

# **Proposed Township Development on the remainder of the farm Leeupoort No 283JS and Prt 79 of the farm Blesboklaagte No 296JS, Emalahleni (Mpumalanga)**

**KOR-EMA-13-12-02**

## **Vegetation Assessment**

Date: May 2014

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**Expertise of author:**

- Working in the field of ecology, and in specific vegetation related assessments, since 2007;
- Is registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions in the field of ecology (Reg. No. 400019/11); and
- Has been working with plants indigenous to South Africa since 1997.

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Based on information provided to Dimela Eco Consulting by the client, and in addition to information obtained during the course of this study, Dimela Eco Consulting present the results and conclusion within the associated document to the best of the authors professional judgement and in accordance with best practise.

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SACNASP Reg. No. 400019/11

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2014- -

Date

## EXECUTIVE SUMMARY

Dimela Eco Consulting, on behalf of Limosella Consulting, was appointed by Shangoni Management Services (Pty) Ltd to undertake a vegetation assessment on the site proposed for a township development north of eMalahleni (Witbank) in Mpumalanga Province.

The terms of reference were as follows:

- Review of relevant literature;
- Undertake a field survey and assessment of the biophysical environment and current status of natural features on the proposed site and compare the findings to the expected natural state as listed in the national vegetation map;
- Field survey with specific reference to plants of conservation concern ("red data" and provincially protected species) that could occur within the study site or immediate surroundings;
- Sensitivity mapping, including possible or confirmed localities of plants of conservation concern; and
- Report on the potential impacts that the proposed township could have on vegetation and recommend mitigation measures to limit or negate the potential negative impacts where possible.

Background information indicated that the site is situated in the nationally endangered Rand Highveld Grassland vegetation type. Therefore, the site was assessed for the presence of intact (undisturbed or untransformed) Rand Highveld Grassland, as remaining portions should be conserved in order to preserve this vegetation type and protect it from extinction. A summary of the actual vegetation communities observed on site, as well as its sensitivity rating are presented below:

Vegetation Description	Summary	Sensitivity
<b>Transformed land</b>	<ul style="list-style-type: none"> <li>• The transformed land comprise alien invasive tree clumps (<i>Acacia mearnsii</i> and <i>Eucalyptus</i> species), areas that was quarried or severely degraded by cattle grazing and trampling.</li> <li>• The transformed land was characterised by vegetation that no longer comprise the natural species composition.</li> <li>• The species diversity was observed to be low, while the ecological function and conservation importance was also considered to be low.</li> </ul>	Low
<b>Secondary and Degraded Grassland</b>	<ul style="list-style-type: none"> <li>• Secondary grassland was characterised by grassland that re-established within the fallow lands. However, succession has not yet progressed to the point where the original species diversity was reached.</li> <li>• It is thought that the constant grazing pressure within the secondary grasslands on site will likely keep these grasslands in a sub-climax state / secondary state.</li> <li>• The degraded Grassland was characterised by a diversity of Increaser II</li> </ul>	Low

Vegetation Description	Summary	Sensitivity
	<p>and III grasses (grass species that increase in over utilised/overgrazed veld) and a high number of the shrub <i>Seripheum plumosum</i> (Bankrupt Bush), which is known to increase in overgrazed areas.</p> <ul style="list-style-type: none"> <li>A gladiolus species was observed within secondary grassland and is provincially protected.</li> </ul>	
<b>Rocky and near-natural grassland</b>	<ul style="list-style-type: none"> <li>These grasslands comprised the highest species diversity and although subjected to grazing, encroachment from alien invasive species, and likely a lack of fire, the rocky and near-natural grasslands were representative of the Rand Highveld Grassland.</li> <li>It is therefore of a higher conservation concern than the other grassland groupings.</li> <li>A number of provincially protected plant species, as well as one Rare and one Declining plant species occurs within the rocky grasslands. The area where most of these plants were concentrated was highlighted in the sensitivity map and should be regarded as sensitive areas.</li> </ul>	Medium
<b>Moist grassland</b>	<ul style="list-style-type: none"> <li>The moist grasslands were well vegetated and play a role in the functionality of the wetlands on site and subsequently the hydrology of the area.</li> <li>It is likely that some plant species of conservation concern such as <i>Crinum bulbispermum</i>, <i>Eucomis autumnalis</i> and <i>Disa extensoria</i> could occur in the moist grasslands. These plants were not observed at the time of the field survey, likely due to the disturbed nature of much of the moist grasslands. However, the possibility that they occur, , could not be ruled out.</li> <li>Wetlands and rivers are protected by national legislation and are essential to maintain ecological corridors for the movement and survival of species within a landscape fragmented by cultivation and urbanisation</li> </ul>	High

#### *Plants of conservation concern*

A list of twelve (12) plants of conservation concern that could occur on the site was compiled. During the field survey, species for which suitable habitat exists on site were surveyed for. Of these short-listed species, suitable habitat existed for about four species, while two were confirmed to occur. The Declining species *Boophone distichia* (Poison Bulb) and the Rare species (*Pavetta zeyheri* subsp *middelburgensis*) were confirmed to occur within the rocky grassland on the ridge. A *Crinum* species, thought to be *Crinum graminicola* was also recorded on site. Although this plant is not threatened, the closely related *Crinum macowanii* is a Declining species that may occur on the site. It is advised that the plants be visited during their flowering period (Oct-Dec) to confirm the species identification.

The Endangered *Frithia humilis* is a small succulent, which is known to occur within the area that the site is situated in. This species is inconspicuous when not in flower and can easily be overlooked as the plants can draw themselves deeper into the soil to avoid desiccation during

winter months. The plant was not observed on the site at the time of the field survey. The absence of gravelly quartz on the rocky sheets surveyed on the site makes it unlikely that the plant occurs on site. However the possibility cannot be ruled out. It is advised that a site visit during its flowering time focus on scanning suitable habitat on the site (flowering period: January).

#### *Vegetation sensitivity compared to the MBCP*

The observed vegetation sensitivities were compared to the Mpumalanga Biodiversity Conservation Plan (MBCP). The MBCP classified the terrestrial biodiversity of much of the site as being of low conservation concern in the province as a whole. However, the site visit determined that some localised sensitivities, the rocky ridge in particular, are present on the site. The confluence of the Blesbokspruit and its tributary are classified as 'Important and Necessary' by the MBCP. This area coincide with the sensitive moist grassland and some remnant near-natural and rocky grassland.

From a vegetation perspective, the main sensitivities are restricted to the moist grassland and the rocky ridge where a higher occurrence of plants of conservation concern were noted. A number of mitigation measures can be implemented in order for the proposed development to continue, while impacting as little possible on sensitive vegetation groupings:

- Moist grasslands and the rocky ridge where a high frequency of plants of conservation concern occurs, should not be developed. Instead, these areas should form part of open space planning which allows for a movement corridor for species and ecological processes along the Blesbokspruit.
- Construction should not impact on these open spaces and a management plan must be implemented that will ensure that the open spaces are managed as for example an eco-park, to prevent deterioration during the operational phase.

If the open space cannot be adequate preserved, the plants of conservation concern should be removed (where survival is possible) and relocated. This can only be done once a permit authorising the removal of the plants are granted by the Mpumalanga Tourism and Parks agency. (MTPA). In addition, it is advised that a summer scan (during November) be undertaken to limit the possibility that any plants of conservation concern that was not identified at the time of this report (April survey) are lost.

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## 1. INTRODUCTION

Dimela Eco Consulting, on behalf of Limosella Consulting, was appointed by Shangoni Management Services (Pty) Ltd to undertake a vegetation assessment on the site proposed for a township development north of eMalahleni (Witbank) in Mpumalanga Province.

### 1.1 Terms of reference

The terms of reference were as follows:

- Review of relevant literature;
- Undertake a field survey and assessment of the biophysical environment and current status of natural features on the proposed site and compare the findings to the expected natural state as listed in the national vegetation map (Mucina & Rutherford, 2006);
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- Sensitivity mapping, including possible or confirmed localities of plants of conservation concern; and
- Report on the potential impacts that the proposed township could have on vegetation and recommend mitigation measures to limit or negate the potential negative impacts where possible.

### 1.2 Assumptions and Limitations

Vegetation studies should be conducted during the growing season of all plant species that may potentially occur. According to the Mpumalanga Minimum Requirements for Biodiversity Assessment (Mpumalanga Tourism and Parks Agency, 2008):

*"A floristic (plant) survey must be conducted during the growing season of all species that may potentially occur (this may require more than one season's survey in order to identify flowering species) with two (2) visits undertaken (November & February). Visits during other seasons will be determined by the flowering and fruiting times of species that do not occur during the summer."*

However, one survey was undertaken during April 2014. Although this assessment was undertaken after sufficient summer rainfall, species flowering in early summer or spring might have been overlooked at the time of this survey.

### 1.3 Methodology

The assessment entailed a literature review which included short listing plants of conservation concern that could potentially occur on the site, a field survey, the analysis of data collected and reporting. The methodology used is listed in Appendix A, as well as a map of sampled areas. The two day field survey was undertaken on the 3<sup>rd</sup> and 9<sup>th</sup> of April 2014.

## **2. BACKGROUND TO THE STUDY SITE**

### **2.1 Locality**

The site is situated about 6km north of the town of Emalahleni (Witbank) in the Mpumalanga Province. The site is located directly north of the Pine Ridge residential area and within the quarter degree squares 2529CC. The site assessed comprised the remainder of the farm Leeupoort No 283JS and portion 79 of the farm Blesboklaagte No 296JS (Figure 1). The R544 road runs south and west of the site. A small eastern corner of the site is situated opposite a main road (Figure 1).

### **2.2 Climate**

The eMalahleni-area receives summer rainfall of about 700mm per year, usually peaking in January. The average midday temperatures range from 17.2°C in June to 25.8°C in January. Frost in winter is common.

### **2.3 Topography and Hydrology**

The site included a small ridge along its south-western boundary with the highest elevation, at about 1520m, on the southern portion of the site. The ridge sloped west and northwards towards the Blesbokspruit River that flowed along the western boundary of the site. A tributary to the Blesbokspruit flowed westward along the northern boundary of the study site (Figure 1).

### **2.4 Land Use**

A dirt road traverse the site from west to east and divided the site in a northern and southern section for discussion purposes in this report. Historical aerial images (Google Earth) indicated that much of the northern and eastern portions of the site were historically cultivated, as well as a small portion on the north westerly corner. An Eskom line traversed the northern portion of the site, just south of the tributary to the Blesbokspruit. A large quarry was situated on the northern section of the site and disturbances (likely sand mining) along the tributary was evident (Figure 2). In addition, a large herd of cattle (estimated at over 300 cattle) were grazing the site and numerous kraals (past and present) were noted. The kraal areas were transformed and comprised a number of weedy plant species. A township area is situated along the southern portion of the site.

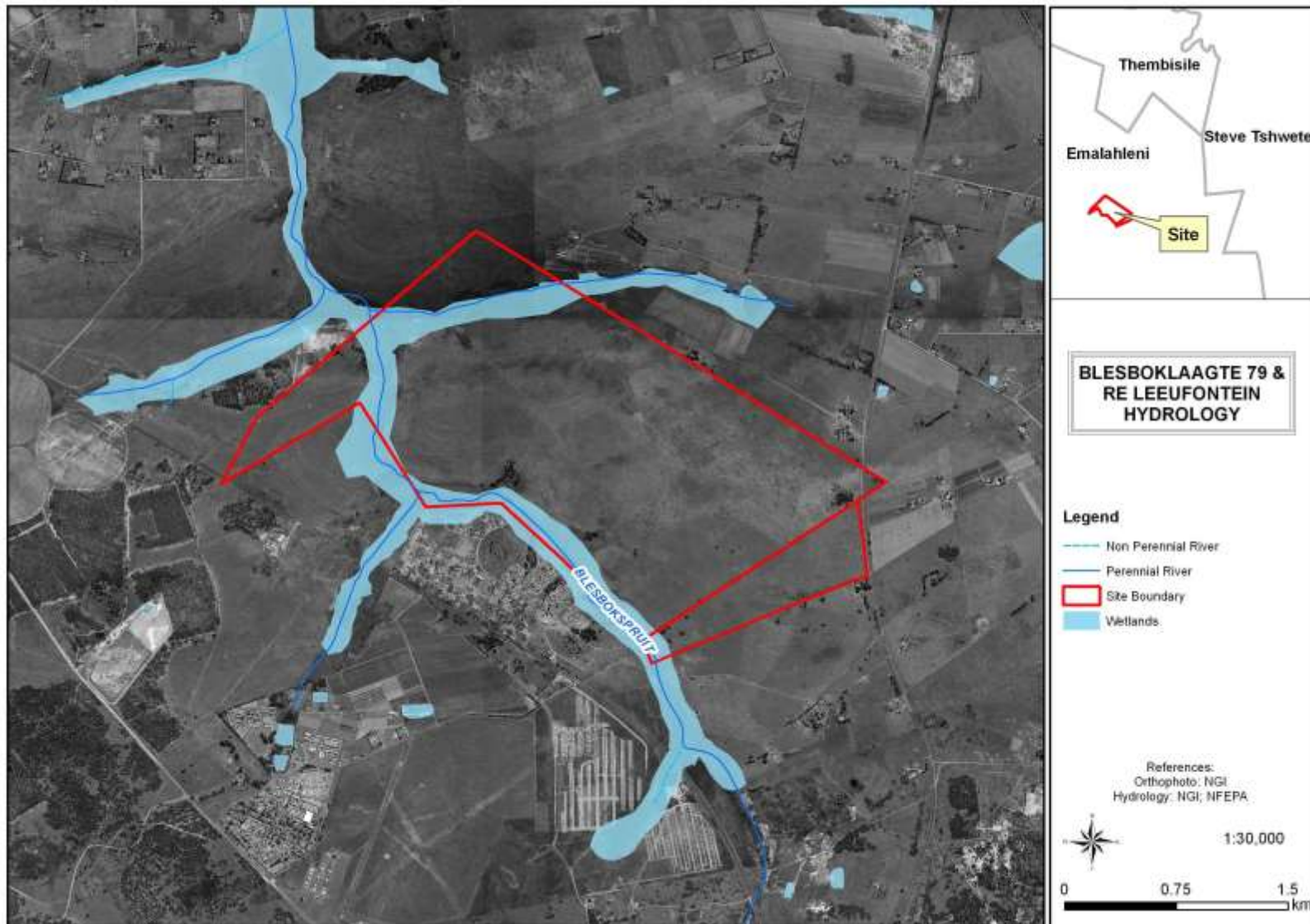


Figure 1: Hydrology map (as per national spatial layers)

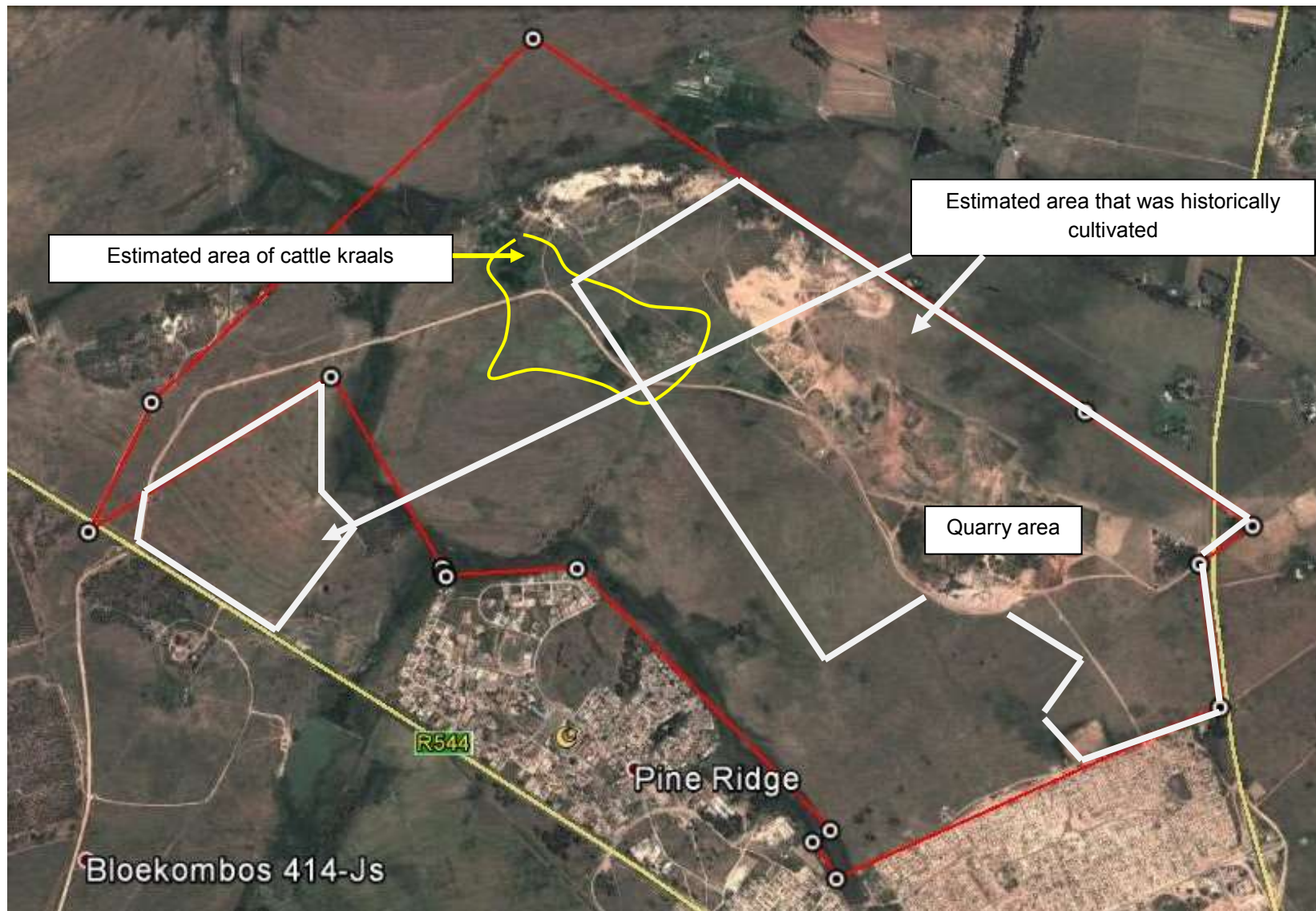


Figure 2: Land use on and around the site



## 2.5 National Vegetation Map

The study site was situated within the Grassland Biome of South Africa. This biome is dominated by grasslands wherein high summer rainfall, combined with dry winters, frost and veld fires are unfavourable to the growth of indigenous trees. The Grassland Biome therefore comprises mainly of grasses and plants with perennial underground storage organs, for example bulbs and tubers. The majority of plant species in grasslands are non-grassy herbs (forbs) of which the growth of various species are stimulated by fires. Furthermore, the majority of Rare and Threatened plant species in the summer rainfall regions of South Africa are restricted to high-rainfall grasslands, making the Grassland Biome in most urgent need of conservation.

The Grassland Biome can be divided into smaller units known as vegetation types wherein the vegetation, soil and landscapes are similar. As per the National Vegetation Map, the vegetation type that is expected to occur on the study site is classified as Rand Highveld Grassland (Mucina & Rutherford, 2006). In its natural state, Rand Highveld Grassland is a species rich grassland that vary from sour grassland to low shrubland on rocky outcrops and steeper slopes. The landscape is typically variable with sloping plains, ridges and undulating plains (Mucina & Rutherford, 2006). The most common grasses are *Themedia*, *Eragrostis*, *Elionorus* and *Heteropogon* species. The rocky outcrops and ridges include sparse woodland with *Protea caffra* and *P. welwitschii*, *Acacia caffra* and *Celtis africana* on an undulating landscape with low hills and pan depressions (Mucina & Rutherford, 2006).

Rand Highveld Grassland is a poorly conserved vegetation unit with much of its area transformed by cultivation, grazing, and mining. Where disturbances occur, the invasive exotic tree *Acacia mearnsii* (Black Wattle) can become dominant and displace the natural vegetation. Due to the extensive usage of the areas covered by the endangered Rand Highveld Grassland the remaining portions are of high conservation value and sensitivity and are thus classified as endangered vegetation communities (Mucina & Rutherford, 2006). Therefore, the site was assessed for the presence of intact (undisturbed or untransformed) Rand Highveld Grassland, as remaining portions should be conserved in order to preserve this vegetation type and protect it from extinction.

## 2.6 Listed Ecosystems

The National Environmental Management: Biodiversity Act (Act 10 of 2004) provides for listing threatened or protected ecosystems in one of four categories: critically endangered (CR), endangered (EN), Vulnerable (VU) or Protected (Section 52(1)(a) of the National Environmental Management: Biodiversity Act (Government Gazette 34809, Government Notice 1002, 9 December 2011)). The ecosystem status is based on the percentage of original area remaining untransformed (by croplands, mining, urban development & roads) in relation to the biodiversity target and a threshold for ecosystem functioning. The purpose of listing threatened ecosystems

is primarily to reduce the rate of ecosystem and species extinction. This includes preventing further degradation and loss of structure, function and composition of threatened ecosystems.

The listed ecosystems incorporates the South African Vegetation Map (Mucina and Rutherford, 2006) as indicated in 2.5, as well as national forest types recognised by the Department of Water Affairs (DWA), priority areas identified in a provincial systematic biodiversity plan, or high irreplaceability forests patches or clusters systematically identified by DWA in order to determine ecosystems in need of protection.

The Rand Highveld Grassland is classified as an 'Endangered' vegetation unit, but is listed as a 'Vulnerable' ecosystems based on irreversible loss of natural habitat (Government Gazette 34809, 2011). Note that the ecosystems were listed after the national vegetation classification and that the conservation status of a vegetation unit could therefore differ from the category of the listed ecosystem, likely due to updated information.

Implications of listing threatened ecosystems (only where the area is found to be in natural state):

- Planning related implications, linked to the requirement in the Biodiversity Act for listed ecosystems to be taken into account in municipal Integrated Development Plans (IDPs) and Strategic Development Frameworks (SDF)s;
- Environmental authorisation implications, in terms of the National Environmental Management Act (NEMA) and Environmental Impact Assessment (EIA) regulations;
- Proactive management implications, in terms of the National Environmental Management Biodiversity Act (NEMBA); and
- Monitoring and reporting implications, in terms of the NEMBA.

## **2.7 Mpumalanga Biodiversity Conservation Plan (MBCP)**

The Mpumalanga Biodiversity Conservation Plan (MBCP) groups the biodiversity assets of Mpumalanga into six conservation categories, based on the measured distribution of hundreds of biodiversity and ecological features throughout the province which are analysed for rarity and response to the pressures of various forms of land-use that diminish them. The conservation categories are:

1. Protected areas currently under formal biodiversity protection;
2. Irreplaceable areas, in urgent need of Protected Area status;
3. Highly Significant areas, requiring strict land-use controls;
4. Important and Necessary areas, requiring special care;
5. Areas of Least Concern, providing areas for development; and
6. Areas with No Natural Habitat remaining, providing preferred sites for all forms of development.

In addition to the above conservation categories, important Ecological Corridors have also been delineated for the province. The purpose of the ecological corridors is to provide intact mega-

pathways for long-term biological movement, and they are selected primarily along river lines and altitude gradients in order to provide for the natural retreat and advance of plants and animals in response to environmental change.

According to the MBCP, the site comprised mainly of areas classified as having “No Natural Habitat Remaining” and “Least Concern” to reach conservation targets. However, a portion classified as “Important and Necessary” to reach the conservation targets of the province is situated on the northern boundary of the site (Figure 3). Areas that are classified as “Important & Necessary” are significantly important areas of natural vegetation that play an important role in meeting biodiversity targets. As per the MBCP, these areas should only be used to benefit the biodiversity assets and reducing the vulnerability. Therefore, land uses that transform the natural state is not supported in “Important and Necessary” areas.

Accompanying each of these conservation categories indicated above are broad land-use guidelines. Table 1 indicates the suitability of the biodiversity categories present on site to the proposed township development. It follows that the township development are not a permissible land use in the “Important and Necessary” area, while the remainder could be suitable to the proposed development.

**Table 1: Types of land-use suited to each biodiversity conservation category present on site. Guidelines apply only to untransformed land with natural vegetation cover.**

Types of Land Use	Important and Necessary	Least Concern / No Natural habitat
Urban and business development	N	Y

Y – Yes, permitted and actively encouraged activity

N – No, not permitted, actively discouraged activity

R – Restricted by compulsory, site-specific conditions and controls when unavoidable, not usually permitted



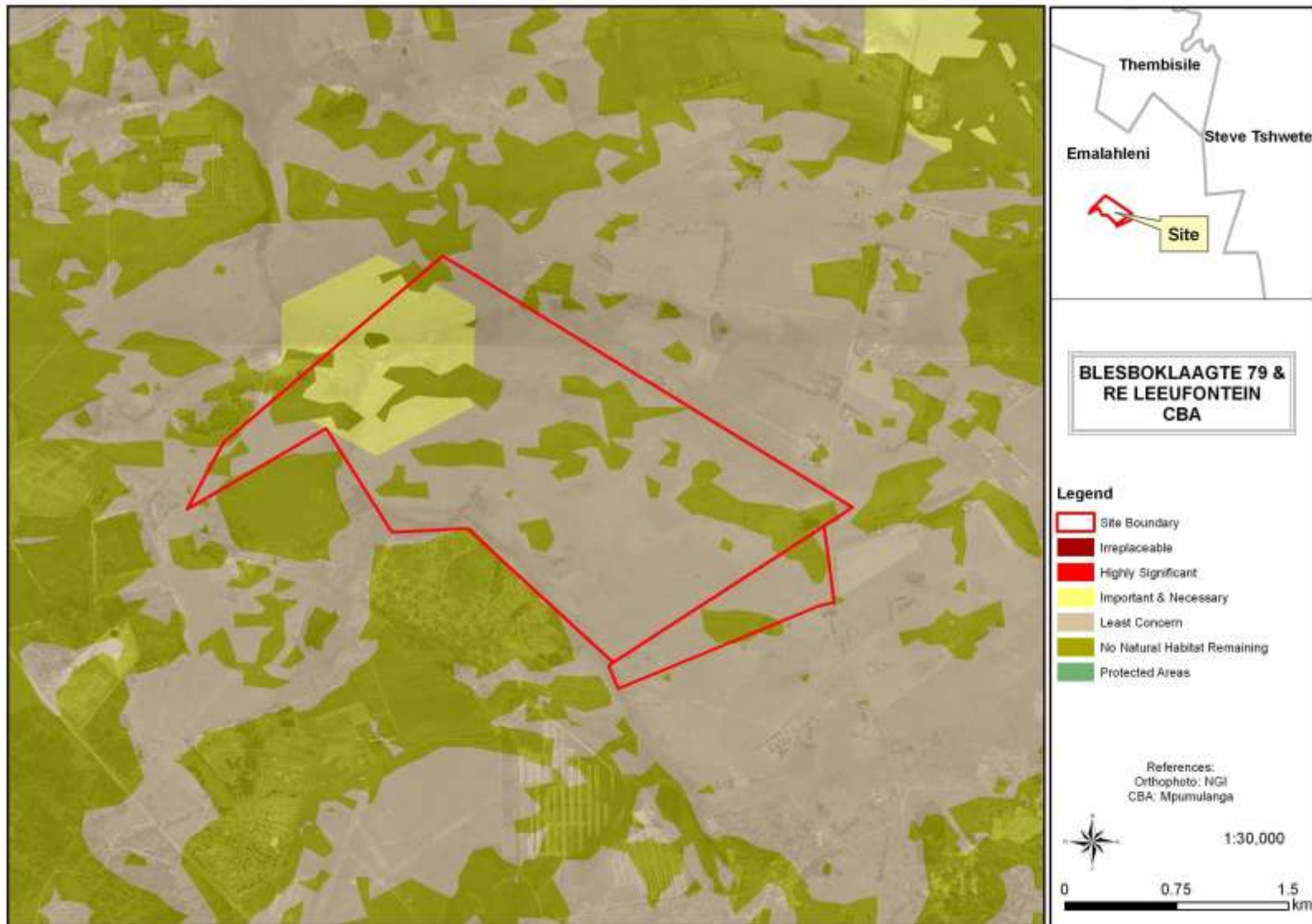


Figure 3: Site in relation to the MBCP (terrestrial)

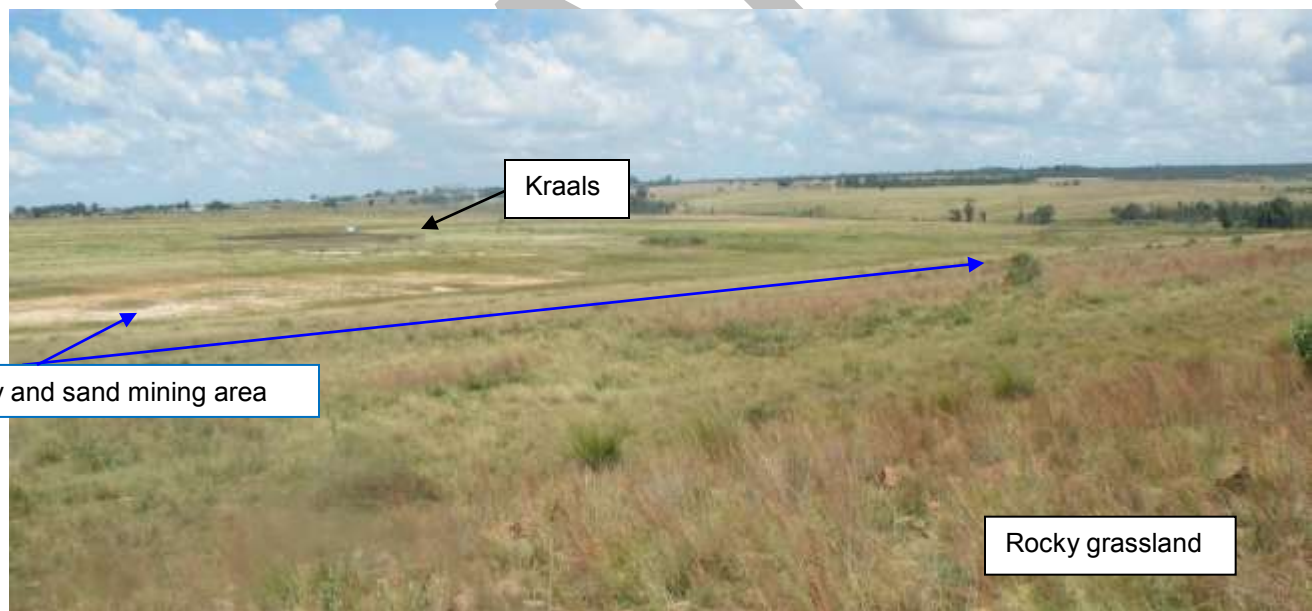
### 3. RESULTS OF THE FIELD ASSESSMENT

#### 3.1 Vegetation groupings present on the study site

The vegetation groupings on the site were classified as follows:

1. Transformed vegetation
  - Alien invasive tree clumps;
  - Areas transformed by mining and intense trampling and grazing by cattle.
2. Grassland:
  - Secondary and Degraded grassland;
  - Rocky grassland; and
  - Moist grassland.

A record of plant species observed at the time of the field survey within the above mentioned broad vegetation groupings are listed in Appendix B. Photograph 1- 3 presents an overview of the different vegetation groupings. The vegetation groupings are geographically represented in Figure 4.



**Photograph 1: View of the site from the northern boundary towards to south**



**Photograph 2: Dammed tributary at the confluence with the Belsbokspruit (Important and necessary area in MBCP)**



**Photograph 3: View of the Blesbokspruit and Pine Ridge from the rocky ridge**



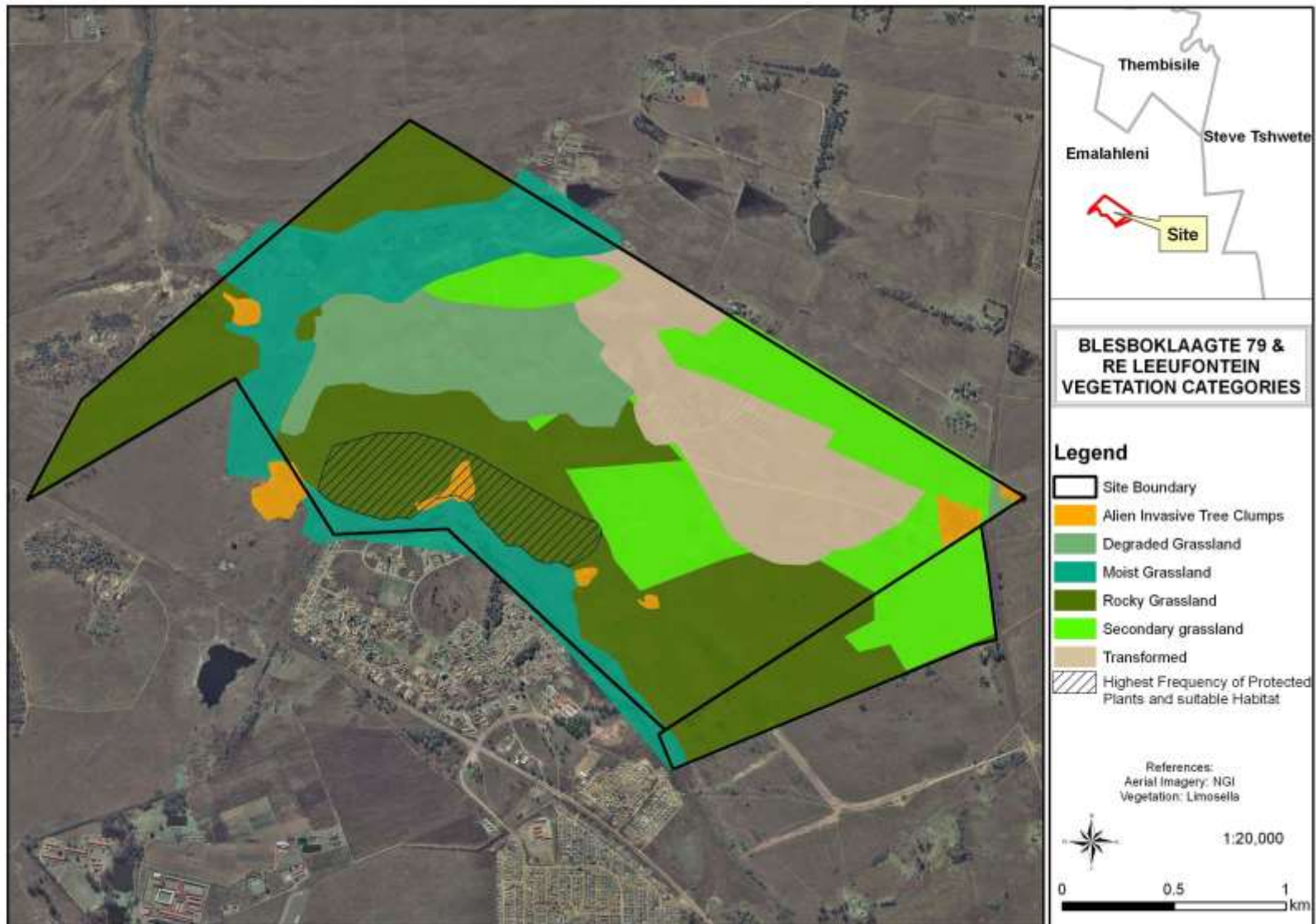


Figure 4: Vegetation groupings on the study site

### 3.1.1 Transformed land

#### a) Alien invasive tree plantations

The transformed land on site was characterised by vegetation that no longer comprised the expected natural grassland species diversity. Instead, the transformed land was dominated by alien invasive tree species. Clumps of *Acacia mearnsii* and *A. dealbata* (Wattle species) and *Eucalyptus camaludensis* (Red River Gum) were likely planted from where it spread into disturbed soils and along moisture gradients on the site. The *Eucalyptus* species is a declared category 1b invasive plant and must be removed (see Section 3.4). Due to the degraded nature of the transformed land, no plants species of conservation concern was observed here and neither are these species expected to persist within the transformed land.

#### b) Areas disturbed by mining and cattle kraals

A large quarry area was situated on the north-eastern portion of the site and it seemed that much of the north-eastern section was quarried historically (Photograph 4). The area was highly degraded from the natural grassland state. Areas that was rehabilitated around the quarry included a number of indigenous pioneer grass species such as *Hyparrhenia hirta* (Common Thatching Grass), *Cynodon dactylon* (Couch Grass) and *Eragrostis gummiflua* (Gum Grass). The herbaceous layer comprised of weedy species such as *Richardia brassiliensis* and *Solanum sisymbirifolium*.

Furthermore, the site was grazed by a large herd of cattle. A kraal area was situated on the northern portion of the site in proximity to the confluence of the Blesbokspruit and the tributary. It appeared that this kraal or areas where the cattle were concentrated overnight, had moved a number of times, leaving behind overgrazed and trampled patches, which were subsequently colonised by weedy and pioneer species, as well as the exotic grass *Pennisetum clandestinum* (Kikuyu Grass). No plants of conservation concern was observed in the transformed areas. The high degree of transformation and invasive species lowers the ecological function, as well as conservation value of these areas.



Photograph 4: *Eucalyptus* stands (left) and water-filled quarry (right)

### 3.1.2 Grassland

Grassland vegetation present on site was characterised by the dominance of grass and herbaceous species, with only a limit number of tree and shrub species present. The various patches of grassland were observed to vary in species composition depending on past and current land use, as well as its position in the landscape. Lower lying areas were observed to contain plant species adapted to temporary or permanently wet soils, while other grassland areas contain rocky substrate and a higher plant species composition. Yet other portions were degraded due to grazing or in a secondary state due to historic cultivation. The various grassland types were classified as follows and geographically represented in Figure 4:

#### a) Secondary and degraded grassland

##### Secondary grassland

The secondary grassland was observed where past cultivation removed the vegetation layer and disturbed the soils. Prolonged cultivation reduced the seed bank in the soils as well as the likelihood of geophytes (e.g. bulbs) surviving. Although the fallow lands were colonised by indigenous grass and some herbaceous species, the species diversity remained low compared to what could be expected in intact, primary (undisturbed) Rand Highveld Grassland (Mucina & Rutherford, 2006)(Photograph 5).



**Photograph 5: Secondary grassland dominated by *Hyparrhenia hirta* and *Eragrostis* species**

The following grass species were observed to be dominant: *Hyparrhenia hirta* (Common Thatching Grass), *Eragrostis curvula* (Weeping Love Grass), *Aristida congesta* and *Cynodon dactylon* (Couch Grass). Some herbaceous species (mostly pioneer species) were re-establishing in fallow lands and included *Selago densiflora*, *Hypoxis rigidula*, *Oldenlandia*



*herbacea*, *Pollichia campestris* (Waxberry) and the shrub *Seripheum plumosum* (Bankrupt Bush) which tends to proliferate in overgrazed grasslands. Weedy species included *Richardia brasiliensis*, *Solanum elaeagnifolium* (Silverleaf Bitter Apple) and *Solanum sisymbriifolium* which grew abundantly where grazing and trampling took place in the secondary grasslands. One geophyte, a *Gladiolus* species, was observed in the secondary as well as in the rocky grassland. The plant was dormant and the dried plant parts hampered identification to species level. It is likely that more individuals occur sporadically in the secondary grassland.

Although grassland re-established within the fallow lands, succession has not yet progressed to the point where the original species diversity was reached. It is thought that the constant grazing pressure within the secondary grasslands on site will likely keep these grasslands in a sub-climax state / secondary state.

#### *Degraded grassland*

The degraded grassland comprised grassland that was degraded by continuous grazing pressure as well as the invasion of alien invasive plant species such as *Pennisetum clandestinum* (Kikuyu) Grass) and various *Solanum* species (Photograph 6).



**Photograph 6: Degraded grassland with a high frequency of weedy *Solanum* species (left) and low basal cover (right)**

The grassland was further characterised by a diversity of Increaser II and III grasses (grass species that increase in over utilised/overgrazed veld) and a high frequency of the shrub *Seripheum plumosum* (Bankrupt Bush), which is known to increase in overgrazed grassland (Photograph 7). Although some of these areas were not ploughed in the recent past, continuous grazing pressure reduced palatable grasses and subsequently changed the species composition from what is expected in natural Rand Highveld Grassland (Mucina & Rutherford, 2006). The degraded grassland included grasses such as *Eragrostis chloromelas* (Curly Leaf), *E. rigidus* (Broad Curly Leaf), *Cymbopogon caesius* (Broad-leafed Turpentine Grass), *Cynodon dactylon* (Couch Grass), *Eragrostis gummiflua* some *Pogonarthria squarrosa* (Herringbone

Grass) and *Hyparrhenia hirta* (Common Thatching Grass). The herbaceous layer included *Pollichia campestris* (Waxberry), *Gnidia kraussiana* and *Hermannia depressa*.



**Photograph 7: Low basal cover in the disturbed grasslands and a high frequency of *Seripheum plumosum* suggesting a high grazing pressure (arrows)**

At the time of this survey, the transformed and degraded grasslands were found to have a lower species diversity than that of the rocky grasslands that although grazed, were never ploughed. At the time of the survey, 18 grass species (of which the majority was pioneer or Increaser I & II species), 33 herbaceous and small shrubs species and 7 invasive plant species were noted. Other than what appeared to be *Gladiolus elliotti* (a provincially protected species that was dry at the time of the survey), no plant species that are known to be of conservation concern was observed within the secondary and degraded grasslands (Appendix B).

#### *b) Rocky grassland and near-natural grassland*

Areas that were not historically ploughed or severely trampled and grazed were included in the rocky grassland vegetation grouping. The rocky grasslands were observed on top of the ridge growing on and between rocky sheets, boulders and within shallow soils. Rocky grasslands



were also noted on the slopes and lower lying areas where rocky sheets occurred sporadically. The shallow soil layer was likely the reason that these areas were not historically ploughed. The species composition was characterised by a higher diversity of species naturally occurring within the Rand Highveld Grassland, although a number of Increaser II & III grasses dominated due to the high grazing pressure. At the time of this survey, the rocky grasslands were grazed short, and in some areas a low basal cover was noted (especially areas where short term disturbances i.e. under the powerline took place).

The rocky grasslands included grasses such as *Monocymbium ceresiliforme* (Boat Grass), *Eragrostis curvula* (Weeping Love Grass), *Harpochloa falx* (Caterpillar Grass), as well as the increaser grasses *Aristida congesta* and *Cynodon dactylon* (Couch Grass). The grazed ridge and rocky sheets lower down, contained large numbers of the shrub/small tree *Lopholaena coriifolia* (Pluisbossie). This plant, in high numbers, is an indicator of shallow rocky soils and veld that has been mismanaged. Although the Pluisbossie is a natural component of the Rand Highveld Grassland, overgrazing could lead to the encroachment of this species (the increase in density, cover and biomass of this indigenous woody species in relation to herbaceous species), as was seen on site (Photograph 8). In addition, the shrub *Seripheum plumosum* also occurred in patches within the rocky grassland.



Photograph 8: Large numbers of *Lopholaena coriifolia* within the grazed rocky grassland

Additional shrub and small tree species included *Diospyros lycioides* (Bluebush), the suffrutescent *Elephantorrhiza elephantina*, *Parinari capensis* (Dwarf Mobola Plum) and *Pygmaeothamnus zeyheri* (Sand Apple). The herbaceous layer included *Xerophyta retinervis* (Monkey's Tail), *Acalypha punctata*, *Leonotus leonorus*, *Senecio coronatus*, *Sphenostylis angustifolia* (Wild Sweet Pea), and *Lapeirousia sandersonii* (Autumn Painted Petals).

The ridge area contained a number of plants of conservation concern (see Section 3.2). One individual of the Declining bulb *Boophane distichia* (Poison Bulb) and the Rare *Pavetta zeyheri* subsp. *middelburgensis* were observed, while the provincially protected *Protea welwitschii* (White Sugarbush) grew abundantly on the ridge. An unidentified *Crinum* species (thought to be *Crinum graminicola*) was also observed to occur sporadically in the rocky grasslands, but in deeper soils (Photograph 9).



**Photograph 9: *Protea welwitschii* on the rocky ridge (left) and *Crinum* cf. *graminicola* (right)**

At the time of this survey, 11 grass species, 67 herbaceous and small shrub species and 4 tree species were observed within the rocky grassland vegetation grouping. Only one invasive species (*Richardia brasiliensis*) was noted. The rocky grasslands comprised the highest species diversity. Although the grazing pressure is high and there are disturbances from encroachment from alien invasive species, and likely a lack of fire, the rocky grasslands were representative of the Rand Highveld Grassland. It is therefore of a higher conservation concern than the secondary grasslands.

#### c) Moist grassland

Moist areas and seepage were observed along the Blesbokspruit and the tributary on the northern boundary of the site. These seep areas extended into the rocky grasslands and included species that are adapted to grow in temporary saturated condition, likely due to an impervious soil layer. Even areas where sand was likely mined in the past, showed clear signs of surface and subsurface water movement towards the tributary (Photograph 10). The grass *Andropogon eucomus* (Old Man's Beard Grass) and *Ischaemum fasciculatum* (Hippo Grass) dominated seep areas. Disturbed and overgrazed areas included the exotic grass *Paspalum*



*dilatatum* (Dalis Grass), *Eragrostis gummiflua* (Gum Grass), *E. plana* (Tough Love Grass) and *Aristida scabrivalis*. Much of the seep areas in the northern portion of the site were overgrazed due to the availability of moisture for longer periods during the year (Photograph 11).



**Photograph 10: Water seeping towards the tributary in areas that was historically mined for sand.**



**Photograph 11: Stands of *Seripheum plumosum* (Bankrupt Bush) in moist grasslands (arrows)**

Permanently moist areas, such as the Blesbokspruit and the tributary, were dominated by the tall growing grass, *Phragmites australis* and the reed *Typha capensis* (Bulrush) (Photograph 12).



**Photograph 12: Moist grassland adjacent to the Blesbokspruit, which was dominated by *Phragmites australis* (arrow)**

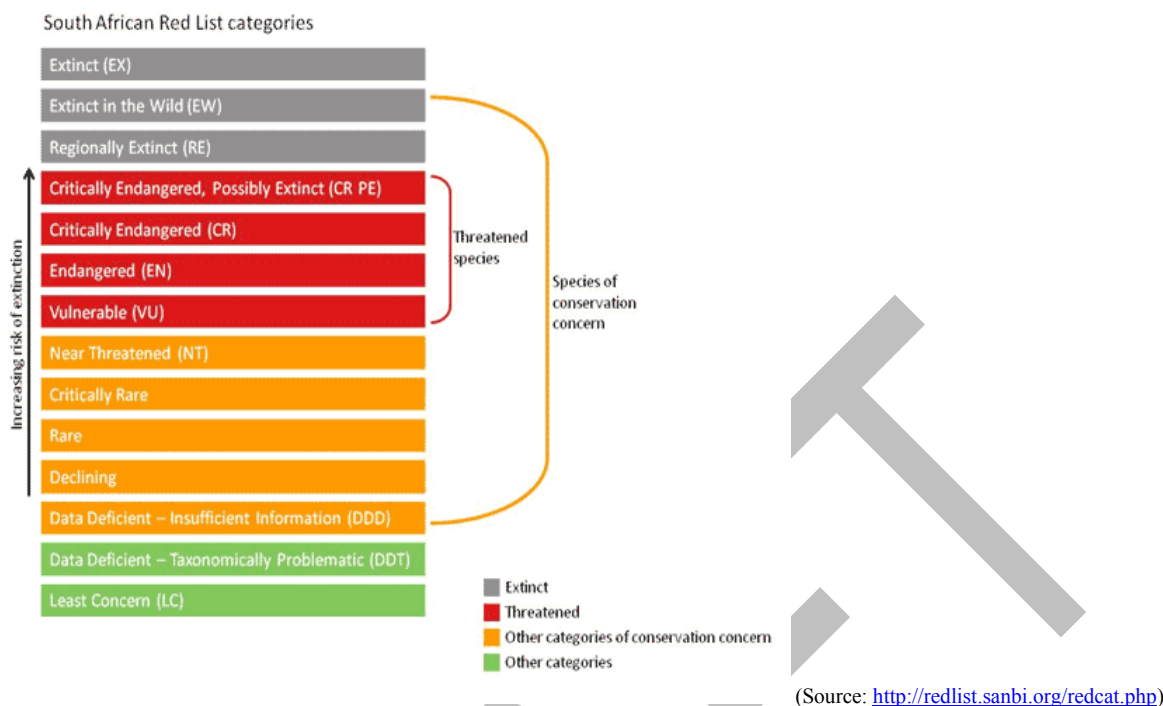
Although sand mining historically impacted on the tributary and grazing and invasive tree species are currently impacting on the moist grassland, the moist grasslands were well vegetated and play a role in the functionality of the wetlands on site and subsequently the hydrology of the area.

At the time of this survey 15 grass species, 17 herbaceous species, 8 sedges, and 4 alien or invasive plant species were noted in the moist grasslands (Appendix B). Moist grasslands are expected to have a lower diversity than terrestrial grasslands as fewer plants are adapted to grow in saturated conditions. It is likely that some plant species of conservation concern such as *Crinum bulbispermum*, *Eucomis autumnalis* and a number of orchid species could occur in the moist grasslands. These plants were not observed at the time of the field survey, likely due to the disturbed nature of some moist grasslands, grazing pressure or the late season of the site visit. A wetland buffer zone, as recommended by the wetland specialist (Limosella, 2014), should be adequate to protect these plants if they indeed occur.

### **3.2 Plants of Conservation Importance**

#### **3.2.1 Nationally Protected Plant (Plants of Conservation Concern)**

Plants of conservation concern are those plants that are important for South Africa's conservation decision making processes and include all plants that are Threatened, Extinct in the wild, Data deficient, Near-threatened, Critically rare, Rare and Declining (Figure 5). Chapter 4, Part 2 of NEMA Biodiversity Act, 2004 (Act No. 10, 2004) provides for listing of species that are threatened or in need of protection to ensure their survival in the wild, while regulating the activities, including trade, which may involve such listed threatened or protected species and activities which may have a potential impact on their long-term survival.



**Figure 5: Threatened species and species of conservation concern**

A list of twelve (12) plants of conservation concern was compiled using information from the South African National Biodiversity Institute's (SANBI) checklist (SANBI, 2009), Raimondo *et al*, (2009), information from the Mpumalanga Tourism and Parks Agency (MTPA) and relevant literature pertaining to the area that the study site is situated in (Table 2). Of these listed species, 1 species is classified as Endangered, 2 are Vulnerable, 3 are Near Threatened, 4 are Declining, 1 is naturally Rare and 1 is classified as Data Deficient (Table 2).

During the field survey, species for which suitable habitat exists on site were surveyed for. Of these short-listed species, suitable habitat existed for about four species, while two were confirmed to occur (Table 2). The Declining species *Boophone distichia* (Poison Bulb) and the Rare species (*Pavetta zeyheri* subsp. *middelburgensis*) were confirmed to occur within the rocky grassland on the ridge. A *Crinum* species, thought to be *Crinum graminicola* was also recorded on site. Although this plant is not threatened, the closely related *Crinum macowanii* is a Declining species that may occur on the site. It is advised that the plants be visited during their flowering period (Oct-Dec) to confirm the species identification.

**Table 2: Plant species of concern that was confirmed to occur or could occur** (species printed in **bold** were confirmed to occur)

Specie	Status	Typical habitat	Occurrence on site
<i>Anacampseros subnuda</i> subsp. <i>lubbersii</i>	Vulnerable	Occurs in the Emalahleni (Witbank) and Middelburg area in grassland on rhyolite	Not observed on the rocky areas on the site. The geology of the site comprised tillite and arenite and

Specie	Status	Typical habitat	Occurrence on site
		boulders	therefore the plants are not likely to occur on the site.
<i>Eucomis vandermerwei</i>	Vulnerable	Short sour montane grassland on low pH sandy soils derived from quartzitic rocky outcrops. In rock crevices or under overhanging rocks, confined to outcrops on slopes and plateaus of higher peaks, predominantly on north-facing slopes. 2200-2500 m. Dullstroom to Steenkampsberg and Middelburg.	No suitable habitat.
<i>Frithia humulis</i>	Endangered	Rocky sheets. Only occur in a small band from Ogies to Loskop Dam.	According to available records, this plant was recorded in the quarter degree that the site was situated in. Suitable habitat such as rocky sheets on the site were surveyed but the plant was not observed in walked transects at the time of this (April) survey. This plant historically occurred about 4km north east of the site on the Inyanda Colliery (Exxaro) property and was translocated (Kruger & Sibert, 2012). Although likelihood that this plant occur on site should not be ruled out, the rocky areas lacked the typical gravelly quartz nature that the author has observed this plant in before. Also note that these plants can draw themselves deeper into the soil to avoid desiccation during the dry winter months – this makes these small plants even more difficult to observe.
<i>Argyrolobium megarrhizum</i>	Near threatened	Mixed Bushveld mainly from Pretoria to Bronkhorstspuit	This plant was not noted at the time of the field survey and it is thought to be <i>unlikely</i> to occur on the site. However this site visit was undertaken outside of the flowering period of this plant and therefore the possibility of the plant occurring



Specie	Status	Typical habitat	Occurrence on site				
			cannot be ruled out completely.				
<i>Brachystelma chlorozonum</i>	Near threatened	On rocky hills -confirmed to occur in the Middelburg area	Likely to occur on the rocky outcrops area, but not observed at the time of the visit.				
<i>Boophane disticha</i>	Declining	Rocky grasslands on the site, but particularly in proximity or on rocky outcrops.	<b>Confirmed to occur. Suitable habitat exists within rocky grassland. Only one individual was noted within walked transects. However, it is likely that more individuals occur, or that the plants were harvested for their medicinal properties. Minimum localities:</b> <table><tr><th>Lat</th><th>Long</th></tr><tr><td>25°48'46.70"S</td><td>29°12'17.56"E</td></tr></table>	Lat	Long	25°48'46.70"S	29°12'17.56"E
Lat	Long						
25°48'46.70"S	29°12'17.56"E						
<i>Callilepis leptophylla</i>	Declining	Grassland or open woodland, often on rocky outcrops or rocky hill slopes	Not observed at the time of the field survey. However, it likely occurs within the rocky grassland and was not noted due to the late season of the survey (April).				
<i>Disa extintoria</i>	Near threatened	Crest of the escarpment in damp grassland and swamps. 1000-1300 m. Historic records indicated that the plant occurred about 20km north-east of the site	Moist grasslands on site was degraded by grazing and some areas were invaded by alien invasive plants. This plant was not recorded at the time of the survey.				
<i>Eucomis autumnalis</i>	Declining	Usually occurs in proximity or on rocky outcrops, sometimes also in seepage areas on rocky slopes	This plant was not observed at the time of the field survey. However, suitable habitat are present in seepage areas and the rocky grasslands.				
<i>Pavetta zeyheri</i> subsp. <i>middelburgensis</i>	Rare	This plant occurs in the Middelburg area on outcrops of rocks and boulders or rocky sheets.	<b>A <i>Pavetta zeyheri</i> was observed on site. The plants resembles subsp <i>middelburgensis</i> in its growth form and habitat. Although the plants was not recorded in this quarter degree before, but in close proximity thereto, the author is of the opinion that the two individuals found within the rocky ridge area are indeed subsp <i>middelburgensis</i>.</b>				
<i>Aspidoglossum validum</i>	Data deficient-D	Poorly known species. It has	Not observed and highly unlikely to				

Specie	Status	Typical habitat	Occurrence on site
		been collected only a few times, however it may also be overlooked. It is potentially threatened in some areas by expanding forestry plantations and human settlements, however, the exact habitat of this species is not known, and threats are therefore difficult to determine.	occur. More likely to occur in the Lydenburg-Baberton area

The Endangered *Frithia humilis* is a small succulent, which is known to occur within the area that the site is situated in. This species is inconspicuous when not in flower and can easily be overlooked as the plants can draw themselves deeper into the soil to avoid desiccation during winter months. The plant was not observed on the site at the time of the field survey. The absence of gravelly quartz on the rocky sheets surveyed on the site makes it unlikely that the plant occurs on site. However the possibility cannot be ruled out. It is advised that a site visit during its flowering time focus on scanning suitable habitat on the site (flowering period: January).

Although only one individual of *Boophone distichia* (Poison Bulb) was identified in a walked transect during the site visit, it is likely that more plants could be present. Poison Bulb is extensively harvested for the medicinal plant trade and therefore the numbers in the wild is declining. If the *Boophone distichia* and the *Pavetta zeyheri* subsp *middelburgensis* are deemed to be under threat of the proposed development, the plants should be removed and relocated to nearby, suitable habitat. Note that these plants can only be removed with permission of the Mpumalanga Tourism and Parks Agency (MTPA).

### 3.2.2 Provincially Protected Plants

A number of plants are provincially protected by the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998). Table 3 lists the four (4) provincially protected species that were confirmed to occur, as well as some that likely occurs but that was not recorded during the field survey. These species may not be removed, pruned or damaged without a permit from the Mpumalanga Tourism and Parks Agency (MTPA).

**Table 3: List of protected plants that were confirmed to occur or could potentially occur in the area**

Species	Protection	Occurrence
<i>Crinum</i> species	All species	A <i>Crinum</i> species was <b>confirmed</b> to occur in the rocky grassland. The species is likely <i>C. graminicola</i>



Species	Protection	Occurrence								
		<b>Minimum localities:</b> <table><tr><th>Lat</th><th>Long</th></tr><tr><td>25°48'16.77"S</td><td>29°11'36.90"E</td></tr><tr><td>25°48'31.81"S</td><td>29°11'53.32"E</td></tr></table>	Lat	Long	25°48'16.77"S	29°11'36.90"E	25°48'31.81"S	29°11'53.32"E		
Lat	Long									
25°48'16.77"S	29°11'36.90"E									
25°48'31.81"S	29°11'53.32"E									
<i>Protea welwitschii</i>	All species	<b>Confirmed</b> to occur in rocky grassland on the hill directly east of the Belsbokspruit (Figure 6)								
<i>Gladiolus</i> species	All species	<b>Confirmed</b> sporadic occurrence of at least two species in rocky and secondary grassland as below. Note that the individuals noted were dry and becoming dormant which hampered positive identification. However, all species that occur naturally in Mpumalanga are provincially protected <b>Minimum localities:</b> <table><tr><th>Lat</th><th>Long</th></tr><tr><td>25°48'37.01"S</td><td>29°11'47.04"E</td></tr><tr><td>25°48'32.82"S</td><td>29°11'7.21"E</td></tr><tr><td>25°48'58.95"S</td><td>29°12'59.48"E</td></tr></table>	Lat	Long	25°48'37.01"S	29°11'47.04"E	25°48'32.82"S	29°11'7.21"E	25°48'58.95"S	29°12'59.48"E
Lat	Long									
25°48'37.01"S	29°11'47.04"E									
25°48'32.82"S	29°11'7.21"E									
25°48'58.95"S	29°12'59.48"E									
<i>Pellaea calomelanos</i>	Species	<b>Confirmed</b> sporadic occurrence in rocky grassland, wedged between rocks <b>Minimum localities:</b> <table><tr><th>Lat</th><th>Long</th></tr><tr><td>25°48'17.46"S</td><td>29°11'35.35"E</td></tr><tr><td>25°47'53.28"S</td><td>29°11'53.85"E</td></tr></table>	Lat	Long	25°48'17.46"S	29°11'35.35"E	25°47'53.28"S	29°11'53.85"E		
Lat	Long									
25°48'17.46"S	29°11'35.35"E									
25°47'53.28"S	29°11'53.85"E									
<i>Eucomis</i> species (Pineapple plant)	All species	<i>E. autumnalis</i> likely to occur in moist- and rocky grassland.								
<i>Habenaria</i> species <i>Eulophia ovalis</i> subsp <i>ovalis</i> <i>E. welwitshii</i>	Whole family: Orchidaceae	Possible occurrence in moist grasslands Can be overlooked when not in flower (Flowers from Feb-April)								

### 3.3 Medicinal Plant Species

Rising demand for medicinal plants has led to increased pressure on wild plant populations. This combined with shrinking habitats, means that many species in South Africa are now facing local extinction (Botha *et al*, 2004). The demise of medicinal plant species holds dire consequences both socially and ecologically. People stand to lose their medicine, and in the case of traditional healers and plant gatherers, their livelihoods (McKean, unknown). Medicinal plants that are highly utilised will soon become extinct as they are harvested from natural environments or destroyed by development and mining. The trade in medicinal plants is high and it is unlikely that at current levels of exploitation, the sustainable supply of medicinal plants will ever meet the demand. Therefore it is important to be able to identify areas that could potentially support, or provide plants to the medicinal plant trade (Emery *et al*, 2002). A

minimum of 16 plants known to be used medicinally were recorded on the study site (Appendix B).

### 3.4 Alien Invasive Plant Species

Declared weeds and invader plant species have the tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition and function of natural ecosystems. Therefore, it is important that these plants are controlled and eradicated by means of an eradication and monitoring programme. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species (Henderson, 2001).

Currently, two laws govern the control of alien invasive plant species in South Africa:

1. **The amended Regulations (Regulation 15) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA)** identifies three categories of problem plants:

Category 1 (Declared weeds): plants may not occur on any land other than a biological control reserve and must be controlled or eradicated. Therefore, no person shall establish plant, maintain, propagate or sell/import any category 1 plant species;

Category 2 (Declared invaders): plants are plants with commercial application and may only be cultivated in demarcated areas (such as biological control reserves) otherwise they must be controlled; and

Category 3 (Declared invaders): plants are ornamentally used and may no longer be planted, except those species already in existence at the time of the commencement of the regulations (30 March 2001), unless they occur within 30 m of a 1:50 year flood line and must be prevented from spreading.

2. The **National Environmental Management: Biodiversity Act (NEMBA)** is the most recent legislation pertaining to alien invasive plant species. In February 2014 the list of Draft Alien Invasive Species was published in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (Government Gazette No 78 of 2014). The Alien and Invasive Species Regulations was published in the Government Gazette No. 36683, 19 July 2013. The legislation calls for the removal and / or control of alien invasive plant species (Category 1 species). In addition, unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring within close proximity to a watercourse.

Below is a brief explanation of the three categories in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA):

Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.

Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.

Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.

Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

The alien plant species identified on the study site are listed in Appendix B. Note that according to the regulations, a person who has under his or her control a category 1b listed invasive species must immediately:

- (a) notify the competent authority in writing
- (b) take steps to manage the listed invasive species in compliance with
  - (i) section 75 of the Act;
  - (ii) the relevant invasive species management programme developed in terms of regulation 4; and
  - (iii) any directive issued in terms of section 73(3) of the Act.

The following category 1b species exist on the site and must therefore be removed by implementing an alien invasive plant management programme in compliance of section 75 of the Act as stated above.

1. *Cirsium vulgare* (Scotch Thistle)
2. *Eucalyptus camaldulensis* (Red River Gum)
3. *Solanum sisymbirifolium* (Wild Tomato)

#### 4. VEGETATION IMPORTANCE AND SENSITIVITY

It has been clearly demonstrated that vegetation not only forms the basis of the trophic pyramid in an ecosystem, but also plays a crucial role in providing the physical habitat within which organisms complete their life cycles (Kent & Coker 1992). Therefore, the vegetation of an area will largely determine the ecological sensitivity thereof. The vegetation sensitivity assessment aims to identify whether the vegetation within the study area is of conservation concern and thus sensitive to development as it is amongst others:

- Situated in a listed ecosystem or threatened vegetation unit;
- Protected by national or provincial legislation;
- Habitat or potential habitat to plants species of conservation concern, protected plants or protected trees;
- Situated within ecologically sensitive features such as wetlands or riparian areas;
- Natural, untransformed and un-fragmented natural vegetation.

##### 4.1 Sensitivity Ratings and Analysis

In order to determine the sensitivity of the vegetation observed on the study site, weighting scores as listed below (Table 4; Appendix A) were applied. The vegetation with the lowest score represents the vegetation that has the least / limited sensitivity. Sensitive vegetation or areas of conservation importance were classified based on the findings of the study and the criteria as listed in Appendix A.

**Table 4: Weighting scores**

<b>Scoring</b>	<b>13-18</b>	<b>7-12</b>	<b>0-6</b>
<b>Sensitivity</b>	<b>High</b>	<b>Medium</b>	<b>Low</b>

**Table 5: Scoring of vegetation that occur within the study area**

Vegetation	*Conservation Status of regional Vegetation unit	*Listed Ecosystem	Legislated protection	Plants of conservation concern	Ecological Function	Conservation Importance	Total Score out of max of 18
Transformed land	N/A	0	0	0	0	0	0
Secondary and Degraded grassland	N/A	1	0	1	1 to 2	1 to 2	4 - 6
Rocky and natural grassland	2	2	2	2	2	2	12
Moist grassland	2	2	3	2	3	3	15

\* only applicable to where natural or near natural vegetation persists

As per Table 5, the transformed, secondary and degraded grasslands scored low ratings, while the rocky, natural grasslands as well as the moist grasslands scored a higher rating. The vegetation sensitivity is geographically represented in Figure 6.

#### 4.1.1 Vegetation of Low Sensitivity

Vegetation with low sensitivity is generally degraded and disturbed vegetation with little ecological function and is usually species poor (most species are usually exotic or monocultures e.g. maize). This vegetation has little or no conservation potential.

##### *Transformed Land*

The transformed land displayed low or no species diversity and comprised mainly of clumps of Wattle and Blue Gum trees, as well as the area disturbed by the past and current quarry activities. No plants of conservation concern or provincially protected plants were observed or expected to occur within the transformed vegetation (Figure 6).

##### *Secondary and Degraded Grassland*

The secondary grasslands as well as the Degraded grasslands comprised of a relatively low species diversity. These grasslands were extensively grazed. It does however provide open space for the movement of fauna species, but it is thought that no plants of conservation concern persist here. The only plant species of concern was the provincially protected *Gladiolus* species within the secondary grassland (Figure 6).

Degraded grassland on the study site shows signs of disturbance due to a high grazing pressure and encroachment by alien invasive plant species and as with the secondary grassland, it is unlikely to support threatened plant species.

#### 4.1.2 Vegetation of Medium Sensitivity

Vegetation of medium sensitivity comprised slightly modified systems which occur along gradients of disturbances of low to medium intensity with a degree of connectivity with other ecological systems.

##### *Rocky grassland*

Rocky grassland on site comprised the highest species diversity and although also subjected to grazing and encroachment, these areas are more likely to support plant species of conservation concern such as *Frithia humilis*. The provincially protected bulb *Crinum* cf *graminicola* was recorded in this vegetation grouping as well as *Protea welwitschii* and the fern *Pellaea calomelanos*, the Declining bulb *Boophone distichia* as well as the Rare *Pavetta zeyheri* subsp *middelburgensis*. This vegetation grouping presents remnant Rand Highveld Grassland.

The plants of conservation concern were mainly concentrated on the rocky ridge. An area that includes all these species were marked on Figure 6 and should be regarded as a sensitive area that should be incorporated into open space planning.

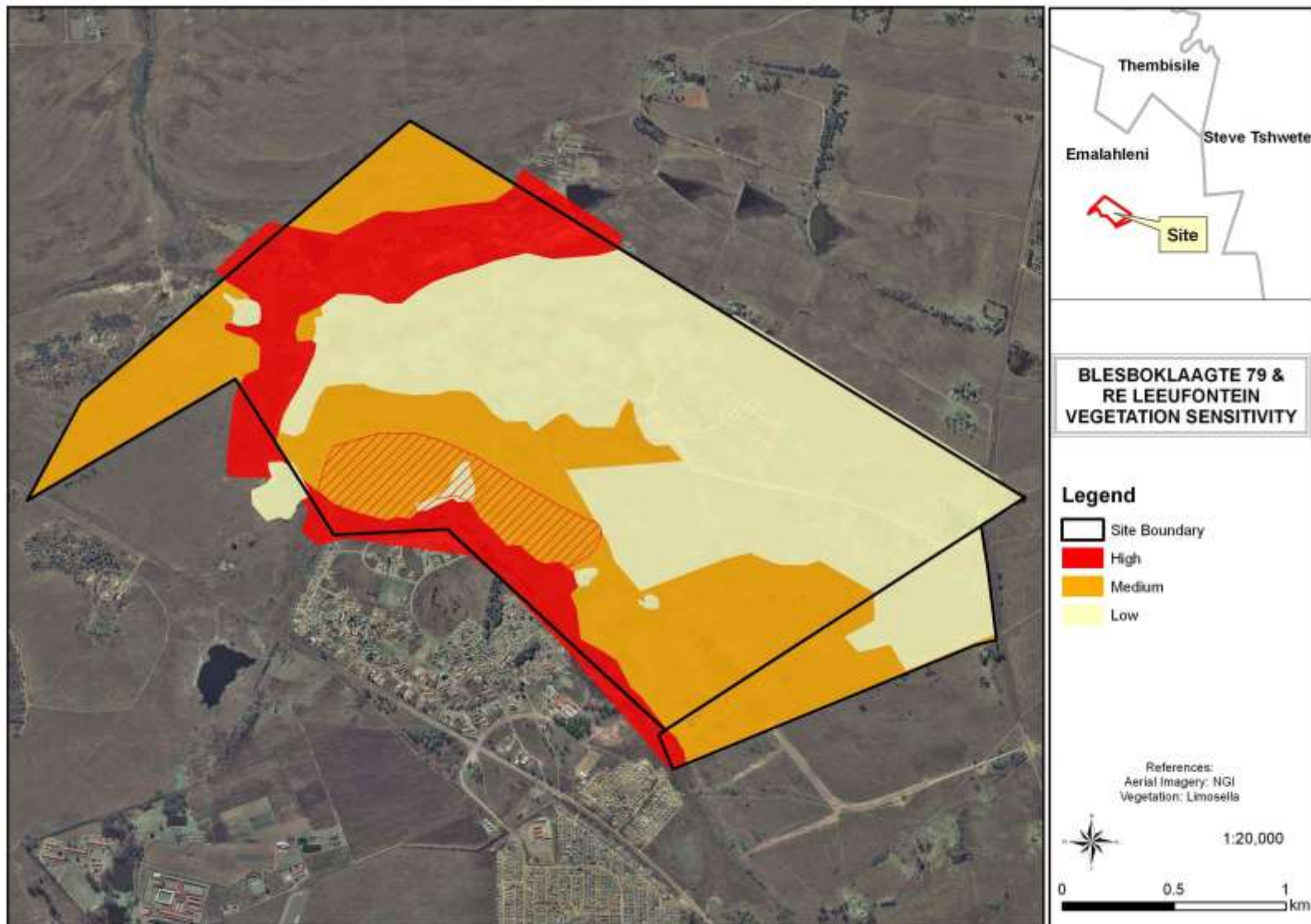


Figure 6: Vegetation sensitivity map

#### 4.1.3 Vegetation of High Sensitivity

Vegetation of high sensitivity comprised communities with low inherent resistance or resilience towards disturbance factors and vegetation that are considered important for the maintenance of ecosystem integrity. Most of these vegetation communities represent late succession ecosystems with high connectivity with other important ecological systems. The vegetation comprised high species diversity and usually provide suitable habitat for a number of threatened species, or the vegetation forms part of protected ecosystems e.g. wetlands, riparian vegetation etc.

##### *Moist Grassland*

Moist grassland vegetation was observed on the study site and although these areas were somewhat disturbed, the vegetation is crucial to the functioning and health of wetland systems. The vegetation subsequently plays a role on the hydrology and water quality on the catchment. The vegetation plays a role in:

- Flow regulation: vegetation slows the flow of water, both by physically blocking the passage of water, and by absorbing the water into its root systems. This moderates the impacts of flooding on downstream and surrounding areas.
- Water quality regulation: the vegetation acts as a buffer or filter between nutrients, sediments, contaminants, and bacteria from the surrounding land and air, and the river channel itself. The vegetation therefore prevents soil, pesticides, fertilizers and oil from entering the river and impacting on in-stream communities.
- Habitat provision: wetlands and riparian areas provide important habitat for many plants and animals, because these are areas of transition between the land and the river. These relatively steep environmental gradients (moisture, temperature, topography, and soil) generally support higher levels of biodiversity than more homogeneous areas.
- Corridor functions: because it follows the river or drainage line, the moist grassland and riparian vegetation serves as a corridor, connecting two or more habitats that may otherwise be isolated by land transformation of areas in between. Many species of animals use corridors to disperse, and find food and mates.

In addition, wetlands are protected by national legislation and are essential to maintain ecological corridors for the movement and survival of species within a landscape fragmented by mining and plantations. The hydrological processes associated with the wetlands are closely associated with the intactness of the vegetation within and surrounding these areas. Furthermore, the seasonally water logged soils could provide habitat for some threatened species such as the Declining *Crinum bulbispermum*. Therefore the vegetation associated with riparian areas and wetlands should be regarded as sensitive.

#### 4.2 Vegetation sensitivity compared to the MBCP

The observed vegetation sensitivities were compared to the Mpumalanga Biodiversity Conservation Plan (MBCP) (compare Figure 3 and Figure 6). The MBCP classified the

terrestrial biodiversity of much of the site as being of low conservation concern in the province as a whole. This assessment corresponds greatly to the MBCP as much of the grassland vegetation was found to be degraded. The MBCP indicated a portion of “Important and Necessary” at the confluence of the tributary and the Blesbokspruit. This area is also included in this reports sensitive moist grasslands and adjacent rocky grassland.

## **5. IMPACT ASSESSMENT AND MITIGATION**

Mankind depends on the natural environment for a large number of ecological services provided for by ecosystems, ecological processes and plant species in general. However, any development activities in natural systems will impact on the surrounding natural environment and usually in a negative way. In order to limit or negate these impacts, the source, extent, duration and intensity of the possible impacts need to be identified. Once the significance of the impacts is understood, the development could both adequately plan for and mitigate these impacts to a best practise and acceptable level. However, if the impacts are significant, especially in already threatened ecosystems and vegetation units, and no adequate mitigation measures could reduce or avert these impacts, then the development should not be allowed to proceed.

### **5.1 Impact Assessment Criteria**

The possible impacts, as described in the next section, were assessed based on the following:

#### **5.1.1 Extent of the Impact**

A description of whether the impact is restricted to the development footprint, the study site (extending only as far as the study site), or whether the impact will extend beyond the study area and its immediate surroundings, regional, or to a national scale.

#### **5.1.2 Duration of the Impact**

- Short term: the impact will disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase
- Short to Medium term: the impact will be relevant to the end of a construction phase
- Medium term: the impact will last up to the end of the development phases, where after it will be entirely negated
- Long term: the impact will continue or last for the entire operational lifetime of the development, but will be mitigated by direct human action or by natural processes thereafter
- Permanent: this impact is not reversible and human intervention e.g. rehabilitation, is unlikely to negate the impact sufficiently (e.g. acid mine drainage)



### 5.1.3 Intensity

This indicates the degree to which the impact changes or could change the conditions or quality of the environment. This was qualified as:

- Low: the impact alters the affected environment in such a way that the natural processes or functions are not affected
- Medium: the affected environment is altered, but functions and processes continue, albeit in a modified way
- High: function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

### 5.1.4 Probability of Occurrence

This describes the probability of the impact actually occurring. This is rated as:

- Improbable: low likelihood, the chance of this impact occurring is between 0 and 25%. However, mitigation measures might be needed in the event of this impact occurring.
- Probable: a distinct possibility, the chance of this impact actually occurring is approximately 50% and therefore it needs to be mitigated
- Highly probable: the impact is most likely to occur and the planning phase must address the relevant mitigation measures to limit the impact
- Definite: this impact will occur regardless of any prevention measures, or is currently occurring. Mitigation measures or contingency plans must be implemented to contain the impact.

### 5.1.5 Significance with and without mitigation

Without mitigation measures (WOMM):

- Low: the impact is of little importance, but may require some mitigation
- Medium: the impact is of importance and is therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels
- High: the impact is of major importance and mitigation is essential. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable.

With mitigation measures (WMM):

- Low: the impact will be mitigated to the point where it is of limited importance
- Medium: despite the successful implementation of the mitigation measures that reduce the negative impacts to acceptable levels, the negative impact remains significant. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw
- High: The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high

significance, after mitigation could render the entire development option or entire project proposal unacceptable.

“The mitigation hierarchy is inherently proactive. It illustrates the steps that should be followed to firstly avoid, then minimize, then repair or restore, and finally compensate for or offset the negative effects of any development on biodiversity” (SANBI, 2012). Therefore in areas of high conservation importance, avoidance of the impacts should be considered first.

On the study site, portions of near-natural and natural vegetation remains of medium conservation importance as well as moist grasslands of higher sensitivity. The impact assessment is based on the recommendation that the areas of High sensitivity (moist grasslands) as well as the rocky grassland area with a high frequency of plants of conservation concern within the rocky grassland be avoided (Figure 6).

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## 5.2 Impacts Assessment

Table 6 lists the potential impacts on the vegetation that the development may have, as well as impacts that may be associated with the operational phase of the township development. The impacts are also assessed in Table 6 below and suitable mitigation measures are given in Section 5.3.

**Table 6: Assessment of impacts associated with the construction and operation of the proposed development**

Phase	Impact	Source	Extent	Duration	Intensity	Probability of occurrence	Significance	
							WOMM	WMM
A: Construction	1. Destruction of natural rocky vegetation, in particular the rocky ridge; and Deterioration of rocky grassland	<ul style="list-style-type: none"> <li>Clearing of vegetation for construction of the township as well as infrastructure</li> <li>Access roads</li> <li>Illegal disposal and dumping of construction material such as cement or oil during construction</li> <li>Edge effects from construction</li> </ul>	Site	Long term	High	Definite except of the rocky ridge area remains as open space	High	Medium to Low
	2. Destruction of plant species that are 'Declining' 'Rare' or provincially protected	<ul style="list-style-type: none"> <li>Construction activity on the rocky ridge, especially the area where these plants are concentrated (Figure 6)</li> </ul>	Rocky ridge	Permanent	High	Definite except of the rocky ridge area remains as open space	High	Medium - Low
	3. Destruction of moist grassland ; and Deterioration of the vegetation associated with moist grasslands	<ul style="list-style-type: none"> <li>Clearing of the vegetation and change to water runoff patterns and soil hydrology</li> <li>Deterioration of vegetation in moist grasslands due to edge effects, sedimentation, compaction or increased pollutants</li> </ul>	Site and down stream	Long term	High	Definite, except if no activities are allowed to impact as per mitigation measures	High	Medium
	4. Possible increase in exotic and invasive	<ul style="list-style-type: none"> <li>Alien vegetation spreading from existing infestation into disturbed soils as well as the</li> </ul>	Study site and surrounds	Long term	Medium	Probable	Medium	Low

Phase	Impact	Source	Extent	Duration	Intensity	Probability of occurrence	Significance	
							WOMM	WMM
	vegetation	moist grasslands						
<b>B: Operation</b>	5. Loss of the ecological function of the moist grasslands	<ul style="list-style-type: none"> <li>• Polluted water reaching the watercourse and moist grassland</li> <li>• Lack of natural vegetation and the subsequent loss of the ecological function of the vegetation as catchment to the moist grassland and downstream watercourse</li> </ul>	Study site and downstream area	Long term	High	Definite	High	Medium
	6. Deterioration of natural vegetation and eventual loss of rocky grassland	<ul style="list-style-type: none"> <li>• Edge effects from the development</li> <li>• Altered fire regime – natural fire prevented</li> </ul>	Rocky grasslands	Long term	Medium	Probable	Medium	Low
	7. Possible increase in exotic and invasive vegetation	<ul style="list-style-type: none"> <li>• Alien vegetation spreading from existing infestation into disturbed soils as well as the wetland area</li> <li>• Exotic plant species from gardens spreading to the rocky grasslands, moist grasslands and subsequently down stream</li> </ul>	Study site and surrounds	Long term	Medium	Probable	Medium	Low

### 5.3 Mitigation Measures

#### A: Construction

##### 5.3.1 Destruction of natural rocky grassland vegetation

The construction of the infrastructure and clearing of the development footprint will necessitate the removal of vegetation. Areas that will not be developed, but where structures are stored would flatten vegetation that could be detrimental to the persistence of the vegetation. In addition, the illegal disposal of construction material such as oil, cement etc. could destroy natural vegetation.

##### Mitigation measures

- An independent Ecological Control Officer (ECO) should be appointed to oversee construction.
- The construction footprint should incorporate as much rocky grassland as possible into open space planning, especially the area marked on Figure 6 that contains the highest concentration of plants of conservation concern.
- A permanent fence or demarcation must be erected around the construction area to prevent access or edge effects to surrounding environs that will not be developed.
- Prohibit vehicular or pedestrian access into natural areas beyond the demarcated boundary of the construction area.
- Formalise access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas that will not be developed.
- Where the localities of provincially protected and threatened plants cannot be avoided by construction, it must be removed - where possible and feasible - and either used during rehabilitation or be relocated to dedicated open space or conserved areas. These plants can only be removed and relocated with permission (permit) from the Mpumalanga Parks Board (MPB).
- Re-vegetate developed areas with indigenous plant species as soon as possible. This will prevent erosion and invasion by alien invasive plant species.

##### 5.3.2 Destruction of 'Declining', 'Rare' plant species and provincially protected plants

A 'Declining' plant species (*Boophane distichia*), a Rare species (*Pavetta zeyheri* subsp. *middelburgensis*), as well as the provincially protected *Protea welwitschii* and a *Crinum* species are situated on the rocky ridge area. If this area is developed, it will result in the removal of these plant species, or impact on their habitat, pollinators and inevitably the persistence of these species. This could put further strain on the already declining populations.

##### Mitigation Measures

- It is recommended that the rocky ridge area be regarded as sensitive due to the concentration of plants of conservation concern in this area. In addition, the Gauteng



Ridge Policy (GDACEL, 2001) should be followed as best practise. This policy discourages development on ridges or rocky outcrops. These areas are characterized by high spatial heterogeneity due to the range of differing aspects (north, south, east, west and variations thereof), slopes and altitudes all resulting in differing soil (e.g. depth, moisture, temperature, drainage, nutrient content), light and hydrological conditions (GDACEL, 2001) and are usually characterized by high biodiversity and therefore their protection contributes to conservation of biodiversity. According to climate change modelling, level topography will be particularly sensitive to future climate change and major extinction in these areas can be expected (Rutherford *et al.*, 2001). As such, in a landscape affected by climate change, chances for species survival will be higher on ridges (GDACEL, 2011).

- Implement a Plant Rescue Plan: Where the plants of conservation concern or provincially protected plants are deemed to be under threat from the construction activity, the plants should be removed by a suitably qualified specialist and replanted into suitable open spaces (this can also be undertaken in collaboration with Operation Wildflower, or the Custodians of Rare and Endangered Wildflowers (CREW)). These plants may only be removed with the permission of the provincial authority.
- The *Crinum* species observed was not in flower at the time of the field survey and the species should be confirmed during the summer months. However, it is believed to be *Crinum graminicola*, which is provincially protected. These plants should be removed prior to commencement construction and where possible, be relocated to suitable habitat outside of the impacted area and monitored for survival.
- The provincially protected *Gladiolus* species and *Protea welwitschii* also occurs within the development area. Although the *Gladiolus* species can be transplanted elsewhere, it is unlikely that the *Protea* species will survive transplanting.
- Although the 'Endangered' *Frithia humilis* was not observed on the site, the possibility of it occurring cannot be ruled out. It is advised that a site visit during its flowering time focus on scanning suitable habitat on the site (flowering period: January).
- In order to minimise the potential destruction of protected and threatened plants, it is advised that a summer assessment be undertaken to the sensitive areas in order to identify any species flowering or those that might have been overlooked during the April survey.
- Construction workers may not tamper or remove these plants and neither may anyone collect seed from the plants without permission from the local authority.

### 5.3.3 Destruction and deterioration of the moist grassland

Clearing of the vegetation and removal of the soils from the moist grassland could change the soil hydrology. Although no sensitive plant species were observed here, wetlands are protected by legislation. The removal of surface vegetation around moist grasslands will expose the soils, which in rainy events would wash down into the moist grasslands and watercourse causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from nearby alien invasive trees can spread easily into these

eroded soils or moist grasslands. Furthermore, polluted water from the development construction could run down the slope and reach the watercourse.

#### Mitigation measures

- A minimum buffer zone, as recommended by the wetland specialist (Limosella consulting, 2014), around the moist grassland must be regarded as No-Go areas for the development. Instead these areas should be incorporated into open space planning
- In order to maintain catchment areas to the moist grassland, use permeable paving within the development.
- Make use of existing roads and tracks where feasible, rather than creating new routes through moist grassland areas.
- Runoff from roads must be managed to avoid erosion and pollution problems.
- Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover.
- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas.
- Prevent polluted water from reaching the watercourse and surrounding moist grasslands.
- An ecologically sound, storm water management plan must be implemented during construction and ensure that the stormwater management of the completed development is adequate to prevent deterioration of the moist grasslands and the Blesbokspruit.
- The construction stormwater plan could include berms or swales to allow infiltration of rainwater into the soil on the site, thereby retaining the function of the study site as a catchment area for the moist grassland, Blesbokspruit and its tributary.
- Do not allow stormwater to be canalised.
- Prevent contamination of rainwater on the site.
- Place and maintain erosion control barriers as appropriate to prevent sedimentation into the watercourse and moist grasslands.
- Trucks and equipment should only be washed in dedicated areas and the dirty water is not allowed to discharge into the watercourse or surrounding natural vegetation.

#### 5.3.4 Possible increase in exotic and invasive vegetation

The seed of alien invasive plant species that occur on and in the vicinity of the site, could spread into the disturbed and stockpiled soils. Also, construction vehicles and equipment were likely used on various other sites and could introduce alien invasive plant seeds or indigenous plants not belonging to this vegetation unit to the construction site, rocky grassland and subsequently the moist grassland and downstream areas.

### Mitigation measures

- Alien invasive species, especially category 1b invaders that were identified within the study area should be removed. By removing these species, the spread of seeds will be prevented into disturbed soils which could thus have a positive impact on the surrounding natural vegetation.
- All alien seedlings and saplings must be removed as they become evident for the duration of construction.
- Manual / mechanical removal is preferred to chemical control.
- All construction and operation vehicles and equipment, as well as construction material should be free of plant material. Therefore, all equipment and vehicles should be thoroughly cleaned prior to access on to the construction areas. This should be verified by the ECO.

## **B: Operation (completed and functional development)**

### 5.3.5 Loss of ecological function of the moist grasslands

During operational phase of the development, polluted water or sediment containing water reaching the watercourse and moist grassland will have detrimental effects on the vegetation and hydrology. Soil erosion could lead to increased sedimentation and turbidity in the nearby watercourse, which could then reduce water storage capacity, smother vegetation, and decrease oxygen concentration. In addition, the lack of natural vegetation could drastically reduce water holding capacity and the subsequent loss of the ecological function of the vegetation as catchment to the watercourse. Soil erosion could also alter water flow rates into and out of wetlands, thereby impacting local hydrology. This could have a cumulative impact on plants within these areas as well as downstream from the site where confirmed habitat for plants of conservation concern that could occur in moist grasslands.

### Mitigation measures

- Implement an ecologically sound storm water management plan that will allow rainwater within the development to penetrate the soil e.g. via berms or swales as well as permeable paving.
- Ensure that the stormwater management system prevent contamination of stormwater and that no polluted water reach the moist grasslands, Blesbokspruit and the tributary.
- Cordon off the main developed area from the surrounding natural vegetation and moist grasslands to prevent any disturbances into the surrounding areas.
- Place and maintain erosion control barriers as appropriate to prevent sedimentation into the watercourse and moist grasslands.
- Incorporate the moist grasslands into open space planning and maintenance.

### 5.3.6 Deterioration and loss of rocky grassland

Edge effects from the operational area (vehicle access, impacts from pedestrians, dumping) could destroy the rocky grassland vegetation outside the development footprint, in particular

vegetation on the rocky ridge. In addition, fire will likely be excluded from the landscape and the altered fire regime could impact on the natural grassland processes and therefore lead to degradation of the rocky grassland. Excluding fire from the landscape could contribute to grassland degradation as grassland ecosystems are generally thought to be maintained by periodic fire and the absence of fire are considered by some as a disturbance to grasslands processes.

#### Mitigation measures

- Incorporate the rocky grassland into open space planning e.g. an eco-park with formal pathways for pedestrians and cyclist. Ensure that a home owners association takes responsibility for maintaining the natural grasslands and to ensure that no dumping a vehicular access impact on the rocky ridge area.
- Regular surveys to ensure the survival of plants of conservation concern within the rocky grassland.
- In consultation with a specialist, consider a burning programme to maintain the rocky grassland.

#### 5.3.7 Possible increase in exotic and invasive vegetation

The seed of alien invasive plant species that occur on and in the vicinity of the proposed development, could spread into the disturbed and stockpiled soils. Alien invasive plants from residential gardens could spread into naturally vegetated areas.

#### Mitigation measures

- Alien invasive species that were identified within the study area should be removed prior to construction-related soil disturbances. By removing these species, the spread of seeds will be prevented into disturbed soils which could thus have a positive impact on the surrounding natural vegetation.
- Landscaping in the development must make use of indigenous vegetation and no alien invasive plant species should be allowed within home gardens.

## **6. CONCLUSION**

The vegetation on the proposed site was grouped into two main vegetation categories: transformed vegetation and natural to near natural grasslands. The transformed areas included alien invasive tree clumps, mined areas and grassland that was observed to be severely degraded by overgrazing and trampling. It also included secondary grasslands on historically cultivated lands. These transformed areas were characterised by low species diversities, low ecological function and low conservation importance and were accordingly classified as not posing a constraint to the development in terms of vegetation sensitivities.

The near natural to natural grasslands included rocky grassland and moist grassland. The rocky grassland was also grazed but comprised a species diversity that is comparable to the regional Rand Highveld Grassland which is an endangered vegetation type. In addition, the rocky grassland included a number of plant species that are of conservation concern, either as they are declining in numbers, rare or protected by the Mpumalanga Conservation Ordinance. Most of these plant species were concentrated on the rocky ridge. Although most of the rocky grassland was classified as posing a medium constraint or sensitivity to the proposed development, the rocky ridge area with its higher frequency of plants of conservation concern was highlighted in the sensitivity map as an area that should be incorporated in to open space planning, provided that the area can be adequately maintained during the operational phase of the township development.

Moist grasslands comprised vegetation in and surrounding the Blesbokspruit and its tributary, as well as areas where water seeps out of the soil, likely due to an impervious layer in the soil. Although no species of conservation concern were observed here, these areas are suitable habitat for some plants of conservation concern, furthermore, moist grasslands and watercourses are nationally protected habitats and due to its high ecological function and conservation importance, it was classified as being of a high sensitivity to development.

A number of mitigation measures can be implemented in order for the proposed development to continue, while impacting as little possible on sensitive vegetation groupings:

- Moist grasslands and the rocky ridge where a high frequency of plants of conservation concern occurs, should not be developed. Instead, these areas should form part of open space planning which allows for a movement corridor for species and ecological processes along the Blesbokspruit.
- Construction should not impact on these open spaces and a management plan must be implemented that will ensure that the open spaces are managed as for example an eco-park, to prevent deterioration during the operational phase.

If the open space cannot be adequate preserved, the plants of conservation concern should be removed (where survival is possible) and relocated. This can only be done once a permit authorising the removal of the plants are granted by the Mpumalanga Tourism and Parks agency. (MTPA). In addition, it is advised that a summer scan (during November) be undertaken to limit the possibility that any plants of conservation concern that was not identified at the time of this report (April survey) are lost.



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## GLOSSARY

<b>Alien species</b>	Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity
<b>Biodiversity</b>	Biodiversity is the variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems
<b>Biome</b>	A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.
<b>Buffer zone</b>	A collar of land that filters edge effects.
<b>Conservation</b>	The management of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystems function and integrity.
<b>Conservation concern (Plants of..)</b>	Plants of conservation concern are those plants that are important for South Africa's conservation decision making processes and include all plants that are Threatened (see <b>Threatened</b> ), Extinct in the wild, Data deficient, <b>Near threatened</b> , Critically rare, Rare and <b>Declining</b> . These plants are nationally protected by the National Environmental Management: Biodiversity Act. Within the context of these reports, plants that are provincially protected are also discussed under this heading.
<b>Conservation status</b>	An indicator of the likelihood that species remaining extant either in the present day or the near future. Many factors are taken into account when assessing the conservation status of a species: not simply the number remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on.
<b>Community</b>	Assemblage of populations living in a prescribed area or physical habitat, inhabiting some common environment.
<b>Critically Endangered</b>	A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
<b>Decreaser Grass</b>	Grass species that decrease when veld is either overgrazed or underutilised. These species are usually preferred by grazers such as <i>Themeda triandra</i> and <i>Digitaria eriantha</i>
<b>Data Deficient</b>	There is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. However, "data deficient" is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.
<b>Declining</b>	A taxon is declining when it does not meet any of the five IUCN criteria and does not qualify for the categories Threatened or Near Threatened, but there are threatening processes causing a continuous decline in the population (Raimondo <i>et al</i> , 2009).
<b>Ecological Corridors</b>	Corridors are roadways of natural habitat providing connectivity of various patches of native habitats along or through which faunal species may travel without any obstructions where other solutions are not feasible
<b>Ecosystem</b>	Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space
<b>Edge effect</b>	Inappropriate influences from surrounding activities, which physically degrade habitat, endanger

	resident biota and reduce the functional size of remnant fragments including, for example, the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution
<b>Endangered</b>	A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future
<b>Endemic</b>	Naturally only found in a particular and usually restricted geographic area or region
<b>Exotic species</b>	Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity
<b>Forb</b>	A herbaceous plant other than grasses.
<b>Habitat</b>	Type of environment in which plants and animals live
<b>Increaser I Grass</b>	Grass species that occur abundantly in underutilised veld – can grow without defoliation. These are usually unpalatable grasses
<b>Increaser II Grass</b>	Grass species that increase in over utilised (overgrazed) veld, include pioneer and sub-climax species
<b>Increaser III Grass</b>	Grass species that are common in overgrazed veld. These are usually unpalatable grasses that outcompete the palatable grasses when overgrazed.
<b>Indigenous</b>	Any species of plant, shrub or tree that occurs naturally in South Africa
<b>In Situ</b>	“In the place” In Situ conservation refers to on-site conservation of a plant species where it occurs. It is the process of protecting an endangered plant or animal species in its natural habitat. The plant(s) are not removed, but conserved as they are. Removal and relocation could kill the plant and therefore in situ conservation is preferred/ enforced.
<b>Invasive species</b>	Naturalised alien plants that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas
<b>Mitigation</b>	The implementation of practical measures to reduce adverse Impacts
<b>Near Threatened</b>	A Taxon is Near Threatened when available evidence indicates that it nearly meets any of the five IUCN criteria for Vulnerable, and is therefore likely to qualify for a threatened category in the near future (Raimondo <i>et al</i> , 2009).
<b>Plant community</b>	A collection of plant species within a designated geographical unit, which forms a relatively uniform patch, distinguishable from neighbouring patches of different vegetation types. The components of each plant community are influenced by soil type, topography, climate and human disturbance. In many cases there are several soil types within a given plant community (Gobbat <i>et al</i> , 2004)
<b>Protected Plant</b>	According to Provincial Nature Conservation Ordinances or Acts, no one is allowed to sell, buy, transport, or remove this plant without a permit from the responsible authority. These plants are protected by provincial legislation.
<b>Threatened</b>	Species that have naturally small populations, and species which have been reduced to small (often unsustainable) population by man's activities
<b>Red Data</b>	A list of species, fauna and flora that require environmental protection - based on the IUCN definitions. <i>Now termed Plants of Conservation Concern</i>



<b>Species diversity</b>	A measure of the number and relative abundance of species
<b>Species richness</b>	The number of species in an area or habitat
<b>Threatened</b>	Threatened Species are those that are facing a high risk of extinction, indicated by placing in the categories Critically Endangered (CR), Endangered (E) and Vulnerable (VU) (Raimondo <i>et al</i> , 2009)
<b>Transformation</b>	<p>The removal or radical disturbance of natural vegetation, for example by crop agriculture, plantation forestry, mining or urban development.</p> <p>Transformation mostly results in a serious and permanent loss of biodiversity and fragmentation of ecosystems, which in turn lead to the failure of ecological processes. Remnants of biodiversity may survive in transformed landscapes</p>
<b>Vegetation Unit</b>	A complex of plant communities ecologically and historically (both in spatial and temporal terms) occupying habitat complexes at the landscape scale. Mucina and Rutherford (2006) state: "Our vegetation units are the obvious vegetation complexes that share some general ecological properties such as position on major ecological gradients and nutrient levels, and appear similar in vegetation structure and especially floristic composition".
<b>Vulnerable</b>	A taxon is Vulnerable when it is not Critically Endangered or Endangered but meets any of the five IUCN criteria for Vulnerable and are therefore facing a high risk of extinction in the wild in the future(Raimondo <i>et al</i> , 2009)
<b>Water Course</b>	According to the National Water Act (Act No.36 of 1998), a watercourse means a river or spring; a natural channel in which water flows regularly or intermittently; a wetland, lake or dam into which, or from which, water flows.

## APPENDIX A: METHODOLOGY

### *Literature Review:*

The description of the regional vegetation relied on literature from Mucina & Rutherford (2006). Plant names follow Onderstall, (1996), Van Wyk & Van Wyk (1997), Van Wyk & Malan (1997), Pooley (1998), Henderson (2001), Van Oudtshoorn (2002) and Bromilow (2010). The study was undertaken in accordance with the Mpumalanga Minimum Requirements for Biodiversity Assessment (Mpumalanga Tourism and Parks Agency, 2008). Aerial images (Google Earth) were assessed prior to the field survey in order to identify areas where disturbances took place, homogenous areas and areas where wetland conditions were likely to occur.

### *Field survey:*

The field survey was undertaken on the 3<sup>rd</sup> and 9<sup>th</sup> of April 2013. The field survey focussed on identifying natural and untransformed vegetation, unique features that could indicate local sensitivities such as threatened and protected plants, as well as sensitive ecological features such as wetlands, ridges and rivers that are essential for the maintenance of ecosystems and ecological processes. Sample points are given in Figure A1 below.



**Figure A1 Sample plot localities**

Plots were sampled within the homogenous areas, as derived from the aerial imagery, on the site. In addition, random transects were walked through the site, while representative sample areas were surveyed. Within the sample plots, all identifiable species were recorded as well as their cover abundance. Transects concentrated on moving through environmental gradients encountered and was continued until few or no new species were encountered. Any additional information on any other feature thought to have ecological significance within the site, such as

dominant species cover abundance, soil type, erosion, rocky cover, alien/exotic/invasive plants, as well as plant species of conservation concern and/or their habitat was also recorded. Plant identification and vegetation description relied on species recorded in the sampling plots and points along the walked transects.

### *Vegetation Sensitivity*

The following criteria and weighting was used to determine the vegetation sensitivity, function and conservation importance:

1. The status of the regional vegetation that is expected to occur on the study site, only where natural vegetation is still remaining.

<b>Conservation status*</b>	<b>Scoring</b>
Critically Endangered	3
Endangered	2
Vulnerable	1
Least threatened	0

\*This scoring is not applicable (N/A) for areas devoid of natural vegetation.

2. Whether the study area is situated within a Listed Ecosystem in terms of Section 52 of the National Environmental Management: Biodiversity Act (Act 10 of 2004).

<b>Listed Ecosystem*</b>	<b>Scoring</b>
Primary state	3
Sub-climax state	2
Secondary state	1
No natural vegetation remaining	0

3. Whether the vegetation or ecological feature is protected by legislation:

<b>Listed Ecosystem*</b>	<b>Scoring</b>
National legislation	3
Provincial policies and guidelines	2
Municipal or other protection	1
No legislated protection	0

4. The presence of suitable habitat for plants of conservation concern as well as the actual occurrence thereof.

Suitable habitat / presence	Scoring
Confirmed presence	3
Confirmed presence of Declining species and Suitable habitat and some likelihood of occurrence of Threatened species	2
Suitable habitat but unlikely to occur	1
No suitable habitat	0

5. Ecological Function: areas important to ecological processes such as ecological corridors, hydrological processes and important topographical features such as ridges.

Ecological function	Scoring
<b>High:</b> Sensitive vegetation communities with low inherent resistance or resilience towards disturbance factors; vegetation that are considered important for the maintenance of ecosystem integrity. Most of these vegetation communities represent late succession ecosystems with high connectivity with other important ecological systems.	3
<b>Medium to high:</b> Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with a high degree of connectivity with other ecological systems OR disturbed vegetation connected to an ecological and protected system e.g. ridge, wetland or river	2
<b>Medium:</b> Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with some degree or limited connectivity with other ecological systems	1
<b>Low:</b> Degraded and highly disturbed vegetation with little ecological function	0

6. Conservation Importance: indication of the necessity to conserve areas based on factors such as the importance of the site on a national and/or provincial scale and on the ecological state of the area (degraded or pristine). This is determined by the presence of a high diversity, rare or endemic species and areas that are protected by legislation.

Ecological importance	Scoring
<b>High:</b> Ecosystems with high species diversity and usually provide suitable habitat for a number of threatened species. OR protected ecosystems e.g. wetlands, riparian vegetation etc These areas should be protected	3
<b>Medium to high:</b> Ecosystems with intermediate levels of species with the possible occurrence of threatened species	2
<b>Medium:</b> Ecosystems with intermediate levels of species diversity without any threatened species.	1
<b>Low:</b> Areas with little or no conservation potential and usually species poor (most species are usually exotic).	0

**APPENDIX B: PLANT SPECIES**

The table below lists the plant species that were observed per vegetation community on site. Note that the species diversity is likely higher. However at the time of the survey (April), grasses were grazed and some forbs have already seeded or were dormant.

**M**=plants known to be used medicinally      **P**=provincially protected plant      **D**=declining plant species

Specie name	Common Name	Relevant Notes	Rocky grassland	Secondary grassland	Moist grassland	Transformed land
<b>Herbaceous plants / small shrubs</b>						
<i>Acalypha angustata</i>	Copper Leaf	Grassland, rocky grassland	X			
<i>Afroscidium magalismontanum</i>		Grassland	X		X	
<i>Albuca</i> specie		Grassland	X		X	
<i>Alectra sessiliflora</i>	Verfblommietjie	Grassland, moist grassland			X	
<i>Anthospermum hispidulum</i>		Grassland, moist grassland	X		X	
<i>Asparagus species</i>		Grassland	X	X		
<i>Babiana hypogea</i> (P)	Bobbejaanuintjie	Grassland, usually in sandy soils.	X			
<i>Blepharis</i> species			X	X		
<i>Boophone disticha</i> (P) (D) (M)	Poison Bulb	Grassland, often in rocky places	X			
<i>Centella asiatica</i> (M)	Marsh Pennywort	Marshes, vlei's.			X	
<i>Cleome maculata</i>		Grassland, often a weed of disturbed sandy places	X	X		X
<i>Comelina africana</i> var <i>krebsiana</i> (M)		Grassland	X	X		
<i>Crabbea angustifolia</i>		Grassland	X	X		
<i>Crassula capitella</i> subsp <i>nodulosa</i>		Grassland	X			
<i>Crinum cf graminicola</i>	Graslelie	Grassland, usually in sandy soil, localized and rather rare	X			
<i>Dicoma anomala</i>		Grassland	X	X		
<i>Dipcadi</i> specie	Dronkui	Grassland	X			
<i>Elephantorrhiza elephantina</i> (suffrutex)	Elephant's root	Grassland	X	X		
<i>Eriosema burkei</i>		Grassland	X	X		
<i>Eriospermum specie</i>		Rocky grassland	X			



Specie name	Common Name	Relevant Notes	Rocky grassland	Secondary grassland	Moist grassland	Transformed land
<i>Euryops gilfillanii</i>		Grassland, rocky	X	X		
<i>Fadogia homblei</i>	Wildedadel	Rocky ridges, sandy soils	X	X		
<i>Gladiolus</i> cf <i>ecklonii</i> (P) (M)	Sheeted Gladiolus	Grassland, often in vleis or rocky places	X			
<i>Gladiolus</i> cf <i>elliottii</i> (P)	Sheeted Gladiolus	Grasslands	X	X		
<i>Gnidia kraussiana</i>	Harige gifbossie	Grassland	X	X		
<i>Gomphocarpus fruticosus</i>	Milkweed	Grassland, often along roadsides and abandoned cultivated fields.		X	X	X
<i>Helichrysum acutatum</i>	Sticky everlasting	Grassland	X	X		
<i>Helichrysum cephaloideum</i>		Grassland	X			
<i>Helichrysum nudifolium</i> (M)	Hottentot's tea	Grassland	X	X	X	
<i>Helichrysum rugulosum</i> (M)		Grassland, often in vlei's or patches in disturbed areas		X	X	X
<i>Syncolostemon</i> (was <i>Hemizygia</i> ) <i>pretoriae</i>	Dwarf Sage Bush	Rocky grassland	X			
<i>Haplocarpa scaposa</i> (M)	Tonteldoosbossie	Grassland, often in moist places			X	
<i>Hermannia depressa</i>	Rooi-opslag / Creeping Hermannia	Grassland, also in trampled and overgrazed areas	X	X		
<i>Hermannia lancifolia</i>		Grassland, sandy soil	X			
<i>Hypoxis iridifolia</i>		Grassland	X			
<i>Hypoxis rigidula</i> (M)	Kaffirtulp	Grassland	X	X		
<i>Indigofera comosa</i>		Grassland and rocky ridges	X			
<i>Indigofera filipes</i>		Grassland, often in disturbed places		X		
<i>Indigofera newbrowniana</i>		Grassland	X			
<i>Indigofera zeyheri</i>		Rocky grassland, sometimes in moist depressions				
<i>Ipomoea transvaalensis</i>		Grassland, mainly on rocky slopes,	X			
<i>Kalanchoe paniculata</i>		Grows in shallow soils overlaying rock.	X			
<i>Kohautia amatymbica</i>		Grassland, often appearing after fire.	X	X		

Specie name	Common Name	Relevant Notes	Rocky grassland	Secondary grassland	Moist grassland	Transformed land
<i>Kyphocarpa angustifolia</i>	Silky Burweed	Grassland and disturbed areas.	X	X		
<i>Lapeirousia sandersonii</i>	Autumn painted petals	Rocky grassland	X			
<i>Ledebouria cooperi</i> (M)		Grassland, often in moist places	X		X	
<i>Ledebouria cf marginata</i>		Grassland, often in moist places, also disturbed areas		X	X	
<i>Leonotus leonorus</i>	Wild Dagga	Grassland				
<i>Lopholaena coriifolia</i>	Pluisbossie	Rocky grassland, can become dominant in overgrazed areas. An indicator of shallow rocky soils or veld that has been mismanaged	X	X		
<i>Melolobium wilmsii</i>	Heuningbosie	Wide range of habitats	X			
<i>Oldenlandia herbacea</i>		Grassland, usually on rocky ridges	X			
<i>Oxalis obliquifolia</i>	Sorrel	Grassland, often in moist places			X	
<i>Parinari capensis</i> (Suffretex)	Dwarf Mobola Plum	Grassland, usually rocky places	X	X		
<i>Pearsonia cajanifolia</i>		Grassland, usually in rocky places	X			
<i>Pelargonium luridum</i> (M)		Grassland, often in moist places.			X	
<i>Pentanissia prunelloides</i> (M)	Broad-leaved Pentanissia	Grassland	X			
<i>Pollichia campestris</i>	Waxberry	Grassland	X	X		
<i>Pygmaeothamnus zeyheri</i>	Sand Apple / Goor Apple	Sandy or stony grassland and bushveld, often forming colonies.	X	X		
<i>Rhynchosia caribaea</i> (M)		Grassland and bushveld	X			
<i>Scabiosa columbaria</i>	Wild scabiosa	Grassland, mainly in rocky areas	X			
<i>Selago densiflora</i>		Grassland and bushveld.	X	X		
<i>Senecio coronatus</i> (M)	Wooly Grassland Senecio / Sybossie	Grassland usually in large colonies	X			
<i>Senecio gregatus</i>		Grassland, often in moist places		X	X	X
<i>Senecio venosus</i>		Grassland, often in rocky places	X			
<i>Seripheum plumosum</i>	Bankruptbush	Grassland, often proliferating in overgrazed areas.	X	X		
<i>Smithia erubescens</i>		Moist grassland			X	

Specie name	Common Name	Relevant Notes	Rocky grassland	Secondary grassland	Moist grassland	Transformed land
<i>Sphenostylis angustifolia</i> (M)	Wild Sweetpea	Clumps of bush, bushveld and rocky ridges	X			
<i>Tephrosia lupinifolia</i>	Vingerblaartertjie	Grassland, sandy soil	X			
<i>Teucrium trifidum</i>	Koorsbossie	Bushveld or rocky ridges	X			
<i>Thesium cf hystrix</i>	Besembossie	Hemi-root parasite	X			
<i>Tulbachia leucantha</i>	Highland Wild Garlic	Damp grassland or rocky areas in mountains	X	X		
<i>Wahlenbergia caledonica</i>		Grassland, rocky or seasonally moist places	X	X		
<i>Watsonia species</i>		Rocky grassland	X			
<i>Withania somnifera</i> (M)	Geneesbossie / Wilde-appelliefie	Along permanent and seasonal streams, often in disturbed areas		X	X	
<i>Xerophyta humilis</i>		Open or rocky areas	X			
<i>Xerophyta retinervis</i> (M)	Monkey's tail	Rocky ridges	X			
<i>Xysmalobium asperum</i>		Grassland	X			
<i>Zaluzianskya specie</i>	Drumsticks	Grassland	X	X		
<b>Number of herbaceous species identified = 81</b>			<b>67</b>	<b>33</b>	<b>17</b>	<b>4</b>
<b>GRASSES</b>						
<i>Andropogon appendiculatus</i>	Vlei Bluestem	Occurs in moist places, often associated with shady areas. Decreaser grass		X	X	
<i>Andropogon eucomus</i>	Old Man's Beard Grass / Veergras	Wet areas such as vlei's, seepage lines. Good stabiliser of wet soils and indicative of a poor drainage. Increaser II		X	X	
<i>Andropogon schirensis</i>	Stab Grass	Rocky slopes in well-drained soils, often in moist places.	X		X	
<i>Aristida bipartita</i>	Rolling Grass	Moist places or overgrazed veld and road reserves. Increaser II		X	X	
<i>Aristida congesta subsp barbicollis</i>	Spreading Three-awn	Disturbed areas such as fallow lands and road reserves. Not palatable, Increaser II	X	X		

Specie name	Common Name	Relevant Notes	Rocky grassland	Secondary grassland	Moist grassland	Transformed land
<i>Aristida congesta subsp congesta</i>	Tassel Three-awn	Disturbed, overgrazed or farmed land. Increaser II grass	X	X		
<i>Aristida scabrivalvis</i>	Purple Three-awn	Shallow sandy soil where water accumulates			X	X
<i>Ctenium concinnum</i>	Sickle Grass	Dry sandy soil and often on moist soil- Increaser Grass		X	X	
<i>Cymbopogon validus</i>	Giant Turpentine Grass	Open veld in moist soils.		X	X	
<i>Cynodon dactylon</i>	Couch grass	Most soils, usually in disturbed areas. Increaser II grass		X	X	X
<i>Eragrostis chloromelas</i>	Curly leaf	Rocky slopes, mostly in open grassland. Increaser II grass	X	X		
<i>Eragrostis curvula</i>	Weeping Love Grass	Mostly occurs in disturbed areas / sown as pasture. Increaser II grass		X		X
<i>Eragrostis gummiiflua</i>	Gum Grass	Subclimax grass, disturbed areas and often in moist soils. Increaser II grass	X	X	X	
<i>Eragrostis inamoena</i>	Tite Grass	Moist areas such as marshes, vlei's and drainage lines. Increaser II grass		X	X	
<i>Eragrostis plana</i>	Tough Love Grass	Disturbed areas, mostly in moist patches. Increaser II grass			X	
<i>Harpochloa falx</i>	Caterpillar Grass	Rocky slopes, well-drained soil. Increaser I grass	X	X		
<i>Hyparrhenia hirta</i>	Common Thatching Grass	Well drained, rocky soil in open grassland and disturbed areas. Increaser I grass	X	X		
<i>Ischaemum fasciculatum</i>	Hippo Grass	Grows in moist areas and often in flowing water			X	
<i>Melinis nerviglumis</i>	Bristle-leaved Red Top	Undisturbed grassland, rocky slopes and soils. Increaser I	X			
<i>Melinis repens</i>	Natal Red Top	Disturbed grassland. Increaser II grass	X	X		X
<i>Monocymbium ceresiliforme</i>	Boat Grass	Grassland, rocky ridges or vlei's.	X		X	

Specie name	Common Name	Relevant Notes	Rocky grassland	Secondary grassland	Moist grassland	Transformed land
		Decreaser Grass.				
<i>Paspalum dilatatum</i>	Dallis Grass	Introduced grass, moist areas in vlei's and close to rivers. Sometimes planted for pasture		X	X	
<i>Pennisetum clandestinum</i>	Kikuyu	Exotic grass specie, planted as ornamental grass. Spreads to disturbed areas and also invade moist areas.		X		X
<i>Themeda triandra</i>	Red Grass	Undisturbed or disturbed open grassland. Decreaser Grass	X			
<i>Tristachya leucothrix</i>	Hairy Trident Grass	Commonly found in overgrazed veld and marshy areas. Increaser I grass		X	X	
<b>Number of grasses identified = 25</b>			<b>11</b>	<b>18</b>	<b>15</b>	<b>5</b>
<b>SEDGES</b>						
<i>Cyperus congestus</i>		Depressions in grassland, damp and temporary wet areas, ditches				
<i>Cyperus esculentus</i>		Weedy exotic in marshy areas			X	
<i>Cyperus margaritaceus</i>		Grassland		X		X
<i>Cyperus marginatus</i>		Wetland areas			X	
<i>Eleocharis species</i>		Wetland areas			X	
<i>Fimbristylis complanata</i>		Moist grasslands			X	
<i>Phragmites australis</i>	Common Reed	Drainage lines, marshy places along streams, often in pure stands.			X	
<i>Typha capensis</i>	Bulrush	Grows in marshy areas and along watercourses.			X	
<i>Juncus lomatophyllus</i>		Permanently wet places, along streams, often forming a distinct zone around pans			X	
<i>Bulbostylis burchellii</i>		Grassland, common on rocky ridges			X	
<b>Number of sedges identified = 10</b>			<b>1</b>	<b>1</b>	<b>8</b>	<b>1</b>

Specie name	Common Name	Relevant Notes	Rocky grassland	Secondary grassland	Moist grassland	Transformed land
<b>Ferns and mosses</b>						
<i>Sellaginella dregei</i>	Resurrection Selaginella	Forms mats on granite outcrops, in full sun.	X			
<i>Pellaea calomelanos</i> (P)	Hard Fern	Grassland, often in moist or rocky places.	X			
<b>Total number identified = 2</b>			<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>TREES</b>						
<i>Diospyros lycioides</i>	Bluebush	Wide variety of habitats	X			
<i>Pavetta zeyheri</i> subsp. <i>middelburgensis</i> (RARE)		Wedge between rocks	X			
<i>Searsia magalismontana</i>	Bergtaabos	Grassland and Bushveld, on rocky ridges.	X			
<i>Searsia zeyheri</i> (Rhus)	Blue Currant	Bushveld and rocky places	X			
<b>Total number of indigenous trees identified = 4</b>			<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>INVADERS</b>						
<i>Acacia dealbata</i>	Silver Wattle	Invader-NEMBA category 2				X
<i>Acacia mearnsii</i>	Black Wattle	Category 2 invader (NEMBA)				X
<i>Cirsium vulgare</i>	Scotch Thistle	Category 1b (NEMBA)		X		X
<i>Eucalyptus camaldulensis</i>	Red River Gum	Category 1b (NEMBA)			X	X
<i>Hibiscus trionum</i> *	Bladderweed	Invasive weed. Grassland, usually in stony places and sandy soil		X		X
<i>Hibiscus cannabinus</i> (M)	Wild Stockrose	Invasive weed. Aggressive and competitive. Pioneer or problem plant in disturbed areas		X		
<i>Pennisetum clandestinum</i>	Kikuyu Grass	Proposed declared invader.		X	X	X
<i>Persicaria lapathifolia</i>	Spotted Knotweed	Invasive weed			X	



Specie name	Common Name	Relevant Notes	Rocky grassland	Secondary grassland	Moist grassland	Transformed land
<i>Richardia brasilliensis</i>		A weed from S America, naturalised in disturbed places	X	X		X
<i>Solanum sisymbriifolium</i>	Wild Tomato	Exotic weed in disturbed places, Category 1b (NEMBA)		X		X
<i>Tagetes minuta</i>	Khaki Weed	Weed in disturbed places. Has become naturalised and due to the vast amount of seed set, difficult to control		X	X	X
<b>Number of invasive plants identified = 11</b>			<b>1</b>	<b>7</b>	<b>4</b>	<b>9</b>