

ENVIRONMENTAL SCOPING REPORT:

Specialist ecological study on the potential impacts of the proposed
Karoo Renewable Energy Facility Project, near Victoria West,
Northern Cape

Prepared by

David Hoare
(Ph.D., Pr.Sci.Nat.)

David Hoare Consulting cc
Postnet Suite no. 116
Private Bag X025
Lynnwood Ridge, 0040

for

Savannah Environmental (Pty) Ltd
PO Box 148,
Sunninghill,
2197

on behalf of
South African Renewable Green Energy (Pty) Ltd

12 November 2010

DRAFT SCOPING REPORT: 2nd Draft



David Hoare Consulting cc
Biodiversity Assessments, Vegetation Description /
Mapping, Species Surveys

CONTROL SHEET FOR SPECIALIST REPORT

The table below lists the specific requirements for specialist studies, according to Regulation 33 of Government Notice No. R385 of 1996 EIA Regulations.

Activity	Yes	No	Comment
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	√		
A declaration that the person is independent in a form as may be specified by the competent authority	√		
An indication of the scope of, and the purpose for which, the report was prepared	√		
A description of the methodology adopted in preparing the report or carrying out the specialised process	√		
A description of any assumptions made and any uncertainties or gaps in knowledge	√		
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment		√	To do in EIA
Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority		√	To do in EIA
A description of any consultation process that was undertaken during the course of carrying out the study		√	
A summary and copies of any comments that were received during any consultation process		√	
Any other information requested by the competent authority		√	

REGULATIONS GOVERNING THIS REPORT

This report has been prepared in terms the EIA Regulations promulgated under the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 385 Section 33 - Specialist reports and reports on specialized processes under the Act. Relevant clauses of the above regulation are quoted below and reflect the required information in the "Control sheet for specialist report" given above.

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 specialized process.

Regulation 33. (2): A specialist report or a report on a specialized 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 specialized process;
- (b) declaration that the person is independent in a form as may be specified by the competent authority;
- (c) indication of the scope of, and the purpose for which, the report was prepared;
- (d) description of the methodology adopted in preparing the report or carrying out the specialized process;
- (e) description of any assumptions made and any uncertainties or gaps in knowledge;
- (f) 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) description of any consultation process that was undertaken during the course of carrying out the study;
- (i) summary and copies of any comments that were received during any consultation process;
- (j) any other information requested by the competent authority.

Appointment of specialist

David Hoare of David Hoare Consulting cc was commissioned by Savannah Environmental (Pty) Ltd to provide specialist consulting services for the Environmental Impact Assessment for the proposed Karoo Renewable Energy Facility Project near Victoria West in the Northern Cape Province. The consulting services comprise an assessment of potential impacts on the flora, fauna, vegetation and ecology in the study area by the proposed project.

Details of specialist

Dr David Hoare
David Hoare Consulting cc
Postnet Suite no. 116
Private Bag X025
Lynnwood Ridge, 0040

Telephone: 012 804 2281
Cell: 083 284 5111
Fax: 086 550 2053
Email: dhoare@lantic.net

Summary of expertise

Dr David Hoare:

- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science, Botanical Science), registration number 400221/05.
- Founded David Hoare Consulting cc, an independent consultancy, in 2001.
- Ecological consultant since 1995.
- Conducted, or co-conducted, over 250 specialist ecological surveys as an ecological consultant.
- Published six technical scientific reports, 15 scientific conference presentations, seven book chapters and eight refereed scientific papers.
- Attended 15 national and international congresses & 5 expert workshops, lectured vegetation science / ecology at 2 universities and referee for 2 international journals.

Independence

David Hoare Consulting cc and its Directors have no connection with South African Renewable Green Energy (Pty) Ltd. David Hoare Consulting cc is not a subsidiary, legally or financially, of the proponent. Remuneration for services by the proponent in relation to this project is not linked to approval by decision-making authorities responsible for authorising this proposed project and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. David Hoare is an independent consultant to Savannah Environmental (Pty) Ltd and has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of this specialist performing such work. The percentage work received directly or indirectly from the proponent in the last twelve months is zero.

Scope and purpose of report

The scope and purpose of the report are reflected in the "Terms of reference" section of this report.

Conditions relating to this report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. David Hoare Consulting cc and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

TABLE OF CONTENTS

REGULATIONS GOVERNING THIS REPORT.....	3
<i>APPOINTMENT OF SPECIALIST</i>	3
<i>DETAILS OF SPECIALIST</i>	3
<i>SUMMARY OF EXPERTISE</i>	4
<i>INDEPENDENCE</i>	4
<i>SCOPE AND PURPOSE OF REPORT</i>	4
<i>CONDITIONS RELATING TO THIS REPORT</i>	5
INTRODUCTION.....	8
TERMS OF REFERENCE AND APPROACH.....	8
STUDY AREA.....	8
METHODOLOGY.....	9
ASSESSMENT PHILOSOPHY.....	9
PLANT AND ANIMAL SPECIES OF CONCERN.....	10
VEGETATION HABITATS OF CONCERN.....	11
LIMITATIONS.....	11
DESCRIPTION OF STUDY AREA.....	12
LOCATION.....	12
TOPOGRAPHY.....	13
LAND TYPES AND SOILS.....	13
CLIMATE.....	14
LANDUSE AND LANDCOVER OF THE STUDY AREA.....	14
BROAD VEGETATION TYPES OF THE REGION.....	14
<i>Eastern Upper Karoo</i>	14
<i>Southern Karoo Riviere</i>	15
<i>Upper Karoo Hardeveld</i>	16
CONSERVATION STATUS OF BROAD VEGETATION TYPES.....	16
RED LIST PLANT SPECIES OF THE STUDY AREA.....	16
RED LIST ANIMAL SPECIES OF THE STUDY AREA.....	17
PROTECTED TREES.....	18
PRELIMINARY SENSITIVITY ASSESSMENT.....	18
RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS.....	20
LEGISLATION.....	20
IDENTIFICATION OF RISKS AND POTENTIAL IMPACTS.....	22
DESCRIPTION OF POTENTIAL IMPACTS.....	22
<i>Impact 1: Impacts on indigenous natural vegetation (terrestrial)</i>	23
<i>Impact 2: Impacts on threatened plants</i>	24
<i>Impact 3: Impacts on threatened animals</i>	24
<i>Impact 4: Impacts on protected tree species</i>	25
<i>Impact 5: Impacts on wetlands / watercourses</i>	25
<i>Impact 6: Establishment and spread of declared weeds and alien invader plants</i>	26
DISCUSSION AND CONCLUSIONS.....	27
SUMMARY OF PROPOSED EIA METHODOLOGY.....	28
REFERENCES:.....	29
APPENDIX 1: PLANT SPECIES OF CONSERVATION IMPORTANCE (THREATENED, NEAR THREATENED AND DECLINING) THAT HAVE HISTORICALLY BEEN RECORDED IN THE STUDY AREA.....	31
APPENDIX 2: THREATENED VERTEBRATE SPECIES WITH A GEOGRAPHICAL DISTRIBUTION THAT INCLUDES THE CURRENT STUDY AREA.....	32

APPENDIX 3: LIST OF PROTECTED TREE SPECIES (NATIONAL FORESTS ACT).....33
**APPENDIX 4: CHECKLIST OF PLANT SPECIES RECORDED DURING PREVIOUS
BOTANICAL SURVEYS IN THE STUDY AREA AND SURROUNDS..... 34**

INTRODUCTION

Terms of reference and approach

Savannah Environmental (Pty) Ltd. was appointed by South African Renewable Green Energy (Pty) Ltd to undertake an application for environmental authorisation through an Environmental Impact Assessment (EIA) for the proposed "Karoo Renewable Energy Facility." The project involves the establishment of both a wind energy facility component and a photovoltaic solar facility component for power generation and its associated infrastructure, including a sub-station, distribution powerline, accommodation facilities, temporary waste storage facilities and internal access roads. The purpose of the EIA is to identify environmental impacts associated with the project.

In October 2010 David Hoare Consulting cc was appointed by Savannah Environmental (Pty) Ltd to undertake an ecological assessment of the study area. The specific terms of reference for the ecological scoping study include:

- to provide a description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project;
- to provide a description and evaluation of potential environmental issues and potential impacts (including direct, indirect and cumulative impacts) that have been identified;
- Direct, indirect and cumulative impacts of the identified issues must be evaluated within the Scoping Report in terms of the following criteria:
 - the **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected;
 - the **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international;
- a statement regarding the potential significance of the identified issues based on the evaluation of the issue/impacts;
- A statement regarding the desk-top evaluation of full site, with high-level identification of potential areas of sensitivity (for input into a sensitivity map)
- identification of potentially significant impacts to be assessed within the EIA phase;
- to provide recommendations regarding the methodology to be adopted in assessing potentially significant impacts in the EIA phase (sufficiently detailed to be included within the Plan of Study for EIA and must include a description of the proposed method of assessing the potential environmental impacts associated with the project).

This report provides details of the results of the Scoping phase. The findings of the study are based on a desktop assessment of the study area.

Study area

At a regional level the study area falls within the Northern Cape Province to the south of the town of Victoria West. A more detailed description of the study area is provided in a section below.

METHODOLOGY

The assessment is to be undertaken in two phases, a Scoping phase and an Environmental Impact Assessment phase. The objective of the Scoping phase study was to review fauna and flora patterns within the study area in order to identify any highly sensitive areas that should be avoided during development. It was therefore necessary to provide checklists of sensitive species that could potentially occur in the study area as well as habitats with high conservation value. For potential species, only those of high conservation concern are provided. It was also intended to provide a draft habitat map of the study area based on available maps and database information. The results of the Scoping phase study are provided in this report.

Assessment philosophy

Many parts of South Africa contain high levels of biodiversity at species and ecosystem level. At any single site there may be large numbers of species or high ecological complexity. Sites also vary in their natural character and uniqueness and the level to which they have been previously disturbed. Assessing the potential impacts of a proposed development often requires evaluating the conservation value of a site relative to other natural areas and relative to the national importance of the site in terms of biodiversity conservation. A simple approach to evaluating the relative importance of a site includes assessing the following:

- Is the site unique in terms of natural or biodiversity features?
- Is the protection of biodiversity features on site of national/provincial importance?
- Would development of the site lead to contravention of any international, national or provincial legislation, policy, convention or regulation?

Thus, the general approach adopted for this type of study is to identify any critical biodiversity issues that may lead to the decision that the proposed project cannot take place, i.e. to specifically focus on red flags and/or potential fatal flaws. Biodiversity issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. These can be organised in a hierarchical fashion, as follows:

Species

1. threatened plant species
2. protected trees
3. threatened animal species

Ecosystems

1. threatened ecosystems
2. protected ecosystems
3. critical biodiversity areas
4. areas of high biodiversity
5. centres of endemism

Processes

1. corridors
2. mega-conservancy networks
3. rivers and wetlands
4. important topographical features

It is not the intention to provide comprehensive lists of all species that occur on site, since most of the species on these lists are usually common or widespread species. Species that are Threatened, protected or otherwise of conservation concern, are considered to be the highest priority, the presence of which are most likely to result in significant negative impacts on the ecological environment. The focus on national and provincial priorities and critical biodiversity issues is in line with National legislation protecting environmental and biodiversity resources, including, but not limited to the following which ensure protection of ecological processes, natural systems and natural beauty as well as the preservation of biotic diversity in the natural environment:

1. Environment Conservation Act (Act 73 of 1989)
2. National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998)
3. National Environmental Management Biodiversity Act, 2004. (Act 10 Of 2004)

Plant and animal species of concern

The purpose of listing Red List plant and animal species is to provide information on the potential occurrence of species of special concern in the study area that may be affected by the proposed infrastructure. Species appearing on these lists could then be assessed in terms of their habitat requirements to determine whether any of them have a likelihood of occurring in habitats that may be affected by the proposed infrastructure.

Lists were compiled specifically for any species of conservation concern previously recorded in the area and any other species with potential conservation value. Historical occurrences of threatened plant species were obtained from the South African National Biodiversity Institute for the quarter degree squares within which the study area is situated.

Regulations published for the National Forests Act provide a list of protected tree species for South Africa. The species on this list were assessed in order to determine which protected tree species have a geographical distribution that coincides with the study area and habitat requirements that may be met by available habitat in the study area.

Lists of threatened animal and bird species that have a geographical range that includes the study area were obtained from literature sources (Barnes 2000, Branch 1988, 2001, Friedmann & Daly 2004, Mills & Hes 1997). The probability of any of them occurring was evaluated on the basis of habitat preference and habitats available at each of the proposed sites. The three parameters used to assess the probability of occurrence for each species were as follows:

- *Habitat requirements*: most Red List animals have very specific habitat requirements and the presence of these habitat characteristics within the study area were assessed;
- *Habitat status*: in the event that available habitat is considered suitable for these species, the status or ecological condition was assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red List species (especially wetland-related habitats where water-quality plays a major role); and
- *Habitat linkage*: 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 these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red List species within the study area.

For all threatened organisms (flora and fauna) that occur in the general geographical area of the site, a rating of the likelihood of it occurring on site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- MEDIUM: habitats on site match general habitat description for species (e.g. fynbos), but detailed microhabitat requirements (e.g. mountain fynbos on shallow soils overlying Table Mountain sandstone) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. mountain fynbos on shallow soils overlying Table Mountain sandstone);
- DEFINITE: species found in habitats on site.

Vegetation habitats of concern

The purpose of producing a vegetation habitat map was to provide information on the location of potentially sensitive features in the broad study area. The National Spatial Biodiversity Assessment (NSBA) was taken into consideration in compiling the vegetation habitat map.

The general status of the vegetation of the study area was derived by updating the National Landcover data layer for this part of the study area (Fairbanks et al. 2000) using available satellite imagery and aerial photography. From this it could be determined which areas were transformed and no longer had primary vegetation.

Limitations

- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the 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. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be unexpectedly located in an area.

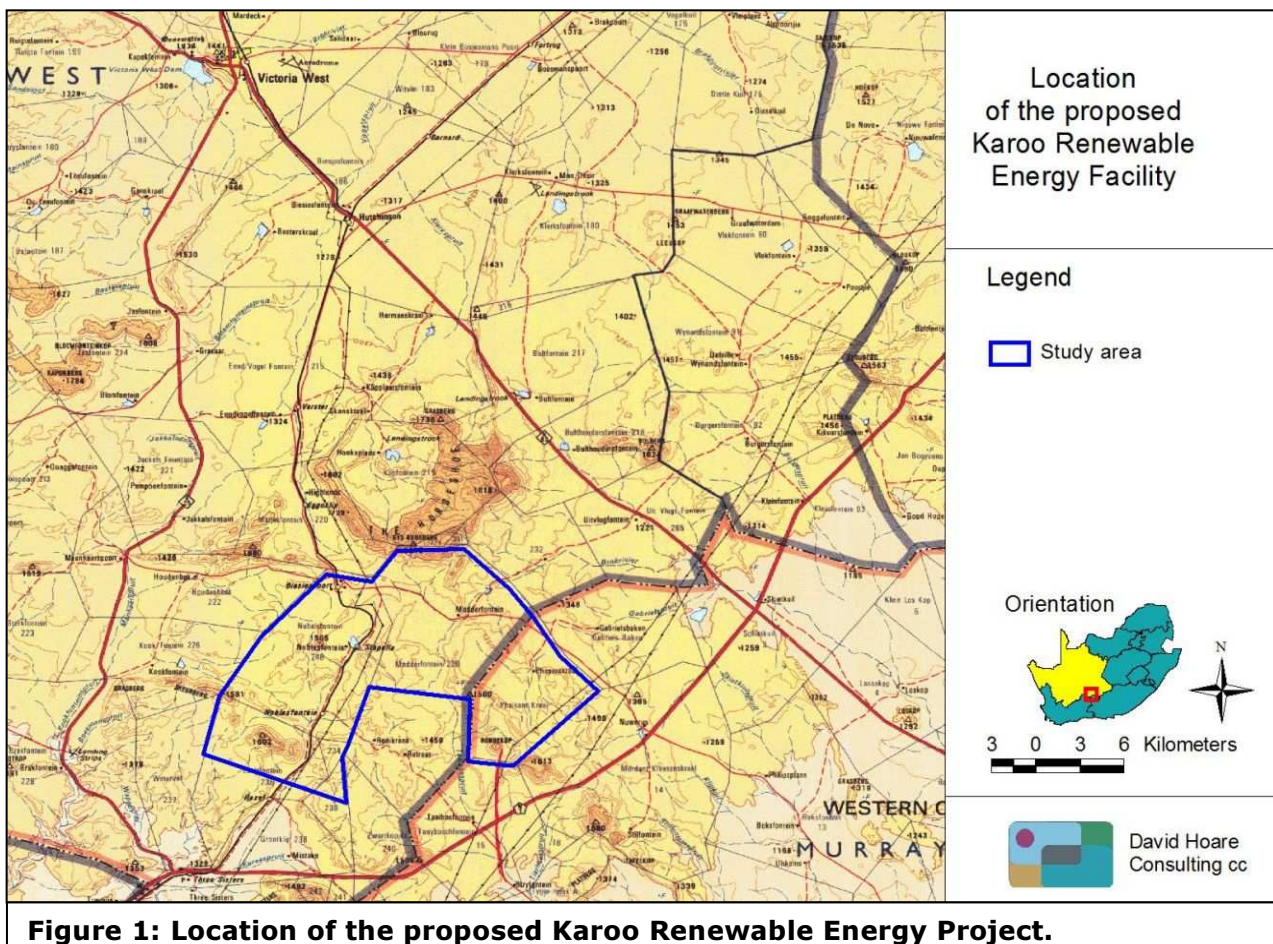
DESCRIPTION OF STUDY AREA

Location

The study site is situated approximately 35 km south of the town of Victoria West within the Northern Cape (Figure 1). The site falls within the quarter degree grids 3123CA, 3123CB, 3123CC and 3123CD. The proposed facility would occur on the following farm portions: Nobelsfontein 227, Annex Nobelsfontein 234, Ezelsfontein 235, Rietkloofplaat 239, Modderfontein 228 and Phaisantkraal 1.

No alternative site is currently being considered for the proposed facility. A technical feasibility study was undertaken which considered favourable climatic conditions (wind and solar renewable energy facilities are directly reliant on average wind speeds and solar radiation values for a particular area), access to the electricity grid, accessibility of the study site, and local site topography, the current site has been identified as being ideal for the establishment of the proposed renewable energy facility.

The study area is relatively from the N1, which runs past the southern part of the site. A relatively substantial secondary road leads from the N1 to Biesiespoort, which is on site. A number of smaller roads lead from this road to various parts of the site. There is also a railway line that traverses the site and which could conceivably be used to transport goods and materials to the site during construction.



Topography

The study site is relatively topographically diverse. The area is undulating with various small outcrops of rock and hills as well as the southern extent of a relatively significant mountain in the northern part of the site. The elevation on site varies from 1255 to 1775 m above sea level.

There are various drainage lines draining the study area, all non-perennial. These drain in primarily a southerly direction from the western half of the site and in a northerly direction from the eastern half of the site. The aggregation of these form the non-perennial streams called the Matjiesrivier and the Klein-Leerkransspruit.

Land types and soils

Detailed soil information is not available for broad areas of the country. As a surrogate, landtype data was used to provide a general description of soils in the study area (landtypes are areas with largely uniform soils, topography and climate). There are a variety of landtypes in the study area (Figure 2). The most common landtypes in the study area are Fb and Ib, but there are also small areas of the Ia and Da landtypes (Land Type Survey Staff, 1987).

The Fb unit, the most common unit on site (Figure 2) refers to pedologically young landscapes that are not predominantly rock and nor predominantly alluvial or aeolian and in which the dominant soil-forming processes have been rock weathering, the formation of orthic topsoil horizons and, commonly, clay illuviation, giving rise typically to lithocutanic horizons (MacVicar

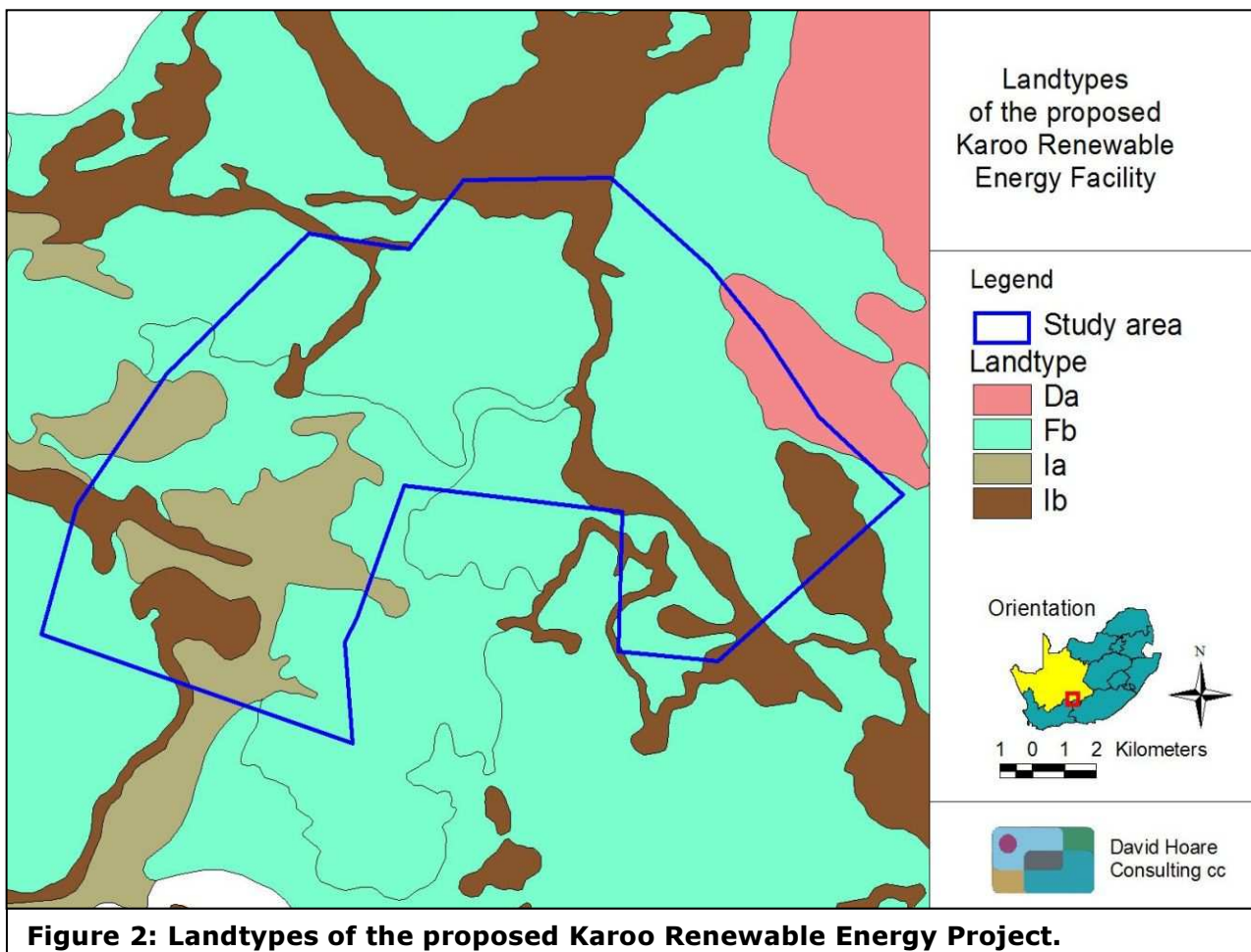


Figure 2: Landtypes of the proposed Karoo Renewable Energy Project.

et al. 1974). Fb indicates land where lime occurs regularly (there need not be much of it) in one or more valley bottom soils (MacVicar et al. 1974).

The Da unit refers to land where duplex soils with red B horizons comprise more than half of the area covered by duplex soils (MacVicar et al. 1974). A small area in the eastern part of the site falls within this unit.

The Ia unit refers to land types with a soil pattern difficult to accommodate elsewhere, at least 60% of which comprises pedologically youthful, deep (more than 1 000 mm to underlying rock) unconsolidated deposits (MacVicar et al. 1974). In the study area, the areas in the hills in the south-western part of the study area, fall within this category.

The Ib unit refers to landtypes with exposed rock (exposed country rock, stones or boulders) covering 60- 80% of the area (MacVicar et al. 1974). The mountains and hills of the site fall within this land type unit.

Climate

The climate is semi-arid to arid. Rainfall occurs in late summer to Autumn, peaking in March. Mean annual rainfall is approximately 300 mm per year. All areas with less than 400 mm rainfall are considered to be arid. The study area can therefore be considered to be arid. Mean minimum and maximum temperatures for Victoria West are -8°C and 36.6°C.

Landuse and landcover of the study area

A landcover map of the study area (Fairbanks *et al.* 2000) indicates that the entire site consists of natural vegetation. Topocadastral maps of the area at 1:50 000 scale from the Surveyor-General show some linear infrastructure (roads and railway line), but no cultivation or other transformation. Google imagery of the site supports this assessment. Based on these map and aerial imagery sources, it is clear that the study area has not been impacted upon to a great degree by human activities. It is possible, however, that livestock farming has affected the vegetation to some degree. This area of the country consists primarily of farms used as rangeland for commercial livestock production. Commercial farming systems are characterised by land stocked at economically sustainable levels. These regions have been commercially farmed as stock ranches for close to 100 years. Degradation of vegetation has been blamed on high stocking rates of domestic livestock in commercial farming areas. The study area is no exception and degradation due to overgrazing is likely, at least in places.

Broad vegetation types of the region

The study area falls within the Nama-Karoo Biome (Rutherford & Westfall 1986, Mucina & Rutherford 2006). The most recent and detailed description of the vegetation of this region is part of a national map (Mucina, Rutherford & Powrie, 2005; Mucina *et al.* 2006). This map shows three vegetation types occurring within the study site, namely Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld (Figure 3). These three vegetation types are described in more detail below.

Eastern Upper Karoo

This vegetation type occurs on flats and gently sloping plains and is dominated by dwarf microphyllous shrubs with grasses from the genera *Aristida* and *Eragrostis* (Mucina et al.

2006). There are some endemics in this vegetation (Mucina *et al.* 2006), including the succulent shrubs, *Chasmatophyllum rouxii*, *Hertia cluytifolia*, *Rabiea albinota* and *Salsola tetrandra*, the tall shrub, *Phymaspermum scoparium* and the low shrubs, *Aspalathus acicularis* subsp. *planifolia*, *Selago persimilis* and *Selago walpersii*.

Dominant species include the tall shrubs, *Lycium cinereum*, the low shrubs, *Chrysocoma ciliata*, *Eriocephalus ericoides* subsp. *ericoides*, *Eriocephalus spinescens*, *Pentzia globosa*, *Pentzia incana* and *Phymaspermum parvifolium*, and the grasses, *Aristida congesta*, *Aristida diffusa*, *Cynodon incompletus*, *Eragrostis bergiana*, *Eragrostis bicolor*, *Eragrostis lehmanniana*, *Eragrostis obtusa*, *Sporobolus fimbriatus*, *Stipagrostis ciliata* and *Tragus koelerioides*.

Southern Karoo Riviere

This vegetation is found on the narrow riverine flats in the southern parts of the Karoo, especially on heavier and salt-laden soils on broad alluvia (Mucina *et al.* 2006). It consists of a complex of *Acacia karroo* or *Tamarix usneoides* thickets up to 5 m tall fringed by tall *Salsola*-dominated shrubland up to 1.5 m tall. In sandy drainage lines, *Stipagrostis namaquensis* may occasionally also dominate. There is one endemic taxon, the graminoid, *Isolepis expallens*.

Dominant species include, in riparian thickets, the small trees, *Acacia karroo* and *Rhus lancea*, the tall shrubs, *Diospyros lycioides* and *Tamarix usneoides* and the succulent shrub, *Lycium cinereum*, in river canals, the graminoid, *Stipagrostis namaquensis*, in alluvial areas, the succulent shrubs, *Malephora uitenhagensis*, *Salsola aphylla* and *Salsola arborea*, and the graminoid, *Cynodon incompletus*, and in reed beds, the megagraminoid, *Phragmites australis*.

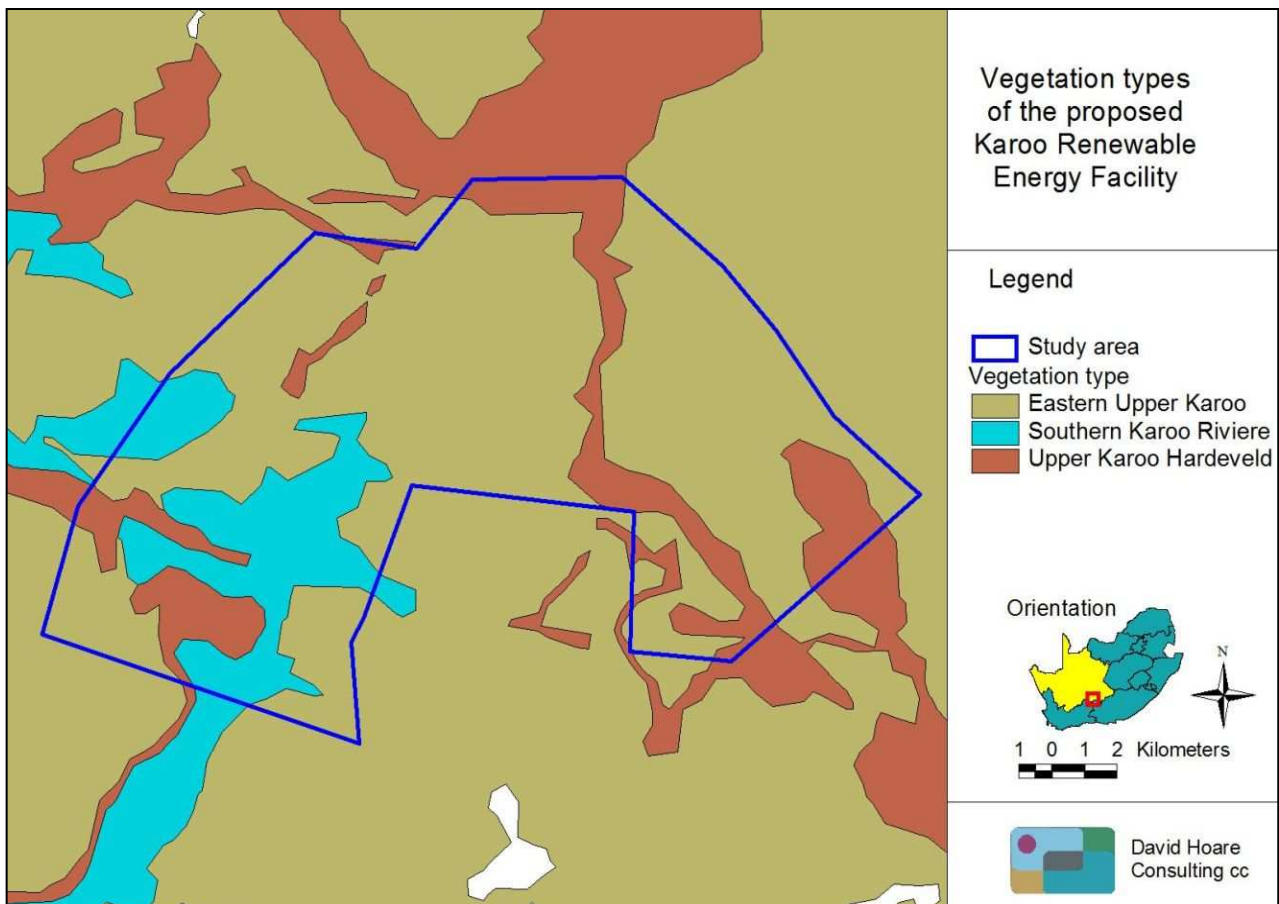


Figure 3: Vegetation types of the Karoo Renewable Energy Project.

Upper Karoo Hardeveld

This vegetation is found on steep slopes of koppies, butts, mesas and parts of the Great Escarpment covered with large boulders and stones. The vegetation is a sparse dwarf Karoo scrub with drought tolerant grasses of genera such as *Aristida*, *Eragrostis* and *Stipagrostis* (Mucina *et al.* 2006). There are a number of endemics in this vegetation (Mucina *et al.* 2006), including the succulent shrubs, *Aloe chlorantha*, *Crassula barbata* subsp. *broomii*, *Delosperma robustum*, *Sceletium expansum* and *Stomatium suaveolens*, the low shrubs, *Cineraria polycephala*, *Euryops petraeus*, *Lotononis azureoides* and *Selago magnakarooica*, the tall shrub, *Anisodonteia malvastroides*, the herbs *Cineraria arctotideia* and *Vellereophyton niveum*, the succulent herbs, *Adromischus fallax* and *Adromischus humilis*, and the geophytic herbs, *Gethyllis longistyla*, *Lachenalia auriolae* and *Ornithogalum paucifolium* subsp. *karooparkense*.

Dominant species include the tall shrubs, *Lycium cinereum* and *Cadaba aphylla*, the low shrubs, *Chrysocoma ciliata*, *Eriocephalus ericoides* subsp. *ericoides*, *Euryops lateriflorus*, *Felicia muricata*, *Limeum aethiopicum* and *Pteronia glauca*, the semiparasitic shrub, *Thesium lineatum*, and the graminoids, *Aristida adscensionis*, *Aristida congesta*, *Aristida diffusa*, *Cenchrus ciliaris*, *Enneapogon desvauxii*, *Eragrostis lehmanniana*, *Eragrostis obtusa*, *Sporobolus fimbriatus* and *Stipagrostis obtusa*.

Conservation status of broad vegetation types

On the basis of a recently established approach used at national level by SANBI (Driver *et al.* 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 1, as determined by best available scientific approaches (Driver *et al.* 2005).

The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver *et al.* 2005).

All three vegetation types occurring in the study area (Table 2) are classified as Least Threatened (Driver *et al.* 2005; Mucina *et al.*, 2006).

Table 2: Conservation status of different vegetation types occurring in the study area, according to Driver *et al.* 2005 and Mucina *et al.* 2005.

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status	
				Driver <i>et al.</i> 2005; Mucina <i>et al.</i> , 2006	Draft Ecosystem List (NEMBA)
Eastern Upper Karoo	21	1	2	Least Threatened	Not listed
Southern Karoo Riviere	24	3	12	Least Threatened	Not listed
Upper Karoo Hardeveld	21	3	0	Least Threatened	Not listed

Red List plant species of the study area

Lists of plant species previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute. These are listed

in Appendix 1. Additional species that could occur in similar habitats, as determined from database searches and literature sources, but have not been recorded in these grids are also listed.

There is one species on this list, *Aloe broomii* var *tarkaensis*. According to collection information and published accounts of the species, there is some doubt as to whether it occurs in the study area or not. According to IUCN Ver. 3.1 (IUCN, 2001), this species is listed as Rare (see Table 3 for explanation of categories). There are, therefore, no threatened, near threatened or critically rare species that could potentially occur on site.

Table 3: Explanation of IUCN Ver. 3.1 categories (IUCN, 2001), and Orange List categories (Victor & Keith, 2004).

IUCN / Orange List category	Definition	Class
EX	Extinct	Extinct
CR	Critically Endangered	Red List
EN	Endangered	Red List
VU	Vulnerable	Red List
NT	Near Threatened	Orange List
Declining	Declining taxa	Orange List
Rare	Rare	Orange List
Critically Rare	Rare: only one subpopulation	Orange List
Rare-Sparse	Rare: widely distributed but rare	Orange List
DDD	Data Deficient: well known but not enough information for assessment	Orange List
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient

Red List animal species of the study area

All Red List vertebrates (mammals, reptiles, amphibians) that could occur in the study area are listed in Appendix 2. Birds are excluded here and are covered in a separate specialist assessment. Those vertebrate species with a geographical distribution that includes the study area and habitat preference that includes habitats available in the study area are discussed further.

There is one threatened mammal species classified as Critically Endangered (CR), the Riverine Rabbit, that could occur in available habitats in the study area. This species is found in riverine vegetation on alluvial soils adjacent to seasonal rivers.

There are three mammal species of low conservation concern that could occur in available habitats in the study area. This includes three species classified nationally as near threatened (NT), the Honey Badger, Geoffroy's Horseshoe Bat and Lesueur's Wing-gland Bat, all three of which are classified as Least Concern globally.

The Giant Bullfrog is the only amphibian species with a distribution that includes the study area and which could occur on site. This species is classified as Least Concern globally and Near threatened in South Africa. It is, however, protected under the National Environmental Management: Biodiversity Act.

There is one reptile species of conservation concern that has a distribution that includes the study area and which could occur in available habitats in the study area. This is the Namaqua Plated Lizard, classified as Near Threatened. This species is found in dry sandy areas, bare rocky hillsides and *Acacia* scrub.

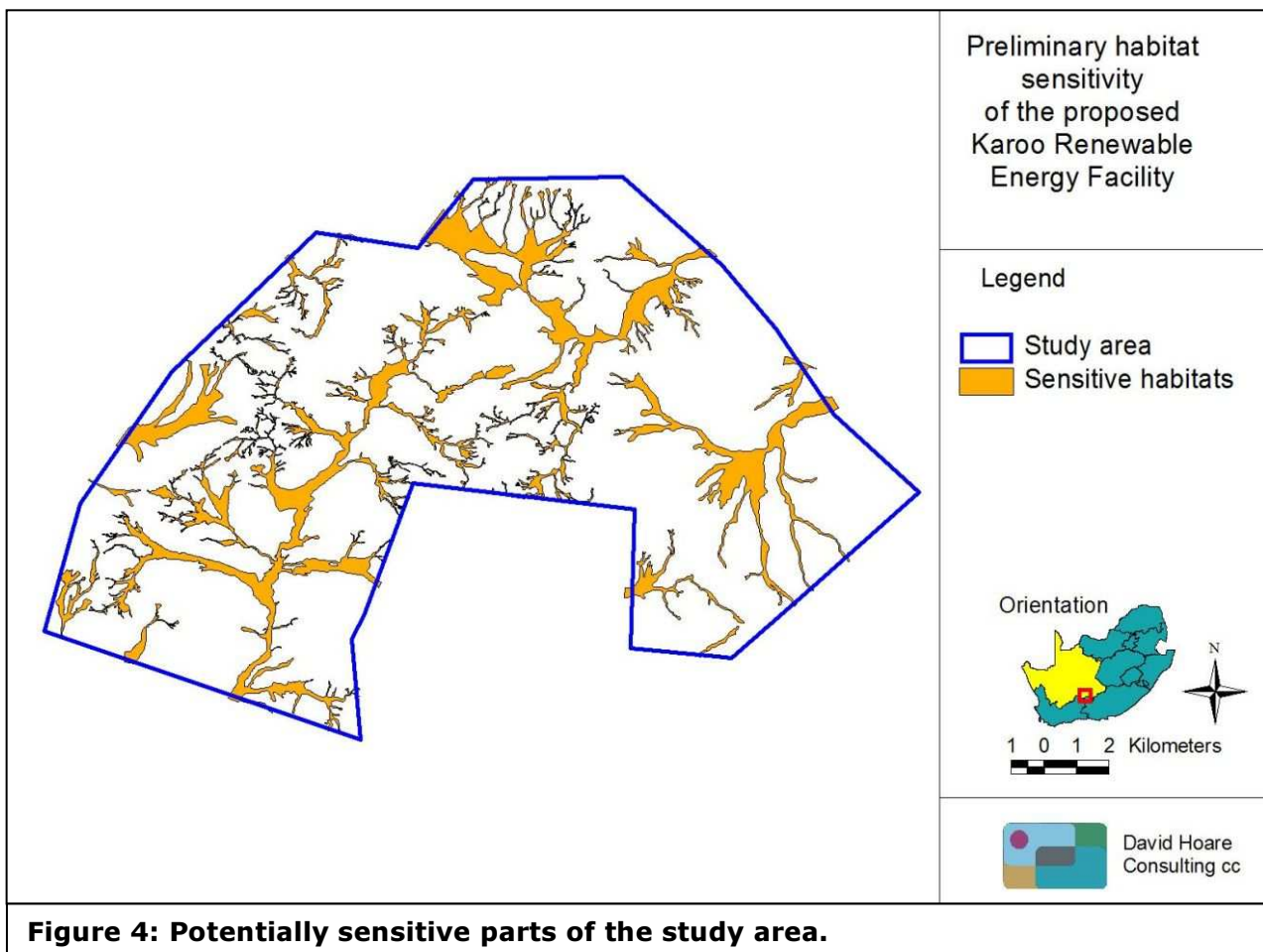
Protected trees

Tree species protected under the National Forest Act are listed in Appendix 3. There are none that have a geographical distribution that includes the study area.

Preliminary sensitivity assessment

The preliminary sensitivity assessment identifies those parts of the study area that could possibly have high conservation value or that may be sensitive to disturbance. Areas of potentially high sensitivity are shown in Figure 4 in yellow. Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity. The information provided in the preceding sections was used to compile a preliminary map of remaining natural habitats and areas important for maintaining ecological processes in the study area. The location and identity of these will be confirmed in the EIA field study. Broad scale mapping was used to provide information on the location of sensitive features. There are a number of features that need to be taken into account in order to evaluate sensitivity in the study area. These include the following:

1. Perennial and non-perennial rivers, streams and drainage lines: this represents a



- number of ecological processes including groundwater dynamics, hydrological processes, nutrient cycling and wildlife dispersal;
2. Potential occurrence of populations of a Red List animal species that has been evaluated as having a high chance of occurring within natural habitats within the study area (the Riverine Rabbit).

These factors have been taken into account in evaluating sensitivity within the study area. Indications are that drainage lines on site could potentially be classified as sensitive. From a sensitivity point of view, the higher order drainage lines are more important to map correctly; the main drainage lines are more sensitive and therefore important to protect than the very ephemeral ones.

It must be emphasised that this is a preliminary map (Figure 4), based on a desktop scoping level assessment. It is therefore vitally important to establish, during the EIA phase, which areas constitute natural vegetation in good enough condition to be considered sensitive and which areas are degraded to the extent that they could be considered to be no longer of conservation value. This knowledge will be important for producing a final sensitivity map. This will provide guidance for the exact positioning of infrastructure, ensuring that potentially sensitive areas are avoided.

RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS

Relevant legislation is provided in this section to provide a description of the key legal considerations of importance to the proposed project. The applicable legislation is listed below.

Legislation

National Environmental Management Act, Act No. 107 of 1998 (NEMA)

NEMA requires, inter alia, that:

- "development must be socially, environmentally, and economically sustainable",
- "disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied." ,
- "a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions",

NEMA states that "the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage."

Environment Conservation Act No 73 of 1989 Amendment Notice No R1183 of 1997

The ECA states that:

Development must be environmentally, socially and economically sustainable. Sustainable development requires the consideration of inter alia the following factors:

- that pollution and degradation of the environment is avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
- that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; and
- that negative impacts on the environment and on peoples' environmental rights be anticipated and prevented, and where they cannot be altogether prevented are minimised and remedied.

The developer is required to undertake Environmental Impact Assessments (EIA) for all projects listed as a Schedule 1 activity in the EIA regulations in order to control activities which might have a detrimental effect on the environment. Such activities will only be permitted with written authorisation from a competent authority.

National Forests Act (Act no 84 of 1998)

Protected trees

According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide 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 licence granted by the Minister'.

Forests

Prohibits the destruction of indigenous trees in any natural forest without a licence.

National Environmental Management: Biodiversity Act (Act No 10 of 2004)

In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).

- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants: are prohibited and must be controlled.
- Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands.

National Water Act

Wetlands, riparian zones and watercourses are defined in the Water Act as a water resource and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998). A "watercourse" in terms of the National Water Act (act 36 of 1998) means:

- River or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and

Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

IDENTIFICATION OF RISKS AND POTENTIAL IMPACTS

Potential issues relevant to potential impacts on the ecology of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern (flora and fauna), 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.
- Impacts on sensitive habitats: this includes impacts on any sensitive or protected habitats, including indigenous forest, fynbos and wetland vegetation that leads to direct or indirect loss of such habitat.
- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:
 - disruption to 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;
 - increased invasion by alien plants.

Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or change in ecosystem function.

- Secondary and cumulative impacts on ecology: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic or ecological environment.
- Impacts on the economic use of vegetation: this includes any impacts that affect the productivity or function of ecosystems in such a way as to reduce the economic value to users, e.g. reduction in grazing capacity, loss of harvestable products. It is a general consideration of the impact of a project on the supply of so-called ecosystem goods and services.

A number of direct risks to ecosystems would result from construction of the proposed facility are as follows:

- Clearing of land for construction.
- Construction of access roads.
- Placement of powerlines & cables.
- Establishment of borrow and spoil areas.
- Chemical contamination of the soil by construction vehicles and machinery.
- Operation of construction camps.
- Storage of materials required for construction.

There are also risks associated with operation of the proposed facility, as follows:

- Maintenance of surrounding vegetation as part of management of the facility.

Description of potential impacts

Standard Photovoltaic Plants (PV) typically require relatively large areas of land surface for placement of reflectors/heliostats/photovoltaic panels and ancillary infrastructure. Once operational, the PV plants do not use fuel and there is a limited amount of vertical infrastructure that could potentially pose a hazard for flying animals.

Major potential impacts are described briefly below. These are compiled from a generic list of possible impacts derived from previous projects of this nature and from a literature review of the potential impacts of solar and wind energy facilities on the ecological environment. The major expected negative impact will be due to loss of habitat which may have direct or indirect impacts on individual organisms. The most important potential negative ecological impacts of a WEF are related to bird and bat mortality in addition to loss of habitat.

Impact 1: Impacts on indigenous natural vegetation (terrestrial)

Nature: Construction of infrastructure will lead to direct loss of vegetation. This will lead to localised or more extensive reduction in the overall extent of vegetation. There are factors that may aggravate this potential impact. For example, where this vegetation has already been stressed due to degradation and transformation at a regional level, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat and a change in the conservation status (current conservation situation). The general condition of the vegetation on site can only be assessed during the field survey to be undertaken during the EIA phase. Consequences of the potential impact of loss of indigenous natural vegetation occurring may include:

1. negative change in conservation status of habitat (Driver et al. 2005);
2. increased vulnerability of remaining portions to future disturbance;
3. general loss of habitat for sensitive species;
4. loss in variation within sensitive habitats due to loss of portions of it;
5. general reduction in biodiversity;
6. increased fragmentation (depending on location of impact);
7. disturbance to processes maintaining biodiversity and ecosystem goods and services; and
8. loss of ecosystem goods and services.

It has been established that the vegetation types on site are Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld, all of which are classified as Least Threatened. Transformation rates within these vegetation types are low compared to the overall extent of the vegetation types. The vegetation on site is also not part of any Centre of Floristic Endemism or classified in any conservation plan as being important to conserve.

Duration: The impact will be long-term to permanent due to the fact that clearing of vegetation for construction purposes cannot be reversed.

Extent: The impact will occur at the site of the proposed facility.

Magnitude: The potential magnitude of this impact will be small due to the small area of vegetation likely to be affected relative to the overall extent of the vegetation types concerned.

Probability: It is definite that there will be impacts on natural vegetation. This is based on the fact that solar plants require large areas of land and there is very little transformation of natural vegetation on site. This implies that natural vegetation will have to be cleared in order to build the facility.

Potential significance: The potential significance of this impact could potentially be of low significance at a regional scale and medium significance at a local scale, depending on the amount of vegetation that will need to be cleared.

Impact 2: Impacts on threatened plants

Nature: Plant species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened plant species, loss of a population or individuals could lead to a direct change in the conservation status of the species, possibly extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations. Consequences may include:

1. fragmentation of populations of affected species;
2. reduction in area of occupancy of affected species; and
3. loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chance of survival of the species.

There are no threatened plants that are likely to occur on site. This potential impact will therefore not occur.

Impact 3: Impacts on threatened animals

Nature: Threatened animal species are indirectly affected primarily by the overall loss of habitat, since direct construction impacts can often be avoided due to movement of individuals from the path of construction. Animals are generally mobile and, in most cases, can move away from a potential threat.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations or the habitat that they depend on. Consequences may include:

1. fragmentation of populations of affected species;
2. reduction in area of occupancy of affected species; and
3. loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species overall survival chances.

It has been evaluated that there are three animal species of conservation concern that could occur in available habitats in the proposed study area. These are the Riverine Rabbit (CR), Namaqua Plated Lizard (NT) and Giant Bullfrog (LC, but protected). The site is therefore considered to be important for one threatened animal species and two species of lesser conservation concern.

Duration: The impact will be long-term to permanent due to the fact that clearing of land for construction purposes cannot be reversed. Some construction-related impacts may, however, be short-term, for example, disturbance from construction may cause some animals to move away, but they could return to remaining habitat after construction has been completed.

Extent: The impact will occur at the site of the proposed facility. It could potentially have an effect at a more regional level, since it could affect entire populations of affected species, but it is more likely to affect local populations, depending on the species.

Magnitude: The potential magnitude of this impact will be low to moderate, depending on the species concerned, the proportion of the landscape potentially affected and the specific locality of affected sites.

Probability: It is probable that there could be some impacts on a threatened species.

Potential significance: The potential significance of this impact could potentially be of low significance at a regional scale and of medium significance at a local scale. The suitability of the site for these species can only be assessed by assessing the habitat on site in some detail.

Impact 4: Impacts on protected tree species

There are a number of tree species that are protected according to Government Notice no. 1012 under section 12(I)(d) of the National Forests Act, 1998 (Act No. 84 of 1998). In terms of section 15(1) of the National Forests Act, 1998 "no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license granted by the Minister to an (applicant and subject to such period and conditions as may be stipulated".

There are no species that have a geographic distribution that includes the study area. This potential impact will therefore not occur.

Impact 5: Impacts on wetlands / watercourses

Nature: The site is in a very arid area. There are unlikely to be any wetlands on site, but there are clearly a number of dry stream beds and drainage areas. According to the National Water Act, these are classified as wetlands or water resources. Construction may lead to some direct or indirect loss of or damage to some of these areas or changes to the catchment of these areas. This may affect the hydrology of the landscape or lead to loss of habitat for species that depend on this habitat type.

Dry river beds and drainage lines occur in the study area.

Duration: The impact will be long-term to permanent due to the fact that clearing of land for construction purposes cannot be reversed.

Extent: The impact will occur at the site of the proposed facility, but could have downstream impacts. The extent of the potential impact is therefore on the site and surroundings.

Magnitude: The potential magnitude of this impact will be moderate to high, depending on the proportion of the landscape potentially affected and the specific locality of affected sites.

Probability: Due to the fact that drainage lines occur on site, it is highly probable that there will be drainage lines affected. This is also based on the fact that solar plants require large areas of land and there is very little transformation of natural habitat on site.

Potential significance: The potential significance of this impact may be moderate to high due to the sensitivity of wetlands to disturbance thus leading to impacts of potentially high magnitude. An indication of the location of wetlands could ensure that mitigation measures could be put in place to avoid or reduce the potential impact to a low significance. There is also a legal obligation to apply for a Water Use Licence for any drainage lines that may be affected, since they are classified in the National Water Act as a water resource.

Impact 6: Establishment and spread of declared weeds and alien invader plants

Major factors contributing to invasion by alien invader plants includes *inter alia* high disturbance (such as clearing for construction activities) and negative grazing practices (Zachariades *et al.* 2005). Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins *et al.* 2003). Consequences of this may include:

1. loss of indigenous vegetation;
2. change in vegetation structure leading to change in various habitat characteristics;
3. change in plant species composition;
4. change in soil chemical properties;
5. loss of sensitive habitats;
6. loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
7. fragmentation of sensitive habitats;
8. change in flammability of vegetation, depending on alien species;
9. hydrological impacts due to increased transpiration and runoff; and
10. impairment of wetland function.

It is not known to what extent the site contains alien plants. Potential weeds with a distribution centred on arid regions of the country include *Salsola kali*, *Atriplex lindleyi*, *Opuntia ficus-indica*, *Opuntia imbricata*, *Prosopis glandulosa*, *Prosopis velutina*, *Atriplex numularia*, and *Nicotiana glauca*. The shrub, *Prosopis glandulosa*, is potentially the most problematic. This species invades riverbeds, riverbanks and drainage lines in semi-arid and arid regions and has been recorded near to the site. There is therefore the potential for alien plants to spread or invade following disturbance on site.

Duration: The impact will be long-term unless alien plants are controlled.

Extent: The impact will occur at the site of the proposed facility, but could spread into neighbouring areas.

Magnitude: The potential magnitude of this impact is potentially high for local ecosystems.

Probability: There is a high likelihood that alien species will spread on site in the absence of control measures.

Potential significance: The impact could potentially be of moderate significance. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low.

DISCUSSION AND CONCLUSIONS

There are three major vegetation types that occur in the study area, namely Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld. Eastern Upper Karoo occurs on flats and gently sloping plains and is dominated by dwarf microphyllous shrubs. Southern Karoo Riviere is found on the narrow riverine flats in the southern parts of the Karoo, especially on heavier and salt-laden soils on broad alluvia. Upper Karoo Hardeveld is found on steep slopes of koppies, butts, mesas and parts of the Great Escarpment covered with large boulders and stones. All of these vegetation types are classified as Least Threatened and also have a wide distribution and extent. The natural vegetation across most of the site is therefore not considered to have high conservation priority status.

The entire study area is in a natural condition. There may be localised degradation due to livestock farming and there is a small amount of linear infrastructure on site, otherwise human impacts on site are minimal.

There are no protected tree species that occur in the area. There are also no plant species of conservation concern that have a high likelihood of occurring in available habitats in the study area.

There are three animal species of conservation concern that may occur in habitats within the study area. These are the Riverine Rabbit (classified as Critically Endangered), Namaqua Plated Lizard (classified as Near Threatened) and Giant Bullfrog (classified as Least Concern, but protected under the National Environmental Management: Biodiversity Act). The site is therefore considered to be important for one threatened animal species and two species of lesser conservation concern. Habitat requirements for these species are provided in the appendices to this report.

Factors that may lead to parts of the study area having high ecological sensitivity are the presence of drainage lines on site and the potential presence of a small number of animal species of conservation concern. The actual presence of these features will have to be confirmed during detailed field surveys to be undertaken during the EIA phase of the project.

Drainage lines (wetlands) represent particularly vital natural corridors as they function both as wildlife habitat, providing resources needed for survival, reproduction and movement, and as biological corridors, providing for movement between habitat patches. Wetlands (including drainage lines) are protected under national legislation (National Wetlands Act). Any impacts on these areas would require a permit from the relevant National Department.

A risk assessment was undertaken which identified five main potential negative impacts on the ecological receiving environment. The significance of these impacts will be assessed during the EIA phase after collection of relevant field data. An initial assessment indicates that some of these impacts are likely to be significant or that there is a legislative benefit to establishing whether they will occur or not. The identified potential impacts which need to be evaluated further are the following:

1. Impacts on indigenous natural vegetation
2. Impacts on threatened animals
3. Impacts on wetlands and/or watercourses
4. Establishment and spread of declared weeds and alien invader plants

Summary of proposed EIA methodology

The following assessments will be done during the EIA phase in order to properly assess potential impacts on the ecological receiving environment by the proposed facility:

- The presence and distribution of drainage lines on site will be confirmed. This will be done primarily using aerial photograph interpretation, but will be confirmed in the field and with reference to other specialist studies being done on site.
- A detailed sensitivity map of the entire site will be produced from aerial photography during the EIA phase. This will include mapping and incorporation of any sensitive features, for example drainage lines, that may occur on site.
- The presence of species of concern will be evaluated during the EIA phase. For plant species this will be done by searching for populations that could occur in the study area based on habitat requirements and historical collection records. For animal species this will be done by assessing habitat suitability for those species that have been assessed as potentially occurring in the area. The lists provided in this Draft Scoping Report will form the basis for those assessments and surveys. Particular attention will be paid to those species classified as threatened (VU, EN or CR), Near Threatened or Critically rare, including one mammal species classified as Critically Endangered (the Riverine Rabbit), one Near Threatened reptile species (the Namaqua Plated Lizard) and one protected frog species (the Giant Bullfrog).

REFERENCES:

- BARNES, K.N. (ed.) (2000) The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa, Johannesburg.
- BRANCH, W.R. (1988) South African Red Data Book—Reptiles and Amphibians. South African National Scientific Programmes Report No. 151.
- DENT, M.C., LYNCH, S.D. & SCHULZE, R.E. 1989. Mapping mean annual and other rainfall statistics in southern Africa. Department of Agricultural Engineering, University of Natal. ACRU Report No. 27. Massachusetts: Clark University.
- DRIVER, A., MAZE, K., ROUGET, M., LOMBARD, A.T., NEL, J., TURPIE, J.K., COWLING, R.M., DESMET, P., GOODMAN, P., HARRIS, J., JONAS, Z., REYERS, B., SINK, K and STRAUSS, T. 2005. National Spatial Biodiversity Assessment 2004: priorities for biodiversity conservation in South Africa. *Strelitzia* 17. South African National Biodiversity Institute, Pretoria.
- DU PREEZ, L. & CARRUTHERS, V. 2009. A complete guide to the frogs of southern Africa. Random House Struik, Cape Town.
- FAIRBANKS, D.H.K., THOMPSON, M.W., VINK, D.E., NEWBY, T.S., VAN DEN BERG, H.M & EVERARD, D.A. 2000. The South African Land-Cover Characteristics Database: a synopsis of the landscape. *S.Afr.J.Science* 96: 69-82.
- FRIEDMANN, Y. & DALY, B. (eds.) 2004. The Red Data Book of the Mammals of South Africa: A Conservation Assessment: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.
- GERMISHUIZEN, G., MEYER, N.L., STEENKAMP, Y and KEITH, M. (eds.) (2006). A checklist of South African plants. Southern African Botanical Diversity Network Report No. 41, SABONET, Pretoria.
- HENNING, S.F. & HENNING, G.A. 1989. South African Red Data Book - Butterflies. *South African National Scientific Programmes* No. 158, Foundation for Research Development, CSIR, Pretoria.
- IUCN (2001). *IUCN Red Data List categories and criteria: Version 3.1*. IUCN Species Survival Commission: Gland, Switzerland.
- MACVICAR, C. N., SCOTNEY, D. M. SKINNER, T. E. NIEHAUS, H. S. & LOUBSER, J. H., 1974. A classification of land (climate, terrain form, soil) primarily for rainfed agriculture. *S. Afr. J. Agric. Extension*, 3(3): 1-4.
- MILLS, G. & HES, L. 1997. The complete book of southern African mammals. Struik Publishers, Cape Town.
- MINTER, L.R., BURGER, M., HARRISON, J.A., BRAACK, H.H., BISHOP, P.J. and KLOEPFER, D. (eds.) 2004. Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. SI/MAB Series #9. Smithsonian Institution, Washington, DC.
- MUCINA, L. AND RUTHERFORD, M.C. (editors) 2006. Vegetation map of South Africa, Lesotho and Swaziland: an illustrated guide. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.
- MUCINA, L., RUTHERFORD, M.C. AND POWRIE, I.W. (editors) 2005. Vegetation map of South Africa, Lesotho and Swaziland, 1:1 000 000 SCALE SHEET MAPS South African National Biodiversity Institute, Pretoria.
- MUCINA, L., RUTHERFORD, M.C., PALMER, A.R., MILTON, S.J., SCOTT, L., VAN DER MERWE, B., **HOARE, D.B.**, BEZUIDENHOUT, H., VLOK, J.H.J., EUSTON-BROWN, D.I.W., POWRIE, L.W. & DOLD, A.P. 2006. *Nama-Karoo Biome*. In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
- PASSMORE, N.I. & CARRUTHERS, V.C. (1995) South African Frogs; a complete guide. Southern Book Publishers and Witwatersrand University Press. Johannesburg.
- RUTHERFORD, M.C. & WESTFALL, R.H. (1994). Biomes of southern Africa: an objective categorization. *Memoirs of the Botanical Survey of South Africa* No. 63.

- VAN WYK, A.E. & SMITH, G.F. 2001. Regions of floristic endemism in southern Africa. Umdaus press, Hatfield.
- WHITE, F. 1983. The vegetation of Africa: a descriptive memoir to accompany the UNESCO/AETFAT/UNISO vegetation map of Africa. Natural Resources Research 20. Unesco, Paris.

Appendix 1: Plant species of conservation importance (Threatened, Near Threatened and Declining) that have historically been recorded in the study area.

Sources: South African National Biodiversity Institute in Pretoria.

Family	Taxon	Status	Habitat	Likelihood of occurrence on site
ASPHODALACEAE	Aloe broomii var. tarkaensis	Rare	Nama Karoo, found on low, stony ridges. Rarely on grassy flats. Occurs mainly around Tarkastad, but also found near Cradock and Conway (Reynolds 1969). The distribution map in Glen & Hardy (2000) indicates that this variant also occurs in the Victoria West district in the northern Cape. Specimen in Preci: Marloth 5128 comes from 3123CA but the distribution could be an error as this specimen falls out of the known distribution range and has not been re-collected there.	MEDIUM

* Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as evaluated by the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria. *IUCN (3.1) Categories: VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NT = Near Threatened.

Appendix 2: Threatened vertebrate species with a geographical distribution that includes the current study area.

MAMMALS

Common name	Taxon	Habitat ¹	Status (Friedman & Daly 2004)	Status ² (IUCN)	Likelihood of occurrence
Black rhinoceros	<i>Diceros bicornis bicornis</i>	Wide variety of habitats, but currently only occurs in game reserves.	CR	CR	NONE , only occurs in game reserves
Honey badger	<i>Mellivora capensis</i>	Wide variety of habitats. Probably only in natural habitats.	NT	LC	HIGH , overall geographical distribution includes this area, habitat is suitable.
Geoffroy's horseshoe bat	<i>Rhinolophus clivosus</i>	Caves and subterranean habitats; fynbos, shrubland, grassland, succulent and Nama-karoo; insectivore	NT	LC	MEDIUM , not recorded in nearby grid, on edge of distribution; suitable roosting habitat may occur nearby
Riverine rabbit	<i>Bunolagus monticularis</i>	Riverine vegetation on alluvial soils adjacent to seasonal rivers	CR	CR	HIGH , previously recorded in 2 western grids of study area. Suitable habitat probably exists on site
Lesueur's Wing-gland bat	<i>Cistugo lisueuri</i>	Rock crevices in fynbos.	NT	LC	MEDIUM , not recorded in nearby grid, on edge of distribution; suitable roosting habitat may occur nearby.

¹Distribution and status according to Friedmann & Daly 2004.

²Global status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 28 October 2010.

AMPHIBIANS

Common name	Species	Habitat	Status	Likelihood of occurrence
Giant Bullfrog	<i>Pyxicephalus adspersus</i>	Widely distributed in southern Africa, mainly at higher elevations. Inhabits a variety of vegetation types where it breeds in seasonal, shallow, grassy pans in flat, open areas; also utilises non-permanent vleis and shallow water on margins of waterholes and dams. Prefer sandy substrates although they sometimes inhabit clay soils.	NT ¹ LC ² Protected (NEMBA)	MEDIUM , near edge of known distribution range. Suitable habitat could occur on site.

¹Status according to Minter et al. 2004.

²Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 11 September 2010.

REPTILES

Common name	Species	Habitat	Status ³	Likelihood of occurrence
Namaqua plated lizard	<i>Gerrhosaurus typicus</i>	Dry sandy areas, bare rocky hillsides and Acacia scrub.	Rare ³ NT ⁴	HIGH , Suitable habitat could occur on site.

³Distribution according to Branch 1988.

⁴Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 5 November 2010.

Appendix 3: List of protected tree species (National Forests Act).

<i>Acacia erioloba</i>	<i>Acacia haematoxylon</i>
<i>Adansonia digitata</i>	<i>Azelia quanzensis</i>
<i>Balanites</i> subsp. <i>maughamii</i>	<i>Barringtonia racemosa</i>
<i>Boscia albitrunca</i>	<i>Brachystegia spiciformis</i>
<i>Breonadia salicina</i>	<i>Bruguiera gymnorhiza</i>
<i>Cassipourea swaziensis</i>	<i>Catha edulis</i>
<i>Ceriops tagal</i>	<i>Cleistanthus schlechteri</i> var. <i>schlechteri</i>
<i>Colubrina nicholsonii</i>	<i>Combretum imberbe</i>
<i>Curtisia dentata</i>	<i>Elaeodendron (Cassine) transvaalensis</i>
<i>Erythrophysa transvaalensis</i>	<i>Euclea pseudebenus</i>
<i>Ficus trichopoda</i>	<i>Leucadendron argenteum</i>
<i>Lumnitzera racemosa</i> var. <i>racemosa</i>	<i>Lydenburgia abottii</i>
<i>Lydenburgia cassinoides</i>	<i>Mimusops caffra</i>
<i>Newtonia hildebrandtii</i> var. <i>hildebrandtii</i>	<i>Ocotea bullata</i>
<i>Ozoroa namaensis</i>	<i>Philenoptera violacea (Lonchocarpus capassa)</i>
<i>Pittosporum viridiflorum</i>	<i>Podocarpus elongatus</i>
<i>Podocarpus falcatus</i>	<i>Podocarpus henkelii</i>
<i>Podocarpus latifolius</i>	<i>Protea comptonii</i>
<i>Protea curvata</i>	<i>Prunus africana</i>
<i>Pterocarpus angolensis</i>	<i>Rhizophora mucronata</i>
<i>Sclerocarya birrea</i> subsp. <i>caffra</i>	<i>Securidaca longependunculata</i>
<i>Sideroxylon inerme</i> subsp. <i>inerme</i>	<i>Tephrosia pondoensis</i>
<i>Warburgia salutaris</i>	<i>Widdringtonia cedarbergensis</i>
<i>Widdringtonia schwarzii</i>	

No species have a geographical distribution that coincides with the study area.

Appendix 4: Checklist of plant species recorded during previous botanical surveys in the study area and surrounds.

Aloe broomii Schönland var. tarkaensis Reynolds
Acacia karroo Hayne
Amaranthus dinteri Schinz ssp. dinteri var. a
Aptenia geniculiflora (L.) Bittrich ex Gerbaulet
Arctotis sulcocarpa K.Lewin
Aristida adscensionis L.
Aristida congesta Roem. & Schult. ssp. congesta
Atriplex semibaccata R.Br. var. appendiculata Aellen
Atriplex suberecta I.Verd.
Aspalathus fusca Thunb.
Asparagus capensis L. var. capensis
Astroloba cf. congesta (Salm-Dyck) Uitewaal
Atriplex lindleyi Moq. ssp. inflata (F.Muell.) Paul G.Wilson
Avonia ustulata (E.Mey. ex Fenzl) G.D.Rowley
Berkheya annectens Harv.
Cenia microglossa DC.
Chaenostoma pauciflorum Benth.
Chloris virgata Sw.
Convolvulus sagittatus Thunb.
Crassula corallina Thunb. ssp. corallina
Crassula muscosa L. var. polpodacea (Eckl. & Zeyh.) G.D.Rowley
Cucumis africanus L.f.
Cynanchum orangeanum (Schltr.) N.E.Br.
Cynodon incompletus Nees
Dipcadi viride (L.) Moench
Delosperma sp.
Drosanthemum hispidum (L.) Schwantes
Drosanthemum karrooense L.Bolus
Drosanthemum lique (N.E.Br.) Schwantes
Duvalia maculata N.E.Br.
Enneapogon scoparius Stapf
Eragrostis bergiana (Kunth) Trin.
Eragrostis bicolor Nees
Eragrostis lehmanniana Nees var. lehmanniana
Eragrostis obtusa Munro ex Ficalho & Hiern
Eragrostis procumbens Nees
Eriospermum zeyheri R.A.Dyer
Erodium cicutarium (L.) L'Hér.
Euphorbia atrispina N.E.Br. var. viridis A.C.White, R.A.Dyer & B.Sloane
Euphorbia decepta N.E.Br.
Euphorbia mundii N.E.Br.
Euryops subcarnosus DC. ssp. vulgaris B.Nord.
Felicia filifolia (Vent.) Burt Davy ssp. filifolia
Felicia muricata (Thunb.) Nees ssp. muricata
Fingerhuthia sesleriiformis Nees
Fockea comaru (E.Mey.) N.E.Br.
Galenia subcarnosa Adamson
Gazania krebsiana Less. ssp. arctotoides (Less.) Roessler
Helichrysum zeyheri Less.
Heliophila pusilla L.f.

Hermannia comosa Burch. ex DC.
Hermannia grandiflora Aiton
Hermannia spinosa E.Mey. ex Harv.
Hibiscus trionum L.
Indigofera alternans DC. var. *alternans*
Lepidium schinzii Thell.
Lessertia annularis Burch.
Limeum aethiopicum Burm.f. var. *aethiopicum*
Lycium schizocalyx C.H.Wright
Medicago laciniata (L.) Mill. var. *laciniata*
Melolobium canescens Benth.
Mestoklema arboriforme (Burch.) N.E.Br. ex Glen
Moraea marlothii (L.Bolus) Goldblatt
Nemesia fruticans (Thunb.) Benth.
Ochna arborea Burch. ex DC. var. *arborea*
Ornithogalum tenuifolium F.Delaroche ssp. *aridum* Oberm.
Osteospermum spinescens Thunb.
Pentaschistis airoides (Nees) Stapf ssp. *airoides*
Pentzia globosa Less.
Phyllobolus grossus (Aiton) Gerbaulet
Pleiospilos compactus (Aiton) Schwantes ssp. *canus* (Haw.) H.E.K.Hartmann & Liede
Polygala asbestina Burch.
Polygala ephedroides Burch.
Polygala leptophylla Burch. var. *leptophylla*
Portulaca hereroensis Schinz
Pseudognaphalium undulatum (L.) Hilliard & B.L.Burt
Psilocaulon bicorne (Sond.) Schwantes
Psilocaulon coriarium (Burch. ex N.E.Br.) N.E.Br.
Pteronia viscosa DC.
Radyera urens (L.f.) Bullock
Rhynchosia capensis (Burm.f.) Schinz
Rosenia humilis (Less.) K.Bremer
Rumex crispus L.
Rumex lanceolatus Thunb.
Ruschia sp.
Salsola calluna Fenzl ex C.H.Wright
Salsola kali L.
Salvia stenophylla Burch. ex Benth.
Salvia verbenaca L.
Selago albida Choisy
Selago geniculata L.f.
Senecio niveus (Thunb.) Willd.
Sisymbrium burchellii DC. var. *burchellii*
Sporobolus ioclados (Trin.) Nees
Stipagrostis anomala De Winter
Stipagrostis ciliata (Desf.) De Winter var. *capensis* (Trin. & Rupr.) De Winter
Stipagrostis namaquensis (Nees) De Winter
Stomatium difforme L.Bolus
Strumaria gemmata Ker Gawl.
Sutherlandia frutescens (L.) R.Br.
Sutherlandia humilis E.Phillips & R.A.Dyer
Talinum cafferum (Thunb.) Eckl. & Zeyh.
Tetragonia arbuscula Fenzl

Tetragonia calycina Fenzl
Thesium lineatum L.f.
Tragus racemosus (L.) All.
Tribulus terrestris L.
Trichodiadema barbatum (L.) Schwantes
Trichodiadema intonsum (Haw.) Schwantes
Trichodiadema setuliferum (N.E.Br.) Schwantes
Tripteris sinuata DC. var. sinuata
Zygophyllum incrustatum E.Mey. ex Sond.