AN ECOLOGICAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED RENEWABLE ENERGY GENERATION PROJECT ON THE FARM RHODES 269, NORTHERN CAPE PROVINCE

An EOH Company

Prepared for: **MIKO ENERGY (PTY) LTD**

Prepared by: **Exigo Sustainability**

Email info@exigo3.com
Tel +27 012 751 2160
Fax +27 086 607 2406

The Village Office Park (Block E),
309 Glenwood Road, Faerie Glen,
Pretoria, 0043

Postnet Suite 74,
Private Bag X07,
Arcadia, 0007

An EOH Company

Innovation in Sustainability

www.exigo3.com

AN ECOLOGICAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED RENEWABLE ENERGY GENERATION PROJECT ON THE FARM RHODES 269, NORTHERN CAPE PROVINCE

ECOLOGICAL REPORT

April 2016

Conducted on behalf of:
MIKO ENERGY (PTY) LTD

Compiled by:

Dr. BJ Henning (PhD plant Ecology; M.Sc Botany - Soil Science related Pr.Sci.Nat)

Reviewed by:

Ms. E. Grobler (EAP.)

REPORT DISTRIBUTION LIST

Name	Institution
	MIKO ENERGY (PTY) LTD
Ms. E. Grobler	AGES Limpopo

DOCUMENT HISTORY

Date	Version	Status
April 2016	1.0	Final

Table of contents

List of Figures

List of Tables

1. ASSIGNMENT

Exigo Sustainability was appointed by AGES Limpopo on behalf of MIKO ENERGY (PTY) LTD to conduct an EIA phase study on the ecological components (fauna and flora) for the proposed establishment of a solar energy generation facility to be known as the Rhodes 2 Solar Park with associated and structures on a footprint area of approximately 250 hectares. Rhodes 2 solar park will be developed on the farm Rhodes 269 (1810.83 ha), in Joe Morolong Local Municipality, John Taolo Gaetsewe District Municipality, Northern Cape Province.

This report will include detailed impact assessment of the proposed development on the biodiversity of the site. This assessment is essential as it will contribute to meeting the requirements of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998).

The assignment is interpreted as follows: Compile an ecological study on the flora (vegetation units), fauna and general ecology of the site and determine the potential impacts of the proposed development on the fauna and flora of the area as well as proposed mitigation measures. The study will be done according to guidelines and criteria set by the Northern Cape (NC) Department of Environmental Affairs and Nature Conservation (DENC) for biodiversity studies. The study will include an impact assessment and mitigation measures to limit potential negative impacts to a minimum. In order to compile this, the following had to be done:

1.1 INFORMATION SOURCES

The following information sources were obtained:

1. All relevant topographical maps, aerial photographs and information (previous studies and environmental databases) related to the ecological components in the study area;
2. Requirements regarding the fauna and flora survey as requested by the NCDENC;
3. Legislation pertaining to the fauna and flora study as relevant;
4. Red data species list from the South African National Biodiversity Institute (SANBI).

1.2 REGULATIONS GOVERNING THIS REPORT

1.2.1 National Environmental Management Act Regulation 543 Section 32

This report has been prepared in terms of Regulation 32 of the National Environmental Management Act (No. 107 of 1998) Regulations GN 33306 GNR 543 for environmental impact assessment. Regulation 33 states that a specialist report must contain:

1. An application or the EAP managing an application may appoint a person to carry out a specialist study or specialized process.
2. The person referred to in sub-regulation 1 must comply with the requirements of

regulation 17 (General requirements for EAPs or a person compiling a specialist report or undertaking a specialized process).

3. A specialist report or a report on a specialized process prepared in terms of these regulations must contain:
    a. Details of
        i. The person who prepared the report; and Letter of Appointment
        ii. The expertise of that person to carry out the specialist study or specialized process.
    b. A declaration that the person is independent in a form as may be specified by the competent authority;
    c. An indication of the scope of, and purpose for which, the report was prepared;
    d. A description of the methodology adopted in preparing the report or carrying out the specialized process;
    e. A description of any assumptions made and any uncertainties or gaps in knowledge;
    f. A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
    g. Recommendations in respect of any mitigation measures that should be considered by the applicant and competent authority;
    h. A description of any consultation process that was undertaken during the course of carrying out the study;
    i. A summary and copies of any comments that were received during any consultation process;
    j. Any other information requested by the competent authority.

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

This Act embraces all three fields of environmental concern namely: resource conservation and exploitation; pollution control and waste management; and land-use planning and development. The environmental management principles include the duty of care for wetlands and special attention is given to management and planning procedures.

1.2.3 Conservation of Agricultural Resources Act (Act No. 43 of 1983)

This Act regulates the utilization and protection of wetlands, soil conservation and all matters relating thereto; control and prevention of veld fires, control of weeds and invader plants, the prevention of water pollution resulting from farming practices and losses in biodiversity.

1.2.4 National Environmental Management Biodiversity Act (NEMBA: Act 10 0f 2004)

Following aspects of the NEMBA (2004) are important to consider for the ecological report. It:

- Lists ecosystems that are threatened or in need of national protection;
- Links to Integrated Environmental Management processes;
- Must be taken into account in EMP and IDPs;
- The Minister may make regulations to reduce the threats to listed ecosystems.

1.2.5 The National Forest Act (Act 84 of 1998)

The National Forest Act:

- Promotes sustainable management and development of forests for the benefit of all;
- Creates the conditions necessary to restructure forestry in State Forests;
- Provide special measures for the protection of certain forests and protected trees;
- Promotes the sustainable use of forests for environmental, economic, educational, recreational, cultural, health and spiritual purposes.
- Promotes community forestry.

1.2.6 Northern Cape Nature Conservation Act, No. 9 of 2009

This Act deals with the following:

- To provide for sustainable utilisation and protection of biodiversity in the Northern Cape Province;
- To provide for professional hunting;
- To provide for the preservation of caves and cave formations;
- To provide for the establishment of zoos and similar institutions;
- To provide for the appointment of nature conservators;
- To provide for the issuing of permits and other authorisations;
- To provide for offences and penalties for contravention of the Act;

To implement the provisions of the Act; and to provide for matters connected therewith.

1.3 TERMS OF REFERENCE

1.3.1 Rationale of solar plant development

South Africa currently relies principally on fossil fuels (coal and oil) for the generation of electricity. At the present date, Eskom generates approximately 95% of the electricity used in South Africa. On the other hand, South Africa has a largely unexploited potential in renewable energy resources such as solar, wind, biomass and hydro-electricity to produce electricity as opposed to other energy types (fuel or coal).

South Africa's electricity supply still heavily relies upon coal power plants, whereas the current number of renewable energy power plants is very limited. In the last few years, the demand for electricity in South Africa has been growing at a rate of approximately 3% per annum. These factors, if coupled with the rapid advancement in community development, have determined the growing consciousness of the significance of environmental impacts, climate change and the need for sustainable development. The use of renewable energy technologies is a sustainable way in which to meet future energy requirements.

The development of clean, green and renewable energy has been qualified as a priority by the Government of South Africa with a target goal for 2013 of 10,000 GWh, as planned in the Integrated Resource Plan 1 (IRP1) and with the Kyoto Protocol. Subsequently the Department of Energy of South Africa (DoE) decided to undertake a detailed process to determine South Africa's 20-year electricity plan, called Integrated Resources Plan 2010-2030 (IRP 2010).

The IRP1 (2009) and the IRP 2010 (2011) outline the Government's vision, policy and strategy in matter of the use of energy resources and the current status of energy policies in South Africa.

In particular, the IRP 2010 highlights the necessity of commissioning 1200 MW with solar PV technology by the end of 2015. In order to achieve this goal, in 2011 the DoE announced a Renewable Energy IPP (Independent Power Producers) Procurement Programme. The IPP Procurement Programme, issued on 3rd August 2011, envisages the commissioning of 3725 MW of renewable projects (1450 MW with solar photovoltaic technology) capable of beginning commercial operation before the end of 2017.

Therefore, the development of photovoltaic power plants will represent a key feature in the fulfilment of the proposed target goal and the reduction of CO2 emissions.

The purpose of the Rhodes 2 Solar Park is to add new capacity for the generation of renewable electrical energy to the national electricity supply in compliance with the IPP Procurement Programme and in order to meet the "sustainable growth" of the Limpopo Province.

The use of solar radiation for power generation is considered as a non-consumptive use and a renewable natural resource which does not produce greenhouse gas emissions. With specific reference to photovoltaic energy and the proposed project, it is important to consider that South Africa has one of the highest levels of solar radiation in the world.

1.3.2 Objectives

1. The primary aim of this project is to investigate options for enhancing and / or maintaining biodiversity to mitigate the impact of the proposed development and related infrastructure with the overall objective of preventing further loss of biodiversity. The end product would be a tool for promoting and lobbying for the recognition of the importance of species habitat and habitat conservation. Options available to maintain the current level of floral diversity include:
    a. Protection of native vegetation restored elsewhere in return for unavoidable clearing;
    b. Minimisation of habitat fragmentation;
    c. Minimisation of any threats to the native flora and fauna and their habitats during the construction and operational phases of the developments and;
    d. Rehabilitation to establish plant communities / landscaping that will provide future habitat values.
2. To produce a clear and agreed species and habitat priorities for conservation actions. This includes the following:
    i. Determine the potential ecological impacts and actions the developments will have on the biodiversity on a species and habitat level;
    ii. Conduct a risk analyses of the impacts identified to determine the significance of the impacts on the fauna and flora of the study area;
    iii. Protection and enhancement of vegetation / habitats of high conservation value;
    iv. The retention of a substantial amount of native vegetation / habitat of adequate size and configuration to promote the conservation of the existing flora communities;
    v. The retention and / or creation of vegetation links, wildlife corridors and vegetation buffers wherever possible, subject to the appropriate bush fire risk management; and
    vi. The protection of water quality in the locality so as not to threaten native aquatic flora that rely on the watercourse for survival.
3. Provide recommendations on the ecological mitigation measures to be implemented by the developer and the way forward.

1.3.3 Scope

1. Detailed flora survey – in each vegetation type/plant community on site:
    a. After studying the aerial photograph identify specific areas to be surveyed and confirm location by making use of a Geographical Positioning System (GPS).
    b. Conduct a site visit and list the plant species (trees, shrubs, grasses, succulents and other herbaceous species of special interest) present for plant community and ecosystem delimitation.
    c. Identify potential red data plant species, possible encroacher species, medicinal plants of value and exotic plant species.
    d. Indicate suitable plant species that can be used for the landscaping around the proposed developments.
2. Plant community delimitation and description
    a. Process data (vegetation and habitat classification) to determine vegetation types on an ecological basis.
    b. Describe the habitat and vegetation.
3. Fauna scoping
    a. List the potential fauna (mammal species, red data birds, reptiles, amphibians, invertebrates) present linked to the specific potential habitats that occur as identified in the vegetation survey.
    b. Analyse the data and identify potential red data fauna species, as well as other endemic or protected species of importance.
    c. Indicate species mitigation measures and management measures to be implemented to prevent any negative impacts on the fauna of the area.
4. General
    a. Identify and describe ecologically sensitive areas. Create a sensitivity map to indicate specific sensitive areas based on various environmental parameters such as natural vegetation in a good condition, rockiness, slopes, flood lines etc.
    b. Identify problem areas in need of special treatment or management, e.g. bush encroachment, erosion, degraded areas, reclamation areas.
    c. Make recommendations, impact ratings and risk assessments for each specific impact.

1.3.4 Limitations and assumptions

- In order to obtain a comprehensive understanding of the dynamics of the flora of the study area, surveys should ideally be replicated over several seasons and over a number of years. However, due to project time constraints such long-term studies are not feasible and this floral study was conducted over two seasons;
- The large study area did not allow for the finer level of assessment that can be obtained in smaller study areas. Therefore, data collection in this study relied heavily on data from representative, homogenous sections of vegetation units, as well as general observations, aerial photograph analysis, generic data and a desktop analysis;
- The surveys were focused on the proposed footprint areas as well as areas in close proximity to the access point in the south. The northern vegetation units were broadly identified through a drive through survey.
- Visibility proved to be a constraint in encroached areas where plant species might have been missed beneath the densely overgrown and obstructed by surface vegetation;

Even though it can be assumed that survey findings are representative of the ecosystem of the project area, the possibility exists that individual plants species might have been missed due to the nature of the terrain (dense vegetation). Therefore, maintaining due cognisance of the integrity and accuracy of the ecological survey, the ecological resources identified during the study do not necessarily represent all the ecological resources present on the property.

2 INTRODUCTION

South Africa has one of the world's greatest diversity of plant and animal species contained within one country, and is home to many species found nowhere else in the world. Terrestrial resources are rapidly disappearing however, due to conversion of natural habitat to farmland, forestry, human settlement, and industrial development. Some species are under threat from over-collection for medicinal, ornamental, and horticultural purposes.

Today it is widely recognised that it is of utmost importance to conserve natural resources in order to maintain ecological processes and life support systems for plants, animals and humans. Recent policies, international conventions, and community-based initiatives being carried out are aimed at improved conservation and more sustainable use of natural resources in future. To ensure that sustainable development takes place, it is therefore important that the environment is considered before local authorities approve any development.

All components of any of the ecosystems (physical environment, vegetation, animals) of a site are interrelated and interdependent. A holistic approach is therefore imperative to effectively include any proposed development, utilisation and where necessary conservation of the given natural resources in an integrated development plan, which will address all the needs of the modern human population (Bredenkamp & Brown 2001). Ideally the area should be developed so that the quality of the resources does not decrease, as this would inevitably lead to ecosystem degradation and lower productivity. It is therefore necessary to make a thorough inventory of the plant communities at the site of the proposed development, their biota and their associated habitats (=ecosystems), in order to evaluate its potential for development, or conservation. This inventory should then serve as a scientific and ecological basis for the planning exercises.

3 STUDY AREA

3.1 LOCATION AND DESCRIPTION OF ACTIVITY

Rhodes 2 Solar Park will be established on the farm Rhodes 269 (1810.83 ha), located in Joe Morolong Local Municipality, John Taolo Gaetsewe District Municipality, Northern Cape Province (Figure 1). The proposed project is situated directly north of Hotazel and 62 kilometers North of Kathu, with the footprint planned east of Eskom's "Hotazel - Heuningvlei" 132 kV power line.

The solar project is called RHODES 2 SOLAR PARK, and a Photovoltaic (PV) Power Plant having a maximum generating capacity up to 120 MW is planned. The PV power plant will have a footprint (fenced area) up to 250 ha, within the total study area of 1810 ha in extent.

The new access road will start from a local upgraded farm road diverted of the regional road R31, which runs parallel to the eastern boundary of Rhodes.

The chosen site is suitable for the installation of a photovoltaic (PV) power plant. It is appropriate morphologically (flat terrain) and regarding the favourable radiation conditions. The available radiation allows a high rate of electric energy production, as a combination of latitude-longitude and climatic conditions.

The aerial image of the site is indicated in figure 2, while the layout plan of the proposed development is indicated in figure 3.

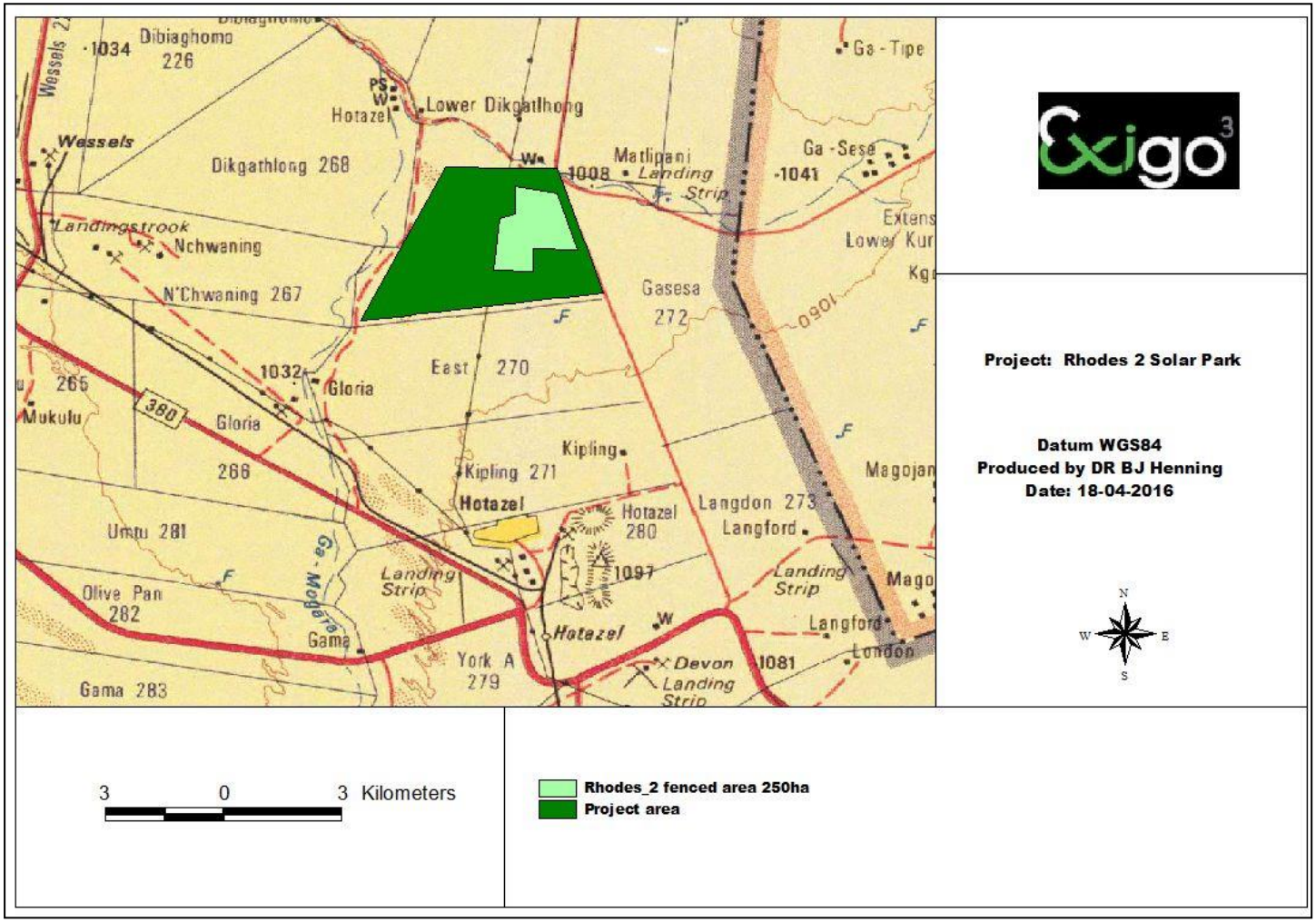


Figure 1. Regional Location Map

Rhodes 2 Avifauna Study

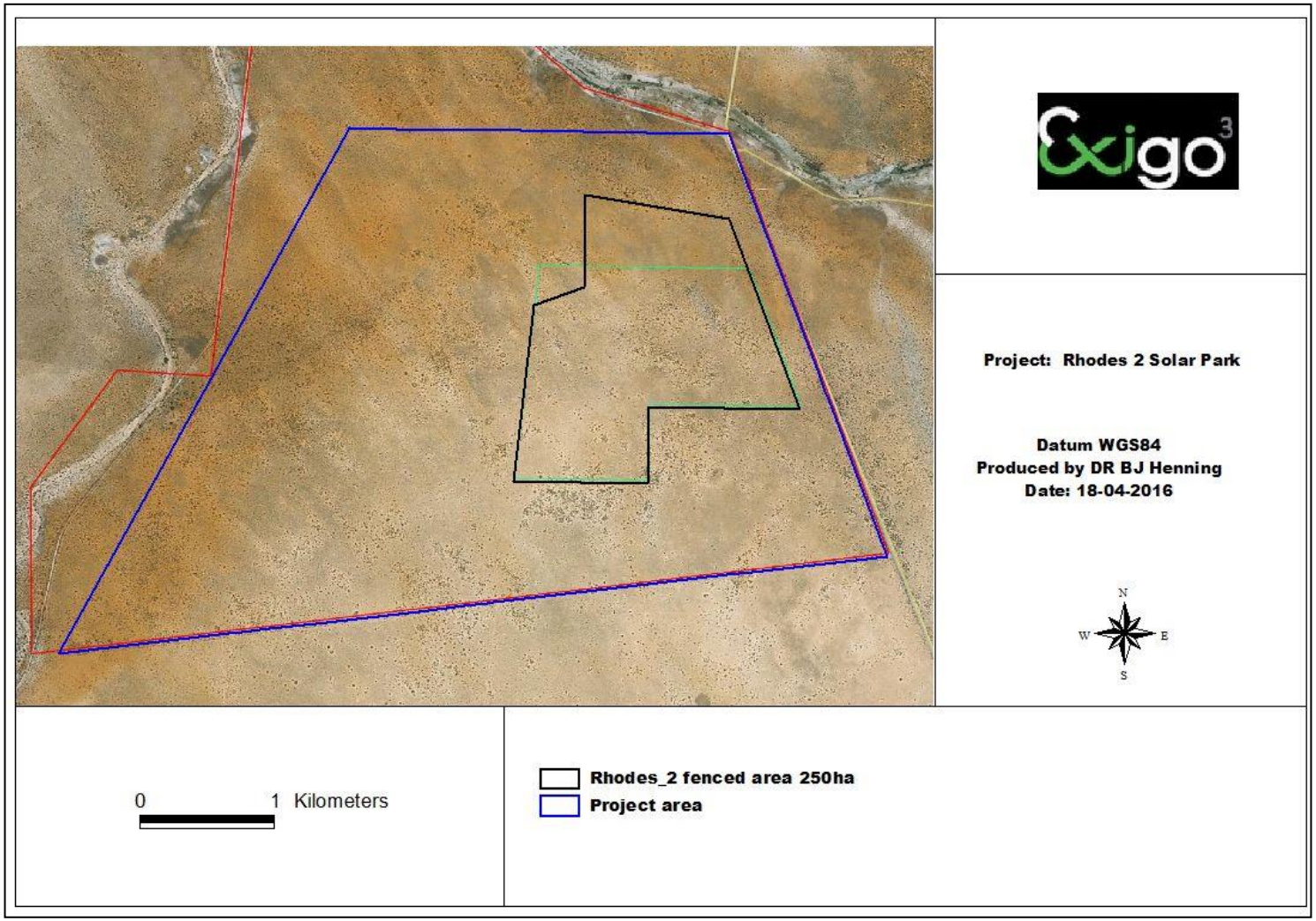


Figure 2. Satelite image showing the project area and proposed access road and focus area (Google Pro, 2010)

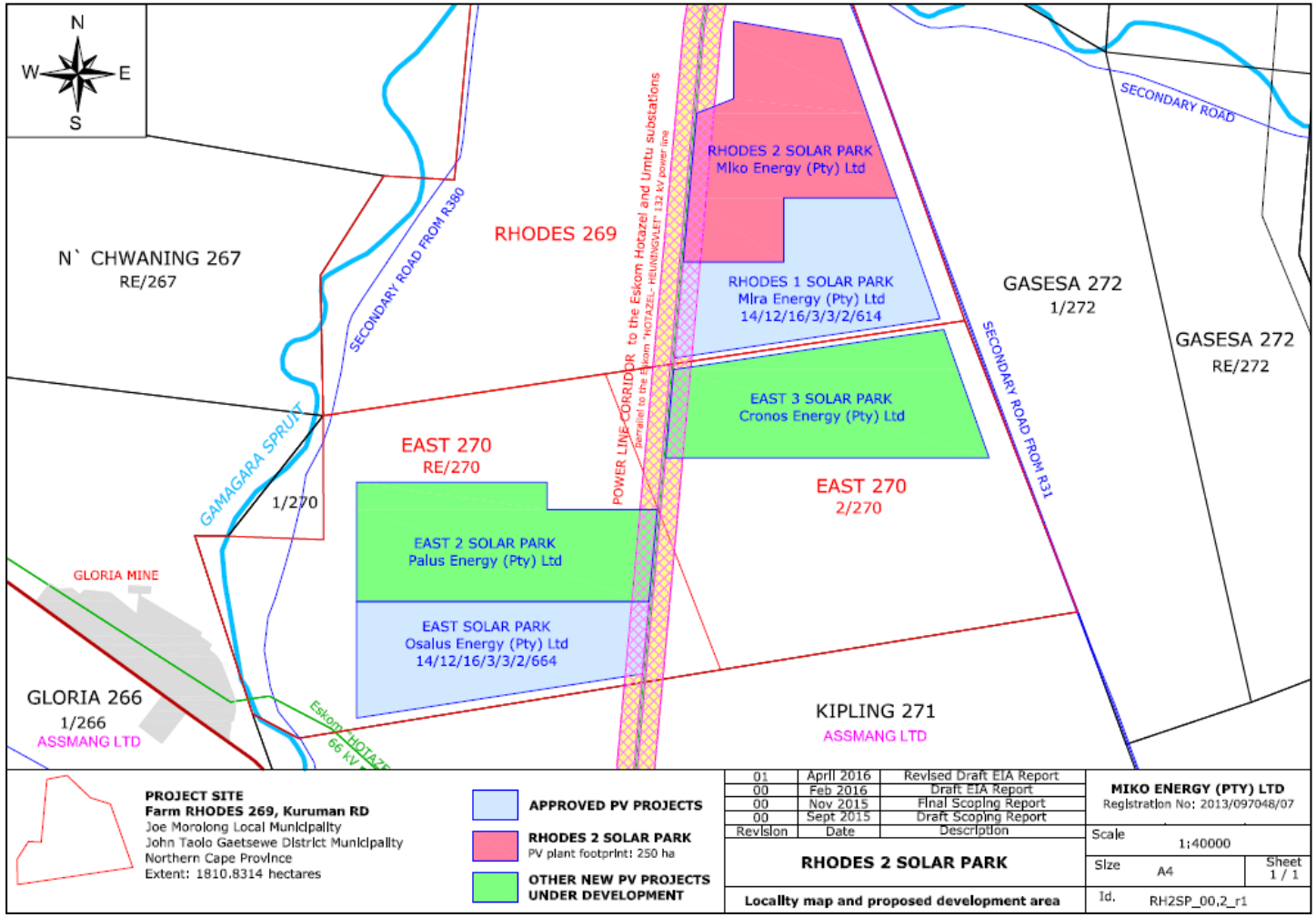


Figure 3. Layout plan for the proposed Rhodes 2 Solar Park in relation to other planned solar park and power lines in the larger area

3.2 CLIMATE

Climate in the broad sense is a major determinant of the geographical distribution of species and vegetation types. However, on a smaller scale, the microclimate, which is greatly influenced by local topography, is also important. Within areas, the local conditions of temperature, light, humidity and moisture vary greatly and it is these factors which play an important role in the production and survival of plants (Tainton, 1981). The climate for the region can be described as warm-temperate. In terrestrial environments, limitations related to water availability are always important to plants and plant communities.

The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987). The study area is situated within the summer and autumn rainfall region with very dry winters and frequent frost that occurs during the colder winter months. The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987). The mean annual precipitation varies between 120 and 260mm. The mean monthly maximum and minimum temperatures for the area are 41.5°C and -4°C, for December and July, respectively.

3.3 VEGETATION TYPES

3.3.1 REGIONAL CONTEXT: THE GRIQUALAND WEST CENTRE OF ENDEMISM

The vegetation of the proposed development site falls within the south-eastern range of the Griqualand West Centre of Endemism (Van Wyk & Smith 2001). A centre of plant endemism is an area with high concentrations of plant species with very restricted distributions. Centres of endemism are important because it is these areas, which if conserved, would safeguard the greatest number of plant species. They are extremely vulnerable; relatively small disturbances in a centre of endemism may easily pose a serious threat to its many range-restricted species (Van Wyk & Smith 2001). The Griqualand West Centre (GWC) is one of the 84 African centres of endemism and one of 14 centres in southern Africa, and these centres are of global conservation significance.

The endemic and near-endemic species make up 2.2% of the total flora, and are mostly from the Asclepiadaceae, Euphorbiaceae and Mesembryanthemaceae families. Some of the endemics are edaphic specialists, adapted to lime-rich substrates.

Endemics and near-endemics include *Searsia tridactyla, Aloinopsis orpenii, Euphorbia planiceps, Euphorbia bergii, Lebeckia macrantha, Lithops aucampiae* subsp*. aucampiae* and *Tarchonanthus obovatus*.

The GWC of endemism is extremely poorly conserved, and is a national conservation priority. Figure 4 shows the extent of the GWC.

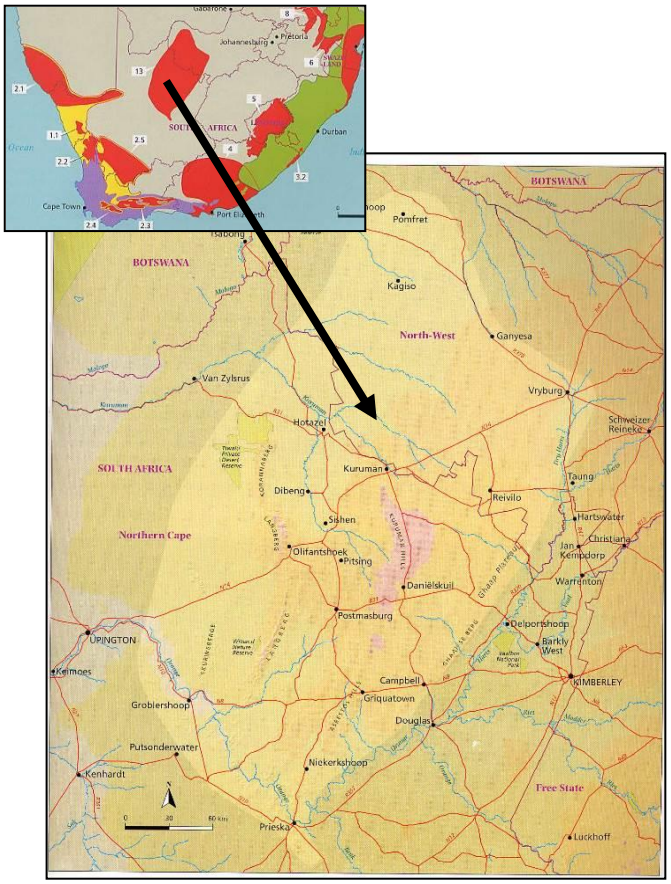


Figure 4. Map showing the extent of the Griqualand West Centre of Endemism (light centre). It is centred on the surface outcrops of the Ghaap Group (limestone and dolomite) and those of the Olifantshoek Supergroup (quartzite). From Van Wyk & Smith (2001)

3.3.2 LOCAL CONTEXT

The development site lies within the Savanna biome which is the largest biome in Southern Africa. It is characterized by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs). The environmental factors delimiting the biome are complex and include altitude, rainfall, geology and soil types, with rainfall being the major delimiting factor. Fire and grazing also keep the grassy layer dominant. The most recent classification of the area by Mucina & Rutherford (2006) shows that the sites forms part of the Kathu Bushveld and Gordonia Dunveld vegetation types.

The vegetation and landscape characteristics of the Kathu Bushveld include a medium-tall tree layer with dense stands of *Acacia erioloba* in places, but mostly an open woodland with *Boscia albitrunca* as the prominent tree species, while the shrub layer is dominated by *Acacia mellifera, Lycium hirsitum* and *Diospyros lycioides*. This vegetation type in its pristine state is characterized by plains with layer of scattered, low to medium high deciduous microphyllous trees and shrubs with a few broadleaved tree species, and an almost continuous herbaceous layer dominated by grass species.

This vegetation type has a Least Threatened conservation status, with 1% transformed and none statutorily conserved.

The landscape features of the Gordonia Duneveld vegetation type are mostly parallel dunes (3-8m in height) with an open shrubland woody structure and ridges of grassland dominated by *Stipagrostis amabilis* on the dune crests and *Acacia haematoxylon* on the dunes slopes. The conservation status of the Gordonia Duneveld is Least Threatened with very little transformation and 14% statutorily conserved in the Kgalagadi Transfrontier Park (Mucina & Rutherford, 2006).

3.4 GEOLOGY AND SOIL TYPES

Geology is directly related to soil types and plant communities that may occur in a specific area (Van Rooyen & Theron, 1996). A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type unit represented within the proposed footprint area include the Ah9 and Af28 land types (Land Type Survey Staff, 1987) (ENPAT, 2000). The land types, geology and associated soil types is presented in Table 1 below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2000), while the location of the land types are indicated in Figure 6.

Table 1. Land types, geology and dominant soil types of the proposed development site

Land type	Soils	Geology
Ah9	Red-yellow apedal, freely drained soils; red and yellow, high base status, usually < 15% clay	Aeolian sand of Recent age with a few outcrops of Tertiary Kalahari beds (surface limestone, silcrete and sandstone) in the riverbeds.
Af28	Red-yellow apedal, freely drained soils; red, high base status, > 300 mm deep (with dunes)	Red to flesh-coloured wind-blown sand (sand dunes) of Tertiary to Recent age with some outcrops of coarse-grained brown quartzite and subgreywacke and conglomerate (Matsap Formation).

Soils associated with the site are mostly deep, Aeolian sands overlying calcrete

3.5 TOPOGRAPHY & DRAINAGE

Two land facets are present on the site. Dunes occur as high-gradient hills in the western and northern section of the site, while the remainder of the site represent slightly undulating plains. The topography across the site is slightly undulating with the average elevation of 1030 mamsl. The site is located within two quaternary catchments namely D41K (Eastern section of site) and D41L (western section of site) and is situated in the Lower Vaal Water Management Area. Drainage occurs as sheet-wash towards the major rivers namely the Gamagara River west of the site and the Kuruman River to the north of the site.

3.6 LAND USE AND EXISTING INFRASTRUCTURE

The current land-use of the proposed development site is grazing by livestock and game. Neighbouring farms are being used for livestock grazing and game farming, with mining further away from the site.

The major land use of the study area as classified by the Environmental Potential Atlas of South Africa (2000) is vacant / unspecified land.

4 METHODS

4.1 VEGETATION SURVEY

Two basic methods were used during the vegetation survey:

- Line transects were walked on the site surveyed to record the plant species present. Rare and threatened plant species and any botanically sensitive sites or habitats were searched for in the various vegetation units.
- The Braun-Blanquet survey technique to describe plant communities as ecological units was also used for this study. It allows for the mapping of vegetation and the comparison of the data with similar studies in the area.

The vegetation survey was conducted on site during March 2014 and July 2015. The vegetation was in a moderate to good condition and most species could be identified, although some species might have been missed as a result of the large site. No further surveys were necessary considering that the area received sufficient precipitation during the wet season to allow for the identification of most plants in the study area.

4.1.1 Data recorded:

Plant names used in this report are in accordance with Arnold & De Wet (1993), with the exception of a few newly revised species. A list of all plant species present, including trees, shrubs, grasses, forbs, geophytes and succulents were compiled. All identifiable plant species were listed. Notes were additionally made of any other features that might have an ecological influence as well as potential fauna habitat that might occur.

4.1.2 Red data species

A species list of the red data species previously recorded in the vicinity of the proposed development was obtained from the South African Biodiversity Institute (SANBI), South Africa as classified by the IUCN red data list categories.

4.1.3 Protected trees

A species list of the protected tree species was obtained from the Department of Forestry. These trees are listed by the NFA (Act 84 of 1998) as protected.

4.1.4 Protected plants

A list of protected and specially protected plants was obtained from the LEMA (2004).

4.1.5 Data processing

A classification of vegetation data was done to identify, describe and map vegetation types. The descriptions of the vegetation units include the tree, shrub and herbaceous layers.

Conservation priority of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the Northern Cape Province, as well as the Kathu Bushveld and Gordonia Duneveld vegetation types.

The following four conservation priority categories were used for each vegetation unit:

- High: Ecologically sensitive and valuable land with high species richness that should be conserved and no development allowed.
- Medium: Land that should be conserved but on which low impact development could be considered with the provision of mitigation measures.
- Medium-low: Land that has some conservation value but on which development could be considered with limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation be maintained.
- Low: Land that has little conservation value and that could be considered for developed with little to no impact on the vegetation / ecosystem.

4.2 FAUNA SURVEY

The fauna survey was conducted as follows:

- A site survey was done to identify potential habitats after identifying the vegetation units. Fauna observed on site or any specific indication of species was noted and confirmed in species lists.
- A scoping survey was then conducted by comparing the habitat types identified with the preferred habitats of species occurring in the area.

4.2.1 Data recorded:

A list of all species of fauna and their status as observed on the site or that could potentially occur on the site. Notes were made of any specific sensitive or specialized habitats that occur on the site.

4.2.2 Red data species lists

A species list of the red data species of the different faunal classes was obtained from the following references:

- Red Data Book of the Mammals of South Africa (Friedman & Daly, 2004)
- The Atlas of the Southern African Birds - digital data on quarter degree grid data (Avian Demography Unit, University of Cape Town)
- Atlas and red data book of the frogs of South Africa, Lesotho and Swaziland (Minter et al. 2004)
- South African Red Data Book – Reptiles and Amphibians. National Scientific Programmes Report no. 151;

4.2.3 Data processing

A comparison of the habitats (vegetation units) occurring on the property was made to the preferred habitats of the faunal species. In addition to species observed on the site, lists of the potential mammal, bird, reptile, amphibian and insect species were compiled and mitigating measures recommended if needed.

4.3 SENSITIVITY ASSESSMENT

The ecological sensitivity of any piece of land is based on its inherent ecosystem service and overall preservation of biodiversity.

4.3.1 Ecological function

The ecological function relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to ecosystem service (e.g. wetlands) or overall preservation of biodiversity.

4.3.2 Conservation importance

Conservation importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.

4.3.3 Sensitivity scale

- High – sensitive ecosystem with a low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems or high species diversity and usually provide habitat for a number of threatened/rare species and should be protected;
- Medium – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems or ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species;
- Low – Degraded and highly disturbed / transformed systems with little ecological function and which are generally very poor in species diversity.

4.4 IMPACT RATING ASSESSMENT MATRIX

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need. The significance of the impacts will be determined through a synthesis of the criteria below (Plomp, 2004):

Probability. This describes the likelihood of the impact actually occurring:

- Improbable: The possibility of the impact occurring is very low, due to the circumstances, design or experience.
- Probable: There is a probability that the impact will occur to the extent that provision must be made therefore.
- Highly Probable: Most likely that impact will occur at some stage of development.
- Definite: The impact will take place regardless of any prevention plans, and there can only be relied on mitigation actions or contingency plans to contain the effect.

Duration. The lifetime of the impact

- Short term: The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.
- Medium term: Impact will last up to the end of the phases, where after it will be negated.
- Long term: The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.
- Permanent: Impact will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.

Scale. The physical and spatial size of the impact

- Local: The impacted area extends only as far as the activity, e.g. footprint.
- Site: Impact could affect the whole, or a measurable portion of proposed site.
- Regional: The impact could affect the area including the neighbouring areas.

Magnitude/ Severity. Does the impact destroy the environment, or alter its function.

- Low: Impact alters the affected environment in such a way that natural processes are not affected.
- Medium: Affected environment is altered, but functions and processes continue in a modified way.
- High: Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Significance. This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.

- Negligible: The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.
- Low: The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.
- Moderate: The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
- High: The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The following weights will be assigned to each attribute:

Aspect	Description	Weight
Probability	Improbable	1
	Probable	2
	Highly Probable	4
	Definite	5
Duration	Short term	1
	Medium term	3
	Long term	4
	Permanent	5
Scale	Local	1
	Site	2
	Regional	3
Magnitude/Severity	Low	2
	Medium	6
	High	8
Significance	**Sum (Duration, Scale, Magnitude) x Probability**	
	Negligible	<20
	Low	<40
	Moderate	<60
	High	>60

The significance of each activity will be rated without mitigation measures and with mitigation measures for the development.

5 RESULTS

5.1 VEGETATION UNITS

The proposed development is planned on a landscape that varies from slightly undulating plains to moderately undulating terrain associated with dunes. The importance to survey the area as a whole to have a better understanding of the ecosystem and the potential impact of the development on the natural environment was identified as a key factor, and subsequently the property was completely surveyed. The farm is currently managed as a livestock and game farm. The vegetation units on the site vary according to soil characteristics, topography and land-use. Most of the site is characterized by microphyllous woodland that varies in density and species composition. No drainage features occur on site, although the Kuruman and Gamagara Rivers occur to the north and west of the site, respectively. Vegetation units were identified and can be divided into 5 distinct vegetation units according to soil types and topography.

The vegetation communities identified on the proposed development site are classified as physiographic physiognomic units, where physiognomic refers to the outer appearance of the vegetation, and physiographic refers to the position of the plant communities in the landscape. The physiographic-physiognomic units will be referred to as vegetation units in the following sections. These vegetation units are divided in terms of the land-use, plant species composition, topographical and soil differences that had the most definitive influence on the vegetation units. Each unit is described in terms of its characteristics and detailed descriptions of vegetation units are included in the following section. A species list for the site is included in Appendix A, while a plant species list for the quarter degree grid square (QDS) is included in Appendix B. Photographs of each unit is included in the next section to illustrate the grass layer, woody structure and substrate (soil, geology etc.). The following vegetation units were identified during the survey.

1. Open *Acacia haematoxylon* woodland on deep Aeolian sand;
2. *Acacia mellifera* thickets;
3. *Acacia mellifera – Acacia hebeclada* woodland;
4. Mixed *Acacia haematoxylon – Grewia flava – Acacia mellifera* duneveld;
5. *Acacia mellifera – Grewia flava* woodland

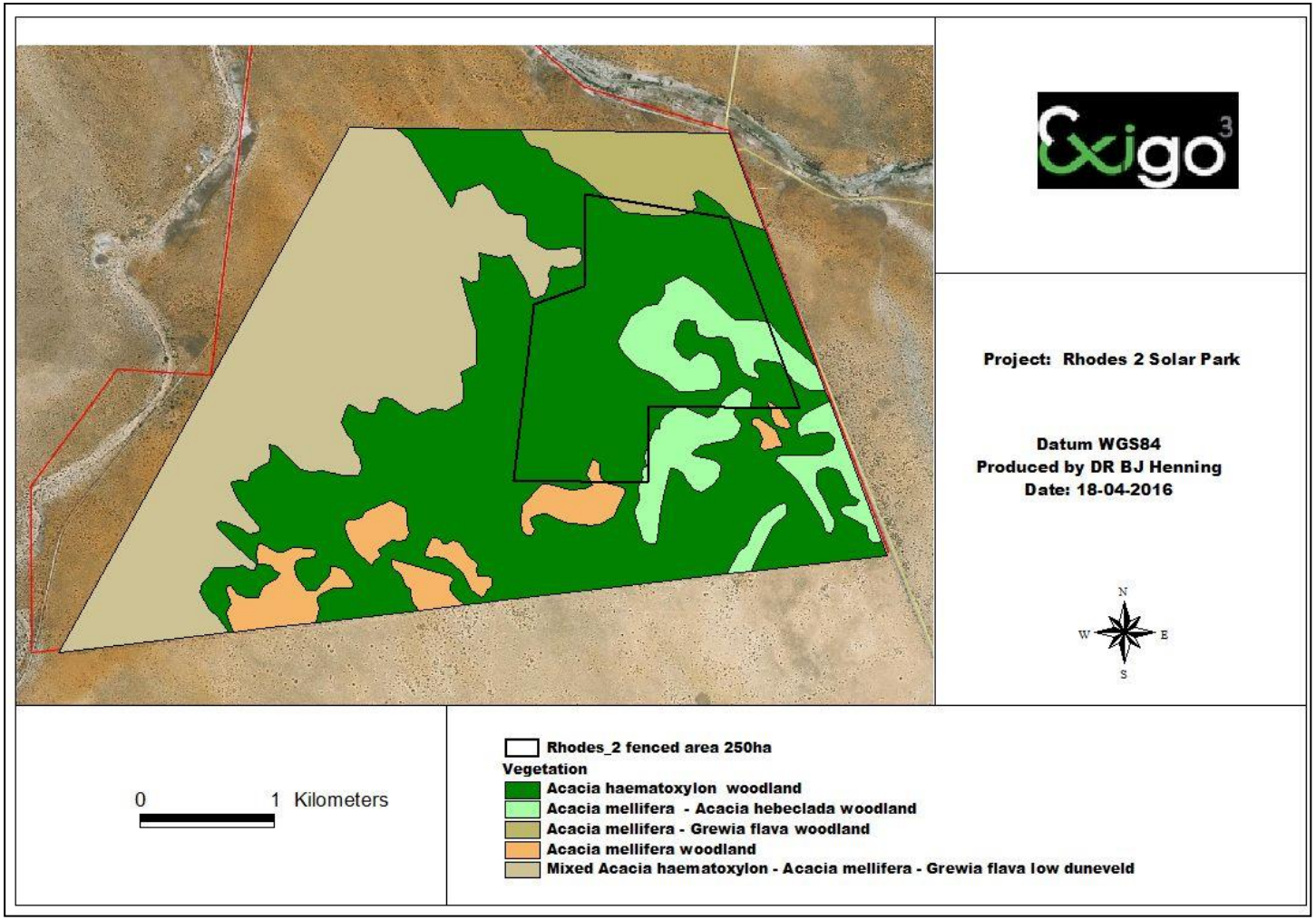


Figure 5. Vegetation Map

5.1.1 OPEN *ACACIA HAEMATOXYLON* WOODLAND ON DEEP AEOLIAN SAND

This vegetation unit occurs throughout large sections of the farm Rhodes and specifically on the proposed footprint areas of the solar parks. The woody structure is open woodland dominated by the protected tree species *Acacia haematoxylon* (grey camel thorn), while the herbaceous layer is dominated by grass species such as *Stipagrostis uniplumis*, *Eragrostis pallens* and *Schmidtia kalaharense*. The characteristics of this vegetation unit are summarized in Table 2, while the state of the vegetation indicated in photograph 1.

Table 2. Botanical analysis and characteristics of Open *Acacia haematoxylon* woodland

State of the vegetation:	Natural woodland in a pristine state
Need for rehabilitation	Low
Conservation priority	Medium-high
Characteristics	Open woodland component. The woodlands are completely dominated by *Acacia haematoxylon* and the grass layer is well developed.
Soils & Geology	Deep, red Aeolian (wind-blown) sands
Dominant spp.	*Acacia haematoxylon, Stipagrostis uniplumis, Schmidtia kalaharense, Crotalaria orientalis*
Density of woody layer	Trees: 5-10% (avg. height: 3-6m) Shrubs: 2-5% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 60-70% (avg. height: 0.8-1.2m) Forbs: 1-2% (avg. height: 0.8m)
Sensitivity	Medium-high
Red data species	None observed
Protected species	*Acacia haematoxylon* *Acacia erioloba*

The following specific recommendations for the area should be adhered to

- The vegetation unit is classified as having a medium sensitivity due to the dense stands of protected trees observed in the area;
- The development can be supported provided that a licence is obtained from DAFF for the eradication of the protected trees. The remainder of the site outside of the proposed footprint should be preserved as an offset area.

Photograph 1. *Acacia haematoxylon* woodland on deep, red Aeolian sands in the project area

5.1.2 *ACACIA MELLIFERA* THICKETS / BUSHCLUMPS

This vegetation unit occurs in isolated pockets where the calcrete bedrock is closer to the surface, although still overlied by kalahari sands. Bushclumps are almost completely dominated by *Acacia mellifera* (black thorn). A poor grass layer occurs in and around the bushclumps as a result of overgrazing. The habitat type can be considered slightly degraded and no red data species occurs on site. The state of the vegetation is indicated in photograph 2, while the characteristics of the variations of this vegetation unit are summarized in Table 3.

Table 3. Botanical analysis and characteristics of *Acacia mellifera* thickets / bushclumps

State of the vegetation:	Slightly to moderately degraded
Need for rehabilitation	Medium
Conservation priority	Low
Characteristics	Microphyllous thickets dominated by *Acacia mellifera.* The herbaceous layer is poorly developed as a result of the higher nutrient content that causes overgrazing of the grass layer.
Soils & Geology	Shallow to medium depth Aeolian sand overlying calcrete.
Dominant spp.	*Acacia mellifera, Grewia flava*
Density of woody layer	Trees: 10-15% (avg. height: 3-6m) Shrubs: 15-20% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 10-15% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)
Sensitivity	Medium-low
Red data species	None observed

State of the vegetation:	Slightly to moderately degraded
Need for rehabilitation	Medium
Protected species	None observed

Photograph 2. *Acacia mellifera* thickets in the project area

The following specific recommendations for the area should be adhered to

- The vegetation unit is classified as having a medium-low sensitivity due to the encroachment and overgrazing observed in the area;
- The development can be supported in this vegetation unit considering the widespread status of this vegetation entity in the Savanna Biome.

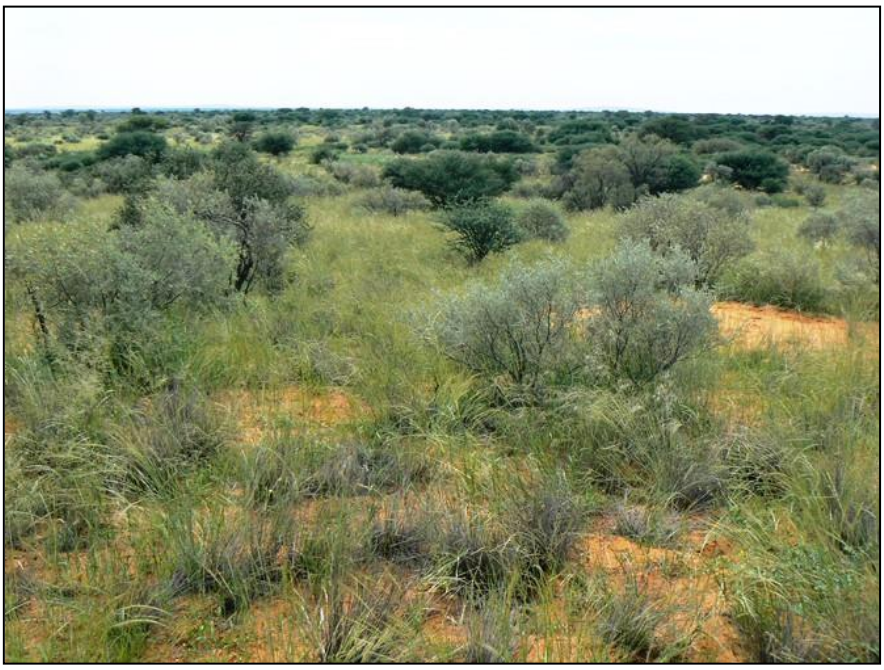
5.1.3 MIXED *ACACIA HAEMATOXYLON – GREWIA FLAVA – ACACIA MELLIFERA* LOW DUNEVELD

The western and some of the northern areas of the project area is characterised by low duneveld. These areas form an undulating landscape with calcrete outcrops overlain by Aeolian sand (dunes). The vegetation are characterised by dense stands of *Acacia haematoxylon* on the deeper sandy areas, while *Acacia mellifera* dominate where the calcrete bedrock are closer to the surface. The shrub species *Grewia flava* occur on low-lying areas where higher clay content occurs in the soil. Where deeper sand occur on top of dunes, isolated individuals of *Terminalia sericea* occurs. Typical grass species associated with the duneveld include *Stipagrostis amabilis, Enneapogon scabra* and *Schmidtia kalahariense.*

The characteristics of this vegetation unit are summarized in Table 4, while the state of the vegetation indicated in photograph 5.

Table 4. Botanical analysis and characteristics of the Mixed *Acacia haematoxylon – Grewia flava – Acacia mellifera* low duneveld

Vegetation unit characteristics	
State of the vegetation:	Natural woodland in a pristine state
Need for rehabilitation	Low
Conservation priority	Medium-high
Characteristics	Open woodland component. The dunes are dominated by *Acacia haematoxylon,* while the lower-lying interdune areas are dominated by *Acacia mellifera* and *Grewia flava*.
Soils & Geology	Medium depth red Aeolian (wind-blown) sands on calcrete bedrock. Dunes are calcrete outcrops overlied by
Dominant spp.	*Acacia haematoxylon, Acacia mellifera, Grewia flava, Schmidtia kalaharense, Crotalaria orientalis*
Density of woody layer	Trees: 10-15% (avg. height: 3-6m) Shrubs: 5-10% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 60-70% (avg. height: 0.8-1.2m) Forbs: 1-2% (avg. height: 0.8m)
Sensitivity	Medium-high
Red data species	None observed
Protected species	*Acacia haematoxylon* *Acacia erioloba*



Photograph 3. Low mixed duneveld associated with the western section of the project area

The following specific recommendations for mixed duneveld on site should be adhered to

- The vegetation unit is classified as having a medium-high sensitivity due to the sloping terrain and dense stands of protected trees observed in the area. The development of a solar park within this vegetation unit should be restricted to flatter areas, while sloping terrain associated with dunes should be avoided;
- The development can be supported provided that a licence is obtained from DAFF for the eradication of the protected trees. The remainder of the site outside of the proposed footprint should be preserved as an offset area.

5.1.4 *ACACIA MELLIFERA – GREWIA FLAVA* WOODLAND

This vegetation unit is located to the south of the Kuruman River and forms the North-eastern section of the project area. The landscape is undulating calcrete outcrops with shallow Mispah soils. The woody layer is completely dominated by *Acacia mellifera* and *Grewia flava,* while the herbaceous layer is dominated by the grass species *Enneapogon cenchroides* and *Enneapogon desvauxii*.

The characteristics of this vegetation unit are summarized in Table 5, while the state of the vegetation indicated in photograph 4.

Table 5. Botanical analysis and characteristics of the *Acacia mellifera – Grewia flava* woodland

Vegetation unit characteristics	
State of the vegetation:	Slightly degraded woodland
Need for rehabilitation	Medium-low
Conservation priority	Medium-low
Characteristics	Open to denser shrubveld / woodland dominated by *Acacia mellifera* and *Grewia flava* on shallow calcareous soils.
Soils & Geology	Shallow calcareous soils derived from limestone. Small pockets of Aeolian sands
Dominant spp.	*Acacia mellifera, Grewia flava, Enneapogon cenchroides, Enneapogon desvauxii*
Density of woody layer	Trees: 10-15% (avg. height: 3-6m) Shrubs: 15-20% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 30-40% (avg. height: 0.8-1.2m) Forbs: 1-2% (avg. height: 0.8m)
Sensitivity	Medium
Red data species	None observed
Protected species	*Acacia erioloba*

Photograph 4. Acacia mellifera – Grewia flava woodland on shallow, exposed calcrete bedrock

5.1.5 *ACACIA MELLIFERA – ACACIA HEBECLADA* WOODLAND

This vegetation unit become more prominent in the central and western sections of the farm Rhodes. The vegetation structure is a low shrubveld and dominated by the microphyllous species *Acacia hebeclada* and *Acacia mellifera*. The substrate is red Kalahari sands overlying limestone, and the presence of *Acacia hebeclada* is often associated with calcrete. It is considered to be a good indicator of calcium–rich soils. The habitat type can be considered slightly degraded due to overgazing on the calcium rich soils. No red data species occurs; probably as a result of the habitat being different compared to the potential red data species that could occur. The state of the vegetation is indicated in photograph 5, while the characteristics of the variations of this vegetation unit are summarized in Table 6.

Table 6. Botanical analysis and characteristics of *Acacia mellifera – Acacia hebeclada* woodland

State of the vegetation:	Slightly degraded
Need for rehabilitation	Low
Conservation priority	Medium-low
Characteristics	Microphyllous shrubveld dominated by *Acacia mellifera* and Acacia *hebeclada.* The herbaceous layer is poorly developed as a result of the higher nutrient content that causes overgrazing of the grass layer.
Soils & Geology	Shallow to medium depth Aeolian sand overlying calcrete.
Dominant spp.	*Acacia mellifera, Acacia hebeclada, Rhigozum trichotomum, Stipagrostis obtusa*
Density of woody layer	Trees: 10-15% (avg. height: 3-6m) Shrubs: 15-20% (avg. height: 1-2m)

State of the vegetation:	Slightly degraded
Need for rehabilitation	Low
Density of herbaceous layer	Grasses: 10-15% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)
Sensitivity	Medium-low
Red data species	None observed
Protected species	None observed

The following specific recommendations for the area should be adhered to

- The vegetation unit is classified as having a medium-low sensitivity due to the encroachment and overgrazing observed in the area;
- The development can be supported in this vegetation unit considering the widespread status of this vegetation entity in the Savanna Biome.

Photograph 5. *Acacia mellifera – Acacia hebeclada* woodland

5.2 FLORA: SPECIES LEVEL ASSESSMENT

South Africa has been recognized as having remarkable plant diversity with high levels of endemism. The major threats to plants in the study area are urban expansion, non-sustainable harvesting, collecting, overgrazing/browsing, mining and agriculture. The objective of this section was to compile a list of plant species for which there is conservation concern. This included threatened, rare, declining, protected and endemic species.

5.2.1 RED DATA FLORA SPECIES

A list of red data plant species previously recorded in the study area in which the proposed development is planned was obtained from the Plants of Southern Africa (POSA) database of SANBI. There are various categories for Red Data Book species, such as 'Endangered', 'Vulnerable', 'Rare' and 'Near threatened' as listed in the Red Data List of Southern African Plants (Hilton-Taylor 1996). No red data species exist according to the SANBI data base for the grid square 2722BB and no other potential red data species was observed during the surveys.

5.2.2 ENDEMIC OR NEAR-ENDEMIC SPECIES

These species are classified as such according to the species' restricted distribution. For the purposes of this assessment this refers to species which are largely restricted to the GWC and should also be protected. Table 7 indicate the two species classified as endemic or near-endemic in the study area.

Table 7.Plant species endemic or near-endemic to the Griqualand West Centre of endemism, present in the study area

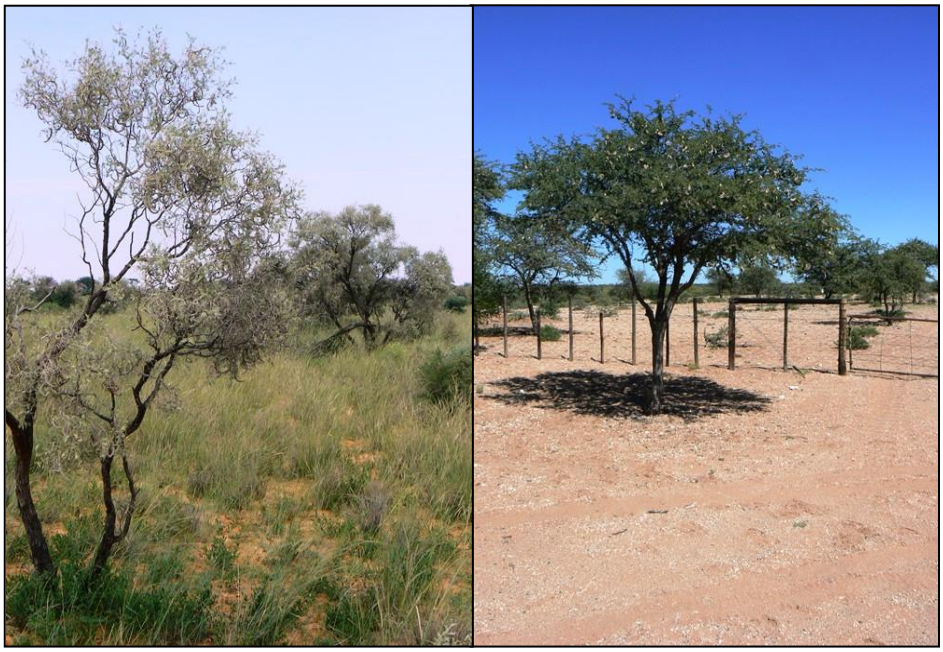
Species	Status
Searsia tridactyla	Endemic
Tarchonanthus obovatus	Near Endemic

However, as the site falls within the Griqualand West Centre of Endemism the following endemics can also occur within the area:
Tall shrubs: *Lebeckia macrantha, Nuxia gracilis*
Low shrubs: *Blepharis marginata, Putterlickia saxatalis, Tarchonanthus obovatus*
Succulent shrubs: *Euphorbia wilmaniae, Prepodesma orpenii*
Graminoids: *Digitaria polyphylla, Panicum kalaharense*
Herbs: *Corchorus pinnatipartitus, Helichrysum arenicola*
Succulent herb: *Orbea knobelii*

These species' habitat is mainly found on rocky areas and around drainage channels at the edge of dense scrub. No individuals of these plants were observed during the surveys.

5.2.3 PROTECTED TREE SPECIES (NFA)

The National Forest Act (no.84 of 1998: National Forest Act, 1998) provides a list of tree species considered important in a South African perspective as a result of scarcity, high utilization, common value, etc. In terms of the National Forest Act of 1998, these tree species may not be cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold – except under license granted by DWAF (or a delegated authority). Obtaining relevant permits are therefore required prior to any impact on these individuals. Taking cognizance of the data obtained from the field surveys, the following tree species occur in the area namely *Acacia haematoxylon (*Grey camel thorn, Photograph 7) *and Acacia erioloba* (Camel thorn, Photograph 7). A licence application should be submitted to DAFF before any of these trees can be removed.



Photograph 6. *Acacia haematoxylon* (left) and *Acacia erioloba* (right) are protected tree species that occurs on site

5.2.4 PROTECTED PLANTS (NCNCA)

Plant species are also protected according to the Northern Cape Nature Conservation Act (NCNCA), No. 9 of 2009. According to this Act, no person may pick, import, export, transport, possess, cultivate or trade in a specimen of a specially protected or protected plant species. The Appendices to the Act provide an extensive list of species that are protected, comprising a significant component of the flora expected to occur on site. Communication with Provincial authorities indicates that a permit is required for all these species, if they are expected to be affected by the proposed project. After a detailed survey was conducted during March 2014 and July 2015, no protected plant was found on site.

5.2.5 INVASIVE ALIEN SPECIES

Invasive alien plants pose a direct threat not only to South Africa's biological diversity, but also to water security, the ecological functioning of natural systems and the productive use of land. They intensify the impact of fires and floods and increase soil erosion. Of the estimated 9000 plants introduced to this country, 198 are currently classified as being invasive. It is estimated that these plants cover about 10% of the country and the problem is growing at an exponential rate. The Alien and Invasive Species Regulations (GNR 599 of 2014) are stipulated as part of the National Environmental Management: Biodiversity Act (10/2004). The regulation listed a total of 559 alien species as invasive and further 560 species are listed as prohibited and may not be introduced into South Africa. Below is a brief explanation of the four categories of Invasive Alien Plants as per the regulation.

- Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
- Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. Plants deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
- Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants in riparian zones.
- Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones

The fight against invasive alien plants is spearheaded by the Working for Water (WfW) programme, launched in 1995 and administered through the DWA. This programme works in partnership with local communities, to whom it provides jobs, and also with Government departments including the Departments of Environmental Affairs and Tourism, Agriculture, and Trade and Industry, provincial departments of agriculture, conservation and environment, research foundations and private companies. WfW currently runs over 300 projects in all provinces. Scientists and field workers use a range of methods to control invasive alien plants. These include:

- Mechanical methods - felling, removing or burning invading alien plants.
- Chemical methods - using environmentally safe herbicides.
- Biological control - using species-specific insects and diseases from the alien plant's country of origin. To date 76 bio-control agents have been released in South Africa against 40 weed species.

- Integrated control - combinations of the above three approaches. Often an integrated approach is required in order to prevent enormous impacts.

Vehicles often transport many seeds and some may be of invader species, which may become established along the roads through the area, especially where the area is disturbed. The construction phase of the development will almost certainly carry the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that invasive alien species such as the seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project. The following alien invasive and exotic plant species were recorded on the site during the surveys (Table 7) although no eradication is needed since these species do not occur on the proposed development footprint:

Table 8. List of exotic plant species of the study area

Species	Category
Datura stramonium	1b
Opuntia ficus-indica	1b
Prosopis glandulosa	3

5.2.6 GENERAL

An important aspect relating to the proposed development should be to protect and manage the biodiversity (structure and species composition) of the Kathu Bushveld and Gordonia Duneveld vegetation types which are represented in the project area. Vegetation removal should be kept to a minimum during any future construction activities and only vegetation on the footprint areas should be removed. The unnecessary impact on the surrounding vegetation types and riverine ecosystems should be avoided as far as possible.

Considering the footprint area to form part of a widespread vegetation entity and slightly degraded state of the proposed development sites, the impact on the vegetation of the larger area would be medium. Mitigation measures and monitoring should therefore be implemented should the development be approved.

5.3 FAUNAL ASSESSMENT

5.3.1 OVERVIEW

A healthy environment is inhabited by animals that vary from micro-organisms to the birds and mammals. The species composition and diversity are often parameters taken into consideration when determining the state of the environment. A comprehensive survey of all animals is a time consuming task that will take a long time and several specialists to conduct. The alternative approach to such a study is to do a desktop study from existing databases and conduct a site visit to verify the habitat requirements and condition of the habitat. If any rare or endangered species are discovered in the desktop study that will be negatively influenced by the proposed development, specialist surveys will be conducted.

5.3.2 RESULTS OF DESKTOP SURVEY AND SITE VISITS DURING MARCH 2014 AND JULY 2015

A survey was conducted during March 2014 and July 2015 to identify specific fauna habitats, and to compare these habitats with habitat preferences of the different fauna groups (birds, mammals, reptiles, amphibians) occurring in the QDS. The area represents microphyllous woodland with some broadleaf elements in isolated areas. Detailed fauna species list for the area is included in Appendix C (birds), D (mammals) and E (herpetofauna). During the site visits mammals, birds, reptiles, and amphibians were identified by visual sightings through random transect walks. In addition, mammals were also recognized as present by means of spoor, droppings, burrows or roosting sites. The 500 meters of adjoining properties were scanned for important fauna habitats.

a. Mammal Habitat Assessment

Large mammals such as black rhino occurred historically in the area but are now absent, owing to anthropogenic impacts in recent centuries. Black rhinoceros is today confined to game reserves and national parks in South Africa and therefore will not occur naturally in the study area. This loss of large species means that the mammal diversity at the site is far from its original natural state not only in terms of species richness but also with regards to functional roles in the ecosystem. One larger predator of which the existence in the larger area could not be ruled out completely is brown hyena (*Hyaena brunnea*). Brown hyena tracks were not found during the surveys.

b. Avifaunal Habitat Assessment

Three major bird habitat systems were identified within the borders of the study site, including microphyllous woodland, duneveld and wetland habitat (pan). The Kalahari is essentially a dry subset of the woodland biome generally.

It comprises the extensive central depression of Southern Africa, characterized by its deep Kalahari sands and low rainfall. In the north, where rainfall averages 400 500 mm, the vegetation mostly comprises dense shrubland or woodland dominated by semi deciduous to deciduous acacia, *Terminalia* and *Combretum* trees, and *Acacia, Grewia* and *Catophractes alexandri* shrubs. The avifauna of the Kalahari is characteristic and essentially comprises a subset of the birds of drier woodlands generally. Many species widespread in moister woodlands avoid the Kalahari, e.g. Greenspotted Dove and Blue Waxbill, with perhaps the absence of surface water in most of the Kalahari providing the major constraint. This is not matched by the presence of any species truly endemic to the Kalahari, as all Kalahari woodland birds also extend into many of the other woodland types, where patches of acacia dominated woodland occur. Nevertheless, the Fawncoloured Lark and Kalahari Robin are two examples of species with their ranges and abundances obviously centred on the Kalahari vegetation type. Within the Kalahari, many species also show clear differences between the southern and northern Kalahari. For example, the Namaqua Sandgrouse and Sociable Weaver are widespread and common in the south but are uncommon in the north, and the reverse applies to the Lilacbreasted Roller, Forktailed Drongo and Marico Flycatcher. Another interesting feature is the large difference in abundance of several species in the central Kalahari across the South Africa Botswana border, e.g. Laughing Dove, Whitebacked Mousebird, Fiscal Flycatcher and Cape Sparrow. It seems likely that the increase in surface water points, presence of farm homesteads and irrigated farming is responsible for the greater abundance of these species in South Africa.

Woodland habitat, in its undisturbed state, is suitable for a wide range of birds – in fact the woodland species are the most species rich community. Relevant to this study is the fact that many power line sensitive raptor species utilize woodland extensively. Both broadleaf and microphyllous woodland components occur in the study area.

The conservation status of many of the bird species that are dependent on wetlands reflects the critical status of wetland nationally, with many having already been destroyed. In the study area, only small salt pans were observed. These pans are extremely important sources of water for most bird species and will be regularly utilised not only as a source of drinking water and food, but also for bathing. The pans in this study area could also be used as flight paths for certain species. Species such as greater flamingos will utilize the salt pans in the area for foraging during the wet season.

c. Reptiles and Amphibians Assessment

Typical species associated with arid and semi-arid habitat types occur in the study area. Venomous species such as the puff adder, boomslang and cape cobra is expected to occur in the study area, although the presence of these snakes is dependent on the presence of their prey species (rodents, frogs etc.). The general habitat type for reptiles consists of shrubveld with limited available habitat for diurnally active and sit-and-wait predators, such as terrestrial skinks and other reptiles. The amphibians appear to be poorly represented on site and the seasonal pools in the drainage channel represent the most suitable habitat for the few amphibian species that could occur in the area. No threatened herpetofauna occur in the area

d. Red data species

According to existing databases and field survey the following fauna species included in the IUCN red data lists can potentially be found in the study area (Table 8):

Table 9. Red data list of potential fauna for the study area

English Name	Conservation status
Bateleur	Vulnerable
Black Harrier	Near threatened
Black Stork	Near threatened
Blackwinged Pratincole	Near threatened
Blue Crane	Vulnerable
Cape Vulture	Vulnerable
Chestnutbanded Plover	Near threatened
Greater Flamingo	Near threatened
Kori Bustard	Vulnerable
Lanner Falcon	Near threatened
Lappetfaced Vulture	Vulnerable
Lesser Flamingo	Near threatened
Lesser Kestrel	Vulnerable
Ludwig's Bustard	Vulnerable
Marabou Stork	Near threatened
Peregrine Falcon	Near threatened
Secretarybird	Near threatened
Tawny Eagle	Vulnerable
Whitebacked Vulture	Vulnerable
MAMMALS	
Reddish grey musk shrew	Data deficient
Lesser red musk shrew	Data deficient
Black rhino	Critically endangered

English Name	Conservation status
Hartman's mountain zebra	Endangered
Roan antelope	Vulnerable
Brown hyaena	Near threatened
Honey badger	Near threatened
Schreiber's long-fingered bat	Near threatened
African weasel	Data deficient
Geoffrroy's Horseshoe bat	Near threatened
Darling's horseshoe bat	Near threatened
Dent's horseshoe bat	Near threatened
Bushveld gerbil	Data deficient

The following general observations with regards to the study area can be made. Recommendations and mitigating measures need to be implemented to ensure the survival of these species other fauna habitats and feeding grounds:

- The impact of the proposed development on the red data and other mammal species will mostly have a medium probability as a result of the following:
    - Habitat of red data species such as water birds is mostly in and around drainage features (on and off-site) nad will not be impacted on by the development.
    - If one considers the habitat descriptions of the red data species, some of them are limited in range or threatened as a direct result of habitat loss in the southern African sub-region (blue crane), although other species with large home ranges (*e.g* martial eagle) are not directly threatened by habitat loss. Impact of development on the red data species would be less than predicted.
    - Larger mammal species such as black rhino and roan antelope no longer occur naturally in the area and are confined to nature reserves;
    - The development would not have a significant impact on the above mentioned red data fauna since the herbaceous layer will be preserved below the solar panels while adequate natural habitat/vegetation would be available on the peripheral habitats outside the study area as.
    - The habitats of the fauna will not be significantly fragmented since the area below the panels will still be available for fauna to move through. Development also won't influence the natural feeding and movement patterns of the existing fauna in the area. Peripheral impacts on the larger area should however still be avoided.

- The protection of different habitat types in the area will be important to ensure the survival of the different animals due to each species' individual needs and requirements. Sufficient natural corridor sections should be protected around the proposed development footprints to allow fauna to move freely between the different vegetation units on the property. In this regard the surrounding shrubveld and woodland areas outside the footprint of the solar plant, and herbaceous layer that will be preserved beneath the solar panels, will be sufficient as corridors.

If the following general mitigation and management actions are taken on site, the impact on faunal populations should be low.

- Where trenches pose a risk to animal safety, they should be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by constant excavating and backfilling of trenches during construction;
- No animals may be poached during construction of the PV Power Plant. Many are protected by law and poaching or interference could result in a fine or jail term;
- Do not feed any wild animals on site;
- Waste bins and foodstuffs should be made scavenger proof;
- Roads in the area should be designed without pavements to allow for the movement of small mammals;
- Power line structures on site, associated with the PV Power Plant can present electrocution hazards to birds when less than adequate separation exist between energized conductors or between energized conductors and grounded conductors. Avian-safe facilities can be provided by one or more of the following mitigation measures:
    - Increasing separation between conductors to achieve adequate separation for the species involved (larger birds, raptors);
    - Covering energized parts and / or covering grounded parts with materials appropriate for providing incidental contact protection to birds;
    - Applying perch managing techniques such as conspicuous objects and support roosting sites along the power line that would allow large raptors and bustards to safely roost;
    - A detailed avifauna study should address the impact of the power line on birds in more detail.
- Monitoring of the environmental aspects should be done over the longer term to ensure that impacts are limited to a minimum during the construction and operational phases. Monitoring of specific species is necessary to ensure that these species would be unaffected over the longer term by the development. Information on red data species should be provided to construction workers to make them more aware of these fauna and their behaviour.

6 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE FAUNA AND FLORA

An environmental impact is defined as a change in the environment, be it the physical/chemical, biological, cultural and or socio-economic environment. Any impact can be related to certain aspects of human activities in this environment and this impact can be either positive or negative. It could also affect the environment directly or indirectly and the effect of it can be cumulative. There are three major categories of impacts on biodiversity namely:

- Impacts on habitat resulting in loss, degradation and / or fragmentation.
- Direct impacts on fauna and flora and species, for example plants and animals that are endemic / threatened / special to a particular habitat will not be able to survive if that habitat is destroyed or altered by the development.
- Impact on natural environmental processes and ecosystem functioning. This can lead to an accumulated effect on both habitat and species.

There are three levels at which biodiversity can be approached - namely the genetic, the species and the ecosystem levels. Genetic diversity refers to the variation of genes within species. Species diversity refers to the variety and abundance of species within a geographic area. Ecosystem diversity can refer to the variety of ecosystems within a certain political or geographical boundary (National Environmental Management Biodiversity Act, 2004). This biodiversity assessment focused on the description of ecosystem- and species-related biodiversity. It can be expected that if ecosystem diversity is managed effectively, species and genetic diversity should also be protected. Emphasis was therefore placed on the ecosystem diversity (landscape/habitat types) within the proposed development area, with reference to biota observed and expected to utilise these landscapes or habitat types.

6.1 POTENTIAL IMPACTS

6.1.1 Direct habitat destruction

6.1.1.1 Description of impact:

The construction of the solar plant and associated infrastructure will result in loss of and damage to natural habitats. During the construction phase and maintenance of this infrastructure, some habitat modification and alteration inevitably takes place. However re-growth of grass under the power line and solar panels will take place. The areas below the panels and power line will have to be cleared (slashed) of excess vegetation at regular

intervals in order to allow access to the area for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the power line conductors and to minimize the risk of fire which can result in electrical flashovers. These activities will have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through modification of habitat. Rehabilitation of some of these areas would be possible but there is likely to be long-term damage in large areas. Most habitat destruction will be caused during the construction of the infrastructure.

6.1.1.1.1 Destruction or loss of floral diversity or vegetation communities

The following major impacts will potentially impact on the flora of the site:

- Loss of threatened, “near-threatened” and endemic taxa: The anticipated loss of some of the woodland habitats that support endemic species will result in the local displacement of endemic listed flora;
- The construction will lead to the loss of individual plants such as trees and shrubs that will be cleared on the footprint area;
- The construction activities can impact on surrounding vegetation by dust and altered surface run-off patterns;
- The disturbance of the area could lead to an increase in the growth of alien vegetation;

6.1.1.1.2 Loss of faunal diversity through migration and decline in animal numbers

The following major impacts will potentially impact on faunal habitats on site:

- The construction activities by heavy vehicles and back-actors could cause fauna mortalities and even impact on small populations of rare / threatened fauna species (e.g. amphibian species in small wetlands);
- Habitat loss and construction activities will force animals out of the area and animal numbers will decrease. This impact could also take place because of hunting and snaring of animals in natural areas.
- When the area is rehabilitated and the new habitats begin to establish, animals will start to return to the area.
- Changes in the community structure: It is expected that the faunal species composition will shift, due to an anticipated loss in habitat surface area. In addition, it is predicted that more generalist species (and a loss of functional guilds) will dominate the study area. Attempts to rehabilitate will attract taxa with unspecialized and generalist life-histories. It is predicted that such taxa will persist for many years before conditions become suitable for succession to progress.

6.1.1.2 Mitigation measures:

- The removal of grassland, indigenous trees and shrubs should be kept to a minimum necessary. Trim, rather than fell of woody species along the power line route where possible. Brushwood should be left for the use of the landowner or the local community, as agreed to by the landowner and with due regard to preventing fire hazards. The clearing and damage of plant growth in these areas should be restricted to the servitude and way leave area. Where protected flora will need to be cleared permits should be obtained from the relevant authority;
- Peripheral impacts around the footprint area on the surrounding vegetation of the area should be avoided and a monitoring programme should be implemented to ensure impacts are kept to a minimum, while the rehabilitation of the site should be prioritised after the construction has been completed.
- During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, in order to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place.
- All development activities should be restricted to specific recommended areas. The Environment Control Officer (ECO) should control these areas. Storage of equipment, fuel and other materials should be limited to demarcated areas. Layouts should be adapted to fit natural patterns rather than imposing rigid geometries. Development footprint should be clearly demarcated prior to initial site clearance and prevent construction personnel from leaving the demarcated area. This is applicable to the construction phase of the proposed development.
- The ECO should advise the construction team in all relevant matters to ensure minimum destruction and damage to the environment. The ECO should enforce any measures that he/she deem necessary. Regular environmental training should be provided to construction workers to ensure the protection of the habitat, fauna and flora and their sensitivity to conservation.
- Where holes for poles pose a risk to animal safety, they should be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by the constant excavating and backfilling during planting of the poles along the lines.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.

- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
- Monitoring should be implemented during the construction phase of the development to ensure that minimal impact is caused to the fauna and flora of the area.

6.1.2 Habitat fragmentation

6.1.2.1 Description of impact:

The construction of the solar plant, access road and power line will result in natural movement patterns being disrupted for a limited period of time and, to a varying degree depending on how different species react to these barriers will result in the fragmentation of natural populations, although the impact will be minimal and restricted to the construction phase.

6.1.2.2 Mitigation measures:

- Use existing facilities (e.g., access roads) to the extent possible to minimize the amount of new disturbance.
- Ensure protection of important resources by establishing protective buffers to exclude unintentional disturbance. All possible efforts must be made to ensure as little disturbance as possible to the sensitive features such as riparian zones and wetlands during construction;
- During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, in order to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place.
- Construction activities must remain within defined construction areas and the road servitudes. No construction / disturbance will occur outside these areas.

6.1.3 Increased Soil erosion and sedimentation

6.1.3.1 Description of impact:

The construction activities associated with the development may result in widespread soil disturbance and is usually associated with accelerated soil erosion. Soil erosion promotes a variety of terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous flora.

6.1.3.2 Mitigation measures:

The following mitigation measures should be implemented to prevent erosion along slopes and drainage channels during trench excavation:

- When possible, topsoil stripping and excavation activities should be scheduled for the low rainfall season (winter);
- The project should be divided into as many phases as possible, to ensure that the exposed areas prone to erosion are minimal at any specific time;
- Cover disturbed soils, using vegetation or other materials;
- Control the flow of runoff to move water safely off-site without gully formation;
- Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices. Control dust on construction sites and access roads using water-sprayers;
- Stormwater and run-off systems: install temporary drains and minimize concentrated water flows. Divert run-off around trench excavations or disturbed areas. Institute a storm water management plan including strategies such as:
    - Increasing infiltration to soil by use of recharge areas;
    - Use of natural vegetated swales instead of pipes; or
    - Do not allow surface water or storm water to be concentrated, or to flow down cut or fill slopes or along power line route without erosion protection measures being in place;
    - Line overflow and scour channels with stone pitching along their length and at their points of discharge to prevent soil erosion. The point of discharge must be at a point where there is dense natural grass cover;
    - Ensure that channels do not discharge straight down contours and must be aligned at such an angle that they have the least possible gradient;
    - Temporary water diversion measures are to be designed and protected so that no undue scouring of river banks occurs.
- Have both temporary (during construction) and permanent erosion control plans:
    - Temporary control plans should include:
        - Brush-packing of exposed areas to prevent overgrazing and erosion;
        - Silt fencing;
        - Short term seeding or mulching of exposed soil areas (particularly on slopes);
        - Limitations on access for heavy machinery and the storage of materials to avoid soil compaction;
    - Permanent erosion control plans should focus on the establishment of stable native vegetation communities.

- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion from activities in and adjacent to the construction camp and Work Areas;
- Repair all erosion damage as soon as possible;
- Gravel roads must be well drained in order to limit soil erosion;

6.1.4 Soil and water pollution

6.1.4.1 Description of impact:

Construction work for the proposed development will always carry a risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface or ground water, leading to potential medium/long-term impacts on fauna and flora. During the constructional phase heavy machinery and vehicles as well as sewage and domestic waste from workers would be the main contributors to potential pollution problems.

6.1.4.2 Mitigation measures:

- Water falling on areas polluted with oil/diesel or other hazardous substances must be contained. Any excess or waste material or chemicals should be removed from the site and discarded in an environmental friendly way. The ECO should enforce this rule rigorously.
- Chemicals to be stored on an impervious surface protected from rainfall and storm water run-off.
- Spill kits should be on-hand to deal with spills immediately;
- Spillages or leakages must be treated according to an applicable procedure as determined by a plan of action for the specific type of disturbance;
- All construction vehicles should be inspected for oil and fuel leaks regularly and frequently. Vehicle maintenance will not be done on site except in emergency situations in which case mobile drip trays will be used to capture any spills. Drip trays should be emptied into a holding tank and returned to the supplier.

6.1.5 Air pollution

6.1.5.1 Description of impact:

The environmental impacts of wind-borne dust, gases and particulates from the construction activities associated with the proposed development are primarily related to human health and ecosystem damage. The proposed development will typically comprise the following sources and associated air quality pollutants:

- Stockpiling (particulate matter);
- Materials handling operations (truck loading & unloading, tipping, stockpiling);
- Vehicle entrainment on paved and unpaved roads;
- Windblown dust-fugitive emissions (stockpiles).

One of the primary impacts on the biophysical environment is linked to emission of dusts and fumes from both the transportation system. Dust pollution will impact the most severely during the construction phase. Construction vehicles and equipment are the major contributors to the impact on air quality. Dust is generated during site clearance for the construction of infrastructure. Diesel exhaust gasses and other hydrocarbon emissions all add to the deterioration in air quality during this phase. Vehicles travelling at high speeds on dirt roads significantly aggravate the problem.

Although the potential for severe fugitive dust impacts is greatest within 100 m of dust-generating activities, there is still the potential for dust to affect vegetation up to five kilometres or more downwind from the source. Dust deposited on the ground may cause changes in soil chemistry (chemical effects), and may over the long-term result in changes in plant chemistry, species composition and community structure. Sensitivities to dust deposition of the various plant species present in the area are not known. It is therefore difficult to predict which species may be susceptible.

Poor air quality results in deterioration of visibility and aesthetic landscape quality of the region, particularly in winter due to atmospheric inversions.

6.1.5.2 Mitigation measures:

- Implement standard dust control measures, including periodic spraying (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation.
- A speed limit (preferably 40 km/hour) should be enforced on dirt roads.

6.1.6 Spread and establishment of alien invasive species

6.1.6.1 Description of impact:

Construction of the PV plant carries by far the greatest risk of alien invasive species being imported to the site, and the high level of habitat disturbance provides great opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project.

6.1.6.2 Mitigation measures:

- Institute strict control over materials brought onto site, which should be inspected for potential invasive invertebrate species and steps taken to eradicate these before transport to the site.
- Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish.
- Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds.
- Institute an eradication/control programme for early intervention if invasive species detected, so that spreading to surrounding natural ecosystems can be prevented.

6.1.7 Negative effect of human activities and road mortalities

6.1.7.1 Description of impact:

An increase in human activity on the site and surrounding areas is anticipated. The risk of snaring, killing and hunting of certain faunal species is increased. If staff compounds are erected for construction workers, the risk of pollution because of litter and inadequate sanitation and the introduction of invasive fauna and flora are increased. The presence of a large number of construction workers or regular workers during the construction phase on site over a protracted period will result in a greatly increased risk of uncontrolled fires arising from cooking fires, improperly disposed cigarettes etc.

Large numbers of fauna are also killed daily on roads. They are either being crushed under the tyres of vehicles in the case of crawling species, or by colliding with the vehicle itself in the case of avifauna or flying invertebrates. The impact is intensified at night, especially for flying insects, as result of their attraction to the lights of vehicles.

6.1.7.2 Mitigation measures:

- The minimum staff should be accommodated on the site. If practical, construction workers should stay in one of the nearby villages and transported daily to the site.
- The ECO should regularly inspect the site, including storage facilities and compounds and eradicate any invasive or exotic plants and animals.
- Maintain proper firebreaks around entire development footprint.
- Educate construction workers regarding risks and correct disposal of cigarettes.

- More fauna are normally killed the faster vehicles travel. A speed limit should be enforced (preferably 40 km/hour). It can be considered to install speed bumps in sections where the speed limit tends to be disobeyed. (Speed limits will also lessen the probability of road accidents and their negative consequences).
- Travelling at night should be avoided or limited as much as possible.

6.2 IMPACT ASSESSMENT MATRIX

Table 11 indicate the impacts described above and specific ratings of significance the impact will potentially have on the ecological components of the study area:

Table 10. Impact assessment Matrix

Impacts	Probability	Duration	Scale	Magnitude (WOM)	Magnitude (WM)	Scoring (WOM)	Scoring (WM)
1. Direct habitat destruction	5	5	1	6	2	60 (High)	40 (Moderate)
2. Habitat fragmentation	5	5	2	6	2	65 (High)	45 (Moderate)
3. Soil erosion	4	4	3	8	2	60 (High)	36 (low)
4. Soil and water pollution	4	4	3	6	2	52 (moderate)	36 (low)
5. Air pollution (dust)	5	4	3	8	2	75 (High)	45 (Moderate)
6. Spread and establishment of alien invasives	3	4	2	6	2	36 (Low)	24 (Low)
7. Negative effect of human activities	4	3	2	6	2	44 (Moderate)	28 (Low)

7 SENSITIVITY

Following the ecological surveys, the classification of the study area into different sensitivity classes and development zones was based on information collected at various levels on different environmental characteristics. Factors which determined sensitivity classes were as follows:

- Presence, density and potential impact of development on rare, endemic and protected plant species;
- Conservation status of vegetation units;
- Soil types, soil depth and soil clay content;
- Previous land-use;
- State of the vegetation in general as indicated by indicator species.

Below included is the sensitivity map for the proposed development site (Figure 5). Only criteria applicable to the specific vegetation units were used to determine the sensitivity of the specific unit.

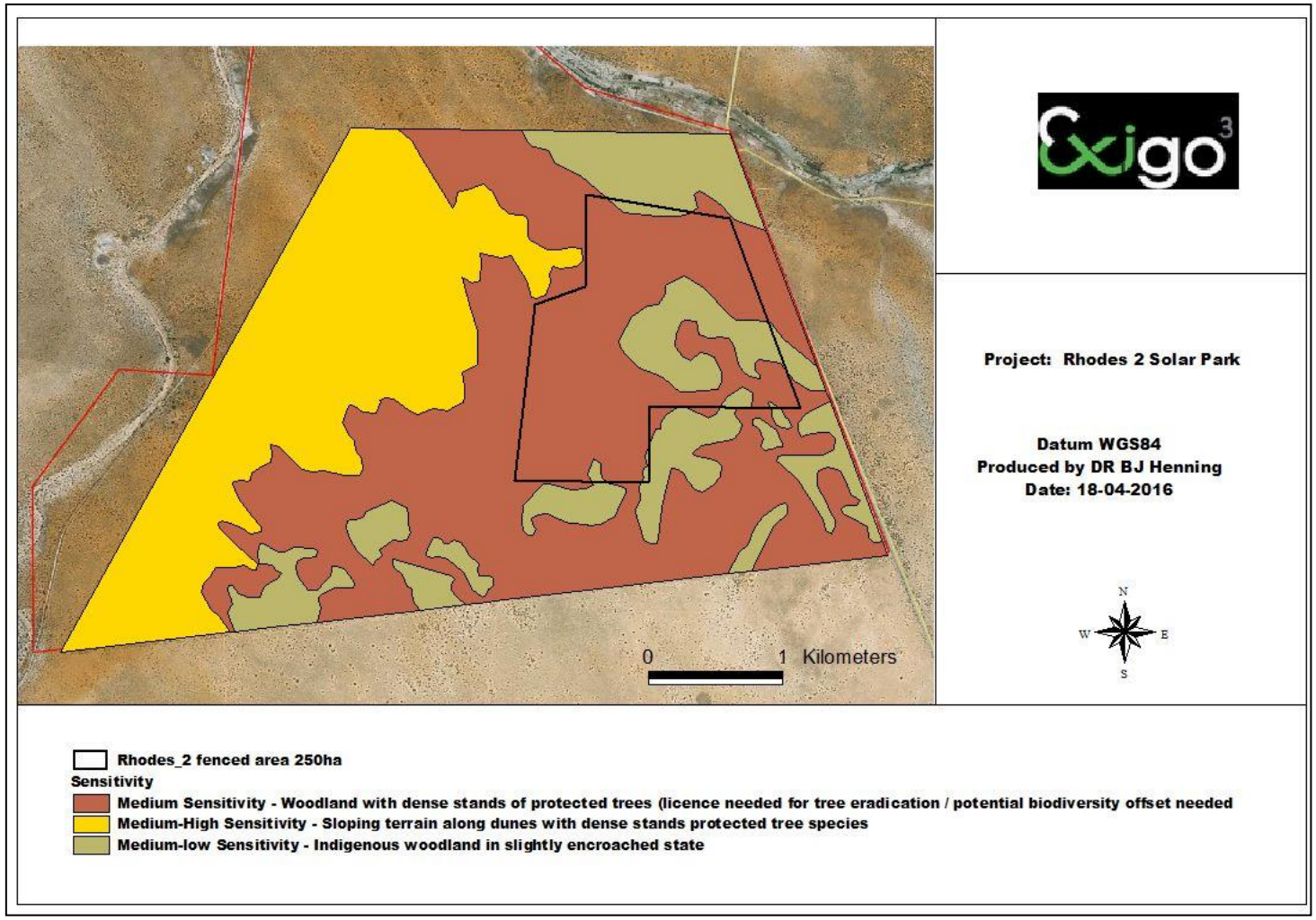


Figure 6. Sensitivity Map of the proposed development site

8 DISCUSSION

Most development has an impact on the environment. In this case the area on which the proposed development footprint will be built will be cleared, therefore directly impacting on the environment. Most of the vegetation will be completely modified during the construction. Detailed ecological (fauna habitat & flora) surveys were conducted during March 2014 and July 2015 to verify the ecological sensitivity and ecological components of the site at ground level.

The development will have a medium to high impact on the vegetation and general ecology of the area, due to the sensitive habitats (dunes, woodland with dense stands of protected tree species) that occur in the area, and therefore the least sensitive areas should be considered for the proposed footprint of Rhodes 2 Solar Park. Considering the results from the field surveys, mitigation needs to be implemented to prevent any negative impacts on the ecosystem, since most of the site is in a natural state. A sensitivity analyses was conducted to identify the most suitable site for the development. From this investigation and ecological survey, the following main observations was made:

- The duneveld areas have a medium to high sensitivity. These areas play an important role as habitat for fauna and flora. Strict mitigation is needed for the preservation of some sections of this natural vegetation entity. The solar plant development should avoid these areas if possible;
- The most suitable area for the development of the solar farm would be in the woodland areas with a Medium (*Acacia haematoxylon* dominated woodland) or Medium-low Sensitivity (*Acacia mellifera* dominated woodland). Limited mitigation is needed for the preservation of some sections of this natural vegetation entity, and the main mitigation would be to obtain a licence from DAFF for the eradication of protected tree species. The herbaceous layer should be preserved below the solar panels and managed through slashing during the lifetime of the project;

Some potential rare fauna may occur in the area, and specific mitigation measures need to be implemented to ensure that the impact of the development on the species' habitat will be low. Specific mitigation relating to red data fauna includes the following:

- Disturbances in close vicinity of the development (periphery) should be limited to the smallest possible area in order to protect species habitat;
- Corridors between the development zones are important to allow fauna to move freely between the areas of disturbance. The preservation of the herbaceous layer below the solar panels will play an important role in this regard and therefore habitat fragmentation for smaller mammals, birds and herpetofauna will be minimal.

A number of ecological potential impacts were identified and assessed. A few of these were assessed as having potentially medium or high significance, including the following:

- Destruction or disturbance to ecosystems leading to reduction in the overall extent of a particular habitat;
- Impairment of the movement and/or migration of animal species resulting in genetic and/or ecological impacts (habitat fragmentation);
- Increased soil erosion;
- Destruction/permanent loss of individuals of rare, endangered, endemic and/or protected species;
- Establishment and spread of declared weeds and alien invader plants;
- Soil and water pollution due to spillages;
- Air pollution as a result of dust;
- Negative effect of human activities and road mortality.

Mitigation measures are provided that would reduce these impacts from a higher to a lower significance. A monitoring plan is recommended for the construction phase of the development should the proposed application be approved.

9 CONCLUSION

All aspects of the environment, especially living organisms, are vulnerable to disturbance of their habitat. If we can bring about a more integrated approach to living within our ecosystems, we are much more likely to save the fundamental structure of biodiversity. Positive contributions can be made even on a small scale such as within the proposed Rhodes 2 Solar Park and associated infrastructure. All stakeholders need to be involved to avoid a loss of biodiversity in the area. The proposed development site will partially modify the natural vegetation and faunal habitats, although the herbaceous layer will be preserved below the panels. The importance of rehabilitation and implementation of mitigation processes to prevent negative impacts on the environment during and after the development phase should be considered a high priority. The proposed development should avoid sensitive areas such as duneveld habitats, while sections of the woodland with dense stands of protected trees should be preserved. Where sensitive areas of natural vegetation cannot be avoided, a number of mitigation measures have been recommended to minimise and/or offset impacts (licence application for eradication of protected species, identification of offset areas). Negative impacts can be minimised by strict enforcement and compliance with an Environmental Management Plan which takes into account the recommendations for managing impacts detailed above. Provided that the proposed development is consistent with the sensitivity map and take all the mitigation measures into consideration stipulated in this report, the planned development can be supported.

10 REFERENCES

Acocks, J.P.H. 1988. Veld types of South Africa, 3rd ed. Memoirs of the Botanical Survey of South Africa. 57: 1–146.

Barbour, M.G., J.H. Burk, and W.D. Pitts. 1987. Terrestrial Plant Ecology. Second Edition. Benjamin/Cummings Publishing, Menlo Park, CA.

BOTHMA, J. DU. P. 1996. Game Ranch Management. Van Schaick, Pretoria.

Bredenkamp, G.J. & Brown, L.R. 2001. Vegetation – A reliable ecological basis for environmental planning. Urban Greenfile Nov-Dec 2001: 38-39.

Branch, B. (1998). Field guide to snakes and other reptiles of Southern Africa. Struik Publishers. Cape Town.

Briza publications. 2001. Problem plants of South Africa. Pretoria.

CHECHI, F. & ROBERTS, L. 2005. Interpreting and using mortality data in humanitarian emergencies: A primer for non-epidemiologists. Humanitarian practice Network at ODI.

CONSERVATION OF AGRICULTURAL RESOURCES ACT, 1983. (ACT No. 43 OF 1983)

Convention on Biological Diversity. Signed 1993 and ratified 2 November 1995.

Cowling, W. E. 2005. Tourism- A Catalyst For Attitudinal Changes in Aitutaki, Cook Islands University of Waikato, Hamilton, New Zealand

DEAT, 1998. Guideline Document on the EIA Regulations implementation of sections 21, 22 and 26 of the Environment Act, Government Printer, Pretoria.

DEAT, 2002. Impact Significance, Integrated Environmental Management, Information Series 5, Department of Environmental Affairs and Tourism, Pretoria

Enpat, 2000.Environmental Potential Atlas. Department of Environmental Affairs and Tourism, Pretoria.

Fabian, A & Germishuizen, G. 1997. Wild flowers of Northern South Africa. Fernwood Press.

Friedman, Y & Daly, B. 2004. Red Data Book of the Mammals of South Africa: A Conservation Assessment: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust. South Africa.

Germishuizen, G. and Clarke, B. (2003). Illustrated Guide to the Wildflowers of Northern South Africa. Briza Publications, Pretoria

GERTENBACH, W. P. D. 1983. Landscapes of the Kruger National Park. Koedoe 26: 9-121.

GOLDING, J. (Ed.) 2002. Southern African Plant Red Data Lists. Southern African Botanical Diversity Network report no. 14. National Botanical Institute. pp. 237.

HILTON-TAYLOR, C. 1996a. Red Data list of southern African plants. Strelitzia 4: 1 - 117.

HILTON-TAYLOR, C. 1996b. Red Data list of southern African plants. 1. corrections and additions. Bothalia 26: 177 - 182.

HILTON-TAYLOR, C. 1997. Red Data list of southern African plants. 2. corrections and additions. Bothalia 27:

195 - 209.

IFC. Performance Standard 6 Biodiversity Conservation and Sustainable Natural Resource Management

Kent, LE. 1980. Stratigraphy of South Africa. Part 1: Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia and the Republics of Bophuthatswana, Transkei and Venda. Pretoria: Department of Mineral and Energy Affairs, Handbook 8.

Land type Survey Staff, 1987. Land types of the maps. Mem. Agric. Nat. Resour. S. Afr. no. 8.

LEE, K. E. & WOOD, T. G. 1971. Termites and Soils. Academic Press, London.

LOW, A. B. & REBELO, A. G. 1996. Vegetation of South Africa, Lesotho and Swaziland. Dept. Environmental Affairs and Tourism, Pretoria.

MacKay, H. 1998: Towards a Classification System for Water Resources in South Africa. Institute for Water Quality Studies. Internal Report. Department of Water Affairs and Forestry, Pretoria, South Africa.

Manning, J. (2003). Photographic Guide to the Wildflowers of South Africa. Briza Publications. Pretoria.

Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J. and Kloepfer, D. (2004). Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. Smithsonian Institute, Washington, DC.

Mucina, L., Bredenkamp, G.J., Hoare, D.B. & McDonald, D.J. 2000. A National vegetation database for South Africa. South Africa Journal of Science 96:497-498.

Mueller-Dombois, D. & Ellenberg, H. 1974. Aims and methods of vegetation ecology. Wiley, New York.

Mucina, L & Rutherford, M. C. 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19, SANBI, Pretoria.

NATIONAL FOREST ACT, 1998 (Act No. 84 of 1998). Government Gazette No. 29062, Notice 897, 8 September 2006)

NATIONAL WATER ACT, 1998. Act No 36 of 1998.

Onderstall, J. (1996). Wild Flower Guide for Mpumalanga and Northern Province. DynamicAd. Nelspruit.

Palgrave, M.C. (2002). Trees of Southern Africa.Struik Publishers.Cape Town.

Pooley, E. 1998. A field guide to wild flowers of Kwazulu Natal and the Eastern Region. Natal Flora Publications Trust.

SANBI & DEAT. 2009. Threatened Ecosystems in South Africa: Descriptions and Maps. DRAFT for Comment. South African National Biodiversity Institute, Pretoria, South Africa.

Sinclair, A. R. E. & A. E. Byrom. 2006. Understanding ecosystem dynamics for conservation of biota. Journal of Animal Ecology, 75: 64–79

Smithers, R.H.N. (1983). Soogdiere van die Suider-Afrikaanse Substreek. Universiteit van Pretoria. Pretoria

Tainton, N. M. (ed.), 1981. Veld and Pasture Management in South Africa. Shuter and Shooter, Pietermaritzburg, 481pp.

The National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004).

Government Gazette RSA Vol. 467, 26436, Cape Town, June 2004.

The National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004). Draft. List of Threatened Ecosystems. Government Gazette RSA Vol. 1477, 32689, Cape Town, 6 Nov 2009.

The Natural Scientific Professions Act (Act 27 of 2003)

THOMPSON H (2006) Water Law: A Practical Approach to Resource Management and the Provision of Services. Juta, Cape Town.

Van Der Merwe, C. R. 1952. Soil Groups and subgroups of South Africa. Science Bulletin356.

VAN WYK, B-E. & GERICKE, N. 2000. People's Plants: A Guide to useful plants of southern Africa. Briza publications, Pretoria.

Van Wyk, B & Malan, S. 1988. Field Guide to the wild flowers of the Highveld. Struik Publishers.

Van Wyk, B. & Van Wyk, P. 1997. Field Guide to Trees of Southern Africa. Struik Publishers. Cape Town.

Van Wyk, B.E., Van Oudtshoorn, B. & Gericke, N. 1997. Medicinal plants of South

Africa. Briza, Pretoria.

Van Oudtshoorn, F. (1991) Gids tot grasse van Suid Afrika. Briza Publikasies. Pretoria.

WERGER, M.J.A. 1978. Biogeography and Ecology of Southern Africa. Monographie Biologicae vol. 31. Junk, The Hague.

Westhoff, V. & Van der Maarel, E. 1978. The Braun-Blanquet approach. In: Whittaker, R.H. (ed.) Classification of plant communities. W. Junk, The Hague.

WHITE, F. 1983. The vegetation of Africa: a descriptive memoir to accompany the UNESCO/AETFAT/UNSO vegetation map of Africa. UNESCO, Paris, France.

APPENDIX A. PLANT SPECIES LIST FOR SITE

Tree & shrub species	Grass species	Dwarf shrubs, Forbs, succulents & geophytes
Acacia erioloba	*Aristida congesta*	*Acanthosicyos naudinianus*
Acacia haematoxylon	*Aristida meridionalis*	*Argemone ochroleuca*
Acacia hebeclada	*Digitaria eriantha*	*Bulbostylis hispidula*
Acacia mellifera	*Enneapogon cenchroides*	*Chrysocoma obtusata*
Gewia bicolor	*Enneapogon desvauxii*	*Citrullis lanatus*
Terminalia sericea	*Eragrostis echinocloidea*	*Cleome angustifolia*
Ziziphus mucronata	*Eragrostis pallens*	*Convolvulus sagittatus*
Grewia flava	*Melinis repens*	*Crotalaria orientalis*
	Panicum coloratum	*Cucumis zeyheri*
	Schmidtia kalaharense	*Cyperus obtusiflorus*
	Stipagrostis amabilis	*Dicerocarium eriocarpum*
	Stipagrostis hirtigluma	*Elephanthorhiza elephanthina*
	Stipagrostis obtusa	*Giseckia africana*
	Tragus racemosus	*Heliotropium ciliatum*
		Hermbstaedtia fleckii
		Hirpicium echninus
		Indigofera alternans
		Indigofera charlieriana
		Ipomoea magnusiana
		Kedrostis africana
		Kohautia caespitosa
		Limeum argute-carinatum
		Limeum viscosum
		Momordica balsamina
		Monechma genistifolium
		Oxygonum delagoense
		Pavonia burchelli
		Pergularia daemia
		Polygala spp.
		Pupalia lapaceae
		Senecio eenii
		Senna italic
		Sesamum triphyllum
		Sida cordifolia
		Tribulis terrestris
		Verbesina encelioides
		Walafrida saxatalis
		Xenostegia tridentate

APPENDIX B. PLANT SPECIES LIST FOR QDS 2722BB

Family Name	Species Name
CUCURBITACEAE	*Acanthosicyos naudinianus*
POACEAE	*Anthephora argentea*
POACEAE	*Aristida adscensionis*
POACEAE	*Aristida congesta*
POACEAE	*Aristida congesta subsp. congesta*
POACEAE	*Aristida stipitata subsp. spicata*
POACEAE	*Aristida vestita*
ASTERACEAE	*Berkheya ferox var. tomentosa*
POACEAE	*Brachiaria marlothii*
POACEAE	*Chrysopogon serrulatus*
CAPPARACEAE	*Cleome angustifolia subsp. diandra*
POACEAE	*Coelachyrum yemenicum*
LOPHIOCARPACEAE	*Corbichonia rubriviolacea*
FABACEAE	*Crotalaria virgultalis*
FABACEAE	*Cullen tomentosum*
POACEAE	*Cymbopogon pospischilii*
POACEAE	*Cynodon dactylon*
CYPERACEAE	*Cyperus margaritaceus var. margaritaceus*
ASTERACEAE	*Dimorphotheca zeyheri*
POACEAE	*Enneapogon cenchroides*
POACEAE	*Enneapogon desvauxii*
POACEAE	*Eragrostis echinochloidea*
POACEAE	*Eragrostis lehmanniana var. lehmanniana*
POACEAE	*Eragrostis pallens*
POACEAE	*Eragrostis trichophora*
POACEAE	*Eustachys paspaloides*
POACEAE	*Fingerhuthia africana*
ASTERACEAE	*Geigeria ornativa subsp. ornativa*
GISEKIACEAE	*Gisekia pharnacioides var. pharnacioides*
MALVACEAE	*Grewia flava*
PEDALIACEAE	*Harpagophytum procumbens*
AMARANTHACEAE	*Hermbstaedtia fleckii*
FABACEAE	*Indigastrum argyraeum*
FABACEAE	*Indigofera alternans var. alternans*
FABACEAE	*Indigofera hololeuca*
MOLLUGINACEAE	*Limeum myosotis var. myosotis*
POACEAE	*Megaloprotachne albescens*
FABACEAE	*Melolobium candicans*
FABACEAE	*Melolobium humile*
CONVOLVULACEAE	*Merremia verecunda*

Family Name	Species Name
ACANTHACEAE	*Monechma genistifolium subsp. australe*
IRIDACEAE	*Moraea longistyla*
IRIDACEAE	*Moraea pallida*
POLYGONACEAE	*Oxygonum delagoense*
POACEAE	*Panicum coloratum*
ASTERACEAE	*Pentzia calcarea*
POACEAE	*Pogonarthria squarrosa*
POLYGALACEAE	*Polygala leptophylla var. leptophylla*
POLYGALACEAE	*Polygala seminuda*
FABACEAE	*Prosopis glandulosa var. glandulosa*
FABACEAE	*Prosopis velutina*
AMARANTHACEAE	*Pupalia lappacea var. velutina*
RICCIACEAE	*Riccia albolimbata*
MESEMBRYANTHEMACEAE	*Ruschia sp.*
CHENOPODIACEAE	*Salsola kali*
CHENOPODIACEAE	*Salsola patentipilosa*
POACEAE	*Schmidtia kalahariensis*
ANACARDIACEAE	*Searsia dregeana*
ANACARDIACEAE	*Searsia erosa*
SCROPHULARIACEAE	*Selago mixta*
AMARANTHACEAE	*Sericorema remotiflora*
POACEAE	*Setaria verticillata*
POACEAE	*Sporobolus fimbriatus*
LAMIACEAE	*Stachys spathulata*
POACEAE	*Stipagrostis ciliata var. capensis*
OROBANCHACEAE	*Striga gesnerioides*
FABACEAE	*Tephrosia burchellii*
SANTALACEAE	*Thesium hystrix*
POACEAE	*Tragus racemosus*
POACEAE	*Tricholaena monachne*

APPENDIX C. BIRD SPECIES LIST FOR QDS

English Name	Map Status	General Status
Abdim's Stork	NBM-U	NBM-C

English Name	Map Status	General Status
African Black Duck	R-C	R-U
African Cuckoo	BM-U	BM-U
African Fish Eagle	R-U	R-C
African Hoopoe	R-VC	R(n)-C
African Jacana	R-U	R-VC
African Marsh Harrier	R-U	R-C
African Marsh Warbler	BM-C	BM-C
African Pied Wagtail	R-C	R-C
African Rail	R-C	R/BM-C
African Spoonbill	R-U	R(n)-C
Alpine Swift	BM-U	BM-C
Anteating Chat	E-VC	E-C
Ashy Tit	E-C	Er-U
Baillon's Crake	R-U	R-C
Banded Martin	BM-U	BM-U
Barn Owl	R-C	R-C
Bennett's Woodpecker	R-U	R-U
Black Crake	R-C	R-C
Black Crow	R-U/VC	R-C
Black Eagle	R-C	R-U
Black Egret	R-U	R-LC/R
Black Harrier	NBM-U	E-U
Black Kite	NBM-U	NBM-LC
Black Stork	R-U	R-U/R
Black Swift	BM-U	R-C
Blackbreasted Snake Eagle	R-C	R-U
Blackcheeked Waxbill	R-C	R-LC
Blackchested Prinia	E-VC	Er-C
Blackcrowned Night Heron	R-U	R-C
Blackheaded Heron	R-VC	R-C
Blacknecked Grebe	R-U	R(n)-U
Blackshouldered Kite	R-VC	R(n)-C
Blacksmith Plover	R-A	R-VC
Blacktailed Godwit	Rare	NBM-R
Blackthroated Canary	R-VC	R-C
Blackwinged Pratincole	NBM-U	NBM-LA
Blackwinged Stilt	R-C	R-C
Blue Crane	E-U	E-U
Bluecheeked Bee-eater	NBM-U	NBM-LC
Bokmakierie	E-VC	Er-C
Booted Eagle	NBM-U	R/NBM-C

English Name	Map Status	General Status
Bradfield's Swift	E-U	Er-C
Brownhooded Kingfisher	R-C	R-C
Brownthroated Martin	R-C	R-C
Brubru	R-U	R-C
Buffy Pipit	R-U	R-U
Burchell's Coucal	R-U	R-C
Burchell's Courser	E-U	Er-U
Burchell's Sandgrouse	E-C	E-C
Cape Bunting	R-U	R-C
Cape Penduline Tit	E-C	Er-C
Cape Reed Warbler	R-C	R-C
Cape Robin	R-VC	R-C
Cape Shoveller	E-VC	Er-C
Cape Sparrow	E-A	Er-VC
Cape Teal	R-C	R-C
Cape Turtle Dove	R-A	R-VC
Cape Vulture	E-U	E-LC
Cape Wagtail	R-VC	R-C
Capped Wheatear	R-C	R/BM-C
Cardinal Woodpecker	R-U	R-C
Caspian Plover	NBM-C	NBM-U
Cattle Egret	R-A	R-C
Chat Flycatcher	E-C	Er-C
Chestnutbanded Plover	R-U	R-U
Common Moorhen	R-C	R-C
Common Quail	R-U	R/BM/NBM-C
Common Sandpiper	NBM-C	NBM-C
Common Waxbill	R-VC	R-C
Crested Barbet	R-U	R-C
Crimsonbreasted Shrike	E-VC	Er-C
Crowned Plover	R-VC	R-C
Curlew	NBM-U	NBM-U
Curlew Sandpiper	NBM-C	NBM-VC
Dabchick	R-VC	R-C
Darter	R-U/C	R-C
Desert Barred Warbler	E-U	Er-C
Desert Cisticola	R-C	R-C
Diederik Cuckoo	BM-C	BM-VC
Doublebanded Courser	R-C	R-LC
Dusky Sunbird	E-VC	Er-C
Eastern Clapper Lark	E-C	Er-C

English Name	Map Status	General Status
Egyptian Goose	R-VC	R-A
Ethiopian Snipe	R-U	R-LC
Eurasian Bee-eater	NBM-VC	NBM/BM-C
Eurasian Golden Oriole	NBM-U	NBM-U
Eurasian Marsh Harrier	NBM-U	NBM-R
Eurasian Nightjar	NBM-U	R-U
Eurasian Roller	NBM-U	NBM-C
Eurasian Swallow	NBM-VC	NBM-A
Eurasian Swift	NBM-U	NBM-C
Fairy Flycatcher	NBM-C	E-C
Familiar Chat	R-VC	R-C
Fantailed Cisticola	R-C	R-VC
Fawncoloured Lark	R-VC	R-C
Feral Pigeon	R-C	R-A
Fiscal Flycatcher	E-VC	E-C
Fiscal Shrike	R-A	R-C
Forktailed Drongo	R-VC	R-C
Fulvous Duck	R-U	R-C
Gabar Goshawk	R-U	R-C
Garden Warbler	NBM-U	NBM-C
Giant Eagle Owl	R-U	R-U
Giant Kingfisher	R-U	R-U
Glossy Ibis	R-C	R-U
Glossy Starling	E-VC	Er-C
Golden Bishop	R-U/C	R(n)-LC
Goldenbreasted Bunting	R-U/VC	R-U
Goldentailed Woodpecker	R-U	R-C
Goliath Heron	R-C	R-U
Grassveld Pipit	R-VC	R-C
Great Crested Grebe	R-U	R(n)-U
Great Reed Warbler	NBM-U	NBM-C
Great Sparrow	R-C	R-U
Great Spotted Cuckoo	BM-U	NBM-U
Great White Egret	R-U/C	R-C
Greater Flamingo	R-C	R(n)-LA
Greater Honeyguide	R-U	R-U
Greater Kestrel	R-C	R-C
Greater Striped Swallow	BM-VC	BM-C
Greenshank	NBM-C	NBM-C
Grey Heron	R-C	R-C
Grey Hornbill	R-C	R-C

English Name	Map Status	General Status
Greybacked Finchlark	E-C	Er-VC
Greyheaded Gull	R-C	R-VC
Groundscraper Thrush	R-VC	R-C
Gymnogene	R-U	R-C
Hadeda Ibis	R-C/VC	R-A
Hamerkop	R-VC	R-C
Helmeted Guineafowl	R-VC	R-VC
Horus Swift	BM-U	BM-LC
Hottentot Teal	R-C	R-C
House Martin	NBM-U	NBM-LC
House Sparrow	R-VC	R-VC
Icterine Warbler	NBM-U	NBM-C
Jackal Buzzard	E-U	E-C
Jacobin Cuckoo	BM-C	BM-C
Kalahari Robin	E-VC	Er-C
Karoo Robin	E-VC	E-C
Karoo Thrush	E-VC	E-C
Kittlitz's Plover	R-C	R-C
Knobbilled Duck	R-U	R-LC
Kori Bustard	R-VC	R-R
Kurrichane Buttonquail	R-U	R(n)-U/LC
Lanner Falcon	R-C	R-C
Lappetfaced Vulture	R-U/C	R-U
Larklike Bunting	E-VC	Er-VC
Laughing Dove	R-A	R-VC
Lesser Flamingo	R-C	R(n)-LA
Lesser Grey Shrike	NBM-C	NBM-C
Lesser Honeyguide	R-U	R-LC
Lesser Kestrel	NBM-C	NBM-VC
Levaillant's Cisticola	R-U	R-C
Lilacbreasted Roller	R-VC	R/LM-C
Little Bittern	R-U	R/NBM-U
Little Egret	R-C	R-C
Little Stint	NBM-C	NBM-C
Little Swift	R-VC	R/BM-VC
Longbilled Crombec	R-VC	R-C
Longtailed Widow	R-VC	R(n)-C
Maccoa Duck	R-VC	R-U
Malachite Kingfisher	R-U	R-C
Marabou Stork	R-U	R-R/LC
Marico Flycatcher	E-C	Er-C

English Name	Map Status	General Status
Marsh Owl	R-U	R-C
Marsh Sandpiper	NBM-C	NBM-C
Martial Eagle	R-C	R-U
Masked Weaver	R-VC	R-C
Melba Finch	R-U	R-C
Monotonous Lark	E-U	Er-C
Montagu's Harrier	NBM-U	NBM-R
Mountain Chat	E-VC	Er-C
Namaqua Dove	R-VC	R-VC
Namaqua Sandgrouse	E-VC	Er-C
Neddicky	R-C	R-C
Old World Painted Snipe	R-U	R-U
Orange River Francolin	R-U	R-C
Orange River White-eye	E-VC	E-VC
Orangethroated Longclaw	E-VC	E-C
Ostrich	R-C	R-C
Pale Chanting Goshawk	E-VC	Er-C
Palewinged Starling	E-VC	Er-C
Palm Swift	R-U	R-C
Paradise Whydah	R-U	R-C
Pearlbreasted Swallow	NBM-U	R/BM-C
Pearlspotted Owl	R-C	R-C
Peregrine Falcon	R-U	R/NBM-R
Pied Avocet	R-C	R-LC
Pied Barbet	E-VC	Er-C
Pied Crow	R-A	R-A
Pied Kingfisher	R-C	R-C
Pied Starling	E-C	E-C
Pinkbilled Lark	E-C	Er-C
Pintailed Whydah	R-VC	R(n)-C
Pririt Batis	E-VC	Er-C
Purple Gallinule	R-U	R-C
Purple Heron	R-U	R-U
Purple Roller	R-C	R-U
Pygmy Falcon	R-U	R-C
Quail Finch	R-U/C	R-C
Red Bishop	R-VC	R-C
Redbacked Shrike	NBM-VC	NBM-C
Redbilled Firefinch	R-U	R-C
Redbilled Quelea	R-VC	R(n)-LA
Redbilled Teal	R-C	R-C

English Name	Map Status	General Status
Redbilled Woodhoopoe	R-U	R-C
Redbreasted Swallow	BM-C	BM-C
Redcapped Lark	R-C	R(n)-C
Redchested Cuckoo	BM-U	BM-C
Redcrested Korhaan	E-VC	Es-C
Redeyed Bulbul	E-A	Er-VC
Redeyed Dove	R-VC	R-C
Redfaced Mousebird	R-VC	R-C
Redheaded Finch	E-VC	Er-VC
Redknobbed Coot	R-VC	R-A
Reed Cormorant	R-VC	R-C
Ringed Plover	NBM-U	NBM-C
Rock Bunting	R-U	R(n)-LC
Rock Kestrel	R-U/VC	R-C
Rock Martin	R-VC	R-C
Rock Pigeon	R-VC	R-C
Ruddy Turnstone	NBM-U	NBM-C
Ruff	NBM-U/C	NBM-C
Rufouscheeked Nightjar	BM-C	BM-C
Rufouseared Warbler	E-U	E-C
Rufousnaped Lark	R-U	R-C
Sabota Lark	E-VC	Er-C
Sacred Ibis	R-VC	R-C
Sand Martin	NBM-U	NBM-C
Sanderling	NBM-U	NBM-C
Scalyfeathered Finch	E-VC	Er-C
Scimitarbilled Woodhoopoe	R-VC	R-C
Secretarybird	R-C	R-U
Shafttailed Whydah	E-U	Er-C
Shorttoed Rockthrush	E-U/C	Er-U
Sociable Weaver	E-U	E-C
South African Cliff Swallow	BM-C	Ebm-LC
South African Shelduck	E-VC	E-C
Southern Greyheaded Sparrow	E-VC	Er-C
Southern Pochard	R-C	R-C
Southern Yellowbilled Hornbill	E-VC	Er-C
Spikeheeled Lark	E-VC	Er-C
Spotted Dikkop	R-C	R-C
Spotted Eagle Owl	R-C	R-C
Spotted Flycatcher	NBM-C	NBM-C
Spurwinged Goose	R-C	R-VC

English Name	Map Status	General Status
Squacco Heron	NBM-U	R/NBM-U
Steelblue Widowfinch	R-U	R(n)-C
Steppe Buzzard	NBM-C	NBM-C
Stonechat	R-U	R-VC
Swainson's Francolin	E-VC	Er-C
Swallowtailed Bee-eater	R-U/VC	R-LC
Tawny Eagle	R-U	R-LC
Temminck's Courser	R-U	R-U
Threebanded Plover	R-VC	R-C
Threestreaked Tchagra	R-U	R-C
Tinkling Cisticola	R-U	R-U
Titbabbler	E-VC	Er-C
Violeteared Waxbill	E-U	Er-LC
Wattled Starling	R-VC	R(n)-LA
Whimbrel	NBM-U	NBM-C
Whiskered Tern	BM-C	R(n)-LC
White Stork	NBM-C	NBM-C
Whitebacked Duck	R-U	R-U
Whitebacked Mousebird	E-VC	E-C
Whitebacked Vulture	R-U	R-C
Whitebellied Sunbird	R-U	R-C
Whitebreasted Cormorant	R-VC	R-C
Whitebrowed Sparrowweaver	R-VC	R-VC
Whitefaced Duck	R-VC	R-C
Whitefaced Owl	R-U	R-C
Whitefronted Bee-eater	R-U	R-C
Whiterumped Swift	BM-C	BM-VC
Whitethroat	NBM-U	NBM-U
Whitethroated Canary	E-U	Er-C
Whitethroated Swallow	BM-C	BM-C
Whitewinged Korhaan	E-VC	E-VC
Whitewinged Tern	NBM-C	NBM-A
Willow Warbler	NBM-C	NBM-VC
Wood Sandpiper	NBM-C	NBM-C
Yellow Canary	E-VC	Er-C
Yellowbellied Eremomela	R-C	R-U
Yellowbilled Duck	R-VC	R-A
Yellowbilled Egret	R-C	R-U
Yellowbilled Kite	BM-U	BM-C
Yellowbilled Stork	NBM-U	NBM/R-LC

R=RESIDENT; E=ENDEMIC; BM=BREEDING MIGRANT; NBM=NON-BREEDING MIGRANT; V=VAGRANT; A=ABUNDANT;

VC=VERY COMMON; C=COMMON; U=UNCOMMON; R=RARE

APPENDIX D MAMMAL SPECIES LIST

Scientific name	Vernacular name	Status (Friedman & Daly, 2004)
Aethomys namaquensis	Namaqua rock mouse	Least concern
Alcelaphus buselaphus	Red hartebeest	Least concern
Antidorcas marsupialis	Springbok	Least concern

Scientific name	Vernacular name	Status (Friedman & Daly, 2004)
Canis mesomelas	Black backed jackal	Least concern
Caracal caracal	Caracal	Least concern
Ceratotherium simum	White Rhino	Least concern
Connochaetes taurinus taurinus	Blue wildebeest	Least concern
Crocidura cyanea	Reddish grey musk shrew	Data deficient
Cynictus penicillata	Yellow mongoose	Least concern
Crocidura hirta	Lesser red musk shrew	Data deficient
Cryptomys hottentotus	Common mole rat	Least concern
Desmodillus auricularis	Short-tailed gerbil	Least concern
Diceros bicornis bicornis	Black rhino	Critically endangered
Equus zebra hartmannae	**Hartman's mountain zebra**	**Endangered**
Felis nigipes	Black footed cat	Least concern
Felis silvestris	African wild cat	Least concern
Galerella pulverulenta	Small grey mongoose	Least concern
Galerella sanguinea	Slender mongoose	Least concern
Genetta genetta	Small spotted genet	Least concern
Gerbilurus paeba	Hairy footed gerbil	Least concern
Giraffae camelopardalis	Giraffe	Least concern
Hippotragus equinus	**Roan antelope**	**Vulnerable**
Hyaena brunnea	**Brown hyaena**	**Near threatened**
Hystrix africaeaustralis	Porcupine	Least concern
Ictonyx striatus	Striped polecat	Least concern
Lepus capensis	Cape hare	Least concern
Lepus saxatilis	Schrub hare	Least concern
Malacotrhix typica	Large-eared mouse	Least concern
Mastomys coucha	Multimammate mouse	Least concern
Mellivora capensis	**Honey badger**	**Near threatened**
Miniopterus schreibersii	**Schreiber's long-fingered bat**	**Near threatened**
Neoromicia capensis	Cape serotine bat	Least concern
Nycteris thebaica	Common slit-faced bat	Least concern
Oreotragus oreotragus	Klipspringer	Least concern
Orycteropus afer	Antbear	Least concern
Oryx gazella	Gemsbok	Least concern
Otocyon megalotis	Bat-eared fox	Least concern
Panthera pardus	Leopard	Least concern
Pedetes capensis	Springhare	Least concern
Poecilogale albinucha	African weasel	Data deficient
Procavia capensis	Rock dassie	Least concern

Scientific name	Vernacular name	Status (Friedman & Daly, 2004)
Pronolagus capensis	Smith's red rock rabbit	Least concern
Proteles cristatus	Aardwolf	Least concern
Raphicerus campestris	Steenbok	Least concern
Rhabdomys pumilio	Striped mouse	Least concern
Rhinolophus clivosus	**Geoffrroy's Horseshoe bat**	**Near threatened**
Rhinolophus darlingii	**Darling's horseshoe bat**	**Near threatened**
Rhinolophus denti	**Dent's horseshoe bat**	**Near threatened**
Saccostomus campestris	Pouched mouse	Least concern
Suricata suricatta	Suricate	Least concern
Sylvicapra grimmia	Common duiker	Least concern
Tadarida aegyptiaca	Egyptian free-tailed bat	Least concern
Tatera brantsii	Highveld gerbil	Least concern
Tatera leucogaster	Bushveld gerbil	Data deficient
Tragelaphus sterpsiceros	Kudu	Least concern
Vulpes chama	Cape fox	Least concern
Xerus inaris	Cape ground squirrel	Least concern

APPENDIX E HERPETOFAUNA LIST

Common Name	Status
AMPHIBIANS	
Bubbling Kassina	Least Concern
Eastern Olive Toad	Least Concern
Flat-backed toad	Least Concern
Common river frog	Least Concern
REPTILES	
Bibron's thick toed gecko	Least Concern
Boomslang	Least Concern
Bushveld lizard	Least Concern
Brown house snake	Least Concern
Cape Cobra	Least Concern
Cape skink	Least Concern
Cape thick-toed gecko	Least Concern
Cape wolf snake	Least Concern
Cape, Namib and Fork-Marked sand snakes	Least Concern
Common barking gecko	Least Concern
Common egg eater	Least Concern
Common night adder	Least Concern
Common rough scaled lizard	Least Concern

Common Name	Status
Delalande's beaked blind snake	Least Concern
Dusky spade-snouted worm lizard	Least Concern
Beetz' Tiger snake	Least Concern
Flap-neck chameleon	Least Concern
Giant ground gecko	Least Concern
Ground agama	Least Concern
Herald snake	Least Concern
Horned Adder	Least Concern
Kalahari round headed worm lizard	Least Concern
Kalahari sand snake	Least Concern
Kalahari tent tortoise	Least Concern
Kalahari tree skink	Least Concern
Kalahari whip snake	Least Concern
Karoo girdled lizard	Least Concern
Karoo sand snake	Least Concern
Leopard tortoise	Least Concern
Marsh terrapin	Least Concern
Mole snake	Least Concern
Mountain skink	Least Concern
Namaqua sand lizard	Least Concern
Peter's thread snake	Least Concern
Puffadder	Least Concern
Rock Monitor	Least Concern
Southern stilletto snake	Least Concern
Southern rock agama	Least Concern
Spotted sandveld lizard	Least Concern
Spotted sand lizard	Least Concern
Sundevall's shovel snout	Least Concern
Thin-tailed legless skink	Least Concern
Variegated skink	Least Concern
Western rock skink	Least Concern
Western three striped skink	Least Concern
Yellow-throated plated lizard	Least Concern