EIA REPORT

Specialist ecological study on the potential impacts of the proposed Pofadder Solar Thermal Facility Project, Pofadder, Northern Cape

Prepared by

David Hoare
(M.Sc., Pr.Sci.Nat.)

David Hoare Consulting cc
41 Soetdoring Ave
Lynnwood Manor,
Pretoria

for

Savannah Environmental (Pty) Ltd
Unit 606, 1410 Eglin Office Park, 14 Eglin Road, Sunninghill.
PO Box 148,
Sunninghill,
2157

on behalf of
KaXu CSP South Africa (Pty) Ltd

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David Hoare Consulting cc
Biodiversity Assessments, Vegetation Description / Mapping, Species Surveys

CONTROL SHEET FOR SPECIALIST REPORT

The table below lists the specific requirements for specialist studies, according to Regulation 33 of Government Notice No. R385 of 1996 EIA Regulations.

Activity	Yes	No	Comment
Details of: i. the person who prepared the report; and	√		
ii. the expertise of that person to carry out the specialist study or specialised process	√		
A declaration that the person is independent in a form as may be specified by the competent authority	√		
An indication of the scope of, and the purpose for which, the report was prepared	√		
A description of the methodology adopted in preparing the report or carrying out the specialised process	√		
A description of any assumptions made and any uncertainties or gaps in knowledge	√		
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	√		
Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	√		
A description of any consultation process that was undertaken during the course of carrying out the study	√		
A summary and copies of any comments that were received during any consultation process	√		
Any other information requested by the competent authority	√		

REGULATIONS GOVERNING THIS REPORT

This report has been prepared in terms the EIA Regulations promulgated under the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 385 Section 33 - Specialist reports and reports on specialised processes under the Act. Relevant clauses of the above regulation are quoted below and reflect the required information in the "Control sheet for specialist report" given above.

Regulation 33. (1): An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialized process.

Regulation 33. (2): A specialist report or a report on a specialized process prepared in terms of these Regulations must contain:

(a) Details of (i) the person who prepared the report, and
(ii) The expertise of that person to carry out the specialist study or specialized process;

(b) Declaration that the person is independent in a form as may be specified by the competent authority;

(c) Indication of the scope of, and the purpose for which, the report was prepared;

(d) Description of the methodology adopted in preparing the report or carrying out the specialized process;

(e) Description of any assumptions made and any uncertainties or gaps in knowledge;

(f) Description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;

(g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;

(h) Description of any consultation process that was undertaken during the course of carrying out the study;

(i) Summary and copies of any comments that were received during any consultation process;

(j) Any other information requested by the competent authority.

Appointment of specialist

David Hoare of David Hoare Consulting cc was commissioned by Savannah Environmental (Pty) Ltd to provide specialist consulting services for the Environmental Impact Assessment for the proposed Pofadder Solar Thermal Plant near Pofadder in the Northern Cape. The consulting services comprise an assessment of potential impacts on the flora, fauna, vegetation, and ecology in the study area by the proposed project.

Details of specialist

Dr David Hoare
David Hoare Consulting cc
Postnet Suite no. 116
Private Bag X025
Lynnwood Ridge, 0040

Telephone: 012 804 2281
Cell: 083 284 5111
Fax: 086 550 2053
Email: dhoare@lantic.net

Summary of expertise

Dr. David Hoare:

- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science, Botanical Science), registration number 400221/05.
- Founded David Hoare Consulting cc, an independent consultancy, in 2001.
- Ecological consultant since 1995.
- Conducted, or co-conducted, over 250 specialist ecological surveys as an ecological consultant.
- Published six technical scientific reports, 15 scientific conference presentations, seven book chapters, and eight refereed scientific papers.
- Attended 15 national and international congresses & 5 expert workshops, lectured vegetation science / ecology at 2 universities and referee for 2 international journals.

Independence

David Hoare Consulting cc and its Directors have no connection with KaXu CSP South Africa (Pty) Ltd (KaXu CSP). David Hoare Consulting cc is not a subsidiary, legally or financially, of the proponent. Remuneration for services by the proponent in relation to this project is not linked to approval by decision-making authorities responsible for authorising this proposed project and the consultancy has no interest in secondary or downstream developments because of the authorisation of this project. David Hoare is an independent consultant to Savannah Environmental (Pty) Ltd 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 this specialist performing such work. The percentage work received directly or indirectly from the proponent in the last twelve months is approximately 0% of turnover.

Scope and purpose of report

The scope and purpose of the report are reflected in the "Terms of reference" section of this report

Conditions relating to this report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. David Hoare Consulting cc and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements, or conclusions drawn from or based on this report must refer to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

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INTRODUCTION

Terms of reference and approach

Savannah Environmental (Pty) Ltd. was appointed by KaXu CSP South Africa (Pty) Ltd (KaXu CSP) to undertake an application for environmental authorisation through an Environmental Impact Assessment (EIA) for the proposed "Pofadder Solar Thermal Plant." The project involves the establishment of a solar thermal facility and associated infrastructure, including but not limited to a substation, powerlines, water supply pipelines and internal access roads. The purpose of the EIA is to identify potential environmental impacts associated with the project.

In March 2010 David Hoare Consulting cc was appointed by Savannah Environmental (Pty) Ltd to undertake an ecological assessment of the study area. The specific terms of reference for the ecological study include:

- An indication of the methodology used in determining the significance of potential environmental impacts;
- A description of the environmental issues that were identified during the environmental impact assessment process;
- An assessment of the significance of direct, indirect and cumulative impacts in terms of standard criteria;
- A description and comparative assessment of all alternatives identified during the environmental impact assessment process;
- Recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Plan;
- An indication of the extent to which the issue could be addressed by the adoption of achievable 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 the distribution line alternatives,
- A comparative assessment of the positive and negative implications of the access road alternatives.

This report provides details of the results of the EIA phase. The findings of the study are based on a combination of a desktop assessment of the study area and fieldwork undertaken on site.

Study area

At a regional level the study area falls within the Northern Cape to the north-east of the town of Pofadder. A more detailed description of the study area is provided below.

METHODOLOGY

The project was to be undertaken in two phases, a Scoping phase, and an Environmental Impact Assessment phase. The objective of the Scoping phase study was to undertake a desktop study to review fauna and flora patterns within the study area in order to identify any highly sensitive areas that should be avoided during development. It was therefore necessary to provide checklists of sensitive species that could potentially occur in the study area as well as habitats with high conservation value. For potential species, only those of high conservation concern are provided. It was also intended to provide a draft habitat map of the study area based on available maps and database information. The results of the Scoping phase study are provided in this report.

Assessment philosophy

Many parts of South Africa contain high levels of biodiversity at species and ecosystem level. At any single site there may be large numbers of species or areas of high ecological complexity. Sites also vary in their natural character, uniqueness and the level to which they have been previously disturbed. Assessing the potential impacts of a proposed development often requires evaluating the conservation value of a site relative to other natural areas and relative to the national importance of the site in terms of biodiversity conservation. A simple approach to evaluating the relative importance of a site includes assessing the following:

- Is the site unique in terms of natural or biodiversity features?
- Is the protection of biodiversity features on site of national/provincial importance?
- Would development of the site lead to contravention of any international, national, or provincial legislation, policy, convention, or regulation?

Thus, the general approach adopted for this type of study is to identify any critical biodiversity issues, i.e. to specifically focus on red flags and/or potential fatal flaws. Biodiversity issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. These can be organised in a hierarchical fashion, as follows:

Species

1. threatened plant species
2. protected trees
3. threatened animal species

Ecosystems

1. threatened ecosystems
2. protected ecosystems
3. critical biodiversity areas
4. areas of high biodiversity
5. centres of endemism

Processes

1. corridors
2. mega-conservancy networks
3. rivers and wetlands
4. important topographical features

It is not the intention to provide comprehensive lists of all species that occur on site, since most of the species on these lists are usually common or widespread. Rare, threatened,

protected, and conservation-worthy species and habitats are considered the highest priority, the presence of which is most likely to result in significant negative impacts on the ecological environment. The focus on national and provincial priorities as well as critical biodiversity issues is in line with National legislation protecting environmental and biodiversity resources, including, but not limited to the following which ensure protection of ecological processes, natural systems, and natural beauty as well as the preservation of biotic diversity in the natural environment:

1. Environment Conservation Act (Act 73 of 1989)
2. National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998)
3. National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004)

Plant and animal species of concern

The purpose of listing Red Data plant and animal species was to provide information on the potential occurrence of species of special concern in the study area that may be affected by the proposed infrastructure. Species appearing on these lists could then be assessed in terms of their habitat requirements in order to determine whether any of them have a likelihood of occurring in habitats that may be affected by the proposed infrastructure.

Lists were compiled specifically for any species of conservation concern previously recorded in the area and any other species with potential conservation value. Historical occurrences of threatened plant species were obtained from the South African National Biodiversity Institute for the quarter degree squares within which the study area is situated.

Regulations published for the National Forests Act (Act 84 of 1998) provide a list of protected tree species for South Africa. The species on this list were assessed in order to determine which protected tree species have a geographical distribution that coincides with the study area and habitat requirements that may be met by available habitat in the study area.

Lists of threatened animal and bird species that have a geographical range that includes the study area were obtained from literature sources (Barnes 2000, Branch 1988, 2001, Friedmann & Daly 2004, Mills & Hes 1997). The likelihood of any of them occurring was evaluated based on habitat preference and habitats available on site. The three parameters used to assess the probability of occurrence for each species were as follows:

- *Habitat requirements*: most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics within the study area were assessed;
- *Habitat status*: in the event that available habitat is considered suitable for these species, the status or ecological condition was assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water-quality plays a major role); and
- *Habitat linkage*: movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red Data species within the study area.

For all threatened organisms (flora and fauna) that occur in the general geographical area of the site, a rating of the likelihood of it occurring on site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- MEDIUM: habitats on site match general habitat description for species (e.g. Karoo), but detailed microhabitat requirements (e.g. sparse karroid shrubland on shallow soils

overlying dolerite) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. mountain Fynbos on shallow soils overlying Table Mountain sandstone);
- DEFINITE: species found in habitats on site.

Vegetation habitats of concern

The purpose of producing a vegetation habitat map was to provide information on the location of potentially sensitive features in the study area. Various provincial, regional, or national level conservation planning studies have been undertaken in the area, e.g. the National Spatial Biodiversity Assessment (NSBA), and the mapped results from these were taken into consideration in compiling the vegetation habitat map.

The general status of the vegetation of the study area was derived by updating the National Landcover data layer for this part of the study area (Fairbanks *et al*. 2000) using available satellite imagery and aerial photography. From this it could be determined which areas were transformed and no longer had primary vegetation.

Assessment of impacts

Direct, indirect, and cumulative impacts of the issues identified through the scoping study, as well as all other issues identified in the EIA phase were assessed in terms of the following criteria:

» The **nature**, which includes a description of what causes the effect, what will be affected, and how it will be affected.
» The **extent**, wherein it is 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 was assigned as appropriate (with 1 being low and 5 being high):
» The **duration**, wherein it was indicated whether:
  * the lifetime of the impact will be of a very short duration (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 describes the likelihood of the impact actually occurring. Probability was estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but 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**, was determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
» The **status**, which was described as 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** was calculated by combining the criteria in the following formula:

S= (E+D+M) P

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).

Limitations

- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list will be located in an area where it was not previously known to exist.

DESCRIPTION OF STUDY AREA

Location

The study site is situated to the north-east of the town of Pofadder in the Northern Cape (Figure 1). The site falls within the quarter degree grid 2819DC. This is within 20 km of the Orange River, which is also the national border with Namibia. The solar thermal facility is proposed on Portion 4 of the Farm Scuit-Klip 92. No alternative site is currently being considered for the proposed solar thermal facility.

The study area is relatively isolated and is situated along a minor road that connects the N14 and the R358. The N14 connects Pofadder and Kakamas and the R358 connects Pofadder, Onseepkans, and Karasburg in Namibia. Although these are relatively minor roads, the site is easily accessible from Upington which is located approximately 180 km to the east. The town of Kakamas which is the gateway to the Augrabies Falls National Park, is located approximately 100 km to the east,

There is a local access road on the farm that traverses part of the site. Most of the site is relatively accessible, even the hills to the north of the site, which contain various vehicle tracks through them.

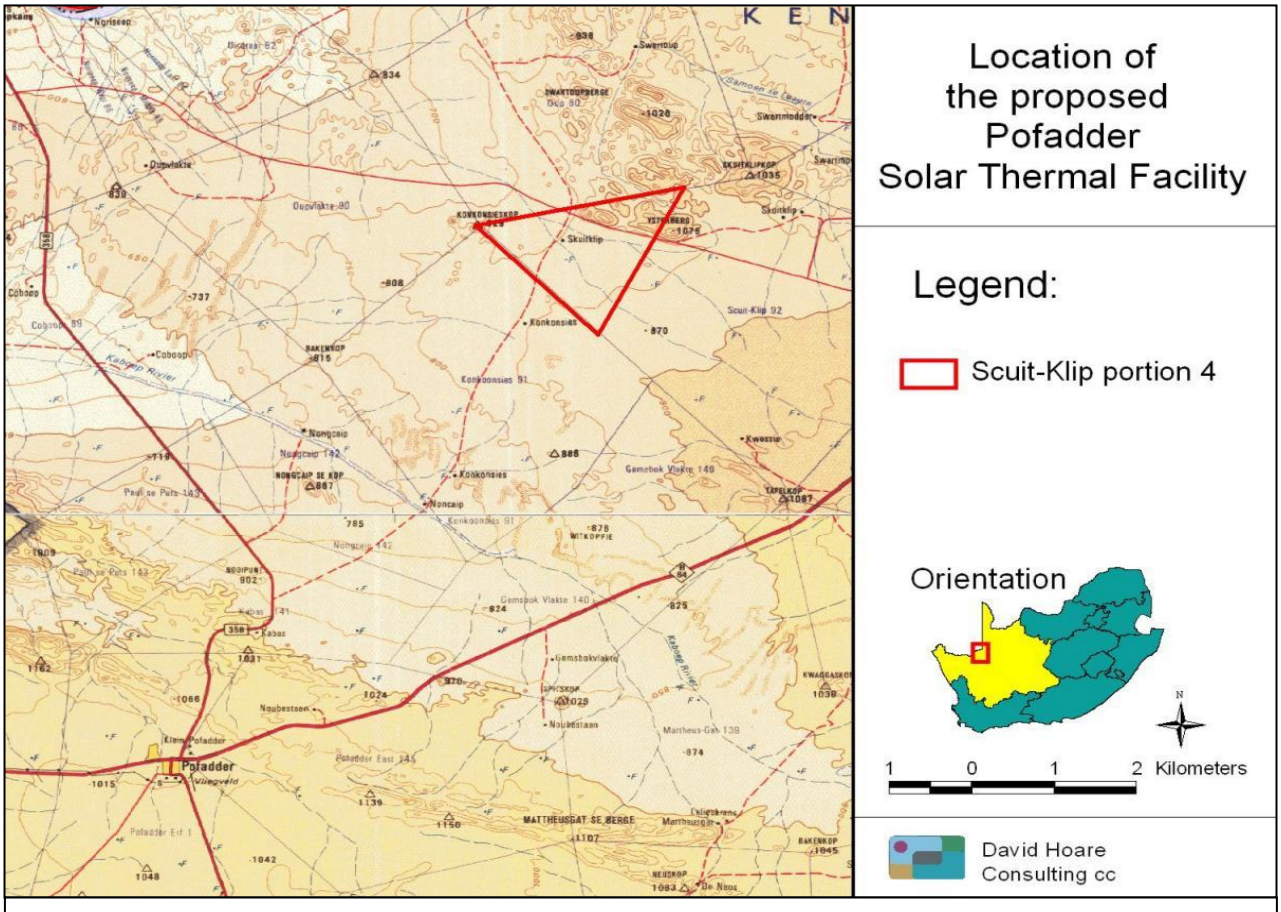

Figure 1: Location of proposed Pofadder Solar Thermal Facility.

Topography

A general view of the topography of the study area is given in Figure 2. The study site is located mostly on flat plains with a single hill in the north-western corner (Konkonsieskop) and a range of hills in the north-eastern corner (Ysterberg). The hills are extremely rugged and, in places, quite steep. In contrast, the plains are flat, although sloping slightly towards the north-west. This landscape is typical of the broader region within which the study area is located and the pattern repeats itself up to 80 km southwards and south-eastwards.

The plains are at an elevation of 770 - 870 m. The highest point on the plains is at the southern end of the site. The lowest point is in the north-western corner. Konkonsieskop, in the north-western corner of the site, reaches a peak of 929 m above sea level, approximately 150 m above the surrounding plains over a distance of approximately 250 m. The hills around Ysterberg reach a maximum height of 1075 m above sea level, although most of the peaks are below 1000 m and above 900 m.

The site is in a very arid part of South Africa. Nevertheless, drainage patterns on site are quite clear. A large proportion of the plains have the appearance of an alluvial fan. The plains drain from the wide part of this fan towards the narrow side in the north-west. Almost the entire plain area within the study area, except for some mobile dunes in the western side, appear to have drainage patterns. There are various drainage lines and non-perennial stream beds within the hills. These drain towards the north-west and the north. Eventually these all drain northwards towards the Orange River.

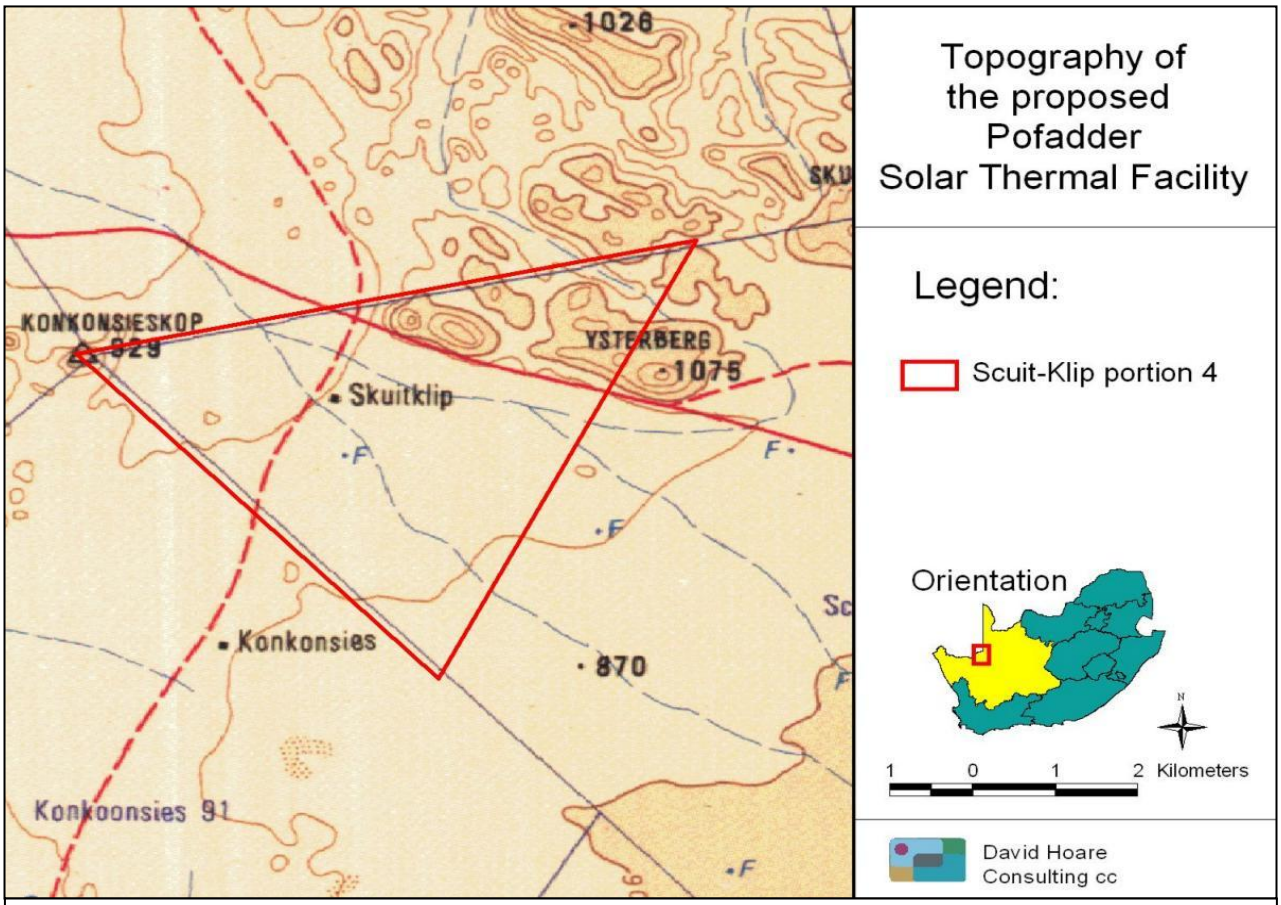

Figure 2: Topography of the study area.

Geology and soils

There are three major geological formations occurring in the study area. On the plains are Quaternary sedimentary deposits of sand and calcrete that are alluvial in origin. The hills are Witwater Gneiss Formation composed primarily of granite. Granite is a type of igneous rock, which usually has a medium to coarse grained texture. In between the hills and the plains is a band of Mokolian Era Kinzigite. Kinzigite is a coarse-grained metamorphic rock that is formed principally of garnet and biotite. Garnet is a metamorphic mineral and biotite is a type of black mica.

Detailed soil information is not available for broad areas of the country. As a surrogate, land type data was used to provide a general description of soils in the study area (land types are areas with largely uniform soils, topography and climate). There are a variety of land types in the study area (Figure 3). The most common land types in the study area are Ag and Ic (Land Type Survey Staff, 1987).

The A land type refers to yellow and red soils without water tables belonging to one or more of the following soil forms: Inanda, Kranskop, Magwa, Hutton, Griffin, Clovelly. The Ag landtype consists of red, high base status soils, generally less than 300 mm deep (MacVicar et al. 1974). In the study area these occur on the plains.

The Ic landtype refers to land types with exposed rock (exposed country rock, stones or boulders) covering more than 80% of the area. with shallow and/or rocky soils (MacVicar et al. 1974). There is therefore very little soil. These are the soils on the steeper slopes and hills, primarily in the north-eastern part of the site.

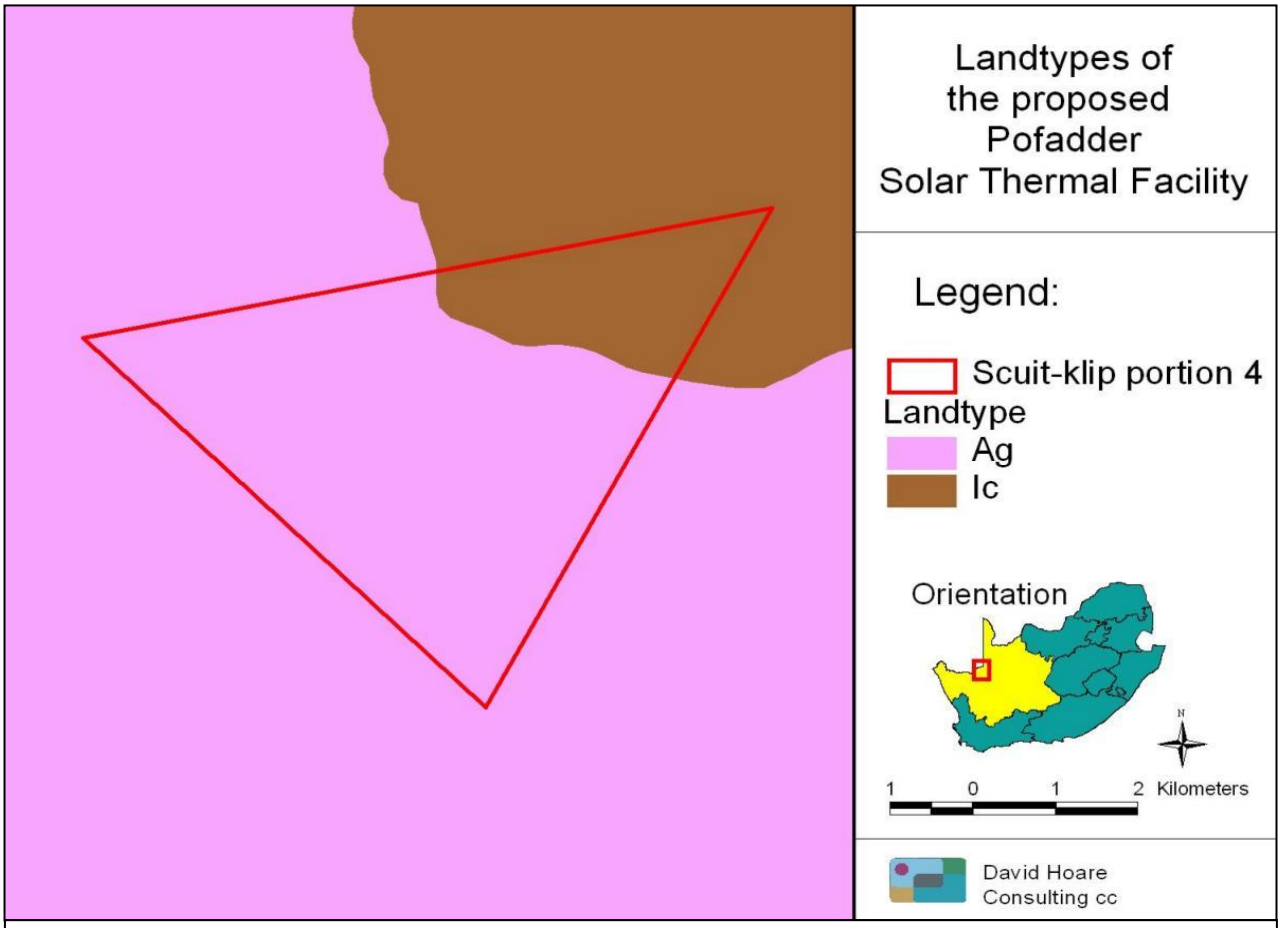

Figure 3: Landtypes of the proposed Pofadder Solar Thermal Facility.

Climate

The climate is arid and rainfall is indicated as primarily summer, but the presence of the Orange River valley means that winter rainfall is able to extend up this river valley deep into the interior. Fog is a common phenomenon up the river valley. Mean annual rainfall is approximately 100 mm per year. Temperatures are hot in summer and cold in winter. Mean maximum summer temperatures are around 38^{o}C and mean minimum winter temperatures are around -1^{o}C.

Landuse and landcover of the study area

A landcover map of the study area (Fairbanks *et al*. 2000) indicates that the entire site consists of natural vegetation. The Surveyor General's 1:50 000 topocadastral maps for the study area and Google imagery for the study area indicate that the landcover map is largely correct.

This area of the country consists primarily of farms used as rangeland for commercial livestock production. Commercial farming systems are characterised by land stocked at economically sustainable levels. These regions have been commercially farmed as stock ranches for close to 100 years. Degradation of vegetation has been blamed on high stocking rates of domestic livestock in commercial farming areas. The study area is no exception and degradation due to overgrazing is a possibility.

Based on these map sources, aerial photography and knowledge of the land-use on site, it is probable that the study area has been impacted upon to some degree by livestock farming, but that the vegetation is probably in relatively good condition and mostly natural. Areas in good condition could potentially support unique populations of plants or animals.

Broad vegetation types of the region

The study area falls within the Karoo Biome (Rutherford & Westfall 1986). The most recent and detailed description of the vegetation of this region is part of a national map (Mucina, Rutherford & Powrie, 2005; Mucina *et al*. 2006). This map shows two vegetation types occurring in the area. The vegetation types are Bushmanland Arid Grassland and Lower Gariep Broken Veld (Figure 4). These vegetation types are described in more detail below.

Bushmanland Arid Grassland

This vegetation type occurs on extensive, relatively flat plains and is sparsely vegetated by tussock grasses, including *Stipagrostis ciliata*, *Aristida adscensionis*, *Aristida congesta*, *Enneapogon desvauxii*, *Eragrostis nindensis*, *Schmidtia kalahariensis,* and *Stipagrostis obtusa*. In some years after good rains there are abundant displays of annual herbs (Mucina et al. 2006). There are no known endemics in this vegetation (Mucina et al. 2006), but the vegetation contains endemics belonging to the Griqualand West or Gariep Centres of Endemism (van Wyk & Smith 2001), namely *Aizoon asbestinum*, *Maerua gilgii*, *Ruschia muricata* and *Aloe gariepensis*. The vegetation type also contains the protected tree species, *Acacia erioloba, Acacia haematoxylon* and *Boscia albitrunca*. At a national scale this vegetation type has been transformed only a small amount and 27% is conserved in Augrabies Falls National Park; it is not therefore considered to be a threatened vegetation type (Mucina et al. 2006).

Lower Gariep Broken Veld

This consists of sparse vegetation dominated by shrubs and dwarf shrubs, with annuals conspicuous, especially in spring, and perennial grasses and herbs occurring in low amounts. On the slopes of koppies groups of widely scattered low trees such as *Aloe dichotoma* occur and the sandy soils of footslopes *Acacia mellifera* occurs. Known endemics in this vegetation include the tall shrub *Caesalpinia bracteata* and the succulent shrub *Ruschia pungens* (Mucina et al. 2006). The vegetation contains endemics belonging to the Griqualand West or Gariep Centres of Endemism (van Wyk & Smith 2001), namely *Digitaria polyphylla* and *Crassula corallina* subsp. *macrorrhiza*. At a national scale this vegetation type has been transformed only a small amount and is also conserved in Augrabies Falls National Park. It is not considered to be a threatened vegetation type (Mucina et al. 2006).

Conservation status of broad vegetation types

On the basis of a recently established approach used at national level by SANBI (Driver et al. 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 1, as determined by best available scientific approaches (Driver et al. 2005).

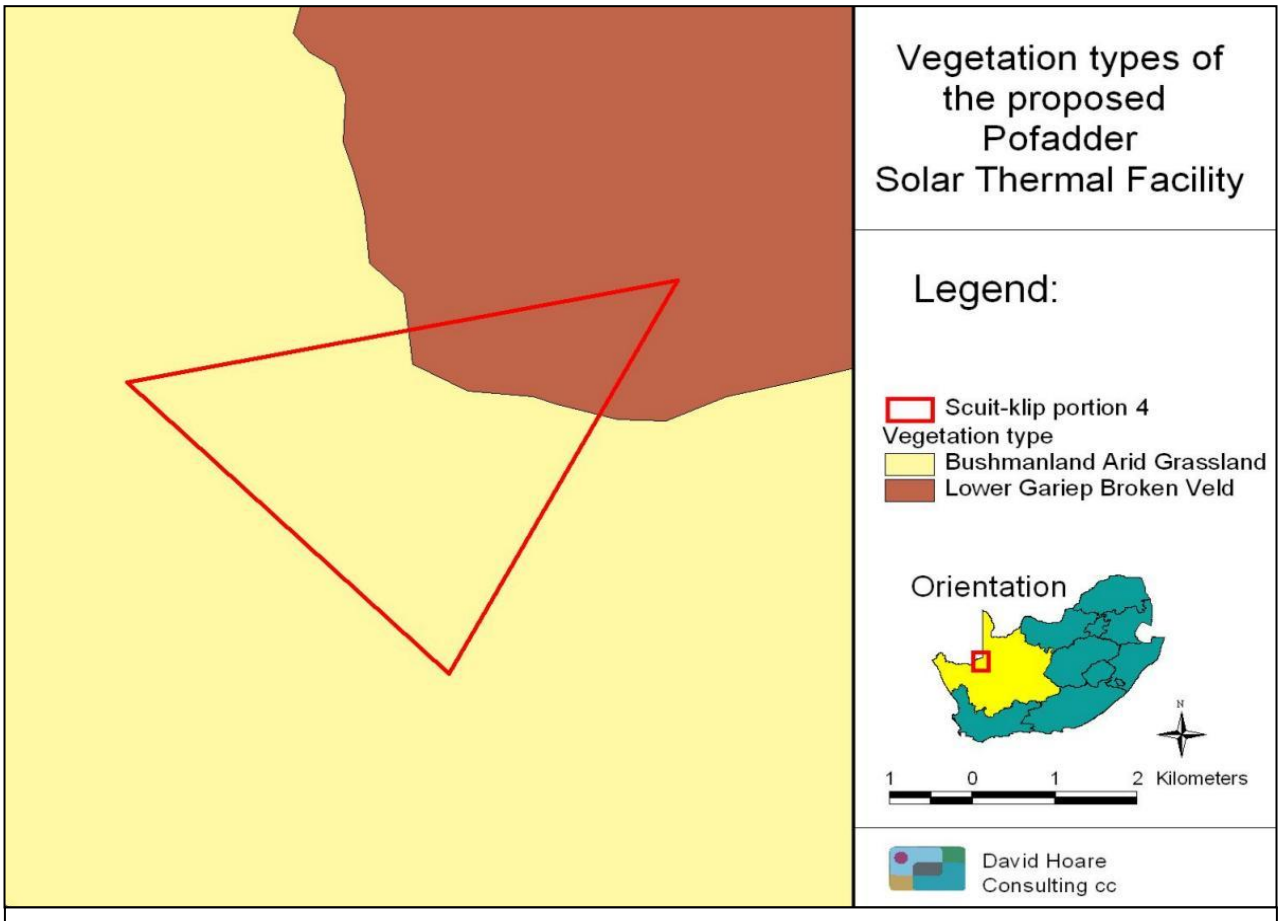

Figure 4: Vegetation types of the study area.

The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

Both vegetation types occurring in the study area are classified as Least Threatened (Driver *et al*. 2005; Mucina *et al*., 2006).

Table 2: Conservation status of different vegetation types occurring in the study area, according to Driver et al. 2005 and Mucina et al. 2005.

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status
Bushmanland Arid Grassland	21	1	1	Least Threatened
Lower Gariep Broken Veld	21	4	1	Least Threatened

Red List plant species of the study area

Lists of plant species previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute. These are listed in Appendix 1. Additional species that could occur in similar habitats, as determined from database searches and literature sources, but have not been recorded in these grids are also listed. There were eleven species on this list.

It became clear during research on this project that the quantity and quality of floristic data for the study area is poor. There are few taxonomic collections and relatively little floristic information for the area (van Wyk & Smith 2001). There are over 400 succulent species listed as being endemic or near-endemics for the Gariep Centre of Endemism as well as a long list of non-succulents (van Wyk & Smith 2001). A number of these have been recorded in the region around the current study area, for example, *Aloe gariepensis*, *Crassula corallina* subsp. *macrorrhiza*, *Hoodia gordonii*, *Maerua gilgii*, *Ruschia muricata,* and *Sarcocaulon patersonii*. *Aloe gariepensis*, *Ruschia muricata* and *Maerua gilgii* are found in Bushmanland Arid Grassland, *Crassula corallina* subsp. *macrorrhiza* is found in Lower Gariep Broken Veld and *Sarcocaulon patersonii* is found in a variety of vegetation types, including Lower Gariep Broken Veld and Bushmanland Arid Grassland. The Gariep Centre is centred along the Orange River. Areas associated with calcareous soils and heavy metals are likely to have high numbers of species of restricted distribution. The probability is high that there are unknown species from the site or surrounding areas.

The species that have been previously recorded in the grid in which the site is located and surrounding grids were evaluated to determine the likelihood of any of them occurring on site based on habitat suitability. Of the species that are considered to occur within the geographical area under consideration, five species could occur in habitats that are available in the study area. According to IUCN Ver. 3.1 (IUCN, 2001) two of these are listed as Vulnerable, one as Near Threatened and two as Declining (see Table 3 for explanation of categories).

- One of the vulnerable species, *Aloe dichotoma*, has been evaluated from the species habitat preference as having a high probability of occurring on site. It occurs on rocky slopes and could occur anywhere within Lower Gariep Broken Veld (hills on site) or in rocky areas in Bushmanland Arid Grassland on site (on the plains). A number of individuals of this species were found on site during the field survey.
- The other vulnerable species, *Lithops olivaea*, is a habitat specialist, occurring in white translucent quartzite patches. The species *Lithops olivaea* has been recorded 30 km away and has a wide distribution within the Gariep Centre of Floristic Endemism. There is therefore a high probability that it could occur on site, if available habitat is present.

No such habitat was found during the field survey of the site and it is therefore assessed that the species probably does not occur on site.

- The Near Threatened species, *Conophytum limpidum*, is found on inselbergs in Bushmanland in vertical crevices in rocks, generally preferring shaded situations. If it occurs on site, it is most likely to be found in Lower Gariep Broken Veld (hills in the northern part of the site). This area will not be affected by the proposed project (see "Description of Infrastructure" section below).
- The two Declining species, *Acacia erioloba* and *Hoodia gordonii*, both have a high probability of occurring on site. *Acacia erioloba* is also a protected tree. It occurs in deep sandy soils, along drainage lines and sometimes on rocky outcrops. No individuals of either of these species were found on site.

Table 3: Explanation of IUCN Ver. 3.1 categories (IUCN, 2001), and Orange List categories (Victor & Keith, 2004).

IUCN / Orange List category	Definition	Class
EX	Extinct	Extinct
CR	Critically Endangered	Red List
EN	Endangered	Red List
VU	Vulnerable	Red List
NT	Near Threatened	Orange List
Declining	Declining taxa	Orange List
Rare	Rare	Orange List
Critically Rare	Rare: only one subpopulation	Orange List
Rare-Sparse	Rare: widely distributed but rare	Orange List
DDD	Data Deficient: well known but not enough information for assessment	Orange List
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient

Red List animal species of the study area

All Red List vertebrates (mammals, reptiles, amphibians), except birds, that could occur in the study area are listed in Appendix 2. Those vertebrate species with a geographical distribution that includes the study area and habitat preference that includes habitats available in the study area are discussed further. Impacts on birds are addressed in a separate specialist report.

There are seven mammal species of conservation concern (including threatened and near threatened species) of which three could occur in available habitats in the study area. The species that could occur on site include three species classified as near threatened (NT), Darling's Horseshoe Bat, Littledale's Whistling Rat, and the Dassie Rat. There are, therefore, no threatened species with a distribution range that includes the site and habitat conditions on site that favour the occurrence of the species.

There are no threatened reptile species that have a distribution that includes the study area and which could occur on site.

Protected trees

Tree species protected under the National Forest Act are listed in Appendix 3. Those that have a geographical distribution that includes the study area are *Acacia erioloba, Acacia haematoxylon, Boscia albitrunca* and *Euclea pseudebenus*.

The tree *Acacia erioloba* occurs in dry woodland along watercourses in arid areas where underground water is present as well as on deep Kalahari sands (mostly Bushmanland Arid Grassland). *Acacia haematoxylon* occurs on deep Kalahari sand between dunes or along dry watercourses (Bushmanland Arid Grassland). *Boscia albitrunca* occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils (mostly Bushmanland Arid Grassland). *Euclea pseudebenus* occurs in semi-desert and desert areas, usually along watercourses and in depressions. It could occur in the hills or on the flats. *Acacia erioloba* is relatively common in the study area, whereas *Acacia haematoxylon*, *Euclea pseudebenus,* and *Boscia albitrunca* occur more sparsely.

Only one protected species was found on site, *Boscia albitrunca*. This was recorded in the hills in the northern part of the site, which will not be affected by the proposed project.

Natural habitats on site

The main natural habitats on site are rocky areas, plains, drainage areas, and dunes (Figure 5). The rocky areas consist of the large low mountain area in the north-eastern part of the site, a similar but smaller area in the north-western corner and various low koppies scattered

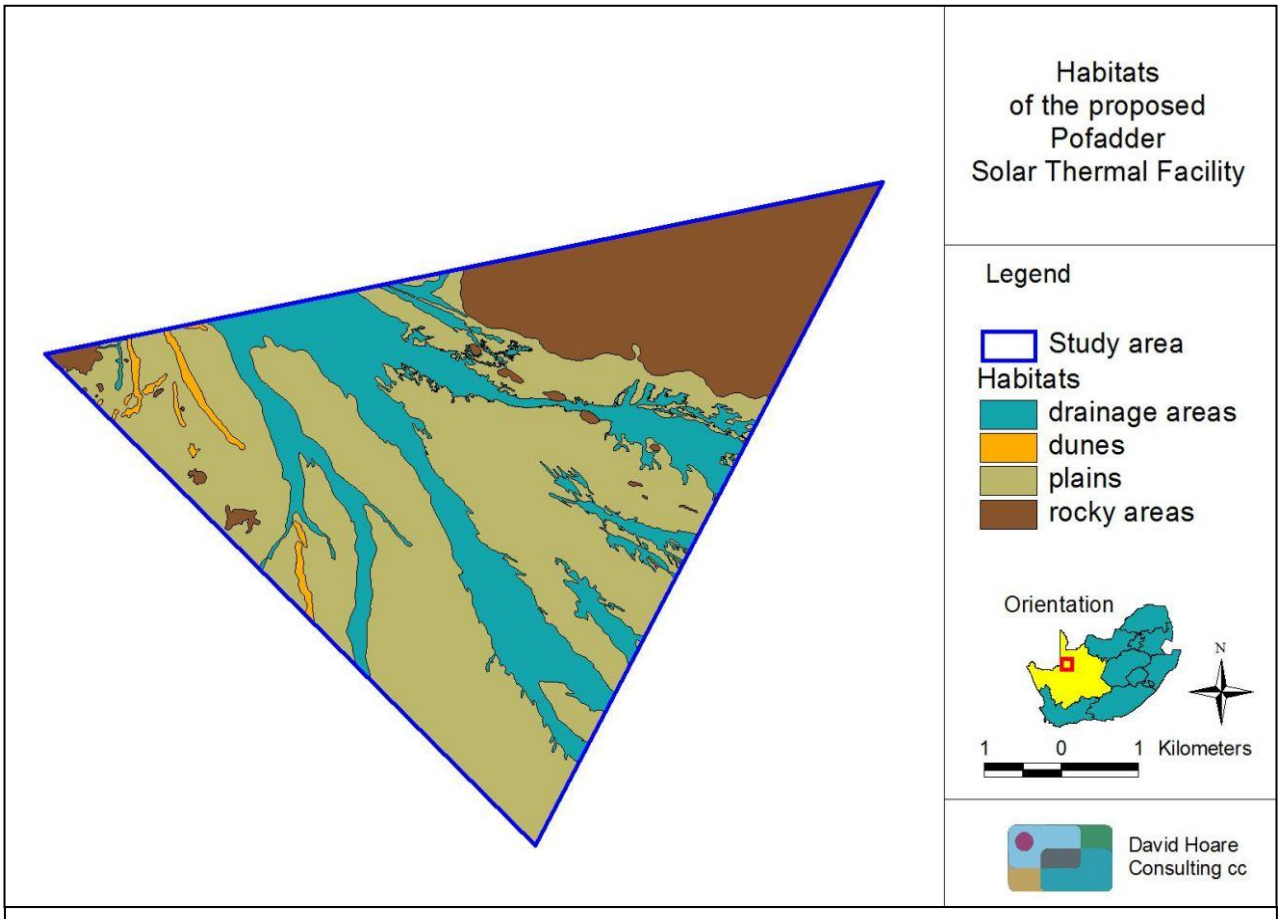

Figure 4: Natural habitats of the study area.

around the main rocky areas. The topography in these areas is generally very steep and rocky with very little soil. The plains are relatively flat, but slope towards the drainage lines that traverse the site. There are a few low dune ridges in the western to south-western part of the site.

Wetlands, riparian zones and watercourses

In terms of legislation, wetlands, riparian zones and watercourses are defined in the National Water Act as a water resource, and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act No 36 of 1998). In addition they are also regarded as sensitive habitats in the National Environmental Management Act implying that they are afforded a higher level of protection. A "watercourse" in terms of the National Water Act means:

1. River or spring;
2. A natural channel in which water flows regularly or intermittently;
3. A wetland, lake or dam into which, or from which, water flows; and
4. Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

Drainage areas on site are classified as watercourses. These were mapped directly from Google imagery of the study area, taking into account only topographic and vegetation indicators. The drainage areas tended to be dominated by medium-height shrubs, whereas surrounding plains were dominated by dwarf shrubs. Use was made of 1:50 000 topographical maps and geo-referenced Google Earth Imagery to create digital base maps of the study area onto which the wetland boundaries could be delineated using ArcView 3.1. A desktop delineation of suspected drainage areas was undertaken by digitizing directly onto the digital base maps. An example of a delineated watercourse is shown in Figure 6. All identified areas suspected to be watercourses were then further investigated in the field. During the field survey, a selection of different types of wetlands in different parts of the catchment were investigated to determine whether the mapped wetland areas matched the extent of the features on the ground.

The results of the study indicate that the site contains a number of non-perennial drainage lines and watercourses. These drain towards the north-west. The drainage areas are very shallow and anastamose to a significant degree. The general topography is so shallow that much of the site probably forms part of a general drainage basin, although only obvious channels were mapped here.

Other features of conservation concern

The study site occurs within the Gariep Centre of Floristic Endemism (van Wyk & Smith 2001). This Centre is located in the northwestern corner of the Northern Cape and adjacent parts of Namibia. Within South Africa, it broadly follows the region located around the lower Orange River. There are various sub-centres, one of which is the Pofadder Centre (van Wyk & Smith 2001). The site falls completely within the Gariep Centre and also includes vegetation types (in this case Lower Gariep Broken Veld), which is endemic to the Centre (Figure 5).

The geology and topography of the Gariep Centre is complex. The topography includes sandy plains and dunes, rugged inselbergs, gravel plains, dry river beds; steep, rock-strewn mountains and deep gorges (van Wyk & Smith 2001). Moisture from fog, which penetrates

quite far at night up the Orange River valley, is essential for the survival of many Gariep Centre plants (van Wyk & Smith 2001). There are high levels of succulent diversity and endemism in the Gariep Centre, unparalleled by any other arid region of similar size in the world (van Wyk & Smith 2001). Most of these belong to the family Mesembryanthemaceae, but other families with many succulent endemics in the region include Asclepiadaceae, Asteraceae, Crassulaceae, Euphorbiaceae and Liliaceae. The vegetation and flora of the Gariep Centre is primarily of Succulent Karoo affinity. Most endemics are succulents, although there are also non-succulent endemics. In some parts of the Centre, endemism may be as high as 25% of species (van Wyk & Smith 2001). The flora of the region is not well-known despite many botanical expeditions to the area. Every new botanical visit to the area results in the discovery of new endemic species.

Sensitivity assessment

The sensitivity assessment identifies those parts of the study area that have high conservation value or that may be sensitive to disturbance. Areas containing untransformed natural vegetation, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have low sensitivity. There are a number of features that need to be taken into account in order to evaluate sensitivity in the study area. These include the following:

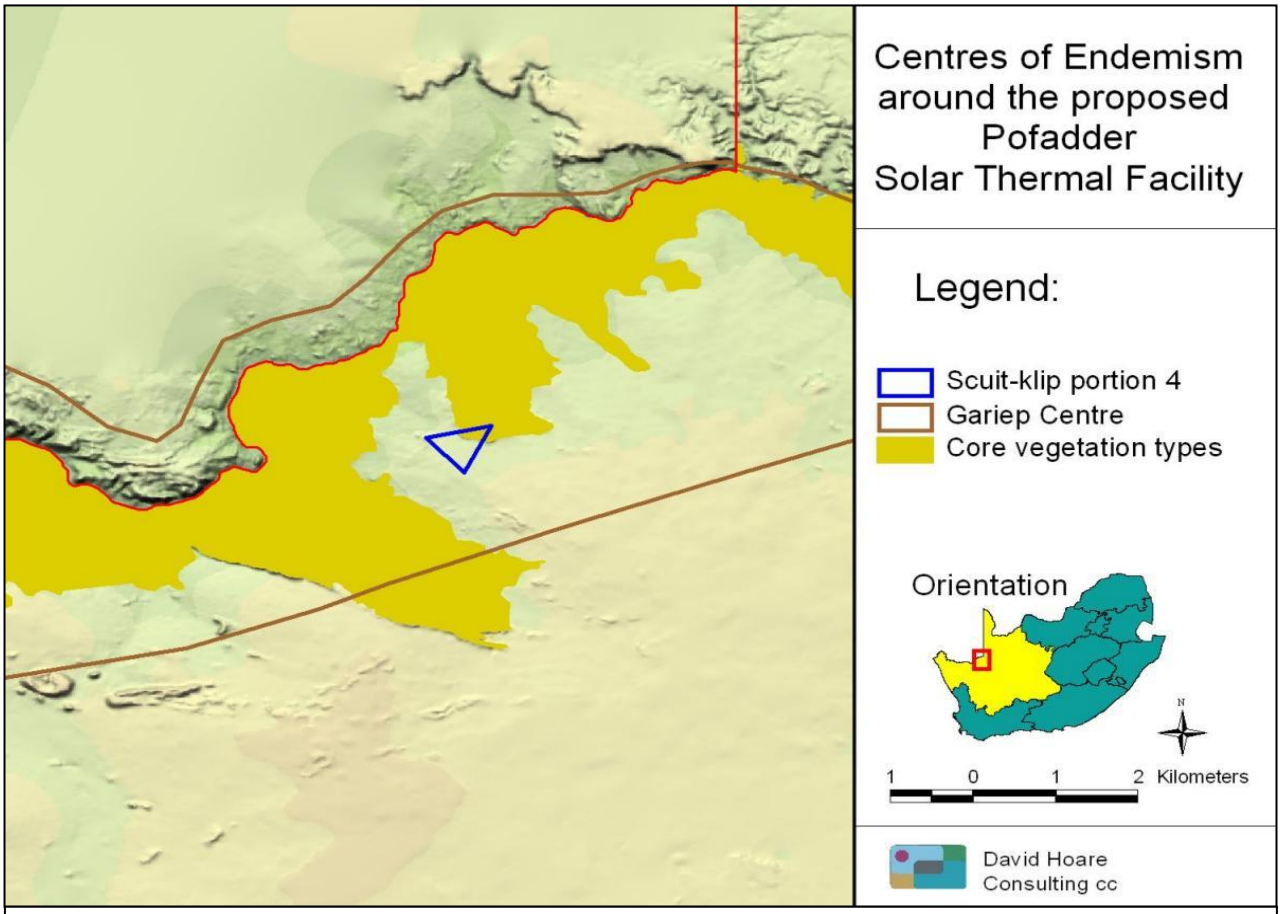

Figure 7: Centres of Endemism in relation to the study area.

1. Vegetation of conservation importance: this is based primarily on the location of the site within the Gariep Centre of Floristic Endemism (see Figure 5);
2. Non-perennial watercourses: this represents a number of ecological processes including groundwater dynamics, hydrological processes, nutrient cycling and wildlife dispersal as well as being an important habitat for a number of protected or restricted species;
3. Areas classified as mountains, ridges or steep slopes: some of the steeper scarp slopes in the southern portion of the study area are steep enough to be sensitive to erosion and downslope impacts from disturbance or represent links to the mountain chain, an important biogeographical corridor;
4. Potential occurrence of populations of Red List or protected organisms, including flora and fauna that have been evaluated as having a high chance of occurring within remaining natural habitats within the study area.

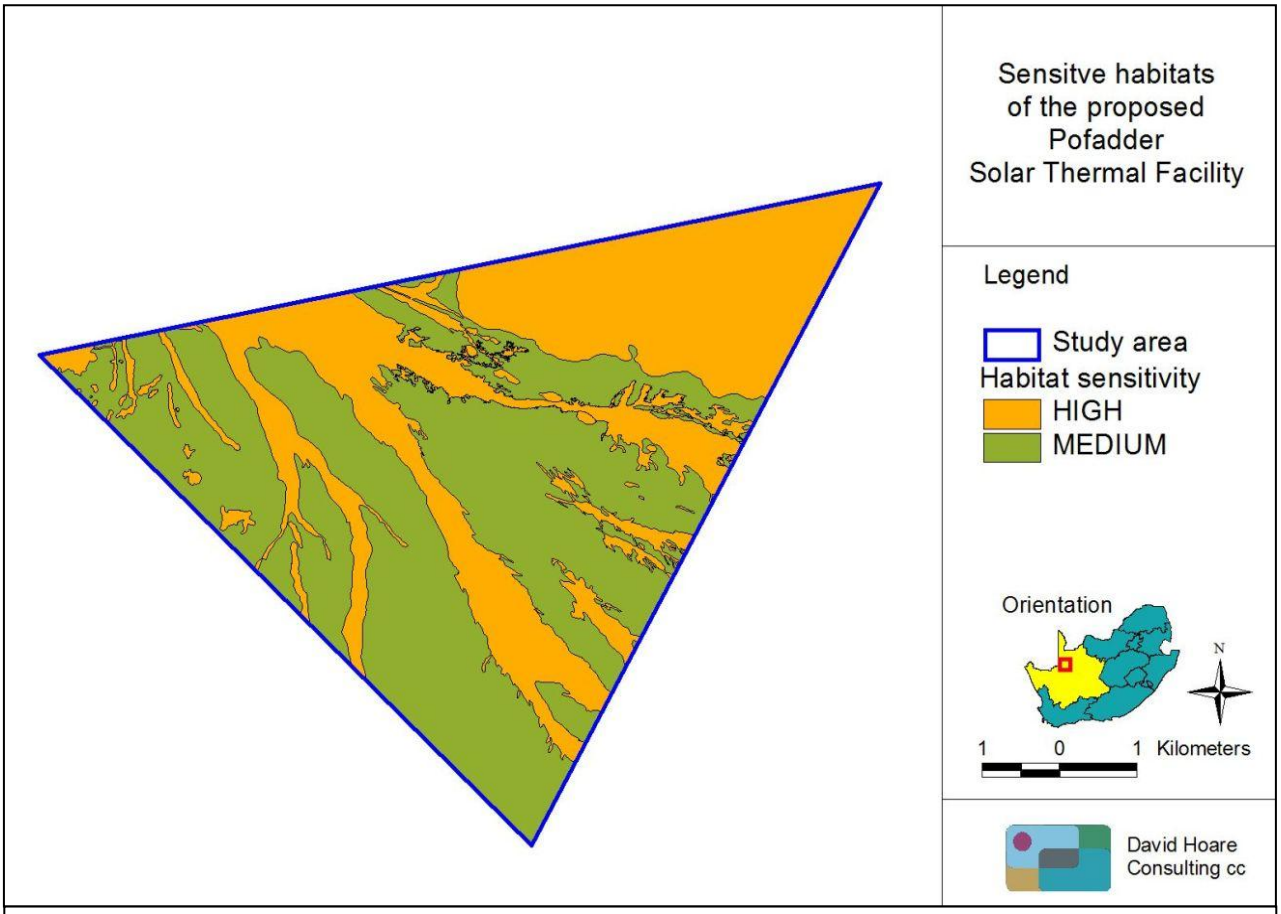

Figure 8: Sensitive areas within the study area.

These factors have all been taken into account in evaluating sensitivity within the study area. A map of sensitive areas is provided in Figure 8.

RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS

Relevant legislation is provided in this section to provide a description of the key legal considerations of importance to the proposed project. The applicable legislation is listed below.

Legislation

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

NEMA requires, inter alia, that:

- "Development must be socially, environmentally, and economically sustainable",
- "Disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied."
- "A risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions",

NEMA states that "the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage."

Environment Conservation Act No 73 of 1989 Amendment Notice No R1183 of 1997

The ECA states that:

Development must be environmentally, socially, and economically sustainable. Sustainable development requires the consideration of inter alia the following factors:

- That pollution and degradation of the environment is avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- That the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
- That the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; and
- That negative impacts on the environment and on peoples' environmental rights be anticipated and prevented, and where they cannot be altogether prevented are minimised and remedied.

The developer is required to undertake Environmental Impact Assessments (EIA) for all projects listed as a Schedule 1 activity in the EIA regulations in order to control activities which might have a detrimental effect on the environment. Such activities will only be permitted with written authorisation from a competent authority.

National Forests Act (Act no 84 of 1998)

Protected trees

According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that ` no person may cut, damage, disturb, destroy or remove any *protected tree*, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.

Forests

Prohibits the destruction of indigenous trees in any natural forest without a licence.

National Environmental Management: Biodiversity Act (Act No 10 of 2004)

In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).
- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants: are prohibited and must be controlled.
- Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands.

National Water Act

Wetlands, riparian zones, and watercourses are defined in the Water Act as a water resource and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998). A "watercourse" in terms of the National Water Act (act 36 of 1998) means:

- River or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and

Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

DESCRIPTION OF INFRASTRUCTURE

The facility is proposed to have a maximum generating capacity of 310 MW which will be comprised of a combination of the following technologies (in any combination):

1. Parabolic troughs (i.e. concentrating solar thermal power)
2. Power tower and heliostat field (i.e. concentrating solar thermal power)
3. Photovoltaic array (concentrating and/or tracking)

The general position of these is shown in Figure 9. The power tower would be located in the centre of the heliostat field.

Ancillary infrastructure within the footprint of the facility on site will include the following:

1. Steam turbine and generator housed within a 2-storey building.
2. Generator transformer and small substation outside the building,
3. Energy storage plant and vessels,
4. Workshop, office and storage areas,
5. Evaporation pond to receive waste-water from the generation process.

Additional infrastructure with its own footprint (not included within the infrastructure described above) includes the following:

1. Pipeline, water abstraction point and associated infrastructure,

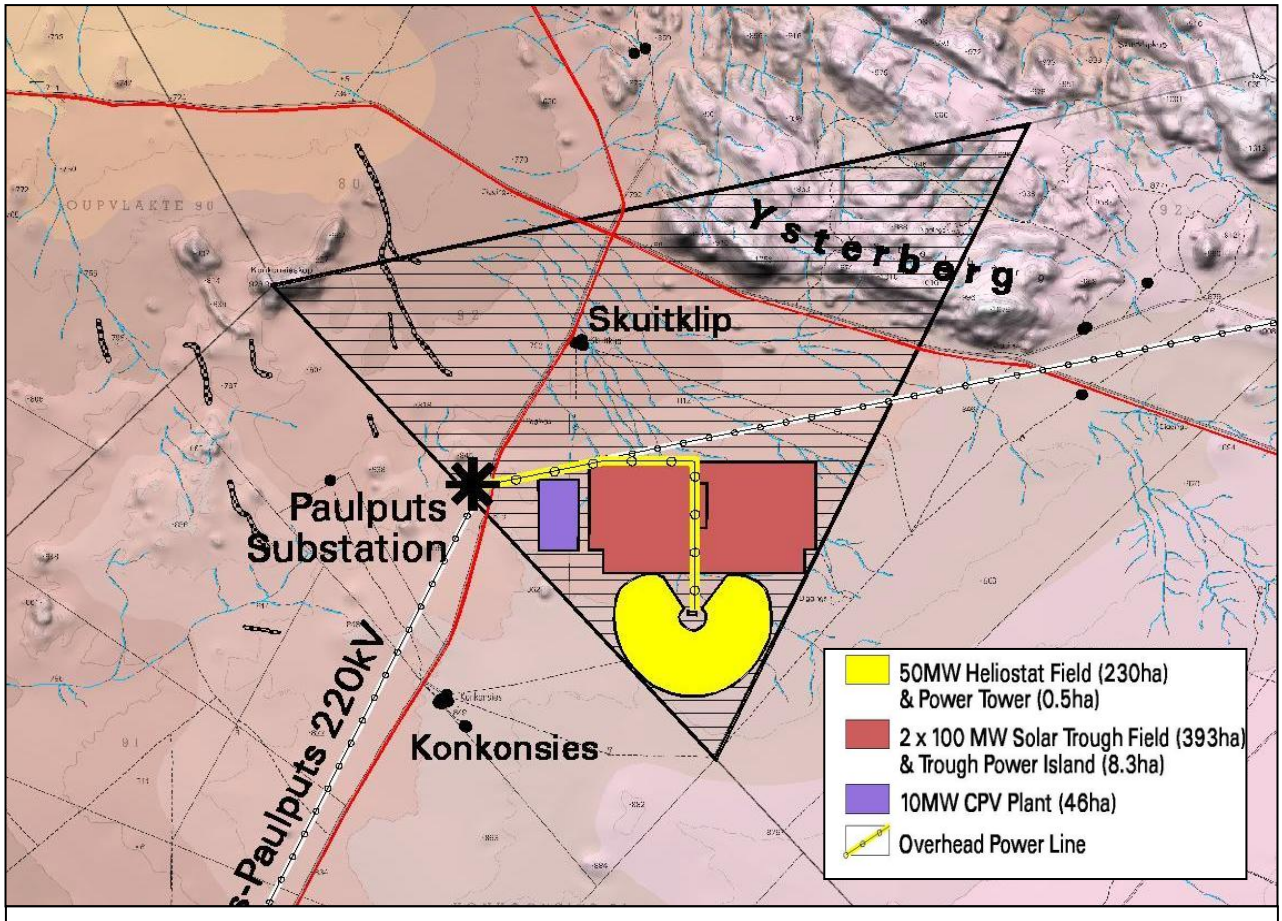

Figure 9: Infrastructure position in relation to site boundaries.

2. Power line to carry power from the facility to the grid connection point at the Paulputs substation,
3. Access roads to the site.

The position of the proposed water pipeline from the Orange River to the site is shown in Figure 10. This figure also shows the abstraction point on the Orange River.

There are four route options for the 132kV overhead powerline. There are also four route options for access roads onto the site. In all except one case the power line route option and the access road route option are the same. These are shown in Figure 11. The exception is option 2, where the power line and the access road are proposed to follow different routes.

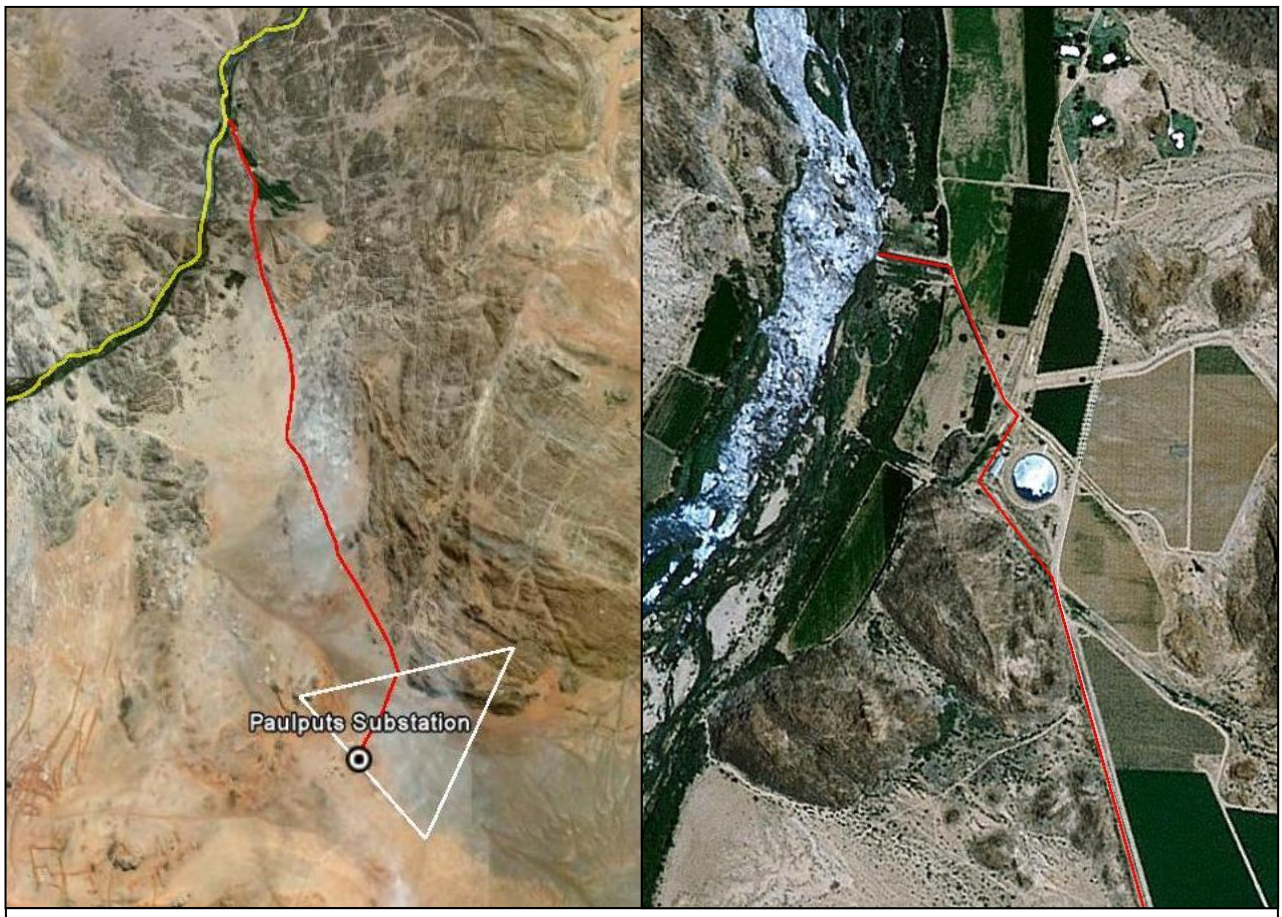

Figure 10: Pipeline route (left) and abstraction point on Orange River (right).

IDENTIFICATION OF RISKS AND POTENTIAL IMPACTS

Potential issues relevant to potential impacts on the ecology of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern (flora and fauna), including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence, or health and on habitats important for species of concern.
- Impacts on sensitive habitats: this includes impacts on any sensitive or protected habitats, including, for example, indigenous forest and wetland vegetation, that leads to direct or indirect loss of such habitat.
- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:
    - Disruption to nutrient-flow dynamics;
    - Impedance of movement of material or water;
    - Habitat fragmentation;
    - Changes to abiotic environmental conditions;
    - Changes to disturbance regimes, e.g. Increased or decreased incidence of fire;
    - Changes to successional processes;
    - Effects on pollinators;
    - Increased invasion by alien plants.

  Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or change in ecosystem function.

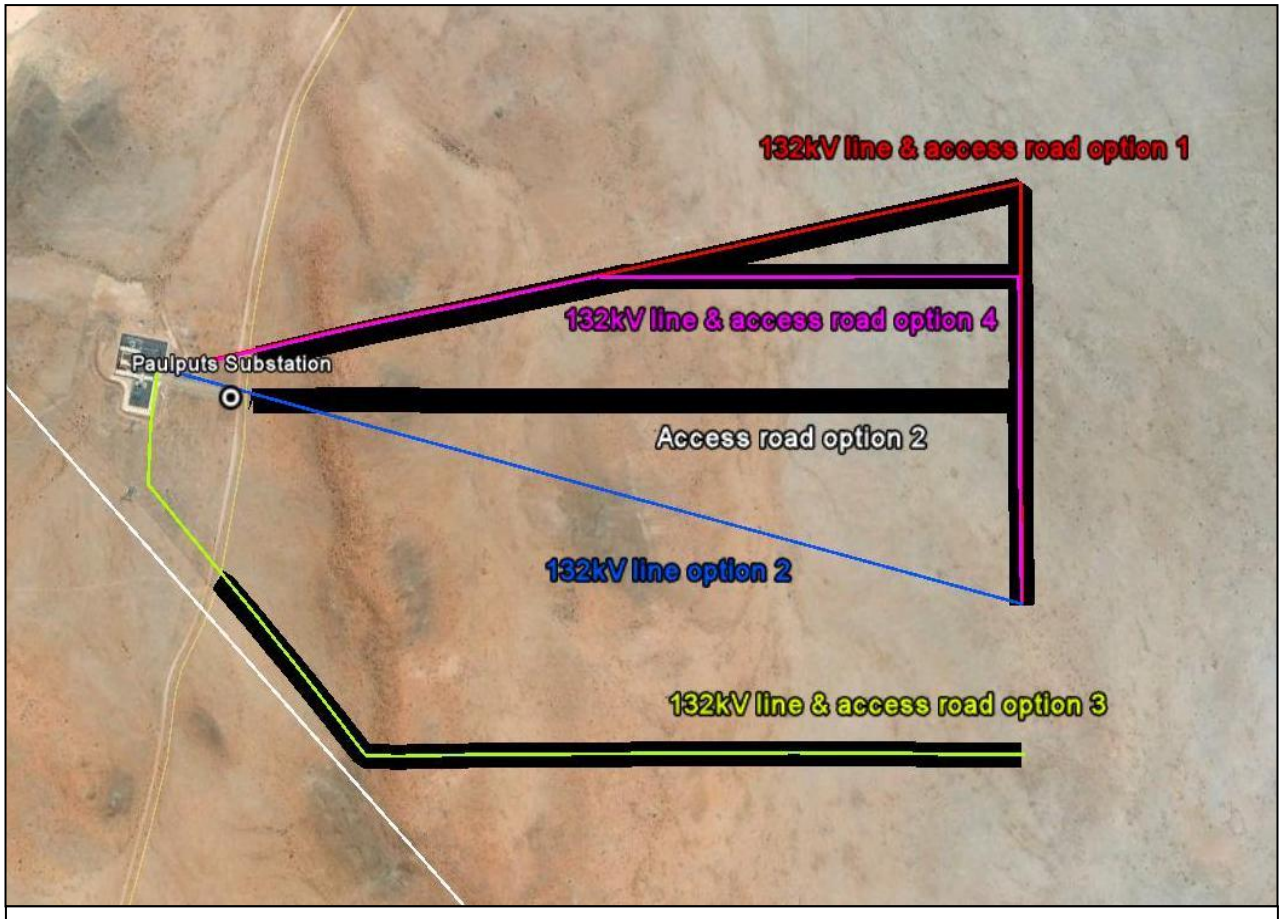

Figure 11: 132kV overhead power line and access road route options.

- Secondary and cumulative impacts on ecology: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic, or ecological environment.
- Impacts on the economic use of vegetation: this includes any impacts that affect the productivity or function of ecosystems in such a way as to reduce the economic value to users, e.g. reduction in grazing capacity, loss of harvestable products. It is a general consideration of the impact of a project on the supply of so-called ecosystem goods and services.

A number of direct risks to ecosystems would result from construction of the proposed solar thermal plant are as follows:

- Clearing of land for construction.
- Construction of access roads.
- Placement of powerlines, cables and water pipelines.
- Establishment of borrow and spoil areas.
- Chemical contamination of the soil by construction vehicles and machinery.
- Operation of construction camps.
- Storage of materials required for construction.

There are also risks associated with operation of the proposed CSP, as follows:

- Water usage for cooling.
- Maintenance of surrounding vegetation as part of management of the facility.

Description of potential impacts

Solar Concentrating Plants typically require relatively large areas of land surface for placement of reflectors and infrastructure. They also potentially, depending on the technology used, require large amounts of water for cooling purposes, amounts which could be equivalent to coal power generation per GWh or electricity produced (http://en.wikipedia.org/wiki/Solar_thermal_energy, accessed on 2 April 2010). Once operational, the CSP plant does not use fuel and there is a limited amount of vertical infrastructure that could potentially pose a hazard for flying animals.

Major potential impacts are described briefly below. These are compiled from a generic list of possible impacts derived from previous projects of this nature and from a literature review of the potential impacts of CSP and CPV facilities on the ecological environment. The major expected negative impact will be due to loss of habitat which may have direct or indirect impacts on individual organisms. The most important positive environmental impact is related to decreased dependency on coal power.

Impact 1: Impacts on indigenous natural vegetation (terrestrial)
Nature: Construction of infrastructure will lead to direct loss of vegetation. This will lead to localised or more extensive reduction in the overall extent of vegetation. There are factors that may aggravate this potential impact. For example, where this vegetation has already been stressed due to degradation and transformation at a regional level, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat and a change in the conservation status (current conservation situation). The general condition of the vegetation on site can only be assessed during the field survey to be undertaken during the EIA phase. Consequences of the potential impact of loss of indigenous natural vegetation occurring may include:

1. Negative change in conservation status of habitat (Driver et al. 2005);
2. Increased vulnerability of remaining portions to future disturbance;
3. General loss of habitat for sensitive species;
4. Loss in variation within sensitive habitats due to loss of portions of it;
5. General reduction in biodiversity;
6. Increased fragmentation (depending on location of impact);
7. Disturbance to processes maintaining biodiversity and ecosystem goods and services; and
8. Loss of ecosystem goods and services.

It has been established that the most widespread vegetation type on site is Bushmanland Arid Grassland and Lower Gariep Broken Veld, both of which are classified as Least Threatened. The site falls within the Gariep Centre of Floristic Endemism, an area with very high levels of succulent diversity and endemism. Specific floristic components of this Centre of Endemism are, however, usually restricted to specific habitats that support endemic species.

Impact 2: Impacts on threatened plants
Nature: Plant species are especially vulnerable to infrastructure development because they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat.

Threatened species include those classified as critically endangered, endangered, or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened plant species, loss of a population or individuals could lead to a direct change in the

conservation status of the species, possibly extinction. This may arise if the proposed infrastructure is located where it will affect such individuals or populations. Consequences may include:

1. Fragmentation of populations of affected species;
2. Reduction in area of occupancy of affected species; and
3. Loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chance of survival of the species.

There are very few threatened species listed for the area surrounding the site. This is unfortunately because this is an extremely under collected area floristically speaking and the local flora is not well documented. There may, therefore, be a number of species that occur within this area for which there are no records. One Vulnerable species, *Aloe dichotoma* (Kokerboom), was found on site during the field survey. None of the other species occurs or is likely to occur in the path of the proposed infrastructure. It is likely that there will be impacts on populations of a Threatened species (*Aloe dichotoma*).

Impact 3: Impacts on protected tree species

There are a number of tree species that are protected according to Government Notice no. 1012 under section 12(I) (d) of the National Forests Act, 1998 (Act No. 84 of 1998). In terms of section1 5(1) of the National Forests Act, 1998 "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 granted by the Minister to an (applicant and subject to such period and conditions as may be stipulated".

A number of species have a geographic distribution that includes the study area appear on this list, including the following: *Acacia erioloba, Acacia haematoxylon, Boscia albitrunca* and *Euclea pseudebenus*. Only one protected species was found on site, *Boscia albitrunca*. This was recorded in the hills in the northern part of the site, which will not be affected by the proposed project. Impacts on protected trees will therefore not occur and are scored as zero for infrastructure components. The impact is not evaluated further.

Impact 4: Impacts on threatened animals

Nature: Threatened animal species are indirectly affected primarily by the overall loss of habitat, since direct construction impacts can often be avoided due to movement of individuals from the path of construction. Animals are generally mobile and, in most cases, can move away from a potential threat.

Threatened species include those classified as critically endangered, endangered, or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species. This may arise if the proposed infrastructure is located where it will affect such individuals or populations or the habitat that they depend on. Consequences may include:

1. Fragmentation of populations of affected species;
2. Reduction in area of occupancy of affected species; and
3. Loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species overall survival chances.

It has been evaluated that there are no threatened animal species that could occur in available habitats in the area. This potential impact is therefore not evaluated further.

Impact 5: Impacts on watercourses

Nature: The site is in a very arid area. There are no wetlands on site, but there are clearly a number of drainage areas. Construction may lead to some direct or indirect loss of or damage to some of these areas or changes to the catchment of these areas. This may affect the hydrology of the landscape.

Impact 6: Establishment and spread of declared weeds and alien invader plants

Major factors contributing to invasion by alien invader plants includes high disturbance and negative grazing practices. Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins *et al*. 2003). Consequences of this may include:

1. Loss of indigenous vegetation;
2. Change in vegetation structure leading to change in various habitat characteristics;
3. Change in plant species composition;
4. Change in soil chemical properties;
5. Loss of sensitive habitats;
6. Loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
7. Fragmentation of sensitive habitats;
8. Change in flammability of vegetation, depending on alien species;
9. Hydrological impacts due to increased transpiration and runoff; and
10. Impairment of wetland function.

The site contains very few alien plants. Potential weeds with a distribution centred on arid regions of the country include *Salsola kali*, *Atriplex lindleyi*, *Opuntia ficus-indica, Opuntia imbricata, Prosopis glandulosa, Prosopis velutina, Atriplex numularia,* and *Nicotiana glauca*. The shrub, *Prosopis glandulosa*, is potentially the most problematic. This species invades riverbeds, riverbanks, and drainage lines in semi-arid and arid regions. There is therefore the potential for alien plants to spread or invade following disturbance on site.

ASSESSMENT OF IMPACTS

Impacts are assessed for each component of infrastructure for the proposed wind energy plant, as follows:

- Solar array, power block and ancillary infrastructure;
- Access roads to site;
- Overhead power line (132kv);
- Water supply pipeline, abstraction point, and associated infrastructure.

Solar array, power block and ancillary infrastructure

Impact 1: Impacts on indigenous natural vegetation

The vegetation types on site are Bushmanland Arid Grassland and Lower Gariep Broken Veld, both of which are classified as Least Threatened. The total footprint of the infrastructure is close to 8 km^2, but this is insignificant compared to the overall extent of these two vegetation types. Impacts are therefore relevant only at a local scale and will be scored relative to the study area.

Duration: The impact will be permanent because clearing of vegetation for construction purposes cannot be reversed.

Extent: The impact will occur at the site of the proposed plant.

Magnitude: At a regional scale, the potential magnitude of this impact will be small due to the small area of vegetation likely to be affected relative to the overall extent of the vegetation types concerned. At a site scale, the impact will be moderate (will result in processes continuing but in a modified way).

Probability: It is definite that there will be impacts on natural vegetation.

Potential significance: The potential significance of this impact could potentially be of low significance at a regional scale and medium significance at a local scale.

Mitigation measures: Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the construction site.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Medium (6)	Medium (5)
Probability	Definite (5)	Definite (5)
Significance	**Medium (60)**	**Medium (55)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To a small extent	
Mitigation: Avoid unnecessary impacts on natural vegetation surrounding infrastructure. Impacts should be contained, as much as possible, within the footprint of the construction site.		
Cumulative impacts: Soil erosion, alien invasions may lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of this vegetation type will occur, but this is insignificant relative to the total extent of the vegetation type.		

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 2: Impacts on threatened plant species

There is only one species of plant of conservation concern considered a potential issue for this site, namely *Aloe dichotoma* subsp. *dichotoma* (quiver tree). A detailed search of the site recorded a number of individuals of this species. It is possible, but unlikely, that more plants could occur on site. The species also occurs throughout similar habitats in the broader area surrounding the site and beyond. More than one plant was found on site within the footprint of the solar array.

Duration: The impact will be permanent because individuals of this species will have to be removed to accommodate construction of the infrastructure. More importantly, loss of suitable habitat for this species means that the plants cannot become re-established within these areas.

Extent: The impact will occur at the site of the proposed solar array and associated infrastructure.

Magnitude: The potential magnitude of this impact will be minor at a local scale for this vulnerable plant species because only a single plant is likely to be affected.

Probability: It is definite that this impact will occur because an individual of this species was recorded within the footprint of the proposed solar array.

Significance: The potential significance of this impact emerges as being of medium significance at a local scale. This score is based purely on the fact that the impact is permanent and will definitely occur. In reality, the loss of a single or small number of individuals of a widespread species, even though it is listed as Vulnerable, will not affect the conservation status of the species.

Mitigation measures: The plant should be rescued and planted at a suitable locality adjacent to the infrastructure, either in a natural area where it will not be disturbed further or as a horticultural subject somewhere within the development, for example, at the main entrance or in a garden. Large plants in surrounding areas must not be disturbed.

Nature: Destruction/permanent loss of individuals of threatened plant species		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (1)
Probability	Definite (5)	Definite (5)
Significance	**Medium (40)**	**Medium (35)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Partially	
Mitigation: Rescue the plant that will be affected and plant it in adjacent habitat where it will not be disturbed further.		
Cumulative impacts: Loss of habitat, soil erosion, and alien invasions may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: None likely		

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 5: Impacts on watercourses

There are a number of drainage areas on site that could potentially be affected by the proposed construction of the solar array and ancillary infrastructure (Figure 6).

Duration: The impact will be permanent because clearing of land for construction purposes cannot be reversed.

Extent: The impact will occur at the site of the proposed plant.

Magnitude: The potential magnitude of this impact will be moderate at a local scale (will result in processes continuing but in a modified way).

Probability: Because drainage lines occur within the footprint of the proposed solar array on site, it is definite that drainage areas will be affected.

Potential significance: The significance of this impact is rated as high at a scale of local and surroundings before mitigation.

Mitigation measures: Stormwater and runoff water must be controlled and managed to avoid impacts on watercourses. A permit from the Department of Water Affairs (DWA) is required if there are expected to be any impacts on any wetland or water resources.

Nature: Damage to watercourses and drainage lines		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Moderate (5)
Probability	Definite (5)	Definite (5)
Significance	**Medium (60)**	**Medium (55)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: Control stormwater and runoff water and obtain a permit from DWA to impact on any wetland or water resource.		
Cumulative impacts: Soil erosion, alien invasions may lead to additional impacts on watercourses that will exacerbate this impact.		
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 6: Establishment and spread of declared weeds and alien invader plants

The site is not known to harbour alien plants in significant numbers. There is therefore a weak potential for alien trees to spread or become established following disturbance on site. The presence of a diffuse disturbance over a wide area could, however, lead to the spread of species that are present in the area. Watercourses are especially vulnerable to such impacts.

Duration: The impact will be long-term unless alien plants are controlled.

Extent: The impact will occur at the site of the proposed plant, but could spread into neighbouring areas.

Magnitude: The potential magnitude of this impact is potentially moderate for local ecosystems (result in processes continuing but in a modified way).

Probability: It is probable that alien species will spread on site in the absence of control measures.

Potential significance: The impact could potentially be of moderate to high significance. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low.

Mitigation measures: Disturbance of indigenous vegetation outside of the footprint of the proposed infrastructure must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be

translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled to avoid the development of a soil seed bank of alien plants within the stock-piled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank that would take decades to remove. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	Long-term (4)	Short-term (4)
Magnitude	Moderate (6)	Low (3)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (33)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) Keep disturbance of indigenous vegetation to a minimum (2) Rehabilitate disturbed areas as quickly as possible following completion of construction activities in an area (3) Do not translocate soil stockpiles from areas with alien plants (4) Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) Establish an ongoing monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands and increased frequency of veld fires may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Access road to site

There are four alternative access roads to site. The assessment of impacts is identical for all alternatives, except where specifically indicated.

Impact 1: Impacts on indigenous natural vegetation

The vegetation types on site are Bushmanland Arid Grassland and Lower Gariep Broken Veld, both of which are classified as Least Threatened. The total footprint of the access road (any option) is insignificant compared to the overall extent of these two vegetation types. Impacts are therefore relevant only at a local scale and will be scored relative to the study area.

Duration: The impact will be permanent because clearing of vegetation for construction purposes cannot be reversed.

Extent: The impact will occur at the site of the proposed access road.

Magnitude: At a regional scale, the potential magnitude of this impact will be small due to the small area of vegetation likely to be affected relative to the overall extent of the vegetation types concerned. At a site scale, the impact will be low (will cause a slight impact on processes).

Probability: It is definite that there will be impacts on natural vegetation.

Potential significance: The potential significance of this impact could potentially be of low significance at a regional scale and medium significance at a local scale.

Mitigation measures: Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the construction site.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (3)
Probability	Definite (5)	Definite (5)
Significance	**Medium (50)**	**Medium (45)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To a small extent	
Mitigation: Avoid unnecessary impacts on natural vegetation surrounding infrastructure. Impacts should be contained, as much as possible, within the footprint of the construction site.		
Cumulative impacts: Soil erosion, alien invasions may lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of this vegetation type will occur, but this is insignificant relative to the total extent of the vegetation type.		

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 2: Impacts on threatened plant species

There is only one species of plant of conservation concern considered to be a potential issue for this site, namely *Aloe dichotoma* subsp. *dichotoma* (quiver tree). Despite a detailed search of the affected area within the site, no individuals of this species were recorded within the footprint of the proposed access road to site (all options). The impact will therefore not occur and is scored as zero.

Impact 5: Impacts on watercourses

There are a number of drainage areas on site that could potentially be affected by the proposed construction of the access road to the site (all alternatives) (Figure 6).

Duration: The impact will be permanent because clearing of land for construction purposes cannot be reversed.

Extent: The impact will occur at the site of the proposed road.

Magnitude: The potential magnitude of this impact will be low at a local scale (will cause a slight impact on processes).

Probability: Because drainage lines occur within the footprint of the proposed access road to site, it is definite that drainage areas will be affected.

Potential significance: The significance of this impact is rated as high at a scale of local and surroundings before mitigation.

Mitigation measures: Stormwater and runoff water must be controlled and managed to avoid impacts on watercourses. Proper culvert structures with channel dissipating features are required to prevent canalization of watercourses. A permit from the Department of Water Affairs (DWA) is required if there are expected to be any impacts on any wetland or water resources.

Nature: Damage to watercourses and drainage lines		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)

Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (3)
Probability	Definite (5)	Definite (5)
Significance	**Medium (50)**	**Medium (45)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: Control stormwater and runoff water and obtain a permit from DWA to impact on any wetland or water resource. Proper culvert structures with features to dissipate hydrological energy are required to prevent canalization of drainage areas.		
Cumulative impacts: Soil erosion, alien invasions may lead to additional impacts on watercourses that will exacerbate this impact.		
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 6: Establishment and spread of declared weeds and alien invader plants

The site is not known to harbour alien plants in significant numbers. There is therefore a weak potential for alien trees to spread or become established following disturbance on site. The presence of a diffuse disturbance over a wide area could, however, lead to the spread of species that are present in the area. Watercourses are especially vulnerable to such impacts.

Duration: The impact will be long-term unless alien plants are controlled.

Extent: The impact will occur at the site of the proposed plant, but could spread into neighbouring areas.

Magnitude: The potential magnitude of this impact is potentially moderate for local ecosystems (result in processes continuing but in a modified way).

Probability: It is probable that alien species will spread on site in the absence of control measures.

Potential significance: The impact could potentially be of moderate to high significance. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low.

Mitigation measures: Disturbance of indigenous vegetation outside of the footprint of the proposed infrastructure must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled to avoid the development of a soil seed bank of alien plants within the stock-piled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank that would take decades to remove. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	Long-term (4)	Short-term (4)
Magnitude	Moderate (6)	Low (3)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (33)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible	Reversible

Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) Keep disturbance of indigenous vegetation to a minimum (2) Rehabilitate disturbed areas as quickly as possible following completion of construction activities in an area (3) Do not translocate soil stockpiles from areas with alien plants (4) Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) Establish an ongoing monitoring programme to detect and quantify any aliens that may become established.		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands and increased frequency of veld fires may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Overhead power line

There are four alternative power lines to site. The assessment of impacts is identical for all alternatives, except where specifically indicated.

Impact 1: Impacts on indigenous natural vegetation

The vegetation types on site are Bushmanland Arid Grassland and Lower Gariep Broken Veld, both of which are classified as Least Threatened. The total footprint of the power line (any option) is insignificant compared to the overall extent of these two vegetation types. Impacts are therefore relevant only at a local scale and will be scored relative to the study area.

Duration: The impact will be permanent because clearing of vegetation for construction purposes cannot be reversed. The footprint of the power line towers is, however, very small. The impact is therefore evaluated in terms of general disturbance to vegetation. The duration of this impact will be short-term (2-5 years) after which time it is expected that vegetation will recover from the disturbance and natural processes will continue in a similar fashion to before the disturbance.

Extent: The impact will occur at the site of the proposed power line.

Magnitude: At a regional scale, the potential magnitude of this impact will be small due to the small area of vegetation likely to be affected relative to the overall extent of the vegetation types concerned. At a site scale, the impact will be low (will cause a slight impact on processes).

Probability: It is definite that there will be impacts on natural vegetation.

Potential significance: The potential significance of this impact could potentially be of low significance at a regional scale and medium significance at a local scale.

Mitigation measures: Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the construction site. Disturbed areas must be rehabilitated as quickly as possible after construction. Unstable substrates must be stabilized to prevent wind erosion.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)

Probability	Definite (5)	Definite (5)
Significance	**Medium (35)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To a small extent	
Mitigation: Avoid unnecessary impacts on natural vegetation surrounding infrastructure. Impacts should be contained, as much as possible, within the footprint of the construction site. Rehabilitate disturbed areas quickly after construction.		
Cumulative impacts: Soil erosion, alien invasions may lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of this vegetation type will occur, but this is insignificant relative to the total extent of the vegetation type.		

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 2: Impacts on threatened plant species

There is only one species of plant of conservation concern considered a potential issue for this site, namely *Aloe dichotoma* subsp. *dichotoma* (quiver tree). No individuals of this species were recorded along the route of any of the proposed overhead power lines. The impact will therefore not occur and is scored as zero.

Impact 5: Impacts on watercourses

The 132kV power line (all alternatives) cross drainage areas in one place, although it is unlikely that power line towers will be positioned within drainage areas. The impact is assessed assuming that drainage lines will be spanned.

Extent: The impact will be local and surrounding areas, although downstream areas could be affected.

Duration: The impact will be of medium-term duration, until vegetation has re-established around disturbed tower positions.

Magnitude: The potential magnitude of this impact will be low at a local scale (will result in a slight impact on processes).

Probability: According to the current position of the power line alternatives, it is possible that the impact will occur, but it is considered unlikely that towers will be placed within drainage lines.

Mitigation measures: Power line towers must not be positioned in drainage lines. Stormwater and runoff water around tower bases must be controlled and managed to avoid impacts on watercourses. A permit from DWA is required if there are expected to be any impacts on any wetland or water resources.

Nature: Damage to wetland areas resulting in hydrological impacts		
	Without mitigation	**With mitigation**
Extent	local and surroundings (2)	Local and surroundings (2)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Low (2)	Low (1)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (14)**	**Low (12)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) Ensure towers are not positioned in watercourses, where practical		

(2) Avoid unnecessary impacts on wetland areas. Impacts should be contained, as much as possible, within the power line servitude. (3) Obtain a permit from DWA to impact on any wetland or water resource. (4) Rehabilitate any disturbed areas immediately to stabilise landscapes
Cumulative impacts: None
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 6: Establishment and spread of declared weeds and alien invader plants

The site is not known to harbour alien plants in significant numbers. There is therefore a weak potential for alien trees to spread or become established following disturbance on site. The presence of a diffuse disturbance over a wide area could, however, lead to the spread of species that are present in the area. Watercourses are especially vulnerable to such impacts.

Duration: The impact will be long-term unless alien plants are controlled.

Extent: The impact will occur at the site of the proposed plant, but could spread into neighbouring areas.

Magnitude: The potential magnitude of this impact is potentially moderate for local ecosystems (result in processes continuing but in a modified way).

Probability: It is probable that alien species will spread on site in the absence of control measures.

Potential significance: The impact could potentially be of moderate to high significance. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low.

Mitigation measures: Disturbance of indigenous vegetation outside of the footprint of the proposed infrastructure must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled to avoid the development of a soil seed bank of alien plants within the stock-piled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank that would take decades to remove. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	Long-term (4)	Short-term (4)
Magnitude	Moderate (6)	Low (3)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (33)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) Keep disturbance of indigenous vegetation to a minimum (2) Rehabilitate disturbed areas as quickly as possible following completion of construction activities in an area (3) Do not translocate soil stockpiles from areas with alien plants (4) Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) Establish an ongoing monitoring programme to detect and quantify any aliens that may become established		

Cumulative impacts: Soil erosion, habitat loss, damage to wetlands and increased frequency of veld fires may all lead to additional impacts that will exacerbate this impact.
Residual Impacts: Will probably be very low if control measures are effectively applied

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Water pipeline and associated infrastructure

The water pipeline follows an existing road from the site to the Orange River (Figure 10).

Impact 1: Impacts on indigenous natural vegetation

The vegetation types on site and surrounding areas are Bushmanland Arid Grassland and Lower Gariep Broken Veld, both of which are classified as Least Threatened. The total footprint of the water pipeline is insignificant compared to the overall extent of these two vegetation types. Impacts are therefore relevant only at a local scale and will be scored relative to the study area. In addition, the water pipeline follows an existing road from the site to the Orange River. There are, therefore, not expected to be significant impacts on surrounding natural habitat due to construction of the pipeline.

Duration: The impact will be permanent because clearing of vegetation for construction purposes cannot be reversed. The footprint of the pipeline is, however, very small. The impact is therefore evaluated in terms of general disturbance to vegetation. The duration of this impact will be short-term (2-5 years) after which time it is expected that vegetation will recover from the disturbance and natural processes will continue in a similar fashion to before the disturbance.

Extent: The impact will occur at the site of the proposed water pipeline.

Magnitude: At a regional scale, the potential magnitude of this impact will be small due to the small area of vegetation likely to be affected relative to the overall extent of the vegetation types concerned. At a site scale, the impact will be minor (will cause a slight impact on processes).

Probability: It is probable that there will be impacts on natural vegetation.

Potential significance: The potential significance of this impact could potentially be of low significance at a regional scale and of low significance at a local scale.

Mitigation measures: Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the construction site. The water pipeline must be kept as close as possible to the existing road. Disturbed areas must be rehabilitated as quickly as possible after construction. Unstable substrates must be stabilized to prevent wind erosion.

Nature: Loss of habitat within indigenous natural vegetation types		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Minor (2)	Minor (2)
Probability	Highly probable (4)	Probable (3)
Significance	**Low (20)**	**Low (15)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes

Can impacts be mitigated?	To a small extent	
Mitigation: Avoid unnecessary impacts on natural vegetation surrounding infrastructure. Keep the pipeline as close as possible to the existing road. Impacts should be contained, as much as possible, within the footprint of the construction site. Rehabilitate disturbed areas quickly after construction.		
Cumulative impacts: Soil erosion, alien invasions may lead to additional loss of habitat that will exacerbate this impact.		
Residual Impacts: Some loss of this vegetation type will occur, but this is insignificant relative to the total extent of the vegetation type.		

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 2: Impacts on threatened plant species

There is only one species of plant of conservation concern considered a potential issue for this site, namely *Aloe dichotoma* subsp. *dichotoma*. No individuals of this species were recorded along the route of the pipeline. The impact will therefore not occur and is scored as zero.

Impact 5: Impacts on watercourses

There are various minor watercourses that will be affected by the proposed construction of the pipeline (between the site of the plant and the Orange River). At the slopes overlooking the Orange River, the habitat is disturbed.

Extent: The impact will be local, although downstream areas could be affected.

Duration: The impact will be of short-term duration.

Magnitude: The potential magnitude of the impact could be minor at a local scale.

Probability: According to the current alignment of the proposed pipeline, it is definite that watercourses will be traversed, but these are already affected by an existing road. It is therefore unlikely that additional impacts on drainage areas will occur.

Mitigation measures: Disturbed areas must be rehabilitated as quickly as possible.

Nature: Damage to wetland areas.		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (3)	Improbable (3)
Significance	**Low (15)**	**Low (15)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible with effective rehabilitation	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) Cross wetlands or drainage lines perpendicularly. (2) Avoid unnecessary impacts on natural vegetation. Impacts should be contained, as much as possible, within the footprint of the proposed watercourse crossing. (3) Obtain a permit from DWA to impact on any wetland or water resource. (4) Rehabilitate any disturbed areas immediately to stabilise landscapes (5) Proper culvert and bridge structures are required for permanent roads.		
Cumulative impacts: None		
Residual Impacts: Despite proposed mitigation measures, it is expected that this impact will still occur to some degree.		

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

Impact 6: Establishment and spread of declared weeds and alien invader plants

The site is not known to harbour alien plants in significant numbers. There is therefore a weak potential for alien trees to spread or become established following disturbance on site. The presence of a diffuse disturbance over a wide area could, however, lead to the spread of species that are present in the area. Watercourses are especially vulnerable to such impacts.

Duration: The impact will be long-term unless alien plants are controlled.

Extent: The impact will occur at the site of the proposed plant, but could spread into neighbouring areas.

Magnitude: The potential magnitude of this impact is potentially moderate for local ecosystems (result in processes continuing but in a modified way).

Probability: It is probable that alien species will spread on site in the absence of control measures.

Potential significance: The impact could potentially be of moderate to high significance. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low.

Mitigation measures: Disturbance of indigenous vegetation outside of the footprint of the proposed infrastructure must be kept to a minimum. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible. Soil stockpiles should not be translocated from areas with alien plants into the site and within the site alien plants on stockpiles must be controlled to avoid the development of a soil seed bank of alien plants within the stock-piled soil. Any alien plants must be immediately controlled to avoid establishment of a soil seed bank that would take decades to remove. An ongoing monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

Nature: Establishment and spread of declared weeds and alien invader plants		
	Without mitigation	**With mitigation**
Extent	Site & surroundings (2)	Site & surroundings (2)
Duration	Long-term (4)	Short-term (4)
Magnitude	Moderate (6)	Low (3)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (33)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	To some degree	
Mitigation: (1) Keep disturbance of indigenous vegetation to a minimum (2) Rehabilitate disturbed areas as quickly as possible following completion of construction activities in an area (3) Do not translocate soil stockpiles from areas with alien plants (4) Control any alien plants immediately to avoid establishment of a soil seed bank that would take decades to remove (5) Establish an ongoing monitoring programme to detect and quantify any aliens that may become established		
Cumulative impacts: Soil erosion, habitat loss, damage to wetlands and increased frequency of veld fires may all lead to additional impacts that will exacerbate this impact.		
Residual Impacts: Will probably be very low if control measures are effectively applied		

*Significance calculated as (magnitude + duration + extent) x probability. Significance: <30 = low, 30–60 = medium, >60 = high.

DISCUSSION AND CONCLUSIONS

There are two major vegetation types that occur in the study area, namely Bushmanland Arid Grassland (plains) and Lower Gariep Broken Veld (hills / mountains). Both of these vegetation types are classified as Least Threatened. The site occurs within the Gariep Centre of Floristic Endemism, an area with very high levels of diversity and endemism within succulent plants. Thus, despite the fact that the vegetation is classified as Least Threatened, the vegetation on site potentially has high conservation value due to the location of the site within the Centre of Endemism. The natural features on site that are most likely to contain floristic elements from the Gariep Centre of Floristic Endemism are the low mountains and hills.

Mountains and ridges are considered to have high ecological value due to the ecological processes that they support. Mountains, ridges, and drainage lines represent particularly vital natural corridors as they function both as wildlife habitat, providing resources needed for survival, reproduction and movement, and as biological corridors, providing for movement between habitat patches. Both functions are potentially critical to conservation of biological diversity as the landscape becomes increasingly fragmented into smaller, more isolated patches (Rosenberg *et al.*, 1997).

Drainage lines are protected under national legislation (National Wetlands Act). Any impacts on these areas would require a permit from the relevant National Department.

Other factors that may lead to parts of the study area having high ecological sensitivity are the presence of drainage areas on site, steep slopes, and the presence of one plant species of conservation concern, the quiver tree (*Aloe dichotoma*).

One protected tree species occurs on site, the Shepherd's Bush (*Boscia albitrunca*). The only plants were found in the mountainous area in the north-eastern part of the study area.

Most of the study area is in a natural condition, although some parts may be degraded to various degrees due to over-grazing.

A risk assessment was undertaken which identified seven main potential negative impacts on the ecological receiving environment. The significance of these impacts was assessed during this phase after collection of relevant field data. The identified potential impacts are the following:

1. Impacts on indigenous natural vegetation
2. Impacts on threatened plants
3. Impacts on protected tree species
4. Impacts on threatened animals
5. Impacts on wetlands
6. Change in runoff and drainage patterns
7. Establishment and spread of declared weeds and alien invader plants

Impacts were assessed separately for the solar plant and ancillary infrastructure, access road, overhead power lines and the water pipeline. A summary of impacts, as evaluated, is provided in the table below (Table 3).

The solar plant has the greatest impact on ecological systems. This is due to the size of these components and the fact that the footprint will be cleared of vegetation during construction. It will lead to local impacts on vegetation, impacts on a single individual of a plant species classified as threatened (*Aloe dichotoma* subsp. *dichotoma*), and impacts on drainage lines.

The main access road, overhead power line and the water pipeline (including reservoir and extraction point) are unlikely to have impacts of high significance on any ecological features. This is primarily because they occupy a relatively small space in the landscape.

Disturbance due to construction of any infrastructure could lead to the spread of alien plants, but this impact can be effectively controlled with suggested measures.

Assessment of alternatives for infrastructure components

Access road to site
There are four proposed alternative access roads within the site (Figure 11). All four of these cross the same dune and one ephemeral drainage area. The impacts of all roads are therefore almost identical. Slight differences are the fact that option 1 and 4 are next to an existing powerline, which consolidates impacts on the landscape and option 3 is near the terminal end of the dune, which reduces the potential for fragmenting this feature. These two options (one, four and three) are therefore marginally preferred over the remaining option. The location of options 1 and 4 next to the existing powerline are proposed as the best alternatives from an ecological perspective.

Power lines
There are four proposed alternative power line routes from the facility to the substation (Figure 11). All four of these cross the same dune and one ephemeral drainage area. The impacts of all power lines are therefore almost identical. Slight differences are the fact that option 1 and 4 are next to an existing power line, which consolidates impacts on the landscape, and option 3 is near the terminal end of the dune, which reduces the potential for fragmenting this feature. These two options (one, four and three) are therefore marginally preferred over the remaining option. The location of options 1 and 4 next to the existing powerline are proposed as the best alternatives.

Conclusion

The overall impacts of the proposed project have been assessed as being of low or medium significance (see Table 3 below). If mitigation measures are put in place to manage impacts, then most potential impacts can be reduced to having low to medium significance.

The proposed project is therefore considered acceptable in terms of potential impacts on flora, fauna, and watercourses and it is recommended that it should be permitted to go ahead.

Recommendations

The following recommendations are made to reduce impacts or provide additional information that can lead to reduction or control of impacts:

- Alien invasive plants should be controlled on site. Currently, the site contains very little alien vegetation. It is important to maintain this situation and not allow alien species to become established on site.
- A permit (water-use license) is required to impact on any watercourse. Watercourses should be avoided, where possible, and measures taken to reduce impacts where it is not possible to avoid watercourses.

Table 3: Summary of the significance of impacts for different infrastructure components before and after mitigation.

	Solar array and ancillary infrastructure		Access road		Overhead power line		Water pipeline	
Impact on:	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation
1. Vegetation	medium (60)	medium (55)	medium (50)	medium (45)	medium (35)	low (20)	low (20)	low (15)
2. Threatened plants	medium (40)	medium (35)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)
3. Protected trees	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)
4. Threatened animals	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)	zero (0)
5. Watercourses	medium (60)	medium (55)	medium (50)	medium (45)	low (14)	low (12)	low (15)	low (15)
6. Alien plants	medium (33)	low (18)	medium (33)	low (18)	medium (33)	low (18)	medium (33)	low (18)

*Significance: <30 = low, 30–60 = medium, >60 = high.

MANAGEMENT PLAN

Control measures are only proposed for those impacts where mitigation measures are proposed to reduce the significance of impacts, i.e. some impacts are of low significance and thus no mitigation measures are proposed or no mitigation measures are possible or required.

OBJECTIVE: Control alien invasive plants

Project component/s	Any infrastructure or activity that will result in disturbance to natural areas
Potential Impact	Invasion of natural vegetation surrounding the site by declared weeds or invasive alien species
Activity/risk source	Construction, environmental management
Mitigation: Target/Objective	Target: no alien plants within project control area Time period: construction, operation

Mitigation: Action/control	Responsibility	Timeframe
» Avoid creating conditions in which alien plants may become established: • Keep disturbance of indigenous vegetation to a minimum • Rehabilitate disturbed areas as quickly as possible • Do not import soil from areas with alien plants » Establish an ongoing monitoring programme to detect and quantify any alien species that may become established and identify the problem species (as per Conservation of Agricultural Resources Act) » Immediately control any alien plants that become established using registered control methods	EPC Contractor	Construction, Operation

Performance Indicator	For each alien species: number of plants and aerial cover of plants within project area and immediate surroundings
Monitoring	» Ongoing monitoring of area by environmental control officer during construction » Ongoing monitoring of area by environmental manager during operation » Annual audit of project area and immediate surroundings by qualified

	botanist. If no species are detected, then this can be stated. If any alien invasive species are detected then the distribution of these should be mapped (GPS co-ordinates of plants or concentrations of plants), number of individuals (whole site or per unit area), age and/or size classes of plants and aerial cover of plants. The results should be interpreted in terms of the risk posed to sensitive habitats within and surrounding the project area. The environmental manager should be responsible for driving this process. Reporting frequency depends on legal compliance framework

OBJECTIVE: Relocate threatened tree

Project component/s	Solar array
Potential Impact	Loss of protected trees
Activity/risk source	Construction
Mitigation: Target/Objective	Target: rescue of protected trees Time period: construction

Mitigation: Action/control	**Responsibility**	**Timeframe**
Dig out affected tree with the use of suitable equipment that will allow removal of entire root structure. Plant tree in open natural veld nearby that has similar ecological attributes as current position of tree, i.e. similar slope, aspect and topographical position. Alternatively, plant tree as a horticultural subject on site. A horticulturalist should be consulted to ensure that measures taken maximize the chances of the tree surviving, e.g. whether to water the tree or not, use of fertilizer and/or compost and possible treatment of tree during translocation.	EPC Contractor	Construction

Performance Indicator	Successful transplanting of affected tree
Monitoring	None required

OBJECTIVE: Control loss of/disruption to indigenous vegetation

Project component/s	Any infrastructure or activity that will result in disturbance to natural areas
Potential Impact	Loss of indigenous natural vegetation due to construction activities
Activity/risk source	Construction
Mitigation: Target/Objective	Target: minimal loss of natural vegetation Time period: construction

Mitigation: Action/control	**Responsibility**	**Timeframe**
(1) The construction impacts must be contained to the footprint of the infrastructure (2) Limit unnecessary impacts on surrounding natural vegetation, e.g. driving around in the veld, use access roads only	EPC Contractor	Construction

Performance Indicator	Minimum loss of natural vegetation outside of the exact footprint of the proposed project
Monitoring	Before construction, demarcate footprint of proposed infrastructure and construction area and ensure that construction impacts are contained within this area.

OBJECTIVE: Limit damage to watercourses (drainage areas)

Project component/s	Any infrastructure or activity that will result in disturbance to watercourses
Potential Impact	Damage to watercourses by any means that will result in hydrological changes (includes erosion, siltation, dust, direct removal of soil of vegetation, dumping of material within wetlands). The focus should be on the functioning of the watercourse as a natural system
Activity/risk source	Construction, operation
Mitigation: Target/Objective	Target: no unnecessary damage to watercourses within project area Time period: construction, operation

Mitigation: Action/control	**Responsibility**	**Timeframe**
» For any new construction, cross	EPC Contractor	Construction, Operation

watercourses perpendicularly to minimise disturbance footprints » Rehabilitate any disturbed areas as quickly as possible » Control stormwater and runoff water » Obtain a permit from DWA to impact on any wetland or water resource.		

Performance Indicator	No impacts on water quality, water quantity, wetland vegetation, natural status of watercourses outside of footprint of infrastructure
Monitoring	» Habitat loss in watercourses should be monitored before and after construction » The environmental manager should be responsible for driving this process » Reporting frequency depends on legal compliance framework

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Appendix 1: Plant species of conservation importance (Threatened, Near Threatened and Declining) that have historically been recorded in the study area.

Sources: South African National Biodiversity Institute in Pretoria.

Family	Taxon	Status	Habitat	Likelihood of occurrence on site
FABACEAE	Acacia erioloba	Declining	Savanna, semi-desert and desert areas, deep sandy soils and along drainage lines in very arid areas, sometimes in rocky outcrops.	HIGH
ASPHODALACEAE	Aloe dichotoma subsp. dichotoma	VU	North-facing rocky slopes (particularly dolomite) in the south of its range. Lower Gariep Broken Veld and rocky areas in Bushmanland Arid Grassland	**DEFINITE**, found on site
APIACEAE	Anginon jaarsveldii	EN	Pofadder. Groot Pellaberg. Dry rocky area, xerophytic plants. Agganeys Gravel Vygieveld.	LOW, nearest locality is 50 km away
ASPHODALACEAE	Bulbine striata	Critically rare	Groot Pellaberg, this species appears to be endemic to the mountains north of Pella. Quartz pebbles and rocks in well-drained soil on the upper and middle slopes at the base of sheer rock faces.	LOW, nearest locality is 50 km away
FABACEAE	Caesalpinia bracteata	VU	This species is only known from below the Augrabies Falls near the Orange River and Klein Pella on granite. Blouputs Karroid Thornveld.	LOW, nearest locality is 20 km away
MESEMBRYANTHEMACEAE	Conophytum achabense	VU	Namiesberge, near Poffader. Western end of the Namiesberge on an elevated quartz vlakte. Bushmanland Inselberg Shrubland.	LOW, nearest locality is 60 km away
MESEMBRYANTHEMACEAE	Conophytum limpidum	NT	Inselbergs in Bushmanland. Particularily dense on the Namiesberg. Vertical crevices generally prefering shaded situations. Lower Gariep Broken Veld	HIGH, hills in northern part of site
MESEMBRYANTHEMACEAE	Conophytum ratum	VU	Ghaamsberg, South West of Pofadder. Spongy quartz soil.	LOW, nearest locality is 70 km away
APOCYNACEAE	Hoodia gordonii	Declining	Wide variety of arid habitats	HIGH
MESEMBRYANTHEMACEAE	Lithops dinteri subsp. frederici	VU	Only known from a small area near Pella (near Pofadder) in Northern Cape. Eastern Gariep Plains Desert	LOW, nearest locality is 50 km away
MESEMBRYANTHEMACEAE	Lithops dorotheae	EN	Just N of Pofadder / Pella vicinity, Pella mountains between Pella and Pofadder. Grows on fine grained, sheared, feldspathic quartzite. False Succulent Karoo Veld or Orange River Broken Veld (Eastern Gariep Rocky Desert)	LOW, known distribution is to the west
MESEMBRYANTHEMACEAE	Lithops olivacea	VU	Aggenys to Pofadder. Habitat specialist - grows on white translucent quartzite in Arid Karoo Veld (Aggeneys Gravel Vygieveld).	LOW, no suitable habitat

* Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as evaluated by the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria. *IUCN (3.1) Categories: VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NT = Near Threatened.

Appendix 2: Threatened vertebrate species with a geographical distribution that includes the current study area.

MAMMALS

Common name	Taxon	Habitat	Status	Likelihood of occurrence
Black rhinoceros	*Diceros bicornis bicornis*	Wide variety of habitats, but currently only occurs in game reserves.	CR[1, 2]	**NONE**, only occurs in game reserves
Hartmann's mountain zebra	*Equus zebra hartmannae*	Rocky barren areas, ecotones between mountains and plains / flats, grazer.	EN[1, 2]	**LOW,** historical record from nearby grid, overall geographical distribution includes site, habitat is suitable. Outside Namibia, mostly occurs in reserves, including Richtersveld and Augrabies Falls National Parks.
Angolan Wing-gland Bat	*Cistugo seabrai*	West coast of southern Africa in arid and semi-arid areas.. Occurs in areas with less than 100 mm rainfall. Usually found in riverine vegetation of dry river beds.	VU[1], NT[2]	**LOW**, previously recorded in neighbouring grid, on edge but within geographical distribution. No riverine vegetation on or immediately near site
Darling's horseshoe bat	*Rhinolophus darlingii*	Savanna, rossting in caves and sub-terranean habitats, including mine adits, and in smaller groups or singly in culverts and crevices in rock piles	NT[1], LC[2]	**MEDIUM**, recorded in nearby grid, on edge of distribution; suitable habitat may occur in hills in northern part of site.
Dent's horseshoe bat	*Rhinolophus denti*	Savanna, nama-Karoo, succulent Karoo, distribution follows rivers. Caves and subterranean habitats. Aerial insectivore.	NT[1], NT[2]	**LOW**, on edge of distribution; suitable habitat may occur on site or may be vagrant from Orange River valley.
Littledale's whistling rat	*Parotomys littledalei*	Desert, Karoo. Sandy or gravel open plains. Tends to excavate burrow beneath a shrub, but will also contruct stick nest at the base of a shrub. Herbivorous, favouring leaves of *Zygophullum* and Mesembryanthemaceae.	NT[1], LC[2]	**HIGH**, site is in core of distribution range. Habitat suitable on site.
Dassie Rat	*Petromus typicus*	Rocky barren areas on rocky outcrops and koppies. Flat rock crevices. Eats soft vegetable matter, including leaves of shrubs and flowers of many Asteraceae.	NT[1], LC[2]	**HIGH**, site is in core of distribution range. Habitat suitable on site.

[1]Status according to Friedmann & Daly 2004
[2]Status according to Monadjem et al. 2010 and IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org).

AMPHIBIANS

Common name	Species	Habitat	Status[2]	Likelihood of occurrence
Giant Bullfrog	*Pyxicephalus adspersus*	Widely distributed in southern Africa, mainly at higher elevations. Inhabits a variety of vegetation types where it breeds in seasonal, shallow, grassy pans in flat, open areas; also utilises non-permanent vleis and shallow water on margins of waterholes and dams. Prefer sandy substrates although they sometimes inhabit clay soils.	NT[1] LC[2] Protected (NEMBA)	**LOW**, just outside known distribution range.

[1]Status according to Minter et al. 2004.
[2]Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 11 September 2010.

REPTILES

Common name	Species	Habitat	Status[3]	Likelihood of occurrence
Black spitting cobra	*Naja nigricollis woodi*	Favours rocky terrain and dry rocky watercourses.	RARE[3], LC[4]	**HIGH**, overall geographical distribution includes this area; suitability of habitat on site appears favourable.

[3]Status according to Branch 1988.
[4]Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org).

Appendix 3: List of protected tree species (National Forests Act).

Acacia erioloba	*Acacia haematoxylon*
Adansonia digitata	*Afzelia quanzensis*
Balanites subsp. *maughamii*	*Barringtonia racemosa*
Boscia albitrunca	*Brachystegia spiciformis*
Breonadia salicina	*Bruguiera gymnhorrhiza*
Cassipourea swaziensis	*Catha edulis*
Ceriops tagal	*Cleistanthus schlectheri* var. *schlechteri*
Colubrina nicholsonii	*Combretum imberbe*
Curtisia dentata	*Elaedendron (Cassine) transvaalensis*
Erythrophysa transvaalensis	*Euclea pseudebenus*
Ficus trichopoda	*Leucadendron argenteum*
Lumnitzera racemosa var. *racemosa*	*Lydenburgia abottii*
Lydenburgia cassinoides	*Mimusops caffra*
Newtonia hildebrandtii var. *hildebrandtii*	*Ocotea bullata*
Ozoroa namaensis	*Philenoptera violacea* (*Lonchocarpus capassa*)
Pittosporum viridiflorum	*Podocarpus elongatus*
Podocarpus falcatus	*Podocarpus henkelii*
Podocarpus latifolius	*Protea comptonii*
Protea curvata	*Prunus africana*
Pterocarpus angolensis	*Rhizophora mucronata*
Sclerocarya birrea subsp. *caffra*	*Securidaca longependunculata*
Sideroxylon inerme subsp. *inerme*	*Tephrosia pondoensis*
Warburgia salutaris	*Widdringtonia cedarbergensis*
Widdringtonia schwarzii	

Acacia erioloba, Acacia haematoxylon, Boscia albitrunca, *Euclea pseudebenus* have a geographical distribution that coincides with the study area.

Appendix 4: Checklist of plant species recorded during previous botanical surveys in the study area and surrounds.

Aizoon canariense L.
Anacampseros filamentosa (Haw.) Sims ssp. tomentosa (A.Berger) Gerbaulet
Aptosimum procumbens (Lehm.) Steud.
Augea capensis Thunb.
Avonia albissima (Marloth) G.D.Rowley
Barleria lancifolia T.Anderson ssp. lancifolia
Blepharis pruinosa Engl.
Cleome oxyphylla Burch. var. oxyphylla
Diospyros acocksii (De Winter) De Winter
Eriocephalus pauperrimus Merxm. & Eberle
Euryops dregeanus Sch.Bip.
Galenia africana L.
Galenia fruticosa (L.f.) Sond.
Geigeria filifolia Mattf.
Grielum humifusum Thunb. var. parviflorum Harv.
Helichrysum herniarioides DC.
Hermannia minutiflora Engl.
Hermannia stricta (E.Mey. ex Turcz.) Harv.
Ifloga molluginoides (DC.) Hilliard
Indigastrum argyroides (E.Mey.) Schrire
Jamesbrittenia aridicola Hilliard
Kohautia cynanchica DC.
Lophiocarpus polystachyus Turcz.
Manulea schaeferi Pilg.
Mesembryanthemum crystallinum L.
Microloma sagittatum (L.) R.Br.
Pappea capensis Eckl. & Zeyh.
Pharnaceum brevicaule (DC.) Bartl.
Psilocaulon subnodosum (A.Berger) N.E.Br.
Ruschia spinosa (L.) Dehn
Searsia burchellii (Sond. ex Engl.) Moffett
Searsia populifolia (E.Mey. ex Sond.) Moffett
Senecio niveus (Thunb.) Willd.
Senecio sisymbriifolius DC.
Sericocoma avolans Fenzl
Sisyndite spartea E.Mey. ex Sond.
Stachys burchelliana Launert
Suessenguthiella scleranthoides (Sond.) Friedrich
Thesium lineatum L.f.
Trianthema parvifolia E.Mey. ex Sond. var. parvifolia
Viscum capense L.f.
Wahlenbergia psammophila Schltr.
Zygophyllum dregeanum Sond.