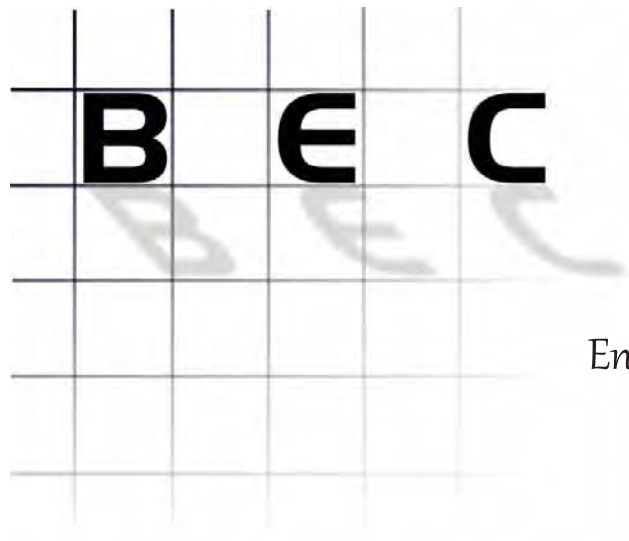


*Terrestrial Biodiversity Impact Assessment for the proposed  
Concentrated Solar Plant (CSP) on the Farm Humansrus 469,  
Northern Cape Province*

compiled by



Bathusi

Environmental

Consulting

August 2011



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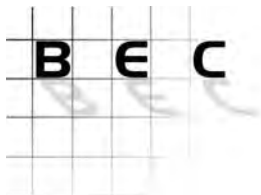
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## I PROJECT DETAILS

<b>Client:</b>	Worley Parsons RSA PTY (LTD) & SSI Engineers & Environmental Consultants
<b>Report name:</b>	Strategic Biodiversity Impact Assessment for the proposed Concentrated Solar Plant (CSP) on Farm Humansrus 469, Northern Cape Province.
<b>Report type:</b>	Biodiversity Impact Assessment Report
<b>BEC Project number:</b>	SSI - HSP – 2012/01
<b>Authority Reference:</b>	N/A
<b>Compiled by:</b>	Riaan A. J. Robbeson (Pr.Sci.Nat.), Bathusi Environmental Consulting

## II RESERVED COPYRIGHT

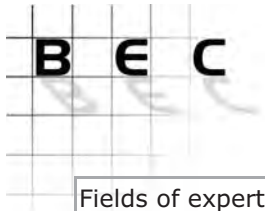
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## III SPECIALIST INVESTIGATORS

The Natural Scientific Professions Act of 2003 aims to *'provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP), and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith'*.

Quoting the Natural Scientific Professions Act of 2003: *'Only a registered person may practice in a consulting capacity'* (20(1) – pg 14).

<b>Table 1: Biodiversity Specialists for this project</b>	
<b>Floristic Investigator:</b>	<b>Riaan Robbeson (Pr.Sci.Nat.)</b>
Qualification:	M.Sc. (Botany), UP
Affiliation:	South African Council for Natural Scientific Professions
Fields of Expertise:	Botanical Scientist & Ecological Scientist
Registration Number:	400005/03
Affiliation:	Grassland Society of Southern Africa
Membership Status:	Professional Member
Membership Number:	667.08/08
<b>Investigator:</b>	<b>Dewald Kamffer (Pr.Sci.Nat.)</b>
Qualification:	M.Sc. (Conservation Biology), UP
Affiliation:	South African Council for Natural Scientific Professions

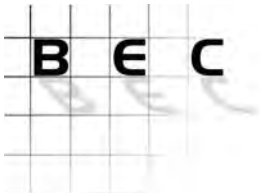


Biodiversity Impact Assessment

Humansrus CSP



Fields of expertise:	Ecological Scientist & Zoological Scientist
Registration number:	400204/05



IV DECLARATION OF INDEPENDENCE

All specialist investigators, project investigators and members of companies employed for conducting this biodiversity investigation declare that:

- We act as independent ecologists compiling this report
- We consider ourselves bound to the rules and ethics of the South African council for natural scientific professions;
- At the time of completing this report, we did not have any interest, hidden or otherwise, in the proposed development or activity as outlined in this document, other than financial compensation for work performed in a professional capacity in terms of the environmental impacts assessment regulations, 2005;
- We will not be affected in any manner by the outcome of the environmental process of which this report forms part of, other than being part of the general public;
- We do not have any influence over decisions made by the governing authorities;
- Undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the environmental impact assessment regulations, 2005;
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- We do not necessarily object to or endorse the proposed development, but aim to present facts and recommendations based on scientific data and relevant professional experience; and
- Should we consider ourselves to be in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and register as an Interested and Affected Party.

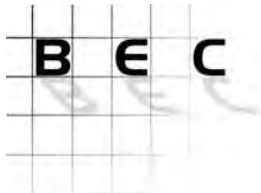
Signature of principal ecologist:

**Bathusi Environmental Consulting cc (CK1999/052182/23)**

Name of company:

**1<sup>st</sup> August 2011**

Date:



V SURVEY DETAILS

Field surveys were conducted from the 30<sup>th</sup> May 2011 to the 3<sup>rd</sup> June 2011.

VI LEGISLATION

This report has been prepared in terms of the *National Environmental Management Act No. 107 of 1998 (NEMA)* and is compliant with Regulation 385 Section 33 – Specialist reports and reports on specialised processes under the Act. Relevant clauses of the above regulation include:

Regulation 33.(1): An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialised process.

Regulation 33.(2): A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:

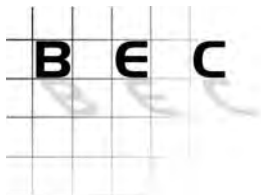
- (a) Details of
  - (i) The person who prepared the report, and
  - (ii) The expertise of that person to carry out the specialist study or specialised process;
- (b) A declaration that the person is independent in a form as may be specified by the competent authority;
- (c) An indication of the scope of, and the purpose for which, the report was prepared;
- (d) A description of the methodology adopted in preparing the report of carrying out the specialised process;
- (e) A description of any assumptions made and any uncertainties or gaps in knowledge;
- (f) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
- (g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
- (h) A summary and copies of any comments that were received during any consultation process;
- (i) Any other information requested by the competent authority.

Compliance with provincial, national and international legislative aspects is strongly advised during the planning, assessment, authorisation and execution of this particular project. Legislative aspects of which cognisance were taken during the compilation of this report are summarised in, but not necessarily limited to, Table 2.

<b>Table 2: Legislative guidance for this project</b>	
<b>Biodiversity Act (No. 10 of 2004)</b>	To provide for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from

**Table 2: Legislative guidance for this project**

	bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.
<b>Conservation of Agricultural Resources Act 43 of 1983</b>	The conservation of soil, water resources and vegetation is promoted. Management plans to eradicate weeds and invader plants must be established to benefit the integrity of indigenous life.
<b>Constitution of the Republic of South Africa (Act 108 of 1996)</b>	The Bill of Rights, in the Constitution of South Africa (No. 108 of 1996), states that everyone has a right to a non-threatening environment and requires that reasonable measures are applied to protect the environment. This protection encompasses preventing pollution and promoting conservation and environmentally sustainable development. These principles are embraced in NEMA and given further expression.
<b>Convention on Biological Diversity, 1995</b>	International legally binding treaty with three main goals; conserve biological diversity (or biodiversity); ensure sustainable use of its components and the fair and equitable sharing of benefits arising from genetic resources.
<b>Convention on International Trade in Endangered Species of Wild Life and Fauna</b>	International agreement between governments, drafted because of a resolution adopted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN). Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival and it accords varying degrees of protection to more than 33,000 species of animals and plants.
<b>Environmental Conservation Act (No. 73 of 1989)</b>	To provide for the effective protection and controlled utilization of the environment and for matters incidental thereto.
<b>National Environmental Management Act (No. 107 of 1998)</b>	Requires adherence to the principles of Integrated Environmental Management (IEA) in order to ensure sustainable development, which, in turn, aims to ensure that environmental consequences of development proposals be understood and adequately considered during all stages of the project cycle and that negative aspects be resolved or mitigated and positive aspects enhanced.
<b>National Environmental Management Act (No 10 of 2004)</b>	Restriction of activities involving alien species, restricted activities involving certain alien species totally prohibited and duty care relating to listed invasive species.
<b>National Forest Act, 1998 (No 84 of 1998)</b>	Cutting, disturbing, damaging or destroying any indigenous, living tree in a natural forest, except in terms of a licence issued under section 7(4) or section 23; or an exemption from the provisions of the subsection published by the Minister in the Gazette. The sections include protected tree species, a particular tree, a group of trees or particular woodland to be a protected tree, group of trees, woodland or species. In terms of section 15, no person may cut, disturb, damage, destroy or remove any protected tree; or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister.
<b>Northern Cape Nature Conservation Act, No. 9 of 2009</b>	Provides for the sustainable utilisation of wild animals, aquatic biota and plants, provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Amongst other regulations, the following may apply to the current project: <ul style="list-style-type: none"> <li>• Boundary fences may not be altered in such a way as to prevent wild animals from freely moving into or off of a property;</li> <li>• Aquatic habitats may not be destroyed or damaged; and</li> <li>• The Act provides lists of protected species for the Province.</li> </ul>
<b>Protected Areas Act (No. 57 of 2003)</b>	To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.



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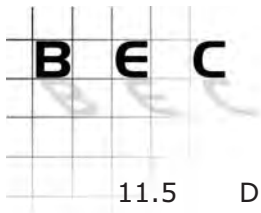
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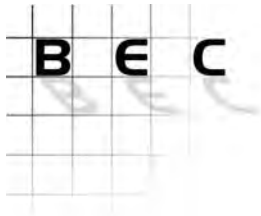
In order to explore new generation options, find solutions that can contribute to meeting the growing electricity demand and in an effort to utilise renewable energy resources, Solar Reserve is assessing the feasibility of constructing a Concentrated Solar Plant (CSP) with a maximum capacity of 100 MW. A technically feasible site was identified on the farm Humansrus 469, located approximately 4km southeast of Groenwater and 30km east of Postmasburg in the Northern Cape Province, comprising approximately 1,354ha, of which roughly 650ha will be utilized for the solar plant. Bathusi Environmental Consulting cc was appointed to conduct the relevant terrestrial biodiversity investigations. Riaan A. J. Robbeson (Pr.Sci.Nat.) conducted the floristic assessment while Dewald Kamffer (Pr.Sci.Nat.) assessed the faunal components.

The study area falls within the upper reaches of the Orange Primary Catchment area. Non-perennial streams are present in the southwestern part of the study area. In addition to the presence of these non-perennial streams, it appears as if wider floodplains are associated with many of the drainage lines in the region. No significant wetlands, estuaries, Ramsar Sites or major dams are present within the immediate vicinity of the study area.

The general region comprises extensive untransformed habitat with limited areas characterised by agriculture and mining in particular. The topography of the study area is described as Hills and Lowlands, situated approximately between 1,500 and 1,600m above sea level. The eastern section of the study area comprises the Ib land type and is typically variable in relief and spatial heterogeneity, characterised by ridges and low mountains. The presence of these habitat types is important in terms of habitat variability and biodiversity attributes that characterise these parts. The Ae214, 215 and Ib237 land type units are present in the study area. Ae land types are typical of undulating plains and low-lying topography.

The geology of the area conforms to banded iron formations, with jaspilite, chert and riebeckite asbestos in the rocky/ stony parts of the study area. Low-lying sandy plains comprise red aeolian sand of Tertiary to Recent age with silcrete and calcrete. An informal/ small-scale, mine on the site excavates the semi-precious jaspilite.

The study area is situated within the Savanna Biome, the largest Biome in southern Africa, occupying 46% of its area, and over one-third the area of South Africa. The Kalahari savanna is a sandy, arid region in the western interior. Two regional vegetation types of the Kalahari savanna system are present within the study area, namely the Kalahari Plain Thorn Bushveld (Olifantshoek Plains Thornveld, Least Threatened) and Kalahari Mountain Bushveld (Kuruman Mountain Bushveld, Least Threatened).



## 1.2 FLORA

The SANBI database indicates the known presence of only 146 plant species within the ¼-degree grid (2823AD), which is regarded a poor reflection of the true floristic diversity of the regional vegetation that includes both grassland and savanna habitat types. Dwarf shrubs, shrubs and trees dominate the physiognomy in most areas, but open grassland plains are also present.

The site investigation revealed the presence of approximately 129 plant species on the site. Because of the winter survey period, this species composition is by no means regarded comprehensive. The savanna physiognomy of woodland and shrubland habitat of the site is indicated by the structural dominance of woody species. A diverse composition of grasses and forbs was noted in the grassland habitat types. A total of 41 plant families are represented by the floristic diversity of the site, dominated by Poaceae.

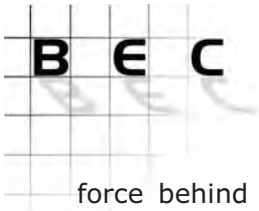
No Threatened plant species are known to occur in this particular ¼-degree grid, but four protected tree species are known to occur in the region, three of which was confirmed on the study area. Application for permits for the removal/ damage/ cutting or pruning of protected tree species as per National Forest Act, 1998 (No 84 of 1998) need to be submitted to the relevant authority prior to the commencement of construction activities. These species include:

<i>Acacia erioloba</i>	Less than 20
<i>Boscia albitrunca</i>	Single individual observed
<i>Olea europaea</i> subsp. <i>africana</i>	Many (>300)

Results of the photo analysis and site investigations revealed the presence of the following habitat types (with estimated floristic sensitivities):

- Closed Shrubveld (Medium-high floristic sensitivity);
- Drainage Line (High floristic sensitivity);
- Excavations (Low floristic sensitivity);
- Floodplains (High floristic sensitivity);
- Grassland Plains (Medium floristic sensitivity);
- Homestead (Low floristic sensitivity);
- *Olea europaea* Woodland (High floristic sensitivity); and
- Open Shrubveld (High floristic sensitivity).

The vegetation of the study area is largely representative of the regional vegetation types. The interplay between rocky areas and low-lying grasslands with intermittent drainage lines is typical of the region, resulting in clearly defined communities. Although not unique, slight variations do occur, which become important on a local scale, such as the *Olea* Woodland and localised rock sheets in the Floodplain habitat type. *Olea* woodland variations occur in small patches in the larger region, but it is by no means a frequent occurrence. The driving



force behind the development of this unit is thought to be anthropogenic in nature, fire frequency and intensity in particular that affected the occurrence of other woody species adversely while favouring *Olea europaea*. Rock sheets associated with shallow gravelly soils in the close vicinity of drainage lines and floodplains are important in terms of the occurrence of succulent species.

Remaining parts of the study area is characterised by open shrubveld to the west, closed shrubveld to the east, as well as drainage lines with associated floodplains and grassland plains. These habitat types are well defined and clear boundaries exist, mostly driven by the presence/ absence of rocky/ stony soils and slopes. Grazing practices have resulted in slight deterioration of the status of particularly the grassland areas, resulting in the influx of low shrub species.

A large part of the study area comprises floristic habitat of medium sensitivity. The loss of these areas is not expected to result in severe impacts on the floristic environment when considered on a regional scale. However, it should be noted that the proposed footprint for the development is situated in close vicinity to floristic habitat types of high sensitivity, including the Drainage line, Floodplains and *Olea* Woodland habitat types. Impacts within these areas are therefore likely to occur unless strict mitigation measures are implemented.

The proposed footprint is indicated to exclude most of the sensitive habitat types. The close vicinity of these areas to the proposed development is an aspect that should receive attention during the EMP phase of the project where protection and conservation measures are developed to provide for protection of sensitive areas.

### 1.3 FAUNA

Please note that the avifaunal component was excluded from this assessment, as it will form the subject of a separate investigation.

Animals known to be present in the Q-grid of the study area were considered potential inhabitants of the study area (all species known from the Northern Cape Province were included to minimize the effect of sampling bias). The presence of 41 animal species was confirmed during the site investigation (Table 23), by means of visual sightings, tracks, faecal droppings, burrows, characteristic behaviour patterns as well as confirmation obtained from the landowner. Signs of, or individuals of, four butterflies, 10 reptiles and 25 mammals were confirmed for the study area. This includes the Red Data mammals South African Hedgehog (*Atelerix frontalis*, NT), Lesser Dwarf Shrew (*Suncus varilla*, DD) and Brown Hyaena (*Hyaena brunnea*, NT).

The forty-one animals confirmed to occur in the study area are regarded typical of an area the size of the study site in the Eastern Kalahari Bioregion, given the mixture of habitat types present in the study area. It must be noted that a study conducted during the raining

period (i.e. in the warm, wet season) would likely reveal other species that are unlikely to be found during the cold, dry season (migrant birds, summer-active invertebrates, amphibians and reptiles etc.); it might even include additional red data species.

Fifty-six Red Data animals are known to occur in the Northern Cape Province (mammals, reptiles, amphibians and invertebrates); 41 have a low probability of occurring in the study area, 10 have a moderate probability and two species have a high probability of occurring, namely *Tatera leucogaster* (Bushveld Gerbil, DD) and *Manis temminckii* (Pangolin, VU). Three species, *Mellivora capensis* (red), *Atelerix frontalis* (NT), *Suncus varilla* (DD) and *Hyaena brunnea* (NT) were confirmed for the study area.

Floristic habitat types are considered representative of faunal habitat types; the following sensitivities were ascribed:

- Closed Shrubveld (Medium-high faunal sensitivity);
- Drainage Line (High faunal sensitivity);
- Excavations (Low faunal sensitivity);
- Floodplains (High faunal sensitivity);
- Grassland Plains (Medium faunal sensitivity);
- Homestead (Low faunal sensitivity);
- Olea europaea Woodland (High faunal sensitivity); and
- Open Shrubveld (High faunal sensitivity).

Areas that have limited distribution within the larger region, as well as areas where unique biophysical attributes occur are regarded sensitive and should preferably be excluded from the proposed development, particularly all habitat types that have an aquatic origin. Sensitive habitat types include the Drainage line, Floodplains and Olea Woodland. When the proposed footprint for the development is evaluated, it is clear that only 12.1 ha (1.86%) of the proposed area comprises habitat of high faunal sensitivity (mainly Olea Woodland, 11.2 ha). This habitat type is limited in nature and is only infrequently represented in the region. The loss of this habitat, when considered on a regional scale is regarded to be of medium importance and while it is not regarded a red flag for the proposed development, the conservation of remaining habitat located immediately outside the proposed footprint should be ensured.

A total of 629.4 ha (97.3%) of the proposed footprint area comprises habitat of medium faunal sensitivity, including the Grassland Plains and Open Shrubveld habitat. An important aspect is the loss of migration potential in an east-west direction for animals that utilises the grassland and low shrubveld habitat. It is however conceivable that animals will adapt and utilise other available migration routes, particularly to the north of the site. The general region comprises extensive areas of similar habitat and this proposed development is not regarded to contribute significantly to habitat fragmentation and isolation on a regional scale. The loss of these habitat types is regarded to be of medium importance, particularly because of the extensive size of the proposed development.

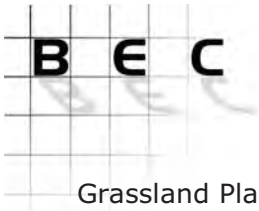
The significance of impacts across the entire site is regarded to be of moderate significance. However, on closer inspection it is clear that certain impacts, particularly those of a direct nature, are expected to result in significant impacts in parts of the study area. Of particular importance is the significance of impacts on Red Data animals. Some species are unable to evacuate the area with disturbance and will likely be destroyed. The only sensible mitigation measure will be to remove these animals by means of an intensive search and rescue operation. The destruction of extensive areas on the property is also expected to result in significant impacts on fauna species present on the neighbouring areas that utilise this area on an infrequent basis.

**Closed Shrubveld Habitat Type** Impacts within this habitat type are regarded significant on a local scale; excluding this area from the development, as far as technically feasible, is recommended. It is indicated that a small portion of this habitat type will be affected. The loss of a small portion of this habitat type is not expected to result in significant impacts on a regional scale since this vegetation type is well represented to the north of this particular site, with a Least Threatened conservation status afforded by VEGMAP. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

**Drainage Line Habitat Type** Any impact within this habitat type will be regarded as significant. Although the proposed footprint does not include any part of this drainage line, the proximity of the drainage line to the development area will require strict management and development measures to prevent impacts to this area. Drainage of water from the development area towards this habitat will result in deterioration of the status on the site as well as in wetland habitat further downstream. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

**Floodplains Habitat Type** Any impact within this habitat type will be significant, excluding this area from the development represents the major mitigation measure. It is indicated that only an extremely small portion of this habitat type is located within the proposed footprint, but the proximity of these areas to the footprint will highly likely result in peripheral impacts affecting this area adversely. It should also be noted that this habitat type buffers the drainage line from the proposed development, keeping this buffer intact is therefore important in terms of preserving the drainage line. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.



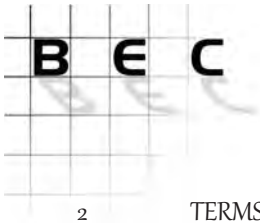


**Grassland Plains Habitat Type** Large extents of this habitat type will be affected, during the construction phase. However, the ecological sensitivity is indicated as moderate and the loss of these areas is not expected to result in significant impacts on a when considered on a large scale. It should be noted that termite mounds occur within this habitat type, which is habitat for Red Data fauna species; a search and rescue operation is recommended. It should also be noted that this habitat type is adequately represented in the surrounding region. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

**Olea Woodland Habitat Type** A portion of this habitat type will be affected by the proposed development, the presence of protected tree species represents an important consideration. While the presence of these individuals does not represent a red flag to the development, careful planning and execution of development plans must be made to avoid impacts in adjacent parts of this habitat type. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

**Open Shrubveld Habitat Type** Large extents of this habitat type will be affected, during the construction phase. However, the ecological sensitivity is indicated as moderate and the loss of these areas is not expected to result in significant impacts on a when considered on a large scale. It should be noted that termite mounds occur within this habitat type, which is habitat for Red Data fauna species; a search and rescue operation is recommended. It should also be noted that this habitat type is adequately represented in the surrounding region. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.





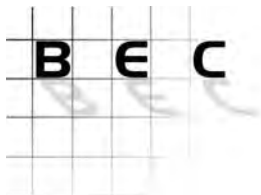
The major objectives of this Biodiversity Impact Assessment are to establish the presence/absence of ecologically sensitive areas or species within the proposed project area, briefly assess the potential impacts of the proposed development on the natural environment, provide pertinent comments on the suitability of the area for the proposed project and to make pertinent development recommendations based on results of the field assessments and available desktop knowledge.

**The Terms of Reference for the floristic assessment are as follows:**

- Obtain all relevant Précis and Red Data flora information;
- Conduct a photo analysis of the proposed area;
- Identify preliminary floristic variations;
- Survey preliminary habitat types to obtain a broad understanding of the floristic diversity;
- Assess the potential presence of Red List flora species according to information obtained from SANBI;
- Incorporate existing knowledge of the region into the assessment;
- Describe broad habitat variations present in the study area in terms of biophysical attributes and phytosociological characteristics;
- Compile a floristic sensitivity analysis;
- Incorporate results into the Biodiversity Impact Evaluation;
- Map all relevant aspects;
- Provide pertinent recommendations; and
- Present all results in a suitable format.

**The Terms of Reference for the faunal assessment are as follows:**

- Obtain available faunal distribution records and Red Data faunal information
- Survey the site to obtain a broad overview of available faunal habitat types;
- Assess the potential presence of Red Data fauna species;
- Incorporate existing knowledge of the region;
- Describe the status of available habitat in terms of faunal attributes, preferences and conservation potential;
- Compile a faunal sensitivity analysis;
- Incorporate results into the Biodiversity Impact Evaluation;
- Map all relevant aspects; and
- Present all results in a suitable format.



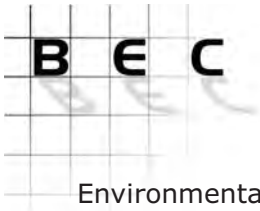
Destructive activities in a natural environment require vigilance to ensure that the biological and cultural heritage of future generations is not adversely affected by activities of today. Concern is growing about the consequences of biodiversity losses, for ecosystem functioning, for the provision of ecosystem services and for human well being.

Why is Biodiversity Conservation Important? Biodiversity sustains life on earth. An estimated 40 percent of the global economy is based on biological products and processes. Biodiversity has allowed massive increases in the production of food and other natural materials, which in turn have fed the (uncontrolled) growth and development of human societies. Biodiversity is also the basis of innumerable environmental services that keep humans and the natural environment alive, from the provision of clean water and watershed services to the recycling of nutrients and pollination.

Current pressures on and losses of biodiversity are unfortunately threatening to undermine the functionality of natural ecological processes and adaptive responses of the environment. The last few centuries have witnessed brutal increases in the rate at which biodiversity is being altered by humanity. With uncontrolled growth of human population, consumption needs have increased exponentially as well as the drive to extract more economically valuable resources at ever-faster rates. Natural habitats that harbour some of the world's most valuable biodiversity are being lost at increasingly faster and over progressively wider areas, while managed lands are undergoing increasing simplification. Adopting 'biodiversity friendly' practices remains challenging within the entire developmental sphere, especially for smaller companies and peripheral players. This is partly because governments, while perhaps committed on paper to biodiversity, have found it difficult to create the right incentives and apply the necessary regulations in a way that could encourage all players to conserve biodiversity.

Humanity faces the challenge of supporting the needs of growing populations from a rapidly shrinking natural resource base. Achieving a balance while doing this will require a better understanding and recognition of conservation and development imperatives and this is only a step towards more strategic and integrated approach to land use planning and management that helps societies make better-informed decisions. Evidence illustrate how management tools, rehabilitation and restoration processes, together with improved scientific knowledge, can help conserve biodiversity; also highlighting that mutual benefits can result from stronger collaboration between the mining and conservation sectors. Good practice, collaboration and innovative thinking can advance biodiversity conservation worldwide while ensuring that the minerals and products that society needs are produced responsibly.

In 1992, the Convention of Biological Diversity, a landmark convention, was signed by more than 90 % of all members of the United Nations. The enactment of the National



Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004), together with the abovementioned treaty, focuses on the preservation of all biological diversity in its totality, including genetic variability, natural populations, communities, ecosystems up to the scale of landscapes. Hence, the local and global focus changed to the sustainable utilisation of biological diversity.

Savannah Environmental has appointed by Momentous Energy as an independent Environmental Assessment Practitioner (EAP), to undertake the necessary environmental studies to identify and assess all potential environmental impacts associated with the proposed project. Bathusi Environmental Consultants (BEC) has been appointed as independent ecological specialists to conduct a strategic biodiversity impact evaluation of the biological environment that will be affected by this proposed development. Dewald Kamffer (FSI) conducted the faunal assessment; Riaan Robbeson (BEC) conducted the floristic assessment, provided the ecological interpretation and compiled the ecological sensitivity analysis.

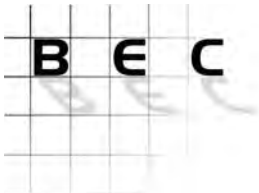
#### 4 LIMITATIONS OF THIS INVESTIGATION

Although care was taken to ensure the proper investigation the study area, it is only reasonable to expect that not all areas could be investigated in detail and not all species could be located or identified during a single survey that was conducted during the winter period. Because rare and endemic species normally do not occur in great densities and because of customary limitations in the search and identification of Red Listed species, the detailed investigation of these species was not possible and results are ultimately based on estimations and specialist interpretation of limited data.

Results presented in this report are based on a snapshot investigation of the study area and not on detailed and long-term investigations of all environmental attributes and the varying degrees of biological diversity that may be present in the study area. No concrete conclusions may therefore be drawn concerning biological diversity or conservation strategies as far as this study area is concerned.

It is emphasised that information, as presented in this document, only have bearing on the site as indicated on accompanying maps. This information cannot be applied to any other area, however similar in appearance or any other aspect, without proper investigation.

Furthermore, additional information may become known during a later stage of the process or development. This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from the surveys or requests made to them at the time of this report.



Solar energy use currently contributes a very small portion of the total energy supply in the Northern Cape Province. Approximately 0.2% of households use it for cooking, and 0.15% uses it for heating, but the Northern Cape has the highest solar energy use for lighting (1%) when compared to other provinces. In particular, the area of the Northern Cape bordering Namibia has the highest solar radiation intensity in southern Africa, and there is a national drive to increase the use of solar energy technologies (SoER, 2004).

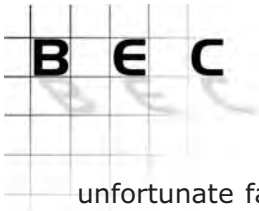
Solar Reserve SA is planning a Concentrated Solar Power (CSP) plant on the Farm 469, Hay RD (Humansrus), situated approximately 4 km southeast of Groenwater and 30 km east of Postmasburg, in the Northern Cape, Kheis Local Municipality. Beal Environmental Consulting was appointed as independent environmental consultants to conduct the Environmental Impact Assessment (EIA) process for the proposed development. WPRSA / SSI were appointed as independent consultants to carry out the Public Participation process.

In order to explore new generation options, find solutions that can contribute to meeting the growing electricity demand and in an effort to utilise renewable energy resources, Solar Reserve is assessing the feasibility of constructing a CSP plant with a maximum capacity of 100 MW in the Northern Cape. This CSP plant will comprise of four main subsystems, namely:

- **Solar Field** – the solar field consists out of all services and infrastructure related to the management and operation of the heliostats.
- **Molten Salt Circuit** which includes the thermal storage tanks for storing the hot and cold liquid salt, a concentration tower, pipelines and heat exchangers;
- The **Power Block**; and
- **Auxiliary facilities and infrastructure** which includes the steam turbine, condenser-cooling system, electricity transmission lines, a grid connection, access routes, water supplies and facility start-up energy plant (gas or diesel generators).

Bathusi Environmental Consulting cc was appointed to conduct the relevant terrestrial biodiversity investigations. Riaan A. J. Robbeson (Pr.Sci.Nat.) conducted the floristic assessment while Dewald Kamffer (Pr.Sci.Nat.) assessed the faunal components.

While a proper knowledge of the biodiversity of the region is not negotiable to the ultimate success of this project, an attempt was made to remove any subjective opinions that might be held on any part of the study area as far as possible. Inherent characteristics of a project of this nature implies that no method will be foolproof, mainly as a result of shortcomings in available databases and lack of site specific detail that could be obtained from limited detailed site investigations conducted over a short period of time. It is an



unfortunate fact that inherent sensitivities within certain areas are likely to exist that could not be captured or illustrated during the process. This is a limitation of every scientific study; it simply is not possible to know everything or to consider aspects to a level of molecular detail. However, the approach followed in this study is considered effective in presenting objective comments on the comparison of biodiversity sensitivity of parts in the study area.

In order to present an objective opinion of the biodiversity sensitivity of the study area and how this relates to the suitability/ unsuitability of any area within the site in terms of the proposed development, all opinions and statements presented in this document are based on the following aspects, namely:

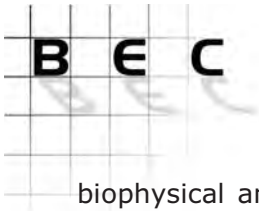
- A desk-top assessment of all available biological and biophysical data;
- Augmentation of existing knowledge by means of site specific and detailed field surveys;
- Specialist interpretation of available data, or known sensitivities of certain regional attributes; and
- An objective impact assessment, estimating potential impacts on biological and biophysical attributes.

#### 6.1 BACKGROUND INFORMATION

The overall goal of this section of the biodiversity investigation is to establish a reference point for the biophysical and biological sensitivities of the study area by means of the Ecosystem Approach or Landscape Ecology. The Ecosystem Approach is advocated by the Convention on Biological Diversity. It recognizes that people and biodiversity are part of the broader ecosystems on which they depend, and that it should thus be assessed in an integrated way. Principles of the Ecosystem Approach include the following:

- The objectives of ecosystem management are a matter of societal choice;
- Ecosystem managers should consider the effects of their activities on adjacent and other systems;
- Conservation of ecosystem structure and functioning, to maintain ecosystem services, should be a priority target;
- Ecosystems must be managed within the limits of their functioning;
- The approach must be undertaken at appropriate spatial and temporal scales;
- Objectives for ecosystem management should be set for the long-term;
- Management must recognise that change is inevitable;
- The approach should seek an appropriate balance between, and integration of, conservation and use of biodiversity;
- All forms of relevant information should be considered; and
- All relevant sectors of society and scientific disciplines should be involved.

For the purpose of this particular study, a local scale was selected as suitable in terms of the size of the study area. The approach of Landscape Ecology includes the assessment of



biophysical and societal causes, consequences of landscape heterogeneity and factors that causes disturbance to these attributes. In non-professionals' terms, it implies that if sensitive habitat types/ ecosystems (frequently associated with biodiversity elements of high sensitivity or conservation importance) are protected, species that are highly sensitive to changes in the environment will ultimately be protected. Species conservation is therefore largely replaced by the concept of habitat conservation. This approach is regarded effective since the protection of sensitive ecosystems will ultimately filter down to species level.

It is inevitable that the Landscape Ecology Approach will not function effectively in all cases since extremely localised and small areas of sensitivity do occur scattered in the study area, which cannot always be captured on available databases or might have been missed during the site investigations. In addition to the compilation of basic species lists and the identification and description of localised ecological habitat, it was also regarded important to identify areas of sensitivity on a local scale and, where possible, communities or species that are considered sensitive to influences arising from the proposed development.

This investigation therefore aims to:

- Determine the biological sensitivity of the receiving natural environment as it relates to the construction and operation of the plant and associated infrastructure in a natural environment;
- Highlight the known level of biodiversity;
- Highlight flora and fauna species of conservation importance that are likely to occur within the study area;
- Estimate the level of potential impacts of the construction and operation of proposed power lines on the biological resources of the study area;
- Apply the Precautionary Principal throughout the assessment<sup>1</sup>.

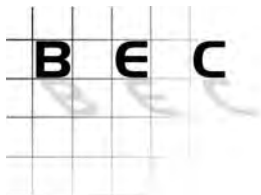
Available databases of biophysical attributes are implemented to identify regional areas of importance as it relates to biodiversity. Biophysical attributes that are known to be associated with biodiversity aspects of importance, conservation potential or natural status of the environment were implemented to compile the ecological sensitivity analysis of the study area. These attributes include the following:

- Areas of known biological importance (ENPAT);
- Geology and soil types;
- Areas of surface water (ENPAT);
- Degradation classes (ENPAT Land Cover Classes);
- Regional vegetation types (VEGMAP);
- Land cover categories (ENPAT);
- Regional conservation plans (where available); and
- Ridges and outcrops.

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<sup>1</sup> ([www.pprinciple.net/the\\_precautionary\\_principle.html](http://www.pprinciple.net/the_precautionary_principle.html)).





The floristic assessment was conducted by R. A. J. Robbeson (Pr.Sci.Nat.).

#### 6.2.1 *General Floristic Attributes*

The vegetation investigation is based on a variation of the Braun-Blanquet method whereby vegetation is stratified on aerial images with physiognomic<sup>2</sup> characteristics as a first approximation. These initial stratifications are then surveyed for floristic and environmental diversity during a site investigation and ultimately subjected to a desktop analysis to establish differences/ similarities between observed units.

In preparation for the site survey, physiognomic homogenous units are identified and delineated on digital aerial photos, using standard aerial photo techniques (downloaded from [www.googleearth.com](http://www.googleearth.com) and georectified on Arcview 3.2). A site visit was conducted to examine the general floristic attributes and -diversity of the study area. Because of the seasonality of the surveys, only qualitative observations were made at sample points with limited floristic diversity noted.

A desktop analysis of sample data was conducted to establish differences/ similarities between delineated vegetation units, which were subsequently described in terms of species composition and dominance as well as driving (developmental) environmental parameters. Preliminary results and species lists that are provided should be interpreted with normal liabilities in mind.

It is not the intention to provide exhaustive and comprehensive lists of all species that occur on this site, since most of the species on these lists are usually common or widespread species. Rare, threatened, protected and conservation worthy species and habitat associated with these species are considered the highest priority, the presence of which is most likely to result in significant negative effects on the ecological environment.

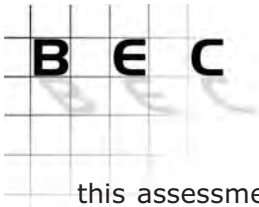
#### 6.2.2 *Red Data Flora*

The purpose of listing Red Data plant species is firstly to provide information on the potential occurrence of species of special concern in the study area that may be affected by the proposed infrastructure. Secondly, the potential occurrence of these species can then be assessed in terms of their habitat requirements in order to determine whether they have a likelihood of occurring in habitats that may be affected by the proposed infrastructure. Red Listed flora information, as presented by SANBI was used as a point of departure for

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<sup>2</sup> Physiognomy refers to the visual appearance of vegetation in terms of different growth classes, biomass, height, etc.





this assessment. A snapshot investigation of an area, such as this particular investigation, represents a severe limitation in terms of locating and identification potential Red Listed flora species. Particular emphasis was therefore placed on the identification and assessment of habitat deemed suitable for the potential presence of Red Listed.

It should be noted that Red List species are, by nature, usually rare and difficult to locate. Compiling a list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. Notwithstanding the application of the Precautionary Principle, there is always the likelihood that a species that is not included in a list might be unexpectedly present in an area.

Furthermore, regulations in terms of the National Forest Act provide a list of protected tree species for South Africa. The most important legislation is the following: *National Environmental Management: Biodiversity Act (act No 10 of 2004)*.

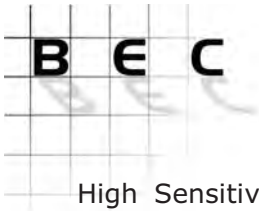
6.2.3 Floristic Sensitivity

The aim of this exercise is to determine the inherent sensitivity of vegetation communities or habitat types by means of the comparison of weighted floristic attributes. Results of this exercise are not 'stand-alone' and will eventually be presented in conjunction with results obtained from the faunal investigation.

Each vegetation unit is subjectively rated on a scale of 1 to 10 (**Sensitivity Values**) in terms of the influence that the particular Sensitivity Criterion has on the floristic status of the plant community. Separate Values are multiplied with the specific Criteria Weighting, which emphasises the importance/ triviality that the individual Sensitivity Criteria have on the status of each community. **Ranked Values** are then added and expressed as a percentage of the maximum possible value (**Floristic Sensitivity Value**) and placed in a particular class, namely:

<b>High</b>	80% - 100%
<b>Medium - high</b>	60% - 80%
<b>Medium</b>	40% - 60%
<b>Medium - low</b>	20% - 40%
<b>Low</b>	0% - 20%

This method is considered effective in highlighting sensitive areas, based on observed floristic attributes rated across the spectrum of communities. Phytosociological attributes (species diversity, presence of exotic species, etc.) and physical characteristics, e.g. human impacts, size, fragmentation are important in assessing the status of the various communities.



High Sensitivity Index Values indicate areas that are considered pristine, unaffected by human influences or generally managed in an ecological effective manner. These areas are comparable to nature reserves and even well managed farm areas. Low Sensitivity Index Values indicate areas of lower ecological status or importance in terms of vegetation attributes, or areas that have been negatively affected by human impacts or poor management. Sensitivity Criteria employed in assessing the floristic sensitivity of separate units may vary between different areas, depending on location, type of habitat, size, etc.

### 6.3 FAUNAL ASSESSMENT

The faunal assessment was conducted by D. Kamffer (Pr.Sci.Nat.). This faunal assessment included qualitative surveys across major habitat types observed in the study area.

#### 6.3.1 *Data analysis*

- All GPS acquired data is converted from text to shapefiles to allow GIS analyses.
- Shapefiles of environmental attributes such as geology, soil, hydrology and vegetation are incorporated in the analyses of available faunal habitats.
- Sensitivity maps are compiled, where relevant, subsequent to data analyses.
- Species lists are compiled for relevant taxa using fieldwork data, literature and data supplied by various other institutions and specialists.

#### 6.3.2 *Red Listed fauna Probabilities*

Three parameters are used to assess the Probability of Occurrence of each Red Listed species:

- Habitat requirements (HR) - Red Listed animals have specific habitat requirements and the presence of these habitat characteristics in the study area is evaluated.
- Habitat status (HS) - The status or ecological condition of available habitat in the study area is assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Listed species (especially wetland-related habitats where water quality plays a major role); and
- Habitat linkage (HL) - Movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to surrounding habitats and adequacy of these linkages are evaluated for the ecological functioning of Red Listed species within the study area.

#### 6.3.3 *Ecological Function*

The extent to which a site is ecologically connected to surrounding areas is an important determinant of its sensitivity. Systems with a high degree of landscape connectivity or with

extensive grassland and drainage systems amongst one another are perceived to be more sensitive and will be those contributing to important faunal assemblages or overall preservation of faunal diversity.

The estimated Probability of Occurrence for Red Data fauna species is presented in five categories, namely:

- Very low;
- Low;
- Moderate;
- High; and
- Very high.

#### 6.3.4 Faunal Habitat Sensitivities

Faunal habitat sensitivities are subjectively estimated based on the following criteria:

- Habitat status;
- Connectivity;
- Observed species composition & RD Probabilities; and
- Functionality.

and is place in one of the following classes:

- High;
- Medium-high
- Medium;
- Medium-low; or
- Low.

### 6.4 IMPACT EVALUATION

#### 6.4.1 Status of the Impact

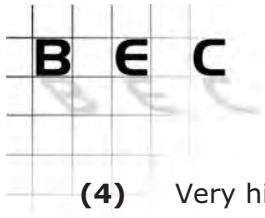
The impacts are assessed as either having a:

- Negative effect (i.e. at a cost to the environment);
- Positive effect (i.e. at a benefit to the environment); or
- Neutral effect on the environment.

#### 6.4.2 Spatial Scale of the Impact

The spatial scale of the impact was assessed according to the following criteria:

- (0)** None - no impact;
- (1)** Low - site specific, within the boundaries of the site;
- (2)** Medium – local, extending beyond the boundaries of the site, (i.e. up to 5km);
- (3)** High – Regional, extends far beyond the site boundaries (i.e. >5km); or



**(4)** Very high – National and/ or international.

6.4.3 *Temporal Scale of Impacts*

The lifespan of the impact was assessed to be either:

- (0)** None – no impact
- (1)** Low – short term, quickly reversible (0 – 5 years);
- (2)** Medium - medium term, reversible over time (5 – 15 years);
- (3)** High - long term, approximate life span of project (16 - 30 years); or
- (4)** Very high – permanent, over 30 years, resulting in permanent and lasting changes.

6.4.4 *Probability of Occurrence*

The likelihood of the impact actually occurring was indicated as either:

- (0)** No impact;
- (1)** Improbable - possibility of the impact materializing is negligible (<10%);
- (2)** Probable – possibility that impact will materialise is likely, (10 – 49%);
- (3)** Highly probable - expected that impact will occur, (50 – 90%); or
- (4)** Definite - the impact will occur regardless of any prevention measures (>90%).

6.4.5 *Severity of Impacts*

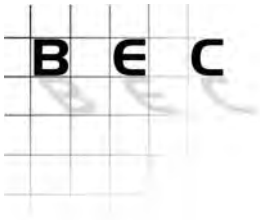
The magnitude or severity of the impacts is indicated as either:

- (0)** None - Small (where the aspect will have no impact on the environment);
- (1)** Negligible/ minor – Systems are marginally affected by proposed development;
- (2)** Average - Medium or short-term impacts on the affected system. Mitigation is easy, cheap, less time consuming or not necessary. For example, a temporary fluctuation in the water table due to water abstraction;
- (3)** Severe - Medium to long term impacts on the affected system that could be mitigated. For example constructing a narrow road through vegetation with a low conservation value; or
- (4)** Very Severe - An irreversible and permanent change to the affected system that cannot be mitigated. For example, the permanent change to topography resulting from a quarry.

6.4.6 *Accumulative Impact*

The impact of the development is considered together with additional developments of the same or similar nature and magnitude. The combined impacts may be:

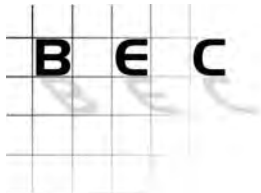
- Negligible – i.e. the net effect is the same as the single development;
- Marginal – i.e. the impact of two developments of a similar nature is less than twice the impact of a single development; or
- Compounding – i.e. the impact of two developments is more than twice the impact of two single - developments.



6.4.7 *Significance of the Impact*

Based on a synthesis of the information contained in the points above, the potential impacts were assigned a significance weighting, which is formulated by adding the sum of the numbers assigned to Spatial Scale, Temporal Scale, Probability of Impacts and Severity of Impacts.

- None: 0 (There is no impact);
- Low: 1 - 5 (Impact is of a low order, mitigation measures are easy, inexpensive and simple);
- Medium: 6 - 11 (Impact is real, but not substantial, mitigation measures are costly);
- High: 12 - 16 (Impact is substantial and will occur even with the application of costly and complicated mitigation measures)



## 7 THE BIOPHYSICAL ENVIRONMENT

### 7.1 LOCATION

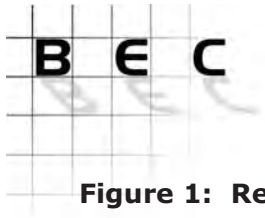
The regional setting of the proposed site is indicated in Figure 1, with georeferenced Google Earth images presented in Figure 2, downloaded from the Google Earth website and This site is situated approximately 4km southeast of Groenwater and 30km east of Postmasburg, in the Northern Cape and falls within the jurisdiction of the Kheis Local Municipality. Existing overhead powerlines is situated on the northern and southern boundary of the farm and will be utilised to evacuated electricity into the grid.

### 7.2 SURFACE WATER

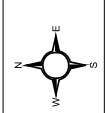
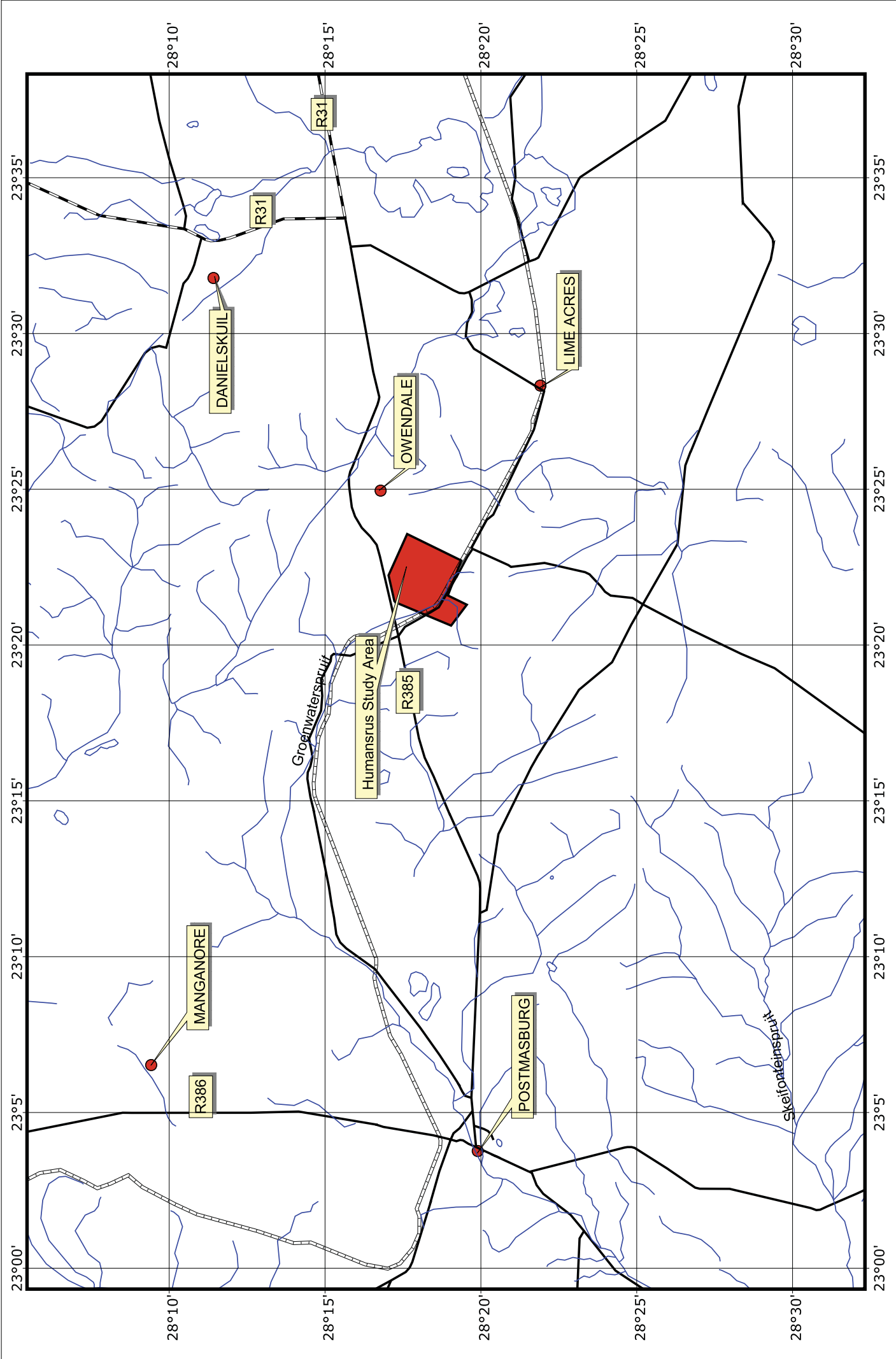
The study area falls within the upper reaches of the Orange Primary Catchment area. Non-perennial streams are present in the southwestern part of the study area (Figure 2). In addition to the presence of these non-perennial streams, it would appear as if wider floodplains are associated with the drainage lines. The region is generally classified as relative dry and the ecological functionality of these areas would therefore be important on a local and regional scale on a temporary basis. The northern part of the study area is characterised by mountainous terrain and seasonal flow from these areas created floodplains at the foothills of the mountains. These areas are mostly characterised by wide, flat and sandy beds.

No significant wetlands, estuaries, Ramsar Sites or major dams are present within the immediate vicinity of the study area.

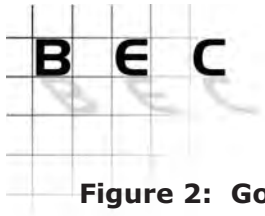




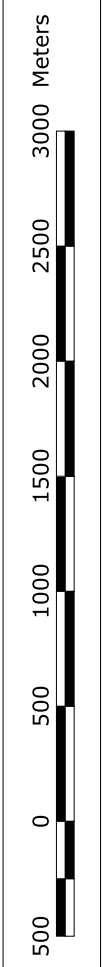
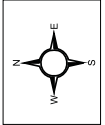
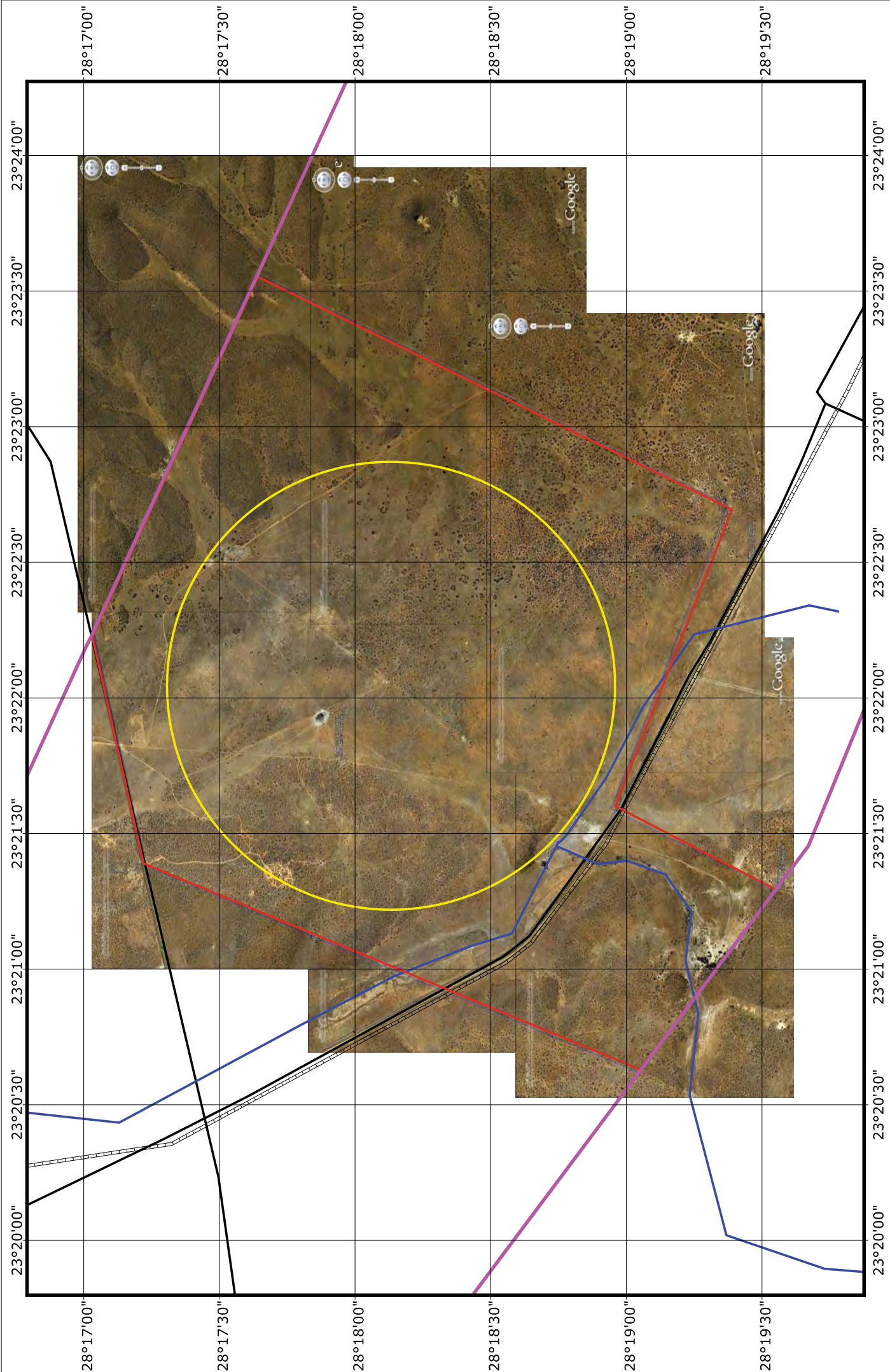
**Figure 1: Regional setting of the study area**









Humansrus study area  
 Towns  
 National Roads  
 Railway  
 Rivers  
 Secondary Roads



**Figure 2: Google Earth image of the general region**



	Existing overhead powerlines		Study area		Roads
	Proposed footprint		Drainage lines		Railway Lines

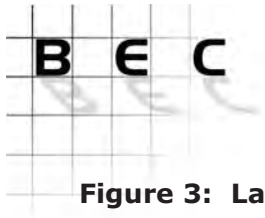
Land use often determines land cover; it is an important factor contributing to the condition of the land. Different uses have varying effects on the integrity of the land. Most of the Province is dominated by vast open areas of natural vegetation; 69.7% of the total area is covered by shrubland and low fynbos. A further 14.2% of the Northern Cape is dominated by thicket vegetation and bushland. A total of 0.7% of the Province is classified as degraded whilst 0.2% has dongas and sheet erosion. Urbanisation in the Province is relatively low at 0.1% (SoER, 2004).

Land cover categories of the general region are presented in Figure 3. For the purpose of this assessment, land cover are loosely categorised into classes that represent natural habitat and land cover categories that resulted from habitat degradation and transformation on a local or regional scale. Areas that are characterised by high levels of transformation and habitat degradation is generally more suitable for development purposes as it is unlikely that biodiversity attributes of importance will be present or affected by development. Conversely, areas that are characterised by extensive untransformed and pristine habitat are generally not regarded suitable options for development purposes.

The region of the study area comprises extensive untransformed habitat with limited areas characterised by development, agriculture, mining and other forms of habitat transformation. One of the shortfalls of the ENPAT database is that it does not reflect the status of natural habitat within the study area.

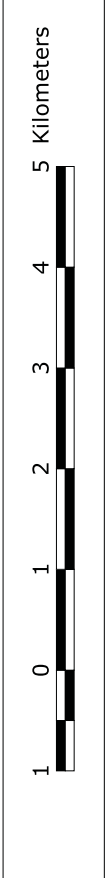
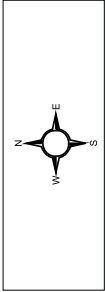
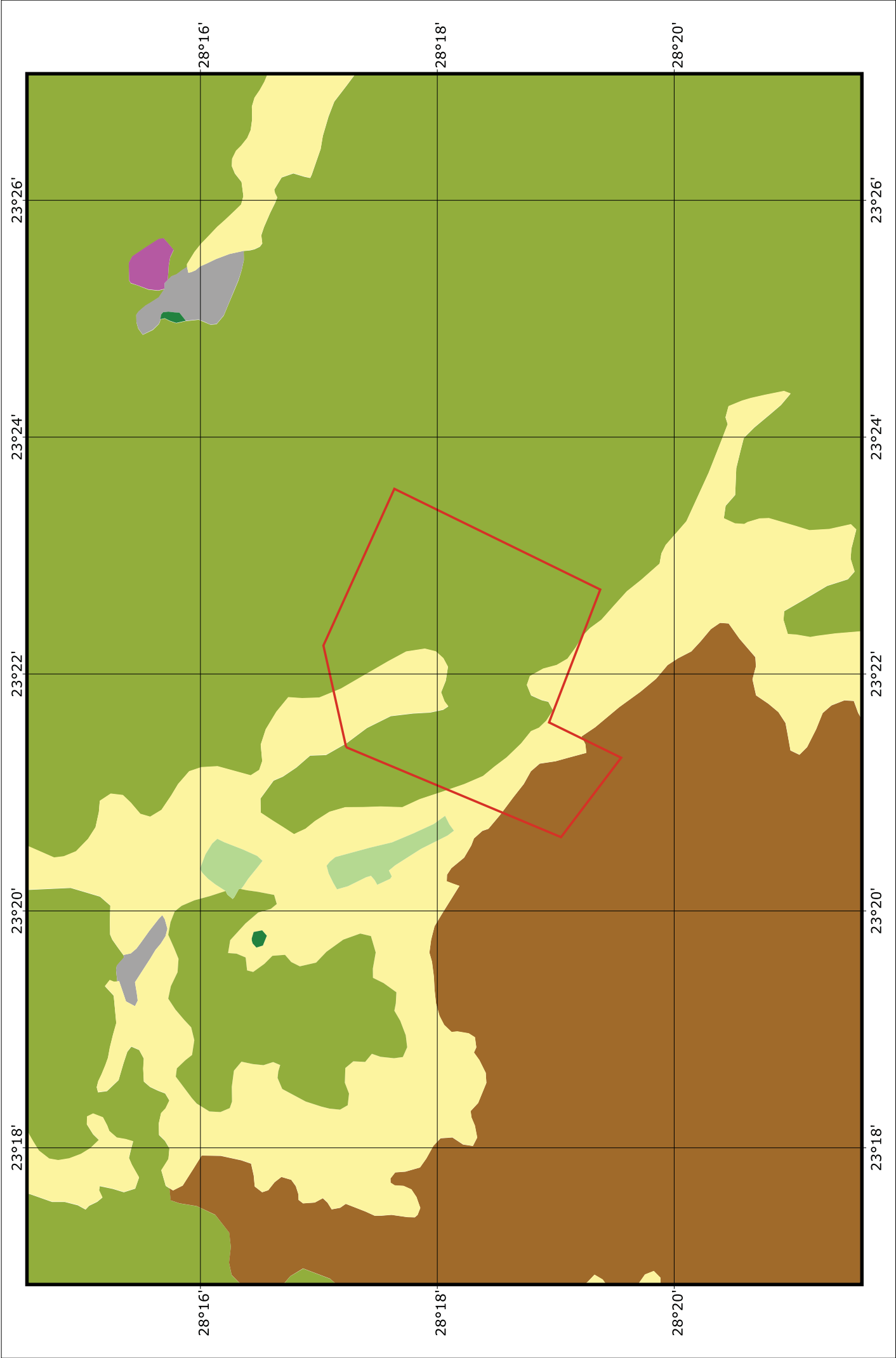
The topography of the study area is described as Hills and Lowlands, situated approximately between 1,500 and 1,600m above sea level. The eastern section of the study area comprising the Ib land type, is likely to be variable in relief and spatial heterogeneity. The presence of these habitat types is important in terms of habitat variability and ultimately biodiversity attributes that characterise these parts. Hills and ridges have generally been shown to have a rich biodiversity consisting of an important habitat for sensitive species as well as high plant diversity.

Topographical categories are presented in Figure 4.

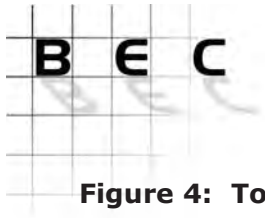


**Figure 3: Land Cover of the general region**

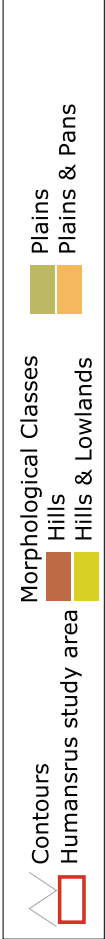
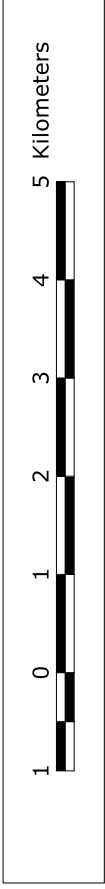
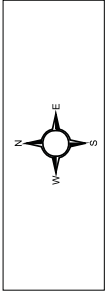
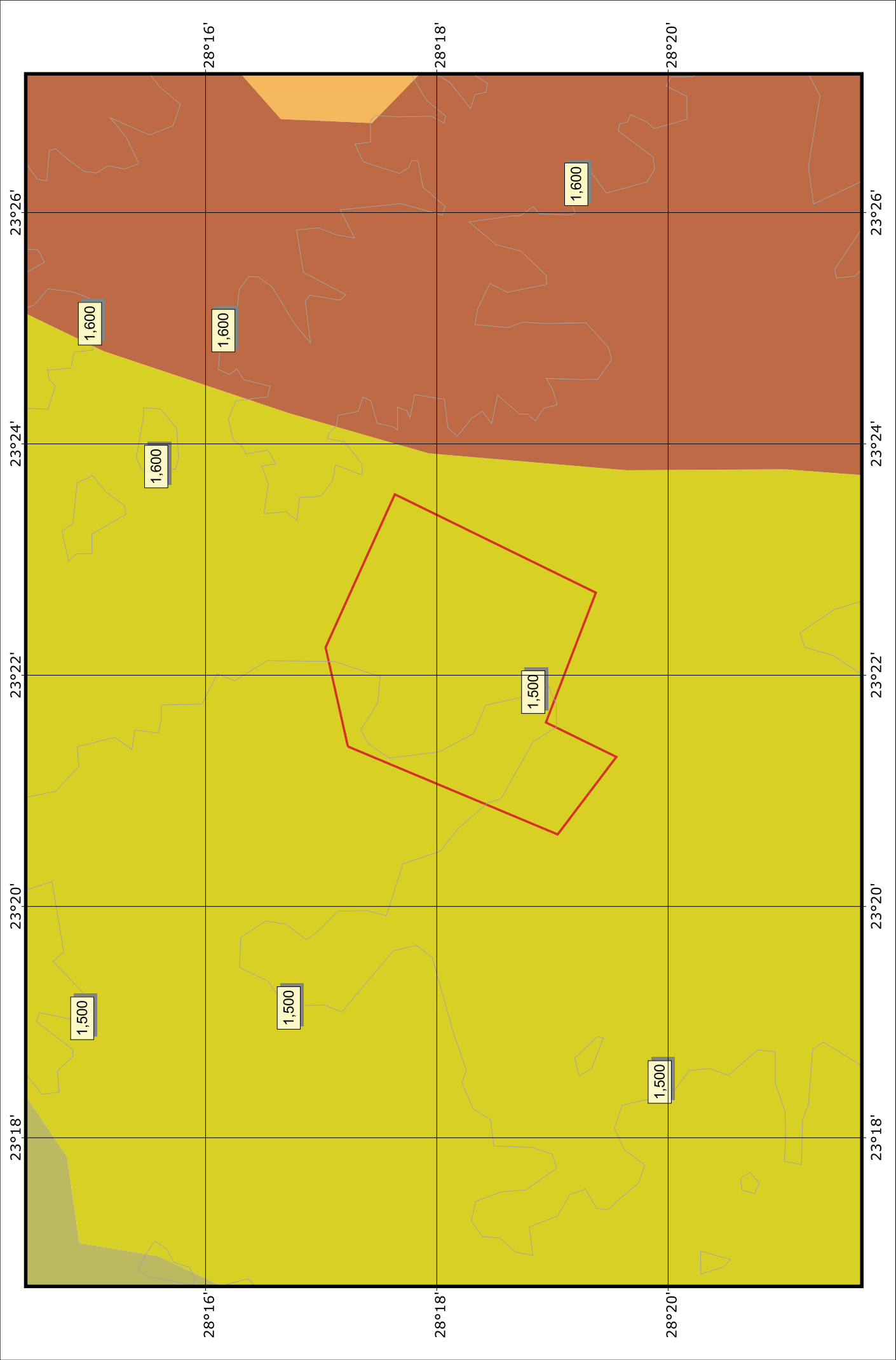








**Figure 4: Topographical categories of the general region**



7.5 DECLARED AREAS OF CONSERVATION

No declared area of conservation is present within the general surrounds of the study area. The study area does however fall within the Griqualand West Centre of Endemism.

7.5.1 *Griqualand West Centre of Endemism*

This area is named after Griqualand West, the region comprising the Hay District and parts of the Barkley West District in the Northern Cape Province. The region was so called because of the Griqua, a Khoekhoe people, who lived there.

The mountainous western parts of the WC are covered by Kalahari Mountain Bushveld, and the eastern plateau area is covered by Kalahari Plateau Bushveld, both endemic to the centre (Low & Rebelo, 1996). *Tarchonanthus camphoratus* is a particularly common woody species in these two bushveld types. Typical mountain species include *Searsia tridactyla*, *Croton gratissimus* and *Buddleja saligna*. Pockets of Karoo-type vegetation increase towards the south and west, especially in overgrazed areas. Succulents of the Asclepiadaceae, Euphorbiaceae and Mesembryanthemaceae are well represented in the centre.

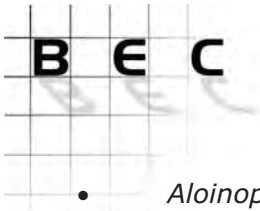
The proximity of the GWC is signified by the pockets and tongues of wind-blown, orange-red Kalahari sand that have accumulated in some of the intermontane valleys. The vegetation of the GWC is still fairly intact, although extremely poorly conserved. Apparently, the Kalahari Plateau Bushveld is the only Savanna Biome vegetation type that is not represented in any sizeable nature reserve (Van Rooyen & Bredenkamp, 1996b). Bush encroachment, which is due to inappropriate management practices (mainly overgrazing by domestic livestock), is a major problem in many parts of the region.

**Vascular Plants:**

• Total number of species/ infraspecific taxa	± 1,800
• Endemic/ near endemic families	0
• Endemic/ near endemic genera	0
• Endemic/ near endemic species/ infraspecific taxa	>40 (2.2%)
• Percentage succulents among endemics	32.5%

Representative endemic/ near endemic succulents include:

- *Aizoon asbestinum*;
- *Euphorbia bergii*
- *Euphorbia inornata*;
- *Euphorbia planiceps*;
- *Euphorbia rectirama*;
- *Euphorbia wilmaniae*



- *Aloinopsis orpenii*
- *Aloinopsis wilmanii*
- *Ebracteola wilmaniae*
- *Lithops aucampiae* subsp. *aucampiae* var. *aucampiae*
- *Lithops aucampiae* subsp. *aucampiae* var. *koelemanii*
- *Lithops bromfeldii* var. *glaudinae*
- *Lithops lesliei* subsp. *burchelli*

## 7.6 LAND TYPES & GEOLOGY

Although it is not in the scope of this report to present a detailed description of the soil types of the area, a basic description will suffice for this assessment as a strong association between habitat types and land types are typically known to occur. The following land type units are encountered in the study area (Figure 5):

- Ae214/215 - A- land types generally represent flat or slightly undulating landscapes, on granite, shale and Karoo sediments, which mostly give rise to deep, freely drained soils. Yellow & red soils without a water table predominate, belonging in one or more of the Inanda, Kranskop, Magwa, Hutton, Griffon or Clovelly soil forms. The land does not qualify as a plinthic catena and one of the above soil forms occupy at least 40% of the area (red, high base status, >300mm deep, no dunes); and
- Ib237 - This land type is characteristic of the very rocky quartzite hills and ridges, with very little, shallow soil. These ridges have grassland on cooler, exposed sites and bush on warmer sheltered sites [land types with exposed rock (exposed country rock, stones or boulders) covering more than 80% of the area. The rocky portion may be underlain by soils, which would have qualified the unit for inclusion in another broad soil pattern was it not for the surface rockiness].

The geology of the area conforms to banded iron formations, with jaspilite, chert and riebeckite asbestos in the rocky/ stony parts of the study area. Low-lying sandy plains comprise red aeolian sand of Tertiary to Recent age with silcrete and calcrete.

## 7.7 REGIONAL ECOLOGY

### 7.7.1 Background

The study area is situated within the Savanna Biome, the largest Biome in southern Africa, occupying 46% of its area, and over one-third the area of South Africa. The term savanna is widely used to describe a vegetation type with a well-developed grassy layer and an upper layer of woody plants. The distribution of variations and smaller communities are correlated with many environmental factors, including geology, landform, climate, soil types, fire and a very specific faunal composition. South African savannas of nutrient-poor

substrates are characteristically broad-leaved and without thorns, while those of nutrient-rich substrates are fine-leaved and thorny. Nutrient-rich savannas have high grass layer productivity and the grasses are acceptable to grazers, resulting in a high grazing capacity. A major factor delimiting the biome is the lack of sufficient rainfall, which prevents the upper layer from dominating. This, coupled with fires and grazing, keeps the grass layer dominant.

Conservation of savanna is good in principle, mainly due to the presence of the Kruger and Kalahari Gemsbok National Parks within the biome. Similarly, in neighbouring countries, large reserves occur, such as Etosha, Gemsbok, Chobe and Hwange National Parks and the Central Kalahari Game Reserve. However, this high area conserved in South Africa, belies the fact that half of savanna vegetation types are inadequately conserved, in having less than 5% of their area in reserves. However, much of the area is used for game farming and can thus be considered effectively preserved if sustainable stocking levels are maintained. The importance of tourism and big game hunting in the conservation of the area must not be underestimated.

African savannas are inhabited by 13,000 plant species, of which 8,000 are savanna endemics. Dry savannas, specifically, have more than 3,300 endemic species, a diversity equalling that of the South African grasslands and only exceeded by the Fynbos biome. In respect of animal biodiversity, the savannas are without peer. Dry South African savannas have more recorded species of amphibians (52 species), reptiles (177 species), birds (519 species) and mammals (171 species) than any other biome.

The Kalahari savanna is a sandy, arid region in the western interior. Within the Kalahari savanna system, seven major vegetation types have been described. Two of these vegetation types are present within the study area, namely the Kalahari Plain Thorn Bushveld (Olifantshoek Plains Thornveld) and Kalahari Mountain Bushveld (Kuruman Mountain Bushveld).

Flagship fauna species for the Savanna Biome include:

- Starbust Horned Baboon Spider (*Ceratogyrus bechuanicus*);
- Ground Hornbill (*Bucorvus leadbeateri*);
- Cape Griffon (*Gyps coprotheres*);
- Wild Dog (*Lycaon pictus*);
- Short-eared Trident Bat (*Cloeorotis percivali*); and
- White Rhinoceros (*Ceratotherium simum*).

The study area comprises two VEGMAP vegetation types (Figure 6), namely:

- Kuruman Mountain Bushveld; and
- Olifantshoek Plains Thornveld.

This vegetation is characterised by rolling hills with gentle to moderate slopes and hill pediment areas with an open shrubveld with *Lebeckia macrantha* prominent in places with a well-developed grass layer. The conservation status of this unit is set at Least Threatened, but none of this vegetation type is formally conserved in statutory conservation areas. The transformation status is low, but some parts are heavily utilised for grazing purposes.

Species of conservation importance that are present in this vegetation type include the Griqualand West Endemics *Lebeckia macrantha*, *Justicia puberula*, *Tarchonanthus obovata*, *Euphorbia wilmaniae*, *Digitaria polyphylla*, *Sutera griquensis* and the Endemic *Euphorbia planiceps*. The following species are characteristic of this vegetation type:

### Small Trees & Tall Shrubs

*Searsia lancea*, *Diospyros austro-africana*, *Euclea crispa* subsp. *crispa*, *Euclea undulata*, *Olea europaea* subsp. *europaea*, *Searsia pyroides* var. *pyroides*, *S. tridactyla*, *Tarchonanthus camphoratus* and *Tephrosia longipes*.

### Low Shrubs

*Searsia ciliata*, *Amphiglossa triflora*, *Anthospermum rigidum* subsp. *pumilum*, *Gomphocarpus fruticosus* subsp. *fruticosus*, *Helichrysum zeyheri*, *Lantana rugosa* and *Wahlenbergia nodosa*.

### Succulent Shrubs

*Ebracteola wilmaniae* and *Hertia pallens*.

### Graminoids

*Andropogon chinensis*, *A. schirensis*, *Antheophora pubescens*, *Aristida congesta*, *Digitaria eriantha*, *Themeda triandra*, *Triraphis andropogonoides*, *Aristida diffusa*, *Brachiaria nigropedata*, *Bulbostylis burchelli*, *Cymbopogon caesius*, *Diheteropogon amplexans*, *Elionurus muticus*, *Eragrostis chloromelas*, *E. nindensis*, *Eustachys paspaloides*, *Heteropogon contortus*, *Melinis repens*, *Schizachyrium sanguineum* and *Trichoneura grandiglumis*.

### Herbs

*Dicoma anomala*, *D. schinzii*, *Geigeria ornativa*, *Helichrysum cerastioides*, *Heliotropium strigosum*, *Hibiscus marlothianus*, *Kohautia cynanchica*, *Rhynchosia totta* and *Kyphocarpa angustifolia*.

### Geophytic Herbs

*Boophane disticha* and *Pellaea calomelanos*.

This vegetation type comprises the pediment areas of the major mountains in the region as well as some of the ridges to the west. The vegetation comprises very wide and diverse units on plains with usually open tree and shrub layers with *Acacia luederitzii*, *Boscia albitrunca* and *Searsia tenuinervis*. The grass layer is typically poorly developed and sparse. Red aeolian sands characterise the substrate.

The conservation status of this vegetation type is set at Least Threatened, with only 0.3% statutorily conserved in the Witsand Nature Reserve. Only about 1% of the area has been transformed and erosion is low.

Species of conservation importance that are present in this vegetation type include the Kalahari and Griqualand West Endemics *Acacia luederitzii* var. *luederitzii*, *Lebeckia macrantha*, *Hermannia burchelli*, *Justicia puberula*, *Putterlickia saxatilis*, *Tarchonanthus obovata*, *Antheophora argentea*, *Sutera griquensis* and the Endemic *Amphiglossa tecta*. Important taxa for this unit include the following:

#### **Trees**

*Acacia erioloba*, *Boscia albitrunca*, *Acacia mellifera* subsp. *detinens* and *Terminalia sericea*.

#### **Shrubs**

*Lessertia frutescens*, *Lycium hirsutum*, *Rhigozum obovatum*, *Searsia tridactyla*, *Tarchonanthus camphoratus*, *Aptosimum procumbens*, *Grewia retinervis*, *Hoffmannseggia burchelli*, *Lycium pilifolium* and *Solanum tomentosa*.

#### **Succulent Shrubs**

*Lycium cinereum* and *Talinum cafferum*.

#### **Graminoids**

*Schmidtia pappophoroides*, *Stipagrostis uniplumis*, *Aristida congesta*, *Brachiaria serrata*, *Digitaria eriantha* subsp. *eriantha* and *Melinis repens*.

#### **Herbs**

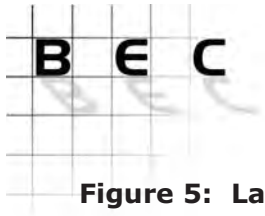
*Acanthosicyos naudinianus*, *Gisekia pharnacioides*, *Hermannia tomentosa*, *Ipomoea magnusiana*, *Oxygonum delagoense*, *Pollichia campestris* and *Tephrosia purpurea* subsp. *leptostachys*.

#### **Succulent Herb**

*Piранthus decipiens*

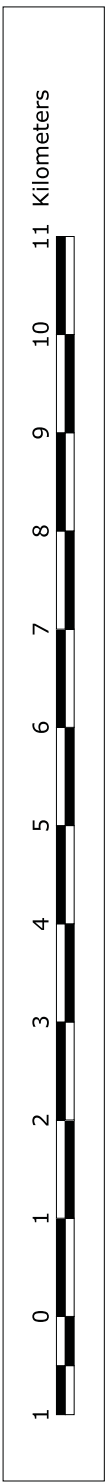
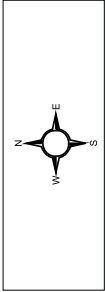
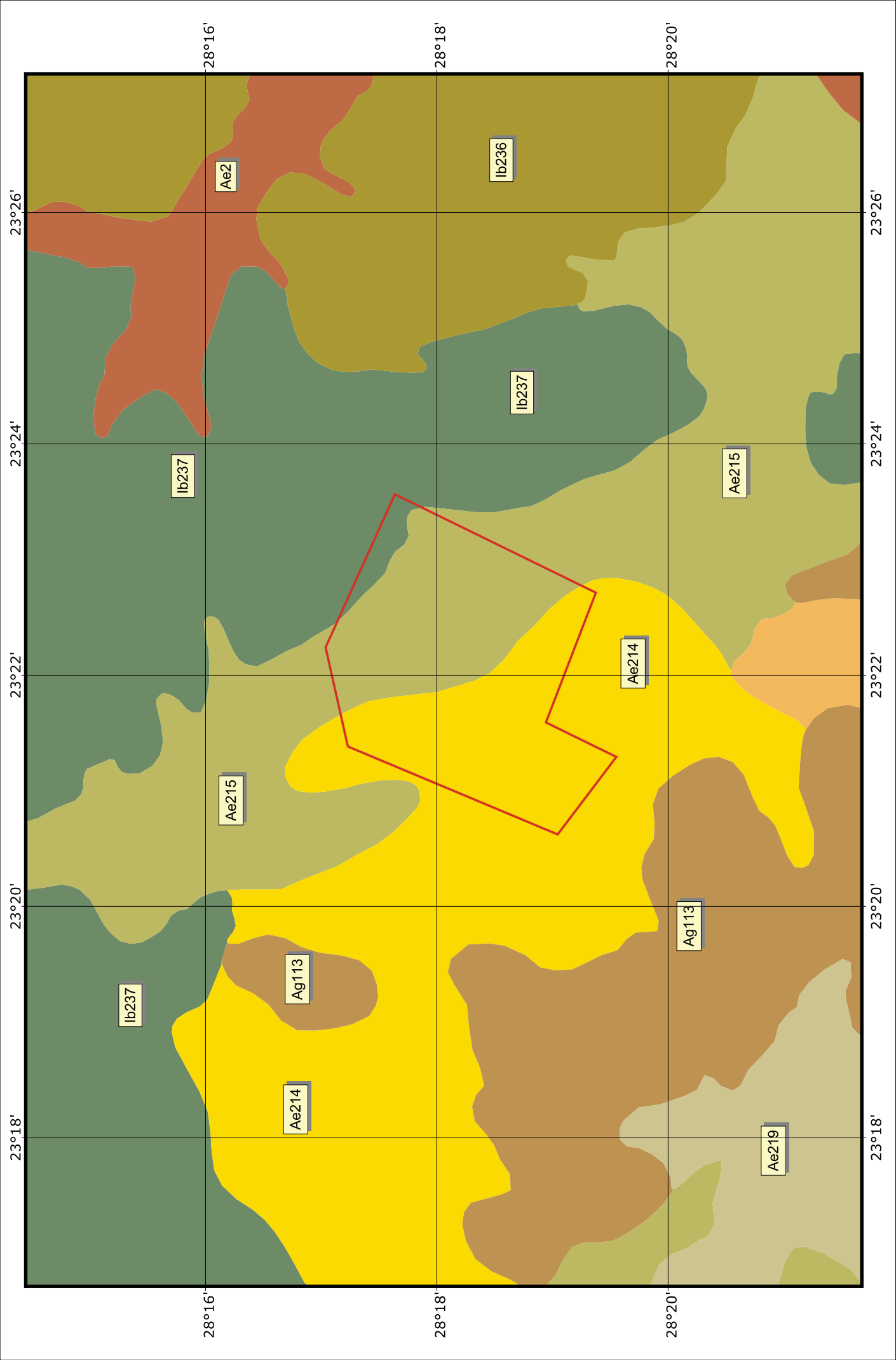
#### **Geoxylic suffrutex**

*Elephantorrhiza elephantina*

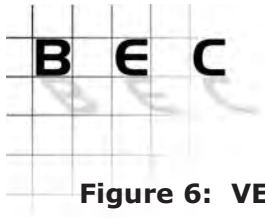


**Figure 5: Land Types of the general region**

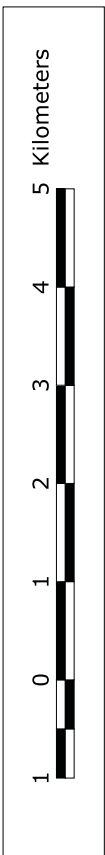
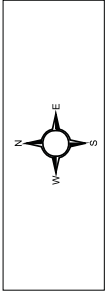
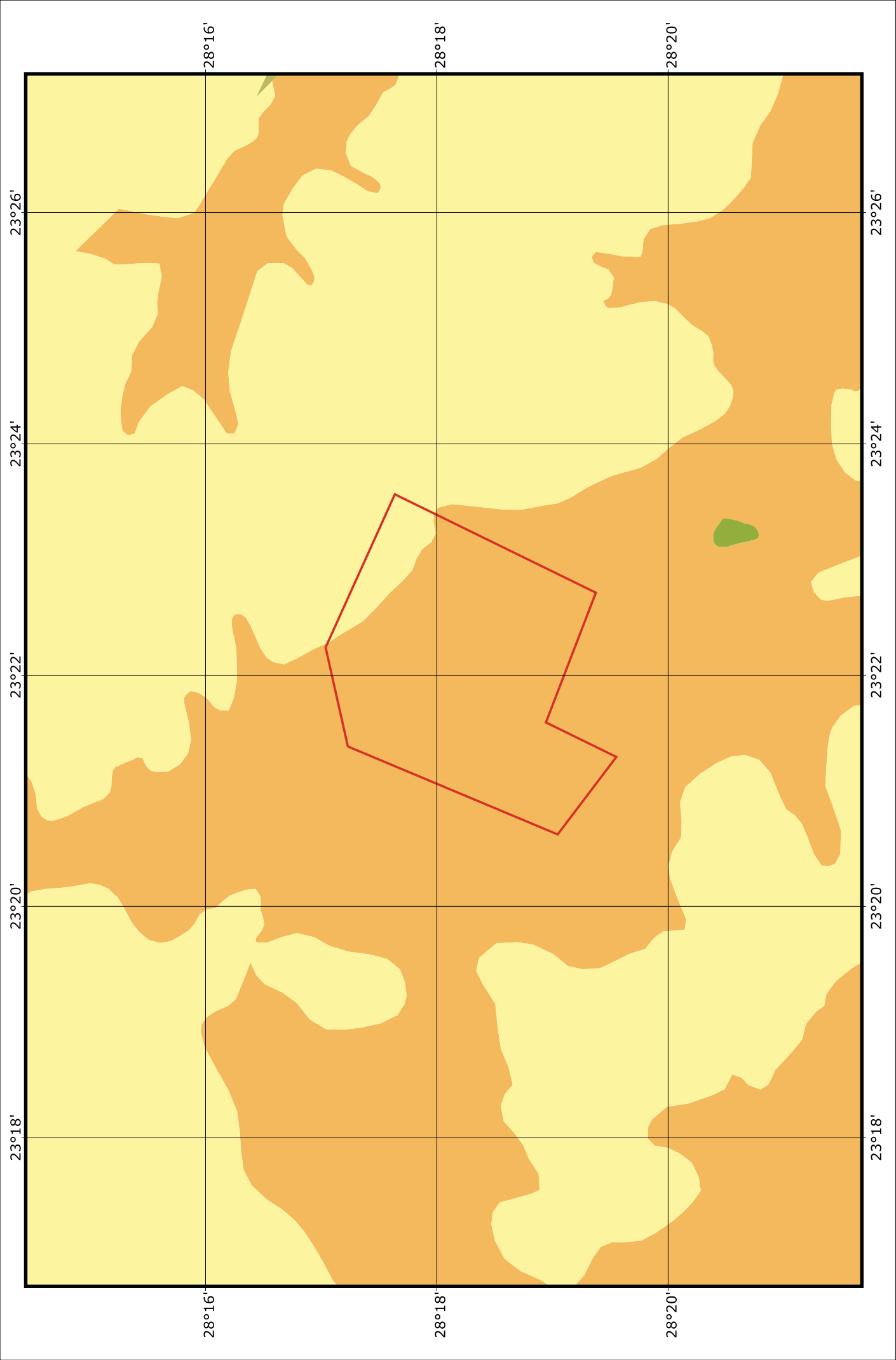




Humansrus study area



**Figure 6: VEGMAP vegetation types of the region**



- Humansrus study area
  - Olifantshoek Plains Thornveld
  - Southern Kalahari Salt Pans
  - Kuruman Mountain Bushveld
- VEGMAP Vegetation Types

8 FLORA OF THE STUDY AREA

8.1 REGIONAL DIVERSITY

The SANBI database indicates the known presence of only 146 plant species within this particular ¼-degree grid (2823AD). This relative low diversity is the result of poor floristic knowledge of the area and is not a reflection of a poor habitat and floristic diversity (POSA, 2009). As a rule, it is estimated that any grid where less than 300 species are known to occur is regarded a result of undersampling and does not reflect the floristic diversity of the particular area. The existing database is therefore not regarded an accurate reflection of the true floristic diversity of the region. A list of plant species of the 2823AD ¼-degree grid is presented in Appendix 1.

Notwithstanding the relative poor floristic knowledge of the region, the species composition of the general region adequately displays the varying physiognomy of the area that comprises both grassland and savanna habitat types (Table 3) with 22 dwarf shrub species (15.1%), 24 shrub species (16.4%), 5 trees species (3.4%) as well as 35 grass species (24.0% and 44 herb species (30.1%).

**Table 3: Growth forms of the region**

Growth Form	Number	Percentage
Climber	4	2.7%
Dwarf shrub	22	15.1%
Geophyte	6	4.1%
Graminoid	35	24.0%
Herb	44	30.1%
Parasite	1	0.7%
Shrub	24	16.4%
Succulent	5	3.4%
Tree	5	3.4%
<b>Total</b>	<b>146</b>	

8.2 FLORISTIC DIVERSITY OF THE SITE

The site investigation revealed the presence of approximately 144 plant species on the farm (Appendix 2). The diversity of this portion of land, in spite of the moderately degraded status of extensive parts of the site, is regarded diverse, reflecting not only on the species richness of the regional vegetation types, but also the effect of transformation and the influx of plant species not normally associated with the region.

The savanna physiognomy of parts of the area is indicated by the presence of several woody species in areas of natural vegetation. These woody species comprise a relative large proportion of diversity and their dominance in certain areas, particularly in wetter and

untransformed parts of the study area, is noted. Grasses (37 species, 25.7%), forbs (46 species, 31.9%), shrubs (24 species, 16.7%), geophytes (14 species, 9.7%) and succulents (14 species, 9.7%) comprise a high percentage of the species diversity (Table 4).

**Table 4: Growth forms of the study area**

Growth Form	Number	Percentage
Forbs	46	31.9%
Geophytes	14	9.7%
Grasses	37	25.7%
Hydrophilics	1	0.7%
Sedges	3	2.1%
Shrubs	24	16.7%
Succulents	14	9.7%
Trees	5	3.5%
<b>Total</b>	<b>144</b>	

A total of 45 plant families are represented by the floristic diversity of the site, dominated by Poaceae (37, species, 25.7%) and Asteraceae (20 species, 13.9%) (Table 5).

It should be noted that the survey was conducted during the winter period and while the most of the plants on site was still in a suitable condition for identification purposes, a summer survey is likely to reveal additional flowering species that are not generally observed during the winter period.

**Table 5: Plant families of the study area**

Family	Number	Percentage
Aizoaceae	1	0.7%
Amaranthaceae	2	1.4%
Amaryllidaceae	3	2.1%
Anacardiaceae	4	2.8%
Apocynaceae	1	0.7%
Asclepiadaceae	1	0.7%
Asteraceae	20	13.9%
Bignoniaceae	1	0.7%
Boraginaceae	1	0.7%
Cactaceae	2	1.4%
Campanulaceae	1	0.7%
Capparaceae	1	0.7%
Celastraceae	1	0.7%
Colchicaceae	1	0.7%
Commelinaceae	1	0.7%
Convolvulaceae	1	0.7%
Crassulaceae	2	1.4%
Cyperaceae	3	2.1%
Dipsacaceae	1	0.7%
Ebenaceae	2	1.4%

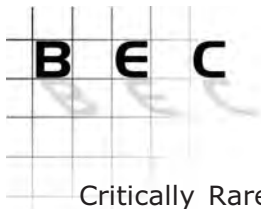
<b>Family</b>	<b>Number</b>	<b>Percentage</b>
Ehretiaceae	1	0.7%
Euphorbiaceae	1	0.7%
Fabaceae	1	0.7%
Fabaceae	11	7.6%
Geraniaceae	2	1.4%
Hyacinthaceae	2	1.4%
Iridaceae	3	2.1%
Lamiaceae	2	1.4%
Liliaceae	9	6.3%
Lobeliaceae	1	0.7%
Malvaceae	2	1.4%
Mesembryanthemaceae	2	1.4%
Oxalidaceae	1	0.7%
Papaveraceae	1	0.7%
Pedaliaceae	1	0.7%
Poaceae	37	25.7%
Polygalaceae	1	0.7%
Polygonaceae	1	0.7%
Rhamnaceae	1	0.7%
Scrophulariaceae	4	2.8%
Selaginaceae	1	0.7%
Solanaceae	3	2.1%
Sterculiaceae	3	2.1%
Thymelaeaceae	2	1.4%
Tiliaceae	1	0.7%

### 8.3 FLORA SPECIES OF CONSERVATION IMPORTANCE

#### 8.3.1 Red List Species

South Africa's Red List system is based on the IUCN Red List Categories and Criteria Version 3.1 (finalized in 2001), amended to include additional categories to indicate species that are of local conservation concern. The IUCN Red List system is designed to detect risk of extinction. Species that are at risk of extinction, also known as threatened or endangered species are those that are classified in the categories Critically Endangered (CR), Endangered (EN) and Vulnerable (VU).

The South African Red List contains three additional categories (Critically Rare, Rare and Declining) to highlight plant species that are not in danger of extinction, but are of local conservation concern because they are rare, or there are threatening processes affecting their populations. These categories have been developed to highlight those taxa classified as Least Concern according to the IUCN system, should be considered in conservation prioritization processes. It is important to emphasize that the South African categories



Critically Rare, Rare and Declining are intended for use in local conservation prioritization processes only. In submission to the IUCN Red List of Threatened Species, these taxa have to be categorized according to the IUCN system and therefore their global status will be Least Concern.

No Threatened plant species are known to occur in this particular ¼-degree grid. The near endemic species *Lithops aucampiae* subsp. *aucampiae* var. *aucampiae* was observed in the study area.

*Aloe grandidentata* is protected under CITES (Appendix II). Northern Cape Nature & Environmental Conservation Ordinance included the following genus and species that were observed during the surveys:

- All species of the genus *Aloe* (*Aloe grandidentata*);
- All species of the family Apocynaceae (*Pachypodium succulentum*);
- Certain species of the family Liliaceae (*Lachenalia* species); and
- All species of the family Mesembryanthemaceae (*Lithops aucampiae* subsp. *aucampiae* var. *aucampiae*, *Chasmatophyllum musculinum*, *Nananthus aloides*).

### 8.3.2 Protected Tree Species

According the Act (National Forests Act (Act no 84 of 1998)), the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions that 'no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

A taxon is 'Declining' when it does not meet any of the five IUCN criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline in the population.

The following protected tree species do occur in the study area as well as surrounding areas (Table 6). Survey conditions were not particularly conducive for identifying Red Data species during the site investigation, but it is regarded highly unlikely that any Threatened flora species would occur on this site.

Taxon	Family	Abundance	Status
<i>Acacia erioloba</i>	Fabaceae	Less than 20	Declining, confirmed presence
<i>Acacia haematoxylon</i>	Fabaceae	None observed	Declining, not confirmed
<i>Boscia albitrunca</i>	Capparaceae	Single individual observed	Declining, confirmed presence
<i>Olea europaea</i> subsp. <i>africana</i>	Oleaceae	Many (>300)	Declining, confirmed presence



An application for permits for the removal/ damage/ cutting or pruning of protected tree species as per National Forest Act, 1998 (No 84 of 1998) need to be submitted to the relevant authority prior to the commencement of construction activities.

Comments were made about the status and size of Wild Olive individuals in the Olea woodland. It should be noted that the accurate determination of the age of a tree is a specialist field and only rough estimates can be presented in this document. Aspects that were taken into account include the general appearance, stem diameter/ girth, environmental aspects, evidence and observations from other areas. A rough estimate of the age of these trees would be in the region of 50 -60 years.

The relatively dense stand of Olea individuals is likely to have resulted from changes in the fire regime that indicated the arrival of cattle farming to the area. Increased fire frequency likely caused other woody species to disappear, whilst favouring the growth of Olea. An important aspect to note is that most of the individuals are roughly the same size (and therefore age), representing an abnormal population structure. Normally there would be a few old (particularly large) individuals area present while numbers increase as size (age) decrease. This would suggest that the presence of these individuals could be attributed to a specific period in the past. It should be noted that this species do occur naturally in the region, albeit at lower densities. When compared to other part of the geographical distribution area of this species, the size and age of these individuals are not particularly unique.

However, taking the status of this community into consideration, the presence of these trees is regarded an important aspect of the biodiversity; application of the rules and guidelines of the Ecosystem Approach will dictate that as much as possible of this community be preserved.

#### 8.4 ALIEN & INVASIVE PLANT SPECIES

The following invasive and weed species were noted on the study site (Table 7).

<b>Table 7: Invasive and weed plant species of the study area</b>			
<b>Species Name</b>	<b>Growth Form</b>	<b>Family</b>	<b>Status/ Uses</b>
<i>Acacia hebeclada</i>	Fabaceae	Shrub	Indigenous invader, declared indicator of encroachment
<i>Acacia mellifera</i>	Fabaceae	Shrub	Declared indicator of encroachment, medicinal uses, poison source
<i>Alternanthera pungens</i>	Amaranthaceae	Forb	Weed, pioneer species
<i>Argemone ochroleuca</i>	Papaveraceae	Forb	Declared Invader - Category 1
<i>Berkheya species</i>	Asteraceae	Forb	Weed
<i>Bidens pilosa</i>	Asteraceae	Forb	Weed, edible parts
<i>Cynodon dactylon</i>	Poaceae	Grass	Indicator of disturbed areas, grazing potential
<i>Cyperus esculentus</i>	Cyperaceae	Sedge	Weed, edible parts
<i>Datura stramonium</i>	Solanaceae	Forb	Declared Invader - Category 1, weed
<i>Echinopsis sphaciana</i>	Cactaceae	Succulent	Declared Invader - Category 1

**Table 7: Invasive and weed plant species of the study area**

Species Name	Growth Form	Family	Status/ Uses
<i>Opuntia ficus-indica</i>	Cactaceae	Succulent	Declared Invader - Category 1
<i>Rhigozum trichotomum</i>	Bignoniaceae	Shrub	Declared indicator of encroachment
<i>Schinus molle</i>	Anacardiaceae	Tree	Exotic, invasive, S. America
<i>Schkuhria pinnata</i>	Asteraceae	Forb	Medicinal uses, weed (S. America)
<i>Solanum panduriforme</i>	Solanaceae	Forb	Weed
<i>Xanthium strumarium</i>	Asteraceae	Forb	Category 1, weed (S. America)

8.5 MACRO HABITAT TYPES

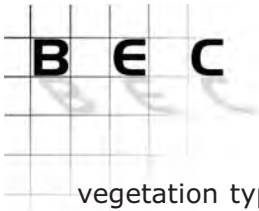
Due to the relative high levels of transformation as well as low utilisation levels and the effect of frequent burning noted across most of the site, vegetation within the study area was found to be relatively degraded, albeit in a well-developed status. Because of intensive human activities, remaining natural vegetation within the study area is not regarded entirely representative of the regional vegetation type, i.e. pristine. Results of the photo analysis and site investigations revealed the presence of the following habitat types (Figure 7):

- Closed Shrubveld;
- Drainage Line;
- Excavations;
- Floodplains;
- Grassland Plains;
- Homestead;
- *Olea europaea* Woodland
- Open Shrubveld; and
- Road.

8.5.1 *Closed Shrubveld*

The Closed Shrubveld unit is situated in the northern section of the study area, comprising the hills and low ridges that form part of the Kuruman Mountain Bushveld regional vegetation type. The vegetation is dominated by a well-developed shrub layer with heights between 0.5 and 3m. The status of this unit is regarded pristine and little evidence of degradation and over-utilisation was observed within the study area. Although remarkably similar in species composition to the Open Shrubveld habitat type, the woody component is much more dominant; assumed to be an effect of low burning frequencies. The substrate is typically rocky, stony and slopes vary between 5 and 15%.

Although this habitat type comprises only approximately 115.8ha (8.1%) of the study area, it is well represented outside the study area towards the north. The VEGMAP database also indicates that very little of this vegetation type (Kuruman Mountain Bushveld) is transformed by human activities, representing a regional area of untransformed and pristine



vegetation type. It is therefore possible to assume that the faunal component that typifies this habitat type is similarly unaffected.

The species composition is typical of a pristine vegetation type, represented by a number of co-dominant species. The woody species *Acacia mellifera*, *Calobota cuspidosa*, *Ehretia rigida*, *Euclea crispa*, *Euryops multifidus*, *Grewia flava*, *Gymnosporia buxifolia*, *Lycium bosciifolium*, *Olea europaea*, *Searsia ciliata*, *S. lancea*, *S. pentheri* and *Ziziphus mucronata* occurs in this unit. A well-developed herbaceous layer includes the dominant grasses *Aristida congesta subsp. congesta*, *Brachiaria nigropedata*, *Digitaria eriantha*, *Echinochloa colona*, *Eragrostis lehmanniana*, *Fingerhuthia africana*, *Heteropogon contortus*, *Pogonarthria squarrosa* as well as the forbs *Aptosimum albomarginatum*, *Babiana hypogea*, *Bulbine abyssinica*, *Geigeria species*, *Kyphocarpa angustifolia* and *Sutherlandia frutescens*.

The floristic status of this habitat type is regarded pristine and a high floristic sensitivity is ascribed to these parts. Aspects that affect the sensitivity of this unit is the pristine nature, absence of any human activities that contribute to habitat degradation, fragmentation or isolation and a moderate likelihood of Red Data species being present.

#### 8.5.2 Drainage Line

The drainage line is present in the southern part of the study area, originating further to the south. This habitat type occurs in terrain type 5 (Valley bottoms). The character of this habitat changes as it progresses first northwards and then to the north-west. The portion of the river located in the southern section of the property (south of the road) is characterised by a rocky streambed that takes its nature from the surrounding habitat types and topography. Areas surrounding the drainage line in this part of the property conform to the Open Shrubveld habitat type where soils are typically rocky/ stony and slopes are steeper than the surrounding Grassland Plains habitat type. It is also noted that the Floodplain habitat type is absent from this part of the drainage line. The vegetation of this part is characterised by the presence of trees and shrubs on the banks, while the streambed is largely devoid of soil and vegetation. The presence of rocks and boulders within the streambed results in pockets of standing water in which hydrophilic vegetation grows. Woody species associated with this part of the Drainage Line habitat type include *Olea europaea*, *Searsia lancea*, *Tarchonanthus camphoratus*, and *Ziziphus mucronata*.

The section of the drainage line north of the road is characterised by the relative flat surrounding Grassland Plains and Floodplains habitat type where a dam interrupts the flow of a period. The dam is partly filled with water and is characterised by species associated with standing water, such as *Falkia oblonga*, *Persicaria lapathifolia* and *Schoenoplectus corymbosus*. The soils in these parts are typically sandy/ loamy of nature and stones are mostly absent from the streambed. The streambed is characterised by low, eroded banks that becomes shallower further to the southeast. The vegetation of the streambed as well as the surrounding Floodplain habitat is characterised by short grassland and low herb

species. Species that are dominant in these habitat types include the grasses *Aristida congesta* subsp. *barbicollis*, *Cymbopogon plurinodis*, *Eragrostis obtusa*, *Eragrostis rigidior*, *Heteropogon contortus*, *Microchloa caffra* and *Themeda triandra*. Forbs that were noted within the Drainage line include *Androcymbium melanthioides*, *Arctotis arctotoides*, *Berkheya* species, *Falkia oblonga*, *Felicia* species, *Gazania krebsiana*, *Geigeria* species, *Indigofera* species, *Monsonia angustifolia*, *Scabiosa columbaria* and *Walafrida densiflora*.

Any habitat associated with water is regarded sensitive and this drainage line, with small variations along the progression across the study area is typical of this type of habitat where ecotonal areas are created by the interplay between topography and biophysical attributes of the area. This habitat comprises approximately 16.1 ha (1.1%) of the study area, but the importance and sensitivity is however underlined by the dependency of this habitat from surrounding areas that are the origin of water that ultimately feeds into the drainage line. The vegetation, although not in a pristine state because of high utilisation factors, is regarded sensitive, particularly because of the association with the adjacent Floodplain habitat type.

#### 8.5.3 Excavations

Small portions of the study area are subjected to small-scale surface mining operations (Jaspilite). These areas are devoid of vegetation because of severe surface disturbances, either excavation or dumping of overburden materials. No sensitivity is ascribed to these areas, but it should be noted that surrounding habitat comprises relative untransformed shrubveld.

#### 8.5.4 Floodplains

The wide levees adjacent to the Drainage line habitat type is characterised by low grassland vegetation where soils are relatively deep, but shallow rock sheets with gravely soils do occur scattered in this habitat type. This habitat is situated on terrain type 4 (footslopes) where slopes are low, comprising approximately 45.6 ha (3.2%) of the study area.

The nature of this habitat type is determined by drainage of water from higher lying areas towards the drainage line. Vegetation is characterised by low grasses that include the dominant species *Aristida congesta* subsp. *barbicollis*, *Cymbopogon plurinodis*, *Eragrostis obtusa*, *E. plana*, *E. species*, *Microchloa caffra* and *Themeda triandra*, as well as the forbs *Androcymbium melanthioides*, *Arctotis arctotoides*, *Argemone ochroleuca*, *Berkheya* species, *Bulbine narcissifolia*, *Euphorbia clavarioides*, *Felicia* species, *Gazania krebsiana*, *Geigeria* species, *Hibiscus* species, *Homeria* species, *Scabiosa columbaria* and *Walafrida densiflora*.

The presence of *Aristida congesta* subsp. *barbicollis*, *Cymbopogon plurinodis*, *E. plana*, *Argemone ochroleuca*, *Berkheya* species and *Walafrida densiflora* indicates a high utilisation factor.

A small variation is present that significantly increases the sensitivity ascribed to the unit. Small, localised rock sheets occur scattered and is characterised by open sheets of rock and shallow gravely soils along the edges. The vegetation occurring on these sheets is entirely different to that of the immediate surrounding grassland where deeper soils prevail. The grass *Microchloa caffra* is dominant along the edges and of particular note is the presence of three succulent species, namely *Lithops aucampiae* subsp. *aucampiae* var. *aucampiae* (single individual), cf. *Nananthus aloides* and cf. *Chasmatophyllum musculinum*.

While none of these species are included in a Threatened category. All of these species are categorised as Least Threatened, their presence is regarded an important addition to the biodiversity of the area, furthermore enhancing the sensitivity of this habitat type. While the vegetation of this habitat type is not regarded pristine, a high sensitivity is ascribed because of the presence of unique plant species that occur in small, unique habitat variations.

#### 8.5.5 Grassland Plains

A large portion of the study area comprises open grassland plains (approximately 658.0 ha, 46.2%). These areas are characterised by the dominance of the herbaceous layer and the absence of trees and shrubs, although localised stands of *Searsia ciliata* occur scattered within this unit. Biophysical attributes include the presence of relative deep, yellow, yellow/brown and red soils that mostly falls into a sandy category. Rocks are generally absent, but localised, small areas of stony soil do occur, but not as dominant as in the woodland and shrubveld habitat types. A characteristic feature of this unit is the flat slopes; woodland and shrubveld generally becomes dominant as soon as a slight incline occurs. These areas are therefore generally low-lying in the landscape. This habitat type is situated within the Olifantshoek Plains Thornveld regional vegetation type, but is not particularly representative thereof, it rather represents small grassveld variations of this regional vegetation type that is associated with the low-lying areas along the drainage lines. Although it comprises a large extent of the study area, it is moderately represented in the surrounding region.

The vegetation, because of the grassland nature, is heavily utilised and evidence is noted in the absence or dominance of the grass *Themeda triandra* within certain camps of the property, depending whether the camp is grazed or not. Grass species that occur within this unit include *Aristida congesta* subsp. *barbicollis*, *Aristida stipitata*, *Cymbopogon plurinodis*, *Digitaria monodactyla*, *Eragrostis lehmanniana*, *Eragrostis obtusa*, *Fingerhuthia africana*, *Heteropogon contortus*, *Microchloa caffra*, *Sporobolus nitens* and *Stipagrostis ciliata*. The herbaceous stratum is diverse and includes the dominant species *Arctotis arctotoides*, *Babiana hypogea*, *Berkheya* species, *Boophane disticha*, *Brunsvigia natalensis*, *Dicoma capensis*, *Felicia* species, *Gazania krebsiana*, *Geigeria* species, *Hermannia* species and *Jamesbrittenia aurantiaca*

Shrubs occur at low densities, including *Acacia hebeclada*, *A. mellifera*, *Euryops multifidus*, *Calobota cuspidosa*, *Lycium bosciifolium*, *Searsia ciliata* and *Tarchonanthus camphoratus*.

Within this unit, there are watering points for animals where other infrastructure also occurs, such as animal pens. The release of cattle and horses from other parts of the country where *Acacia erioloba* (Camel thorn) occurs around these parts has resulted in the germination of this protected tree species through germination of seeds contained in droppings. Similar to other protected tree species on the property, these trees should receive consideration in terms of required permits for removal.

#### 8.5.6 Homestead

An old homestead is situated in the southern part of the study area (south of the road), characterised by farming infrastructure, fences, animal pens and buildings. Introduced plants are dominant and include tall trees, cacti and weeds. A low sensitivity is ascribed to these parts as the normal vegetation is entirely transformed.

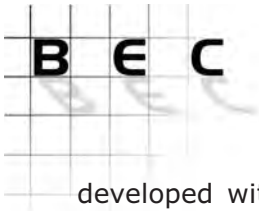
#### 8.5.7 *Olea europaea* Woodland

Approximately 35.1 ha (2.5%) of the site comprises a relative dense stand of *Olea europaea* trees. While this species occur normally in the woodland/ shrubland areas of the study area, this particular site is characterised by a particularly high cover abundance value of this species. Many of the other species normally associated with the woodland areas in the study area are not present, or occur at much lower cover abundance values. Biophysical habitat characteristics are similar to that of the Open Shrubveld with stony/ rocky soils, slight slopes.

The origin of this community of trees is not clear, but it would appear as if fire has played some part as a driving force. The difference between this and the Closed Shrubveld habitat type located further to the north, might be that this unit has received more frequent fires in the past; fire resistant properties of this species has resulted in it becoming more dominant than other species that were affected to a higher degree. It is also noted that the boundaries of this unit is not particularly defined, but rather a gradient between this and the Open Shrubveld habitat type. Where the boundaries are defined, it is bordering the Grassland Plains, similar to the Open Shrubveld. This provides further evidence that this unit has developed from the Open Shrubveld.

Evidence from aerial images also indicates that this particular physiognomy is not repeated frequently in the surrounding region. Areas of potentially similar physiognomy are observed, always located on the interface of open shrubveld and grassland habitat. In association with the dominant tree species *Olea europaea* the following woody species are present: *Acacia mellifera*, *Calobota cuspidosa*, *Ehretia rigida*, *Euryops multifidus*, *Searsia ciliata*, *S. lancea*, *S. pentheri* and *Tarchonanthus camphoratus*. The grass layer is well





developed with *Aristida meridionalis*, *Cymbopogon plurinodis*, *Digitaria eriantha*, *Elionurus muticus*, *Enneapogon scoparius*, *Eragrostis lehmanniana*, *Eragrostis obtusa*, *Eragrostis rigidior*, *Fingerhuthia africana*, *Heteropogon contortus*, *Microchloa caffra*, *Stipagrostis ciliata* and *Themeda triandra*. The forbs *Arctotis arctotoides*, *Babiana species*, *Bulbine species*, *Felicia species*, *Gazania krebsiana*, *Geigeria species* and *Jamesbrittenia aurantiaca* occur frequently.

A single individual of the protected tree *Boscia albitrunca* (Shepard's Tree) was observed within this unit. The floristic status of this unit is regarded relative pristine; little evidence of grazing is noted. The density of the protected tree *Olea europaea* renders this unit fairly unique in the region and a high sensitivity is therefore ascribed.

#### 8.5.8 Open Shrubveld

This unit comprises approximately 528.8 ha (37.2%) of the study area, representing the second largest habitat. Evidence from aerial images indicates that this physiognomy is repeated in the region, representing the regional vegetation type (Olifantshoek Plains Thornveld). The biophysical attributes of this community include stony/ rocky soils, situated on slightly elevated areas from nearby grassland and drainage habitat types. The physiognomy is dominated by shrubs that developed because of the rockiness of the substrate, but not to the extent that a closed/ dense canopy is formed like the Closed Woodland habitat further to the north. The prominence of a well-developed and diverse herbaceous layer prevents the shrubs from dominating.

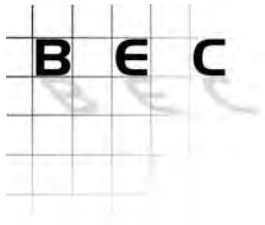
The species composition of this unit is similar to that of the Closed Woodland habitat type, but woody species occur at much lower densities. Prominent woody species include *Acacia mellifera*, *Calobota cuspidosa*, *Ehretia rigida*, *Euclea undulata*, *Euryops multifidus*, *Gymnosporia buxifolia*, *Olea europaea*, *Searsia ciliata*, *Tarchonanthus camphoratus* and *Ziziphus mucronata*. The grass layer is diverse and includes species such as *Aristida congesta* subsp. *barbicollis*, *Cymbopogon plurinodis*, *Digitaria eriantha*, *Elionurus muticus*, *Enneapogon scoparius*, *Eragrostis obtusa*, *Fingerhuthia africana*, *Heteropogon contortus*, *Sporobolus nitens*, *Stipagrostis ciliata*, *Themeda triandra* and *Trichoneura grandiglumis*. Frequently observed herb species include *Aptosimum albomarginatum*, *Babiana species*, *Euphorbia clavarioides*, *Gazania krebsiana*, *Geigeria species*, *Gnidia species*, *Hibiscus species*, *Kalanchoe species*, *Rhynchosia totta* and *Walafrida densiflora*.

This community is well represented in the general region and, while the vegetation is relatively pristine, no particularly sensitive attribute is common to this unit. A medium-high floristic status is ascribed, but a medium floristic sensitivity results.

#### 8.5.9 Road

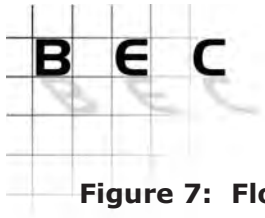
The study area is divided by an east-west road.



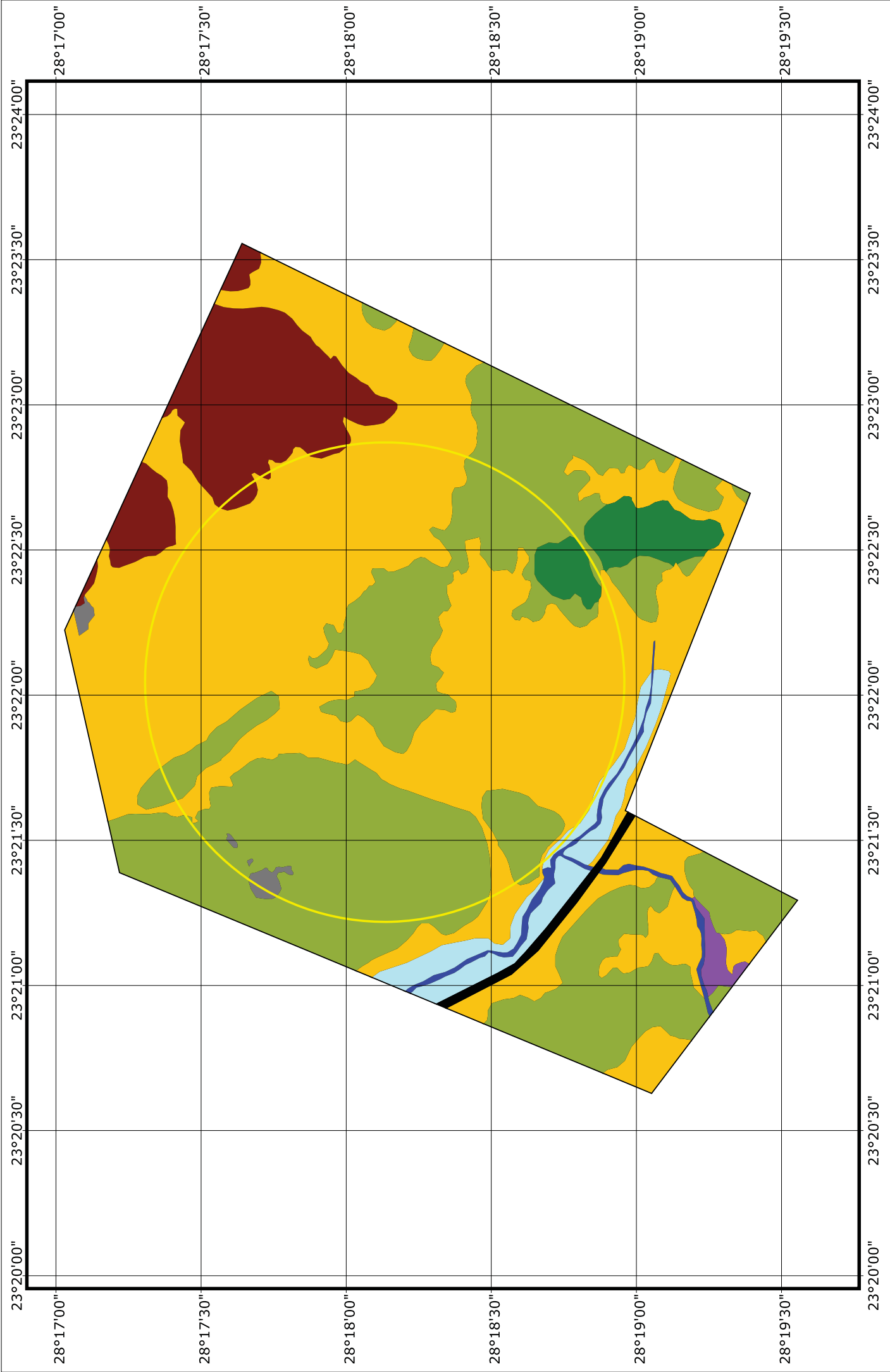


Biodiversity Impact Assessment  
Humansrus CSP





**Figure 7: Floristic habitat types of the study area**



<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid yellow; margin-right: 5px;"></span> Proposed footprint</li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; margin-right: 5px;"></span> Humansrus Habitat Types</li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; margin-right: 5px;"></span> Closed Shrubveld</li> </ul>	<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: yellow; margin-right: 5px;"></span> Grassland Plains</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: green; margin-right: 5px;"></span> Homestead</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: purple; margin-right: 5px;"></span> Olea europaea Woodland</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: darkgreen; margin-right: 5px;"></span> Floodplains</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: lightblue; margin-right: 5px;"></span> Excavations</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: darkblue; margin-right: 5px;"></span> Drainage Line</li> </ul>	<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: lightgreen; margin-right: 5px;"></span> Open Shrubveld</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: black; margin-right: 5px;"></span> Road Infrastructure</li> </ul>
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500    0    500    1000    1500    2000 Meters

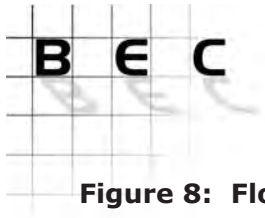
8.6 FLORISTIC SENSITIVITY

Floristic sensitivity calculations are presented in Table 8 and illustrated in Figure 8.

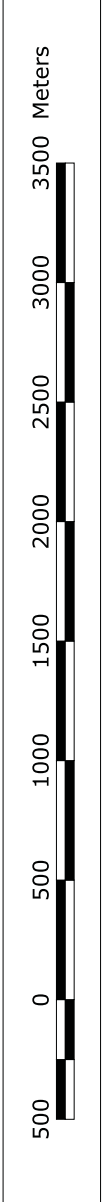
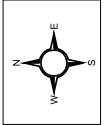
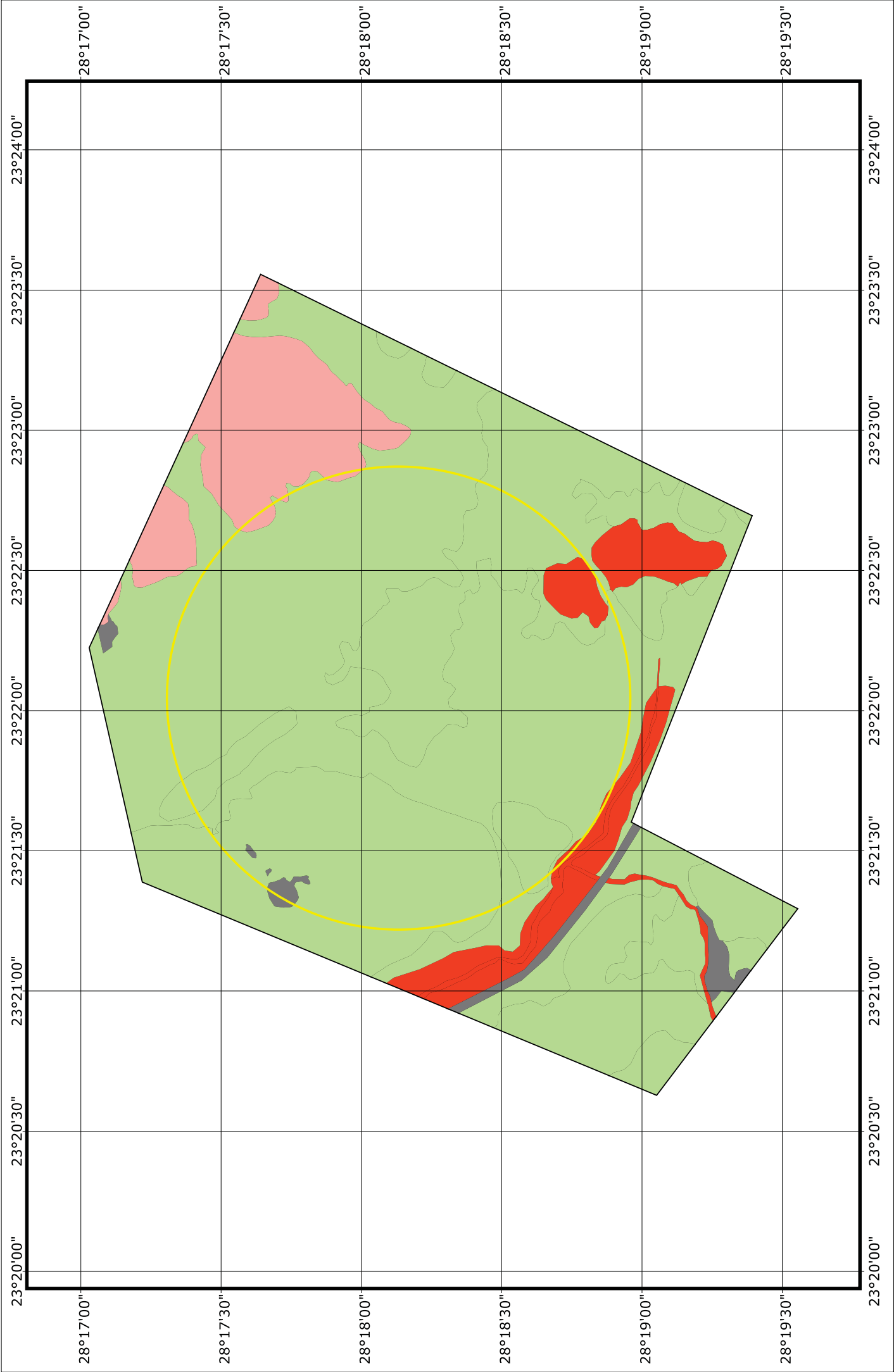
Table 8: Floristic sensitivity estimations for the respective habitat types									
Criteria	RD species	Landscape sensitivity	Status	Species diversity	Functionality/ fragmentation	TOTAL	SENSITIVITY INDEX	SENSITIVITY CLASS	
<b>Community</b>									
<b>Criteria Ranking</b>									
Closed Shrubveld	3	10	10	10	10	250	78%	medium-high	
Drainage Line	6	10	8	9	10	263	82%	high	
Excavations	0	5	1	0	1	49	15%	low	
Floodplains	8	10	8	9	9	280	88%	high	
Grassland Plains	3	5	7	8	8	176	55%	medium	
Homestead	0	3	2	2	2	52	16%	low	
Olea woodland	4	10	10	10	10	260	81%	high	
Open Shrubveld	3	5	8	8	10	188	59%	medium	

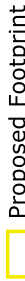

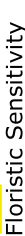

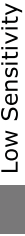

The extent of habitat sensitivities within the respective alternatives is presented in Table 9.

Table 9: Extent of floristic habitat sensitivities within the study area		
Habitat Sensitivity	Extent	Percentage
Low	24.0ha	1.7%
Medium	1,186.8ha	83.4%
Medium-high	115.8ha	8.1%
High	96.8ha	6.8%



**Figure 8: Flora habitat sensitivities of the study area**



	Proposed Footprint		Medium Sensitivity
	Floristic Sensitivity		Medium-High Sensitivity
	Low Sensitivity		High Sensitivity

The vegetation of the study area is largely representative of the regional vegetation types. The interplay between rocky areas and low-lying grasslands with intermittent drainage lines is typical of the region, resulting in clearly defined communities. The vegetation of the study area is therefore not considered unique on a regional scale. Slight variations do however exist and these variations become important on a local scale, such as the *Olea* Woodland and localised rock sheets in the Floodplain habitat type. The high density of *Olea* trees, as well as slightly higher structure of this habitat type, renders it fairly unique. It should be noted that it does occur in small patches in the larger region, but it is by no means a frequent occurrence. The driving force behind the development of this unit is thought to be anthropogenic in nature, fire frequency and intensity in particular. Rock sheets associated with shallow gravely soils in the close vicinity of drainage lines is important in terms of the occurrence of succulent species.

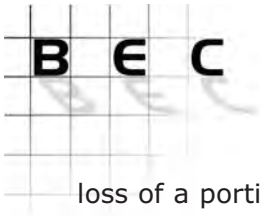
Remaining parts of the study area is characterised by open shrubveld to the west, closed shrubveld to the east, as well as drainage lines with associated floodplains and grassland plains. These habitat types are well defined and clear boundaries exist, mostly driven by the presence/ absence of rocky/ stony soils and slopes. Grazing practices have resulted in slight deterioration of the status of particularly the grassland areas, resulting in the influx of low shrub species.

While no Red Data plant species were observed in the study area, the presence of three protected trees are confirmed, namely the prominent *Olea europaea*, a small number of *Acacia erioloba* and a single individual of *Boscia albitrunca*. The near endemic *Lithops aucampiae* subsp. *aucampiae* var. *aucampiae* was observed in the study area. Suitable habitat for this species is located outside the proposed footprint for the site. Due to the cryptic nature of this species, it is nonetheless recommended that a detailed walkthrough of all moderately suitable habitat be conducted prior to the commencement of construction activities.

A large part of the study area comprises floristic habitat of medium sensitivity (approximately 1,128.7 ha, 83.4%). These habitat types are well represented in the surrounding region and the loss thereof is not expected to result in severe impacts on the floristic environment when considered on a regional scale. However, it should be noted that the proposed footprint for the development is situated in close vicinity to floristic habitat types of high sensitivity, including the Drainage line, Floodplains and *Olea* Woodland habitat types. Impacts within these areas are therefore likely to occur unless strict mitigation measures are implemented.

The high sensitivity ascribed to the *Olea* Woodland habitat type is mainly the result of a unique physiognomy created by the dominant *Olea europaea* trees. Because the species composition of this unit does not vary significantly from surrounding shrubveld habitat, the





loss of a portion of this habitat type (11.2 ha) is not regarded a significant impact. The loss of a relative high number of protected tree species should be viewed in light of the presence of this species across the region.

The proposed footprint is indicated to exclude most of the other sensitive habitat types. The close vicinity of these areas to the proposed development is an aspect that should receive attention during the EMP phase of the project where protection and conservation measures are developed to provide for protection of these areas.

## 9 FAUNA OF THE STUDY AREA

Please note that the avifaunal component was excluded from this assessment, as it is addressed in a separate investigation.

### 9.1 REGIONAL FAUNAL DIVERSITY

Only specific faunal groups are used during the species-specific element of this faunal assessment because of restrictions concerning database availability. Data on the Q-degree level is available for the following faunal groups:

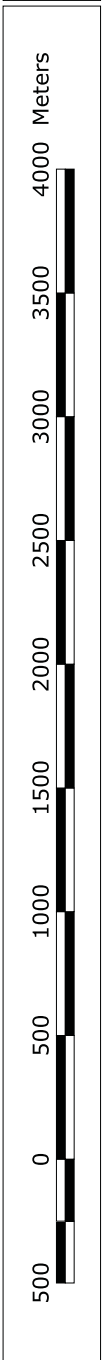
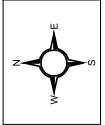
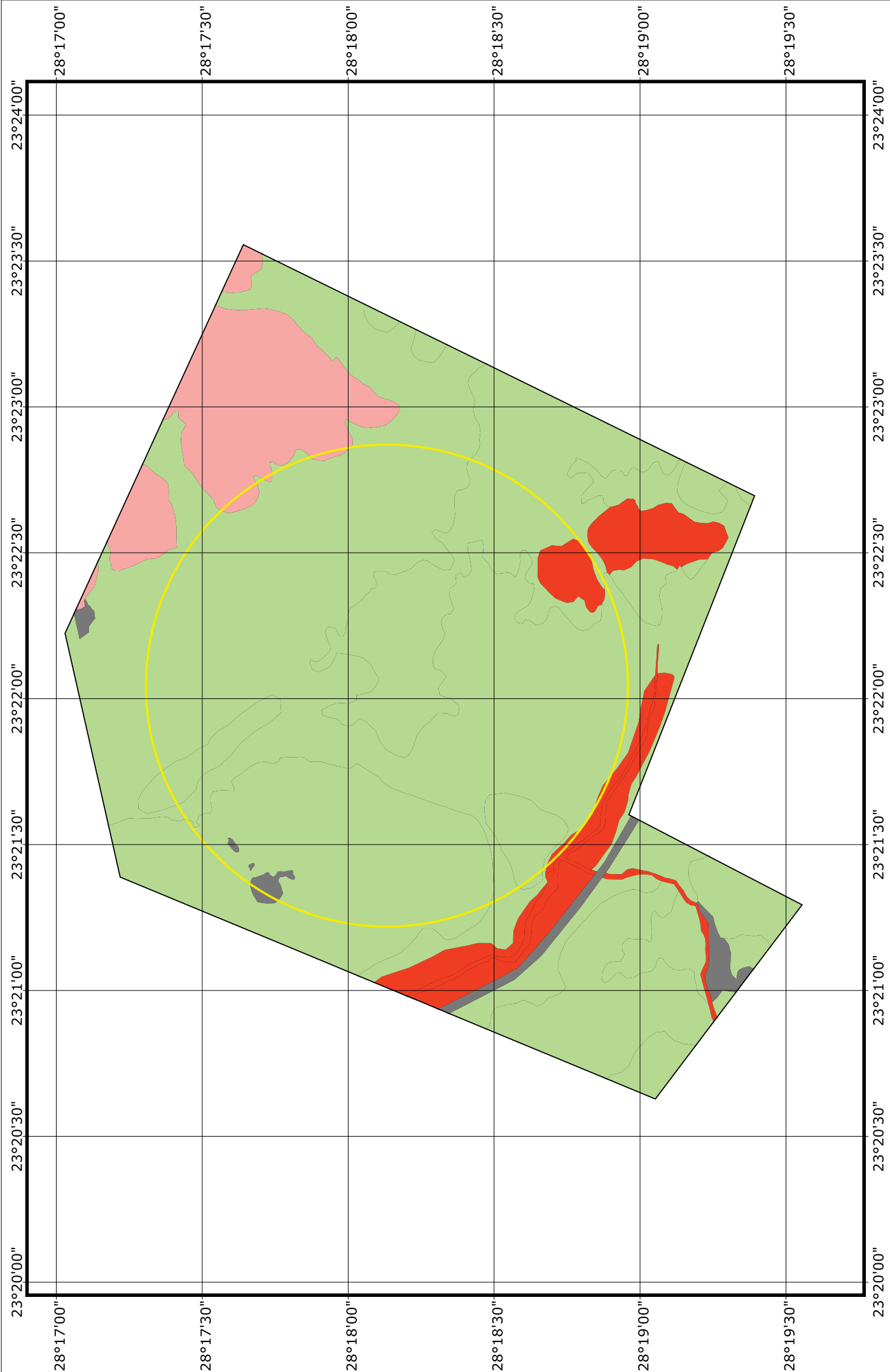
- Invertebrates: Butterflies (South African Butterfly Conservation Assessment – <http://sabca.adu.org.za>)
- Amphibians: Frogs (Atlas and Red Data Book of the South Africa, Lesotho and Swaziland)
- Reptiles: Snakes and other Reptiles (South African Reptile Conservation Assessment - <http://sarca.adu.org.za>)
- Mammals: Terrestrial Mammals (Red Data Book of the Mammals of South Africa: A Conservation Assessment.)

Animals known to be present in the Q-grid of the study area are considered potential inhabitants of the study area (all species known from the Northern Cape Province were included to minimize the effect of sampling bias). The likelihood of each species' presence in the study areas was estimated based on known ecological requirements of species; these requirements were compared to the ecological conditions found in the study area and surrounding faunal habitat.

### 9.2 FAUNAL DIVERSITY OF THE SITE

The presence of 41 animal species was confirmed during the site investigation (Table 23), by means of visual sightings, tracts, faecal droppings, burrows, characteristic behaviour patterns as well as confirmation obtained from the landowner. Signs of, or individuals of, four butterflies, 10 reptiles and 25 mammals were confirmed for the study area. This includes the Red Data mammals South African Hedgehog (*Atelerix frontalis*, NT), Lesser Dwarf Shrew (*Suncus varilla*, DD) and Brown Hyaena (*Hyaena brunnea*, NT).

The forty-one animals confirmed to occur in the study area are regarded typical of an area the size of the study site in the Eastern Kalahari Bioregion, given the mixture of habitat types present in the study area. It must be noted that a study conducted during the raining period (i.e. in the warm, wet season) would likely reveal other species that are unlikely to be observed or present during the cold, dry season (migrant birds, summer-active invertebrates, amphibians and reptiles etc.); it might even include additional Red Data species.



	Proposed Footprint
	Medium Sensitivity
	Medium-High Sensitivity
	High Sensitivity
	Faunal Sensitivity
	Low Sensitivity

**Table 10: Animal species occurring on the study area**

Class	Order	Family	Genus-Species	Common Name
Insecta	Lepidoptera	Nymphalidae	<i>Junonia hierta</i>	Yellow Pansy
			<i>Vanessa cardui</i>	Painted Lady
		Pieridae	<i>Belenois aurota</i>	Brown-veined White
			<i>Colias electo</i>	Lucerne Butterfly
Amphibia	Anura	Pipidae	<i>Xenopus laevis</i>	Common Platanna
		Pyxicephalidae	<i>Cacosternum boettgeri</i>	Boettger's Caco
Reptilia	Testudines	Pelomedusidae	<i>Pelomedusa subrufa</i>	Marsh Terrapin
	Squamata	Boidae	<i>Python natalensis</i>	Southern African Python
		Colubridae	<i>Dasypeltis scabra</i>	Common Egg Eater
			<i>Dispholidus typus</i>	Boomslang
			<i>Pseudaspis cana</i>	Mole Snake
			<i>Lycophidion capense</i>	Cape Wolf Snake
		Elapidae	<i>Naja nivea</i>	Cape Cobra
		Viperidae	<i>Bitis arietans</i>	Puff Adder
Scincidae	<i>Panaspis wahlbergii</i>	Wahlberg's Snake-eyed Skink		
Agamidae	<i>Agama atra</i>	Southern Rock Agama		
Mammalia	Insectivora	Erinaceidae	<i>Atelerix frontalis</i>	South African Hedgehog
		Soricidae	<i>Suncus varilla</i>	Lesser Dwarf Shrew
	Primates	Cercopithecidae	<i>Papio ursinus</i>	Chacma Baboon
	Lagomorpha	Leporidae	<i>Lepus capensis</i>	Cape Hare
	Rodentia	Sciuridae	<i>Xerus inauris</i>	Cape Ground Squirrel
		Pedetidae	<i>Pedetes capensis</i>	Springhare
		Hystriidae	<i>Hystrix africaeaustralis</i>	Porcupine
		Bathyergidae	<i>Cryptomys hottentotus</i>	Common Mole-rat
		Muridae	<i>Aethomys chrysophilus</i>	Red Veld Rat
	Carnivora	Canidae	<i>Otocyon megalotis</i>	Bat-eared Fox
			<i>Vulpes chama</i>	Cape Fox
			<i>Canis mesomelas</i>	Black-backed Jackal
		Viverridae	<i>Suricata suricatta</i>	Suricate
		Hyaenidae	<i>Hyaena brunnea</i>	Brown Hyaena
		Protelidae	<i>Proteles cristatus</i>	Aardwolf
		Felidae	<i>Felis silvestris</i>	African Wild Cat
			<i>Caracal caracal</i>	Caracal
	Felidae	<i>Panthera pardus</i>	Leopard	
	Tubulidentata	Orycteropodidae	<i>Orycteropus afer</i>	Aardvark
	Hyracoidea	Procaviidae	<i>Procavia capensis</i>	Rock Hyrax
Artiodactyla	Bovidae	<i>Tragelaphus strepsiceros</i>	Kudu	
		<i>Damaliscus pygargus phillipsi</i>	Blesbok	
		<i>Antidorcas marsupialis</i>	Springbok	
		<i>Raphicerus campestris</i>	Steenbok	
		<i>Sylvicapra grimmia</i>	Common Duiker	

Fifty-six Red Data animals are known to occur in the Northern Cape Province (mammals, reptiles, amphibians and invertebrates) (Table 9). This includes 12 listed as Data Deficient (DD), 21 as Near Threatened (NT), 12 as Vulnerable (VU), 5 as Endangered (EN) and 5 as Critically Endangered (CR). It is estimated that 41 of the 56 animals are listed have a low probability of occurring in the study area, 10 have a moderate probability and two species have a high probability of occurring. Three species, *Mellivora capensis* (red), *Atelerix frontalis* (NT), *Suncus varilla* (DD) and *Hyaena brunnea* (NT) were confirmed for the study area (Table 8).

This assessment is based on:

- the size of the study area;
- the location of the study area within a largely untransformed environment; and
- the presence of relatively pristine habitat such as those associated with grassland, woodland, wetlands and outcrops.

**Table 11: Red Data Assessment for the study area**

Species Details			Probability Assessment
Biological Name	English Name	Status	
<b>Butterflies</b>			
<i>Athene lindae</i>	Linda's Hairtail	Vulnerable	low
<b>Amphibians</b>			
<i>Cacosternum karooicum</i>	Karoo Caco	Data Deficient	low
<i>Pyxicephalus adspersus</i>	Giant Bullfrog	Near Threatened	moderate
<i>Strongylopus springbokensis</i>	Namaqua Stream Frog	Vulnerable	low
<b>Reptiles</b>			
<i>Bitis schneideri</i>	Namaqua Dwarf Adder	Vulnerable	low
<i>Cordylus cataphractus</i>	Armadillo Girdled Lizard	Vulnerable	low
<i>Cordylus lawrenci</i>	Lawrence's Girdled Lizard	Near Threatened	low
<i>Dermochelys coriacea</i>	Leatherback Turtle	Critically Rarea	low
<i>Gerrhosaurus typicus</i>	Namaqua Plated Lizard	Near Threatened	low
<i>Goggia microlepidota</i>	Small-scaled Dwarf Leaf-toed Gecko	Near Threatened	low
<i>Homopus signatus</i>	Speckled Cape Tortoise	Near Threatened	low
<i>Lamprophis fiskii</i>	Fisk's House Snake	Vulnerable	low
<i>Phelsuma ocellata</i>	Namaqua Day Gecko	Near Threatened	low
<i>Typhlosaurus lomii</i>	Lomi's Blind Legless Skink	Vulnerable	low
<b>Mammals</b>			
<i>Acinonyx jubatus</i>	Cheetah	Vulnerable	low
<i>Atelerix frontalis</i>	South African Hedgehog	Near Threatened	confirmed
<i>Bathyergus janetta</i>	Namaqua Dune Mole-rat	Near Threatened	low
<i>Bunolagus monticularis</i>	Riverine Rabbit	Critically Rare	low
<i>Chrysochloris asiatica</i>	Cape Golden Mole	Data Deficient	low
<i>Chrysochloris visagiei</i>	Visagie's Golden Mole	Critically Rare	low
<i>Cistugo lesueuri</i>	Leseur's Wing-gland Bat	Near Threatened	moderate
<i>Cistugo seabrai</i>	Angolan Wing-gland Bat	Vulnerable	low
<i>Crociodura cyanea</i>	Reddish-grey Musk Shrew	Data Deficient	moderate

<i>Crociodura fuscomurina</i>	Tiny Musk Shrew	Data Deficient	low
<i>Crociodura hirta</i>	Lesser Red Musk Shrew	Data Deficient	low
<i>Crociodura silacea</i>	Lesser Grey-brown Musk Shrew	Data Deficient	low
<i>Crocuta crocuta</i>	Spotted Hyaena	Near Threatened	low
<i>Cryptochloris wintoni</i>	De Winton's Golden Mole	Critically Rare	low
<i>Damaliscus lunatus lunatus</i>	Tsessebe	Endangered	low
<i>Diceros bicornis bicornis</i>	Black Rhinoceros - arid ecotype	Critically Rare	low
<i>Elephantulus intufi</i>	Bushveld Elephant-shrew	Data Deficient	low
<i>Equus zebra hartmannae</i>	Hartmann's Mountain Zebra	Endangered	low
<i>Erimitalpa granti</i>	Grant's Golden Mole	Vulnerable	low
<i>Graphiurus platyops</i>	Rock Dormouse	Data Deficient	low
<i>Hippotragus equinus</i>	Roan Antelope	Vulnerable	low
<i>Hyaena brunnea</i>	Brown Hyaena	Near Threatened	confirmed
<i>Lycaon pictus</i>	African Wild Dog	Endangered	low
<i>Manis temminckii</i>	Pangolin	Vulnerable	high
<i>Mellivora capensis</i>	Honey Badger	Near Threatened	moderate
<i>Miniopterus schreibersii</i>	Schreiber's Long-fingered Bat	Near Threatened	moderate
<i>Mirounga leonina</i>	Southern Elephant Seal	Endangered	low
<i>Myosorex varius</i>	Forest Shrew	Data Deficient	low
<i>Mystromys albicaudatus</i>	White-tailed Rat	Endangered	low
<i>Otomys slogetti</i>	Sloggett's Rat	Data Deficient	low
<i>Panthera leo</i>	Lion	Vulnerable	low
<i>Paratomys littledalei</i>	Littledale's Whistling Rat	Near Threatened	moderate
<i>Petromys typicus</i>	Dassie Rat	Near Threatened	low
<i>Poecilogale albinucha</i>	African Weasel	Data Deficient	moderate
<i>Rhinolophus capensis</i>	Cape Horseshoe Bat	Near Threatened	low
<i>Rhinolophus clivosus</i>	Geoffroy's Horseshoe Bat	Near Threatened	moderate
<i>Rhinolophus darlingi</i>	Darling's Horseshoe Bat	Near Threatened	moderate
<i>Rhinolophus denti</i>	Dent's Horseshoe Bat	Near Threatened	moderate
<i>Rhinolophus fumigatus</i>	Ruppel's Horseshoe Bat	Near Threatened	low
<i>Suncus varilla</i>	Lesser Dwarf Shrew	Data Deficient	confirmed
<i>Tatera leucogaster</i>	Bushveld Gerbil	Data Deficient	high
<i>Xerus princeps</i>	Mountain Ground Squirrel	Near Threatened	low

9.3.2 *Brown Hyaena (Hyaena brunnea)*

This species is found in southern Africa from Namibia in the north-west to Mozambique in the east and utilises a variety of relatively arid habitats from open desert to tree savanna. Brown Hyaena is an extremely efficient scavenger with an omnivorous diet. It is primarily a nocturnal animal, but is able to migrate great distances. The status of this species is Near Threatened on the IUCN Red List; it is generally considered widespread yet rare (the total population is estimated to be between 5,000 and 8,000).





9.3.3 *South African Hedgehog (Atelerix frontalis)*

This species occurs in a variety of habitats, excluding desert and high-rainfall areas. It eats various food items including insects, millipedes, earthworm, mice, lizards, fungi as well as certain fruit types. It is mainly nocturnal, resting up in dry vegetation or the burrows of other species during daytime. The status of this species is Near Threatened on the IUCN Red List.



9.3.4 *Lesser Dwarf Shrew (Suncus varilla)*

This species is widespread in South Africa, extending into East Africa, occurring in a broad range of habitats. Dwarf shrews eat insects and other small invertebrates; they are commonly associated with old termite mounds (as was the case in the study area) which provide food and shelter. The species is listed as Data Deficient on the IUCN Red List. This species was observed in old termite mounds, which were present across the study area. They, typically, were not present in high numbers; only two individuals were located.

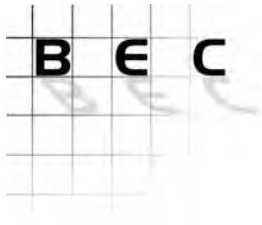


9.3.5 *Other Red Data Species*

Another two Red Data species are considered highly likely to occur in the study area based on habitat preferences and availability of habitat, namely:

- *Tatera leucogaster* (Bushveld Gerbil, DD)
- *Manis temminckii* (Pangolin, VU)





#### 9.4 FAUNAL HABITAT TYPES

The close relationship between vegetation units and specific faunal composition has been noted in several scientific studies. For the purpose of this investigation, floristic units are therefore considered representative of the faunal habitat types (Refer Figure 9). The following characteristics of untransformed habitat types are regarded pertinent.

##### 9.4.1 *Closed Shrubveld*

- Significant shelter for medium and large mammals.
- Food provision for browsers, but little in terms of grazing.
- Contribute towards un-fragmented nature of the natural landscape of the study area and neighbouring regions.
- Include unique habitat characteristics (rockiness and steeper slopes) that are absent from the other faunal habitat types in the study area.
- The presence of microhabitats (termite mounds) that serve as suitable Red Data habitat.

##### 9.4.2 *Drainage Line*

- Contribute towards un-fragmented nature of the natural landscape of the study area and neighbouring regions.
- Includes some unique habitat characteristics (wetland-related habitat characteristics) that are absent from other faunal habitat types in the study area.
- Is a scarce faunal habitat type within the study area, and probably in the region, represented by less than 12ha within the study area.
- Represents an important migration route for aquatic, amphibian and terrestrial animals within the study area as well as on a local scale.

##### 9.4.3 *Floodplains*

- Food provision for grazers but little in terms of browsing.
- Contribute towards un-fragmented nature of the natural landscape of the study area and neighbouring regions.
- Include some unique habitat characteristics (wetland-related habitat characteristics) that are absent from the other faunal habitat types in the study area.
- Is a scarce faunal habitat type (within the study area, probably in the region) represented by less than 44ha within the study area.



9.4.4

*Grassland Plains*

- Habitat largely untransformed, but some degradation due to management and over-grazing.
- Lack of significant shelter for medium and large mammals.
- Food provision for grazers but little in terms of browsing.
- Contribute towards un-fragmented nature of the natural landscape of the study area and neighbouring regions.
- Includes very few unique habitat characteristics (that may be considered scarce in the region of the study area).
- The presence of microhabitats (termite mounds) that serve as suitable Red Data habitat.

9.4.5

*Olea europaea Woodland*

- Food provision for both grazers and browsers.
- Contribute towards un-fragmented nature of the natural landscape of the study area and neighbouring regions.
- Significant shelter for medium and large mammals present.
- Includes some unique habitat characteristics (closed woodland and *Olea europaea* specific characteristics) that are absent from the other faunal habitat types in the study area.
- Represents a scarce faunal habitat type (within the study area as well as in the general region); represented by less than 36ha within the study area.
- The presence of microhabitats (termite mounds) that serve as suitable Red Data habitat.

9.4.6

*Open Shrubveld*

- Habitat type not transformed, but some degradation due to management and over-grazing.
- Lack of significant shelter for medium and large mammals.
- Food provision for grazers but little in terms of browsing.
- Contribute towards un-fragmented nature of the natural landscape of the study area and neighbouring regions.
- Includes very few unique habitat characteristics (that may be considered scarce in the region of the study area).
- The presence of microhabitats (termite mounds) that serve as suitable Red Data habitat.

During the field assessment, the study area was investigated and assessed in terms of the following biodiversity attributes:

- Habitat status: level of habitat transformation and degradation vs. pristine faunal habitat;
- Habitat diversity: the number of different faunal habitat types (both on micro- and macro-scale) found within the proposed site and bordering areas;
- Habitat linkage: the degree to which the faunal habitat of the proposed site is linked to other natural areas enabling movement of animals to and from the habitat found on site;
- Red Data species: the degree to which suitable habitat for the red data species likely to be found in the study area (larger study area) is located on each site; and
- Sensitive faunal habitat: the relative presence of faunal sensitive habitat type elements such as surface rock associated with outcrops and hills as well as wetland elements.

**Table 12: Faunal Habitat Sensitivities for the study area**

Community	Status	Diversity	Linkage	RD Likelihood	Habitat Sensitivity	Average	Sensitivity Class
Closed Shrubveld	8	7	7	7	8	74%	medium-high
Drainage Line	8	8	10	8	9	86%	high
Excavations	1	1	2	1	1	12%	low
Floodplains	8	9	9	8	8	84%	high
Grassland Plains	6	5	6	5	6	56%	medium
Homestead	1	1	1	1	1	10%	low
Olea woodland	8	9	7	8	8	80%	high
Open Shrubveld	6	5	6	6	6	58%	medium

Calculated faunal habitat sensitivities are similar to the floristic habitat sensitivities, for an illustration thereof, the reader is referred to Figure 8. The extent of habitat sensitivities within the study area is presented in Table 11.

**Table 13: Extent of faunal habitat sensitivities within the study area**

Habitat Sensitivity	Extent	Percentage
Low	24.0ha	1.7%
Medium	1,186.8ha	83.4%
Medium-high	115.8ha	8.1%
High	96.8ha	6.8%

The study area includes faunal habitat types of varying sensitivities, ecological system characteristics and functionalities. Based on habitat status (levels of degradation and transformation), habitat scarcity and general habitat sensitivity the faunal habitat types present in the study area were assigned various levels of faunal habitat sensitivity with regards to the proposed activity. Areas that have limited distribution within the larger region, as well as areas where unique biophysical attributes occur are regarded sensitive and should preferably be excluded from the proposed development, particularly all habitat types that have an aquatic origin. Sensitive habitat types include the Drainage line, Floodplains and Olea Woodland. These habitat types comprise a small portion of the entire study area, namely 6.6% (89.8 ha) in total.

When the proposed footprint for the development is evaluated, it is evident that only 12.1 ha (1.86%) of the proposed area comprises habitat of high faunal sensitivity (mainly Olea Woodland, 11.2 ha). This habitat type is limited in nature and occurs infrequently in the region. However, it is estimated that the faunal component of this habitat type is not likely to be significantly dissimilar to surrounding areas of shrubveld and woodland. The presence of a higher stratum of trees than surrounding woodland habitat is the main structural characteristic that differentiates this from other habitat types. Surrounding woodland and shrubland areas will therefore likely provide in the requirements of fauna species observed in this habitat. The loss of this habitat, when considered on a regional scale is regarded to be of medium importance and while it is not regarded a red flag for the proposed development, the conservation of remaining habitat located immediately outside the proposed footprint should be ensured.

A total of 629.4 ha (97.3%) of the proposed footprint area comprises habitat of medium faunal sensitivity, including the Grassland Plains and Open Shrubveld habitat. An important aspect is the loss of migration potential in an east-west direction for animals that utilises the grassland and low shrubveld habitat. It is however conceivable that animals will adapt and utilise other migration routes that is available to the north of the site. The general region comprises extensive areas of similar habitat and this proposed development is not regarded to contribute significantly to habitat fragmentation and isolation on a regional scale. The loss of these habitat types is regarded to be of medium importance, particularly because of the extensive size of the proposed development.

Results of the respective floristic- and faunal habitat sensitivity assessments are interpreted to present an estimation (Table 12) that would reflect the expected impact of the construction and operation of the proposed CSP site on the biological environment. While the estimations of habitat sensitivity, as presented in preceding chapters do provide an indication in terms of the extent and locality of important habitat, an interpretation of the surrounding habitat sensitivity is also implemented in these estimations.

**Table 14: Ecological Sensitivity of the study area**

Community	Floristic Sensitivity	Faunal Sensitivity	Ecological Sensitivity
Closed Shrubveld	medium-high	medium-high	<b>medium-high</b>
Drainage Line	high	high	<b>high</b>
Excavations	low	low	<b>low</b>
Floodplains	high	high	<b>high</b>
Grassland Plains	medium	medium	<b>medium</b>
Homestead	low	low	<b>low</b>
Olea woodland	high	high	<b>high</b>
Open Shrubveld	medium	medium	<b>medium</b>

Ascribed floristic and faunal sensitivities are similar in nature providing further evidence how the faunal status of an area reflects the floristic status. Since these sensitivities are similar, the reader is referred to Figure 8 for an illustration of the habitat sensitivities within the study area.

Results of the floristic and faunal investigations were interpreted holistically in order to assess the potential impact on the ecological environment. The impact assessment is aimed at presenting a description of the nature, extent significance and potential mitigation of identified impacts on the biological environment. These tabular assessments are presented in Section 11.4 in the form of an Impact Rating Matrix for each identified impact within the respective habitat types.

Please note that only habitat types that exhibit attributes of Medium or higher sensitivities will be evaluated in this section. Impacts in areas of lower than Medium sensitivity are regarded acceptable and the implementation of generic mitigation measures is expected to result in minimising potential impacts within these areas. Habitat types that will be evaluated include:

- Closed Shrubveld;
- Drainage Line;
- Floodplains;
- Grassland Plains;
- Olea Woodland; and
- Open Shrubveld.

11.1

IDENTIFICATION OF IMPACTS

No impacts were identified that could lead to a beneficial impact on the ecological environment of the study area since the proposed development is largely destructive as it involves the alteration of natural habitat or further degradation of habitat that is currently in a sub-climax status.

Impacts resulting from the proposed development on ecological attributes of the study area are largely restricted to the physical impacts on biota or the habitat in which they occur. Direct impacts include any impacts on populations of individual species of concern, including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern. In addition, impacts on sensitive or protected habitat are included in this category, but only on a local scale. These impacts are mostly measurable and easy to assess, as the effects thereof is immediately visible and can be determined to an acceptable level of certainty.

In contrast, indirect impacts are not immediately evident and can consequently not be measured immediately. In addition, the extent of the effect is frequently large scale, mostly regional. A measure of estimation is therefore necessary in order to evaluate the importance of these impacts.

Lastly, impacts of a cumulative nature places direct and indirect impacts of this projects into a regional and national context, particularly in view of similar or resultant developments and activities.

Eleven impacts were identified that are relevant to the proposed development and are placed in three categories, namely:

- **Direct impacts:**
  - Direct impacts on threatened flora species;
  - Direct impacts on protected tree species;
  - Direct impacts on threatened fauna species;
  - Loss, or disruption of mammal migration routes on a local scale;
  - Direct impacts on sensitive/ pristine habitat types of the study area;
  - Direct impacts on common fauna species occurring on the study area;
- **Indirect Impacts:**
  - Faunal interactions with structures, servitudes and personnel;
  - Impacts on surrounding habitat/ species, including ecosystem functioning;
- **Cumulative Impacts:**
  - Impacts on SA's conservation obligations & targets (VEGMAP vegetation types);
  - Increase in local and regional fragmentation/ isolation of habitat; and
  - Increase in environmental degradation, pollution (air, soils, surface water).

Other, more subtle impacts on biological components, such as changes in local, regional and global climate, effects of noise pollution on fauna species, increase in acid rain, ground water deterioration, etc., are impacts that cannot be quantified to an acceptable level of certainty and is mostly subjective in nature as either little literature is available on the topic or contradictory information exist. These impacts are therefore omitted from this assessment.

## 11.2 NATURE OF IMPACTS

### 11.2.1 *Direct Impacts on Threatened Flora Species*

This is regarded as a direct impact since it results in the physical damage or destruction of Red Data species or areas that are suitable for these species, representing a significant impact on the biodiversity of a region. Threatened plant species, in most cases, do not contribute significantly to the biodiversity of an area in terms of sheer numbers, as there are generally few of them, but a high ecological value is placed on the presence of such species in an area as they represent an indication of pristine habitat conditions. Conversely, the presence of pristine habitat conditions can frequently be accepted as an indication of the potential presence of species of conservation importance, particularly in moist habitat conditions.



Red Data species are particularly sensitive to changes in their environment, having adapted to a narrow range of specific habitat requirements. Changes in habitat conditions resulting from human activities is one of the greatest reasons for these species having a threatened status. Surface transformation/ degradation activities within habitat types that are occupied by flora species of conservation importance will ultimately result in significant impacts on these species and their population dynamics. Effects of this type of impact are usually permanent and recovery or mitigation is generally not perceived as possible.

One of the greatest limitations in terms of mitigating or preventing this particular impact, is that extremely little information is generally available in terms of the presence, distribution patterns, population dynamics and habitat requirements of Red Data flora species. To allow for an accurate assessment, it is usually necessary to assess the presence/ distribution, habitats requirements, etc. associated with these species in detail and over prolonged periods; something that is generally not possible during EIA investigation such as this. However, by applying ecosystem conservation principles to this impact assessment and subsequent planning and development phases, potential impacts will be limited to some extent.

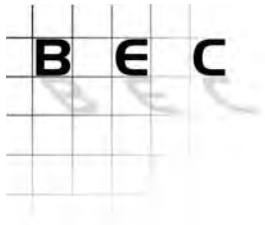
**The likelihood of Red Data flora species occurring within the study area is regarded relatively low. Available data did not indicate the known presence of Red Data plants in the region. However, habitat types present on the property is in an optimum condition and Red Data plant species might be present. Since this survey was conducted during the winter, no definitive comments could be made about the absence of Red Data plants on the study area.**

#### 11.2.2 *Direct Impacts on Protected Tree Species*

When the proposed footprint is evaluated, it is clear that a number of protected tree species will be removed during construction. While *Acacia erioloba* and *Boscia albitrunca* occur in low numbers on the property, *Olea europaea* is present as shrubs in most of the woodland and shrubveld habitat types and as relatively dense stands of trees in the Olea Woodland. Impacts within this area in particular will result in direct and significant impacts on this protected tree. It is not regarded as a cause to stop the proposed development, since the species occurs in commonly across most of the region. In addition, most of the habitat where this species occurs is captured within areas where human related impacts are unlikely to happen, thereby ensuring adequate protection for the species.

However, this species is under increasing threat that causes a continuous decline in numbers and it has been placed in a Declining Category; it is a legal requirement to report the presence of this species to relevant authorities in order to monitor their numbers as well as impacts on the status of the species.

**The presence of protected tree species on the property has been established and impacts on a number of these trees will occur.**



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The presence of three Red Data fauna species on this property has been confirmed and any surface disturbance therefore represents a direct and significant impact on these species. While some of them are highly mobile and will ultimately be able to avoid impacts that result from the proposed development, some like the Lesser Dwarf Shrew will not be able to avoid effects of microhabitat destruction, such as the termite mounds, which they occupy. A direct approach can be implemented in order to relocate these animals to adjacent suitable habitat. Similar to Red Data plants, the presence of Red Data animal species is seen as a significant attribute to the biodiversity of an area. Any impact is therefore viewed as significant. Additional aspects that will be affected include migration patterns and suitable habitat for breeding and foraging purposes.

**The presence of Red Data fauna species within the study area is confirmed.**

11.2.4 *Loss, or Disruption of Migration Routes*

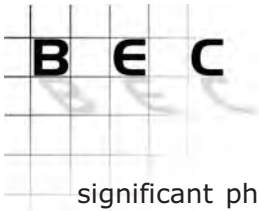
The region is characterised by untransformed and large expanses of relatively pristine woodland and grassland habitat types that will likely be occupied by a high diversity of animal species. Evidence of this snapshot investigation has confirmed this and it is therefore possible to assume that the animals that utilises these habitat types migrate across the region for various reasons. Foraging, available water, food sources, breeding patterns and seasonal climate changes include some of the more obvious explanations for migration of animals.

While most of the larger mammal species (ungulates) are restricted in their movement by fences, small and medium sized animals, that include predators, burrowing species, small mammals, invertebrate species, reptiles, amphibians, etc. utilises all available natural habitat as either corridors or habitat. The loss of an area as large, as this property, will affect the migration pattern of a number of species that are present in the immediate region. While larger animals are able to avoid unsuitable habitat, smaller animals might not be able to cross or avoid these areas.

**The size of the proposed development implies that much of the natural habitat that is present on the study area will become unsuitable for a number of species that might utilise this area on a frequent or infrequent nature.**

11.2.5 *Direct Impacts on Sensitive/ Pristine Habitat Types*

The loss/ change of pristine habitat types or habitat that are regarded sensitive as a result of restricted presence in the larger region (atypical habitat) represents a potential loss of habitat and biodiversity on a local and regional scale. Sensitive habitat types include mountains, ridges, koppies, wetlands, rivers, streams and localised habitat types of



significant physiognomic variation and unique species composition. These areas represent centres of atypical habitat and contain biological attributes that are not frequently encountered in the greater surrounds. A high conservation value is generally ascribed to floristic communities and faunal assemblages that occupy these areas as they contribute significantly to the biodiversity of a region.

Furthermore, these habitat types are generally isolated and are frequently linear in nature, such as rivers and ridges. Any impact that disrupts this continuous linear nature will risk fragmentation and isolation of existing ecological units, affecting the migration potential of some fauna species adversely, pollinator species in particular.

**Parts of the study area are regarded as highly sensitive.**

*11.2.6 Direct Impacts on Common Fauna Species*

The likelihood of this direct impact occurring is relatively low due to the ability of most animal species to evacuate an area that becomes unsuitable. The presence of a relative diverse faunal species composition on this property has been established. Considering the low levels of habitat transformation and degradation of the surrounding region, most animal species are likely to evacuate towards adjacent areas of natural habitat during the development. While the tolerance levels of common animal species is generally of such a nature that surrounding areas will suffice in habitat requirements of species forced to move from areas of impact, some species are not able to relocate, such as ground living and small species. The proposed development will result in severe impacts on these species.

**While some fauna species are able to avoid areas of disturbance, some species are simply not able to relocate such vast distances. The proposed development will therefore result in destruction of these animals. It is unlikely that their conservation status will be affected, but any direct and sever impact on animals is considered significant.**

*11.2.7 Faunal Interactions with Structures, Servitudes & Personnel*

It should be noted that animals generally avoid contact with human structures, but do grow accustomed to structures after a period. While the structures are visible, injuries and death of animals could potentially occur because of accidental contact. An aspect that is of concern is the presence of vehicles on access and infrastructure roads, leading to road kills, particularly amongst nocturnal animals that abound in the study area.

The presence of personnel within the development area during construction and maintenance periods will inevitably result in some, but normally limited, contact with animals. While most of the larger animal species are likely to move away from humans, encounters with snakes and scorpions remain likely. Similarly, the presence of humans

within areas of natural habitat could potentially result in killing of animals by means of snaring, poaching, poisoning, trapping, etc.

**The nature of the proposed development is expected to result in limited indirect impacts on the fauna species.**

*11.2.8 Impacts on Surrounding Habitat/ Species & Ecosystem Functioning*

Surrounding areas and species present in the direct vicinity of the study area could potentially be affected by indirect impacts resulting from construction and operational activities. This indirect impact also includes adverse effects on any processes or factors that maintain ecosystem health and character, including the following:

- Disruption of nutrient-flow dynamics;
- Impedance of movement of material or water;
- Habitat fragmentation;
- Changes to abiotic environmental conditions;
- Changes to disturbance regimes, e.g. increased or decreased incidence of fire;
- Changes to successional processes;
- Effects on pollinators; and
- Increased invasion by plants.

Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or changes in ecosystem function. Furthermore, regional ecological processes, particularly aquatic processes that is dependent on the status and proper functioning of the drainage line, is regarded important. It is well known that the status of a catchment is largely determined by the status of the upper reaches of the rivers. Small drainage lines, such as the one on this property, might be insignificant on a regional scale, but the combined status of numerous such small drainage lines will determine the quality of larger rivers further downstream.

**The nature of this impact dictates that potential impacts are likely to spread from the development area into bordering areas of high sensitivity.**

*11.2.9 Impacts on SA's Conservation Obligations & Targets*

This impact is regarded a cumulative impact since it affects the status of conservation strategies and targets on a local as well as national level and is viewed in conjunction with other types of local and regional impacts that affects conservation areas. The importance of vegetation types is based on the conservation status ascribed to regional vegetation types and while any impact that results in irreversible transformation of natural habitat is regarded significant, no significant disruption of ecosystem functioning is assumed in least threatened vegetation types, which still have more than 80% of their original extent untransformed.

**Loss of parts of the natural vegetation is expected to result in an insignificant, indirect impact on the conservation status of the regional vegetation types; which is regarded Least Concern.**

*11.2.10 Increase in Local & Regional Fragmentation/ Isolation of Habitat*

Uninterrupted habitat is a precious commodity for biological attributes in modern times, particularly in areas that are characterised by moderate and high levels of transformation. The loss of natural habitat, even small areas, implies that biological attributes have permanently lost that ability of occupying that space, effectively meaning that a higher premium is placed on available food, water and habitat resources in the immediate surrounds. This, in some instances might mean that the viable population of plants or animals in a region will decrease proportionally with the loss of habitat, eventually decreasing beyond a viable population size.

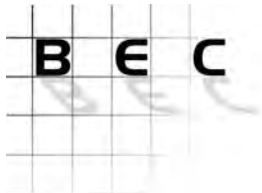
The danger in this type of cumulative impact is that effects are not known or is not visible with immediate effect and normally when these effects become visible, they are beyond repair. Impacts on linear areas of natural habitat affect the migratory success of animals in particular.

**The general region is characterised by extremely low levels of transformation and habitat fragmentation. Impacts from the proposed development are unlikely to increase regional or local levels of fragmentation and habitat isolation significantly.**

*11.2.11 Increase in Environmental Degradation*

Cumulative impacts associated with this type of development could lead to initial, incremental or augmentation of existing types of environmental degradation, including impacts on the air, soil and water present within available habitat. Pollution of these elements might not always be immediately visible or readily quantifiable, but incremental or fractional increases might rise to levels where biological attributes could be affected adversely on a local or regional scale. In most cases are these effects are not bound and is dispersed, or diluted over an area that is much larger than the actual footprint of the causal factor. Similarly, developments in untransformed and pristine areas are usually not characterised by visibly significant environmental degradation and these impacts are usually most prevalent in areas where continuous and long-term impacts have been experienced.

**The nature of the proposed development dictates that the biological environment is unlikely to be affected since no effluents, spillages or chemical are likely to be produced or transported. However, the general region is characterised by low levels of degradation, this impact therefore becomes more important since it represents the 'thin end of the wedge'.**



In estimating the significance and likelihood of impacts of the proposed development on the biological environment, cognisance is taken of all biophysical, floristic and faunal attributes that characterise the study area as well as the immediate region. It represents a subjective interpretation of the biophysical attributes, estimated sensitivities of habitat types that are present on the study area as well as taking cognisance of the larger region and how the proposed project will affect the biodiversity issues on a larger scale. Impacts are assessed prior to as well as subsequent to the implementation of all recommended mitigation measures.

11.3.1

Impact Assessment Prior to Implementation of Mitigation Measures

Potential Environmental Impact		Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
<b>Issues related to Biodiversity - Closed Shrubveld Habitat Type</b>									
Direct impacts on RD flora	Negative	2	4	1	3	Negligible	10	10	medium
Direct impacts on Protected Trees	Negative	2	4	2	2	Negligible	10	10	medium
Direct impacts on RD fauna	Negative	2	4	3	3	Negligible	12	12	high
Disruption of Migration Routes	Negative	1	4	2	2	Negligible	9	9	medium
Direct impacts on pristine/ sensitive habitat	Negative	1	4	3	2	Negligible	10	10	medium
Direct impacts on common fauna species	Negative	1	4	4	2	Negligible	11	11	medium
Faunal Interactions w structures	Negative	1	4	2	1	Negligible	8	8	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	3	3	Negligible	12	12	high
Impacts on conservation targets	Negative	3	4	1	1	Negligible	9	9	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	Negligible	11	11	medium
Increase in environmental degradation	Negative	2	4	2	1	Negligible	9	9	medium
Average Impact Status							10.1		medium

Potential Environmental Impact		Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
<b>Issues related to Biodiversity - Drainage Line Habitat Type</b>									
Direct impacts on RD flora	Negative	2	4	2	3	Negligible	11	11	medium
Direct impacts on Protected Trees	Negative	2	4	1	2	Negligible	9	9	medium
Direct impacts on RD fauna	Negative	3	4	2	3	Negligible	12	12	high
Disruption of Migration Routes	Negative	2	4	2	2	Negligible	10	10	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	2	4	Negligible	12	12	high
Direct impacts on common fauna species	Negative	2	4	2	2	Negligible	10	10	medium
Faunal Interactions w structures	Negative	2	4	1	1	Negligible	8	8	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	3	4	3	3	Negligible	13	13	high
Impacts on conservation targets	Negative	3	4	2	2	Negligible	11	11	medium
Increase in fragmentation & isolation	Negative	2	4	1	2	Negligible	9	9	medium
Increase in environmental degradation	Negative	3	4	2	3	Negligible	12	12	high
Average Impact Status							10.6		medium

Potential Environmental Impact							Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance	
<b>Issues related to Biodiversity - Floodplains Habitat Type</b>															
Direct impacts on RD flora							Negative	2	4	1	3	Negligible	10	medium	
Direct impacts on Protected Trees							Negative	2	4	1	1	Negligible	8	medium	
Direct impacts on RD fauna							Negative	3	4	2	3	Negligible	12	high	
Disruption of Migration Routes							Negative	2	4	2	3	Negligible	11	medium	
Direct impacts on pristine/ sensitive habitat							Negative	2	4	2	4	Negligible	12	high	
Direct impacts on common fauna species							Negative	2	4	2	2	Negligible	10	medium	
Faunal Interactions w structures							Negative	2	4	2	1	Negligible	9	medium	
Impacts on surrounding habitat/ ecosystem functioning							Negative	3	4	3	3	Negligible	13	high	
Impacts on conservation targets							Negative	2	4	2	2	Negligible	10	medium	
Increase in fragmentation & isolation							Negative	2	4	2	2	Negligible	10	medium	
Increase in environmental degradation							Negative	2	4	2	3	Negligible	11	medium	
Average Impact Status												10.5	medium		

Potential Environmental Impact							Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance	
<b>Issues related to Biodiversity - Grassland Plains Habitat Type</b>															
Direct impacts on RD flora							Negative	2	4	1	3	Marginal	10	medium	
Direct impacts on Protected Trees							Negative	1	4	4	1	Marginal	10	medium	
Direct impacts on RD fauna							Negative	2	4	4	4	Marginal	14	high	
Disruption of Migration Routes							Negative	3	4	3	2	Marginal	12	high	
Direct impacts on pristine/ sensitive habitat							Negative	2	4	2	2	Marginal	10	medium	
Direct impacts on common fauna species							Negative	2	4	4	2	Marginal	12	high	
Faunal Interactions w structures							Negative	2	4	3	1	Marginal	10	medium	
Impacts on surrounding habitat/ ecosystem functioning							Negative	2	4	2	2	Marginal	10	medium	
Impacts on conservation targets							Negative	2	4	2	1	Marginal	9	medium	
Increase in fragmentation & isolation							Negative	2	4	4	1	Marginal	11	medium	
Increase in environmental degradation							Negative	2	4	2	1	Marginal	9	medium	
Average Impact Status												10.6	medium		

Potential Environmental Impact		Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
<b>Issues related to Biodiversity - Olea Woodland Habitat Type</b>									
Direct impacts on RD flora	Negative	3	4	1	3	Marginal	11	medium	
Direct impacts on Protected Trees	Negative	2	4	4	3	Marginal	13	high	
Direct impacts on RD fauna	Negative	2	4	4	3	Marginal	13	high	
Disruption of Migration Routes	Negative	3	4	2	2	Marginal	11	medium	
Direct impacts on pristine/ sensitive habitat	Negative	2	4	3	3	Marginal	12	high	
Direct impacts on common fauna species	Negative	2	4	2	3	Marginal	11	medium	
Faunal Interactions w structures	Negative	2	4	3	1	Marginal	10	medium	
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	3	3	Marginal	12	high	
Impacts on conservation targets	Negative	2	4	1	1	Marginal	8	medium	
Increase in fragmentation & isolation	Negative	2	4	4	1	Marginal	11	medium	
Increase in environmental degradation	Negative	2	4	2	1	Marginal	9	medium	
Average Impact Status							11.0	medium	

Potential Environmental Impact		Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
<b>Issues related to Biodiversity - Open Shrubveld Habitat Type</b>									
Direct impacts on RD flora	Negative	2	4	1	3	Marginal	10	medium	
Direct impacts on Protected Trees	Negative	2	4	4	2	Marginal	12	high	
Direct impacts on RD fauna	Negative	2	4	4	4	Marginal	14	high	
Disruption of Migration Routes	Negative	2	4	3	2	Marginal	11	medium	
Direct impacts on pristine/ sensitive habitat	Negative	2	4	3	2	Marginal	11	medium	
Direct impacts on common fauna species	Negative	2	4	4	2	Marginal	12	high	
Faunal Interactions w structures	Negative	2	4	2	1	Marginal	9	medium	
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	2	2	Marginal	10	medium	
Impacts on conservation targets	Negative	2	4	2	1	Marginal	9	medium	
Increase in fragmentation & isolation	Negative	2	4	4	1	Marginal	11	medium	
Increase in environmental degradation	Negative	2	4	2	2	Marginal	10	medium	



Average Impact Status

10.8

medium

Potential Environmental Impact		Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
<b>Issues related to Biodiversity - Closed Shrubveld Habitat Type</b>									
Direct impacts on RD flora	Negative	1	2	1	1	1	Negligible	5	low
Direct impacts on Protected Trees	Negative	1	2	2	1	1	Negligible	6	medium
Direct impacts on RD fauna	Negative	2	2	1	1	1	Negligible	6	medium
Disruption of Migration Routes	Negative	1	2	1	1	1	Negligible	5	low
Direct impacts on pristine/ sensitive habitat	Negative	1	2	1	1	1	Negligible	5	low
Direct impacts on common fauna species	Negative	1	2	1	1	1	Negligible	5	low
Faunal Interactions w structures	Negative	1	2	1	1	1	Negligible	5	low
Impacts on surrounding habitat/ ecosystem functioning	Negative	1	2	1	1	1	Negligible	5	low
Impacts on conservation targets	Negative	3	4	1	1	1	Negligible	9	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	1	Negligible	11	medium
Increase in environmental degradation	Negative	2	4	2	1	1	Negligible	9	medium
Average Impact Status								6.5	medium

Potential Environmental Impact		Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
<b>Issues related to Biodiversity - Drainage Line Habitat Type</b>									
Direct impacts on RD flora	Negative	2	2	2	1	1	Negligible	7	medium
Direct impacts on Protected Trees	Negative	1	1	0	0	0	Negligible	2	low
Direct impacts on RD fauna	Negative	1	2	1	1	2	Negligible	6	medium
Disruption of Migration Routes	Negative	1	1	1	1	1	Negligible	4	low
Direct impacts on pristine/ sensitive habitat	Negative	1	2	1	1	2	Negligible	6	medium
Direct impacts on common fauna species	Negative	1	1	1	1	1	Negligible	4	low
Faunal Interactions w structures	Negative	1	1	1	1	1	Negligible	5	low
Impacts on surrounding habitat/ ecosystem functioning	Negative	1	2	1	1	2	Negligible	6	medium
Impacts on conservation targets	Negative	2	2	1	1	2	Negligible	7	medium
Increase in fragmentation & isolation	Negative	1	1	1	1	1	Negligible	4	low
Increase in environmental degradation	Negative	1	1	1	1	1	Negligible	4	low

Average Impact Status	5.0	low
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Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
<b>Issues related to Biodiversity - Floodplains Habitat Type</b>								
Direct impacts on RD flora	Negative	2	2	1	2	Negligible	7	medium
Direct impacts on Protected Trees	Negative	1	1	0	0	Negligible	2	low
Direct impacts on RD fauna	Negative	1	2	1	2	Negligible	6	medium
Disruption of Migration Routes	Negative	1	1	1	1	Negligible	4	low
Direct impacts on pristine/ sensitive habitat	Negative	1	2	2	2	Negligible	7	medium
Direct impacts on common fauna species	Negative	1	2	1	1	Negligible	5	low
Faunal Interactions w structures	Negative	1	1	2	1	Negligible	5	low
Impacts on surrounding habitat/ ecosystem functioning	Negative	1	2	1	2	Negligible	6	medium
Impacts on conservation targets	Negative	1	2	1	1	Negligible	5	low
Increase in fragmentation & isolation	Negative	1	1	1	1	Negligible	4	low
Increase in environmental degradation	Negative	1	1	1	1	Negligible	4	low
Average Impact Status							5.0	low

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
<b>Issues related to Biodiversity - Grassland Plains Habitat Type</b>								
Direct impacts on RD flora	Negative	2	4	0	1	Negligible	7	medium
Direct impacts on Protected Trees	Negative	1	4	4	1	Negligible	10	medium
Direct impacts on RD fauna	Negative	2	4	2	2	Negligible	10	medium
Disruption of Migration Routes	Negative	2	4	2	2	Negligible	10	medium
Direct impacts on pristine/ sensitive habitat	Negative	1	4	2	1	Negligible	8	medium
Direct impacts on common fauna species	Negative	1	4	4	2	Negligible	11	medium
Faunal Interactions w structures	Negative	2	4	2	1	Negligible	9	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	2	1	Negligible	9	medium
Impacts on conservation targets	Negative	2	4	1	1	Negligible	8	medium
Increase in fragmentation & isolation	Negative	2	4	4	1	Negligible	11	medium
Increase in environmental degradation	Negative	2	4	2	1	Negligible	9	medium

Average Impact Status	9.3	medium
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Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
<b>Issues related to Biodiversity - Olea Woodland Habitat Type</b>								
Direct impacts on RD flora	Negative	2	4	1	1	Negligible	8	medium
Direct impacts on Protected Trees	Negative	2	4	4	2	Negligible	12	high
Direct impacts on RD fauna	Negative	2	4	2	2	Negligible	10	medium
Disruption of Migration Routes	Negative	2	4	2	1	Negligible	9	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	3	2	Negligible	11	medium
Direct impacts on common fauna species	Negative	2	4	2	2	Negligible	10	medium
Faunal Interactions w structures	Negative	2	4	2	1	Negligible	9	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	2	2	Negligible	10	medium
Impacts on conservation targets	Negative	2	4	1	1	Negligible	8	medium
Increase in fragmentation & isolation	Negative	2	4	3	1	Negligible	10	medium
Increase in environmental degradation	Negative	2	4	1	1	Negligible	8	medium
Average Impact Status							9.5	medium

Potential Environmental Impact	Status	Spatial	Temporal	Probability	Severity	Accumulative	Total	Significance
<b>Issues related to Biodiversity - Open Shrubveld Habitat Type</b>								
Direct impacts on RD flora	Negative	2	4	1	2	Negligible	9	medium
Direct impacts on Protected Trees	Negative	2	4	4	1	Negligible	11	medium
Direct impacts on RD fauna	Negative	2	4	2	2	Negligible	10	medium
Disruption of Migration Routes	Negative	2	4	2	1	Negligible	9	medium
Direct impacts on pristine/ sensitive habitat	Negative	2	4	2	2	Negligible	10	medium
Direct impacts on common fauna species	Negative	2	4	3	1	Negligible	10	medium
Faunal Interactions w structures	Negative	2	4	2	1	Negligible	9	medium
Impacts on surrounding habitat/ ecosystem functioning	Negative	2	4	1	1	Negligible	8	medium
Impacts on conservation targets	Negative	2	4	1	1	Negligible	8	medium
Increase in fragmentation & isolation	Negative	2	4	1	1	Negligible	8	medium

Increase in environmental degradation	Negative	2	4	1	1	Negligible	8	medium
Average Impact Status							9.1	medium

**Table 15: Summary of impacts within respective habitat types**

Habitat Type	Impact without mitigation	Impact with mitigation
Closed Shrubveld Habitat Type	10.1 (medium)	6.5 (medium)
Drainage Line Habitat Type	10.6 (medium)	5.0 (low)
Floodplains Habitat Type	10.5 (medium)	5.0 (low)
Grassland Plains Habitat Type	10.6 (medium)	9.3 (medium)
Olea Woodland Habitat Type	11.0 (medium)	9.5 (medium)
Open Shrubveld Habitat Type	10.8 (medium)	9.1 (medium)

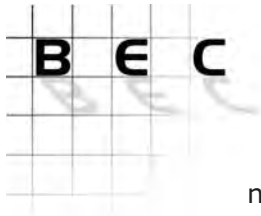
The significance of impacts across the entire area is regarded medium. However, on closer inspection it is revealed that certain impacts, particularly those of a direct nature, are expected to result in significant impacts in localised parts of the study area. This is mainly the result of the environment and biodiversity that characterises the area being in a relatively pristine state, as well as the destructive effect that clearing of land will have on biodiversity attributes of the study area.

Of particular importance is the significance of impacts on Red Data animals. Some species are unable to evacuate the area with disturbance and will likely be destroyed. The only sensible mitigation measure will be to remove these animals by means of an intensive search and replace activity. The destruction of extensive areas on the property is also expected to result in significant impacts on fauna species present on the neighbouring areas that utilise this area on an infrequent basis.

The implementation of generic mitigation measures is expected to result in a reduction of the impacts, mostly to a medium significance. Site specific and detailed mitigation measures in certain areas of the property will reduce the significance of impacts within high sensitivity areas to an acceptable level.

**Closed Shrubveld Habitat Type** Impacts within this habitat type are regarded significant on a local scale, excluding this area from the development, as far as technically feasible, is recommended. It is indicated that only an extremely small portion of this habitat type is located within the proposed footprint. The loss of a small portion of this habitat type is not expected to result in significant impacts on a regional scale since much of this habitat are present to the north of this particular site, while the regional vegetation type is also afforded a Least Threatened status (VEGMAP). The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

**Drainage Line Habitat Type** Any impact within this habitat type will be regarded as significant on a local and regional scale. Although the proposed footprint does



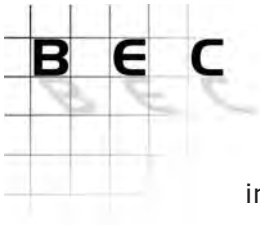
not include any part of this drainage line, the proximity of the drainage line to the development area will require strict management and development measures to prevent impacts to this area. Drainage of water from the development area towards this habitat will result in deterioration of the status on the site as well as in wetland habitat further downstream. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

**Floodplains Habitat Type** Any impact within this habitat type will be significant on a local scale, excluding this area from the development represents the major mitigation measure. It is indicated that only an extremely small portion of this habitat type is located within the proposed footprint, but the proximity of these areas to the footprint will highly likely result in peripheral impacts affecting this area adversely. It should also be noted that this habitat type buffers the drainage line from the proposed development, keeping this buffer intact is therefore important in terms of preserving the drainage line. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level. This habitat type is suitable for the cryptic near endemic species *Lithops aucampiae* subsp. *aucampiae* var. *aucampiae*. Due to the cryptic nature of this species, it is nonetheless recommended that a detailed walkthrough of all moderately suitable habitat be conducted prior to the commencement of construction activities.

**Grassland Plains Habitat Type** Large extents of this habitat type will be affected, during the construction phase. However, the ecological sensitivity is indicated as moderate and the loss of these areas is not expected to result in significant impacts on a when considered on a large scale. It should be noted that termite mounds occur within this habitat type, which is habitat for Red Data fauna species; a search and rescue operation is recommended. It should also be noted that this habitat type is adequately represented in the surrounding region. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

**Olea Woodland Habitat Type** A portion of this habitat type will be affected by the proposed development; the presence of protected tree species represents an important consideration. While the presence of these individuals does not represent a red flag to the development, careful planning and execution of development plans must be made to avoid impacts in adjacent parts of this habitat type. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.

**Open Shrubveld Habitat Type** Large extents of this habitat type will be affected, during the construction phase. However, the ecological sensitivity is indicated as moderate and the loss of these areas is not expected to result in significant



impacts on a when considered on a large scale. It should be noted that termite mounds occur within this habitat type, which is habitat for Red Data fauna species; a search and rescue operation is recommended. It should also be noted that this habitat type is adequately represented in the surrounding region. The implementation of site specific and generic mitigation measures, together with development recommendations is expected to lower the expected impacts to an acceptable level.



12.1.1 *General Aspects*

- Mitigation Measure 1** - Exclude all areas of the Drainage line and Floodplain habitat types from the proposed development. This should be done during the planning phase of the project;
- Mitigation Measure 2** - Exclude as much of the Closed shrubveld habitat type from the proposed development as technically feasible. This should be done during the planning phase of the project;
- Mitigation Measure 3** - Allow for a suitable buffer in order to provide some protection of sensitive areas against peripheral impacts, wetland related habitat types in particular. All areas that were ascribed a High Ecological Sensitivity should be buffered against potential impacts. Guidelines of the wetland specialist should be implemented in this regard;
- Mitigation Measure 4** - Appoint an Environmental Control Officer (ECO) prior to start of construction. Responsibilities should include, but not be limited to, ensuring adherence to EMP guidelines, guidance of activities, planning, reporting;
- Mitigation Measure 5** - Compile and implement environmental monitoring programme, the aim of which should be ensuring long-term success of rehabilitation and prevention of environmental degradation. Environmental monitoring should be conducted at least twice per year (Summer, Winter);
- Mitigation Measure 6** - Limit construction, maintenance and inspection activities to dry periods in order to curb occurrence/ augmentation of erosion in areas of existing erosion, destabilizing of substrate in areas of high slopes, drainage lines, etc;
- Mitigation Measure 7** - Ensure off site storage of hazardous materials, chemicals, fuels, oils, etc. in order to prevent accidental spillage, contamination or pollution;
- Mitigation Measure 8** - Develop emergency maintenance operational plan to deal with any event of contamination, pollution or spillages, particularly in sensitive areas;
- Mitigation Measure 9** - Construction sites/camps need a detailed ecological assessment prior to construction;
- Mitigation Measure 10** - Limit damage to protected tree species in the Olea woodland as far as possible. Adapt layout plans to avoid any excessive damage to this habitat type;
- Mitigation Measure 11** - All individuals/ stands of Protected trees must be clearly and visibly marked prior to the start of construction or maintenance procedures;
- Mitigation Measure 12** - Implement strict erosion monitoring and management procedures in all areas where slopes are present.

**Mitigation Measure 13** - Demarcate construction areas by semi-permanent means in order to control movement of personnel, vehicles, providing boundaries for construction sites in order to limit spread of impacts;

**Mitigation Measure 14** - No painting or marking of rocks or vegetation to identify locality or other information shall be allowed, as it will disfigure the natural setting. Marking shall be done by steel stakes with tags, if required;

**Mitigation Measure 15** - Marking of plants should be done by means of semi-permanent (removable) marker tape;

**Mitigation Measure 16** - Prevent all open fires;

**Mitigation Measure 17** - Provide demarcated fire-safe zones, facilities and suitable fire control measures;

**Mitigation Measure 18** - Access is to be established by vehicles passing over the same track on natural ground. Multiple tracks are not permitted;

**Mitigation Measure 19** - Vehicular traffic shall not be allowed in permanently wet areas, no damage shall be caused to wet areas. Where necessary, alternative methods of construction shall be used to avoid damage to wet areas.

**Mitigation Measure 20** - Prohibit construction of new access roads. Use should be made of existing roads, ensuring proper maintenance/ upgrade. Alternative methods of construction/ access to sensitive areas is recommended;

**Mitigation Measure 21** - The Contractor shall select a suitable level area free of rock and large bushes as lay down area;

**Mitigation Measure 22** - The Contractor shall select an area a suitable distance from any sensitive environmental feature as a construction camp;

**Mitigation Measure 23** - Provide temporary on-site ablution, sanitation, litter and waste management and hazardous materials management facilities;

**Mitigation Measure 24** - Abluting anywhere other than in provided toilets shall not be permitted. Under no circumstances shall use of the veld be permitted;

**Mitigation Measure 25** - Use of branches of trees and shrubs for fire making purposes is strictly prohibited;

- Mitigation Measure 26** - Removal of vegetation/ plants shall be avoided until such time as soil stripping is required and similarly exposed surfaces must be re-vegetated or stabilised as soon as is practically possible;
- Mitigation Measure 27** - Remove and store topsoil separately in areas where excavation/ degradation takes place. Topsoil should be used for rehabilitation purposes in order to facilitate regrowth of species that occur naturally in the area;
- Mitigation Measure 28** - Disturbance of vegetation must be limited to areas of construction;
- Mitigation Measure 29** - The removal or picking of any protected or unprotected plants shall not be permitted and no horticultural specimens (even within the demarcated working area) shall be removed, damaged or tampered with unless agreed to by the ECO;
- Mitigation Measure 30** - Cut vegetation (grass and shrubs) only if required. No clearing of vegetation or soil by grading machinery shall be undertaken;
- Mitigation Measure 31** - The establishment and regrowth of alien vegetation must be controlled after the removal of grass;
- Mitigation Measure 32** - All declared aliens must be identified and managed in accordance with the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);
- Mitigation Measure 33** - Ensure proper surface restoration and resloping in order to prevent erosion, taking cognisance of local contours and landscaping;
- Mitigation Measure 34** - Exposed areas with slopes less than 1:3 should be rehabilitated with a grass mix that blends in with the surrounding vegetation;
- Mitigation Measure 35** - The grass mix should consist of indigenous grasses adapted to the local environmental conditions;
- Mitigation Measure 36** - The revegetated areas should be temporarily fenced to prevent damage by grazing animals;
- Mitigation Measure 37** - Re-vegetated areas showing inadequate surface coverage (less than 30 % within eight months after re-vegetation) should be prepared and re-vegetated from scratch;
- Mitigation Measure 38** - Damage to re-vegetated areas should be repaired promptly;
- Mitigation Measure 39** - Exotic weeds and invaders that might establish on the re-vegetated areas should be controlled to allow the grasses to properly establish;
- Mitigation Measure 40** - Monitoring the potential spread of declared weeds and invasive alien vegetation to neighbouring land and protecting the agricultural resources and soil conservation works are regulated by the Conservation of Agricultural Resources Act, No. 43 of 1983 and should be addressed on a continuous basis;

- Mitigation Measure 41** - No animal may be hunted, trapped, snared or killed for any purpose whatsoever;
- Mitigation Measure 42** - Conduct a search and rescue operation in all affected areas to remove animals from old termite mounds prior to the commencement of construction activities (vegetation clearing and ground levelling). Reptiles and small mammals that utilises these micro-habitat should be captured and released in suitable nearby areas;
- Mitigation Measure 43** - Vehicular traffic should not be allowed after dark in order to limit accidental killing of nocturnal animals;
- Mitigation Measure 44** - Dangerous animals should be handled by a competent person;
- Mitigation Measure 45** - Compile a graphic list of potentially dangerous animals and present this to all workers as part of site induction; and
- Mitigation Measure 46** - Ensure that a snake handler and/ or anti venom serum is available at all times, together with a competent person to administer this serum.

12.1.8 Protected Trees/ Conservation Important Species

- Mitigation Measure 47** - Conduct a suitable assessment of the abundance and structure of protected tree species on the property to assist the client with regards to the submission of relevant applications;
- Mitigation Measure 48** - Obtain necessary and required approval per application for damage/ removal/ cutting/ pruning of Protected tree species from Department of Forestry, as per National Forests Act (Act No. 84 of 1998) under Government Notice GN 1012 of 2004 and GN 767 of 2005 as well as NCDENC;
- Mitigation Measure 49** - Cutting/ pruning/ damaging of any Protected tree species should not be allowed at any circumstances, unless a permit has been obtained for this purpose; and
- Mitigation Measure 50** - Conduct a detailed walkthrough of moderately suitable habitat for *Lithops aucampiae* subsp. *aucampiae* var. *aucampiae*. Implement a removal and relocation programme if required.





Photo 1: Example of the Open Shrubveld habitat type



Photo 2: Example of the Drainage Line habitat type, upper parts in southern section of the study area





Photo 3: Example Grassland Plains habitat type.



Photo 4: Example of the Olea Woodland habitat type





Photo 5: Example of the Drainage Line habitat type



Photo 6: Example of the Floodplains habitat type





Photo 7: Example of informal mining operations on the property



Photo 8: Example of Closed Shrubveld habitat type



Species	Family	Threat status	Growth forms
<i>Acacia haematoxylon</i>	Fabaceae	LC	Shrub
<i>Acacia hebeclada</i> subsp. <i>hebeclada</i>	Fabaceae	LC	Shrub
<i>Acacia tortilis</i> subsp. <i>heteracantha</i>	Fabaceae	LC	Tree
<i>Antheophora pubescens</i>	Poaceae	LC	Graminoid
<i>Antizoma angustifolia</i>	Menispermaceae	LC	Climber
<i>Aristida adscensionis</i>	Poaceae	LC	Graminoid
<i>Aristida congesta</i> subsp. <i>congesta</i>	Poaceae	LC	Graminoid
<i>Aristida meridionalis</i>	Poaceae	LC	Graminoid
<i>Aristida stipitata</i> subsp. <i>spicata</i>	Poaceae	LC	Graminoid
<i>Aristida vestita</i>	Poaceae	LC	Graminoid
<i>Asparagus suaveolens</i>	Asparagaceae	LC	Shrub
<i>Asplenium cordatum</i>	Aspleniaceae	LC	Geophyte
<i>Atriplex semibaccata</i> var. <i>appendiculata</i>	Chenopodiaceae	LC	Dwarf shrub
<i>Barleria bechuanensis</i>	Acanthaceae	LC	Herb
<i>Boscia albitrunca</i>	Capparaceae	LC	Tree
<i>Brachiaria marlothii</i>	Poaceae	LC	Graminoid
<i>Caesalpinia gilliesii</i>	Fabaceae	NE	Shrub
<i>Calobota cuspidosa</i>	Fabaceae		Shrub
<i>Chascanum pinnatifidum</i> var. <i>pinnatifidum</i>	Verbenaceae	LC	Herb
<i>Cheilanthes eckloniana</i>	Sinopteridaceae	LC	Geophyte
<i>Cheilanthes hirta</i> var. <i>hirta</i>	Sinopteridaceae	LC	Geophyte
<i>Chenopodium hederiforme</i> var. <i>dentatum</i>	Chenopodiaceae	LC	Herb
<i>Chloris virgata</i>	Poaceae	LC	Graminoid
<i>Cirsium vulgare</i>	Asteraceae	NE	Herb
<i>Cleome angustifolia</i> subsp. <i>diandra</i>	Capparaceae	LC	Herb
<i>Coccinia sessilifolia</i>	Cucurbitaceae	LC	Climber
<i>Convolvulus boedeckerianus</i>	Convolvulaceae	LC	Herb
<i>Cucumis heptadactylus</i>	Cucurbitaceae	LC	Herb
<i>Cynodon dactylon</i>	Poaceae	LC	Graminoid
<i>Datura inoxia</i>	Solanaceae	NE	Herb
<i>Deverra burchellii</i>	Apiaceae	LC	Shrub
<i>Digitaria eriantha</i>	Poaceae	LC	Graminoid
<i>Diospyros austro-africana</i> var. <i>microphylla</i>	Ebenaceae	LC	Shrub
<i>Ehretia alba</i>	Boraginaceae	LC	Shrub
<i>Enneapogon desvauxii</i>	Poaceae	LC	Graminoid
<i>Enneapogon scoparius</i>	Poaceae	LC	Graminoid
<i>Eragrostis bicolor</i>	Poaceae	LC	Graminoid
<i>Eragrostis echinochloidea</i>	Poaceae	LC	Graminoid
<i>Eragrostis homomalla</i>	Poaceae	LC	Graminoid
<i>Eragrostis lehmanniana</i> var. <i>lehmanniana</i>	Poaceae	LC	Graminoid
<i>Eragrostis mexicana</i> subsp. <i>virescens</i>	Poaceae	NE	Graminoid
<i>Eragrostis pallens</i>	Poaceae	LC	Graminoid
<i>Eragrostis pilgeriana</i>	Poaceae	LC	Graminoid
<i>Eragrostis porosa</i>	Poaceae	LC	Graminoid
<i>Eragrostis procumbens</i>	Poaceae	LC	Graminoid
<i>Eragrostis trichophora</i>	Poaceae	LC	Graminoid
<i>Eragrostis truncata</i>	Poaceae	LC	Graminoid

Species	Family	Threat status	Growth forms
<i>Eriocephalus ericoides</i> subsp. <i>griquensis</i>	Asteraceae	LC	Shrub
<i>Erucastrum strigosum</i>	Brassicaceae	LC	Herb
<i>Eucalyptus camaldulensis</i>	Myrtaceae	NE	Tree
<i>Euclea crispa</i> subsp. <i>ovata</i>	Ebenaceae	LC	Shrub
<i>Euphorbia duseimata</i>	Euphorbiaceae	LC	Dwarf shrub
<i>Euphorbia mauritanica</i> var. <i>mauritanica</i>	Euphorbiaceae	LC	Succulent
<i>Geigeria filifolia</i>	Asteraceae	LC	Herb
<i>Glossochilus burchellii</i>	Acanthaceae	LC	Herb
<i>Gnidia polycephala</i>	Thymelaeaceae	LC	Dwarf shrub
<i>Gymnosporia buxifolia</i>	Celastraceae	LC	Shrub
<i>Helichrysum cerastioides</i> var. <i>cerastioides</i>	Asteraceae	LC	Herb
<i>Helichrysum zeyheri</i>	Asteraceae	LC	Dwarf shrub
<i>Heliophila suavissima</i>	Brassicaceae	LC	Dwarf shrub
<i>Heliotropium ciliatum</i>	Boraginaceae	LC	Herb
<i>Hermannia comosa</i>	Malvaceae	LC	Herb
<i>Hermannia eenii</i>	Malvaceae	LC	Herb
<i>Hermannia erodioides</i>	Malvaceae	LC	Herb
<i>Hermannia jacobaeifolia</i>	Malvaceae	LC	Dwarf shrub
<i>Hermbstaedtia fleckii</i>	Amaranthaceae	LC	Herb
<i>Hermbstaedtia odorata</i> var. <i>aurantiaca</i>	Amaranthaceae	LC	Herb
<i>Hertia ciliata</i>	Asteraceae	LC	Succulent
<i>Heteropogon contortus</i>	Poaceae	LC	Graminoid
<i>Hyparrhenia hirta</i>	Poaceae	LC	Graminoid
<i>Hypertelis salsoloides</i> var. <i>salsoloides</i>	Molluginaceae	LC	Dwarf shrub
<i>Indigofera alternans</i> var. <i>alternans</i>	Fabaceae	LC	Herb
<i>Indigofera denudata</i>	Fabaceae	LC	Shrub
<i>Ipomoea oenotheroides</i>	Convolvulaceae	LC	Succulent
<i>Jamesbrittenia atropurpurea</i> subsp. <i>atropurpurea</i>	Scrophulariaceae	LC	Dwarf shrub
<i>Jamesbrittenia aurantiaca</i>	Scrophulariaceae	LC	Herb
<i>Jamesbrittenia tysonii</i>	Scrophulariaceae	LC	Dwarf shrub
<i>Juncus rigidus</i>	Juncaceae	LC	Herb
<i>Justicia puberula</i>	Acanthaceae	LC	Dwarf shrub
<i>Kedrostis foetidissima</i>	Cucurbitaceae	LC	Climber
<i>Kohautia cynanchica</i>	Rubiaceae	LC	Herb
<i>Kyphocarpa angustifolia</i>	Amaranthaceae	LC	Herb
<i>Lactuca inermis</i>	Asteraceae	LC	Herb
<i>Laggera decurrens</i>	Asteraceae	LC	Herb
<i>Lantana rugosa</i>	Verbenaceae	LC	Shrub
<i>Lessertia affinis</i>	Fabaceae	LC	Herb
<i>Leucas capensis</i>	Lamiaceae	LC	Dwarf shrub
<i>Limeum argute-carinatum</i> var. <i>argute-carinatum</i>	Molluginaceae	LC	Herb
<i>Lopholaena cneorifolia</i>	Asteraceae	LC	Succulent
<i>Lycium horridum</i>	Solanaceae	LC	Dwarf shrub
<i>Melinis repens</i> subsp. <i>repens</i>	Poaceae	LC	Graminoid
<i>Melolobium microphyllum</i>	Fabaceae	LC	Dwarf shrub
<i>Menodora africana</i>	Oleaceae	LC	Dwarf shrub
<i>Mirabilis jalapa</i>	Nyctaginaceae	NE	Herb
<i>Monechma divaricatum</i>	Acanthaceae	LC	Shrub
<i>Nemesia lilacina</i>	Scrophulariaceae	LC	Herb
<i>Oenothera indecora</i>	Onagraceae	NE	Herb

Species	Family	Threat status	Growth forms
<i>Olea europaea</i> subsp. <i>africana</i>	Oleaceae	LC	Tree
<i>Ornithoglossum dinteri</i>	Colchicaceae	LC	Geophyte
<i>Osteospermum spinescens</i>	Asteraceae	LC	Shrub
<i>Oxalis depressa</i>	Oxalidaceae	LC	Geophyte
<i>Oxalis lawsonii</i>	Oxalidaceae	LC	Geophyte
<i>Pachypodium succulentum</i>	Apocynaceae	LC	Succulent
<i>Panicum stapfianum</i>	Poaceae	LC	Graminoid
<i>Parkinsonia aculeata</i>	Fabaceae	NE	Shrub
<i>Pavonia burchellii</i>	Malvaceae	LC	Dwarf shrub
<i>Pelargonium multicaule</i> subsp. <i>multicaule</i>	Geraniaceae	LC	Dwarf shrub
<i>Peliostomum leucorrhizum</i>	Scrophulariaceae	LC	Dwarf shrub
<i>Pentarrhinum insipidum</i>	Apocynaceae	LC	Climber
<i>Pentzia quinquefida</i>	Asteraceae	LC	Shrub
<i>Plantago lanceolata</i>	Plantaginaceae	LC	Herb
<i>Platycarphella parvifolia</i>	Asteraceae		Herb
<i>Pogonarthria squarrosa</i>	Poaceae	LC	Graminoid
<i>Pollichia campestris</i>	Caryophyllaceae	LC	Herb
<i>Pteronia cylindracea</i>	Asteraceae	LC	Shrub
<i>Rosenia humilis</i>	Asteraceae	LC	Shrub
<i>Salvia disermas</i>	Lamiaceae	LC	Herb
<i>Salvia stenophylla</i>	Lamiaceae		Herb
<i>Salvia verbenaca</i>	Lamiaceae	LC	Herb
<i>Schmidtia kalahariensis</i>	Poaceae	LC	Graminoid
<i>Searsia lancea</i>	Anacardiaceae	LC	Tree
<i>Searsia pendulina</i>	Anacardiaceae	LC	Shrub
<i>Searsia pyroides</i> var. <i>pyroides</i>	Anacardiaceae	LC	Shrub
<i>Searsia tridactyla</i>	Anacardiaceae	LC	Shrub
<i>Selago albida</i>	Scrophulariaceae	LC	Dwarf shrub
<i>Selago mixta</i>	Scrophulariaceae	LC	Herb
<i>Senecio carnosus</i>	Asteraceae	LC	Herb
<i>Sericorema sericea</i>	Amaranthaceae	LC	Herb
<i>Sesamum triphyllum</i> var. <i>triphyllum</i>	Pedaliaceae	LC	Herb
<i>Solanum namaquense</i>	Solanaceae	LC	Dwarf shrub
<i>Sporobolus fimbriatus</i>	Poaceae	LC	Graminoid
<i>Stachys spathulata</i>	Lamiaceae	LC	Herb
<i>Stipagrostis ciliata</i> var. <i>capensis</i>	Poaceae	LC	Graminoid
<i>Stipagrostis uniplumis</i> var. <i>uniplumis</i>	Poaceae	LC	Graminoid
<i>Tarchonanthus camphoratus</i>	Asteraceae	LC	Shrub
<i>Tecoma stans</i> var. <i>stans</i>	Bignoniaceae	NE	Shrub
<i>Themeda triandra</i>	Poaceae	LC	Graminoid
<i>Thesium lacinulatum</i>	Santalaceae	LC	Dwarf shrub
<i>Tragus racemosus</i>	Poaceae	LC	Graminoid
<i>Triraphis purpurea</i>	Poaceae	LC	Graminoid
<i>Typha capensis</i>	Typhaceae	LC	Herb
<i>Viscum rotundifolium</i>	Viscaceae	LC	Parasite
<i>Wahlenbergia androsacea</i>	Campanulaceae	LC	Herb
<i>Withania somnifera</i>	Solanaceae	LC	Dwarf shrub
<i>Zinnia peruviana</i>	Asteraceae	NE	Herb
<i>Zygophyllum pubescens</i>	Zygophyllaceae	LC	Dwarf shrub

## APPENDIX 2 – FLORISTIC DIVERSITY OF THE SITE

Species	Family	Growth form	Status/ Uses/ Properties
<i>Acacia erioloba</i>	Fabaceae	Tree	Protected Tree (National Forest Act, 1998), edible parts, medicinal uses, firewood
<i>Acacia hebeclada</i>	Fabaceae	Shrub	Indigenous invader, declared indicator of encroachment
<i>Acacia karroo</i>	Fabaceae	Tree	Edible parts, dyes and tans, medicinal uses, firewood
<i>Acacia mellifera</i>	Fabaceae	Shrub	Declared indicator of encroachment, medicinal uses, poison source
<i>Albucca cf longipes</i>	Liliaceae	Geophyte	None
<i>Aloe grandidentata</i>	Liliaceae	Succulent	None
<i>Alternanthera pungens</i>	Amaranthaceae	Forb	Weed, pioneer species
<i>Aptosimum albomarginatum</i>	Scrophulariaceae	Forb	None
<i>Arctotis arctoides</i>	Asteraceae	Forb	None
<i>Argemone ochroleuca</i>	Papaveraceae	Forb	Declared Invader - Category 1
<i>Aristida congesta</i> subsp. <i>barbicollis</i>	Poaceae	Grass	None
<i>Aristida congesta</i> subsp. <i>congesta</i>	Poaceae	Grass	None
<i>Aristida meridionalis</i>	Poaceae	Grass	None
<i>Aristida</i> species	Poaceae	Grass	None
<i>Aristida stiptitata</i>	Poaceae	Grass	None
<i>Asparagus</i> species	Liliaceae	Shrub	None
<i>Babiana hypogea</i>	Iridaceae	Geophyte	Edible parts
<i>Babiana</i> species	Iridaceae	Geophyte	None
<i>Berkheya</i> species	Asteraceae	Forb	Weed
<i>Bidens pilosa</i>	Asteraceae	Forb	Weed, edible parts
<i>Boophane disticha</i>	Amaryllidaceae	Geophyte	Poisonous, medicinal uses
<i>Boscia albitrunca</i>	Capparaceae	Tree	Protected Tree (National Forest Act, 1998)
<i>Brachiaria nigropedata</i>	Poaceae	Grass	None
<i>Brachiaria serrata</i>	Poaceae	Grass	None
<i>Brunsvigia bosmaniae</i>	Amaryllidaceae	Geophyte	None
<i>Brunsvigia natalensis</i>	Amaryllidaceae	Geophyte	None
<i>Bulbine abyssinica</i>	Liliaceae	Succulent	None
<i>Bulbine narcissifolia</i>	Liliaceae	Succulent	Medicinal uses
<i>Bulbine</i> species	Liliaceae	Succulent	None

Species	Family	Growth form	Status/ Uses/ Properties
<i>Calobota cuspidosa</i>	Fabaceae	Shrub	None
<i>Cenchrus ciliaris</i>	Poaceae	Grass	Palatable grazing species, Decreaser
<i>Ceratotheca triloba</i>	Pedaliaceae	Forb	Medicinal properties
<i>Chaenostoma halimifolium</i>	Scrophulariaceae	Forb	None
<i>Chasmatophyllum musculinum</i>	Mesembryanthemaceae	Succulent	None
<i>Chloris virgata</i>	Poaceae	Grass	None
<i>Colchicum melanthioides</i>	Colchicaceae	Geophyte	None
<i>Crassula</i> species	Crassulaceae	Succulent	None
<i>Cyanotis speciosa</i>	Commelinaceae	Forb	Medicinal properties
<i>Cymbopogon plurinodis</i>	Poaceae	Grass	Unpalatable grazing
<i>Cynodon dactylon</i>	Poaceae	Grass	Indicator of disturbed areas, grazing potential
<i>Cyperus esculentus</i>	Cyperaceae	Sedge	Weed, edible parts
<i>Cyperus</i> species	Cyperaceae	Sedge	None
<i>Datura stramonium</i>	Solanaceae	Forb	Declared Invader - Category 1, weed
<i>Dicoma capensis</i>	Asteraceae	Forb	Medicinal uses
<i>Dicoma schinzii</i>	Asteraceae	Forb	Medicinal uses
<i>Digitaria eriantha</i>	Poaceae	Grass	Weaving, palatable
<i>Digitaria monodactyla</i>	Poaceae	Grass	None
<i>Digitaria tricholaenoides</i>	Poaceae	Grass	None
<i>Echinochloa colona</i>	Poaceae	Grass	None
<i>Echinopsis sphaciana</i>	Cactaceae	Succulent	Declared Invader - Category 1
<i>Ehretia rigida</i>	Ehretiaceae	Shrub	None
<i>Elionurus muticus</i>	Poaceae	Grass	None, unpalatable
<i>Enneapogon scoparius</i>	Poaceae	Grass	None
<i>Eragrostis curvula</i>	Poaceae	Grass	Edible parts, indicator of degraded areas
<i>Eragrostis echinochloidea</i>	Poaceae	Grass	None
<i>Eragrostis lehmanniana</i>	Poaceae	Grass	Weaving
<i>Eragrostis obtusa</i>	Poaceae	Grass	Indicator of poor habitat conditions
<i>Eragrostis plana</i>	Poaceae	Grass	Weaving, unpalatable, indicator of degraded areas
<i>Eragrostis racemosa</i>	Poaceae	Grass	Palatable grazing
<i>Eragrostis rigidior</i>	Poaceae	Grass	None
<i>Eragrostis</i> species	Poaceae	Grass	None

Species	Family	Growth form	Status/ Uses/ Properties
<i>Eriocephalus species</i>	Asteraceae	Shrub	None
<i>Eriocephalus spinescens</i>	Asteraceae	Shrub	None
<i>Euclia crispa</i>	Ebenaceae	Shrub	Medicinal uses
<i>Euclia undulata</i>	Ebenaceae	Shrub	Firewood
<i>Euphorbia clavarioides</i>	Euphorbiaceae	Succulent	None
<i>Euryops multifidus</i>	Asteraceae	Shrub	None
<i>Falkia oblonga</i>	Convolvulaceae	Forb	None
<i>Felicia species</i>	Asteraceae	Forb	None
<i>Fingerhuthia africana</i>	Poaceae	Grass	Moderate grazing potential
<i>Gazania krebsiana</i>	Asteraceae	Forb	None
<i>Geigeria species</i>	Asteraceae	Forb	None
<i>Gnidia species</i>	Thymelaeaceae	Forb	None
<i>Gnidia species</i>	Thymelaeaceae	Shrub	None
<i>Gomphocarpus fruticosus</i>	Asclepiadaceae	Shrub	Medicinal uses
<i>Grewia flava</i>	Tiliaceae	Shrub	Edible parts, weaving
<i>Gymnosporia buxifolia</i>	Celastraceae	Shrub	None
<i>Helichrysum argyrosphaerum</i>	Asteraceae	Forb	None
<i>Helichrysum species</i>	Asteraceae	Forb	None
<i>Heliotropium ciliatum</i>	Boraginaceae	Forb	None
<i>Hermannia althaeifolia</i>	Sterculiaceae	Forb	None
<i>Hermannia coccocarpa</i>	Sterculiaceae	Forb	None
<i>Hermannia species</i>	Sterculiaceae	Forb	None
<i>Heteropogon contortus</i>	Poaceae	Grass	None
<i>Hibiscus species</i>	Malvaceae	Forb	None
<i>Homeria pallida</i>	Iridaceae	Geophyte	None
<i>Indigofera species</i>	Fabaceae	Forb	None
<i>Jamesbrittenia aurantiaca</i>	Scrophulariaceae	Forb	None
<i>Kalanchoe species</i>	Crassulaceae	Succulent	None
<i>Kyphocarpa angustifolia</i>	Amaranthaceae	Forb	None
<i>Lachenalia species</i>	Hyacinthaceae	Geophyte	None
<i>Lactuca capensis</i>	Asteraceae	Forb	None
<i>Ledebouria cooperi</i>	Liliaceae	Geophyte	None

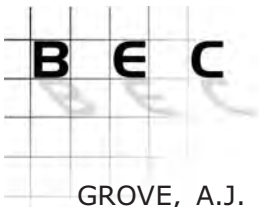
Species	Family	Growth form	Status/ Uses/ Properties
<i>Ledebouria revoluta</i>	Liliaceae	Geophyte	Edible parts
<i>Ledebouria</i> species	Liliaceae	Geophyte	None
<i>Leonotis ocyimifolia</i> var. <i>raineriana</i>	Lamiaceae	Forb	Medicinal uses, colours & dyes
<i>Leucas capensis</i>	Lamiaceae	Forb	None
<i>Lobelia</i> species	Lobeliaceae	Forb	None
<i>Lotononis</i> species	Fabaceae	Forb	None
<i>Lycium bosciifolium</i>	Solanaceae	Shrub	None
<i>Malva</i> species	Malvaceae	Forb	None
<i>Massonia</i> species	Hyacinthaceae	Geophyte	None
<i>Melinis nerviglumis</i>	Poaceae	Grass	Increaseer I
<i>Melolobium canescens</i>	Fabaceae	Shrub	Non
<i>Melolobium</i> species	Fabaceae	Shrub	None
<i>Microchloa caffra</i>	Poaceae	Grass	None
<i>Monsonia angustifolia</i>	Geraniaceae	Forb	None
<i>Nananthus aloides</i>	Mesembryanthemaceae	Succulent	None
<i>Opuntia ficus-indica</i>	Cactaceae	Succulent	Declared Invader - Category 1
<i>Oxalis</i> species	Oxalidaceae	Geophyte	None
<i>Pachypodium</i> species	Apocynaceae	Succulent	None
<i>Persicaria lapathifolia</i>	Polygonaceae	Hydrophilic	Indicator of moist conditions
<i>Pogonarthria squarrosa</i>	Poaceae	Grass	Unpalatable, indicator of poor habitat conditions
<i>Polygala hottentotta</i>	Polygalaceae	Forb	None
<i>Pteronia pallens</i>	Asteraceae	Shrub	None
<i>Rhigozum trichotomum</i>	Bignoniaceae	Shrub	Declared indicator of encroachment
<i>Rhynchosia totta</i>	Fabaceae	Forb	None
<i>Ruschia</i> species	Aizoaceae	Succulent	None
<i>Sarcocaulon</i> species	Geraniaceae	Succulent	None
<i>Scabiosa columbaria</i>	Dipsacaceae	Forb	Medicinal uses
<i>Schinus molle</i>	Anacardiaceae	Tree	Exotic, invasive, S. America
<i>Schkuhria pinnata</i>	Asteraceae	Forb	Medicinal uses, weed (S. America)
<i>Schmidtia pappophoroides</i>	Poaceae	Grass	None
<i>Schoenoplectus corymbosus</i>	Cyperaceae	Sedge	None
<i>Searsia lancea</i>	Anacardiaceae	Tree	Edible parts, tanning



Species	Family	Growth form	Status/ Uses/ Properties
<i>Searsia pentheri</i>	Anacardiaceae	Shrub	None
<i>Searsia tridactyla</i>	Anacardiaceae	Shrub	None
<i>Solanum panduriforme</i>	Solanaceae	Forb	Weed
<i>Sonchus species</i>	Asteraceae	Forb	None
<i>Sporobolus africanus</i>	Poaceae	Grass	Palatable, indicator of degraded areas
<i>Sporobolus nitens</i>	Poaceae	Grass	None
<i>Sporobolus pectinatus</i>	Poaceae	Grass	None
<i>Stipagrostis ciliata</i>	Poaceae	Grass	None
<i>Sutherlandia frutescens</i>	Fabaceae	Forb	Medicinal uses
<i>Sutherlandia frutescens</i>	Fabaceae	Shrub	Medicinal uses
<i>Tagetes minuta</i>	Asteraceae	Forb	Essential oils, colours & dyes
<i>Tarchoanthus camphoratus</i>	Asteraceae	Shrub	Medicinal uses
<i>Themeda triandra</i>	Poaceae	Grass	Palatable grazing
<i>Trichoneura grandiglumis</i>	Poaceae	Grass	None
<i>Wahlenbergia species</i>	Campanulaceae	Forb	None
<i>Walafida densiflora</i>	Selaginaceae	Forb	None
<i>Xanthium strumarium</i>	Asteraceae	Forb	Category 1, weed (S. America)
<i>Zaluzianskya species</i>	Scrophulariaceae	Forb	None
<i>Ziziphus mucronata</i>	Rhamnaceae	Shrub	Edible parts, medicinal uses

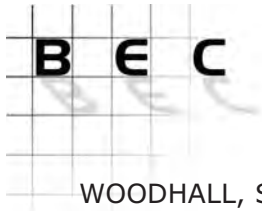


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