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Report on the biodiversity and ecological assessment of the proposed establishment of a township development on the Remainder of Erf 1, Postmasburg, Northern Cape Province.

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Executive Summary

Anticipated impacts which the development will have is primarily concerned with the loss of habitat. The site is largely natural although the vegetation composition and structure has been somewhat degraded by overgrazing. As a result this decreases the impact somewhat when compared to the loss of pristine habitat (not degraded by overgrazing). The vegetation type on the site, Kruruman Thornveld, is also listed as being of Least Concern (LC) and is not currently subjected to any pronounced developmental pressures (Map 2). Nonetheless certain portions of the site contain species compositions, prominent landscape features and high levels of protected species which should be excluded from development (Map 3). This will considerably mitigate the impact as this will provide refugia to mammal species and provide natural corridors for species to migrate between natural areas. It will also prevent habitat fragmentation whereby corridors remain for species to migrate between natural areas.

The development will also entail the loss of several species which are protected and considered significant to conservation (Appendix C). These species include *Aloe hereroensis*, *A. claviflora*, *A. grandidentata*, *Pachypodium succulentum*, *Boscia albitrunca*, *Mestoklema tuberosum*, *Boophane distichia*, *Harpagophytum procumbens*, *Fockea angustifolia*, *Sarcostemma veminale*, *Nananthus aloides*, *Euphorbia crassipes*, *Anancampseros filamentosa*, *Vachellia erioloba* and *Nerine laticoma*. As mitigation it is recommended that permits be obtained to removed and transplant these species to adjacent areas. These species consists of succulent and bulb species and as a result will be easily transplanted and the transplant success rate is anticipated to be high as long as it is adequately done.

The exception is the two protected tree species, the Camel Thorn (*Vachellia erioloba*) and the Shephers Tree (*Boscia albitrunca*). These species will not transplant easily. Instead it is recommended that specimens be incorporated into the development as far as possible and for those where it is not possible the necessary permits be obtained to remove them. As offset for removing these trees seedlings can be planted as part of the landscaping of the development.

It is recommended that a walkthrough of the site be done prior to construction to mark and map all protected plants on the site. Several of these species are also cryptic and well camouflaged and it is recommended that a suitably qualified ecologist/botanist perform the walkthrough. Following this transplanting of succulent and bulb species should be done adequately and establishment overseen by an ecologist or person with suitable qualifications. These species should be transplanted to areas excluded from development. The monitoring of re-establishment should also be undertaken. In these areas they will remain within the natural genetic population, will be protected, will enable exchange of genetic material with adjacent populations and will provide a population for the possible re-distribution of propagules.

The drainage line traversing the site has been identified as being highly sensitive (Map 3). As a result it should be excluded from development and treated as a no-go area. In addition a buffer of at least 30 meters should be kept on either side of it. This will mitigate most impacts on the system and will ensure it remains intact. Further mitigation should however also include a storm water management plan to ensure that runoff is managed in such a way as to prevent erosion of the drainage system and prevent polluted runoff from entering the system. Any crossing of this drainage line by roads, bridges and infrastructure should also be designed to cause minimal disturbance of the systems and should not significantly impact on the flow and flooding regime. Erosion measures should also be implemented where required. Where development occurs within 100 meters or within the floodplain of the drainage line a Water Use License

Application (WULA) should be lodged as required by the Department of Water and Sanitation (DWS).

The Groenwaterspruit occurs just south of the development. It is listed as a National Freshwater Ecosystems Priority Area (NFEPA) with a Present Ecological State (PES) of Category B: Largely Natural. Although this system will not be included in the site proposed for development the impact that the development may have should still be taken into account. Therefore in any instance where development occurs within 100 meters or within the 1:100 year floodline a Water Use License Application (WULA) should also be lodged as required by the Department of Water and Sanitation (DWS).

As listed in the species list, several exotic species occur on the site, especially along the border with the residential area where disturbance is high. These should be removed from the site during construction as well as from areas which are excluded from development. Where category 1 and 2 weeds are 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 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 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 before mitigation will be significant. However, if adequate mitigation is implemented these impacts will be considerably decreased. The impact before mitigation is anticipated to be moderately-high and will be moderately-low after mitigation.

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.


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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.

South Africa contains 19 known centres of endemism. These areas contain a high number of species endemic to this specific area. Due to the limited range of most of these species many are rare, protected or endangered. The proposed power line is situated within the Griqualand West Centre of Endemism. Many species occurring within this centre is unique and localised to this area. Development in such centres of endemism should be done with careful investigation of the biodiversity and species composition of the area. Areas with rare, endangered or endemic species and areas with a high biodiversity should be avoided when planning a development.

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 residential development will occur on the Remainder of Erf 1 of the town of Postmasburg (Map 1). The extent of the area to be developed is approximately 450 ha. The site is situated on the north western boundary of the town of Postmasburg and the site consists primarily of natural vegetation although degraded in areas by communal grazing and the adjacent residential areas .

A site visit was conducted on 4 April 2016. The entire footprint of the residential development 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 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 residential development.
- To identify possible negative impacts that could be caused by the proposed construction of a residential housing 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

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

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, Court 2010, Hartmann 2001, Manning 2009, Roberts & Fourie 1975, Shearing & Van Heerden 2008, Van Oudtshoorn 2004, Van Rooyen 2001, Van Wyk & Malan 1998, Van Wyk & Van Wyk 1997).

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 Kuruman Thornveld (SVk 9) (Map 2). This vegetation type is listed as being of Least Concern (LC) within the National List of Threatened Ecosystems (Notice 1477 of 2009)(National Environmental Management Biodiversity Act, 2004) (Map 2). It is not currently subjected to any pronounced development pressures.

The site consists primarily of natural vegetation although communal grazing and activities associated with the adjacent residential areas cause disturbance in some areas. Only small areas occur where the natural vegetation has been totally transformed. This is notably the construction of a water reservoir and associated infrastructure on top of one of the hills and soil excavations and rock dumps along the southern boundary of the site.

The site is situated on the north western border of the town of Postmasburg and has an approximate extent of 450 ha (Map 1). The site is situated in the Savannah Biome and the vegetation therefore consists of a grassland with well developed shrub/tree layer. Certain areas also contain a well developed dwarf karroid shrub layer which indicates transitional areas with the Nama Karoo Biome. The site also contains two low but prominent hills and these have a much more denser shrub canopy.

The topography of the site consists of a plain sloping gradually from north to south and toward the Groenwaterspruit. This is a large seasonal river flowing to the south of the site. It is located approximately 100 meters south of the site. The slope of the plains portion varies in elevation from 1339 m in the north to 1325 m in the south also indicating the slope of this area. Two low but prominent hills also occur on the site and influence the topography. they are situated in the north western portion and south central portion of the site. These hills have an approximate elevation of 1350 m and 1370 m. They are prominent features in the topography of the site. In the eastern portion of the site low calcrete ridges also occur. They do not form prominent features in terms of topography but in terms of soil and geology are readily distinguished. A small seasonal drainage line also traverses the site from the north to south and is a tributary of the Groenwaterspruit.

The site has soils of the Hutton soil form which are shallow soils with an orthic A/red apedal B/hard rock. This soil type is generally resistant to erosion .

The geology of the site consists of unconsolidated windblown sand of the Quarternary Kalahari Formation Precambrian and the Transvaal Supergroup underlain by the Campbell Rand Supergroup which in turn consists of cherts, shales, dolomites and carbonate rocks.

The differing topographical units and their associated vegetation will be discussed separately. These units can be divided into the plains with sandy soils, the two low hills, calcrete ridges and drainage line.

Low Hill (North eastern corner of site)

This free standing hill has a relatively uniform slope from the central point and two rocky outcrops along the eastern slope. The hill has a uniform vegetation although canopy cover along the southern slope is much more dense. The vegetation on the two rock outcrops are distinctly different to the surroundings although they cover a small area of the hill. The central highest point of the hill has been transformed by a reservoir and associated structures and infrastructure. The Groenwaterspruit border the hill on the south and east. Communal grazing on this hill is evident and is considered likely to have increased the canopy cover of unpalatable species such as *Senegalia melifera* subsp. *detinens* (Black Thorn). The hill is largely dominated by *Senegalia melifera* subsp. *detinens* (Black Thorn) and *Tarchonanthus camphoratus* (Vaalbos). Other shrubs and small trees include *Searsia trydactyla*, *S. burchellii*, *Grewia flava*, *Ehretia rigida*, *Rhigozum trichotomum* and *Boscia albitrunca*. Of these the *Boscia albitrunca* (Witgat/Shepherds Tree) is a protected species. As a result where required the necessary permits will have to be acquired to remove them. The hill also contains a variety of succulent species which include *Aloe hereroensis*, *A. grandidentata*, *Pachypodium succulentum* and *Mestoklema tuberosum*. These species are all listed as protected species in the Northern Cape Province (Appendix C). They widespread and do not constitute a fatal flaw but are however still of conservation significance. It is therefore recommended that where required the necessary permits be obtained and the plants transplanted to an area on site where they will not be affected by construction. The two rocky outcrops on the eastern slope contain a species composition which is markedly different from the surrounding area. These species include *Vangueria infausta*, *Achyranthes aspera*, *Hermannia bryoniifolia*, *Sutera griquensis* and *Abutilon austro-afrikanum*. Although the vegetation itself is not of conservation significance, the composition of species and positive landscape features are considered to be of conservation significance. The hill does not contain any significant infestation or establishment of exotic weeds.

As from the above the following is recommended. That any specimens of the protected Witgat/Shepherds Trees (*B. albitrunca*) that require removal only be done so with the possession of a permit from the relevant authorities. All protected succulent species as listed above be transplanted to an area on the site where they will not be affected by the development. The two rocky outcrops on the eastern slope of the hill contain a unique species composition and form prominent landscape features and should be excluded from development. The hill itself is considered to have a significant conservation value and although no elements exist which would make it a no-go area it is still recommended that the hill be the last to be developed, i.e. the areas of lower conservation sensitivity should be developed first and if more development space is required the hill should then be developed. As a consequence of all of the above it is mapped as an area of high sensitivity (Map 3).

Plains portion (Central and western portions of the site)

The plains portions consist of a much more open structure with a grass layer which is better developed although sparse and of low height as a result of the relatively low rainfall in this region. The shrub composition is quite similar to the hill as described above but some species differ the two hills. The plains portion in the centre of the site consists of sandy soils. Overgrazing of this portion is evident and decreases the vegetation cover. The plains portion in the western portion of the site are very similar to that of the central portion but the sandy soils are replaced by shallow calcrete which alters the species composition to some degree. Dwarf karroid shrubs are much more abundant as a result. This portion is also heavily affected by

communal overgrazing. The shrub tree layer is similar between the two plains areas and is dominated by *Tarchonanthus camphoratus* and *Searsia ciliata*. The latter is more dominant in the calcrete areas and the former more dominant in the sandy areas. Other species which are common include *Ziziphus mucronata* and *Senegalia melifera* subsp. *detinens*. The sandy portion of the plains also contain isolated specimens of the protected *Vachellia erioloba* (Camel Thorn). The species is also listed as a Declining species in the National Red List. It should therefore be considered of conservation significance. It is however widespread and will not be possible to transplant the specimens. It is therefore recommended that where possible plants should be kept intact and incorporated into the residential development and where not possible permits should be obtained to remove them. Those that are removed should be replaced by seedlings in the landscaping of the residential development. Another protected species occurring in this area which is also listed as a Declining species is the bulb, *Boophane distichia*. This species is easily transplanted and permits should be obtained to transplant them to areas on the site which will not be affected by construction. The species may also occur in the other areas of the site and this should be taken into consideration during the final walkthrough of the site. Another protected species which is confined to the sandy portions, the geophyte *Harpogophytum procumbens* (Devils Claw). The species can be easily transplanted but has a deep taproot and this should be taken into consideration. Permits should be obtained and they should be transplanted to an area on the site where they will not be affected by construction. The portion which contains shallow calcretes may also contain protected species but these will be discussed under the clacrete ridge portion of the site.

From the above the following is recommended. Any specimens of Camel Thorn (*V. erioloba*) which require removal should only be done with the necessary permits (Appendix C). It is recommended that where possible specimens of Camel Thorn (*V. erioloba*) should be kept intact and incorporated into the residential development and where not possible permits should be obtained to remove them. Those that are removed should be replaced by seedlings in the landscaping of the residential development. The bulb, *Boophane distichia* is easily transplanted and permits should be obtained to transplant them to areas on the site which will not be affected by construction (Appendix C). The geophyte *Harpogophytum procumbens* (Devil's Claw) can be easily transplanted but has a deep taproot and this should be taken into consideration. Permits should be obtained and they should be transplanted to an area on the site where they will not be affected by construction (Appendix C). These plains portions of the site contain less protected species and is much more uniform in terms of species composition. It is also not a prominent landscape feature and overgrazing has degraded the vegetation. As a result these portions have been mapped as being of moderate sensitivity (Map 3).

Low Hill (South western portion of site)

This free standing hill is very similar to the other hill on the site but does however differ somewhat in terms of species composition. The vegetation is also rather uniform but with the same differences in density on the northern and southern slopes. The hill is relatively natural although small areas of excavations are present and overgrazing is evident. The Groenwaterspruit also borders the hill to the south. The species composition of dominant shrubs and trees is very similar to the other hill. The same protected species occur on this hill as on the other although three additional species are found (Appendix C). These are *Fockea angustifolia*, *Sarcostemma veminale* and *Aloe claviflora*. These species are also widespread but should still be considered of conservation significance.

As can be seen the two hills are very similar and as a result the same mitigation is recommended for this hill as the other. The only difference would be that the hill in the north east of the site contains prominent rocky outcrops which should be excluded whereas the south western hill contains no such outcrops. The mitigation recommended for this hill would then be the following. That any specimens of the protected Witgat/Shepherds Trees (*B. albitrunca*) that require removal only be done so with the possession of a permit from the relevant authorities. All protected succulent species should be transplanted to an area on the site where they will not be affected by the development. The hill itself is considered to have a significant conservation value and although no elements exist which would make it a no-go area it is still recommended that the hill be the last to be developed, i.e. the areas of lower conservation sensitivity should be developed first and if more development space is required the hill should then be developed. As a consequence of all of the above it is mapped as an area of high sensitivity (Map 3).

Drainage line

A small drainage line transects the site from north to south within the western portion of the site. It drains from the residential area along the northern border of the site. As a result of the increased storm water runoff caused by the built-up area and tarred surfaces the drainage line is increased in size, flow rate and flow volumes. This increased flow dissipates with distance from the residential area and downstream resumes a more natural flow rate. It is also a tributary of the Groenwaterspruit and as such should be considered of significance to conservation. The habitats bordering the drainage line in the southern portion, calcrete ridges, is also considered sensitive habitats which warrant conservation. The drainage line is still natural to a large degree but has been degraded by several impacts. These impacts are primarily as a result of the upstream residential area and include increased runoff and consequently increased erosion, littering in the drainage line, obstruction to flow from roads and other obstructions and increased establishment of exotic weeds as a result of the disturbance. Downstream a dirt road also acts as a flow barrier and affected the flow regime of the drainage line. As the drainage line flows into the Groenwaterspruit it is considered of significance and will have a prominent impact on the flow with this watercourse. The Groenwaterspruit is listed as a National Freshwater Ecosystems Priority Area (NFEPA) with a Present Ecological State (PES) of Category B: Largely Natural. It should therefore be clear that this watercourse is of high priority with a high sensitivity. Although the Groenwaterspruit does not form part of the site this drainage line tributary does flow into the river and any impacts on it will therefore also affect the Groenwaterspruit. As a result the drainage line is considered to be of very high sensitivity (Map 3).

The drainage line is very small and in several areas is not easily discernible. Riparian vegetation is present in it and includes among others *Nidorella resedifolia*, *Vachellia karroo* and *Cyperus longus*. Where disturbance is evident such as where it exits the residential area weeds and exotics are present and these include *Pennisetum setaceum*, *Eucalyptus camaldulensis*, *Schinus molle*, *Flaveria bidentis*, *Tagetes minuta* and *Conyza bonariensis*.

Due to the sensitivity of this drainage line it is recommended that it be excluded from development and a buffer of at least 30 meters be kept around it. Construction within the drainage line will also promote flooding and may cause problems with storm water management. It is also recommended that the drainage line be maintained as a no-go area and that crossing of it by roads be kept to a minimum and that the design of these crossings be designed to keep impacts on the flow regime and erosion to a minimum.

Calcrete ridge (alongside the lower portion of the drainage line)

A calcrete ridge and areas with shallow soils and high percentage calcrete occur adjacent to the lower portion of the drainage line. The vegetation along these calcrete areas are similar to that of the surrounding plain areas as discussed above (Plains portion) but contain a few species which are uniquely adapted to the shallow calcrete soils. Grass cover is lower with a higher degree of dwarf karroid shrubs. Grass and karroid shrubs adapted and occurring in this habitat include *Enneapogon desvauxii*, *Geigeria filifolia*, *Blepharis mitrata*, *Fingerhuthia africana*, *Tragus koelerioides* and *Pentzia incana*. Unique species with significant conservation value is the two succulents *Nananthus aloides* and *Euphorbia crassipes*. These species are protected and considered to be rare, are widespread but never common (Appendix C). Another protected species, *Anancampseros filamentosa*, also occurs in this habitat. Due to the unique assemblage of species it is recommended that this calcrete be excluded from development and be included in the 30 meter buffer kept adjacent to the drainage line. Any of the protected species which will still be affected by construction should then be transplanted into the buffer area adjacent to the drainage line.

From the above discussions it should be clear that no fatal flaws occur on the in terms of the ecology and biodiversity. The vegetation type present on the site is also not in any way under development pressures and large portions of it is still intact. The site is also bordering on residential areas and consequently is being degraded by the close proximity to human activities. The overgrazing of the area by communal grazing is especially evident and degrades the site. However, several elements of conservation value occur and requires special mitigation in order to minimise the impact of the development.

The following summarises the mitigation of sensitive areas and protected species. The two hills on the site forms prominent landscape features and harbour a high amount of protected species (Appendix C). As a result these hills are considered sensitive and it is recommended that these hills be the last to be developed, i.e. the areas of lower conservation sensitivity should be developed first and if more development space is require the hills should then be developed (Map 3). The two rocky outcrops on the north eastern hill is also prominent and contain a unique species composition. It is recommended that these outcrops be excluded from development. The drainage line transecting the site is small and degraded by the adjacent residential area but is nonetheless considered to be of very high sensitivity and should be excluded from development (Map 3). A buffer of at least 30 meters should also be kept on either side of the drainage line. Furthermore, the calcrete ridge adjacent to the drainage line in its lower portion is also considered a unique habitat and should be included in this buffer to be excluded from development (Map 3). The large amount of protected species occurring on the site is of conservation significance (Appendix C). These species should be managed as recommended in the above discussions. Furthermore, several of these species are cryptic and well camouflaged and it is recommended that a final walkthrough of the site be done prior to construction. This should be done by a qualified ecologist/botanist and all protected species marked on site and GPS coordinates taken. Those species that will then require removal or transplanting can be determined. The transplanting of these species should also be supervised by a suitably qualified ecologist/botanist and monitoring of success rates of re-establishment undertaken.

4.2 Overview of terrestrial fauna (actual & possible)

Signs and tracks of mammal species are common on the site and indicates a varied mammal population on the site. This includes Burrows of unidentified small carnivores, dungheaps of Rock Hyrax (*Procavia capensis*) and dungheaps of small antelope, possibly Steenbok (*Raphicerus campestris*) or Duiker (*Sylvicapra grimmia*). However, it is considered highly likely that the mammal population has been affected by the adjacent residential areas and impacts associated with this such as feral dogs hunting small mammals and trapping of mammals using snares, etc. The site is also utilised for communal grazing and the farmers will undoubtedly hunt small carnivores such as Black Backed Jackal (*Canis mesomelas*). Furthermore the farmers make use of herding dogs which will also impact on the small mammals in the area. As a result it is considered unlikely that species of conservational importance will occur on the site.

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.

In light of the above the site will contain a significant mammal population during construction. Care should therefore be taken to ensure none of the faunal species on site is harmed. The hunting, capturing or harming in any way of mammals on the site should not be allowed.

Table 2: Likely mammal species in the region.

Order	Family	Common name	Scientific name	
Phylum Vertebrata; Class Mammalia				
Macroscelidea	Macroscelididae	Round-eared Sengi	<i>Macroscelides proboscideus</i>	
Eulipotyphla	Erinaceidae	Southern African Hedgehog	<i>Atelerix frontalis</i>	
Pholidota	Manidae	Ground Pangolin	<i>Smutsia temminckii</i>	
Lagomorpha	Leporidae	Cape Hare	<i>Lepus capensis</i>	
		Scrub Hare	<i>Lepus saxatilis</i>	
Rodentia	Sciuridae	Southern African Ground Squirrel	<i>Xerus inauris</i>	
	Pedetidae	Southern African Springhare	<i>Pedetes capensis</i>	
	Bathyergidae	Common Mole-rat	<i>Cryptomys hottentotus</i>	
	Hystriidae	Cape Porcupine	<i>Hystrix africaeaustralis</i>	
	Muridae		Woosnam's Desert Mouse	<i>Zelotomys woosnami</i>
			Pouched Mouse	<i>Saccostumus campestris</i>
			Grey Climbing Mouse	<i>Dendromus melanotis</i>
			Large-eared Mouse	<i>Malacothrix typica</i>
			Cape Short-tailed Gerbil	<i>Desmodillus auricularis</i>
		Pygmy Hairy-footed Gerbil	<i>Gerbillurus paebe</i>	

		Bushveld Gerbil	<i>Gerbilliscus leucogaster</i>
		Highveld Gerbil	<i>Gerbilliscus brantsii</i>
		Red Veld Rat	<i>Aethomys chrysophilus</i>
		Four-striped Grass Mouse	<i>Rhabdomys</i> spp
		Black-tailed Tree Rat	<i>Thallomys nigricauda</i>
		Southern Multimammate Mouse	<i>Mastomys Coucha</i>
		Brant's Whistling Rat	<i>Parotomys brantsii</i>
Carnivora	Canidae	Cape Fox	<i>Vulpes chama</i>
		Bat-eared Fox	<i>Otocyon megalotis</i>
		Black-backed Jackal	<i>Canis mesomelas</i>
	Mustelidae	Honey Badger	<i>Mellivora capensis</i>
		African Striped Weasel	<i>Poecilogale albinucha</i>
		Striped Polecat	<i>Ictonyx striatus</i>
	Herpestidae	Slender Mongoose	<i>Galerella sanguinea</i>
		Yellow Mongoose	<i>Cynictis penicillata</i>
		Suricate	<i>Suricata suricatta</i>
	Viverridae	Small-spotted Genet	<i>Genetta genetta</i>
	Hyaenidae	Brown Hyaena	<i>Hyaena brunnea</i>
		Aardwolf	<i>Proteles cristatus</i>
		Felidae	African Wild Cat
	Small Spotted Cat		<i>Felis nigripes</i>
Caracal	<i>Caracal caracal</i>		
Leopard	<i>Panthera pardus</i>		
Tubulidentata	Orycteropodidae	Aardvark	<i>Orycteropus afer</i>
Cetartiodactyla	Bovidae	Common Eland	<i>Taurotragus oryx</i>
		Greater Kudu	<i>Tragelaphus strepsiceros</i>
		Springbok	<i>Antidorcas marsupialis</i>
		Steenbok	<i>Raphicerus campestris</i>
		Common Duiker	<i>Sylvicapra grimmia</i>

5. ANTICIPATED IMPACTS

Anticipated impacts which the development will have is primarily concerned with the loss of habitat. The site is largely natural although the vegetation composition and structure has been somewhat degraded by overgrazing. As a result this decreases the impact somewhat when compared to the loss of pristine habitat (not degraded by overgrazing). The vegetation type on the site, Kruruman Thornveld, is also listed as being of Least Concern (LC) and is not currently subjected to any pronounced developmental pressures. Nonetheless certain portions of the site contain species compositions, prominent landscape features and high levels of protected species which should be excluded from development (Map 2). This will considerably mitigate the impact as this will provide refugia to mammal species and provide natural corridors for species to migrate between natural areas. It will also prevent habitat fragmentation whereby corridors remain for species to migrate between natural areas.

The development will also entail the loss of several species which are protected and considered significant to conservation (Appendix C). These species include *Aloe hereroensis*, *A. claviflora*, *A. grandidentata*, *Pachypodium succulentum*, *Boscia albitrunca*, *Mestoklema tuberosum*, *Boophane distichia*, *Harpagophytum procumbens*, *Fockea angustifolia*, *Sarcostemma viminalis*, *Nananthus aloides*, *Euphorbia crassipes*, *Anancampseros filamentosa*, *Vachellia erioloba* and *Nerine laticoma*. As mitigation it is recommended that permits be obtained to remove and transplant these species to adjacent areas. These species consists of succulent and bulb species and as a result will be easily transplanted and the transplant success rate is anticipated to be high as long as it is adequately done.

The exception is the two protected tree species, the Camel Thorn (*Vachellia erioloba*) and the Shephers Tree (*Boscia albitrunca*). These species will not transplant easily. Instead it is recommended that specimens be incorporated into the development as far as possible and for those where it is not possible the necessary permits be obtained to remove them. As offset for removing these trees seedlings can be planted as part of the landscaping of the development.

It is recommended that a walkthrough of the site be done prior to construction to mark and map all protected plants on the site. Several of these species are also cryptic and well camouflaged and it is recommended that a suitably qualified ecologist/botanist perform the walkthrough. Following this transplanting of succulent and bulb species should be done adequately and establishment overseen by an ecologist or person with suitable qualifications. These species should be transplanted to areas excluded from development. The monitoring of re-establishment should also be undertaken. In these areas they will remain within the natural genetic population, will be protected, will enable exchange of genetic material with adjacent populations and will provide a population for the possible re-distribution of propagules.

The drainage line traversing the site has been identified as being highly sensitive (Map 3). As a result it should be excluded from development and treated as a no-go area. In addition a buffer of at least 30 meters should be kept on either side of it. This will mitigate most impacts on the system and will ensure it remains intact. Further mitigation should however also include a storm water management plan to ensure that runoff is managed in such a way as to prevent erosion of the drainage system and prevent polluted runoff from entering the system. Any crossing of this drainage line by roads, bridges and infrastructure should also be designed to cause minimal disturbance of the systems and should not significantly impact on the flow and flooding regime. Erosion measures should also be implemented where required. Where development occurs within 100 meters or within the floodplain of the drainage line a Water Use License

Application (WULA) should be lodged as required by the Department of Water and Sanitation (DWS).

The Groenwaterspruit occurs just south of the development. It is listed as a National Freshwater Ecosystems Priority Area (NFEPA) with a Present Ecological State (PES) of Category B: Largely Natural. Although this system will not be included in the site proposed for development the impact that the development may have should still be taken into account. Therefore in any instance where development occurs within 100 meters or within the 1:100 year floodline a Water Use License Application (WULA) should also be lodged as required by the Department of Water and Sanitation (DWS).

As listed in the species list, several exotic species occur on the site, especially along the border with the residential area where disturbance is high. These should be removed from the site during construction as well as from areas which are excluded from development. Where category 1 and 2 weeds are 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 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 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 before mitigation will be significant. However, if adequate mitigation is implemented these impacts will be considerably decreased. The impact before mitigation is anticipated to be moderately-high and will be moderately-low after mitigation.

Please refer to Appendix E 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	3	5	3	3.6	5	5	5	18
Loss of protected species	4	5	3	4	5	5	5	20
Loss of watercourses	4	5	3	4	5	5	5	20
Infestation with weeds and invaders	3	3	3	3	4	4	4	12

Impact on Terrestrial fauna	3	5	3	3.6	5	3	4	14.4
After Mitigation								
Loss of vegetation type and clearing of vegetation	2	5	2	3	5	5	5	15
Loss of protected species	1	5	1	2.3	2	1	1.5	3.5
Loss of watercourses	2	5	2	3	2	2	2	6
Infestation with weeds and invaders	1	3	2	3	2	2	2	6
Impact on Terrestrial fauna	2	5	2	3	3	3	3	9

6. SITE SPECIFIC RESULTS

Habitat diversity and species richness:

Habitat diversity is considered to be moderate on the site. The varying topography contributes to habitat diversity and different soils and surface geology also contribute to habitat diversity. The habitat so on the site include two low hills with high percentage surface stone, sandy plains, calcrete ridges with shallow soils and a drainage line. As a result the species diversity is also considered moderate. The numerous protected species on the site also attests to this.

Presence of rare and endangered species:

The site contains numerous protected species including *Aloe hereroensis*, *A. claviflora*, *A. grandidentata*, *Pachypodium succulentum*, *Boscia albitrunca*, *Mestoklema tuberosum*, *Boophane distichia*, *Harpagophytum procumbens*, *Fockea angustifolia*, *Sarcostemma veminale*, *Nananthus aloides*, *Euphorbia crassipes*, *Anancampseros filamentosa*, *Vachellia erioloba* and *Nerine laticoma* (Appendix C). These species are all widespread and therefore not a fatal flaw to the development but they area however protected and transplanting of these species should be done.

Of these species the following are also listed under the National Red List as Declining species: *Vachellia erioloba* and *Boophane distichia*.

None of these species as listed above are considered endangered or exceptionally rare and does not cause the development to be fatally flawed.

Ecological function:

The site has a significant and largely intact ecological function. The variety of habitats provide habitat to a variety of fauna and flora. The area also sustains a wide variety of protected species.

The drainage line on the site also has an important ecological although altered somewhat as a result of the upstream residential area. In addition the drainage line is a direct tributary of the Groenwaterspruit which borders the site to the south and which is considered to be a high priority system as it is listed as a National Freshwater Ecosystems Priority Area (NFEPA) with a Present Ecological State (PES) of Category B: Largely Natural. These systems provide services in terms of water transportation, flood retention, water purification and providing habitat and food to a variety of fauna.

Degree of rarity/conservation value:

The vegetation type on the site, Kuruman Thornveld is listed as being of least Concern (LC) and therefore not of high conservation value (Map 2). However, several of the prominent landscape features on the site such as the two low hills, rocky outcrops and calcrete ridge is habitats supporting a unique species composition and high amounts of protected species and these are considered of conservation value (Map 3).

The drainage line traversing the site has a high conservation value but will be excluded from development and will therefore remain relatively intact (Map 3). A buffer of at least 30 meters will also be kept on either side of the drainage line.

The numerous protected species occurring on the site also has a significant conservation value (Appendix C). Although none of these species are considered rare or endangered they are

considered significant to conservation. Permits must be obtained and these species transplanted to area which will be excluded from development (Appendix C).

Percentage ground cover:

Due to the recent drought conditions and heavy overgrazing of the grassland on the site the percentage ground cover is relatively low. Overgrazing has however lead to an increase in canopy cover of the unpalatable Black Thorn (*Senegalia melifera* subsp. *detinens*).

Vegetation structure:

The vegetation structure is relatively natural in that the savannah vegetation is represented by a grass and tree/shrub layer. However, due to sustained overgrazing of the area the grass layer has been decreased in terms of cover and structure height. In this region this quickly leads to unpalatable trees and shrubs such as the Black Thorn (*Senegalia melifera* subsp. *detinens*). This has also occurred on the site and this species and consequently canopy cover has drastically increased on the site. In this regard the vegetation structure has been altered to some degree.

Infestation with exotic weeds and invader plants:

The site is relatively free of exotic species with the exception being adjacent to the northern residential area where disturbance associated with this area has caused susceptible conditions for the establishment of several exotic species.

Degree of grazing/browsing impact:

Grazing and browsing by domestic stock is sustained and high and has degraded the grass layer and increased the canopy cover.

Signs of erosion:

Erosion is moderate in the form of sheet erosion. Gully erosion is not prominent along the drainage line.

Terrestrial animals:

Signs and tracks of mammal species are common on the site and indicates a varied mammal population on the site. However, it is considered highly likely that the mammal population has been affected by the adjacent residential areas and impacts associated with this such as feral dogs hunting small mammals and trapping of mammals using snares, etc. The site is also utilised for communal grazing and the farmers will undoubtedly hunt small carnivores such as Black Backed Jackal (*Canis mesomelas*). Furthermore the farmers make use of herding dogs which will also impact on the small mammals in the area. As a result it is considered unlikely that species of conservational importance will occur on the site.

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

	Low (3)	Medium (2)	High (1)
Vegetation characteristics			
Habitat diversity & Species richness			1
Presence of rare and endangered species		2	
Ecological function		2	
Uniqueness/conservation value		2	
Vegetation condition			
Percentage ground cover		2	
Vegetation structure	3		
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		2	
Sub total	6	14	1
Total		21	

7. BIODIVERSITY SENSITIVITY RATING (BSR) INTERPRETATION

Table 3: Interpretation of Biodiversity Sensitivity Rating.

Site	Score	Site Preference Rating	Value
Residential development	20	Acceptable	3

8. DISCUSSION AND CONCLUSION

The site proposed for the residential development has been rated as being acceptable for the development.

According to Mucina & Rutherford (2006) the area consists of Kuruman Thornveld (SVk 9) (Map 2). This vegetation type is listed as being of Least Concern (LC) within the National List of Threatened Ecosystems (Notice 1477 of 2009)(National Environmental Management Biodiversity Act, 2004) (Map 2). It is not currently subjected to any pronounced development pressures.

The site consists primarily of natural vegetation although communal grazing and activities associated with the adjacent residential areas cause disturbance in some areas. Only small areas occur where the natural vegetation has been totally transformed. This is notably the construction of a water reservoir and associated infrastructure on top of one of the hills and soil excavations and rock dumps along the southern boundary of the site.

Anticipated impacts which the development will have is primarily concerned with the loss of habitat. The site is largely natural although the vegetation composition and structure has been somewhat degraded by overgrazing. As a result this decreases the impact somewhat when compared to the loss of pristine habitat (not degraded by overgrazing). The vegetation type on the site, Kuruman Thornveld, is also listed as being of Least Concern (LC) and is not currently subjected to any pronounced developmental pressures (Map 2). Nonetheless certain portions of the site contain species compositions, prominent landscape features and high levels of protected species which should be excluded from development (Map 3). This will considerably mitigate the impact as this will provide refugia to mammal species and provide natural corridors for species to migrate between natural areas. It will also prevent habitat fragmentation whereby corridors remain for species to migrate between natural areas.

The development will also entail the loss of several species which are protected and considered significant to conservation (Appendix C). These species include *Aloe hereroensis*, *A. claviflora*, *A. grandidentata*, *Pachypodium succulentum*, *Boscia albitrunca*, *Mestoklema tuberosum*, *Boophane distichia*, *Harpagophytum procumbens*, *Fockea angustifolia*, *Sarcostemma viminalis*, *Nananthus aloides*, *Euphorbia crassipes*, *Anancampseros filamentosa*, *Vachellia erioloba* and *Nerine laticoma*. As mitigation it is recommended that permits be obtained to remove and transplant these species to adjacent areas. These species consists of succulent and bulb species and as a result will be easily transplanted and the transplant success rate is anticipated to be high as long as it is adequately done.

The exception is the two protected tree species, the Camel Thorn (*Vachellia erioloba*) and the Shephers Tree (*Boscia albitrunca*). These species will not transplant easily. Instead it is recommended that specimens be incorporated into the development as far as possible and for those where it is not possible the necessary permits be obtained to remove them. As offset for removing these trees seedlings can be planted as part of the landscaping of the development.

It is recommended that a walkthrough of the site be done prior to construction to mark and map all protected plants on the site. Several of these species are also cryptic and well camouflaged and it is recommended that a suitably qualified ecologist/botanist perform the walkthrough. Following this transplanting of succulent and bulb species should be done adequately and establishment overseen by an ecologist or person with suitable qualifications. These species

should be transplanted to areas excluded from development. The monitoring of re-establishment should also be undertaken. In these areas they will remain within the natural genetic population, will be protected, will enable exchange of genetic material with adjacent populations and will provide a population for the possible re-distribution of propagules.

The drainage line traversing the site has been identified as being highly sensitive (Map 3). As a result it should be excluded from development and treated as a no-go area. In addition a buffer of at least 30 meters should be kept on either side of it. This will mitigate most impacts on the system and will ensure it remains intact. Further mitigation should however also include a storm water management plan to ensure that runoff is managed in such a way as to prevent erosion of the drainage system and prevent polluted runoff from entering the system. Any crossing of this drainage line by roads, bridges and infrastructure should also be designed to cause minimal disturbance of the systems and should not significantly impact on the flow and flooding regime. Erosion measures should also be implemented where required. Where development occurs within 100 meters or within the floodplain of the drainage line a Water Use License Application (WULA) should be lodged as required by the Department of Water and Sanitation (DWS).

The Groenwaterspruit occurs just south of the development. It is listed as a National Freshwater Ecosystems Priority Area (NFEPA) with a Present Ecological State (PES) of Category B: Largely Natural. Although this system will not be included in the site proposed for development the impact that the development may have should still be taken into account. Therefore in any instance where development occurs within 100 meters or within the 1:100 year floodline a Water Use License Application (WULA) should also be lodged as required by the Department of Water and Sanitation (DWS).

As listed in the species list, several exotic species occur on the site, especially along the border with the residential area where disturbance is high. These should be removed from the site during construction as well as from areas which are excluded from 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 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 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 before mitigation will be significant. However, if adequate mitigation is implemented these impacts will be considerably decreased. The impact before mitigation is anticipated to be moderately-high and will be moderately-low after mitigation.

9. RECOMMENDATIONS

- The two rocky outcrops on the eastern slope of the north eastern hill on the site contain a unique species composition and form prominent landscape features and should be excluded from development.
- The two low hills on the site is considered to have a significant conservation value and although no elements exist which would make them no-go areas it is still recommended that these hills be the last to be developed, i.e. the areas of lower conservation sensitivity should be developed first and if more development space is required the hills should then be developed. As a consequence these hills are mapped as areas of high sensitivity (Map 3).
- Protected species occurring on the site include *Aloe hereroensis*, *A. claviflora*, *A. grandidentata*, *Pachypodium succulentum*, *Boscia albitrunca*, *Mestoklema tuberosum*, *Boophane distichia*, *Harpagophytum procumbens*, *Fockea angustifolia*, *Sarcostemma veminale*, *Nananthus aloides*, *Euphorbia crassipes*, *Anancampseros filamentosa* and *Nerine laticoma*. As mitigation it is recommended that permits be obtained to remove and transplant these species to adjacent areas (Appendix C). These species consists of succulent and bulb species and as a result will be easily transplanted and the transplant success rate is anticipated to be high as long as it is adequately done.
- The exception is the two protected tree species, the Camel Thorn (*Vachellia erioloba*) and the Shepherds Tree (*Boscia albitrunca*) (Appendix C). These species will not transplant easily. Instead it is recommended that specimens be incorporated into the development as far as possible and for those where it is not possible the necessary permits be obtained to remove them. As offset for removing these trees seedlings can be planted as part of the landscaping of the development.
- It is recommended that a walkthrough of the site be done prior to construction to mark and map all protected plants on the site. It is recommended that a suitably qualified ecologist/botanist perform the walkthrough. Following this transplanting of succulent and bulb species should be done adequately and establishment overseen by an ecologist or person with suitable qualifications. These species should be transplanted to areas excluded from development. The monitoring of re-establishment should also be undertaken.
- The drainage line traversing the site has been identified as being highly sensitive (Map 3). As a result it should be excluded from development and treated as a no-go area. In addition a buffer of at least 30 meters should be kept on either side of it.
- Further mitigation should however also include a storm water management plan to ensure that runoff is managed in such a way as to prevent erosion of the drainage system and prevent polluted runoff from entering the system. Any crossing of this drainage line by roads, bridges and infrastructure should also be designed to cause minimal disturbance of the systems and should not significantly impact on the flow and flooding regime. Erosion measures should also be implemented where required. Where development occurs within 100 meters or within the floodplain of the drainage line a Water Use License Application (WULA) should be lodged as required by the Department of Water and Sanitation (DWS).

- The Groenwaterspruit occurs just south of the development. Although this system will not be included in the site proposed for development the impact that the development may have should still be taken into account. Therefore in any instance where development occurs within 100 meters or within the 1:100 year floodline a Water Use License Application (WULA) should also be lodged as required by the Department of Water and Sanitation (DWS).
- Further mitigation should however also include a storm water management plan to ensure that runoff is managed in such a way as to prevent erosion of the stream systems and prevent polluted runoff from entering the systems. Any crossing of these systems by roads, bridges and infrastructure should also be designed to cause minimal disturbance of the systems and should not significantly impact on the flow and flooding regime. Erosion measures should also be implemented where required. Where development occurs within 100 meters or within the floodplain of the systems a Water Use License Application (WULA) should be lodged as required by the Department of Water and Sanitation (DWS).
- Alien weeds and invaders occurring on the site should be removed and monitored for re-establishment.
- The hunting, capturing and trapping of fauna should be prevented by making this a punishable offense during the construction phase.
- After construction has ceased all construction materials should be removed from the area.

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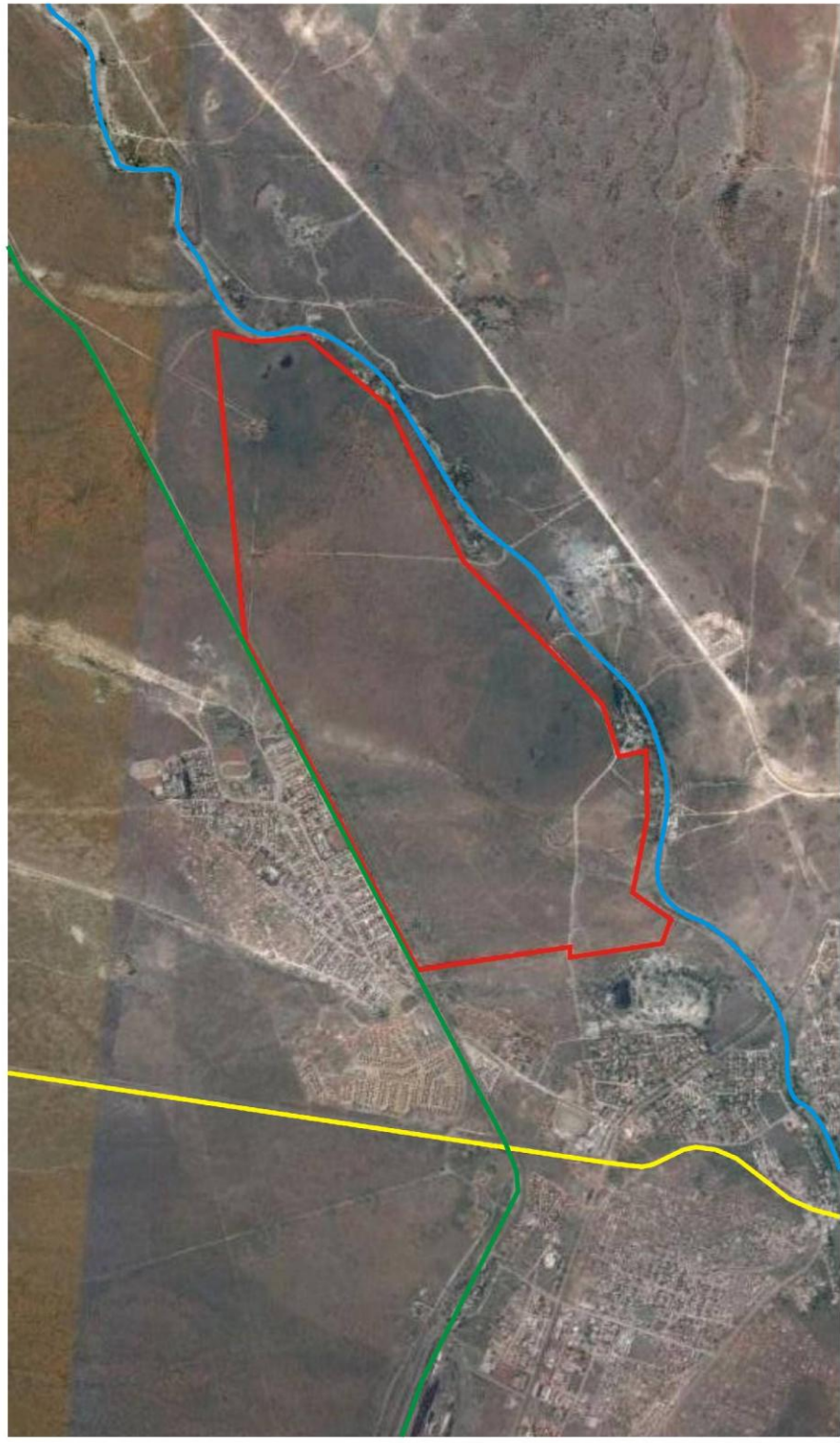
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Annexure A: Maps and Site photos



Locality map of the proposed residential development on the Remainder of Erf 1 in Postmasburg, Northern Cape Province.







Map 1: Locality map for the proposed Postmasburg residential development. Note the Groenwaterspruit flowing just south of the site. Note also that the site is located adjacent to existing urban areas.



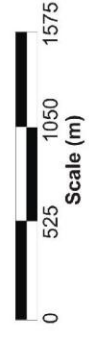
Prepared for:
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Danhof
9310

Legend:

-  Site boundary
-  R325 Tarrred Road
-  Railway line
-  Groenwaterspruit

Map Information

Spheroid: WGS 84

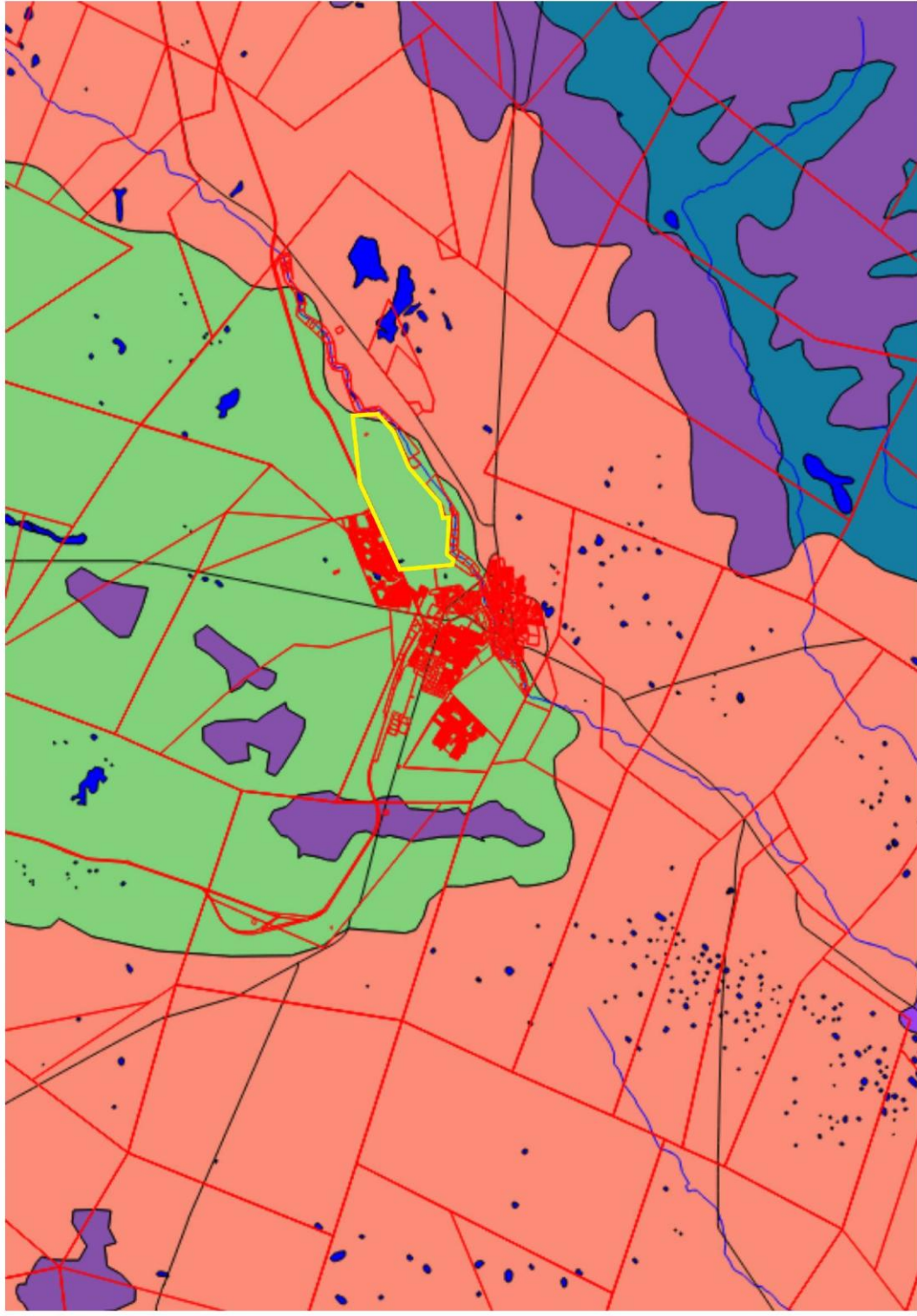
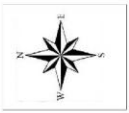


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General ecology map of the proposed residential development on the Remainder of Erf 1 in Postmasburg, Northern Cape Province.



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Legend:

- Site boundary
- Kuruman Thornveld
- Kuruman Mountain Bush
- Olifantshoek Plains Thorn
- Postmasburg Thornveld
- Wetlands and waterbodies
- Road network
- Property boundaries
- Watercourses

Map Information

Spheroid: WGS 84

Scale: 1:100 000

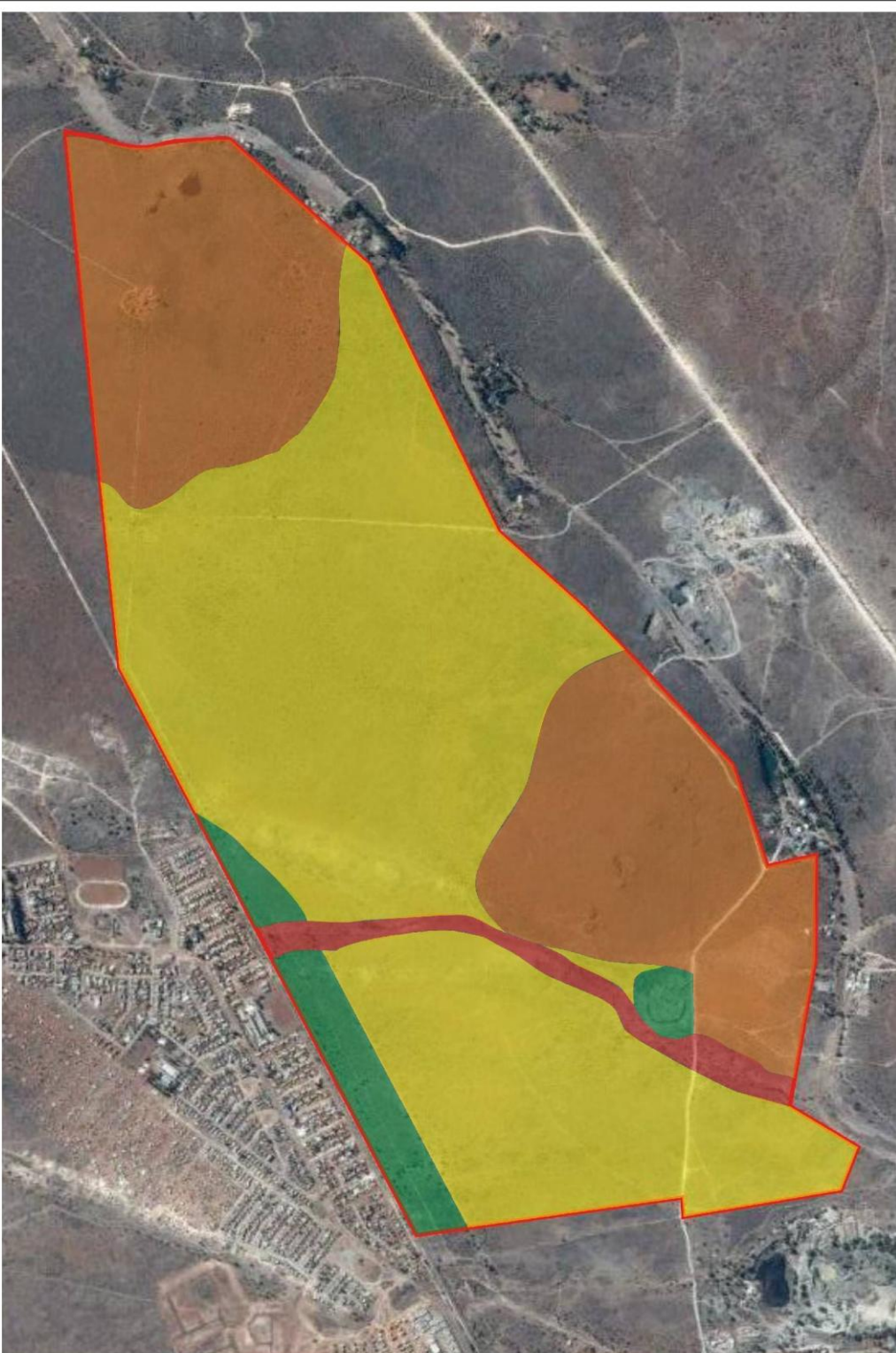
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Map 2: Ecology map for the proposed Postmasburg residential development. Vegetation types, Threatened ecosystems, wetlands and watercourses are indicated.

Sensitivity map of the proposed residential development on the Remainder of Erf 1 in Postmasburg, Northern Cape Province.



Map 3: Sensitivity map for the proposed Postmasburg residential development. Areas of very high sensitivity should be excluded from development. Areas of high sensitivity may be developed using suitable mitigation measures but should be developed last. Areas of moderate sensitivity may be developed with suitable mitigation measures. Areas of low sensitivity require little mitigation and should be developed first.

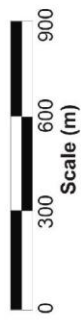


Prepared for:
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- Legend:**
- Site boundary
 - Low
 - Moderate
 - High
 - Very high

Map Information

Spheroid: WGS 84



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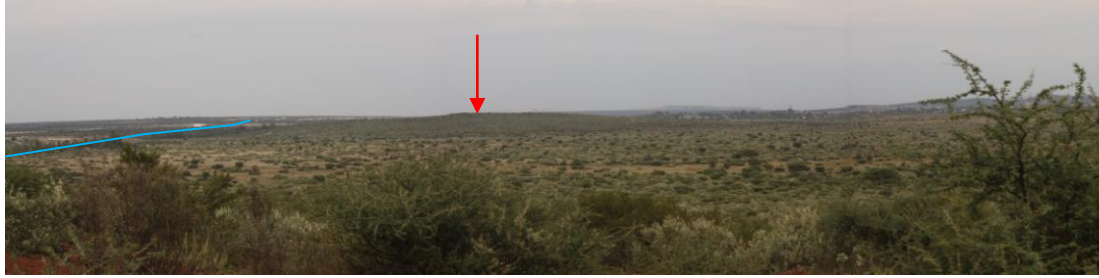


Figure 1: Panorama from the low hill in the north eastern portion of the site. The Groenwaterspruit to the south of the site is indicated in blue and the adjacent low hill in the south western portion of the site is indicated by the red arrow.



Figure 2: Pipeline in construction being installed up to the reservoir on the low hill in the north eastern portion of the site.



Figure 3: One of the rocky outcrops on the low hill in the north east of the site.



Figure 4: Panorama of the plains portion. Note the sandy soils and sparse grass cover. This grass cover has been altered due to heavy overgrazing.



Figure 5: Panorama of the plains portion adjacent to the residential area bordering the site along the northern border. The residential area and boundary is indicated in red. The low hill in the south west of the site is indicated by the red arrow.

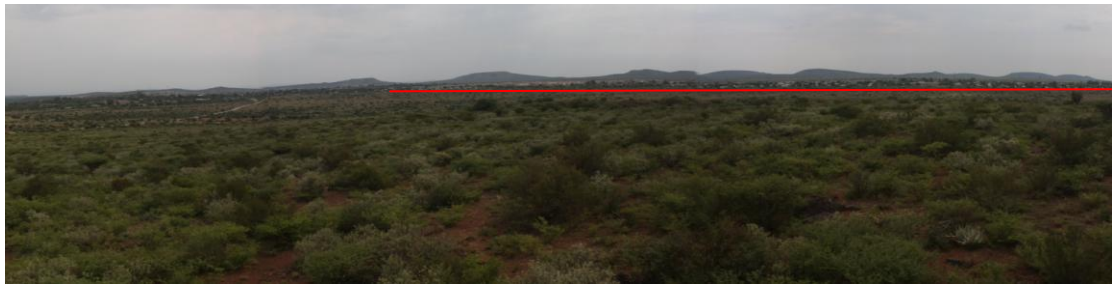


Figure 6: Panorama from the low hill in the south west of the site. Note the much denser canopy cover on the hill. The adjacent residential area is indicated in red.



Figure 7: Panorama from the low hill in the south west of the site. The adjacent low hill in the north east of the site is indicated by the red arrow.



Figure 8: Panorama of the calcrete ridge and adjacent drainage line in the western portion of the site. The drainage line is indicated in red.



Figure 9: Panorama of the Groenwaterspruit to the south of the site (indicated in red). The point of confluence with the drainage line is indicated in blue.



Figure 10: View of the drainage line where it exits the residential area. Here the drainage line is visibly disturbed.

Appendix B: Species list

Species indicated with an * are exotic.

Protected species are coloured orange and Declining species red.

Species	Growth form
* <i>Conyza bonariensis</i>	Herb
* <i>Eucalyptus camaldulensis</i>	Tree
* <i>Flaveria bidentis</i>	Herb
* <i>Pennisetum setaceum</i>	Grass
* <i>Schinus molle</i>	Tree
* <i>Tegetes minuta</i>	Herb
<i>Abutilon austro-africanum</i>	
<i>Achyranthes aspera</i>	Herb
<i>Aloe claviflora</i>	Succulent
<i>Aloe grandidentata</i>	Succulent
<i>Aloe hereroensis</i>	Succulent
<i>Anacampseros filamentosa</i>	Succulent
<i>Antheaphora pubescens</i>	Grass
<i>Aptosimum indivisum</i>	Herb
<i>Aristida adscensionis</i>	Grass
<i>Asparagus suaveolens</i>	Dwarf shrub
<i>Blepharis mitrata</i>	Herb
<i>Boophane distichia</i>	Geophyte/Bulb
<i>Boscia albitrunca</i>	Tree
<i>Brachiata serrata</i>	Grass
<i>Cadaba aphylla</i>	Shrub
<i>Cenchrus ciliaris</i>	Grass
<i>Cenchrus ciliaris</i>	Grass
<i>Chloris virgata</i>	Grass
<i>Chrysocoma ciliata</i>	Dwarf shrub
<i>Cleome angustifolia</i>	Herb
<i>Cleome rubella</i>	Herb
<i>Cucumis zeyheri</i>	Creeper
<i>Cynodon dactylon</i>	Grass
<i>Cyperus longus</i>	Sedge
<i>Dipcadi glauca</i>	Bulb
<i>Dipcadi sp.</i>	Bulb
<i>Ehretia rigida</i>	Shrub
<i>Enneapogon cenchroides</i>	Grass
<i>Enneapogon desvauxii</i>	Grass
<i>Eriocephalus ericoides</i>	Dwarf shrub
<i>Euphorbia crassipes</i>	Succulent
<i>Fingerhuthia africana</i>	Grass
<i>Fockea angustifolia</i>	Succulent
<i>Geigeria filifolia</i>	Herb

<i>Gisekia africana</i>	Herb
<i>Grewia flava</i>	Shrub
<i>Harpagophytum procumbens</i>	Geophyte
<i>Hermannia bryoniifolia</i>	Dwarf shrub
<i>Kalanchoe paniculata</i>	Succulent
<i>Kleinia longiflora</i>	Succulent
<i>Ledebouria</i> sp.	Bulb
<i>Leucas capensis</i>	Herb
<i>Limeum aethiopicum</i>	Herb
<i>Lophiocarpus polystachyus</i>	Herb
<i>Melinis repens</i>	Grass
<i>Mestoklema tuberosum</i>	Succulent
<i>Monechma divaricatum</i>	Herb
<i>Nananthus aloides</i>	Succulent
<i>Nerine laticoma</i>	Bulb
<i>Nidorella resedifolia</i>	Herb
<i>Oxalis</i> sp.	Geophyte/Herb
<i>Oxygonum delagoense</i>	Herb
<i>Pachypodium succulentum</i>	Succulent
<i>Pegolettia retrofracta</i>	Dwarf shrub
<i>Pentzia incana</i>	Dwarf shrub
<i>Pentzia viridis</i>	Dwarf shrub
<i>Pupalia lappacea</i>	Herb
<i>Rhigozum obovatum</i>	Shrub/Small tree
<i>Rhigozum trichotomum</i>	Shrub
<i>Sansevieria aethiopica</i>	Succulent
<i>Sarcostemma veminale</i>	Succulent
<i>Schmidtia pappophoroides</i>	Grass
<i>Searsia burchellii</i>	Shrub
<i>Searsia ciliata</i>	Shrub
<i>Searsia trydactyla</i>	Shrub/Small tree
<i>Seddera</i> sp.	Herb
<i>Senegalia melifera</i> subsp. <i>detinens</i>	Shrub/Small tree
<i>Senna italica</i>	Herb
<i>Sericocoma avolans</i>	Herb
<i>Sesamum triphyllum</i>	Herb
<i>Sporobolus fimbriatus</i>	Grass
<i>Sutera griquensis</i>	Herb
<i>Tarchonanthus camphoratus</i>	Shrub
<i>Tragus berteronianus</i>	Grass
<i>Tribulus terrestris</i>	Herb
<i>Vachellia erioloba</i>	Tree
<i>Vachellia hebeclada</i>	Shrub
<i>Vachellia karroo</i>	Tree
<i>Vangueria infausta</i>	Tree

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.



Aloe grandidentata
Bont Aalwyn

Protected in the Northern Cape Province

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

Method: **The species is abundant on the site especially the two low hills. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected.**



Aloe claviflora
Canon Aloe/Kraal Aalwyn

Protected in the Northern Cape Province

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

Method: **The species is abundant on the site especially the two low hills. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected.**



Aloe hereroensis
Herero Aloe/Sandaalwyn

Protected in the Northern Cape Province

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

Method: **The species is abundant on the site especially the two low hills. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected.**

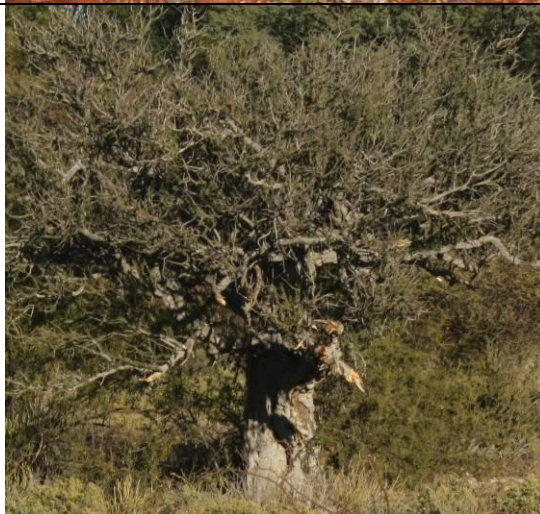


Pachypodium succulentum
Bobbejaankambroo/Dikvoet

Protected in the Northern Cape Province

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

Method: **The species is abundant on the site especially the two low hills. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected. Large underground tubers need to be taken into account for this species.**



Boscia albitrunca
Shepherds Tree/Witgat Boom

Protected in the Northern Cape Province

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

Method: **The species is abundant on the site especially the two low hills. Where they are affected by construction permits must be obtained to removed them.**



Mestoklema tuberosum
Donkievybossie

Protected in the Northern Cape Province

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

Method: **The species is abundant on the site especially the two low hills. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected.**



Boophane distichia
Poison Bulb/Tumblehead/Gifbol

Protected in the Northern Cape Province

National Red List Status: **Declining**

Method: **Scattered on the site. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected.**



Harpagophytum procumbens
Devil's Claw/Duiwelsklou

Protected in the Northern Cape Province

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

Method: **Numerous specimens occur in the sandy plains on the site. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected. They have an exceedingly large taproot which will have to be taken into account with the transplanting.**



Fockea angustifolia
Kambroo

Protected in the Northern Cape Province

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

Method: **Rare specimens encountered on the low hill in south west of the site. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected. Large underground tubers need to be taken into account for this species.**



Sarcostemma veminale
Caustic Vine/Melktou

Protected in the Northern Cape Province.

National Red List Status: **Least Concern**

Method: **Numerous on the site especially the two low hills. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected.**



Nananthus aloides
Vlaktevygie/Brakveldvygie

Protected in the Northern Cape Province

National Red List Status: **Least Concern**

Method: **Numerous specimens occur on the calcrete ridge in the south western portion of the site. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected.**



Euphorbia crassipes
Melkpol/Vingerpol

Protected in the Northern Cape Province

National Red List Status: **Least Concern**

Method: **Numerous specimens occur on the calcrete ridge in the south western portion of the site. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected.**



Anacampseros filamentosa
Haaskos

Protected in the Northern Cape Province

National Red Listed Status: **Least Concern**

Method: **Common but scattered on the on the calcrete ridge in the south western portion of the site. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected.**



Acacia erioloba
Camel Thorn/Kameeldoring

Protected species

National Red List Status: **Declining**

The species is subjected to a continuing decline and is therefore listed as a **Declining** species.

Method: **A single specimen noted in the central sandy plains portion. Other trees may also occur. Where they are affected by construction permits must be obtained to removed them.**





Nerine laticoma
Gifbol/Vleilelie

Protected in the Northern Cape Province

National Red Listed Status: **Least Concern**

Method: **Common but scattered along the drainage line in the south western portion of the site. Where they are affected by construction they should be removed and transplanted to an area where they will not be affected.**

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.

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- Heritage assessments