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Ecologists & Environmental Services

Report on the ecological assessment of a proposed development of an emulsion plant on Erf 1559 in Harrismith, Free State Province.

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DECLARATION OF INDEPENDENCE

DPR Ecologists and Environmental Services is an independent company and has no financial, personal or other interest in the proposed project, apart from fair remuneration for work performed in the delivery of ecological services. There are no circumstances that compromise the objectivity of the study.

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Executive Summary

The proposed emulsion plant will be constructed within the Hardustria industrial area of the town of Harrismith (Map 1). It will therefore form part of an already industrialised area and will have an approximate extent of 1 hectare. Although the site is situated within an industrial area it still consists of natural vegetation though surrounding activities as well as disturbances on the site does cause significant transformation of the natural vegetation.

According to Mucina & Rutherford (2006) the area consists of Eastern Free State Sandy Grassland (Gm 4). This vegetation type is currently listed as being of Least Concern (LC) under the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004) (Map 2). The site still consists of natural grassland though this has been degraded from the natural condition by surrounding activities and on-site disturbance. The Free State Province Biodiversity Management Plan (2015) has recently been published and has identified areas which are essential to meeting conservation targets for specific vegetation types, i.e. Critical Biodiversity Areas (CBA). The site in question is however listed as being an Ecological Support Area 1 (Map 3). The overall conservation value of the site is therefore relatively low.

The topography of the site consists of a relatively flat area, but with a slight slope from north east to south west. The Wilge River occurs approximately 1.3 km to the south west of the site and forms a low point in the area (Map 2). The site itself does not contain any concentrated runoff pattern, wetlands or watercourses though surface runoff will still follow the natural slope and available aerial images and mapping resources do indicate watercourses and drainage lines in the surrounding area (Map 1 & 2). Surface runoff generated on the site will also follow this drainage pattern and this should be taken into consideration on the site, i.e. storm water management should contain dirty water on the site and divert clean runoff around it and into the natural drainage pattern.

Due to the largely modified and transformed nature of the vegetation on the site no rare or threatened species were observed and it is considered unlikely that such a species would occur. However, two protected geophytic species still remain, *Asclepias gibba* and *A. multicaulis* (Appendix C). Although not considered rare or threatened they are still protected species and as such the necessary permits must be obtained and affected specimens transplanted to an adjacent area where they will remain intact.

In conclusion, the site still contains natural grassland but which has been modified and degraded to a large extent. The natural vegetation type, Eastern Free State Sandy Grassland (Gm 4), is not currently considered to be affected by significant transformation pressures and is therefore considered to be of Least Concern (LC) (Map 2). This together with the degraded condition of the site decreases its conservation value significantly. According to the Free State Province Biodiversity Management Plan (2015) it is also not listed as a Critical Biodiversity Area (Map 3). However, it still functions as an Ecological Support Area. This is especially relevant where surface water runoff generated on the site will drain toward the Wilge River, a sensitive system (Map 1 & 2). Care should therefore be taken that the storm water management system of the development prevents contamination of surface water and contains any dirty storm water on the site.

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Ecological assessment

1. INTRODUCTION

1.1 Background

Natural vegetation is an important component of ecosystems. Some of the vegetation units in a region can be more sensitive than others, usually as a result of a variety of environmental factors and species composition. These units are often associated with water bodies, water transferring bodies or moisture sinks. These systems are always connected to each other through a complex pattern. Degradation of a link in this larger system, e.g. tributary, pan, wetland, usually leads to the degradation of the larger system. Therefore, degradation of such a water related system should be prevented.

Though vegetation may seem to be uniform and low in diversity it may still contain species that are rare and endangered. The occurrence of such a species may render the development unviable. Should such a species be encountered the development should be moved to another location or cease altogether.

South Africa has a large amount of endemic species and in terms of plant diversity ranks third in the world. This has the result that many of the species are rare, highly localised and consequently endangered. It is our duty to protect our diverse natural resources. The eastern portions of the Free State Province is also known for its high species diversity with numerous Red Listed plant and animal species.

South Africa's water resources have become a major concern in recent times. As a water scarce country, we need to manage our water resources sustainably in order to maintain a viable resource for the community as well as to preserve the biodiversity of the system. Thus, it should be clear that we need to protect our water resources so that we may be able to utilise this renewable resource sustainably. Areas that are regarded as crucial to maintain healthy water resources include wetlands, streams as well as the overall catchment of a river system.

Development around cities and towns are necessary to accommodate an ever-growing population. Areas along the boundaries of cities and towns are usually in a degraded state due to the impact of the large population these areas house. Though this may be the case in most situations there may still be areas that consist of sensitive habitats such as water courses, wetlands or rare vegetation types that need to be conserved. These areas may also contain endangered fauna and flora.

The proposed emulsion plant will be constructed within the Hardustria industrial area of the town of Harrismith (Map 1). It will therefore form part of an already industrialised area and will have an approximate extent of 1 hectare. Although the site is situated within an industrial area it still consists of natural vegetation though surrounding activities as well as disturbances on the site does cause significant transformation of the natural vegetation.

A site visit was conducted on 26 November 2019. The entire footprint of the site was surveyed. The site survey was conducted during spring after sufficient rains and the plant identification on the site was considered optimal.

For the above reasons it is necessary to conduct an ecological assessment of an area proposed for development.

The report together with its recommendations and mitigation measures should be used to minimise the impact of the proposed development.

1.2 The value of biodiversity

The diversity of life forms and their interaction with each other and the environment has made Earth a uniquely habitable place for humans. Biodiversity sustains human livelihoods and life itself. Although our dependence on biodiversity has become less tangible and apparent, it remains critically important.

The balancing of atmospheric gases through photosynthesis and carbon sequestration is reliant on biodiversity, while an estimated 40% of the global economy is based on biological products and processes.

Biodiversity is the basis of innumerable environmental services that keep us and the natural environment alive. These services range from the provision of clean water and watershed services to the recycling of nutrients and pollution. These ecosystem services include:

- Soil formation and maintenance of soil fertility.
- Primary production through photosynthesis as the supportive foundation for all life.
- Provision of food, fuel and fibre.
- Provision of shelter and building materials.
- Regulation of water flows and the maintenance of water quality.
- Regulation and purification of atmospheric gases.
- Moderation of climate and weather.
- Detoxification and decomposition of wastes.
- Pollination of plants, including many crops.
- Control of pests and diseases.
- Maintenance of genetic resources.

2. SCOPE AND LIMITATIONS

- To evaluate the present state of the vegetation and ecological functioning of the area proposed for the development.
- To identify possible negative impacts that could be caused by the proposed development.

2.1 Vegetation

Aspects of the vegetation that will be assessed include:

- The vegetation types of the region with their relevance to the proposed site.
- The overall status of the vegetation on site.
- Species composition with the emphasis on dominant-, rare- and endangered species.

The amount of disturbance present on the site assessed according to:

- The amount of grazing impacts.
- Disturbance caused by human impacts.
- Other disturbances.

2.2 Fauna

Aspects of the fauna that will be assessed include:

- A basic survey of the fauna occurring in the region using visual observations of species as well as evidence of their occurrence in the region (burrows, excavations, animal tracks, etc.).
- The overall condition of the habitat.
- A list of species that may occur in the region (desktop study).

2.3 Limitations

Some geophytic or succulent species may have been overlooked due to a specific flowering time or cryptic nature.

Due to the current drought and late rains in the area several plant species may not yet have emerged or started growing and may have been overlooked.

Although a comprehensive survey of the site was done it is still likely that several species were overlooked.

Some animal species may not have been observed as a result of their nocturnal and/or shy habits.

3. METHODOLOGY

3.1 Several literature works were used for additional information.

Vegetation:

Red Data List (Raymondo *et al.* 2009)

Vegetation types (Mucina & Rutherford 2006)

Field guides used for species identification (Bromilow 1995, 2010, Coates-Palgrave 2002, Fish *et al* 2015, Gibbs-Russell *et al* 1990, Manning 2009, Moffett 1997, Pooley 1998, 2003, Retief & Meyer 2017, Van Oudtshoorn 2004, Van Wyk & Malan 1998, Van Wyk & Van Wyk 1997, Venter & Joubert 1985).

Terrestrial fauna:

Field guides for species identification (Smithers 1986a, Child *et al* 2016).

3.2 Survey

The site was assessed by means of transects and sample plots.

Noted species include rare and dominant species.

The broad vegetation types present on the site were determined.

The state of the environment was assessed in terms of condition, grazing impacts, disturbance by humans, erosion and presence of invader and exotic species.

Animal species were also noted as well as the probability of other species occurring on or near the site according to their distribution areas and habitat requirements.

The state of the habitat was also assessed.

3.3 Criteria used to assess sites

Several criteria were used to assess the site and determine the overall status of the environment.

Vegetation characteristics

Characteristics of the vegetation in its current state. The diversity of species, sensitivity of habitats and importance of the ecology as a whole.

Habitat diversity and species richness: normally a function of locality, habitat diversity and climatic conditions.

Scoring: Wide variety of species occupying a variety of niches – 1, Variety of species occupying a single nich – 2, Single species dominance over a large area containing a low diversity of species – 3.

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species on a proposed site plays a large role on the feasibility of a development. Depending on the status and provincial conservation policy, presence of a Red Data species can potentially be a fatal flaw.

Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely – 3.

Ecological function: All plant communities play a role in the ecosystem. The ecological importance of all areas though, can vary significantly e.g. wetlands, drainage lines, ecotones, etc.

Scoring: Ecological function critical for greater system – 1, Ecological function of medium importance – 2, No special ecological function (system will not fail if absent) – 3.

Degree of rarity/conservation value:

Scoring: Very rare and/or in pristine condition – 1, Fair to good condition and/or relatively rare – 2, Not rare, degraded and/or poorly conserved – 3.

Vegetation condition

The sites are compared to a benchmark site in a good to excellent condition. Vegetation management practises (e.g. grazing regime, fire, management, etc.) can have a marked impact on the condition of the vegetation.

Percentage ground cover: Ground cover is under normal and natural conditions a function of climate and biophysical characteristics. Under poor grazing management, ground cover is one of the first signs of vegetation degradation.

Scoring: Good to excellent – 1, Fair – 2, Poor – 3.

Vegetation structure: This is the ratio between tree, shrub, sub-shrubs and grass layers. The ratio could be affected by grazing and browsing by animals.

Scoring: All layers still intact and showing specimens of all age classes – 1, Sub-shrubs and/or grass layers highly grazed while tree layer still fairly intact (bush partly opened up) – 2, Mono-layered structure often dominated by a few unpalatable species (presence of barren patches notable) – 3.

Infestation with exotic weeds and invader plants or encroachers:

Scoring: No or very slight infestation levels by weeds and invaders – 1, Medium infestation by one or more species – 2, Several weed and invader species present and high occurrence of one or more species – 3.

Degree of grazing/browsing impact:

Scoring: No or very slight notable signs of browsing and/or grazing – 1, Some browse lines evident, shrubs shows signs of browsing, grass layer grazed though still intact – 2, Clear browse line on trees, shrubs heavily pruned and grass layer almost absent – 3.

Signs of erosion: The formation of erosion scars can often give an indication of the severity and/or duration of vegetation degradation.

Scoring: No or very little signs of soil erosion – 1, Small erosion gullies present and/or evidence of slight sheet erosion – 2, Gully erosion well developed (medium to large dongas) and/or sheet erosion removed the topsoil over large areas – 3.

Faunal characteristics

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species on a proposed site plays a large role on the feasibility of a development. Depending on the status and provincial conservation policy, presence of a Red Data species or very unique and sensitive habitats can potentially be a fatal flaw.

Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely.

3.4 Biodiversity sensitivity rating (BSR)

The total scores for the criteria above were used to determine the biodiversity sensitivity ranking for the sites. On a scale of 0 – 30, six different classes are described to assess the suitability of the sites to be developed. The different classes are described in the table below:

Table 1: Biodiversity sensitivity ranking

BSR	BSR general floral description	Floral score equating to BSR class
Ideal (5)	Vegetation is totally transformed or in a highly degraded state, generally has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area has lost its inherent ecological function. The area has no conservation value and potential for successful rehabilitation is very low. The site is ideal for the proposed development.	29 – 30
Preferred (4)	Vegetation is in an advanced state of degradation, has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area's ecological function is seriously hampered, has a very low conservation value and the potential for successful rehabilitation is low. The area is preferred for the proposed development.	26 – 28
Acceptable (3)	Vegetation is notably degraded, has a medium level of species diversity although no species of concern are present. Invasive plants are present but are still controllable. The area's ecological function is still intact but may be hampered by the current levels of degradation. Successful rehabilitation of the area is possible. The conservation value is regarded as low. The area is acceptable for the proposed development.	21 – 25
Not preferred (2)	The area is in a good condition although signs of disturbance are present. Species diversity is high and species of concern may be present. The ecological function is intact and very little rehabilitation is needed. The area is of medium conservation importance. The area is not preferred for the proposed development.	11 – 20
Sensitive (1)	The vegetation is in a pristine or near pristine condition. Very little signs of disturbance other than those needed for successful management are present. The species diversity is very high with several species of concern known to be present. Ecological functioning is intact and the conservation importance is high. The area is regarded as sensitive and not suitable for the proposed development.	0 - 10

4. ECOLOGICAL OVERVIEW OF THE SITE

4.1 Overview of ecology and vegetation types

Refer to the list of species encountered on the site in Appendix B.

According to Mucina & Rutherford (2006) the area consists of Eastern Free State Sandy Grassland (Gm 4). This vegetation type is currently listed as being of Least Concern (LC) under the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004) (Map 2). Although it is subjected to significant agricultural transformation this is not currently considered to be a threatened ecosystem. The site still consists of natural grassland though this has been degraded from the natural condition by surrounding activities and on-site disturbance.

The Free State Province Biodiversity Management Plan (2015) has recently been published and has identified areas which are essential to meeting conservation targets for specific vegetation types, i.e. Critical Biodiversity Areas (CBA). The site in question is however listed as being an Ecological Support Area 1 (Map 3). Although this is not a CBA it does still support the function of surrounding areas and watercourses.

The proposed emulsion plant will be constructed within the Hardustria industrial area of the town of Harrismith (Map 1). It will therefore form part of an already industrialised area and will have an approximate extent of 1 hectare. Although the site is situated within an industrial area it still consists of natural vegetation though surrounding activities as well as disturbances on the site does cause significant transformation of the natural vegetation.

The majority of the site has been significantly modified from the natural condition although remnants of the natural grassland is still prominent. The site is affected by the surrounding industrial activities and a portion of the site has been transformed by heavy vehicles using it as a turning point which has removed the vegetation in these areas and compacted the soil surface (Figure 1). Rubble and rubbish dumping is also present in significant amounts and leads to local disturbance of the grass layer. The site also borders on communal grazing within the municipal area and it was evident that overgrazing by domestic stock does occur on the site. The site is also surrounded by industrial developments to the south and east and the N3 National Road borders it to the north. This causes further significant disturbances along the fringes of the site. The combination of these impacts causes significant disturbance of the site which is quite apparent in the vegetation on the site which contains a high proportion of exotic weeds, pioneer species and a low vegetation cover.



Figure 1: Aerial view of the proposed site (Google Earth 2014). Note the areas of vegetation clearance on the site (Truck turning circle, etc.) as well as transformation of the surroundings by industrial developments and roads.

The topography of the site consists of a relatively flat area, but with a slight slope from north east to south west. This is caused by a significant hill and ridge to the north east of the site and the natural drainage pattern toward the south west. The Wilge River occurs approximately 1.3 km to the south west of the site and forms a low point in the area (Map 2). The site has an elevation of 1653 m along the northern border, decreasing to 1650 m along the southern border and also confirms the slight slope of the site. The site itself does not contain any concentrated runoff patterns, wetlands or watercourses though surface runoff will still follow the natural slope and available aerial images and mapping resources do indicate watercourses and drainage lines in the surrounding area (Map 1 & 2).

As indicated, the site does not contain any wetlands or watercourses. However, a few drainages lines occur in the surrounding area and these all follow the gradual slope toward the Wilge River, located approximately 1.3 km to the south west of the site (Map 1 & 2). Surface runoff generated on the site will also follow this drainage pattern and this should be taken into consideration on the site, i.e. storm water management should contain dirty water on the site and divert clean runoff around it and into the natural drainage pattern. Given the nature of the proposed development this is especially important as emulsion plants are known to cause contamination of surface water.

The area has a mean average temperature of 13.9°C, with a maximum of 25.6°C in January and temperatures below zero common in winter (-1.3°C in July). Summer rainfall occurs mostly as thunderstorms with an average annual rainfall of 741 mm.

The following description of the vegetation on the site should give a good indication of the condition of the ecology on it.

As previously discussed, several impacts on the site cause significant degradation of the natural grass layer. A grass layer still dominates the vegetation layer but is significantly modified from the natural condition. The grass is quite short, a likely consequence of

overgrazing, and the percentage ground cover is also quite low in an area receiving a relatively high rainfall, probably also caused by overgrazing but also impacts such as vehicles. As a result, the diversity of grass species is much lower than the natural condition and include *Eragrostis lehmanniana*, *Cynodon dactylon*, *Hyparrhenia hirta*, *Cymbopogon pospischillii*, *Aristida congesta*, *Sporobolus fimbriatus*, *Eragrostis racemosa* and *Heteropogon contortus*. Of these several are also clear indicators of disturbances, including *E. lehmanniana*, *A. congesta* and *C. dactylon*. Numerous herbaceous species, considered to be part of the natural vegetation type, is still prominent in the grass layer and include *Ipomoea oblongata*, *Helichrysum nudifolium*, *Teucrium trifidum*, *Polygala hottentotta*, *Hermannia depressa*, *Barleria monticola*, *Rhynchosia sp.* and *Thesium costatum*. However, numerous herbaceous species are also present which are indicators of disturbance. These include *Berkheya macrocephala*, *B. onopordifolia*, *Rumex lanceolata*, *Atriplex semibaccata*, *Salvia verbenaca*, *Gazania krebsiana*, *Gomphocarpus fruticosus*, *Euphorbia striata* and *Lactuca inermis*. This is all considered to be indicative of a natural grass layer, but degraded to a significant extent. This is also affirmed by the prominent presence of several exotic weeds including *Plantago major*, *Physalis viscosa*, *Verbena tenuisecta*, *V. bonariensis*, *Alternanthera pungens* and *Plantago lanceolata*. Another component of the natural grass layer is the presence of several geophytic species. These include *Asclepias gibba*, *A. multicaulis*, *Ledebouria sandersonii*, *L. marginata* and *Albuca sp.* These are all relatively widespread and common and therefore not of high conservation value. However, *A. gibba* and *A. multicaulis* are both protected species and are therefore still of significant conservation value. Although not considered rare or threatened they are still protected species and as such the necessary permits must be obtained and affected specimens transplanted to an adjacent area where they will remain intact.

From the description of the vegetation on the site it is clear that it still consists of natural grassland but which has been modified and degraded to a large extent. This has significantly decreased its conservation value. No elements of high conservation value or sensitivity occur on the site footprint itself although two protected species, *Asclepias gibba* and *A. multicaulis*, is present as scattered specimens and still has some conservation value (Appendix C).

In conclusion, the site still contains natural grassland but which has been modified and degraded to a large extent. The natural vegetation type, Eastern Free State Sandy Grassland (Gm 4), is not currently considered to be affected by significant transformation pressures and is therefore considered to be of Least Concern (LC) (Map 2). This together with the degraded condition of the site decreases its conservation value significantly. According to the Free State Province Biodiversity Management Plan (2015) it is also not listed as a Critical Biodiversity Area. However, it still functions as an Ecological Support Area (Map 3). This is especially relevant where surface water runoff generated on the site will drain toward the Wilge River, a sensitive system (Map 1 & 2). Care should therefore be taken that the storm water management system of the development prevents contamination of surface water and contains any dirty storm water on the site. Despite the degraded condition of the site two protected geophytic species still remain, *Asclepias gibba* and *A. multicaulis* (Appendix C). Although not considered rare or threatened they are still protected species and as such the necessary permits must be obtained and affected specimens transplanted to an adjacent area where they will remain intact.

4.2 Overview of terrestrial fauna (actual & possible)

The site is situated within an industrialised area and, in addition, remaining habitat is degraded and transformed and consequently it is considered highly unlikely that a viable mammal

population will be present on the site. It is still likely that small rodents may be present but these will likely be confined to opportunistic species adapted to urban environments.

The impact that the proposed development will have is mainly concerned with the loss of habitat which will decrease the available habitat for faunal species. The faunal population will vacate the site into adjacent natural areas which will put a strain on surrounding populations. However, due to the already degraded and modified condition of the habitat on the site this is not regarded as a high impact.

It is also considered likely that some mammal species were not observed during the survey but owing to the degraded condition of the site and proximity to urban areas it is considered highly unlikely that any rare or endangered species would occur on the site.

In order to ensure no direct impact on the mammals on the site the hunting, capturing or trapping of mammals on the site should be strictly prohibited during the construction and operational phases.

List of some Red Data terrestrial mammals that could occur in the region (Child *et al* 2016):

South African Hedgehog	<i>Atelerix frontalis</i>
Striped Weasel	<i>Poecilogale albinucha</i>
Small-Spotted Cat	<i>Felis nigripes</i>

It is considered unlikely that these species would occur on the site due to the degraded condition of the site and proximity of urban area.

5. ANTICIPATED IMPACTS

Anticipated impacts that the development will have is primarily concerned with the loss of habitat and species diversity.

As previously discussed, the vegetation on the site has largely been modified by the surrounding industrial developments, clearing of vegetation by a truck turning point and rubble and rubbish dumping. The vegetation type on the site, Eastern Free State Sandy Grassland (Gm 4), is only listed as being of Least Concern (LC) (Map 2). This together with the degraded condition of the site decreases its conservation value significantly. Furthermore, the site is not listed as a Critical Biodiversity Area (Map 3). Despite this the site still has a moderate species diversity although this is much lower than the natural condition but simply illustrates that this area is situated in a region with a high natural species diversity. As a result of the above, the loss of the vegetation and species diversity cannot be regarded as a high impact.

Due to the largely modified and transformed nature of the vegetation on the site no rare or threatened species were observed and it is considered unlikely that such a species would occur. However, two protected geophytic species still remain, *Asclepias gibba* and *A. multicaulis* (Appendix C). Although not considered rare or threatened they are still protected species and as such the necessary permits must be obtained and affected specimens transplanted to an adjacent area where they will remain intact. Unmitigated, the loss of this protected species is anticipated to be at least moderate and should mitigation as recommended be implemented adequately the impact should be decreased to low.

The site does not contain any watercourses, including drainage lines or wetlands and the impact on these would therefore be negligible. However, as previously indicated, the surface runoff on the site will drain toward the Wilge River, located near the site (Map 1 & 2). Contaminated storm water generated on the site may therefore adversely affect the river. It will therefore be important to incorporate adequate storm water management on the site which should contain dirty water on the site. Given the nature of the proposed development this is especially important as emulsion plants are known to cause contamination of surface water.

The site contains several exotic weeds, of which a few are considered problematic (Appendix B). Construction activities will also increase disturbance and therefore increase the susceptibility for the establishment of weeds and their spread into the surroundings. Monitoring of weed establishment and eradication should form a prominent part of management of the development. Where category 1 and 2 weeds occur, they require removal by the property owner according to the Conservation of Agricultural Resources Act, No. 43 of 1983 and National Environmental Management: Biodiversity Act, No. 10 of 2004.

The impact that the proposed development will have on the mammal population is mainly concerned with the loss of habitat which will decrease the available habitat for faunal species. The faunal population will vacate the site into adjacent natural areas which will put a strain on surrounding populations. However, due to the already degraded and modified condition of the habitat on the site this is not regarded as a high impact. In order to ensure no direct impact on the mammals on the site the hunting, capturing or trapping of mammals on the site should be strictly prohibited during the construction and operational phases.

The impact significance has been determined and it is clear that the proposed development is not anticipated to have significant impacts in terms of the ecology. Prior to mitigation most

impacts will be low-moderate although there is a moderate impact anticipated on the Wilge River as well as the likely spread of exotic weeds. However, with adequate mitigation these can easily be reduced to low impacts.

Please refer to Appendix D for the impact methodology.

Significance of the impact:

Impact	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before Mitigation								
Loss of vegetation type and clearing of vegetation	2	5	1	2.6	4	3	3.5	9.1
Loss of protected species	3	5	1	3	5	3	4	12
Impact on watercourses	2	5	2	3	3	3	3	9
Infestation with weeds and invaders	3	4	2	3	4	3	3.5	10.5
Impact on Terrestrial fauna	2	4	1	2.3	3	3	3	6.9
After Mitigation								
Loss of vegetation type and clearing of vegetation	2	5	1	2.6	4	3	3.5	9.1
Loss of protected species	1	5	1	2.3	2	2	2	4.6
Impact on watercourses	1	5	1	2.3	2	1	1.5	3.45
Infestation with weeds and invaders	2	2	1	1.6	3	2	2.5	4
Impact on Terrestrial fauna	2	4	1	2.3	3	3	3	6.9

6. SITE SPECIFIC RESULTS

Habitat diversity and species richness:

The proposed site is quite small with a uniform topography and as a result, under natural conditions, it would also not have a significant habitat diversity. The region does however have quite a high species diversity. Disturbance and degradation of the site however decreases the species diversity, though it is still moderate.

Presence of rare and endangered species:

Due to the largely modified and transformed nature of the vegetation on the site no rare or threatened species were observed and it is considered unlikely that such a species would occur. However, two protected geophytic species still remain, *Asclepias gibba* and *A. multicaulis* (Appendix C). Although not considered rare or threatened they are still protected species and as such the necessary permits must be obtained and affected specimens transplanted to an adjacent area where they will remain intact.

Ecological function:

The ecological function of the site has been modified to a large degree. The site functions as habitat for fauna, sustains a specific vegetation type, i.e. Eastern Free State Sandy Grassland and also forms part of the catchment of the adjacent Wilge River (Map 1 & 2). The natural vegetation on the site has clearly been at least moderately modified by surrounding and on-site impacts. This, together with the proximity of industrial developments has modified the functioning as habitat to a large degree. Furthermore, the function of the site is not paramount to the continued functioning of the surrounding natural areas. In other words, development of the site should not impair the functioning of the surrounding area to a large extent. The functioning of the site as part of the catchment of the Wilge River has also been modified to a large extent. The surroundings roads and developments seriously alter the surface runoff patterns and storm water volumes which in turn modifies the functioning as catchment.

Degree of rarity/conservation value:

According to Mucina & Rutherford (2006) the area consists of Eastern Free State Sandy Grassland (Gm 4). This vegetation type is currently listed as being of Least Concern (LC) under the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004) (Map 2). The site still consists of natural grassland though this has been degraded from the natural condition by surrounding activities and on-site disturbance. The Free State Province Biodiversity Management Plan (2015) has recently been published and has identified areas which are essential to meeting conservation targets for specific vegetation types, i.e. Critical Biodiversity Areas (CBA). The site in question is however listed as being an Ecological Support Area 1 (Map 3). Although this is not a CBA it does still support the function of surrounding areas and watercourses. The overall conservation value of the site is therefore relatively low.

Percentage ground cover:

The percentage vegetation cover is relatively low. Naturally the vegetation cover would have been relatively high but due to the on-site disturbances such as overgrazing and vehicle movement this significantly decreases the vegetation cover (Map 1).

Vegetation structure:

Naturally the vegetation structure should consist of a dense grass cover with a prominent herbaceous component. These are both still present though their percentage cover has been significantly decreased. The herbaceous component is also increase due to numerous exotic weeds and pioneer species. Overall the vegetation structure is therefore considered to be moderately modified.

Infestation with exotic weeds and invader plants:

Exotic weeds are quite abundant on the site but do not yet dominate the vegetation (Appendix B).

Degree of grazing/browsing impact:

The site borders on communal grazing within the municipal area of Harrismth and it was evident that overgrazing by domestic stock is quite high on the site.

Signs of erosion:

Although signs of erosion are not prominent, the decrease in vegetation cover, disturbance of the soil surface and overgrazing by domestic stock will cause at least a moderate level of sheet erosion.

Terrestrial animals:

The site is situated within an industrialised area and in addition remaining habitat is degraded and transformed and consequently it is considered highly unlikely that a viable mammal population will be present on the site. It is still likely that small rodents may be present but these will likely be confined to opportunistic species adapted to urban environments. It is also considered likely that some mammal species were not observed during the survey but owing to the degraded condition of the site and proximity to urban areas it is considered highly unlikely that any rare or endangered species would occur on the site.

Table 2: Biodiversity Sensitivity Rating for the proposed Asphalt Plant development.

	Low (3)	Medium (2)	High (1)
Vegetation characteristics			
Habitat diversity & Species richness		2	
Presence of rare and endangered species		2	
Ecological function	3		
Uniqueness/conservation value	3		
Vegetation condition			
Percentage ground cover	3		
Vegetation structure		2	
Infestation with exotic weeds and invader plants or encroachers		2	
Degree of grazing/browsing impact	3		
Signs of erosion		2	
Terrestrial animal characteristics			
Presence of rare and endangered species	3		
Sub total	15	10	0
Total		25	

7. BIODIVERSITY SENSITIVITY RATING (BSR) INTERPRETATION

Table 3: Interpretation of Biodiversity Sensitivity Rating.

Site	Score	Site Preference Rating	Value
Asphalt Plant	25	Acceptable	3

8. DISCUSSION AND CONCLUSION

The proposed site has been rated as being acceptable for the development mostly as a result of the already degraded condition of the vegetation, the small extent of the site and the already surrounding industrial developments.

The proposed emulsion plant will be constructed within the Hardustria industrial area of the town of Harrismith (Map 1). It will therefore form part of an already industrialised area and will have an approximate extent of 1 hectare. Although the site is situated within an industrial area it still consists of natural vegetation though surrounding activities as well as disturbances on the site does cause significant transformation of the natural vegetation.

According to Mucina & Rutherford (2006) the area consists of Eastern Free State Sandy Grassland (Gm 4). This vegetation type is currently listed as being of Least Concern (LC) under the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004) (Map 2). The site still consists of natural grassland though this has been degraded from the natural condition by surrounding activities and on-site disturbance. The Free State Province Biodiversity Management Plan (2015) has recently been published and has identified areas which are essential to meeting conservation targets for specific vegetation types, i.e. Critical Biodiversity Areas (CBA). The site in question is however listed as being an Ecological Support Area 1 (Map 3). Although this is not a CBA it does still support the function of surrounding areas and watercourses. The overall conservation value of the site is therefore relatively low.

The majority of the site has been significantly modified from the natural condition although remnants of the natural grassland is still prominent. The is affected by the surrounding industrial activities and a portion of the site has been transformed by heavy vehicles using it as a turning point which has removed the vegetation in these areas and compacted the soil surface (Figure 1). Rubble and rubbish dumping is also present in significant amounts and leads to local disturbance of the grass layer. The site also borders on communal grazing within the municipal area and it was evident that overgrazing by domestic stock does occur on the site. The site is also surrounded by industrial developments to the south and east and the N3 National Road borders it to the north. This causes further significant disturbances along the fringes of the site. The combination of these impacts causes significant disturbance of the site which is quite apparent in the vegetation on the site which contains a high proportion of exotic weeds, pioneer species and a low vegetation cover.

The topography of the site consists of a relatively flat area, but with a slight slope from north east to south west. The Wilge River occurs approximately 1.3 km to the south west of the site and forms a low point in the area (Map 2). The site itself does not contain any concentrated runoff pattern, wetlands or watercourses though surface runoff will still follow the natural slope and available aerial images and mapping resources do indicate watercourses and drainage lines in the surrounding area (Map 1 & 2). Surface runoff generated on the site will also follow

this drainage pattern and this should be taken into consideration on the site, i.e. storm water management should contain dirty water on the site and divert clean runoff around it and into the natural drainage pattern. Given the nature of the proposed development this is especially important as emulsion plants are known to cause contamination of surface water.

Due to the largely modified and transformed nature of the vegetation on the site no rare or threatened species were observed and it is considered unlikely that such a species would occur. However, two protected geophytic species still remain, *Asclepias gibba* and *A. multicaulis* (Appendix C). Although not considered rare or threatened they are still protected species and as such the necessary permits must be obtained and affected specimens transplanted to an adjacent area where they will remain intact. Unmitigated, the loss of this protected species is anticipated to be at least moderate and should mitigation as recommended be implemented adequately the impact should be decreased to low.

The site contains several exotic weeds, of which a few are considered problematic (Appendix B). Construction activities will also increase disturbance and therefore increase the susceptibility for the establishment of weeds and their spread into the surroundings. Monitoring of weed establishment and eradication should form a prominent part of management of the development. Where category 1 and 2 weeds occur, they require removal by the property owner according to the Conservation of Agricultural Resources Act, No. 43 of 1983 and National Environmental Management: Biodiversity Act, No. 10 of 2004.

The impact that the proposed development will have on the mammal population is mainly concerned with the loss of habitat which will decrease the available habitat for faunal species. The faunal population will vacate the site into adjacent natural areas which will put a strain on surrounding populations. However, due to the already degraded and modified condition of the habitat on the site this is not regarded as a high impact. In order to ensure no direct impact on the mammals on the site the hunting, capturing or trapping of mammals on the site should be strictly prohibited during the construction and operational phases.

In conclusion, the site still contains natural grassland but which has been modified and degraded to a large extent. The natural vegetation type, Eastern Free State Sandy Grassland (Gm 4), is not currently considered to be affected by significant transformation pressures and is therefore considered to be of Least Concern (LC) (Map 2). This together with the degraded condition of the site decreases its conservation value significantly. According to the Free State Province Biodiversity Management Plan (2015) it is also not listed as a Critical Biodiversity Area (Map 3). However, it still functions as an Ecological Support Area. This is especially relevant where surface water runoff generated on the site will drain toward the Wilge River, a sensitive system (Map 1 & 2). Care should therefore be taken that the storm water management system of the development prevents contamination of surface water and contains any dirty storm water on the site. Despite the degraded condition of the site two protected geophytic species still remain, *Asclepias gibba* and *A. multicaulis* (Appendix C). Although not considered rare or threatened they are still protected species and as such the necessary permits must be obtained and affected specimens transplanted to an adjacent area where they will remain intact.

9. RECOMMENDATIONS

- Scattered specimens of the protected geophytes, *Asclepias gibba* and *A. multicaulis*, occurs on the site (Appendix C):
 - Permits should be obtained and affected specimens transplanted to adjacent areas where they will remain unaffected.
 - The species is deciduous and will only be visible after sufficient summer rains. It is a geophyte with a subterranean tuber which should be taken into consideration when transplanting specimens.
- The Wilge River occurs to the west of the site (approximately 1.3 km) and runoff generated on the site may affect it (Map 1 & 2). An adequate storm water management system should be implemented and should contain dirty water on the site and divert clean runoff around it and into the natural drainage pattern.
- The hunting, capturing or trapping of fauna, including mammals, reptiles, birds and amphibians, on the site should be strictly prohibited during construction and operation.
- Adequate monitoring of weed establishment and their continued eradication must be maintained (Appendix B). Where category 1 and 2 weeds occur, they require removal by the property owner according to the Conservation of Agricultural Resources Act, No. 43 of 1983 and National Environmental Management: Biodiversity Act, No. 10 of 2004.
- After construction has ceased all construction waste should be removed from the area.
- Monitoring of construction including weed establishment and erosion should take place.

10. REFERENCES

- Bromilow, C. 1995. Problem Plants of South Africa. Briza Publications CC, Cape Town.
- Bromilow, C. 2010. Problem plants and alien weeds of South Africa. Briza Publications CC, Cape Town.
- Child MF, Roxburgh L, Do Linh San E, Raimondo D, Davies-Mostert HT, editors. The 2016 Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.
- Coates-Palgrave, M. 2002. Keith Coates-Palgrave Trees of Southern Africa, edn 3, imp. 4. Random House Struik (Pty.) Ltd, Cape Town.
- Conservation of Agricultural Resources Act, 1983 (ACT No. 43 OF 1983) Department of Agriculture.
- Department of Water Affairs and Forestry. 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Edition 1. Department of Water Affairs and Forestry, Pretoria.
- DWAF. 2008. Updated manual for the identification and delineation of wetlands and riparian areas, prepared by M.Rountree, A.L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.
- Fish, L., Mashau, A.C., Moeaha, M.J. & Nembudani, M.T. 2015. Identification guide to the southern African grasses. An identification manual with keys, descriptions and distributions. *Strelitzia* 36. South African National Biodiversity Institute, Pretoria.
- Government of South Africa. 2008. National Protected Area Expansion Strategy for South Africa 2008: Priorities for expanding the protected area network for ecological sustainability and climate change adaptation. Government of South Africa, Pretoria.
- Germishuizen, G. & Meyer, N.L. (eds) 2003. Plants of Southern Africa: an annotated checklist. *Strelitzia* 14. National Botanical Institute, Pretoria.
- Gibbs Russell, G.E., Watson, L., Koekemoer, M., Smook, L., Barker, N.P., Anderson, H.M. & Dallwitz, M.J. 1990. Grasses of Southern Africa. Memoirs of the Botanical Survey of South Africa No. 58. Botanical Research Institute, South Africa.
- Google Earth V 7.3.2.5776. 2014. Hardustria, Harrismith, South Africa. S 28.296260°, E 29.137535°. Eye alt. 2.10 km. Digital Globe 2019. <http://www.earth.google.com> (January 2020).
- Manning, J. 2009. Field Guide to Wild Flowers. Struik Nature, Cape Town.
- Moffett, R. 1997. Grasses of the Eastern Free State: Their description and uses. Qwa-Qwa Campus of the University of the North, Phuthaditjhaba.

Mucina, L. & Rutherford, M.C. (eds.) 2006. The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

National Environmental Management: Biodiversity Act (10/2004): National list of ecosystems that are threatened and in need of protection. Government Notice 1002 of 2011, Department of Environmental Affairs.

National Environmental Management: Biodiversity Act (10/2004): Publication of lists of critically endangered, endangered, vulnerable and protected species. Government Notice 151 of 2007, Department of Environmental Affairs.

National Water Act (Act No. 36 of 1998). Republic of South Africa.

Pooley, E. 1998. A field guide to wild flowers: Kwazulu-Natal and the Eastern Region. Natal Flora Publications Trust, Durban.

Pooley, E. 2003. Mountain flowers: A field guide to the flora of the Drakensberg and Lesotho. The Flora Publications Trust, Durban.

Raymondo, D. Van Staden, L. Foden, W. Victor, J.E. Helme, N.A. Turner, R.C. Kamundi, D.A. Manyama, P.A. (eds.) 2009. Red List of South African Plants. *Strelitzia* 25. South African National Biodiversity Institute, Pretoria.

Retief, E. & Meyer, N.L. 2017. Plants of the Free State: Inventory and identification guide. *Strelitzia* 38. South African National Biodiversity Institute, Pretoria.

South African National Biodiversity Institute, 2011. List of threatened ecosystems.

Smithers, R.H.N. 1986. Land Mammals of Southern Africa. Macmillan, Johannesburg.

Van Oudtshoorn, F. 2004. Gids tot Grasse van Suider-Afrika. Briza Publications, Pretoria.

Van Wyk, B. & Malan, S. 1998. Field guide to the wild flowers of the Highveld. Struik Publishers, Cape Town.

Van Wyk, B. & Van Wyk, P. 1997. Field guide to trees of Southern Africa. Struik Publishers, Cape Town.

Venter, H.J.T. & Joubert, A.M. 1985. Climbers, trees and shrubs of the Orange Free State. P.J. de Villiers Publishers, Bloemfontein.

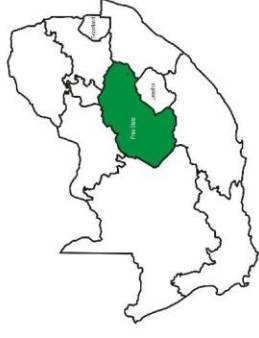
Annexure A: Maps and Site photos



Layout map of a proposed development of an emulsion plant on Erf 1559 in Harrismith, Free State Province.



Map 1: Layout map of the proposed development of an emulsion plant in Harrismith. Note the site being surrounded by existing industrial developments and the N3 National Road bordering the site to the north. Disturbance of the vegetation on the site is also visible from the aerial image. Note watercourses and drainage lines occurring in the surroundings indicating the natural drainage patterns.



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Legend:

- Site location
- Road network
- Property boundaries
- Wetlands and impoundments

Map Information

Spheroid: WGS 84

Quantum GIS

Scale: 1:5 000

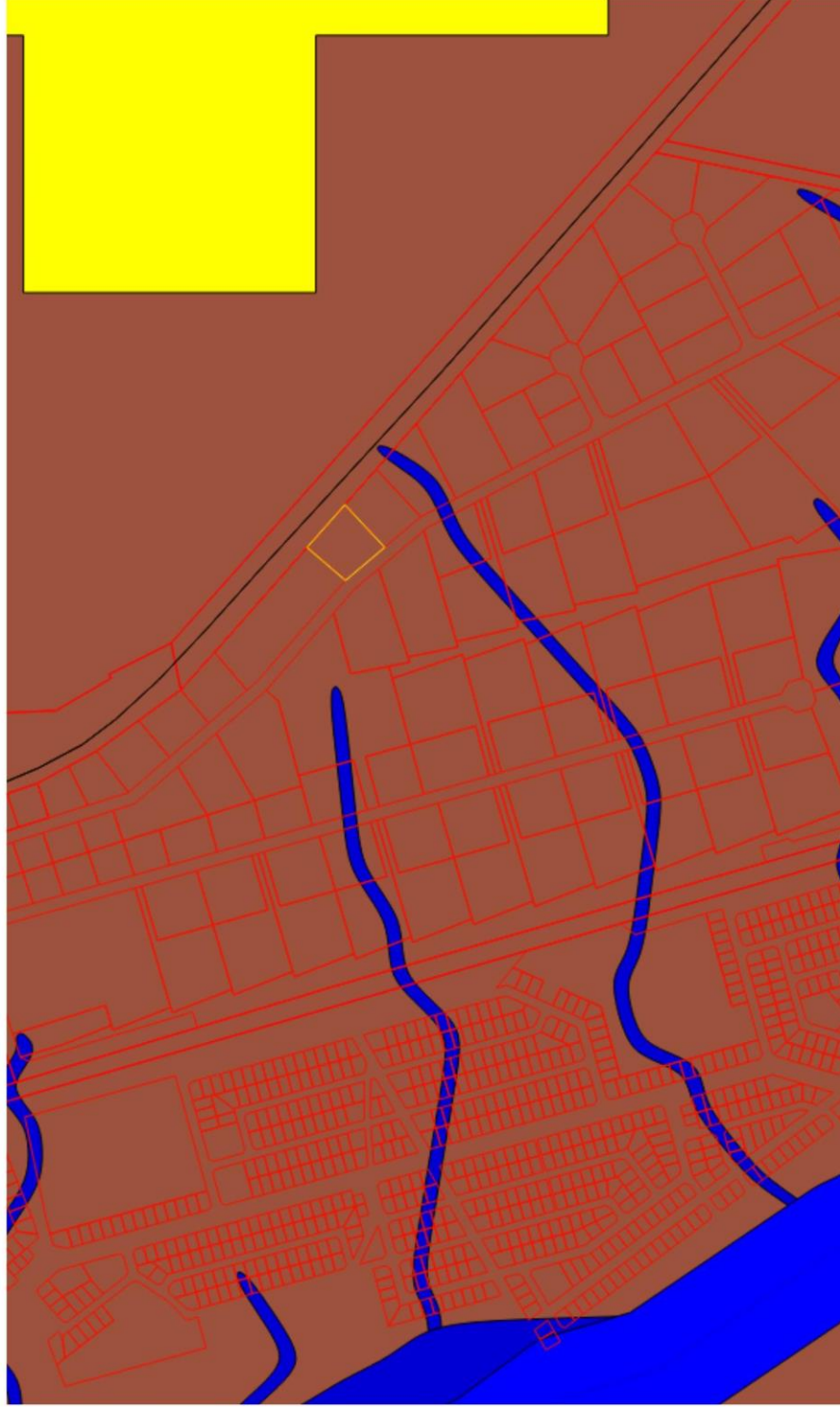
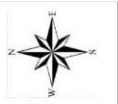
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General ecology map of a proposed development of an emulsion plant on Erf 1559 in Harrismith, Free State Province.









Map 2: General ecology map of the proposed development of an emulsion plant in Harrismith. The vegetation type on the site is indicated. Note that the site does not contain a Threatened Ecosystem. A National Protected Areas Expansion Strategy (NPAES) Focus Area is located to the east of the site associated with the hill and ridge. Note the proximity of the Wilge River to the west of the site.



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Legend:

-  Site location
-  Road network
-  Wetlands and impoundments
-  Threatened Ecosystems
-  NPAES Focus Areas
-  Eastern FS Sandy Grassland

Map Information

Spheroid: WGS 84

Quantum GIS

Scale: 1:10 000

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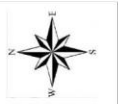
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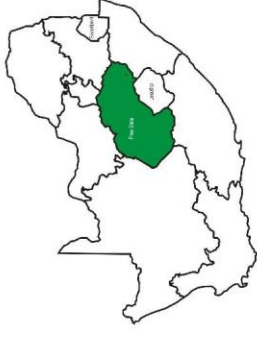
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Free State Biodiversity Plan map of a proposed development of an emulsion plant on Erf 1559 in Harrismith, Free State Province.












Map 3: Biodiversity plan map of the proposed development of an emulsion plant in Harrismith. The site is situated in an Ecological Support Area 1 and aids in the functioning of surrounding watercourses.



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Legend:

-  Site location
-  Road network
-  Wetlands and impoundments
-  Critical Biodiversity Area 1
-  Critical Biodiversity Area 2
-  Ecological Support Area 1
-  Ecological Support Area 2
-  Degraded
-  Other

Map Information

Spheroid: WGS 84
Quantum GIS
Scale: 1:10 000

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Figure 1: Panorama of the site toward the east. Note the large hill and ridge as well as the N3 National Road (red) bordering the site. In the foreground of the site the loss of vegetation is clear due to vehicles turning.



Figure 2: Panorama of the site toward the north. Note again clearance of vegetation in the foreground but also rubble and rubbish dumping (blue). Again, note the site being surrounding by the N3 National Road to the east and industrial area to the west (red).



Figure 3: Panorama of the site toward the south as seen from the portion of remaining natural grassland. Note however the low percentage vegetation cover and short grass layer.



Figure 4: Panorama of the site toward the west. Note again the low percentage and short grass cover.



Figure 5: Rubbish and rubble dumping is common on the site.

Appendix B: Species list

Species indicated with an * are exotic.

Protected species are coloured orange and Red Listed species red.

Species	Growth form
* <i>Alternanthera pungens</i>	Herb
* <i>Physalis viscosa</i>	Herb
* <i>Plantago lanceolata</i>	Herb
* <i>Plantago major</i>	Herb
* <i>Verbena bonariensis</i>	Herb
* <i>Verbena tenuisecta</i>	Herb
<i>Albuca sp.</i>	Geophyte
<i>Aristida congesta</i>	Grass
<i>Asclepias gibba</i>	Geophyte
<i>Asclepias multicaulis</i>	Geophyte
<i>Atriplex semibaccatta</i>	Herb
<i>Barleria monticola</i>	Herb
<i>Berkheya macrocephala</i>	Herb
<i>Berkheya onopordifolia</i>	Herb
<i>Convolvulus sp.</i>	Herb
<i>Conyza podocephala</i>	Herb
<i>Cymbopogon pospischillii</i>	Grass
<i>Cynodon dactylon</i>	Grass
<i>Eragrostis lehmanniana</i>	Grass
<i>Eragrostis racemosa</i>	Grass
<i>Euphorbia striata</i>	Herb
<i>Felicia muricata</i>	Dwarf shrub
<i>Gazania krebsiana</i>	Herb
<i>Gomphocarpus fruticosus</i>	Herb
<i>Helichrysum nudifolium</i>	Herb
<i>Hermannia depressa</i>	Herb
<i>Hermannia sp.</i>	Herb
<i>Heteropogon contortus</i>	Grass
<i>Hyparrhenia hirta</i>	Grass
<i>Ipomoea oblongata</i>	Herb
<i>Lactuca inermis</i>	Herb
<i>Ledebouria marginata</i>	Geophyte
<i>Ledebouria sandersonii</i>	Geophyte
<i>Polygala hottentotta</i>	Herb
<i>Rhynchosia sp.</i>	Herb
<i>Rumex lanceolata</i>	Herb
<i>Salvia verbenaca</i>	Herb
<i>Searsia dentata</i>	Shrub
<i>Sporobolus africanus</i>	Grass
<i>Tephrosia sp.</i>	Herb

<i>Teucrium trifidum</i>	Herb
<i>Thesium costatum</i>	Herb

Appendix C: Protected species on the site

Protected species on the site may not be limited to these species but these species have identified on and around the site. Additional sources should be consulted to confirm the presence of protected species.



Asclepias gibba
Turret Flower

Protected in the Free State Province

National Red List Status: **Least Concern (LC)**

Remove this species if present and transplant to a suitable area where no disturbance will take place. Plants are deciduous and will not be visible during winter.



Asclepias multicaulis
Doily Cartwheel/Melkbossie

Protected in the Free State Province

National Red List Status: **Least Concern (LC)**

Remove this species if present and transplant to a suitable area where no disturbance will take place. Plants are deciduous and will not be visible during winter.

Appendix D: Impact methodology

The environmental significance assessment methodology is based on the following determination:

Environmental Significance = Overall Consequence x Overall Likelihood

Determination of Consequence

Consequence analysis is a mixture of quantitative and qualitative information and the outcome can be positive or negative. Several factors can be used to determine consequence. For the purpose of determining the environmental significance in terms of consequence, the following factors were chosen: **Severity/Intensity, Duration and Extent/Spatial Scale**. Each factor is assigned a rating of 1 to 5, as described below and in tables 6, 7, 9 and 10.

Determination of Severity

Severity relates to the nature of the event, aspect or impact to the environment and describes how severe the aspects impact on the biophysical and socio-economic environment.

Table 7 will be used to obtain an overall rating for severity, taking into consideration the various criteria.

Table 7: Rating of severity

Type of criteria	Rating				
	1	2	3	4	5
Quantitative	0-20%	21-40%	41-60%	61-80%	81-100%
Qualitative	Insignificant / Non-harmful	Small Potentially harmful	Significant / Harmful	Great / Very harmful	Disastrous Extremely harmful
Social/ Community response	Acceptable / I&AP satisfied	Slightly tolerable / Possible objections	Intolerable/ Sporadic complaints	Unacceptable / Widespread complaints	Totally unacceptable / Possible legal action
Irreversibility	Very low cost to mitigate/ High potential to mitigate impacts to level of insignificance / Easily reversible	Low cost to mitigate	Substantial cost to mitigate / Potential to mitigate impacts / Potential to reverse impact	High cost to mitigate	Prohibitive cost to mitigate / Little or no mechanism to mitigate impact Irreversible
Biophysical (Air quality, water quantity and quality, waste production, fauna and flora)	Insignificant change / deterioration or disturbance	Moderate change / deterioration or disturbance	Significant change / deterioration or disturbance	Very significant change / deterioration or disturbance	Disastrous change / deterioration or disturbance

Determination of Duration

Duration refers to the amount of time that the environment will be affected by the event, risk or impact, if no intervention e.g. remedial action takes place.

Table 8: Rating of Duration

Rating	Description
1: Low	Almost never / almost impossible
2: Low-Medium	Very seldom / highly unlikely
3: Medium	Infrequent / unlikely / seldom
4: Medium-High	Often / regularly / likely / possible
5: High	Daily / highly likely / definitely

Determination of Extent/Spatial Scale

Extent refer to the spatial influence of an impact be local (extending only as far as the activity, or will be limited to the site and its immediate surroundings), regional (will have an impact on the region), national (will have an impact on a national scale) or international (impact across international borders).

Table 9: Rating of Extent / Spatial Scale

Rating	Description
1: Low	Immediate, fully contained area
2: Low-Medium	Surrounding area
3: Medium	Within Business Unit area of responsibility
4: Medium-High	Within Mining Boundary area
5: High	Regional, National, International

Determination of Overall Consequence

Overall consequence is determined by adding the factors determined above and summarised below, and then dividing the sum by 4.

Table 10: Example of calculating Overall Consequence

Consequence	Rating
Severity	Example 4
Duration	Example 2
Extent	Example 4
SUBTOTAL	10
TOTAL CONSEQUENCE:(Subtotal divided by 4)	3.3

Likelihood

The determination of likelihood is a combination of Frequency and Probability. Each factor is assigned a rating of 1 to 5, as described below and in Table 11 and Table 12.

Determination of Frequency

Frequency refers to how often the specific activity, related to the event, aspect or impact, is undertaken.

Table 11: Rating of frequency

Rating	Description
1: Low	Once a year or once/more during operation/LOM
2: Low-Medium	Once/more in 6 Months
3: Medium	Once/more a Month
4: Medium-High	Once/more a Week
5: High	Daily

Determination of Probability

Probability refers to how often the activity/event or aspect has an impact on the environment.

Table 12: Rating of probability

Rating	Description
1: Low	Almost never / almost impossible
2: Low-Medium	Very seldom / highly unlikely
3: Medium	Infrequent / unlikely / seldom
4: Medium-High	Often / regularly / likely / possible
5: High	Daily / highly likely / definitely

Overall Likelihood

Overall likelihood is calculated by adding the factors determined above and summarised below, and then dividing the sum by 2.

Table 13: Example of calculating the overall likelihood

Consequence	Rating
Frequency	Example 4
Probability	Example 2
SUBTOTAL	6
TOTAL LIKELIHOOD (Subtotal divided by 2)	3

Determination of Overall Environmental Significance

The multiplication of overall consequence with overall likelihood will provide the environmental significance, which is a number that will then fall into a range of LOW, LOW-MEDIUM, MEDIUM, MEDIUM, MEDIUM-HIGH or HIGH, as shown in the table below.

Table 14: Determination of overall environmental significance

Significance or Risk	Low	Low-Moderate	Moderate	Moderate-High	High
Overall Consequence X Overall Likelihood	1 - 4.9	5 - 9.9	10 - 14.9	15 - 19.9	20 - 25

Qualitative description or magnitude of Environmental Significance

This description is qualitative and is an indication of the nature or magnitude of the Environmental Significance. It also guides the prioritisations and decision making process associated with this event, aspect or impact.

Table 15: Description of the environmental significance and the related action required.

Significance	Low	Low-Moderate	Moderate	Moderate-High	High
Impact Magnitude	Impact is of very low order and therefore likely to have very little real effect. Acceptable.	Impact is of low order and therefore likely to have little real effect. Acceptable.	Impact is real, and potentially substantial in relation to other impacts. Can pose a risk to the company	Impact is real and substantial in relation to other impacts. Pose a risk to the company. Unacceptable	Impact is of the highest order possible. Unacceptable. Fatal flaw.
Action Required	Maintain current management measures. Where possible improve.	Maintain current management measures. Implement monitoring and evaluate to determine potential increase in risk. Where possible improve	Implement monitoring. Investigate mitigation measures and improve management measures to reduce risk, where possible.	Improve management measures to reduce risk.	Implement significant mitigation measures or implement alternatives.