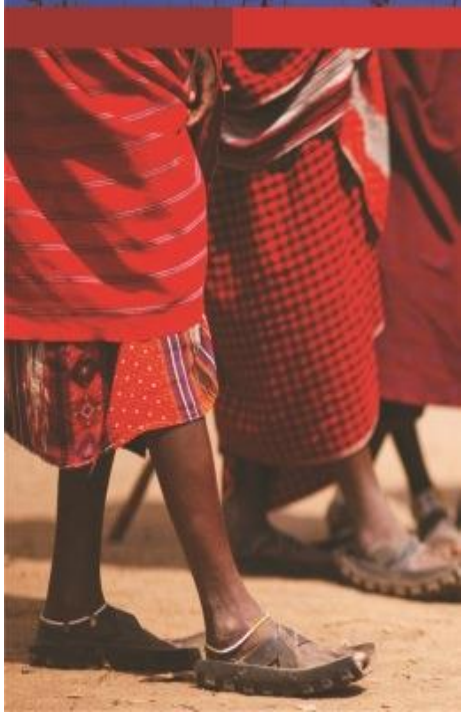

DIGBY WELLS
ENVIRONMENTAL

Section 102 Amendment Lanxess Chrome Mine

Fauna and Flora Report

Project Number:

LAN3111

Prepared for:

Lanxess Chrome Mining (Pty) Ltd

March 2015

Digby Wells and Associates (South Africa) (Pty) Ltd
(Subsidiary of Digby Wells & Associates (Pty) Ltd). Co. Reg. No. 2010/008577/07. Fern Isle, Section 10, 359 Pretoria Ave Randburg Private Bag X10046, Randburg, 2125, South Africa
Tel: +27 11 789 9495, Fax: +27 11 789 9498, info@digbywells.com, www.digbywells.com

This document has been prepared by Digby Wells Environmental.

Report Type:	**Fauna and Flora Report**
Project Name:	**Section 102 Amendment Lanxess Chrome Mine**
Project Code:	**LAN3111**

Name	Responsibility	Signature	Date
Rudi Greffrath (Cert. Sci. Nat.)	Report Writer		2014/08/06
Andrew Husted (Pr. Sci. Nat.)	Reviewer		2014/08/07
Phil Patton (Pr. Sci. Nat.)	Reviewer		2014/08/08

EXECUTIVE SUMMARY

Introduction

Digby Wells Environmental has been appointed by Lanxess Chrome Mine (Pty) Ltd (Lanxess) to complete a Section 102 Application for an amendment to the existing Mine Works Plan (MWP), Social Labour Plan (SLP) and Environmental Management Plan (EMP). As requested, the EMP update will include an Environmental Impact Assessment (EIA) in terms of the Mineral and Petroleum Resources Development Act (No. 28 of 2002).

This report serves as the fauna and flora assessment which must be completed as part of the Section 102 Amendment reporting process. This report will identify species and habitat of potential concern associated with the proposed project area.

In addition, the report concludes with an Impact Assessment that identifies the potential impacts that future mining development and operation of the project area will have on the fauna and flora environment on site. The Mitigation Hierarchy will be considered in order to ensure that impacts are avoided, mitigated and where necessary, rehabilitated.

Methodology

A literature review and desktop study was completed in order to determine the expected species composition or baseline conditions of the study area before field work was conducted. Vegetation was then sampled with stratified random sampling and the use of the Braun Blanquet assessment in order to define vegetation communities which were then mapped. In addition, a species list was compiled listing all species recorded in the field survey with particular emphasis on dominant species, alien invasive species and Species of Special Concern (SSC).

Sensitivity of the study site was determined based on available information on both National and Provincial level. In addition to the field survey, an assessment of the biodiversity value was also undertaken.

Study area

The project area is located in the Savanna Biome of South Africa. The dominant vegetation type, according to literature for the proposed development area is Marikana Thornveld, formally classified as an Endangered vegetation type nationally with none conserved and 55% altered, primarily by cultivation (Mucina & Rutherford 2006).

A total of 71 plant species were recorded on the study site. Of these, one is regarded as SSC, *Boophone distcha*, with no plants on the national list of Protected Trees. Nine invasive species were recorded from Schedules 1 and 3 of Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA). No mammal species were recorded from the site. Twenty one bird species were recorded, none of which are protected, one reptiles and no amphibians were recorded.

Sensitivity

High sensitivity is traditionally assigned to areas occurring within a Threatened Ecosystem, and those areas that were pristine or close to pristine with low or no anthropogenic impacts. None of these areas were however encountered in the study area.

Areas of medium sensitivity include those natural areas with some anthropogenic change or degradation, with high numbers of species of special concern and moderate rocky slopes, such an area was encountered on site.

Low sensitivity is usually assigned to areas completely transformed or heavily degraded, on relatively flat ground. The current study area was found to be in completely transformed state, as the current land use has altered the landscape. The significance of this sensitivity, for the project, is that the project activities may go ahead with adequate mitigation measures in place.

Conclusion

The remaining natural areas within the study site was deemed to be Sensitive and must not be disturbed, if possible and infrastructure should be placed in less sensitive areas such as the fallow fields/agricultural areas. Plant species of concern was encountered and, if encountered on site, must be relocated.

From the findings presented here one can draw the conclusion that the portion of the open pit that covers the agricultural area may go ahead and will have little to no impact on the natural vegetation and habitat types present. However if any construction is going to take place in the high sensitivity natural areas, this will have negative impacts in the natural environment.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1 Introduction

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 Grassland, in which the area of interest is located, leaving biomes such as Savanna and Succulent Karoo under conserved (DEAT, 2005). Many of these under conserved areas overlap with areas of high population density, high agricultural potential, mineral deposits and scenic beauty important for tourism. This can lead to conflict regarding decisions over land use allocations. For this reason extensive consultation regarding land use changes is required and areas considered irreplaceable for biodiversity conservation and important for ecosystem services, need to be set aside.

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

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

Table 1-1: 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.**
OBJECTIVE 1	Policy framework for biodiversity management.
OBJECTIVE 2	Institutional framework for biodiversity management.
OBJECTIVE 3	Integrated management of terrestrial and aquatic ecosystems.
OBJECTIVE 4	Sustainable use of biological resources.
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 operational 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 the 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. The overall statement drives home that biodiversity is the responsibility of the industry and that practices should be carried out in a way that is

responsible, sustainable and preserves biodiversity of the area. It also states that rehabilitation efforts should consider biodiversity.

The focus of this study is for the abovementioned strategic objectives to be the backbone of this investigation and subsequently to inform environmental management decisions on site. In order for this to be accomplished, the primary objective of this investigation is to characterise the flora and fauna present and to investigate the potential impacts of the proposed project on the vegetation and animal life in the study area. Thereafter to suggest management measures that will firstly avoid, and then mitigate the effects that construction and operation will have on the area, thereby striving for the attainment of the National Biodiversity Strategy goal. This report details field work findings of the Lanxess study area, as well as an in depth description of the study area and expected impacts.

1.1 Project Description

This report serves as the fauna and flora assessment which must be completed as part of the Section 102 EIA/EMP Report amendment process. This report will identify species and habitat of potential concern associated with the proposed opencast project area.

The activities are considered in relation to the potential impacts that could be experienced during the construction, operation and decommissioning phases

1.2 Study Area

Lanxess Chrome Mine is located 7 km east of Kroondal and 11 km south-east of Rustenburg and falls within the Rustenburg Local Municipality of the North West Province. The current mining rights of Lanxess cover various portions of the farms Kroondal 304 JQ, Rietfontein 338 JQ and Klipfontein 300 JQ. The extent of this area is 952.5 ha. The mine is part of a mineral deposit known as the Bushveld Igneous Complex which holds the majority of South Africa's chrome ore deposits. Currently the only mining that is taking place is done underground. The ore is broken underground and brought to the surface through conveyor belts (Figure 1-1).

The latest vegetation map of South Africa, Lesotho and Swaziland describes the area as Marikana thornveld (Mucina & Rutherford, 2006).

Marikana thornveld occurs at an altitude between 1050 m and 1450 m. It is described as open Acacia karroo woodland, occurring in valleys and slightly undulating plains with some lowland hills. Shrubs are denser along drainage lines, on termitaria and rocky outcrops or in other habitats protected from fire. The climate is moderate and this is a strongly seasonal summer - rainfall region with very dry winters. The mean annual precipitation is 600 –700m with incidence of frost frequent in winter (Mucina & Rutherford, 2006).

The conservation status of this vegetation type is considered to be endangered; with 48% transformed and industrial development is a major threat to the remainder. Its conservation target is 19%, with less than 1% of it statutorily conserved in the Magaliesberg Nature Area and Onderstepoort Nature Reserve. More than 48% has already undergone transformation

due to cultivation, mines, and building of roads. Agricultural and industrial developments are a threat of land transformation. Alien invasive plants occur in high densities particularly along drainage lines (Mucina & Rutherford, 2006). Important taxa includes:

Tall tree: *Acacia burkei;*

Small trees: *Acacia caffra* (d), A. *gerrardii* (d), A. *karroo* (d), *Combretum molle* (d), *Rhus lancea* (d), *Ziziphus mucronata* (d), *Acacia nilotica,* A. *tortilis* subsp. *heteracantha, Celtis africana, Dombeya rotundifolia, Pappea capensis, Peltophorum africanum, Terminalia sericea;*

Tall shrubs: *Euclea crispa* subsp. *crispa* (d), *Olea europaea* subsp. *africana* (d), *Rhus pyroides* var. *pyroides* (d), *Diospyros lyeioides* subsp. *guerkei, Ehretia rigida* subsp. *rigida, Euclea undulata, Grewia flava, Pavetta gardeniifolia;*

Low shrubs: *Asparagus cooperi* (d), *Rhynchosia nitens* (d), *Indigofera zeyheri, Justicia flava;*

Woody climbers: *Clematis brachiata* (d), *Helinus integrifolius;*

Herbaceous climbers: *Pentarrhinum insipidum* (d), *Cyphostemma cirrhosum; g*raminoids: *Elionurus muticus* (d), *Eragrostis lehmanniana* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Aristida scabrivalvis* subsp. *scabrivalvis, Fingerhuthia africana, Heteropogon contortus, Hyperthelia dissoluta, Melinis nerviglumis, Pogonarthria squarrosa;*

Herbs: *Hermannia depressa* (d), *Ipomoea obscura* (d), *Barleria macrostegia, Dianthus mooiensis* subsp. *mooiensis, Ipomoea oblongata, Vernonia oligocephala;* and

Geophytic herbs: *Ledebouria revoluta, Ornithogalum tenuifolium, Sansevieria aethiopica*

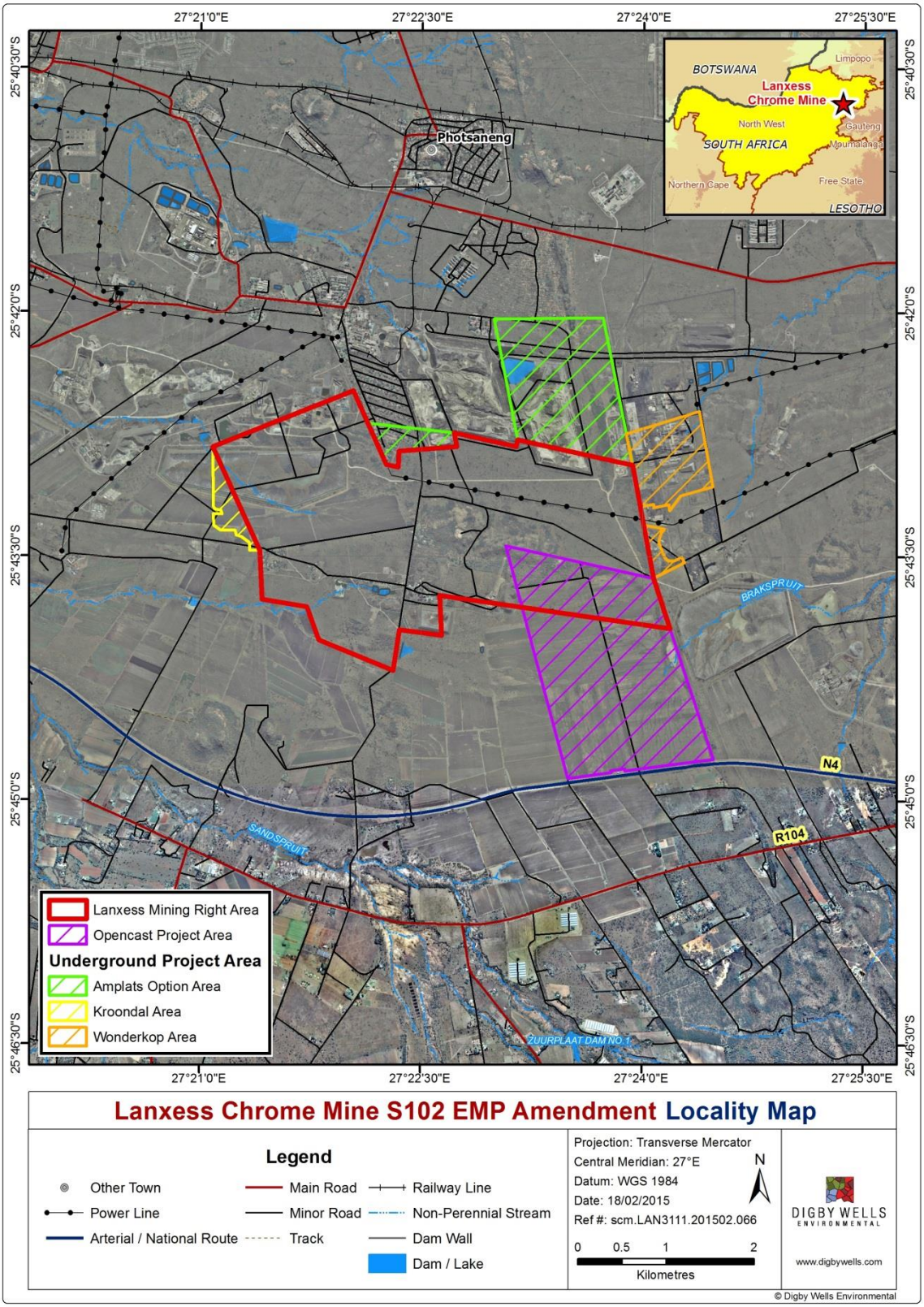

Figure 1-1: Locality map of the study area indicating the Lanxess Chrome Mine study area and the expansion area

1.3 Terms of Reference

A terrestrial fauna and flora assessment report will be compiled and will include the findings of the vegetation survey and fauna survey as detailed in the methodology section below. Potential impacts on terrestrial biodiversity will be identified and the significance of these impacts assessed in order to prescribe measures to avoid any impacts, and then to determine suitable mitigation measures that can be included in an EMP for the additional properties.

Digby Wells was commissioned by Lanxess Chrome Mine, as the ecological consultants to assess the terrestrial ecosystems associated with opencast expansion area associated with the Lanxess Chrome Mine. The specific terms of reference are as follows:

- Perform a flora and fauna survey;
- Identify during the survey and confirm with desktop studies the following:
  - Dominant habitat type;
  - Dominant vegetation types;
  - Bird species present;
  - Mammal species present;
  - Amphibian species present; and
  - Reptile species present.
- Evaluate the current ecological state of the ecosystems based on the survey findings;
- Communicate any relevant issues that might be of significance to the project, specifically flooding upstream of the weir; and
- Compile a report that discusses the findings and provides recommendations

1.4 Expertise of the Specialist

Rudi Greffrath, a fauna and flora specialist achieved a Bachelor of technology degree in Biodiversity Conservation at the Nelson Mandela Metropolitan University; and is an environmental consultant specialising in both terrestrial ecology and environmental management. He is SACNASP affiliated as a Certificated Natural Scientist in Ecological Science, Reg no. 200245/13. Experience includes ecological impact assessments including flora and fauna surveys, biodiversity assessments, Biodiversity Action Plans, species relocation and environmental rehabilitation. Furthermore, experience has been acquired in environmental Rehabilitation Monitoring, Rehabilitation Action Plans, EIA and Environmental Management Plans (EMP). Project experience includes various countries such as Botswana, Sierra Leone, Mali, Mozambique, Ghana, Democratic Republic of the Congo, Namibia and throughout South Africa including the Mpumalanga, Limpopo, Gauteng, North West, Kwazulu Natal, Free State, Northern, Southern and Western Cape.

A curriculum vita is included in Appendix A.

1.5 Aims and Objectives

This specialist study serves to undertake a basic ecological assessment of the local flora and fauna communities associated with the are proposed by Lanxess for the new opencast mining mine expansion operation in order to determine the current state of these areas and to conduct an impact assessment. Information generated from this survey has been used to address the impacts that the construction operational and decommissioning activities will have on this environment. In order to achieve this aim the following objectives were considered:

- To delineate the various vegetation/habitat types and describe their sensitivity, present within the study area;
- To determine if any flora and fauna species or assemblages will be directly impacted upon by the proposed opencast mining activities (no surface infrastructure), this includes flora and fauna communities present, the state of these communities, identification of possible red data species according to the International Union for the Conservation of Nature (IUCN), National and Provincial criteria; and
- To undertake an assessment of the impacts associated with various activities on the health of the flora and fauna species or assemblages; and to recommend measures that should be included in the EMP to prevent or limit impacts to flora and fauna species or assemblages.

2 Methodology

2.1 Literature review and desktop study

A desktop study was undertaken, aiming to identify:

- Potential species in the site area according to the South African National Biodiversity Institute (SANBI);
- Potential Red Data species and their current status;
- Expected vegetation type and community structure, (Low & Rebelo, and Mucina & Rutherford 2006); and
- Current Biodiversity and Ecosystem Status.

2.2 Vegetation analysis

2.2.1 Sample plots

As the sampling of the entire study area is not feasible, representative samples of the vegetation were assessed. The vegetation was classified according to available aerial imagery as well as through an initial site inspection. The number of sample sites visited was

determined by the time available for the study as well as the accessibility of each of the sample sites. Then, areas of each vegetation type classified before going to site were randomly sampled. This methodology allows for more efficient sampling other than overall random sampling.

There is a method for determining the number of plots required for a statistically accurate sample for each vegetation type. However, time limitations did not allow for such complete sampling. The result is the sampling of as many plots as possible in each predetermined vegetation type. At each sample site, a plot size of 25m^2 was sampled. Each plot was described with topographical and environmental data recorded. In each plot; the species were identified in the field as far as possible. Plants that could not be identified in the field through the use of field guides, such as Pooley (1988) and Van Outshoorn (1999) were collected and photographed. These were identified later through the use of ispot (www.ispot.org.za). The Braun Blanquet method was used for the listing of species and their associated cover. The Braun Blanquet method is the standard for phytosociological studies (plant description and mapping) in South Africa and is an internationally recognised method of surveying.

2.2.2 Vegetation communities

Vegetation communities were defined using the data gathered from each sample plot. The presence of each of the different species in relation to environmental data defined several different vegetation types. Each of these vegetation types exhibits some diagnostic species.

2.2.3 Vegetation mapping

Vegetation was mapped using the information gathered from the sample plots and resultant vegetation communities, as well as aerial imagery.

2.3 Flora

Through the sample plots, several aspects of the flora were identified. These included the Species list, a list of Species of Special Concern, and the list of alien and invasive species.

2.3.1 Species list

The species list is compiled mainly from the data gathered from the sample plots. All species occurring in each of the sample plots were identified as far as possible, either during the site visit or afterwards from photographs. In addition, species seen within the study area, but not occurring within specific sample plots were also recorded. This allowed for the production of a species list representative of the entire study area.

2.3.2 Species of Special Concern

From the overall species list, a list of SSC can be drawn up. In order to be fully comprehensive, this list includes plants on each of the following lists:

- South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1;
- National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species;
- National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees; and
- An initial list of SCC expected to be found within the study area comprises Possible Species of Special Concern (PSSC).

If any of these (and any additional species on the above lists) are recorded on site, they are ascribed the status Confirmed Species of Special Concern (CSSC).

The South African red data list uses the same criteria as that defined by the IUCN. According to the IUCN all species are classified in nine groups, set through criteria such as rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation (IUCN, 2010). The categories are described in Table 2-1 below.

Table 2-1: Red Data Categories (IUCN, 2010)

Category		Description
Extinct	(EX)	No known individuals remaining.
Extinct in the Wild	(EW)	Known only to survive in captivity.
Critically Endangered	(CR)	Extremely high risk of extinction in the wild.
Endangered	(EN)	High risk of extinction in the wild
Vulnerable	(VU)	High risk of endangerment in the wild.
Near Threatened	(NT)	Likely to become endangered in the near future.
Least Concern	(LC)	Lowest risk. Does not qualify for a more at risk category. Widespread and abundant taxa are included in this category.
Data Deficient	(DD)	Not enough data to make an assessment of its risk of extinction.
Not Evaluated	(NE)	Has not yet been evaluated against the criteria.

The online IUCN data base was referenced in order to identify Red Data species and their various threat status categorisations.

2.3.3 Alien invasive species

Alien invasive species are recorded from each of the sample plots, as well as through opportunistic sightings throughout the study area. Alien invasive species are those that are classified by the Alien species in South Africa are categorised according to the Alien and Invasive Species Lists, 2014 (GN R599 in *GG* 37886 of 1 August 2014) of the NEMBA (Act 10 of 2004). Each of the categories defined by this Act has associated legislated control measures.

2.4 Fauna

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

2.4.1 Mammals

Visual sightings and ecological indications were used to identify mammals located within the study area; this includes scats, tracks and habitat such as burrows and dens. Scats found were collected (if required), photographed to scale along with any tracks observed and identified. For identification purposes the following field guides were used, Mammals of Southern Africa (Smithers, 1983), The Mammals of the Southern African Sub-region (Skinner & Chimimba, 2005), Red Data Book of the Mammals of South Africa (Friedman & Daly 2004), Bats of Southern and Central Africa (Monadjem et al) and The Kingdon field guide to African Mammals (Kingdon, 1997). The following was recorded:

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

Species of conservation concern and listed by the IUCN or by the South African Environmental legislation and Free State provincial as protected and endemic within the study area, took priority and the Red Data status identified and recorded.

2.4.2 Avifauna

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

The following was recorded:

- All birds encountered or noted during the survey (by call and by sight);
- All birds observed or heard by people residing in the study area; and
- A list of rare and endangered species encountered or obtained from relevant databases.

Visual identification of birds was used to confirm bird calls where possible. Bird species were confirmed using the South African Bird Atlas Project (SABAP 2014) and Robert's birds (2009).

2.4.3 Reptiles and amphibians

Herpetofauna include reptile and amphibian species. Direct/opportunistic observation was completed along trails or paths within the project area. Any herpetofauna species seen or heard along such paths or trails within the project area were identified and recorded. Another method used was refuge examinations using visual scanning of terrains to record smaller herpetofaunal species which often conceal themselves under rocks and in fallen logs, rotten tree stumps, under rocks, in leaf litter, rodent burrows, ponds, old termite mounds, etc.Branch (2001), Du Preez and Caruthers (2009) and Carruthers (2009) was used to confirm identification where necessary.

2.4.4 Red Data faunal assessment

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

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

Probability of occurrence is presented in four categories, namely:

- Low (will not occur);
- Medium (could possibly occur);
- High (most likely could occur); or

- Recorded (does occur on site).

The IUCN Red Data categories are used for the status identification of mammals, birds, reptiles and amphibians globally.

2.5 Sensitivity assessment

Following the field survey and vegetation classification, vegetation sensitivity analysis was quantified by subjectively assessing two factors, namely ecological function and conservation importance. These were defined as follows:

2.5.1 Ecological function

- High ecological function: Sensitive ecosystems with either low inherent resistance or resilience towards disturbance factors or highly dynamic systems considered to be stable and important for the maintenance of ecosystem integrity (e.g. pristine grasslands, pristine wetlands and pristine ridges);
- Medium ecological function: Relatively important ecosystems at gradients of intermediate disturbances. An area may be considered of medium ecological function if it is directly adjacent to sensitive/pristine ecosystem;
- Low ecological function: Degraded and highly disturbed systems with little or no ecological function.

2.5.2 Conservation importance

- High conservation importance: Ecosystems with high species richness which usually provide suitable habitat for a number of threatened species. Usually termed ‘no-go’ areas and unsuitable for development, and should be conserved;
- Medium conservation importance: Ecosystems with intermediate levels of species diversity without any threatened species. Low-density development may be accommodated, provided the current species diversity is conserved;
- Low conservation importance: Areas with little or no conservation potential and usually species poor (most species are usually exotic).

Ecological health is an indication of carrying capacity of an ecosystem and therefore its ability to perform ecological services. In order to adequately gauge the ecological health of the study site it was important to give a qualitative definition of the ‘perceived biodiversity value’ of the land. This is done at a broad level, to simply categorise the total area of land owned based on potential biodiversity value. Biodiversity Value is understood as being a combination of the conservation status and the functional status of the area.

Functional Status refers to an indication of the services provided by an area and includes both ecological and human related services. Functional Status depends on the degree to which the area or system still provides a noticeable service (Figure 2-1).

Conservation Status depends on:

- The amount of the area or system remaining (the extent);
- The diversity in terms of 1. Proportional species composition of the area of system, and 2. The presence of ecosystems/habitat and species which are endemic, threatened, vulnerable or have particularly high religious/cultural value; and
- The degree to which the area or system reflects/represents its original state.

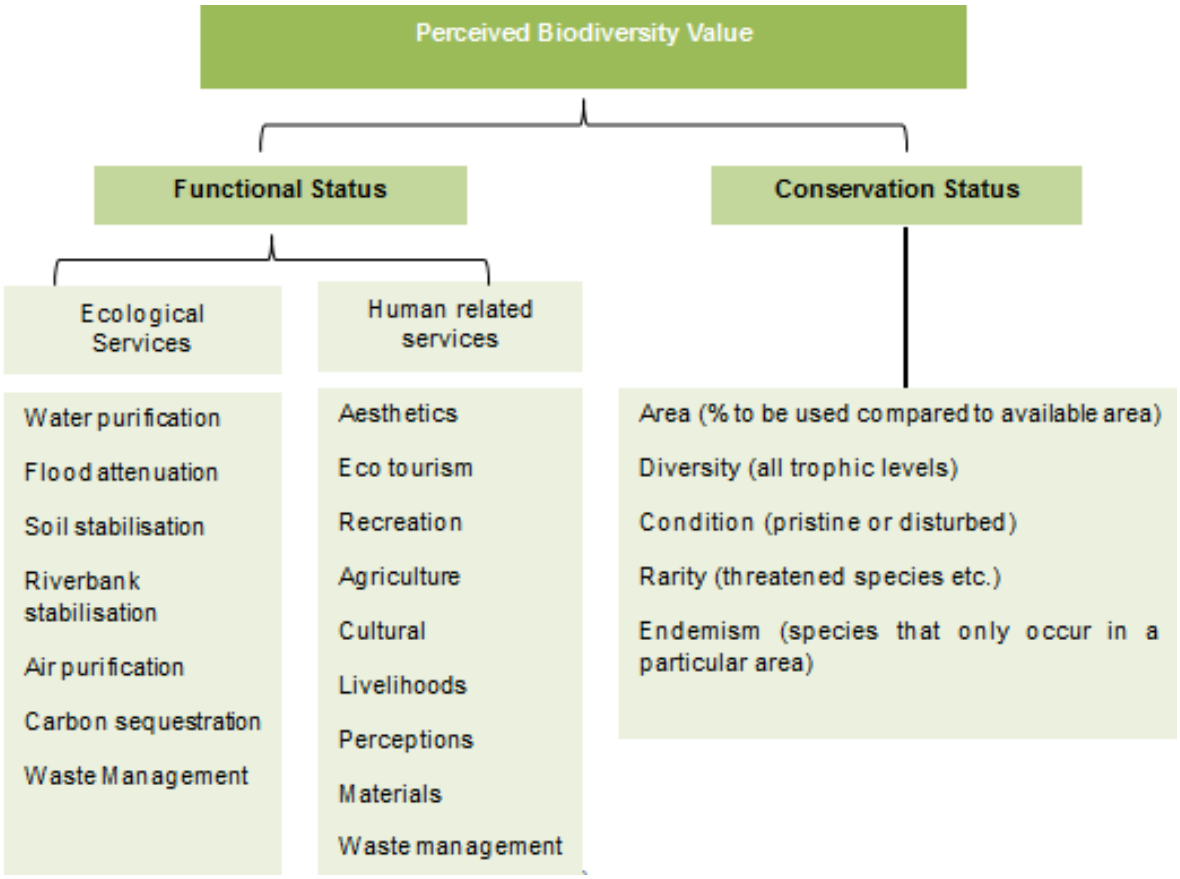

Figure 2-1: Perceived Biodiversity Value (Coombes, 2004)

The final decision on the biodiversity value of an area depends on the combination of the functional and conservation status (Coombes, 2004). In assessing the biodiversity value of the area various literature and data is referenced such as:

- International Union of the Conservation of Nature ,
- The National Protected Areas Expansion Strategy,
- The National Vegetation Map (Mucina and Rutherford, 2006),
- The National List of Ecosystems that are Threatened and in need of Protection, and
- The National Spatial Biodiversity Assessment.

In addition, the data gathered from the field assessment allows for more fine-scale and accurate view of the vegetation in the study area. This data is pivotal for the determination of sensitivity of the area. Based on this approach the total land surface within the project area is categorised into the following biodiversity classes as listed in Table 2-2 below.

Table 2-2: Score table describing the Biodiversity Value scores

Score	Biodiversity Value	Percentage Score
1	Very High Biodiversity Value	0 - 25%
2	High Biodiversity Value	25-50%
3	Moderate Biodiversity Value	50 – 75%
4	Low Biodiversity Value	75 – 100%

3 Results and Discussion

3.1 Vegetation

The Savanna Biome 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 region of South Africa and is also the dominant vegetation in Botswana, Namibia and Zimbabwe.

It is characterized by a grassy ground layer and a distinct upper layer of woody plants. Where this upper layer is near the ground the vegetation may be referred to as Shrubveld, where it is dense as Woodland, and the intermediate stages are locally known as Bushveld.

The study area itself falls within the Marikana thornveld vegetation type according to Mucina and Rutherford (2006) (Figure 3-3). The study site can be divided into two main sections Transformed and Natural land. Certain areas of the study site are currently being used for commercial farming, more specifically Sorghym (*Sorghum bicolor*). Whereas other areas of the study site on hill slopes remain largely natural with some disturbance from grazing evident. Some parts of the study site are difficult to access and, from a farming perspective, and as a result, are in an unaltered condition. These relatively pristine areas tend to be on hill slopes and crests of the Koppie areas that are very rocky (Figure 3-1).

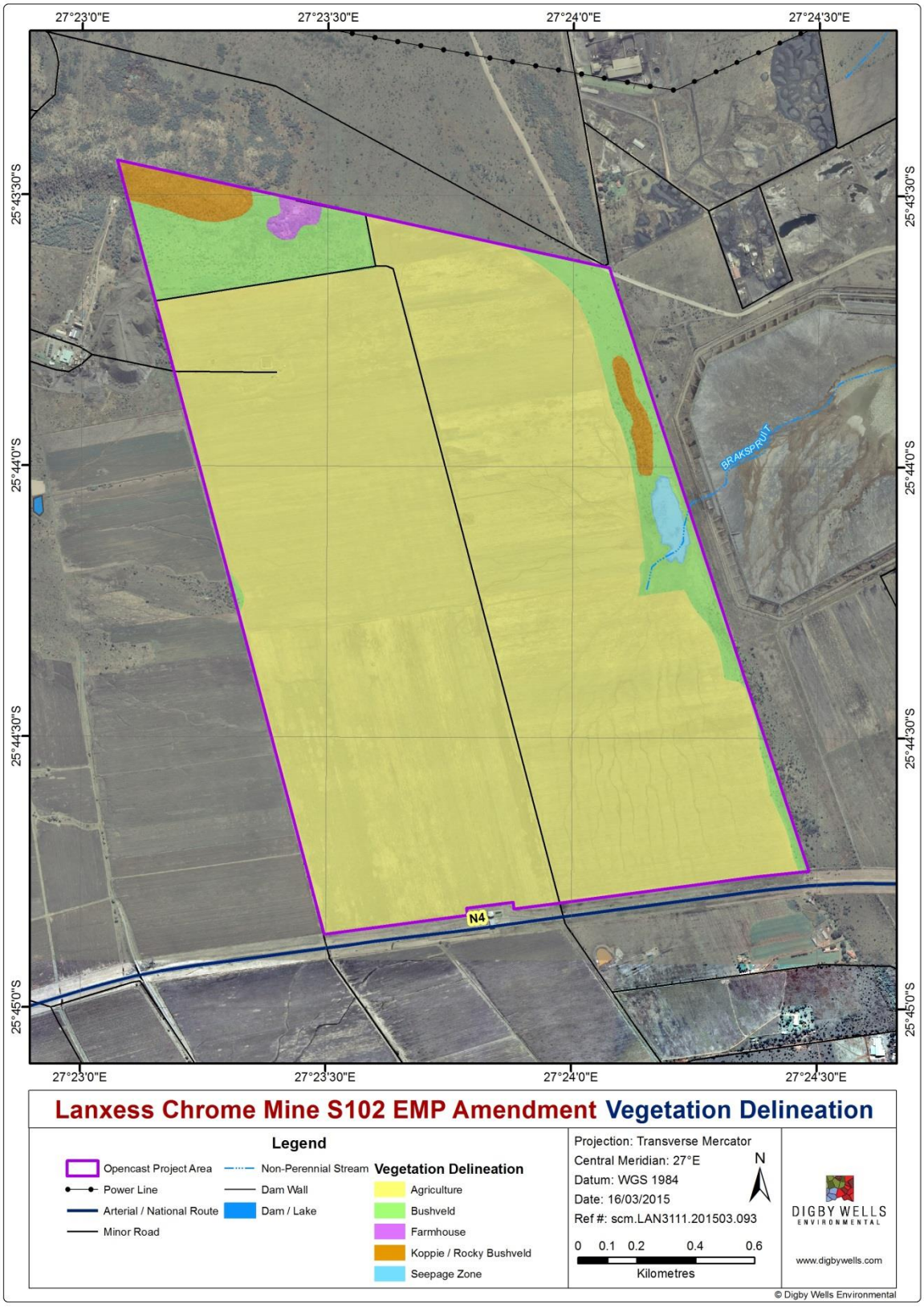

Figure 3-1: Vegetation delineations on site and sampling points

Areas that are under cultivation (for crops or grazing), and those areas that have been used for cultivation in the past (Figure 3-2), but are now fallow, are all grouped into the Transformed category. Transformed Land contains very few indigenous species, some areas of fallow fields have started to regenerate with indigenous pioneer species.

Figure 3-2: Transformed area, specifically fallow lands during the wet season survey

Melinis repens is a well-known pioneer grass in southern Africa and plays an important role in stabilizing disturbed soil (van Oudtshoorn, 1999). *Aristida adscensionis* was present at all sample sites. This grass is a typical pioneer species. These are hardy annual plants that can grow in very unfavorable conditions. As plant succession progresses these plants will be replaced by sub climax species and finally climax species. *Themeda triandra* is an example of a climax grass and was found in two of the sample sites. The *Cynodon dactylon – Brachiaria eruciformis* grassland of the old field is situated on an almost flat piece of land between the bushveld, sunflowers and the chrome mining activities on the neighbouring property. This grassland has developed from a previously ploughed field. There are still ridges in the topsoil layer from ploughing activities. The vegetation is comprised predominantly of grassland species with a few herbs (forbs) and small individual tree species dotted about. The grass layer is well developed with a cover abundance of approximately 40%. The dominant grass species of this plant community are *Cynodon dactylon, Brachiaria eruciformis, Melinis repens, Aristida congesta, Aristida congesta* subsp *congesta, Panicum* spp and *Setaria* cf *sphacelata.* Other prominent grass species include *Digitaria* sp, *Hyparrhenia hirta, Bothriochloa insculpta, Heteropogon contortus, Panicum maximum,*

Sorghum bicolour, Eragrostis cf *trichophora, Trachypogon spicatus* and *Eragrostis chloromelas. Cynodon dactylon* is abundant and is generally found in disturbed places such as cultivated lands (van Oudtshoorn, 1999). The majority of the grass species identified are classified as decreaser 2.

species, which increase in abundance due to disturbing effects such as overgrazing or old ploughed fields. These species produce large amounts of viable seed and are therefore able to establish quickly on new, exposed ground. This group of decreaser 2 species contains mainly pioneer and subclimax species.

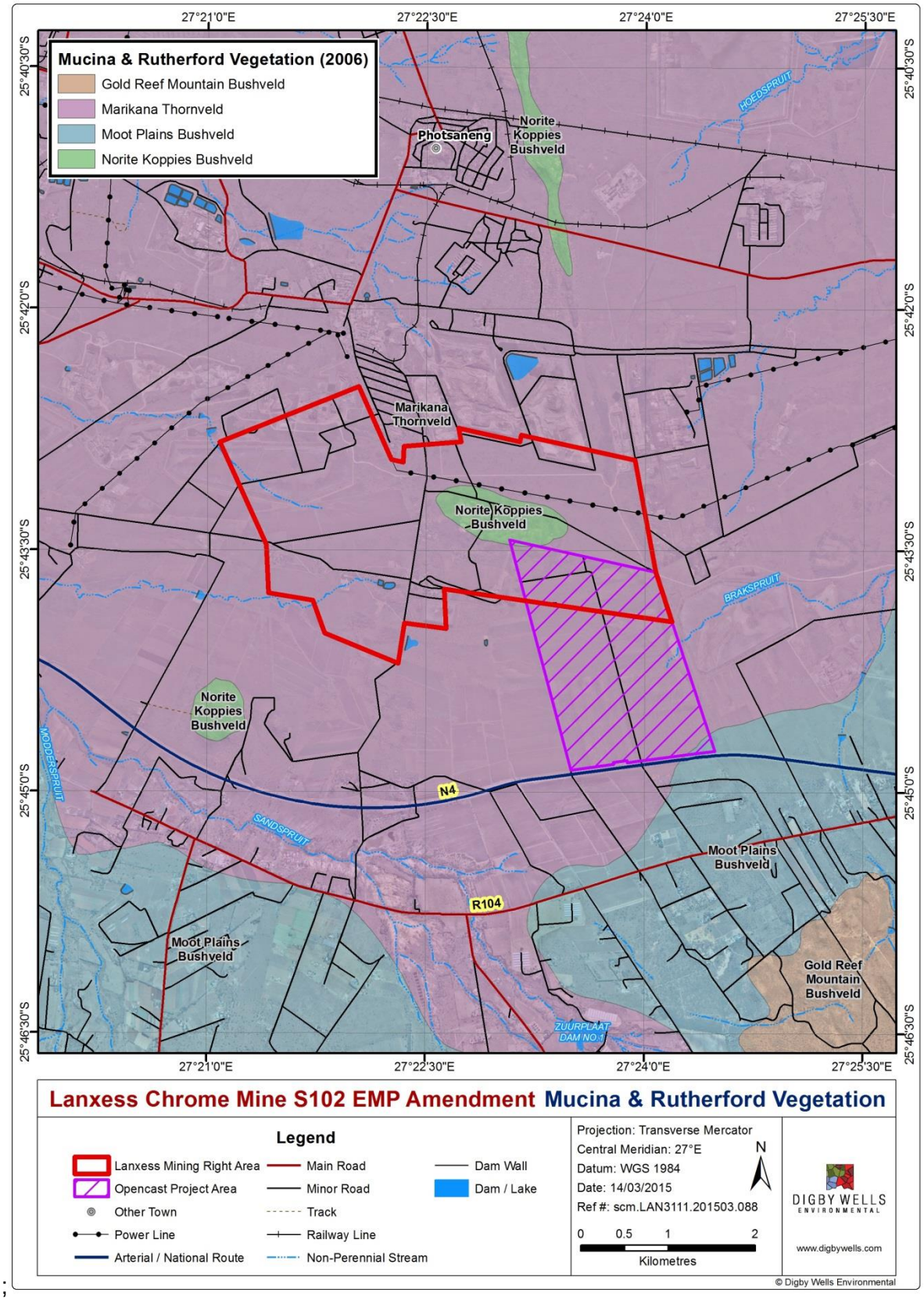

Figure 3-3: Vegetation types according to Mucina and Ruterford (2006)

3.1.1 Bushveld

This vegetation type occurs on the level areas of the study site, with few rocks and a high erodibility (Figure 3-4). Areas of this vegetation type tend to be dominated by short shrubs (up to 1.5m tall) with others supporting larger trees (up to 2.5m tall). Although this vegetation type can be patchy and dominated by different species, it is considered one community type. Extensive areas of short bushveld dominated by *Peltophorum africanum, Searsia lancea, Heteropogon contortus* and *Urochloa mosambicensis* occur throughout the natural areas. The majority of the flat areas within the study site are dominated by a shrubland comprising mainly *Vitex rehmanii, Dichrostachys cinerea, Grewia flavescens* and *Setaria sphacelata var. sphacelata* This vegetation type is easily discerned by its occurrence on comparatively flat areas, and the presence of the diagnostic Sickle Bush (*Dichrostachys cinerea*) and *Heteropogon contortus* both of which do not occur (or occur very rarely) on the steeper, rocky slopes of the remaining natural area.

The tree and shrub layers are very well developed with *Dichrostachys cinerea, Acacia tortilis, Aloe greatheadii, Acacia karroo, Asparagus africanus, Gymnosporia heterophylla, Acacia nilotica, Aloe marlothii* and *Acacia caffra* the dominant trees and shrubs. The cover abundance of the tree and shrub layer was estimated at approximately 15 and 25% respectively. The dominant grass species of this sub-community are *Themeda triandra, Eragrostis rigidior, Eragrostis heteromera, Eragrostis superba, Cynodon dactylon, Eragrostis chloromela* and *Aristida congesat subsp congesta*. The herb (forb) layer was poorly developed at the time of the survey with a cover abundance of approximately 8-10%. Identification to species level was difficult due to the absence of flowers, leaves (dead) and fruit/seeds. Most of the herb species present were dead or dormant and therefore difficult to identify to species level. It is expected that many more herbs could be present during spring and summer. The dominant herbs/forbs recorded at the time of the survey include *Kalanchoe rotundifolia, Solanum incanum, Solanum panduriforme, Verbena bonariesnis, Lippia javanica, Felicia muricata* and *Vernonia oligocephala*.

Figure 3-4: A: The bushveld occurring on flat areas within the study site during the wet season survey. Dominant species include B: *Dichrostachys cinerea*, C: *Grewia flava*, D: *Kirkia wilmsii*

3.1.2 Rocky Bushveld/Koppies

This vegetation community occurs over comparatively little of the study area, but comprises the largest area of pristine and near-pristine vegetation. It has high species richness (demonstrated by the overall number of species) and may contain SSC. These areas are very rocky, and characterised by a reddish soil created from the weathering of iron-containing rocks. Trees can grow large, with some reaching at approximately 5m in height. The structure is typically that of bushveld with scattered trees and a few shrubs with a herbaceous layer comprising grass species (such as *Themeda triandra*) and various herbs.

This vegetation community develops from the bushveld in the flats and occurrences of *Dichrostachys cinerea* decrease with an increase in altitude and reduction in the evidence of grazing.

The grass layer in this community was tall and well developed. There were a few trees scattered about, making this community more of a savannah system than a grassland. This area consists of undulating, convex rocky outcrops/Koppies. This community is dominated by open savannah vegetation with shrubs and trees scattered through it and with a well-developed grass layer. Rocky outcrops were evident in certain locations (northern and eastern portions) but were not very abundant. The tree and shrub layer is fairly well to well

developed as a more open bushveld savannah with *Acacia caffra, Rhus leptodictya, Ziziphus mucronata* and *Acacia nilotica* being the dominant trees and shrubs. The dominant grass species of this community are *Themeda triandra, Eragrostis rigidior, Bothriochloa insculpta, Eragrostis chloromelas, Heteropogon contortus* and *Setaria sphacelata.* The herb (forb) layer was relatively poorly developed at the time of the survey with a cover abundance of approximately 15%. During the dry season identification of the species down to species level was difficult due to the absence of flowers, leaves (dead) and fruit/seeds, this was however rectified during the wet season survey. The dominant herbs/forbs recorded during both surveys include *Nidorella anomala, Acrotome* sp and *Vernonia oligocephala.* Other herbs recorded include *Gladiolus* sp, *Hibiscus trionum, Ocimum americanum, Pollichia campestris, Puplia lappacea Rhynchosia minima, Rhynchosia totta, Teucrium* sp, *Crabbea angustifolia, Felicia muricata,Nidorella hottentotica* and *Tagetes minuta*

Figure 3-5: Rocky Bushveld vegetation during the winter survey

3.2 Flora

3.2.1 Species list

A total of 71 species were recorded from the study site. It is likely that a more in-depth study may record more species. Some of the most common species include *Searsia leptodictya*, *Ziziphus mucronata* and *Heteropogon contortus* which occurred in most study areas. With *Aloe marlothii*, and *Aloe greatheadii var davyana* occurring in the more rocky undisturbed areas of the study site (Figure 3-6). Poaceae (the grass family) is well represented with 32

species, accompanied by no reed and no sedge species. Certain areas of the site also comprise of problem species (these are discussed in depth is section 3.2.3 below), especially *Verbena bonariensis* and *Dichrostachys cinerea*.

Figure 3-6: A- *Aloe marlothii*, B- *Searsia leptodictya*, C- *Aloe greatheadii var davyana*, D- *Ziziphus mucronata*

3.2.2 Species of Special Concern (Protected Species)

Boophone disticha was encountered on site the extremely toxic bulb is used extensively throughout Africa for traditional medicine, and its medicinal uses have been extensively documented. “It is very popular in the muthi markets and amongst urban and rural healers. The bulbs are usually very large and always present in the muthi markets. Cunningham (1988) recorded it in the KwaZulu-Natal muthi markets and classed its vulnerability to over-exploitation as 'indeterminate' - i.e. a species whose status is uncertain, but which appears to be heavily exploited and for which more data are required. Preliminary research has shown that it is a popular species with approximately 60% of traders stocking a quantity equivalent to least three medium-sized shopping bags per trader. Large bulbs are traded, and the average bulb size is 9.3 ± 2.6cm diameter. The bulbs are consistently traded throughout the year; flowering bulbs are not seen in the market, but some bulbs flower under greenhouse conditions. It has a wide distribution range that buffers it from over-exploitation. The workshop participants concluded that *Boophone disticha* should be assessed as

Declining due its loss of habitat in KwaZulu-Natal and Gauteng and because the volumes traded in the market imply that harvesting is having an impact on the population. The species is, however, long lived and widely distributed" (Raimondo et al. (2009). This plant, if encountered during clearing of vegetation on site (Figure 3-7), must be relocated using qualified specialists and under the correct permits.

Figure 3-7: *Boophone disticha*

3.2.3 Alien vegetation and problem plants

Nine alien invasive or weed species were recorded from the study sites. These usually occurred in the transformed areas along roadsides and in disturbed areas such as the edges of fields. Some species occurred in natural vegetation where there was some disturbance, specifically in the vicinity of agricultural activity. The conservation importance of these areas is therefore considered low. A management plan and monitoring programme is recommended to control these plants.

Alien species in South Africa are categorised according to the Alien and Invasive Species Lists, 2014 (GN R599 in *GG* 37886 of 1 August 2014) of the NEMBA (Act 10 of 2004).

The national list of invasive plant species listed in NEMBA represents the following categories:

- Category 1a: Species requiring compulsory control;
- Category 1b: Invasive species controlled by an invasive species management programme;
- Category 2: Invasive species controlled by area, and
- Category 3: Invasive species controlled by activity.

Certain species have different alien invasive categories for different provinces in South Africa. The aliens recorded from site, their NEMBA status and where they were encountered are presented in Table 3-1 below.

Table 3-1: List of all Alien Invasive species recorded from the project sites.

Scientific Name	Common Name	Form	Fallow fields	Rocky areas	Bushveld
Datura ferox 1b	Large Thorn Apple	Herb	X	X	
Flaveria bidentis 1b	Smelter's bush	Shrub			X
Hibiscus cannabinus	Wild Stock Rose	Herb	X		
Melia azedarach 1b	Syringa	Tree	X		
Paspalum urvillei	Vasey Grass	Grass	X		
Schkuhria pinnata	Darf Marigold	Herb		X	
Tagetes minuta	Tall Khaki Weed	Herb	X	X	
Verbena bonariensis 1b	Tall Verbena	Shrub	X		
Xanthium spinosum 1b	Spiny Cocklebur	Herb	X		

Problem plants are those that are not necessarily listed as alien species, but may be on the draft list of invasive species to be enacted by NEMBA. They may be indigenous species that reduce the biodiversity of natural vegetation and reduce the function of natural vegetation. Some of the more common alien invasive plant species encountered during the survey are depicted in Figure 3-8.

Figure 3-8: *Flaveria bidentis, Melia azedarach, Datura ferox* and *Tagetes minuta*

Two species known for bush encroachment were also identified, these were, *Acacia antaxacantha* and *Acacia caffra.*

Defined as the change in vegetation from open Savanna or mixed grass and woodland, to shrubland. Bush encroachment has been noted in many parts of the world including southern African Savannas, and is considered to be a major threat to biodiversity where it occurs. It has been ascribed to changes in the vertical distribution of soil moisture and nutrients, which may encourage the growth of shrubs. However, recent research, in areas of central southern Africa which have experienced bush encroachment, has not found evidence to support this thesis. More probable causes are: increased grazing levels; reduced use of burning to create grassland; changes in rainfall regimes; and the interactions between these factors.

3.2.4 Alien Vegetation control measures

Chemical control methods often involve some form of mechanical / physical control to aid in the application of herbicides. Protection of the environment is of prime importance. Riparian areas, where much infestation occurs, require a particularly careful approach (Table 3-2)

Employees tasked with the handling, use and application of herbicides shall be informed of the risk of working with the selected chemicals and how to avoid that risk and shall receive appropriate hazardous chemicals training. The method and rate of application of all herbicides must be done according to label instructions / MSDS (Material Safety Data Sheet). Spray mix adjuvants (wetters, buffers, dyes) must be used according to label instructions/ MSDS. Washing of equipment or disposal of waste spray mixture or washings is prohibited in or near water courses where contamination of water can occur.

Herbicide application must not take place in unsuitable weather conditions; e.g. foliar application in windy conditions. Application methods must be monitored for correct targeting, rates and to avoid spray drift.

Application equipment shall be standardised and obtained from approved suppliers. Equipment appropriate to the application method and treatment must be used. All equipment must be properly maintained according to regular scheduled services. Backpack sprayers must be fitted with pressure regulators set to the correct pressure (1bar / 100Kpa) or fitted with a constant flow valve. Backpack sprayers must be fitted with the correct nozzle in good condition, appropriate for the application method used. Washing and maintenance of equipment must take place in a designated area designed for the purpose off site and not in the field.

Safe storage and handling of herbicide at store and in-field site shall be strictly according to label instructions and MSDS.

Herbicides and equipment will be stored in a designated, demarcated site:

- Away from rest / eating areas;
- At least 20m from any water body (rivers, vleis);
- Away from indigenous vegetation/crops/gardens;
- Containers must be leak-proof;
- Containers must be UV resistant and stored in shade or under cover to prevent degradation of the herbicide;
- Containers must be clearly labelled, showing the herbicide concentration of the contents;
- A MSDS and Label must be on-site for each herbicide used on site;
- Containers must stand on a suitably absorbent material to absorb accidental drips and leaks;
- Refilling must be done using a funnel or spout to prevent spillage and on similar absorbent material;
- Refilling and mixing must not be done near natural water bodies or desirable vegetation;
- Washing and rinsing may not be done in natural water bodies or thrown away on site;

- Have a bucket, spade and absorbent material available in case of spills;

When handling herbicides the following is to be adhered to:

- Label instructions and MSDS at all times;
- Suitable protective clothing must be available and use thereof is compulsory;
- Adequate hygiene aids should be provided, such as water, soap, towels, and eye wash;
- Suitable absorbent material, such as fine dry sand, and cleaning equipment must be available to handle accidental spillage;
- In case of spillage, the spill must be contained immediately and cleaned up with absorbent material such as fine dry soil. The contaminated material should then be disposed of at an appropriately licensed hazardous waste facility;
- Concentrates should if possible be decanted in a safe, suitable place and not in the field. Such a handling and mixing area should have a hard impermeable floor, be bunded and have an adequate sump to accommodate run-off from washing, flooding or fire containment;
- All containers into which herbicides or adjuvants are decanted must be clearly marked and a copy of the original label secured to the container;
- Suitable equipment must be available to prepare spray mixtures. These include plastic measuring cylinders and beakers, mixing containers (buckets) and funnels.

When handling herbicides in the field the following is to be adhered to:

- All the above handling instructions shall apply;
- Containers should stand on suitable absorbent material, e.g. a large piece of thick hesian sack, that will absorb minor drips, out of direct sunlight in a cool place;
- Containers must be kept at least 20m away from water bodies;
- Filling sites should be selected to prevent damage to desirable vegetation and to enable spillage to be cleaned up and disposed of;
- Spray mixture containers must be clearly labelled and only reused for the specific herbicide;
- Application equipment and containers should not be cleaned on site but at a suitable designated area at the store;
- Suitable PPE as described on herbicide label instructions and MSDS must be worn by operators when handling and applying herbicides. At a minimum this is to include suitable protective clothing, overalls, rubber boots, gloves and eye protection

Table 3-2: Problem plant eradication measures

Scientific Name	Common Name	Form	Herbicide	Treatment

*Datura ferox**	Large Thorn Apple	Herb	None	Physical removal of entire plant
Flaveria bidentis	Smelter's bush	Shrub	glyphosate (isopropylamine) 360 g/L SL *Glyph 360 SL (L4767), Mamba 360 SL (L4817), Roundup 360 SL (L407)*	300ml / 10 Litres water
Hibiscus cannabinus	Wild Stock Rose	Herb	Garlon 4 (triclopyr (butoxy ethyl ester)	480g/ l
*Melia azedarach****	Syringa	Tree	imazapyr 100 g/L SL *Chopper 100 SL (L3444), Hatchet 100 SL (L7409)*	300ml / 10 Litres Water
Paspalum urvillei	Vasey Grass	Grass	glyphosate (isopropylamine) 360 g/L SL *Glyph 360 SL (L4767), Mamba 360 SL (L4817), Roundup 360 SL (L407)*	300ml / 10 Litres water
Schkuhria pinnata	Darf Marigold	Herb	glyphosate (isopropylamine) 360 g/L SL *Glyph 360 SL (L4767), Mamba 360 SL (L4817), Roundup 360 SL (L407)*	300ml / 10 Litres water
Tagetes minuta	Tall Khaki Weed	Herb	glyphosate (isopropylamine) 360 g/L SL *Glyph 360 SL (L4767), Mamba 360 SL (L4817), Roundup 360 SL (L407)*	300ml / 10 Litres water
Verbena bonariensis	Tall Verbena	Shrub	Garlon 4 (triclopyr (butoxy ethyl ester)	480g/ l
*Xanthium spinosum**	Spiny Cocklebur	Herb	**glyphosate (isopropylamine) 360 g/L SL** *Glyph 360 SL (L4767), Mamba 360 SL (L4817), Roundup 360 SL (L407)*	300ml / 10 Litres water

3.3 Fauna

As described in the Flora findings the existing study areas illustrate three distinct vegetation communities or habitat types, two of which were in a good ecological state and one area in a transformed state. As a result the expected fauna assemblages within the natural areas were more than in the transformed area. The bushveld and rocky bushveld habitat types offered refuge and shelter to small and medium sized animals with many bird species encountered here. The transformed habitat type was found to not offer shelter refuge or food to animals, and was consequently void of many species.

3.3.1 Mammals

No mammals were seen during the field survey. However, previous studies confirmed that five species of mammals have been seen in the area of interest (Digby Wells and Associates EIA/EMP report 2008).

The steenbok is a small, shy antelope which occurs throughout most of South Africa, in various habitats, including savannah, shrubland, and grassland. It is not Red data listed (Least Concern category) but its potential future threats could include livestock farming and direct exploitation through hunting (Friedmann and Daly, 2004).

The black-backed jackal is a predator and scavenger occurring throughout South Africa in various habitats. Its main threat is hunting, but is currently not Red listed (Least Concern category) (Friedmann and Daly, 2004).

The yellow mongoose is common (Least Concern Red Data category) through most of South Africa and is adaptable to various habitats (Friedmann and Daly, 2004).

The brown hyena occurs in large parts of South Africa (excluding the lowveld, most of the Northern and Western Cape) and is also relatively adaptable to various habitats. It is currently listed as Near Threatened, a Red Data category describing animals that might in the future become vulnerable or endangered. Its main threat is direct exploitation by hunting for vermin control, by hunting for traditional medicines and by direct poisoning. Other threats include accidental mortalities by trapping and road kills (Friedmann and Daly, 2004). This species is reported on because it was listed as being recorded during the 2008 Digby Wells and Associates EIA/EMP report.

The South African hedgehog is also listed as Near Threatened. It prefers drier habitats with good ground cover and temperate climates. Its main threats include habitat loss due to agricultural activities, direct loss by hunting/trapping for traditional medicine and trade, road kills, and poisoning by pesticides and chemicals (Friedmann and Daly, 2004).

3.3.2 Birds

Birds are viewed as good ecological indicators, since their presence or absence tends to represent conditions pertaining to the proper functioning of an ecosystem. Bird communities and ecological condition are linked to land cover. As the land cover of an area changes, so do the types of birds in that area (The Bird Community Index, 2007). Land cover is directly linked to habitats within the study area. The diversity of these habitats should give rise to many different species. A total of 21 bird species were identified as occurring in the area of interest. Most of these birds were observed in the vicinity of less disturbed bushveld areas. The presence of Sorghum fields close to the project site will attract seed eating birds during seed setting times.

Table 3-3 summarizes all species of birds recorded, this list cannot be considered as a complete list as many other birds can be present within any given season or day of the year. During the end of the wet season survey, bird activity is greatly reduced due to the lack of summer breeding and non-breeding migrants.

Table 3-3: Bird species identified during the field survey.

Scientific name	Common Name
Amandava subflava	Orange-breasted Waxbill
Centropus burchellii	Burchell's Coucal
Corvus albus	Pied Crow
Corythaixoides concolor	Grey Go-away-bird
Coturnix coturnix	Common Quail
Elanus caeruleus	Black-shouldered Kite
Estrilda astrild	Common Waxbill
Laniarius atrococcineus	Crimson-breasted Shrike
Lanius collaris	Common Fiscal Shrike
Motacilla capensis	Cape Wagtail
Numida meleagris	Helmeted Guineafowl
Passer domesticus	House Sparrow
Passer melanurus	Cape Sparrow
Streptopelia capicola	Cape Turtle-Dove
Streptopelia senegalensis	Laughing Dove
Trachyphonus vaillantii	Crested Barbet
Upupa africana	African Hoopoe
Uraeginthus angolensis	Blue Waxbill
Urocolius indicus	Red-faced Mousebird
Vanellus coronatus	Crowned Lapwing
Vanellus armatus	Blacksmith Lapwing

Many raptor species have been recorded in the Magaliesberg IBA however their numbers have declined considerably during the last number of years. For example Cape Vulture *Gyps africanus* and Lappet-faced Vulture *Aegypius tracheliotus* have been recorded in the IBA on a regular basis in the past but are now less common. Another raptor species Verreaux's Eagle *Aquila verreauxii* breeds in the Magaliesberg.

One pair of Black Stork *Ciconia nigra* also breeds in the mountains although there is a possibility that more birds can occur in the area IBA 2014).

In the densely wooded valleys along the slow-flowing overgrown streams, especially the Skeerpoort River Half-collared Kingfisher *Alcedo semitorquata* is recorded. African Finfoot *Podica senegalensis* is only recorded sporadically.

The surrounding woodland holds Martial Eagle *Polemaetus bellicosus* (although in lesser numbers than in the past), Striped Kingfisher *Halcyon chelicuti*, Burnt-necked Eremomela *Eremomela usticollis*, Barred Wren-Warbler *Calamonastes fasciolatus*, Marico Flycatcher *Melaenornis mariquensis*, Crimson-breasted Shrike *Laniarius atrococcineus*, Scaly-feathered Finch *Sporopipes squamifrons*, Violet-eared Waxbill *Granata granatina*, Black-cheeked Waxbill *Estrilda erythronotos*, Striped Pipit *Anthus lineiventris* and Shorttoed Rock Thrush *Monticola brevipes*. Patches of grassland are known to hold small numbers of Blue Crane *Anthropoides paradiseus* but in recent years only a few birds have been recorded. Secretarybirds *Sagittarius serpentarius* are occasionally seen in the IBA

The tables below indicate species which are regarded as important, according to the IBA priorities according to Birdlife International.

Table 3-4: Globally/Regionally Threatened Birds which occur within the study area IBA

Family	Species	Common Name
Accipitridae	*Gyps coprotheres*	Cape Vulture
Sagittariidae	*Sagittarius serpentarius*	Secretarybird
Otididae	*Eupodotis senegalensis*	White-bellied Korhaan
Falconidae	*Falco biarmicus*	Lanner Falcon
Tytonidae	*Tyto capensis*	African Grass-Owl
Heliornithidae	*Podica senegalensis*	African Finfoot
Alcedinidae	*Alcedo semitorquata*	Half-collared Kingfisher

Table 3-5: Range and Biome restricted Bird Species which occur within the study area IBA

Family	Species	Common Name
Turdidae	*Turdus libonyana*	Kurrichane Thrush
Muscicapidae	*Cossypha humeralis*	White-throated Robin-chat
Muscicapidae	*Erythropygia paena*	Kalahari Scrub-robin
Cisticolidae	*Calamonastes fasciolatus*	Barred Wren-Warbler
Nectariniidae	*Cinnyris talatala*	White-bellied Sunbird

Globally protected bird species is of concern at the study site as the site coincides with an IBA, these birds can be seen in Figure 3-9 below.

Figure 3-9: A- Cape Vulture, B- African Finfoot, C- Lanner Falcon, D- African Grass-Owl. http://www.hardaker.co.za/mammalfamilies.htm (Accessed on 10/07/14)

In Figure 3-10 the remiaing globally threatened bird species are visually displyed.

Figure 3-10: A - White-bellied Korhaan, B – Secretarybird, C - Half-collared Kingfisher http://www.hardaker.co.za/mammalfamilies.htm (Accessed on 10/07/14)

3.3.3 Reptiles and Amphibians

According to Carruthers (2009), a number of factors influence the distribution of amphibians, but because amphibians have porous skin they generally prosper in warm and damp habitats. Due to the prevailing habitat at the study area, a lot of suitable habitat for amphibian species was encountered. However no species were encountered due to the duration of the field survey, which was short. As can be seen from Table 3-6, certain factors that have been linked to amphibian declines worldwide could be present at the current study site. The most significant factor is seen as habitat destruction alteration and fragmentation, currently present o the study area.

Table 3-6: Factors involved in Amphibian declines (Young et al. 2001)

Factor	Process(es)
Habitat destruction, alteration and Fragmentation	Roads, introduced species, or other factors separate remaining populations of amphibians from each other.
Introduced Species	Non-native species prey on or compete with native amphibians.
Over-Exploitation	Amphibians are removed from the wild and sold as food, as pets, or for medicinal and biological supply markets.
Climate Change	Amphibians are extremely sensitive to small changes in temperature and moisture. Changes in global weather patterns can alter breeding behaviour, affect reproductive success, decrease immune functions and increase amphibian sensitivity to chemical contaminants.
UV-B Radiation	Levels of UV-B radiation in the atmosphere have risen significantly over the past few decades. Researchers have found that UV-B radiation can kill amphibians directly, cause sub lethal effects such as slowed growth rates and immune dysfunction, and work synergistically with contaminants, pathogens and climate change.
Chemical Contaminants	Chemical stressors (e.g., pesticides, heavy metals, acidification and nitrogen based fertilizers) can have lethal, sub lethal, direct or indirect effects on amphibians. These effects may include death, decreased growth rates, developmental and behavioural abnormalities, decreased reproductive success, weakened immune systems and/or hermaphroditism.
Disease	New diseases (such as chytridiomycosis) or higher susceptibility to existing diseases leads to deaths of adults and larvae.
Deformities	There has been a recent and widespread increase of deformities (or malformations) in natural populations of amphibians; this is now perceived as a major environmental problem.
Synergisms	Multiple factors can act together to cause mortality or sub lethal effects.

The un-impacted and more natural areas of the study site provided perfect habitat for reptiles such as snakes and lizards. However a Mozambique spitting cobra was encountered during the two, one day site visits however it is expected that more reptile species do occur in the area, and further investigations could identify many.

3.3.4 Species of Special Concern

One species encountered during the field survey is listed as Nationally protected, *Boophone disticha* (Poison Bulb) was seen being removed from the site. This species is categorised as Declining (Raimondo 2009). More populations of this plant are expected to be on site. As the remaining natural undisturbed portions of the study area is very small it can be expected that individuals and not populations of protected animal species could be present.

3.4 Sensitivity and Conservation Planning Tools

There are several assessments for South Africa as a whole, as well as on provincial levels that allow for detailed conservation planning as well as meeting biodiversity targets for the country's variety of ecosystems. These guides are essential to consult for development projects, and will form an important part of the sensitivity analysis. Areas earmarked for conservation in the future, or that are essential to meet biodiversity and conservation targets should not be developed, and have a high sensitivity as they are necessary for overall functioning. In addition, sensitivity analysis in the field based in much finer scale data can be used to ground truth the larger scale assessments and put it into a more localised context.

3.4.1 Protected areas

Officially protected areas, either provincially or Nationally that occur close to a project site could have consequences as far as impact on these areas are concerned. The Kgaswane Nature reserve is approximately 10km to the west of the study area, and the Magaliesburg Protected Environment, approximately 15km to the south (Figure 3-11). The current planned activities on the Lanxess site are not likely to have any influence on the protected areas.

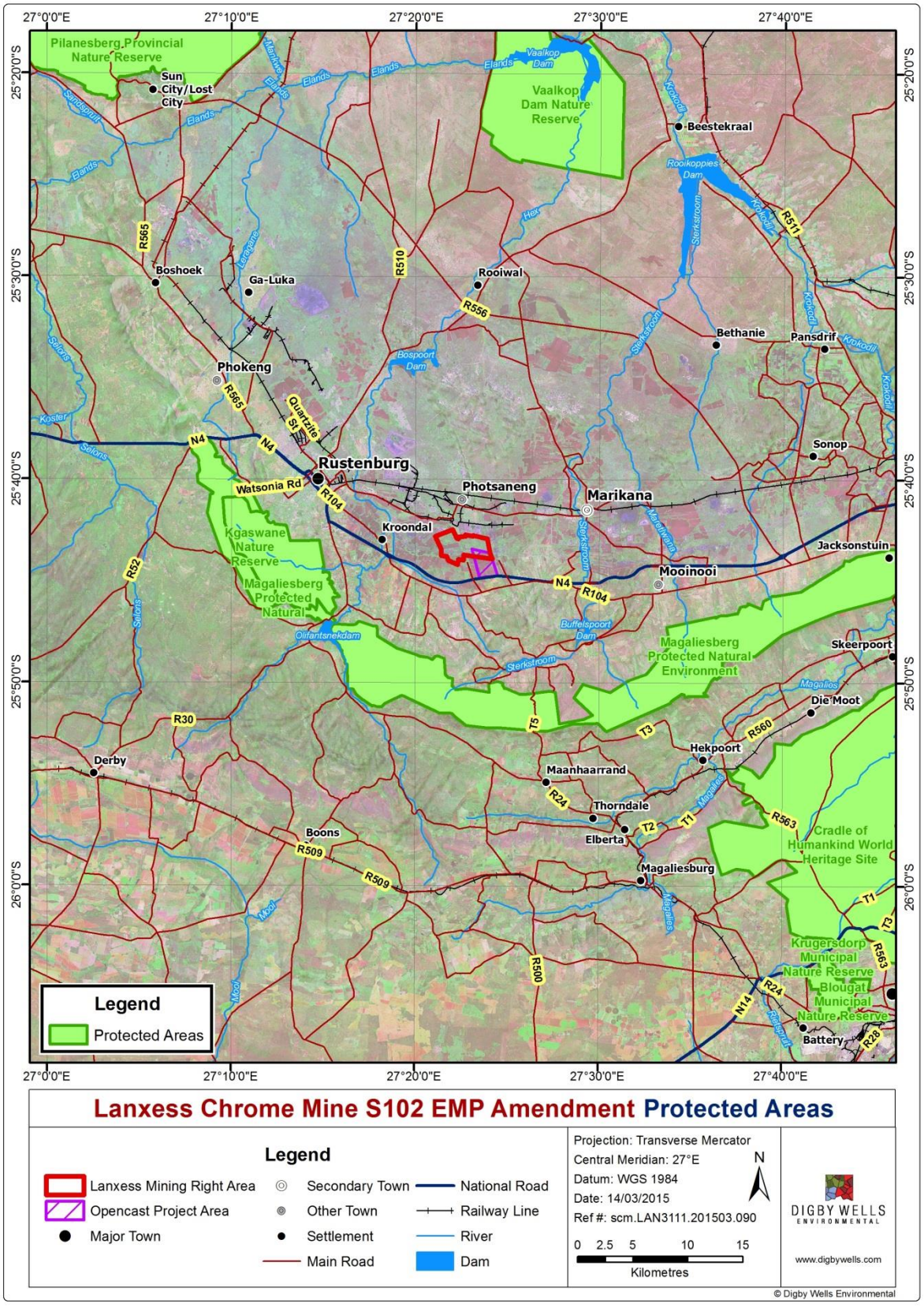

Figure 3-11: Protected area in relation to the study site

3.4.2 Important Bird Areas

An IBA is an area recognised as being globally important habitat for the conservation of bird populations. Currently there are about 10,000 IBAs worldwide. At present, South Africa has 124 IBA's, covering over 14 million hectares of habitat for our threatened, endemic and congregatory birds. Yet only a million hectares of the total land surface covered by our IBA's is legally protected. The BirdLife SA IBA programme continues a programme of stewardship which will ultimately achieve formal protection (Birdlife, 2013).

These areas are identified by BirdLife International. These sites are small enough to be entirely conserved and differ in their character, habitat or ornithological importance from the surrounding habitat. Often IBAs form part of a country's existing protected area network, and so are protected under national legislation. There is no formal National IBA Conservation Strategy for this area within South Africa (Birdlife, 2013).

The study site coincides with an IBA, the Magaliesberg and Witwatersberg IBA (Figure 3-12). The Magaliesberg and Witwatersberg IBA falls mostly within the Magaliesburg Protected Natural Environment and is protected according to the NEMA (Act 107 of 1998). Bird species typical of this IBA include: Martial Eagle (*Polemaetus bellicosus*) (although in lesser numbers than in the past), Striped Kingfisher (*Halcyon chelicuti)*, Burnt-necked Eremomela (*Eremomela usticollis*), Barred Wren-Warbler (*Calamonastes fasciolatus),* Marico Flycatcher (*Melaenornis mariquensis*), Crimson-breasted Shrike (*Laniarius atrococcineus*), Scaly-feathered Finch (*Sporopipes squamifrons*), Violet-eared Waxbill (*Granata granatina*), Black-cheeked Waxbill (*Estrilda erythronotos*), Striped Pipit (*Anthus lineiventris*) and Short-toed Rock Thrush (*Monticola brevipes*). Patches of grassland are known to hold small numbers of Blue Crane *Anthropoides paradiseus* but in recent years only a few birds have been recorded. Secretarybirds *Sagittarius serpentarius* are occasionally seen in the IBA. The study area may provide refuge for some of these species as they move across the landscape in search of resources.

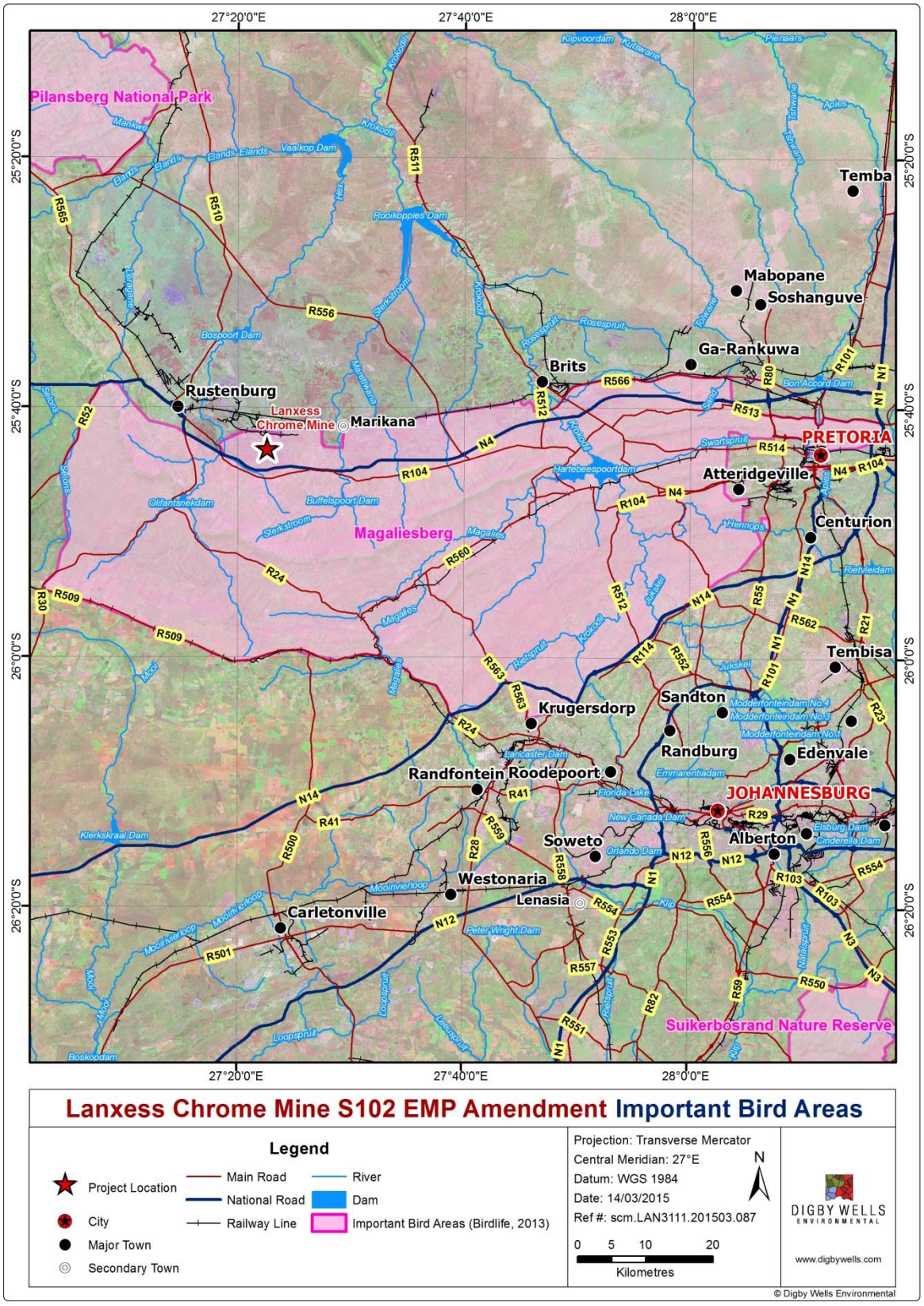

Figure 3-12: IBA's in relation to the study area

3.4.3 Nationally Threatened Ecosystems

The list of national Threatened Ecosystems has been gazetted (NEM:BA: National list of ecosystems that are threatened and in need of protection) and result in several implications in terms of development within these areas. Four basic principles were established for the identification of threatened ecosystems. These include:

- The approach must be explicit and repeatable;
- The approach must be target driven and systematic, especially for threatened ecosystems;
- The approach must follow the same logic as the IUCN approach to listing threatened species, whereby a number of criteria are developed and an ecosystem is listed based on its highest ranking criterion; and
- The identification of ecosystems to be listed must be based on scientifically credible, practical and simple criteria, which must translate into spatially explicit identification of ecosystems.

Areas were delineated based on as fine a scale as possible and are defined by one of several assessments:

- The South African Vegetation Map (Mucina and Rutherford 2006);
- National forest types recognised by the Department of Water Affairs and Forestry (DWAF);
- Priority areas identified in a provincial systematic biodiversity plan; and
- High irreplaceability forest patches or clusters identified by DWAF.

The criteria for identifying threatened terrestrial ecosystems include six criteria overall, two of which are dormant due to lack of data (criteria B and E). The criteria are presented in Table 3-7 below.

Table 3-7: Criteria for the listing of National Threatened Ecosystems

Criterion	Details
A1	Irreversible loss of natural habitat
A2	Ecosystem degradation and loss of integrity
B	Rate of loss of natural habitat
C	Limited extent and imminent threat
D1	Threatened plant species associations
D2	Threatened animal species associations
E	Fragmentation
F	Priority areas for meeting explicit biodiversity targets as defined in a systematic biodiversity plan

These areas are essential for conservation of the country's ecosystems as well as meeting conservation targets. The study area occurs within Marikana thornveld, (Figure 3-13**)**. This designation must however be seen in context, as the field investigations have proven that very little natural habitat still remains within the study area. The majority of the study area is completely transformed to agricultural lands, with the natural vegetation remaining only on isolated areas that are not suitable for agriculture. If the remaining natural areas are conserved by means of management plans it would not only be beneficial for the National threatened ecosystem but also for the general biodiversity present at Lanxess.

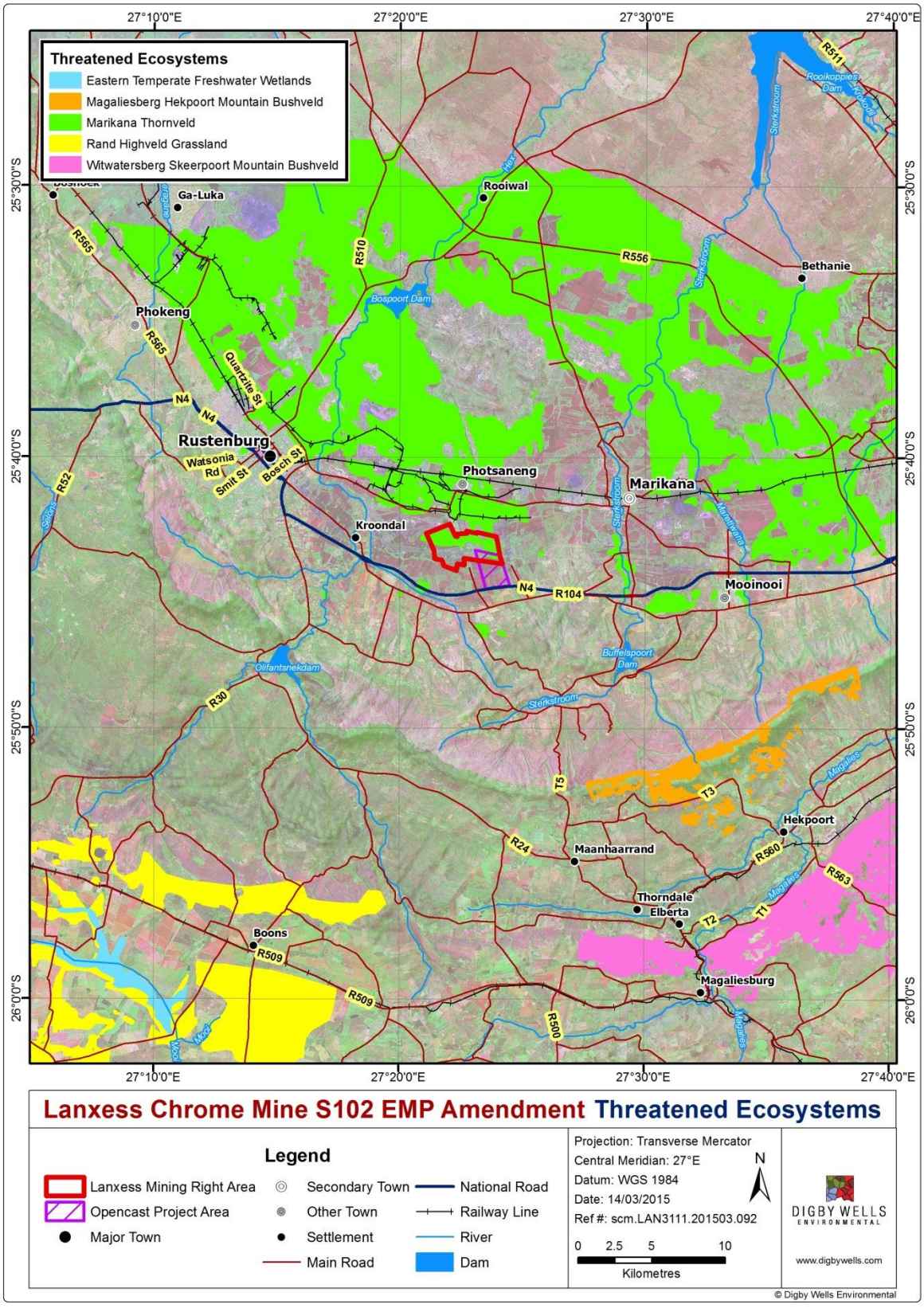

Figure 3-13: Threatened ecosystems and their location with respect to the proposed development

3.4.4 National Protected Areas Expansion Strategy (NPAES)

The NPAES are areas designated for future incorporation into existing protected areas (both National and informal protected areas). These areas are large, mostly intact areas required to meet biodiversity targets, and suitable for protection. They may not necessarily be proclaimed as protected areas in the future and are a broad scale planning tool allowing for better development and conservation planning. There are no areas earmarked for conservation within 20km of the Lanxess Chrome mining area (Figure 3-14).

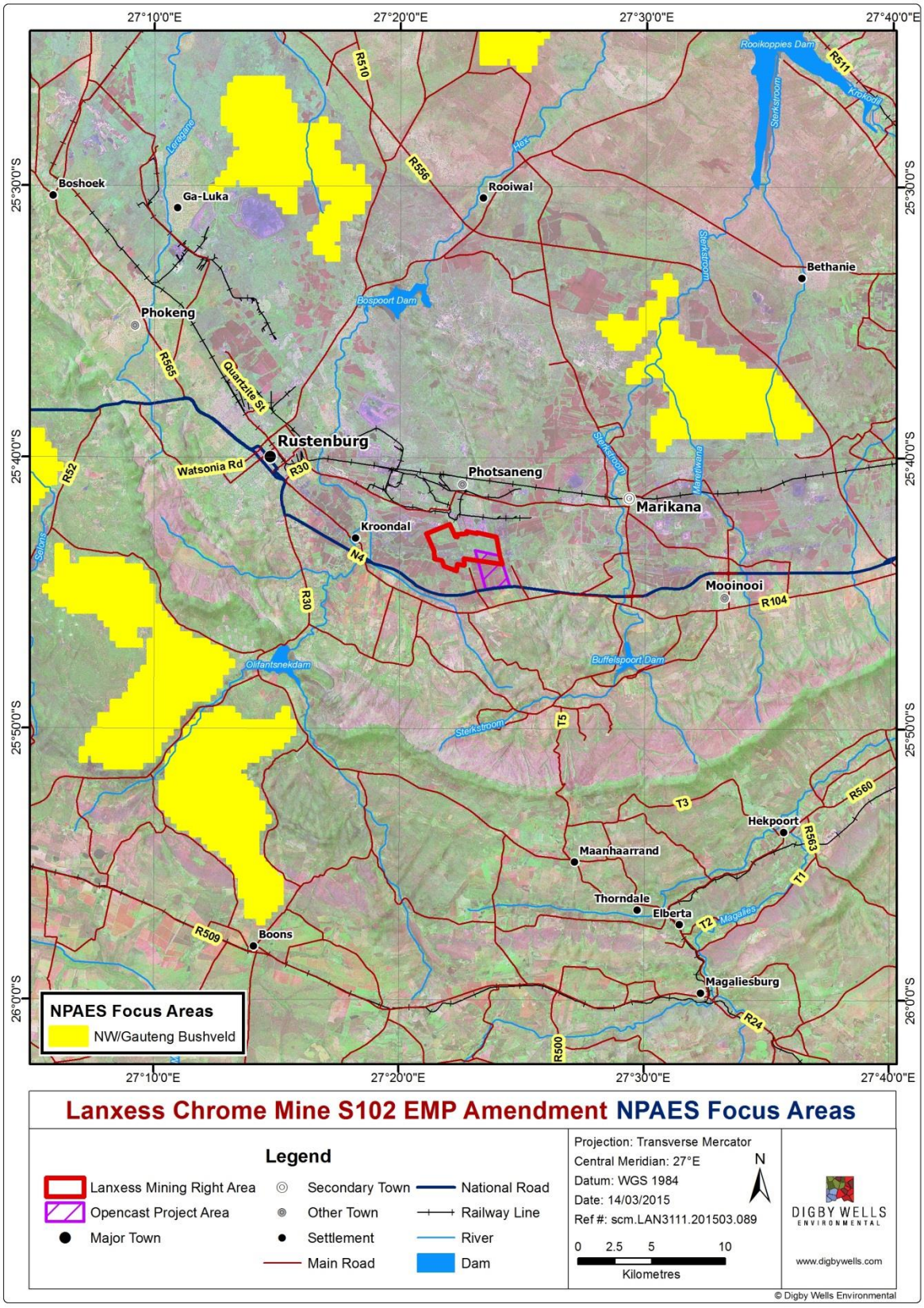

Figure 3-14: NPAES Focus areas in relation to the study site

3.4.5 Sensitivity

From the information that was interrogated for this report it is evident that the study area does occur within the Magaliesberg and Witwatersberg IBA. The study area occurs within Marikana thornveld which is a threatened ecosystem, however through site investigation it was found that much of the study site has been transformed due to agricultural activities. The study area does not form part of the NPAES. As far as protected species are concerned, broad scale data was available for the mammal determination and there are protected species that can occur on site, as listed in this report. No protected reptile species are expected, and none were encountered, no protected amphibian species are expected. Overall it appears that there is a reasonable chance to encounter additional protected species in the remaining natural areas on site. And therefore these areas are seen as sensitive (Figure 3-15).

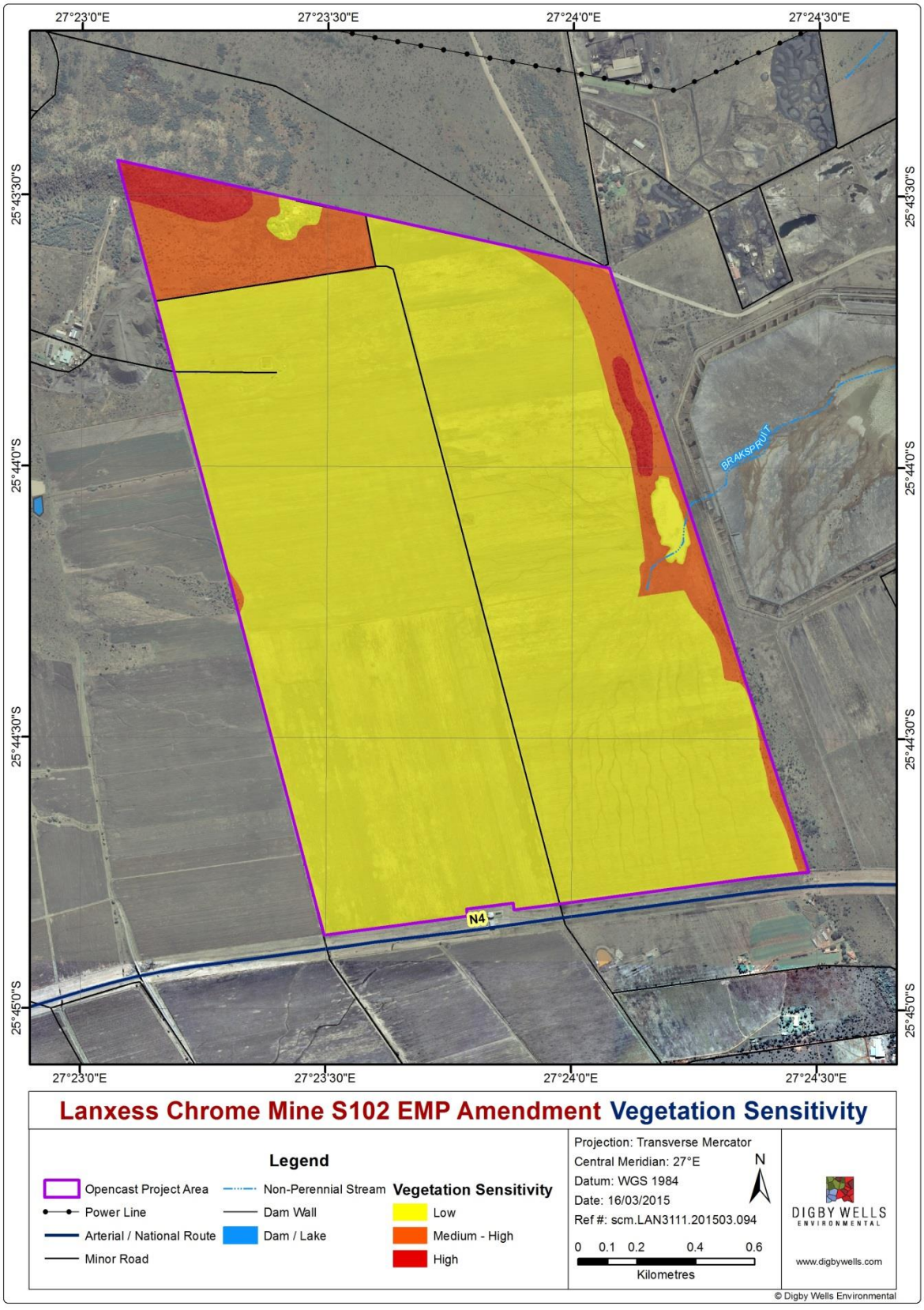

Figure 3-15: Sensitivity on site

4 Impact assessment

Table 4-2 describes the various activities associated with the phases of mining proposed for the Lanxess Mine. Associated with these activities are several impacts, which are described in the section below. The aim of the Impact Assessment is to strive to avoid damage or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (DEA, 2013). The infrastructure layout upon which the impact assessment is based is depicted in Figure 4-1. Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate. The mitigation hierarchy is described in Table 4-1.

Table 4-1: Mitigation hierarchy

↓	**Avoid or Prevent**	Refers to considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services and people. This is the best option, but is not always possible. Where environmental and social factors give rise to unacceptable negative impacts, mining should not take place. In such cases, it is unlikely to be possible or appropriate to rely on the later steps in the mitigation.
	Minimise	Refers to considering alternatives in the project location, sitting, scale, layout, technology and phasing that would minimise impacts on biodiversity, associated ecosystem services. In cases where there are environmental constraints, every effort should be made to minimise impacts.
	Rehabilitate	Refers to rehabilitation of areas where impacts are unavoidable and measures are provided to return impacted areas to near natural state or an agreed land use after mine closure.
	Offset	Refers to measures over and above rehabilitation to compensate for the residual negative impacts on biodiversity after every effort has been made to minimise and then rehabilitate the impacts. Biodiversity offsets can provide a mechanism to compensate for significant residual impacts on biodiversity.

Table 4-2: Activity table

Activity No.	Activity
Construction Phase	
1	The transportation of construction material to the Project site via national, provincial and local roads.
2	Storage of fuel, lubricant and explosives in temporary facilities for the duration of the construction phase.
3	Site clearance and topsoil removal prior to the commencement of physical construction activities across the project area.
4	The construction of waste rock dumps.
5	The construction of topsoil stockpiles.
6	The establishment of the initial boxcut and access ramps to the open-pit mining areas.
7	The establishment of underground access shaft.
8	The construction of haul roads on site
9	The construction of the access or service road.
10	The construction of the hard park area (this is made up of the workshop, office block and parking lot).
Operational Phase	
11	Drilling and blasting of the overburden rock for easy removal by excavators and dump trucks.
12	Dumping of waste rock and maintenance of waste rock dump
13	Removal and loading of ore onto trucks (O/C) or conveyor (U/G) to the plant.
14	Continuing operation of existing processing plant (Crusher, settler, gravity plant and reclamation plant).
15	Storage of fuel in diesel tanks, as well as lubricant and explosives in facilities for

	the duration of the Project.
16	Vehicular activity on the proposed roads and maintenance activities
17	The operation of the TSF (dirty water from stormwater and dewatering mining activities) and the connected return water dam
18	Continuing operation and maintenance of the stockpiles, including topsoil and ROM stockpiles.
19	Waste and sewage generation and disposal.
20	Maintenance of secondary infrastructure (offices, parking)
21	Concurrent replacement of overburden and topsoil and the re-vegetation of mined out strips. The mined strip will be backfilled with the overburden and compacted. Subsequently, the topsoil will be placed on top of the overburden and the area will be vegetated.
Decommissioning Phase	
22	Removal of surface infrastructure (Plant machinery, shafts, conveyors)
23	Decommissioning of services (if necessary, depending on post landuse) incl. waste treatment and removal, power & water facilities)
24	Rehabilitation of roads and cleared areas (offices and workshop area)
25	Removal of fuel, lubricant and explosives
26	Safe closure of shafts and mine access ramps
27	Final replacement of overburden and topsoil and the establishment of vegetation on the final open cast void. Overburden will be backfilled into the final void and compacted. Subsequently, topsoil will placed and the area vegetated.
28	Waste handling of scrap metal and used oil as a result of the Decommissioning Phase will be undertaken.
Post-closure Phase	
29	Post-closure monitoring and rehabilitation will determine the level of success of the rehabilitation, as well as to identify any additional measures that have to be undertaken to ensure that the mining area is restored to an adequate state. Monitoring will include surface water, groundwater, soil fertility and erosion,

	natural vegetation and alien invasive species and dust generation from the discard dumps.

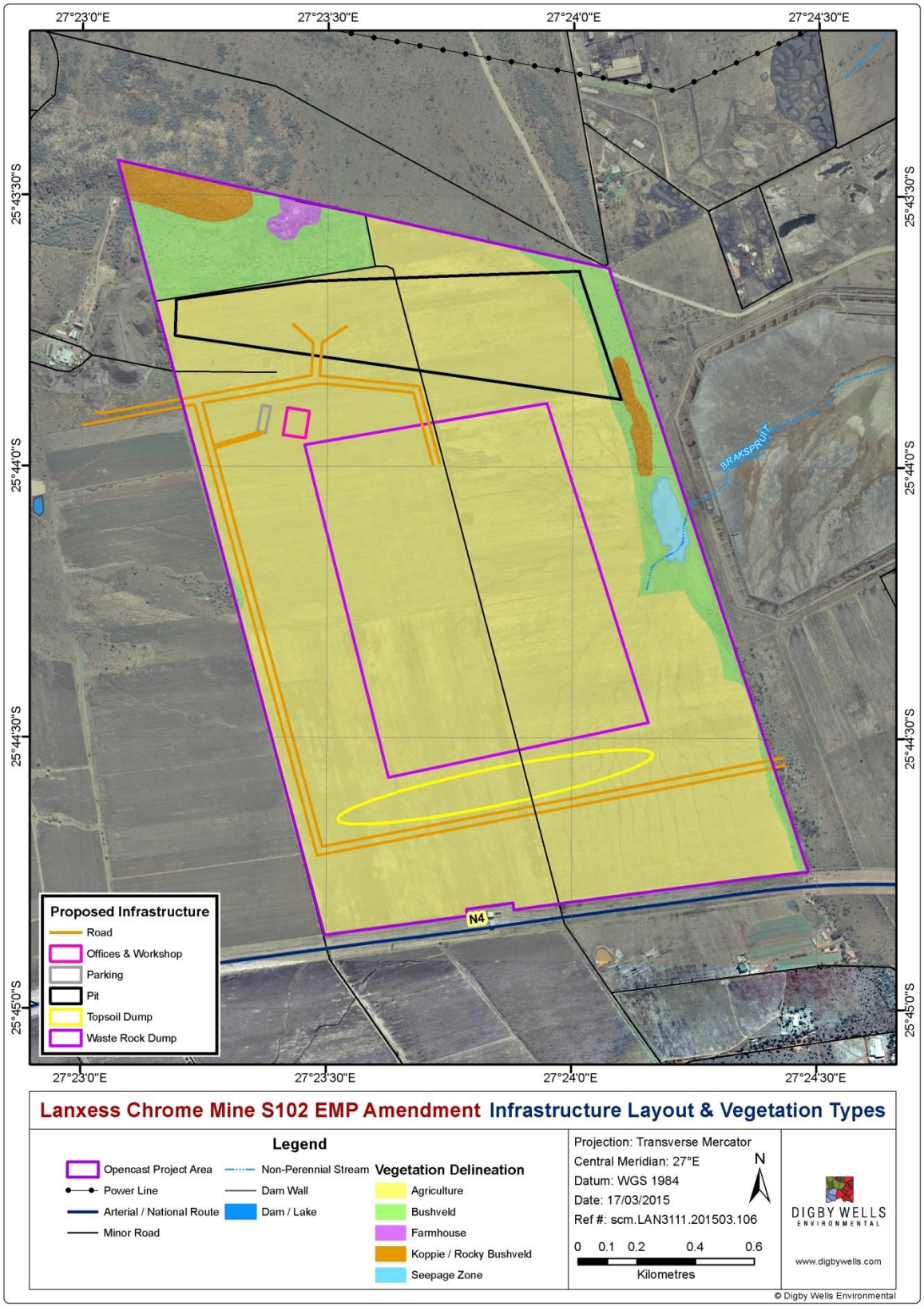

Figure 4-1: Vegetation communities and Infrastructure layout

The five vegetation types delineated during field work are not all affected by infrastructure placement, the area in ha to be affected and the percentage of the vegetation type that this represents are tabulated below in **Error! Reference source not found.**. The vegetation types affected the most are the agricultural fields. Mitigation measures are suggested to minimize the direct and indirect impacts on the natural systems.

Table 4-3: Percentage of each vegetation unit present

Type	Area (ha)
Agriculture	334.813384
Bushveld	37.221653
Farmhouse	1.739929
Koppie / Rocky Bushveld	7.914614
Seepage Zone	2.398356
Total	**384.087936**

Table 4-4: Percentage of each vegetation unit affected by infrastructure

Type	Infrastructure	Area (ha)
Agriculture	Offices & Workshop	0.713996
Agriculture	Parking	0.26559
Agriculture	Pit	39.736392
Agriculture	Pit	0.743068
Agriculture	Road	10.895089
Agriculture	Topsoil Dump	10.869019
Agriculture	Waste Rock Dump	99.839809
Agriculture	Waste Rock Dump	0.326706
Bushveld	Pit	1.692435
Bushveld	Road	0.080348

Koppie / Rocky Bushveld	Pit	0.001044
Total		**165.163496**

4.1 Construction Phase

Activity No. 3: *Site clearance and topsoil removal prior to the commencement of physical construction activities across the project area.*					
Criteria	**Details / Discussion**				
Description of impact	The existing vegetation within the proposed area of development will be impacted on as the existing vegetation (mostly agricultural fields) will be removed to facilitate the construction of mine and related infrastructure. The placement of the infrastructure will include the continuous and complete removal of vegetation on the footprint of the areas mentioned above. The almost complete degradation of natural vegetation and habitat for animal life has already taken place within the general environment due to current land use practices specifically agricultural. No natural vegetation remains within the project area, therefore non will be impacted on, except for the eastern edge of the opencast pit, that will impact on medium high sensitivity Bushveld. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be low.				
Mitigation required	▪ Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the disturbed area to the minimum and within designated areas only. Re-vegetate open areas to limit erosion. ▪ Avoid sensitive landscapes such as the Koppies that were encountered on site. ▪ Restrict nationally restricted alien invasive plant recruitment by ensuring the removal of vegetation during construction and operation will be minimised thereby reducing the risk of open areas occurring. ▪ Maintain top soil biological activity by soils stockpiling without compaction to keep the seed bank viable if topsoil is replaced within a year. This viable seedbank will create an excellent basis for rehabilitated areas where these soils are used.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	2	5	3	6	60
Post-Mitigation	1	5	3	6	54

Activity No. 4: *The construction of waste rock dumps.*					
Criteria	**Details / Discussion**				
Description of impact	The existing vegetation within the waste rock dump will be impacted on as the existing vegetation (agricultural fields) will be removed to facilitate its construction. No natural vegetation remains within the waste rock dump area, therefore none will be impacted on. The agricultural field have a sensitivity rating of low. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be low.				
Mitigation required	▪ Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the rock dump within the low sensitivity agricultural fields. Re-vegetate open areas to limit erosion. ▪ Restrict nationally restricted alien invasive plant recruitment by ensuring the removal of vegetation during construction and operation will be minimised thereby reducing the risk of open areas occurring. ▪ Maintain top soil biological activity by soils stockpiling without compaction to keep the seed bank viable if topsoil is replaced within a year. This viable seedbank will create an excellent basis for rehabilitated areas where these soils are used.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	2	5	2	6	54
Post-Mitigation	1	5	2	6	48

Activity No. 5: *The construction of topsoil stockpiles.*	
Criteria	**Details / Discussion**
Description of impact	The existing vegetation within the topsoil stockpile location will be impacted on as this vegetation (agricultural fields) will be removed to facilitate its construction. No natural vegetation remains within the topsoil stockpiles area, therefore none will be impacted on. The agricultural field have a sensitivity rating of low. The impact will be site specific in extent with impacts likely to

	occur on site. The severity of the impact was determined to be low.				
Mitigation required	▪ Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the topsoil stockpiles within the low sensitivity agricultural fields. Re-vegetate open areas to limit erosion. ▪ Restrict nationally restricted alien invasive plant recruitment by ensuring the removal of vegetation during construction and operation will be minimised thereby reducing the risk of open areas occurring. ▪ Maintain top soil biological activity by soils stockpiling without compaction to keep the seed bank viable if topsoil is replaced within a year. This viable seedbank will create an excellent basis for rehabilitated areas where these soils are used.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	2	5	2	6	54
Post-Mitigation	1	5	1	6	42

Activity No. 6: *The establishment of the initial boxcut and access ramps to the open-pit mining areas.*	
Criteria	**Details / Discussion**
Description of impact	The existing vegetation within the footprint of the initial boxcut will be impacted on as the existing vegetation (agricultural fields) will be removed to facilitate its construction. No natural vegetation remains within the initial boxcut area, therefore none will be impacted on. The agricultural field have a sensitivity rating of low. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be low.
Mitigation required	▪ Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the initial boxcut within the low sensitivity agricultural fields. Re-vegetate open areas to limit erosion.

	▪ Restrict nationally restricted alien invasive plant recruitment by ensuring the removal of vegetation during construction and operation will be minimised thereby reducing the risk of open areas occurring. ▪ Maintain top soil biological activity by soils stockpiling without compaction to keep the seed bank viable if topsoil is replaced within a year. This viable seedbank will create an excellent basis for rehabilitated areas where these soils are used.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	2	5	2	6	54
Post-Mitigation	1	5	1	6	42

Activity No. 8: *The construction of haul roads on site.*	
Criteria	**Details / Discussion**
Description of impact	The existing vegetation, through which the haul roads will go, will be impacted on as the existing vegetation (agricultural fields) will be removed to facilitate its construction. No natural vegetation remains within the haul roads locations, therefore none will be impacted on. The agricultural field have a sensitivity rating of low. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be low.
Mitigation required	▪ Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the haul roads within the low sensitivity agricultural fields. Re-vegetate open areas to limit erosion. ▪ Restrict nationally restricted alien invasive plant recruitment by ensuring the removal of vegetation during construction and operation will be minimised thereby reducing the risk of open areas occurring. ▪ Maintain top soil biological activity by soils stockpiling without compaction to keep the seed bank viable if topsoil is replaced within a year. This viable seedbank will create an excellent basis for rehabilitated areas where these soils are used.

Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	2	5	2	6	54
Post-Mitigation	1	5	1	6	42

Activity No. 9: *The construction of the access or service road.*					
Criteria	**Details / Discussion**				
Description of impact	The existing vegetation, in which the access or service road will be constructed, will be impacted on as the existing vegetation (agricultural fields) will be removed to facilitate its construction. No natural vegetation remains within the access or service road locations, therefore none will be impacted on. The agricultural field have a sensitivity rating of low. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be low.				
Mitigation required	▪ Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the access and service roads within the low sensitivity agricultural fields. Re-vegetate open areas to limit erosion. ▪ Restrict nationally restricted alien invasive plant recruitment by ensuring the removal of vegetation during construction and operation will be minimised thereby reducing the risk of open areas occurring. ▪ Maintain top soil biological activity by soils stockpiling without compaction to keep the seed bank viable if topsoil is replaced within a year. This viable seedbank will create an excellent basis for rehabilitated areas where these soils are used.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	2	5	2	6	54
Post-Mitigation	1	5	1	6	42

Activity No. 9: *The construction of the hard park area.*					
Criteria	**Details / Discussion**				
Description of impact	The existing vegetation within the hard park area will be impacted on as the existing vegetation (agricultural fields) will be removed to facilitate its construction. No natural vegetation remains within the hard park area location, therefore none will be impacted on. The agricultural field have a sensitivity rating of low. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be low.				
Mitigation required	▪ Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the hard park area within the low sensitivity agricultural fields. Re-vegetate open areas to limit erosion. ▪ Restrict nationally restricted alien invasive plant recruitment by ensuring the removal of vegetation during construction and operation will be minimised thereby reducing the risk of open areas occurring. ▪ Maintain top soil biological activity by soils stockpiling without compaction to keep the seed bank viable if topsoil is replaced within a year. This viable seedbank will create an excellent basis for rehabilitated areas where these soils are used.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	2	5	2	6	54
Post-Mitigation	1	5	1	6	42

4.2 Operational Phase

Activity No. 16: *Vehicular activity on haul roads, use of hall roads*					
Criteria	**Details / Discussion**				
Description of impact	Vehicular activity could impact on fauna species in terms of road deaths, the evidence of road deaths were evident during field work. Furthermore, the vehicular activity will result in the creation of soil based dust which will increase the deposits these materials on plant leaves, blocking stomata and inhibiting evapotranspiration. Natural dust will be created from use of the haul road and ash dust will be created during transport by haul trucks. This will impact on the vegetation health and availability as food items as well as inhibit the ability of the plants units to provide ecological services.				
Mitigation required	▪ Prevent excess dust creation that could inhibit plant growth by wetting of the haul roads to suppress dust creation as well as cover haul trucks to prevent dust emissions during transport. ▪ To avoid animal deaths specific speed limits must be adhered to by all mining vehicles.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	2	5	3	5	50
Post-Mitigation	1	5	2	5	40

Activity No. 21: Concurrent replacement of overburden and topsoil and the re-vegetation of mined out strips.	
Criteria	**Details / Discussion**
Description of impact	This may be considered to be a positive impact if implemented properly over time. The replacement of overburden and topsoil throughout the concurrent rehabilitation during 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.

Mitigation required	▪ Reduce areas available for alien infestation by restoring disturbed areas to natural habitat. ▪ Implementation of an alien invasive management program is imperative to reduce the risk of these plant species infesting the mine area.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Enhancement	1	2	2	2	+10
Post-Enhancement	4	5	4	4	+39

4.3 Decommissioning Phase

Activity No 22. : Removal of infrastructure	
Criteria	**Details / Discussion**
Description of impact	The demolition and removal of infrastructure may result in impacts to vegetation, as large machinery is needed for removal of infrastructure. Of concern here is the destruction of vegetation, creation of favourable habitat for fast growing invasive species and ground compaction. Also of concern are the possible spillages from infrastructure holding hazardous material. These spillages and leaks may be considered for infrastructure such as sewerage and waste facilities, toxicant, pollutant and fuel storage infrastructure and general vehicle use. In the event that this infrastructure is not demolished properly and with caution, resulting spillages and leaks would impact on vegetation and soil quality. The demolition of infrastructure may require vehicles making use of non-designated areas, special care must be taken not to destroy rehabilitated areas.
Mitigation 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. ▪ Avoid destruction of vegetation, the creation of favourable habitat for fast growing invasive plants and ground compaction, by forcing

	vehicles to make use of existing roads and designated areas. Avoid rehabilitated and natural habitat areas as far as possible. ▪ The implemented alien invasive control program must be adhered to carefully.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	2	2	4	4	32
Post-Mitigation	2	2	3	4	28

Activity No. 27: *Final replacement of overburden and topsoil and the establishment of vegetation on the final open cast void. Overburden will be backfilled into the final void and compacted. Subsequently, topsoil will placed and the area vegetated*					
Criteria	**Details / Discussion**				
Description of impact	This may be considered to be a positive impact if implemented properly, and managed over time. 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.				
Mitigation required	▪ The footprint of the area disturbed by the mining operation will have topsoil and overburden replaced to restore the vegetation cover, through proper rehabilitation. ▪ Limit the erosion potential of exposed areas by re-vegetation. ▪ Re-vegetated areas will form seepage areas which will help aid infiltration.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Enhancement	1	1	2	2	+8
Post-Enhancement	4	5	4	5	+65

4.4 Post-Closure Phase

Activity No. 24: *Post-closure monitoring and rehabilitation*					
Criteria	**Details / Discussion**				
Description of impact	This activity will commence only after closure has taken place, furthermore this activity will be on-going after operations in the area has stopped.				
Mitigation required	▪ Direct rehabilitation efforts by ensuring correct measures are employed for a variety of rehabilitation projects ▪ Avoid erosion, alien invasive species establishment, by monitoring rehab outcome to ensure open areas are eliminated.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Enhancement	1	1	2	2	+8
Post-Enhancement	4	5	4	5	+65

5 Cumulative Impacts

When determining the impacts of a development such as this, including both positive and negative impacts, one needs to consider the cumulative impacts. Cumulative impacts take into account impacts of current land use and land use change in the broader area. Ideally, all development should take place within a predefined Strategic Environmental Assessment which defines no-go and conservation areas as well as allowing for development such as housing, roads, agriculture and mining. In the absence of such a strategic plan, one can look at the surrounding activity and land use and determine to a certain extent, the overall impacts in the region with the addition of the reclamation process.

There are currently several mines operating in the general area of the project all of which are within the same endangered vegetation type as Lanxess (Figure 5-1). With the extension of the Lanxess operational area by means of opencast activities will have a negative effect on the biodiversity in the study area. However, as the study area is already degraded as a result this impact is seen as mitigatable. The creation of an opencast area will have a negative cumulative impact on specifically the remaining natural habitat.

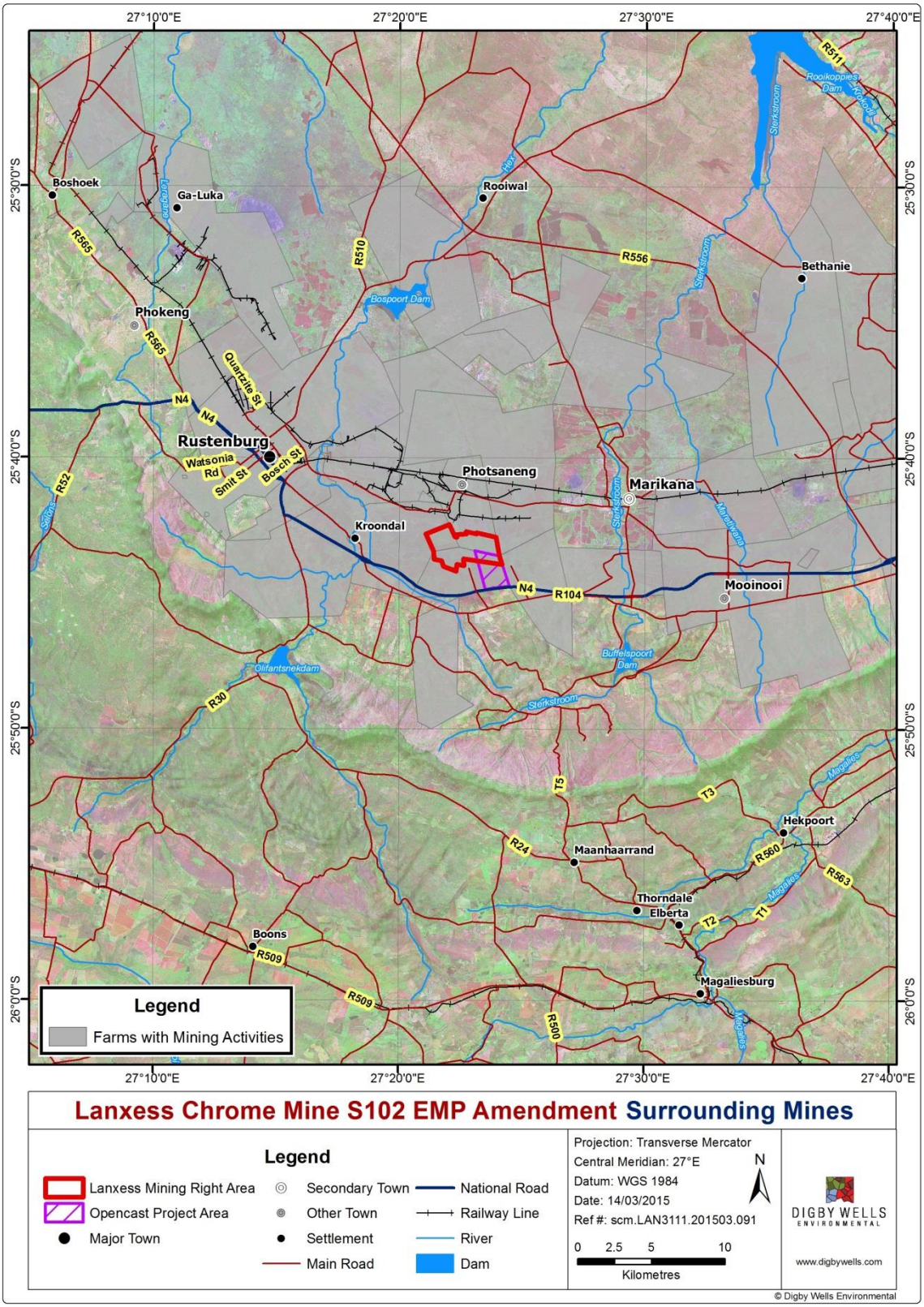

Figure 5-1: Surrounding mines illustrating cumulative impacts with regards to Biodiversity

6 Mitigation Measures and Management Plan

Broad mitigation and management actions are described initially and then activity specific actions are described.

6.1 Avoid sensitive habitat

Avoidance of the rocky bushveld, areas and koppies are strongly recommended. If possible, low sensitivity areas must be favoured for infrastructure placement such as the fallow fields.

The identification of suitable biodiversity offsets need to be explored. This can be done within the general are. If all areas of High and Medium Sensitivity are conserved (rocky areas), the overall impact may be not as negative.

6.2 Rescue and relocation of flora and fauna

6.2.1 Flora

It is recommended that rehabilitation efforts for small areas cleared during construction and not used for operation commence as soon as the project is initiated both prior and during construction activities.

Collection of indigenous grass, herb and shrub seeds is recommended prior to construction activities.

It is recommended that the rocky bushveld, bushveld areas and koppie are set aside as biodiversity corridor and conservation areas (throughout the life of the operation and beyond)

Cattle should be excluded from these areas (or managed correctly within them) and the invasive and problem plant species controlled. Restoration should also occur to restore natural habitat for naturally occurring species of special concern.

6.2.2 Fauna

Mammal SSC are expected to be capable of moving away from habitat impacted by operation activity to habitat which is not impacted by current activities. Fences within the Project Area should be taken down in order to allow for easier movement by species.

Bird SSC are expected to be capable of flying away from habitat impacted by current operational activity to habitat which is not impacted by opencast activities. It is recommended that before and during the construction phase an ecological audit is undertaken to ensure that birds of special concern breeding sites are not within the construction areas. SSC should be avoided where possible. If avoidance is not probable then relocation is obligatory.

Amphibians SSC may be capable of moving away from habitat impacted by opencast activities to habitat which is not impacted by it. The rescue and relocation of these species needs to be explored.

A competent and qualified person should undertake an ecological audit prior to construction to ensure that all burrowing animals have moved away from the disturbance and fauna that might be harmed and are unable to move away are relocated.

6.3 Monitoring programme

A monitoring programme, which assesses the ecological state of the terrestrial ecological resources, is recommended. On site monitoring must take place to identify negative trends in the ecosystem, adaptive management will then be applied to correct these negative trends; bush encroachment and alien invasive plant species should be considered.

6.3.1 Flora

When removing alien invasive species and weeds, care must be taken to eradicate the plants fully. According to the Alien and Invasive Species Lists, 2014 (GN R599 in *GG* 37886 of 1 August 2014) of the NEMBA (Act 10 of 2004). Eradicate means to treat plants by any suitable method in order to prevent such plants from growing, multiplying and propagating. Therefore, when removing plants from the site it should be done at such a time when they are not producing seeds that could easily be spread by wind during cutting and transport. Plants that are known to grow back easily need to be uprooted in order to remove all possible avenues for re-growth and any juvenile plants spotted growing during the operation need to be removed before they become a problem.

6.3.2 Fauna

The animal survey revealed a very poor density and diversity of fauna on and around the Lanxess extension area. For this reason management of fauna during the operation will be minimal, except on the koppie, bushveld area and rocky bushveld areas. It is likely that small mammals such as mongoose or hares are living on the extension area. Should any such animals be disturbed by the activities, the operators will be required to call in qualified people to handle and relocate the animals in question. It is however likely that they will move at their own free will. The same methodology must be applied to bird life when nests are found.

7 Conclusion

The current land use (agricultural) of the study area has removed most of the natural habitat and vegetation, with areas suitable for agriculture dominating, and bushveld areas present in the north east. The current habitat and vegetation present in most of the study area is highly modified and disturbed, with the plant species diversity considered to be very low, and the percentage of alien invasive species (indicative of modified habitats) being more than 60%. The construction of infrastructure here will have minimal impact on biodiversity. The natural areas still remaining are considered sensitive and must be conserved, no construction must take place here, however the open pit's eastern border encroaches on bushveld areas. From the fauna perspective, the habitat degradation and high level of threats in the degraded area has forced most animal species out of this area.

Mitigation measures will suggest that minimal disturbance of natural areas take place. If this is adhered to the project will only affect disturbed and transformed areas with little biodiversity value. The cumulative effect of mining in the Magaliesburg must not be underestimated, and the adherence to mitigation measures is critical.

8 References

ACOCKS, J.H.P, 1988. Veld types of South Africa. 3rd edition. Memoirs of the Botanical Survey of South Africa 57: 1-147

BRANCH, B. 2001. Snakes and Other Reptiles of Southern Africa. Struik Publishers, South Africa.

BRAUN-BLANQUET, J. 1964. Pflanzensociologie. 3 Aulf. Weien. Springer

BROMILOW, C. 2010. Problem Plants of South Africa. Briza Publications, Pretoria.

BOYLES, G.B. CRYAN, P.M. McCRACKEN, G.F. KUNZ, T.H. 2011: Economic Importance of Bats in Agriculture. Sciencemag.org vol. 322.

CARRUTHERS, V. 2009. Frogs and Frogging in Southern Africa. Struck Publishers (Pty) Ltd, Cape Town.

Department of Environmental Affairs and Tourism, 2005. South African Country Study, Situational Assessment undertaken to inform South Africa's National Biodiversity Strategy and Action Plan (NBSAP).

DU PREEZ, L. & CARUTHERS, V. 2009. A Complete guide to the frogs of South Africa. Struik Nature, South Africa.

FENTON, B. & RATCLIFFE, J. 2010 In : Current Biology. 20, p. R1060-R1062.

FRIEDMAN, Y. AND DALY, B. 2004 Red Data Book of the Mammals of South Africa: A Conservation Assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust. South Africa.

KINGDON, J. 1997. The Kingdon Field Guide to African Mammals. Academic Press, San Diego, CA.

LOW, A.B. & REBELO, A.G. 1996. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

MARGULES, C. R. & PRESSEY. R. L. 2010 in Nature: *Nature* 405, 243-253, Systematic Conservation Planning.

MONADJEM, A. TAYLOR, P.J. COTTERILL, F.P.D. SCHOEMAN, M. C. 2010: Bats of Southern and Central Africa. Ultra Litho. Johannesburg.

MUCINA, L. RUTHERFORD. 2006. Vegetation Map of South Africa, Lesotho & Swaziland. SANBI, Pretoria.

PASSMORE N.I., & CARRUTHERS, V.C. 1995. South African Frogs: A complete Guide. Southern Book Publishers, Witwatersrand University Press, South Africa

POOLEY, E.S. 1998. A Field Guide to Wildflowers Kwazulu-Natal and the eastern region. Natal Flora Publishers Trust: Durban, South Africa.

ROBERTS 2011. Roberts' Multimedia Birds of Southern Africa.

RUTHERFORD, M.C & WESTFALL, R.H. 1986. Biomes of Southern Africa – an objective categorization. Memoirs of the Botanical Survey of South Africa 54: 1-98.

SINCLAIR, I., HOCKEY, P. & TARBOTON, W. 2002. Sasol Birds of Southern Africa (3rd Ed.). Struik Publishers, Cape Town.

SMITHERS, R.H.N. (1983). The mammals of the Southern African Subregion. University of Pretoria, Pretoria. 736 pp.

SKINNER JD, SMITHERS RHN. 1990. Family Felidae - Cats. In: The mammals of the Southern African Subregion. 2 ed. University of Pretoria; p 391-423.

SKINNER J.D. & CHIMIMBA C.T. 2005. The Mammals of the Southern African Subregion (3rd Ed.). Cambridge University Press, Cape Town.

VAN OUTSHOORN, F. 1999. Guide to grasses of Southern Africa. Briza Publications, Pretoria, South Africa.

Appendix A: Curriculum Vitae

Mr. Rudolph Greffrath

Senior Fauna and Flora Specialist

Biophysical Department

Education

- 2005: B-tech Degree in Nature Conservation, Nelson Mandela Metropolitan University (NMMU).
- 2001- 2004: National Diploma in Nature Conservation, Nelson Mandela Metropolitan University (NMMU).

Professional Registration

- South African Council for Natural Scientific Professions (Membership No. 200245/13).
- IAIA, International Association for Impact assessments;
- Botanical Society of South Africa.

Employment

- 2006 – Present: Digby Wells Environmental, Johannesburg, South Africa.
- 2002 - 2003: Shamwari Game Reserve, Eastern Cape, South Africa.
- 2001: Kop-Kop Geotechnical instrumentation specialists, Johannesburg, South Africa.

Experience

Rudi's current role is that of a fauna and flora specialist, in this capacity he is responsible for planning and conducting fauna and flora surveys/studies that are either completed in support of environmental authorisations or are focused specialist studies which meet local and international standards. In addition to this, Rudi is responsible for compiling Biodiversity Land Management Programs where different specialist studies are collated into a working document for clients in order to aid in pre or post mining management. He is also involved in rehabilitation studies which entail the planning, implementation and monitoring of vegetative rehabilitation in designated areas on mines. Rudi also fulfils the role of project manager for selected projects; here he manages national and international projects across Africa, specifically west, central and southern Africa, managing a multi-disciplinary team of specialists.

Rudi is also involved in the acquisition of permits for mines, this includes the planning of relocation strategies for protected and endangered plant species in areas where mines are to be established. This involves the planning and execution of data gathering surveys,

thereafter he manages the process involving relevant provincial and National authorities in order to obtain the specific permit that allows for a development to continue.

Information pertaining to the technical expertise of Rudi includes the following:

- Environmental Impact Assessments (EIAs), Basic Assessments and Environmental Management Plans (EMPs) for environmental authorisations in terms of the South African National Environmental Management Act (NEMA), 1998 (Act 107 of 1998);
- Environmental pre-feasibility studies for gold tailings reclamation and iron ore mining projects;
- Biodiversity Assessments including Mammalia, Avifauna, Herpetofauna and Arthropoda;
- Impact assessments based on the terrestrial environment;
- Biodiversity and Land Management Programs;
- Protected plant species management strategies planning and implementation;
- Monitoring of rehabilitation success through vegetation establishment;
- Rehabilitation planning;
- Environmental auditing of rehabilitated areas;
- Project management of ecological specialist studies;
- Planning and design of Rehabilitation off-set strategies.

Training

- Measurements of Biodiversity at the University of the Free State, led by Prof. M. T. Seaman. September 2008.
- Bird Identification course led by Ettiene Maraise November 2009.
- Introduction to VEGRAI and Eco-classification led by Dr. James Mackenzie December 2009.
- Dangerous snake handling and snake bite treatment with Mike Perry 2011.
- Rehabilitation of Mine impacted areas, with Fritz van Oudshoorn, Dr Wayne Truter and Gustav le Roux 2011.

Projects

The following project list is indicative of Rudi's experience, providing insight into the various projects, roles and locations he has worked in.

Project	Location	Client	Main project features	Positions held	Activities performed
Mmamabula Energy Project (MEP).	Botswana	CIC energy	Construction of a railway, opencast mine, wellfield, conveyors, addits, housing.	Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans. Alien eradication plans.
Tongan Biodiversity Land Management Plan	Ivory Coast	Randgold	Design, compilation and implementation of the BLMP	Ecologist, Project Manager	Fauna and Flora surveys for the BLMP, compilation of BLMP. Alien eradication plans.
Kibali Gold mine	DRC Congo	Randgold	Gold mine infrastructure	Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans.
Nzoro Hydroelectric station	DRC Congo	Randgold	Hydroelectric plant	Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans.
Loulo Biodiversity Land Management Plan	Mali	Randgold	Design, compilation and implementation of the BLMP	Ecologist, Project Manager	Fauna and Flora surveys for the project features, compilation of BLMP.
Koidu Diamond Mine	Sierra Leone	Koidu Resources	Construction of new open pit	Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans. Alien eradication plan.

Project	Location	Client	Main project features	Positions held	Activities performed
Resource Generation	South Africa	Temo Coal	Coal mine/Railway Line	Ecologist	Fauna and Flora surveys, Protected plant species management plans, Permitting and Rehabilitation design.
Impunzi Rehabilitation monitoring	South Africa	Glencore	Monitoring of rehabilitation success and suggested management measures	Flora specialist, Project manager	Vegetation surveys, rehabilitation monitoring. Alien eradication plan.

Publications

Biodiversity Action Plans for faunal habitat maintenance and expansion in mining. Poster presented at the 48th Annual Grassland Society of Southern Africa (GSSA) conference.

Appendix B: Plant Species List

Scientific Name	Common Name	Ecological Status	Form	A	B	C
Acacia antaxacantha	Flame pod	Bush Encroacher	Tree		X	
Acacia caffra	Common hook thorn	Bush Encroacher	Tree		X	
Acacia gerrardii	Red Acacia		Tree			X
Acacia karoo	Sweet thorn	Medicinal	Tree		X	X
Acacia nilotica	Scented thorn	Medicinal	Tree			X
Aloe greatheadii var davyana		LC	Aloe		X	
Aloe marlothii	Mountain Aloe	LC	Aloe		X	
Aristida adscensionis	Annual three awn	Pioneer Increase 2	Grass			X
Aristida bipartita	Rolling grass	Increaser 2 - Subclimax	Grass	X		
Aristida congesta congesta	Tassel Tree-awn	Increaser 2 - Pioneer	Grass		X	
Asparagus aethiopicus			Herb		X	
Boophane disticha	Poison bulb	**Protected**	Herb		X	
Bothriochloa insculpta	Pinhole grass	Subclimax Increaser 2	Grass	X	X	X
Brachiaria brizantha	Common signal grass	Climax Increaser 1	Grass			X
Brachiaria deflexa	False signal grass	Pioneer Increaser 2	Grass	X		
Brachiaria eruciformis	Sweet Signal grass	Pioneer Increaser 2	Grass	X		
Cenchrus ciliaris	Foxtail Buffalo grass	Subclimax climax Decreaser	Grass	X		
Chamaecrista comosa	Trailing dwarf cassia		Herb	X		
Chloris gayana	Rhodes grass	Sub climax Decreaser	Grass	X		
Clematis brachiata	Travelers joy		Herb		X	
Commelina africana	Yellow Commelina	Medicinal	Herb		X	
Combretum molle	Velvet Bushwillow		Tree		X	
Corchorus asplenifolius			Herb			X
Crotolaria sphaerocarpa	Mealie Crotalaria		Herb	X		
Cymbopogon pospischilli (plurinodis)	Narrow-leaved Turpentine Grass	Increaser 3 - Climax	Grass	X		X

Scientific Name	Common Name	Ecological Status	Form	A	B	C
Cynodon dactylon	Couch Grass	Increaser 2 - Pioneer	Grass	X		
Datura ferox	Large Thorn Apple	Alien Invasive*	Herb		X	
Dianthus mooiensis	Frilly Dianthus	Medicinal	Herb			X
Dichrostachys cinerea	Sickle bush	Medicinal	Tree		X	X
Dombeya rotundifolia	Wild Pear		Tree		X	
Enneapogon cenchroides	Nine awned grass	Pioneer Subclimax Increaser 2	Grass			X
Eragrostis chloromelas	(Narrow) Curly Leaf	Increaser 2 - Subclimax to climax	Grass			X
Eragrostis inamoena	Tite grass	Increaser 2 - Subclimax	Grass		X	
Eragrostis pseudosclerantha	Footpath Love grass	Pioneer increaser 2	Grass	X		X
Eragrostis racemosa	Narrow Heart Love Grass	Increaser 2 - Subclimax	Grass		X	
Eragrostis superba	Saw tooth Love grass	Increaser 2 - Subclimax	Grass		X	
Eragrostis trichophora	Hairy Love Grass	Increaser 2 - Subclimax	Grass	X		
Euphorbia ingens	Candelabra tree		Succulent		X	
Flaveria bidentis	Smelter's bush	Alien invasive	Shrub			X
Geigeria burkei	Vermeersiektebossie		Herb			X
Grewia flavescens	Sandpaper Raisin		Tree			X
Gymnosporea heterophylla	Spike thorn		Shrub		X	
Heteropogon contortus	Spear Grass	Increaser 2 - Subclimax	Grass		X	X
Hibiscus aethiopicus		Medicinal	Herb	X		
Hibiscus cannabinus	Wild Stock Rose	Invasive	Herb	X		
Hyparrhenia hirta	Common Thatching Grass	Increaser 1 - Subclimax to climax	Grass		X	
Loudetia simplex	Common Russet Grass	Increaser 2 - Climax	Grass	X		
*Melia azedarach****	Syringa	Alien invasive	Tree	X		

Scientific Name	Common Name	Ecological Status	Form	A	B	C
Melinis repens	Natal Red Top	Increaser 2 - Pioneer to subclimax	Grass	X		x
Nidorella hottentotica			Herb	X		
Ozoroa paniculosa	Common Resin Tree	Cultural	Tree			
Panicum maximum	Guinea grass	Decreaser	Grass	X		
Paspalum urvillei	Vasey Grass	Exotic	Grass	X		
Peltophorum africanum	Weeping wattle	Medicinal	Tree			x
Pollichia campestris	Waxberry	Edible/Medicinal	Shrub			x
Schkuhria pinnata	Darf Marigold	Weed	Herb		x	
Searsia lancea	Karee	Edible fruit	Tree		x	x
Searsia leptodictya	Mountain karree		Tree		x	x
Searsia pyroides	Common Wild current	Medicinal	Tree		x	x
Setaria pallide-fusca	Garden Bristle grass	Increaser 1 - Pioneer	Grass	X		
Setaria sphacelata var. sphacelata	Bristle Grass	Decreaser - Climax	Grass	X	x	x
Solanum panduriforme	Yellow Bitter-apple	Medicinal	Shrub			x
Sorghum bicolor	Sorghum	Crop	Grass	X		
Tagetes minuta	Tall Khaki Weed	Alien Invasive	Herb		x	
Tephrosia purpurea	Silver Tephrosia	Medicinal	Herb			x
Themeda triandra	Red Grass	Decreaser - Climax	Grass		x	
Trachypogon spicatus	Giant Spear Grass	Increaser 1 - Climax	Grass			x
Tricholaena monachne	Blue-seed Grass	Increaser 2 - Subclimax	Grass		x	
Trichoneura grandiglumis	Small Rolling Grass	Increaser 2 - Subclimax	Grass	X		
Urochloa mosambicensis	Bushveld Signal Grass	Increaser 2 - Pioneer to subclimax	Grass			x
Verbena bonariensis	Tall Verbena	Alien invasive	Shrub	X		

Scientific Name	Common Name	Ecological Status	Form	A	B	C
Vernonia oligocephala	Bicoloured-leaved Vernonia	Medicinal	Herb			X
Vitex rehmanii	Pipe Stem Fingerleaf	Medicinal	Tree		X	X
Xanthium spinosum	Spiny Cocklebur	Alien/Invasive	Herb	X		
Ximenia caffra	Sourplum	Edible, traditional	Tree			X
Ziziphus mucronata	Buffalo thorn	Medicinal	Tree			X

*A= **Fallow fields**, B= **Rocky areas**, C= **Bushveld**