KEIMOES

KEREN ENERGY HOLDINGS

BIODIVERSITY ASSESSMENT & BOTANICAL SCAN

A preliminary Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa.

March 9, 2012

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PREPARED FOR: ENVIROAFRICA CC

REQUESTED BY: KEREN ENERGY HOLDINGS (Pty) Ltd

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SUMMARY - MAIN CONCLUSIONS

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MAIN VEGETATION TYPES	**Bushmanland Arid Grassland** Described as an open, shrubby thornveld characterized by a dense shrub layer, often lacking a tree layer, with a sparse grass layer. **Least Threatened** But only 4% formally protected (Augrabies Falls National Park)
LAND USE AND COVER	The study area is situated on communal grazing land, with no development or agricultural practices (apart from some grazing) observed. Natural vegetation forms a sparse cover over the entire area of the study area. The Keimoes waste disposal site as well as cemetery are located to the north of the site. Sand mining activities were also observed in some of the non-perennial streams crossing the property (vicinity of the waste disposal site).
RED DATA PLANT SPECIES	None encountered or expected Protected Trees: *Acacia erioloba* (Camel thorn) are present to the north of the site (deeper sands next to main watercourses).
IMPACT ASSESSMENT	Development without mitigation: Sig. rating = 28% Development with mitigation Significance = 5% Where values of ≤15% indicate an insignificant environmental impact and values >15% constitute ever increasing environmental impact.

RECOMMENDATION

From the information available and the site visit, it is clear that the Keimoes final location was well chosen from a biodiversity viewpoint. No irreversible species loss, habitat loss, connectivity or associated impact can be foreseen from locating and operating the solar facility on the final proposed solar site. However, there is a significant difference between development **without** and development **with** mitigation. As a result it is recommended that all mitigating measures must be implemented in order to further minimise the impact of the construction and operation of the facility.

Although solar energy is presently not seen as a viable stand-alone technology for electricity production it will lighten the pressure on the fossil burning facilities of Eskom and in so doing will add to a more sustainable way of electricity production.

With the available information to the author's disposal it is recommended that the project be approved, but that all mitigation measures described in this document is implemented.

CONTENTS

INTRODUCTION

Renewable energy takes many forms, including biomass, geothermal, hydropower, wind and solar. Of these, solar may be the most promising: it can be used to generate electricity or to heat water, has little visual impact, and scales well from residential to industrial levels. Solar is the fastest growing energy source in the world. It offers a limitless supply of clean, safe, renewable energy for heat and power. And it's becoming ever more affordable, more efficient, and more reliable.

According to various experts (www.thesolarfuture.co.za), building solar plants is in many ways more financially viable and sustainable than erecting coal fired power stations. When a coal power plant has reached its life span, usually after 40 years depending on the technology, it must be demolished and rebuild (at a huge price tag). When panels of a solar plant reach their lifespan, you only need to replace the panels. Replacing panels is becoming cheaper and better in what they do as the technology is continuously improving. South Africa has abundant coal reserves, but its reserves of solar power are even greater, and unlike coal, solar power is inflation-proof and doesn't lead to large scale destruction of landscapes or the pollution of precious water. In addition South Africa is the world's best solar energy location after the Sahara and Australia.

The advantages of Solar and other renewable power sources are clear: greater independence from imported fossil fuels, a cleaner environment, diversity of power sources, relief from the volatility of energy prices, more jobs and greater domestic economic development. All over the world, solar energy systems have reduced the need to build more carbon-spewing fossil-fuelled power plants. They are critical weapons in the battle against global warming. As the cost of solar technologies has come down, solar is moving into the mainstream and growing worldwide at 40-50% annually (www.wikepedia.org).

In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating climate change, and keep fossil fuel prices lower than otherwise. These advantages are global.

Keren Energy Holdings is proposing the establishment of a 10 MW concentrated photovoltaic solar energy facility near the town of Keimoes (Northern Cape Province, Kai !Garib Local Municipality). The facility will be established over an area of approximately 20 ha, on the remainder of the Farm 666, approximately 2 km north-east of Keimoes. The purpose of the proposed facility is to sell electricity to Eskom as part of the Renewable Energy Independent Power Producers Procurement Programme. This programme has been introduced by the Department of Energy to promote the development of renewable power generation facilities.

TERMS OF REFERENCE

EnviroAfrica (Pty) Ltd was appointed by Keren Energy Holdings as the independent Environmental Assessment Practitioner (EAP) to undertake the Scoping/Environmental Impact Assessment (EIA) Process for the proposed development. PB Consult was appointed by EnviroAfrica to conduct a Biodiversity Assessment of the proposed development area.

PB Consult was appointed within the following terms of reference:

- Evaluate the general location of the proposed site and make recommendations on a specific location for the 20
- The study must consider short- to long-term implications of impacts on biodiversity and highlight irreversible impacts or irreplaceable loss of species.

INDEPENDENCE & CONDITIONS

PB Consult is an independent consultant to Keren Energy Holdings and has no interest in the activity other than fair remuneration for services rendered. Remunerations for services are not linked to approval by decision making authorities and PB Consult have no interest in secondary or downstream development as a result of the authorization of this proposed project. There are no circumstances that compromise the objectivity of this report. The findings, results, observations and recommendations given in this report are based on the author's best scientific and professional knowledge and available information. PB Consult reserve the right to modify aspects of this report, including the recommendations if new information become available which may have a significant impact on the findings of this report.

DEFINITIONS & ABBREVIATIONS

DEFINITIONS

Environmental Aspect: Any element of any activity, product or services that can interact with the environment.

Environmental Impact: Any change to the environment, whether adverse or beneficial, wholly or partially resulting from any activity, product or services.

No-Go Area(s): Means an area of such (environmental/aesthetical) importance that no person or activity is allowed within a designated boundary surrounding this area.

ABBREVIATIONS

BGIS	Biodiversity Geographical Information System
DEA	Department of Environmental Affairs
DENC	Department of Environment and Nature Conservation (Northern Cape Province)
EAP	Environmental assessment practitioner

EIA	Environmental impact assessment
EMP	Environmental management plan
NEMA	National Environmental Management Act, Act 107 of 1998
NEM: BA	National Environmental Management Biodiversity Act, Act 10 of 2004
NSBA	National Spatial Biodiversity Assessment
SANBI	South African National Biodiversity Institute
SKEP	Succulent Karoo Ecosystem Project
WWTW	Wastewater Treatment Works

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PROJECT DESCRIBTION

Keren Energy Holdings is proposing the establishment of a 10 MW concentrated photovoltaic solar energy facility near the town of Keimoes (Northern Cape Province, Kai !Garib Local Municipality). The facility will be established over an area of approximately 20 ha, on the remainder of the Farm 666, approximately 2 km north-east of Keimoes.

The proposed facility will utilise Concentrated Photovoltaic (CPV) technology, which aims to concentrate the light from the sun, using Fresnel lenses, onto individual PV cells. This method increases the efficiency of the PV panels as compared to conventional PV technology. An inverter is then used to convert the direct current electricity produced into alternating current for connection into the Eskom grid. A single solar generator produces approximately 66kV. In order to produce 10 MW, the proposed facility will require a number of generators arranged in multiples/arrays. The CPV panels will be elevated (2 m above ground) by a support structure, and will be able to track the path of the sun during the day for maximum efficiency. Approximately 1.8 ha is required per installed MW. A 10 MW capacity facility will thus require a development footprint of approximately 20 ha (including associated infrastructure – ancillary infrastructure). Each panel will be approximately 22 m wide by 12.5 m high. When the panels are tracking vertically the structure will have a maximum height of approximately 15 m.

The site will be accessed from the N14, using existing secondary roads. However, additional temporary access roads will have to be established on site. Site preparation will include clearance of vegetation at the footprint of the following infrastructure:

- Support structures (approximately 148 units are proposed) (excavations of 1 m^2 by 5 m deep)
- Switchgear
- Inverters
- Workshops
- Trenches for the underground cabling

The activities may require the stripping of topsoil, which will need to be stockpiled, backfilled and/or spread on site. All in all, the proposed facility can be likened to light agriculture, with the exception that natural vegetation will be allowed to remain on all the non-disturbed areas. All surfaces not used for the facility and associated infrastructure will remain natural.

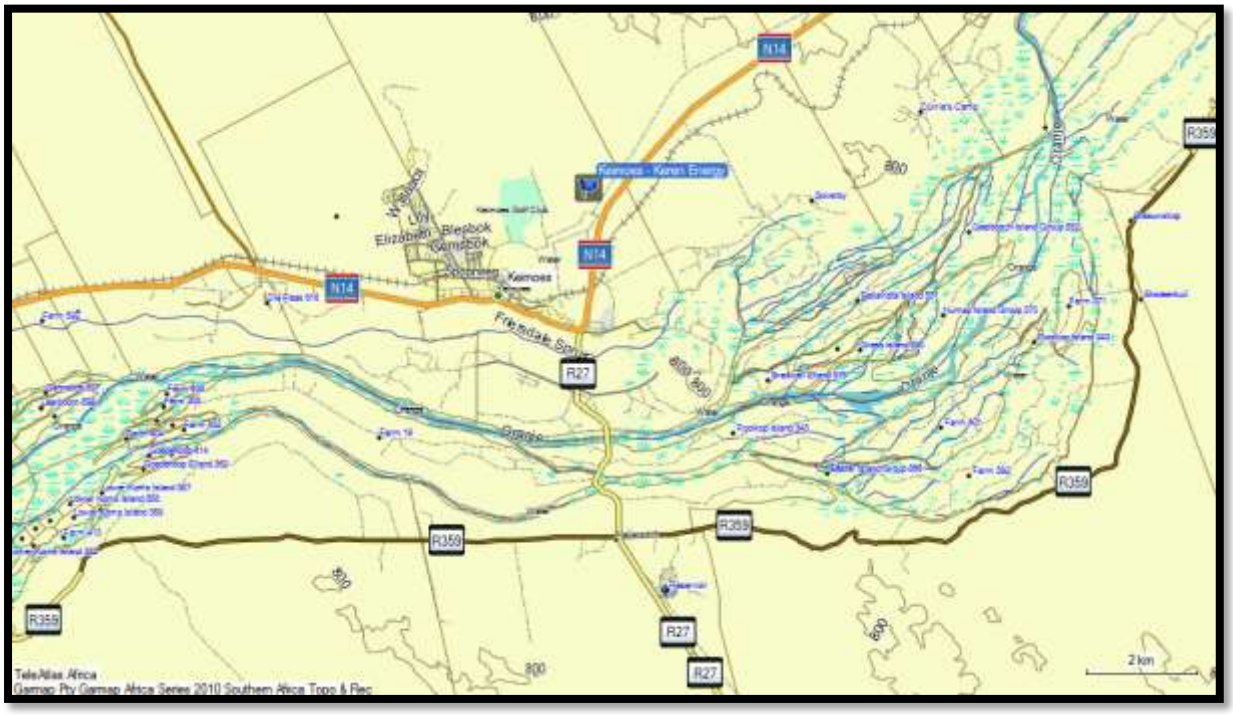
DESCRIPTION OF ENVIRONMENT

The aim of this description is to put the study area in perspective with regards to all probable significant biodiversity features which might be encountered within the study area. The study area has been taken as the proposed site and its immediate surroundings. During the desktop study any significant biodiversity features associated with the larger surroundings was identified, and were taken into account. The desktop portion of the study also informs as to the biodiversity status of such features as classified in the National Spatial Biodiversity Assessment (2004) as well as in the recent National list of ecosystems that are threatened and in need of protection (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004.

LOCATION & LAYOUT

Keimoes is located in the Northern Cape Province (Kai !Garib Local Municipality), just north of the N14 approximately 40 km west of Upington (Refer to Figure). The solar facility is proposed to be located approximately 2 km north-east of Keimoes (just east of the Keimoes Golf course) on a 20 ha potion of the Remainder of Farm 666 (refer to Figure 1).

Figure 1: The general location of the proposed Keimoes Keren Energy Solar Facility



During the biodiversity assessment the following general location for the proposed site was evaluated (Refer to Figure 2).

Please note that this area is much larger than 20 ha and the purpose of the biodiversity assessment was to evaluate the larger site and then to choose a suitable area (within this larger site) on which the solar facility can be located, which will minimise significant biodiversity features.

Figure 2: The general location of the Keimoes Keren Energy Solar Facility evaluated during the Biodiversity Assessment

Biodiversity and other specialist inputs after the physical biodiversity assessment site visit was used to decide on the final proposed location for the solar facility (Refer to Figure 3).

Figure 3: Final proposed site location (approximately 20 ha)

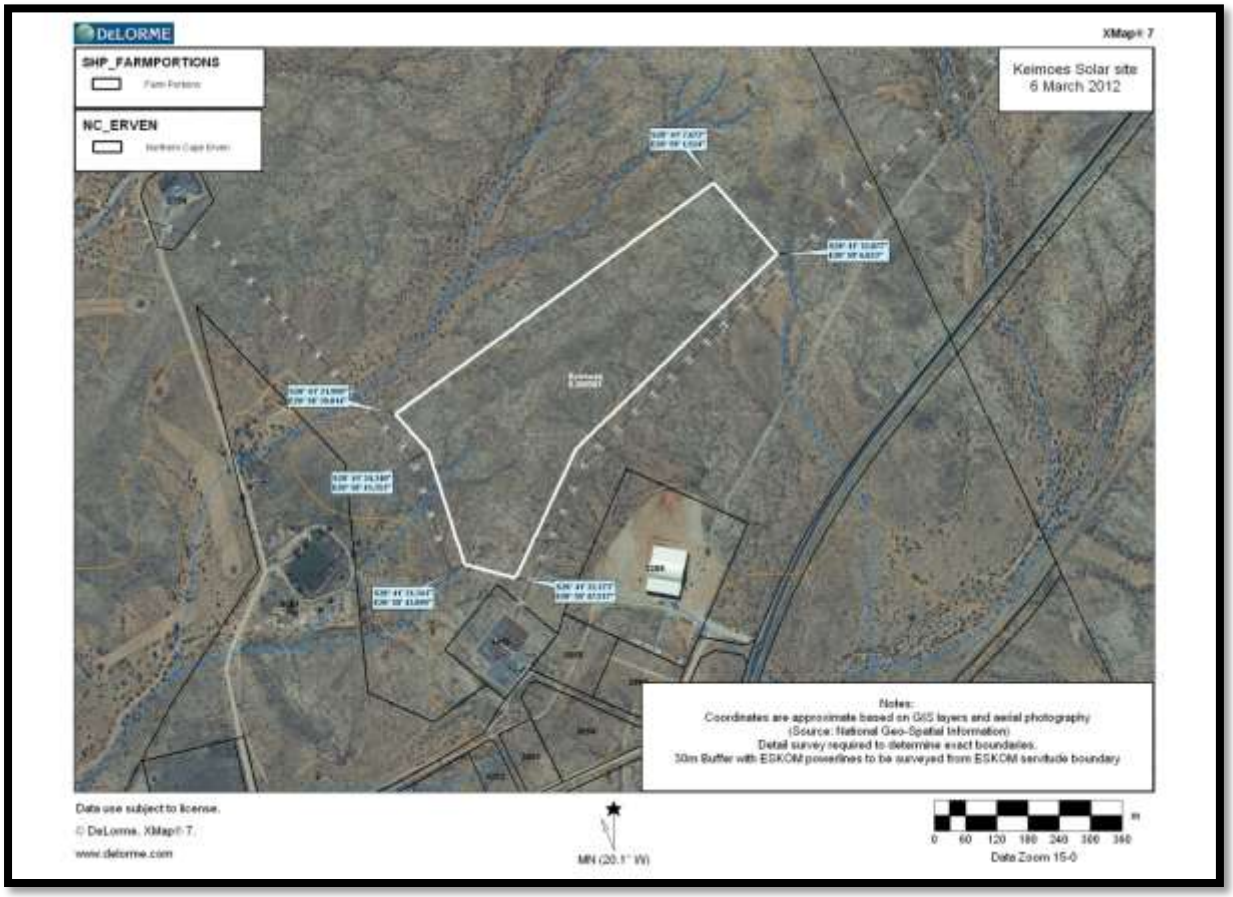


Table 1: GPS coordinates describing the approximate boundaries of the proposed final facility location (WGS 84 format)

DESCRIPTION	LATITUDE AND LONGITUDE	ALTITUDE
North-west corner	S28 41 22.0 E20 58 39.0	766 m
North-east corner	S28 41 07.7 E20 59 01.5	777 m
South-east corner	S28 41 12.1 E20 59 06.0	775 m
South-west corner	S28 41 32.2 E20 58 51.7	766 m
Western boundary	S28 41 31.3 E20 58 43.9	764 m
Western boundary	S28 41 24.3 E20 58 41.4	765 m

METHODS

Various desktop studies were conducted, coupled by a physical site visit conducted in November 2011 and further desktop studies. The timing of the site visit was also reasonable in that essentially all perennial plants were identifiable and although the possibility remains that a few species may have been missed, the author is confident that a fairly good understanding of the biodiversity status in the area was obtained.

The survey was conducted by walking through the site (Refer to Figure 4) and examining, marking and photographing any area of interest. Confidence in the findings is high. During the site visit the author endeavoured to identify and locate all significant biodiversity features, including rivers, streams or wetlands, special plant species and or specific soil conditions which might indicate special botanical features (e.g. rocky outcrops or silcrete patches).

Figure 4: A Google image showing the route (black line) that was walked as well as special features encountered

The site visit was also used to inform the client and EAP of potential conflicting areas (e.g. rivers/streams and plant species) in the larger site. This information together with engineering reasoning and other specialist studies was used to tweak the final proposed location indicated by the red block in Figure 4, above.

TOPOGRAPHY

The proposed final site is located on a relative flat area, which is shown in the elevation data given in Table 1 above as well as in Figure 1, which indicated an average slope of only 1.3% (with its highest point the north-east corner and its lowest point the south-west corner).

Figure 5: Google image indicating the slope following the boundary of the site (direction NW-NE-SE-SW etc).

CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. This area normally receives about 106 mm of rain per year (the climate is therefore regarded as arid to very arid). Keimoes normally receives about 84mm of rain per year, with most rainfall occurring mainly during autumn. It receives the lowest rainfall (0 mm) in June and the highest (27 mm) in March. The monthly distribution of average daily maximum temperatures range from 19.8°C in June to 33°C in January. The region is the coldest during July when the mercury drops to 3°C on average during the night (www.saexplorer.co.za).

The graphs underneath indicate the average climate data for Kuruman (giving an average for the Northern Cape region) (Figure 6 to Figure 9).

Figure 6: Kuruman average minimum and maximum temperatures (www.weather-and-climate.com)

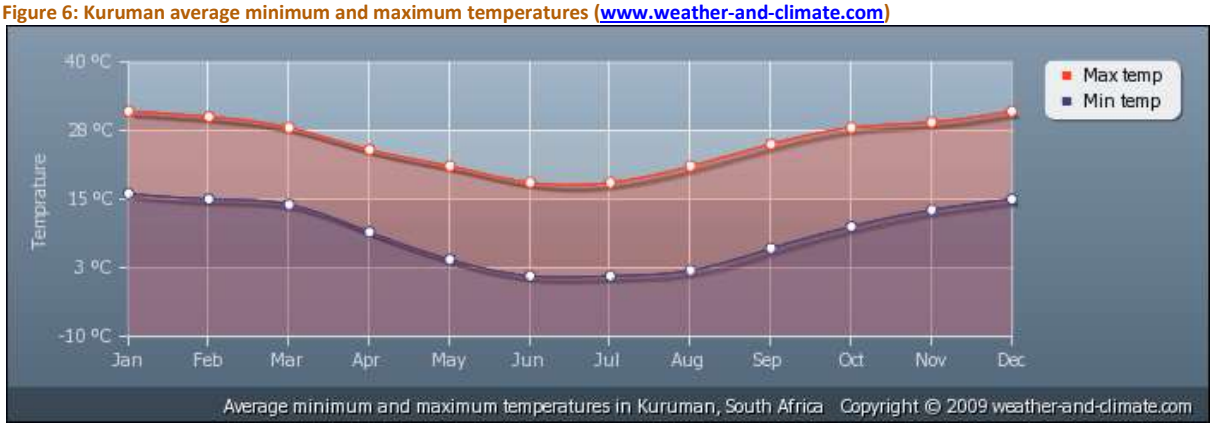


Figure 7: Kuruman average monthly precipitation over the year (www.weather-and-climate.com)

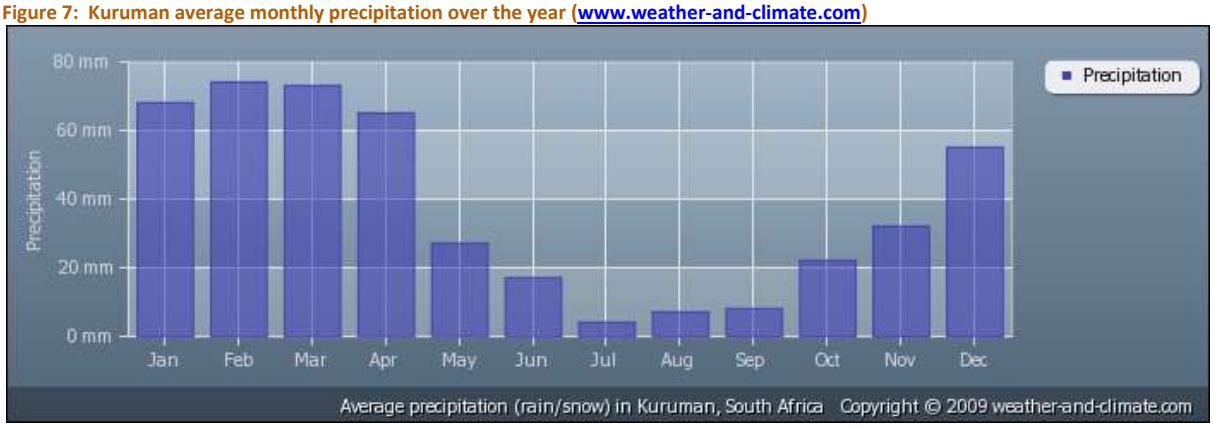


Figure 8: Kuruman average monthly hours of sunshine over the year (www.weather-and-climate.com)

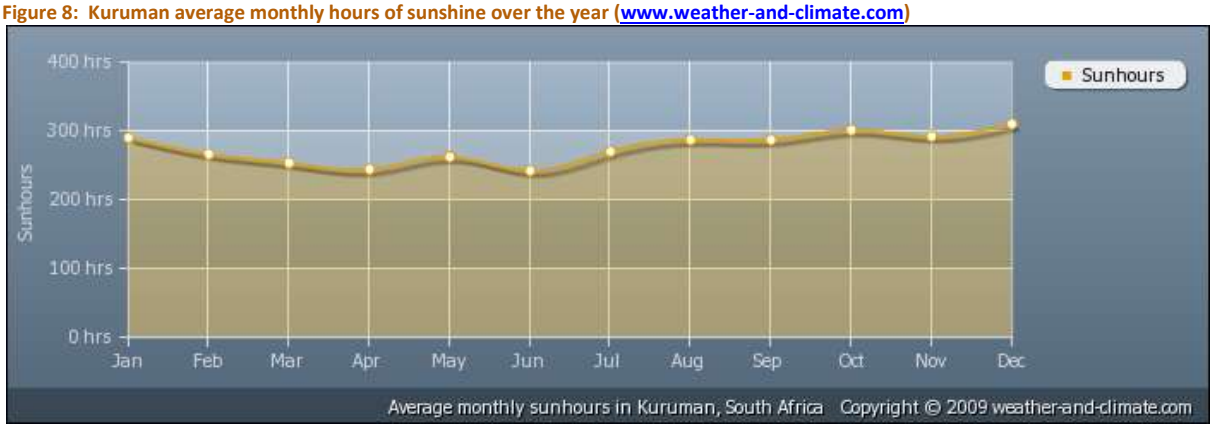
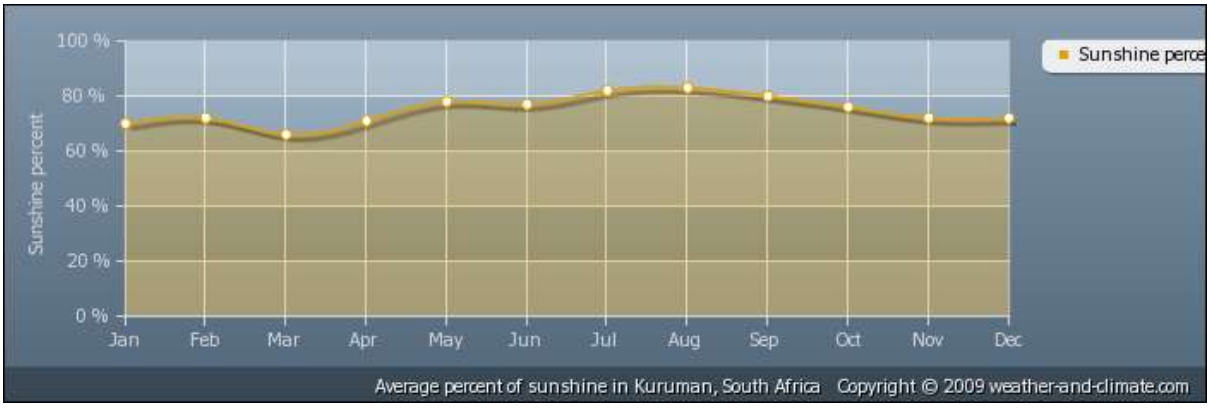


Figure 9: Kuruman average percent of sunshine over the year (mean % of sun hours during the day) (www.weather-and-climate.com)



GEOLOGY & SOILS

Geology is dominated by mudstones and shales of the Ecca Group (Prince Albert and Volksrust Formations) and Dwyka tillites, both of the early Karoo age. About 20% of rock outcrops are formed by Jurassic intrusive dolerite sheets and dykes. Soils are described as soils with minimal development, usually shallow on hard or weathering rock, Glenrosa and Mispah forms, with lime generally present in the entire landscape (Fc land type) and, to a lesser extent, red-yellow apedal, freely drained soils with a high base status and usually <15% clay (Ah and Ai land types) are also found. The salt content in these soils is very high (Mucina & Rutherford, 2006).

LANDUSE AND COVER

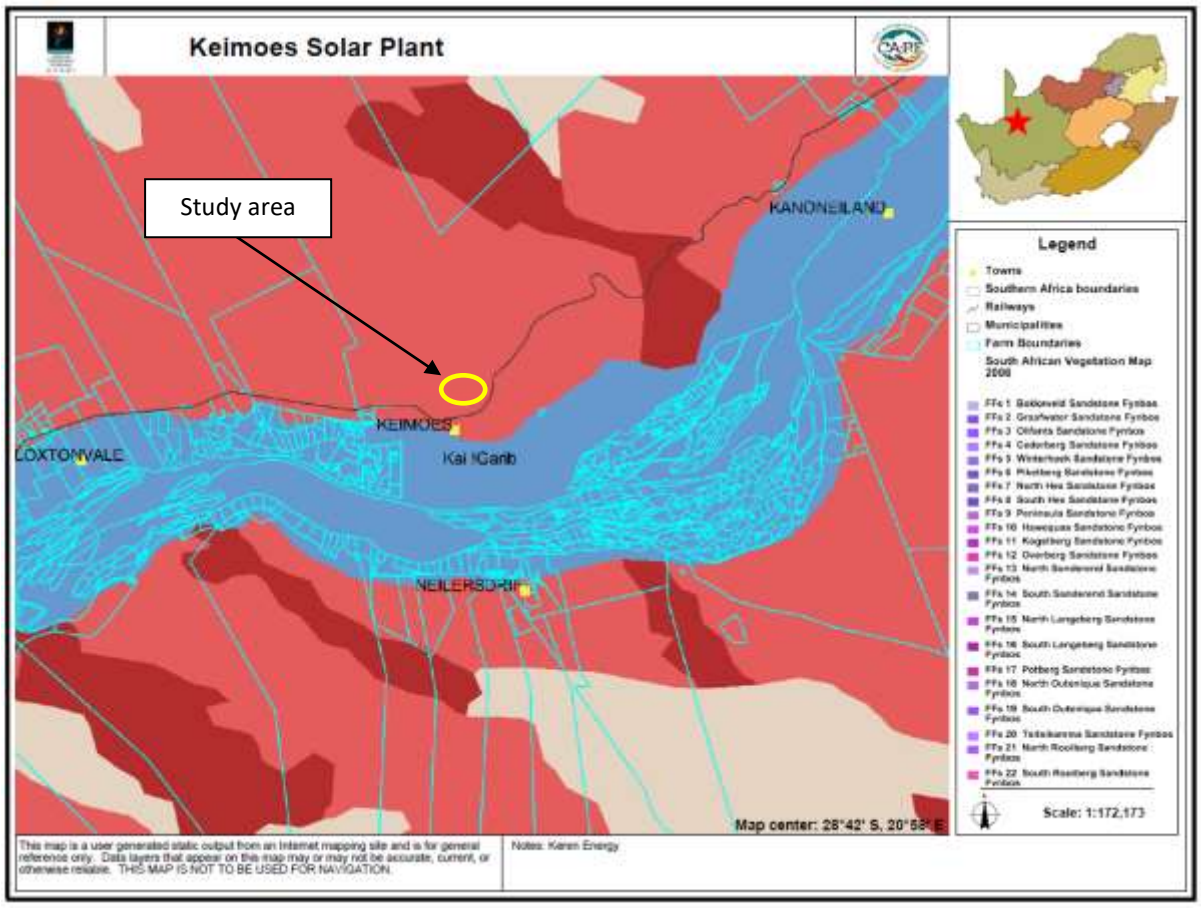
The study area is situated on communal grazing land, with no development or agricultural practices (apart from some grazing) observed. Both the Keimoes waste disposal site as well as Cemetery are located to the north but in the vicinity of the larger study area. To the north of the site, sand mining activities was also observed in some of the non-perennial streams crossing the property. Natural vegetation forms a sparse cover over the entire area of the study area. Various non-perennial streams cross the property to the north of the final proposed study area (Refer to Figure 10). A number of smaller drainage channels are also present to the east of the proposed final site.

Figure 10: A Google image giving an indication of the land use (natural grazing) on the site

VEGETATION TYPES

In accordance with the 2006 Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006) only one broad vegetation type is expected in the proposed area and its immediate vicinity, namely Bushmanland Arid Grassland (Light red in Figure 11). This vegetation type was classified as "Least Threatened" during the 2004 National Spatial Biodiversity Assessment (NSBA). More than 99% of this vegetation still remains in its natural state, but at present only 4% is formally protected (Augrabies Falls National Park) throughout South Africa. Recently the *National list of ecosystems that are threatened and in need of protection* (GN 1002, December 2011), was promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004. According to this National list, **Bushmanland Arid Grassland, remains classified as Least Threatened**.

Figure 11: Vegetation map of SA, Lesotho and Swaziland (2006)



Bushmanland Arid Grassland is found in the Northern Cape Province spanning about one degree of latitude from around Aggeneys in the west to Prieska in the east. The southern border of the unit is formed by edges of the Bushmanland Basin while in the north-west this vegetation unit borders on desert vegetation (north-west of Aggeneys and Pofadder). The northern border (in the vicinity of Upington) and the eastern border (between Upington and Prieska) are formed with often intermingling units of Lower Gariep Broken Veld, Kalahari Karroid Shrubland and Gordonia Duneveld. Most of the western border is formed by the edge of the Namaqualand hills. Altitude varies from 600 – 1 200 m (Mucina & Rutherford, 2006).

BUSHMANLAND ARID GRASSLAND

Bushmanland Arid Grassland is described as extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses (*Stipagrostis* species) giving this vegetation type the character of semi-desert "steppe". Sometimes low shrubs of *Salsola* change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected (Mucina & Rutherford, 2006). Acocks (1953) described this vegetation as Arid Karoo and Desert False Grassland or Orange River Broken Veld while Low & Rebelo (1996) described this vegetation as Orange River Nama Karoo.

Photo 1: A view of the natural veld in the study area (the small trees, *Acacia mellifera* and *Parkinsonia africana,* visible)

According to Mucina & Rutherford (2006) important taxa includes the following:

Graminoides: *Aristida adscensionis, A. congesta, Enneapogon desvauxii, Eragrostis nindensis, Schimdtia kalahariensis, Stipagrostis ciliate, S. Obtuse, Cenchrus ciliaris, Enneapogon scaber, Eragrostis annulata, E. porosa, E. procumbens, Panicum lanipes, Setaria verticillata, Sporobolus nervosus, Stipagrostis brevifolia, S uniplumis, Tragus berteronianus, T racemosus*

Small trees: *Acacia mellifera, Boscia foetida* subsp. *foetida*

Tall shrubs: *Lycium cinereum, Rhigozum trichotomum, Aptosimum spinescens, Hermannia spinosa, Pentzia spinescens, Aizoon asbestinum, Aizoon schellenbergii, Aptosimum elongatum, Aptosimum lineare, A marlothii, Barleria rigida, Berkheya annectens, Eriocephalus ambiguous, Eriocephalus spinescens, Limeum aethiopicum, Polygala seminuda, Pteronia leucoclada, Tetragonia arbuscula, Zygophyllum microphyllum*

Succulent Shrubs: *Kleinia longiflora, Lycium bosciifolium, Salsola tuberculata, S gabrescens*.

Herbs: *Acanthopsis hoffmannseggiana, Aizoon canariense, Amaranthus praetermissus, Dicoma capensis Lotononis platycarpa, Sesamum capense, Tribulus pterophorus* etc.

VEGETATION ENCOUNTERED

The sparse vegetation encountered conforms to that of Bushmanland Arid Grassland. Most of the larger study area was sparsely but fairly uniformly covered by the same vegetation composition and was also mostly associated with shallow soils in which rocky limestone outcrops were fairly frequently observed (Refer to Photo 2). The non-perennial streams, on the other hand, were mostly associated with deeper soils (red-yellow apedal soils) with denser, sometimes almost forming a thicket, stands of *Acacia mellifera*, in which *Acacia erioloba* was also frequently encountered (Refer to Photo 2).

The shallow soils (covering most of the proposed final location) support a distinct 2 stratum vegetation cover, with a grassy/shrub bottom layer and a short shrub/small tree over layer. The author did not spend time on the identification of the grass species (which include a number of Stipagrostis species etc.), but did make an effort to identify most of the shrub and tree species.

The grass bottom layer included a number of shrub species which includes: *Aptosimum* sp., *Aloe* sp., *Coton royenii*, *Eriocephalus* cf. *ambiquus*, *Euphorbia mauritanica*, *Thesium lineatum*, *Zygophyllum microphyllum*.

The top stratum was mostly dominated by *Acacia mellifera* (Swarthaak), and occasional individuals of *Boscia foetida* subsp. *foetida* and *Parkinsonia africana*, with mistletoe *Moquiniella rubra* sometimes present in some of the trees or shrubs, while in the deeper sands along the dry river beds, *Acacia erioloba* are frequently (outside of the final proposed site). In some cases *Acacia mellifera* forms almost a thicket stand next to portions of the dry river beds. One individual of *Aloe dichotoma* (Picture to the right) was also encountered to the north of final proposed solar site location (outside of the final proposed site).

Photo 2: General vegetation composition

Photo 3: Slightly denser vegetation next to stream

Photo 4: ***Boscia foetida*** **subsp.** ***foetida***

Photo 5: ***Euphorbia braunsii***

ENDEMIC OR PROTECTED PLANT SPECIES

Endemic taxa which might be encountered include: *Dinteranthus pole-evansii, Larryleachia dinteri, L marlothii, Ruschia kenhardtensis, Lotononis oligocephala* and *Nemesia maxi*.

The following protected tree species in terms of the National Forest Act of 1998 (Act 84 of 1998) have a geographical distribution that may overlap with the broader study area.

SPECIES NAME	COMMON NAME	TREE NO.	DISTRIBUTION
Acacia erioloba	Camel Thorn Kameeldoring	168	In dry woodlands next to water courses, in arid areas with underground water and on deep Kalahari sand
Acacia haematoxylon	Grey Camel Thorn Vaalkameeldoring	169	In bushveld, usually on deep Kalahari sand between dunes or along dry watercourses.
Boscia albitrunca	Shepherds-tree Witgat/Matopie	130	Occurs in semi-desert and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils.

MAMMAL AND BIRD SPECIES

Mammal and bird species were not regarded, as the proposed activity should have very little permanent impact on these species. Small game is still expected and droppings have been observed. Some of the smaller game (e.g. klipspringers) found at the nearby Augrabies Falls National Park is also expected to still roam the larger area and surroundings of the proposed site.

At the nearby Augrabies Falls National Park, wildlife includes at least 46 mammal and 186 bird species, as well as a number of reptiles. Most show adaptations to the area's large temperature fluctuations – including smaller animals like slender mongooses, yellow mongooses, and rock dassies – which utilise what little shade there is, sheltering in burrows, rock crevices and fallen trees.

Larger mammals found at Augrabies include steenbok, springbok, gemsbok, kudu, eland and Hartmann's Mountain Zebra (*Equus hartmannae*). The giraffe found at Augrabies are said to be lighter in colour than those found in the regions to the east, allegedly as an adaptation to the extreme heat. One of the most common antelope is the klipspringer, pairs of which are often seen bounding across the rocks by keen-eyed walkers. The main mammalian predators found in Augrabies are black-backed jackals, caracals, bat-eared foxes, African wild cats and an elusive population of leopards.

One reptile here is of particular note: Broadley's flat lizard, locally known as the Augrabies flat lizard, is endemic to this area. It only occurs in an area that is within about 100km of the falls. This reptile is, however, not locally rare and on warm days, the brightly-coloured males can often be seen sparring and dancing for dominance.

Birds in the area includes: Augrabies the black stork and Verreaux's (black) eagles which both breed in the area, and also pygmy falcons. As is common in the Kalahari to the north, pale chanting goshawk is one of the more common raptors, whilst flocks of Namaqua sand grouse are also common. Other species includes peregrine and lanner falcons, and rock kestrels (www. sanparks.org.za/augrabies).

RIVERS AND WETLANDS

Rivers maintain unique biotic resources and provide critical water supplies to people. South Africa's limited supplies of fresh water and irreplaceable biodiversity are very vulnerable to human mismanagement. Multiple environmental stressors, such as agricultural runoff, pollution and invasive species, threaten rivers that serve the world's population. River corridors are important channels for plant and animal species movement, because they link different valleys and mountain ranges. They are also important as a source of water for human use. Vegetation on riverbanks needs to be maintained in order for rivers themselves to remain healthy, thus the focus is not just on rivers themselves but on riverine corridors.

Various non-perennial or dry watercourses and drainage lines have been observed, especially to the north of the final solar site location (which has been chosen specifically to avoid these features. Towards the south-eastern side of the final proposed site location a small stream is still present, but the activities are not expected to irreversibly impact on these drainage channels. With care permanent impact could be fully negated.

INVASIVE ALIEN INFESTATION

Most probably because of the aridity of the area, invasive alien rates are generally very low for most of this area. Problem areas are usually associated with river systems and other wetland areas. None have been observed in the study area.

BIODIVERSITY ASSESSMENT

Biological diversity, or biodiversity, refers to the variety of life on Earth. As defined by the United Nations Convention on Biological Diversity, it includes diversity of ecosystems, species and genes, and the ecological processes that supp ort them. Natural diversity in ecosystems provides essential economic benefits and services to human society—such as food, clothing, shelter, fuel and medicines—as well as ecological, recreational, cultural and aesthetic values, and thus plays an important role in sustainable development. Biodiversity is under threat in many areas of the world. Concern about global biodiversity loss has emerged as a prominent and widespread public issue.

The objective of this study was to evaluate the biological diversity associated with the study area in order to identify significant environmental features which should be avoided during development activities and or to evaluate short and long term impact and possible mitigation actions in context of the proposed development.

As such the report aim to evaluate the biological diversity of the area using the Ecosystem Guidelines for Environmental Assessment (De Villiers *et. al*., 2005), with emphasis on:

- Significant ecosystems
    - Threatened or protected ecosystems
    - Special habitats
    - Corridors and or conservancy networks
- Significant species
    - Threatened or endangered species
    - Protected species

METHOD USED

During May 2001, Van Schoor published a formula for prioritizing and quantifying potential environmental impacts. This formula has been successfully used in various applications for determining the significance of environmental aspects and their possible impacts, especially in environmental management systems (e.g. ISO 14001 EMS's). By adapting this formula slightly it can also be used successfully to compare/evaluate various environmental scenario's/options with each other using a scoring system of 0-100%, where any value of 15% or less indicate an insignificant environmental impact while any value above 15% constitute ever increasing environmental impact.

Using Van Schoor's formula (adapted for construction with specific regards to environmental constraints and sensitivity) and the information gathered during the site evaluation the possible negative environmental impact of the activity was evaluated.

Underneath follows a short description of Van Schoor's formula. In the formula the following entities and values are used in order to quantify environmental impact.

***S* = [(*fd* + *int* + *sev* + *ext* + *loc*) x (*leg* + *gcp* + *pol* +*ia* + *str*) x *P*]** (as adapted for construction activities)

Where

S = Significance value

fd = frequency and duration of the impact

int = intensity of the impact

sev = severity of the impact

ext = extent of the impact

loc = sensitivity of locality

leg = compliance with legal requirements

gcp = conformance to good environmental practices

pol = covered by company policy/method statement

ia = impact on interested and affected parties

str = strategy to solve issue

P = probability of occurrence of impact

CRITERIA

The following numerical criteria for the above-mentioned parameters are used in the formula.

fd = frequency and duration of the impact					
low frequency ; low duration	1	medium frequency; low duration	1.5	high frequency ; low duration	2
low frequency; medium duration	1.5	medium frequency ; medium duration	2	high frequency ; medium duration	2.5
low frequency ; high duration	2	medium frequency ; high duration	2.5	high frequency ; high duration	3

int = intensity of the impact					
low probability of species loss; low physical disturbance	1	medium probability of species loss; low physical disturbance	1.5	high probability of species loss; low physical disturbance	2
low probability of species loss; medium physical disturbance	1.5	medium probability of species loss; medium physical disturbance	2	high probability of species loss; medium physical disturbance	2.5
low probability of species loss; high physical disturbance	2	medium probability of species loss; high physical disturbance	2.5	high probability of species loss; high physical disturbance	3

sev = severity of the impact	
changes immediately reversible	1
changes medium/long-term reversible	2
changes not reversible	3

ext = extent of the impact	
locally (on-site)	1
regionally (or natural/critical habitat affected)	2
globally (e.g. critical habitat or species loss)	3

loc = sensitivity of location	
not sensitive	1
moderate (e.g. natural habitat)	2
sensitive (e.g. critical habitat or species)	3

leg = compliance with legal requirements	
compliance	0
non-compliance	1

gcp = good conservation practices	
conformance	0
non-conformance	1

pol = covered by company policy	
covered in policy	0
not covered/no policy	1

ia = impact on interested and affected parties	
not affected	1
partially affected	2
totally affected	3

str = strategy to solve issue	
strategy in place	0
strategy to address issue partially	0.5
no strategy present	1

P = probability of occurrence of impact	
not possible (0% chance))	0
not likely, but possible (1 - 25% chance)	0.25
likely (26 - 50% chance)	0.50
very likely (51 - 75% chance)	0.75
certain (75 - 100% chance)	0.95

EVALUATION OF SIGNIFICANT ECOSYSTEMS

The main drivers in this dry ecosystem would be variations in soil type (e.g. soil depth, moisture capacity, rockiness, mineral composition and acidity), and could largely determine plant community composition and occurrence of rare species. Grazing, especially by small resident antelope may be an important factor in regulating competitive interaction between plants (*Acacia mellifera* encroachment is often a sign of overgrazing or bad veld management). Certain species can act as important "nursery" plants for smaller species and are also important for successional development after disturbance. Tortoises and mammals can be important seed dispersal agents.

Fire is not expected to have any major input in this very dry and sparsely populated vegetation type.

THREATENED OR PROTECTED ECOSYSTEMS

The vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems. However, various watercourses and drainage lines were observed within the larger area surrounding the proposed solar site location. Watercourses and drainage lines are particularly vulnerable to

alien plant invasion, agricultural transformation and or physical disturbance. In order to protect these features the final site location was chosen specifically to protect the dry watercourses and drainage lines of the larger area.

To the south-east of the final proposed site location a few drainage lines might still be affected, but it is felt that the impact on these drainage lines can be minimised (or negated) through placement of the pylons and good environmental control during the construction phase.

Overall the development of the 20 ha Keren Energy solar facility at Keimoes is not expected to a have a significant impact on threatened or protected ecosystems. The possibility of such an impact occurring is rated as low to very low.

SPECIAL HABITATS

The vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

Overall the development of the 20 ha Keren Energy solar facility at Keimoes is not expected to a have a significant impact on any special habitat. The possibility of such an impact occurring is rated as negligible.

CORRIDORS AND OR CONSERVANCY NETWORKS

Looking at the larger site and its surroundings it shows excellent connectivity with remaining natural veld in almost all directions. Corridors and natural veld networks are still relative unscathed (apart from through-road networks). Watercourses and drainage lines are still almost pristine (except for indicators of bush encroachment, sand mining and the road networks crossing the larger area).

Since such good connectivity exists over such a large area, the 20 ha Keren Energy solar facility development is not expected to a have a significant impact on connectivity of the remaining natural veld. The impact is rated as very low.

EVALUATION OF SIGNIFICANT SPECIES

The site visit during November 2011, co-insides with a relative dry spell in the Keimoes area (which normally receives some rain from October). As a result only the hardened drought resistant plant species were observed, herbs, bulbs and annuals were conspicuously absent. This might mean that some of the local

endemic species were not in growth or could not be identified. However, the author is of the opinion that in the larger context it will not constitute a significant contribution.

THREATENED OR ENDANGERED SPECIES

No threatened or endangered species are recorded for this vegetation type. However, a few local endemic species are associated with the broader vegetation type.

During the site visit no such species were observed and in the regional context the author is of the opinion that the development of the 20 ha solar facility will not lead to irreversible Species loss. With good environmental control (e.g. topsoil removal, storage and re-distribution) and rehabilitation after construction (leaving the remaining area as natural as possible) the possibility of such an impact occurring could be almost negated.

The possibility of such an impact occurring is rated as very low.

PROTECTED SPECIES

Three protected tree species have a distribution which could overlap with the general site location of the solar facility namely: *Acacia erioloba* (Camel thorn) *Boscia albitrunca* (Witgat) and *Acacia haematoxylon* (Grey camel thorn). Of these 3 species only *Acacia erioloba* was observed and then only associated with the deeper red sands next to the main dry watercourses. (All of the trees observed were referenced by GPS and are indicated on Figure 4). The final site location was specifically chosen to avoid these watercourses and as such also effectively avoid all the Camel thorns observed.

Since the site location was chosen to avoid any protected tree species, the possibility of such an impact occurring is rated as very low.

PLACEMENT AND CONSTRUCTION METHOD

A single solar generator produces approximately 66kV. In order to produce 10 MW, the proposed facility will require a number of generators arranged in multiples/arrays. The CPV panels will be elevated (2 m above ground) by a support structure, and will be able to track the path of the sun during the day for maximum efficiency. Approximately 1.8 ha is required per installed MW. A 10 MW capacity facility will thus require a development footprint of approximately 20 ha (including associated infrastructure – ancillary infrastructure). Each panel will be approximately 22 m wide by 12.5 m high. When the panels are tracking vertically the structure will have a maximum height of approximately 15 m. The excavation needed for each support structures (approximately 148 units are proposed) will be 1 m^2 by 5 m deep. It means that apart from the

associated structures, approximately 148 holes of 1 m^2 by 5 m deep will be excavated. Each hole must be at least 22 m from the next.

Photo 6: Typical layout of such a solar site (Image courtesy of Amonix, a leading designer of CPV technology)

The activities will require the stripping of topsoil (for the pylon holes and access roads only, leaving the remainder as natural as possible), which will need to be stockpiled, backfilled and/or spread on site. All in all the proposed facility can be likened to light agriculture, with the exception that natural vegetation can be allowed to remain on all the non-disturbed areas. All surfaces not used for the facility and associated infrastructure can remain natural.

DIRECT IMPACTS

As the name suggest, direct impacts refers to those impacts with a direct impact on biodiversity features and in this case were considered for the potentially most significant associated impacts (some of which have already been discussed above).

Direct loss of vegetation type and associated habitat due to construction and operational activities.

- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to construction and operational activities. (Refer to page 18).
- Loss of local biodiversity and threatened plant species (Refer to page 18)
- Loss of ecosystem connectivity (Refer to page 19)

LOSS OF VEGETATION AND ASSOCIATED HABITAT

One broad vegetation type is expected in the study area, namely Bushmanland Arid Grassland (Refer to Vegetation encountered on page 13). Bushmanland Arid Grassland was classified as “Least Threatened”, but “Poorly Protected” during the 2004 National Spatial Biodiversity Assessment. Within the more recent “*National list of ecosystems that are threatened and in need of protection”* (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004, the status of Bushmanland Arid Grassland are still regarded as least threatened. Although only 0.4% of this

vegetation type is formally protected, more than 99% of this vegetation type is still found in a relative natural state. Thus the vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

Even if all of the 20 ha is transformed (such as for intensive cultivation), the impact on the specific vegetation type would most probably only be medium-low as a result of the status of the vegetation and the location of the final proposed solar location. However, with mitigation the impact could still be reduced much further.

Mitigation: The following is some mitigation which will minimise the impact of the solar plant location and operation.

- Pylons should be placed at least 32 m away from the main watercourses on the property. Care should also be taken to protect drainage lines (by controlling the pylons placement).
- All significant plant species should be identified (e.g. *Acacia erioloba*) and all efforts made to avoid damage to such species.
- Only existing access roads should be used for access to the terrain (solar site).
- The internal network of service roads (if needed) must be carefully planned to minimise the impact on the remaining natural veld on the site. The number of roads should be kept to the minimum and should be only two-track roads (if possible). If possible the construction of hard surfaces should be avoided.
- Access roads and the internal road system must be clearly demarcated and access must be tightly controlled (deviations must not be allowed).
- Indiscriminate clearing of areas must be avoided, only pylon sites and sites where associated infrastructure needs to be placed must be cleared (all remaining areas to remain as natural as possible).
- All topsoil (at all excavation sites) must be removed and stored separately for re-use for rehabilitation purposes. The topsoil and vegetation should be replaced over the disturbed soil to provide a source of seed and a seed bed to encourage re-growth of the species removed during construction.
- Once the construction is completed all further movement must be confined to the access tracks to allow the vegetation to re-establish over the excavated areas.

INDIRECT IMPACTS

Indirect impacts are impacts that are not a direct result of the main activity (construction of the solar facility), but are impacts still associated or resulting from the main activity. Very few indirect impacts are associated with the establishment of the solar facility (e.g. no water will be used, no waste material or pollution will be produced through the operation of the facility).

The only indirect impact resulting from the construction and use of the facility is a loss of movement from small game and other mammals, since the property will be fenced. However, it is not considered to result in any major or significant impact on the area as a whole.

CUMULATIVE IMPACTS

In order to comprehend the cumulative impact, one has to understand to what extent the proposed activity will contribute to the cumulative loss of this vegetation type and other biodiversity features on a regional basis. Bushmanland Arid Grassland was classified as "Least Threatened", but "Poorly Protected" during the 2004 National Spatial Biodiversity Assessment. Within the more recent "*National list of ecosystems that are threatened and in need of protection"* (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004, the status of Bushmanland Arid Grassland is still regarded as least threatened. Although only 0.4% of this vegetation type is formally protected, more than 99% of this vegetation type is still found in a relatively natural state. Thus the vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

Even if all of the 20 ha is transformed (such as for intensive cultivation), the impact on the regional status of this vegetation type and associated biodiversity features would likely still be only medium-low. No irreversible species-loss, habitat-loss, connectivity or associated impact can be foreseen from locating and operating the solar facility on the final proposed solar site. However, all mitigation measures should still be implemented in order to further minimise the impact of the construction and operation of the facility.

THE NO-GO OPTION

During the impact assessment only the final proposed site (which was identified after inputs from the various appointed specialists) as described in Figure 3 and Table 1 is discussed. From the above, the "No-Go alternative" does not signify significant biodiversity gain or loss especially on a regional basis. In this case the no-go options will only ensure that the status quo remains, but it is expected that urban creep will anyway impact on the proposed final solar site location over time.

The site visit and desktop studies described and evaluated in this document led to the conclusion that the "No-Go Alternative" alternative will not result in significant gain in regional conservation targets, the conservation of rare & endangered species or gain in connectivity. At the best the No-Go alternative will only support the "status quo" of the region. On the other hand the pressure on Eskom facilities, most of which are currently still dependant on fossil fuel electricity generation, will remain. Solar power is seemingly a much cleaner and more sustainable option for electricity production.

QUANTIFICATION OF ENVIRONMENTAL IMPACTS

Taking all of the above discussions into account and using Van Schoor's formula for impact quantification, impacts of the following can be quantified as follows:

NO DEVELOPMENT

The no development scenario can only take regional biodiversity into account. In this instance national biodiversity (and even possibly global diversity) may, however, show significant gain over time, if for instance fossil burning electricity generation could be reduced and or replaced by cleaner energy production methods. Although solar energy is presently not seen as a viable stand-alone technology for electricity production it will lighten the pressure on the fossil burning facilities of Eskom and in so doing will add to a more sustainable way of electricity production.

DEVELOPMENT WITHOUT MITIGATION

The purpose of this scenario is to illustrate, using Van Schoor's formula, the loss should development be allowed without any mitigation measures. It is assumed that the 20 ha will be totally developed into hard surfaces, but still in context of the regional importance of the biodiversity associated with the area.

***S* = [(*fd* + *int* + *sev* + *ext* + *loc*) x (*leg* + *gcp* + *pol* +*ia* + *str*) x *P*]** (as adapted)

S = [(1.5 + 1.5 + 1 + 1 + 1) x (1 + 1 +1 + 1 +1) x 0.95] = 28 %

In the above any value of 15% or less indicates an insignificant environmental impact, while any value above 15% constitutes ever increasing environmental impact.

DEVELOPMENT WITH MITIGATION

The purpose of this scenario is to illustrate, using Van Schoor's formula, the environmental gain should development be allowed with all proposed mitigation measures implemented. It is assumed that the 20 ha will be developed, but that all areas not directly impacted by infrastructure placement will remain as natural as possible.

***S* = [(*fd* + *int* + *sev* + *ext* + *loc*) x (*leg* + *gcp* + *pol* +*ia* + *str*) x *P*]** (as adapted)

S = [(1.5 + 1 + 1 + 1 + 1) x (0 + 0 +0 + 1 +0) x 0.95] = 5 %

In the above any value of 15% or less indicates an insignificant environmental impact, while any value above 15% constitutes ever increasing environmental impact.

RECOMMENDATIONS & IMPACT MINIMIZATION

From the information discussed in this document it is clear to see that the Keimoes final location was well chosen from a biodiversity viewpoint. Even if all of the 20 ha is transformed (such as for intensive cultivation), the impact on the regional status of this vegetation type and associated biodiversity features would likely still be only medium-low. No irreversible species-loss, habitat-loss, connectivity or associated impact can be foreseen from locating and operating the solar facility on the final proposed solar site.

The site visit and desktop studies described and evaluated this document led to the conclusion that the "No-Go Alternative" alternative will not result in significant gain in regional conservation targets, the conservation of rare & endangered species or gain in connectivity. At the best the No-Go alternative will only support the "status quo" of the region. On the other hand the pressure on Eskom facilities, most of which is currently still dependant on fossil fuel electricity generation, will remain. Solar power is seemingly a much cleaner and more sustainable option for electricity production. However, the No-Go scenario can only take regional biodiversity into account. In this instance national biodiversity (and even possibly global diversity) may show significant gain over time, if for instance fossil burning electricity generation could be reduced and or replaced by cleaner energy production methods. Although solar energy is presently not seen as a viable stand-alone technology for electricity production it will lighten the pressure on the fossil burning facilities of Eskom and in so doing will add to a more sustainable way of electricity production.

Finally, when quantifying the development options, the Van Schoor's formula for impact quantification still shows a significant difference between development **without** and development **with** mitigation. As a result it is recommended that all mitigating measures must be implemented in order to further minimise the impact of the construction and operation of the facility.

With the available information at the author's disposal it is recommended that the project be approved, but that all mitigation measures described in this document is implemented.

IMPACT MINIMIZATION

GENERAL

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must be developed by a suitably experienced Environmental Assessment Practitioner.
- A suitably qualified Environmental Control Officer must be appointed to monitor the construction phase of the solar plant in terms of the EMP and the Biodiversity study recommendations as well as any other conditions which might be required by the Department of Environmental Affairs.
- An integrated waste management system must be implemented during the construction phase.

- All rubble and rubbish (if applicable) must be collected and removed from the site to a suitable registered waste disposal site.
- All alien vegetation should be removed from the property, as is legally required (if applicable)
- Adequate measures must be implemented to ensure against erosion.

SITE SPECIFIC

- Pylons should be placed at least 32 m away from any of the main watercourses on the property. Care should also be taken to protect drainage lines (by controlling the pylon placement).
- All significant plant species should be identified (e.g. *Acacia erioloba*) and all efforts made to avoid damage to such species.
- Only existing access roads should be used for access to the terrain (solar site).
- The internal network of service roads (if needed) must be carefully planned to minimise the impact on the remaining natural veld on the site. The number of roads should be kept to the minimum and should be only two-track/ twee-spoor roads (if possible). If possible the construction of hard surfaces should be avoided.
- Access roads and the internal road system must be clearly demarcated and access must be tightly controlled (deviations must not be allowed).
- Indiscriminate clearing of areas must be avoided, only pylon sites and sites where associated infrastructure needs to be placed must be cleared (all remaining areas to remain as natural as possible).
- All topsoil (the top 15-20 cm at all excavation sites), must be removed and stored separately for re-use for rehabilitation purposes. The topsoil and vegetation should be replaced over the disturbed soil to provide a source of seed and a seed bed to encourage re-growth of the species removed during construction.
- Once the construction is completed all further movement must be confined to the access tracks to allow the vegetation to re-establish over the excavated areas.