Annex E

# Ecology Specialist Report

# G7 RENEWABLE ENERGIES

# ROGGEVELD WIND FARM:

## Ecological and Biodiversity Assessment:

## Terrestrial Vertebrate Fauna & Botanical Specialist Study.

ERM

G7 renewable ENERGIES

**Prepared by**

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## *DECLARATION OF CONSULTANTS INDEPENDENCE*

The author of this report, Simon Todd, does hereby declare that he is an independent consultant appointed by ERM for G7and has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of the specialist performing such work. All opinions expressed in this report are his own.

Simon Todd

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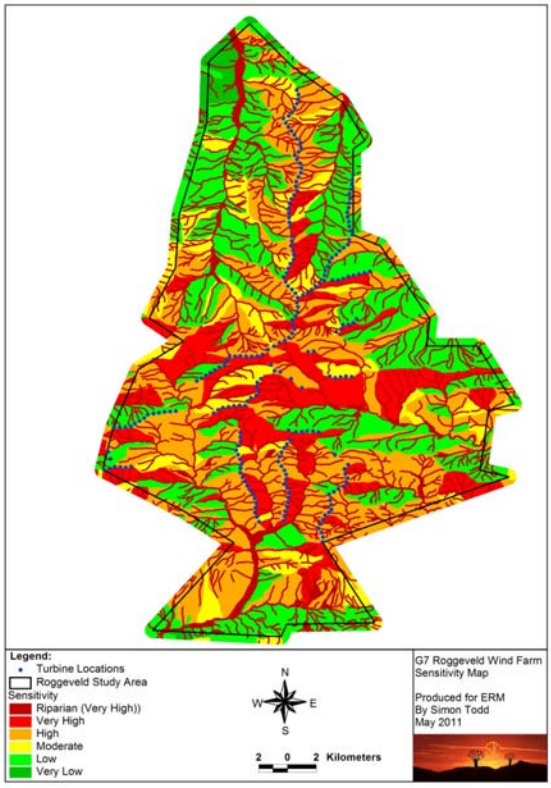
***EXECUTIVE SUMMARY***

G7 Renewable Energies (Pty) (G7) proposes to establish a wind energy facility in the Roggeveld, between Sutherland and Matjiesfontein. The facility will consist of up to 250 wind turbines which will generate up to 750 MW of electricity which will be fed into the National Power Grid. This report details the likely impacts of the proposed development on the flora and terrestrial vertebrate fauna of the site.




Following a site visit and desktop study, a sensitivity map for the site was generated and is depicted left. The assessment revealed that a large proportion of the site can be classified as High and Very High Sensitivity. Development within these areas should be avoided as far as possible. The sensitivity of the site stems from the high biodiversity value of a large proportion of the site which is a recognized centre of endemism and as well as the steep slopes which characterize the area. A number of listed plant species were observed at the site and within the development footprint. In addition to the assessed sensitivity, a large proportion of the site falls within Critical Biodiversity Areas. The development would to some extent compromise the purpose and functioning of the CBAs. Should development within the CBAs take place, then conservation offsets are recommended as a potential mitigation component that should be used to compensate for the impact of the development.

The major risk factors and mitigation priorities associated with the development are seen to be:

- Destruction and Loss of Vegetation
- Impacts on Listed Plant Species
- Direct Faunal Impacts
- Erosion
- Alien Plant Invasion
- Impacts on CBAs

The majority of impacts are assessed to be of Moderate significance, with mitigation potentially reducing the majority of these to Minor significance. The impact on the CBAs is singled out as being difficult to mitigate as there are no alternative less sensitive sites available within the area. Although most of the impacts are seen to be of a local nature, the development covers an extensive area with the consequence the affected environment comprises a significant proportion of the affected mountain range, which to a large extent accounts for the difficulty in mitigating the overall impact of the development which is reflected in the high post-mitigation impact rating on the CBAs. A summary of the

pre-and post-mitigation significance rating for the different impacts identified in the assessment is provided below.

Summary of pre and post mitigation impact significance ratings for the different impacts and risk factors identified for the different phases of the project.

| **Phase** | **Impact** | **Significance Pre Mitigation** | **Significance Post Mitigation** |
|---|---|---|---|
| Construction | Destruction & Loss of Vegetation | Moderate-High | Minor -Moderate |
| | Protected Plant Species | Moderate-High | Minor -Moderate |
| | Faunal impacts – Construction Disturbance | Moderate | Minor -Moderate |
| | Faunal Impacts – Hunting & Illegal Collection | Moderate | Minor |
| Operation | Erosion Potential | Moderate-High | Minor |
| | Alien Plant Invasion | Moderate | Minor |
| | Hunting and Collecting of Fauna & Flora | Moderate | Minor |
| | Loss of landscape connectivity for fauna | Minor | Minor |
| | Maintenance impact on vegetation | Minor -Moderate | Minor |
| | Impact on Critical Biodiversity Areas | Moderate-High | Moderate |
| Decommissioning | Inadequate rehabilitation | Moderate | Minor |

# *1 BACKGROUND & SCOPE*

G7 Renewable Energies (Pty) (G7) proposes to establish a wind energy facility in the Roggeveld, between Sutherland and Matjiesfontein. The proposed site is located west of the R354, 40 km west of Sutherland and approximately 30 km north of Matjiesfontein. The cadastral units associated with the site are depicted in Figure 1. The facility will consist of up to 250 wind turbines and will generate up to 750 MW of electricity which will be fed into the National Power Grid. An Environmental Impact Assessment (EIA) for the proposed development is required in terms of the EIA Regulations of 2006 under the National Environmental Management Act (NEMA) (Act No. 107 of 1998). This report contributes towards meeting these requirements and details the likely impact of the proposed development on the terrestrial ecology (terrestrial vertebrate and flora) of the Site.

The broad terms of reference for the study provided to the consultant by ERM include the following aspects regarding the vegetation assessment:

- Conduct vegetation and plant species surveys noting conservation significance and status.
- Identify and map vegetation habitats in the study area, paying careful attention to conservation constraints, threatened species that exist or may exist in the project area.
- Indicate presence of any seasonal wetlands, rivers, streams, dams etc.
- Provide photos illustrating any conservation action or plant species that may need special attention.
- Produce a vegetation sensitivity map of the project area which will be used to inform the layout of project infrastructure.

In terms of the terrestrial fauna of the site, the following terms of reference were provided:

- A description of the occurrence and distribution of fauna (i.e. amphibians, reptiles and small-, medium- and large mammals) in the study area, which may be influenced by the proposed facility.
- The identification of Red Data species potentially affected by the proposed development.
- The identification of species-specific habitats in the study area, which may be influenced by the proposed development.
- An assessment of the potential impacts (positive, negative or cumulative if relevant) on fauna during the construction and operation of the proposed development.
- The identification of specific mitigating measures, for enhancing benefits and avoiding or mitigating negative impacts and risks, which should be implemented during design, construction and operation of the proposed development.
- The formulation of a simple system to monitor potential impacts, and their management, based on key indicators.

The manner in which the above listed products were produced and requirements met are fully described in the following section which details the approach, assumptions and limitations of the study


**Figure 1.** Location of the G7 Roggeveld Wind Farm site in relation to the regional context (inset) as well as the local environment as depicted by the Google Earth image. The indicative layout of the wind turbines along the ridges of the site is illustrated.

## 2 *APPLICABLE POLICIES, LEGISLATION, STANDARDS AND GUIDELINES*

**National Environmental Management Act (NEMA) (Act No 107, 1998):**

NEMA requires that measures are taken that ”prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.” In addition:

- That the disturbance of ecosystems and loss of biological diversity are avoided, or where they cannot be altogether avoided, are minimised and remedied:
- That a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

**Environmental Conservation Act (ECA) (No 73 of 1989 Amendment Notice No. R1183 of 1997)**

This Act provides for the effective protection and controlled utilisation of the environment. This Act has been largely repealed by NEMA, but certain provisions remain, in particular provisions relating to environmental impact assessments. The ECA requires that developers must undertake Environmental Impact Assessments (EIA) for all projects listed as a Schedule 1 activity in the EIA regulations.

**National Environmental Management: Biodiversity Act (NEMBA) (Act 10 of 2004):**

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The Draft National List of Threatened Ecosystems (Notice 1477 of 2009, Government Gazette No 32689, 6 November 2009) has been gazetted for public comment. The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the NSBA 2004. In terms of the EIA regulations, a basic assessment report is required for the transformation or removal of indigenous vegetation in a critically endangered or endangered ecosystem regardless of the extent of transformation that will occur. However, all of the vegetation types within and surrounding the study site are classified as Least Threatened.

The National Protected Area Expansion Strategy (NPAES) falls under NEMBA and is South Africa's national strategy for expansion of the protected area network. The NPAES sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion. Focus areas for protected area expansion are identified in the NPAES. These are large, intact, unfragmented areas of high importance for land-based protected area expansion, suitable for the creation or expansion of large protected areas, which may occur formally as under proclaimed National Parks or less formally under various stewardship and private conservation arrangements. Development within NPAES areas is not recommended and where fine-scale conservation plans have been conducted, these areas are usually classified as CBAs.

NEMBA also deals with endangered, threatened and otherwise controlled species. The Act provides for listing of species as threatened or protected, under one of the following categories:

- **Critically Endangered:** any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered:** any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- **Vulnerable:** any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- **Protected species:** any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

In terms of the above the following activities are restricted:

- Picking parts of, or cutting, chopping off, uprooting, **damaging or destroying, any specimen of a listed threatened or protected species**;
- Any other prescribed activity which involves a specimen of a listed threatened or protected species;

Certain activities, known as Restricted Activities, are regulated by a set of permit regulations published under the Act. Those relevant to the current study are listed below.

Under the **Environmental Impact Assessment Regulations Listing Notice 1 of 2010** (No. R.544) the following activities are likely to be triggered:

Activity 1: The construction of facilities or infrastructure for the generation of electricity where:
i. the electricity output is more than 10 megawatts but less than 20 megawatts; or
ii. the output is 10 megawatts or less but the total extent of the facility covers an area in excess of 1 hectare.

Activity 11 (Xi): The construction of infrastructure or structures covering 50 square metres or more where where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.

And, under **Environmental Impact Assessment Regulations Listing Notice 3** of 2010 (*R.546):*

*Activity 12.* The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation:
**(b)** Within critical biodiversity areas identified in bioregional plans;

Activity 13. The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, (Linear activities excluded) within:
**(a)** Critical biodiversity areas and ecological support areas as identified in systematic biodiversity plans adopted by the competent authority.
**(b)** National Protected Area Expansion Strategy Focus areas.
**(dd)** Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined.

*Activity 14.* The clearing of an area of 5 hectares or more of vegetation where 75% or more of the vegetation cover constitutes indigenous vegetation.

*Activity 16 IV(d):* The construction of infrastructure covering 10 square meters of more where such construction occurs within a watercourse of within 32 metres of a watercourse measured from the edge of the watercourse, excluding where such construction will occur behind the development setback line. Within:
(bb) National Protected Area Expansion Strategy Focus areas;

(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;

*Activity 19(d)*: The widening of a road by more than 4 meters, or the lengthening of a road by more than 1 kilometre. Within:

ii. All areas outside urban areas;

It is important to note that the above thresholds and activities also apply to phased developments "*where any phase of the activity may be below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold."*

**National Forests Act (No. 84 of 1998):**

The National Forests Act provides for the protection of forests as well as specific tree species, quoting directly from the Act: "*no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated".*

No protected tree species were observed within or near the study area and it is highly unlikely that any protected tree species would be impacted by the development.

**Conservation of Agricultural Resources Act (Act 43 of 1983):**

The Conservation of Agricultural Resources Act provides for the regulation of control over the utilisation of the natural agricultural resources in order to promote the conservation of soil, water and vegetation and provides for combating weeds and invader plant species. The Conservation of Agricultural Resources Act defines different categories of alien plants and those listed under Category 1 are prohibited and must be controlled while those listed under Category 2 must be grown within a demarcated area under permit. Category 3 plants includes ornamental plants that may no longer be planted but existing plants may remain provided that all reasonable steps are taken to prevent the spreading thereof, except within the floodline of water courses and wetlands. This legislation is relevant as the disturbance associated with the development is likely to encourage the invasion of alien plant species on the site.

# 3 METHODOLOGY

## 3.1 APPROACH AND ASSESSMENT PHILOSOPHY

The vegetation (botanical) and terrestrial ecology assessment was conducted according to the ToR provided by ERM and the guidelines and principles for biodiversity assessment provided by Brownlie (2005), De Villiers et al. (2005) and CapeNature. These include the following:

1. A description of the broad ecological characteristics of the site and its surrounds in terms of patchiness, patch size, relative isolation, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.
2. In terms of biodiversity pattern, the following will be identified and described where appropriate:

   *Community and ecosystem level*

   - The main vegetation types, their aerial extent and interaction with neighbouring types, soils or landforms;
   - The types of plant communities that occur on and in the vicinity of the site.
   - Threatened or vulnerable ecosystems (With reference to Mucina and Rutherford (2006) and the NSBA (Driver *et al.* 2005).

   *Species level*

   - Species of Conservation Concern (Red Data Book species), of both flora and fauna.
   - The viability of and 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 (High=70-100% confidence, Medium 40-70% confidence, low 0-40% confidence).
   - The likelihood of other RDB species, or species of conservation concern, occurring in the vicinity (including the degree of confidence).

   *Other pattern issues*

   - Any significant landscape features or rare or important vegetation/faunal 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.
3. In terms of biodiversity process, the following will be identified or described:
   - The key ecological “drivers” of ecosystems on the site and in the vicinity, such as fire and grazing.
   - Environmental gradients (e.g. upland-lowland), biome boundaries, soil interfaces or sand movement corridors on the site or in its vicinity.
   - Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.

- The condition and functioning of rivers and wetlands (if present) in terms of: possible changes to the channel, flow regime and naturally-occurring riparian vegetation.

In addition the Assessment will include:

- A description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed facility.
- A description and evaluation of the environmental issues and potential impacts (including direct, indirect and cumulative impacts) that have been identified.
- The nature and the extent, of the impact.
- A statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts.
- "Red Flag" any sensitive or no-go areas within the broader study area which could influence the siting of the infra-structure.
- Should potential conflicts arise, alternatives will be identified as far as the ToR allow.
- Ecological opportunities and constraints will be identified, which may include mitigation measures and offsets to reduce the ecological impact of the development.
- Recommendations for future management actions and monitoring.

## *3.2 FIELD SAMPLING & ASSESSMENT METHODOLOGY*

The Site was visited over two full days on the 22nd and 23rd of November 2010. During this time as much of the site as possible was reconnoitered using the available roads and tracks. However, it is important to note that the actual area earmarked for development comprises a small proportion of the properties on which the development will occur. Due to the extensive nature of the site (> 50 000 ha) and the rugged terrain it was thus not physically or practically possible to visit all parts of the site. Consequently, the focus of the site visit was those areas which are likely to be directly affected by the development and not the entire cadastral units as such.

Sampling was also focused on the areas where turbines will be located such as the ridgelines and where access roads or overhead lines will be constructed. Sampling sites were located at regular intervals or wherever sensitive or otherwise important environmental conditions were identified. At each site sampled, all plant species present were identified and recorded. In addition, photographs of significant features were taken at each sample site and any sensitive habitats such as wetlands and unique edaphic environments were identified and noted in the field and recorded on a GPS and satellite imagery of the site. In addition, at each site sampled, the environment was assessed in terms of the different habitats present and the likely presence of species of conservation concern as well as the potential impact the development is likely to have on the habitats and species present. The dominant ecological processes operating at the site were identified in the field and the manner in which these may be disrupted by the development noted. Where appropriate, different development alternatives such as the various

substation options were investigated and compared in the field so as to ascertain the most ecologically suitable alternative.

All terrestrial vertebrate fauna directly or indirectly observed at the site were noted and certain habitats such as rocky outcrops or wetlands were specifically searched for reptiles and amphibians. Furthermore, the likely occurrence, based on the availability of suitable habitat, of species of conservation concern known to or potentially occurring in the area was assessed. In particular the Riverine Rabbit, *Bunolagus monticularis* is known to occur in the broad area and the site was assessed in terms of the availability of suitable habitat and the likely occurrence and abundance of the species at the site.

Since not all parts of the site were accessible, it was necessary to assess certain areas based on satellite imagery alone. The vegetation and environment in these inaccessible areas was therefore assessed based on the satellite imagery and the status of adjacent and similar areas that were accessible in the field.

An ecological sensitivity map of the site was produced by integrating the above information collected on-site with the available ecological and biodiversity information available in the literature and various spatial databases (SIBIS, BGIS). 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 negligible impact on ecological processes and terrestrial biodiversity. This category is reserved specifically for areas where the natural vegetation has already been transformed, usually for agricultural purposes. These areas represent opportunities for development since they have low biodiversity value and the impact of development within these areas will generally be low.
- **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. These are can be developed with relatively low ecological impact provided that suitable mitigation and amelioration 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. Development within these areas is undesirable and should proceed extremely cautiously. Extensive mitigation measures may be necessary to reduce the ecological impact of development within these areas to an acceptable level.
- **Very High** – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These are essentially no-go areas from a development perspective and any direct or indirect impacts to these areas should be avoided at all costs.

The approach along with the ecological basis underlying the final classification of the sensitivity map produced is outlined below.

- The subcatchments of the study area were delineated using the hydrological modeling extension in Arcview 3.3. The subcatchments created were then further divided according to aspect and

slope to create homogenous areas with similar physical characteristics. This was then intersected with the SA Vegetation Map (Mucina & Rutherford 2006), to create a vegetation map of the study site which includes physical attributes.

- Riparian areas, wetlands and drainage lines were identified using the 1:50 000 coverages for the area available from the Surveyor General. The shapefiles provided were overlayed on satellite imagery of the site and edited to exclude minor drainage lines which were not reflected in the vegetation and additional drainage lines were digitized from the imagery where necessary. Any other wetlands and water bodies not evident in the shapefiles were also digitized from the imagery. The line features were then buffered, usually by 50 m to create a polygon coverage of the sensitive areas associated with the drainage features of the site. This coverage was then checked and edited to ensure that all important wetland and drainage features were accurately delineated and adequately buffered. Once completed, all contiguous features were merged and the areas mapped by this process were classified as Very High Sensitivity.
- Following the delineation of the drainage features of the site, any other Very High Sensitivity areas associated with specific physical environments were identified and mapped. This includes rocky outcrops, steep slopes and southern aspects which are known to contain high biodiversity and also represent potential refuge areas under climate change.
- Transformed areas were then identified and mapped from the satellite imagery aided by the data and notes collected in the field. Transformed areas were classified as Low to Medium sensitivity depending on the extent of natural vegetation recovery as well as their proximity to sensitive environments such as wetlands.
- The above coverages were then intersected to create a coverage containing all of the above information, with the units so created being assigned the highest sensitivity classification of the contributing polygons. The units are thus homogenous based on the vegetation structure as well as physical characteristics. This was then overlayed on the satellite imagery and checked and corrected where necessary to ensure that each unit was appropriately delineated based on the satellite imagery as well as the information collected in the field.
- The sensitivity of each unit thus identified was then assessed based on the plant species recorded in the field as well as the conservation status of the vegetation type to which the unit belongs. The conservation status of the untransformed vegetation units was assessed in terms of the currently conserved and target amounts as listed for national vegetation types by Rouget et al. (2006) as well as the Draft National List of Threatened Ecosystems (Notice 1477 of 2009, Government Gazette No 32689, 6 November 2009). This list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the NSBA 2004.
- Species-specific information was then incorporated into the map by including any known distribution data of listed plant and animal species in the area. Units known or highly likely to contain listed species were classified as High Sensitivity if they weren't already so ranked.
- General faunal information was incorporated into the map by including the habitat requirements of listed terrestrial vertebrate species. If warranted, the units already identified were further subdivided in order to delineate areas which represent important faunal habitats which were not already captured by the units identified based on the vegetation alone. In the

current scenario, the Riverine Rabbit *Bunolagus monticularis* is a potential concern the site was assessed in terms of the extent to which it contains suitable habitat for this species.

- Finally, local and broad-scale ecological processes were captured. Local processes include the spread of fire and upland-lowland gradients, movement corridors and habitat linkages. Broad-scale ecological processes include migration and dispersal corridors as well as broad-scale habitat linkages for climate change mitigation.

Following the identification of the different ecological features of the site, the lists of mammals, reptiles and amphibians observed at the site were augmented with species likely to occur in the area based on distribution records from the literature. Sources consulted include Branch (1988, 2001), Friendmann and Daly (2004) Marais (2004), Alexander and Marais (2007), Du Preez and Carruthers (2009), Skinner and Chimimba (2005) and spatial databases (SANBI's SIBIS and BGIS databases). The lists provided are based on species which are known to occur in the broad geographical area as well as an assessment of the availability and quality of suitable habitat at the site. For each species, the likelihood that it occurs at the site was rated according to the following scale:

**Low:** The available habitat does not appear to be suitable for the species and it is unlikely that the species occurs at the site.
**Medium:** The habitat is broadly suitable or marginal and the species may occur at the site.
**High:** There is an abundance of suitable habitat at the site and it is highly probable that the species occurs there.
**Definite:** Species that were directly or indirectly (scat, characteristic diggings, burrows etc) observed at the site.

The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria version 3.1 (2010) and where species have not been assessed under these criteria, the CITES status is reported where possible. These lists are adequate for mammals and amphibians, the majority of which have been assessed, however the majority of reptiles have not been assessed and therefore, it is not adequate to assess the potential impact of the development on reptiles, based on those with a listed conservation status alone.

### *3.3 LIMITATIONS AND ASSUMPTIONS OF THE STUDY APPROACH*

Assessments such as the current study are conducted under stringent time constraints which introduce a number of potential shortcomings which should be acknowledged:

- **Limited Spatial Coverage:** At over 50 000 ha, the site is extensive, remote and rugged, with the consequence that large parts of the area are not accessible by road and could not be visited during the site visit due to practical, time and cost constraints. Ideally, all parts of the site that will be directly affected by the development should be assessed in the field. In order to combat this limitation and adhere to the precautionary principle, additional precautionary measures and field-based activities during the construction phase may be recommended.
- **Narrow temporal window:** Ideally the site should be visited repeatedly to ensure that the full complement of species present is captured. However this is seldom possible with the

consequence that the occurrence of many species is based on the literature, the content of various spatial databases or reports by residents or the landowner. The use of literature sources and databases also introduces some bias into the process, since many remote locations have been very poorly sampled for most groups of plants and animals and so the lists generated using these sources may under-represent certain groups of organisms and in particular rare species. In cases where rare or endangered species are involved, a greater degree of certainty is desirable and follow-up surveys may therefore be required or recommended.

- **Taxonomic scope:** A comprehensive faunal survey would examine all fauna, not only the terrestrial vertebrate fauna (this study), birds (separate specialist study), and bats (separate specialist study). There may be important invertebrates present that will be overlooked.
- **Limited expertise:** ideally all aspects of the ecology of the site should be assessed simultaneously and in an integrated fashion. In most cases, the biological component is covered by several separate specialist reports, with the consequence that certain interactions, issues and impacts may be overlooked.

In the current study, the major potential limitations of the study are the narrow temporal window and inaccessibility of the site. It was summer during the time of the site visit with the consequence that most of geophytes species which occur in the area were visible at the time. The perennial grasses, shrubs and succulents were however readily identifiable at the time and the overall vegetation patterns observed are therefore likely to be representative. The inaccessibility of the site is to some extent addressed by the biophysical approach to assessing the sensitivity of the site. The precautionary principle is further applied in that preconstruction surveys of the turbine sites is recommended in order to avoid impacts on listed species and rare edaphic habitats.

## *3.4 RELEVANT ASPECTS OF THE PROPOSED DEVELOPMENT*

According to the information provided to the consultant, the development of the site as a wind farm will involve the following activities and the construction of the following infra-structure as follows:

Wind Turbines

- There will be up to 250 wind turbines on the site.
- The turbines will be approximately 100 m high (to the turbine hub), with a blade diameter of approximately 90—117 m.
- Each turbine will have a concrete foundation at its base. The foundation will be approximately 20 m x 20 m backfilled or 5 m x 5 m protruding.
- There will be a gravel hard standing area adjacent to each turbine (approximately 2500 $m^2$) that will be used during construction and maintenance activities.
- Each turbine will be accompanied by an electrical transformer.

Access Roads

- The site will be accessed via the R354.
- Existing farm tracks will be up-graded and new gravel roads will be constructed within the site to facilitate movement of construction and maintenance vehicles.
- Site access roads will be up to 12 m wide with drainage trenches adjacent to the road.
- Some existing public roads may need to be upgraded to facilitate the transport of the turbines and other construction materials to the site.

Additional Infrastructure

- An office and storage building with security and ablution facilities will be constructed on the site.
- A permanent wind measuring mast of up to 80 m will be erected to monitor wind conditions.
- Site fencing will be erected as required.

Electrical Connections

- The turbines will be connected to each other via medium voltage electrical cables which will be buried under the ground.
- A new substation will be built on the site. This substation will connect the facility to the National Power Grid Network via existing transmission lines.

A number of temporary activities will take place during construction of the wind farm. These will include:

- A temporary laydown area of up to 150 m x 20 m (hard standing) will be constructed for the storage of construction vehicles and materials.
- A temporary site compound will be created for the construction workforce.
- It is possible that borrow pits will be developed within the site (for production of construction aggregate). These will be backfilled as far as possible once construction is complete.

However, based on the extensive nature of the site and limited potential access routes, it is highly likely that more temporary activities than those listed above will be necessary as it will not be possible to access the entire site from a single location. Several lay-down areas is thus a more likely scenario, and more than one site compound is also likely.

# *4 DESCRIPTION OF THE AFFECTED ENVIRONMENT*

## *4.1 TOPOGRAPHY, CLIMATE AND PHYSICAL ENVIRONMENT*

The site lies adjacent to the R354, approximately 30 km north of Matjiesfontein (Figure 1). The topography of the area is very rugged and consists of numerous ridges and intervening valleys. The highest-lying areas are just above 1500 m in elevation while the lowest-lying are around 700 m. The wind-turbines will however be restricted to ridgelines between 1100 m and 1450 m. Due to the large

elevation gradient present within the site, there is also a large precipitation gradient present with the lowlands receiving as little as 200 mm or less, while the uplands receive in the order of 300-400 mm annually. Due to the low overall rainfall the area receives, there are no perennial rivers within the site. There are however several significant ephemeral rivers, including the Wilgebosrivier which forms part of the Tankwa Rivier system and which drains the northern section of the site and the Grootrivier system which drains the southern section of the site.

In terms of geology, the area is fairly homogenous and consists of predominantly of Mudstones and Arenites of the Beaufort Group with some Arenites and Shales of the Tierberg and Koesdoesberg Groups in the south. Soils are often gravelly and are mostly very shallow and contain variable amounts of clay depending on landscape position and weathering. Although the area does not appear to be intrinsically vulnerable to erosion, the steep slopes in the area are susceptible to disturbances which reduce or remove vegetation cover. The large number of access roads which will need to be built in the area will thus need to take this into account when being designed and built and potential impacts appropriately mitigated.

## *4.2 VEGETATION*

### *Broad-Scale Patterns*

Despite the varied topography of the region, the vegetation of the site is relatively homogenous largely as a consequence of the similarly homogenous geology. The higher-lying areas of the central portion of the study area are Central Mountain Shale Renosterveld, while the northern part and southern fringes of the site are Koedoesberge-Moordenaars Karoo (Figure 2). A small area of Tanqua Wash Riviere and fragment of Tanqua Karoo vegetation occur in the low-lying south western corner of the site and are outside the development footprint and are thus not likely to be directly impacted and will not be considered in any further detail. The overall extent and distribution of turbines within the different vegetation types of the study area is listed in Table 1.

According to Mucina & Rutherford (2006) Central Mountain Shale Renosterveld occurs on the southern and southeastern slopes of the Klein Roggeveldberge and Komsberg below the Komsberg section of the Great Escarpment as well as farther east below Besemgoedberg and Suurkop and in the west in the Karookop area. The extent of this vegetation type is relatively limited and the majority of the southwestern section of the vegetation type falls with the study site, while approximately 24% of the entire extent of Central Mountain Shale Renosterveld lies within the boundaries of the study area. Although no endemic species are known to occur within this vegetation type, little is known about this Renosterveld type and it has been poorly sampled. The Koedoesberge-Moordenaars Karoo vegetation type is more extensive than Central Mountain Shale Renosterveld and occurs extensively to the northwest and southeast of the site and only about 4% the vegetation type falls within study area. A relatively large number of endemic species are known from this vegetation type, and the majority of listed plant species which occur in the area are also associated with this vegetation type. The species lists and description of the vegetation type in Mucina and Rutherford, bears little resemblance to the vegetation type as observed in the field at the site. This suggests that the description in Mucina and Rutherford is based on the low-lying parts of the vegetation unit to the south near Matjiesfontein. This

is a very poorly investigated vegetation unit and these discrepancies suggest that the vegetation unit in the higher-lying areas of the Klein Roggeveld does not very closely match the composition in the lower-lying areas to the southwest and further investigation could reveal these as independent vegetation units. The Koedoesberge-Moordenaars Karoo and Central Mountain Shale Renosterveld are also not well differentiated in the field at the site and two vegetation types appear to grade into one another and also tend to form a mosaic with Koedoesberge-Moordenaars Karoo type vegetation dominating the warmer and drier slopes while Central Mountain Shale Renosterveld species typically dominate on the higher-lying and cooler south-facing slopes.

The majority (80%) of turbines are located within the Central Mountain Shale Renosterveld and about 20% within Koedoesberge-Moordenaars Karoo. Although these vegetation types are not well protected within formal conservation areas, they have not been highly impacted by intensive agriculture and both Koedoesberge-Moordenaars Karoo and Central Mountain Shale Renosterveld are 99% intact. The conservation status of all vegetation types within the study area is classified as Least Threatened. There are however a relatively large number of listed plant species known from the area. According to the SBIS data base, 35 listed (Vulnerable, Endangered, Critical) plant species are known to occur within and immediately surrounding the site. Since large parts of the site are highly inaccessible and there are few public roads through the site, it is likely that the area has not been well sampled and the above total is probably an underestimate. Listed species observed during the site visit include *Brunsvigia josephinae* (VU), *Duvalia parviflora* (VU), *Romulea hallii* (VU) and *Adromischus mammillaris* (EN). Since most of the listed geophytes were not flowering at the time of the site visit, it was not possible to ascertain their abundance across most of the site and further studies to document the abundance of such species at the site may be required.

**Plate 1.** Examples of Koedoesberge-Moordenaars Karoo vegetation on the ridges where turbines will be located towards the northern extent of the site. Dominant species within the left image include *Pteronia incana*, *Tylecodon* wallachii and *Galenia Africana*, while in the right hand image, *Crassula rupestris*, *Ruschia cradockensis*, *Leipoldtia schultzei* and *Pteronia glomerata* are conspicuous.

**Plate 2.** Two examples of Central Mountain Shale Renosterveld from the study site. The left image is looking out from Karookop over the two 400 Kv powerlines running through the central part of the site. The right image shows one on the ridges where turbines are planned, the dominant species include *Pteronia glomerata*, *Merxmeullera stricta*, *Ruschia cradockensis* and *Rosenia glandulosa*.

### *Local Drivers*

As discussed above, the majority of the central uplands of the site are classified as Central Mountain Shale Renosterveld while the northern section is predominantly Koedoesberge-Moordenaars Karoo. However, in the field the distinction was not very clear and there was a large overlap in the species composition between these two areas. At a local level, altitudinal gradients, aspect and soil depth were the dominant drivers of vegetation composition. High-lying areas were dominated by typical Renosterveld species while the proportion of succulents and karroid species increased with decreasing altitude or on drier aspects. High-lying areas and cooler southern aspects were typically dominated largely by woody shrubs such as *Elytropappus rhinocerotis*, *Euryops lateriflorus*, *Eriocephalus africanus* and *E.grandiflorus*, *Pteronia ambrariifolia*, *P.glomerata*, *P.glauca*, *Rosenia glandulosa* and *Asparagus capensis*; succulents such as *Ruschia cradockensis*, *Leipoldtia schultzei*, Crassula *deltoidea*, *C.tetragona*; common grasses include *Merxmuellera stricta* and *Karrooclоa purpurea*. The drier, sunny aspects contained a larger proportion of succulent species and were dominated by succulents such as *Ruschia cradockensis*, *Crassula rupestris*, *C.deltoidea*, *C.nudicaulis*, *Tylecodon reticulatus*, *Sarcocaulon pattersonii*, common woody or herbaceous shrubs include *Pteronia glomerata*, *Pteronia sordida*, *Eriocephalus ericoides*, *Pelargonium magenteum* and *P.abrotanifolium*.

Although Renosterveld is usually a fire-prone ecosystem, there was little evidence of regular fires at the site. Discussions with the local farmers also confirmed that although fires do occasionally occur, they are not a regular feature and are not used by farmers as a veld management tool. Within arid Renosterveld types, the significance of fire is reduced and it does not appear that fire is an important ecosystem driver at the site that may be disrupted by the development. Fire scars at the site indicated

that occasional fires may be caused by lightning ground-strikes, but their subsequent spread appears to be limited to high-lying areas of dense vegetation along south-facing slopes.

**Table 1.** Vegetation types which occur within the Roggeveld wind farm and their extent within the site and the number of turbines located within each.

| **Vegetation Type** | **Protection Status** | **Extent (Ha)** | **Turbines** |
|---|---|---|---|
| Tanqua Wash Riviere | Moderately protected | 2 699 | 0 |
| Koedoesberge-Moordenaars Karoo | Hardly protected | 19 841 | 43 |
| Central Mountain Shale Renosterveld | Not protected | 29 972 | 191 |
| Tanqua Karoo | Poorly protected | 4 | 0 |
| **Total** | | **52 516** | **234** |

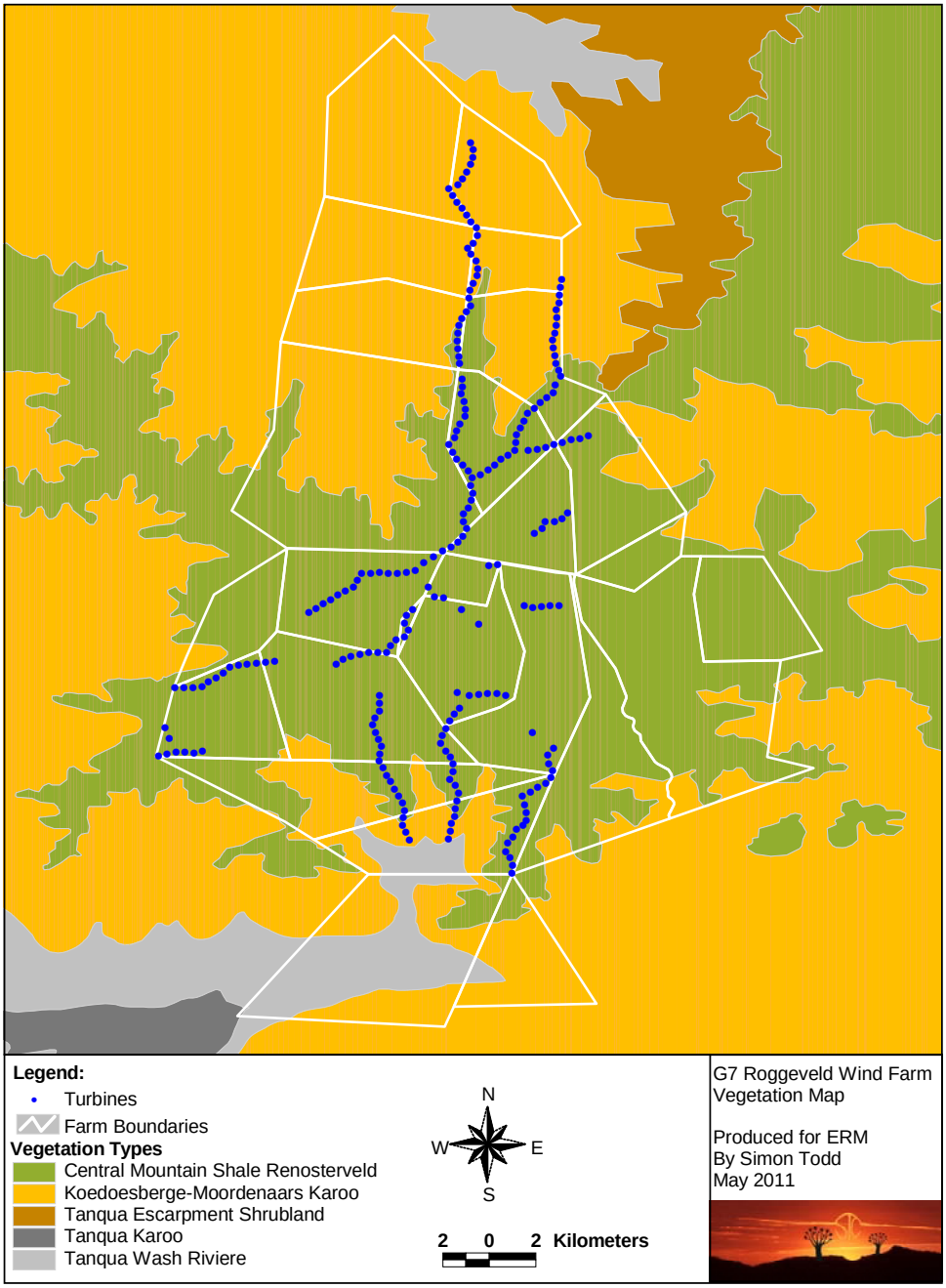



**Figure 2.** Vegetation map (Mucina and Rutherford 2006) of the G7 Roggeveld Wind Farm and surrounding area. The uplands of the site consist of Central Mountain Shale Renosterveld while the lowlands are largely composed of Koedoesberg-Moordenaars Karoo.

In terms of unique and sensitive habitats at the site, a few different potentially sensitive environments can be identified. Firstly, there are several wetlands and a number of rivers within the study area which

should be avoided by the development as these are important habitats for plants as well as fauna and are especially sensitive to disturbance. *Brunsvigia josephinae* which is listed as *Vulnerable*, occurs along river banks and was observed at the site. Although no quartz patches were observed at the site, a number of gravel patches and rock pavements were observed, particularly along the ridges. Although these often look biologically depauperate due to their low plant cover, they frequently contain rare or endemic geophytes and dwarf succulents species and should also not be disturbed. In general, those areas with vegetation associated with Koedoesberg-Moordenaars Karoo were more speciose and contained a greater variety of habitat types than the areas of Central Mountain Shale Renosterveld which were more broadly homogenous. The Koedoesberg-Moordenaars Karoo should therefore be considered more generally sensitive. Within all vegetation types, the proposed turbine locations and laydown areas should be checked in the field for the presence of these sensitive habitats before construction commences and adjusted where necessary to reduce their local impact.

### *4.3 CRITICAL BIODIVERSITY AREAS*

The site straddles the planning domain of two different Biodiversity Assessments. Those parts of the site within the Western Cape fall within the *Biodiversity Assessment of the Central Karoo District Municipality* (Skowno et al. 2009). While those parts of the site which lie within the Northern Cape fall within the *Namakwa District Biodiversity Sector Plan* (Desment & Marsh 2008). These district-wide biodiversity assessments were commissioned to inform Spatial Development Frameworks (SDFs), Biodiversity Sector plans, Environmental Management Frameworks (EMFs), Strategic Environmental Assessments (SEAs) and the Environmental Impact Assessment (EIA) process. The Biodiversity Assessments identify Critical Biodiversity Areas (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 meet national biodiversity objectives. Once gazetted, and incorporated into municipal SDFs and bioregional plans, such fine-scale plans are recognized under NEMA and the various activities listed under the act as described in Section 2.4 come into effect. The CBA map for the general area surrounding the site is depicted in Figure 3. The map indicates that virtually the entire portion of the site within the Western Cape falls within a CBA and a number of turbine locations within the Northern Cape section also fall within areas classified as CBAs.

Given that the objective of CBAs is identify biodiversity priority areas which should be maintained in a natural to near natural state, development within these areas is not encouraged. However, as a result of the scale of the current development, most of the activities listed under NEMA with regards to development within CBAs have already been triggered because the extent of transformation and size of the roads exceed the thresholds required for a full EIA regardless of CBA status. In terms of the regulations there do not therefore appear to be any additional measures beyond those which are already in place which must be taken as a result of the CBA status of a large proportion of the site. However, it is nonetheless necessary to justify why the development should take place within the CBA as well as assess the extent to which the development is likely to compromise the overall ecological functioning of the CBA. The following issues need to be taken into account when considering development within a CBA:

- Are there alternative areas within the site but outside of the CBA that could be developed?

- Does the project undermine the overall ecological functioning of the broad CBA area?
- Can mitigation measures reduce the impact of the development on ecological processes?

In terms of the first issue listed above, this is largely outside the scope of this study as the location of turbines is based largely on wind resource availability and areas outside of the CBA may not meet suitability criteria in this regard. However, from the figure, it is clear that moving or removing the turbines currently within the CBA would have a large effect on the scale or location of the development.

With regards to the second issue raised above, it is important to first recognize the context within which the CBA operates as well as ascertain why the particular area concerned has been classified as a CBA. Within vegetation types that are highly transformed, CBAs include a large proportion of irreplaceable vegetation fragments that cannot be substituted. However, within the study area, all the vegetation types present are little transformed, with both Koedoesberge-Moordenaars Karoo and Central Mountain Shale Renosterveld being 99% intact. Within semi-arid areas where the majority of vegetation is natural, there are often many choices as to which areas could fall under CBAs and the final solution may be a design issue rather than a clear-cut biodiversity-priority one. The extent to which this scenario is representative of the site is discussed below.

Within the study area, the extensive CBA within the Western Cape portion of the site is based on several different criteria, some of which show significant overlap with one another, indicating that some areas qualify for CBA status on several different grounds. A large proportion of this CBA is related to the fact that is has been identified as a priority area within the National Protected Area Expansion Strategy for South Africa (NPAES) (Government of South Africa 2008). This area was identified as priority area on that grounds that apart from being an extensive tract of unfragmented natural vegetation, it is also an area of high climate and landscape variation which is likely to be resilient to climate change. Such areas are likely to be more climatically stable over time, providing refugia where plants and animals can persist. As such, it is important to recognize that the site is therefore not replaceable due to the fact that the development encompasses a large proportion of the mountain range, and that there are not similar areas that can perform the same function and which contain a similar set of species available elsewhere. The Roggeveld is also a known centre of plant endemism (van Wyk & Smith 2001) and the western portion of the site falls within an area identified by experts as being an important area of plant diversity and endemism (SKEP Expert Map - Plants SKEP 2002).

The above discussion highlights the biological significance of the Roggeveld and draws attention to the potential impact of the development on the ecological functioning of the area. Impacts on endemic and listed plant species are a concern as are activities which result in the large-scale loss of CBA area or compromise the connectivity of the landscape. Although the development comprises a small proportion of the site, the impact of the development is not spread equitably across all vegetation and habitat types. As the turbines are restricted to ridgelines within a certain elevation range, these areas will be disproportionately affected and species which are confined to these areas will be similarly disproportionately impacted. A number of species and in particular several geophytes species were observed to be restricted to such ridgelines. This may be related to the fact that elevation is a primary determinant of temperature as well as rainfall.

With regards to the final issue of mitigating the impacts of the development, there are not very many options available under the current layout. Perhaps the most important mitigating measure would be to review and adjust the location of the turbines in the field before construction with the aim of reducing the local impact of the development on listed plant species. The broader-scale, cumulative impacts of the development are not likely to be much affected by the exact turbine location and there does not appear to be very much, apart from reducing the number of turbines that can be done to reduce the overall impact of the development. As a result, conservation offsets to reduce the negative consequences of development within CBAs and areas which have been identified as high-biodiversity value may be required to appropriately mitigate potential impacts. Such offsets will not be discussed in detail at this stage but should form part of the authorization process and should also involve the provincial conservation officials and conservation planners.

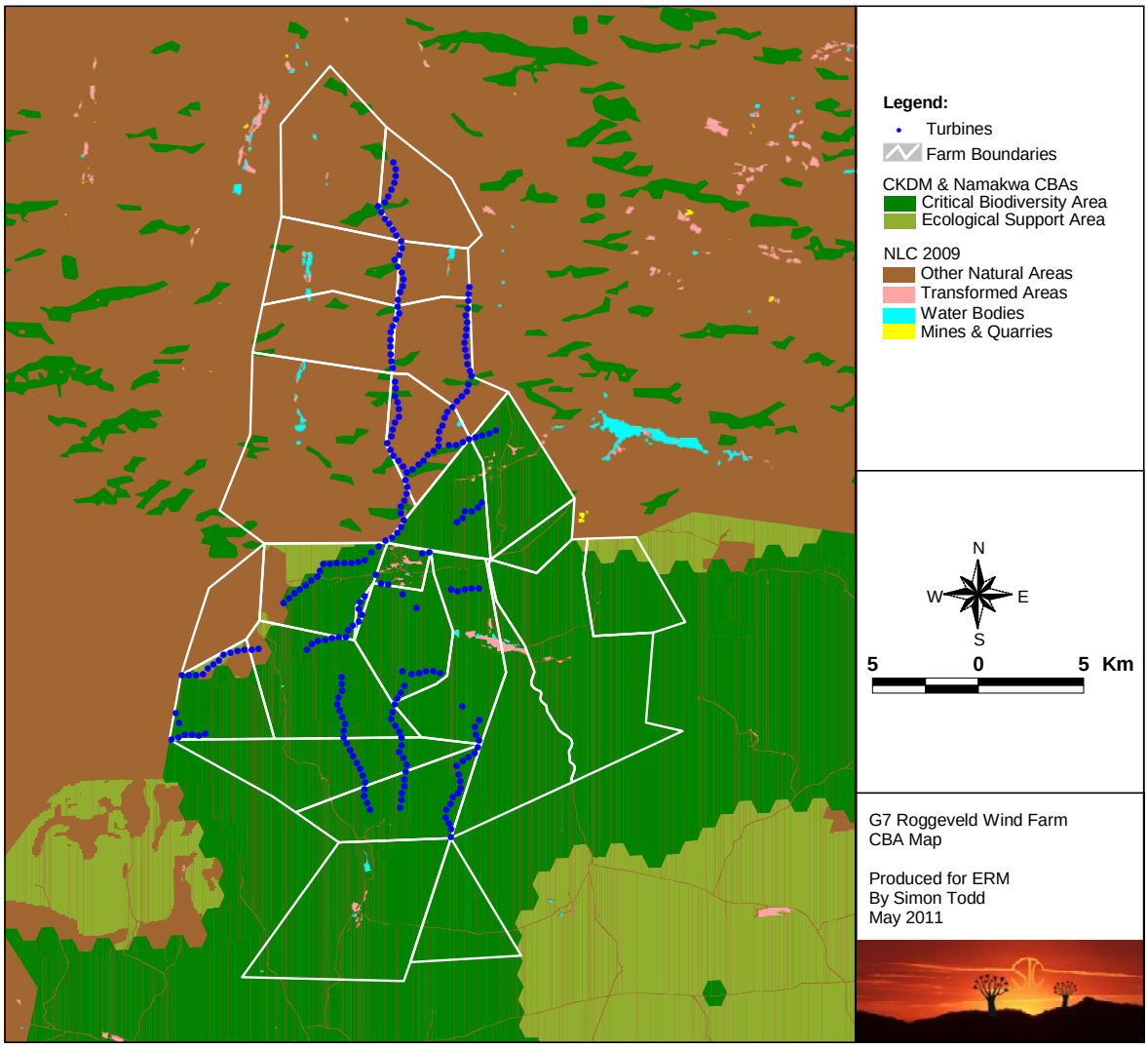



**Figure 3.** Critical Biodiversity Areas map of the proposed G7 Roggeveld Wind Farm and the surrounding area. This map is a combination of the CBA maps produced as part of the Biodiversity Assessment of the Central Karoo District Municipality (Skowno et al. 2009) and *Namakwa District*

*Biodiversity Sector Plan* (Desment & Marsh 2008). The various coverages constituting the map are available from the SANBI BGIS website.

## 4.4 CURRENT STATE OF THE ENVIRONMENT

In terms of the current land use, the site is used largely for extensive livestock grazing with sheep and some cattle. There is little intensive agriculture apart from a few rainfed or irrigated croplands of limited extent along some of the larger drainage lines of the site. The livestock carrying capacity of the area is low for the amount of rainfall the area receives. This is largely as a result of the unpalatable nature of the vegetation which is composed of a large proportion of highly unpalatable species such as *Elytropappus rhinocerotis*, *Merxmeullera stricta* and *Euryops lateriflorus*. Despite the rugged and inaccessible nature of a large proportion of the site, there did not appear to be any areas that were not accessible to livestock and signs of livestock activity were pervasive. In general, from an ecological perspective, the vegetation of the area can be considered to be in a fair to good condition. No extensive areas of highly degraded and overgrazed vegetation were observed at the site. Some localized examples of erosion where observed at the site, and although these were quite severe in some cases, their extent was fairly limited, and erosion was not a widespread problem across the site.

## 4.5 FAUNAL COMMUNITIES

Due to the diversity of habitats and environments present, the site has a diverse and fairly rich faunal community.

### *Mammals*

At least 50 mammal species potentially occur at the site (Appendix 2). Due to the diversity of habitats available, which includes rocky uplands, densely vegetated kloofs and riparian areas, as well as open plains and low shrublands, the majority of species with a distribution that includes the site are likely to be present in at least part of the site. The mammalian community is therefore relatively rich and due to the remote and inaccessible nature of the area probably has not been highly impacted by human activities. Larger carnivores such as jackal and caracal are persecuted by the local farmers in an attempt to reduce livestock losses. Nevertheless discussions with the local farmers indicate that these species appear to remain relatively common in the area. There is likely to be quite a large differentiation in community composition between the lowlands and the uplands of the site. The uplands provide suitable habitat for species which require or prefer rock cover such as Cape Rock Elephant Shrew, *Elephantulus edwardii*, Smith's Red Rock Rabbit, *Pronolagus rupestris*, Namaqua Rock Mouse *Micaelamys namaquensis* and Rock Hyrax, *Procavia capensis*. The lowlands are likely to contain an abundance of species associated with lowland habitats such as deeper soils and floodplain habitats, which includes Brants's Whistling Rat *Parotomys brantsii*, the Bush Vlei Rat *Otomys unisulcatus,* Hairy-footed Gerbil *Gerbillurus paeba* and Common Duiker *Sylvicapra grimmia*.

In general the ungulates present at the site are likely to be fairly widespread. Springbuck are confined by fences and occur only where farmers have introduced them or allowed them to persist and should be considered as part of the farming system rather than as wildlife per se. Both Duiker and Steenbok *Raphicerus campestris* are adaptable species that are able to tolerate high levels of human activity and are not likely to be highly sensitive to the disturbance associated with the development. Klipspringer *Oreotragus oreotragus* and Grey Rhebok *Pelea capreolus* are somewhat more specialized in their habitat requirements and make use of the upper slopes of the site. Klipspringer are associated with steep slopes, cliffs and rocky outcrops and may be more vulnerable to impact from the development due to greater overlap between their habitat and the distribution of the wind turbines.

The Riverine Rabbit which is listed as Critically Endangered (IUCN 2010) and is regarded as the most threatened mammal in South Africa is known to occur within the broad area. Populations of this species occur between Sutherland and Fraserburg to the northeast as well as around Touwsriver to the southwest. Based on the available information, the habitat at the site does not appear to be suitable for this species and there are no known records from the area, indicating that it is highly unlikely that it occurs at the site. Should it occur at the site it would most likely be associated with the alluvial soils and riparian fringe along the major drainage lines that occur in the lowlands of the site which would not be directly impacted by the development which is restricted to the uplands.

### *Reptiles*

There is a wide range or environments present for reptiles at the site, including rocky uplands and cliffs, open lowlands and densely vegetated riparian areas. As a result the site has a rich reptile fauna which is potentially composed of 7 tortoise species, 20 snakes, 17 lizards and skinks, two chameleons and 10 geckos. The site falls within the range of the little-known Fisk's House Snake *Lamprophis fiskii* which is listed as Vulnerable and has usually been recorded in karroid sandy areas. This species may therefore occur within the lowlands of the site and as such would probably not be significantly impacted by the development especially given its nocturnal, largely subterranean and secretive nature. Several protected and listed lizard species are likely to occur at the site including the Namaqua Plated Lizard *Gerrhosaurus typicus* (Near Threatened), the Karoo Girdled Lizard *Cordylus polyzonus* (protected) and the Cape Crag Lizard *Pseudocordylus microlepidotus*. Since the Karoo Girdled Lizard and Cape Crag Lizard are associated with rocky outcrops, it is not likely that these species will be directly affected by the development as the turbines cannot be positioned in areas with steep slopes where such outcrops are likely to be located. The Namaqua Plated Lizard may be more common than believed (Alexander & Marais 2007), and occurs in karroid succulent veld where it digs burrows at the base of shrubs. This species is therefore likely to be restricted to the lowlands of the site which will be little impacted by the development.

Tortoises were relatively abundant at the site and a large number of Angulate Tortoises, *Chersina angulata* were observed as were several Karoo Tent Tortoises, *Psammobates tentorius tentorius*. Tortoises may be negatively impacted by the development as they are vulnerable to collisions with motor vehicles and predation by avian predators while traversing open areas. Attractive species such as

tent tortoises are also vulnerable to collection for use as pets or trade, and the increased accessibility resulting from the new roads that will be constructed as part of the development would raise the risk for these species.

### *Amphibians*

Although there are no perennial rivers at the site, several of the larger drainage lines in the area were observed to contain rocky, sheltered pools that are likely to contain water on a permanent basis. Several wetlands with dense stands of sedges were also observed at the site and are likely to represent important amphibian habitats. Consequently, amphibians which require near-permanent water as well as those adapted to more arid conditions are likely to occur at the site. Nevertheless, only eight frog and toad species are likely to occur at the site, all of which are quite widespread species of low conservation concern. The Karoo Dainty Frog, *Cacosternum karooicum* is listed as Data Deficient reflecting the little-known distribution and ecology of this species. To date, the Karoo Dainty Frog has been recorded from a few scattered locations across the Karoo in the Western and Northern Cape, but it is likely that it occurs more widely across the karoo in general. The site also falls within the distribution of two other regional endemic species, the Cape Sand Frog, *Tomopterna delalandii* and the Raucous Toad, *Amietophrynus rangeri*. The Cape Sand Frog occurs in lowlands and valleys in fynbos and succulent karoo throughout most of the Western Cape and into Namaqualand. The Raucous Toad is more widely distributed and occurs throughout much of South Africa inland and along the east coast into Gauteng and Mpumalanga. There do not therefore appear to be any range-restricted species which occur at the site which would be vulnerable to population-level impacts. In general, the most important areas for amphibians at the site are the riparian areas, seeps and wetlands and the man-made earth dams which occur in the area. As these are widely recognized as sensitive habitats, the development is likely to avoid these areas as far as possible and the potential conflict between amphibians and the development is likely to be fairly low. Amphibians are however highly sensitive to pollutants and the large amount of construction machinery and materials present at the site during the construction phase would pose a risk to amphibians should any spills occur.

## *4.6 SITE SENSITIVITY ASSESSMENT*

The ecological sensitivity of the site as derived from the various physical and ecological indicators is depicted in Figure 4 below. Based on the indicative turbine locations provided, 49 turbines are located within areas classified as Very High Sensitivity, 89 within High Sensitivity, 34 within Moderate and 62 within Low Sensitivity areas. However, it is important to recognize that the turbines are located along the ridgelines which divide polygons of possibly differing sensitivity and the actual sensitivity of the location would need to be assessed in the field. The sensitivity map is more pertinent with regards to the potential of the roads to cause ecological damage as these are linear features which must traverse whole polygons to reach their destination. The map clearly indicates that a large proportion of the roads at the site must traverse areas of high ecological sensitivity and the potential for ecological impact is consequently high.

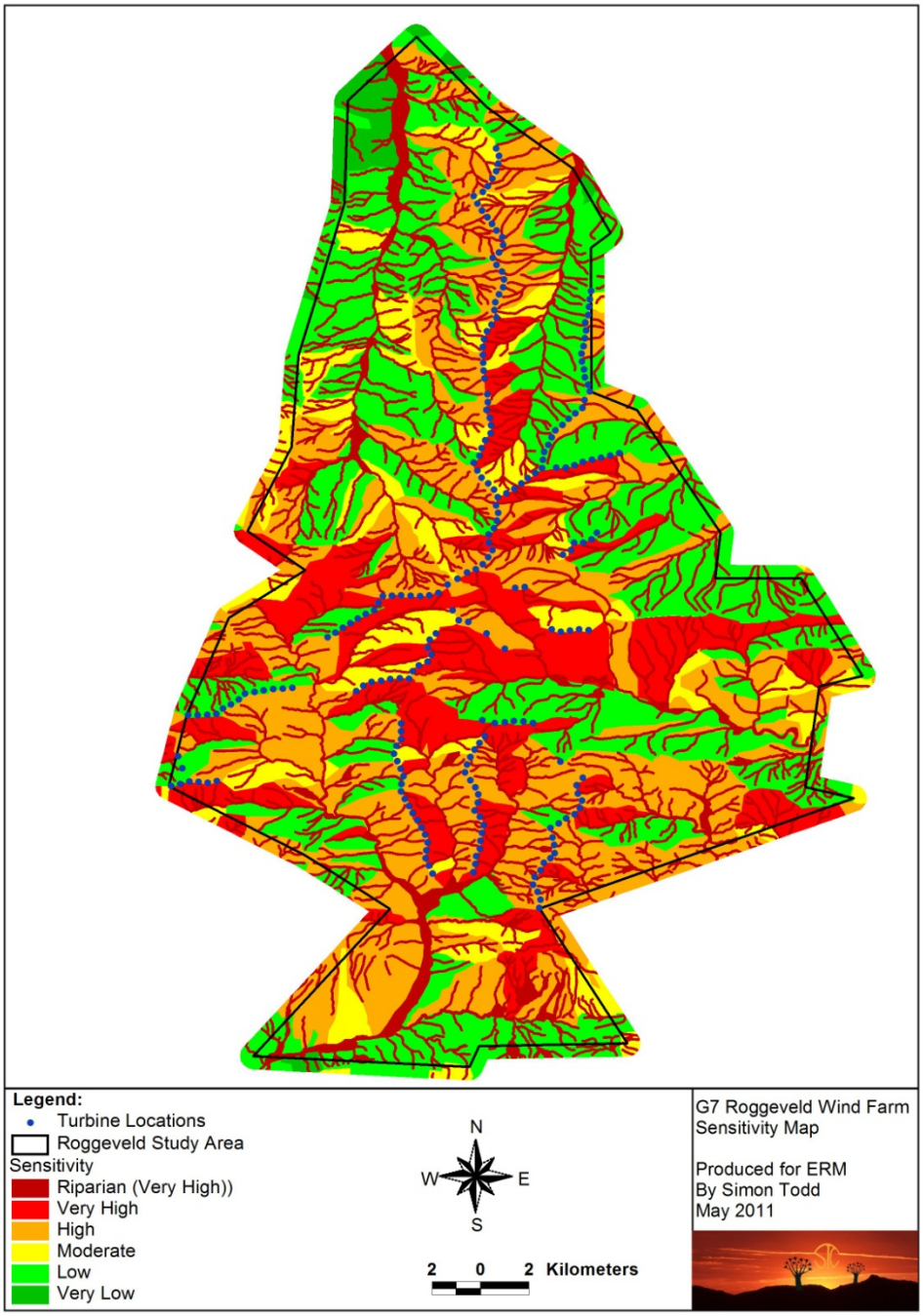



**Figure 4.** Sensitivity map of the G7 Roggeveld wind farm with the turbine locations depicted. As can be seen from the image, a large proportion of the site is considered high or very high sensitivity, largely as a result of the steep slope of these areas.

In general, the sensitivity map indicates that a large proportion of the southern and central portion of the site is of high sensitivity. Within the northern section, the high-lying or steep ridge sections emerge as being high sensitivity while the lowlands generally emerge as being of a lower sensitivity. The overall implications of the sensitivity map include that fact that the site is generally a sensitive environment that would be vulnerable to development and also that there appear to be few options with regards to

finding alternative lower sensitivity placements for the turbines. The ridgelines are by their nature relatively flat, with the result that these areas are less sensitive than the adjacent slopes in terms of physical disturbance and associated erosion risk. However, the ridgelines themselves also represent a different edaphic habitat from the adjacent slopes, with the consequence that plant and animal communities on the ridgelines are often different from the adjacent slopes. As the ridgelines are relatively restricted in extent compared to the slopes, the placement of the turbines along the ridgeline would have a disproportionate impact on this environment.

# 5 IDENTIFICATION OF RISKS AND POTENTIAL IMPACTS

The likely impacts on the terrestrial ecology of the site resulting from the development of the Roggeveld Wind Farm as a wind energy facility are identified and assessed below according to the different phases of the project. The major risk factors and contributing activities associated with the development are identified and briefly outlined and summarized below before the impacts are assessed.

## *Destruction and Loss of Vegetation Cover*

The development of the site will require the construction of an extensive road network as well as lay-down and service areas for the turbines. The full 250 turbines would require an area of approximately 65 ha. The amount of transformation resulting from road construction is more difficult to estimate as a definitive layout of the road network has not been provided. However, the indicative layouts suggest that at least 170 km of roads will be required for the project. A proportion of this will be existing roads that will probably need to be upgraded, but the majority will be new roads that will need to be constructed to access the turbine locations. The total 170 km of road network would create a footprint of approximately 136 ha, based on an 8 m road-width footprint. Other activities such as construction camps and temporary lay-down areas would also result in the loss of some vegetation, however, it is assumed that these would be small in relation to the road and turbine requirements. The development would thus result in the direct loss of about 200 ha of currently intact vegetation. Given the extent of the site, this may seem insignificant, however, the development is dispersed across the site with the result that a large proportion of the site is near to an impacted area and the overall level of habitat fragmentation is potentially high. Furthermore, not all parts of the site are ecologically equivalent and since the development is concentrated on the high-lying ridges of the site, these areas will experience the majority of impact. It should also be clear that under most circumstances, the development of a single contiguous 200 ha area has less of an impact than the development of a similar extent in a linear and dispersed manner.

## *Impacts on Listed Plant Species*

The Roggeveld is known centre of plant endemism and contains a relatively large number of listed and endemic plant species. As some of these are quite widespread at the site, it is inevitable that they will be impacted to a greater or lesser extent by the development. Although, for most species this would probably not compromise the viability of the overall population, some species are either Critically

Endangered or are concentrated within the development footprint, and would potentially be more severely impacted. Furthermore, some species such as *Gasteria* and *Haworthia* spp. are sought after by plant collectors and also for use in traditional medicine and the road network would potentially increase the accessibility of the site and leave these species' vulnerable to illegal collection.

### *Direct Faunal Impacts*

The development of the site would directly impact the fauna of the site in several different ways. Firstly, there would be a large amount of noise and disturbance associated with the construction phase. This would frighten many of the larger mammals away from the area and would probably cause increased mortality among these individuals as they would have to move into sub-optimal habitat or compete with other individuals for new territories. This effect would be transient and affected species would be able to return once construction has been completed. However, the presence of the turbines may deter sensitive species from returning or would require some time for them to become habituated to their presence. Secondly, the transformation of intact vegetation would constitute habitat loss and fragmentation for fauna. Given the limited extent of transformation of the site and the limited land requirement of the development relative to the extent of available intact habitat, the direct loss of habitat would be minimal for most faunal species and there do not appear to be any species which would be significantly impacted by the direct loss of habitat. Fragmentation poses a greater threat as some species may avoid open areas or become vulnerable to predation while traversing open ground. The presence of a construction workforce would also increase the risk of poaching during the construction phase of the project. Smaller antelope such as Klipspringer, Duiker and Steenbok would probably be the most vulnerable. As with listed plant species, the illegal collection of tortoises and other reptiles for food, pets or trade would be an increased risk associated with the development. Attractive species such as the Tent Tortoise would be particularly at risk. The large amount of machinery and construction material present at the site during the construction phase would pose a pollution risk that could negatively affect local amphibian populations should any spills occur. Traffic at the site during all phases of the project would pose a risk of collisions with fauna. Slower groups such as tortoises, snakes and amphibians would be most susceptible and the impact would be largely concentrated to the construction phase when vehicle activity was high.

### *Erosion*

Erosion is probably one of the greatest potential impacts associated with the development. Although the turbines themselves are situated on relatively flat ground, the access roads, underground cables and overhead lines will need to traverse some very steep areas. The soil disturbance associated with the development will render the impacted areas highly vulnerable to erosion and measures to limit erosion will need to be a central component of mitigation measures at the site. Erosion is significant in that it can quickly spread beyond the initial disturbed area and on steep slopes or vulnerable soil types will continue to spread into intact areas even with a good vegetation cover. Furthermore, the eroded material will enter the streams and rivers at the site and may have significant impact on these systems through siltation of pools and changes in the chemistry and turbidity of the water.

### *Alien Plant Invasion*

The disturbance associated with the construction phase of the project will render the disturbed areas vulnerable to alien plant invasion. Since the majority of the site is currently little impacted by alien plants, this could potentially have a large impact on the site as roads will traverse a lot of previously undisturbed areas. Some alien invasion is inevitable and regular alien 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.

### *Impacts on Wetlands and Riparian Areas*

Wetlands and riparian areas are vulnerable to disturbance but provide important ecosystem services as well as ecological functions and contain high biodiversity levels. Consequently, special precautions should be taken to mitigate and avoid impacting these areas. Erosion is a major threat to these areas as increased levels of sediments in runoff will alter the ecological functioning of these areas. Drainage lines are also vulnerable to direct impacts, and roads which must traverse drainage lines must be constructed in a manner which does not promote erosion or disrupt the natural flow of water down the channel. The Namakwa District Biodiversity Sector Plan (Desmet & Marsh 2008), contains a summary of specific guidelines regarding the construction of roads to ensure that their impact on aquatic ecosystems is reduced. These guidelines are contained within the section "*10.9.4 Specific Guidelines for Land Use Activities that May Impact Aquatic Ecosystems*" and the developer is referred to these guidelines as a standard for the construction of roads at the site.

### *Impacts on Critical Biodiversity Areas*

As previously discussed, the site contains a large extent of Critical Biodiversity Areas which are within the development footprint. As development within CBAs is not encouraged, the development would need to justify the need to develop these areas as the development would to some extent compromise the purpose and functioning of the CBAs. Should development within the CBAs take place, then conservation offsets would be an avenue that should be pursued in order to compensate for the impact of the development. In short, conservation or biodiversity offsets can be defined as "*conservation actions intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects, so as to aspire to no net loss of biodiversity. Before developers contemplate offsets, they should have first sought to avoid and minimise harm to biodiversity"* (ten Kate et al 2004). Should this option be followed, then the local conservation authorities would need to become involved as would conservation planners with experience in the area. The exact nature and potential of such biodiversity offsets at the site are not detailed here, but would need to be investigated in a separate study with its own terms of reference.

### *Cumulative impacts*

There are a number of other wind farm developments in the broad area and the potential cumulative effect of these should be considered as the combined presence of several wind farms may disrupt

broad-scale ecological processes such as dispersal and migration as well as prevent conservation targets for certain vegetation types being reached.

### *Contributing Activities*

The above risk factors are in turn caused by or related to the following major activities which will be associated with the development of the site as a wind energy facility:

- Vegetation clearing for roads, lay-down areas, turbines etc.
- Construction activities including noise, pollution etc.
- Vehicle activity during and after construction
- Human activity during and after construction
- The excavation of borrow pits
- The laying of underground cables or overhead transmission lines

# *6 IMPACT ASSESSMENT*

## *6.1 CONSTRUCTION PHASE*

The major impact associated with the development will occur during the construction phase of the project. The major impacts at this stage will be the loss of natural vegetation and transformation and disturbance of natural ecosystems at the site. The presence of a sizeable construction workforce at the site also poses several risks, as does the operation and presence of construction machinery. In general, the major impacts associated with the construction phase of the development can be summarized under the following areas of impact which are discussed and assessed in more detail below.

- Destruction and Loss of Vegetation
- Direct Impact On Protected Plant Species
- Direct Faunal Impact
- Loss of Faunal Habitat
- Impacts On Critical Biodiversity Areas

Prior to the commencement of construction at the site, the following mitigation measures should be taken to reduce the overall impact of the development.

- An Environmental Control Officer (ECO) should be appointed. The responsibilities of the ECO should include monitoring and reporting as well as ensuring that the development takes place within the guidelines provided in this and the other specialist reports.

- Compile a monitoring schedule for the site based on the monitoring recommendations of this and the other specialist reports.
- The final layout of the development should be assessed in the field prior to the commencement of construction activities so that the exact placement of the turbines can be adjusted to avoid potentially sensitive areas.
- The location of borrow pits and any other infrastructure or major activity not specifically dealt with in the EIA phase should be assessed in the field prior to construction to ensure that suitable sites are identified.

*Impact 1*

**Impact 1.** Destruction & Loss of Vegetation

**Nature:** The construction phase will require the construction of a large number of access roads as well as the clearing of vegetation for the turbines, their service areas and for buildings and temporary construction areas. Apart from the direct loss of vegetation, this will also render the disturbed areas vulnerable to erosion.

**Impact Magnitude** – Moderate-High

- Extent: Local, the extent of the impact will be limited to the development footprint and near surroundings. Erosion may however also affect adjacent and downstream areas. As discussed above the footprint of the development in terms of direct habitat loss will be around 200 ha.
- Duration: The duration of the impact will be long-term as the majority of impact will remain until the project is decommissioned.
- Intensity: Since this results in the total loss of vegetation within affected areas, the intensity is seen to be **Moderate-High**.

**Likelihood:** As this infrastructure is required for the operation and construction of the facility, this impact will definitely occur.

**Impact Significance:** Moderate (-ve)

**Degree of Confidence:** High. Based on the project description, this impact will definitely occur.

**Mitigation:**

- Areas to be cleared should be clearly demarcated.
- Vegetation should only be cleared when and where absolutely necessary. If possible a vegetative cover should be left in place. It is preferable to mow the vegetation down to the required height than to use other more destructive clearing methods such as grading.
- Where construction vehicles must traverse the site, they must remain on demarcated roads. If vehicles must leave the road for construction purposes, they should utilize a single track and should not take multiple paths.

- Where construction does not require the clearing of the vegetation, for example for the temporary lay-down areas, then construction should occur without clearing the vegetation as far as possible. Alternatively, already transformed areas such as old croplands should be used for this purpose.
- If topsoil must be removed from an area during construction, it should be replaced or used as soon as possible elsewhere as it will contain seed of local species which will aid the natural recovery of the vegetation.
- Appropriate erosion control and water diversion structures should be constructed at the same time as the vegetation is cleared so that the loosened soil is not left vulnerable to erosion.

*Impact 2*

**Impact 2.** Impact on Protected Plant Species

**Nature:** The construction phase will require the clearing of vegetation in areas which were observed to contain listed plant species. The local populations of these species will therefore be impacted unless mitigation measures are implemented.

**Impact Magnitude** - Moderate

- Extent: Local to regional, the extent of the impact will be regional for highly threatened plant species as their population viability within the broader area may be affected.
- Duration: The duration of the impact will be long-term as the habitat will be unavailable to these species until the project is decommissioned.
- Intensity: Since this would result in the destruction of listed plant species within the affected areas, the intensity is seen to be **High**.

**Likelihood:** Protected plant species were observed within the development footprint indicating that this impact will occur.

**Impact Significance:** Moderate (-ve) unless mitigation measures are implemented.

**Degree of Confidence:** Definite, the listed species were observed to occur at the site and within areas that are within the development footprint.

**Mitigation:**

- The turbine locations should be individually assessed for the presence of listed species and sites found to contain a high abundance of such species should be relocated to a suitable less sensitive adjacent area.
- Since a large proportion of the listed species at the site are geophytes or succulent species, the potential for successful translocation is high. Therefore, it is recommended that before construction commences individuals of listed species within the development footprint should be marked and translocated to similar habitat outside the development footprint under the

supervision of an ecologist or someone with experience in plant translocation. Permits from the relevant provincial authorities will be required to relocate listed plant species.

- Any individuals of protected species observed within the development footprint during construction (ie. Individuals that were missed during initial sweeps), should be translocated under the supervision of the ECO.

*Impact 3*

**Impact 3.** Direct Faunal Impacts Due To Construction Disturbance

**Nature:** The construction phase will result in a lot of physical disturbance at the site as well as habitat destruction for resident faunal species. This will result in direct mortality for smaller fauna unable to move away from the construction activities and a loss of faunal habitat in general. The human activity and noise generated by the construction will also frighten most medium and larger fauna away from the construction area.

**Impact Magnitude** - Moderate

- Extent: **Local**, the extent of the impact will be limited to the site and near surroundings.
- Duration: The duration of the impact will be short term or as along as construction is underway. The impact with regards to habitat loss is considered part of the operational phase.
- Intensity: The large amount of activity at the site and the associated disturbance resulting from clearing and construction will constitute a **Moderate** disturbance intensity.

**Likelihood:** There is a very high likelihood that this impact will occur in and around construction areas.

**Impact Significance:** Moderate (-ve)

**Degree of Confidence:** Definite. Based on the project description, this impact will occur to a greater or lesser extent.

**Mitigation:**

- Any slow-moving fauna, such as tortoises or snakes observed at the site during the construction phase should be removed to safety by the ECO.
- In order to reduce collisions of vehicles with fauna, speed limits should apply to all roads and vehicles using the site, a maximum of 40 km/h is recommended. Animals should have right of way.
- All cleared areas which do not need to remain clear of vegetation should be rehabilitated or seeded with local species if natural recovery does not take place within a year of being cleared.

*Impact 4*

**Impact 4.** Direct faunal impacts due to poaching/hunting/poisoning

**Nature:** A significant number of construction workers will be on site during the construction phase posing a risk to fauna as a result of poaching and hunting of fauna for food or other purpose. Vulnerable species would include Tent Tortoises *Psammobates spp.* as well as mammals such as Klipspringer, Steenbok, Duiker and hares (*Lepus* spp).

**Impact Magnitude** - Moderate

- Extent: **Local**, the extent of the impact will be limited to the site and near surroundings.
- Duration: The duration of the impact will be short-term or as along as construction is underway.
- Intensity: As this impact will be concentrated on a few targeted species, the impact on these species could be of high intensity.

**Likelihood:** There is a high probability that this would occur if appropriate mitigation measures are not taken.

**Impact Significance:** Moderate (-ve)

**Degree of Confidence:** High. This impact can be assessed with a moderate degree of certainty.

**Mitigation:**

- The staff accommodation should be fenced off and no personnel should be allowed to wander around at the site for any purpose after hours.
- The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden.
- Fires should only be allowed within fire-safe demarcated areas.
- No fuelwood collection should be allowed on-site.
- No dogs should be allowed on site.
- As part of the EMP for the site, it should be mandatory for staff of both the developer as well as contractors to attend an environmental briefing and training session with respect to the guidelines outlined in this document and the EMP.

Other general mitigation measures recommended for the site during the construction phase include:

- 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.
- The large number of people on site during the construction phase will require that an on-site ablution, sanitation, litter and waste management program is implemented.

## *6.2 OPERATIONAL PHASE*

During the operational phase, human activity and disturbance levels at the site should be relatively low as compared to the construction phase. During the operational phase, the major impacts are likely to be related to maintenance activities and carry-over effects resulting from the construction phase. In particular the site will remain vulnerable to erosion and alien plant invasion for some time following construction. Some fauna may also avoid areas near to the turbines because of the noise they make as well as their movement. Impacts associated with this phase of the project can be identified as follows:

- Post-construction vulnerability to erosion
- Post-construction vulnerability to alien plant invasion
- Negative consequences resulting from Increased accessibility of the site
- Loss of Landscape Connectivity for Fauna
- Direct impacts on vegetation resulting from maintenance activities
- Impact on Critical Biodiversity Areas

*Impact 1*

**Impact 1.** Erosion Potential

**Nature:** Post construction, there will be a lot of disturbed and loose soil at the site which will render the area vulnerable to erosion. As most of the site is very rugged and many of the roads will traverse very steep areas, the potential for erosion is very high. Roads even on low slopes may capture overland flow, concentrating the water from a large area onto the road which would then be vulnerable to severe erosion. The turbine service areas may also cause or be vulnerable to erosion if they are compacted and create a lot of runoff. Erosion is probably one of the greatest risk factors associated with the development and it is therefore critically important that proper erosion control structures are built and maintained over the lifespan of the project.

**Impact Magnitude** – Moderate - High

- Extent: **Local**, the extent of the impact will be largely limited to the site, but downstream and adjacent areas may also be affected.
- Duration: Should severe erosion occur then the duration of the impact will be **long-term** as such erosion is not easily remedied.
- Intensity: The intensity of the impact is potentially **high** as there are a large number of steep slopes at the site which would be vulnerable to extensive and severe erosion.

**Likelihood:** Based on the large number of roads that will be required at the site and the fact that they will probably not be built along the contour, there is a high likelihood that erosion would occur if mitigation measures are not taken.

**Impact Significance:** Moderate - High (-ve)

**Degree of Confidence:** There is a high degree of confidence in the assessment of this risk.

**Mitigation:**

- Roads should be constructed and routed in manner which minimizes their erosion potential. Roads should therefore follow the contour as far as possible and roads parallel to the slope direction should be avoided as much as possible.
- Appropriate erosion control structures should be built on all roads and other vulnerable areas during the construction phase.
- Regular monitoring of the site (minimum of twice annually) for erosion problems is recommended, particularly after large summer thunder storms have been experienced.
- Any erosion problems observed should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur.
- All bare areas should be revegetated with locally occurring species, to bind the soil and limit erosion potential.
- Roads and other disturbed areas should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring to assess the success of the remediation.

*Impact 2*

**Impact 2.** Alien Plant Invasion

**Nature:** The large amount of disturbed and bare ground that is likely to be present at the site after construction will leave the site vulnerable to alien plant invasion. The presence of alien plants may prevent the natural recovery of the natural vegetation, reduce plant and animal diversity at the site as well as result in various other negative ecosystem consequences. Furthermore, the Conservation of Agricultural Resources Act, (Act No. 43 of 1983) requires that listed alien species are controlled in accordance with the Act.

**Impact Magnitude** - Moderate

- Extent: Local, the extent of the impact will be largely limited to disturbed areas of the site, but adjacent areas may also become affected if invasion is severe.
- Duration: Should alien plants become established this would be considered to have a long-term impact as these plants would probably persist at the site for years or decades and once a seed bank has established, alien plants may be difficult to eradicate.
- Intensity: The intensity of the impact is likely to be of moderate intensity as the soils at the site are generally quite nutrient poor which would reduce the potential for alien plant invasion.

**Likelihood:** Since the development of the site will result in a fairly extensive disturbance, it is highly likely that some alien plant invasion will occur.

**Impact Significance:** Minor to Moderate (-ve)

**Degree of Confidence:** There is a high degree of confidence in the assessment of this risk.

**Mitigation:**

- Regular monitoring for alien plants at the site should occur and could be conducted simultaneously with erosion monitoring.
- When alien plants are detected, these should be controlled and cleared using the recommended control measures for each species to ensure that the problem is not exacerbated or does not re-occur.
- Clearing methods should themselves aim to keep disturbance to a minimum.

*Impact 3*

**Impact 3.** Impacts on fauna and flora due to illegal hunting and collecting

**Nature:** The development will result in the construction of a large amount of roads into previously inaccessible areas. This will increase the risk to fauna and flora as a result of poaching and illegal collection of plants and animals for trade or other purpose. Vulnerable species would include Tent Tortoises *Psammobates spp.* as well as various succulent and geophyte species which are sought-after among collectors.

**Impact Magnitude** - Moderate

- Extent: **Local**, the extent of the impact will be limited to the site.
- Duration: The duration of the impact will be long-term as the roads will remain in place for the foreseeable future.
- Intensity: As this impact will be concentrated on a few targeted species, the impact on these species could be of high intensity.

**Likelihood:** There is a high probability that this would occur if appropriate mitigation measures are not taken.

**Impact Significance:** Moderate (-ve)

**Degree of Confidence:** Moderate. This impact can be assessed with a moderate degree of certainty.

**Mitigation:**

- Access to the turbine roads should be strictly controlled and access to the area in general should be regulated.

- Staff present during the operational phase should receive environmental education so as to ensure that that no hunting or harvesting of plants and animals occurs.
- The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden.

*Impact 4*

**Impact 4.** Loss of Landscape Connectivity for Fauna

**Nature:** Certain animals may avoid or be frightened away by the turbines. This would reduce the connectivity of the landscape as the turbines would form a barrier to movement for these species.

**Impact Magnitude** – Low

- Extent: **Local**, the extent of the impact will be limited to the site and surroundings.
- Duration: The duration of the impact will be **long-term** as the effect would persist as long as the turbines were present.
- Intensity: Since the turbines are not continuously distributed there would be gaps available for movement and most species would probably also become habituated to the presence of the turbines, the effect is deemed to have a **low** intensity.

**Likelihood:** The effect is likely to occur at least to some extent for certain species.

**Impact Significance:** Minor (-ve). The number of species affected is likely to be low and is likely to include the more mobile species present which would in any case probably be able to find the gaps in the turbine strings.

**Degree of Confidence:** This effect can be assessed with a moderate to low degree of confidence as little is known about how the local fauna is likely to respond to the presence of the turbines.

**Mitigation:**

- Apart from leaving gaps in the turbine strings, there is little that can be done to reduce this potential impact.

*Impact 5*

**Impact 5.** Maintenance activity impact on vegetation

**Nature:** During the operational phase, turbine service areas and road surface areas may become revegetated and it may be necessary to clear the vegetation. Inappropriate clearing methods would have a negative effect on local ecosystems. Mechanical means (Mowing) should be used for this purpose. Herbicides should definitely not be used for this purpose as this could have residual effects as well as impact the broader ecosystem.

**Impact Magnitude** - Moderate

- Extent: Local, the extent of the impact will be largely limited to the site, but broader ecosystem-wide effects could occur if herbicides are used.
- Duration: Although the application of herbicides could be short-lived, the effects could persist for some time. The duration of impact is therefore assessed as short to medium term.
- Intensity: The intensity of the impact is likely to be dependent on the exact methods used, and would be moderate to severe if certain herbicides are applied.

**Likelihood:** This impact is contingent on herbicides being used at the site. If no herbicides are used, then this impact will be mitigated.

**Impact Significance:** Minor-Moderate (-ve)

**Degree of Confidence:** There is a high degree of confidence in the assessment of this risk.

**Mitigation:**

- No herbicides to be used at the site
- Vegetation that needs to be reduced in height should be mowed or brush-cut to an acceptable height, and not to ground level except where necessary.

*Impact 6*

**Impact 6.** Impact on Critical Biodiversity Areas

**Nature:** Although the actual impacts on the terrestrial ecology of the site have been identified and assessed above, the nature and consequences of the development for the CBAs of the site require greater clarification. A large proportion of the site particularly the section within the Western Cape has been classified as CBAs. These areas have been identified as CBA based on their high biodiversity value and their irreplaceable nature or important ecological role these areas play. The development would potentially compromise the ecological functioning of the CBAs.

**Impact Magnitude** – Moderate-High

- Extent: Local, the extent of the impact will be largely limited to the site, but broader implications would occur if the ecological functioning or biodiversity value of CBAs were compromised.
- Duration: The impact would persist for the lifespan of the project and is thus considered long-term.
- Intensity: The intensity of the impact is likely to be moderate to severe.

**Likelihood:** This impact is highly likely to occur as a large proportion of the development lies within CBAs.

**Impact Significance:** Moderate to High (-ve)

**Degree of Confidence:** There is a high degree of confidence in the assessment of this risk.

**Mitigation:**

- Based on the indicative layout, moving the development outside the CBA areas does not appear to be a viable strategy. Reducing the number of turbines within the CBAs would to some extent reduce the impact of the development. However, since a similar extent of road network may be required, this aspect would not be mitigated, only those impacts directly related to the number of turbines.
- As previously discussed, a biodiversity offset may be the only viable approach to mitigating the impacts of the development within the CBAs. This would involve committing a proportion of the site to a formal conservation arrangement (stewardship or some other long-term commitment).

## *6.3 DECOMMISSIONING*

During the decommissioning phase the project is likely to face similar issues generated by the construction phase; that is negative impacts related to disturbance and human presence at the site. The decommissioning phase should attempt to rehabilitate the site with as little disturbance as possible. The major risk associated with the decommissioning phase would be that the site is not adequately restored to its previous potential and a degraded and disturbed ecosystem is left behind.

*Impact 1*

**Impact 1.** Inadequate rehabilitation of the site.

**Nature:** Decommissioning will involve a large amount of disturbance at the site as the majority of infrastructure will need to be removed and some roads will need to be rehabilitated. This will leave the site vulnerable to erosion and alien plant invasion. If the site is not adequately restored at decommissioning, a degraded ecosystem would persist at the site for decades.

**Impact Magnitude** - Moderate

- Extent: Local, the extent of the impact will be largely limited to disturbed areas of the site, but adjacent and downstream areas could also be affected in the case of erosion problems.
- Duration: Should erosion occur and alien plants become established this would be considered to have a long-term impact as the problems would probably persist at the site for years or decades.
- Intensity: The intensity of the impact is likely to be of low to moderate intensity as it is likely that the weedy species present at the site will colonise the disturbed areas and reduce the potential extent and severity of erosion and alien plant invasion.

**Likelihood:** Since the decommissioning of the site will result in a fairly extensive disturbance, it is highly likely that some erosion and alien plant invasion will occur if mitigation measures are not implemented.

**Impact Significance:** Moderate (-ve)

**Degree of Confidence:** There is a high degree of confidence in the assessment of this risk.

**Mitigation:**

- All disturbed areas should be rehabilitated with locally-sourced seed of indigenous species.
- The site should be monitored for a period of at least two years after the infrastructure has been removed to ensure that rehabilitation is successful and that areas that do not recover adequately can be identified and remedied.

## *6.4 CUMULATIVE IMPACTS*

Before the cumulative impact of the current development can be adequately assessed, other developments that may occur or are currently being planned for the area need to be identified. At this stage and as far as can be ascertained, other planned development in the broad area include at least two wind farm developments along the escarpment, approximately 20 km northeast of the current site (Mainstream & Suurplaat/Moyeng) as well as a planned development approximately 40 km southwest of the current site (Mainstream Perdekraal) and several along the Witberg from Konstabel to Laingsburg (Mainstream Konstabel, G7 Witberg, Laingsburg). There is therefore a high density of wind energy facilities in the area and the potential for cumulative effects may therefore be high. This potential is to some extent dependent on how many of the planned facilities will actually be built, which is not known at this stage.

The major cumulative impacts associated with the development are likely to include disrupting the movement and migration pathways of fauna, as well as the broad scale fragmentation of habitat and potentially impinging on conservation targets for the affected vegetation types. In terms of disrupting movement and migration pathways, it should firstly be recognized that such movement patterns are very poorly known. Since the various developments listed above occur on different mountain ranges, the potential of the current development to contribute to broad-scale disruption of movement patterns is probably low. The potential of the current development to impinge on conservation targets for the associated vegetation types is high, particularly for Central Mountain Shale Renosterveld which has a large proportion of its entire extent within the study area. The potential is to some extent mitigated by the fact that Central Mountain Shale Renosterveld has been little impacted by transformation and so there should be a sufficient extent of Central Mountain Shale Renosterveld outside the study area to meet conservation targets. It is however important to recognize that there is likely to be some variation in the composition of this vegetation type and so not all areas are likely to be equivalent with the consequence that meeting conservation targets for the vegetation type within a reduced proportion of the vegetation type will not conserve all species. Overall the potential of the site to contribute to cumulative impacts is viewed as being fairly low and the major impact of the development will be at a local scale.

## *6.5 SUMMARY ASSESSMENT*

It is important recognize that although most of the impacts have been assessed as being largely restricted to the local environment of the site, the site is extensive and even impacts which are local in nature will occur across a large area and could disrupt ecological process operating across the Klein Roggeveld mountain range as a whole. A summary of the pre and post mitigation significance ratings for the various impacts as identified is provided below. Most of the impacts can be mitigated to minor significance except for the impacts on the CBAs which can be viewed as being the cumulative impact of all the different impacts that will occur as a result of the development as well as the impact that the development will have on the undisturbed nature of the area. The residual impact for all other impacts should be low once appropriate mitigation measures have been implemented.

**Table 2.** Summary of pre and post mitigation impact significance ratings for the different impacts and risk factors identified for the different phases of the project.

| Phase | Impact | Significance Pre Mitigation | Significance Post Mitigation |
|---|---|---|---|
| Construction | Destruction & Loss of Vegetation | Moderate-High | Minor -Moderate |
| | Protected Plant Species | Moderate-High | Minor -Moderate |
| | Faunal impacts – Construction Disturbance | Moderate | Minor -Moderate |
| | Faunal Impacts – Hunting & Illegal Collection | Moderate | Minor |
| Operation | Erosion Potential | Moderate-High | Minor |
| | Alien Plant Invasion | Moderate | Minor |
| | Hunting and Collecting of Fauna & Flora | Moderate | Minor |
| | Loss of landscape connectivity for fauna | Minor | Minor |
| | Maintenance impact on vegetation | Minor -Moderate | Minor |
| | Impact on Critical Biodiversity Areas | Moderate-High | Moderate |
| Decommissioning | Inadequate rehabilitation | Moderate | Minor |

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# 8 APPENDICES:

## Appendix 1. List of important plant species

List of plant species of conservation concern which are known to occur in the vicinity of the G7 Roggeveld Wind Farm. The list is derived from the SIBIS:SABIF website.

| Family | Species | IUCN Status |
|---|---|---|
| **AMARYLLIDACEAE** | *Brunsvigia josephinae* | **VU** |
| **APOCYNACEAE** | *Duvalia parviflora* | **VU** |
| **ASPHODELACEAE** | *Astroloba herrei* | **VU** |
| | *Gasteria disticha* | **CR** |
| | *Haworthia serrata* | **CR** |
| **ASTERACEAE** | *Antithrixia flavicoma* | **VU** |
| | *Euryops namaquensis* | **VU** |
| **COLCHICACEAE** | *Wurmbea capensis* | **VU** |
| **CRASSULACEAE** | *Adromischus mammillaris* | **EN** |
| **FABACEAE** | *Amphithalea spinosa* | **VU** |
| | *Amphithalea villosa* | **EN** |
| | *Aspalathus candicans* | **EN** |
| | *Lotononis comptonii* | **EN** |
| | *Lotononis densa subsp. congesta* | **VU** |
| | *Lotononis gracilifolia* | **EN** |
| | *Lotononis venosa* | **VU** |
| | *Xiphotheca fruticosa* | **VU** |
| **HYACINTHACEAE** | *Drimia arenicola* | **VU** |
| | *Lachenalia martinae* | **VU** |
| **IRIDACEAE** | *Geissorhiza karooica* | **VU** |
| | *Moraea aspera* | **VU** |
| | *Romulea eburnea* | **VU** |
| | *Romulea hallii* | **VU** |
| | *Romulea multifida* | **VU** |
| | *Romulea syringodeoflora* | **VU** |
| **MESEMBRYANTHEMACEAE** | *Antimima hamatilis* | **VU** |
| | *Didymaotus lapidiformis* | **VU** |
| | *Lampranthus amoenus* | **EN** |
| | *Tanquana archeri* | **VU** |
| | *Tanquana hilmarii* | **CR** |
| **ORCHIDACEAE** | *Pterygodium inversum* | **EN** |
| **POLYGALACEAE** | *Muraltia karroica* | **VU** |

| | | |
|---|---|---|
| **PROTEACEAE** | *Protea convexa* | **CR** |
| **RESTIONACEAE** | *Hypodiscus sulcatus* | **EN** |
| **RUTACEAE** | *Acmadenia argillophila* | **VU** |

**Appendix 2.** List of Mammals

List of Mammals which potentially occur at the G7 RoggeveldRoggeveld Wind Farm site. Taxonomy and habitat notes are derived from Skinner & Chimimba (2005), while conservation status is according to the IUCN 2010.

| Scientific Name | Common Name | Status | Habitat | Likelihood |
|---|---|---|---|---|
| **Afrosoricida (Golden Moles):** | | | | |
| *Chlorotalpa sclateri* | Sclater's Golden Mole | LC | Montane grasslands, scrub and forested kloofs of the Nama Karoo and grassland biomes | High |
| *Chrysochloris asiatica* | Cape Golden Mole | LC | Coastal parts of the Northern and Western Cape | High |
| **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 | High |
| *Elephantulus edwardii* | Cape Rock Elephant Shrew | LC | From rocky slopes, with or without vegetation, from hard sandy ground bearing little vegetation, quite small rocky outcrops | High |
| **Tubulentata:** | | | | |
| *Orycteropus afer* | Aardvark | LC | Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil | Definite |
| **Hyracoidea (Hyraxes)** | | | | |
| *Procavia capensis* | Rock Hyrax | LC | Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies | Definite |
| **Lagomorpha (Hares and Rabbits):** | | | | |
| *Bunolagus monticularis* | Riverine Rabbit | CR | Confined to riparian bush on the narrow alluvial fringe of seasonally dry watercourses in the Central Karoo. | V.Low |
| *Pronolagus rupestris* | Smith's Red Rock Rabbit | LR/LC | Confined to areas of krantzes, rocky hillsides, boulder-strewn koppies and rocky ravines | Definite |
| *Lepus capensis* | Cape Hare | LR/LC | Dry, open regions, with palatable bush and grass | Definite |
| *Lepus saxatilis* | Scrub Hare | LR/LC | Common in agriculturally developed areas, especially in crop-growing areas or in fallow lands where there is some bush development. | High |
| **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. | Definite |
| *Graphiurus ocularis* | Spectacled Dormouse | LC | Associated with sandstones of Cape Fold mountains, which have many vertical and horizontal crevices. | High |
| *Acomys subspinosus* | Cape Spiny Mouse | LC | Associated with rocky areas on mountain slopes in Fynbos | Low |
| *Rhabdomys pumilio* | Four-striped Grass Mouse | LC | Essentially a grassland species, occurs in wide variety of habitats where there is good grass cover. | High |
| *Mus minutoides* | Pygmy Mouse | LC | Wide habitat tolerance | High |
| *Micaelamys 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 | Definite |
| *Micaelamys granti* | Grant's Rock Mouse | LC | Restricted to the karoo where they are associated with rocky terrain. | High |
| *Parotomys brantsii* | Brants's 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 | Low |
| *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. | Definite |
| *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 |
| *Tatera afra* | Cape Gerbil | LC | Confined to areas of loose, sandy soils of sandy alluvium. Common on cultivated lands. | Low |
| *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 |
| *Dendromus melanotis* | Grey Climbing Mouse | LC | Often associated with stands of tall grass especially if thickened with bushes and other vegetation | High |
| **Primates:** | | | | |
| *Papio hamadryas* | Chacma Baboon | LR/LC | Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges. | Definite |
| **Eulipotyphla (Shrews):** | | | | |

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|---|---|---|---|---|
| *Myosorex varius* | Forest Shrew | LC | Prefers moist, densely vegetated habitat | High |
| *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 cristatus* | Aardwolf | LR/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 | Definite |
| *Felis silvestris* | African Wild Cat | LC | Wide habitat tolerance. | High |
| *Panthera pardus* | Leopard | LC | Wide habitat tolerance, associated with areas of rocky koppies and hills, mountain ranges and forest | 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 | LR/LC | Occur in open arid associations | High |
| *Genetta tigrina* | Large-spotted genet | LR/LC | Fynbos and savanna particularly along riverine areas | Low |
| *Suricata suricatta* | Meerkat | LR/LC | Open arid country where substrate is hard and stony. Occur in Nama and Succulent Karoo but also fynbos | Definite |
| *Cynictis penicillata* | Yellow Mongoose | LR/LC | Semi-arid country on a sandy substrate | Definite |
| *Galerella pulverulenta* | Cape Grey Mongoose | LR/LC | Wide habitat tolerance | Definite |
| *Vulpes chama* | Cape Fox | LC | Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub | High |
| *Canis mesomelas* | Black-backed Jackal | LC | Wide habitat tolerance, more common in drier areas. | Definite |
| *Otocyon megalotis* | Bat-eared Fox | LC | Open country with mean annual rainfall of 100-600 mm | Definite |
| *Aonyx capensis* | Cape Clawless Otter | LC | Predominantly aquatic and do not occur far from permanenetpermanenet water | Medium |
| *Ictonyx striatus* | Striped Polecat | LR/LC | Widely distributed throughout the sub-region | Definite |
| *Mellivora capensis* | Ratel/Honey Badger | LR/LC | Catholic habitat requirements | High |
| **Rumanantia (Antelope):** | | | | |
| *Sylvicapra grimmia* | Common Duiker | LR/LC | Presence of bushes is essential | Definite |
| *Pelea capreolus* | Grey Rhebok | LC | Associated with rocky hills, rocky mountainsides, mountain plateaux with good grass cover. | Definite |
| *Antidorcas marsupialis* | Springbok | LC | Arid regions and open grassland. | Definite |
| *Raphicerus campestris* | Steenbok | LR/LC | Inhabits open country, | Definite |

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|---|---|---|---|---|
| *Raphicerus melanotis* | Cape Grysbok | LC | Thick scrub bush, particularly along the lower levels of hills | Medium |
| *Oreotragus oreotragus* | Klipspringer | LR/cd | Closely confined to rocky habitat. | Definite |

**Appendix 3.** List of Reptiles.

List of reptiles which potentially occur at the G7 Roggeveld Wind Farm site. Habitat notes and the conservation status are also provided. Conservation status lists CITES status and where it has been assessed the status according to the IUCN 2010. However, the majority of reptile species have not been assessed by the IUCN.

| Scientific Name | Common Name | Distribution | Status | Habitat |
|---|---|---|---|---|
| **Tortoises and Terrapins:** | | | | |
| *Homopus femoralis* | Greater Padloper | Endemic | Appendix II Protected | Grasslands of mountain plateaux, especially old escarpment |
| *Homopus areolatus* | Parrot-Beaked Tortoise | Endemic | Appendix II Protected | Varied: coastal fynbos; karroid broken veld & valley bushveld |
| *Homopus boulengeri* | Karoo/Boulengeri Padloper | Endemic | Appendix II Protected | Karoid regions |
| *Chersina angulata* | Angulate Tortoise | Endemic | Appendix II Protected | Sandy coastal regions, incl valley bushveld & coastal fynbos, scarcer in arid hinterland |
| *Psammobates tentorius tentorius* | Karoo Tent Tortoise | Endemic | Appendix II Protected | Varied: usually arid karroid areas or rocky sandveld |
| *Psammobates tentorius verroxii* | Bushmanland Tent Tortoise | Endemic | Appendix II Protected | Varied: usually arid karroid areas or rocky sandveld |
| *Pelomedusa subrufa* | Marsh Terrapin | Widespread | Data Deficient | Slow-moving & still water, incl temporary pans |
| **Snakes:** | | | | |
| *Rhinotyphlops lalandei* | Delalande's Beaked Blind Snake | Endemic | Data Deficient | Varied: semi-desert, coastal bush, fynbos & savannah |
| *Leptotyphlops gracilior* | Slender Thread Snake | Endemic | Data Deficient | Fynbos and Karoo scrub |
| *Homoroselaps lacteus* | Spotted Harlequin Snake | Endemic | Data Deficient | Deserted termite mounds or under rocks in fynbos, coastal scrub, sananna and grassland |
| *Lamprophis fuliginosus* | Brown House Snake | Widespread | Data Deficient | Common in highveld grassland & arid karroid regions, but found everywhere & tolerant of urban sprawl |
| *Lamprophis guttatus* | Spotted Rock Snake | Endemic | Data Deficient | Inland mnts of Cape & Cape fold mnts, extending into S.Namibia |
| *Lamprophis fiskii* | Fisk's House Snake | Endemic | VULNERABLE Protected | Karroid sandy veld, but few specimens from widely scattered localities |
| *Pseudaspis cana* | Mole Snake | Widespread | Data Deficient | Sandy scrubland in SW Cape, highveld grassland & mountainous & desert regions |
| *Prosymna sundevallii sundevallii* | Sundevall's Shovel-Snout | Endemic | Data Deficient | Dry areas, incl savannah woodlands, highveld & karroid areas, entering valley bushved & fynbos in the Cape |
| *Dipsina multimaculata* | Dwarf Beaked Snake | Endemic | Data Deficient | Rocky, sandy areas. Cape karroid areas. |
| *Psammophylax rhombeatus* | Spotted Or Rhombic Skaapsteker | Widespread | Data Deficient | Highland grassveld & fynbos, entering karroid areas |
| *Psammophis notostictus* | Karoo Sand or Whip Snake | Widespread | Data Deficient | Arid scrubland & karroid regions |
| *Psammophis crucifer* | Montane Grass Snake | Endemic | Data Deficient | Highveld and montane grassland entering fynbos |
| *Dasypeltis scabra* | Common/Rhombic Egg Eater | Widespread | Data Deficient | Absent only from true desert & closed-canopy forest |
| *Crotaphopeltis hotamboeia* | Herald Snake | Widespread | Data Deficient | Terrestrial but more common in wetlands |
| *Telescopus beetzii* | Namib Tiger Snake | Endemic | Data Deficient | Rocky, arid regions |
| *Aspidelaps lubricus* | Coral Shield Cobra | Widespread | Data Deficient | Karroid & sandveld regions, entering dry valley plains in S and E Cape |
| *Naja nivea* | Cape Cobra | Endemic | Data Deficient | Arid karroid regions, particularly along river courses, entering well drained open areas along the southern coast |
| *Bitis arietans* | Puff Adder | Widespread | Data Deficient | Absent only from desert & mnt tops |
| *Bitis rubida* | Red Adder | Endemic | Data Deficient | Rocky mountain fynbos in the Cedarberg and along the foothills of the inland mountain escarpment |
| *Bitis caudalis* | Horned Adder | Widespread | Data Deficient | Sandy regions, throughout Karoo |

| | | | | |
|---|---|---|---|---|
| **Lizard and Skinks:** | | | | |
| *Acontias meleagris* | Cape Legless Skink | Endemic | Data Deficient | Coastal & fynbos vegetation & richer soils associated with dr river courss & inland escarpment |
| *Mabuya capensis* | Cape Skink | Widespread | Data Deficient | Very varied: arid karroid veld, moist coastal bush, montane grassland, etc |
| *Mabuya sulcata* | Western Rock Skink | Widespread | Data Deficient | Karroid areas |
| *Mabuya variegata* | Variegated Skink | Widespread | Data Deficient | Extremely varied; desert, karroid veld, montane grassland, savanna, coastal bush & valley bushveld |
| *Meroles suborbitalis* | Spotted Desert Lizard | Endemic | Data Deficient | Varied, arid savanna to desert |
| *Nucras tessellata tessellata* | Striped Sandveld Lizard | Widespread | Data Deficient | Open arid savannah & karroid veld |
| *Pedioplanis burchelli* | Burchells' Sand Lizard | Endemic | Data Deficient | Rocky montane grassland |
| *Pedioplanis laticeps* | Cape Sand Lizard | Endemic | Data Deficient | Coastal dunes and succulent karroid veld |
| *Pedioplanis lineoocellata* | Spotted Sand Lizard | Endemic | Data Deficient | Very varied: karroid veld, valley bushveld & arid & mesic savannah |
| *Pedioplanis namaquensis* | Namaqua Sand Lizard | Widespread | Data Deficient | Karroid veld |
| *Cordylosaurus subtessellatus* | Dwarf Plated Lizerd | Endemic | Data Deficient | Sandy areas among rocks |
| *Gerrhosaurus typicus* | Namaqua Plated Lizard | Endemic | Near Threatened | Karroid succulent veld |
| *Cordylus cordylus* | Cape Girdled Lizard | Endemic | Data Deficient | Diverse, coastal cliffs, rock plateaus in fynbos and montane grassland. |
| *Cordylus polyzonus* | Karoo Girdled Lizard | Endemic | Appendix II Protected | Karroid regions |
| *Pseudocordylus microlepidotus* | Cape Crag Lizard | Endemic | Appendix II Protected | Mountain plateaus & upper slopes in fynbos or montane grassland |
| *Agama atra* | Southern Rock Agama | Endemic | Data Deficient | Semi-desert to fynbos, from sea level to mountain tops |
| *Agama hispida* | Spiny Agama | Endemic | Data Deficient | Arid semi-desert, coastal dunes & salt pans |
| **Chameleons:** | | | | |
| *Bradypodion karroicum* | Karoo Dwarf Chameleon | Endemic | Appendix II Protected | Sparse thorn bushes along river courses; adapting to urban gardens |
| *Chamaeleo namaquensis* | Namaqua Chameleon | Widespread | Appendix II Protected | Sandy regions (incl coastal dunes) with scrub vegetation |
| **Geckos:** | | | | |
| *Chondrodactylus angulifer* | Giant Ground Gecko | Endemic | Data Deficient | Gravel plains, interdune spaces & sandy flats |
| *Chondrodactylus bibronii* | Bibron's Tubercled Gecko | Endemic | Data Deficient | Rocky outcrops, cliffs and large trees |
| *Pachydactylus geitje* | Ocellated Gecko | Endemic | Data Deficient | Debris, rotting logs, loose lark, moribund termitaria |
| *Pachydactylus capensis* | Cape Gecko | Widespread | Data Deficient | Karroid veld, grassland and mesic savannah |
| *Pachydactylus maculatus* | Spotted Gecko | Endemic | Data Deficient | Varied: fynbos & coastal bush to arid karroid veld |
| *Pachydactylus oculatus* | Golden Spotted Gecko | Endemic | Data Deficient | Karroid Veld |
| *Pachydactylus kladaroderma* | Thin-skinned Gecko | Endemic | Data Deficient | Rocky areas in succulent veld |
| *Pachydactylus mariquensis* | Marico Gecko | Endemic | Data Deficient | Flat sandy plains with sparse vegetation |
| *Pachydactylus serval* | Western Spotted Gecko | Endemic | Data Deficient | Semi desert and succulent karroid veld |
| *Goggia lineata* | Striped Leaf-Toed Gecko | Endemic | Data Deficient | Coastal fynbos, succulent & transitional karroid veld, montane grassland |

**Appendix 4.** List of Amphibians

List of amphibians which potentially occur at the G7 Roggeveld Wind Farm. Taxonomy and habitat notes are from du Preez and Carruthers (2009) and conservation status from the IUCN 2010. (Status: LC = Least Concern, DD = Data Deficient)

| Scientific Name | Common Name | Status | Habitat | Distribution | Likelihood |
|---|---|---|---|---|---|
| *Amietophrynus rangeri* | Raucous Toad | Not Threatened | Rivers and stream in grassland and fynbos | Endemic | High |
| *Vandijkophrynus gariepensis* | Karoo Toad | Not Threatened | Karoo Scrub | Widespread | High |
| *Xenopus laevis* | Common Platanna | Not Threatened | Any more or less permanent water | Widespread | High |
| *Cacosternum boettgeri* | Common Caco | Not Threatened | Marshy areas, vleis and shallow pans | Widespread | High |
| *Amietia fuscigula* | Cape River Frog | Not Threatened | Large still bodies of water or permanent streams and rivers. | Widespread | High |
| *Cacosternum karooicum* | Karoo Dainty Frog | DD | Arid areas with unpredictable rainfall. Breeds in small streams as well as man-made dams. | Karoo Endemic | High |
| *Tomopterna delalandii* | Cape Sand Frog | Not Threatened | Lowlands in fynbos and Succulent Karoo | Endemic | High |
| *Tomopterna tandyi* | Tandy's Sand Frog | Not Threatened | Nama karoo grassland and savanan | Widespread | High |