaser Increaser 2	Grass
Sclerocaria birrea	Maroela	Medicinal #	Tree
Setaria sphacelata	Bristle Grass	Decreaser - Climax	Grass
Sida cordifolia	Flannel Weed	Invasive	Shrublet
Solanum incanum	Grey Bitter-apple	Medicinal Weed	Shrub
Solanum panduriforme	Yellow Bitter-apple	Medicinal Weed	Shrub
Sporobolus africanus	Ratstail dropseed	Subclimax increaser 3	Grass
Sporobolus fimbriatus	Dropseed grass	Climax decreaser	Grass
Sporobolus ioclados	Pan Dropseed	Subclimax, Increaser 2	Grass
Stipagrostis uniplumis	Silky Bushmans grass	Subclimax increaser 2	Grass
Strychnos spinosa	Green monkey orange	Medicinal	Tree
Tagetes minuta	Tall Khaki Weed	Alien Invasive	Herb
Tephrosia macropoda	Creepin tephrosia	-	Herb
Tephrosia purpurea	Silver Tephrosia	Medicinal	Herb
Terminalia sericea	Silver cluster leaf	Medicinal	Tree
Taversia barklyi		National red data list LC	Succulent
Tragus berteronianus	Carrot-seed Grass	Increaser 2 - Pioneer	Grass
Tribulus terrestris	Devil thorns	Weed	Herb
Trichoneura grandiglumis	Small Rolling Grass	Increaser 2 - Subclimax	Grass
Urochloa mosambicensis	Bushveld Signal	Increaser 2 - Pioneer to subclimax	Grass

	Grass		
Vangueria infausta	Velvet wild medlar	Edible	Tree
Waltheria indica	-	-	Shrublet
Ximenia americana	Blue sourplum	Cultural	Tree
Ximenia caffra	Sourplum	Edible, traditional	Tree
Ziziphus mucronata	Buffalo thorn	Medicinal	Tree

- Nationally Protected tree.

- Limpopo declared weed.

Appendix 2: Bird species observed

English name	Roberts code	Scientific name	IUCN status
African Fish Eagle	R-C	*Haliaeetus vocifer*	
African Hoopoe	R-VC	*Upupa africana*	Least concern
African Jacana	R-VC	*Actophilornis africanus*	-
African Pied Wagtail		*Motacilla aguimp*	-
African Spoonbill	R(n)-C	*Platalea alba*	-
Anteating Chat	E-C	*Myrmecocichla formicivora*	-
Arrowmarked Babbler	R-VC	*Turdoides jardineii*	-
Bearded Woodpecker	R-C	*Dendropicos namaquus*	Least concern
Black Crake	R-C	*Amaurornis flavirostris*	-
Black Cuckoo	BM-C	*Cuculus clamosus*	-
Black Kite		*Milvus migrans*	-
Black Flycatcher	R-C	*Melaenornis pammelaina*	-
Black Sunbird	R-C	*Chalcomitra amethystina*	-
Blackbreasted Snake Eagle	R-U	*Circaetus pectoralis*	-
Blackcollared Barbet	R-C	*Lybius torquatus*	-
Blackeyed Bulbul	R-A	*Pycnonotus tricolor*	Least concern
Blackheaded Heron	R-C	*Ardea melanocephala*	-
Blackshouldered Kite		*Elanus caeruleus*	-
Blacksmith Plover	R-VC	*Vanellus armatus*	-
Blue Waxbill	R-A	*Uraeginthus angolensis*	Least concern
Bluecheeked Bee-eater	NBM-LC	*Merops persicus*	-
Booted Eagle		*Hieraaetus pennatus*	
Brown Snake Eagle	R-U	*Circaetus cinereus*	-
Brownhooded Kingfisher	R-C	*Halcyon albiventris*	-
Cape Turtle Dove	R-VC	*Streptopelia capicola*	-
Cape Vulture		*Gyps coprotheres*	Vulnerable
Cardinal Woodpecker	R-C	*Dendropicos fuscescens*	-
Cattle Egret	R-C	*Bubulcus ibis*	-
Chinspot Batis	R-C	*Batis molitor*	-
Cinnamonbreasted Rock Bunting		*Emberiza tahapisi*	-
Common Moorhen	R-C	*Gallinula chloropus*	-
Common Sandpiper	NBM-C	*Actitis hypoleucos*	-
Coqui francolin		*Francolinus coqui*	-
Crested Barbet	R-C	*Trachyphonus vaillantii*	-
Crested Francolin	R-VC	*Dendroperdix sephaena*	-
Crimsonbreasted Shrike	Er-C	*Laniarius atrococcineus*	-
Crowned Plover	R-VC	*Vanellus coronatus*	Least concern
Dabchick	R-C	*Tachybaptus ruficollis*	-
Darter	R-C	*Anhinga rufa*	-
Diederik Cuckoo	BM-VC	*Chrysococcyx caprius*	-
Egyptian Goose	R-A	*Alopochen aegyptiacus*	-

Eurasian Bee-eater	NBM/BM-C	*Merops apiaster*	-
Eurasian Roller		*Coracias garrulus*	-
Eurasian Swallow	NBM-A	*Hirundo rustica*	-
Fierynecked Nightjar	R/BM-C	*Caprimulgus pectoralis*	-
Fiscal Flycatcher	E-VC	*Sigelus silens*	Least concern
Fiscal Shrike	R-A	*Lanius collaris*	Least concern
Forktailed Drongo	R-A	*Dicrurus adsimilis*	Least concern
Gabar Goshawk	R-C	*Melierax gabar*	
Giant Kingfisher	R-U	*Megaceryle maxima*	
Glossy Ibis	R-U	*Plegadis falcinellus*	
Glossy Starling	E-VC	*Lamprotornis nitens*	Least concern
Great Spotted Cuckoo	NBM-U	*Clamator glandarius*	
Great White Egret	R-C	*Egretta alba*	-
Greater Honeyguide	R-U	*Indicator indicator*	-
Greater Striped Swallow	NBM-C	*Hirundo cucullata*	-
Greenspotted Dove	R-A	*Turtur chalcospilos*	Least concern
Grey Heron	R-C	*Ardea cinerea*	-
Grey Hornbill		*Tockus nasutus*	
Grey Lourie	R-A	*Corythaixoides concolor*	Least concern
Groundscraper Thrush	R-C	*Psophocichla litsipsirupa*	-
Gymnogene	R-C	*Polyboroides typus*	-
Hadeda Ibis	R-VC	*Bostrychia hagedash*	Least concern
Hamerkop	R-C	*Scopus umbretta*	-
Helmeted Guineafowl	R-VC	*Numida meleagris*	Least concern
House Sparrow	R-VC	*Passer domesticus*	Least concern
Jackal Buzzard	E-U	*Buteo rufofuscus*	Least concern
Kalahari Robin	Er-C	*Cercotrichas paena*	-
Knobbilled Duck	R-LC	*Sarkidiornis melanotos*	-
Kori Bustard	R-R	*Ardeotis kori*	VU
Kurrichane Thrush	R-C	*Turdus libonyanus*	-
Laughing Dove	R-A	*Streptopelia senegalensis*	Least concern
Lilacbreasted Roller	R-A	*Coracias caudata*	Least concern
Little Bee-eater	R-VC	*Merops pusillus*	Least concern
Longtailed Shrike	R-C	*Corvinella melanoleuca*	-
Longtailed Starling	R-LC	*Lamprotornis mevesii*	-
Marico Flycatcher	Er-C	*Bradornis mariquensis*	-
Masked Weaver	R-C	*Ploceus velatus*	-
Namaqua Dove	R-VC	*Oena capensis*	-
Natal Francolin	Er-C	*Pternistis natalensis*	-
Ostrich	R-C	*Struthio camelus*	-
Pale Chanting Goshawk	Er-C	*Melierax canorus*	-
Pied Babbler	E-C	*Turdoides bicolor*	-
Pied Barbet	Er-C	*Tricholaema leucomelas*	-
Pied Crow	R-A	*Corvus albus*	Least concern
Pied Kingfisher	R-C	*Ceryle rudis*	Least concern
Puffback	R-C	*Dryoscopus cubla*	-

Pintailed Whydah		*Vidua macroura*	
Purple Roller	R-U	*Coracias naevia*	-
Purple Widowfinch		*Vidua purpurascens*	
Red Bishop	R-C	*Euplectes orix*	-
Redbacked Shrike	NBM-C	*Lanius collurio*	-
Redbilled Buffalo Weaver	R-LC	*Bubalornis niger*	-
Redbilled Hornbill	R-C	*Tockus erythrorhynchus*	-
Redbilled Oxpecker	R-C	*Buphagus erythrorhynchus*	LC
Redbilled Quelea	R(n)-LA	*Quelea quelea*	-
Redchested Cuckoo	BM-C	*Cuculus solitarius*	-
Redcrested Korhaan	Es-C	*Eupodotis ruficrista*	-
Redeyed Dove	R-C	*Streptopelia semitorquata*	-
Redfaced Mousebird	R-VC	*Urocolius indicus*	Least concern
Redknobbed Coot	R-A	*Fulica cristata*	-
Redwinged Starling	R-VC	*Onychognathus morio*	Least concern
Reed Cormorant	R-C	*Phalacrocorax africanus*	-
Rock Pigeon	R-C	*Columba guinea*	-
Ruff	NBM-C	*Philomachus pugnax*	-
Sabota Lark	Er-C	*Calendulauda sabota*	-
Scalyfeathered Finch	Er-C	*Sporopipes squamifrons*	-
Scimitarbilled Woodhoopoe	R-VC	*Rhinopomastus cyanomelas*	Least concern
Shaft tailed Whydah		*Vidua reia*	
Southern Black Tit	Er-C	*Parus niger*	-
Southern Greyheaded Sparrow	Er-C	*Passer diffusus*	-
Southern Yellowbilled Hornbill	E-VC	*Tockus leucomelas*	Least concern
Speckled Mousebird	R-VC	*Colius striatus*	Least concern
Spotted Dikkop	R-C	*Burhinus capensis*	Least concern
Spotted Eagle Owl	R-C	*Bubo africanus*	-
Spotted Flycatcher	NBM-C	*Muscicapa striata*	-
Spurwinged Goose	R-VC	*Plectropterus gambensis*	-
Steppe Buzzard	NBM-C	*Buteo vulpinus*	-
Steppe Eagle	NBM-U	*Aquila nipalensis*	-
Swainson's Francolin	E-VC	*Pternistis swainsonii*	Least concern
Swallowtailed Bee-eater	R-LC	*Merops hirundineus*	-
Tawny Eagle		*Aquila rapax*	
Threebanded Plover	R-C	*Charadrius tricollaris*	-
Violeteared Waxbill	E-VC	*Granatina granatina*	Least concern
Water Dikkop	R-C	*Burhinus vermiculatus*	-
Wattled Starling	R(n)-LA	*Creatophora cinerea*	-
Western Banded Snake Eagle		*Circaetus cinerascens*	
White Stork	NBM-C	*Ciconia ciconia*	-
Whitebacked Vulture	R-C	*Gyps africanus*	VU
Whitebreasted Cormorant	R-C	*Phalacrocorax lucidus*	-

Whitebrowed Sparrowweaver	R-VC	*Plocepasser mahali*	-
Whitecrowned Shrike	Er-C	*Eurocephalus anguitimens*	-
Whitefaced Duck	R-C	*Dendrocygna viduata*	-
Woodland Kingfisher	BM-C	*Halcyon senegalensis*	Least concern
Yellow Canary		*Serinus flaviventris*	
Yellowbilled Egret	R-U	*Egretta intermedia*	-
Yellowbilled Stork	NBM/R-LC	*Mycteria ibis*	NT
Yellowthroated Sparrow	R-U	*Petronia superciliaris*	-

Appendix 3: Species of interest

Figure 13-1: Honey Badger

Figure 13-2: Adult and juvenile Sable antelope

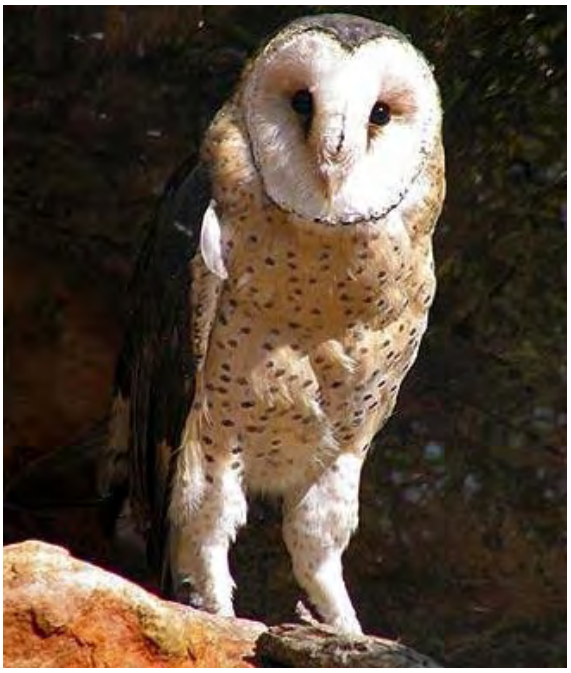

Figure 13-3: Grass owl

Figure 13-4: Kori Bustard

Figure 13-5: Red billed Oxpecker

Figure 13-6: Secretary bird

Figure 13-7: White backed Vulture

Figure 13-8: Yellow billed stork

Appendix 4: Regional setting.

Plan 1

Boikarabelo Coal Mine

Regional Setting

Legend

- Project Area
- Major Town
- Other Town
- Secondary Town
- Settlement
- Main Road
- National Road
- Rivers
- Dams
- International Boundary
- Magisterial District Boundary

resource generation

DWA

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Revision Number: 1
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N

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Kilometres

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Plan 1

Boikarabelo Coal Mine - Railway

Fauna and Flora Sites

Legend

- Fauna and Flora Sites
- Proposed Rail Route
- Railway Line
- Main Road
- Secondary Road
- Minor Road
- Track
- Non-Perennial Stream
- Perennial Stream
- Directly Affected Farms
- Surrounding Farms
- Farm Portions
- Boikarabelo Project Area
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan / Stream
- Wetland
- Zoom

Zoom 1

Zoom 2

Zoom 3

Bitterfontein Site 1
Bitterfontein Site 2
Bitterfontein Site 4
Groot swartbult 5
Groot swartbult 7
Groot swartbult 6
Groot swartbult 4
Groot swartbult 2
Steenbokpan Site 3
Steenbokpan
Steenbokpan Site 1
Vangpan Site 3
Vangpan Site 4
Vangpan Site 1
Vangpan Site 2
Steenbokpan Site 2
Zandbult 1 Site 1
Loopleegte Site 4
Loopleegte Site 3
Loopleegte Site 2
Loopleegte Site 1
Kringat spruit Site 5
Kringat spruit Site 1
Kringat spruit Site 4
Kringat spruit Site 3

27°10'0"E 27°12'30"E 27°15'0"E 27°17'30"E 27°20'0"E 27°22'30"E 27°25'0"E 27°27'30"E

23°35'0"S
23°37'30"S
23°40'0"S
23°42'30"S
23°45'0"S
23°47'30"S
23°50'0"S

resource generation

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N

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Kilometres

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Plan 2

Boikarabelo Coal Mine - Railway

Fauna and Flora Sites -Zoom 1-

27°12'30"E 27°15'0"E

23°37'30"S 23°40'0"S 23°42'30"S

KRUISHOUT
KLEINPAN
TWISTPAN
HOUWHOEK
WILDEBEESTVLAKTE
BITTERFONTEIN
SLANGKOP
GROOT-ZWART-BULT
KAMIESBULT
STEENBOKPAN
OPDRAGT
GROOTDOORN
DWARS-IN-DE-WEG
VAALBOSCHHOEK
THEUNISPAN
GIFTBOSCHPAN
HAAKDOORNPAN

Bitterfontein Site 1
Bitterfontein Site 2
Bitterfontein Site 3
Bitterfontein Site 4
Groot swartbult 5
Groot swartbult 7
Groot swartbult 3
Groot swartbult 6
Groot swartbult 4
Groot swartbult 2
Groot swartbult 1
Steenbokpan Site 3

Legend

- Fauna and Flora Sites
- Proposed Rail Route
- Railway Line
- Main Road
- Secondary Road
- Minor Road
- Track
- Non-Perennial Stream
- Perennial Stream
- Directly Affected Farms
- Surrounding Farms
- Farm Boundaries
- Farm Portions
- Boikarabelo Project Area
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan / Stream
- Wetland

resource generation

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Kilometres
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Plan 3

Boikarabelo Coal Mine - Railway

Fauna and Flora Sites -Zoom 2-

27°17'30"E
27°20'0"E
23°40'0"S
23°42'30"S

SLANGKOP
KAMEELBULT
GANNAVLAKTE
LOOPLEEGTE
STEENBOKPAN
ZANDBULT
VANGPAN
MINNAARSPAN
TOEZICHT
THEUNISPAN

Vangpan Site 4
Zandbult 1 Site 2
Vangpan Site 3
Vangpan Site 2
Vangpan Site 1
Steenbokpan
Steenbokpan Site 1
Steenbokpan Site 2

Legend

- Fauna and Flora Sites
- Proposed Rail Route
- Railway Line
- Main Road
- Secondary Road
- Minor Road
- Track
- Non-Perennial Stream
- Perennial Stream
- Directly Affected Farms
- Surrounding Farms
- Farm Boundaries
- Farm Portions
- Boikarabelo Project Area
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan / Stream
- Wetland

resource generation

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Revision Number: 1
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Kilometres
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Plan 4

Boikarabelo Coal Mine - Railway

Fauna and Flora Sites -Zoom 3-

27°22'30"E

27°25'0"E

23°42'30"S

GANNAVLAKTE

MASSENBERG

VETLEEGTE

LOOPLEEGTE

ZANDBULT

HOOIKRAAL

MINNAARSPAN

KRINGGATSPRUIT

TAAIBOSCHPAN

ZYVERBULT

ENKELDRAAI

Loopleegte Site 4

Loopleegte Site 3

Loopleegte Site 2

Loopleegte Site 1

Kringat spruit Site 5

Kringat spruit Site 4

Kringat spruit Site 1

Kringat spruit Site 3

Kringat spruit Site 2

Legend

- Fauna and Flora Sites
- Proposed Rail Route
- Railway Line
- Main Road
- Secondary Road
- Minor Road
- Track
- Non-Perennial Stream
- Perennial Stream
- Directly Affected Farms
- Surrounding Farms
- Farm Boundaries
- Farm Portions
- Boikarabelo Project Area
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan / Stream
- Wetland

resource generation

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Revision Number: 1
Date: 09/05/2011

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Kilometres

1:30,000

Appendix 5: Fauna and Flora survey positions, and farm boundaries

Plan 7

Boikarabelo Coal Mine

Fauna & Flora Sampling Sites

Legend

- Wet Season Sampling Points
- Dry Season Sampling Points
- Main Road
- Secondary Road
- Minor Road
- Track
- Dam Wall
- Fence
- Contour (20m)
- Non-perennial Stream
- Perennial Stream
- Project Area
- Dam / Lake
- Perennial Pan
- Non-perennial Pan / stream
- Wetland
- International Boundary
- Farm boundaries

resource generation

DWA

Tel: +27 11 789 9495

Projection: Transverse Mercator
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Central Meridian: 27°E

Ref #: glo.ISI543.200909.045
Revision Number: 1
Date: 25/08/2009

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Kilometres

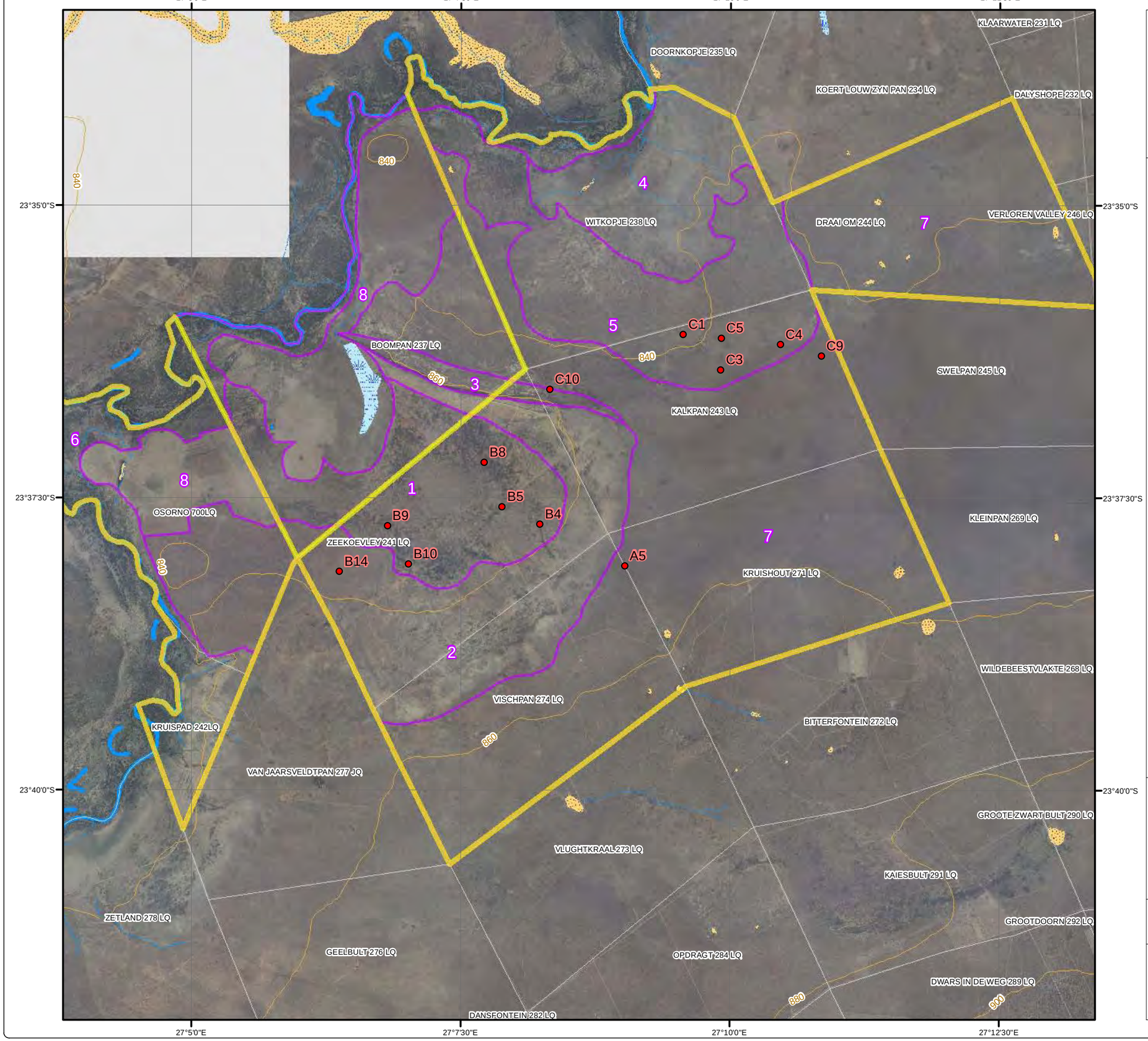
1:75,000

Appendix 6: Plant communities and Red data plant location

Plan 3

Boikarabelo Coal Mine

Plant Communities and Red Data Species



Legend

- Red Data Species
- Boikarabelo Project Area
- Non-perennial Stream
- Perennial Stream
- Contour (20m)
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan / Stream
- Wetland
- Farm Boundaries
- Plant Communities

resource generation

DIGBY WELLS ENVIRONMENTAL

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Datum: Hartebeesthoek 1994	Revision Number: 1
Central Meridian: 27°E	Date: 06/09/2011

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Kilometres

1:60 000

Plan 1

Boikarabelo Coal Mine - Railway

Fauna and Flora Sites

27°12'30"E 27°15'0"E 27°17'30"E 27°20'0"E 27°22'30"E 27°25'0"E

23°35'0"S 23°37'30"S 23°40'0"S 23°42'30"S 23°45'0"S 23°47'30"S

Zoom 1

Zoom 2

Zoom 3

Bitterfontein Site 1
Bitterfontein Site 2
Bitterfontein Site 4
Groot swartbult 5
Groot swartbult 3
Groot swartbult 7
Groot swartbult 6
Groot swartbult 4
Groot swartbult 2
Steenbokpan Site 3
Steenbokpan Site 1
Steenbokpan
Vangpan Site 1
Steenbokpan Site 2
Vangpan Site 3
Vangpan Site 2
Vangpan Site 4
Zandbult 1 Site 2
Loopleegte Site 4
Loopleegte Site 3
Loopleegte Site 2
Loopleegte Site 1
Kringat spruit Site 5
Kringat spruit Site 4

Legend

- Fauna and Flora Sites
- Red Data Species Sites
- Proposed Rail Route
- Railway Line
- Main Road
- Secondary Road
- Minor Road
- Track
- Non-Perennial Stream
- Perennial Stream
- Directly Affected Farms
- Surrounding Farms
- Farm Portions
- Boikarabelo Project Area
- Dam / Lake
- Perennial Pan
- Non-Perennial Pan / Stream
- Wetland
- Zoom

resource generation

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amc.RES901.201105.026
Revision Number: 1
Date: 09/05/2011

N

0 1 2 4 6

Kilometres

1:100,000