ENVIRONMENTAL IMPACT REPORT:

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

Prepared by

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on behalf of
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29 March 2011

DRAFT EIA REPORT: 3rd Draft

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

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

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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

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 study include:

- an indication of the methodology used in determining the significance of potential environmental impacts;
- a description of the environmental issues that were identified during the environmental impact assessment process;
- an assessment of the significance of direct, indirect and cumulative impacts in terms of standard criteria;
- a description and comparative assessment of all alternatives identified during the environmental impact assessment process;
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Plan;
- an indication of the extent to which the issue could be addressed by the adoption of achievable mitigation measures;
- a description of any assumptions, uncertainties and gaps in knowledge;
- an environmental impact statement which contains
- a summary of the key findings of the environmental impact assessment,
- an assessment of the positive and negative implications of the proposed activity,
- a comparative assessment of the positive and negative implications of the distribution line alternatives.

This report provides details of the results of the EIA phase. The findings of the study are based on a desktop assessment of the study area, detailed mapping from aerial imagery and a field survey of the site.

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 EIA phase study was to assess the significance of potential impacts on flora, fauna and ecology within the study area. This report contains all the descriptive information on flora and fauna that were presented in the Scoping report as well as a comprehensive assessment of potential impacts. The results of the EIA 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 the 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. Rare, threatened, protected and conservation-worthy species and habitats 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 0f 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 can then be assessed in terms of their habitat requirements in order 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.

Provincial and National legislation was evaluated in rder to provide lists of any plant or animal species that have protected status. The most important legislation is the following: *National Environmental Management: Biodiversity Act (Act No 10 of 2004)*.

Lists of threatened animal species that have a geographical range that includes the study area were obtained from literature sources (for example, Alexander & Marais 2007, Branch 1988, 2001, du Preez & Carruthers 2009, Friedmann & Daly 2004, Mills & Hes 1997). The likelihood 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 Data 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 Data 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 Data species within the study area.

For all threatened or protected 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 habitat sensitivity map is to provide information on the location of potentially sensitive features in the study area. This was compiled by taking the following into consideration:

1. The general status of the vegetation of the study area was derived by compiling a landcover data layer for the study area (*sensu* Fairbanks et al. 2000) using available satellite imagery and aerial photography. From this it can be seen which areas are transformed versus those that are still in a natural status.
2. Various provincial, regional or national level conservation planning studies have been undertaken in the area, e.g. the National Spatial Biodiversity Assessment (NSBA), Northern Cape Biodiversity Conservation Plan (NCBCP). The mapped results from these were taken into consideration in compiling the habitat sensitivity map.
3. Habitats in which various species of plants or animals occur that may be protected or are considered to have high conservation status are considered to be sensitive.

Assessment of impacts

Direct, indirect and cumulative impacts of the issues identified through the scoping study, as well as all other issues identified in the EIA phase were assessed in terms of the following criteria:

» The **nature**, which includes a description of what causes the effect, what will be affected and how it will be affected.
» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 was assigned as appropriate (with 1 being low and 5 being high):
» The **duration**, wherein it was indicated whether:
  * the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  * the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  * medium-term (5–15 years) – assigned a score of 3;
  * long term (> 15 years) - assigned a score of 4; or
  * permanent - assigned a score of 5;
» The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they

temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

» The **probability** *of occurrence*, which describes the likelihood of the impact actually occurring. Probability was estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
» the **significance**, was determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
» the **status**, which was described as either positive, negative or neutral.
» the degree to which the impact can be reversed.
» the degree to which the impact may cause irreplaceable loss of resources.
» the degree to which the impact can be mitigated.

The **significance** was calculated by combining the criteria in the following formula:

S=(E+D+M)P

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

» < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
» 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
» > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

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.
- No proposed internal road infrastructure was provided.

Exclusions

The avifaunal assessment is excluded from this study and will be undertaken by a separate specialist.

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, Rietkloofplaaten 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 approximately 3km from the N1 at its closest point, which runs past the southern part of the site. A relatively substantial secondary road leads from the N1 to the Biesiespoort Substation, 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 concievably be used to transport goods and materials to the site during construction.

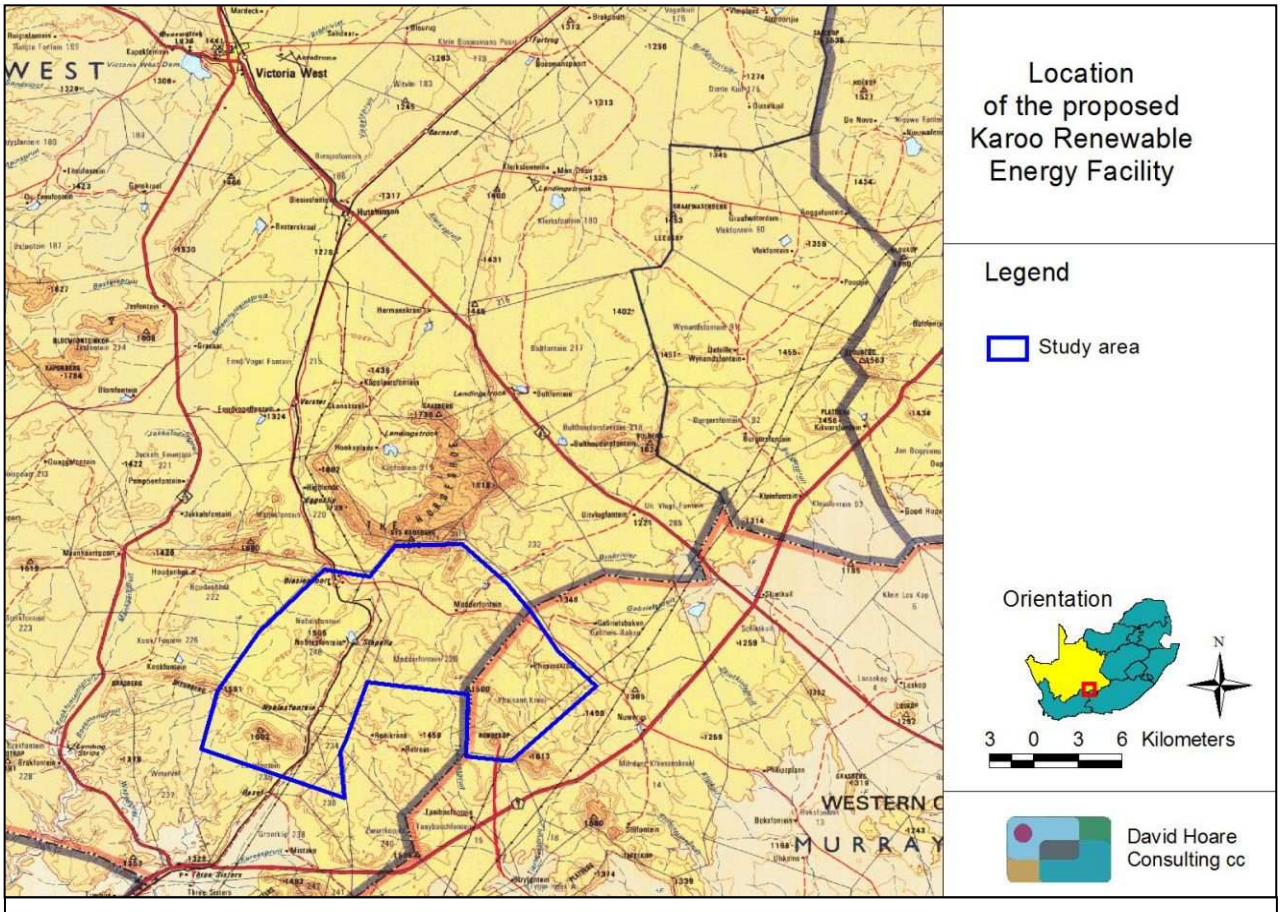

Figure 1: Location of the proposed Karoo Renewable Energy Project.

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

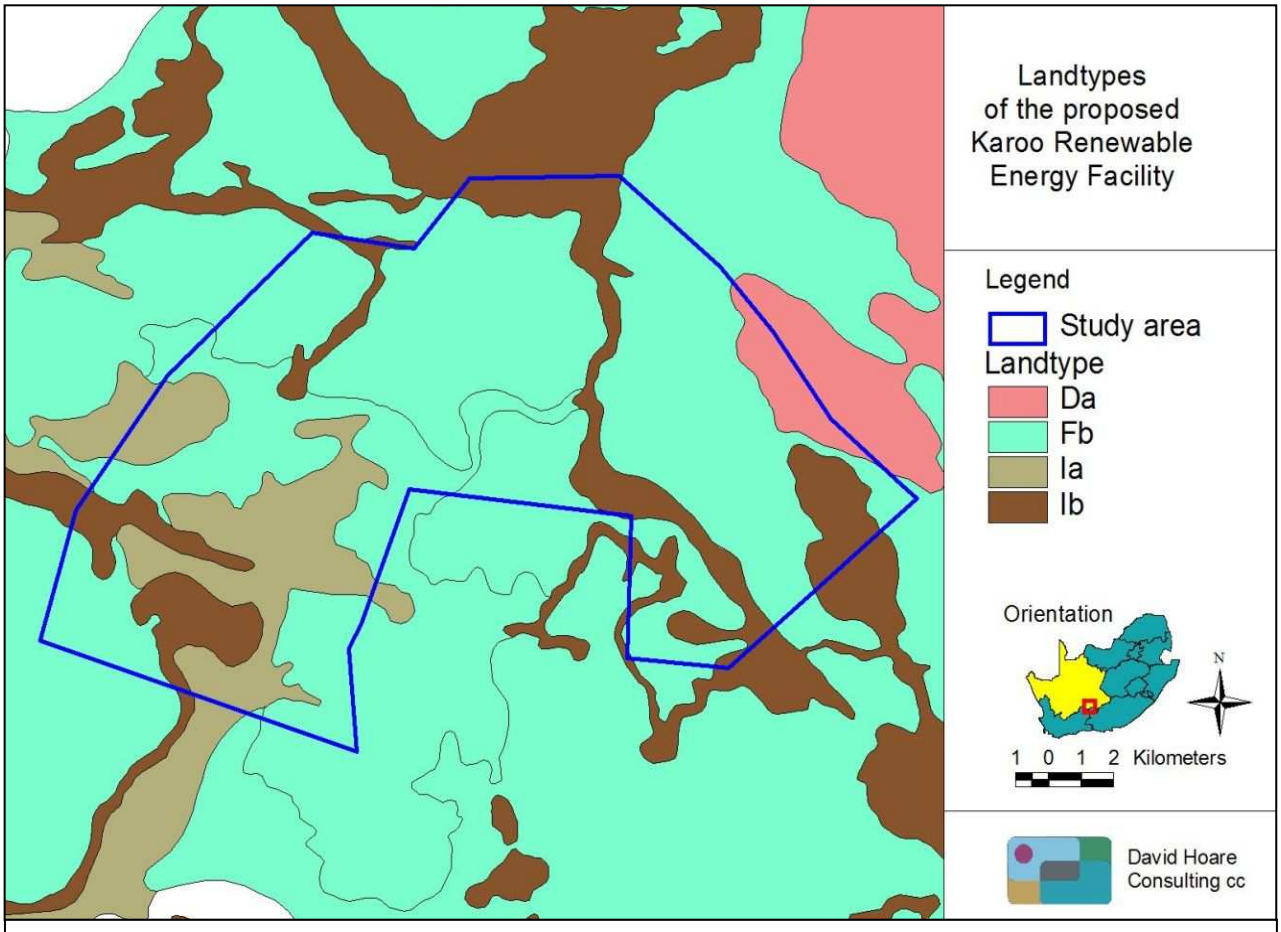

Figure 2: Landtypes of the proposed Karoo Renewable Energy Project.

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^{o}C and 36.6^{o}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*.

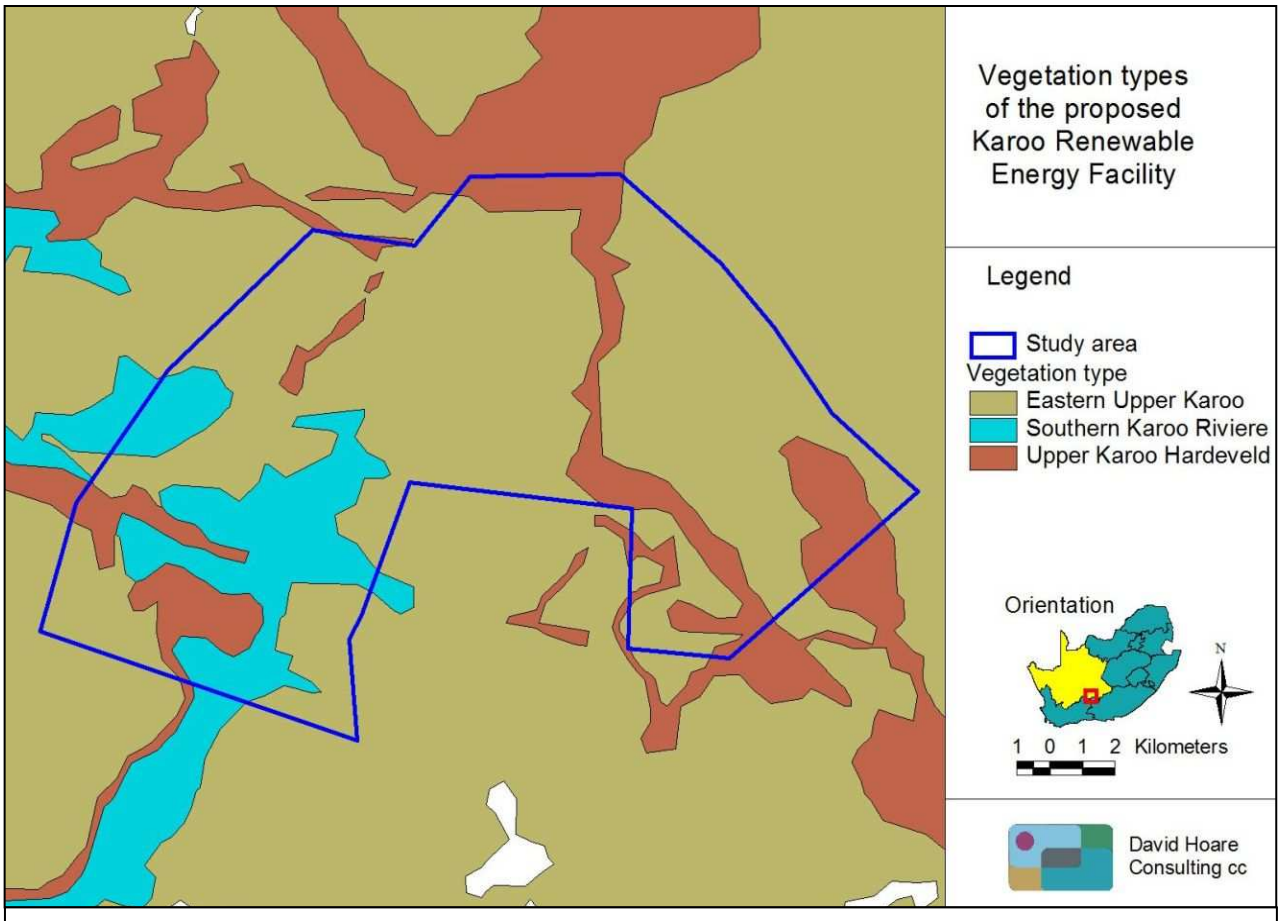

Figure 3: Vegetation types of the Karoo Renewable Energy Project.

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, *Anisodontea malvastroides*, the herbs *Cineraria arctotidea* 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 *et al*. 2005; Mucina *et al*., 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. The Namakwa District map of Critical Biodiversity Areas shows various drainage lines within a defined geographical area as being important habitat for this species (shown in red in Figure 4). Grids in which this species has been documented to occur are shown as green squares in Figure 4. It can be seen that the study area (brown polygon in Figure 4) occurs within grids in which this species has been previously recorded and contains a number of drainage areas in which potential habitat for this species could occur. Based on known distribution and potential availability of suitable habitat, there is, therefore, a high risk of this species occurring on site.

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 Leseur'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.

Sensitivity assessment

The sensitivity assessment identifies those parts of the study area that have high conservation value or that may be sensitive to disturbance. Areas of potentially high sensitivity are shown in Figure 5 in orange. 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 map of areas important for maintaining ecological processes in the study area. Broad scale mapping

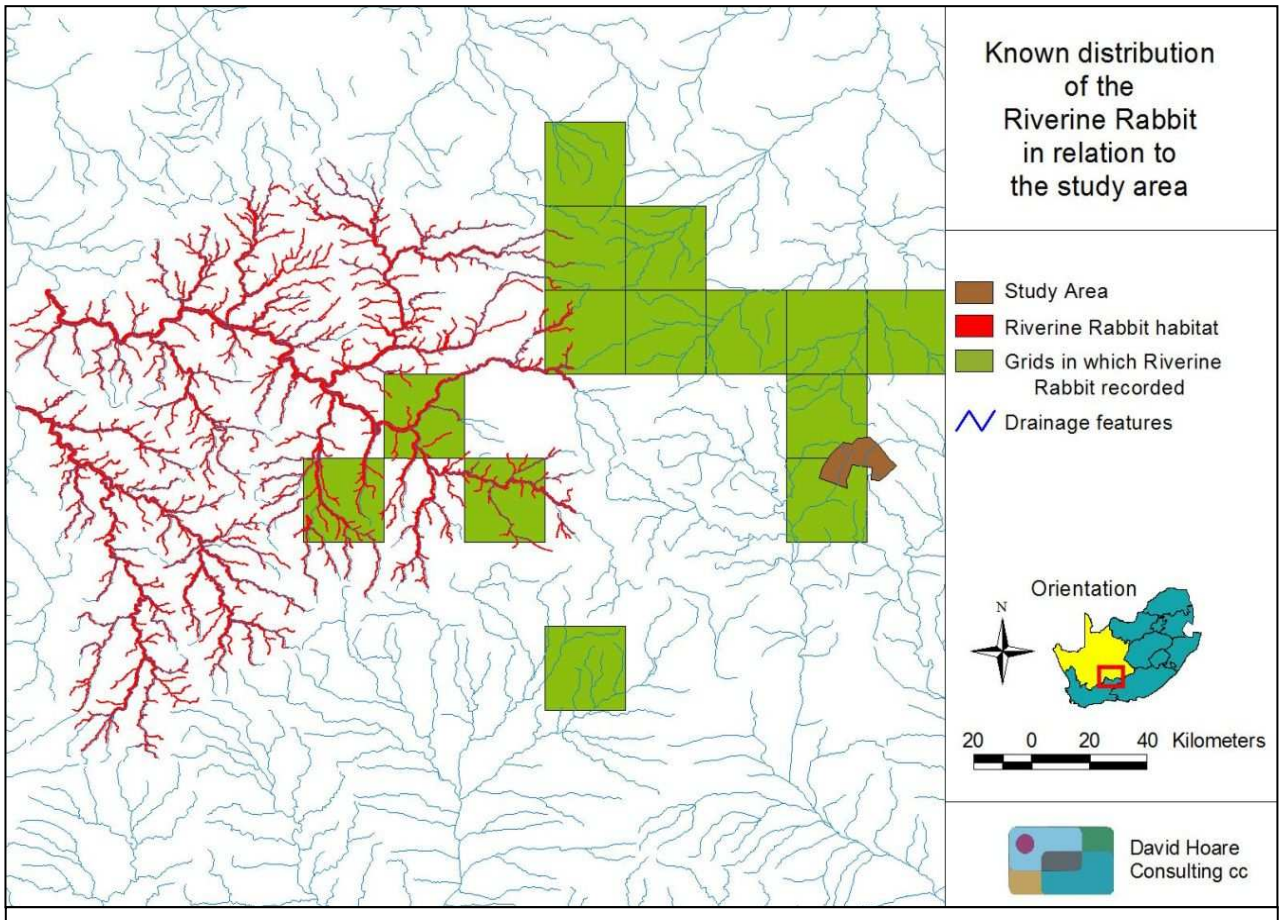

Figure 4: Riverine Rabbit distribution.

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. Drainage lines on site are classified as sensitive. From a sensitivity point of view, the main drainage lines are more sensitive and therefore important to protect than the very ephemeral ones.

It is important to note that this sensitivity assessment is based on a combination of a desktop study, broad-scale mapped information, detailed mapping from aerial photography and field surveys that covered the entire site and that it identifies regional issues that apply to the site as well as local patterns observed on site.

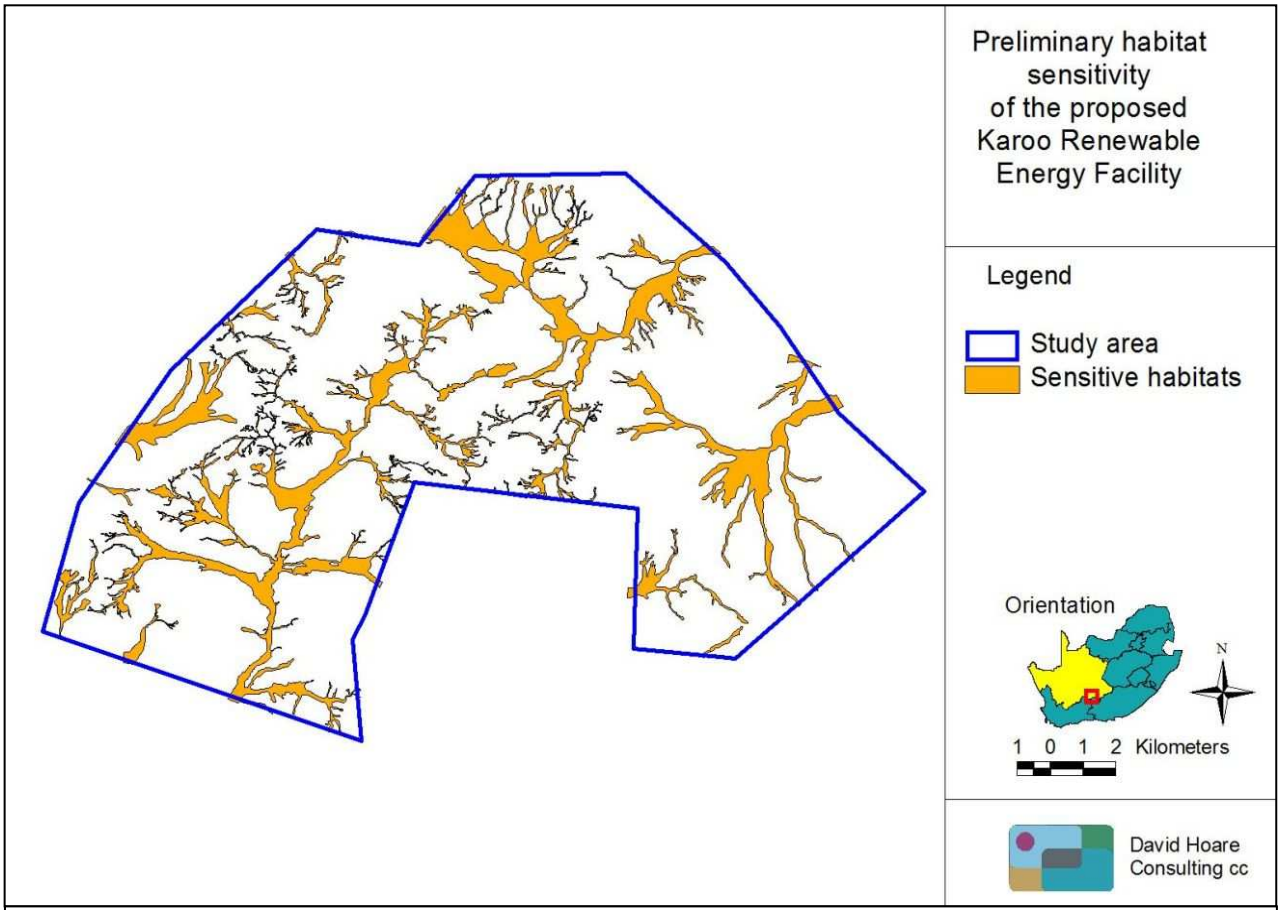

Figure 5: Potentially sensitive parts of the study area.

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.

Northern Cape Nature Conservation Act, No. 9 of 2009

This Act 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; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project:

- Boundary fences may not be altered in such a way as to prevent wild animals from freely moving onto or off of a property;
- Aquatic habitats may not be destroyed or damaged;
- The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species.

The Act provides lists of protected species for the Province.

DESCRIPTION OF INFRASTRUCTURE

The position of the photovoltaic plant, turbines, substations and overhead power line within the property is indicated in Figure 6.

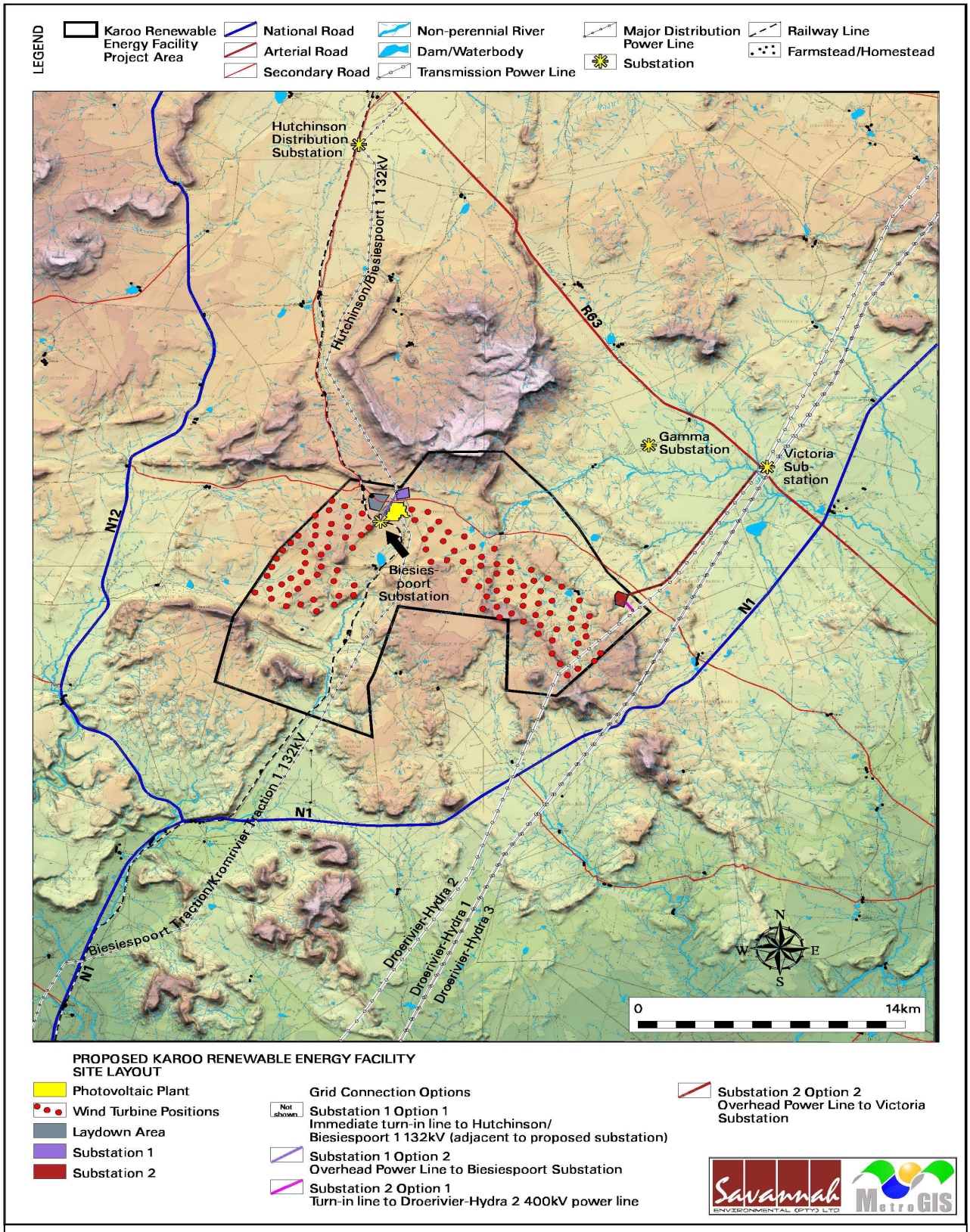

Figure 6: Proposed infrastructure positions in relation to site boundaries.

A total of 113 turbines have been proposed for the site, although the EIA application remains for up to 150 turbines. Each turbine will have a relatively small footprint (i.e. 15 m x 15m). There will be disturbance beyond this during the construction phase since a lay-down area is required prior to raising the turbine to its final position. A single lay-down area has been proposed in the northern part of the site near to the existing Biesiespoort substation(Figure 6).

There are two substations proposed, one in the north-central part of the site and one in the mid-eastern part of the site.
The overhead power line from the wind energy facility to the substation and to the grid will probably be a 132kV line. There are two alternative alignments proposed for each substation (four in total). These are shown in Figure 6 and are as follows:

(1) Substation 1 option 1: immediate turnin to adjacent existing powerline (up to 1 km length of power line),
(2) Substation 1 option 2: up to 2.5 km powerline to Biesiespoort substation,
(3) Substation 2 option 1: turnin to nearby (up to 1.5 km away) existing powerline,
(4) Substation 2 option 2): up to 12 km powerline to Victoria substation.

Road infrastructure and the proposed location of underground cables associated with the wind turbines was not provided. In order to assess potential impacts of internal access roads, it was assumed that any area within the area occupied by the turbines could be affected. It was also not indicated where the underground cables between turbines will be situated, but it was assumed that they will be installed beneath the internal access roads.

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 ancilliary 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 the wind enrgy facility component of the project 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. Terrestrial vegetation on site is therefore not considered to be of high conservation value.

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 and is not assessed further.

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.

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 section1 5(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 and is not assessed further.

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.

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 activites) 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.

ASSESSMENT OF IMPACTS

Impacts are assessed for each component of infrastructure for the proposed wind and solar energy facility. There is therefore a seperate assessment for the photovoltaic plant, turbines, substation, overhead power lines and the combination of underground cables between turbines and internal access roads.

PV plant

The pv power plant is situated in the north-central part of the study area (Figure 5) and will cover an area of approximately 97 ha, including the road network.

Impact 1: Loss or fragmentation of indigenous natural vegetation
the vegetation types on site are Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld, all of which are classified as Least Threatened. Terrestrial vegetation on site is therefore not considered to be of high conservation value.

Extent: The impact will occur at the site of the proposed pv power plant. The construction of the PV plant potentially affects a small proportion of natural vegetation on site and is scored as local. The vegetation in this area is in moderately poor condition due to long-term overgrazing.

Duration: The impact will occur during construction, but will be permanent.

Magnitude: At a local scale, the impact is likely to result in a slight impact on processes, which is scored as low.

Probability: According to the provided layout, it is definite that the impact will occur.

Mitigation measures:

1. Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the PV power plant.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	permanent (5)	permanent (5)
Magnitude	Low (4)	low (3)
Probability	definite (5)	definite (5)
Significance	**medium (50)**	**medium (45)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: (1) Avoid unnecessary impacts on natural vegetation surrounding the pv power plant. Impacts should be contained, as much as possible, within the footprint of the infrastructure.		
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will		

exacerbate this impact.
Residual Impacts: Some loss of this vegetation type will definitely occur.

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 3: Loss of habitat for threatened animals

There is one threatened and four near threatened species that could occur on site. The threatened species is of greatest concern. This assessment is specifically on the potential impact of the infrastructure on the threatened (Critically Endangered) Riverine Rabbit, which was evaluated as having the potential to occur on site. This species is found in riverine vegetation on alluvial soils adjacent to seasonal rivers. Based on the field assessment, it was evaluated that potentially suitable habitat is present in the north-eastern part of the site. No individuals of the species were found on site and land owners on site have indicated that no previous sitings have taken place on site. It was, nevertheless, possible for the species to occur there. The assessment below is based on this possibility.

Extent: The impact will occur at the site of the proposed PV power plant, but could affect the regional status of the species. It is scored as regional.

Duration: The impact will occur during construction, but (if natural habitat is affected) will be permanent.

Magnitude: The impact is being assessed at a regional scale where impacts could result in a slight impact on population processes, which is scored as low.

Probability: No individuals of this species were found on site or are expected to be found on site and there is only a low probability of them occurring on site. In addition, no infrastructure is proposed to be placed in the part of the site where potentially suitable habitat could occur. It is therefore improbable that the impact will occur on the species.

Mitigation measures: On condition natural habitat suitable for the Riverine Rabbit is not affected to a significant degree, it is unlikely that construction of the PV power plant will have a significant impact on this species. Unnecessary impacts on terrestrial habitats and drainage lines in the this specific part of the site where potentially suitable habitat is located should be avoided. No specific mitigation measures are further required for this species.

Nature: Impacts on individuals of threatened animal species (Riverine Rabbit)		
	Without mitigation	**With mitigation**
Extent	regional (3)	regional (3)
Duration	permanent (5)	Short-term (1)
Magnitude	low (4)	low (4)
Probability	improbable (2)	improbable (2)
Significance	**low (24)**	**low (16)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) Avoid impacts on natural habitats suitable for the riverine rabbit.		
Cumulative impacts:		

Impacts that cause loss of habitat (e.g. soil erosion, alien invasions, damage to wetlands) may exacerbate this impact.
Residual Impacts: Unlikely to be residual impacts.

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 5: Damage to wetlands/watercourses

There are a number of dry stream beds and drainage areas on site, of which two small upper reaches are directly affected by the proposed PV power plant. 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 these affected areas or changes to the catchment of these areas.

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

Duration: The impact will occur during construction, but will probably result in impacts that have a long-term effect.

Magnitude: In the long-term, impacts could result in processes continuing but in a modified way, which is scored as moderate.

Probability: According to the provided layout, it is highly likely that the impact will occur.

Mitigation measures:

1. There is a legal obligation to apply for a Water Use Licence for any wetlands that may be affected, since they are classified in the National Water Act as a water resource.
2. Stormwater and runoff water must be controlled for all infrastructure and managed to avoid siltation and surface hydrological impacts on wetlands.
3. Erosion control features must be built into all wetland crossings. This must include structures to break water velocity and prevent concentration of water flow.

Nature: Damage to wetland areas resulting in hydrological impacts		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Highly likely (4)	Highly likely (4)
Significance	**medium (48)**	**medium (40)**
Status (positive or negative)	negative	negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) control stormwater and runoff water and inhibit erosion. (2) obtain a permit from DWA to impact on any wetland or water resource. (3) Place erosion control features at crossings of drainage lines.		

Cumulative impacts: Soil erosion, alien invasions, may all lead to additional impacts on wetland habitats that will exacerbate this impact.
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

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

Extent: The impact will occur at the site of the proposed pv plant, but could potentially spread extensively into the surrounding landscape, depending on the habitat and the alien species that could potentially invade the site. The impact will therefore be evaluated at a scale of site and surroundings.

Duration: The impact will occur for the duration of the operation of the facility, which will be 20 years or more. This is long-term.

Magnitude: The impact is likely to be moderate and will result in processes continuing but in a modified way.

Probability: It is assessed as highly probable that this impact will occur in the absence of control measures.

Mitigation measures: Disturbance of indigenous vegetation must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled so as to avoid the development of a soil seed bank of alien plants within the stockpiled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	long-term (4)	long-term (4)
Magnitude	moderate (6)	low (4)
Probability	highly probable (4)	improbable (2)
Significance	**medium (48)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	

Mitigation: (1) keep disturbance of indigenous vegetation to a minimum (2) rehabilitate disturbed areas as quickly as possible (3) do not translocate soil stockpiles from areas with alien plants (4) control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) establish an ongoing monitoring programme to detect and quantify any aliens that may become established
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands may all lead to additional impacts that will exacerbate this impact.
Residual Impacts: Will probably be very low if control measures are effectively applied

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Wind turbines

A total of 113 turbines have been proposed for the site. The position of these in the study area is indicated in Figure 5.

Impact 1: Loss or fragmentation of indigenous natural vegetation
the vegetation types on site are Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld, all of which are classified as Least Threatened. Terrestrial vegetation on site is therefore not considered to be of high conservation value.

Extent: The impact will occur at the site of the proposed turbines. The construction of the turbines potentially affects a small proportion of natural vegetation on site and is scored as local. The vegetation in the study area varies from moderately good to moderately poor condition.

Duration: The impact will occur during construction, but will be permanent.

Magnitude: At a local scale, the impact is likely to result in a slight impact on processes, which is scored as low.

Probability: According to the provided layout, it is definite that the impact will occur.

Mitigation measures:

2. Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the turbines.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	permanent (5)	permanent (5)
Magnitude	Low (4)	low (3)
Probability	definite (5)	definite (5)
Significance	**medium (50)**	**medium (45)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes

Can impacts be mitigated?	No	
Mitigation: (2) Avoid unnecessary impacts on natural vegetation surrounding the wind turbines. Impacts should be contained, as much as possible, within the footprint of the infrastructure.		
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of this vegetation type will definitely occur.		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 3: Loss of habitat for threatened animals

There is one threatened and four near threatened species that could occur on site. The threatened species is of greatest concern. This assessment is specifically on the potential impact of the infrastructure on the threatened (Critically Endangered) Riverine Rabbit. This species is found in riverine vegetation on alluvial soils adjacent to seasonal rivers. The species is not considered to occur on site, but potentially suitable habitat is present in the north-eastern part of the site. No turbines are proposed to be placed within this area. This potential impact will therefore not occur and is not assessed further.

Impact 5: Damage to wetlands/watercourses

There are a number of dry stream beds and drainage areas on site. The turbines have all been positioned a minimum of 30 m from any mapped drainage line. No turbines are proposed to be placed within wetlands / watercourses. This potential impact will therefore not occur and is not assessed further.

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

Extent: The impact will occur at the site of the proposed turbines, but could potentially spread extensively into the surrounding landscape, depending on the habitat and the alien species that could potentially invade the site. The impact will therefore be evaluated at a scale of site and surroundings.

Duration: The impact will occur for the duration of the operation of the facility, which will be 20 years or more. This is long-term.

Magnitude: The impact is likely to be moderate and will result in processes continuing but in a modified way.

Probability: It is assessed as probable that this impact will occur in the absence of control measures.

Mitigation measures: Disturbance of indigenous vegetation must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled so as to avoid the development of a soil seed

bank of alien plants within the stock-piled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	long-term (4)	long-term (4)
Magnitude	moderate (6)	low (4)
Probability	probable (3)	improbable (2)
Significance	**medium (36)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) keep disturbance of indigenous vegetation to a minimum (2) rehabilitate disturbed areas as quickly as possible (3) do not translocate soil stockpiles from areas with alien plants (4) control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) establish an ongoing monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Substation/s

There are two substations proposed, one in the north-central part of the site and one in the mid-eastern part of the site. The substations are indicated as being approximately 500-600 m x 600-800 m in extent. It is probable that a smaller area is required within this indicated area for the substation, but for the purposes of the EIA it is assumed that the entire area will be affected.

Impact 1: Loss or fragmentation of indigenous natural vegetation

The vegetation types on site are Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld, all of which are classified as Least Threatened. Terrestrial vegetation on site is therefore not considered to be of high conservation value.

Extent: The impact will occur at the site of the proposed substations. The construction of the substations affect a small proportion of natural vegetation on site relative to the overall distribution of the vegetation types and is scored as local. The vegetation in this area is in moderate condition due to long-term overgrazing.

Duration: The impact will occur during construction, but will be permanent.

Magnitude: At a regional scale (the scale of the occurrence of the vegetation unit), the impact will not result in an impact on processes, which is scored as minor.

Probability: According to the provided layout, it is definite that the impact will occur.

Mitigation measures:

1. Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the substation.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	permanent (5)	permanent (5)
Magnitude	minor (2)	minor (2)
Probability	definite (5)	definite (5)
Significance	**medium (40)**	**medium (40)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: (1) Avoid unnecessary impacts on natural vegetation surrounding the substations. Impacts should be contained, as much as possible, within the footprint of the infrastructure.		
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of this vegetation type will definitely occur.		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 3: Loss of habitat for threatened animals

There is one threatened and four near threatened species that could occur on site. The threatened species is of greatest concern. This assessment is specifically on the potential impact of the infrastructure on the threatened (Critically Endangered) Riverine Rabbit. This species is found in riverine vegetation on alluvial soils adjacent to seasonal rivers. The species is not considered to occur on site or nearby (closest known habitat is 50 km to west of site), but potentially suitable habitat is present in the north-eastern part of the site. No substations are proposed to be placed within this area. This potential impact will therefore not occur and is not assessed further.

Impact 5: Damage to wetlands/watercourses

There are a number of dry stream beds and drainage areas on site, of which one small drainage line may be directly affected by substation 2. 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 these affected areas or changes to the catchment of these areas.

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

Duration: The impact will occur during construction, but will probably result in impacts that have a long-term effect.

Magnitude: In the long-term, impacts could cause a slight impact on processes, which is scored as low.

Probability: According to the provided layout, it is probable that the impact will occur.

Mitigation measures:

1. There is a legal obligation to apply for a Water Use Licence for any wetlands that may be affected, since they are classified in the National Water Act as a water resource.
2. Stormwater and runoff water must be controlled for all infrastructure, and managed to avoid siltation and surface hydrological impacts on wetlands.
3. Erosion control features must be built into all wetland crossings. This must include structures to break water velocity and prevent concentration of water flow.

Nature: Damage to wetland areas resulting in hydrological impacts		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	low (4)	Low (4)
Probability	probable (3)	improbable (2)
Significance	**medium (30)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) control stormwater and runoff water and inhibit erosion. (2) move position of substation 2 200 m to the north-west, OR ensure the infrastructure is located in an area that does not impact on any wetland / water source. (3) obtain a permit from DWA to impact on any wetland or water resource.		
Cumulative impacts: Soil erosion, alien invasions, may all lead to additional impacts on wetland habitats that will exacerbate this impact.		
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

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

Extent: The impact will occur at the site of the proposed substations, but could potentially spread extensively into the surrounding landscape, depending on the habitat and the alien species that could potentially invade the site. The impact will therefore be evaluated at a scale of site and surroundings.

Duration: The impact will occur for the duration of the operation of the facility, which will be 20 years or more. This is long-term.

Magnitude: The impact is likely to be moderate and will result in processes continuing but in a modified way.

Probability: It is assessed as highly probable that this impact will occur in the absence of control measures.

Mitigation measures: Disturbance of indigenous vegetation must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled so as to avoid the development of a soil seed bank of alien plants within the stock-piled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	long-term (4)	long-term (4)
Magnitude	moderate (6)	low (4)
Probability	highly probable (4)	improbable (2)
Significance	**medium (48)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) keep disturbance of indigenous vegetation to a minimum (2) rehabilitate disturbed areas as quickly as possible (3) do not translocate soil stockpiles from areas with alien plants (4) control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) establish an ongoing monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Overhead powerline/s

The overhead power line from the wind energy facility to the substation and to the grid will probably be a 132kV line. There are two alternative alignments proposed for each substation (four in total). These are shown in Figure 5 and are as follows:

(1) Substation 1 option 1: immediate turnin to adjacent existing powerline,
(2) Substation 1 option 2: 1.8 km powerline to Biesiespoort substation,
(3) Substation 2 option 1: turnin to nearby (650 m away) existing powerline,
(4) Substation 2 option 2): 10.2 km powerline to Victoria substation.

The assessments below apply to all options, except where differences are stated.

Impact 1: Loss or fragmentation of indigenous natural vegetation

The vegetation types on site are Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld, all of which are classified as Least Threatened. Terrestrial vegetation on site is therefore not considered to be of high conservation value. Power line towers occupy a very small footprint relative to the overall extent of the vegetation types.

Extent: The impact will occur at the site of the proposed powerline towers. The construction of the towers potentially affects a small proportion of natural vegetation on site and is scored as local.

Duration: The impact will occur during construction, but will be permanent.

Magnitude: At a regional scale (the scale of the occurrence of the vegetation units), the impact is likely to result in no impact on processes, which is scored as minor.

Probability: According to the provided layout, it is definite that the impact will occur. However, the scale of the impact is such that it represents a very localized disturbance that is within the magnitude of disturbances potentially present under natural conditions. Natural vegetation succession is therefore likely to result in the vegetation surrounding the disturbance returning to a natural state over the medium-term.

Mitigation measures:

1. Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the servitude of the power line.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	minor (1)	minor (1)
Probability	definite (5)	definite (5)
Significance	**low (25)**	**low (25)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To a small degree	
Mitigation: (1) Avoid unnecessary impacts on natural vegetation surrounding the servitude of the overhead powerlines. Impacts should be contained, as much as possible, within the footprint of the		

infrastructure.
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact.
Residual Impacts: Some loss of this vegetation type will definitely occur.

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 3: Loss of habitat for threatened animals

There is one threatened and four near threatened species that could occur on site. The threatened species is of greatest concern. This assessment is specifically on the potential impact of the infrastructure on the threatened (Critically Endangered) Riverine Rabbit. This species is found in riverine vegetation on alluvial soils adjacent to seasonal rivers. The species is not considered to occur on site or nearby (closest known habitat is 50 km to west of site), but potentially suitable habitat is present in the north-eastern part of the site. No power lines are proposed to be placed within this area. This potential impact will therefore not occur and is not assessed further.

Impact 5: Damage to wetlands/watercourses

There are a number of dry stream beds and drainage areas on site. A small number of these will potentially be affected by the Substation 2 option 2 powerline. None of the other powerline options affect drainage lines / watercourses. 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 these affected areas or changes to the catchment of these areas.

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

Duration: The impact will occur during construction, but will probably result in impacts that have a long-term effect.

Magnitude: In the long-term, impacts could result in processes continuing but in a modified way, which is scored as moderate.

Probability: According to the provided layout, it is probable that the impact will occur.

Mitigation measures:

1. Ensure that tower structures are placed a minimum of 30 m outside the edge of any watercourses OR
2. There is a legal obligation to apply for a Water Use Licence for any wetlands that may be affected, since they are classified in the National Water Act as a water resource.

Nature: Damage to wetland areas resulting in hydrological impacts		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**medium (36)**	**low (20)**

Status (positive or negative)	negative	negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) ensure that tower structures are placed a minimum of 30 m outside of drainage lines / watercourses OR (2) obtain a permit from DWA to impact on any wetland or water resource.		
Cumulative impacts: Soil erosion, alien invasions, may all lead to additional impacts on wetland habitats that will exacerbate this impact.		
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

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

Extent: The impact will occur at the site of the proposed turbines, but could potentially spread extensively into the surrounding landscape, depending on the habitat and the alien species that could potentially invade the site. The impact will therefore be evaluated at a scale of site and surroundings.

Duration: The impact will occur for the duration of the operation of the facility, which will be 20 years or more. This is long-term.

Magnitude: The impact is likely to be moderate and will result in processes continuing but in a modified way.

Probability: It is assessed as probable that this impact will occur in the absence of control measures.

Mitigation measures: Disturbance of indigenous vegetation must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled so as to avoid the development of a soil seed bank of alien plants within the stock-piled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**

Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	long-term (4)	long-term (4)
Magnitude	moderate (6)	low (4)
Probability	probable (3)	improbable (2)
Significance	**medium (36)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) keep disturbance of indigenous vegetation to a minimum (2) rehabilitate disturbed areas as quickly as possible (3) do not translocate soil stockpiles from areas with alien plants (4) control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) establish an ongoing monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Access roads and underground cables between turbines

In order to assess potential impacts of internal access roads, it was assumed that any area within the area occupied by the turbines could be affected. The position of turbines is shown in Figure 5. It was assumed that underground cabling will be installed beneath the internal access roads as far as possible and that roads would follow existing roads, miss drainage lines, where possible, and take the shortest routes.

Impact 1: Loss or fragmentation of indigenous natural vegetation

The vegetation types on site are Eastern Upper Karoo, Southern Karoo Riviere and Upper Karoo Hardeveld, all of which are classified as Least Threatened. Terrestrial vegetation on site is therefore not considered to be of high conservation value.

Extent: The impact will occur at the site of the proposed internal access roads. The construction of the roads potentially affects a moderate proportion of natural vegetation on site and is scored as local.

Duration: The impact will occur during construction, but will be permanent.

Magnitude: At a regional scale (the scale of the occurrence of the vegetation units), the impact is likely to result in a slight impact on processes, which is scored as low.

Probability: According to the provided layout, it is definite that the impact will occur.

Mitigation measures:

1. Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the servitude of the overhead powerlines.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	permanent (5)	permanent (5)
Magnitude	Low (4)	low (3)
Probability	definite (5)	definite (5)
Significance	**medium (50)**	**medium (45)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: (1) Avoid unnecessary impacts on natural vegetation surrounding the servitude of the overhead powerlines. Impacts should be contained, as much as possible, within the footprint of the infrastructure.		
Cumulative impacts: Soil erosion, alien invasions, damage to wetlands may all lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of this vegetation type will definitely occur.		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 3: Loss of habitat for threatened animals

There is one threatened and four near threatened species that could occur on site. The threatened species is of greatest concern. This assessment is specifically on the potential impact of the infrastructure on the threatened (Critically Endangered) Riverine Rabbit. This species is found in riverine vegetation on alluvial soils adjacent to seasonal rivers. The species is not considered to occur on site or nearby (closest known habitat is 50 km to west of site), but potentially suitable habitat is present in the north-eastern part of the site. No internal access roads are proposed to be placed within this area. This potential impact will therefore not occur and is not assessed further.

Impact 5: Damage to wetlands/watercourses

There are a number of dry stream beds and drainage areas on site, of which a large number are directly affected by the proposed internal access roads. 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 these affected areas or changes to the catchment of these areas.

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

Duration: The impact will occur during construction, but will probably result in impacts that have a long-term effect.

Magnitude: Due to the potentially high number of crossings of drainage lines, impacts could result in processes continuing in a modified way or being altered to the extent that they temporarily cease, which is scored as medium to high.

Probability: According to the provided layout, it is definite that the impact will occur. Due to the linear nature of the infrastructure, it is, in fact, almost impossible to miss all drainage lines.

Mitigation measures:

1. There is a legal obligation to apply for a Water Use Licence for any wetlands that may be affected, since they are classified in the National Water Act as a water resource. Mapped wetlands subject to regulation according to the National Water Act are shown in the sensitivity map (Figure 5).
2. Stormwater and runoff water must be controlled for all infrastructure and managed to avoid siltation and surface hydrological impacts on wetlands.
3. Erosion control features must be built into all wetland crossings. This must include structures to break water velocity and prevent concentration of water flow.
4. No structures must be placed within the drainage channel.

Nature: Damage to wetland areas resulting in hydrological impacts		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	moderate to high (7)	moderate (6)
Probability	Definite (5)	Highly likely (4)
Significance	**high (65)**	**medium (48)**
Status (positive or negative)	negative	negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) control stormwater and runoff water and inhibit erosion. (2) obtain a permit from DWA to impact on any wetland or water resource. (3) Place erosion control features at crossings of drainage lines. (4) No structures must be placed within the drainage channel.		
Cumulative impacts: Soil erosion, alien invasions, may all lead to additional impacts on wetland habitats that will exacerbate this impact.		
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

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

Extent: The impact will occur at the site of the proposed internal access roads, but could potentially spread extensively into the surrounding landscape, depending on the habitat and the alien species that could potentially invade the site. The impact will therefore be evaluated at a scale of site and surroundings.

Duration: The impact will occur for the duration of the operation of the facility, which will be 20 years or more. This is long-term.

Magnitude: The impact is likely to be moderate and will result in processes continuing but in a modified way.

Probability: It is assessed as highly probable that this impact will occur in the absence of control measures.

Mitigation measures: Disturbance of indigenous vegetation must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled so as to avoid the development of a soil seed bank of alien plants within the stock-piled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	long-term (4)	long-term (4)
Magnitude	moderate (6)	low (4)
Probability	highly probable (4)	improbable (2)
Significance	**medium (48)**	**low (20)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) keep disturbance of indigenous vegetation to a minimum (2) rehabilitate disturbed areas as quickly as possible (3) do not translocate soil stockpiles from areas with alien plants (4) control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) establish an ongoing monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

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 have not affected the natural vegetation severely. Most of the site is in a natural state.

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. The Riverine Rabbit has been previously recorded in the grids in which the study area is located, but suitable habitat only occurs in the north-eastern corner where no infrastructure is proposed to be located. It has not previously been found on site.

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 one animal species of high conservation concern, i.e. the Riverine Rabbit.

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 Water 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 was assessed during the EIA phase after collection of relevant field data. The identified potential negative impacts are the following (with potential significance without mitigation measures given in brackets):

1. Impacts on indigenous natural vegetation (LOW to MEDIUM).
2. Impacts on threatened animals (ZERO to LOW).
3. Impacts on wetlands and/or watercourses (ZERO to HIGH).
4. Establishment and spread of declared weeds and alien invader plants (MEDIUM).

A summary of the significance of impacts before and after mitigation is provided in Table 4.

The only impact of potentially high significance is that of the internal access roads on drainage lines. Due to the linear nature of access roads and the number of drainage lines across the site, there is the potential for a high number of drainage line crossings. If these are crossed in such a way as to significantly affect hydrological processes, then the impact will be of high significance. Mitigation measures can, however, reduce the significance to moderate.

Assessment of alternative infrastructure

Powerlines

Substation 1 Option 1

This option would be constructed as an immediate turnin from substation 1 into the existing Hutchinson / Biesiespoort 132 kV line. (Up to 1 km length of power line). This power line option does not cross any wetlands and does not affect any threatened animals. Potential impacts on terrestrial vegetation are of low significance. The disturbance associated with construction could potentially result in alien plants becoming established and spreading into surrounding areas, but this can be easily controlled with management of aliens.

Substation 1 Option 2

This option would be constructed as an overhead power line from substation 1 into the existing Biesiespoort substation. The entire power line will be up to 2.5 km long. This power line option does not cross any wetlands and does not affect any threatened animals. Potential impacts on terrestrial vegetation are of low significance. The disturbance associated with construction could potentially result in alien plants becoming established and spreading into surrounding areas, but this can be easily controlled with management of aliens.

Substation 2 Option 1

This option would be constructed as a short power line with a turnin into the existing Droerivier / Hydra 400 kV line. The entire power line will be up to 1.5 km long. This power line option does not cross any wetlands and does not affect any threatened animals. Potential impacts on terrestrial vegetation are of low significance. The disturbance associated with construction could potentially result in alien plants becoming established and spreading into surrounding areas, but this can be easily controlled with management of aliens.

Substation 2 Option 2

This option would be constructed as an immediate turnin from substation 2 into the existing Victoria substation. The entire power will be up to 12 km long, which is significantly longer than any of the other options. This power line option crosses a number of draiange lines. The potential significance of impacts could be moderate, but these can be reduced to low with suggested mitigation. This option does not affect any threatened animals. Potential impacts on terrestrial vegetation are of low significance. The disturbance associated with construction could potentially result in alien plants becoming established and spreading into surrounding areas, but this can be easily controlled with management of aliens.

Comparison of options

The powerline options will not have impacts on the same natural components and may have different relative impacts on some natural features. A summary of potential impacts due to the powerline options is given in the Table below. The four powerline options are similar in their impact on the environment. The exception is Substation 2 option 2 powerline, which is significantly longer and potentially affects a number of drainage lines. Nevertheless, all potential impacts can be adequately mitigated. Residual impacts are low or zero for all options. Any of the power line options is therefore potentially suitable.

Table 5: Summary of the significance of impacts for different powerline options <u>after</u> mitigation measures have been applied.

	Substation 1		Substation 2	
Impact	**Option 1**	**Option 2**	**Option 1**	**Option 2**
Vegetation	Low	Low	Low	Low
Threatened animals	Zero	Zero	Zero	Zero
Wetlands	Zero	Zero	Zero	Low
Weeds	Low	Low	Low	Low

Recommendations

The following recommendations are made to reduce impacts or provide additional information that can lead to reduction or control of impacts:

- Internal access roads must be situated to avoid drainage lines, as far as possible.

Table 4: Summary of the significance of impacts for different infrastructure components before and after mitigation.

Impact	PV power plant		Wind turbines		Substations		Overhead powerlines		Underground cables & access roads	
	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation
1. vegetation	medium (50)	medium (45)	medium (50)	medium (45)	medium (40)	medium (45)	low (25)	low (25)	medium (50)	medium (45)
2. threatened animals (riverine rabbit)	low (24)	low (16)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)
3. wetlands	medium (48)	medium (40)	zero (0)	zero (0)	medium (30)	low (20)	medium (36)	low (20)	high (65)	medium (48)
4. alien plants	medium (48)	low (20)	medium (36)	low (20)	medium (48)	low (20)	medium (36)	low (20)	medium (48)	low (20)

*Significance calculated as (magnitude+duration+extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

MANAGEMENT PLAN

Control measures are only proposed for those impacts where mitigation measures are proposed to reduce the significance of impacts, i.e. some impacts are of low significance and thus no mitigation measures are proposed or no mitigation measures are possible or required.

Impacts on Riverine Rabbit

OBJECTIVE: Limit impacts on habitat of Riverine Rabbit	
Project component/s	Any infrastructure or activity that will result in disturbance to habitat suitable for the Critically Endangered Riverine Rabbit
Potential Impact	Loss of habitat suitable for the Critically Endangered Riverine Rabbit
Activity/risk source	Construction, environmental management
Mitigation: Target/Objective	Target: no significant impacts on identified suitable habitat for the Riverine Rabbit within project control area Time period: construction, operation

Mitigation: Action/control	Responsibility	Timeframe
(1) avoid impacts on riparian habitat identified as being suitable for the Riverine Rabbit. This species is found in riverine vegetation on alluvial soils adjacent to seasonal rivers.	Construction team, management (environmental officer),	construction, operation

Performance Indicator	No loss of habitat suitable for the Riverine Rabbit
Monitoring	• Map extent of suitable habitat before construction. • Identify project components that infringe on habitat. • After construction, record any disturbance to habitat in terms of extent and potential effects on remaining habitat.

Impacts due to alien invasive plants

OBJECTIVE: Control alien invasive plants

Project component/s	Any infrastructure or activity that will result in disturbance to natural areas
Potential Impact	Invasion of natural vegetation surrounding the site by declared weeds or invasive alien species
Activity/risk source	Construction, environmental management
Mitigation: Target/Objective	Target: no alien plants within project control area Time period: construction, operation

Mitigation: Action/control	Responsibility	Timeframe
(1) avoid creating conditions in which alien plants may become established: a. keep disturbance of indigenous vegetation to a minimum b. rehabilitate disturbed areas as quickly as possible c. do not import soil from areas with alien plants (2) establish an ongoing monitoring programme to detect and quantify any alien species that may become established and identify the problem species (as per Conservation of Agricultural Resources Act) (3) immediately control any alien plants that become established using registered control methods	Construction team, management (environmental officer),	construction, operation

Performance Indicator	For each alien species: number of plants and aerial cover of plants within project area and immediate surroundings
Monitoring	• Ongoing monitoring of area by environmental control officer during construction • Ongoing monitoring of area by environmental manager during operation • Annual audit of project area and immediate surroundings by qualified botanist. If no species are detected, then this can be stated. If any alien invasive species are detected then the distribution of these should be mapped (GPS co-ordinates of plants or concentrations of plants), number of individuals (whole site or per unit area), age and/or size classes of plants and aerial cover of plants. The results should be interpreted in terms of the risk posed to sensitive habitats within and surrounding the project area. The environmental manager should be responsible for driving this process. Reporting frequency depends on legal compliance framework.

Impacts on indigenous natural vegetation

OBJECTIVE: Control loss of indigenous natural vegetation

Project component/s	Any infrastructure or activity that will result in disturbance to natural areas
Potential Impact	Loss of indigenous natural vegetation due to construction activities
Activity/risk source	Construction
Mitigation: Target/Objective	Target: minimal loss of natural vegetation Time period: construction

Mitigation: Action/control	Responsibility	Timeframe
(1) The construction impacts must be contained to the footprint of the infrastructure. (2) Internal access roads and underground cables should be aligned as much as possible along existing linear disturbances, e.g. roads on site, or the edges of cultivated lands, and away from steep slopes and drainage lines as much as possible. (3) Unnecessary impacts on surrounding natural vegetation must be avoided. (4) Rehabilitate any disturbed areas immediately to stabilize landscapes.	Construction team, management (environmental officer),	construction

Performance Indicator	No loss of natural vegetation within "no-go" areas
Monitoring	• None

Impacts on wetlands

OBJECTIVE: Limit damage to wetlands & watercourses	
Project component/s	Any infrastructure or activity that will result in disturbance to wetlands
Potential Impact	Damage to watercourses areas by any means that will result in hydrological changes (includes erosion, siltation, dust, direct removal of soil of vegetation, dumping of material within wetlands). The focus should be on the functioning of the watercourse as a natural system
Activity/risk source	Construction, operation
Mitigation: Target/Objective	Target: no damage to watercourses within project area Time period: construction, operation

Mitigation: Action/control	Responsibility	Timeframe
(1) for any new construction where impacts are unavoidable, cross watercourses perpendicularly to minimize disturbance footprints (2) rehabilitate any disturbed areas as quickly as possible (3) control stormwater and runoff water (4) appoint an independent environmental control officer during construction and an environmental manager during operation whose duty it will be to minimise impacts on surrounding sensitive habitats (5) obtain a permit from DWA to impact on any wetland or water resource. (6) Infrastructure (including culverts and/or bridges) should not be placed within drainage line channels but should span them completely.	Construction team, management, environmental control officer	Construction, operation

Performance Indicator	No impacts on water quality, water quantity, wetland vegetation, natural status of watercourses
Monitoring	• Habitat loss in watercourses should be monitored before and after construction. • The presence and development of erosion features downstream of any construction through wetlands must be monitored. • The environmental manager should be responsible for driving this process. • Reporting frequency depends on legal compliance framework.

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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 Precis: 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	*Diceros bicornis bicornis*	Wide variety of habitats, but currently only occurs in game reserves.	CR	CR	**NONE**, only occurs in game reserves
Honey badger	*Mellivora capensis*	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	*Rhinolophus clivosus*	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	*Bunolagus monticularis*	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	*Cistugo lisueuri*	Rock crevices in fynbos.	NT	LC	**MEDIUM**, not recorded in nearby grid, on edge of distribution; suitable roosting habitat may occur nearby.

[1]Distribution and status according to Friedmann & Daly 2004.
[2]Global 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	*Pyxicephalus adspersus*	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.

[1]Status according to Minter et al. 2004.
[2]Status 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	*Gerrhosaurus typicus*	Dry sandy areas, bare rocky hillsides and Acacia scrub.	Rare[3] NT[4]	**HIGH,** Suitable habitat could occur on site.

[3]Distribution according to Branch 1988.
[4]Status 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).

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

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.) Burtt 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.Burtt
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 caffrum (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.