DESKTOP FAUNAL STUDY FOR A PHOTO-VOLTAIC SOLAR POWER PLANT ON FARM 450/6 (NUWERUS), WORCESTER

Client: SanVal Energy
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1. INTRODUCTION

A Photo-Voltaic (PV) Solar Power Plant is proposed for on Portion 6 of Farm 450 (Nuwerus), Worcester (hereafter referred to as the subject land). The Western Cape is known for its rich diversity in floral species, care should also be taken not to negatively impact on fauna and faunal habitats of special concern.

This faunal desktop study was therefore undertaken as part of the Environmental Impact Assessment, with the objective of identifying animals and habitat that have conservation importance. The report makes recommendations on how to avoid, reduce and mitigate predicted impacts associated with the proposed Solar Power Plant. Early detection of these species and their supporting habitat forms an important part in the planning and design phase of any development.

2. METHODOLOGY

Due to the interconnectedness of an ecosystem, biodiversity issues are generally assessed by documenting whether any important biodiversity features occur on site. These include species, ecosystems or processes that maintain ecosystem functioning and/or species on the subject land. Features relevant to this desktop study include:

- **Species:** Potential threatened and protected animal species;
- **Ecosystems:** Area of high biodiversity and a centre of endemism (biodiversity-rich Succulent Karoo biome);
- **Processes:** Potential corridors on site to facilitate ecological processes.

The primary sources of information on vertebrate fauna consulted for this study include:

- CapeNature Vrolijkheids Nature Reserve faunal species lists;
- National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) – Threatened or Protected Species Lists;
- Nature Conservation Ordinance (Ordinance 19 of 1974) – Schedules 1 & 2;
- International Union for Conservation of Nature and Natural Resources (IUCN) - Red Data Species Lists;
- Southern African Bird Atlas Project (SABAP2);
- Southern African Frog Atlas Project (SAFAP);
- Southern African Reptile Conservation Assessment (SARCA);
- National Museum – Bloemfontein: Mammalogy Research Department;
- Google Earth;
- Similar faunal specialist studies.

Due to a lack of site specific faunal information, assessing the potential impacts of the proposed development required evaluating the conservation value of the subject land relative to similar natural areas (in this case the Robertson Karoo vegetation type). A desktop study was thus conducted with the objective of determining what species occur in similar habitat in the greater area to identify species of concern that could potentially occur on the subject land.
The site consists of Robertson Karoo vegetation (Least Threatened) (Mucina and Rutherford, 2006). The more recent Cape Fine-Scale Planning Project (2009) classified the vegetation as Worcester Renosterveld Karoo, also Least Threatened. Animal species list from the Vrolijkheids Nature Reserve, which is also situated in the Robertson Karoo, was used as a starting point to get an indication of what species generally occur in this type of habitat.

The Vrolijkheids Nature Reserve species list was further compared to the IUCN Red Data Species List, the NEMBA Threatened or Protected Species (TOPS) list and the Nature Conservation Ordinance Schedules 1 and 2 (Endangered and Protected species). Any species categorised as Threatened or Protected is assigned a Red List conservation status according to the IUCN structure in Figure 1.

![Figure 1: Structure of the IUCN Version 3.1 Red List Categories](source_image)

**Limitations**

Red List faunal species are by definition usually very rare and difficult to locate. Compiling a list of species that could potentially occur in an area is limited by the lack of collection records that make it difficult to predict whether a species may occur in an area or not. It is always possible that a species that does not occur on a list may be unexpectedly located in an area, or vice versa.

### 3. HABITAT AND ASSOCIATED ANIMALS

Ecosystems consist of communities and their abiotic environments. Habitat, the spatial location where an animal lives, is thus central to ecological studies. Characteristic features of the site are summarized below to provide an indication of the type of habitat that serves to attract and maintain certain species and processes in the area.

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1 IUCN Red List Categories and Criteria: Version 3.1 <[www.iucnredlist.org](http://www.iucnredlist.org)>
The subject land is located within the Succulent Karoo biome which boasts the richest succulent flora on earth with reptiles showing relatively high levels of endemism in the region (Conservation International, 2007). The Succulent Karoo is one of three biomes in South Africa regarded as regions with great biodiversity, containing more than 1 500 endemic vascular plant species (>0.5 % of the world’s total), but which are under extreme pressure (Conservation International, 2007). The other two regions include the Cape Floristic Region and the Thicket Biome (Figure 2).

![Figure 2: Locality of the proposed Photo-Voltaic Solar Power Plant on Portion 6 of Farm 450 (black polygon) in relation to the biodiversity-rich Succulent Karoo biome.](image-url)

The subject land is located approximately 15km south-east of Worcester in the Breede Valley municipal area. The terrain consists of undulating plains with W – E trending low hills. The vegetation consists of Robertson Karoo (Least Threatened), classified as Worcester Renosterveld Karoo (Least Threatened) according to the more recent CAPE Fine-Scale Biodiversity Planning Project. Refer to the Botanical Specialist Study (Krige, 2011) for more detail.

Two non-seasonal water courses, classified as aquatic ecological support areas (OESA) cross the site forming ecological corridors (CAPE Fine-Scale Plan). A small farm dam is located within the larger central water course (Figure 3). No terrestrial or aquatic Critical Biodiversity Areas (CBAs) occur on the subject land.

The prominent occurrence of termitaria (heuweltjies) within the otherwise homogenous landscape increases the potential occurrence of certain plants and animals on the subject land. Termitaria are prominent landscape features in the south-western parts of South Africa and consist of Palaeo-termite nests, in the form of enriched soil mounds, of which the chemical and physical properties differ from...
the surrounding environment, mainly due to the accumulation of organic material. They are major contributors to biodiversity and functional heterogeneity (Bekker, 2011). The high occurrence of termitaria on site can be seen on the Google Earth imagery (green “spots”) see Figure 3 below.

It is likely that a number of animals might naturally occur on the subject land, as the site is in a fairly pristine condition and comprise a large area of natural habitat. Mammals that are commonly found in the Robertson Karoo region include amongst others, Small Grey Mongoose (*Galerella pulverulenta*), Scrub Hare (*Lepus saxatilis*), Cape Porcupine (*Hystrix africaeaustralis*), Cape Grysbok (*Raphicerus melanotis*) and Caracal (*Felis caracal*). Notable reptiles include Angulate Tortoise (*Chersina angulata*), Leopard Tortoise (*Geochelone pardalis*) and Parrot Beaked Tortoise (*Homopus areolatus*).

It is not intended to provide comprehensive lists of all species that could occur on site, since most of the species on these lists are usually common or widespread. Rare, threatened, protected and conservation-worthy species of the area are considered to be the highest priority. Please note that invertebrates were not assessed as part of the study.

### 3.1 ECOLOGICAL CORRIDORS

Habitat transformation and fragmentation are regarded as some of the top pressures on terrestrial biodiversity in the Western Cape. Small, isolated patches of natural habitat and populations of species, caused by the fragmentation of ecosystems through development, cannot be sustained in the long term unless they are functionally connected to other comparable areas (Groom, 2006). A need thus arises for the creation and maintenance of ecological corridors for the transport and movement of species to sustain natural systems.

In this case the habitat in the immediate surrounding areas is comparable to that of the subject land. Mitigation for the transformation and fencing off of the site in question would preferably require connecting the surrounding natural areas by means of ecological corridors through which fauna can move.

The Eskom power line that bisects the site (NW – SE) would provide connectivity in cases where alternative strips of land must be identified due to a lack of natural corridors. The Eskom servitude will be avoided by development to meet safety standards and to ensure free access for maintenance, it does not serve as a potential corridor in this case as it falls within the development footprints that will be fenced off, preventing animals from entering or exiting the corridor.

Watercourses are good ecological corridors, giving their linear nature that connects areas and their capacity to contain various resources needed by animals. The two non-seasonal watercourses that cross the site thus present themselves obvious candidates for ecological corridors and should be preserved (Figure 3).

The R60 between Worcester and Robertson lies on the northern boundary of the site and crosses both watercourses. Intersections like these are known to be points at which road mortality is concentrated. Properly constructed culverts provide animals with an alternative route for crossing a road. Culverts should preferably have certain characteristics to encourage their use by animals i.e. be high and wide enough, have a natural substrate and have an easy and safe access/exit.
There are existing culverts along the R60 where the watercourses cross the road into adjacent properties, as indicated in Figures 4 & 5. The existing culverts are designed to accommodate seasonal water flow, but are not ideal for animals to move through them. It is however not foreseen that the proposed development and corridors will “force” animals to cross the road as there will be sufficient space between the proposed development and the R60 (± 30m buffer) for animals to move around the development without having to cross the road.

**Figure 3:** Annotated Google Earth image (2010) indicating potential ecological corridors following non-seasonal watercourses (blue buffer), corridors along boundary fence lines (green buffer), including the current Eskom power line (white dotted line) and culverts on Farm 450/6, Nuwerus (yellow boundaries).

**Figures 4 & 5:** Existing culverts (A & B) where the non-seasonal watercourses on Farm 450/6, Nuwerus cross the R60 (Worcester – Robertson).
3.2 SPECIES OF CONCERN POTENTIALLY PRESENT

Species categorised as Threatened or Protected are listed in the tables below. The CapeNature, NEMBA and IUCN conservation status are provided for mammals and birds. The Nature Conservation Ordinance (19 of 1974) status is provided for reptiles and amphibians due to a lack of information available in the NEMBA and IUCN lists.

Please note that the following species of concern are known to occur naturally within the Robertson Karoo vegetation type, in which the subject land falls, and does not necessarily occur on the site itself.

### 3.2.1 MAMMALS

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name (English &amp; Afrikaans)</th>
<th>Conservation Status</th>
<th>CapeNature Status</th>
<th>NEMBA Status</th>
<th>IUCN Status (population trend)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Felis silvestris lybica</strong></td>
<td>African wild cat / Vaalboskat</td>
<td>Vulnerable</td>
<td></td>
<td></td>
<td>Least Concern (decreasing)</td>
</tr>
<tr>
<td><strong>Mellivora capensis</strong></td>
<td>Honey badger / Ratel</td>
<td>Vulnerable / Protected</td>
<td>Protected</td>
<td></td>
<td>Near Threatened (decreasing)</td>
</tr>
<tr>
<td><strong>Orycteropus afer</strong></td>
<td>Aardvark / Erdvark</td>
<td>Vulnerable / Protected</td>
<td>Protected</td>
<td></td>
<td>Least Concern (unknown)</td>
</tr>
<tr>
<td><strong>Proteles cristatus</strong></td>
<td>Aardwolf / Aardwolf</td>
<td>Vulnerable</td>
<td>Protected</td>
<td></td>
<td>Least Concern (stable)</td>
</tr>
<tr>
<td><strong>Vulpes chama</strong></td>
<td>Cape fox / Silwervos</td>
<td>Null</td>
<td>Protected</td>
<td></td>
<td>Least Concern (stable)</td>
</tr>
</tbody>
</table>

*CapeNature conservation status is based on the South African Red Data Species Lists


**ii** Population trend indicated in brackets

The African Wild Cat (*Felis silvestris lybica*) is a solitary animal and its diet primarily consists of rodents, small mammals, birds, reptiles and insects (Cillié, 2004). Reptiles, which show relatively high levels of endemism in the Succulent Karoo biome, also make up a substantial portion of the Honey Badger (*Mellivora capensis*) and Cape Fox’s (*Vulpes chama*) diet.

Honey badgers are solitary and tend to be nocturnal in areas where they feel threatened. They occur at low densities throughout South Africa, often outside the confines of formal conservation areas, mainly as a result of their slow reproductive rate and large home ranges. They are listed as “Vulnerable” in the South African Red Data Book for mammals, which indicates that they may become endangered if their numbers decline further (CapeNature, 2011).

If the termitaria on the subject land are still being occupied by termites, it is expected to increase the potential occurrence of termite eating species such as Aardvark or Antbear (*Orycteropus afer*) and Aardwolf (*Proteles cristatus*), which mainly feed on termites, ants and insects.

Although often overlooked, due to their small size and secretiveness, two thirds of all mammals consist of small mammals (mice, shrews, etc.) (Avenant, 2000). They have been identified as valuable indicators of ecosystem integrity because they react rapidly to changes in habitat, have small home ranges and are relatively easy to catch and handle. Some species spend most of their time
underground, while others are known to utilize disused termitaria, which are found on the subject land. Various small mammals such as the Greater Musk Shrew (*Crocidura flavescens*), Common Molerat (*Cryptomus hottentotus*) and Grey Climbing Mouse (*Dendromus melanotis*) are thus expected to occur on site.

### 3.2.2 BIRDS

The subject land consists of open fields and low rolling hills that are covered with relatively homogenous vegetation with no trees. No wetland-type habitat exists on the subject land. The most prominent bird species that are thus expected to occur on site include common ground nesting birds such as dikkop (*Burhinus spp.*), francolin (*Pternistis spp.*) and plovers (*Charadrius spp.*). More sensitive species found in the Robertson Karoo vegetation type include:

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>CapeNature Status</th>
<th>NEMBA Status</th>
<th>IUCN Status (population trend)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ciconia nigra</em></td>
<td>Black Stork</td>
<td>Near-threatened</td>
<td>Vulnerable</td>
<td>Least Concern (N/A)</td>
</tr>
<tr>
<td><em>Circus mauro</em></td>
<td>Black Harrier</td>
<td>Near-threatened</td>
<td>Vulnerable</td>
<td>Stable</td>
</tr>
<tr>
<td><em>Circus ranivorus</em></td>
<td>African Marsh Harrier</td>
<td>Vulnerable</td>
<td>Protected</td>
<td>Least Concern (N/A)</td>
</tr>
<tr>
<td><em>Eupodotis cafra</em></td>
<td>Whitebellied Korhaan</td>
<td>Vulnerable</td>
<td>No entries found</td>
<td></td>
</tr>
<tr>
<td><em>Falco biarmicus</em></td>
<td>Lanner Falcon</td>
<td>Near-threatened</td>
<td>Vulnerable</td>
<td>Least Concern (N/A)</td>
</tr>
<tr>
<td><em>Falco naumanni</em></td>
<td>Lesser Kestrel</td>
<td>Vulnerable</td>
<td>Vulnerable</td>
<td>Decreasing</td>
</tr>
<tr>
<td><em>Falco peregrinus</em></td>
<td>Peregrine Falcon</td>
<td>Near-threatened</td>
<td>Vulnerable</td>
<td>Least Concern (N/A)</td>
</tr>
<tr>
<td><em>Gyps coprotheres</em></td>
<td>Cape Vulture</td>
<td>Vulnerable</td>
<td>Endangered</td>
<td>Decreasing</td>
</tr>
<tr>
<td><em>Polemaetus bellicosus</em></td>
<td>Martial Eagle</td>
<td>Vulnerable</td>
<td>Vulnerable</td>
<td>Near Threatened (decreasing)</td>
</tr>
</tbody>
</table>

### 3.2.3 REPTILES AND AMPHIBIANS

Reptiles include lizards, turtles/tortoises, snakes, frogs/toads and crocodiles. This varied group has an important impact on ecosystems as most reptiles are predators, which help to control the populations of pest species such as rodents, flies and termites. Yet reptiles tend to be overlooked in conservation plans owing to incomplete and rather inaccessible information. Their conservation status also suffers due to their general unpopularity with the general public. The following protected reptiles and amphibians are prone to occur naturally in Robertson Karoo habitat.

#### LIZARDS

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Conservation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acontias meleagris</em></td>
<td>Golden sand-skink</td>
<td>Protected</td>
</tr>
<tr>
<td><em>Afrogecko porphyreus</em></td>
<td>Marbled Leaf-toed gecko</td>
<td>Protected</td>
</tr>
<tr>
<td><em>Agama atra atra</em></td>
<td>Rock agama</td>
<td>Protected</td>
</tr>
<tr>
<td><em>Bradypodion guttural</em></td>
<td>Robertson dwarf chameleon</td>
<td>Protected</td>
</tr>
<tr>
<td><em>Chamaesaura anguina</em></td>
<td>Cape grass lizard</td>
<td>Protected</td>
</tr>
</tbody>
</table>
### Cordylus cordylus
- **Common Name:** Cape girdled lizard
- **Conservation Status:** Protected

### Eremias lineo-ocellata
- **Common Name:** Gespikkelde sandakkedis
- **Conservation Status:** Protected

### Gerrhosaurus flavigularis
- **Common Name:** Yellow-throated plated lizard
- **Conservation Status:** Protected

### Mabuya capensis
- **Common Name:** Striped skink
- **Conservation Status:** Protected

### Mabuya homalocephala
- **Common Name:** Red-sided skink
- **Conservation Status:** Protected

### Nucras tessellata
- **Common Name:** Western sandveld lizard
- **Conservation Status:** Protected

### Pachydactylus bibronii
- **Common Name:** Bibron’s gecko
- **Conservation Status:** Protected

### Pachydactylus geitje
- **Common Name:** Ocellated gecko
- **Conservation Status:** Protected

### Pseudocordylus mircolepidotus
- **Common Name:** Leathery crag-lizard
- **Conservation Status:** Protected

#### TORTOISES & TERRAPINS

Nearly one out of every four known tortoise species occurs in the Western Cape. This can be ascribed to the varied landscape and topography of the region (CapeNature, 2011). All species of tortoises in the Western Cape are protected by the Nature Conservation Ordinance (Ord. no 19 of 1974). Land tortoises are generally threatened because their habitats are constantly threatened by activities such as agriculture and urban development, too frequent fires, uncontrolled spread of alien invasive vegetation and poor land management. Protected species that naturally occur in Robertson Karoo include:

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Conservation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chersina angulata</td>
<td>Angulate tortoise</td>
<td>Protected</td>
</tr>
<tr>
<td>Geochelone pardalis</td>
<td>Leopard tortoise</td>
<td>Protected</td>
</tr>
<tr>
<td>Homopus areaolata</td>
<td>Parrot-beaked tortoise</td>
<td>Protected</td>
</tr>
<tr>
<td>Pelomedusa subrufa</td>
<td>Helmeted terrapine</td>
<td>Protected</td>
</tr>
</tbody>
</table>

#### SNAKES

A number of snakes are expected to occur on site, of which the most common include Puff-adder (*Bitis arietans*), Cape Cobra (*Naja nivea*) and certain burrowing snakes, e.g. blind snakes (considered harmless) (Pers. comm Pieterse, 17 August 2011). The amount of termitaria on site contributes to the expected high occurrence of snakes on the subject land as the former attracts certain small mammals and provides adequate snake nests. Only two protected species could be found that naturally occur in Robertson Karoo:

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Conservation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dasypeltis scabra</td>
<td>Common egg-eater / Rhombic egg eater</td>
<td>Protected</td>
</tr>
<tr>
<td>Duberia lutrix</td>
<td>Common slug-eater</td>
<td>Protected</td>
</tr>
</tbody>
</table>

Snakes are expected to flee from site once construction starts. Recommendations are made below for the safe capture and handling of snakes if difficult or dangerous situations present themselves.

#### FROGS & TOADS

According to Harrison (2009d) the south-western Cape is a centre of amphibian diversity and endemism, making it the most vulnerable “hotspot” for Threatened amphibians in South Africa. A
number of amphibian species, all of which are protected by the Nature Conservation Ordinance (19 of 1974), are known to occur naturally in Robertson Karoo.

Certain species such as the Cape Sand Frog (*Tomopterna delalandii*) inhabit shallowly flooded veld during breeding periods, which mostly consist of flooded terrestrial vegetation and not necessarily aquatic wetland-type vegetation as expected, causing this breeding habitat to be overlooked and not protected. These shallow, ephemeral ponds are depended upon by many amphibians and aquatic invertebrates as they normally lack larger aquatic predators, are relatively warm, well lit and contain organic food (Harrison, 2009d). The only area on site where these types of species would potentially occur is at the farm dam situated in the central ephemeral watercourse. The exclusion of the watercourse as an ecological corridor would thus preserve potential habitat for such species. Protected amphibians of the Robertson Karoo include:

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Conservation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Bufo</em> (Vandijkophrynus) <em>gariepensis</em></td>
<td>Karoo toad</td>
<td>Protected Least Concern (Stable)</td>
</tr>
<tr>
<td><em>Bufo rangeri</em></td>
<td>Raucous toad</td>
<td>Protected No entries found</td>
</tr>
<tr>
<td><em>Cacosternum boettgeri</em></td>
<td>Common caco / Boettger’s dainty frog</td>
<td>Protected Least Concern (Unknown)</td>
</tr>
<tr>
<td><em>Cacosternum namaquense</em></td>
<td>Namaqua caco / Namaqua dainty frog</td>
<td>Protected Least Concern (Stable)</td>
</tr>
<tr>
<td><em>Rana fuscigula</em></td>
<td>Cape river frog</td>
<td>Protected No entries found</td>
</tr>
<tr>
<td><em>Strongylopus grayii</em></td>
<td>Clicking stream frog / Gray’s stream frog</td>
<td>Protected Least Concern (Stable)</td>
</tr>
<tr>
<td><em>Tomopterna delalandii</em></td>
<td>Cape sand frog / Delande’s sand frog</td>
<td>Protected Least Concern (Stable)</td>
</tr>
<tr>
<td><em>Xenopus laevis</em></td>
<td>Common platanna / African clawed frog</td>
<td>Protected Least Concern (Increasing)</td>
</tr>
</tbody>
</table>

4. PREDICTED IMPACTS OF PROPOSED DEVELOPMENT

Potential impacts associated with the proposed development of a Photo-Voltaic Solar Power Plant on Farm 450/6 include:

- **Destruction of natural habitat and animals**

  Limited natural habitat will be lost by the clearance of land for development and at lay-down areas for construction machinery and materials. Land will not be cleared of vegetation except for internal roads and a 70 x 70m area for the substation. Certain animals, especially underground, hibernating (during winter months) and slow moving animals might be killed at the time of construction. Animals are generally mobile, which enable them to move away from potential threats. Construction and operational impacts can therefore often be avoided.

  Animals that are able to escape will most likely establish themselves in similar habitat nearby, but these habitats might already be at carrying capacity for the relevant species which might lead to increased competition and a lower prospect for survival. The impacts will be locally intensive.
Fragmentation of natural habitats
A cumulative impact is exerted over time by the continued construction of buildings, infrastructure, fencing and roads, breaking up natural habitat into isolated fragments. This eventually disintegrates normal ecosystem functioning.

In the case of this development the proposed site is surrounded by intact natural habitat on three sides, making the proposed solar power plant an isolated patch of development within a natural area. The cumulative impact associated with the proposed development is therefore insignificant at this stage. Although limited, the impact will vary from species to species, depending on their mobility. The greatest impact will be on species with restricted movements such as reptiles and tortoises, and the least impact on volant (rapidly moving) species such as birds and mammals. The impact can be mitigated by the maintenance of the ecological corridors on site.

Road mortality
In addition to the fragmentation effect caused by roads, crossings between roads and ecological corridors also negatively impact on faunal species. The subject land is located next to the R60 (Worcester – Robertson). The R60 crosses the watercourses and proposed ecological corridors on the northern boundary of the site. These intersections are known to be points at which road mortality is concentrated. As mentioned earlier, mobile animals will be able to move completely around the proposed development within a 30 – 45m buffer zone.

Fencing and dangers to wildlife
Two types of fence lines are associated with the proposed solar plant – (i) the fence line enclosing the solar plant area (development footprint) and (ii) the existing perimeter fence line that demarcates three sides of the boundaries of Farm 450/6 (Nuwerus), Worcester, namely the north-eastern boundary on the R60, the north-western boundary to Farm 449/RE and the southern boundary with Farm 461/RE. There is currently no fence between Farm 441/RE and the subject land.

Fencing generally presents a direct threat to animals through entanglement, collision and electrification which tend to cause prolonged and painful deaths. According to Harrison (2009c) low visibility is problematic, especially in the case of nocturnal flying animals such as bats and owls. Mammals in turn generally get entangled in an attempt to jump over or through a fence. Wildlife-friendly fences should therefore be installed to prevent these impacts from occurring. The proposed ecological corridors must be accessible at enter and exit points of the boundary fence line. The latter currently consists of a mesh fence that prevents animals from using the corridors at certain points (Figures 6 & 7). See recommendations below.
Birds and Bats

It is assumed that the local birds on site, including potential migratory birds that might cross the area are familiar with the existing infrastructure on and around the subject land i.e. Eskom high voltage power lines, telephone line, internal farm roads and the R60 provincial road passing the site on the north-eastern boundary. There is in turn no habitat for bats on site and it is therefore assumed that they do not inhabit the subject land. The introduction of additional infrastructure components is therefore not expected to pose a significant threat to resident birds or bats flying over the site, especially since the additional infrastructure will not exceed 3m in height, with the only exception being the substation lattice pylon tower of about 14m.

Birds and bats are volant and will thus be able to steer clear of threats imposed by construction and operational activities. The most significant impact will therefore be the loss of habitat for ground nesting birds which will need to vacate the area once construction starts. There is sufficient habitat surrounding the proposed site to accommodate these birds. Existing eggs and nests will most likely be destroyed by construction activities if the latter commences during the breeding season. Hatchlings should be allowed to passively vacate the area along with the adult birds if they are come across during construction.

Potential reduction in populations of Threatened or Protected Species (TOPS)

A number of Vulnerable, Near-Threatened and Protected species, including one Endangered species - the Cape Vulture (Gyps coprotheres) were identified that are known to occur naturally in the Robertson Karoo vegetation type. None of these species were observed on the site during the site visits conducted. It can therefore not be assumed that these species occur on the subject land.

The destruction and/or transformation of potential habitat for these species is in turn not likely to significantly affect population numbers, even if they were to occur on the site, as the habitat surrounding the site is comparable to that of the subject land. As mentioned above, animals that potentially occur on site will be able to escape and move into surrounding areas once construction commences. The proper management of the ecological corridors will make a significant contribution to the safety and sustainability of these populations.
If these species are, however, come across, a translocation plan should be followed. Refer to recommendations below for more detail.

- **Poaching of local wildlife**
  Potential poaching of animals by means of hunting or snaring on and around the site by construction and other workers may cause negative local impacts.

- **Pollution**
  Spillage and/or leakage of hydrocarbons by construction vehicles and machinery may cause chemical contamination of soil and groundwater. The proper storage and maintenance of these vehicles and equipment on site must be monitored, if and where relevant.

- **Overall impacts on biodiversity and ecosystem functioning**
  The above aspects result in an overall impact on biodiversity and ecosystem functioning through the loss and transformation of indigenous fauna, habitat and ecological processes.

Special care must be taken not to impose a significant impact on the rich biodiversity associated with the Succulent Karoo in which the proposed development is situated.

### 5. RECOMMENDED MITIGATION MEASURES

- The first and foremost recommendation would be to maintain intact habitat wherever possible. This will be achieved in part through that clearing of vegetation will not take place except along newly established gravel roads and a 70 x 70m area for a substation.

- Maintain and restore ecological corridors (non-seasonal watercourses) with sufficient buffers that cross the site. It is recommended that a buffer zone of at least 30 meters along watercourses and boundary fences should be established.

- Animals are expected to flee from site once construction starts. It is recommended that the construction of the solar plant and associated infrastructure should be finalised before the fences are constructed to allow animals to escape from site.

- A translocation plan as part of the Environmental Management Programme should be implemented before commencement of the construction phase. This will ensure that animals move out of harm’s way and those remaining trapped inside the development footprint can be translocated.

  The plan should contain a phased translocation process including the following measures:

  - Complete construction before the installation of the perimeter fence lines.
  - Animals must be allowed to passively cross the site when encountered during the construction phase.
Conduct a clearance survey of the entire site before and after installation of the fence lines to ensure that no animals are trapped inside the enclosed development footprint.

- Translocate animals to a suitable location outside the development footprint.
- Conduct long-term monitoring (during construction and operation) to ensure that no animals are trapped by the development.
- Report any observations and follow the translocation plan.

Snake handling and translocation:
- It is recommended that a designated person(s) should undergo training on the correct handling of snakes and snakebite treatment in case these situations present themselves during construction or operation. Most snakes can be translocated with the correct skills and equipment.
- It is suggested that snake capture and handling equipment be kept on site.
- Emergency contact numbers must be kept on site in case of a snakebite which will require immediate treatment in certain cases.

Fences: as mentioned above two types of fence lines are associated with the development – (i) a new fence line enclosing the solar plant area (development footprint) and (ii) the existing perimeter fence line that demarcates the north-western, north-eastern (R60) and southern boundaries of Farm 450/6 (Nuwerus), Worcester.

(i) The fence surrounding the solar power plant should be animal proof, preventing any animals from entering the plant area (including borrowing animals). The proposed fence will consist of small apertures and will be approximately 2m in height which is sufficient for this purpose. See Figures 9 & 10 below:

**Figures 9 & 10:** Proposed fence type provided by Betafence SA.

It is recommended that evenly-spaced small openings (approximately 7cm high and 5cm wide) be left in the fence on ground level to allow small and underground animals that are difficult to spot and translocate (e.g. rodents, snakes, etc.), and that might still be trapped inside the development footprint during the operational phase, to exit, especially since there will be no permanent water source inside the solar plant area.
Note that burrowing animals could occur in the area and this should be taken into account in the design and layout of fence lines. If animals are to be kept out of the solar plant area fences must be buried deep enough to prevent burrowing animals from entering it. The majority of mammals listed in this report either dig holes or live in holes dug by other species (Cillié, 2004).

(ii) The existing perimeter fence surrounding the farm boundaries consists of a mesh fence which currently prevents animals from entering or exiting the proposed ecological corridors running through the site (Figures 6 & 7). The sections in the fence where animal movement is expected to occur should allow free movement and should be removed or modified to achieve this.

Mobile animals will be able to go around the enclosed development or along the boundary corridors. Slow-moving animals will however most likely make use of the corridors that bisect the site. For this purpose corridors must be accessible.

Intersections between the corridors and the boundary fence line should preferably be converted to palisades or a strand fence (horizontal wire strands) that will let most animals through (Pers. comm. James Harrison, August 2011). The following general specifications of Harrison (2009) are also recommended for the boundary fence:

- Visibility of the wire strands (especially the top strand) should be improved at enter and exit points of the corridors. Plastic or aluminium tags can be used. Plastic might disintegrate and should be replaced in time.
- Design features can be added to the fence which helps keep the top wire strands apart. This prevents animals from getting entangled when jumping the fence.
- Barbed wire can be made more visible and safe at entry and exit points of a corridor with the use of split poly pipe.
- Removal of the bottom strands of fencing at points where animals are expected to cross the fence allows them, especially small animals, to go beneath them.
- If electrified fences are used on site (note: none are planned) the bottom wire strand of the fence should not be electrified to prevent small animals from being electrified when touching or crossing the fence.

- Automatic camera traps (remote photographic equipment) should be installed at strategic points on site (e.g. enter/exit points of corridors) during the construction and operational phases, to allow unobtrusive access into wildlife movement and habitats. This will provide an indication of what species occur on site and whether they currently make use of, for instance, the non-seasonal watercourses. Increased knowledge about the site in question will facilitate planning and design of the proposed development and associated infrastructure.

- Artificial food and water sources, including refuse, should be kept out of reach of animals to prevent problem animals from becoming a nuisance or danger to staff and local indigenous species residing on or near the subject land. Refuse should be removed from site regularly, if applicable.

- Speed on internal roads should be restricted to prevent road mortality with the use of speed humps and road signage.
Poaching (hunting without permits, trapping and snaring) of local wildlife must be strictly prohibited. The appointed Environmental Control Officer should monitor poaching, among other duties. Sites where traps and snares are likely to be set should be patrolled, especially during the construction phase. Educate construction and operational personnel, if the need arises, about the importance of conservation and to understand that exploitation of the local resources are prohibited.

An ongoing programme of clearance of invasive alien vegetation should be put in place.

Development and construction activities, including lay-down areas for construction equipment, should be restricted to demarcated areas.

Construction vehicles and machinery should be properly maintained to prevent contamination of soil and water through the spillage or leakage of hydrocarbons such as petrol and diesel. All vehicles leaking fuel or other liquids should immediately be removed to the maintenance area and repaired. Spills should be cleaned up promptly and disposed of correctly. Polluted soil and water should be removed from site, and disposed of where required, to a licensed hazardous facility.

Parked construction vehicles and machinery must be inspected before they are moved to ensure that no animals (e.g. tortoises) are killed while hiding beneath the vehicles.

The Environmental Management Programme compiled as part of the Environmental Impact Assessment Report should incorporate the necessary mitigation measures and must be implemented during all phases of the proposed development.

An Environmental Inspection and Compliance Monitoring programme must be developed, covering both construction and operational phases. A qualified individual must be designated as the Environmental Control Officer to monitor the implementation of the EMP and other activities (e.g. poaching) during the construction phase.

6. CONCLUSION

Although situated in the biodiversity-rich Succulent Karoo biome, the Robertson Karoo vegetation type (more recently classified as Worcester Renosterveld Karoo) is categorised as Least Threatened. Various Threatened and/or Protected species can occur in this vegetation type, but since no faunal species or habitat of significant conservation importance were found it can be assumed that no significant fauna or faunal habitat will be destroyed by the proposed development.

The implementation of the proposed recommendations and mitigation measures are vital to ensure that the potential impacts on the species, ecosystems and processes are avoided, or where not possible, reduced. A risk-averse and cautious approach should be applied that considers the limits of current knowledge about the consequences of decisions and actions associated with the construction and operation of the proposed solar power plant.
7. REFERENCES


HARRISON, J (2009a) An introduction to ecological corridors. JAH Environmental Consultancy, Cape Town.

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