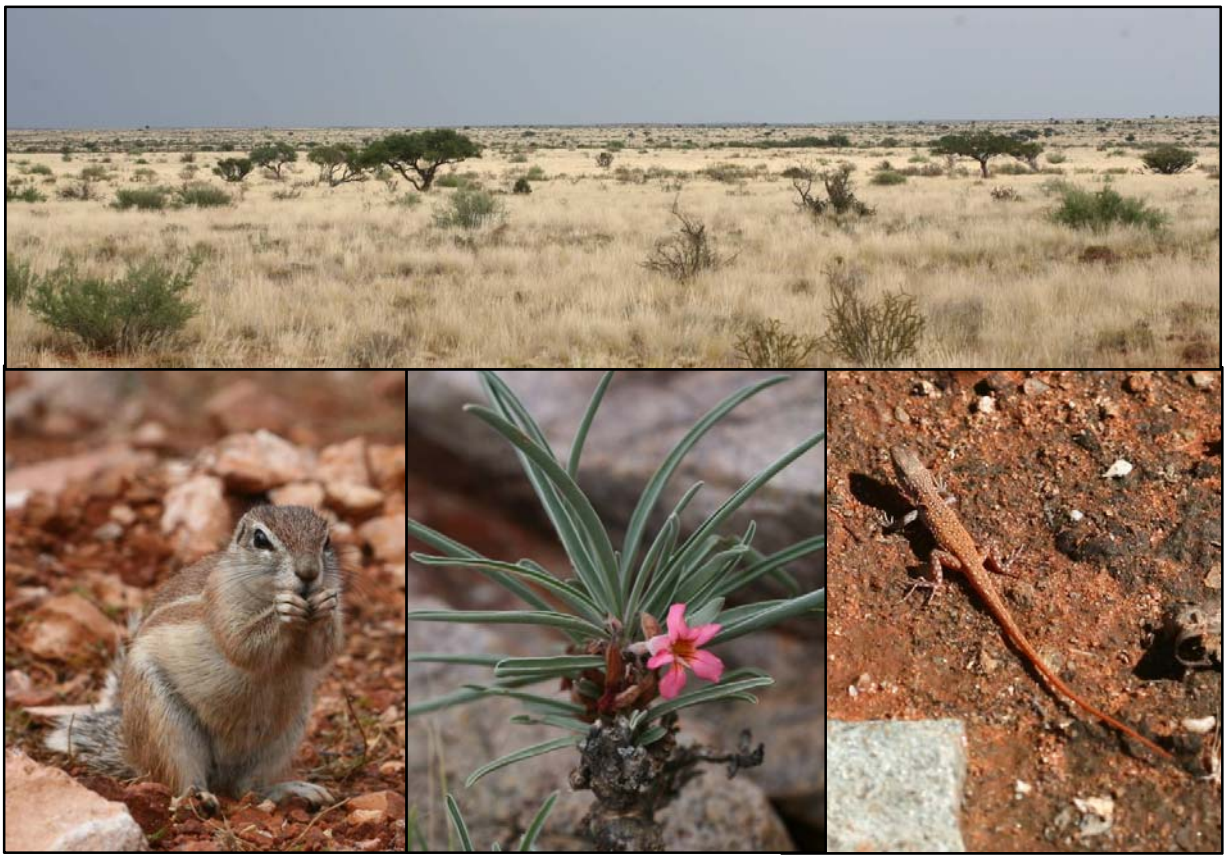
PROPOSED KAROSHOEK SOLAR VALLEY DEVELOPMENT

FAUNA & FLORA SPECIALIST IMPACT ASSESSMENT REPORT



Savannah
ENVIRONMENTAL (PTY) LTD

PRODUCED FOR SAVANNAH ENVIRONMENTAL

ON BEHALF OF

FG EMVELO (PTY) LTD

BY

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MAY 2012

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DECLARATION OF CONSULTANTS' INDEPENDENCE

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

Simon Todd Pr.Sci.Nat

May 2012

EXECUTIVE SUMMARY

This report details the fauna and flora impacts likely to be associated with the Karoshoek Solar Valley development near Upington. The development consists of a number of proposed development areas for solar energy generation as well as grid infrastructure to connect the facility to the ESKOM grid. Although the different proposed development areas are independent, they have been assessed together here on account of the fact that they are part of a larger development and all occur in the same area and would be exposed to a similar array of impacts.

A three-day site visit and desktop study were conducted to assess the presence and distribution of ecologically sensitive, species and habitats within each of the proposed development areas as well as along a proposed power line route. A broad-scale ecological map was generated for the whole area, as well as site specific sensitivity maps for each of the proposed development areas.

The results indicate that the development area is not situated within a highly sensitive environment and it is unlikely that the development would disrupt any highly significant broad-scale ecological processes. There were however some sensitive ecosystems present within many of the proposed development areas, which would need to be avoided. These are mostly pans and the larger drainage lines which occur in the area, which are considered to be ecologically important and sensitive ecosystems.

Five major potential impacts were identified which are likely to accompany the development of the site:

- Impacts on vegetation and listed plant species
- Increased erosion risk
- Increased alien plant invasion risk
- Faunal impacts
- Avifaunal impacts

Both erosion risk and alien plant invasion risk can be effectively mitigated through regular control and monitoring actions. However, the remaining impacts are less easily mitigated as they result to a greater or lesser degree from habitat loss and the long-term presence of the facility itself. Impacts on avifauna are potentially one of the more significant negative impact associated with the development as the risk would persist for as long as power transmission infrastructure was present. With the appropriate mitigation in place, which includes fitting bird flight diverters (bird flappers) to the lines as well as insulating live components, the likely impact would be reduced to an acceptably low level. Regular monitoring for avifaunal impacts with feedback to ecological risk management and mitigation would be an important element of reducing potential impacts on avifauna.

No layouts have been provided at this point, which places some limitations on the assessment, in terms of predicting all the likely impacts as well as recommending the most pertinent mitigation measures. As a result, additional ecological input should be obtained as the development process proceeds. In particular, important actions would be to ensure that an ecologist surveys the final development footprint to ensure that no highly sensitive

ecosystems have been impacted as well as locate listed species for search and rescue. In addition, once the development details have been finalized, additional input from an ecologist into the final EMP for each development site should be obtained.

With the above limitations and recommendations in mind, the various developments which comprise the Karoshoek Solar Valley are not likely to result in long-term degradation of the receiving environment provided that suitable avoidance and mitigation measures are implemented at each of the proposed development areas. The impact of each of the developments is likely be of local extent and of generally low significance on account of the widespread nature of the affected species and vegetation types. A summary assessment of the different impacts identified for each of the different proposed development sites in included below.

Summary assessment of the pre- and post-mitigation impacts associated with each of the different proposed development areas within the Karoshoek Solar Valley.

Site	Mitigation Status	Impact				
		Vegetation and listed plant species	Increased erosion risk	Alien plant invasion	Faunal impact	Avifaunal impact
Site 1.1	Pre Mitigation	Medium (40)	Medium (27)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low(24)	Low (15)	Low (15)	Low (24)	Low (18)
Site 1.3	Pre Mitigation	Medium (52)	Medium (44)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low (27)	Low (15)	Low (15)	Low (24)	Low (18)
Site 1.4	Pre Mitigation	Medium (40)	Medium (27)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low (24)	Low (15)	Low (15)	Low (24)	Low (18)
Site 2	Pre Mitigation	Medium (52)	Medium (54)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low (27)	Low (15)	Low (15)	Low (24)	Low (18)
Site 3	Pre Mitigation	Medium (52)	Medium (54)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low (27)	Low (15)	Low (15)	Low (24)	Low (18)
Site 4	Pre Mitigation	Medium (40)	Medium (27)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low (24)	Low (15)	Low (15)	Low (24)	Low (18)
Site 5	Pre Mitigation	Medium (40)	Medium (27)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low (24)	Low (15)	Low (15)	Low (24)	Low (18)
Transmission Line	Pre Mitigation	Medium (40)	Medium (30)	Low (27)	Low(27)	Medium-High (60)
	Post Mitigation	Low (15)	Low (8)	Low (15)	Low (21)	Low(15)

1 INTRODUCTION

FG Emvelo Energy (Pty) Ltd is proposing to develop a series of solar energy facilities in the Northern Cape near Upington, as part of the Karoshoek Solar Valley Development. Savannah Environmental have been appointed to carry out the EIA process as required in terms of the EIA regulations and have appointed Simon Todd Consulting to conduct the specialist ecological assessment of a portion of the proposed developments. The various proposed developments involved are listed below in Table 1, including the type, output and DEA reference numbers for the projects. Although these are independent developments, they are all solar developments which fall within a similar environment and form part of the larger Karoshoek Solar Valley Development. As such, they will be assessed within a single report as they will share a large number of attributes and potential impacts. However, the different sensitivities and distinguishing features of the different proposed develop areas will be individually assessed.

Table 1. List of projects that are to be assessed in this report.

Site	Project Name and Description	DEA Reference number
Site 2	Karoshoek CPVPD 1 (1 x 25 MW Concentrating photovoltaic or parabolic dish technology project)	14/12/16/3/3/2/292
	Karoshoek CPVPD 2 (1 x 25 MW Concentrating photovoltaic or parabolic dish technology project)	14/12/16/3/3/2/291
	Karoshoek CPVPD 3 (1 x 25 MW Concentrating photovoltaic or parabolic dish technology project)	14/12/16/3/3/2/290
	Karoshoek CPVPD 4 (1 x 25 MW Concentrating photovoltaic or parabolic dish technology project)	14/12/16/3/3/2/289
Site 1.1	Karoshoek LF 1 (1 x 100 MW Linear Fresnel)	14/12/16/3/3/2/293
Site 1.3	Karoshoek PT (1 x 100 MW Parabolic Trough)	14/12/16/3/3/2/294
Site 1.4	Karoshoek LFT 2 (1 x 100 MW Linear Fresnel or Parabolic Trough)	14/12/16/3/3/2/299
Site 3	Karoshoek Tower 1 (1 x 50MW Tower)	14/12/16/3/3/2/298
	Karoshoek Tower 2 (1 x 50MW Tower)	14/12/16/3/3/2/297
Site 4	Karoshoek LFTT 1 (1 X 100 MW Linear Fresnel or Parabolic Trough or Tower)	14/12/16/3/3/2/296
Site 5	Karoshoek LFTT 1 (1 X 100 MW Linear Fresnel or Parabolic Trough or Tower)	14/12/16/3/3/2/295

The broad terms of reference for the assessment include the following

- Assess and detail the potential impacts of the proposed development on both vegetation and fauna at the site
- Outline possible mitigation measures, rehabilitation procedures and or vegetation removal procedures that would reduce the potential impacts of the development.
- Identify and rate the significance of potential impacts and outline any additional management guidelines that might be required.

The detailed terms of reference are provided in the section below.

1.1 SCOPE OF STUDY

The scope of the study includes the following activities

- a description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project
- a description and evaluation of environmental issues and potential impacts (incl using direct, indirect and cumulative impacts) that have been identified
- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts
- an indication of the methodology used in determining the significance of potential environmental impacts
- an assessment of the significance of direct indirect and cumulative impacts in terms of the following criteria :
    - the nature of the impact, which shall include a description of what causes the effect, what will be affected and how it will be affected
    - the extent of the impact, indicating whether the impact will be local (limited to the immediate area or site of development), regional, national or international
    - the duration of the impact, indicating whether the lifetime of the impact will be of a short-term duration (0-5 years), medium-term (5- 15 years), long-term (> 15 years, where the impact will cease after the operational life of the activity) or permanent
    - the probability of the impact, describing the likelihood of the impact actually occurring, indicated as improbable (low likelihood) probable (distinct possibility), highly probable (most likely), or definite (Impact will occur regardless of any preventable measures)
    - the severity/beneficial scale indicating whether the impact will be very severe/beneficial (a permanent change which cannot be mitigated/permanent and significant benefit with no real alternative to achieving this benefit) severe/beneficial (long-term impact that could be mitigated/long-term benefit) moderately severe/beneficial (medium- to long-term impact that could be mitigated/ medium- to long-term benefit), slight or have no effect
    - the significance which shall be determined through a synthesis of the characteristics described above and can be assessed as low medium or high

  - the status which will be described as either positive, negative or neutral
  - the degree to which the impact can be reversed
  - the degree to which the impact may cause irreplaceable loss of resources
  - the degree to which the impact can be mitigated
- a description and comparative assessment of all alternatives
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Programme (EMPr)
- an indication of the extent to which the issue could be addressed by the adoption of mitigation measures
- a description of any assumptions uncertainties and gaps in knowledge
- an environmental impact statement which contains :
  - a summary of the key findings of the environmental impact assessment;
  - an assessment of the positive and negative implications of the proposed activity;
  - a comparative assessment of the positive and negative implications of identified alternatives

1.2 DATA SOURCING AND REVIEW

The data sources consulted and used where necessary in the study includes the following:

Vegetation:

- Vegetation types and their conservation status was extracted from the South African National Vegetation Map (Mucina and Rutherford 2006).
- Information on plant and animal species recorded for the Quarter Degree Squares (QDS) 2821AD, BC, CB and DA was extracted from the SABIF/SIBIS database hosted by SANBI. This is a significantly larger extent than the study area, but this has been done in order to account for the fact that the study area has probably not been well sampled in the past.
- The IUCN conservation status (Table 1) of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (2011).
- Threatened Ecosystem data was extracted from the NEM:BA listed ecosystems layer (SANBI 2008).
- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011).
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).

Fauna

- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and various spatial databases (SANBI's SIBIS and BGIS databases).

- Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
- Bird species lists for the area were extracted from the SABAP 1 and SABAP 2 databases and Birdlife South Africa's Important Bird Areas was also consulted to ascertain if the site falls within the range of any range-restricted or globally threatened species.
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site. For each species, the likelihood that it occurs at the site was rated according to the following scale:
    - **Low:** The available habitat does not appear to be suitable for the species and it is unlikely that the species occurs at the site.
    - **Medium:** The habitat is broadly suitable or marginal and the species may occur at the site.
    - **High:** There is an abundance of suitable habitat at the site and it is highly probable that the species occurs there.
    - **Definite:** Species that were directly or indirectly (scat, characteristic diggings, burrows etc.) observed at the site.

- The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria version 3.1 (2012) (See Table 1) and where species have not been assessed under these criteria, the CITES status is reported where possible. These lists are adequate for mammals and amphibians, the majority of which have been assessed, however the majority of reptiles have not been assessed and therefore, it is not adequate to assess the potential impact of the development on reptiles, based on those with a listed conservation status alone. In order to address this shortcoming, the distribution of reptiles was also taken into account such that any narrow endemics or species with highly specialized habitat requirements occurring at the site were noted.

Table 1. The IUCN Red List Categories for fauna and flora. Species which fall within the categories in red and orange below, are of conservation concern.

IUCN Red List Category
Critically Endangered (CR)
Endangered (EN)
Vulnerable (VU)
Near Threatened (NT)
Critically Rare
Rare
Declining
Data Deficient - Insufficient Information (DDD)

Data Deficient - Taxonomically Problematic (DDT)
Least Concern

1.3 SAMPLING LIMITATIONS AND ASSUMPTIONS

The major potential limitation associated with the sampling approach is the narrow temporal window of sampling. Ideally, a site should be visited several times during different seasons to ensure that the full complement of plant and animal species present are captured. However, this is rarely possible due to time and cost constraints and therefore, the representivity of the species sampled at the time of the site visit should be critically evaluated.

The vegetation at the time of the site was in a reasonable condition for sampling. A lot of the shrubs and grasses were growing and the majority were in a state that they could be identified. The sampling of the perennial component of the vegetation is therefore seen to be accurate and reliable. The annual component was however largely absent at the time of sampling and this component of the vegetation is not well represented. This limitation and the potential that species of conservation concern occur in the area that were not observed is countered by compiling a species list of any listed species known to occur in the general area from the SANBI SIBIS database. This represents a sufficiently conservative and cautious approach which takes account of the study limitations.

2 REGULATORY AND LEGISLATIVE OVERVIEW

A summary of the relevant portions of the Acts which govern the activities and potential impacts to the environment associated with the development are listed below. Provided that standard mitigation and impact avoidance measures are implemented, not all the activities listed in the Acts below would actually be triggered.

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

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

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

planning procedures, especially where they are subject to significant human resource usage and development pressure.

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

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

National Environmental Management: Biodiversity Act (NEM:BA) (Act 10 of 2004):

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

NEM:BA also deals with endangered, threatened and otherwise controlled species, under the TOPS Regulations (Threatened or Protected Species Regulations). The Act provides for listing of species as threatened or protected, under one of the following categories:

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

A TOPS permit is required for any activities involving any TOPS listed species.

Certain activities, known as Restricted Activities, are regulated by a set of permit regulations published under the Act. These activities may not proceed without environmental authorization. Those relevant to the current study are listed below.

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

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

Under the **Environmental Impact Assessment Regulations Listing Notice 2 of 2010** (No. R.387) the following activities are likely to be triggered:

Activity 1: The construction of facilities or infrastructure, including associated structures or infrastructure, for -

(a) the generation of electricity where –

(i) the electricity output is 20 megawatts or more; or

(ii) the elements of the facility cover a combined area in excess of 1 hectare;

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

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

Activity 16 IV: The construction of infrastructure covering 10 square meters of more where such construction occurs within a watercourse of within 32 metres of a watercourse measured from the edge of the watercourse, excluding where such construction will occur behind the development setback line.

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

National Forests Act (No. 84 of 1998):

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

Three tree species protected under the National Forests Act were observed within the site and may be impacted by the development. The protected tree species observed were *Boscia albitrunca* and *Acacia erioloba*. *Aloe dichotoma* is protected under provincial legislation and also occurs in the area. The abundance and distribution of these species within each of the proposed development areas is discussed in detail in a later section of this report.

A permit is required for the destruction or transplant or transport of any protected tree species.

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

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

The abundance of alien plant species at the site was generally low. Some of the watercourses are quite heavily infested with *Prosopis glandulosa*, while the plains were generally free of alien species except around watering points and other disturbed sites where species such as *Salsola kali* and *Flaveria bidentis* occurred at a low density.

National Veld and Forest Fire Act (Act No. 101 of 1998)

The purpose of this Act is to prevent and combat veld, forest and mountain fires. The Act provides for a variety of institutions, methods and practices for achieving the purpose such as the formation of fire protection associations. It also places responsibility on landowners to develop and maintain firebreaks as well be sufficiently prepared to combat veld fires.

The site is however very arid and it is unlikely that sufficient biomass to carry a fire develops on a regular basis. However, should areas be fenced-off and not grazed for some time, a fire risk could potentially develop. Under the Act, the landowner could be held responsible for any damages to neighbors' property caused under such a situation.

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

The Northern Cape Nature Conservation Act provides inter alia for the sustainable utilisation of wild animals, aquatic biota and plants as well as permitting and trade regulations regarding wild fauna and flora within the province. In terms of this act the following section may be relevant with regards to any security fencing the development may require.

Manipulation of boundary fences

19. No Person may –

(a) erect, alter remove or partly remove or cause to be erected, altered removed or partly removed, any fence, whether on a common boundary or on such person's own property, in such a manner that any wild animal which as a result thereof gains access or may gain access to the property or a camp on the property, cannot escape or is likely not to be able to escape therefrom;

The Act also lists protected fauna and flora under 3 schedules ranging from Endangered (Schedule 1), protected (schedule 2) to common (schedule 3). The majority of mammals, reptiles and amphibians are listed under Schedule 2, except for listed species which are under Schedule 1. A permit is required for any activities which involve species listed under schedule 1 or 2.

3 METHODOLOGY

3.1 SITE VISIT

The site visit took place over three days from the 26th to the 28th of April 2012. During the site visit, the various proposed development areas were each visited and extensive walk-through surveys were conducted in each. The different habitats, landscape units and vegetation features observed within each area were identified and mapped onto satellite imagery of the site and species lists of the plant species present within the different habitats identified were drawn up in the field. The presence and density of threatened and protected plant species within each area was also noted. Active searches for reptiles and amphibians were also conducted within habitats likely to harbor or be important for such species. The presence of sensitive habitats such as wetlands or pans and unique edaphic environments such as rocky outcrops or quartz patches were noted in the field if present and recorded on a GPS and mapped onto satellite imagery of the site.

3.2 SENSITIVITY MAPPING & ASSESSMENT

Due to the large extent of the development, ecological sensitivity maps for the site were generated at two different scales. A broad-scale sensitivity map for the whole area including the power line route was generated in order to place the development within the broader landscape context and assess the extent to which the cumulative impact of the development is likely to impact broad-scale ecological processes such as dispersal and migration. Following this, a fine-scale sensitivity map for each site was generated, which should be used to inform the site-specific development planning and the placement of infrastructure within each area.

The ecological sensitivity maps of the area were produced by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various spatial databases as described above. This includes delineating the different vegetation and habitat units identified in the field and assigning sensitivity values to the units based on their ecological properties, values and the potential presence of species of conservation concern. The ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

- **Low** – Units with a low sensitivity where there is likely to be a negligible impact on ecological processes and terrestrial biodiversity. This category is reserved specifically for areas where the natural vegetation has already been transformed,

usually for intensive agricultural purposes such as cropping. Most types of development can proceed within these areas with little ecological impact.

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

3.3 RELEVANT ASPECTS OF THE DEVELOPMENT

As described in the Introduction, the development consists of a number of proposed development areas. A variety of different solar generation technologies would be involved including Tower, Concentrating Photovoltaic, Parabolic Dish technology, Linear Fresnel and Parabolic Trough. Apart from the generating components, a variety of support infrastructure would be required including access roads, transmission lines, water pipelines, substations and other supporting elements. At this point, no detailed layouts for the different developments have been provided, but it is assumed that these will follow as each of the developments proceeds and would take account of the result of this and the other specialist studies. Currently the proposed development areas are restricted to the Karos valley, south east of Upington. Seven different development areas have been identified. Site 1 consists of four adjacent blocks, three of which are included in this assessment. Sites 3, 4 and 5 are to the west and southwest of Site 1, while Site 2 is to the north. Each development area is approximately 400 ha in extent. A 400 kV power line that will loop in and out of the future Eskom CSP MTS/Niewenhoop 400 kV power line (to be constructed in 2016), is also included in the assessment. The transmission line begins within Site 1 and runs westward until it connects with the ESKOM grid just west of the Kleinbegin Road, 18km to the west.

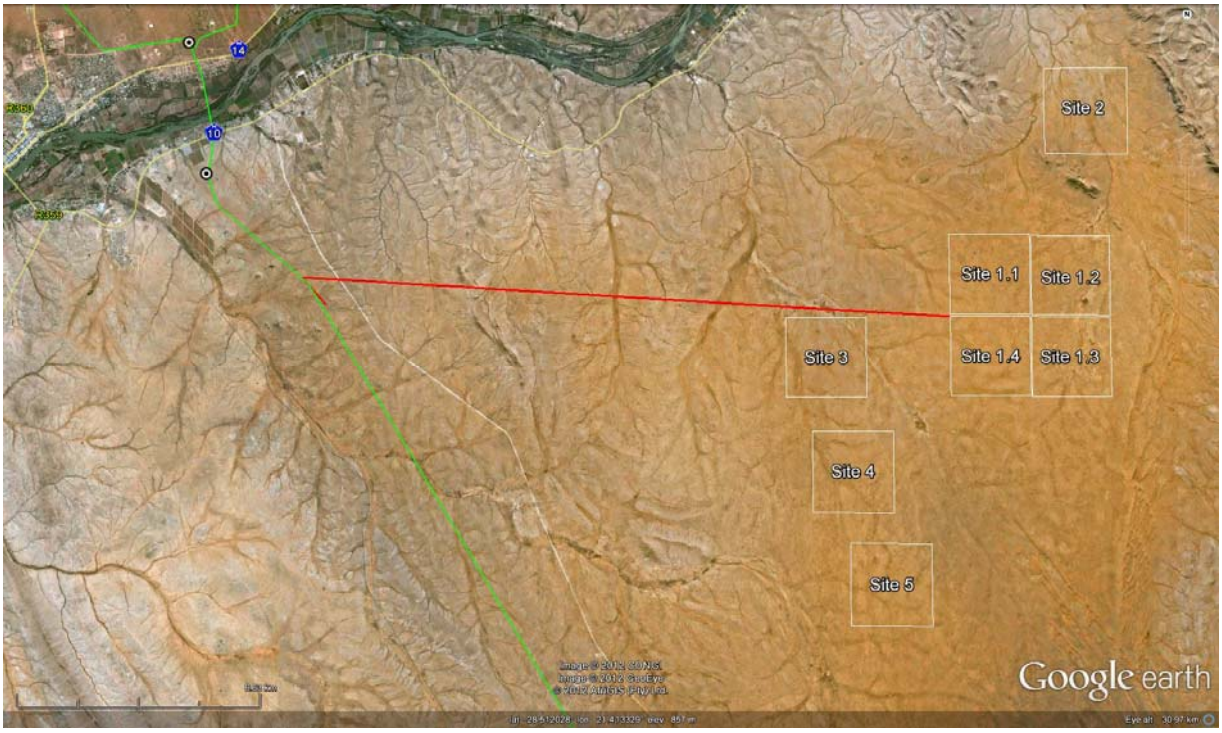

Figure 1. The proposed development areas of the Karoshoek Solar Valley Development and the power line route that will link the facility to the ESKOM grid. Note that Site 1.2 has been depicted, but is not a part of this assessment as it has already been assessed and approved through a separate EIA process.

4 DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 BROAD-SCALE VEGETATION PATTERNS

According to the national vegetation map (Mucina & Rutherford 2006), there are six vegetation types within the broad area around the site (figure 2), but only four of these are likely to be potentially impacted by the development. The basic statistics for these vegetation types are listed below in Table 2. The only vegetation type of conservation concern in the area is Lower Gariep Alluvial Vegetation which is Endangered on account of the fact that only 50% of this vegetation unit remains intact. This vegetation unit is associated with the alluvium along the Orange River and would not be impacted by the current developments which are some distance from the river itself. The other vegetation types are of similar sensitivity at a broad scale and all are overwhelmingly intact and have been little impacted by intensive agriculture or mining across their distribution. Gordonia Duneveld is well protected in comparison to the other vegetation units which are all poorly conserved, with virtually no extent within formal conservation areas. No endemic species are known from Kalahari Karroid Shrubland, while both Gordonia Duneveld and Bushmanland Arid Grassland are known to contain some endemic species, but given that

these are some of the most extensive vegetation types within South Africa, the endemic species tend to be widespread within the vegetation type itself and local-level impacts are not likely to be of significance for any of these species.

Table 1. Vegetation types which occur in the broad vicinity of the Karoshoek Solar Valley development, with their basic conservation statics and status according to Mucina & Rutherford (2006) as well as the National List of Threatened Ecosystems (2009).

Name	Extent km²	Remaining	Conservation Target	Protected	Status
Kalahari Karroid Shrubland	8284	99.2%	21%	0.1%	Least threatened
Gordonia Duneveld	36772	99.8%	16%	14.2%	Least threatened
Lower Gariep Alluvial Vegetation	752	50.3%	31%	5.8%	Endangered
Lower Gariep Broken Veld	4538	99.5%	21%	3.9%	Least threatened
Bushmanland Arid Grassland	45479	99.4%	21%	0.4%	Least threatened

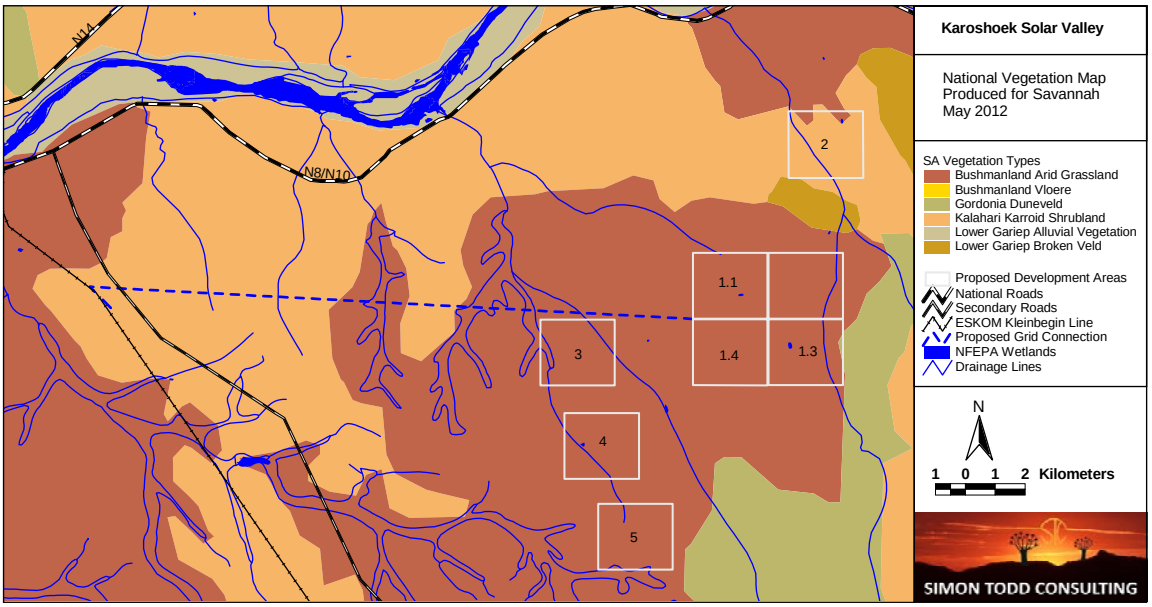

Figure 2. The vegetation in and around the Karoshoek Solar Valley development. The vegetation map is an extract of the National Vegetation Map as produced by Mucina and Rutherford (2006).

4.1.1 Vegetation Descriptions

In this section, a description of the vegetation units which have been mapped by Mucina & Rutherford (2006) is provided. Although vegetation descriptions are available in Mucina &

Rutherford (2006), the descriptions provided here are based on the observations and species lists recorded during the site visit and field assessment. As such, these apply specifically to the units as they occur at the site and may differ to a greater or lesser degree from the descriptions of Mucina & Rutherford.

Bushmanland Arid Grassland

According to the vegetation map of Mucina & Rutherford (2006), all the proposed development areas except for Site 2 fall within Bushmanland Arid Grassland. Within the site, the areas of Bushmanland Arid Grassland were generally extensive open plains with greater or lesser amounts of scattered taller woody species and trees present. Typically, this vegetation unit was dominated by grasses such as *Stipagrostis ciliata*, *S.uniplumis*, *S.amabilis* and *Schmidtia kalahariensis*. Trees and shrubs of the open plains included *Boscia foetida*, *Boscia albitrunca*, *Parkinsonia africana*, *Phaeoptilum spinosum*, *Rhigozum trichotomum* and *Aptosimum albomarginatum*.

There were also rocky and stony outcrops within this vegetation unit that contained a greater amount of woody shrubs and grass species not common in other areas. These areas were dominated by species such as *Aptosimum spinescens*, *Barleria rigida*, *Leucosphaera bainesii*, *Zygophyllum dregeanum* and grasses such as *Enneapogon scaber*, *Stipagrostis obtusa* and *Oropetium capense*. These areas also contained some protected species not observed elsewhere such as *Adenium oleifolium*, *Aloe claviflora* and *Hoodia gordonii*. The drainage lines within this vegetation unit were generally broad and flat, often without a distinct drainage channel. These areas generally contained similar grass species to the surrounding plains but contained a greater proportion of woody trees and shrubs, particularly *Acacia erioloba*, *A.mellifera*, *Boscia albitrunca*, *B.foetida*, *Rhigozum trichotomum* and *Lycium oxycarpum*.

Kalahari Karroid Shrubland

According to Mucina & Rutherford (2006) Site 2 falls largely within this vegetation unit. However, in the field the majority of this site corresponded more closely with Bushmanland Arid Grassland, and only the northern extent of the site could be considered to be representative of Kalahari Karroid Shrubland. Some of the rocky areas and low ridges which occurred in some of the other sites, particularly site 3, also corresponded to this vegetation unit but have not been mapped by Mucina & Rutherford, probably on account of their small extent. Species commonly observed within the areas of Kalahari Karroid Shrubland include shrubs such as *Leucosphaera bainesii*, *Hermannia spinosa*, *Monoechma genistifoilium*, *Salsola rabieana*, *Aptosimum albomarginatum*, *A.spinecens*, *Kleinia longiflora*, *Limeum argute-carinatum*, *Phyllanthus maderaspatensis*, grasses such as *Stipagrostis anomala*, *S.ciliata*, *S.uniplumis*, *S.hochstetteriana*, *S.uniplumis* and *Schmidtia kalariensis*. Few forbs were observed in this vegetation unit at the time of the site visit.

Gordonia Duneveld

No areas of Godonia Duneveld occur within the priopsoed development areas, but some areas of this vegetation type occur along the eastern margin of the development areas.

Common species observed within the areas of Gordonia Duneveld include trees such as *Parkinsonia africana*, *Boscia foetida*, *Boscia albitrunca* and *Acacia erioloba*, shrubs such as *Phaeoptilum spinosum*, *Rhigozum trichotomum*, *Crotalaria orientalis* and *Lycium bosciifolium*, grasses such as *Stipagrostis ciliata*, *S.uniplumis*, *S.amabilis*, *Schmidtia kalahariensis*, and forbs such as *Senna italica*, *Tribulis pterophorus*, *Hermannia tomentosa* and *Requienia sphaerosperma*.

Drainge Lines

Although the drainage lines in the area have not been mapped by Mucina & Rutherford as distinct vegetation units, their composition is distinct and deserves to be recognized independently of the surrounding vegetation types. The vegetation composition of the drainage lines was to some extent contingent on the size of the drainage line as well as the local substrate. Drainage lines within areas of shallow soils and exposed calcrete, were usually confined and narrow and dominated by woody species such as *Acacia mellifera*, *Boscia foetida*, *Phaeoptilum spinosum*, *Cadaba aphylla* and *Parkinsonia africana*, with an understorey of low shrubs and grasses such as *Zygophyllum rigidum*, *Monechma spartioides*, *Indigofera heterotricha*, *Fingerhutia africana* and *Cenchrus ciliaris*. Within areas of deeper sands, the drainage lines tended to be broad and less well defined and in many cases an actual channel where water movement regularly tales place was absent. In these areas, many of the drainage lines appear to result from the in-filling of the shallow valleys and depressions with sand over time. Many of these areas do not appear to ever actually have overland flow, which is not surprising given the infiltration capacity of the sand and low rainfall in the area. Nevertheless these areas may receive some runoff from the adjacent areas and on account of this and the greater depth of the sand have greater water holding capacity, which is expressed as the presence of the greater number of large trees such as Acacia erioloba. In some places, particularly where the rocky ridges were in close proximity, the drainage lines were better developed with clear, incised active channels, resulting from the greater runoff input from the adjacent hills.

The sensitivity of the different drainage lines can only be reliably assessed in the field and it is therefore recommended that sensitive areas associated with the drainage lines should be demarcated by an ecologist with experience in arid areas, prior to construction or even during the planning stage so that these areas can be properly accommodated during the design phase of the development.

Protected and Listed Plant Species

A number of protected species were observed within the study area, in areas that would potentially be impacted by the various developments. This includes *Acacia erioloba*, which was common within some of the larger drainage lines, *Boscia albitrunca* was also widespread at the site and was also particularly common in drainage lines and in areas of red Kalahari sand. *Aloe clavifora* was observed to be common in areas of stony ground, calcrete and on gravel plains. *Adenium oleifolium* was observed to be common on some of the gravel and quartz outcrops, particularly within Site 3. *Hoodia gordonii* was not

common, but a few individuals were observed within Site 4 and it may occur more widely at the site. Listed species that are known to occur in the area, but which were not observed include *Brachystelma huttonii* (Rare) and *Pelargonium reniforme* subsp. *reniforme* (Data Deficient Data). A permit is required for any activities which are likely to directly or indirectly impact the survival of any of these species. Although the various species listed above are regulated under a number of different acts, a single integrated permit obtainable from DENC is required which would cover all of the affected species. A blanket clearing permit would also be required.

4.2 CRITICAL BIODIVERSITY AREAS & BROAD-SCALE PROCESSES

No fine-scale conservation planning has been done in the district and as a result, no Critical Biodiversity Areas have been defined. The site also does not fall within areas that have identified as focus areas under the National Protected Areas Expansion Strategy, indicating that the development areas do not occur within areas that have been identified as being important for biodiversity maintenance at a landscape scale. Furthermore, there was no evidence to suggest that the area is likely to be highly significant as faunal movement or migration pathway. The area is generally homogenous and given the extensive amount of intact vegetation in the area, there is likely to be little overall disruption to the broad-scale connectivity of the landscape. Given the large amount of development which is planned for the area, a significant local impact is likely to occur, but there would remain sufficient intact habitat in the broader area to retain the overall ecological functioning of the landscape.

4.3 FAUNAL COMMUNITIES

Mammals

The site falls within the distribution range of 46 terrestrial mammals, indicating that the mammalian diversity at the site is likely to be moderate to low. At a broad scale, it is likely that a large proportion of these species occur at the area. However, within the affected development areas, mammalian diversity is likely to be quite low on account of the limited range of habitats available. No species associated with rocky outcrops are likely to occur within the proposed development areas, which would significantly reduce the number of the species that would be directly affected. As the affected habitats are widely available in the area, as well as at a broader scale, the impacts would be local in nature and it is not likely that the long-term viability of any populations of terrestrial mammals would be compromised by the development. Three listed terrestrial mammals may occur at the site, the Honey Badger *Mellivora capensis* (Endangered), Brown Hyaena *Hyaena brunnea* (Near Threatened) and Black-footed cat *Felis nigripes* (Vulnerable). Although the area is used for livestock production, human activity in the area is low and it is possible that all three listed species occur in the area. Some habitat loss for mammals is an inevitable consequence of the development but is not likely to be of broader significance. Faunal disturbance and human presence would be highest during the construction phase and terrestrial faunal impacts are also likely to be largely concentrated to this phase of the development.

The site lies within the distribution range of 6 bat species, indicating that the richness of bats at the site is probably quite low. Bat activity is probably focused along the Orange River, where there is ample food as well as an abundance of natural and artificial shelter. The lack of wetlands and large drainage lines away from the Orange River suggests that bat activity patterns within the site are likely to be low. Areas of higher activity are likely to be near the larger ridges of the area and the wooded drainage lines. It is however highly unlikely that the development would create a significant negative impact on bats in the area. Bats are known to occasionally collide with transmission lines and so in order to avoid attracting bats to the area, any buildings and structures required as part of the development should be properly sealed to avoid creating bat roosting spaces and night lighting should be of a type which does not attract insects.

In terms of potential differences in mammalian fauna between the proposed development sites, there is not likely to be a high degree of differentiation, since the range of habitats present is largely similar within each development area. None of the sites had large rocky outcrops or drainage lines which are likely to hold water for significant periods. As most sites had areas of higher and lower grass and shrub cover as well as some areas of deeper sands or harder ground, the suite of mammals present is likely to be broadly similar. There were also few significant differences in land-use or rangeland condition which would have a large impact on mammalian community structure.

Reptiles

The site lies within the distribution range of 34 reptile species, suggesting that the reptile diversity in the area is likely to be quite low. Within the affected plains habitat of the site, the reptile composition is likely to be dominated by species which inhabit open areas, such as Horned Adders, Sand Lizards, Ground and Barking Geckos. As there were no large rocky outcrops within the proposed development areas, species associated with rocky habitats are not likely to occur in these areas and would not be impacted by the development. As with mammals, the development is likely to result in some significant local habitat loss for reptiles but as there are not range-restricted reptiles which would occur in the affected areas, the impacts are not likely to be of broader significance. The development would be likely to create some novel habitats for reptile, which would potentially benefit a limited number of species which could take advantage of the novel habitat created within the development areas. This is likely to be restricted to species such as geckos and agamas, which would utilise the buildings and other vertical infrastructure of the development. This would however be a very limited number of species and is not considered an overall positive outcome.

Given the relative homogeneity of the affected habitat, there is not likely to be a high degree of differentiation in reptilian composition between the proposed development areas. Some of the site contained a greater proportion of trees and drainage lines, which would represent habitat for tree and shrub-dwelling species such as Skinks and Agamas. Important reptile habitats such as rocky outcrops did not occur within the proposed development areas, and most species present within the plains habitat which characterizes the sites are likely to be widespread species of low conservation concern.

Amphibians

The site lies within the distribution range of 10 amphibian species. The only listed species which may occur at the site is the Giant Bullfrog *Pyxicephalus adspersus* which is listed as Near Threatened. Some of the pans observed within the proposed development areas represent potentially suitable breeding habitat for this species as well as any other species present which breed in temporary pools. Those amphibians which require perennial water are likely to be restricted to the vicinity of the Orange River and the plains of the site are likely to contain low amphibian diversity and are not likely to be highly significant from an amphibian perspective. Impacts on amphibians is likely to be local in nature and of low magnitude.

Those development areas which contain pans and extensive drainage systems are likely to contain the greatest amphibian abundance and diversity. The pans have been assessed as being of Very High ecological sensitivity and the development should avoid these areas, including the provision of an adequate buffer between the development and the sensitive receptors.

Avifauna

According to the SABAP 1 and 2 data sets, 190 bird species are known from the broad area surrounding the Karoshoek Solar Valley site. This includes 7 IUCN listed species, detailed below in Table 1. All of the listed species are susceptible to some degree to either or both electrocution or collision from power-line infrastructure. Larger raptors are susceptible to both collision and electrocution, while storks and bustards are all vulnerable to collision with power lines. This is a potentially significant source of impact for these species. Given the relatively long length of the power lines which are required for the development, the potential for negative impacts on avifauna is high. Although the Black Stork would probably occur largely along the Orange River, these birds make long-distance movements between sites and would be vulnerable to collision during such local movement patterns. The two bustard species also move about the karoo in response to rainfall patterns and the distribution of food and are likely to frequent the area on a regular basis. These species are particularly vulnerable to collisions with power lines, and a number of Kori Bustards were observed in the area during the site visits. Apart from direct habitat loss and destruction, the disturbance created during the construction phase of the project would disturb some bird species and deter them from the area temporarily. However, the major impacts on avifauna are likely to occur after construction and without mitigation these would operate on a long-term basis.

Table 1. Listed bird species known to occur in the vicinity of the proposed Karoshoek Solar Valley site, according to the SABAP 1 and 2 databases, and their risk of collision with or electrocution from power line infrastructure.

Species	Common Name	Status	Collision	Electrocution
Falco biarmicus	Lanner Falcon	NT	High	Moderate
Falco naumanni	Lesser Kestrel	VU	High	Moderate
Ciconia nigra	Black Stork	NT	High	
Falco peregrinus	Peregrine Falcon	NT	High	Moderate
Ardeotis kori	Kori Bustard	VU	High	
Neotis ludwigii	Ludwig's Bustard	VU	High	
Polemaetus bellicosus	Martial Eagle	VU	Moderate	High

5 SITE SENSITIVITY ASSESSMENT

5.1 BROAD-SCALE ASSESSMENT

The broad-scale ecological sensitivity map produced for the Karoshoek Solar Valley and surrounding area is depicted below in Figure 3. The map indicates that there are no major broad-scale ecological features which are significantly impacted by the proposed developments. The ridges and larger drainage systems have been largely avoided by the proposed development areas. The proposed power line traverses some sensitive areas, but given the small terrestrial footprint of the power line, it is not likely to create a significant impact on these areas. Furthermore, the impact on the sensitive areas could be further reduced though micrositing and fine-scale adjustment of the final powerline path and support footprints.

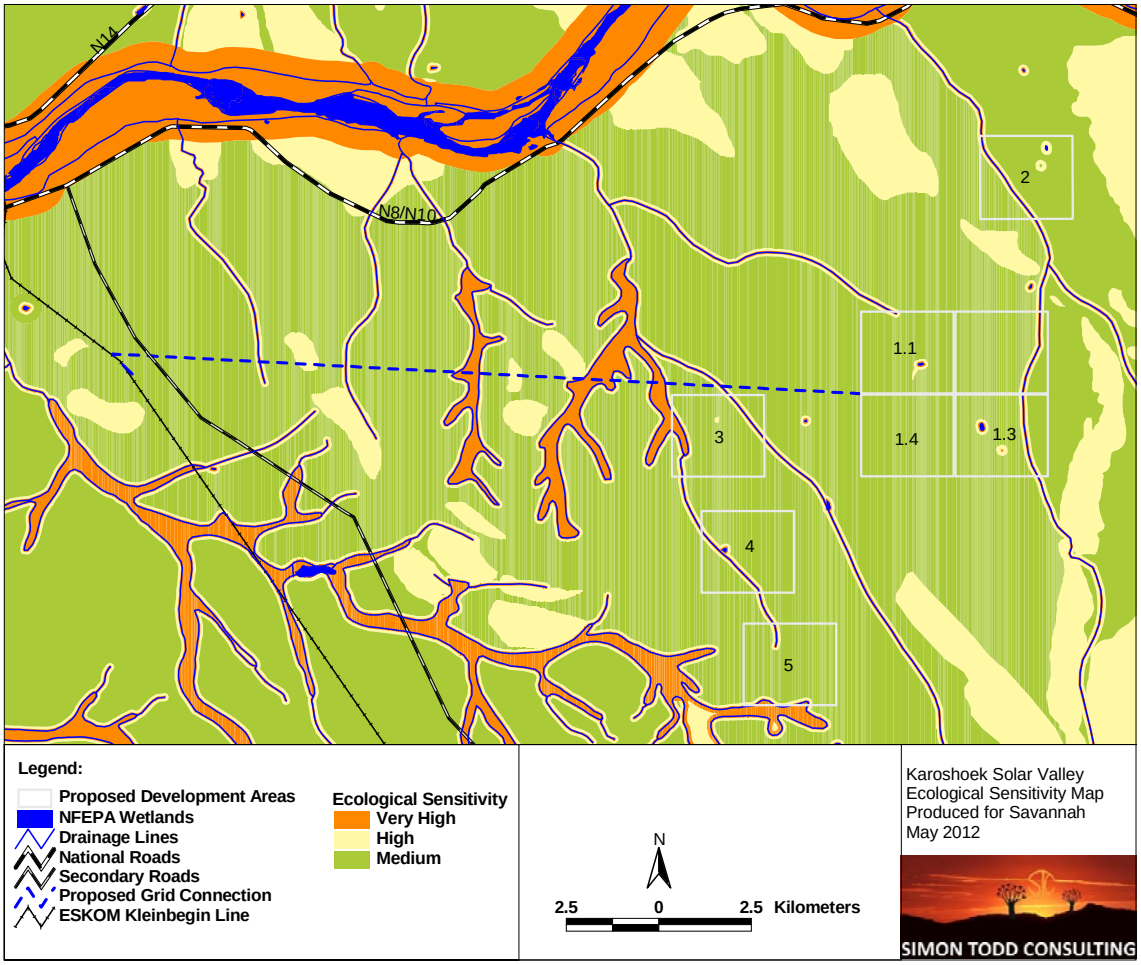

Figure 3. Broad-scale, ecological sensitivity map of the Karoshoek Solar Valley site and surrounding area. A fine scale, site-specific sensitivity map for each site has also been generated.

5.2 SITE SPECIFIC ASSESSMENT

Site 1

The sensitivity map for Site 1.1, Site 1.3 and Site 1.4 is depicted below in Figure 5. In general this area was very homogenous and there were few features present of ecological significance.

Site 1.1

Within Site 1.1 there were some small pans present, which contained water at the time of the site visit on account of the recent rains that had occurred. As it had rained only just before the site visit, fauna such as amphibians had not yet started to breed in the pans and so it was not possible to evaluate the significance of the pans in this regard. However,

some of the pans contained some emergent vegetation and appeared to be quite favorable as breeding habitat. Given the ecological significance of the pans, these areas should be avoided by the development and an adequate buffer of 100m should also be afforded to these areas.

Figure 4. Vegetation within Site 1.1. In the left image, typical view of the site, with dense *Stipagrostis* and scattered *Rhigozum trichotomum*, *Phaeoptilum spinosum* and occasional *Boscia albitrunca* trees. In the right image, the pan which occurs within Site 1.1 and which should be considered a sensitive area that should be avoided by development within the site.

Site 1.3

As with Site 1.1, the pans which occur within this site should be considered sensitive and should not be impacted. The drainage system which occurred within this site was diffuse and not very well differentiated from the surrounding landscape and the areas mapped as part of the drainage system in the sensitivity map took the form of bare or sparsely vegetated areas on the ground. These areas probably only have some overland flow in exceptional circumstances, but have become more silty and less vegetated on account of silt deposition from the surrounding areas. The sensitive areas within these broad drainage systems should be delineated by an ecologist prior to construction.

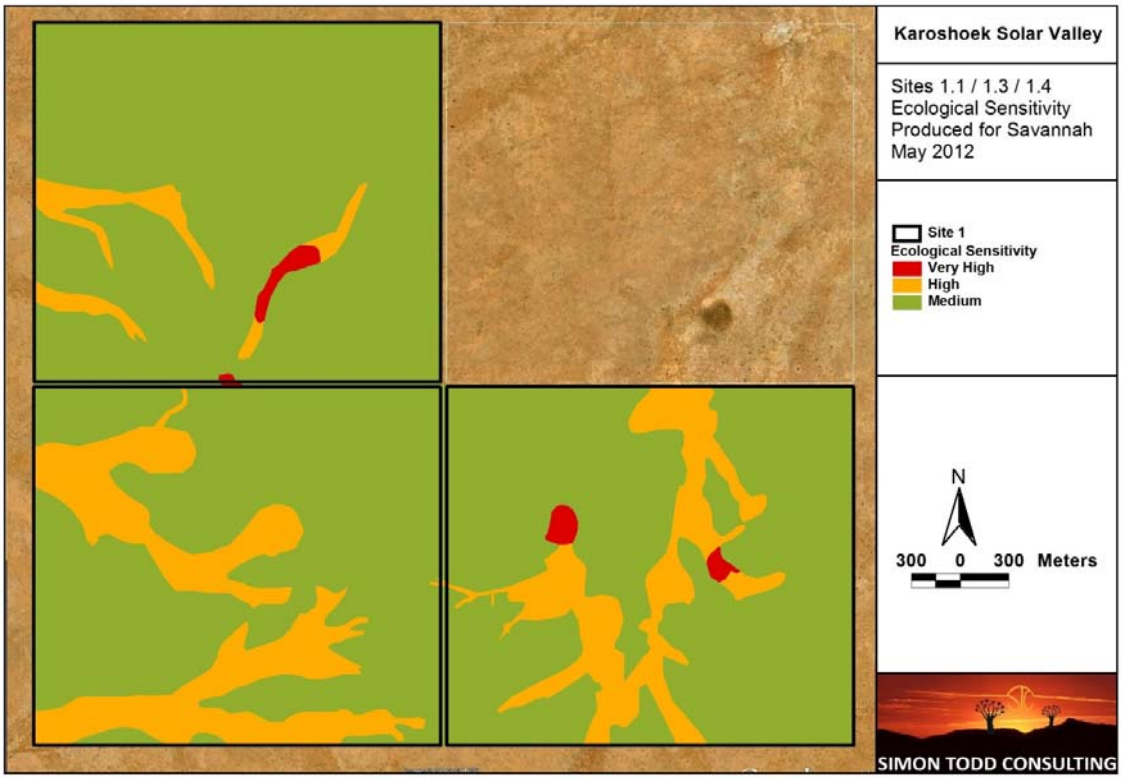

Figure 5. Ecological Sensitivity map of Sites 1.1(top left), 1.3 (bottom right) and 1.4 (bottom left).

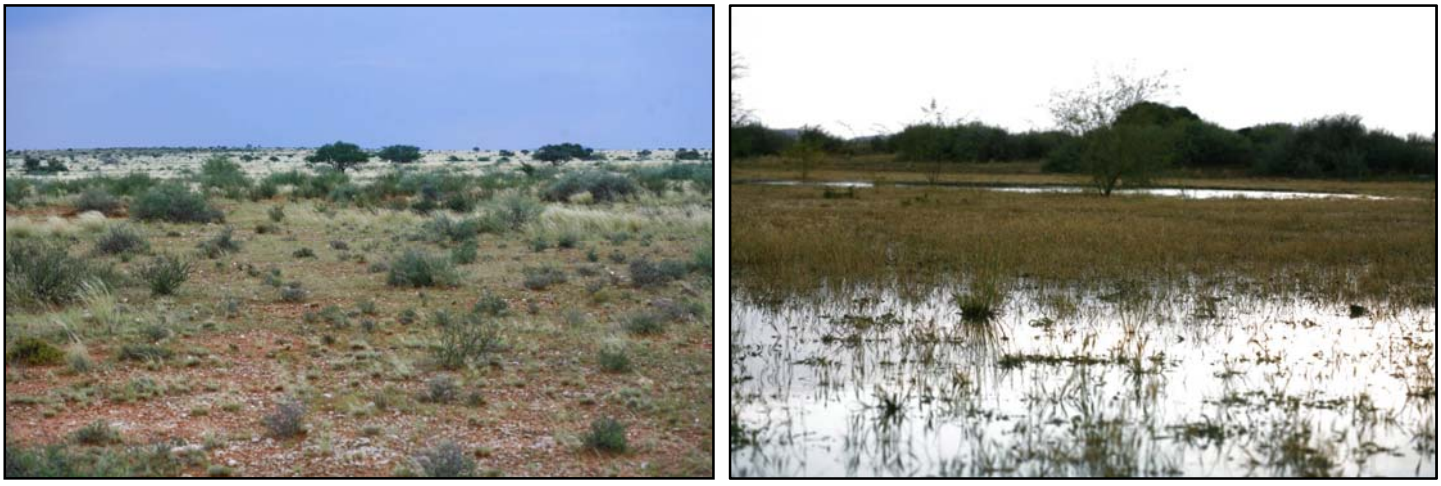

Figure 6. Site 1.3, showing an area of shallow soils in the foreground of the left image, dominated by *Stipagrostis obtusa*, *S.ciliata* and shrubs such as *Lycium*, *Phaeoptilum* and *Rhigozum*. In the background an area of deeper sand can be seen with *Boscia albitrunca* prominent. In the right image, the relatively large pan that was observed within this site, with a lot of emergent vegetation and a number of individuals of the alien tree *Prosopis glandulosa* within the pan. The vegetation around the margin of the pan is largely *Phaeoptilum spinosum*, *Boscia albitrunca* and *Acacia mellifera*.

Site 1.4

Site 1.4 was relatively homogenous at a broad scale. The most conspicuous feature of this area was the extensive drainage system which covers a large proportion of the site. These areas were not drainage lines as such, but rather represent broad areas of deeper sands which have filled-in depressions and valleys in the landscape, which were probably formed in previous times (10's of thousands of years ago) of greater rainfall. These areas were dominated largely by *Boscia albitrunca*, with occasional *Acacia erioloba*. As these areas constitute a large proportion of the site, it is likely that any development within the site will impact these areas to some extent. A greater degree of caution and increased levels of mitigation should be exercised within such areas to avoid negative long-term impacts to these areas. This would include demarcating and core areas or ecologically sensitive areas by an ecologist prior to construction. A large number of Boscia trees occur in some parts of the site and a permit for the removal of these trees would be required. If a large number of trees are affected, the Departmemnt of Environment and Nature Conservation (DENC) may decide that an offset, such as planting additional trees somewhere else is required.

Figure 7. Site 1.4, showing an area of deeper sands in the left image with dense *Stipagrostis* and scattered *Boscia* trees, while the right image shows an area of shallower soils, with a higher proportion of woody shrubs such as *Phaeoptilum spinosum*, *Aptosimum albomarginatum* and *Hermannia spinosa*.

Site 2

Site 2 is characterized by the presence of a large drainage system which traverses the site, as well as two pans in the north-eastern sector of the site. The drainage system was one of the most densely wooded which occurs within any of the proposed development areas. The drainage system was dominated by quite dense stands of *Acacia erioloba* and *Boscia albitrunca* as well as occasional *Zizyphus mucronata*. The drainage line is ecologically significant and should not be disturbed. The two pans at the site are also ecologically important as they occasionally hold water and are probably important amphibian breeding

habitats. Despite the fact the vegetation in this area has been classified by Mucina and Rutherford as Kalahari Karroid Shrubland, the majority of the site was similar in structure to the other proposed development areas which fall within the Bushmanland Arid Grassland vegetation unit. Only the northern margin of the site, which consisted of a low ridge of exposed calcrete could be considered to conform to Kalahari Karroid Shrubland. Dominant grasses present were *Stipagrostis uniplumis*, *Stipagrostis ciliata*, *Enneapogon scaber* and *Schmidtia kalahariensis*, while common larger shrubs were *Phaeoptilum spinosum*, Rhigozum trichotomum and *Lycium pumilum*. Smaller shrubs included *Aptosimum spinescens*, *Aptosimum albomarginatum*, *Zygophyllum rigidum*, *Barleria rigida* and *Eriocephalus microphyllus*. Common trees outside of the drainage lines were *Acacia mellifera* and *Boscia foetida*. Apart from the protected tree species *Acacia erioloba* and *Boscia albitrunca* some individuals of *Aloe claviflora* which is protected under provincial ordinance were also observed at the site, within the areas of exposed calcrete.

Figure 8. Ecological Sensitivity map of Site 2.

Figure 9. Site 2, looking over the central part of the site in the left image and an area of exposed calcrete soils along the northern margin of the site in the let image. In the left image, the vegetation is dominated by *Stipagrostis* with shrubs such as *Monechma incanum*, *Phaeoptilum spinosum* and *Aptosimum albomarginatum*. Within the area of exposed calcrete dominant species included *Leucosphaera bainesii*, *Monoechma genistifoilium*, *Salsola rabieana*, *Aptosimum albomarginatum* and *A.spinecens*.

Figure 10. Sensitive features within Site 2. In the left, the drainage line which characterizes the southwest of Site 2, with *Stipagrostis namaquensis* in the foreground with numerous *Acacia erioloba* and *Boscia albitrunca* in the river and adjacent floodplain. In the right image, one of the small pans which was observed within Site 2, the emergent vegetation in the pan is the *Flaveria bidentis*, while the shrubs around the margin are *Phaeoptilum spinosum* and the trees *Boscia albitrunca*.

Site 3.

Site 3 is characterized by the presence of a large drainage line in the north east of the site, which contains a number of very large *Boscia albitrunca* specimens. There is also a low exposed ridge which forms the western bank of the drainage line. The ridge has some areas of low quartzitic outcrops which contain numerous *Adenium oleifolium* plants, which is

a protected species in the Northern Cape. Preferably, this area should be avoided, however, if some development must impinge on this area, the National Botanical Gardens in Kirstenbosch should be approached to remove the affected individuals as they have requested this species for their collections. The probability of successfully translocating this species at the site is probably low on account of the fact that it has large tuber and replanting it within suitably rocky habitat would be almost impossible.

Figure 11. Ecological Sensitivity map of Site 3.

Figure 12. Site 3, showing the rocky ridge and drainage line in the left image and the plains of the site in the right image. The drainage line is well developed and should not be developed, while the rocky ridge in the foreground is also considered to be sensitive on account of the presence of some listed species in the area. The plains of the site are less sensitive and contained few protected species apart from some *Boscia albitrunca*.

Figure 13. A significant number of *Adenium oleifolium* plants were observed in the areas of rocky outcrop which occurred within Site 3. This is a provincially protected species.

Site 4.

Site 4 was very homogenous and the only feature of the site is a broad drainage line which traverses the site. The drainage line did not contain many trees suggesting that it does not receive very much water and was dominated by the shrubs *Rhigozum trichotomum* and

Phaeoptilum spinosum. The plains of the site were typical of the area, being dominated by Stipagrostis with scattered Boscia and other small trees. The only species of conservation concern observed with the site was an individual of *Hoodia gordonii*. Searches for this and other potential species of concern should be conducted at the site prior to construction.

Figure 14. Ecological Sensitivity map of Site 4.

Figure 15. Site 4, illustrating the plains of the site in the left image and the drainage line which crosses the site in the right image.

Site 5

Site 5, was largely similar to Site 4, but contained only the upper reaches of drainage lines which were not well developed and were not highly significant from an ecological perspective as these areas were not well differentiated from the surrounding vegetation. The vegetation was not highly sensitive and the only listed species observed in the area was *Boscia albitrunca*. *Hoodia gordonii* may however also occur in the area. There are few constraints on development within this area, and aside from searching the development footprint for species suitable for search and rescue, there are few preconstruction activities that would be required in this area.

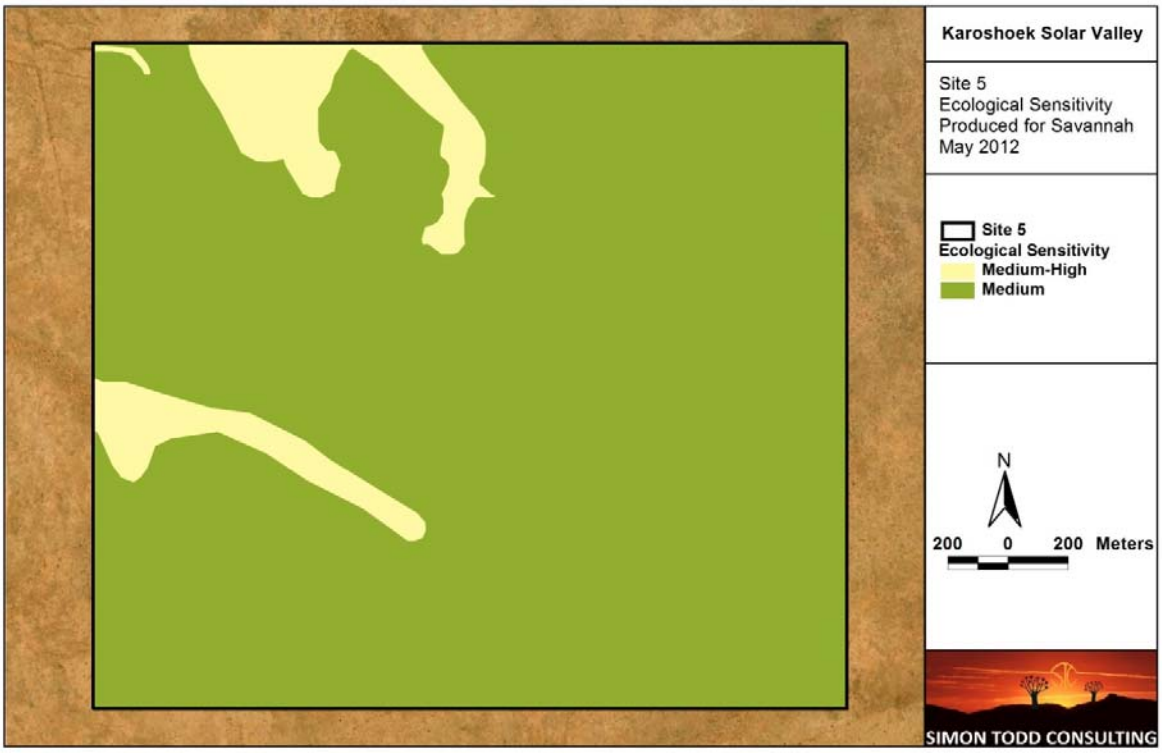

Figure 16. Ecological Sensitivity map of Site 5.

Figure 17. Site 5, illustrating the homogenous nature of the area. The vegetation is dominated by *Stipagrostis* with widely scattered *Boscia* trees. Some areas such as in the right image contained a higher density of *Rhigozum trichotomum* but the overall composition of the area was very similar.

6 IMPACT ASSESSMENT

6.1 ASSESSMENT & SIGNIFICANCE CRITERIA

Direct, indirect and cumulative impacts of the issues identified in this report are assessed in terms of the following criteria:

- The **nature** which shall include a description of what causes the effect what will be affected and how it will be affected.

- The **extent** wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):

- The **duration** wherein it will be indicated whether:

    - the lifetime of the impact will be of a very short du ration (0- 1 years) - assigned a score of 1.
    - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2.
    - medium-term (5-15 years) - assigned a score of 3
    - long term (> 15 years) - assigned a score of 4; or
    - permanent - assigned a score of 5

- The **magnitude** quantified on a scale from 0-10 where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in

processes continuing but in a modified way 8 is high (processes are altered to the extent that they temporarily cease) and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

- The **probability** of occurrence, which shall describe the (likelihood of the impact actually occurring. Probability will be estimated on a scale of 1-5 where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but of low likelihood) , 3 is probable (distinct possibility) , 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).

The **significance** which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high;
and;

- the status, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the degree to which the impact can be mitigated.

The **significance** is calculated by combining the criteria in the following formula:
S = (E + D + M)P
Where

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

The significance weightings for each potential impact are as follows:

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

6.2 IDENTIFICATION & NATURE OF IMPACTS

6.2.1 Impact Risk Factors

Potential ecological impacts resulting from the development would stem from a variety of different activities and risk factors associated with the construction and operational phases of the project including the following:

Construction Phase

- Vegetation clearing for PV panels, troughs, lay down areas, roads, buildings etc could impact listed plant species as well as high-biodiversity plant communities. Vegetation clearing will also lead to habitat loss for fauna and potentially the loss of sensitive faunal species, habitats and ecosystems.
- High erosion risk may result due to the loss of plant cover and soil disturbance created during the construction phase. This may impact downstream riparian and wetland habitats if a lot of silt enters the drainage systems. Although the effects would probably only become apparent during the operational phase, the impact stems from the construction phase and suitable mitigation measures will also need to be applied at this stage.
- Presence and operation of construction machinery on site. This will create a physical impact as well as generate noise, pollution and other forms of disturbance at the site.
- Increased human presence can lead to poaching, illegal plant harvesting and other forms of disturbance such as fire.
- Loss of connectivity & habitat fragmentation may result due to the presence of the generation infrastructure, roads, site fencing and other support infrastructure of the development.

Operational Phase

- The daily maintenance and operation activities of the facilities would generate some noise and disturbance which may deter some fauna from the area, amounting to a loss of connectivity & habitat fragmentation.
- Maintenance activities such as vegetation clearing will impact the biodiversity of the site if not conducted in a sensitive manner.
- Persistent avifaunal impacts would potentially result from the presence of power transmission infrastructure at the site.

6.2.2 Identified Impacts

The above risk factors are likely to be manifested as the following impacts:

Impacts on vegetation and listed plant species

Some loss of vegetation is an inevitable consequence of the development. The vegetation types within the affected area are however widespread and the loss of even a few thousand hectares of these vegetation would be of relatively minor significance when considered at a broad scale. However, the potential impacts on listed plant species is of greater significance given the abundance of certain listed species within the site.

Increased erosion risk

Increased erosion risk would result from soil disturbance and the loss of plant cover within cleared and disturbed areas. As some solar generation technologies such as CSP, usually require that the development footprint is sterilized (completely cleared), these areas would generate a lot more runoff than intact vegetation. As a result, the receiving areas would be vulnerable to erosion and regular monitoring to ensure that erosion problems are addressed would be required.

Increased Alien Plant Invasion Risk

The disturbance created during the construction phase of the project would leave the site highly vulnerable to invasion by alien plant species, which would impact diversity and ecological processes within the area. Alien species that were observed and which might increase in response to the disturbance include *Prosopis glandulosa*, *Salsola kali* and *Flaveria bidentis.*

Faunal impacts

Increased levels of noise, pollution, disturbance and human presence will be detrimental to fauna. Sensitive and shy fauna would move away from the area during the construction phase as a result of the noise and human activities present. Some mammals and reptiles such as tortoises would be vulnerable to illegal collection or poaching during the construction phase as a result of the large number of construction personnel that are likely to be present. The development areas would also amount to habitat loss for most fauna, although there are some species which would potentially increase in the developed areas. Depending on how the development areas were fenced off, the fencing would probably also restrict animal movement and disrupt the connectivity of the landscape for fauna.

Avifaunal Impacts

Direct and indirect impacts of the development on avifauna would result from habitat loss as well as from the risk of electrocution and collisions with transmission lines. Larger species, such as eagles, flamingos, cranes and bustards many of which are listed, are particularly vulnerable to impacts from transmission infrastructure. Transmission line-related impacts may account for a large proportion of mortalities in vulnerable species. Unless mitigation measures are implemented the significance of this impact is potentially very high on account of the fact that the risk would be persistent and would remain for as long the transmission infrastructure is in place.

The extent and significance of each of the above impacts is assessed below according to standard methodology as required by the Department of Environmental Affairs.

6.3 ASSESSMENT OF IMPACTS

The five major impacts identified above which are likely to be associated with the development of the different elements of the Karoshoek Solar Valley are assessed below, for each of the sites and then for the power line and associated infrastructure.

6.3.1 Solar Power Generation Facilities and Support Infrastructure

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

Site 1.1		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (5)	Low (3)
Probability	Highly Probable (4)	Highly Probable (3)
Significance	Medium (40)	Low (24)
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	
Can impacts be mitigated?	To some extent	

Site 1.3		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (7)	Medium-Low (4)
Probability	Highly Probable (4)	Highly Probable (3)
Significance	Medium (52)	Low (27)
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	
Can impacts be	To some extent	

mitigated?	

Site 1.4		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (5)	Medium-Low (3)
Probability	Highly Probable (4)	Highly Probable (3)
Significance	Medium (40)	Low (24)
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	
Can impacts be mitigated?	To some extent	

Site 2		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (7)	Medium-Low (4)
Probability	Highly Probable (4)	Highly Probable (3)
Significance	Medium (52)	Low (27)
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	
Can impacts be mitigated?	To some extent	

Site 3		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Long-term (4)

Magnitude	Medium (7)	Medium-Low (4)
Probability	Highly Probable (4)	Highly Probable (3)
Significance	Medium (52)	Low (27)
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	
Can impacts be mitigated?	To some extent	

Site 4		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (5)	Low (3)
Probability	Highly Probable (4)	Highly Probable (3)
Significance	Medium (40)	Low (24)
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	
Can impacts be mitigated?	To some extent	

Site 5		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (5)	Low (3)
Probability	Highly Probable (4)	Highly Probable (3)
Significance	Medium (40)	Low (24)
Status	Negative	Negative
Reversibility	Low	Low

Irreplaceable loss of resources	Yes	
Can impacts be mitigated?	To some extent	

Mitigation – Vegetation Impacts, all sites	
• Vegetation clearing to be kept to a minimum. No unnecessary vegetation to be cleared. • All areas to be cleared should be clearly demarcated prior to construction. • Sensitive areas as demarcated on the sensitivity map should be avoided as far as possible, and where these areas cannot be avoided, precautions should be taken to ensure that impacts are minimized. • Final development footprint should be surveyed by an ecologist for species of conservation concern for search and rescue. • Sensitive areas such as drainage lines should be demarcated by an ecologist prior to construction.	
Cumulative Impacts	As the development is part of a larger development focus area, there potential for cumulative impacts is quite high as the total area affected and number of individuals of listed species that might be affected would be high.
Residual Impacts	The development would result in some permanent loss of vegetation.

Impact 2. *Increased Erosion Risk*

Site 1.1		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Medium (4)	Low (3)
Probability	Highly Probable (3)	Improbable (3)
Significance	Medium (27)	Very Low (15)
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	Yes	No
Can impacts be mitigated?	Yes	

Site 1.3		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Medium (5)	Low (3)
Probability	Highly Probable (4)	Improbable (3)
Significance	Medium (44)	Very Low (15)
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	Yes	No
Can impacts be mitigated?	Yes	

Site 1.4		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Medium (4)	Low (3)
Probability	Highly Probable (3)	Improbable (3)
Significance	Medium (27)	Very Low (15)
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	Yes	No
Can impacts be mitigated?	Yes	

Site 2		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Medium (7)	Low (3)

Probability	Highly Probable (4)	Improbable (3)
Significance	Medium (52)	Very Low (15)
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	Yes	No
Can impacts be mitigated?	Yes	

Site 3		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Medium (7)	Low (3)
Probability	Highly Probable (4)	Improbable (3)
Significance	Medium (52)	Very Low (15)
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	Yes	No
Can impacts be mitigated?	Yes	

Site 4		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Medium (4)	Low (3)
Probability	Highly Probable (3)	Improbable (3)
Significance	Medium (27)	Very Low (15)
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	Yes	No
Can impacts be	Yes	

mitigated?	

Site 5		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Medium (4)	Low (3)
Probability	Highly Probable (3)	Improbable (3)
Significance	Medium (27)	Very Low (15)
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	Yes	No
Can impacts be mitigated?	Yes	

Mitigation – Erosion Risk, all sites	
• All roads should run along the contour where possible. • All roads should have water diversion structures present at regular intervals to regulate the flow and erosive power of runoff water. • Cleared areas which are not surfaced or required for construction should be revegetated with seed or plants of locally occurring species. • All construction vehicles should remain on a single track and multiple tracks across the veld should not be allowed. • Regular monitoring for erosion after construction to ensure that no erosion problems have developed as result of the disturbance. All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques.	
Cumulative Impacts	Due to the large number of developments within a relatively confined area, the potential for large sediment loads to impact riverine ecosystems and drainage systems is high.
Residual Impacts	If erosion at the site is controlled, then there will be very little residual impact

Impact 3. *Increased alien plant invasion*

Site 1.1, Site 1.3, Site 1.4, Site 2, Site 3, Site 4, Site 5		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Medium-High (6)	Low (3)
Probability	Highly Probable (4)	Improbable (3)
Significance	Medium (48)	Very Low (15)
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	Yes	No
Can impacts be mitigated?	Yes	
Mitigation	• Cleared areas which are not surfaced or required for construction should be revegetated with seed or plants of locally occurring species. • Regular monitoring for alien plants within the development footprint. • Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.	
Cumulative Impacts	If alien species became abundant within the different development areas, it is likely that alien plant abundance would also increase within adjacent intact areas and drainage lines on account of the high seen input from the invaded areas	
Residual Impacts	If alien species at the site are controlled, then there will be very little residual impact	

Impact 4. *Faunal Impacts*

Site 1.1, Site 1.3, Site 1.4, Site 2, Site 3, Site 4, Site 5		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Long-term (4)	Long-term (3)
Magnitude	Medium (4)	Medium-Low (3)

Probability		Highly Probable (4)	Probable (3)
Significance		Medium (40)	Low (24)
Status		Negative	Negative
Reversibility		Low	Low
Irreplaceable loss of resources		No	No
Can impacts be mitigated?		To some extent	
Mitigation	• Any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person. • The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the construction site. • Fires should only be allowed within fire-safe demarcated areas. • No fuelwood collection should be allowed on-site. • No dogs should be allowed on site. • All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. • No unauthorized persons should be allowed onto the site. • Staff present during the operational phase should receive environmental education so as to ensure that that no hunting, killing or harvesting of plants and animals occurs. • If the site must be lit at night for security purposes, this should be done with low-UV type lights (such as most LEDs), which do not attract insects. • Roofs and other building structures should be properly sealed and constructed so as to avoid creating potential bat roosting sites.		
Cumulative Impacts		There is likely to be an intense period of faunal disturbance during the construction phase which would however be transient. The various developments within the Karoshoek Solar valley would amount to a significant cumulative impact on fauna which would be likely to disrupt the connectivity of the landscape for sensitive fauna. However, as there are no range-restricted fauna which are likely to be abundant at the site, these impacts would not be of broader significance.	
Residual Impacts		Residual impacts for fauna would amount to some permanent habitat loss as well as decline in the quality of faunal habitat in the vicinity of the development.	

***Impact 5**. Avifaunal Impacts (Not associated with transmission infrastructure)*

Site 1.1, Site 1.3, Site 1.4, Site 2, Site 3, Site 4, Site 5		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (5)	Short-term (2)
Magnitude	Medium (4)	Low (2)
Probability	Highly Probable (4)	Probable (3)
Significance	Medium (44)	Low (18)
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	No
Can impacts be mitigated?	The habitat loss cannot be mitigated as the facility will occupy the space.	
Mitigation	• Ensure that no poaching or disturbance of birds takes place outside of the development areas. • If any breeding sites of large raptors or other species of conservation concern are observed within the development areas, then an avifaunal expert should be contacted to confirm the most appropriate action for the species concerned. This may involve avoiding the area until breeding has been completed, or leaving an appropriate species-specific buffer around the site.	
Cumulative Impacts	The development would contribute to cumulative avifaunal impacts in the area resulting from habitat loss, but would be of small magnitude.	
Residual Impacts	The loss of habitat would be more of less permanent as it would persist as long as the facility was present. Thereafter it may not be possible to fully restore the quality of habitat.	

6.3.2 Powerline & Associated Infrastructure

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

Impact 1: Impacts on vegetation and protected plant species would occur due to powerline construction activities.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Short-term (2)	Short-term (2)

Magnitude	Medium (6)	Low (2)
Probability	Highly Probable (4)	Probable (3)
Significance	Medium (40)	Low (15)
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	
Can impacts be mitigated?	To a large extent	
Mitigation	• Vegetation clearing to be kept to a minimum. No unnecessary vegetation to be cleared. • Sensitive areas as demarcated on the sensitivity map should be avoided as far as possible, and where these areas must be traversed, precautions should be taken to ensure that impacts are minimized. • Final route to be given a walk-down by an ecologist, at least in the sensitive places.	
Cumulative Impacts	There are already a number of power lines in the area and the new line will contribute a small to moderate amount to cumulative impacts within the area.	
Residual Impacts	With careful route planning there would be little residual impact on the vegetation.	

Impact 2. *Increased Erosion Risk*

Impact Nature: Increased erosion risk as a result of soil disturbance and loss of vegetation cover.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Medium (4)	Low (2)
Probability	Probable (3)	Improbable (2)
Significance	Low (30)	Very Low (8)
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	Yes	No

Can impacts be mitigated?	Yes
Mitigation	• It should not be necessary to establish a cleared road to construct or service the power line. • In places where the line runs up or down slope precautions should be taken to ensure that the tracks created during construction do not capture runoff and initiate erosion. • On slopes, any areas where the vegetation cover has been damaged should be monitored to ensure that adequate recovery takes place. • All construction vehicles should remain on a single track and multiple tracks across the veld should not be allowed. • Regular monitoring for erosion after construction to ensure that no erosion problems have developed as result of the disturbance. All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques.
Cumulative Impacts	Higher sediment loads in rivers and streams will affect in-stream vegetation and biota
Residual Impacts	If erosion at the site is controlled, then there will be no residual impact

Impact 3. *Increased alien plant invasion*

Impact 2: Increased alien plant invasion risk as a result of soil disturbance and loss of vegetation cover.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Low (3)	Low (3)
Probability	Probable (3)	Improbable (3)
Significance	Low (27)	Very Low (15)
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	Yes	No

Can impacts be mitigated?	Yes
Mitigation	• Minimise the disturbed area at foot of each pylon. Revegetate if necessary. • Regular monitoring for alien plants along the route until such time as the indigenous vegetation has recovered sufficiently to resist invasion. • Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.
Cumulative Impacts	The power line should not create a large amount of disturbance and probability that the power line would contribute a large amount to cumulative impact is low
Residual Impacts	If alien species are regularly controlled, then there will be very little residual impact

***Impact 4**. Faunal Impacts*

Impact Nature: Faunal habitat destruction, alteration and physical disturbance.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (3)	Long-term (3)
Magnitude	Medium (4)	Medium-Low (3)
Probability	Probable (3)	Probable (3)
Significance	Medium (27)	Low (21)
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	To some extent	
Mitigation	• Any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person. • The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the construction site. • Fires should only be allowed within fire-safe demarcated areas.	

	• No fuelwood collection should be allowed on-site. • No dogs should be allowed on site. • All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. • No unauthorized persons should be allowed onto the site. • Staff present during the operational phase should receive environmental education so as to ensure that that no hunting, killing or harvesting of plants and animals occurs.
Cumulative Impacts	Fauna are likely to be impacted largely during the construction phase, and if this can be mitigated, there would be little long-term cumulative impact.
Residual Impacts	Residual impacts for fauna would be low.

Impact 5. *Avifaunal Impacts*

Impact Nature: Negative impacts on avifauna, including listed species as a result of disturbance, electrocution and collisions.		
	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Local (1)
Duration	Long-term (5)	Short-term (2)
Magnitude	Medium-High (7)	Low (2)
Probability	Highly Probable (4)	Probable (3)
Significance	High (60)	Very Low (15)
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	No
Can impacts be mitigated?	To a large extent	
Mitigation	• Ensure that all new lines are marked with bird flight diverters along their entire length, but particularly in areas where larger birds are likely to pass such as near drainage lines, dams or pans and hills. If the new lines were to run parallel to existing unmarked lines this would	

	potentially create a net benefit as this could reduce the collision risk posed by the older line. • All new power line infrastructure should be bird-friendly in configuration and adequately insulated (Lehman et al. 2007). These activities should be supervised by someone with experience in this field. • Any electrocution and collision events that occur should be recorded, including the species affected and the date. If repeated collisions occur within the same area, then further mitigation and avoidance measures may need to be implemented.
Cumulative Impacts	The development would contribute to cumulative avifaunal impacts in the area resulting from electrocution and collisions.
Residual Impacts	Despite mitigation actions some birds are still likely to be killed on an occasional basis.

6.3.3 Summary Assessment

The impacts associated with the development of Karoshoek Solar Valley project are potentially of moderate to high significance, but could all be reduced to a low level through suitable avoidance and mitigation measures. Although there are some sensitive ecosystems within the site, these are generally restricted in nature and should not pose a very large obstacle for the development of the site as it should be reasonably easy to avoid these areas. Despite the presence of a relatively high number of protected tree species at the site, it is not deemed to be a highly sensitive area on account of the widespread nature of the species and vegetation types that would be affected by the development. The greatest ecological risks are associated with avifaunal impacts resulting from transmission infrastructure at the site, as well as erosion risk and impacts on listed species at some of the proposed development areas. Overall, provided that suitable avoidance and mitigation measures are implemented at each of the proposed development areas, the impacts of the developments would be local in nature and would not be broader significance or result in long-term degradation of the receiving environment.

Table 2. Summary assessment of the pre- and post-mitigation impacts associated with each of the different proposed development areas within the Karoshoek Solar Valley.

Site	Mitigation Status	Impact				
		Vegetation and listed plant species	Increased erosion risk	Alien plant invasion	Faunal impact	Avifaunal impact
Site 1.1	Pre Mitigation	Medium (40)	Medium (27)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low(24)	Low (15)	Low (15)	Low (24)	Low (18)
Site 1.3	Pre Mitigation	Medium (52)	Medium (44)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low (27)	Low (15)	Low (15)	Low (24)	Low (18)
Site 1.4	Pre Mitigation	Medium (40)	Medium (27)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low (24)	Low (15)	Low (15)	Low (24)	Low (18)
Site 2	Pre Mitigation	Medium (52)	Medium (54)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low (27)	Low (15)	Low (15)	Low (24)	Low (18)
Site 3	Pre Mitigation	Medium (52)	Medium (54)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low (27)	Low (15)	Low (15)	Low (24)	Low (18)
Site 4	Pre Mitigation	Medium (40)	Medium (27)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low (24)	Low (15)	Low (15)	Low (24)	Low (18)
Site 5	Pre Mitigation	Medium (40)	Medium (27)	Medium (48)	Medium (40)	Medium (44)
	Post Mitigation	Low (24)	Low (15)	Low (15)	Low (24)	Low (18)
Transmission Line	Pre Mitigation	Medium (40)	Medium (30)	Low (27)	Low(27)	Medium-High (60)
	Post Mitigation	Low (15)	Low (8)	Low (15)	Low (21)	Low(15)

7 CONCLUSION & RECOMMENDATIONS

7.1 LIMITATIONS AND KNOWLEDGE GAPS IN THE ASSESSMENT

It is important to recognize that no layouts of the actual developments have been provided for the assessment. This places some constraints on the ability to make accurate assessments of the likely impacts of the various developments, as well as suggest the most pertinent mitigation strategies. The extent of transformation required for each development is not known and the placement of the infrastructure within the site is also unknown at this point. As the impact of the development is to some extent contingent on these factors, the impacts can only be assessed in a generic manner. Fortunately, the area is not highly sensitive from an ecological perspective and so this limitation is not of critical importance at this point. However, as a result, additional ecological input would be required as the development process proceeds. In particular, important actions would be to ensure that an ecologist surveys the final development footprint to ensure that no highly sensitive ecosystems have been impacted as well as locate listed species for search and rescue. In addition, once the development details have been finalized, additional input from an ecologist into the final EMP for each development site should be obtained.

7.2 DISCUSSION AND RECOMMENDATIONS

The proposed development areas are largely well located in terms of avoiding sensitive receptors. Drainage lines are present to some degree within all of the proposed development areas. The sensitivity of these areas is however quite variable, depending on the size and the extent of development of associated vegetation within the drainage lines. The sensitivity of these areas should be assessed in the field prior to construction and the sensitive areas clearly delineated so that impacts to these areas can be avoided. There are a large number of individuals of protected tree species within some of the proposed development areas and some impact on these trees is inevitable. However, both *Acacia erioloba* and *Boscia albitrunca* are relatively widespread species and the development would not compromise the viability of local or regional populations of these species. Nevertheless as the development is likely to destroy a significant number of individuals of these species, an offset, such as a greening project within a local community may be appropriate and would need to be negotiated with the relevant authorities.

As mentioned above, avifaunal impacts are a significant concern regarding the potential impacts of the development. The majority of these impacts would only become apparent after the construction of the transmission infrastructure of the development. As is difficult and costly to retro-fit bird impact mitigation measures to existing powerlines, it is strongly recommended that all transmission infrastructure should be bird-friendly in design and that all necessary mitigation measures such as fitting bird flight diverters are carried out during the construction phase of the development. The final design and intended mitigation measures should be reviewed by a suitably qualified avifaunal expert prior to construction. This should also be allied with a regular monitoring schedule for transmission line related mortalities to ensure that any problem areas can be rectified as soon as possible.

Many of the power generation technologies proposed for the development require extensive site clearing. This represents a high risk on several fronts, but particularly in terms of the erosion risk this will generate. The hardened surfaces of developed areas and any PV arrays, troughs, dishes etc are likely to generate a lot of runoff in comparison with intact vegetation. Even if the water runoff within the developed areas is properly regulated, measures to ensure that the runoff does not impact adjacent natural areas outside of the developed area should be implemented. This would include regular monitoring for erosion as well as the construction of water runoff regulation structures such as gabions, spreader banks etc where necessary. These impacts are also likely to be closely allied to alien plant invasion. Particular attention should be paid to preventing the invasion of large woody species in the area, such as *Prosopis glandulosa*, which results in broad-scale ecological degradation of the affected areas.

8 ACTIVITIES FOR INCLUSION THE DRAFT EMP

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

Objective: Limit disturbance of vegetation and loss of protected flora during construction		
Project component/s	All components which require space and vegetation clearing, such as generation infrastructure; access and maintenance roads; buildings, temporary lay down areas etc.	
Potential Impact	Loss of plant cover leading to erosion as well as loss of faunal habitat and loss of specimens of protected plants.	
Activity/risk source	Construction activities	
Mitigation: Target/Objective	Minimal clearing of vegetation. Minimal impact on terrestrial environment. Low impact on protected species	
Mitigation: Action/control	Responsibility	Timeframe
(1) Demarcate sensitive areas as no-go areas. (2) Preconstruction surveys of the development footprints for species suitable to search and rescue operations (3) Erosion control measures should be implemented in areas where slopes have been disturbed. (4) Revegetation of cleared areas or monitoring to ensure that recovery is taking place (5) Alien plant clearing where necessary.	Management/ECO	Construction
Performance Indicator	Minimal areas of bare ground remain after construction has been completed, and those bare areas present are being actively revegetated. Record of avoidance measures implemented to reduce impacts on listed species. Copies of all permits issued for activities which impact listed species	

Monitoring	• Document pre- and post- construction cover and recovery of the ground layer. • Monitor alien plant abundance within the development areas, as well as in the surrounding area on at least a bi-annual basis. • Document revegetation actions taken and their success • Document erosion problems and the control measures implemented

Objective: Limit faunal impacts		
Project component/s	Construction activities and human presence	
Potential Impact	Disturbance of faunal communities due to construction as well as poaching and hunting risk from personnel.	
Activity/risk source	Habitat transformation during construction; site fencing, presence of construction and operation personnel.	
Mitigation: Target/Objective	Low faunal impact, during construction and operation.	
Mitigation: Action/control	Responsibility	Timeframe
(1) Environmental induction for all staff (2) ECO to monitor and enforce ban on hunting, collecting etc of all plants and animals or their products. (3) All building roof structures to be properly sealed so as not to create potential bat roosting sites	Management/ECO	Construction & Operation
Performance Indicator	No mortality of fauna during construction No indirect impacts on fauna such as poaching during construction	
Monitoring	• Monitoring for compliance during the construction phase	

Objective: Limit avifaunal impacts			
Project component/s	Construction-related disturbance and post-construction mortality related to the presence of the line itself.		
Potential Impact	Disturbance of avifaunal communities during construction and mortality related to collisions and electrocution during the operational phase.		
Activity/risk source	Presence of power line infrastructure		
Mitigation: Target/Objective	Low avifaunal impact, during construction and operation.		
Mitigation: Action/control		Responsibility	Timeframe
(1) Preconstruction review of all transmission infrastructure for bird-friendly design features (2) Fit bird flappers to new lines (3) Insulate live components at support structures. (4) Lines to avoid areas with high bird densities, breeding sites of listed species or areas which attract birds.		Management/ECO	Construction & Operation
Performance Indicator	No mortality of avifauna during construction No mortality of avifaunal during operational phase		
Monitoring	• Monitoring to check for dead birds below the lines, post construction to ensure that additional mitigation is not required in certain places. • Records of all line-related avifaunal mortality incidents and corrective actions taken at sites of repeated incidents.		

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10 ANNEX 1. LIST OF PLANTS

List of plant species which have been recorded in the vicinity of the Karoshoek Solar Valley project site, based on the SANBI SIBIS database.

Family	Species	Family	Species
ACANTHACEAE	*Acanthopsis hoffmannseggiana*	ACANTHACEAE	*Barleria lichtensteiniana*
ACANTHACEAE	*Barleria rigida*	ACANTHACEAE	*Blepharis mitrata*
ACANTHACEAE	*Monechma desertorum*	ACANTHACEAE	*Monechma divaricatum*
ACANTHACEAE	*Monechma incanum*	ACANTHACEAE	*Monechma spartioides*
ACANTHACEAE	*Peristrophe cernua*	AIZOACEAE	*Aizoon asbestinum*
AIZOACEAE	*Aizoon schellenbergii*	AIZOACEAE	*Galenia africana*
AIZOACEAE	*Plinthus karooicus*	AIZOACEAE	*Trianthema parvifolia var. parvifolia*
AMARANTHACEAE	*Amaranthus praetermissus*	AMARANTHACEAE	*Amaranthus thunbergii*
AMARANTHACEAE	*Leucosphaera bainesii*	AMARANTHACEAE	*Sericocoma avolans*
APOCYNACEAE	*Adenium oleifolium*	APOCYNACEAE	*Brachystelma huttonii*
APOCYNACEAE	*Ceropegia sp.*	APOCYNACEAE	*Gomphocarpus tomentosus subsp. tomentosus*
APOCYNACEAE	*Huernia hystrix subsp. hystrix*	APOCYNACEAE	*Orbea variegata*
APOCYNACEAE	*Sarcostemma pearsonii*	ASPARAGACEAE	*Asparagus lignosus*
ASPHODELACEAE	*Aloe claviflora*	ASPHODELACEAE	*Aloe dichotoma*
ASTERACEAE	*Berkheya annectens*	ASTERACEAE	*Brachylaena ilicifolia*
ASTERACEAE	*Cineraria geraniifolia*	ASTERACEAE	*Cineraria saxifraga*
ASTERACEAE	*Cotula sericea*	ASTERACEAE	*Dicoma capensis*
ASTERACEAE	*Dimorphotheca cuneata*	ASTERACEAE	*Dimorphotheca sinuata*
ASTERACEAE	*Dimorphotheca zeyheri*	ASTERACEAE	*Eriocephalus microphyllus var. pubescens*
ASTERACEAE	*Euryops brachypodus*	ASTERACEAE	*Felicia echinata*
ASTERACEAE	*Felicia filifolia subsp. filifolia*	ASTERACEAE	*Felicia hyssopifolia subsp. hyssopifolia*
ASTERACEAE	*Felicia muricata subsp. cinerascens*	ASTERACEAE	*Felicia muricata subsp. muricata*
ASTERACEAE	*Felicia ovata*	ASTERACEAE	*Gazania leiopoda*
ASTERACEAE	*Geigeria ornativa*	ASTERACEAE	*Geigeria pectidea*
ASTERACEAE	*Gnaphalium capense*	ASTERACEAE	*Gnaphalium vestitum*
ASTERACEAE	*Gymnostephium ciliare*	ASTERACEAE	*Helichrysum sp.*
ASTERACEAE	*Ifloga sp.*	ASTERACEAE	*Kleinia longiflora*
ASTERACEAE	*Leysera tenella*	ASTERACEAE	*Matricaria sp.*
ASTERACEAE	*Metalasia pulcherrima forma pulcherrima*	ASTERACEAE	*Nidorella auriculata*
ASTERACEAE	*Nidorella sp.*	ASTERACEAE	*Osteospermum grandidentatum*
ASTERACEAE	*Osteospermum imbricatum*	ASTERACEAE	*Osteospermum junceum*
ASTERACEAE	*Othonna eriocarpa*	ASTERACEAE	*Pegolettia retrofracta*
ASTERACEAE	*Pentzia dentata*	ASTERACEAE	*Pentzia incana*
ASTERACEAE	*Pentzia pinnatisecta*	ASTERACEAE	*Pentzia spinescens*
ASTERACEAE	*Pteronia sordida*	ASTERACEAE	*Pteronia teretifolia*
ASTERACEAE	*Pteronia unguiculata*	ASTERACEAE	*Schistostephium crataegifolium*

ASTERACEAE	*Senecio asperulus*	ASTERACEAE	*Senecio erubescens var. erubescens*
ASTERACEAE	*Senecio hastatus*	ASTERACEAE	*Senecio juniperinus var. juniperinus*
ASTERACEAE	*Senecio macroglossus*	ASTERACEAE	*Senecio monticola*
ASTERACEAE	*Senecio othonniflorus*	ASTERACEAE	*Senecio puberulus*
ASTERACEAE	*Senecio retrorsus*	ASTERACEAE	*Senecio sp.*
ASTERACEAE	*Tarchonanthus camphoratus*	ASTERACEAE	*Tarchonanthus littoralis*
AYTONIACEAE	*Plagiochasma rupestre var. rupestre*	BIGNONIACEAE	*Rhigozum obovatum*
BIGNONIACEAE	*Rhigozum trichotomum*	BORAGINACEAE	*Ehretia rigida subsp. rigida*
BORAGINACEAE	*Heliotropium ciliatum*	BORAGINACEAE	*Lappula heteracantha*
BUDDLEJACEAE	*Buddleja saligna*	CAMPANULACEAE	*Wahlenbergia capillacea subsp. capillacea*
CAMPANULACEAE	*Wahlenbergia tenella var. tenella*	CAPPARACEAE	*Boscia foetida subsp. foetida*
CAPPARACEAE	*Cadaba aphylla*	CHENOPODIACEAE	*Salsola glabrescens*
CHENOPODIACEAE	*Salsola namibica*	CHENOPODIACEAE	*Salsola rabieana*
COLCHICACEAE	*Ornithoglossum viride*	CRASSULACEAE	*Cotyledon orbiculata var. orbiculata*
CRASSULACEAE	*Cotyledon woodii*	CUCURBITACEAE	*Coccinia rehmannii*
DIPSACACEAE	*Scabiosa angustiloba*	EBENACEAE	*Euclea undulata*
ERIOSPERMACEAE	*Eriospermum flagelliforme*	EUPHORBIACEAE	*Euphorbia avasmontana var. sagittaria*
EUPHORBIACEAE	*Euphorbia gariepina subsp. balsamea*	EUPHORBIACEAE	*Euphorbia glanduligera*
EUPHORBIACEAE	*Euphorbia inaequilatera var. inaequilatera*	EUPHORBIACEAE	*Euphorbia mauritanica var. mauritanica*
EUPHORBIACEAE	*Euphorbia rudis*	EUPHORBIACEAE	*Euphorbia spinea*
FABACEAE	*Acacia karroo*	FABACEAE	*Acacia mellifera subsp. detinens*
FABACEAE	*Amphithalea williamsonii*	FABACEAE	*Argyrolobium harveyanum*
FABACEAE	*Aspalathus subtingens*	FABACEAE	*Aspalathus tridentata subsp. staurantha*
FABACEAE	*Dipogon lignosus*	FABACEAE	*Indigastrum argyraeum*
FABACEAE	*Indigofera alternans var. alternans*	FABACEAE	*Indigofera angustata*
FABACEAE	*Indigofera auricoma*	FABACEAE	*Indigofera heterotricha*
FABACEAE	*Indigofera holubii*	FABACEAE	*Indigofera zeyheri*
FABACEAE	*Parkinsonia africana*	FABACEAE	*Pomaria lactea*
FABACEAE	*Prosopis glandulosa var. glandulosa*	FABACEAE	*Prosopis velutina*
FABACEAE	*Ptycholobium biflorum subsp. biflorum*	FABACEAE	*Tephrosia angulata*
FABACEAE	*Tephrosia capensis var. capensis*	FABACEAE	*Tephrosia dregeana var. dregeana*
FABACEAE	*Tephrosia grandiflora*	GERANIACEAE	*Monsonia burkeana*
GERANIACEAE	*Monsonia umbellata*	GERANIACEAE	*Pelargonium anethifolium*
GERANIACEAE	*Pelargonium inquinans*	GERANIACEAE	*Pelargonium reniforme subsp. reniforme*
GESNERIACEAE	*Streptocarpus sp.*	GISEKIACEAE	*Gisekia pharnacioides var. pharnacioides*
HYACINTHACEAE	*Albuca setosa*	HYACINTHACEAE	*Dipcadi ciliare*
HYACINTHACEAE	*Dipcadi viride*	HYACINTHACEAE	*Ledebouria undulata*
HYACINTHACEAE	*Ornithogalum tenuifolium subsp. tenuifolium*	IRIDACEAE	*Dierama pulcherrimum*
IRIDACEAE	*Tritonia strictifolia*	LOPHIOCARPACEAE	*Lophiocarpus polystachyus*

LORANTHACEAE	*Tapinanthus oleifolius*
MALVACEAE	*Hermannia abrotanoides*
MALVACEAE	*Hermannia gracilis*
MALVACEAE	*Hermannia mucronulata*
MALVACEAE	*Hermannia sp.*
MELIACEAE	*Nymania capensis*
MESEMBRYANTHEMACEAE	*Lithops bromfieldii*
MESEMBRYANTHEMACEAE	*Psilocaulon granulicaule*
MOLLUGINACEAE	*Limeum aethiopicum subsp. aethiopicum var. aethiopicum*
MOLLUGINACEAE	*Mollugo cerviana var. cerviana*
NYCTAGINACEAE	*Phaeoptilum spinosum*
OLEACEAE	*Olea capensis subsp. capensis*
OROBANCHACEAE	*Hyobanche sanguinea*
OXALIDACEAE	*Oxalis imbricata var. violacea*
PEDALIACEAE	*Sesamum capense*
PHYLLANTHACEAE	*Phyllanthus maderaspatensis*
POACEAE	*Anthephora pubescens*
POACEAE	*Aristida congesta subsp. barbicollis*
POACEAE	*Enneapogon desvauxii*
POACEAE	*Eragrostis annulata*
POACEAE	*Eragrostis echinochloidea*
POACEAE	*Eragrostis rotifer*
POACEAE	*Fingerhuthia africana*
POACEAE	*Schmidtia kalahariensis*
POACEAE	*Sporobolus nervosus*
POACEAE	*Stipagrostis ciliata var. capensis*
POACEAE	*Stipagrostis uniplumis var. neesii*
POACEAE	*Tragus berteronianus*
POLYGONACEAE	*Persicaria attenuata subsp. africana*
PORTULACACEAE	*Talinum arnotii*
ROSACEAE	*Cliffortia serpyllifolia*
RUBIACEAE	*Kohautia cynanchica*
RUBIACEAE	*Pavetta capensis subsp. capensis*
SCROPHULARIACEAE	*Aptosimum albomarginatum*
SCROPHULARIACEAE	*Aptosimum marlothii*
SCROPHULARIACEAE	*Aptosimum spinescens*
SOLANACEAE	*Lycium oxycarpum*
SOLANACEAE	*Solanum nigrum*
THYMELAEACEAE	*Gnidia nana*
THYMELAEACEAE	*Struthiola argentea*
MALPIGHIACEAE	*Triaspis hypericoides subsp. nelsonii*
MALVACEAE	*Hermannia flammea*
MALVACEAE	*Hermannia modesta*
MALVACEAE	*Hermannia salviifolia var. grandistipula*
MALVACEAE	*Hermannia spinosa*
MENISPERMACEAE	*Cissampelos capensis*
MESEMBRYANTHEMACEAE	*Psilocaulon coriarium*
MESEMBRYANTHEMACEAE	*Ruschia vulvaria*
MOLLUGINACEAE	*Limeum myosotis var. confusum*
NEURADACEAE	*Grielum humifusum var. humifusum*
OCHNACEAE	*Ochna arborea var. arborea*
ORCHIDACEAE	*Holothrix burchellii*
OXALIDACEAE	*Oxalis bowiei*
PASSIFLORACEAE	*Adenium repanda*
PHYLLANTHACEAE	*Phyllanthus incurvus*
PLANTAGINACEAE	*Plantago sp.*
POACEAE	*Aristida adscensionis*
POACEAE	*Cenchrus ciliaris*
POACEAE	*Enneapogon scaber*
POACEAE	*Eragrostis biflora*
POACEAE	*Eragrostis porosa*
POACEAE	*Eragrostis sp.*
POACEAE	*Panicum lanipes*
POACEAE	*Setaria verticillata*
POACEAE	*Stipagrostis anomala*
POACEAE	*Stipagrostis obtusa*
POACEAE	*Stipagrostis uniplumis var. uniplumis*
POLYGALACEAE	*Polygala seminuda*
PORTULACACEAE	*Portulaca quadrifida*
ROSACEAE	*Cliffortia linearifolia*
RUBIACEAE	*Kohautia caespitosa subsp. brachyloba*
RUBIACEAE	*Nenax microphylla*
SANTALACEAE	*Thesium gnidiaceum var. gnidiaceum*
SCROPHULARIACEAE	*Aptosimum lineare var. lineare*
SCROPHULARIACEAE	*Aptosimum procumbens*
SCROPHULARIACEAE	*Jamesbrittenia atropurpurea subsp. pubescens*
SOLANACEAE	*Solanum capense*
THYMELAEACEAE	*Gnidia burchellii*
THYMELAEACEAE	*Gnidia sp.*
VERBENACEAE	*Chascanum cuneifolium*

VERBENACEAE	*Chascanum incisum*	ZYGOPHYLLACEAE	*Tribulus terrestris*
ZYGOPHYLLACEAE	*Tribulus zeyheri subsp. zeyheri*	ZYGOPHYLLACEAE	*Zygophyllum dregeanum*
ZYGOPHYLLACEAE	*Zygophyllum flexuosum*	ZYGOPHYLLACEAE	*Zygophyllum lichtensteinianum*
ZYGOPHYLLACEAE	*Zygophyllum rigidum*		

11 ANNEX 2. LIST OF MAMMALS

List of mammals which are likely to occur in the vicinity of the Karoshoek Solar Valley. Habitat notes and distribution records are based on Skinner & Chimimba (2005), while conservation status is from the IUCN Red Lists 2012.

Scientific Name	Common Name	Status	Habitat	Likelihood
Macroscledidea (Elephant Shrews):				
Macroscelides proboscideus	Round-eared Elephant Shrew	LC	Species of open country, with preference for shrub bush and sparse grass cover, also occur on hard gravel plains with sparse boulders for shelter, and on loose sandy soil provided there is some bush cover	High
Elephantulus rupestris	Western Rock Elephant Shrew	LC	Rocky koppies, rocky outcrops or piles of boulders where these offer sufficient holes and crannies for refuge.	Low
Tubulentata:				
Orycteropus afer	Aardvark	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil	Definite
Hyracoidea (Hyraxes)				
Procavia capensis	Rock Hyrax	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies	Definite
Lagomorpha (Hares and Rabbits):				
Lepus capensis	Cape Hare	LC	Dry, open regions, with palatable bush and grass	Definite
Lepus saxatilis	Scrub Hare	LC	Common in agriculturally developed areas, especially in crop-growing areas or in fallow lands where there is some bush development.	High
Rodentia (Rodents):				
Hystrix africaeaustralis	Cape Porcupine	LC	Catholic in habitat requirements.	Definite
Pedetes capensis	Springhare	LC	Occur widely on open sandy ground or sandy scrub, on overgrazed grassland, on the fringes of vleis and dry river beds.	High
Xerus inauris	South African Ground Squirrel	LC	Open terrain with a sparse bush cover and a hard substrate	Definite
Graphiurus ocularis	Spectacled Dormouse	LC	Associated with sandstones of Cape Fold mountains, which have many vertical and horizontal crevices.	Low
Rhabdomys pumilio	Four-striped Grass Mouse	LC	Essentially a grassland species, occurs in wide variety of habitats where there is good grass cover.	High
Mastomys coucha	Southern Multimammate Mouse	LC	Wide habitat tolerance.	High
Thallomys paedulcus	Acacia Tree Rat	LC	Associated with stands of Acacia woodland	Low
Thallomys nigricauda	Black-tailed Tree Rat	LC	Associated with stands of Acacia woodland	Low
Aethomys namaquensis	Namaqua Rock Mouse	LC	Catholic in their habitat requirements, but where there are rocky koppies, outcrops or boulder-strewn hillsides they use these preferentially	Definite
Parotomys brantsii	Brants' Whistling Rat	LC	Associated with a dry sandy substrate in more arid parts of the Nama-karoo and Succulent Karoo. Species selects areas of low percentage of plant cover and areas with deep sands.	High

Parotomys littledalei	Littledale's Whistling Rat	LC	Riverine associations or associated with Lycium bushes or Psilocaulon absimile	Low
Desmodillus auricularis	Cape Short-tailed Gerbil	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush	High
Gerbillurus paeba	Hairy-footed Gerbil	LC	Gerbils associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub or light woodland cover	High
Gerbilliscus leucogaster	Bushveld Gerbil	LC	Predominantly associated with light sandy soils or sandy alluvium	Low
Gerbilliscus brantsii	Higheld Gerbil	LC	Sandy soils or sandy alluvium with some cover of grass, scrub or open woodland	High
Saccostomus campestris	Pouched Mouse	LC	Catholic habitat requirements, commoner in areas where there is a sandy substrate.	High
Malacothrix typica	Gerbil Mouse	LC	Found predominantly in Nama and Succulent Karoo biomes, in areas with a mean annual rainfall of 150-500 mm.	High
Primates:				
Papio ursinus	Chacma Baboon	LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	Definite
Cercopithecus mitis	Vervet Monkey	LC	Most abundant in and near riparian vegetation of savannahs	Definite
Eulipotyphla (Shrews):				
Crocidura cyanea	Reddish-Grey Musk Shrew	LC	Occurs in relatively dry terrain, with a mean annual rainfall of less than 500 mm. Occur in karroid scrub and in fynbos often in association with rocks.	Low
Erinaceomorpha (Hedgehog)				
Atelerix frontalis	South African Hedgehog	LC	Generally found in semi-arid and subtemperate environments with ample ground cover	Moderate
Carnivora:				
Proteles cristata	Aardwolf	LC	Common in the 100-600mm rainfall range of country, Nama-Karoo, Succulent Karoo Grassland and Savanna biomes	Definite
Hyaena brunnea	Brown Hyaena	NT	Nama and Succulent Karoo and the drier parts of the Grassland and Savanna Biomes	Low
Caracal caracal	Caracal	LC	Caracals tolerate arid regions, occur in semi-desert and karroid conditions	High
Felis silvestris	African Wild Cat	LC	Wide habitat tolerance.	High
Felis nigripes	Black-footed cat	VU	Associated with arid country with MAR 100-500 mm, particularly areas with open habitat that provides some cover in the form of tall stands of grass or scrub.	High
Genetta genetta	Small-spotted genet	LC	Occur in open arid associations	High
Suricata suricatta	Meerkat	LC	Open arid country where substrate is hard and stony. Occur in Nama and Succulent Karoo but also fynbos	High
Cynictis penicillata	Yellow Mongoose	LC	Semi-arid country on a sandy substrate	Definite
Galerella sanguinea	Slender Mongoose	LC	Catholic habitat requirements but does not occur in the south.	Low
Herpestes pulverulentus	Cape Grey Mongoose	LC	Wide habitat tolerance	High

Atilax paludinosus	Marsh Mongoose	LC	Associated with well-watered terrain, living in close association with rivers, streams, marshes, etc.	Low
Vulpes chama	Cape Fox	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub	High
Canis mesomelas	Black-backed Jackal	LC	Wide habitat tolerance, more common in drier areas.	High
Otocyon megalotis	Bat-eared Fox	LC	Open country with mean annual rainfall of 100-600 mm	High
Aonyx capensis	African Clawless Otter	LC	Predominantly aquatic and do not occur far from permanenet water	Low
Ictonyx striatus	Striped Polecat	LC	Widely distributed throughout the sub-region	High
Mellivora capensis	Ratel/Honey Badger	IUCN LC/SA RDB EN	Catholic habitat requirements	High
Rumanantia (Antelope):				
Sylvicapra grimmia	Common Duiker	LC	Presence of bushes is essential	High
Raphicerus campestris	Steenbok	LC	Inhabits open country,	Definite
Chiroptera (Bats)				
Pipistrellus capensis	Cape Serotine Bat	LC	Wide habitat tolerances, but often found near open water	High
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC	In arid areas. often associated with water sources	High
Nycteris thebaica	Egyptian Slit-faced Bat	LC	Wide habitat tolerance	High
Rhinolophus denti	Dent's Horseshoe Bat	LC	Arid areas but require caves or rock crevices	High
Rhinolophus darlingi	Darling's Horsehoe Bat	LC	Savanna woodland species but requires caves	Low
Eidolon helvum	Straw-coloured fruit bat	LC	Occasional migratory visitors within southern Africa	Low

12 ANNEX 3. LIST OF REPTILES

List of reptiles which are likely to occur at vicinity of the Karoshoek Solar Valley. Habitat notes and distribution records are based on Branch (1988) and Alexander and Marais (2007), while conservation status is from the IUCN Red Lists 2012.

Scientific Name	Common Name	Distribution		Habitat	Likelihood
Tortoises and Terrapins:					
Psammobates oculiferus	Kalahari Tent Tortoise	Endemic	Data Deficient	Karoo and Kalahari shrublands	High
Snakes:					
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	Endemic	Data Deficient	Varied: semi-desert, coastal bush, fynbos & savannah	Low
Lamprophis capensis	Brown House Snake	Widespread	Data Deficient	Common in highveld grassland & arid karroid regions, but found everywhere & tolerant of urban sprawl	High
Lycophidion capense	Common Wolf Snake	Widespread	Data Deficient	Lowland forest and fynbos to moist savanna, grassland and karoo scrub	High
Pseudaspis cana	Mole Snake	Widespread	Data Deficient	Sandy scrubland in SW Cape, highveld grassland & mountainous & desert regions	High
Dipsina multimaculata	Dwarf Beaked Snake	Endemic	Data Deficient	Rocky, sandy areas. Cape karroid areas.	High
Psammophis notostictus	Karoo Sand or Whip Snake	Widespread	Data Deficient	Arid scrubland & karroid regions	High
Psammophis trinasalis	Kalahari Sand Snake	Widespread	Data Deficient	Mainly Kalahari thornveld but may also occur in savanna and grassland	High
Dasypeltis scabra	Common/Rhombic Egg Eater	Widespread	LC	Absent only from true desert & closed-canopy forest	High
Naja nivea	Cape Cobra	Widespread	Data Deficient	Arid karroid regions, particularly along river courses, entering well drained open areas along the southern coast	High
Bitis arietans	Puff Adder	Widespread	Data Deficient	Absent only from desert & mnt tops	High
Bitis caudalis	Horned Adder	Widespread	Data Deficient	Sandy regions, throughout Karoo	High
Worm Lizards					
Monopeltis infuscata	Dusky Spade-snouted Worm Lizard	Widespread	Data Deficient	Dry and moist savannah	High
Lizard and Skinks:					
Mabuya capensis	Cape Skink	Widespread	Data Deficient	Very varied: arid karroid veld, moist coastal bush, montane grassland, etc	High
Mabuya occidentalis	Western Three-Striped Skink	Widespread	Data Deficient	Arid Savanna karroid veld and desert	High
Mabuya spilogaster	Kalahari Tree Skink	Widespread		Arid Savannah	High
Mabuya sulcata	Western Rock Skink	Widespread	Data Deficient	Karroid areas	High
Mabuya striata	Striped Skink	Widespread	Data Deficient	Varied, except desert areas, succulent karoo and fynbos	High

Mabuya variegata	Variegated Skink	Widespread	Data Deficient	Extremely varied; desert, karroid veld, montane grassland, savanna, coastal bush & valley bushveld	High
Heliobolus lugubris	Bushveld Lizard	Widespread	Data Deficient	Arid and mesic savannah	High
Meroles suborbitalis	Spotted Desert Lizard	Endemic	Data Deficient	Varied, arid savanna to desert	High
Pedioplanis lineoocellata	Spotted Sand Lizard	Endemic	Data Deficient	Very varied: karroid veld, valley bushveld & arid & mesic savannah	High
Pedioplanis namaquensis	Namaqua Sand Lizard	Widespread	Data Deficient	Karroid veld	High
Gerrhosaurus flavigularis	Yellow-throated Plated Lizard	Widespread	Data Deficient	Montane grassland, savanna, bushveld and low open coastal forest	Low
Cordylus polyzonus	Karoo Girdled Lizard	Endemic	Data Deficient	Karroid regions, coastal renosterveld and succulent karoo	High
Varanus albigularis	Rock Monitor	Widespread	Data Deficient	Savanna and arid karroid areas	High
Varanus niloticus	Water Monitor	Widespread	Data Deficient	Rivers pans and major lakes	High
Agama aculeata	Ground Agama	Widespread	Data Deficient	Semi desert and savanna	High
Agama anchietae	Anchieta's Agama	Widespread	Data Deficient	Semi desert and arid savanna	High
Geckos:					
Chondrodactylus angulifer	Giant Ground Gecko	Endemic	LC	Gravel plains, interdune spaces & sandy flats	High
Chondrodactylus bibronii	Bibron's Tubercled Gecko	Endemic	Data Deficient	Rocky outcrops, cliffs and large trees	High
Pachydactylus capensis	Cape Thick-toed Gecko	Widespread	Data Deficient	Karroid veld, grassland and mesic savannah	High
Pachydactylus mariquensis	Marico Thick-toed Gecko	Endemic	Data Deficient	Flat sandy plains with sparse vegetation	High
Ptenopus garrulus	Common Barking Gecko	Endemic	Data Deficient	Desert and semi-desert on various soil types, preferring flat stable sandy soils with sparse vegetation cover	High

13 ANNEX 4. LIST OF AMPHIBIANS

List of amphibians which are likely to occur in the vicinity of the Karoshoek Solar Valley. Habitat notes and distribution records are based on Du Preez and Carruthers (2009), while conservation status is from the IUCN Red Lists 2012.

Scientific Name	Common Name	Status	Habitat	Distribution	Likelihood
Amietophrynus gutturalis	Guttural Toad	Not Threatened	Around open pools, dams, vleis and other semi-permanent or permenent water	Widespread	Low
Amietophrynus poweri	Western Olive Toad	Not Threatened	Around vleis and pans in thornveld savanna	Widespread	Low
Amietophrynus rangeri	Raucous Toad	Not Threatened	Rivers and stream in grassland and fynbos	Endemic	Low
Vandijkophrynus gariepensis	Karoo Toad	Not Threatened	Karoo Scrub	Widespread	High
Pyxicephalus adspersus	Giant Bullfrog	Near Threatened	Breed in shallow margins of rain-filled depressions.	Widespread	Low
Xenopus laevis	Common Platanna	Not Threatened	Any more or less permanent water	Widespread	High
Cacosternum boettgeri	Common Caco	Not Threatened	Marshy areas, vleis and shallow pans	Widespread	High
Amietia angolensis	Common River Frog	Not Threatened	Banks of slow-flowing streams or permanent bodies of water	Widespread	High
Tomopterna cryptotis	Tremelo Sand Frog	Not Threatened	Savanna and grassland	Widespread	High
Tomopterna tandyi	Tandy's Sand Frog	Not Threatened	Nama karoo grassland and savanna	Widespread	High

14 ANNEX 5. LIST OF BIRDS

List of birds which are likely to occur in the vicinity of the Karoshoek Solar Valley. The list is derived from the SABAP 1 and 2 datasets and the South African conservation status from the list of threatened birds available from the Bird Life South Africa website, http://www.birdlife.org.za.

Family	*Species*	Status	Family	*Species*	Status
Alaudidae	*Calandrella cinerea*	LC	Alaudidae	*Calendulauda africanoides*	LC
Alaudidae	*Calendulauda sabota*	LC	Alaudidae	*Certhilauda curvirostris*	LC
Alaudidae	*Chersomanes albofasciata*	LC	Alaudidae	*Eremopterix australis*	LC
Alaudidae	*Eremopterix verticalis*	LC	Alaudidae	*Mirafra apiata*	LC
Alaudidae	*Spizocorys starki*	LC	Anatidae	*Alopochen aegyptiacus*	LC
Anatidae	*Anas capensis*	LC	Anatidae	*Anas erythrorhyncha*	LC
Anatidae	*Anas sparsa*	LC	Anatidae	*Anas undulata*	LC
Anatidae	*Dendrocygna viduata*	LC	Anatidae	*Plectropterus gambensis*	LC
Anatidae	*Tadorna cana*	LC	Anhingidae	*Anhinga rufa*	LC
Apodidae	*Apus affinis*	LC	Apodidae	*Apus apus*	LC
Apodidae	*Apus caffer*	LC	Apodidae	*Cypsiurus parvus*	LC
Bucerotidae	*Tockus leucomelas*	LC	Burhinidae	*Burhinus capensis*	LC
Capitonidae	*Tricholaema leucomelas*	LC	Caprimulgidae	*Caprimulgus rufigena*	LC
Charadriidae	*Charadrius hiaticula*	LC	Charadriidae	*Charadrius pecuarius*	LC
Charadriidae	*Charadrius tricollaris*	LC	Charadriidae	*Vanellus armatus*	LC
Charadriidae	*Vanellus coronatus*	LC	Ciconiidae	*Ciconia abdimii*	LC
Ciconiidae	*Ciconia ciconia*	LC	Ciconiidae	*Ciconia nigra*	NT
Coliidae	*Colius colius*	LC	Coliidae	*Urocolius indicus*	LC
Coraciidae	*Coracias caudatus*	LC	Corvidae	*Corvus albus*	LC
Cuculidae	*Chrysococcyx caprius*	LC	Dicruridae	*Dicrurus adsimilis*	LC
Estrildidae	*Amadina erythrocephala*	LC	Estrildidae	*Estrilda astrild*	LC
Estrildidae	*Granatina granatina*	LC	Estrildidae	*Lagonosticta senegala*	LC
Falconidae	*Falco biarmicus*	NT	Falconidae	*Falco chicquera*	LC
Falconidae	*Falco naumanni*	VU	Falconidae	*Falco peregrinus*	NT
Falconidae	*Falco rupicolus*	LC	Falconidae	*Falco rupicoloides*	LC
Falconidae	*Polihierax semitorquatus*	LC	Fringillidae	*Crithagra albogularis*	LC
Fringillidae	*Crithagra atrogularis*	LC	Fringillidae	*Crithagra flaviventris*	LC
Fringillidae	*Emberiza impetuani*	LC	Fringillidae	*Serinus alario*	LC
Glareolidae	*Cursorius rufus*	LC	Glareolidae	*Rhinoptilus africanus*	LC
Halcyonidae	*Alcedo cristata*	LC	Halcyonidae	*Ceryle rudis*	LC
Halcyonidae	*Megaceryle maximus*	LC	Hirundinidae	*Hirundo albigularis*	LC
Hirundinidae	*Hirundo cucullata*	LC	Hirundinidae	*Hirundo fuligula*	LC
Hirundinidae	*Hirundo rustica*	LC	Hirundinidae	*Riparia paludicola*	LC
Indicatoridae	*Indicator minor*	LC	Jacanidae	*Actophilornis africanus*	LC
Laniidae	*Lanius collaris*	LC	Laniidae	*Lanius minor*	LC

Laridae	*Chlidonias hybrida*	LC	Laridae	*Chlidonias leucopterus*	LC
Laridae	*Larus cirrocephalus*	LC	Malaconotidae	*Laniarius atrococcineus*	LC
Malaconotidae	*Nilaus afer*	LC	Malaconotidae	*Telophorus zeylonus*	LC
Meropidae	*Merops apiaster*	LC	Meropidae	*Merops hirundineus*	LC
Motacillidae	*Anthus cinnamomeus*	LC	Motacillidae	*Anthus similis*	LC
Motacillidae	*Motacilla aguimp*	LC	Motacillidae	*Motacilla capensis*	LC
Muscicapidae	*Batis pririt*	LC	Muscicapidae	*Bradornis infuscatus*	LC
Muscicapidae	*Bradornis mariquensis*	LC	Muscicapidae	*Muscicapa striata*	LC
Muscicapidae	*Sigelus silens*	LC	Muscicapidae	*Stenostira scita*	LC
Nectariniidae	*Cinnyris chalybeus*	LC	Nectariniidae	*Cinnyris fuscus*	LC
Numididae	*Numida meleagris*	LC	Otididae	*Ardeotis kori*	VU
Otididae	*Afrotis afra*	LC	Otididae	*Eupodotis vigorsii*	LC
Otididae	*Lophotis ruficrista*	LC	Otididae	*Neotis ludwigii*	VU
Paridae	*Parus cinerascens*	LC	Phalacrocoracidae	*Phalacrocorax africanus*	LC
Phalacrocoracidae	*Phalacrocorax carbo*	LC	Phasianidae	*Coturnix coturnix*	LC
Phoeniculidae	*Rhinopomastus cyanomelas*	LC	Picidae	*Campethera abingoni*	LC
Picidae	*Dendropicos fuscescens*	LC	Plataleidae	*Bostrychia hagedash*	LC
Plataleidae	*Platalea alba*	LC	Plataleidae	*Threskiornis aethiopicus*	LC
Podicipedidae	*Tachybaptus ruficollis*	LC	Psittacidae	*Agapornis roseicollis*	LC
Pteroclididae	*Pterocles namaqua*	LC	Pycnonotidae	*Pycnonotus nigricans*	LC
Rallidae	*Amaurornis flavirostris*	LC	Rallidae	*Fulica cristata*	LC
Rallidae	*Gallinula chloropus*	LC	Rallidae	*Porphyrio madagascariensis*	LC
Recurvirostridae	*Himantopus himantopus*	LC	Recurvirostridae	*Recurvirostra avosetta*	LC
Remizidae	*Anthoscopus minutus*	LC	Scolopacidae	*Actitis hypoleucos*	LC
Scolopacidae	*Calidris minuta*	LC	Scolopacidae	*Tringa glareola*	LC
Scolopacidae	*Tringa nebularia*	LC	Scopidae	*Scopus umbretta*	LC
Strigidae	*Bubo africanus*	LC	Strigidae	*Glaucidium perlatum*	LC
Strigidae	*Ptilopsus granti*	LC	Struthionidae	*Struthio camelus*	LC
Sturnidae	*Creatophora cinerea*	LC	Sturnidae	*Lamprotornis nitens*	LC
Sturnidae	*Onychognathus nabouroup*	LC	Tytonidae	*Tyto alba*	LC
Upupidae	*Upupa africana*	LC	Viduidae	*Vidua macroura*	LC
Zosteropidae	*Zosterops pallidus*	LC	SYLVIIDAE	*Acrocephalus baeticatus*	LC
SYLVIIDAE	*Acrocephalus gracilirostris*	LC	ACCIPITRIDAE	*Aquila pennatus*	LC
ACCIPITRIDAE	*Aquila verreauxii*	LC	ARDEIDAE	*Ardea cinerea*	LC
ARDEIDAE	*Ardea goliath*	LC	ARDEIDAE	*Ardea melanocephala*	LC
ARDEIDAE	*Bubulcus ibis*	LC	ACCIPITRIDAE	*Buteo rufofuscus*	LC
ACCIPITRIDAE	*Buteo vulpinus*	LC	TURDIDAE	*Cercomela familiaris*	LC
TURDIDAE	*Cercomela schlegelii*	LC	TURDIDAE	*Cercomela sinuata*	LC
TURDIDAE	*Cercomela tractrac*	LC	TURDIDAE	*Cercotrichas coryphoeus*	LC
TURDIDAE	*Cercotrichas paena*	LC	ACCIPITRIDAE	*Circaetus pectoralis*	LC
SYLVIIDAE	*Cisticola aridulus*	LC	SYLVIIDAE	*Cisticola juncidis*	LC

SYLVIIDAE	*Cisticola subruficapilla*	LC	SYLVIIDAE	*Cisticola tinniens*	LC
COLUMBIDAE	*Columba guinea*	LC	COLUMBIDAE	*Columba livia*	LC
TURDIDAE	*Cossypha caffra*	LC	ARDEIDAE	*Egretta alba*	LC
ARDEIDAE	*Egretta garzetta*	LC	ARDEIDAE	*Egretta intermedia*	LC
ACCIPITRIDAE	*Elanus caeruleus*	LC	SYLVIIDAE	*Eremomela icteropygialis*	LC
PLOCEIDAE	*Euplectes orix*	LC	ACCIPITRIDAE	*Haliaeetus vocifer*	LC
SYLVIIDAE	*Malcorus pectoralis*	LC	ACCIPITRIDAE	*Melierax canorus*	LC
ACCIPITRIDAE	*Melierax gabar*	LC	TURDIDAE	*Myrmecocichla formicivora*	LC
COLUMBIDAE	*Oena capensis*	LC	TURDIDAE	*Oenanthe monticola*	LC
TURDIDAE	*Oenanthe pileata*	LC	SYLVIIDAE	*Parisoma subcaeruleum*	LC
PLOCEIDAE	*Passer diffusus*	LC	PLOCEIDAE	*Passer domesticus*	LC
PLOCEIDAE	*Passer melanurus*	LC	PLOCEIDAE	*Philetairus socius*	LC
SYLVIIDAE	*Phragmacia substriata*	LC	PLOCEIDAE	*Plocepasser mahali*	LC
PLOCEIDAE	*Ploceus velatus*	LC	ACCIPITRIDAE	*Polemaetus bellicosus*	VU
SYLVIIDAE	*Prinia flavicans*	LC	PLOCEIDAE	*Quelea quelea*	LC
PLOCEIDAE	*Sporopipes squamifrons*	LC	COLUMBIDAE	*Streptopelia capicola*	LC
COLUMBIDAE	*Streptopelia semitorquata*	LC	COLUMBIDAE	*Streptopelia senegalensis*	LC
SYLVIIDAE	*Sylvietta rufescens*	LC	TURDIDAE	*Turdus olivaceus*	LC
ACCIPITRIDAE	*Milvus migrans*	LC	ACCIPITRIDAE	*Milvus aegyptius*	LC

SHORT CV OF CONSULTANT:

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SUMMARY OF EXPERTISE:

SIMON TODD

- Profession: Ecological Consultant
- Specialisation: Plant & Animal Ecology
- Years of Experience: 15 Years

Skills & Primary Competencies

- Research & description of ecological patterns & processes in Fynbos, Succulent Karoo, Nama Karoo, Thicket, Arid Grassland and Savannah Ecosystems.
- Ecological Impacts of land use on biodiversity
- Vegetation surveys & degradation assessment & mapping
- Long-term vegetation monitoring
- Faunal surveys & assessment.
- GIS & remote sensing

Tertiary Education:

- 1992-1994 – BSc (Botany & Zoology), University of Cape Town
- 1995 – BSc Hons, Cum Laude (Zoology) University of Natal
- 1996-1997- MSc, Cum Laude (Conservation Biology) University of Cape Town

Employment History

- 1997 – 1999 – Research Scientist (Contract) – South African National Biodiversity Institute
- 2000-2004 – Specialist Scientist (Contract) - South African National Biodiversity Institute
- 2004-2007 – Senior Scientist (Contract) – Plant Conservation Unit, Department of Botany, University of Cape Town
- 2007 Present – Senior Scientist (Associate) – Plant Conservation Unit, Department of Botany, University of Cape Town.

General Experience & Expertise

- Conducted a large number of fauna and flora specialist assessments distributed widely across South Africa. Projects have ranged in extent from <50 ha to more then 50 000 ha.
- Extensive experience in the field and exceptional level of technical expertise, particularly with regards to GIS capabilities which is essential with regards to producing high-quality sensitivity maps for use in the design of final project layouts.
- Strong research background which has proved invaluable when working on several ecologically sensitive and potentially controversial sites containing some of the most threatened fauna in South Africa.
- Published numerous research reports as well as two book chapters and a large number of papers in leading scientific journals dealing primarily with human impacts on the vegetation and ecology of South Africa.
- Maintain several long-term vegetation monitoring projects distributed across Namaqualand and the karoo.
- Guest lecturer at two universities and have also served as an external examiner.
- Reviewed papers for more than 10 international ecological journals.
- Past chairman and current committee member of the Arid Zone Ecological Forum.
- SACNASP registered as a Professional Natural Scientist, (Ecology) No. 400425/11.

A selection of recent work is as follows:

Specialist Assessments:

Bitterfontein Solar Plant - Fauna & Flora Specialist Assessment. Specialist Report for Cape EAPrac. 2012.

Beaufort West Solar Facility, Erf 7388 - Fauna & Flora Specialist Assessment. Specialist Report for Cape EAPrac. 2012.

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Lambert's Bay Wind Farm: Ecological and Biodiversity Assessment: Terrestrial Vertebrate Fauna & Botanical Specialist Study. Specialist Report for Environmental Resources Management. 2011.

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Research Reports & Peer Reviewed Publications:

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Hoffman, M.T. & **Todd, S.W.** 2010. Using Fixed-Point Photography, Field Surveys, And Gis To Monitor Environmental Change: An Example From Riemvasmaak, South Africa. Chapter In *Repeat Photography: Methods And Applications In The Natural Sciences.* R.H. Webb, Editor. Island Press. In Press.