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Report on the biodiversity and ecological assessment of the proposed diamond mining operations at the Rooifontein Game Farm on the Remainder of the Farm Dutoitspan 119 (Rooifontein 1722) near Kimberley, Free State Province.

November 2016

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DECLARATION OF INDEPENDENCE

EKO Environmental 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.

Report Version	Final 1.0		
Title	Report on the biodiversity and ecological assessment of the proposed diamond mining operations at the Rooifontein game Farm on the Remainder of the Farm Dutoitspan 119 (Rooifontein 1722) near Kimberley, Free State Province.		
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Table of contents

Vegetation and ecological assessment.

1. Introduction	4
1.1 Background	
1.2 The value of biodiversity	
2. Scope and limitations	6
2.1 Vegetation	
2.2 Fauna	
2.3 Limitations	
3. Methodology	7
3.1 Desktop study	
3.2 Survey	
3.3 Criteria used to assess sites	
3.4 Biodiversity sensitivity rating (BSR)	
4. Ecological overview of the site	10
4.1 Overview of vegetation	
4.2 Overview of fauna	
5. Anticipated impacts	14
5. Site specific results	16
6. Biodiversity sensitivity rating (BSR) interpretation	19
7. Discussion and conclusions	19
8. Recommendations	21
9. References	22
Annexure A: Maps and Site photos	24
Annexure B: Species list	33
Annexure C: Protected species	34
Annexure D: Likely weed species	35
Annexure E: Impact methodology	38

Vegetation and 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 biological 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.

It is well known that diamond mining operations, especially pertaining to open pit mining, has several detrimental impacts on the environment. These impacts are numerous but the most pronounced impacts are associated with the excavation of large amounts of earth materials, the storage and disposal thereof and the sedimentation associated with it. This usually causes degradation of waterways due to sedimentation as well as the transformation of the vegetation and ecosystem on the site.

The proposed diamond mining operations will occur at the Rooifontein Game Farm on the Remainder of the Farm Dutoitspan 119 (Rooifontein 1722) near Kimberley, Free State Province (Map 1). The extent of the area to be mined is no larger than 5 hectares. The area is situated on the Rooifontein Game Farm which is located south of the town of Kimberley outside the urbane edge within an area of natural vegetation. The specific site was however subjected to extensive historical mining operations.

A site visit was conducted on 5 October 2016. The entire footprint of the mining area was surveyed over the period of one day.

For the above reasons, it is necessary to conduct a vegetation and ecological assessment of an area proposed for mining activities.

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 mining operations.
- To identify possible negative impacts that could be caused by the proposed mining operations.

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

Several bulbous and herbaceous species may have finished flowering or has not yet flowered and may have been overlooked or not identifiable.

Due to the current drought, several annual species may be absent and geophytes may also only be present underground making identification unfeasible.

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 (Adams 1976, Bromilow 1995, 2010, Coates-Palgrave 2002, Gibbs Russell *et al.* 1990, Manning 2009, Moffett 1997, Roberts & Fourie 1975, Shearing & Van Heerden 2008, Van Oudtshoorn 2004, Van Wyk & Malan 1998, Van Wyk & Van Wyk 1997, Venter & Joubert 1985).

Terrestrial fauna:

Field guides for species identification (Smithers 1986a).

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 (Mucina & Rutherford 2006)

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

According to Mucina & Rutherford (2006) the area consists of Kimberley Thornveld (SVk 4) (Map 3). The vegetation type is still largely intact with cultivation being the major threat. It is currently as being of Least Concern within the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004) (Map 3).

The site considered for mining operations has been largely transformed by historical mining activities (Map 2). A large portion of the site consists of an old mining pit and tailings dump. A portion of the site is also utilised as a recreational camping area with small building, artificial pond and structures associated with the camping area. Several dirt tracks also occur on the site. Due to the long period after last mining activities the area has rehabilitated itself to a large degree although the species composition is altered from the natural condition largely due to the transformation of the topography and habitat.

The proposed diamond mining operations will occur at the Rooifontein Game Farm on the Remainder of the Farm Dutoitspan 119 (Rooifontein 1722) near Kimberley, Free State Province (Map 1). The extent of the area to be mined is no larger than 5 hectares. The area is situated on the Rooifontein Game Farm which is located south of the town of Kimberley outside the urban edge. The natural vegetation has however been altered by historical mining activities.

The site is situated within the Savanna Biome and the vegetation structure consists of open grassland with scattered trees (Map 2). However, the old mining pit and camping area has caused the increased the tree cover and here a closed canopy occurs (Map 2). Dwarf karroid shrubs are also prominent and indicative of overgrazing and disturbance. No wetlands, drainage lines or watercourses occur on or near the site although the old mining pit has formed an artificial waterbody. An ephemeral pan is located approximately 420 meters north west of the site but is unlikely to be affected by the mining operations (Map 1).

The topography of the site consists of a plain with no discernible slope. The old tailings dump has however formed a positive landscape feature although this is artificial and part of the natural topography. The elevation of the site varies from 1214 m to 1216 m, also indicating no discernible slope on the site.

The artificial waterbody formed by the old mining pit is not considered to have any significant conservation value in terms of ecology (Map 2). The pit does not perform any vital ecosystem function. It is currently utilised by game as a watering hole. However, as an artificial feature this can easily be replicated post mining or at another location. The same can be said for the small artificial pond.

Dominant trees around the mining pit and scattered on the site include *Vachellia tortilis*, *V. karroo*, *Diospyros lycioides*, *Searsia lancea*, *Ziziphus mucronate*, *Lycium hirsutum* and *Ehretia rigida*. A single specimen of the protected *Boscia albitrunca* (Shepherds Tree) was noted on the site. The species is widespread and common and therefore not of significant conservation significance. It is however still a protected species and a permit will have to be obtained to remove it. In shade under trees the grass, *Setaria verticillata*, is common. *Asparagus larcinus*, a shrub

or climber is also associated with the understorey of the tree layer. A common exotic herb under trees is *Urtica urens*. The vegetation surrounding the artificial waterbody within the mining pit is dominated by *Cynodon dactylon*, a common grass along dams. The grass layer remaining on the site is dominated by *Eragrostis lehmanniana*, *E. obtusa*, *Tragus berteronianus*, *Cymbopogon pospischilii*, *Heteropogon contortus* and *Aristida congesta*. Dwarf karroid shrubs are prominent on the site and dominant in areas. This is indicative of overgrazing and disturbance of the site. These include *Gnidia polycephala*, *Lycium horridum*, *L. cinerium*, *Aptosimum spinescens*, *Pentzia incana*, *Chrysocoma ciliata*, *Asparagus suaveolens* and *Rosenia humilis*. According to Anderson (2008) the site is situated within the *Acacia tortilis* Savanna vegetation unit and from the results obtained during the survey the species composition confirms this. This has however been altered to some degree by the historical mining pit and tailings dump. According to this study (Anderson 2008) the vegetation unit is severely over-utilised as indicated by the dominance of the Bitterbush (*Chrysocoma ciliata*). This specific site is also considered to be disturbed with reference to the dominance of dwarf karroid shrubs but overgrazing may be a secondary impact whilst disturbance caused by the mining pit, tailings dump and camping area being the primary impact.

The site does contain a few exotic species including the weed, *Urtica urens*. However, several specimens of the exotic *Prosopis glandulosa* (Mesquite Tree) were identified on the site indicating disturbance (Appendix D). This species is also considered a serious invader of arid areas in the western half of the country and has the potential to spread and form an infestation. Their ability to decrease diversity is well known especially along watercourses.

No rare or endangered species could be identified on the site and it is considered unlikely that such species will occur here. However, a single specimen of the protected *Boscia albitrunca* (Shepherds Tree) was noted on the site (Appendix C). The species is widespread and common and therefore not of significant conservation significance. It is however still a protected species and a permit will have to be obtained to remove it. It is also likely that the site may have other specimens which may have been overlooked.

A large specimen of *Vachellia tortilis* (Umbrella Thorn) occurs on the site. This tree is of significant age and size and is considered to have some conservation value. The species is however common, widespread and not protected. This specimen is also not listed as a Champion Tree of South Africa (Individual Trees and Groups of Trees Declared as Protected Under Section 12 of the National Forests Act of 1998 by the Department of Agriculture, Forestry and Fisheries). It can therefore not be considered of high conservation value. However, efforts should still be made to retain the tree on the site as far as possible.

In conclusion, the site is considered to be modified to a large degree, notably disturbed and no vegetation species or ecological function of high conservation significance occur on the site.

4.2 Overview of terrestrial fauna (actual & possible)

Signs and tracks of mammal species on the site is common and indicates a significant mammal population on the site.

Burrows of a small mammal is common on the site. The inhabitant is most likely Ground Squirrel (*Xerus inauris*) or Yellow Mongoose (*Cynictis penicillata*). Burrows of an Antbear (*Orycteropus afer*) also occurs on the site.

Of these species the Aardvark is listed as a protected species in the Free State Province.

Other species which is likely to occur in the region include:

South African Hedgehog	<i>Atelerix frontalis</i>	Protected Species	Near Threatened in National Red List
Striped Weasel	<i>Poecilogale albinucha</i>	Protected Species	Rare in National Red List
Small-Spotted Cat	<i>Felis negripes</i>	Protected Species	Least Concern in National Red List
Aardwolf	<i>Proteles cristatus</i>	Protected Species	Least Concern in National Red List
Bat-Eared Fox	<i>Orocyon magalotis</i>	Protected Species	Least Concern in National Red List
Brown Hyena	<i>Hyaena brunnea</i>	Protected Species	Near Threatened in the National Red List

It is likely that some of these species may occur in the area.

The area is also utilised as a game farm and the following introduced game occur in the area (Anderson 2008):

Ostrich	<i>Struthio camelus</i>
Waterbuck	<i>Kobus ellipsiprymnus</i> subsp. <i>ellipsiprymnus</i>
Burchell's Zebra	<i>Equus quagga</i> subsp. <i>burchellii</i>
Blesbok	<i>Damaliscus pygargus</i> subsp. <i>phillipsi</i>
Blue Wildebeest	<i>Connochaetus taurinus</i> subsp. <i>taurinus</i>
Mountain Reedbuck	<i>Redunca fulvovufula</i> subsp. <i>fulvorufula</i>
Red Hartebeest	<i>Alcelaphus caama</i>
Eland	<i>Taurotragus oryx</i> subsp. <i>oryx</i>
Gemsbok	<i>Oryx gazella</i>
Impala	<i>Aepyceros melampus</i> subsp. <i>melampus</i>
Springbok	<i>Antidorcas marsupialis</i> subsp. <i>marsupialis</i>
Kudu	<i>Tragelaphus strepsiceros</i> subsp. <i>strepsiceros</i>

These game species are all listed as being of Least Concern (LC).

Of conservation significance and known to occur in the area is the Secretary Bird (*Sagittarius serpentarius*). No nests were noted in trees on the site although these seem to be suitable. The site is however frequented by campers and it is considered unlikely that the species will inhabit the site.

The proposed mining activities on the site is anticipated to have a moderate impact on the mammal species occurring on the site. The protected Aardvark inhabits the site and will vacate the site into adjacent natural areas which will put a strain on surrounding populations. Due to the small scale of the mining area (5 hectares) this impact is not anticipated to be high. The mining activities will likely also dissuade mammal species from inhabiting the immediate

surroundings due to the disturbance caused by mining. If mining operations continue on the site care should be taken that none of them are harmed in any way and any hunting, trapping or capturing should be prevented.

The impact that the proposed mining activities will have on the introduced game is not anticipated to be significant. Due to the small size of the site (5 hectares) the exclusion of the game from this area is not anticipated to have a high impact.

The mining operations is anticipated to have a relatively low impact on the Secretary Bird population due to the current already being disturbed and modified condition and due to the human presence from time to time it is considered unsuitable for nesting.

5. ANTICIPATED IMPACTS

Anticipated impacts which the development will have is primarily concerned with the loss of habitat. The extent of the mining activities is however of small scale (5 hectares) which will not entail a large impact. Furthermore, the site is already transformed and disturbed to some degree further decreasing the impact. The vegetation type occurring on the site is not considered threatened and the loss of such a small portion of this vegetation type will not entail a high impact. However, the site is situated within an area managed as a game farm and although not formally protected still contributes at a smaller scale to conservation. The mining period, a maximum of 5 years, also limits the disturbance to a set time period. Through extensive rehabilitation the site may also be rehabilitated to a close-to-natural condition.

No rare or endangered species could be identified on the site and it is considered unlikely that such species will occur here. However, a single specimen of the protected *Boscia albitrunca* (Shepherds Tree) was noted on the site (Appendix C). The species is widespread and common and therefore not of significant conservation significance. It is however still a protected species and a permit will have to be obtained to remove it. It is also likely that the site may have other specimens which may have been overlooked. This impact is considered to be relatively low.

The artificial waterbody formed by the old mining pit is not considered to have any significant conservation value in terms of ecology. The pit does not perform any vital ecosystem function. It is currently utilised by game as a watering hole. However, as an artificial feature this can easily be replicated post mining or at another location. The same can be said for the small artificial pond. This impact is therefore considered as relatively low.

The site does contain a few exotic species including the weed, *Urtica urens*. However, several specimens of the exotic *Prosopis glandulosa* (Mesquite Tree) were identified on the site indicating disturbance. This species is also considered a serious invader of arid areas in the western half of the country and has the potential to spread and form an infestation. Their ability to decrease diversity is well known especially along watercourses. The mining operations will cause further disturbance which will cause favourable conditions for the establishment of weeds and invaders (Appendix D). The monitoring and eradication of weeds and invaders will therefore have to take place continuously and followed up after cessation of mining activities.

The impact that the proposed development will have on the faunal 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. The extent of the mining area (5 hectares) is however limited and this impact cannot be considered as high. Furthermore, the site is already transformed and disturbed to some degree decreasing the habitat quality for fauna. The direct impact due to hunting, capturing and trapping of fauna should be prevented by making this a punishable offense during the construction phase.

The impact significance has been determined and it is clear that the impacts will be moderate. This is as a result of the limited size of the mining area will not lead to the loss a large portion of the habitat. In addition, as long as extensive rehabilitation measures are implemented the area may be rehabilitated to a near natural condition after mining.

Please refer to Appendix E for the impact methodology.

Significance of the impact:

Impact	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Loss of vegetation type and clearing of vegetation	1	4	2	2.3	5	5	5	11.5
Loss of protected species	2	5	2	3	2	2	2	6
Infestation with weeds and invaders	3	3	3	3	5	3	4	12
Impact on Terrestrial fauna	3	4	3	3.6	3	3	3	10.8

6. SITE SPECIFIC RESULTS

Habitat diversity and species richness:

Habitat diversity on the site is considered relatively low. Habitats include grassland with scattered trees. The habitat has also been modified to some degree by historical mining and an existing recreational camp site (Map 2). The diversity of plant species is also not considered significant.

Presence of rare and endangered species:

No rare or endangered species could be identified on the site and it is considered unlikely that such species will occur here. However, a single specimen of the protected *Boscia albitrunca* (Shepherds Tree) was noted on the site (Appendix C). The species is widespread and common and therefore not of significant conservation significance. It is however still a protected species and a permit will have to be obtained to remove it. It is also likely that the site may have other specimens which may have been overlooked.

A large specimen of *Vachellia tortilis* (Umbrella Thorn) occurs on the site. This tree is of significant age and size and is considered to have some conservation value. The species is however common, widespread and not protected. This specimen is also not listed as a Champion Tree of South Africa (Individual Trees and Groups of Trees Declared as Protected Under Section 12 of the National Forests Act of 1998 by the Department of Agriculture, Forestry and Fisheries). It can therefore not be considered of high conservation value. However, efforts should still be made to retain the tree on the site as far as possible.

Ecological function:

The ecological function of the site is considered to be modified to some degree. This is due to the historical mining; the mining pit and tailings dump as well as the existing recreational camp site (Map 2). The site still functions as habitat for fauna although degraded to some extent. The ecological function is also altered in terms of the functioning of the surrounding area. The ecological functioning of the site is not vital to the continued functioning of the surrounding area. In other words should the site be transformed the surrounding area is anticipated to continue functioning naturally.

Degree of rarity/conservation value:

The vegetation type occurring on the site, Kimberley Thornveld (SVk 4) is currently listed as being of Least Concern (Map 3). It is not currently subjected to any pronounced development pressures. The conservation value and rarity of the vegetation type is therefore not considered significant. The vegetation on the site is also altered to some degree by historical and current impacts.

The site forms part of a game farm owned and managed by a mining company and therefore contributes to conservation. It is however not formally protected which would have increased its conservation value. In spite of this it is still considered to have a significant conservation value.

According to the Free State Biodiversity Plan 2015 the area is listed as an Ecological Support Area 1 (ESA 1). It is therefore not considered a Critical Biodiversity Area (CBA) but functions in maintaining the integrity of surrounding areas.

Percentage ground cover:

Due to the recent drought conditions and overgrazing of the grassland on the site the percentage ground cover is relatively low. The historical tailings dump and mining pit also decrease the vegetation cover.

Vegetation structure:

The vegetation structure on the site is altered to some degree due to the increase in canopy cover brought on by the mining pit and recreational camp site. An increase in dwarf karroid shrubs also transform the vegetation to some degree.

Infestation with exotic weeds and invader plants:

The site does contain a few exotic species including the weed, *Urtica urens*. However, several specimens of the exotic *Prosopis glandulosa* (Mesquite Tree) were identified on the site indicating disturbance (Appendix D). This species is also considered a serious invader of arid areas in the western half of the country and has the potential to spread and form an infestation. Their ability to decrease diversity is well known especially along watercourses.

Degree of grazing/browsing impact:

Grazing by introduced game is considered as moderate. An increase in dwarf karroid shrubs also indicates this.

Signs of erosion:

Some erosion is evident and prominent within and around the historical mining pit.

Terrestrial animals:

The proposed mining activities on the site is anticipated to have a moderate impact on the mammal species occurring on the site. The protected Aardvark inhabits the site and will vacate the site into adjacent natural areas which will put a strain on surrounding populations. Due to the small scale of the mining area (5 hectares) this impact is not anticipated to be high. The mining activities will likely also dissuade mammal species from inhabiting the immediate surroundings due to the disturbance caused by mining. If mining operations continue on the site care should be taken that none of them are harmed in any way and any hunting, trapping or capturing should be prevented.

The impact that the proposed mining activities will have on the introduced game is not anticipated to be significant. Due to the small size of the site (5 hectares) the exclusion of the game from this area is not anticipated to have a high impact.

The mining operations is anticipated to have a relatively low impact on the Secretary Bird population due to the current already being disturbed and modified condition and due to the human presence from time to time it is considered unsuitable for nesting.

Table 2: Biodiversity Sensitivity Rating for the proposed mining development.

	Low (3)	Medium (2)	High (1)
Vegetation characteristics			
Habitat diversity & Species richness	3		
Presence of rare and endangered species		2	
Ecological function	3		
Uniqueness/conservation value		2	
Vegetation condition			
Percentage ground cover	3		
Vegetation structure	3		
Infestation with exotic weeds and invader plants or encroachers		2	
Degree of grazing/browsing impact		2	
Signs of erosion		2	
Terrestrial animal characteristics			
Presence of rare and endangered species		2	
Sub total	12	12	0
Total		24	

7. BIODIVERSITY SENSITIVITY RATING (BSR) INTERPRETATION

Table 3: Interpretation of Biodiversity Sensitivity Rating.

Site	Score	Site Preference Rating	Value
Mining development	24	Acceptable	3

8. DISCUSSION AND CONCLUSION

The site proposed for the mining operations has been rated as being acceptable for the development. This is however subject to adequate rehabilitation taking place.

According to Mucina & Rutherford (2006) the area consists of Kimberley Thornveld (SVk 4) (Map 3). The vegetation type is still largely intact with cultivation being the major threat. It is currently as being of Least Concern within the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004) (Map 3). The vegetation on the site is also altered to some degree by historical and current impacts.

The site considered for mining operations has been largely transformed by historical mining activities (Map 2). A large portion of the site consists of an old mining pit and tailings dump. A portion of the site is also utilised as a recreational camping area with small building, artificial pond and structures associated with the camping area. Several dirt tracks also occur on the site. Due to the long period after last mining activities the area has rehabilitated itself to a large degree although the species composition is altered from the natural condition largely due to the transformation of the topography and habitat.

The artificial waterbody formed by the old mining pit is not considered to have any significant conservation value in terms of ecology (Map 2). The pit does not perform any vital ecosystem function. It is currently utilised by game as a watering hole. However, as an artificial feature this can easily be replicated post mining or at another location. The same can be said for the small artificial pond.

The site does contain a few exotic species including the weed, *Urtica urens*. However, several specimens of the exotic *Prosopis glandulosa* (Mesquite Tree) were identified on the site indicating disturbance (Appendix D). This species is also considered a serious invader of arid areas in the western half of the country and has the potential to spread and form an infestation. Their ability to decrease diversity is well known especially along watercourses.

No rare or endangered species could be identified on the site and it is considered unlikely that such species will occur here. However, a single specimen of the protected *Boscia albitrunca* (Shepherds Tree) was noted on the site (Appendix C). The species is widespread and common and therefore not of significant conservation significance. It is however still a protected species and a permit will have to be obtained to remove it. It is also likely that the site may have other specimens which may have been overlooked.

A large specimen of *Vachellia tortilis* (Umbrella Thorn) occurs on the site. This tree is of significant age and size and is considered to have some conservation value. The species is however common, widespread and not protected. This specimen is also not listed as a Champion Tree of South Africa (Individual Trees and Groups of Trees Declared as Protected Under Section 12 of the National Forests Act of 1998 by the Department of Agriculture,

Forestry and Fisheries). It can therefore not be considered of high conservation value. However, efforts should still be made to retain the tree on the site as far as possible

In conclusion, the site is considered to be modified to a large degree, notably disturbed and no vegetation species or ecological function of high conservation significance occur on the site.

The proposed mining activities on the site is anticipated to have a moderate impact on the mammal species occurring on the site. The protected Aardvark inhabits the site and will vacate the site into adjacent natural areas which will put a strain on surrounding populations. Due to the small scale of the mining area (5 hectares) this impact is not anticipated to be high. The mining activities will likely also dissuade mammal species from inhabiting the immediate surroundings due to the disturbance caused by mining. If mining operations continue on the site care should be taken that none of them are harmed in any way and any hunting, trapping or capturing should be prevented.

The impact that the proposed mining activities will have on the introduced game is not anticipated to be significant. Due to the small size of the site (5 hectares) the exclusion of the game from this area is not anticipated to have a high impact.

The mining operations is anticipated to have a relatively low impact on the Secretary Bird population due to the current already being disturbed and modified condition and due to the human presence from time to time it is considered unsuitable for nesting.

Anticipated impacts which the development will have is primarily concerned with the loss of habitat. The extent of the mining activities is however of small scale (5 hectares) which will not entail a large impact. Furthermore, the site is already transformed and disturbed to some degree further decreasing the impact. The vegetation type occurring on the site is not considered threatened and the loss of such a small portion of this vegetation type will not entail a high impact. However, the site is situated within an area managed as a game farm and although not formally protected still contributes at a smaller scale to conservation. The mining period, a maximum of 5 years, also limits the disturbance to a set time period. Through extensive rehabilitation the site may also be rehabilitated to a close-to-natural condition.

The impact significance has been determined and it is clear that the impacts will be moderate. This is as a result of the limited size of the mining area will not lead to the loss a large portion of the habitat. In addition, as long as extensive rehabilitation measures are implemented the area may be rehabilitated to a near natural condition after mining.

9. RECOMMENDATIONS

- The monitoring and eradication of weeds will have to take place continuously and followed up after cessation of mining activities (Appendix D).
- Hunting, capturing and trapping of fauna should be prevented by making this a punishable offense during the construction phase.
- A permit should be obtained to remove any specimens of the protected *Boscia albitrunca* (Shepherds Tree) occurring on the site.
- The large *Vachellia tortilis* (Umbrella Thorn) on the site is not formally protected but should be retained as far as possible due to its significant age and size.
- Rehabilitation of the mining area should be comprehensive and should include the following:
 - Spoil and tailings resulting from the mining operations should be returned to excavations in order to re-instate the topography of the site.
 - Any slimes dam or storage facility should be demolished and material returned to excavations. The risk of groundwater pollution should also be determined.
 - The topography of the site should be re-instated as far as possible.
 - Eradication and monitoring of weed establishment should take place and should be extended after cessation of mining (Appendix C).
 - The mined area should be seeded with vegetation from the surrounding area.
 - Seedlings of the trees on the site, *Vachellia tortilis*, should be established on the site to replace those which were removed during mining.
 - Topsoil should be removed prior to mining, protected from wind erosion and weed establishment and replaced on the site during rehabilitation.
 - Adequate monitoring of rehabilitation success should be done and remedial action taken where required.
 - After mining has ceased all manmade materials should be removed from the site, i.e. structures, concrete, waste, etc.

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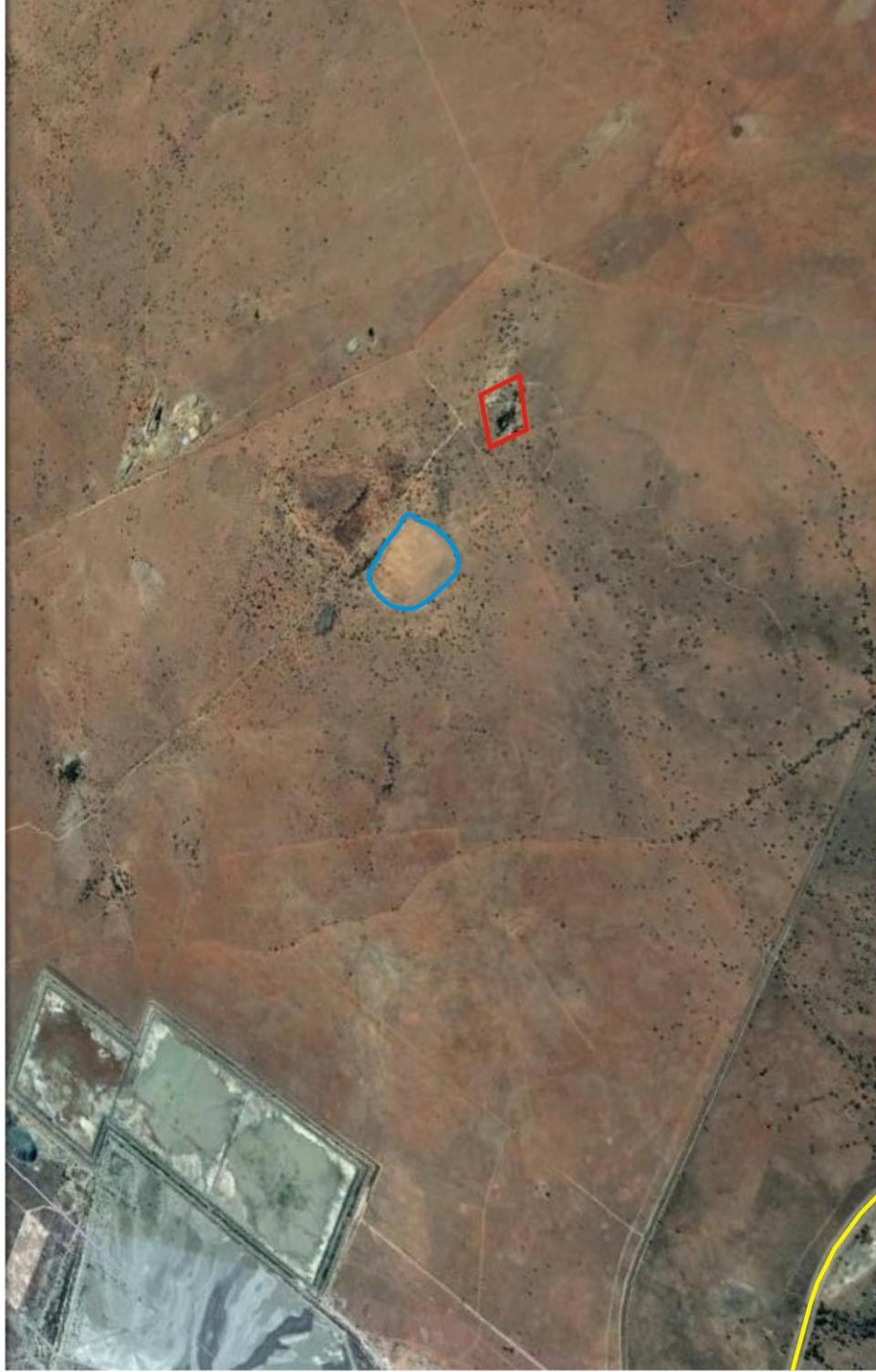
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Annexure A: Maps and Site photos

Locality map for the proposed diamond mining operations at the Rooifontein Game Farm on the Remainder of the Farm Dutoitpan 119 (Rooifontein 1722) near Kimberley, Free State Province.



Map 1: Locality map of the proposed mining area at the Rooifontein Game Farm near Kimberley. Note the site is situated in a largely natural surroundings although the existing mining pit is visible on the site. Also take note of current mining operations to the east of the site. The ephemeral pan north west of the site is also indicated.



Prepared for:
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Legend:

- Site boundary
- N8 National Road
- Ephemeral pan

Map Information

Spheroid: WGS 84



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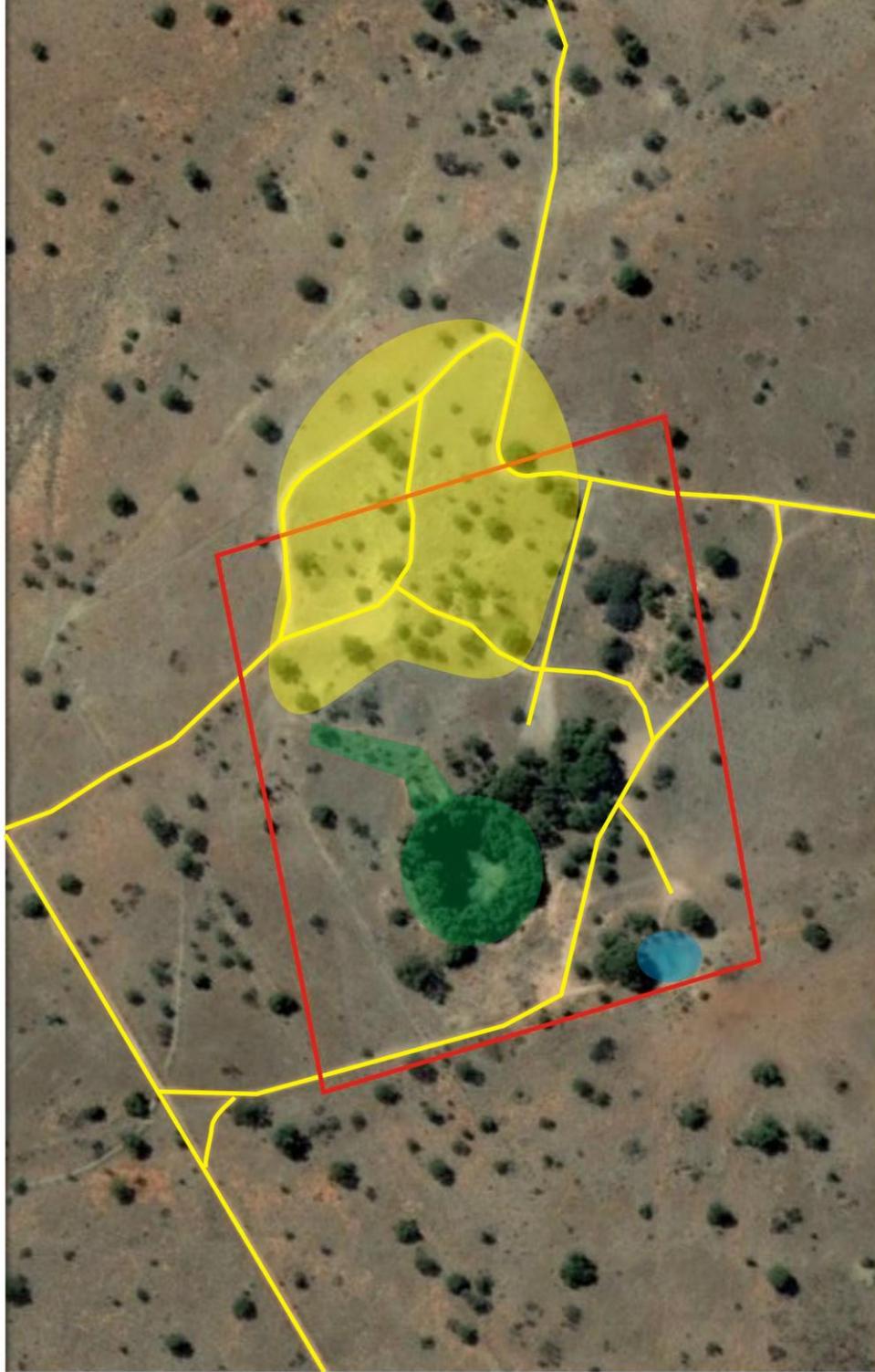
Tel: 051 4444 700

Fax: 086 6976 132





Layout map for the proposed diamond mining operations at the Rooifontein Game Farm on the Remainder of the Farm Dutoitpan 119 (Rooifontein 1722) near Kimberley, Free State Province.



Map 2: Layout map of the proposed mining area at the Rooifontein Game Farm near Kimberley. The site boundary is indicated as well as dirt tracks, artificial pond, historical mining pit and tailings dump.



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Legend:

-  Site boundary
-  Dirt tracks
-  Artificial pond
-  Mining pit
-  Tailings dump

Map Information

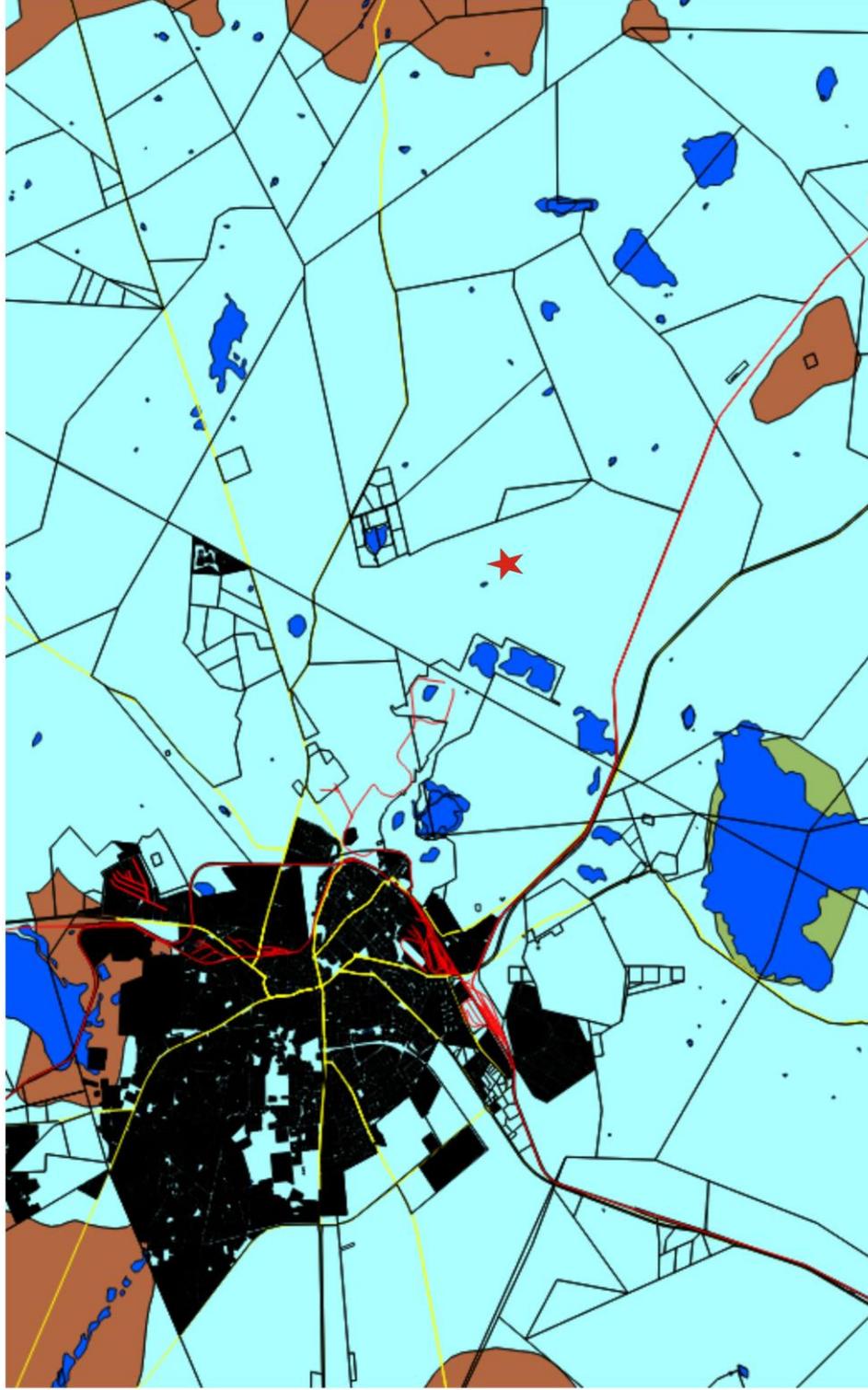
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General ecology for the proposed diamond mining operations at the Rooifontein Game Farm on the Remainder of the Farm Dutoitpan 119 (Rooifontein 1722) near Kimberley, Free State Province.



Map 3: General ecology of the proposed mining area at the Rooifontein Game Farm near Kimberley. The site is indicated. Note no wetlands are present near the site. No formal or informal protected areas are present near the site.



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Legend:

- ★ Site location
- Road network
- Rail network
- Property boundaries
- Kimberley Thornveld
- Vaalbos Rocky Shrubland
- Northern Upper Karoo
- Wetlands and waterbodies
- Urban Area

Map Information

Spheroid: WGS 84

Scale: 1:100 000

Quantum GIS

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Figure 1: View of the existing mining pit on the site. Note that the pit has formed an artificial waterbody.



Figure 2: View of the site surrounding the mining pit. Note abundance of dwarf karroid shrubs indicating disturbance. One of the dirt tracks on the site is also indicated (red).



Figure 3: View of the site with the recreational camp site (red) adjacent to the mining pit.



Figure 4: View of the small artificial pond on the site. The water inlet is indicated in red.



Figure 5: Excavated trench adjacent to the mining pit used for hauling material from the pit. Note erosion along the banks of the trench.



Figure 6: View of the historical tailings dump.



Figure 7: View from the top of the tailings dump. Note the low vegetation cover.



Figure 8: View of the large *Vachellia tortilis* (Umbrella Thorn) in the camp site.



Figure 9: Tracks and signs of mammals are abundant on the site. From the top left clockwise are the burrow of a small unidentified mammal, a burrow of an Aardvark (*Orycteropus afer*) and several burrows of a small unidentified mammal.

Appendix B: Species list

Species indicated with an * are exotic.

Protected species are coloured orange and Red Listed species red.

Species	Growth form
* <i>Prosopis glandulosa</i>	Tree
* <i>Urtica urens</i>	Herb
<i>Aptosimum spinescens</i>	Dwarf shrub
<i>Aristida congesta</i>	Grass
<i>Asparagus larcinus</i>	Shrub/climber
<i>Asparagus suaveolens</i>	Dwarf shrub
<i>Boscia albitrunca</i>	Tree
<i>Chrysocoma ciliata</i>	Dwarf shrub
<i>Cymbopogon pospischilii</i>	Grass
<i>Cynodon dactylon</i>	Grass
<i>Diospyros lycioides</i>	Shrub/tree
<i>Ehretia rigida</i>	Shrub/tree
<i>Eragrostis lehmanniana</i>	Grass
<i>Eragrostis obtusa</i>	Grass
<i>Gnidia polycephala</i>	Dwarf shrub
<i>Hetereopogon contortus</i>	Grass
<i>Lycium cinerium</i>	Dwarf shrub
<i>Lycium hirsutum</i>	Shrub
<i>Lycium horridum</i>	Dwarf shrub
<i>Pentzia incana</i>	Dwarf shrub
<i>Rosenia humilis</i>	Dwarf shrub
<i>Searsia lancea</i>	Tree
<i>Setaria verticillata</i>	Grass
<i>Themeda triandra</i>	Grass
<i>Tragus berteronianus</i>	Grass
<i>Vachellia tortilis</i>	Tree
<i>Ziziphus mucronata</i>	Tree

Appendix C: Protected species present

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



Boscia albitrunca
Shepherds Tree/Witgat Boom

Protected species

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

Obtain a permit to remove any of this species from the site.

Appendix D: Likely invader weed species

Invader weed species on the site may not be limited to these species but these are considered to be the most likely and significant invaders to occur. Additional sources should be consulted to confirm invader weed species as well as the best method to eradicate them.

According to the Conservation of Agricultural Resources Act, No. 43 of 1983 any Category 1 declared plants must be controlled by the land user on whose land such plants are growing.



Cirsium vulgare
Scotch Thistle/Skotse Dissel

Type: Weed
Category: 1

Mechanical removal is effective to control this weed. Cutting should be done below soil level and no leaves should remain.



Xanthium spinosum
Spiny Cocklebur/Boetebos

Type: Weed
Category: 1

Mechanical removal by hand is effective to control this weed.

Several chemicals have also been registered for control: amitrole/simazine, bromoxynil, metribuzin, MCPA-K and 2,4-D(A).



Xanthium strumarium
Large cocklebur/Kankerroos

Type: Weed
Category: 1

Mechanical removal by hand is effective to control this weed. Cutting is not recommended as this leads to re-sprouting.

Several chemicals have also been registered for control: bromoxynil, metribuzin, cyanazine/atrazine, bendioxide, MCPB, MCPA-K and 2,4-D(A), (T), (I).



Argemone ochroleuca
Mexican Poppy

Type: Weed
Category: 1

Mechanical removal by hand is effective against this weed.

Several chemicals have also been registered for control: 2, 4-D, 2, 4-DB, dicamba, diuron, fluroxypyr, hexazinone, isoproturon, karbutilate, MCPA, picloram and terbutryn.



Datura stramonium
Common Thorn Apple/Gewone stinkblaar

Type: Weed
Category: 1

Mechanical control is most effective. Pulling of plants and correct disposal of seed bearing plants is effective.

Chemical control is by means of a glyphosate spray



Datura ferox
Large thorn-apple/Grootstinkblaar

Type: weed
Category: 1

Mechanical removal by hand is effective for this weed.

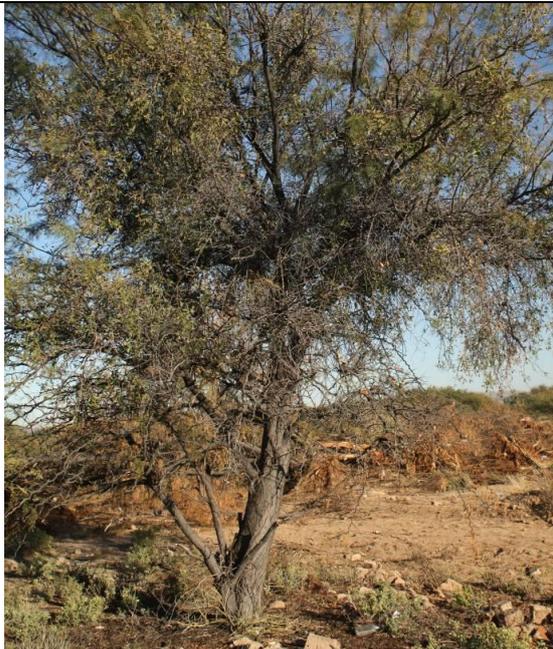


Opuntia spp.
Prickly Pear

Type: Weed
Category: 1

Mechanical control is effective for single specimens. All parts of the plant must be removed and burned.

Chemical is most effective control method. Monosodium methanearsonate (MSMA) and glyphostae must be injected into the stem as concentrated solutions.



Prosopis glandulosa
Mesquite/Muskietboom/Prosopis

Type: Invader
Category: 1b

The species is highly problematic in the Northern Cape and is not easily eradicated.

Trees should be cut and the stumps immediately treated with a ticlopyr or ticlopyr/picloram herbicide.

Afterwards the area must be monitored for the germination of any seedlings which must be pulled out and disposed of. The area must also be monitored for the coppicing of any of the stumps which must be cut and treated with a herbicide.



Appendix E: Impact methodology

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

$$\text{Environmental Significance} = \text{Overall Consequence} \times \text{Overall Likelihood}$$

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.

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