ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED KOKERBOOM 2 WIND FARM NEAR LOERIESFONTEIN:

FAUNA & FLORA SPECIALIST IMPACT ASSESSMENT REPORT

PRODUCED FOR AURECON

ON BEHALF OF BUSINESS VENTURE INVESTMENTS NO. 1788

SIMON TODD CONSULTING

Simon.Todd@3foxes.co.za

Christy@3foxes.co.za

December 2017

CONTENTS

NEMA 2014 CHECKLIST

Section		*NEMA 2014 Regulations for Specialist Studies*	Position in report (pg.)	check
1	1	A specialist report prepared in terms of these Regulations must contain—		
	(a)	details of-		
		(i) the specialist who prepared the report; and	4-5	✓
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	5	✓
	(b)	a declaration that the person is independent in a form as may be specified by the competent authority;		✓
	(c)	an indication of the scope of, and the purpose for which, the report was prepared;	6	✓
	(d)	a description of the methodology adopted in preparing the report or carrying out the specialised process;	8-10	✓
	(e)	a description of any assumptions made and any uncertainties or gaps in knowledge;	8	✓
	(f)	a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	10-17	✓
	(g)	recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;	20-23	✓
	(h)	a description of any consultation process that was undertaken during the course of carrying out the specialist report;	See main EIA report	✓
	(i)	a summary and copies of any comments that were received during any consultation process; and	See main EIA report	✓
	(j)	any other information requested by the competent authority.		
2		Where a proposed development and the geographical area within which it is located has been subjected to a pre-assessment using a spatial development tool, and the output of the pre-assessment in the form of a site specific development protocol has been adopted in the prescribed manner, the content of a specialist report may be determined by the adopted site specific development protocol applicable to the specific proposed development in the specific geographical area it is proposed in.	N/A	✓

PROFESSIONAL PROFILE OF CONSULTANT:

Simon Todd Consulting has extensive experience in the assessment of renewable energy developments, having provided ecological assessments for more than 80 different renewable energy developments. This includes a large number of developments in the immediate vicinity of the current site as well as in the broader Northern Cape Province. Simon Todd is a recognised ecological expert and is a past chairman of the Arid-Zone Ecology Forum and has 18 years' experience working throughout the country. Simon Todd is registered with the South African Council for Natural Scientific Professions (No. 400425/11).

Recent experience and relevant projects in the immediate vicinity of the current site include the following:

- Mainstream South Africa Dwarsrug Wind Energy Facility: Fauna & Flora Specialist Impact Assessment Report. Sivest 2014.
- Basic Assessment Process for the Proposed Construction of the Transnet 15km 50 kV Power Line from Eskom Helios Substation to the proposed new Transnet Helios Traction Feeder Substation. Nsovo Environmental Consulting. 2014.
- Loeriesfontein Wind Energy Facility – Substation & Grid Connection. Fauna & Flora Specialist Report for Basic Assessment. Specialist Report for Savannah Environmental. 2012.
- Proposed Re-Alignment of the Authorised Power Line for The Loeriesfontein 2 Wind Energy Facility.: Fauna & Flora Specialist Report for Basic Assessment. Savannah Environmental 2014.
- Mainstream Loeriesfontein 2 Wind Energy Facility: Fauna and Flora Preconstruction Walk-Through Report. Savannah Environmental 2014.
- Mainstream Khobab Wind Energy Facility: Fauna And Flora Preconstruction Walk-Through Report. Savannah Environmental 2014.

1 INTRODUCTION

Business Venture Investments No. 1788 (Pty) Ltd (herein after referred to as the Proponent) has appointed Aurecon South Africa (Pty) Ltd (Aurecon) to undertake the required environmental authorisation process for the proposed Kokerboom 2 Wind Energy Facility (WEF) located north of Loeriesfontein in the Northern Cape Province. It is anticipated that the Kokerboom 2 WEF will have an output capacity of up to 240MW from up to 60 turbines. A grid connection will also be required, but this will be assessed through an independent Basic Assessment process. The development is currently in the environmental impact assessment (EIA) phase and the Department of Environmental Affairs (DEA) have accepted (26 January 2017) the Scoping Study for the site. Aurecon has appointed Simon Todd Consulting to provide a specialist terrestrial biodiversity impact assessment of the development site as part of the EIA process.

As part of the above EIA process, this ecological specialist study details the ecological characteristics of the site and provides an assessment of the likely ecological impacts associated with the development of the proposed Kokerboom 2 WEF. Impacts are assessed for the preconstruction, construction, operation, and decommissioning phases of the development. A variety of avoidance and mitigation measures associated with each identified impact are recommended to reduce the likely impact of the development, which should be included in the EMPr for the development. The full scope of study is detailed in Section 1.1 below.

1.1 SCOPE OF STUDY

The scope of the study includes the following activities:

- a description of the environment that may be affected by a specific activity and the manner in which the environment may be affected by the proposed project;
- a description and evaluation of environmental issues and potential impacts (including assessment of direct, indirect and cumulative impacts) that have been identified;
- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts;
- an indication of the methodology used in determining the significance of potential environmental impacts;
- an assessment of the significance of direct indirect and cumulative impacts of the development;
- a description and comparative assessment of all alternatives including cumulative impacts;
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Programme (EMPr);
- an indication of the extent to which the issue could be addressed by the adoption of mitigation measures;
- a description of any assumptions uncertainties and gaps in knowledge; and

- an environmental impact statement which contains:
- a summary of the key findings of the environmental impact assessment;
- an assessment of the positive and negative implications of the proposed activity; and
- a comparative assessment of the positive and negative implications of identified alternatives.

General Considerations for the study included the following:

- Disclose any gaps in information (and limitations in the study) or assumptions made.
- Identify recommendations for mitigation measures to minimise impacts.
- Outline additional management guidelines.
- Provide monitoring requirements, mitigation measures and recommendations in a table format as input into the EMPr for faunal or flora related issues.
- The assessment of the potential impacts of the development and the recommended mitigatiom measures provided have been separated into the following project phases:
- Pre-construction
- Construction
- Operational
- Decomissioining

1.2 ASSESSMENT APPROACH & PHILOSOPHY

This assessment is conducted according to the 2014 EIA Regulations (Government Notice Regulation 982) in terms of the National Environmental Management Act (Act 107 of 1998) as amended (NEMA), as well as best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers *et al*. (2005).

In terms of NEMA, this assessment demonstrates how the proponent intends to comply with the principles contained in Section 2 of NEMA, which amongst other things, indicates that environmental management should:

- (In order of priority) aim to: avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;
- Avoid degradation of the environment;
- Avoid jeopardising ecosystem integrity;
- Pursue the best practicable environmental option by means of integrated environmental management;
- Protect the environment as the people's common heritage;
- Control and minimise environmental damage; and
- Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems.

These principles serve as guidelines for all decision-making matters that may affect the environment. As such, it is incumbent upon the proponent to show (through the EIA process) how proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined in terms of NEMA.

Furthermore, in terms of best practice guidelines as outlined by Brownlie (2005) and De Villiers et al. (2005), a precautionary and risk-averse approach should be adopted for projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (CBAs) (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.

In order to adhere to the above principles and best-practice guidelines, the following approach forms the basis for the study approach and assessment philosophy:

- The study includes data searches, desktop studies, site walkovers / field survey of the property and baseline data collection, describing:
- A description of the broad ecological characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

In terms of **pattern**, the following will be identified or described:

Community and ecosystem level

- The main vegetation type, its aerial extent and interaction with neighbouring types, soils or topography;
- Threatened or vulnerable ecosystems (*cf. SA vegetation map/National Spatial Biodiversity Assessment, fine-scale systematic conservation plans, etc*).

Species level

- Species of Conservation Concern (SCC) (giving location if possible using GPS)
- The viability of an estimated population size of the RDB species that are present (including the degree of confidence in prediction based on availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, low 0-40% confident)
- The likelihood of other RDB species, or species of conservation concern, occurring in the vicinity (include degree of confidence).

Fauna

- Describe and assess the terrestrial fauna present in the area that will be affected by the proposed development.

- Conduct a faunal assessment that can be integrated into the ecological study.
- Describe the existing impacts of current land use as they affect the fauna.
- Clarify species of special concern (SSC) and that are known to be:
    - endemic to the region;
    - that are considered to be of conservational concern;
    - that are in commercial trade (CITES listed species); or
    - are of cultural significance.
- Provide monitoring requirements as input into the EMPr for faunal related issues.

Other pattern issues

- Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity.
- The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than infestation of undisturbed sites).
- The condition of the site in terms of current or previous land uses.

In terms of **process**, the following will be identified and/or described:

- The key ecological “drivers” of ecosystems on the site and in the vicinity, such as fire.
- Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. *corridors* such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and *vegetation boundaries* such as edaphic interfaces, upland-lowland interfaces or biome boundaries).
- Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- Furthermore, any further studies that may be required during or after the EIA process will be outlined.
- All relevant legislation, permits and standards that would apply to the development will be identified.
- The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image or map delineated at an appropriate level of spatial accuracy.

1.3 RELEVANT ASPECTS OF THE DEVELOPMENT

It is anticipated that entire the Kokerboom 2 WEF will have an output capacity of up to 240MW. It is anticipated that there will be up to 60 turbines (maximum hub height of 150m and maximum rotor diameter of 150m). Proposed associated infrastructure will include:

- Access roads ~6 - 10 m wide;
- Hard standings of ~50 m x 25 m alongside turbines;
- Satellite substation (~120 x 100 m) to step up the current from medium voltage (e.g. 33kV) to 132kV;
- Workshop and administration buildings;
- Temporary lay down areas and construction site camp/s;
- Medium voltage (MV) and High Voltage (HV) overhead lines; and
- MV underground lines, laid generally alongside roads.

A separate basic assessment process (BA) will be undertaken for an associated high voltage (HV) 132kV overhead transmission line and two proposed switching stations which will be used to connect the proposed Kokerboom 2 WEF to the existing Eskom Helios substation. A study area was provided by Aurecon for the project prior to undertaking the desktop and site visit components of the assessment, which provided an indicative area for the proposed turbines. During the scoping phase of this EIA process, feedback from the site visit of this assessment (and other specialist assessments) was used to identify sensitive and no-go options for turbines. The turbine layout was subsequently provided and is illustrated below in Figure 1.

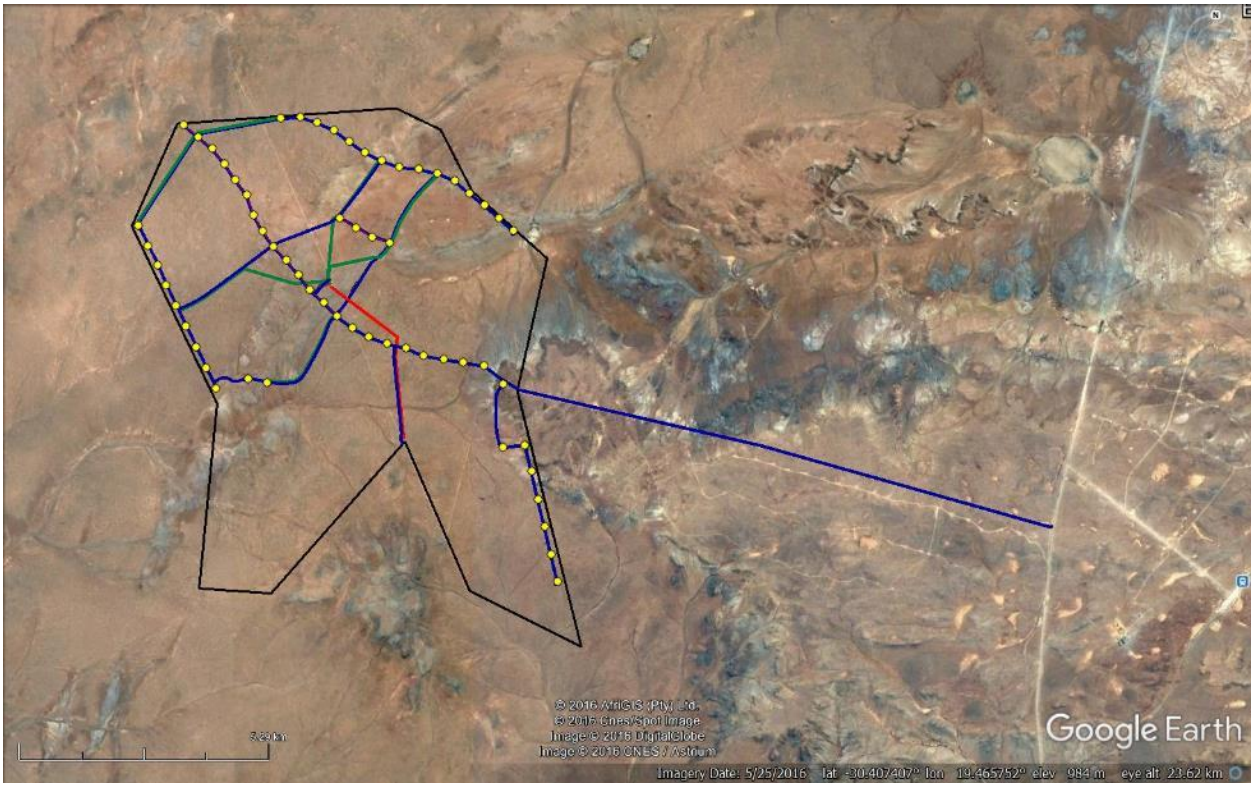

Figure 1. The proposed layout of the Kokerboom 2 WEF, showing the turbines in yellow, with internal access roads in blue and medium voltage overhead lines in green and the high voltage connection to a shared switching substation with Kokerboom 1 to the south in red.

1.4 LIMITATIONS & ASSUMPTIONS

The current study consisted of two site visits as well as a desktop study, which serves to reduce the limitations and assumptions required for the study. As the vegetation was in a good condition for sampling at the time, there are few limitations with regards to the vegetation sampling and the species lists obtained are considered comprehensive. Many fauna are difficult to observe in the field and their potential presence at the site must be evaluated based on the literature and available databases. In many cases, these databases are not intended for fine-scale use and the reliability and adequacy of these data sources relies heavily on the extent to which the area has been sampled in the past. Many remote areas have not been well sampled with the result that the species lists derived for the area do not always adequately reflect the actual fauna and flora present at the site. This is acknowledged as a limitation of the study, however it is substantially reduced by the fact that the consultant has sampled the adjacent properties including Sous on multiple occasions across different seasons. In order to further reduce this limitation, and ensure a conservative approach, the species lists derived for the site from the literature were obtained from an area significantly larger than the study site.

2 METHODOLOGY

2.1 DATA SOURCING AND REVIEW

Data sources from the literature consulted and used where necessary in the study includes the following:

Vegetation:

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006) as well as the National List of Threatened Ecosystems (2011), where relevant.
- Information on plant and animal species recorded for Quarter Degree Squares (QDS) 3019AD, CB, BC and DA was extracted from the Plants of South Africa (POSA) database hosted by the South African National Biodversity Institute (SANBI). This is a considerably larger area than the study area, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself has not been well sampled in the past.
- The IUCN conservation status (Table 1) of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (2014).

Habitats:

- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011).
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).

Fauna:

- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and the ADU databases http://vmus.adu.org.za.
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site.
- The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria version 3.1 (2016) (See Figure 1) and where species have not been assessed under these criteria, the CITES status is reported where possible.

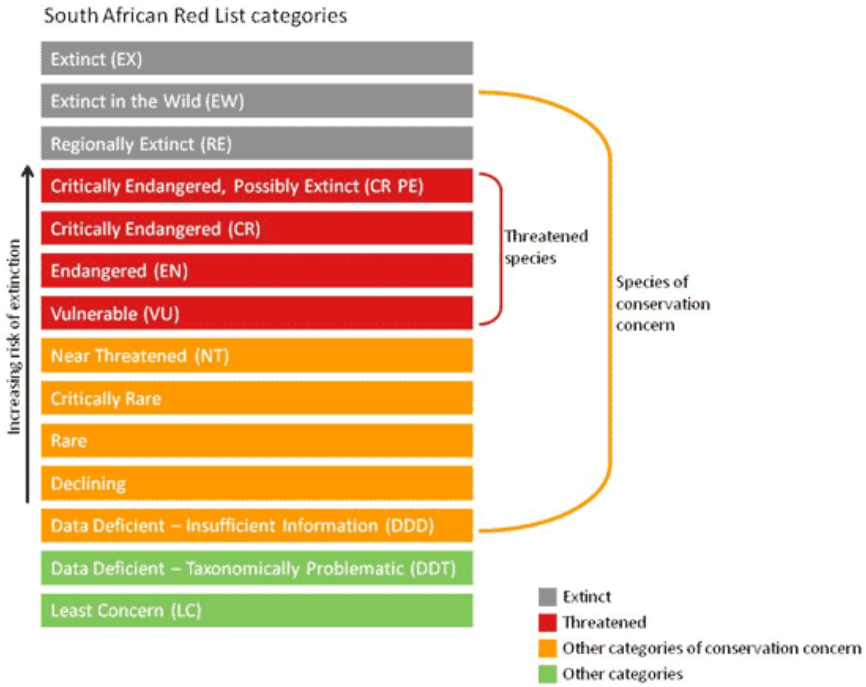

Figure 1. Schematic representation of the South African Red List categories. Taken from http://redlist.sanbi.org/redcat.php

2.2 SENSITIVITY MAPPING & ASSESSMENT

An ecological sensitivity map of the site was produced by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various spatial databases as described above. Sensitive features such as wetlands, drainage lines and water bodies were mapped and buffered where appropriate to comply with legislative requirements or ecological considerations. Additional sensitive areas were then identified based on the results of the site visit and delineated. Features that were specifically captured in the sensitivity map include drainage features, wetlands and dams, as well as rocky outcrops and steep slopes. The ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

- **Low** – Units with a low sensitivity where there is likely to be a low impact on ecological processes and terrestrial biodiversity. This category represents transformed or natural areas where the impact of development is likely to be local in nature and of low significance with standard mitigation measures.
- **Medium** - Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. Development within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.
- **High** – Areas of natural or transformed land where a high impact is anticipated due to the high biodiversity value, sensitivity or important ecological role of the area. These areas are not no-go areas, however development within these areas is undesirable and should only proceed with caution as it may not be possible to mitigate all impacts appropriately.
- **Very High** – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are essentially no-go areas from a developmental perspective and should be avoided as much as possible.

In some situations, areas where also categorised between the above categories, such as Medium-High, where an area appeared to be of intermediate sensitivity with respect to the two defining categories. However, it is important to note that there are no sensitivities that are identified as “Medium to High” or similar ranged categories because this adds uncertainty to the mapping as it is not clear if an area falls at the bottom or top of such a range.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT- BASELINE

3.1 BROAD-SCALE VEGETATION PATTERNS

The national vegetation map (Mucina & Rutherford 2006) for the study area is depicted below in Figure 2. The entire site falls within the Bushmanland Basin Shrubland vegetation type. With an extent of 34 690 km^2 this is one of the most extensive vegetation types in South Africa. Bushmanland Basin Shrubland occurs on the extensive basin centered on Brandvlei and Van Wyksvlei, spanning Granaatboskolk in the west to Copperton in the east, and Kenhardt in the north to around Williston in the south. The area is characterised by slightly irregular plains dominated by a dwarf shrubland, with succulent shrubs or perennial grasses in places. The geology consists largely of mudstones and shales of the Ecca group and Dwyka tillites with occasional dolerite intrusions. Soils are largely shallow to non-existent, with calcrete present in most areas. Rainfall ranges from 100-200 mm and falls mostly during the summer months as thunder storms. As a result of the arid nature of the area, very little of this vegetation type has been affected by intensive agriculture and it is classified as Least Threatened. There are few endemic and biogeographically important species present at the site and only *Tridentea dwequensis* is listed by Mucina and Rutherford as biogeographically important while *Cromidon minimum*, *Ornithogalum bicornutum* and *O.ovatum* subsp *oliverorum* are listed as being endemic to the vegetation type.

However, the national vegetation does not provide a good representation of the vegetation at the site, and it is clear that large parts of the site are more closely allied with Bushmanland Arid Grassland. Bushmanland Arid Grassland is also an extensive vegetation type and is the second most extensive vegetation type in South Africa and occupies an area of 45 478 km^2. It extends from the study area around Aggeneys in the east to Prieska in the west. It is associated largely with red-yellow apedal (without structure), freely drained soils, with a high base status and mostly less than 300mm deep. Due the arid nature of the unit which receives between 70 and 200 mm annual rainfall, it has not been significantly impacted by intensive agriculture and more than 99% of the original extent of the vegetation type is still intact. Mucina & Rutherford (2006) list six endemic species for the vegetation type which is a relatively low number given the extensive nature of the vegetation type.

The vegetation of the site is a mosaic of grassy and shrub-dominated areas, which is related to the soil conditions, with sandy soils being dominated by grasses and exposed calcrete or gravel soils dominated by shrubs, with many transitional areas with mixed-shrub-grass communities. The site is described in greater detail, with characteristic and dominant species in the next section.

Other vegetation types which occur in the wider area include Hantam Karoo and Western Bushmanland Klipveld. However, neither of these vegetation types fall within the site and would

not be affected by the Kokerboom WEF. There are also some small pans in the area which fall within the Bushmanland Vloere vegetation type. These are however outside of the current site and would not be affected by the Kokerboom 2 wind farm.

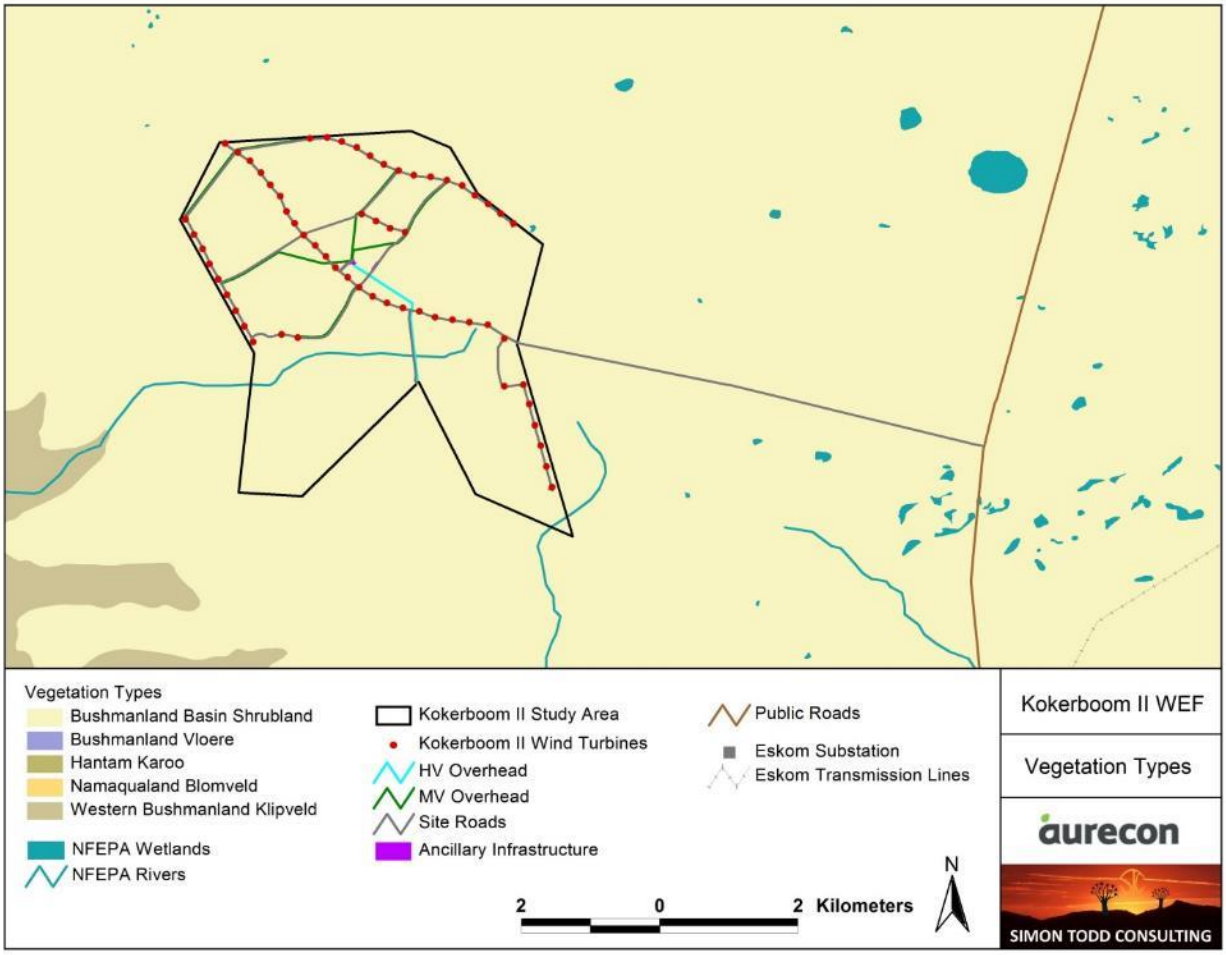

Figure 2. The national vegetation map (Mucina & Rutherford 2006/2012) for the Kokerboom 2 study area. Rivers and wetlands (pans) delineated by the National Freshwater Ecosystem Priority Areas Assessment (Nel et al. 2011) are also depicted.

3.2 FINE-SCALE VEGETATION PATTERNS

The site consists of flat to gently undulating open plains dominated by low shrubs or arid tussock grasses. It is typical of southwestern Bushmanland and does not contain any remarkable ecological features. Although there are some significant pans and large hills in the broader area, there are no such features within the site itself. The only landscape features present are some low ridges along the eastern boundary of the site and some poorly developed drainage lines. The

vegetation of the site is very homogenous and shifts from shrub-dominated vegetation on gravelly soils to tussock-grass-dominated areas on sandy soils, with large areas also transitional between these extremes. Plant diversity is low and the only areas with moderate levels of diversity are the low ridges along the eastern boundary of the site. Each of the different features and landscape units of the site is described in detail below.

Gravelly Plains

Image 1. The typical shrub-dominated gravel plains prevalent across large parts of the Kokerboom 2 WEF. This represents typical Bushmanland Basin Shrubland vegetation as described in Mucina & Rutherford (2006). These plains are homogenous and exhibit little variation and as there are few species of concern present, they are not considered highly sensitive and are generally considered suitable for development.

The gravelly areas are dominated by low shrubs typical of the Bushmanland Basin Shrubland vegetation type. Typical species include the shrubs *Pentzia incana*, *Zygophyllum lichtensteinianum*, *Asparagus capensis*, *Zygophyllum retrofractum*, *Eriocephalus spinescens*, *Aptosimum spinescens*, *Tripteris sinuata*, *Hermannia spinosa*, *Thesium lineatum*, *Felicia clavipilosa*, *Osteospermum armatum*, *Pegolettia retrofracta*, *Pteronia mucronata*, *Pteronia sordida*, *Rosenia humilis*, *Galenia fruticosa*, *Lycium pumilum* and *Salsola tuberculata*; succulent shrubs such as *Aridaria noctiflora*, *Ruschia intricata*, *Drosanthemum lique*, *Psilocaulon coriarium* and *Sarcocaulon patersonii* forbs such as *Aptosimum indivisum*, *Hypertelis salsoloides*, *Gazania lichtensteinii*, *Galenia sarcophylla* and *Fockea sinuata*; geophytes including *Drimia intricata* and *Moraea miniata*. Overall diversity within this vegetation type at the site is low, which can be

ascribed to the aridity of the area and the poorly developed soils. Areas of higher diversity include exposed calcrete soils which contain specialist species such as *Titanopsis calcarea*, while there are also some low shale-derived hills present which have species such as *Aloinopsis luckhoffii*, *Cephalophyllum fulleri* which is listed as Rare and protected species such as *Aloe falcata*, *Aloe claviflora* and *Hoodia gordonii*.

Image 2. The gravel slopes along the eastern boundary of the site are considered somewhat more sensitive than the open plains, but do not contain a high abundance of species of concern and are not considered high sensitivity.

Image 3. Examples of listed and protected species at the site incude *Hoodia gordonii* which is occasional across the site but more common on the gravel hills, while *Aloe falcata* is a provincially protected species that also occurs on the gravel hills.

Grassy Plains

Image 4. Grassy plains typical of the western and northern sections of the Kokerboom 2 site, corresponding with the Bushmanland Arid Grassland vegetation type. The vegetation is dominated by *Stipagrostis* cilita or *Stipagrostis brevifolia* with occasional *Lycium pumilum* bushes. This area is not considered sensitive as the diversity is low and there are very few species of concern present.

The grassy areas of the site are dominated by grasses such as *Stipagrostis ciliata*, *Stipagrostis brevifolia*, *Stipagrostis anomala* and *Aristida adscenionis*, shrubs including *Lycium pumilum*, *Aptosimum spinescence*, *Melolobium candicans*, *Plinthus karooicus*, *Salsola tuberculata*, with occasional annuals such as *Leysera tenella*, *Arctotis leiocarpa*, *Osteospermum pinnatum*, *Limeum africanum* and *Trianthema parvifolia*. These areas are not considered sensitive and contain few species of conservation concern. As they are homogenous and widely available in the area and in the rest of bushmandland, cumulative impacts on this community would be low.

Image 5. Image ilustrating the transitional nature of large parts of the Kokerboom 2 site, where there is a shrub-grass mix that shifts in either direction, based on substrate conditions and sometimes landuse as well.

Drainage Lines

The drainage lines of the site are not very well developed and do not have a tall woody component. Typical and dominant species include *Rhigozum trichotomum*, *Phaeoptilum spinosum*, *Zygophyllum retrofractum*, *Salsola tuberculata*, *Stipagrostis namaquensis*, *Stipagrostis obtusa*, *Osteospermum armatum*, *Lycium pumilum*, *Lycium oxycarpum*, *Galenia sarcophylla*, *Salsola aphylla* and *Sesamum capense*. Although the drainage lines are not well developed, which can be ascribed to aridity of the area, they are ecologically important because the higher cover and productivity of these areas is important for fauna forage and habitat availability and they also play an important hydrological role and regulate flow following occasional strong rainfall events. As such disturbance to these areas should be minimised as far as possible.

Image 6. Example of one of the drainage lines of the Kokerboom 2 site, dominated by *Rhigozum trichotomum*, *Phaeoptilum spinosum* and *Lycium pumilum* shrubs.

3.3 LISTED PLANT SPECIES

The study area has been very poorly sampled in the past and many of the quarter degree squares in the area have no data available. According to the SIBIS database, a total of 135 indigenous species are known from the area, of which 89 have been observed by the consultant on the site and an additional 28 species were observed that have not been recorded from the area before. Although some additional species would undoubtedly be discovered with additional sampling, the area is not species-rich and even with intensive sampling the area is not likely to demonstrate exceptional richness. Listed and protected species observed in the area include *Cephalophyllum fulleri* which is classified as Rare and a number of provincially protected species including *Aloe falcata*, *Hoodia gordonii* and *Aloinopsis luckhoffii* and *Euphorbia multiceps*. *Hoodia gordonii* is protected under NEMA and is listed as DDD (Data Deficient – insufficient information) while *Aloinopsis luckhoffii* is provincially protected is listed as taxonomically uncertain (DDT).

3.4 CRITICAL BIODIVERSITY AREAS & BROAD-SCALE PROCESSES

The recently completed Northern Cape Critical Biodiversity Areas (CBAs) map (Oosthuysen & Holness 2016) is depicted below for the study area (Figure 3). This biodiversity assessment identifies CBAs which represent biodiversity priority areas which should be maintained in a natural to near natural state. The CBA maps indicate the most efficient selection and classification of

land portions requiring safeguarding in order to maintain ecosystem functioning and meet national biodiversity objectives. There are some tier one and tier two CBAs within the site and within the development footprint. The overall footprint within the CBAs is however low and there are only two turbines within the CBA 1 and seven turbines within the CBA 2, which is not considered highly significant and the low overall development footprint would not compromise the ecological functioning of the CBAs. It is also important to note that the CBAs are based on broad-scale buffering of pans and drainage features and not on the known presence of significant biodiversity within the development footprint. As the site visit clearly illustrates, there are no specific features within the site and the biodiversity of the area is considered low and so direct development impacts on biodiversity within the development footprint would be low. The CBA 2 areas are based on the presence of some large pans on the adjacent property to the west of the site, which would not be affected by the current development. Consequently, the presence of the CBAs at the site is a potential concern, but due to the underlying reasons for their presence, the likely impact of the development on the CBAs would be low. In addition, the site does not lie within a National Protected Area Expansion Strategy (NPAES) focus area and has therefore not been identified as an important area for future conservation area expansion.

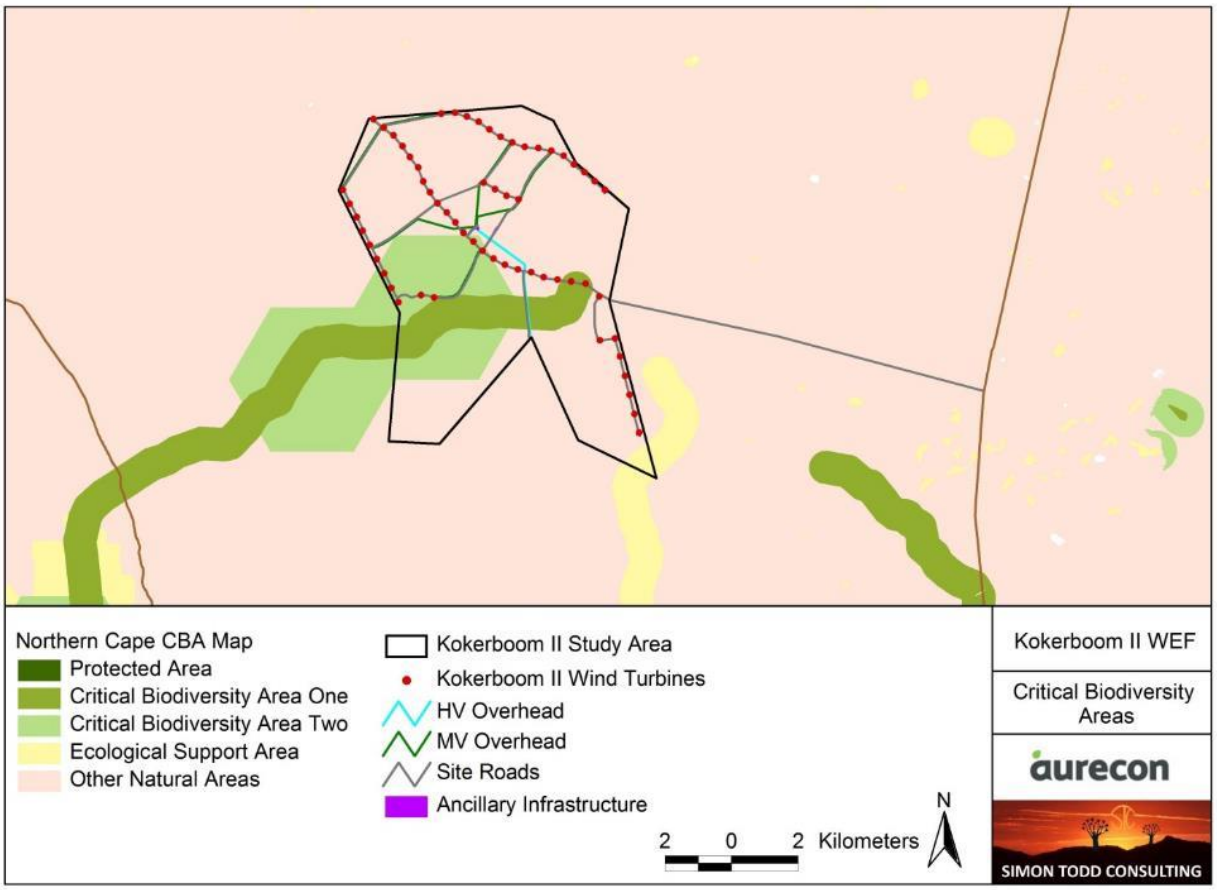

Figure 3. Critical Biodiversity Areas map of the study area, showing the presence of tier one and two CBAs within the Kokerboom 2 study area.

In terms of existing impacts in the area and the potential for the Kokerboom 2 Wind Farm to contribute to cumulative impacts, the DEA-registered renewable energy projects for the area are depicted below in Figure 4. Although there is not a lot of development in the wider area, there are two wind farm preferred bidders adjacent to to the site that are currently under construction and nearing completion, as well as a solar farm that is a preferred bidder. To the west of the Eskom Helios substation, there is the Dwarsrug WEF, which has authorisation but is not a preffered bidder.

A node of wind energy development is developing around the Helios Substation which would potentially generate significant local impact. However, there are no specific features of the affected area such as the presence of large drainage corridors, which would indicate that it is likely to be more important than the surrounding areas for faunal movement or landscape connectivity. In addition, the intensity of development in the wider area is still low sothe contribution of the development to cumulative impact would be relatively low and would operate at a local scale only. In addition, the existing and proposed wind energy developments are not very extensive (approximately 70-80ha of habitat loss each) and even with the development of several wind farms, the overall intensity of development within a 20-30km radius of the Helios substation would be very low. Taking a worst-case estimate of 100ha of direct habitat loss per wind farm development, even if all developments in the area were to go ahead, there would be 500ha of habitat loss in the area, which is not significant in context of the overwhelmingly intact surrounding landscape. In addition, cumulative impacts are further reduced by the homogenous nature of the landscape in the area and the paucity of species and habitats of concervation concern in the affected areas.

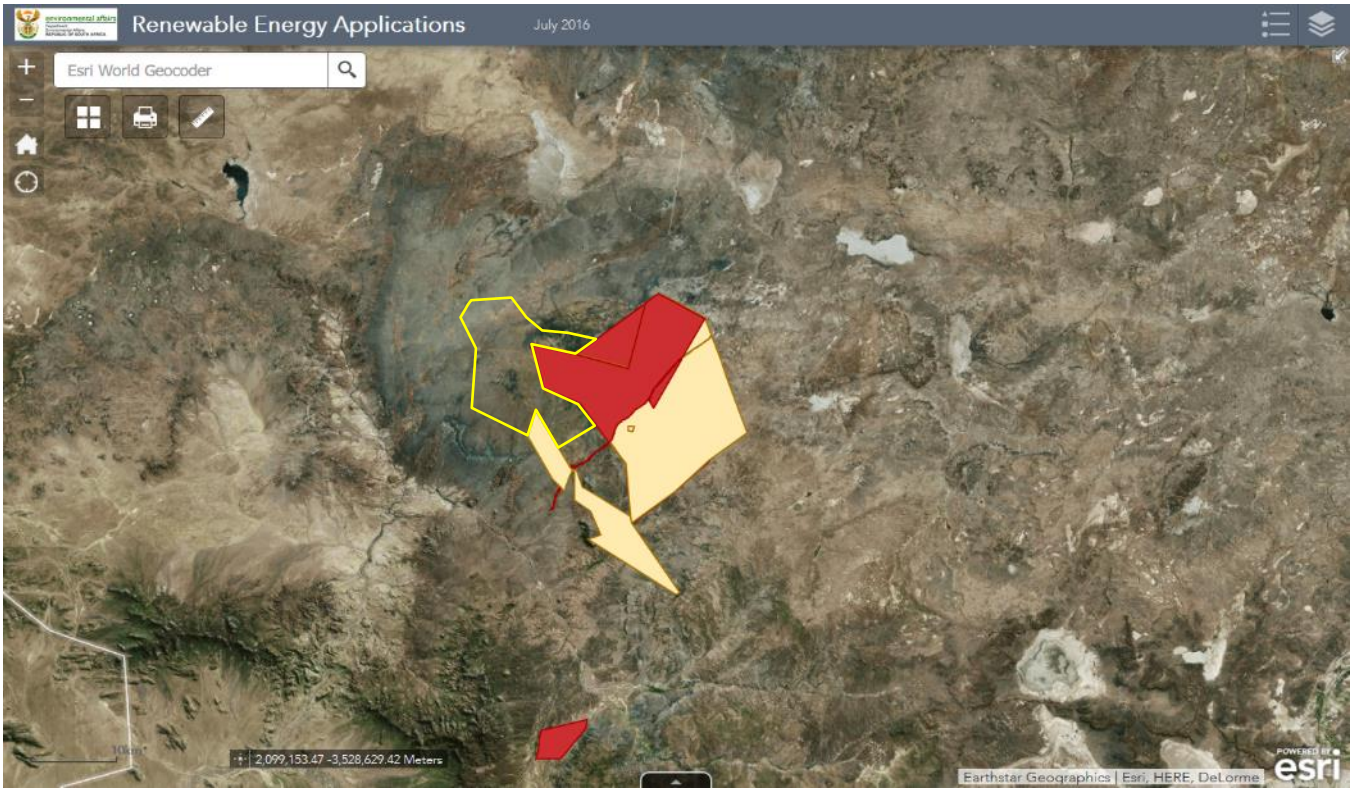

Figure 4. DEA-registered renewable energy projects in the vicinity of the wider Kokerboom study area which is indicated in yellow. The colours of the map are not correct as red indicates solar development and pale yellow wind energy development, but the properties east of the Kokerboom site are the Mainstream Khobab and Loeriesfontein wind farms. Although there is a node of development around the Helios substation, the broader area has very little development impact.

3.5 FAUNAL COMMUNITIES

Mammals

The site falls within the distribution range of 40 terrestrial mammals suggesting that potential mammalian diversity at the site is quite low. Species observed in the area include Steenbok *Raphicerus campestris*, Cape Porcupine *Hystrix africaeaustralis*, Aardvark *Orycteropus afer*, Yellow Mongoose *Cynictis penicillata*, Cape Hare *Lepus capensis,* Cape Fox *Vulpes chama*, Bat-eared Fox *Otocyon megalotis* and Round-eared Elephant Shrew *Macroscelides proboscideus*. In terms of specific habitats which are likely to be of above average significance, the low ridges and drainage lines are likely to contain the highest fauna abundance and diversity.

Listed mammal species which may occur at the site includes the Black-footed cat *Felis nigripes* (Vulnerable) and Honey Badger *Mellivora capensis* which is listed as Endangered in the South African Red Data Book of Mammals, but is listed as Least Concern by the IUCN. As these species have a broad distribution across South Africa, the relatively limited footprint of the development

is not likely to compromise the local or regional populations of these species, especially given the aridity of the area and the associated very low density of such species in the area.

Reptiles

The site lies in or near the distribution range of at least 40 reptile species (Appendix 3), comprising 5 tortoises, 12 snakes, 15 lizards and skinks, 8 geckos and 1 chameleon. This is a comparatively low total, suggesting that reptile diversity at the site is likely to be low. There are no listed species which are likely to occur at the site. Species which were observed in the area include the Namaqua Sand Lizard *Pedioplanis namaquensis*, Spotted Desert Lizard *Meroles suborbitalis*, Western Sandveld Lizard *Nucras tessellata*, Southern Rock Agama *Agama atra*, Ground Agama *Agama aculeata* subsp. *aculeata* and Bushmanland Tent Tortoise *Psammobates tentorius verroxii*. In terms of the likely impacts of the development on reptiles, habitat loss is not likely to be highly significant as the direct footprint of the development is not likely to exceed a few hundred hectares and this would not be significant in context of the relatively homogenous and intact surrounding landscape. In some situations, the loss of vegetation cover associated with roads and other cleared areas can generate significant impact on reptiles as they may be vulnerable to predation while crossing such cleared areas, but as the site is arid, plant cover is already low and the reptile species present are mostly well adapted to low-cover environments.

The Spotted Desert Lizard *Meroles suborbitalis* is the most common reptile at the Kokerboom site and is frequent on the open plains of the site.

Amphibians

Given the aridity of the site and lack of surface water in the area, it is not surprising that only six frog species may occur in the area. Of these only those which are relatively independent of water such as the Karoo Toad *Vandijkophrynus gariepensis* and Tandy's Sand Frog *Tomopterna tandyi* are likely to occur within the site itself. Impacts on amphibians are likely to be low given the limited extent of the development as well as low likely density of amphibians in the area. Although there are some pans present in the area, these are not necessarily available to amphibians as many of the pans are saline and not suitable for amphibians.

3.6 KOKERBOOM 2 SENSITIVITY ASSESSMENT

The sensitivity map for the Kokerboom 2 study area, is depicted below in Figure 5. The majority of the site consists of low open shrublands or arid grasslands on flat plains and gently sloping hills that are not considered highly sensitive. The overall diversity of the vegetation is very low and the abundance of listed plant species is also very low. The listed species that are present at the site occur at a very low density or in localised environments and would not be significantly affected by the development with the appropriate avoidance.

The site does not have a lot of features and the only features of some significance at the site are some poorly developed drainage lines and some low gravelly hills. The drainage lines are not well developed and large buffers (above those required by law) around these features is not necessary. There are several areas of gravel flats or hills spread across the site and although the diversity of these areas is slightly higher than the surrounding plains these areas are not considered highly sensitive.

The final layout assessed is considered acceptable in terms of the locations of the turbines, none of which are in the high sensitivity areas. Some of the access roads traverse drainage lines and medium sensitive areas, but with mitigation, the impacts on these areas would be reduced to acceptable levels.

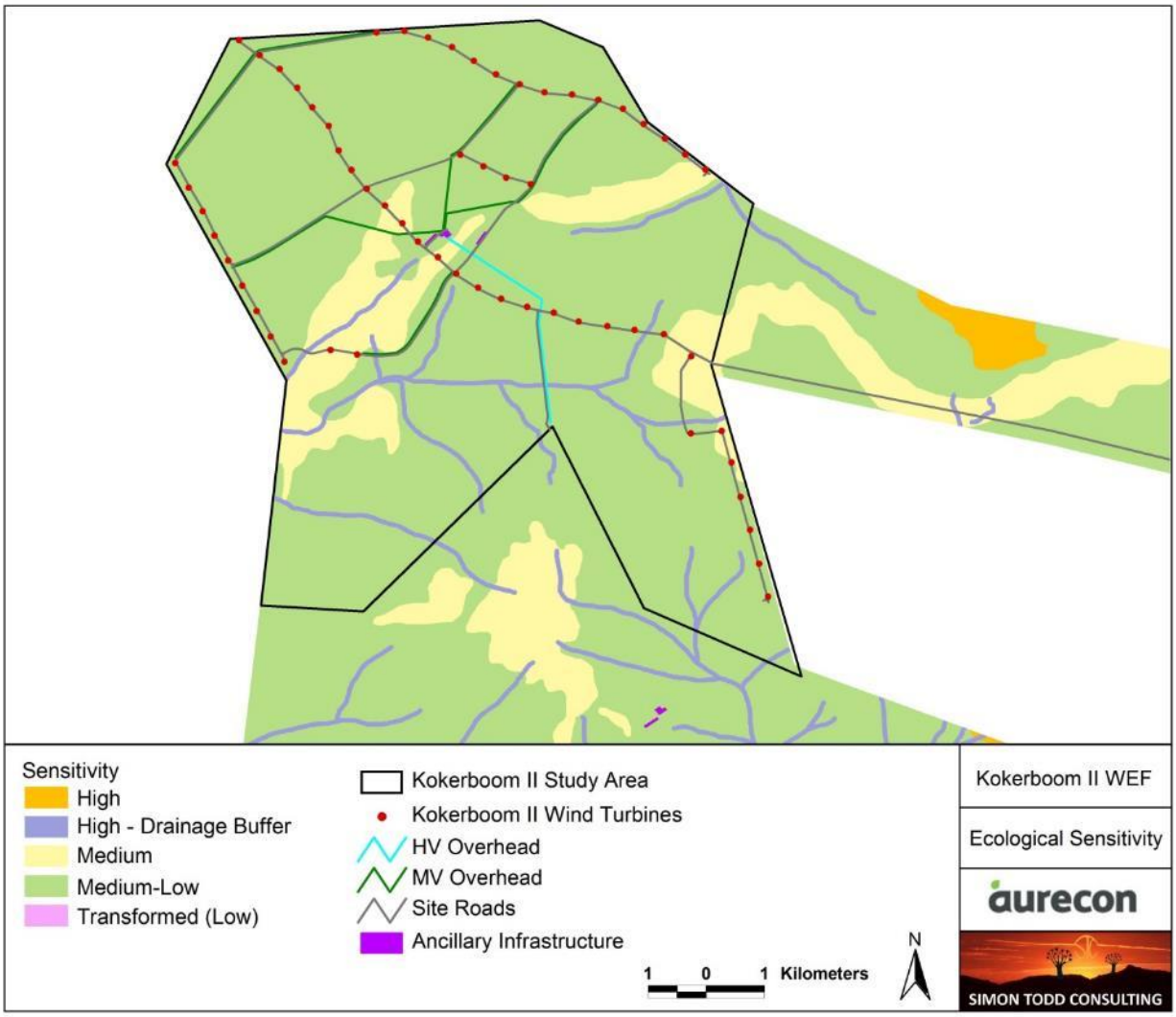

Figure 4. Ecological sensitivity map for the Kokerboom 2 WEF study area. The majority of the site is low open shrubland and arid grassland of medium-low sensitivity and considered suitable for development.

4 *IMPACTS AND ISSUES IDENTIFICATION*

The development of the proposed Kokerboom 2 WEF is likely to result in a variety of impacts, associated largely with the disturbance, loss and transformation of intact vegetation and faunal habitat to hard infrastructure such as turbine foundations and service areas, roads, operations buildings etc. The following impacts are identified as the major impacts that are likely to be associated with the development and which are assessed for the construction, operational and decommissioning phases of the development.

4.1 IDENTIFICATION OF POTENTIAL IMPACTS

The likely impacts on the terrestrial ecology of the site resulting from the development of the Kokerboom 2 Wind Farm are identified and discussed below with reference to the characteristics and features of the site. The major risk factors and contributing activities associated with the development are identified and briefly outlined and summarised below before the impacts are assessed

Impact 1. Impacts on vegetation and listed or protected plant species

The development would require vegetation clearing for turbines, roads and other hard infrastructure. Apart from the direct loss of vegetation within the development footprint, listed and protected species would potentially be impacted. These impacts are likely to occur during the construction phase of the development, with additional vegetation impacts during operation likely to be relatively low. This impact is therefore assessed for the facility, for the construction phase only.

Impact 2. Direct Faunal Impacts

Increased levels of noise, pollution, disturbance and human presence during construction will be detrimental to fauna. Sensitive and shy fauna are likely to move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed if proper management and monitoring is not in place. Traffic at the site during all phases of the project would pose a risk of collisions with fauna. Slower types such as tortoises, snakes and amphibians would be most susceptible and the impact would be largely concentrated to the construction phase when vehicle activity is high. Some mammals and reptiles would be vulnerable to illegal collection or poaching during the construction phase as a result of the large number of construction personnel that are likely to be present. During the operational phase, noise generated by the operation of the turbines is likely to negatively affect at least some fauna. Faunal impacts are therefore assessed for the all phases of the development.

Impact 3. Increased Erosion Risk

The large amount of disturbance created during construction would leave the site vulnerable to wind and water erosion. Soil disturbance associated with the development will render the impacted areas vulnerable to erosion and measures to limit erosion will need to be implemented. This impact is likely to manifest during construction and would persist into the operational phase and is therefore assessed for both phases.

Impact 4. Alien Plant Invasion

The disturbance associated with the construction phase of the project will render the disturbed areas vulnerable to alien plant invasion. Some alien plant invasion is inevitable and regular alien

plant clearing activities would be required to limit the extent of this problem. Once the natural vegetation has returned to the disturbed areas, the site will be less vulnerable to alien plant invasion, however, the roadsides and turbine service areas are likely to remain foci of alien plant invasion for several years. This impact would manifest during the operational phase, although some of the required measures to reduce this impact are required during construction.

Cumulative Impact 1. Impacts on broad-scale ecological processes and cumulative habitat loss

The development will contribute to cumulative impacts in the area and potentially the ability to meet future conservation targets. In addition, the presence of the wind turbines and daily operational activities at the site may deter certain species from the area, resulting in a loss in broad-scale landscape connectivity. In this regard it is important to note that while the development footprint is low in comparison with the total extent of the site some fauna may be affected across a much wider area than the footprint due to noise and other effects which extend beyond the direct footprint of the development.

Cumulative Impact 2. Impacts on Critical Biodiversity Areas

The development will contribute to impacts on CBAs given that part of the footprint is within CBAs. Development within CBAs may compromise the ecological functioning of the CBA or impact on significant biodiversity within the footprint. However, the CBAs at the site are based on the presence of drainage features and pans in the area and not on known fauna or flora biodiversity features. As such the impact would be on broad-scale ecological functioning of the CBA.

5 ASSESSMENT OF IMPACTS

An assessment of the identified impacts above is made below for the different phases of the development, for the Kokerboom 2 Wind Farm and associated infrastructure.

5.1 PLANNING & CONSTRUCTION PHASE IMPACTS

Impact 1. *Impact on vegetation and listed plant species.*

Impact Phase: Construction							
Impact Description: Impact on vegetation and listed plant species due to transformation within the development footprint							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Site Specific	Long Term	Medium	-'tve	**Medium**	Definite	Certain
With Mitigation	Site Specific	Long Term	Low	-'tve	**Low**	Definite	Certain

Reversibility	No - transformation is a necessary outcome of the development
Will impact cause irreplaceable loss of resources?	Not likely
Can impact be avoided, managed or mitigated?	To some extent through avoidance, but some residual impact is likely
Mitigation measures to reduce residual risk or enhance opportunities: 1) Placement of turbines within the High Sensitivity areas and drainage lines should be avoided. 2) Preconstruction walk-though of the approved development footprint to ensure that sensitive habitats and species are be avoided where possible. 3) Ensure that lay-down and other temporary infrastructure is within lower sensitivity areas, preferably previously transformed areas if possible. 4) Minimise the development footprint as far as possible and rehabilitate disturbed areas that are no longer required by the operational phase of the development. 5) A large proportion of the impact of the development stems from the access roads and the number of roads should be reduced to the minimum possible and routes should also be adjusted to avoid areas of high sensitivity as far as possible, as informed by a preconstruction walk-though survey. 6) Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes topics such as no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc. 7) Demarcate all areas to be cleared with construction tape or similar material. However caution should be exercised to avoid using material that might entangle fauna.	
Cumulative Impacts	The development will contribute to cumulative vegetation impacts in the area, but as the affected vegetation types are extensive and still more than 98% intact, this would not be significant.

Impact 2. Direct faunal impacts due to construction

Impact Phase: Construction							
Impact Description: Direct faunal impacts due to construction phase noise and physical disturbance.							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Site Specific	Short Term	Medium	-'tve	**Low**	Definite	Certain
With Mitigation	Site Specific	Short Term	Low	-'tve	**Low**	Definite	Certain
Can the impact be reversed?			Construction phase disturbance will be transient, but some habitat loss would be long term.				
Will impact cause irreplaceable loss or resources?			Highly unlikely.				
Can impact be avoided, managed or mitigated?			Only partly as noise and construction phase disturbance cannot be entirely avoided or mitigated.				
Mitigation measures to reduce residual risk or enhance opportunities:							

1) Preconstruction walk-through of the facility to identify areas of faunal sensitivity. 2) During construction any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person. 3) The illegal collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the construction site. 4) No open fires should be allowed within the site as there is a risk of runaway veld fires. 5) No fuelwood collection should be allowed on-site. 6) No dogs or cats should be allowed on site apart from that of the landowners. 7) If any parts of site such as construction camps must be lit at night, this should be done with low-UV type lights (such as most LEDs) as far as possible, which do not attract insects and which should be directed downwards. 8) All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. 9) No unauthorized persons should be allowed onto the site and site access should be strictly controlled and vehicles which need to roam around the site should be accompanied by the ECO or security personnel. 10) All construction vehicles should adhere to a low speed limit (40km/h for cars and 30km/h for trucks) to avoid collisions with susceptible species such as snakes and tortoises and rabbits or hares. Speed limits should apply within the facility as well as on the public gravel access roads to the site. 11) All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises and owls which are often persecuted out of superstition.	
Cumulative Impacts	The development will contribute to cumulative faunal impacts in the area, but the overall development pressure in the region is low and there are no speicfiic fauna of concern that would be affected.

5.2 OPERATIONAL PHASE IMPACTS

Impact 1. Direct faunal impacts due to operation

Impact Phase: Operation							
Impact Description: Faunal impacts due to operational phase activities.							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Site Specific	Long Term	Medium	-'tve	**Medium**	Probable	Sure
With Mitigation	Site Specific	Long Term	Low	-'tve	**Low**	Probable	Sure
Can the impact be reversed?			The impact will persist for the lifespan of the facility.				
Will impact cause irreplaceable loss or resources?			Unlikely				

Can impact be avoided, managed or mitigated?	Some management is possible, but residual impact from the wind turbines and general disturbance will persist.
Mitigation measures to reduce residual risk or enhance opportunities: 1) Management of the site should take place within the context of an Open Space Management Plan. 2) No unauthorised persons should be allowed onto the site. 3) Any potentially dangerous fauna such snakes or fauna threatened by the maintenance and operational activities should be removed to a safe location. 4) The illegal collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden by anyone except landowners or other indivuals with the appropriate permits where required. 5) If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most LEDs) as far as possible, which do not attract insects. 6) All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. 7) All vehicles accessing the site should adhere to a low speed limit (40km/h max) to avoid collisions with susceptible species such as snakes and tortoises. 8) If parts of the facility are to be fenced, then no electrified strands should be placed within 30cm of the ground as some species such as tortoises are susceptible to electrocution from electric fences as they do not move away when electrocuted but rather adopt defensive behaviour and are killed by repeated shocks. Alternatively, the electrified strands should be placed on the inside of the fence and not the outside.	
Cumulative Impacts	The devlepment will contribute to cumulatlve fauna disturbance and habitat loss in the area, but as the fauna of the area are widesperead species of low conservation concern, impacts would be of a local nature only, even with the presence of other operational facilities in the area.

Impact 2. Soil Erosion Risk

Impact Phase: Operation							
Impact Description: Following construction, the site will be vulnerable to soil erosion							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Site Specific	Long Term	Medium	-'tve	**Medium**	Probable	Certain
With Mitigation	Site Specific	Long Term	Low	-'tve	**Low**	Unlikely	Sure
Can the impact be reversed?			With appropriate mitigation the impact can be ameliorated				
Will impact cause irreplaceable loss or resources?			The loss of large amounts to topsoil would potentially be an irreplaceable loss of resources.				

Can impact be avoided, managed or mitigated?	With appropriate control measures, erosion risk can be mitigated to a very low level
Mitigation measures to reduce residual risk or enhance opportunities: 1) Erosion management at the site should take place according to the Erosion and Rehabilitation Plan. 2) All roads and other hardened surfaces should have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk. 3) Regular monitoring for erosion after construction to ensure that no erosion problems have developed as result of the disturbance. 4) All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. 5) All cleared areas should be revegetated with indigenous perennial shrubs and grasses from the local area. These can be cut when dry and placed on the cleared areas if natural recovery is slow.	
Cumulative Impacts	The development would potentially contribute to cumulative soil erosion problems in the area, but with mitigation, this impact can be mitigated to a very low level.

Impact 3. Alien Plant Invasion

Impact Phase: Operation							
Impact Description: Following construction, the site will be highly vulnerable to alien plant invasion							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Site Specific	Long Term	Medium	-'tve	**Medium**	Probable	Sure
With Mitigation	Site Specific	Long Term	Low	-'tve	**Low**	Unlikely	Sure
Can the impact be reversed?			With appropriate mitigation the impact can be ameliorated				
Will impact cause irreplaceable loss or resources?			With mitigation there would not be loss of resources				
Can impact be avoided, managed or mitigated?			With appropriate control measures, alien plants can be controlled and reduced to very low impact				
Mitigation measures to reduce residual risk or enhance opportunities: 1) Wherever excavation is necessary, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species. 2) Due to the disturbance at the site as well as the increased runoff generated by the hard infrastructure, alien plant species are likely to be a long-term problem at the site and a long-term control plan will need to be implemented. Problem woody species such as Prosopis are already present in the area and are likely to increase rapidly if not controlled. 3) Regular monitoring for alien plants within the development footprint as well as adjacent areas which receive runoff from the facility as there are also likely to be prone to invasion problems.							

4) Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.	
Cumulative Impacts	The development would potentially contribute to cumulative alien invasion and degradation in the area, but with mitigation, this will be reduced to a low level.

5.3 DECOMISSIONING PHASE IMPACTS

Impact 1. Direct faunal impacts due to decomissioning

Impact Phase: Decomissioning							
Impact Description: Faunal impacts due to decomissioing phase activities.							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Site Specific	Long Term	Medium	-'tve	**Medium**	Probable	Sure
With Mitigation	Site Specific	Long Term	Low	-'tve	**Low**	Probable	Sure
Can the impact be reversed?			The impact will persist for the lifespan of the facility.				
Will impact cause irreplaceable loss or resources?			Unlikely				
Can impact be avoided, managed or mitigated?			Some management is possible, but residual impact from the wind turbines and general disturbance will persist.				
Mitigation measures to reduce residual risk or enhance opportunities: 1) Any potentially dangerous fauna such as snakes or fauna threatened by the decommissioning activities should be removed to a safe location prior to the commencement of decomissioining activties. 2) All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. 3) All vehicles accessing the site should adhere to a low speed limit (40km/h max) to avoid collisions with susceptible species such as snakes and tortoises. 4) No excavated holes or trenches should be left open for extended periods as fauna may fall in become trapped. 5) All above-ground infrastructure should be removed from the site. Below-ground infrastructure such as cabling can be left in place if it does not pose a risk, as removal of such cables may generate additional disturbance and impact, however, this should be in accordance with the facilities' decommissioning and recycling plan.							
Cumulative Impacts			Decommissioning may contribute to cumulative fauna impacts in the area, but with mitigation this would be transient and in the long-term the removal of the facility would return the site largely to its previous state in terms of faunal habitats and impacts.				

Impact 2. Soil Erosion Risk due to Decommissioning

Impact Phase: Decommissioning							
Impact Description: Following construction, the site will be vulnerable to soil erosion							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Site Specific	Long Term	Medium	-'tve	**Medium**	Probable	Certain
With Mitigation	Site Specific	Long Term	Low	-'tve	**Low**	Unlikely	Sure
Can the impact be reversed?			With appropriate mitigation the impact can be ameliorated				
Will impact cause irreplaceable loss or resources?			The loss of large amounts to topsoil would potentially be an irreplaceable loss of resources.				
Can impact be avoided, managed or mitigated?			With appropriate control measures, erosion risk can be mitigated				
Mitigation measures to reduce residual risk or enhance opportunities: 1) Any roads that will not be rehabilitated should have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk. 2) There should be regular monitoring for erosion for at least 2 years after decommissioning by the applicant to ensure that no erosion problems develop as result of the disturbance, and if they do, to immediately implement erosion control measures. 3) All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. 4) All disturbed and cleared areas should be revegetated with indigenous perennial shrubs and grasses from the local area.							
Cumulative Impacts			Decommissioning would potentially contribute to cumulative erosion problems in the area, but with mitigation this would be largely avoided.				

Impact 3. Alien Plant Invasion following decommissioning

Impact Phase: Decommissioning							
Impact Description: Following decommissioning, the site will be highly vulnerable to alien plant invasion							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Site Specific	Long Term	Medium	-'tve	**Medium**	Probable	Sure
With Mitigation	Site Specific	Long Term	Low	-'tve	**Low**	Unlikely	Sure
Can the impact be reversed?			With appropriate mitigation the impact can be ameliorated				
Will impact cause irreplaceable loss or resources?			With mitigation there would not be loss of resources				

Can impact be avoided, managed or mitigated?	With appropriate control measures, alien plants can be controlled and reduced to very low impact
Mitigation measures to reduce residual risk or enhance opportunities: 1) Wherever excavation is necessary for decommissioning, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species. 2) Due to the disturbance at the site alien plant species are likely to be a long-term problem at the site following decommissioning and regular control will need to be implemented until a cover of indigenous species has returned. 3) Regular monitoring for alien plants within the disturbed areas for at least two years after decommissioning or until alien invasives are not longer a problem at the site. 4) Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.	
Cumulative Impacts	Decommissioning would potentially result in increased alien invasive plant problems in the area, but will post-decommissioning mitigation, this can be minimized.

5.4 CUMULATIVE IMPACTS

Impact on Cumulative effects and Broad-Scale Ecological Processes

Impact Phase: Operation							
Impact Description: Cumulative impact on broad scale ecological processes							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Local	Long Term	Medium	-'tve	**Medium**	Probable	Sure
With Mitigation	Local	Long Term	Low	-'tve	**Low**	Unlikely	Sure
Can the impact be reversed?			The impact would last for the lifetime of the development				
Will impact cause irreplaceable loss or resources?			Unlikely				
Can impact be avoided, managed or mitigated?			To some extent, but the main impact results from the loss and transformation of habitat which cannot be avoided				
Mitigation measures to reduce residual risk or enhance opportunities: 1) Minimise the development footprint within the high sensitivity areas. 2) There should be an integrated management plan for the development area during operation, which is beneficial to fauna and flora.							

Impact on Critical Biodiversity Areas

Impact Phase: Operation							
Impact Description: Impact on Critical Biodiversity Areas due to the development.							
	Extent	**Duration**	**Magnitude**	**Status**	**Significance**	**Probability**	**Confidence**
Without Mitigation	Local	Long Term	Medium	-'tve	**Medium**	Probable	Sure
With Mitigation	Local	Long Term	Low	-'tve	**Low**	Unlikely	Sure
Can the impact be reversed?			The impact would last for the lifetime of the development				
Will impact cause irreplaceable loss or resources?			Unlikely				
Can impact be avoided, managed or mitigated?			To some extent, but the main impact results from the loss and transformation of habitat which cannot be avoided				
Mitigation measures to reduce residual risk or enhance opportunities: 1. Footprint within the CBAs should be kept as low as possible. Turbines in these areas are considered acceptable as the CBAs relate to broad-scale processes and not biodiversity features on the ground, within the site. 2. There should be an integrated management plan for the development area during operation, which is beneficial to fauna and flora.							

6 ASSESSMENT OF ALTERNATIVES

There are no site alternatives considered in the current assessment, as the suitability of the site to meet the technical requirements for the wind farm were established at the Scoping Phase. In addition, the proposed wind farm layout has taken into account the environmental sensitivities and recommendations identified during the Scoping phase specialist assessment. Therefore, the only alternative considered at this stage is the no-go alternative. The no-go alternative would result in the continuation of the current land use at the site which is extensive livestock grazing. When properly managed, this is a sustainable land use that can be used indefinitely. However, many parts of the site have been heavily grazed in the past, leading to some degradation of the site. The no-go alternative would maintain the current land use, resulting in some degradation due to overgrazing or alien invasion in parts of the site, but would also result in biodiversity maintenance across the majority of the site. Therefore the impact of the no-go alternative on terrestrial biodiversity is considered to be a low negative impact. The development of the wind farm would not result in the cessation of farming activities and the development would be an additional impact to the prevailing low-level farming impact.

7 CONCLUSION & RECOMMENDATIONS

The majority of the Kokerboom 2 Wind Farm consists of low open shrubland or grassland on flat plains and gently sloping hills that are medium-low sensitivity and are considered suitable for wind energy development. The overall diversity of the vegetation is very low and the abundance of listed plant species is also very low. The listed species that are present at the site occur at a very low density or in localised environments and would not be significantly affected by the development with the appropriate avoidance.

The site does not have a lot of landscape features and the only conspicuous features of the site are some poorly developed drainage lines and some low gravelly hills. The diversity of the low gravel hills is fairly low and they not are considered highly sensitive. The drainage lines at the site are not well developed but are considered high sensitivity on account of their vulnerability to disturbance as well as the ecological function that they perform in terms of hydrological regulation and the provision of habitat. These sensitive features however occupy a small proportion of the landscape. The final layout assessed is considered acceptable in terms of the locations of the turbines, none of which are in the high sensitivity areas. Some of the access roads traverse drainage lines, but with mitigation, the impacts on these areas would be reduced to acceptable levels.

Parts of the site are located within CBAs, which is a potential concern for the development. The overall footprint within the CBAs is however low and there are only two turbines within the CBA 1 and seven turbines within the CBA 2, which is not considered highly significant and the low overall development footprint would not compromise the ecological functioning of the CBAs. The CBAs are based on broad-scale buffering of pans and drainage features and not on the known presence of significant biodiversity within the development footprint. The biodiversity of the site and wider area is considered low and so direct development impacts on biodiversity within the development footprint would be low. The CBA 2 areas are based on the presence of some large pans on the adjacent property to the west of the site, which would not be affected by the current development. Consequently, due to the underlying reasons for the presence of the CBAs, the likely impact of the development on the CBAs would be low.

Although a node of wind energy development is developing around the Helios Substation, the intensity of development in the wider area is still low. The affected area is not considered sensitive and there are no specific features of the affected area which would indicate that it is of broad-scale significance for faunal movement or landscape connectivity. Although there are two existing wind farms and serveral more applications in the area, the total extent of habitat loss due to wind energy is currently less than 200ha and with all applications would still be less than 1000ha and this is not considered significant in context of the affected vegetation types, which are among the more extensive in the country. In addition, cumulative impacts are further reduced by the

homogenous nature of the landscape in the area and the paucity of species and habitats of concervation concern in the affected areas.

With the application of relatively simple mitigation and avoidance measures, the impact of the Kokerboom 2 Wind Farm can be reduced to a low overall level. There are no specific long-term impacts likely to be associated with the wind farm that cannot be reduced to an acceptable level through mitigation and avoidance. As such, there are no fatal flaws associated with the development and from a terrestrial ecology perspective the site is considered favourable for the development of the Kokerboom 2 wind farm.

8 ACTIVITIES FOR INCLUSION THE DRAFT EMPR

An EMPr provides a link between the predicted impacts and mitigation measures recommended within the EIA and the implementation and operational activities of a project. As the construction and operation of the Kokerboom 2 Facility may impact the environment, activities which pose a threat should be managed and mitigated so that unnecessary or preventable environmental impacts do not result. The primary objective of the EMPr is to detail actions required to address the impacts identified in the EIA during the establishment, operation and rehabilitation of the proposed infrastructure. The EMPr provides an elaboration of how to implement the mitigation measures documented in the EIA. As such the purpose of the EMPr can be outlined as follows:

- To outline mitigation measures and environmental specifications which are required to be implemented for the planning, establishment, rehabilitation and operation/maintenance phases of the project in order to minimise and manage the extent of environmental impacts.
- To ensure that the establishment and operation phases of the wind farm do not result in undue or reasonably avoidable adverse environmental impacts, and ensure that any potential environmental benefits are enhanced.
- To identify entities who will be responsible for the implementation of the measures and outline functions and responsibilities.
- To propose mechanisms for monitoring compliance, and preventing long-term or permanent environmental degradation.
- To facilitate appropriate and proactive response to unforeseen events or changes in project implementation that were not considered in the EIA process

Below are the ecologically-orientated measures that should be implemented as part of the EMPr for the development to reduce the significance or extent of the above impacts. The measures below do not exactly match with the impacts that have been identified, as certain mitigation measures, such as limiting the loss of vegetation may be effective at combating several different impacts, such as erosion, faunal impact etc.

8.1 CONSTRUCTION PHASE ACTIVITIES

Objective: Limit disturbance of vegetation and loss of protected flora during construction			
Project component/s	All infrastructure and activities which result in vegetation loss or clearing including: » Clearing and excavation for plant establishment; » Construction camps & other temporary infrastructure » Access roads.		
Potential Impact	Loss of plant cover leading to erosion as well as loss of faunal habitat and loss of specimens of protected plants.		
Activity/risk source	Vegetation clearing for the following » Clearing for plant establishment. » Access roads » Laydown areas » Construction Camps		
Mitigation: Target/Objective	» Low footprint and low impact on terrestrial environment. » Low impact on protected plant species		
Mitigation: Action/control		Responsibility	Timeframe
» Preconstruction walk-through of facility footprint and support structure positions and use micro-siting to reduce local impact where possible. » Obtain relevant permits from the Department of Agriculture, Forestry and Fisheries (DAFF) and the Northern Cape Department of Environment and Nature Conservation (DENC) prior to any construction activities at the site. » Affected individuals of protected species which cannot be avoided should be translocated to a safe area on the site prior to construction. » Erosion control measures should be implemented in areas where slopes have been disturbed. » Revegetation of cleared areas or monitoring to ensure that recovery is taking place » Alien plant clearing where necessary.		Management/ECO	Construction & Operation
Performance Indicator	» Vegetation loss restricted to infrastructure footprint. » Low impact on protected plant species. » Permit obtained to destroy or translocate affected individuals of protected species.		
Monitoring	ECO to monitor construction to ensure that: » Vegetation is cleared only within essential areas.		

	» Erosion risk is maintained at an acceptable level through flow regulation structures where appropriate and the maintenance of plant cover wherever possible.

Objective: Limit direct and indirect terrestrial faunal impacts during construction			
Project component/s	Construction activities especially the following: » Vegetation clearing » Human presence » Operation of heavy machinery		
Potential Impact	Disturbance of faunal communities due to construction as well as poaching and hunting risk from construction staff.		
Activity/risk source	» Habitat transformation during construction; » Presence of construction crews » Operation of heavy vehicles		
Mitigation: Target/Objective	Low faunal impact during construction.		
Mitigation: Action/control		Responsibility	Timeframe
» Environmental induction for all construction staff » ECO to monitor and enforce ban on illegal hunting, collecting etc of all plants and animals or their products. » Any fauna encountered during construction should be removed to safety by the ECO or other suitably qualified person, » All vehicles to adhere to low speed limits (40km/h max) on the site, to reduce risk of faunal collisions as well as reduce dust. » All night-lighting should use low-UV type lights (such as most LEDs) as far as possible, which do not attract insects. The lights should also be of types which are directed downward and do not result in large amounts of light pollution.		Management/ECO	Construction
Performance Indicator	» Low mortality of fauna due to construction machinery and activities » No poaching etc of fauna by construction personnel during construction » Removal to safety of fauna encountered during construction		
Monitoring	Monitoring for compliance during the construction phase. All incidents to be noted.		

8.2 OPERATION PHASE ACTIVITIES

OBJECTIVE: Limit the ecological footprint of the Facility			
Project component/s	Presence and operation of the facility including » Movement of maintenance vehicles along the access and service roads » Vegetation management within the site » Faunal management within the facility		
Potential Impact	» Alien plant invasion » Erosion » Pollution		
Activity/risk source	» Alien plant invasion in and around the plant » Unregulated runoff from the facility area as well as access roads » Human presence during vegetation clearing or plant maintenance activities » Pollution from maintenance vehicles due to oil or fuel leaks etc » Maintenance activities which may lead to negative impacts such as pollution, herbicide drift etc.		
Mitigation: Target/Objective	Low ecological footprint of the facility during operation		
Mitigation: Action/control		Responsibility	Timeframe
Vegetation control should be by manual clearing and herbicides should not be used except to control alien plants in the prescribed manner		Management/ Contractor	Operation
Annual monitoring for alien plant species - with follow up clearing		Management/ Contractor	Operation
Annual site inspection for erosion or water flow regulation problems – with follow up remedial action where problems are identified		Management/ Contractor	Operation
Performance Indicator	» No erosion problems within the facility or along access roads » Low abundance of alien plants within the site » Maintenance of a ground cover of perennial grasses and forbs that resist erosion.		
Monitoring	» Annual monitoring with records of alien species presence and clearing actions » Annual monitoring with records of erosion problems and mitigation actions taken with photographs		

9 REFERENCES

Alexander, G. & Marais, J. 2007. *A Guide to the Reptiles of Southern Africa*. Struik Nature, Cape Town.

Branch W.R. 1998. *Field guide to snakes and other reptiles of southern Africa*. Struik, Cape Town.

Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. & de Villiers, M. S. 2013. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. Strelitzia 32. SANBI, Pretoria.

Department of Environmental Affairs and Tourism, 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication of lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Gazette, Republic of South Africa.

Desmet, P and Marsh A. 2008. *Namakwa District Biodiversity Sector Plan*. Available from BGIS at http://bgis.sanbi.org/namakwa/project.asp.

Du Preez, L. & Carruthers, V. 2009. *A Complete Guide to the Frogs of Southern Africa*. Struik Nature., Cape Town.

Minter LR, Burger M, Harrison JA, Braack HH, Bishop PJ & Kloepfer D (eds). 2004. *Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland*. SI/MAB Series no. 9. Smithsonian Institution, Washington, D.C.

Mucina L. & Rutherford M.C. (eds) 2006. *The Vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. (2011). Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

Oosthuysen, E. & Holness, S. 2016. Northern Cape Critical Biodiversity Areas (CBA) Map. https://cirrus.nmmu.ac.za/index.php/s/20fe43905396fca0025948bc0d3b514d. Northern Cape Department of Environment and Nature Conservation & Nelson Mandela Metropolitan University.

Skinner, J.D. & Chimimba, C.T. 2005. The mammals of the Southern African Subregion. Cambridge University Press, Cambridge.

10 ANNEX 1. LIST OF PLANTS

List of plant species known from the vicinity of the Kokerboom study site, based on the SANBI SIBIS database, supplemented wih additional species not on the list and showing which species were observed at the site. IUCN conservation status is from the South African Red Data List of Plants 2016.

Family	Species	IUCN	Obs.	Family	Species	IUCN	Obs.
ACANTHACEAE	*Acanthopsis disperma*	LC		ACANTHACEAE	*Blepharis furcata*	LC	
ACANTHACEAE	*Blepharis mitrata*	LC		ACANTHACEAE	*Monechma spartioides*	LC	
AIZOACEAE	*Aizoon canariense*	LC	1	AIZOACEAE	*Galenia africana*	LC	1
AIZOACEAE	*Galenia fruticosa*	LC	1	AIZOACEAE	*Galenia sarcophylla*	LC	1
AIZOACEAE	*Galenia squamulosa*	LC		AIZOACEAE	*Plinthus cryptocarpus*	LC	
AIZOACEAE	*Plinthus karooicus*	LC	1	AIZOACEAE	*Tetragonia arbuscula*	LC	
AIZOACEAE	*Tetragonia fruticosa*	LC	1	AIZOACEAE	*Tetragonia microptera*	LC	
AIZOACEAE	*Trianthema parvifolia*	LC	1	AMARANTHACEAE	*Amaranthus praetermissus*	LC	
AMARANTHACEAE	*Sericocoma avolans*	LC		AMARANTHACEAE	*Sericocoma pungens*	LC	
AMARYLLIDACEAE	*Brunsvigia comptonii*	LC		APIACCEAE	*Deverra denudata*	LC	1
APOCYNACEAE	*Fockea sinuata*	LC	1	APOCYNACEAE	*Gomphocarpus filiformis*	LC	1
APOCYNACEAE	*Hoodia gordonii*	DDD	1	APOCYNACEAE	*Microloma armatum var. armatum*	LC	
APOCYNACEAE	*Microloma incanum*	LC		APOCYNACEAE	*Microloma longitubum*	LC	
APOCYNACEAE	*Quaqua incarnata*	LC	1	APOCYNACEAE	*Sarcostemma viminale subsp. viminale*	LC	
ASPARAGACEAE	*Asparagus africanus*	LC		ASPARAGACEAE	*Asparagus capensis var. capensis*	LC	1
ASPHODELACEAE	*Aloe claviflora*	LC	1	ASPHODELACEAE	*Aloe falcata*	LC	1
ASPHODELACEAE	*Aloe variegata*	LC	1	ASTERACEAE	*Amellus microglossus*	LC	
ASTERACEAE	*Amellus strigosus subsp. pseudoscabridus*	LC		ASTERACEAE	*Arctotis fastuosa*	LC	1
ASTERACEAE	*Arctotis leiocarpa*	LC	1	ASTERACEAE	*Athanasia minuta subsp. minuta*	LC	
ASTERACEAE	*Berkheya annectens*	LC		ASTERACEAE	*Berkheya spinosissima subsp. namaensis var. namaensis*	LC	1
ASTERACEAE	*Cotula microglossa*	LC		ASTERACEAE	*Dicoma capensis*	LC	
ASTERACEAE	*Didelta carnosa var. carnosa*	LC		ASTERACEAE	*Didelta spinosa*	LC	
ASTERACEAE	*Dimorphotheca polyptera*	LC		ASTERACEAE	*Eriocephalus ericoides subsp. ericoides*	LC	
ASTERACEAE	*Eriocephalus microphyllus var. pubescens*	LC	1	ASTERACEAE	*Eriocephalus spinescens*	LC	1
ASTERACEAE	*Felicia clavipilosa subsp. clavipilosa*	LC	1	ASTERACEAE	*Felicia hyssopifolia subsp. hyssopifolia*	LC	
ASTERACEAE	*Foveolina dichotoma*	LC		ASTERACEAE	*Gazania jurineifolia*	LC	1
ASTERACEAE	*Gazania lichtensteinii*	LC	1	ASTERACEAE	*Helichrysum herniarioides*	LC	
ASTERACEAE	*Kleinia longiflora*	LC		ASTERACEAE	*Lasiopogon glomerulatus*	LC	

ASTERACEAE	*Osteospermum armatum*	LC	1	ASTERACEAE	*Osteospermum pinnatum var. pinnatum*	LC	1
ASTERACEAE	*Osteospermum spinescens*	LC	1	ASTERACEAE	*Pegolettia retrofracta*	LC	1
ASTERACEAE	*Pentzia globosa*	LC	1	ASTERACEAE	*Pentzia lanata*	LC	
ASTERACEAE	*Pentzia pinnatisecta*	LC		ASTERACEAE	*Pentzia spinescens*	LC	1
ASTERACEAE	*Pteronia adenocarpa*	LC		ASTERACEAE	*Pteronia glauca*	LC	
ASTERACEAE	*Pteronia glomerata*	LC	1	ASTERACEAE	*Pteronia inflexa*	LC	
ASTERACEAE	*Pteronia leucoclada*	LC	1	ASTERACEAE	*Pteronia mucronata*	LC	1
ASTERACEAE	*Pteronia oblanceolata*	LC		ASTERACEAE	*Pteronia sordida*	LC	
ASTERACEAE	*Rosenia humilis*	LC	1	ASTERACEAE	*Senecio abbreviatus*	LC	1
ASTERACEAE	*Senecio niveus*	LC	1	ASTERACEAE	*Tripteris sinuata var. linearis*	LC	
ASTERACEAE	*Tripteris sinuata var. sinuata*	LC	1	ASTERACEAE	*Ursinia nana subsp. nana*	LC	1
BIGNONIACEAE	*Rhigozum trichotomum*	LC	1	BRASSICACEAE	*Heliophila arenosa*	LC	1
BRASSICACEAE	*Heliophila trifurca*	LC		BRASSICACEAE	*Lepidium desertorum*	LC	1
BRASSICACEAE	*Sisymbrium burchellii var. burchellii*	LC		CAPPARACEAE	*Cleome angustifolia subsp. diandra*	LC	
CARYOPHYLLACEAE	*Dianthus namaensis var. dinteri*	LC		CHENOPODIACEAE	*Atriplex cinerea subsp. bolusii var. adamsonii*	LC	
CHENOPODIACEAE	*Atriplex lindleyi subsp inflata*	Alien	1	CHENOPODIACEAE	*Atriplex semibaccata*	Alien	1
CHENOPODIACEAE	*Atriplex vestita var. appendiculata*	LC	1	CHENOPODIACEAE	*Bassia salsoloides*	LC	1
CHENOPODIACEAE	*Exomis microphylla var. axyrioides*	LC	1	CHENOPODIACEAE	*Salsola aellenii*	LC	
CHENOPODIACEAE	*Salsola aphylla*	LC	1	CHENOPODIACEAE	*Salsola glabrescens*	LC	
CHENOPODIACEAE	*Salsola henriciae*	LC		CHENOPODIACEAE	*Salsola procera*	LC	
CHENOPODIACEAE	*Salsola rabieana*	LC		CHENOPODIACEAE	*Salsola tuberculata*	LC	1
CHENOPODIACEAE	*Sasola kali*	Alien	1	CHENOPODIACEAE	*Suaeda fruticosa*	LC	
CHENOPODIACEAE	*Suaeda merxmuelleri*	LC		COLCHICACEAE	*Ornithoglossum viride*	LC	
CRASSULACEAE	*Crassula corallina subsp. corallina*	LC	1	CUCURBITACEAE	*Cucumis africanus*	LC	
CUCURBITACEAE	*Cucumis myriocarpus subsp. leptodermis*	LC		CYPERACEAE	*Cyperus capensis*	LC	
EUPHORBIACEAE	*Euphorbia aequoris*	LC	1	EUPHORBIACEAE	*Euphorbia decussata*	LC	1
EUPHORBIACEAE	*Euphorbia inaequilatera var. inaequilatera*	LC		EUPHORBIACEAE	*Euphorbia multiceps*	LC	1
EUPHORBIACEAE	*Euphorbia rectirama*	LC		EUPHORBIACEAE	*Euphorbia rudis*	LC	
FABACEAE	*Indigastrum argyraeum*	LC		FABACEAE	*Indigofera hololeuca*	LC	
FABACEAE	*Lebeckia spinescens*	LC	1	FABACEAE	*Lessertia macrostachya var. macrostachya*	LC	
FABACEAE	*Lessertia pauciflora var. pauciflora*	LC		FABACEAE	*Lotononis leptoloba*	LC	
FABACEAE	*Melolobium candicans*	LC	1	FABACEAE	*Parkinsonia africana*	LC	1
FABACEAE	*Prosopis glandulosa*	Alien	1	FABACEAE	*Sutherlandia frutescens*	LC	
FABACEAE	*Tephrosia capensis var. acutifolia*	LC		FRANKENIACEAE	*Frankenia pulverulenta*	LC	
GERANIACEAE	*Monsonia umbellata*	LC		GERANIACEAE	*Pelargonium minimum*	LC	1

GERANIACEAE	*Sarcocaulon patersonii*	LC	1	GISEKIACEAE	*Gisekia pharnacioides var. pharnacioides*	LC	
HYACINTHACEAE	*Albuca concordiana*	LC	1	HYACINTHACEAE	*Albuca cooperi*	LC	1
HYACINTHACEAE	*Dipcadi gracillimum*	LC		HYACINTHACEAE	*Drimia elata*	LC	1
HYACINTHACEAE	*Drimia intricata*	LC		HYACINTHACEAE	*Drimia physodes*	LC	
HYACINTHACEAE	*Ledebouria undulata*	LC		IRIDACEAE	*Moraea pallida*	LC	
IRIDACEAE	*Moraea speciosa*	LC		IRIDACEAE	*Tritonia karooica*	LC	
LAMIACEAE	*Salvia disermas*	LC	1	LOPHIOCARPACEAE	*Lophiocarpus polystachyus*	LC	
LORANTHACEAE	*Septulina glauca*	LC		MALVACEAE	*Hermannia cueneifolia*	LC	1
MALVACEAE	*Hermannia erodioides*	LC		MALVACEAE	*Hermannia grandiflora*	LC	
MALVACEAE	*Hermannia johanssenii*	LC		MALVACEAE	*Hermannia paucifolia*	LC	
MALVACEAE	*Hermannia spinosa*	LC	1	MALVACEAE	*Hermannia vestita*	LC	
MALVACEAE	*Radyera urens*	LC	1	MELIANTHACEAE	*Melianthus comosus*	LC	1
MESEMBRYANTHEMACEAE	*Aloinopsis luckhoffii*	DDT	1	MESEMBRYANTHEMACEAE	*Antimima evoluta*	LC	
MESEMBRYANTHEMACEAE	*Aridaria noctiflora subsp. straminea*	LC	1	MESEMBRYANTHEMACEAE	*Brownanthus ciliatus*	LC	1
MESEMBRYANTHEMACEAE	*Cephalophyllum fulleri*	Rare		MESEMBRYANTHEMACEAE	*Cephalophyllum rigidum*	LC	1
MESEMBRYANTHEMACEAE	*Conophytum uviforme subsp. uviforme*	LC		MESEMBRYANTHEMACEAE	*Drosanthemum lique*	LC	1
MESEMBRYANTHEMACEAE	*Lampranthus haworthii*	LC		MESEMBRYANTHEMACEAE	*Lampranthus uniflorus*	LC	1
MESEMBRYANTHEMACEAE	*Lithops otzeniana*	VU		MESEMBRYANTHEMACEAE	*Mesembryanthemum crystallinum*	LC	1
MESEMBRYANTHEMACEAE	*Mesembryanthemum stenandrum*	LC	1	MESEMBRYANTHEMACEAE	*Prenia tetragonia*	LC	1
MESEMBRYANTHEMACEAE	*Psilocaulon articulatum*	LC		MESEMBRYANTHEMACEAE	*Psilocaulon coriarium*	LC	1
MESEMBRYANTHEMACEAE	*Psilocaulon junceum*	LC	1	MESEMBRYANTHEMACEAE	*Ruschia abbreviata*	LC	1
MESEMBRYANTHEMACEAE	*Ruschia robusta*	LC	1	MESEMBRYANTHEMACEAE	*Ruschia spinosa*	LC	1
MESEMBRYANTHEMACEAE	*Sceletium tortuosum*	LC	1	MESEMBRYANTHEMACEAE	*Stoeberia frutescens*	LC	
MESEMBRYANTHEMACEAE	*Stomatium mustellinum*	LC		MOLLUGINACEAE	*Hypertelis salsoloides var. salsoloides*	LC	1
MOLLUGINACEAE	*Limeum aethiopicum*	LC	1	MOLLUGINACEAE	*Limeum africanum*	LC	1
MOLLUGINACEAE	*Limeum argute-carinatum var. argute-carinatum*	LC		MOLLUGINACEAE	*Limeum rhombifolium*	LC	
MOLLUGINACEAE	*Mollugo cerviana var. cerviana*	LC		NEURADACEAE	*Grielum humifusum var. parviflorum*	LC	1
NYCTAGINACEAE	*Phaeoptilum spinosum*	LC	1	OXALIDACEAE	*Oxalis beneprotecta*	LC	
OXALIDACEAE	*Oxalis lawsonii*	LC		PEDALIACEAE	*Sesamum capense*	LC	1
PLUMBAGINACEAE	*Dyerophytum africanum*	LC	1	POACEAE	*Aristida adscensionis*	LC	1
POACEAE	*Aristida congesta subsp. barbicollis*	LC		POACEAE	*Ehrharta calycina*	LC	
POACEAE	*Enneapogon cenchroides*	LC		POACEAE	*Enneapogon desvauxii*	LC	1
POACEAE	*Enneapogon scaber*	LC	1	POACEAE	*Eragrostis annulata*	LC	
POACEAE	*Fingerhuthia africana*	LC	1	POACEAE	*Schismus barbatus*	LC	
POACEAE	*Stipagrostis anomala*	LC	1	POACEAE	*Stipagrostis brevifolia*	LC	1
POACEAE	*Stipagrostis ciliata var. capensis*	LC	1	POACEAE	*Stipagrostis namaquensis*	LC	1

POACEAE	*Stipagrostis obtusa*	LC	1	POACEAE	*Stipagrostis uniplumis var. neesii*	LC	
POACEAE	*Tragus berteronianus*	LC		POLYGALACEAE	*Polygala pungens*	LC	
POLYGALACEAE	*Polygala seminuda*	LC	1	PORTULACACEAE	*Talinum arnotii*	LC	
RUTACEAE	*Agathosma virgata*	LC		SANTALACEAE	*Thesium hystricoides*	LC	
SANTALACEAE	*Thesium hystrix*	LC	1	SANTALACEAE	*Thesium lineatum*	LC	1
SCROPHULARIACEAE	*Aptosimum elongatum*	LC		SCROPHULARIACEAE	*Aptosimum indivisum*	LC	1
SCROPHULARIACEAE	*Aptosimum marlothii*	LC		SCROPHULARIACEAE	*Aptosimum procumbens*	LC	1
SCROPHULARIACEAE	*Aptosimum spinescens*	LC	1	SCROPHULARIACEAE	*Jamesbrittenia atropurpurea subsp. atropurpurea*	LC	1
SCROPHULARIACEAE	*Nemesia calcarata*	LC		SCROPHULARIACEAE	*Peliostomum leucorrhizum*	LC	1
SCROPHULARIACEAE	*Polycarena filiformis*	Rare		SCROPHULARIACEAE	*Selago albida*	LC	
SCROPHULARIACEAE	*Selago pinguicula*	LC	1	SOLANACEAE	*Lycium cinereum*	LC	1
SOLANACEAE	*Lycium oxycarpum*	LC	1	SOLANACEAE	*Lycium pumilum*	LC	1
SOLANACEAE	*Solanum burchellii*	LC	1	SOLANACEAE	*Solanum capense*	LC	
URTICACEAE	*Forsskaolea candida*	LC		VERBENACEAE	*Chascanum incisum*	LC	
VERBENACEAE	*Chascanum pumilum*	LC		ZYGOPHYLLACEAE	*Augea capensis*	LC	1
ZYGOPHYLLACEAE	*Tribulus pterophorus*	LC		ZYGOPHYLLACEAE	*Tribulus terrestris*	LC	1
ZYGOPHYLLACEAE	*Tribulus zeyheri*	LC	1	ZYGOPHYLLACEAE	*Zygophyllum flexuosum*	LC	
ZYGOPHYLLACEAE	*Zygophyllum lichtensteinianum*	LC	1	ZYGOPHYLLACEAE	*Zygophyllum retrofractum*	LC	1
ZYGOPHYLLACEAE	*Zygophyllum simplex*	LC	1				

11 ANNEX 2. LIST OF MAMMALS

List of mammals which are likely to occur in the broad vicinity of the Kokerboom study area. Habitat notes and distribution records are based on Skinner & Chimimba (2005), while conservation status is from the IUCN Red Lists 2013. Species observed on the adjacent wind farm property are assumed present on the current site as well.

Scientific Name	Common Name	Status	Habitat	Likelihood
Macroscledidea (Elephant Shrews):				
Macroscelides proboscideus	Round-eared Elephant Shrew	LC	Species of open country, with preference for shrub bush and sparse grass cover, also occur on hard gravel plains with sparse boulders for shelter, and on loose sandy soil provided there is some bush cover	Confirmed
Tubulentata:				
Orycteropus afer	Aardvark	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil	Confirmed
Hyracoidea (Hyraxes)				
Procavia capensis	Rock Hyrax	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies	Low
Lagomorpha (Hares and Rabbits):				
Pronolagus rupestris	Smith's Red Rock Rabbit	LC	Confined to areas of krantzes, rocky hillsides, boulder-strewn koppies and rocky ravines	Low
Lepus capensis	Cape Hare	LC	Dry, open regions, with palatable bush and grass	High
Lepus saxatilis	Scrub Hare	LC	Common in agriculturally developed areas, especially in crop-growing areas or in fallow lands where there is some bush development.	Confirmed
Rodentia (Rodents):				
Cryptomys hottentotus	African Mole Rat	LC	Wide diversity of substrates, from sandy soils to heavier compact substrates such as decomposed schists and stony soils	High
Hystrix africaeaustralis	Cape Porcupine	LC	Catholic in habitat requirements.	Confirmed
Graphiurus ocularis	Spectacled Dormouse	LC	Associated with sandstones of Cape Fold mountains, which have many vertical and horizontal crevices.	Low
Rhabdomys pumilio	Four-striped Grass Mouse	LC	Essentially a grassland species, occurs in wide variety of habitats where there is good grass cover.	Confirmed
Mus minutoides	Pygmy Mouse	LC	Wide habitat tolerance	High
Aethomys namaquensis	Namaqua Rock Mouse	LC	Catholic in their habitat requirements, but where there are rocky koppies, outcrops or boulder-strewn hillsides they use these preferentially	High
Parotomys brantsii	Brants' Whistling Rat	LC	Associated with a dry sandy substrate in more arid parts of the Nama-karoo and Succulent Karoo. Species selects areas of low percentage of plant cover and areas with deep sands.	High

Parotomys littledalei	Littledale's Whistling Rat	LC	Riverine associations or associated with Lycium bushes or Psilocaulon absimile	High
Otomys unisulcatus	Bush Vlei Rat	LC	Shrub and fynbos associations in areas with rocky outcrops Tend to avoid damp situations but exploit the semi-arid Karoo through behavioural adaptation.	Confirmed
Desmodillus auricularis	Cape Short-tailed Gerbil	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush	High
Gerbillurus paeba	Hairy-footed Gerbil	LC	Gerbils associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub or light woodland cover	High
Malacothrix typica	Gerbil Mouse	LC	Found predominantly in Nama and Succulent Karoo biomes, in areas with a mean annual rainfall of 150-500 mm.	High
Petromyscus collinus	Pygmy Rock Mouse	LC	Arid areas on rocky outcrops or koppies with a high rock cover	Low
Primates:				
Papio ursinus	Chacma Baboon	LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	Low
Eulipotyphla (Shrews):				
Crocidura cyanea	Reddish-Grey Musk Shrew	LC	Occurs in relatively dry terrain, with a mean annual rainfall of less than 500 mm. Occur in karroid scrub and in fynbos often in association with rocks.	High
Carnivora:				
Proteles cristata	Aardwolf	LC	Common in the 100-600mm rainfall range of country, Nama-Karoo, Succulent Karoo Grassland and Savanna biomes	High
Caracal caracal	Caracal	LC	Caracals tolerate arid regions, occur in semi-desert and karroid conditions	Confirmed
Felis silvestris	African Wild Cat	LC	Wide habitat tolerance.	High
Felis nigripes	Black-footed cat	VU	Associated with arid country with MAR 100-500 mm, particularly areas with open habitat that provides some cover in the form of tall stands of grass or scrub.	High
Genetta genetta	Small-spotted genet	LC	Occur in open arid associations	High
Suricata suricatta	Meerkat	LC	Open arid country where substrate is hard and stony. Occur in Nama and Succulent Karoo but also fynbos	Confirmed
Cynictis penicillata	Yellow Mongoose	LC	Semi-arid country on a sandy substrate	Confirmed
Herpestes pulverulentus	Cape Grey Mongoose	LC	Wide habitat tolerance	High
Vulpes chama	Cape Fox	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub	Confirmed
Canis mesomelas	Black-backed Jackal	LC	Wide habitat tolerance, more common in drier areas.	Confirmed
Otocyon megalotis	Bat-eared Fox	LC	Open country with mean annual rainfall of 100-600 mm	Confirmed

Ictonyx striatus	Striped Polecat	LC	Widely distributed throughout the sub-region	High
Mellivora capensis	Ratel/Honey Badger	IUCN LC/SA RDB EN	Catholic habitat requirements	Low
Rumanantia (Antelope):				
Sylvicapra grimmia	Common Duiker	LC	Presence of bushes is essential	Confirmed
Pelea capreolus	Grey Rhebok	LC	Associated with rocky hills, rocky mountainsides, mountain plateaux with good grass cover.	Low
Antidorcas marsupialis	Springbok	LC	Arid regions and open grassland.	Confirmed
Raphicerus campestris	Steenbok	LC	Inhabits open country,	Confirmed
Oreotragus oreotragus	Klipspringer	LC	Closely confined to rocky habitat.	V.Low

12 ANNEX 3. LIST OF REPTILES

List of reptiles which are likely to occur in the broad vicinity of the Kokerboom site, based on records from the SARCA database, conservation status is from Bates et al. 2013.

Type	Family	Genus	Species	Subspecies	Common name	Red list category
Chameleon	*Chamaeleonidae*	*Chamaeleo*	*namaquensis*		Namaqua Chameleon	Least Concern
Geckos	*Gekkonidae*	*Chondrodactylus*	*angulifer*	*angulifer*	Common Giant Ground Gecko	Least Concern
Geckos	*Gekkonidae*	*Chondrodactylus*	*bibronii*		Bibron's Gecko	Least Concern
Geckos	*Gekkonidae*	*Goggia*	*lineata*		Striped Pygmy Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*capensis*		Cape Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*labialis*		Western Cape Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*latirostris*		Quartz Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*weberi*		Weber's Gecko	Least Concern
Geckos	*Gekkonidae*	*Ptenopus*	*garrulus*	*maculatus*	Spotted Barking Gecko	Least Concern
Lizards	*Agamidae*	*Agama*	*aculeata*	*aculeata*	Common Ground Agama	Least Concern
Lizards	*Agamidae*	*Agama*	*atra*		Southern Rock Agama	Least Concern
Lizards	*Cordylidae*	*Karusasaurus*	*polyzonus*		Karoo Girdled Lizard	Least Concern
Lizards	*Cordylidae*	*Namazonurus*	*peersi*		Peers' Girdled Lizard	Least Concern
Lizards	*Gerrhosauridae*	*Cordylosaurus*	*subtessellatus*		Dwarf Plated Lizard	Least Concern
Lizards	*Lacertidae*	*Meroles*	*suborbitalis*		Spotted Desert Lizard	Least Concern
Lizards	*Lacertidae*	*Nucras*	*tessellata*		Western Sandveld Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*laticeps*		Karoo Sand Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*lineoocellata*	*lineoocellata*	Spotted Sand Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*lineoocellata*	*pulchella*	Common Sand Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*namaquensis*		Namaqua Sand Lizard	Least Concern
Lizards	*Scincidae*	*Acontias*	*lineatus*		Striped Dwarf Legless Skink	Least Concern
Lizards	*Scincidae*	*Trachylepis*	*occidentalis*		Western Three-striped Skink	Least Concern
Lizards	*Scincidae*	*Trachylepis*	*sulcata*	*sulcata*	Western Rock Skink	Least Concern
Lizards	*Scincidae*	*Trachylepis*	*variegata*		Variegated Skink	Least Concern
Snakes	*Colubridae*	*Boaedon*	*capensis*		Brown House Snake	Least Concern
Snakes	*Colubridae*	*Dasypeltis*	*scabra*		Rhombic Egg-eater	Least Concern
Snakes	*Colubridae*	*Dipsina*	*multimaculata*		Dwarf Beaked Snake	Least Concern
Snakes	*Colubridae*	*Lamprophis*	*guttatus*		Spotted House Snake	Least Concern

Snakes	*Colubridae*	*Psammophis*	*crucifer*		Cross-marked Grass Snake	Least Concern
Snakes	*Colubridae*	*Psammophis*	*notostictus*		Karoo Sand Snake	Least Concern
Snakes	*Colubridae*	*Pseudaspis*	*cana*		Mole Snake	Least Concern
Snakes	*Colubridae*	*Telescopus*	*beetzii*		Beetz's Tiger Snake	Least Concern
Snakes	*Elapidae*	*Aspidelaps*	*lubricus*	*lubricus*	Coral Shield Cobra	Not listed
Snakes	*Elapidae*	*Naja*	*nivea*		Cape Cobra	Least Concern
Snakes	*Typhlopidae*	*Rhinotyphlops*	*lalandei*		Delalande's Beaked Blind Snake	Least Concern
Snakes	*Viperidae*	*Bitis*	*arietans*	*arietans*	Puff Adder	Least Concern
Tortoises	*Testudinidae*	*Chersina*	*angulata*		Angulate Tortoise	Least Concern
Tortoises	*Testudinidae*	*Homopus*	*signatus*	*signatus*	Namaqua Speckled Padloper	Not listed
Tortoises	*Testudinidae*	*Psammobates*	*tentorius*	*subsp. ?*	Tent Tortoise (subsp. ?)	Least Concern
Tortoises	*Testudinidae*	*Psammobates*	*tentorius*	*tentorius*	Karoo Tent Tortoise	Not listed
Tortoises	*Testudinidae*	*Psammobates*	*tentorius*	*verroxii*	Verrox's Tent Tortoise	Not listed

13 ANNEX 4. LIST OF AMPHIBIANS

List of amphibians which are likely to occur in in the broad vicinity of the Kokerboom site. Habitat notes and distribution records are based on Du Preez and Carruthers (2009), while conservation status is from the Minter et al. 2004.

Scientific Name	Common Name	Status	Habitat	Distribution	Likelihood
Vandijkophrynus gariepensis	Karoo Toad	Least Concern	Karoo Scrub	Widespread	High
Xenopus laevis	Common Platanna	Least Concern	Any more or less permanent water	Widespread	Very Low
Amietia fuscigula	Cape River Frog	Least Concern	Large still bodies of water or permanent streams and rivers.	Widespread	Very Low
Cacosternum namaquense	Namaqua Caco	Least Concern	Marshy areas, vleis and shallow pans	Widespread	Moderate
Cacosternum boettgeri	Common Caco	Least Concern	Marshy areas, vleis and shallow pans	Widespread	Moderate
Tomopterna tandyi	Tandy's Sand Frog	Least Concern	Nama karoo grassland and savanna	Widespread	High