BA REPORT:

Specialist ecological study on the potential impacts of the proposed Cookhouse II Wind Energy Facility Project, Eastern Cape

Prepared by

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on behalf of
African Clean Energy Developments (ACED)

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DRAFT BA REPORT: 1st 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

Dr David Hoare of David Hoare Consulting cc was commissioned by Savannah Environmental (Pty) Ltd to provide specialist consulting services for the Basic Assessment for the proposed Cookhouse II Wind Energy Facility in the Eastern 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:

- PhD in ecology
- 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 300 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 African Clean Energy Developments (ACED). 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 0% of turnover.

Scope and purpose of report

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

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INTRODUCTION

Terms of reference and approach

Savannah Environmental (Pty) Ltd. was appointed by African Clean Energy Developments (ACED) to undertake an application for environmental authorisation through an Environmental Impact Assessment (EIA) for the proposed "Cookhouse II Wind Energy Facility Project." The project involves the establishment of a wind energy facility and associated infrastructure, including 30 wind turbines, up to 2 internal substations, 132 kV powerlines linking to the Eskom Poseidon substation, internal cables linking turbines and internal access roads to each turbine. The purpose of the BA is to identify environmental impacts associated with the project.

On 11 October 2011 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 all 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 the following criteria:
    a. the nature of the impact, which shall include a description of what causes
    b. the effect, what will be affected and how it will be affected
    c. the extent of the impact, indicating whether the impact will be local (limited to the immediate area or site of development), regional, national or international
    d. the duration of the impact, indicating whether the lifetime of the impact will be of a short-term duration (0–5 years), medium-term (5–15 years), long-term (> 15 years, where the impact will cease after the operational life of the activity) or permanent
    e. the probability of the impact, describing the likelihood of the impact actually occurring, indicated as improbable (low likelihood), probable (distinct possibility), highly probable (most likely), or definite (impact will occur regardless of any preventative measures)
    f. The severity/beneficial scale, indicating whether the impact will be very severe/beneficial (a permanent change which cannot be mitigated/permanent and significant benefit, with no real alternative to achieving this benefit), severe/beneficial (long-term impact that could be mitigated/long term benefit), moderately severe/beneficial (medium- to long-term impact that could be mitigated/medium- to long-term benefit), slight or have no effect
    g. The significance, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high
    h. The status, which will be described as either positive, negative or neutral
    i. The degree to which the impact can be reversed
    j. The degree to which the impact may cause irreplaceable loss of resources
    k. The degree to which the impact can be mitigated
- 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 (EMP)
- an indication of the extent to which the issue can be addressed by the adoption of mitigation measures

- a description of any assumptions, uncertainties and gaps in knowledge
- an environmental impact statement which contains:
    a. a summary of the key findings of the environmental impact assessment;
    b. an assessment of the positive and negative implications of the proposed activity
    c. a comparative assessment of the positive and negative implications of identified alternatives.

This report provides details of the results of the BA process. The findings of the study are based on a combination of a desktop assessment of the study area, fieldwork undertaken on site for a previous project and expert knowledge of the area gained from general fieldwork conducted in the Eastern Cape and in the area around Bedford and Cookhouse over a number of years.

Study area

At a regional level the study area falls within the Eastern Province to the west of the town of Bedford and east of the town of Cookhouse. A more detailed description of the study area is provided in a section below.

METHODOLOGY

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

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. National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998)
2. 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.

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),. 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 and exclusions

- 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.
- Impacts on birds are covered in a separate specialist study.

DESCRIPTION OF STUDY AREA

Location

The study site is situated west of Bedford and east of Cookhouse in the Eastern Province and falls within the quarter degree grids 3225DB, 3225DD and 3226CA (Figure 1). The farm portions on which the proposed wind energy facility would occur include the following: Portion 0 and remainder of portions 1 and 4 of the Farm Van Wyks Kraal 73, Portion 0 and the remaining extent of the Farm Roberts Kraal 72, Portion 3 of the Farm Gallants Kloof 70, Portion 0, the remaining extent, Portion 11 and Portion 12 of the Farm Request 17 and Portion 2 of the Farm 75.

No alternative site is currently being considered for the proposed wind energy facility.

The study area is to the east of the N10 national road that links Cradock to Port Elizabeth. This road runs from north to south approximately 2.7 km to the west of the study site. The R350 route from Bedford to Grahamstown runs in a north-south direction approximately 7 km to the east of the site. There is a road running southwards from Bedford through the southern side of the study site that goes to Cookhouse from Bedford. The site is therefore well-connected to a number of major routes in this region.

The Poseidon Substation is on the south-western edge of the study area. A number of powerlines distribute outwards from this point, some of which traverse the study area.

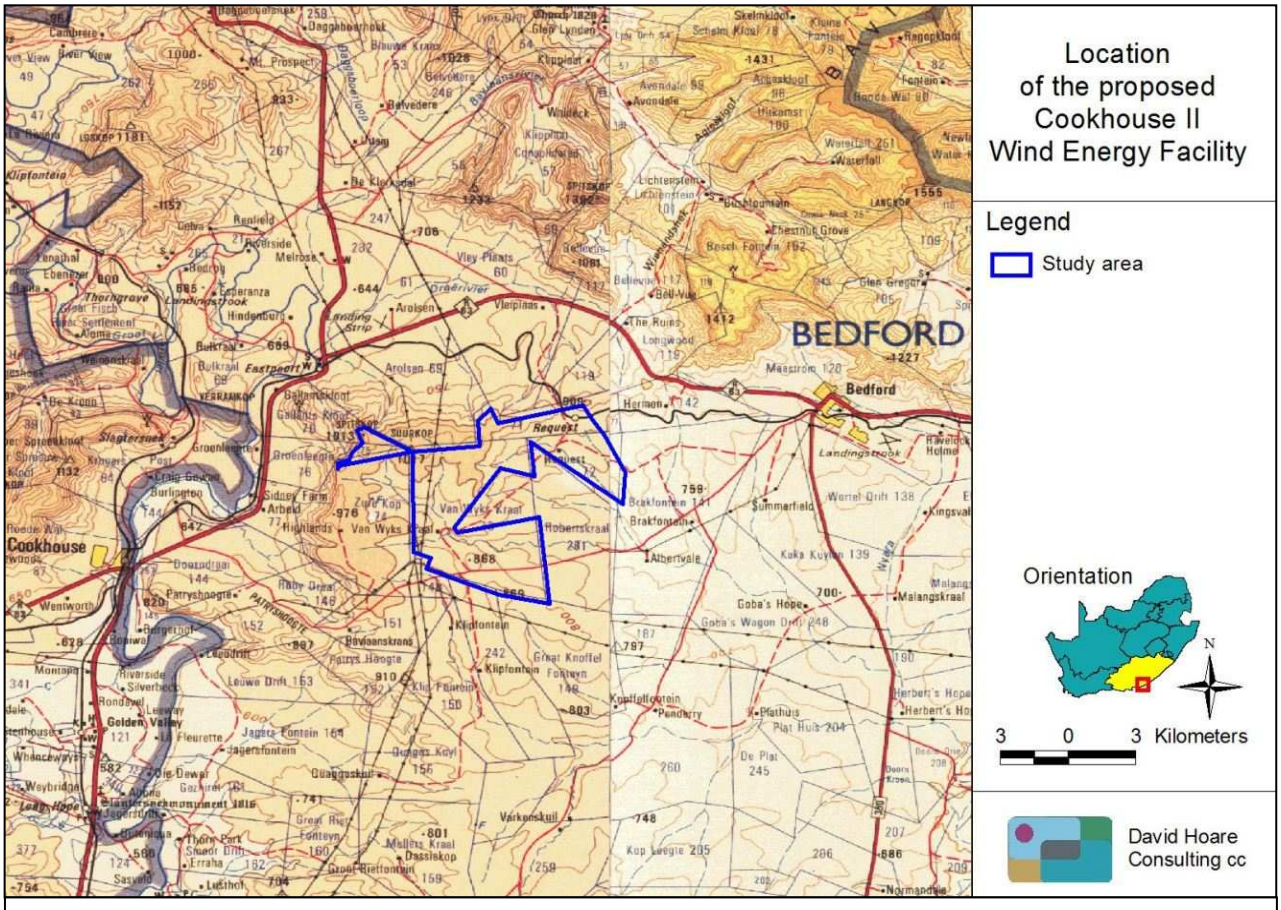

Figure 1: Location of the proposed Wind Energy Facility.

Topography

The study site is located on the plains just to the south of a mountain range. The Amathole / Winterberg Mountains run in an east-west direction in this area to the north of the site, although the southern faces contain numerous valleys that run perpendiculalry to the main mountain chain. The Great Fish River cuts through the mountains just to the north-east of the study area and has also created a rugged landscape adjacent to it where it has cut into the plains. The study site is situated on the upland part of the plains adjacent to this river valley.

The study area is gently to moderately sloping across the plains and more steeply sloping in the areas surrounding the river valley. The site of the proposed wind energy facility is on the flat plains south and south-west of Bedford quite close to the edge of the scarp slope that drops into the river valley of the Great Fish River.

The elevation on site varies from 719 m above sea level to 1002 m above sea level.

Geology and soils

The major geological formation occurring in the study area is Beaufort Group of the Karoo Supergroup, consisting of mudstone and arenite. Mudstone is a fine grained sedimentary rock whose original constituents were clays or muds, thus its grain size is relatively fine. It lacks distinct lamination, which distinguishes it from shale. Arenite is also a sedimentary rock, but has larger grain size.

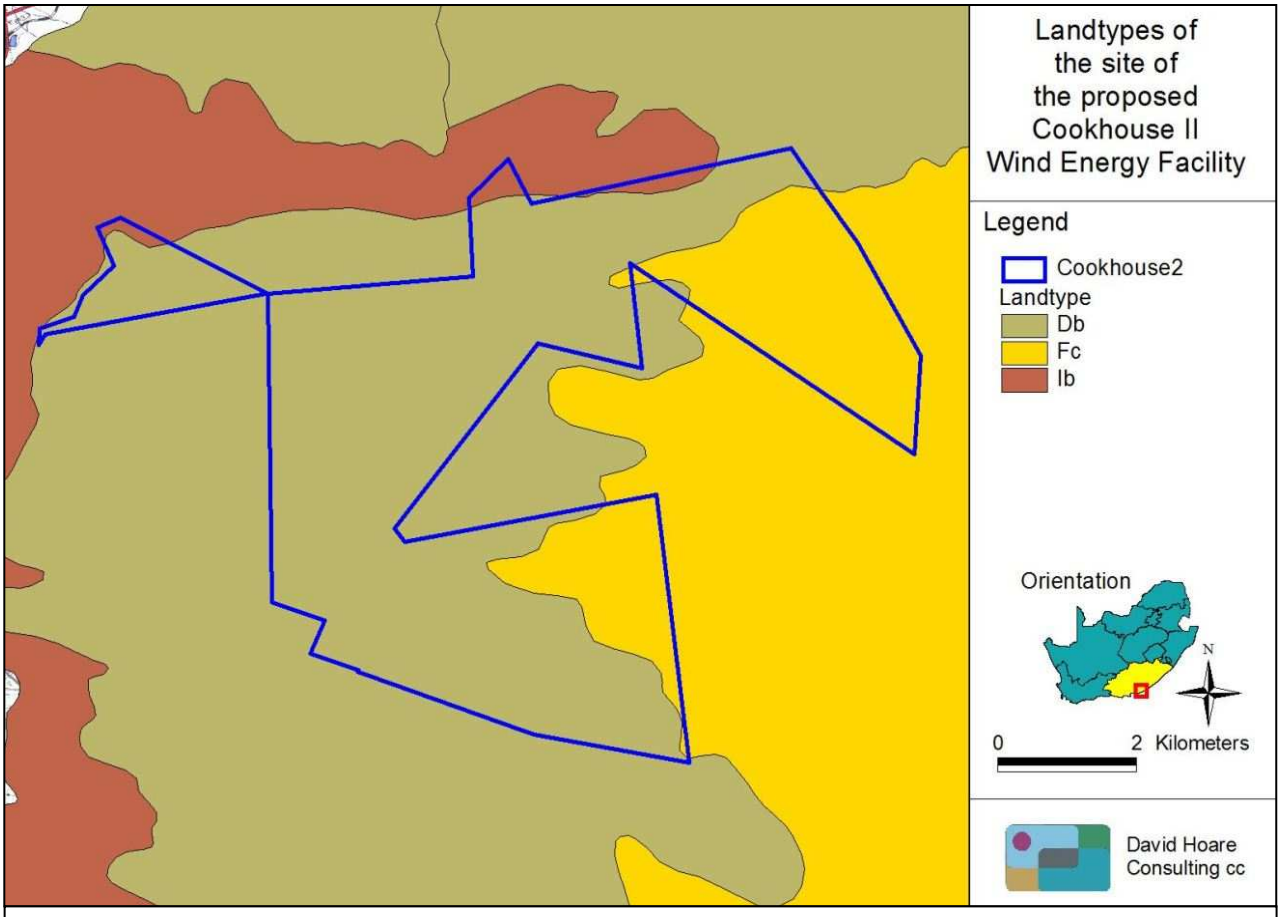

Figure 2: Landtypes of the study area.

Detailed soil information is not available for broad areas of the Eastern Cape. 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 three landtypes in the study area (Figure 2), the Fc, Ib and Db landtypes (Land Type Survey Staff, 1987). The Db landtype (the most widespread in the study area) consists of duplex soils (sandier topsoil on clay subsoil). These are the deeper, more structured soils of the plains areas. The Fc landtype consists mostly of shallow and/or rocky, slightly leached soils, often on steeper slopes. These also occur primarily on the plains, but also on the slopes overlooking the river valley. The Ib land type consists of exposed rock (exposed country rock, stones or boulders) covering 60 – 80% of the area. It occurs on the steep slopes overlooking the Great Fish River valley.

Climate

The study area has warm summers and mild winters. Frost is a common phenomenon and the coldest periods (usually from June to August) are exacerbated by seasonal aridity (Kopke 1988). The average daily minima for the coldest months are below freezing. Winter frost and cold is therefore a potentially limiting factor for plant growth.

Altitude has a strong influence on most climatic variables. Generally, an increase in altitude corresponds with a decrease in temperature and an increase in rainfall. Mountains also have an orographic influence on rainfall, escarpment zones usually experiencing increased rainfall and mists, depending on aspect, cause either an increase or decrease in mean daily insolation levels. The study site is located just south of the Amathole / Winterberg mountain range and the climate is therefore strongly influenced by the presence of these mountains.

Strong bimodal pattern of rainfall exist in the study area with a high proportion of spring and autumn rainfall. The mean annual rainfall in the study area is estimated to vary from approximately 340 - 500 mm for different parts of the study area (Dent *et al*. 1989). The areas with the lowest mean annual rainfall are in the lower-lying areas (<360 mm) and the areas with the highest rainfall are in the southern part of the study area on the south-facing slopes overlooking the river valley (> 440 mm). The mean annual rainfall on the plains, which constitutes the largest part of the study area, varies from 360 - 440 mm (Dent *et al*. 1989). In grasslands, all areas with less than 400 mm are considered to be arid grasslands. The study area can therefore be considered to be relatively dry and, from a floristic point of view, to represent the boundary between grassland and karroid vegetation types.

The study area has high lightning flash densities, which makes the incidence of lightning-induced fire a high likelihood (Schulze 1984). The Eastern Cape is considered to be one of the windiest parts of South Africa (Kopke 1988). Persistent north-westerly winds occur throughout the year bringing dry heat. This can have a severe desiccating effect on the vegetation in any aspects exposed to this wind. In contrast, cold, moist, south-easterly winds blow occasionally in summer. Northerlies, mostly in summer, bring thunderstorms by advecting moist tropical air. Cold fronts, mostly in winter, bring cold, sometimes dry winds.

Landuse and landcover of the study area

The majority of the study area is natural, although parts may be degraded to varying degrees through land-use practices. The landscape 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 grasslands, including the spread of karroid shrublands into the Grassland Biome, 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 evident in the amount and type of vegetation cover.

There are small patches of the study area, primarily within the main drainage lines, that have been cultivated.

Broad vegetation types of the region

According to this most recent vegetation map of the country the study area falls within two main vegetation types, ***Bedford Dry Grassland*** and ***Great Fish Thicket*** (Figure 3). The vegetation types have been categorised according to their conservation status which is, in turn, assessed according to degree of transformation. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. On a national scale these 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).

Both of the vegetation types occurring in the study area are classified as Least Threatened (Table 2) on the basis of rates of transfomration and conservation (Driver et al. 2005; Mucina et al., 2006). In both of these vegetation types, the amount of transformation is relatively low (3-4%, Table 2). The rates of conservation are not very high (1-11%, Table 2), but most of these vegetation types are utilized in their natural state to support commercial livestock farming and there is no immediate threat of them becoming transformed to another landcover type in which natural vegetation is not supported. Despite low levels of transformation, rates of degradation may be relatively high.

Table 1: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)		
80–100	least threatened	LT
60–80	vulnerable	VU
*BT–60	endangered	EN
0–*BT	critically endangered	CR

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
Bedford Dry Grassland	23	1	3	Least Threatened
Great Fish Thicket	19	11	4	Least Threatened

Bedford Dry Grassland is considered to be Least Threatened, with 1% conserved of a target of 23% and 3% transformed (Mucina et al. 2006). This vegetation type is found on the gently undulating plains south of the Winterberg Mountains from Somerset East in the west to Fort Beaufort in the east (Mucina et al. 2006). It is an open, dry grassland interspersed with *Acacia karroo* woodland, especially along drainage lines (Mucina et al. 2006). The grassland is relatively short and contains a dwarf shrubby component of karroid origin (Mucina et al. 2006). This is the most widespread vegetation type within the study area and occurs on all the farm portions under assessment (Figure 4).

Great Fish Thicket is considered to be Least Threatened, with 11% conserved of a target of 19% and 4% transformed (Hoare et al. 2006). This vegetation type occurs mainly in the lower Great Fish River and Keiskamma River valleys, extending up the Great Fish River to Cookhouse and into the southernmost part of the Cradock District (Hoare et al. 2006). It is found on the steep slopes of deeply dissected rivers (Hoare et al. 2006). The vegetation is a short, medium or tall thicket (Hoare et al. 2006). Woody trees and shrubs and succulents are common to dominant and there are many spinescent shrubs (Hoare et al. 2006). The succulent shrub, *Portulacaria afra*, is locally dominant, but is replaced by *Euphorbia bothae* with increasing aridity, and by woody elements and the tall emergent succulents, *Euphorbia tetragona* and *Euphorbia triangularis* on southern aspects (Hoare et al. 2006). There is high heterogeneity within this vegetation unit and it has been divided up into nine distinct subtypes (Vlok & Euston-Brown 2002). This vegetation type is found along the steep slopes on the northern and western side of the study area overlooking the Great Fish River (Figure 4).

Plant species of conservation concern

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 (e.g. Victor & Dold 2003), but have not been recorded in these grids are also listed.

Figure 3: Vegetation types of the study area (Mucina et al. 2005).

The species on this list were evaluated to determine the likelihood of any of them occurring on site. Of the species that are considered to occur within the geographical area under consideration, there were four species recorded in the quarter degree grids that are listed on the Red List that could occur in habitats that are available in the study area. According to IUCN Ver. 3.1 (IUCN, 2001) one of these is listed as Near Threatened, one as Declining and two as Rare (see Table 3 for explanation of categories). The Near Threatened species is *Encephalartos lehmannii* (Karoo cycad). This species is found in arid low succulent shrubland on rocky ridges and slopes. Its overall distribution is concurrent with Albany Thicket. It has been recorded twice within the grids in which the study area is located. The likely distribution of this species is probably to the west of the site in the thicket areas that overlook the Great Fish River Valley, especially in rocky areas. It is therefore highly unlikely to occur on site. Although there is suitable habitat, the plant was last recorded in 1964 on site and, in all likelihood, has already been removed from the site by collectors. No individuals of this species were found 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
LC	Least Concern	Least Concern

Animal species of conservation concern

All Red List vertebrates (mammals, reptiles, amphibians) that could occur in the study area are listed in Appendix 2. The assessment of impacts on birds is undertaken in a separate specialist study. 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.

Other than bats, there are no mammal species of conservation concern that are likely to occur in available habitats in the study area. There is one EN species, the White-tailed Rat, which occurs in Highveld and montane grassland and has a geographical distribution that includes the site, but requires sandy soils with good cover. Geological information and a site visit indicates that soils on site are likely to be clay, although more sandy soils could occur in drainage lines. The remaining mammal species with a geographical distribution that includes the site were assessed as having a low chance of occurring in available habitats in the study area or the study site is at the margin of their distribution range.

There are six bat species of low conservation concern that may occur in the study area. All six species are listed globally as Least Concern, but are listed as Near Threatened in South Africa. There is, therefore, some concern within South Africa that they may be declining within the national boundaries, which has resulted in the status in a low conservation category. A seventh species listed as Near Threatened globally and Endangered in South Africa has a

distribution that is close to the site, but does not quite include it and has been included due to the marginal possibility that it may migrate across the site. Essentially, there are no threatened bat species that are likely to occur on site.

There is one protected frog species previously recorded in the grids in which the study area is located and which could occur on site. This is the Giant Bullfrog. This species was previously listed as Near Threatened, but is now listed as Least Concern. It is, however, protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

There are no reptile species of conservation concern that could occur on site.

Protected trees

Tree species protected under the National Forest Act are listed in Appendix 3. Those that have a geographical distribution that includes the study area are *Catha edulis* (Bushman's Tea), *Curtisia dentata* (Assegai), *Ocotea bullata* (Stinkwood), *Pittosporum viridiflorum* (Cheesewood), *Podocarpus falcatus* (Outeniqua Yellowwood), *Podocarpus latifolius* (Real Yellowwood), *Prunus africana* (Red Stinkwood) and *Sideroxylon inerme* subsp. *inerme* (White Milkwood).

Catha edulis is found in evergreen forest, often in rocky places. *Curtisia dentata* occurs in coastal and montane forest. *Ocotea bullata* occurs in montane forest. *Pittosporum viridiflorum* occurs along forest margins, in bush-clumps and in bushveld, often in rocky outcrops. *Podocarpus falcatus* is found in Afromontane forest. *Podocarpus latifolius* is found in coastal and Afromontane forest. *Prunus africana* occurs in montane forest, usually in mistbelt areas. *Sideroxylon inerme* subsp. *inerme* usually only occurs in coastal areas, in dune thicket and forest, but may also occur on termitaria in bushveld.

None of these species was seen on site, but the size of the area and the fact that some species may occur as small individuals amongst other plants indicates that there is still a very small possibility that they may occur on site. *Pittosporum viridiflorum* could occur in any dense woodland in the study area, especially with any thicket vegetation that may occur in the study area, although no especially dense areas of thicket were encountered. *Catha edulis* has been previously recorded in the study area (see Appendix 4) in the grid 3226CA. This grid includes the forested areas to the north of Bedford where the species is most likely to occur, which means it is unlikely to occur on site.

Regional conservation assessments

There have been a number of regional conservation assessments produced within the Eastern Cape Province, including the following:

- Subtropical Thicket Ecosystem Programme (STEP)
- Succulent Karoo Ecosystems Programme (SKEP)
- National Spatial Biodiversity Assessment (NSBA)
- Eastern Cape Biodiversity Conservation Plan (ECBCP).

These studies identify patterns and processes that are important for maintaining biodiversity in the region. Unfortunately, many of these studies have been done using coarse scale satellite imagery that does not provide spatial or spectral accuracy at the scale of the present study. They are, however, useful for understanding broad issues and patterns within the area. The

ECBCP has integrated all previous studies and is a useful reference for identifying conservation issues in the study area and surrounds.

The ECBCP identifies Critical Biodiversity Areas (CBAs), which are terrestrial and aquatic features in the landscape that are critical for conserving biodiversity and maintaining ecosystem functioning (Berliner & Desmet 2007). The ECBCP identifies CBAs at different levels with decreasing biodiversity importance, as follows (for the study area and surroundings):

1. PA: Protected areas.
2. CBA 1: CR vegetation types and irreplaceable biodiversity areas (areas definitely required to meet conservation targets).
3. CBA 2: EN vegetation types, ecological corridors, forest patches that do not fall into CBA 1, 1 km coastal buffer, irreplaceable biodiversity areas that do not fall into CBA 1.
4. CBA 3: VU vegetation types.

Within and around the study area, the ECBCP identifies CBAs at two levels that occur within the study area (Figure 5). The CBA 2 areas that fall within the study area are corridor areas, which are important for a number of reasons, including the maintenance of ecological processes. The CBA3 areas that fall within the study area are thicket areas that have been identified in STEP as being of elevated conservation value.

The study site occurs within the Albany Centre of Floristic Endemism (van Wyk & Smith 2001). Moreover, it is one of the earth's 25 hotspots, i.e. geographical areas that contain the world's

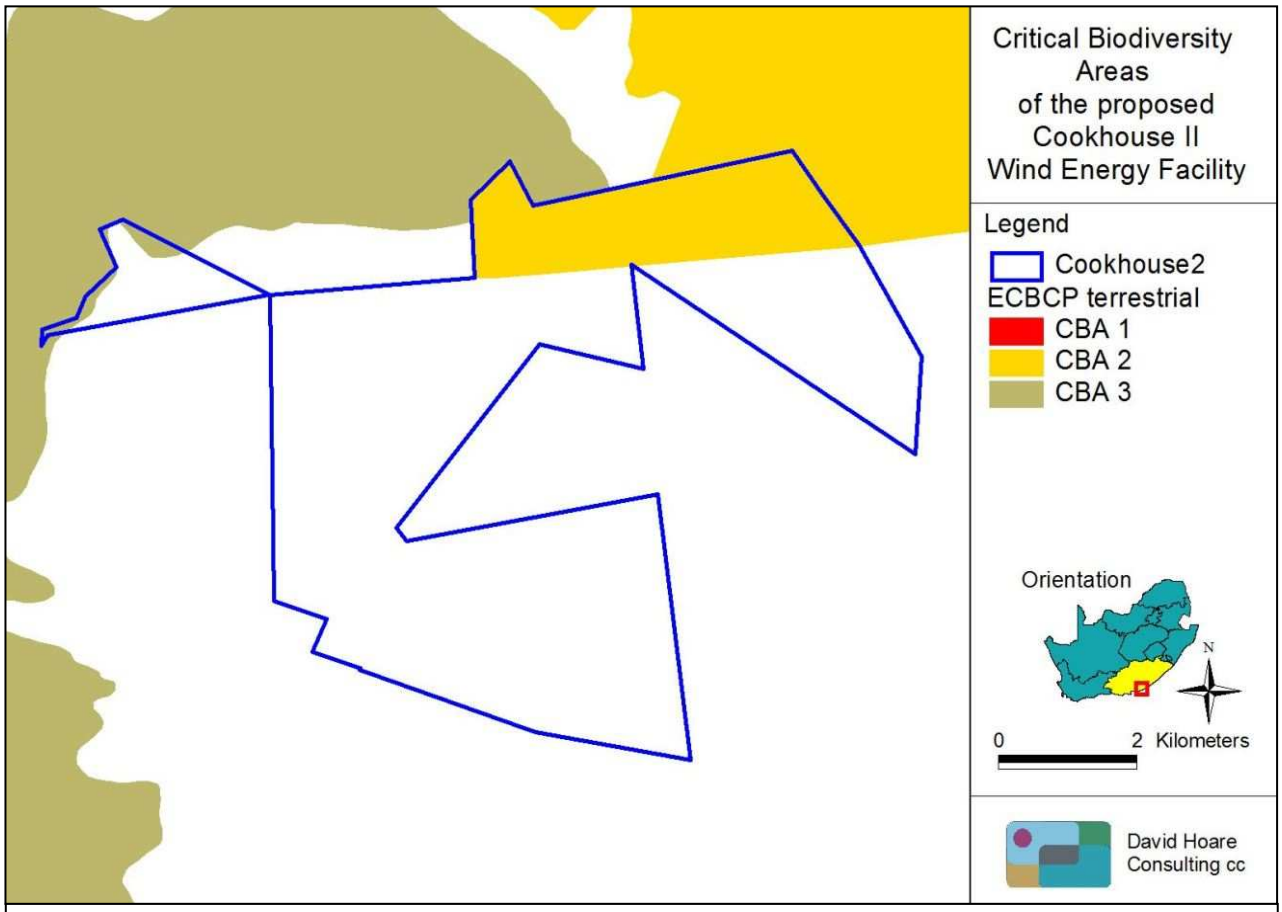

Figure 4: Important biodiversity areas of the study area (from ECBCP).

greatest plant and animal diversity while also being subjected to high levels of pressure from development and/or degradation (Mittermeier et al. 2000, Steenkamp et al. 2004, 2005). Thicket is the most conspicuous component of this Centre and there is a high degree of endemism amongst succulent plants in this Centre of Endemism. It may be presumed that assessments of vegetation types and species in the sections above will also address components that would be important for the Albany Centre of Endemism, but ensuring that no endemic elements of the Albany Centre are negatively affected is also important.

Wetlands and watercourses

In terms of legislation, 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). In addition they are also regarded as sensitive habitats in the National Environmental Management Act implying that they are afforded a higher level of protection. A "watercourse" in terms of the National Water Act (act 36 of 1998) means:

1. River or spring;
2. A natural channel in which water flows regularly or intermittently;
3. A wetland, lake or dam into which, or from which, water flows; and
4. 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.

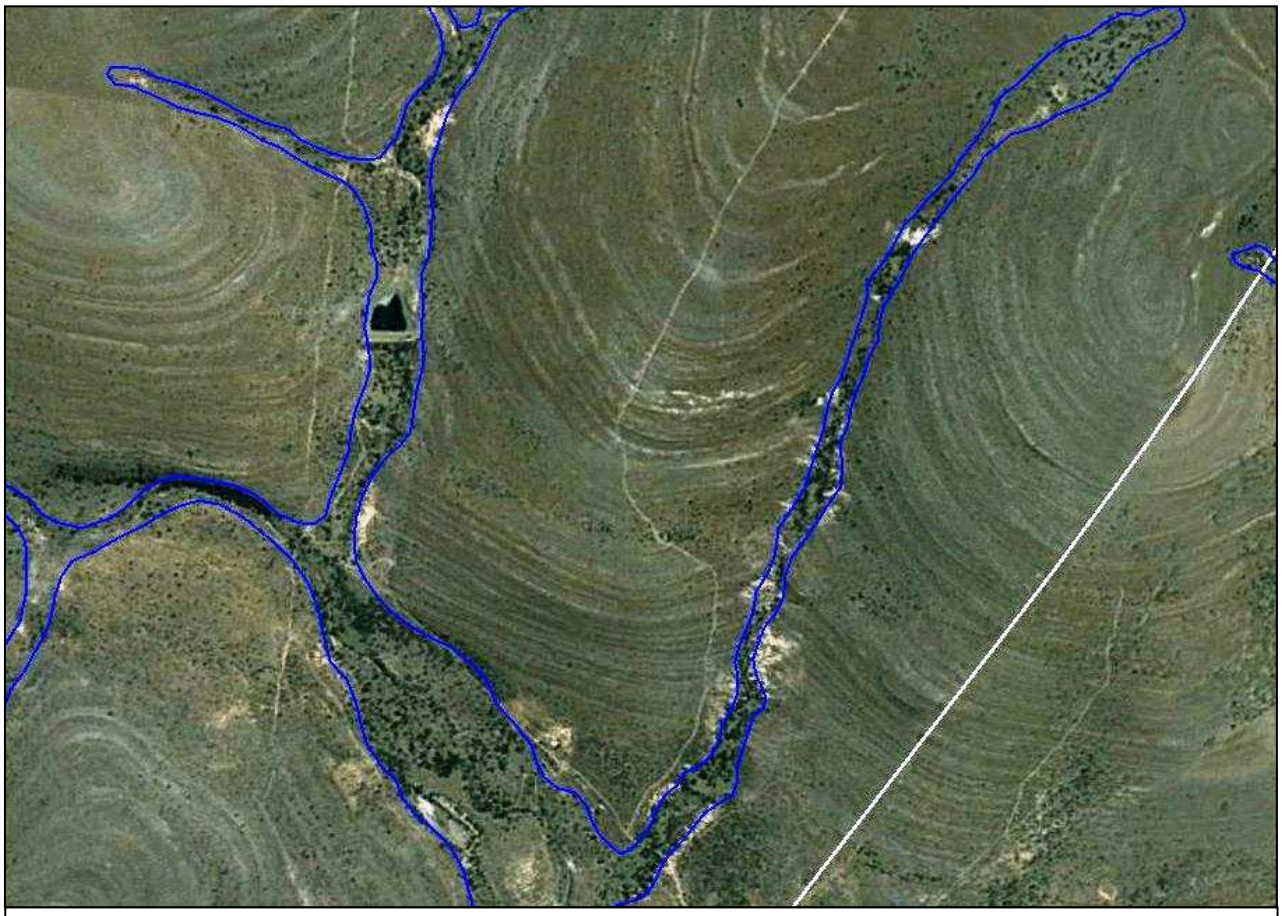

Figure 5: Example from study area of delineated watercourses and wetlands.

A "wetland'' in terms of the National Water Act (act 36 of 1998) means land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

Topo-cadastral maps generally indicate watercourses as lines of narrow dimension. Wetlands associated with these features are, however, wider than this and include, amongst others, floodplain areas, hillslope seepage areas, riparian vegetation in a band along watercourses and valley bottom wetlands.

Wetlands are typically fully delineated according to a delineation procedure as set out by the "*A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*" document, as described by DWAF (2005) and Kotze and Marneweck (1999). Wetland boundaries are then usually verified in the field using soil form, soil wetness, vegetation and terrain unit indicators. A full delineation of wetland boundaries was beyond the requirements for the ecological study. However, it was important to map these wetland features as accurately as possible without extensive soil-based field verification. The following methodology was therefore used for delineating wetland habitats on site:

Watercourses and wetlands were mapped directly from Google imagery of the study area, taking into account only topographic and vegetation indicators of elevated moisture conditions and wet signals apparent from aerial imagery. Use was made of 1:50 000 topographical maps and geo-referenced Google Earth Imagery to create digital base maps of the study area onto which the wetland boundaries could be delineated using ArcView 3.1. A desktop delineation of

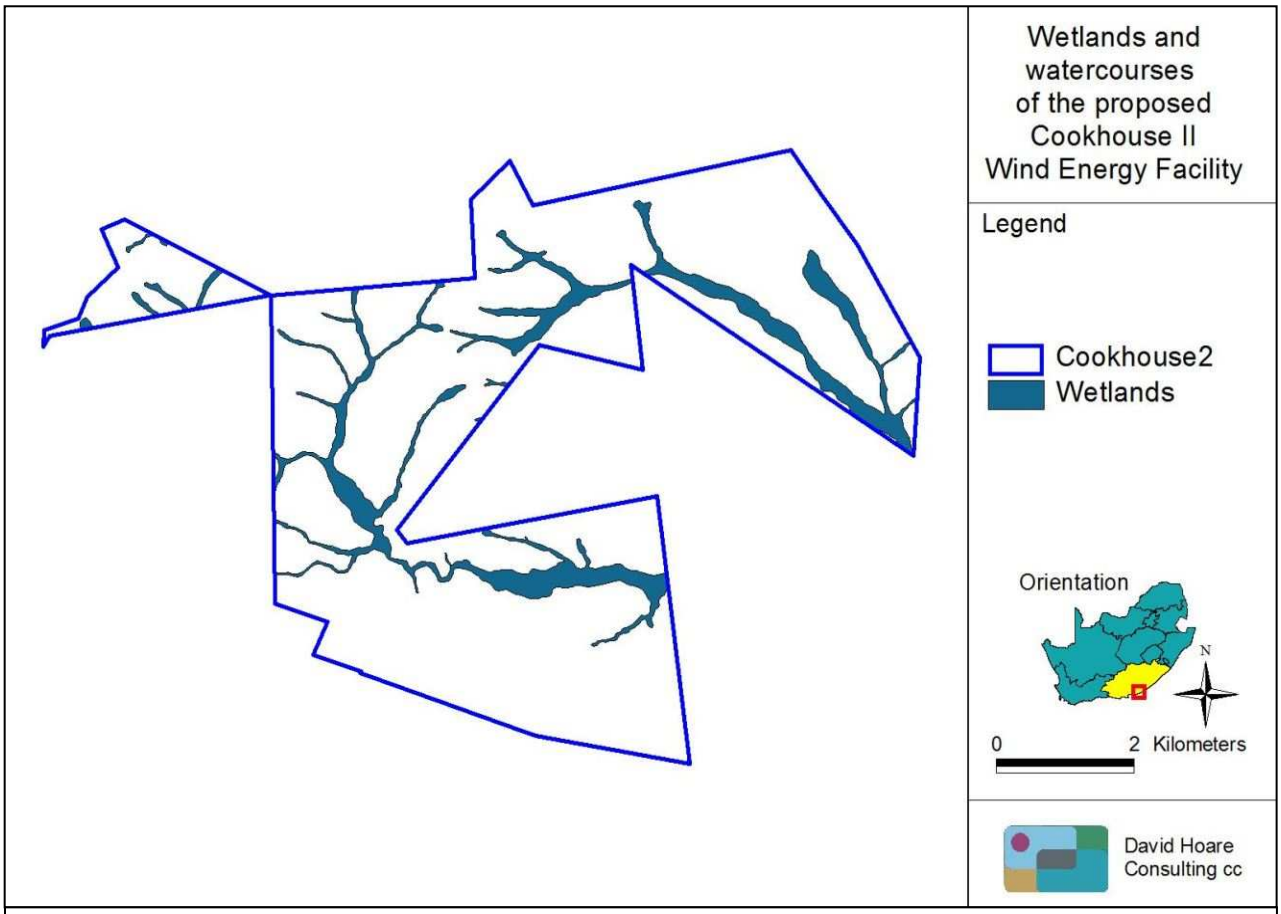

Figure 6: Watercourses and wetlands on site.

suspected wetland areas was undertaken by identifying wetness signatures on the digital base maps. An example of a delineated area of wetland on this site is shown in Figure 5.

The results of the study indicate that the site contains a number of non-perennial drainage lines and watercourses. These drain into more significant riparian areas, some of which may contain flowing water for significant parts of the year, although they are all considered to be non-perennial. The watercourses and riparian zones are often dry with a sandy or rocky bed, but there are also grassy watercourses and seepage areas in upper reaches. The distribution of wetlands, riparian zones and watercourses in the study area is shown in Figure 6.

Any developments contemplated in the sections of the site occupied by the wetlands, riparian zones and watercourses will have a direct negative impact on them and will also interfere with the flow of water from the site or potentially reduce water quality. They are considered to be ecologically sensitive due to the important role they play in supporting biodiversity.

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 containing untransformed natural vegetation, high diversity or habitat complexity, organisms of conservation concern, steep slopes or systems vital to sustaining ecological functions are considered sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have low sensitivity. The information provided in the preceding sections was used to compile a map of natural habitats and areas important for maintaining ecological processes in the study area. Broad scale mapping was used to provide information on the location of sensitive features. There are a number of features that need to be taken into account in order to evaluate sensitivity in the study area. These include the following:

1. vegetation of conservation importance: this is based primarily on the ECBCP assessment (see Figure 4);
2. perennial and non-perennial rivers and streams: this represents a number of ecological processes including biodiversity support, groundwater dynamics, hydrological processes, nutrient cycling and wildlife dispersal (see Figure 6);
3. potential occurrence of populations of organisms of conservation concern or protected, including flora and fauna that have been evaluated as having a chance of occurring within remaining natural habitats within the study area.

These factors have all been taken into account in mapping sensitive areas within the study area. These are mapped in Figure 7. This map shows all watercourses to have HIGH sensitivity, the thicket vegetation in the north-western part of the site and corridor areas (from the ECBCP) to have MEDIUM-HIGH sensitivity and conservation value and other natural areas to have MEDIUM sensitivity and conservation value (Figure 7). A summary of the sensitivity classification and reasons is given in Table 4.

The sensitivity classification provides an indication of potential issues and does not indicate "no-go" areas. In the "Impact Assessment" section (below), specific measures are provided to manage potential impacts on sensitive features where these are potentially affected by proposed infrastructure.

Table 4: Summary of sensitivity classification of site.

Feature	Sensitivity	Reason for classification
Wetlands & watercourses	HIGH	Represents or supports a number of ecological processes including biodiversity support, groundwater dynamics,

		hydrological processes, nutrient cycling and wildlife dispersal.
Vegetation of conservation importance	MEDIUM-HIGH	Based primarily on the ECBCP assessment, all areas falling within an area defined as having elevated conservation value are defined as having medium-high sensitivity, irrespective of condition. This co-incides with areas mapped in the VegMap vegetation map as being Great Fish Thicket and co-incide with corridor areas in the ECBCP.
Habitats that support species of conservation concern	MEDIUM-HIGH	Areas mapped in the VegMap vegetation map as being Great Fish Thicket are potential habitat for one near threatened plant species, the Karoo Cycad.
Remaining natural habitat	MEDIUM	Any natural vegetation not classified as having high sensitivity. The classification of medium sensitivity distinguishes these remaining natural areas from transformed areas and also captures the fact that the site falls within the Albany Centre of endemism.
Transformed areas	LOW	Areas with no natural vegetation remaining (e.g. cultivated areas, urban areas, mines & borrow pits).

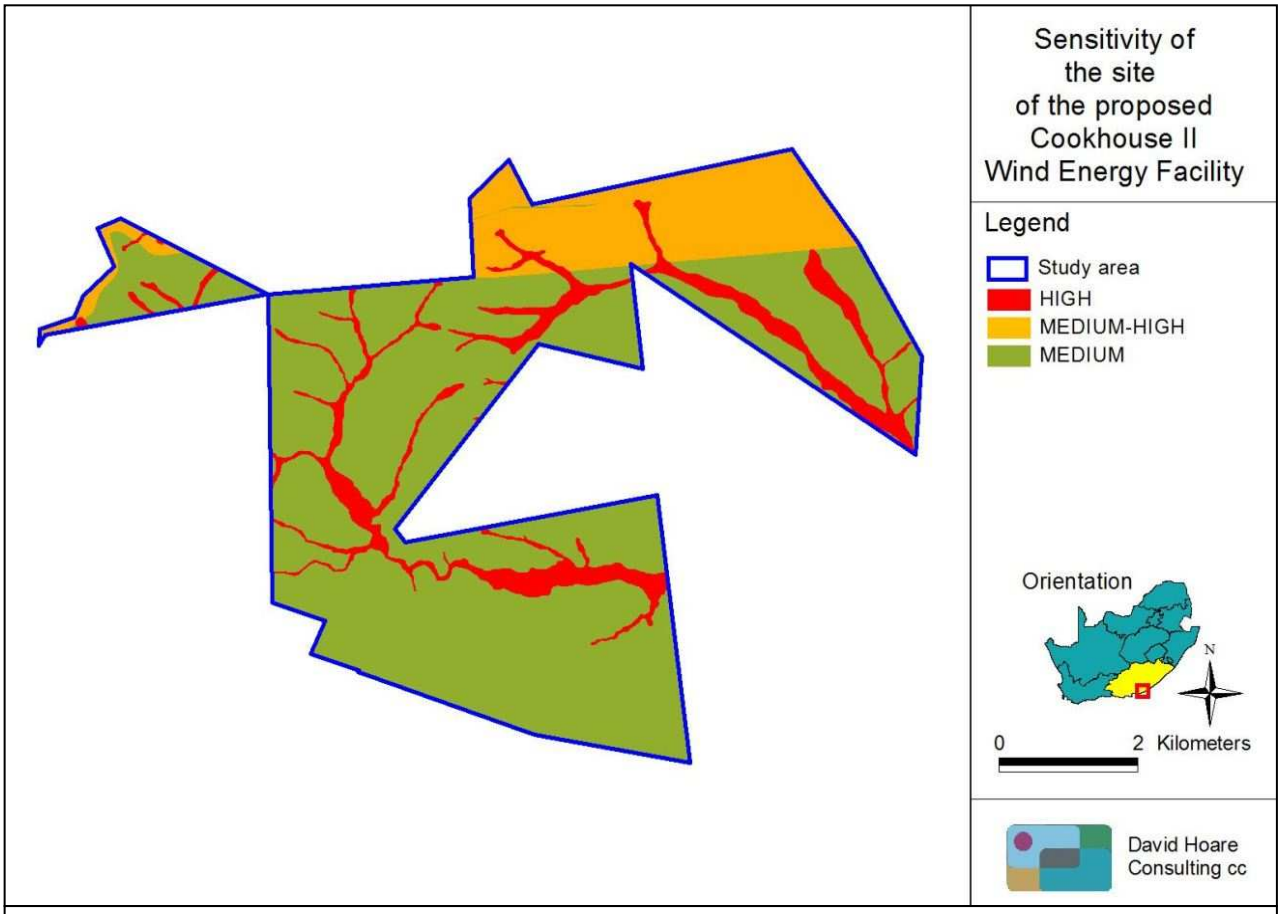

Figure 7: Sensitivity within different parts of the study area.

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."

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.

DESCRIPTION OF INFRASTRUCTURE

A total of up to 50 turbines have been proposed for the site, although only 30 have been indicated in current plans. Each turbine will have a relatively small footprint. There will be disturbance beyond this during the construction phase since a lay-down area is required prior to raising the turbine to it's final position.

There are also up to 2 internal substations, internal cables for connecting turbines to one another and to internal substations, access roads to site and internal access roads to turbines.

The positions of the turbines and internal access roads in the study area are indicated in Figure 8. No substation positions were provided.

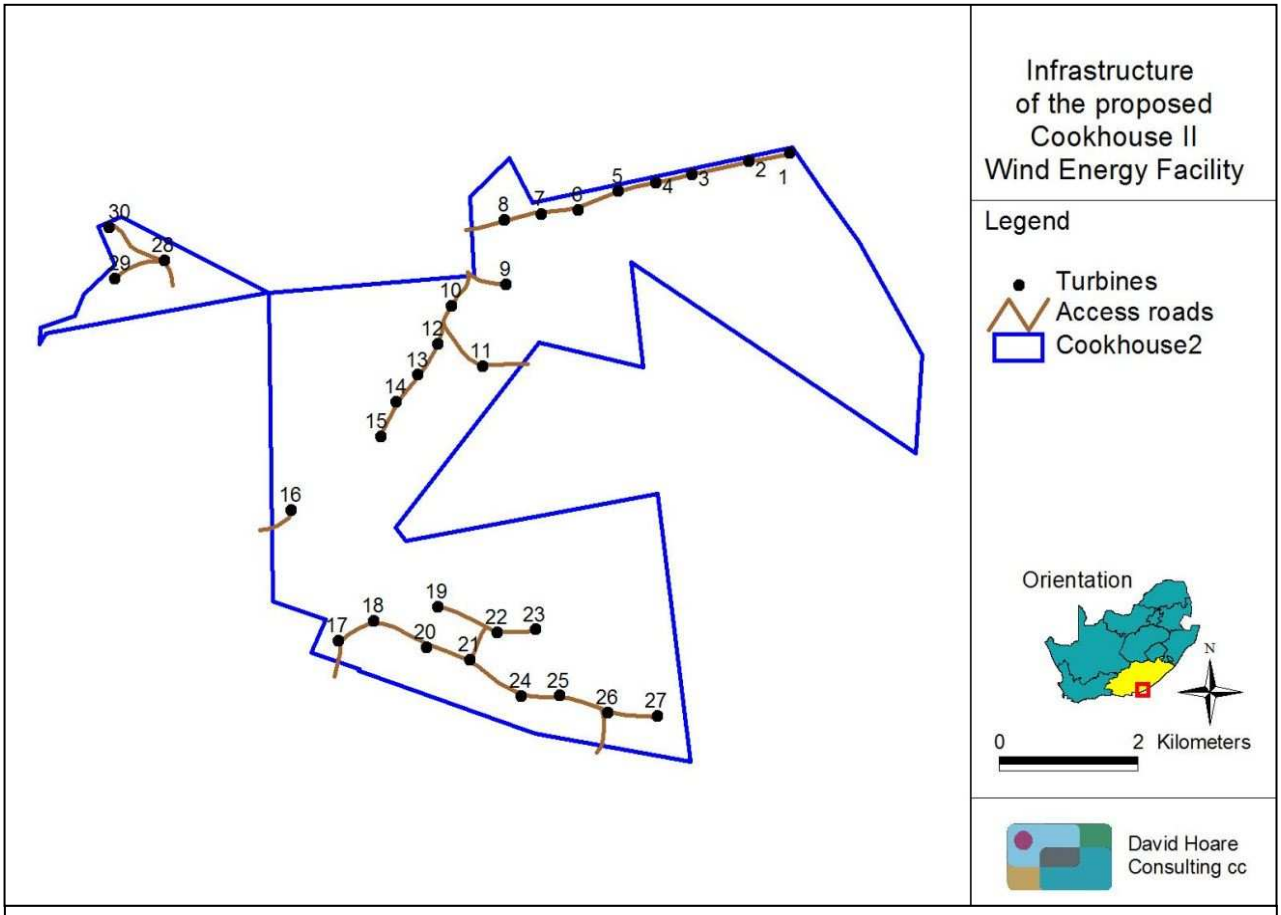

Figure 8: Infrastructure positions in relation to site boundaries.

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 wind energy facility, as follows:

- Clearing of land for construction.
- Construction of access roads.
- 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.

Description of potential impacts

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 wind energy facilities on the ecological environment. There are two major ways that wind-energy development may influence ecosystem structure and functioning—through direct impacts on individual organisms and through impacts on habitat

structure and functioning. The most important potential negative ecological impacts of a wind energy facility are related to bird and bat mortality and loss of habitat.

Impact 1: Impacts on bats

Bird and bat deaths are one of the most controversial biological issues related to wind turbines. The deaths of birds and bats at wind farm sites have raised concerns by conservation agencies internationally. In order to address this issue in South Africa, the Endangered Wildlife Trust (EWT) and BirdLife South Africa (BLSA) have combined efforts to lobby for the appropriate consideration of the potential negative effects of wind energy production.

Bats have been found to be particularly vulnerable to being killed by wind turbines. It has long been a mystery why they should be so badly affected since bat echo-location allows them to detect moving objects very well. A recent study in America has found that the primary cause for mortality is a combination of direct strikes and barotrauma (bats are killed when suddenly passing through a low air pressure region surrounding the turbine blade tips causing low pressure damage the bat's lungs, Baerwald *et al*. 2008). The relative importance of this impact on bat populations depends on which species are likely to be affected, the importance of the site for those species and whether the site is within a migration corridor for particular bat species.

The most vulnerable species are those that are already classified as threatened species, including 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 unless the impact occurs across a wide area that co-incides with their overall distribution range. 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 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.

There are no threatened bat species that are likely to occur on site. There are six species listed globally as Least Concern, but as Near Threatened in South Africa, that could occur on site. The construction of a wind energy facility on site could potentially have a negative impact on these species. A seventh species, listed globally as Near Threatened and in South Africa as Endangered, could occur in Afromontane forest in surrounding areas (within 5 km of the site). Migration of these bats between patches of forest could result in bats flying across the site and being impacted upon by turbines.

Impact 2: Impacts on threatened animals

Threatened animal species are 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.

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, possibly extinction. 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 is one mammal species of conservation concern, classified as Endangered, and one protected frog species that could potentially be affected by the proposed wind energy facility. Neither are considered to have a high chance of occurring on site.

The Endangered (EN) mammal species is the White-tailed Rat, which occurs in Highveld and montane grassland, but requires sandy soils with good cover. Geological information indicates that soils on site are likely to be clay, although more sandy soils could occur in drainage lines. This reflects patterns observed on site during the field survey. Furthermore, habitat information collected in the field indicates that grassland habitat suitable for this species does not occur on site. It is therefore considered unlikely that this species occurs on site. Impacts on this species are, therefore, not considered further.

There is one frog species of conservation concern previously recorded in the grids in which the study area is located and which could occur on site. This is the Giant Bullfrog. This species was previously listed as Near Threatened, but is now listed as Least Concern (www.iucnredlist.org). It is, however, protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004). It inhabits a variety of vegetation types where it breeds in seasonal, shallow, grassy pans in flat, open areas. It also utilises non-permanent vleis and shallow water on margins of waterholes and dams. It prefers sandy substrates although they sometimes inhabit clay soils. There are some farm dams in watercourses that could potentially provide breeding habitat for this species, although not ideal. Bullfrogs could forage in surrounding vegetation.

There are no reptile species of conservation concern that could occur on site.

There are therefore no animal species of conservation concern that are likely to occur on site and one protected animal species that may occur on site, the Giant Bullfrog.

Impact 3: Impacts on threatened plants

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 chances of the species overall survival chances.

There is one plant species of conservation concern that has a geographic distribution that includes the site and two species of lesser conservation concern. The plant species of concern is *Encephalartos lehmannii* (Karoo cycad), classified as Near Threatened. This species is only likely to occur in rocky areas within thicket vegetation, which only occurs in the southern part of the site.

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 section15 (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".

A number of species have a geographic distribution that includes the study area appear on this list, including the following: *Catha edulis* (Bushman's Tea)*, Curtisia dentata* (Assegai)*, Ocotea bullata* (Stinkwood)*, Pittosporum viridiflorum* (Cheesewood)*, Podocarpus falcatus* (Outeniqua Yellowwood)*, Podocarpus latifolius* (Real Yellowwood), *Prunus africana* (Red Stinkwood) and *Sideroxylon inerme* subsp. *inerme* (White Milkwood). They all occur primarily in forest habitat, which, as confirmed from the field survey, does not occur on site. It is therefore not considered likely that they occur on site. This impact is therefore considered unlikely to occur and is not evaluated further. Nevertheless, if in the unlikely event that any protected trees are found on site, a permit would need to be obtained for any trees that are affected, so a legal obligation remains irrespective of the significance of the impact.

Impact 5: Impacts on indigenous natural vegetation (terrestrial)

Construction of infrastructure may lead to direct loss of vegetation. This will lead to localised or more extensive reduction in the overall extent of grassland vegetation. 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). Consequences of the impact 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 on site is classified as Least Threatened. However, the site falls within the Albany Centre of Endemism and also affects areas classified as important corridors in the ECBCP. Those areas classified as having elevated conservation value according to the ECBCP are the areas of Great Fish Thicket in the southern part of the site.

Impact 6: Impacts on watercourses / wetlands

Construction may lead to some direct or indirect loss of or damage to seasonal marsh wetlands or drainage lines or impacts that affect the catchment of these wetlands. This will lead to localised loss of wetland habitat and may lead to downstream impacts that affect a greater extent of wetlands or impact on wetland function. Where these habitats are already stressed due to degradation and transformation, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat. Physical alteration to wetlands can have an impact on the functioning of those wetlands. Consequences may include:

1. increased loss of soil;
2. loss of or disturbance to indigenous wetland vegetation;
3. loss of sensitive wetland habitats;
4. loss or disturbance to individuals of rare, endangered, endemic and/or protected species that occur in wetlands;
5. fragmentation of sensitive habitats;
6. impairment of wetland function;
7. change in channel morphology in downstream wetlands, potentially leading to further loss of wetland vegetation; and
8. reduction in water quality in wetlands downstream of road.

The site contains a number of wetlands, watercourses and drainage lines.

Impact 7: Change in runoff and drainage patterns

Infrastructure and roads crossing landscapes cause local hydrological and erosion effects resulting in major peak-flow and sediment impacts (Forman & Alexander 1998). This may occur around construction sites, but also in areas where the infiltration rates of the landscape are changed due to an impermeable surface being constructed. Increased runoff associated with infrastructure may increase the rates and extent of erosion, reduce percolation and aquifer recharge rates, alter channel morphology and increase stream discharge rates. Consequences may include:

1. increased loss of soil;
2. loss of or disturbance to indigenous vegetation, especially in wetlands;
3. loss of sensitive habitats, especially in wetlands;
4. loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
5. fragmentation of sensitive habitats;
6. impairment of wetland function;
7. change in channel morphology in downstream wetlands, potentially leading to loss of wetland vegetation; and
8. reduction in water quality in wetlands downstream of road.

There are both steep slopes and wetlands potentially occurring on site.

Impact 8: Establishment and spread of declared weeds and alien invader plants

Major factors contributing to invasion by alien invader plants includes high disturbance, fostering/utilisation as hedges, woodlots or fruit trees, negative grazing practices, and deforestation (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.

The site does not currently harbour alien plants in significant densities. There are localised concentrations of *Eucalyptus* species (gum trees) around homesteads and other species that occur sporadically in the landscape. Alien invasions are therefore not a major issue in the study area at the moment, but the presence of a diffuse disturbance over a wide area could lead to the spread of a number of species that are present in the area. The habitats most likely to be affected are watercourses and grasslands.

ASSESSMENT OF IMPACTS

Impacts are assessed for each component of infrastructure for the proposed wind energy facility, as follows:

- wind turbines;
- underground cables between turbines and linking turbines to internal substations;
- internal access roads.

Underground cables linking turbines and internal access roads are expected to generally follow the same alignment. The two components of the infrastructure are therefore assessed as a single impact.

Wind turbines

Impact 1: Collision of bats with turbine blades

There are six Near Threatened (in South Africa) and one Endangered (in South Africa) bat species that could occur on site. These species may be negatively impacted by collisions with turbine blades. For all six Near Threatened species, their distribution includes a minimum of a coastal to escarpment width. The site may constitute a part of a corridor through which these species may migrate and, to a lesser extent, they may occur on site or nearby. The overall distribution of these species is, however, relatively wide. Loss of some individuals on site is therefore unlikely to have a significant impact on population numbers of any of these six species. For the Endangered bat species (Swinny's Horseshoe Bat), the site is just outside the edge of the distribution range of the species. It is possible that there may be local migrations between forest patches across the site, but the site is unlikely to be a regional migration route, the loss of which would fragment the species.

Extent: The impact will occur at the site of the proposed wind energy facility, but may affect populations in surrounding areas or affect migration routes of species and is therefore scored as "regional".

Magnitude: At a local scale, it is likely to be an impact of low magnitude (may cause a slight impact on population processes).

Duration: The impact will be of long-term duration (operation phase only).

Probability: It is considered that there is a high probability of Near Threatened species occurring on site and a low probability of the Endangered species occurring on site. The probability is therefore rated as "probable" for the six Near Threatened species and "improbable" for the Endangered species.

Potential significance: On the basis of this assessment, the impact is likely to be of low significance.

Mitigation measures: A preconstruction survey for bats should be undertaken to determine whether bat species of concern occur on site or not and whether roosting habitats or known important maternity roosts occur within close proximity to the site. If this preconstruction survey finds that the presence of bats or roosting habitats of concern occur, then a monitoring programme must be implemented to document the effect on bats of the turbines. The detail of this monitoring programme must be informed by the outcomes of the preconstruction survey. If the turbines are found to have a significant negative impact on bats then further measures

will need to be implemented to control the impact, for example, halting operation during low wind conditions.

Nature: Impacts on individuals of threatened animal species		
	Without mitigation	**With mitigation**
Extent	regional (3)	regional (3)
Duration	long-term (4)	long-term (4)
Magnitude	low (4)	minor (2)
Probability	(NT) probable (3) (EN) improbable (2)	(NT) improbable (2) (EN) improbable (2)
Significance	**(NT) medium (33)** **(EN) low (22)**	**(NT) low (18)** **(EN) low (18)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) A preconstruction survey for bats should be undertaken to determine whether bat species of concern occur on site or not and whether roosting habitats or known important maternity roosts occur within close proximity to the site. (2) If this preconstruction survey finds that the presence of bats or roosting habitats of concern occur, then a monitoring programme should be implemented to document the effect of wind turbines on bat species of concern. (3) If the turbines are found to have a significant negative impact on bats then further measures will need to be implemented to control the impact.		
Cumulative impacts: Impacts that cause loss of habitat (e.g. soil erosion, alien invasions, damage to wetlands and increased frequency of veld fires) 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 2: Impacts on threatened animal species

There is one protected frog species that is likely to occur on site, the Giant Bullfrog, and no other species of conservation concern. Likely breeding sites are the edges of small farm dams in watercourses on site. They may forage in surrounding vegetation. On the condition that habitat in watercourses is not affected to a significant degree, it is unlikely that construction of the wind energy facility will have a significant impact on this species, even if it occurs on site.

Extent: The impact will occur at the site of the proposed wind energy facility and is therefore scored as "local".

Magnitude: At a local scale, it is likely to be an impact of low magnitude (may cause a slight impact on population processes).

Duration: The impact will be of short-term duration (construction phase only, on condition watercourses are not affected). Foraging habitat could potentially be disturbed during the construction phase, but once vegetation has recovered, any bullfrogs that may occur on site will be able to utulise the habitats again with little interference from the wind energy facility.

Probability: It is considered that there is a low probability of bullfrogs occurring on site. No turbines are currently positioned in areas that could potentially be breeding habitat for this species. The probability is therefore rated as "improbable".

Potential significance: On the basis of this assessment, the impact is likely to be of low significance.

Mitigation measures: Unnecessary impacts on dams and pans within watercourses must be avoided. If, in the unlikely event that any individuals of the Giant Bullfrog are found on site, personnel on site may not harm these animals in any way. Harming them will amount to a contravention of the Act protecting this species (the National Environmental Management: Biodiversity Act, Act No. 10 of 2004).

Nature: Impacts on individuals of threatened animal species		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	short-term (2)	short-term (2)
Magnitude	low (2)	low (2)
Probability	improbable (2)	Highly improbable (1)
Significance	**low (15)**	**low (5)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) Avoid impacts on wetlands and watercourses, especially small dams and pans in which bullfrogs could potentially breed. (2) No personnel on site may cause harm to any individual Giant Bullfrog, at risk of contravening legislation that protects this species.		
Cumulative impacts: Impacts that cause loss of habitat (e.g. soil erosion, alien invasions, damage to wetlands and increased frequency of veld fires) 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 3: Impacts on threatened plant species

There is one near threatened plant species that has been evaluated as having a probability of occurring on site, *Encephalartos lehmannii* (Karoo cycad). A picture of this is shown below (Plate 1) This species is most likely to occur in the thicket vegetation in the western part of the site. There are no turbines that are proposed to be positioned in this area.

Extent: The impact will occur at the site of the proposed wind energy facility, but will have an impact at a more regional level, since it potentially affects the global status of the affected species.

Magnitude: At a regional scale, it is likely to be an impact of small magnitude (will have no effect on population processes).

Duration: The impact will be of permanent duration (due to construction) because individual plants that are lost will be permanently displaced from natural habitat.

Probability: It is considered that there is a low probability of encountering this plant species on site. Although there is suitable habitat, the plant was last recorded in 1964 on site and, in all likelihood, has already been removed from the site by collectors. The probability is therefore rated as "highly improbable".

Potential significance: On the basis of this assessment, the impact is likely to be of low significance.

Mitigation measures: If any cycads are found by personnel on site, the position must be reported to the conservation authorities and steps taken to avoid damaging any plants. If damage to plants is unavoidable, then a reputable organisation must be contacted to remove the plants to safety and record relevant information about the plant and the habitat in which it was found. A permit will be required for removal of the plant.

Nature: Destruction/permanent loss of individuals of threatened plant species		
	Without mitigation	**With mitigation**
Extent	regional (3)	regional (3)
Duration	permanent (5)	permanent (5)
Magnitude	small (2)	small (1)
Probability	Highly improbable (1)	Highly improbable (1)
Significance	**low (10)**	**low (9)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: (1) If any cycads are found by personnel on site, the position must be reported to the conservation authorities and steps taken to avoid damaging any plants. (2) Plants should be avoided, where possible. (3) If damage to plants is unavoidable, then a reputable organisation must be contacted to remove the plants to safety and record relevant information about the plant and the habitat in which it was found. A permit will be required for removal of the plant.		
Cumulative impacts: Loss of habitat, soil erosion, alien invasions may all lead to additional impacts that will exacerbate this impact.		

Plate 1: *Encephalartos lehmannii* (Karoo cycad).

Residual Impacts: None likely.

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

Impact 5: Impacts on indigenous natural vegetation

Each wind turbine will require an area of up to 20 x 20 m to be cleared. There will therefore be localised impacts associated with the construction of each wind turbine. The collective impact of up to 50 turbines is likely to lead to a loss of up to approximately 2 ha of natural vegetation. The vegetation types on site are classified as Least Threatened, although the site occurs within a Centre of Endemism and parts of the site have been identified in the Eastern Cape Biodiversity Conservation Plan as being within a corridor area. Components of the site have therefore been classified as having medium-high conservation value on this basis.

Extent: The impact will occur at the site of the proposed wind energy facility, which is scored as local.

Magnitude: At a regional scale, it is likely to be an impact of low magnitude (may cause a slight impact on processes). Loss of some vegetation is unlikely to affect the global conservation status of the vegetation, nor affect the integrity of ecological corridors.

Duration: The impact will be of permanent duration because loss of some vegetation is unavoidable.

Probability: It is definite that the impact will occur.

Potential significance: On the basis of this assessment, the impact is likely to be of medium significance.

Mitigation measures: If the project takes place then there will have to be clearing of vegetation for each turbine. Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the turbine, lay-down area and the approach road.

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 (3)	small (2)
Probability	definite (5)	definite (5)
Significance	**medium (45)**	**medium (40)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To a small extent	
Mitigation: (1) Avoid unnecessary impacts on natural vegetation surrounding turbine position. Impacts should be contained, as much as possible, within the footprint of the turbine and the surrounding laydown area.		
Cumulative impacts: Soil erosion, alien invasions and 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 occur, but this is insignificant relative to the total extent of the vegetation type.		

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

Impact 6: Impacts on watercourses

There are a small number of wetlands, drainage lines and watercourses on site that could potentially be affected by the proposed construction of wind turbines. No turbines are currently positioned within mapped watercourse areas. This impact will therefore not occur for this infrastructure component and is not assessed further.

Impact 7: Change in runoff and drainage patterns

Hard surfaces created as part of the development, for example, the cement slab at the footprint of each wind turbine, may lead to increased runoff rather than infiltration of water into the ground. Where the ground is relatively flat, this is unlikely to pose too many problems, but on sloping ground, this may lead to increased erosion and siltation of downslope areas. There are both steep slopes and watercourses occurring on site, but turbine positions vary in terms of slope and substrate properties. No turbines appear to be located on slopes that are steep, but there are turbines (nos 29 and 30) that are in close proximity to steep slopes.

Extent: The impact will be local, although downslope areas could be affected. It is scored as "local and surroundings".

Magnitude: It is likely to be an impact of medium magnitude (in terms of the degree to which erosion may be caused that damages downslope areas).

Duration: The impact will be of long-term duration.

Probability: Based on the current position of the infrastructure, it is unlikely that the impact will occur.

Potential significance: On the basis of this assessment, the impact is likely to be of medium significance.

Mitigation measures: A comprehensive stormwater management plan must be compiled, prior to construction, that details how stormwater off hard surfaces will be managed to reduce velocities and volumes of water that could lead to erosion of surfaces. Any disturbed areas should be immediately rehabilitated in order to stabilise landscapes and prevent exposed surfaces from becoming susceptible to erosion. Water velocity off hard surfaces must be reduced and diffused before water is returned to natural systems in order to minimise the risk of creating erosion channels. If any erosion features develop, they should be stabilised using typical measures, such as gabions, weirs, rock-packing, etc.

Nature: Change in runoff and drainage leading to increased soil erosion and siltation of downslope areas		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	long-term (4)	short-term (2)
Magnitude	Moderate (6)	low (4)
Probability	Improbable (2)	improbable (2)
Significance	**low (24)**	**low (16)**
Status (positive or negative)	negative	negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: (1) compile a comprehensive storm-water management plan (2) rehabilitate any disturbed areas immediately to stabilise landscapes		

(3) water velocity must be reduced and diffused before water is returned to natural systems (4) erosion features must be immediately stabilised, if they develop. (5) The position of some of the turbines on very steep slopes must be re-considered and these turbines moved to more appropriate positions.
Cumulative impacts: Alien invasions, damage to wetlands, loss of habitat may all lead to additional impacts 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 8: Establishment and spread of declared weeds and alien invader plants

The site is not known to harbour alien trees in significant numbers. There is therefore a weak potential for alien trees to spread or become established following disturbance on site. The presence of a diffuse disturbance over a wide area could, however, lead to the spread of species that are present in the area.

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

Magnitude: It is likely to be an impact of medium magnitude on local ecosystems.

Duration: The impact will be of long-term duration.

Probability: It is probable that the impact will occur in the absence of control measures. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low

Potential significance: On the basis of this assessment, the impact is likely to be of medium significance.

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 that would take decades to remove. 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	sight & surroundings (2)	sight & surroundings (2)
Duration	long-term (4)	long-term (4)
Magnitude	moderate (6)	small (2)
Probability	probable (3)	improbable (2)
Significance	**medium (36)**	**low (16)**
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 following completion of construcrtion		

activities in an area (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 and increased frequency of veld fires 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.

Underground cables between turbines and internal access roads

The preferred option for this project is to connect turbines via underground cables. Internal access roads and underground cables are expected to follow the same alignments. Installation of underground cables will require the digging of a trench between turbines. The position of underground cables and internal access roads is shown in Figure 8.

Impact 2: Impacts on threatened animal species

There is one protected frog species that is likely to occur on site, the Giant Bullfrog, and no other species of conservation concern. Likely breeding sites are the edges of small farm dams in watercourses on site. They may forage in surrounding vegetation. On the basis of the proposed position of turbines and the fact that turbines will be linearly linked by underground cables, it is almost certain that a number of drainage lines and a significant amount of foraging habitat will be directly impacted upon by the proposed infrastructure.

Extent: The impact will occur at the site of the proposed wind energy facility and is therefore scored as "local".

Magnitude: At a local scale, it is likely to be an impact of moderate to high magnitude (in terms of the individuals and habitats that will be affected).

Duration: The impact will be of medium-term duration (until vegetation has recovered / been rehabilitated following construction). Foraging habitat could potentially be disturbed during the construction phase, but once vegetation has recovered, any bullfrogs that may occur on site will be able to utulize the habitats again with little interference from the wind energy facility.

Probability: It is considered that there is a low probability of bullfrogs occurring on site. However, underground cables and internal access roads will definitely impact on potential habitat. The probability of impacts occurring on this species is rated as "probable".

Potential significance: On the basis of this assessment, the impact is likely to be of low significance.

Mitigation measures: Unnecessary impacts on dams and pans within watercourses must be avoided. If, in the unlikely event that any individuals of the Giant Bullfrog are found on site, personnel on site may not harm these animals in any way. Harming them will amount to a contravention of the Act protecting this species (the National Environmental Management: Biodiversity Act, Act No. 10 of 2004).

Nature: Impacts on individuals of threatened animal species		
	Without mitigation	**With mitigation**

Extent	local (1)	local (1)
Duration	medium-term (3)	medium-term (3)
Magnitude	medium (5)	medium (5)
Probability	probable (3)	improbable (2)
Significance	**low (27)**	**low (18)**
Status (positive or negative)	negative	negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) Avoid impacts on wetlands and watercourses, especially small dams and pans in which bullfrogs could potentially breed. (2) No personnel on site may cause harm to any individual Giant Bullfrog, at risk of contravening legislation that protects this species.		
Cumulative impacts: Impacts that cause loss of habitat (e.g. soil erosion, alien invasions, damage to wetlands and increased frequency of veld fires) 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 3: Impacts on threatened plant species

There is one near threatened plant species that has been evaluated as having a high probability of occurring on site, *Encephalartos lehmannii* (Karoo cycad). A picture of this is shown above (Plate 1). This species is most likely to occur in the thicket vegetation in the western part of the site. No underground cables and internal access roads linking turbines are proposed to be located in these areas. It is thus highly unlikely to impact on potential habitat for this species in this part of the site.

Extent: The impact will occur at the site of the proposed wind energy facility, but will have an impact at a more regional level, since it potentially affects the global status of the affected species.

Magnitude: At a regional scale, it is likely to be an impact of small magnitude (will have no effect on population processes).

Duration: The impact will be of permanent duration (due to construction) because individual plants that are lost will be permanently displaced from natural habitat.

Probability: It is considered that there is a low probability of encountering this plant species on site. Although there is suitable habitat, the plant was last recorded in 1964 on site and, in all likelihood, has already been removed from the site by collectors. The probability is therefore rated as "highly improbable".

Potential significance: On the basis of this assessment, the impact is likely to be of low significance.

Mitigation measures: If any cycads are found by personnel on site, the position must be reported to the conservation authorities and steps taken to avoid damaging any plants. If damage to plants is unavoidable, then a reputable organisation must be contacted to remove the plants to safety and record relevant information about the plant and the habitat in which it was found. A permit will be required for removal of the plant.

Nature: Destruction/permanent loss of individuals of threatened plant species		
	Without mitigation	**With mitigation**
Extent	regional (3)	regional (3)

Duration	permanent (5)	permanent (5)
Magnitude	small (2)	small (1)
Probability	Highly improbable (1)	Highly improbable (1)
Significance	**low (10)**	**low (9)**
Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: (1) If any cycads are found by personnel on site, the position must be reported to the conservation authorities and steps taken to avoid damaging any plants. (2) If damage to plants is unavoidable, then a reputable organisation must be contacted to remove the plants to safety and record relevant information about the plant and the habitat in which it was found. A permit will be required for removal of the plant.		
Cumulative impacts: Loss of habitat, soil erosion, alien invasions may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: None likely.		

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

Impact 5: Impacts on indigenous natural vegetation

Significant areas of vegetation will be cleared for the underground cables and internal access roads between turbines. There will therefore be localised impacts that affect areas throughout the site. The vegetation types on site are classified as Least Threatened, although the site occurs within a Centre of Endemism and has been identified in the Eastern Cape Biodiversity Conservation Plan as being within a corridor area. Components of the site have therefore been classified as having medium-high conservation value.

Extent: The impact will occur at the site of the proposed wind energy facility, which is scored as local.

Magnitude: At a regional scale, it is likely to be an impact of low to medium magnitude (may result in processes continuing but in a modified way). Loss of some vegetation is unlikely to affect the global conservation status of the vegetation, but may affect the integrity of ecological corridors.

Duration: The impact will be of permanent duration because loss of some vegetation is unavoidable.

Probability: It is definite that the impact will occur.

Potential significance: On the basis of this assessment, the impact is likely to be of medium significance.

Mitigation measures: If the project takes place then there will have to be clearing of vegetation for access roads and underground cables. Unnecessary impacts on surrounding natural vegetation must be avoided. Infrastructure should not be located within the areas classified as thicket in the southern parts of the site.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	local (1)	local (1)
Duration	permanent (5)	permanent (5)
Magnitude	medium (5)	low (4)
Probability	definite (5)	definite (5)
Significance	**medium (55)**	**medium (50)**

Status (positive or negative)	negative	negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some extent	
Mitigation: (1) Avoid unnecessary impacts on natural vegetation surrounding internal access roads. Impacts should be contained, as much as possible, within the planned footprint of the access roads and underground cables. (2) Do not put infrastructure into the southern parts of the site classified as thicket.		
Cumulative impacts: Soil erosion, alien invasions and 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 occur, but this is insignificant relative to the total extent of the vegetation type.		

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

Impact 6: Impacts on watercourses

On the basis of the proposed position of internal access roads and underground cables, it is definite that two small watercourses on site will be affected by the construction of infrastructure.

Extent: The impact will be local and surrounding areas, although downstream areas could be affected.

Magnitude: It is likely to be an impact of low magnitude (will cause a slight impact on processes).

Duration: The impact will be of permanent duration.

Probability: Based on the current position of the infrastructure, it is highly probable that the impact will occur.

Potential significance: On the basis of this assessment, the impact is likely to be of medium significance.

Mitigation measures: Stormwater and runoff water must be controlled and managed to avoid impacts on watercourses. A permit from DWA is required if there are expected to be any impacts on any wetland or water resources. Infrastructure should be kept a minimum of 30 m away from the edge of the temporary zone of any wetland feature. Access roads and underground cables should be positioned outside watercourses, as far as possible. Crossings should be perpendicular. Adequate bridge and/or culvert structures should be used for crossing watercourses. Erosion control measures are required downstream of any watercourse crossing.

Nature: Damage to wetland areas resulting in hydrological impacts		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Permanent (5)	Long-term (4)
Magnitude	Low (4)	Low (3)
Probability	Highly probable (4)	probable (3)
Significance	**medium (44)**	**low (27)**
Status (positive or negative)	negative	negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of	Yes	Yes

resources?		
Can impacts be mitigated?	To some degree	
Mitigation: (1) control stormwater and runoff water (2) obtain a permit from DWA to impact on any wetland or water resource OR move access roads and underground cables slightly that are currently located within or close to watercourses (3) for any new construction, cross watercourses perpendicularly to minimise disturbance footprints (4) rehabilitate any disturbed areas as quickly as possible		
Cumulative impacts: Soil erosion, alien invasions may 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 7: Change in runoff and drainage patterns

Hard surfaces created as part of the development may lead to increased runoff rather than infiltration of water into the ground. The access roads will probably all promote this effect. Where the ground is relatively flat, this is unlikely to pose too many problems, but on sloping ground, this may lead to increased erosion and siltation of downslope areas. There are both steep slopes and watercourses occurring on site, but internal access road positions vary in terms of slope and substrate properties. It is therefore likely that internal access roads and underground cables will also affect susceptible areas.

Extent: The impact will be local, although downslope areas could be affected. It is scored as "local and surroundings".

Magnitude: It is likely to be an impact of medium magnitude (in terms of the degree to which erosion may be caused that damages downslope areas).

Duration: The impact will be of long-term duration.

Probability: Based on the current position of the infrastructure, it is likely that the impact will occur.

Potential significance: On the basis of this assessment, the impact is likely to be of medium significance.

Mitigation measures: A comprehensive stormwater management plan must be compiled, prior to construction, that details how stormwater off hard surfaces will be managed to reduce velocities and volumes of water that could lead to erosion of surfaces. Any disturbed areas should be immediately rehabilitated in order to stabilise landscapes and prevent exposed surfaces from becoming susceptible to erosion. Water velocity off hard surfaces must be reduced and diffused before water is returned to natural systems in order to minimise the risk of creating erosion channels. If any erosion features develop, they should be stabilised using typical measures, such as gabions, weirs, rock-packing, etc.

Nature: Change in runoff and drainage leading to increased soil erosion and siltation of downslope areas		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	local and surroundings (2)
Duration	Long-term (4)	short-term (2)
Magnitude	Moderate (6)	low (4)
Probability	Probable (3)	improbable (2)

Significance	**medium (36)**	**low (16)**
Status (positive or negative)	negative	negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: (1) compile a comprehensive storm-water management plan (2) rehabilitate any disturbed areas immediately to stabilise landscapes (3) water velocity must be reduced and diffused before water is returned to natural systems (4) erosion features must be immediately stabilised, if they develop. (5) The position of some of the turbines and associated underground cables and internal access roads on very steep slopes must be re-considered and these turbines moved to more appropriate positions (turbine numbers 21 and 131).		
Cumulative impacts: Alien invasions, damage to wetlands, loss of habitat may all lead to additional impacts 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 8: Establishment and spread of declared weeds and alien invader plants

The site is not known to harbour alien trees in significant numbers. There is therefore a weak potential for alien trees to spread or become established following disturbance on site. The presence of a diffuse disturbance over a wide area could, however, lead to the spread of species that are present in the area.

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.

Magnitude: It is likely to be an impact of medium magnitude on local ecosystems.

Duration: The impact will be of long-term duration.

Probability: It is probable that the impact will occur in the absence of control measures. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low

Potential significance: On the basis of this assessment, the impact is likely to be of medium significance.

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 that would take decades to remove. 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	sight & surroundings (2)	sight & surroundings (2)
Duration	long-term (4)	long-term (4)
Magnitude	moderate (6)	small (2)

Probability	probable (3)	improbable (2)
Significance	**medium (36)**	**low (16)**
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 following completion of construcrtion activities in an area (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 and increased frequency of veld fires 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 two major vegetation types that occur in the study area, namely *Bedford Dry Grassland* and *Great Fish Thicket* (both classified as Least Threatened). Most of the study area is is still in natural condition, although parts are degraded due to commercial livestock farming. Taking rates of transformation and conservation into account, which have already been used to classify all national vegetation types, none of the vegetation in the study area is considered to be threatened. However, the thicket in the study area has been classified in the Succulent Thicket Ecosystems Programme as having elevated conservation value and, for that reason, has been classified here as having medium-high sensitivity. This is consistent with the treatment of these areas in the Eastern Cape Biodiversity Conservation Plan, where these areas are classified as sensitive and part of an ecological corridor region.

Local factors that may lead to parts of the study area having high ecological sensitivity are the presence of watercourses and wetlands within the shallow drainage lines on site and the presence of steep slopes. Steep slopes can be problematic in constructing infrastructure due to the fact that any impact can have an effect downslope from that point. Depending on the steepness and the length of the slope, particular areas may be more sensitive to disturbance than others. Any steep slopes are therefore considered to have elevated sensitivity. This applies primarily to the western parts of the study area on the scarp overlooking the Great Fish River (Great Fish Thicket vegetation type). Potential issues that may arise from development of these areas includes erosion of substrates downslope and the impacts of stormwater runoff.

Wetlands and watercourses contain important ecological processes that maintain ecological patterns and biodiversity elements. Wetlands are also protected under national legislation (National Wetlands Act). Any impacts on these areas would require a permit from the relevant National Department.

There are eight tree species that are protected under the National Forests Act that have a geographic distribution that includes this area (*Catha edulis, Curtisia dentata, Ocotea bullata, Pittosporum viridiflorum, Podocarpus falcatus, Podocarpus latifolius*, *Prunus africana and Sideroxylon inerme* subsp. *inerme*) (Appendix 3). It has been determined during the field survey for neighbouring areas that forest does not occur on site and these protected tree species are unlikely to occur on site.

There is one plant species of conservation concern that could occur in available habitats in the study area. This is the Near Threatened *Encephalartos lehmannii* (Karoo cycad). It is considered that there is a low probability of encountering this plant species on site. Although there is suitable habitat, the plant was last recorded in 1964 on site and, in all likelihood, has already been removed from the site by collectors.

There is a single terrestrial animal species of conservation concern that may occur in habitats within the study area, the protected Giant Bullfrog. This species was previously listed as Near Threatened, but according to the IUCN website, is currently treated as Least Concern. It is, however, protected according to the National Environmental Management: Biodiversity Act. Likely breeding sites are the edges of small farm dams in watercourses on site. They may forage in surrounding vegetation.

There are six Near Threatened (in South Africa) and one Endangered (in South Africa) bat species that could occur on site. These species may be negatively impacted by collisions with turbine blades. The Near Threatened species are listed globally as Least Concern and the Endangered species is listed globally as Near Threatened. The Endangered species has a

distribution that is close to the site (ends just to the east of the site), but has been included in this assessment due to the marginal possibility that it may migrate across the site between forest patches. The Near Threatened species have a high probability of occurring on site, but the overall distribution of the species includes a wide area of South Africa and beyond. Impacts on site are therefore not likely to have more than a small effect on population processes within these species.

A risk assessment was undertaken which identified eight potential negative impacts on the ecological receiving environment. The identified potential impacts are the following:

1. Impacts on bats
2. Impacts on threatened animals
3. Impacts on threatened plants
4. Impacts on protected tree species
5. Impacts on indigenous natural vegetation
6. Impacts on watercourses / wetlands
7. Change in runoff and drainage patterns
8. Establishment and spread of declared weeds and alien invader plants

The field survey for the surrounding site established that no protected tree species are likely to occur on site. This potential impact was therefore not evaluated further.

Impacts were assessed separately for wind turbines and the combination of internal access roads and underground cables between turbines. A summary of impacts, as evaluated, is provided in the table below (Table 4).

The wind turbines are unlikely to have impacts of high significance on any ecological features. This is primarily due to the fact that they occupy a relatively small space in the landscape. Wind turbines may have impacts of moderate significance on bat species and on terrestrial vegetation and due to invasion by alien plants. Impacts on bats and due to alien invasions can be reduced to low significance with mitigation measures.

Internal road infrastructure and underground cables between turbines could potentially have a significant impact on natural vegetation, watercourses/wetlands and on steep slopes. Nevertheless, impacts can be contained to some degree to within the construction area, which reduces potential impacts. Except for the impact on terrestrial vegetation, the significance of all of these can be reduced to low significance with mitigation measures.

Disturbance due to construction of any infrastructure could lead to the spread of alien plants, but this impact can be effectively controlled with suggested measures.

Conclusions

The overall impacts of the proposed project have been assessed as largely being of medium to low significance (see Table 4 below). If mitigation measures are put in place to manage impacts, then all potential impacts can be reduced to having low significance, except for the impact on terrestrial vegetation which will remain as having medium signficance.

Based on current information, the site has been evaluated as having a low probability of containing plant or animal species of conservation concern. There is also a low likelihood of the site containing protected trees. Parts of the site are classified in the ECBCP as occurring within a corridor area. If potential impacts are well-managed, it is unlikely that the ecological

integrity of this corridor will be affected by the construction of the proposed wind energy facility.

The proposed project is therefore considered to be acceptable in terms of potential impacts on fauna, flora, vegetation and wetlands / watercourses and it is recommended that it should be permitted to go ahead.

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

Impact		Wind turbines		Underground cables & internal access roads	
		Without mitigation	With mitigation	Without mitigation	With mitigation
1. bats	NT species	medium (33)	low (18)	zero (0)	zero (0)
	EN species	low (22)	low (18)	zero (0)	zero (0)
2. threatened animals		low (15)	low (5)	low (27)	low (18)
3. threatened plants		low (10)	low (9)	low (10)	low (9)
4. protected trees		zero (0)	zero (0)	zero (0)	zero (0)
5. terrestrial vegetation		medium (45)	medium (40)	medium (55)	medium (50)
6. watercourses		zero (0)	zero (0)	medium (44)	low (27)
7. runoff/ drainage		low (24)	low (16)	medium (36)	low (16)
8. alien plants		medium (36)	low (16)	medium (36)	low (16)

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.

OBJECTIVE: Limit impacts on Karoo Cycad (*Encephalartos lehmannii*)

Project component/s	Any infrastructure or activity that will result in disturbance to habitat suitable for the Karoo cycad
Potential Impact	Loss of individuals of the protected / near threatened plant species, *Encephalartos lehmannii*
Activity/risk source	Construction, operation
Mitigation: Target/Objective	Target: no loss of individuals within project control area Time period: construction, operation

Mitigation: Action/control	Responsibility	Timeframe
(1) If any cycads are found by personnel on site, the position must be reported to the conservation authorities and steps taken to avoid damaging any plants. (2) Avoid damage to plants as much as possible. (3) If damage to plants is unavoidable, then a reputable organisation must be contacted to remove the plants to safety and record relevant information about the plant and the habitat in which it was found. (4) A permit will be required for removal of the plant.	Management (environmental officer),	operation

Performance Indicator	Number of individuals affected within project area
Monitoring	• Determine densities and localities of *Encephalartos lehmannii* within the project area before and after construction. • Record losses of individual plants.

OBJECTIVE: Limit potential impacts on Giant Bullfrog

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

Mitigation: Action/control	Responsibility	Timeframe
(1) avoid impacts on dams and wetland habitat identified as being suitable for the Giant Bullfrog. (2) No personnel on site may cause harm to any individual Giant Bullfrog. Environmental orientation of personnel must include information on identifying this species. (3) Where possible, locate any crossings at sites where there are existing road crossings. (4) For any new river crossings, apply the following measures: a. use adequate bridge or culvert structures that do not limit water or sediment flow through the river bed. b. Ensure bridge structures do not cause canalization or erosion. c. implement adequate erosion control measures below river crossings d. obtain a permit from DWA for any infrastructure to be located within a watercourse.	Construction team, management (environmental officer),	construction, operation

Performance Indicator	No loss of habitat suitable for or individuals of the protected Giant Bullfrog
Monitoring	• Map extent of suitable habitat before construction (general map of suitable habitat is provided in this report; requires further refinement). • Identify project components that infringe on habitat. • After construction, record any disturbance to habitat in terms of extent and potential effects on remaining habitat.

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.

OBJECTIVE: Control loss of indigenous 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) Roads should be aligned away from steep slopes and drainage lines as much as possible. (3) Limit unnecessary impacts on surrounding natural vegetation, e.g. driving around in the veld, use access roads only	Construction team, management (environmental officer),	construction

Performance Indicator	Loss of natrual vegetation equivalent to the exact footprint of the proposed project
Monitoring	• Before construction, determine required number of hectares to accommodate footprint of proposed infrastructure. • After construction, determine amount of natura vegetation lost due to construction.l

OBJECTIVE: Control runoff and soil erosion, especially on steep slopes

Project component/s	Any infrastructure or activity that will result in conditions favouring erosion or increased runoff, sedimentation or increased silt loads in water.
Potential Impact	Increased soil erosion, silt loads or sedimentation that may cause damage to sensitive habitats
Activity/risk source	Construction, operation
Mitigation: Target/Objective	Target: no erosion emanating from project activities Time period: construction, operation

Mitigation: Action/control	Responsibility	Timeframe
(1) rehabilitate any disturbed areas immediately after construction in that area is complete in order to stabilise landscapes (2) water velocity from precipitation and runoff must be reduced and diffused before water is returned to natural systems (3) compile a comprehensive stormwater management plan as part of the final design of the project (4) Erosion features must be immediately stabilised with erosion control measures, if they develop (5) The position of some of the proposed turbines on very steep slopes must be reconsidered and these turbines moved to more appropriate positions (numbers 21 and 131).	Construction team, management, environmental control officer	Construction, operation

Performance Indicator	No erosion features within project control area and immediate surroundings
Monitoring	• Ongoing monitoring of area by environmental control officer during construction • Ongoing monitoring of area by environmental manager during operation • Regular audit of project area and immediate surroundings by geomorphologist/soil specialist to identify erosion features associated with infrastructure. • The environmental manager should be responsible for driving this process. • Reporting frequency depends on legal compliance framework.

OBJECTIVE: Limit damage to watercourses

Project component/s	Any infrastructure or activity that will result in disturbance to watercourses
Potential Impact	Damage to wetland 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) align underground cables and internal access roads as much as possible along existing infrastructure. (2) for any new construction, cross watercourses perpendicularly to minimise disturbance footprints (3) rehabilitate any disturbed areas as quickly as possible (4) control stormwater and runoff water (5) 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 (6) obtain a permit from DWA to impact on any wetland or water resource.	Construction team, management, environmental control officer	Construction, operation

Performance Indicator	No impacts on water quality, water quantity, wetland vegetation, natural status of watercourses
Monitoring	• Water quality monitoring to take place on a regular basis. This should include the water quality and quantity leaving the project area through the watercourses (should be monitored within main drainage systems that exit site). • Habitat loss in watercourses should be monitored before and after construction. • The environmental manager should be responsible for driving this process. • Reporting frequency depends on legal compliance framework.

OBJECTIVE: Monitor impacts on bats due to turbine blade collisions

Project component/s	Turbines
Potential Impact	Loss of individuals of the threatened bat species
Activity/risk source	Operation
Mitigation: Target/Objective	Target: low mortalities within project control area Time period: operation

Mitigation: Action/control	Responsibility	Timeframe
(1) A preconstruction survey for bats should be undertaken to determine whether bat species of concern occur on site or not and whether roosting habitats or known important maternity roosts occur within close proximity to the site. (2) If this preconstruction survey finds that the presence of bats or roosting habitats of concern occur, then a monitoring programme should be implemented to document the effect of wind turbines on bat species of concern. (3) If the turbines are found to have a significant negative impact on bats then further measures will need to be implemented to control the impact, for example, halting operation during low wind conditions.	Management (environmental officer),	operation

Performance Indicator	Number of individuals killed by turbine blades within project area
Monitoring	• Record bat mortalities and, as far as possible, the circumstances surrounding collisions. Standard protocols should be used when undertaking such surveys.

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APPENDICES:

Appendix 1: Plant species of conservation importance that have historically been recorded in the study area.

*IUCN (3.1) Categories:
VU = Vulnerable
EN = Endangered
CR = Critically Endangered
NT = Near Threatened

Table A: Threatened, Near Threatened and Declining plant species that have been previously recorded in the study area

Taxon	Family	Distribution relevant to study area	Global IUCN (3.1) category *	Likelihood of occurrence
Nerine huttoniae Schonland	AMARYLLIDA-CEAE	Banks of the Great Fish River: upper reaches of the Fish River and its tributaries. On floodplains in alluvial sandy flats, sometimes very stony.	VU	LOW, no suitable habitat
Apodolirion macowanii	AMARYLLIDA-CEAE	Heavy clay soils in renosterveld or valley bushveld. Found from Fish River to Jeffrey's Bay. Nearest population is within Fish River valley in Great Fish Noorsveld vegetation.	VU	LOW, no suitable habitat on site
Ceropegia fimbriata subsp. fimbriata	APOCYNACEAE	Great Fish River Valley in Karoo-type thicket on the banks of the river.	VU	LOW, no suitable habitat on site
Encephalartos lehmannii Lehm.	ZAMIACEAE	Found in arid low succulent shrubland on rocky ridges and slopes in the Eastern Cape. Overall distribution is concurrent with Albany Thicket bioregion.	NT	**MEDIUM**, previously recorded in study area
Crassula decidua	CRASSULACEAE	Cookhouse, Somerset East and Cradock. Low karroid vegetation or amongst succulent Euphorbia shrubs close to rivers.	NT	LOW, no suitable habitat on site
Hermannia violacea	MALVACEAE	Bruintjieshoogte to the Amathole Mountains. Forest margins.	Rare	LOW, no suitable habitat on site
Huernia kennedyana	APOCYNACEAE	Cradock and Somerset East. Occasionally on flat areas, more usually associated with slightly raised gravelly spots, on low dolerite ridges, also on shale ridges in crevices among rocks.	Rare	**HIGH**, previously recorded in study area
Drimia altissima (L.f.) Ker Gawl.	HYACINTHA-CEAE	The species is currently considered to be LC-declining because large volumes are evident in the medicinal markets, but the species appears to be widespread in southern Africa. It is common on farms in the Bedford area.	Declining	**HIGH**, previously recorded in study area
Crinum macowanii Baker	AMARYLLIDA-CEAE	Widespread in Africa, in mountain grassveld and stony slopes in hard dry shale, gravely soil or sandy flats.	Declining	**HIGH**, previously recorded in study area
Holothrix macowaniana Rchb.f.	ORCHIDACEAE	In South Africa this species is restricted to the forests of the Eastern Cape in the Grahamstown and Stockenstrom districts and the Katberg. Also recorded from Zimbabwe (Linder & Kurzweil 1999). It grows in ravines in forests.	DDD	LOW, no forests in study area
Corycium tricuspidatum	ORCHIDACEAE	Montane grasslands of the Eastern Cape, Lesotho and KZN.	DDD	LOW, no suitable habitat on site

* 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

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

MAMMALS

Common name	Taxon	Habitat	National status	Global status	Likelihood of occurrence
Black rhinoceros	*Diceros bicornis bicornis*	Wide variety of habitats.		CR[2]	NONE, only occurs in game reserves
White-tailed rat	*Mystromus albicaudatus*	Highveld and montane grassland, requires sandy soils with good cover. Found throughout South Africa except Northern Cape and Limpopo		EN[2]	LOW, not previously recorded in grids, but overall geographical distribution includes this area. Few areas with sandy soils on site.
Samango Monkey	*Cercopithecus mitis labiatus*	Eastern parts of South Africa towards the coast; arboreal species inhabiting Afromontane forests		EN[2]	LOW, not previously recorded in grids, but overall geographical distribution includes this area. No suitable habitat on site
Lesser woolly bat	*Kerivoula lanosa*	Found from near Knysna, through the eastern Cape into KwaZulu-Natal and northwards from there. Possibly associated with forest and woodland. Often found roosting in weaver and sunbird nests.	NT	LC	MEDIUM, recorded from neighbouring grid. May occur in wooded parts of site.
Lesser long-fingered bat	*Miniopterus fraterculus*	Eastern parts of South Africa and Swaziland. Temperate species, occurring in montane grasslands of the escarpment region. Roosts in caves. Site at edge of known distribution.	NT	LC	MEDIUM, may occur in escarpment region north of the site, but unlikely to be found on site. Suitable habitat occurs nearby and species may migrate across site.
Natal long-fingered bat	*Miniopterus natalensis*	Occurs widely in southern African region, but less often in arid parts. Found mostly in temperate to sub-tropical savanna and grassland. Dependent on caves and sub-terranean habitats for roosting, where it occurs in large numbers.	NT	LC	MEDIUM, site is within known distribution range, may be caves on site or nearby
Temminck's hairy bat	*Myotis tricolor*	Widely distributed over the eastern and interior parts of South Africa. Roosts gregariously in caves and switches between winter hibernacula and summer maternity caves. Associated with mountainous terrain due to roosting requirements.	NT	LC	HIGH, within known distribution and suitable roosting sites probably occur within 10 km of the site.
Cape horseshoe bat	*Rhinolophus capensis*	Endemic to south-western parts of southern Africa, mostly from the Eastern Cape to Cape Town and then north to southern Namibia. Roosts in caves and subterranean habitats, such as mine adits. May form colonies of a thousand or more individuals. Forages predominantly in the canopies of trees.	NT	LC	HIGH, within known distribution and suitable roosting sites probably occur within 10 km of the site.
Geoffroy's horseshoe bat	*Rhinolophus clivosus*	Occurs widely in southern African region, but less often in arid parts. Roosts in caves and subterranean habitats, such as mine adits, as well as rock hollows. May form colonies of several thousand individuals.	NT	LC	HIGH, within known distribution and suitable roosting sites probably occur within 10 km of the site.
Swinney's	*Rhinolophus*	Widely but sparsely distributed in	EN	NT	LOW, site is within known

horseshoe Bat	*swinnyi*	eastern parts of southern Africa, from Eastern Cape to KwaZulu-Natal and northwards. Roosts singly or in small groups of up to five individuals in caves and old mines. In the southern part of its range (the current study area), it appears to be associated with temperate Afromontane forest.			distribution range, but species most likely to occur in habitat not found on site. Suitable habitat occurs in the escarpment mountains some distance to the north of the site and the species may migrate across site.

[1]Distribution according to Friedmann & Daly 2004.
[2]Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 20 September 2010.

AMPHIBIANS

Common name	Species	Habitat	Status[2]	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, previously recorded in grid, but habitat may not be suitable 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 20 September 2010.

REPTILES

Common name	Species	Habitat	Status[3]	Likelihood of occurrence
African rock python	*Python sebae natalensis*	Wide range of habitats, but mostly moist, rocky well-wooded valleys. Frequently found in and around water. Prefer open savanna type habitat but have been found in forest areas	VU	LOW, not previously recorded in grids, but overall geographical distribution includes this area. Habitat may not be entirely suitable. Species seldom found very close to human habitation.

[3]Status according to Branch 1988 and Alexander & Marais 2008.

BIRDS

Common name	Species	Habitat	Status[3]	Importance of site for species
Cape Vulture	*Gyps coprotheres*	The Cape Vulture is concentrated in the Lesotho Highlands and the northern provinces of South Africa. It has been reported from areas in the study site, and in adjacent grids to the north. It forages over open grassland and woodland. Reporting rates in the study site and adjacent areas are low as it is the edge of its known range. It is dependent on tall cliffs for roosting and breeding but also roosts on trees and pylons. It has declined dramatically due to threats such as food shortages, electrocutions, poisonings, drownings and disturbance at breeding and roosting sites.	VU A1a,c,d; A2b,c,d; C1; C2b	LOW, breeding, MEDIUM, foraging
Martial Eagle	*Polemaetus bellicosus*	The Martial Eagle is widespread but uncommon throughout South Africa and neighbouring countries. It tolerates a wide range of vegetation types, being found in open grassland, scrub, Karoo and woodland. It relies on large trees (and electricity pylons) to provide nest sites. It is found typically in flat country and is rarer in mountains and forests. One of the main reason it is declining is because of persecution on private land. This species has been recorded from the study area and many surrounding areas.	VU A1a; C1	LOW, breeding, HIGH, foraging
Lesser Kestrel	*Falco naumannii*	This species is widespread in South Africa except for most of the Northern Cape, and occurs in other countries. This species occurs in open country and roosts communally in tall trees (mainly *Eucalyptus*), in urban areas. They prefer to forage in pristine	VU A1a,c,e	LOW, breeding, MEDIUM, foraging

		grassland, which is scarce since few areas are not transformed by agriculture. Most of the threats, however, exist in the Palearctic part of its range, and conservation is therefore complex as it only occurs in South Africa for part of its cycle. They forage on insect swarms and are beneficial to agriculture in this way. They have been sited within the study area, but with low reporting rates: 3225DB (<2%); 3226CA (<2%); 3226CB (7—16%).		
Blue Crane	*Anthropoides paradiseus*	This species is a near-endemic to South Africa, occurring in every province. It is locally abundant in parts of its range. It has experienced substantial decline due to poisoning of birds and indirect loss of grassland breeding habitat. It occupies dry short grassland, being more abundant in the eastern sour grasslands where natural grazing of livestock is the predominant land use. Not dependent on wetland habitats for breeding. They have been recorded frequently throughout the study area. Nesting sites are secluded open grasslands with full view around the nest for predator evasion.	VU A1acde; A2bc	MEDIUM, breeding, HIGH, foraging
Striped Flufftail	*Sarothrura affinis*	Discontinuous relict distribution mainly in highland regions from southern Sudan through eastern Africa to the Cape Peninsula; the nominate race is endemic to SA and Swaziland. Over most of its range it inhabits dense, tussocky upland sourveld grassland, mainly dominated by *Themeda triandra* with other grasses such as *Hyparrhenia, Festuca, Tristachya and Cymbopogon* species occurring locally; vegetation is typically dominated by *T. triandra*. It also inhabits grassland with woody vegetation e.g. *Protea*), or grass near forest edges, but it avoids rocky areas and steep slopes. It is adapted to fire-climax grassland and its habitat is improved by partial burning on a biennial cycle; controlled grazing is an alternative to burning. Although often associated with drainage lines, seepage zones or small marshy areas, there is no convincing evidence that it regularly inhabits wetlands. It also occurs in bracken-brair, and crops such as lucerne and millet. It is regarded as sedentary, and is resident in areas where cover and food remain suitable throughout the year. Main threats are continued loss of upland grassland habitat and degradation of habitat. It has been reported in the grid 3226CC, but in no other areas nearby.	VU A1c; A2c; C1+2a	LOW, breeding, MEDIUM, foraging (plains grassland)
Stanley's Bustard	*Neotis denhami*	This is an Afrotropical endemic that occurs through the central parts of South Africa, and Limpopo Province and Mpumalanga. It occurs throughout the study area with a large reporting rate. In the grassland biome, its habitat is high-rainfall, open, exposed, hilly, sour grassland, usually at high altitudes in the breeding season. In the non-breeding season, it can be found in lower-lying regions.	VU A1ac; A2bc; C1	MEDIUM, breeding & foraging (plains grassland)
Ludwig's Bustard	*Neotis ludwigii*	This is a near-endemic to southern Africa, with its range centred on the Nama Karoo and Succulent Karoo biomes. It occurs in western grasslands of the Eastern Cape, but supposedly as a nonbreeding visitor. The most important threat to this species is collisions with overhead powerlines and telephone wires. It has been reported (<2% rate) from the grids 3225DB and at higher rates from 3226 CA and 3226CC. It inhabits the open plains of the semi-arid Karoo and especially in areas where extensive sheep farming is prevalent.	VU A1a; A2b	LOW, breeding, MEDIUM, foraging
Whitebellied Korhaan	*Eupodotis cafra*	This species is found in eastern South Africa. In the Eastern Cape it is sparse, and its distribution is fragmented and isolated. Inhabits relatively tall	VU A1c; A2c; C1	LOW, breeding, LOW, foraging

		vegetation, typically fairly dense grassland in either open or lightly wooded regions. Most abundant in hilly areas at the interface between grassland and savanna biomes. Habitat loss through crop farming, overgrazing, burning and high human densities have lead to its decline. It occurs in the grid 3226CA at a reporting rate of <2%.		
Southern Ground Hornbill	*Bucorvus leadbeateri*	A widespread but sparse breeding resident, extending from the Northern Province down the eastern side of South Africa to the Eastern Cape. It nests in holes in rock faces or trees, and is impacted on by removal of trees and disturbance of cliff faces. It is also threatened by transformation of its grassland foraging habitat. The westernmost edge of its distribution lies in the grid 3226CA where it has been reported at a rate of < 12%.	Vu C1	MEDIUM, breeding & foraging

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 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 namaquensis	*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	

Catha edulis, Curtisia dentata, Ocotea bullata, Pittosporum viridiflorum, Podocarpus falcatus, Podocarpus latifolius, *Prunus africana and Sideroxylon inerme* subsp. *inerme* 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.

Adiantum capillus-veneris L.
Adiantum poiretii Wikstr.
Agapanthus sp.
Agrostis avenacea C.C.Gmel.
Aizoon glinoides L.f.
Alepidea macowani Dummer
Allophylus decipiens (Sond.) Radlk.
Aloe sp.
Aloe striata Haw. ssp. striata
Aloe variegata L.
Amellus strigosus (Thunb.) Less. ssp. pseudoscabridus Rommel
Ammocharis coranica (Ker Gawl.) Herb.
Ammocharis coranica (Ker Gawl.) Herb.
Anredera baselloides (Kunth) Baill.
Arctotis arctotoides (L.f.) O.Hoffm.
Aristida adscensionis L.
Aristida congesta Roem. & Schult. ssp. congesta
Aristida junciformis Trin. & Rupr. ssp. galpinii (Stapf) De Winter
Asclepias gibba (E.Mey.) Schltr. var. gibba
Aspalathus frankenioides DC.
Asparagus aethiopicus L.
Asparagus concinnus (Baker) Kies
Asparagus striatus (L.f.) Thunb.
Asplenium platyneuron (L.) Britten, Sterns & Poggenb.
Asplenium varians Wall. ex Hook. & Grev. ssp. fimbriatum (Kunze) Schelpe
Astroloba sp.
Athanasia dentata (L.) L.
Bergeranthus vespertinus (A.Berger) Schwantes
Berkheya carlinifolia (DC.) Roessler ssp. carlinifolia
Berkheya onopordifolia (DC.) O.Hoffm. ex Burtt Davy var. onopordifolia
Blechnum australe L. ssp. australe
Boerhavia cordobensis Kuntze
Bonatea cassidea Sond.
Bothriochloa radicans (Lehm.) A.Camus
Brachylaena elliptica (Thunb.) DC.
Bromus catharticus Vahl
Bromus speciosus Nees
Bryum canariense Brid.
Buddleja saligna Willd.
Bulbine abyssinica A.Rich.
Calpurnia aurea (Aiton) Benth. ssp. aurea
Canthium ciliatum (Klotzsch) Kuntze
Carex glomerabilis Krecz.
Carex mossii Nelmes
Catha edulis (Vahl) Forssk. ex Endl.
Ceropegia zeyheri Schltr.
Chasmatophyllum musculinum (Haw.) Dinter & Schwantes
Cheilanthes bergiana Schltdl.
Cheilanthes quadripinnata (Forssk.) Kuhn
Chloris virgata Sw.
Chrysocoma ciliata L.
Cineraria sp.
Colchicum longipes (Baker) J.C.Manning & Vinn.
Convolvulus farinosus L.
Cotyledon orbiculata L. var. orbiculata
Crassula sp.
Crinum campanulatum Herb.
Crinum macowanii Baker
Cucumis zeyheri Sond.
Cuscuta africana Willd.
Cussonia spicata Thunb.
Cymbopogon prolixus (Stapf) E.Phillips
Cyperus owanii Boeck.
Cyperus pulcher Thunb.
Cyrtanthus huttonii Baker
Cyrtanthus smithiae Watt ex Harv.
Cystopteris fragilis (L.) Bernh.
Delosperma affine Lavis

Dianthus namaensis Schinz var. dinteri (Schinz) S.S.Hooper
Digitaria eriantha Steud.
Diospyros lycioides Desf. ssp. lycioides
Disa crassicornis Lindl.
Disa sagittalis (L.f.) Sw.
Disa versicolor Rchb.f.
Doryopteris concolor (Langsd. & Fisch.) Kuhn
Drimia altissima (L.f.) Ker Gawl.
Drosanthemum hispidum (L.) Schwantes
Drosanthemum sp.
Echinochloa colona (L.) Link
Encephalartos cycadifolius (Jacq.) Lehm.
Encephalartos lehmannii Lehm.
Eragrostis curvula (Schrad.) Nees
Eragrostis lehmanniana Nees var. lehmanniana
Eragrostis planiculmis Nees
Erica caespitosa Hilliard & B.L.Burtt
Erica gracilis J.C.Wendl.
Erica rupicola Klotzsch
Euclea racemosa Murray ssp. macrophylla (E.Mey. ex A.DC.) F.White
Euphorbia globosa (Haw.) Sims
Euphorbia micracantha Boiss.
Euphorbia ornithopus Jacq.
Falkia repens Thunb.
Faucaria tuberculosa (Rolfe) Schwantes
Felicia muricata (Thunb.) Nees ssp. muricata
Fingerhuthia sesleriiformis Nees
Garuleum tanacetifolium (MacOwan) Norl.
Gasteria bicolor Haw. var. bicolor
Gazania rigens (L.) Gaertn. var. uniflora (L.f.) Roessler
Gomphostigma virgatum (L.f.) Baill.
Gomphrena celosioides Mart.
Grewia robusta Burch.
Grimmia laevigata (Brid.) Brid.
Habenaria epipactidea Rchb.f.
Habenaria lithophila Schltr.
Haemanthus albiflos Jacq.
Haemanthus montanus Baker
Haworthia limifolia Marloth var. ubomboensis (I.Verd.) G.G.Sm.
Haworthia nigra (Haw.) Baker var. nigra
Haworthia sp.
Helichrysum teretifolium (L.) D.Don
Hermannia althaeoides Link
Hermannia glabrata L.f.
Hermannia gracilis Eckl. & Zeyh.
Hermannia sp.
Hibiscus pusillus Thunb.
Hyparrhenia anamesa Clayton
Hyparrhenia dregeana (Nees) Stapf ex Stent
Hypoxis argentea Harv. ex Baker var. argentea
Hypoxis villosa L.f. var. villosa
Indigofera alternans DC. var. alternans
Indigofera disticha Eckl. & Zeyh.
Ipomoea crispa (Thunb.) Hallier f.
Isolepis costata Hochst. ex A.Rich.
Isolepis diabolica (Steud.) Schrad.
Jamesbrittenia sp.
Juncus effusus L.
Juncus oxycarpus E.Mey. ex Kunth
Karroochloa curva (Nees) Conert & Türpe
Kniphofia triangularis Kunth ssp. triangularis
Kniphofia uvaria (L.) Oken
Lampranthus stayneri (L.Bolus) N.E.Br.
Lepidium africanum (Burm.f.) DC. ssp. divaricatum (Aiton) Jonsell
Leucas capensis (Benth.) Engl.
Lobelia flaccida (C.Presl) A.DC. ssp. flaccida
Lobelia thermalis Thunb.
Lycium schizocalyx C.H.Wright
Malephora crassa (L.Bolus) H.Jacobsen & Schwantes
Medicago lupulina L.
Melinis nerviglumis (Franch.) Zizka

Melinis repens (Willd.) Zizka ssp. repens
Muraltia alopecuroides (L.) DC.
Muraltia mixta (L.f.) DC.
Nasturtium officinale R.Br.
Nemesia melissifolia Benth.
Nerine huttoniae Schönland
Ocimum burchellianum Benth.
Olea europaea L. ssp. africana (Mill.) P.S.Green
Oligocarpus calendulaceus (L.f.) Less.
Orthotrichum diaphanum (Schrad. ex Brid.) Lindb.
Oxalis semiloba Sond. ssp. semiloba
Panicum deustum Thunb.
Panicum stapfianum Fourc.
Papillaria africana (Müll.Hal.) A.Jaeger
Pappea capensis Eckl. & Zeyh.
Paspalum dilatatum Poir.
Pelargonium abrotanifolium (L.f.) Jacq.
Pelargonium alchemilloides (L.) L'Hér.
Pelargonium aridum R.A.Dyer
Pelargonium odoratissimum (L.) L'Hér.
Pennisetum sphacelatum (Nees) T.Durand & Schinz
Persicaria lapathifolia (L.) Gray
Pimpinella caffra (Eckl. & Zeyh.) D.Dietr.
Plectranthus ambiguus (Bolus) Codd
Plectranthus grallatus Briq.
Pleopeltis sp.
Poa annua L.
Polygala macowaniana Paiva
Polygala virgata Thunb. var. virgata
Polypodium vulgare L.
Polystichum pungens (Kaulf.) C.Presl
Psilocaulon granulicaule (Haw.) Schwantes
Pteronia glomerata L.f.
Pterygodium magnum Rchb.f.
Resnova lachenalioides (Baker) Van der Merwe
Rhoicissus tridentata (L.f.) Wild & R.B.Drumm. ssp. tridentata
Rhynchosia ciliata (Thunb.) Schinz
Ruschia complanata L.Bolus
Salix mucronata Thunb. ssp. mucronata
Salvia repens Burch. ex Benth. var. repens
Salvia stenophylla Burch. ex Benth.
Schoenoplectus decipiens (Nees) J.Raynal
Schoenoplectus paludicola (Kunth) J.Raynal
Schoenoxiphium lehmannii (Nees) Steud.
Sclerochiton odoratissimus Hilliard
Searsia chirindensis (Baker f.) Moffett
Searsia dregeana (Sond.) Moffett
Searsia rehmanniana (Engl.) Moffett var. glabrata (Sond.) Moffett
Sebaea sedoides Gilg var. confertiflora (Schinz) Marais
Selago galpinii Schltr.
Selago geniculata L.f.
Senecio oxyodontus DC.
Senecio radicans (L.f.) Sch.Bip.
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. sphacelata
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. torta (Stapf) Clayton
Silene burchellii Otth var. angustifolia Sond.
Solanum lichtensteinii Willd.
Spiloxene trifurcillata (Nel) Fourc.
Sporobolus africanus (Poir.) Robyns & Tournay
Sporobolus fimbriatus (Trin.) Nees
Stachys sp.
Stegnogramma pozoi (Lag.) K.Iwats.
Stiburus conrathii Hack.
Syntrichia fragilis (Taylor) Ochyra
Talinum caffrum (Thunb.) Eckl. & Zeyh.
Tetrachne dregei Nees
Teucrium africanum Thunb.
Themeda triandra Forssk.
Thesium sp.
Trachyandra giffenii (F.M.Leight.) Oberm.
Tragus berteronianus Schult.

Tribulus terrestris L.
Trichodiadema mirabile (N.E.Br.) Schwantes
Trichostomum brachydontium Bruch
Triraphis andropogonoides (Steud.) E.Phillips
Tritonia gladiolaris (Lam.) Goldblatt & J.C.Manning
Unknown sp.
Urginea sp.
Viscum continuum E.Mey. ex Sprague
Viscum crassulae Eckl. & Zeyh.
Wahlenbergia cuspidata Brehmer
Xysmalobium parviflorum Harv. ex Scott-Elliot
Zaluzianskya spathacea (Benth.) Walp.
Zornia capensis Pers. ssp. capensis

Surrounding areas (including habitats not occurring on site):
Acacia karroo Hayne
Acacia mearnsii De Wild.
Acalypha caperonioides Baill.
Acrotome inflata Benth.
Agathosma apiculata G.Mey.
Agathosma bicornuta R.A.Dyer
Agathosma ovata (Thunb.) Pillans
Agathosma puberula (Steud.) Fourc.
Aizoon glinoides L.f.
Albuca species
Alchemilla capensis Thunb.
Alepidea capensis
Alloteropsis semialata (R.Br.) Hitchc. ssp. semialata
Aloe africana Mill.
Aloe species
Aloe speciosa Baker
Aloe striata Haw. subsp. striata
Alternanthera pungens Kunth in Humb., Bonpl. & Kunth
Amaranthus capensis Thell. subsp. capensis
Amaranthus species
Amaranthus thunbergii
Anacampseros arachnoides (Haw.) Sims
Anisodontea sp.
Anthospermum aethiopicum L.
Anthospermum species
Aptosimum procumbens (Lehm.) Steud.
Arctotis arctotoides (L.f.) O.Hoffm.
Arctotis microcephala (DC.) P.Beauv.
Argemone ochroleuca
Argyrolobium pauciflorum
Argyrolobium species
Aristea confusa Goldblatt
Aristida congesta Roem. & Schult. ssp. congesta
Aristida diffusa
Asclepias species
Aspalathus chortophila Eckl. & Zeyh.
Aspalathus cinerascens E.Mey.
Aspalathus species
Aspalathus subtingens Eckl. & Zeyh.
Asparagus aethiopicus L.
Asparagus burchellii Baker
Asparagus capensis
Asparagus concinnus (Baker) Kies
Asparagus cooperi Baker
Asparagus densiflorus (Kunth) Jessop
Asparagus denudatus (Kunth) Baker
Asparagus laricinus Burch.
Asparagus mucronatus Jessop
Asparagus species
Asparagus striatus (L.f.) Thunb.
Asparagus suaveolens Burch.
Aster bakeranus Burtt Davy ex C.A.Sm.
Astroloba sp.
Azima tetracantha Lam.
Barleria pungens L.f.
Barleria species

Becium burchellianum (Benth.) N.E.Br.
Berkheya decurrens (Thunb.) Willd.
Berkheya discolor (DC.) O.Hoffm. & Muschl.
Berkheya heterophylla
Berkheya onopordifolia
Berkheya species
Bidens bipinnata L.
Blepharis capensis (L.f.) Pers. var. capensis
Blepharis integrifolia
Blepharis mitrata C.B.Clarke
Blepharis sp.
Bobartia orientalis
Boophane disticha (L.f.) Herb.
Boscia oleoides (Burch. ex DC.) Toelken
Bothriochloa insculpta (A.Rich.) A.Camus
Brachiaria serrata (Thunb.) Stapf
Brachylaena ilicifolia (Lam.) E.Phillips & Schweick.
Brunsvigia species
Bulbine abyssinica A.Rich.
Bulbine frutescens (L.) Willd.
Bulbine narcissifolia Salm-Dyck
Bulbostylis humilis (Kunth) C.B.Clarke
Burchellia bubalina (L.f.) Sims
Cadaba aphylla (Thunb.) Wild
Capparis sepiaria L. var. citrifolia (Lam.) Toelken
Carissa haematocarpa (Eckl.) A.DC.
Carpobrotus species
Centella asiatica (L.) Urb.
Chasmatophyllum musculinum (Haw.) Dinter & Schwantes
Cheilanthes eckloniana (Kunze) Mett.
Chenopodium pumilio R.Br.
Chlorophytum crispum (Thunb.) Baker
Chrysanthemoides monilifera
Chrysocoma ciliata L.
Cineraria saxifraga DC.
Clematis brachiata Thunb.
Cliffortia paucistaminea Weim.
Cliffortia species
Clutia heterophylla Thunb.
Clutia pulchella L. var. pulchella
Colpoon compressum P.J.Bergius
Commelina africana L. var. africana
Convolvulus farinosus L.
Conyza bonariensis (L.) Cronquist
Conyza scabrida DC.
Conyza ulmifolia (Burm.f.) Kuntze
Cotula heterocarpa DC.
Cotyledon orbiculata
Cotyledon sp.
Crassula arborescens
Crassula capitella Thunb. ssp. capitella
Crassula capitella Thunb. subsp. thyrsiflora (Thunb.) Toelken
Crassula cultrata L.
Crassula dependens Bolus
Crassula latibracteata Toelken
Crassula mesembryanthoides
Crassula mollis Thunb.
Crassula muscosa
Crassula ovata (Mill.) Druce
Crassula perfoliata
Crassula rupestris Thunb. subsp. rupestris
Crassula species
Crassula tetragona
Crinum campanulatum Herb.
Crinum macowanii Baker
Cucumis species
Cucumis zeyheri Sond.
Cuscuta campestris Yunck.
Cuspidia cernua (L.f.) B.L.Burtt subsp. cernua
Cussonia paniculata
Cussonia paniculata Eckl. & Zeyh. subsp. paniculata

Cyanotis speciosa (L.f.) Hassk.
Cymbopogon excavatus (Hochst.) Stapf ex Burtt Davy
Cymbopogon plurinodis (Stapf) Stapf ex Burtt Davy
Cymbopogon validus (Stapf) Stapf ex Burtt Davy
Cynodon dactylon (L.) Pers.
Cynodon incompletus Nees
Cyperus usitatus
Cyphia species
Cyphia sylvatica
Cyphostemma cirrhosum
Cyphostemma quinatum (Dryand.) Desc. ex Wild & R.B.Drumm.
Cyrtanthus obrienii Baker
Delosperma species
Dianthus micropetalus Ser.
Diascia cuneata E.Mey. ex Benth.
Dicoma species
Dierama species
Dietes iridioides (L.) Sweet ex Klatt
Digitaria argyrograpta (Nees) Stapf
Digitaria eriantha Steud.
Digitaria sp.
Dioscorea elephantipes (L'Hér.) Engl.
Diospyros dichrophylla (Gand.) De Winter
Diospyros lycioides Desf. subsp. lycioides
Diospyros scabrida
Diplachne fusca (L.) P.Beauv. ex Roem. & Schult.
Disparago ericoides (P.J.Bergius) Gaertn.
Dolichos hastaeformis E.Mey.
Dolichos species
Drosanthemum opacum L.Bolus
Drosanthemum species
Ehrharta calycina
Ehrharta erecta
Elionurus muticus (Spreng.) Kunth
Elytropappus rhinocerotis (L.f.) Less.
Enneapogon scoparius Stapf
Eragrostis capensis (Thunb.) Trin.
Eragrostis chloromelas Steud.
Eragrostis curvula (Schrad.) Nees
Eragrostis obtusa Munro ex Ficalho & Hiern
Eragrostis plana Nees
Erica cerinthoides
Eriocephalus africanus L.
Eriosema salignum E.Mey.
Euclea crispa
Euclea racemosa Murray
Euclea schimperi (A.DC.) Dandy var. schimperi
Eulalia villosa (Thunb.) Nees
Euphorbia bothae Lotsy & Goddijn
Euphorbia brachiata E.Mey. ex Boiss.
Euphorbia caterviflora N.E.Br.
Euphorbia coerulescens Haw.
Euphorbia epicyparissias E.Mey. ex Boiss. var. epicyparissias
Euphorbia gorgonis A.Berger
Euphorbia inconstantia R.A.Dyer
Euphorbia micracantha Boiss.
Euphorbia pentagona Haw.
Euphorbia rhombifolia Boiss.
Euphorbia species
Euphorbia stellata Willd.
Euryops algoensis DC.
Euryops anthemoides B.Nord. subsp. anthemoides
Euryops brachypodus (DC.) B.Nord.
Euryops species
Euryops subcarnosus DC. subsp. vulgaris B.Nord.
Eustachys paspaloides (Vahl) Lanza & Mattei
Faucaria felina (L.) Schwantes subsp. felina
Faucaria tuberculosa (Rolfe) Schwantes
Felicia filifolia
Felicia hyssopifolia
Felicia muricata

Ficinia acuminata (Nees) Nees
Ficinia gracilis Schrad.
Ficinia nigrescens (Schrad.) J.Raynal
Ficinia stolonifera Boeck.
Ficus thonningii Blume
Flueggea verrucosa (Thunb.) G.L.Webster
Galium species
Gasteria bicolor
Gasteria disticha (L.) Haw.
Gazania krebsiana
Gazania linearis
Geranium grandistipulatum Hilliard & B.L.Burtt
Gerbera piloselloides (L.) Cass.
Gladiolus ochroleucus
Gnaphalium confine Harv.
Gnaphalium vestitum Thunb.
Gnidia cuneata Meisn.
Gnidia species
Grewia robusta Burch.
Haemanthus albiflos Jacq.
Haplocarpha lyrata Harv.
Haworthia altilinea Haw.
Haworthia deltoidea (Hook.f.) Parr var. deltoidea
Haworthia reinwardtii (Salm-Dyck) Haw. var. reinwardtii forma reinwardtii
Haworthia species
Helichrysum anomalum Less.
Helichrysum cymosum (L.) D.Don subsp. cymosum
Helichrysum felinum Less.
Helichrysum herbaceum (Andrews) Sweet
Helichrysum miconiifolium DC.
Helichrysum nudifolium (L.) Less.
Helichrysum odoratissimum (L.) Sweet
Helichrysum pilosellum (L.f.) Less.
Helichrysum rosum
Helichrysum rugulosum Less.
Helichrysum species
Helichrysum spiralepis Hilliard & B.L.Burtt
Helictotrichon turgidulum (Stapf) Schweick.
Heliophila species
Hermannia althaeifolia L.
Hermannia depressa N.E.Br.
Heteromorpha arborescens (Spreng.) Cham. & Schltdl. var. abyssinica (A.Rich.) H.Wolff
Heteropogon contortus (L.) Roem. & Schult.
Hibiscus aethiopicus
Hibiscus pusillus Thunb.
Hibiscus species
Hyparrhenia hirta (L.) Stapf
Hypericum lalandii Choisy
Hypertelis salsoloides
Hypochaeris microcephala (Sch.Bip.) Cabrera var. albiflora (Kuntze) Cabrera
Hypoestes forskaolii (Vahl) R.Br.
Hypoxis argentea
Hypoxis costata Baker
Hypoxis hemerocallidea Fisch. & C.A.Mey.
Hypoxis multiceps Buchinger ex Baker
Hypoxis species
Hypoxis villosa
Indigofera burchellii DC.
Indigofera verrucosa Eckl. & Zeyh.
Ipomoea crispa (Thunb.) Hallier f.
Ipomoea oenotheroides (L.f.) Raf. ex Hallier f.
Jamesbrittenia atropurpurea
Jamesbrittenia filicaulis (Benth.) Hilliard
Jamesbrittenia foliolosa (Benth.) Hilliard
Jatropha capensis (L.f.) Sond.
Justicia orchioides L.f. subsp. glabrata Immelman
Justicia species
Knowltonia cordata H.Rasm.
Koeleria capensis (Steud.) Nees
Kyllinga alata Nees
Lachenalia bowkeri Baker

Lachenalia species
Lactuca inermis Forssk.
Lampranthus productus
Lantana rugosa Thunb.
Lasiospermum pedunculare Lag.
Ledebouria species
Leonotis ocymifolia (Burm.f.) Iwarsson var. ocymifolia
Lepidium africanum
Lessertia annularis Burch.
Leucas capensis (Benth.) Engl.
Linum thunbergii Eckl. & Zeyh.
Lithospermum papillosum Thunb.
Lobelia species
Lobelia thermalis Thunb.
Lobelia tomentosa L.f.
Lotononis laxa Eckl. & Zeyh.
Lycium cinereum Thunb. sensu lato
Lycium oxycarpum Dunal
Lycium prunus-spinosa Dunal
Lycium species
Maerua cafra (DC.) Pax
Malva species
Mariscus congestus (Vahl) C.B.Clarke
Mariscus uitenhagensis Steud.
Maytenus heterophylla (Eckl. & Zeyh.) N.Robson
Maytenus linearis (L.f.) Marais
Medicago laciniata (L.) Mill.
Melinis nerviglumis (Franch.) Zizka
Melolobium burchelli N.E.Br.
Merxmuellera disticha (Nees) Conert
Merxmuellera stricta (Schrad.) Conert
Mesembryanthemum aitonis Jacq.
Mesembryanthemum species
Metalasia densa (Lam.) P.O.Karis
Metalasia muricata (L.) D.Don
Metalasia trivialis P.O.Karis
Microchloa kunthii Desv.
Mohria caffrorum (L.) Desv. var. caffrorum
Monopsis unidentata
Moquiniella rubra (A.Spreng.) Balle
Moraea polystachya (Thunb.) Ker Gawl.
Myrica serrata Lam.
Myrsine africana L.
Nenax microphylla (Sond.) Salter
Nidorella auriculata DC.
Nidorella sp.
Oedera genistifolia (L.) Anderb. & K.Bremer
Oldenburgia grandis (Thunb.) Baill.
Olea europaea L. subsp. africana (Mill.) P.S.Green
Opuntia aurantiaca Lindl.
Opuntia ficus-indica (L.) Mill.
Ornithogalum fimbrimarginatum Leight.
Ornithogalum juncifolium Jacq.
Ornithogalum unifolium Retz.
Osteospermum bidens Thunb.
Oxalis species
Pachypodium succulentum (L.f.) Sweet
Panicum aequinerve Nees
Panicum coloratum
Panicum maximum Jacq.
Panicum natalense Hochst.
Panicum stapfianum Fourc.
Pappea capensis Eckl. & Zeyh.
Paspalum dilatatum Poir.
Passerina montana Thoday
Passerina vulgaris Thoday
Pegolettia retrofracta (Thunb.) Kies
Pelargonium multicaule Jacq. ssp. multicaule
Pelargonium reniforme Curtis subsp. velutinum (Eckl. & Zeyh.) Dreyer
Pelargonium sidoides DC.
Pellaea calomelanos (Sw.) Link var. leucomelas (Mett. ex Kuhn) J.E.Burrows

Pennisetum sphacelatum (Nees) T.Durand & Schinz
Pentaschistis oreodoxa Schweick.
Pentzia globosa Less.
Pentzia incana (Thunb.) Kuntze
Phragmites australis (Cav.) Steud.
Phylica gnidioides Eckl. & Zeyh.
Phylica paniculata Willd.
Phylica species
Plagiochasma rupestre (G.Forst.) Steph. var. rupestre
Polygala illepida E.Mey. ex Harv.
Polygala leptophylla Burch.
Polygala uncinata E.Mey. ex Meisn.
Portulacaria afra Jacq.
Pseudocrossidium crinitum (Schultz) R.H.Zander
Ptaeroxylon obliquum (Thunb.) Radlk.
Pteridium aquilinum (L.) Kuhn
Pterocelastrus tricuspidatus (Lam.) Sond.
Pteronia adenocarpa Harv.
Pteronia incana (Burm.) DC.
Pteronia glomerata L.f.
Putterlickia pyracantha (L.) Szyszyl.
Rabiea species
Rafnia elliptica Thunb.
Relhania pungens
Restio sejunctus Mast.
Restio triticeus Rottb.
Rhodocoma fruticosa (Thunb.) H.P.Linder
Rhoicissus rhomboidea (E.Mey. ex Harv.) Planch.
Rhoicissus tridentata (L.f.) Wild & R.B.Drumm. subsp. tridentata
Rhus burchellii Sond. ex Engl.
Rhus crenata Thunb.
Rhus dentata Thunb.
Rhus dregeana Sond.
Rhus glauca Thunb.
Rhus gueinzii Sond.
Rhus incisa
Rhus lancea L.f.
Rhus longispina Eckl. & Zeyh.
Rhus lucida L. fo. elliptica (Sond.) Moffett
Rhus rhodesiensis R.& A.Fern. forma rhodesiensis
Rhus species
Rhynchosia calvescens Meikle
Rhynchosia ciliata (Thunb.) Schinz
Rhynchosia totta (Thunb.) DC. var. totta
Rubus pinnatus Willd.
Rumohra adiantiformis (G.Forst.) Ching
Ruschia cradockensis (Kuntze) H.E.K.Hartmann & Stber ssp. cradockensis
Ruschia orientalis L.Bolus
Ruschia uncinata (L.) Schwantes
Salvia stenophylla Burch. ex Benth.
Sansevieria aethiopica Thunb.
Sansevieria hyacinthoides (L.) Druce
Sansevieria species
Satyrium membranaceum Sw.
Satyrium parviflorum Sw.
Scabiosa columbaria L.
Scabiosa tysonii L.Bolus
Schkuhria pinnata (Lam.) Cabrera
Schoenoplectus decipiens (Nees) J.Raynal
Schoenoxiphium sparteum (Wahlenb.) C.B.Clarke
Schotia afra (L.) Thunb. var. afra
Schotia latifolia Jacq. x S. sfra (L.) Thunb. form A
Scutia myrtina (Burm.f.) Kurz
Selago corymbosa L.
Selago dolosa Hilliard
Senecio brachypodus DC.
Senecio conrathii N.E.Br.
Senecio erubescens
Senecio inaequidens DC.
Senecio juniperinus
Senecio linifolius L.

Senecio radicans (L.f.) Sch.Bip.
Senecio retrorsus DC.
Senecio species
Senecio speciosus Willd.
Setaria sphacelata (Schumach.) Moss var. torta (Stapf) Clayton
Setaria nigrirostris (Nees) T.Durand & Schinz
Solanum nigrum L.
Solanum retroflexum Dunal
Solanum supinum Dunal
Solanum tomentosum L.
Sonchus dregeanus DC.
Sporobolus africanus (Poir.) Robyns & Tournay
Sporobolus nitens Stent
Stachys aethiopica L.
Stapelia macowanii N.E.Br. var. conformis (N.E.Br.) L.C.Leach
Sutera campanulata (Benth.) Kuntze
Sutera pinnatifida (Benth.) Kuntze
Sutera species
Sutherlandia frutescens (L.) R.Br.
Sutherlandia humilis E.Phillips & R.A.Dyer
Sutherlandia microphylla Burch. ex DC.
Tagetes minuta L.
Tarchonanthus camphoratus L.
Tephrosia capensis
Tephrosia species
Tetragonia species
Tetraria cuspidata (Rottb.) C.B.Clarke
Teucrium africanum Thunb.
Themeda triandra Forssk.
Thesium pallidum A.DC.
Thesium species
Thunbergia capensis Retz.
Trachyandra asperata
Trachyandra saltii
Trachyandra species
Tragus berteronianus Schult.
Tragus koelerioides Asch.
Tribolium hispidum (Thunb.) Desv.
Tribulus terrestris L.
Trichodiadema species
Trifolium burchellianum
Triraphis sp.
Tristachya leucothrix Nees
Tritonia strictifolia (Klatt) Benth. ex Klatt
Verbena tenuisecta Briq.
Vicia hirsuta (L.) Gray
Viscum rotundifolium L.f.
Wahlenbergia albens (Spreng. ex A.DC.) Lammers
Wahlenbergia juncea (H.Buek) Lammers
Walafrida densiflora (Rolfe) Rolfe
Walafrida geniculata (L.f.) Rolfe
Walafrida gracilis Rolfe
Walafrida saxatilis (E.Mey.) Rolfe
Watsonia species
Withania somnifera (L.) Dunal
Zanthoxylum capense (Thunb.) Harv.
Zygophyllum uitenhagense Sond.