Appendix D2: Updated Biodiversity Assessment and Botanical Scan Addendum (2017 revision)

ADDENDUM

TO THE BIODIVERSITY ASSESSMENT & BOTANICAL SCAN

Revision 1

for the,

DISSELFONTEIN SOLAR PROJECT

A re-assessment of the area that will be impacted by the proposed solar project at Disselfontein, Northern Cape Province.

DATE: 28 MARCH 2017

PREPARED BY: PB CONSULT

PREPARED FOR: ENVIROAFRICA CC

Peet Botes (Pr.Sci.Nat: 400184/05) Registered Professional Environmental and Ecological Scientist
Cell: 082 921 5949; Fax 086 611 0726; Email: pbconsult@vodamail.co.za; 22 Buitekant Street, Bredasdorp, 7280.

SUMMARY - MAIN CONCLUSIONS

PREPARED BY:	PREPARED FOR:
PB Consult 22 Buitekant Street Bredasdorp 7280	EnviroAfrica CC PO Box 5367 Helderberg 7135
CONTACT PERSON	**CONTACT PERSON**
Peet Botes Cell: +(27)82 – 921 5949 Fax: +(27)86 – 415 8595 Email: pbconsult@vodamail.co.za	Mr. Bernard de Witt Tel: +(27) 21 – 851 1616 Fax: +(27) 86 – 512 0154 Email: bernard@enviroafrica.co.za

MAIN VEGETATION TYPE(S)	**Vaalbos Rocky Shrubland** occurs on slopes and elevated hills and ridges within plains of mainly Kimberley Thornveld but also in the vicinity of Northern Upper Karoo. It is described as evergreen shrub communities dominated by *Tarchonanthus camphoratus*, *Olea europaea* subsp. *africana*, *Euclea crispa*, *Diospyros lycioides*, *Rhus burchelli* and *Buddleja saligna*. **Least Threatened:** Although more than 98% of this vegetation type remains, very little is formally conserved.
CRITICAL BIODIVERSITY AREAS	Fine scale maps are not yet defined for this Municipal area. In terms of possible future CBA's and ESA delineation the following was considered: • The site is still covered by natural veld (subject to grazing by livestock (cattle), which shows signs of impact as a result of grazing, some areas (notably along the south boundary) shows signs of disturbance; • The site does not fall within the Griqualand West Centre of Endemism; • Vaalbos Rocky Shrubland is classified as *"Least Threatened"* with more than 98% still remaining in its natural state, but only 1.7% of this vegetation type is formally protected; • The site is enclosed by two small seasonal streams flowing along its northern and southern boundaries, draining towards the Orange River, but the proposed layout should not impact encroach within 32m of these streams; • The proposed site contains 5 Boscia albitrunca individuals as well as 5 NCNCA protected plant species. • The site is also located near the Orange River (1.2km) but is not expected to impact on its ecological support area. • It is considered unlikely that the proposed footprint would be included into a CBA or ESA on strength of its floristic value, but it might have connectivity value, which might warrant its inclusion within a potential ESA associated with the Orange River (although it is probably not likely because of the distance separating the two features). In addition, the small size of the proposed development is unlikely to have any significant impact on connectivity within the larger area.
LAND USE AND COVER	The whole of the property site is currently used for cattle grazing. The proposed footprint will only occupy a very small portion of the larger farm and should thus have very little effect on the existing land use.
SIGNIFICANT PLANT SPECIES	**No red list plant species were encountered** or is expected (Refer to Heading 5.3.1). **No species protected in terms of NEM: BA was encountered** (Heading 5.3.2). One species protected in terms of the NFA were encountered (Refer to Table 3), namely 5 individuals of the **Sheppard's trees** (*Boscia albitrunca*). Five (5) species (Refer to Table 5) protected in terms of the NCNCA were encountered.
IMPACT ASSESSMENT	**Significance before mitigation:** The impact assessment suggests that the proposed Disselfontein development is expected to have a **Medium-Low cumulative** impact, with the most significant aspect being the potential impact on the protected trees encountered within the site and to a lesser degree potential accidental veld fires.

	Significance after mitigation: Since the proposed development footprint needs only be approximately 50% of the 20ha, there is great potential for micro-adjustment of the final layout plans. It should be possible to reduce the direct impact on large protected trees significantly (e.g. avoiding trees on the outskirts of the site and minimising the actual development footprint wherever possible). The impact on the regional status of the vegetation type and associated biodiversity features (e.g. corridor function or special habitats) will also be minimised through the above mitigations. Apart from the potential impact on protected tree species no further irreversible species-loss, habitat-loss, connectivity or associated impact can be foreseen from locating and operating the solar facility on the proposed site. With mitigation the impact on biodiversity features can be reduced to **Low**. Please refer to Table 13 for the full impact assessment.
SUMMARY & RECOMMENDATION	**The NO-GO option:** 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 maintain the "*status quo*" on the site. 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 remains a much cleaner and more sustainable option for electricity production. **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 BE IMPLEMENTED.**

INDEPENDENCE & CONDITIONS

PB Consult is an independent consultant 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.

RELEVANT QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Mr. Peet Botes holds a BSc. (Hons.) degree in Plant Ecology from the University of Stellenbosch (Nature Conservation III & IV as extra subjects). Since qualifying with his degree, he had worked for more than 20 years in the environmental management field, first at the Overberg Test Range (a Division of Denel) managing the environmental department of OTB and being responsible for developing and implementing an ISO14001 environmental management system, ensuring environmental compliance, performing environmental risk assessments with regards to missile tests and planning the management of the 26 000 ha of natural veld, working closely with CapeNature (De Hoop Nature Reserve). In 2005 he joined Enviroscientific, an independent environmental consultancy specializing in wastewater management, botanical and biodiversity assessments, developing environmental management plans and strategies, environmental control work as well as doing environmental compliance audits and was also responsible for helping develop the biodiversity part of the Farming for the Future audit system implemented by Woolworths. During his time with Enviroscientific he performed more than 400 biodiversity and environmental legal compliance audits. During 2010 he joined EnviroAfrica in order to move back to the biodiversity aspects of environmental management. Experience with EnviroAfrica includes EIA applications, biodiversity assessment, botanical assessment, environmental compliance audits and environmental control work.

Mr. Botes is also a registered Professional Botanical, Environmental and Ecological Scientists at SACNASP (South African Council for Natural Scientific Professions) as required in terms of Section 18(1)(a) of the Natural Scientific Professions Act, 2003, since 2005.

Yours sincerely,

P.J.J. Botes *(Pr.Sci.Nat: 400184/05)*
Registered Professional Environmental and Ecological Scientist

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1. INTRODUCTION

Roma Energy Holdings is proposing the establishment of a solar energy facility on the remainder of Farm Disselfontein No. 77, near Hopetown (Northern Cape Province, Thembelihle Local Municipality). The facility will be established on an area of approximately 20 ha, on a portion of the property. The purpose of the proposed facility is to supply electricity to Eskom as part of the Renewable Energy Independent Power Producers Procurement Programme.

During 2012, PB Consult was appointed by EnviroAfrica to assessed and reported on the potential biodiversity impacts of this project on the proposed footprint (Refer to the Biodiversity Assessment & Botanical Scan report dated 28 March 2012) as part an environmental impact assessment application to the Department of Environmental Affairs (in terms of the NEMA EIA Regulations). Environmental authorisation (EA) as amended was originally granted by the Department of Environmental Affairs (DEA) for the above application on the 5th June 2013 but the EA expired before physical work on the site could commence. To continue with the development, reapplication for an EA is required. Original DEA Reference Number: 12/12/20/2682 (NEAS Ref: DEA/EIA/0000884/2012).

PB Consult was instructed to re-visit the site and re-evaluate the original biodiversity report in order to determine if the findings of the original report (PB Consult, 2012) is still applicable. **The terms of reference remained the same, but the physical footprint moved slightly to the south-east of the original site (but on the same property and within the same vegetation type.**

1.1 STATUS OF THE ORIGINAL REPORT

In terms of the above a further site visit was performed on the 6th of March 2017, during which the author re-evaluated the site. Most of the Northern Cape and including the Kuruman area recently received good summer rains, which showed in the veld and its conditions. As a result a number of additional plan species (mostly annual species) was recorded. However, the site visit and updated desk studies did not resulted in any significant additional impacts being identified by the author, which was not considered in the original report. The proposed site showed a well-developed evergreen shrub layer dominated by *Senegalia mellifera* (=Acacia mellifera) with a grassy and herbaceous bottom layer. Five *Boscia albitrunca* (Shepard's tree) were encountered.

The author would like to confirm that the original report still stands, but must be read in conjunction with this addendum, which includes the following:

- Updated legal requirements register;
- Potential impacts on the Griqualand West Centre of Endemism;
- Updated plant species lists,
- Updated impact evaluation on endangered or protected plant species;

- Updated impact assessment to include cumulative impacts (based on the latest available information).
- Updated recommendations.

2. METHODS USED

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

2.1 SITE VISIT

Please note that the site location was changed slightly, with the new site slightly to the south and south-east of the original location (but the vegetation remained the same). The original site visit was done during January 2012. The follow-up site visit was done on the 6th of March 2017, after recent good rains. The site visit compromises walking the site, whilst examining and photographing any area of interest. The timing of the site visit was good in those essentially all perennial plants where identifiable. The possibility remains that a few species may have been missed, but the author is confident that a fairly good understanding of the biodiversity status of the site was obtained.

Figure 1: Google image showing the area covered as part of the follow-up site visit (March 2017)

In Figure 1 above, the blue markers refer to *Boscia albitrunca* locations (5 in total).

3. APPLICABLE LEGISLATION (UPDATED)

Constitution of the Republic of South Africa (1996): of special relevance in terms of environment is section 24

Conservation of Agricultural Resources Act 43 of 1983 (CARA): supports conservation of natural agricultural resources (soil, water, plant biodiversity) by maintaining the production potential of the land and combating/preventing erosion; for example, by controlling or eradicating declared weeds and invader plants.

Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947), to control the sell, purchase, use and disposal of agricultural or stock remedies.

Hazardous Substances Act 15 of 1973: to control substances that may cause injury, ill-health, or death through their toxic, corrosive, irritant, strongly sensitizing or flammable nature, or by the generation of pressure

National Environmental Management Act 107 of 1998 (as amended): replaces the Environmental Conservation Act (ECA) and establishes principles for decision-making on matters affecting the environment, and for matters connected therewith.

- **Environmental Impact Assessment Regulations** (R543 of 2010): procedures to be followed for application to conduct a listed activity.

National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA): replaces the Atmospheric Pollution Prevention Act (No. 45 of 1965).

National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA): supports conservation of plant and animal biodiversity, including the soil and water upon which it depends.

- **National list of ecosystems that are threatened and in need of protection** (GN 1002 of 9 December 2011).
- **Alien and invasive species list 2016** (GN R. 864 of 29 July 2016).

National Environmental Management: Protected Areas Act 57 of 2003 (as amended Act 31 of 2004) (NEMPAA): To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes.

National Environmental Management: Waste Act 59 of 2008 (NEMWA): To reform the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development.

- **List of Waste Management Activities that have, or are likely to have a detrimental effect on the environment** (GN 718 of 3 July 2009): Identifies activities in respect of which a waste management license is required.

National Forests Act 84 of 1998 (as amended): supports sustainable forest management and the restructuring of the forestry sector.

- **List of protected tree species** (as updated)

National Heritage Resources Act 25 of 1999: supports an integrated and interactive system for the management of national heritage resources, including supports soil, water and animal and plant biodiversity.

National Veld and Forest Fire Act 101 of 1998 (NVFFA): protects soil, water and plant life through the prevention and combating of veld, forest, and mountain fires

National Water Act 36 of 1998 (NWA): promotes the protection, use, development, conservation, management, and control of water resources in a sustainable and equitable manner.

Northern Cape Nature Conservation Act 9 of 2009 (NCNCA): which provides for the sustainable utilization of wild animals, aquatic biota and plants.

4. DEFINITIONS & ABBREVIATIONS

4.1 DEFINITIONS

Contaminated water: means water contaminated by the activities associated with construction, *e.g.* concrete water and runoff from plant/ personnel wash areas.

Environment: means the surroundings within which humans exist and that are made up of:

- the land, water and atmosphere of the earth;
- micro-organisms, plant and animal life;
- any part of the combination of the above two bullets and the interrelationships between them;
- the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being

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

Environmental Control Officer: a suitably qualified environmental agent responsible for overseeing the environmental aspects of the Construction phase of the EMP.

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

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

Owner: the owner, or dedicated person, responsible for the management of the property on which the proposed activity will be performed.

Solid waste: means all solid waste, including construction debris, chemical waste, excess cement/concrete, wrapping materials, timber, tins and cans, drums, wire, nails, food and domestic waste (e.g. plastic packets and wrappers).

Precautionary principle: means the basic principle, that when in doubt or having insufficient or unreliable information on which to base a decision, to then limit activities in order to minimise any possible environmental impact.

Watercourse: in this report the author uses a very simplified classification system to define the difference between a river, a water course and an ephemeral stream as encountered in the study area.

- River: A river is a natural watercourse with a riverbed wider than 3m, usually freshwater, flowing toward an ocean, a lake, a sea or another river. In a few cases, a river simply flows into the ground or dries up completely before reaching another body of water. The flow could be seasonal or permanent.

- Stream: A small river or natural watercourse with a riverbed of less than 3 m, usually freshwater, flowing toward an ocean, a lake, a sea or another river. In a few cases, a river simply flows into the ground or dries up completely before reaching another body of water. The flow could be seasonal or permanent.
- Ephemeral drainage line: A very small and poorly defined watercourse, mostly on relatively flat areas, which only flows for a short period after heavy rains, usually feeding into a stream or river or dries up completely before reaching another body of water.

4.2 ABBREVIATIONS

AIP	Alien and invasive plants
AIS	Alien and invasive species
BGIS	Biodiversity Geographical Information System
CARA	Conservation of Agricultural Resources Act 43 of 1983
CBA	Critical Biodiversity Areas (Municipal)
DEA	Department of Environmental Affairs
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMF	(Municipal) Environmental Management Framework
EMP	Environmental management plan
GWC	Griqualand West Centre of endemism
IDP	Integrated development plan
IUCN	International Union for Conservation of Nature
NCNCA	Northern Cape Nature Conservation Act, Act 9 of 2009
NEMA	National Environmental Management Act, Act 107 of 1998
NEMAQA	National Environmental Management Air Quality Act 39 of 2004
NEMBA	National Environmental Management Biodiversity Act, Act 10 of 2004
NEMPAA	National Environmental Management Protected Areas Act 57 of 2003
NEMWA	National Environmental Management Waste Act 59 of 2008
NFA	National Forests Act 84 of 1998
NSBA	National Spatial Biodiversity Assessment
NVFFA	National Veld and Forest Fire Act 101 of 1998
NWA	National Water Act 36 of 1998
SABIF	South African Biodiversity Information Facility
SANBI	South African National Biodiversity Institute
SIBIS	SANBI's Integrated Biodiversity Information System
SKEP	Succulent Karoo Ecosystem Project

5. VEGETATION (UPDATED)

Please note that the proposed site location changed slightly, and was shifted slightly to the south-east of the original site. The new site is better located in terms of direct impacts on seasonal streams and the area is also less rocky and probably slightly more level (although the eastern boundary does slope slightly towards the Orange River). The vegetation conforms to the expected Vaalbos Rocky Shrubland, which is described as occurring on slopes and elevated hills and ridges within plains of mainly Kimberley Thornveld, but also in the vicinity of Northern Upper Karoo (Mucina & Rutherford, 2006). It is described as evergreen shrub communities dominated by Tarchonanthus camphoratus, *Olea europaea* subsp. *africana*, *Euclea crispa*, *Diospyros lycioides*, *Searsia* (=*Rhus*) *burchelli* and *Buddleja saligna*. On the foot slopes of dolerite hills, where calcium rich soils occur, shrub and small trees of *Vachellia* (=*Acacia*) *tortilis* and *Ziziphus mucronata* can be dominant.

Most probably as a result of the difference in substrate (deeper sandy soils and less rocky outcrops), the vegetation composition changed slightly as well as the height of the stratums. The effects of the recent good rains experienced in the Northern Cape could be seen in the much more visible herbaceous and grassy layer.

Photo 1: Typical vegetation encountered (dominated by *Senegalia mellifera*)

Photo 2: Open herbaceous and grassy layer between denser stands of *Senegalia mellifera*

Overall the vegetation cover on the new site was denser with an evergreen shrub layer dominated by *Senegalia mellifera* (=*Acacia mellifera*), and a prominent grass and herbaceous layer in-between (Refer to Photo 1, Photo 2 and Photo 3). A few larger individuals of *Boscia albitrunca* (Sheppard's tree) were also encountered, where they can dominate the immediate surroundings in height and splendour (Photo 4), but this was the exception. Most of the Sheppard's trees encountered were relative small. No *Vachellia tortilis* individuals were observed.

Photo 3: A more disturbed version of the vegetation encountered to the south of the site

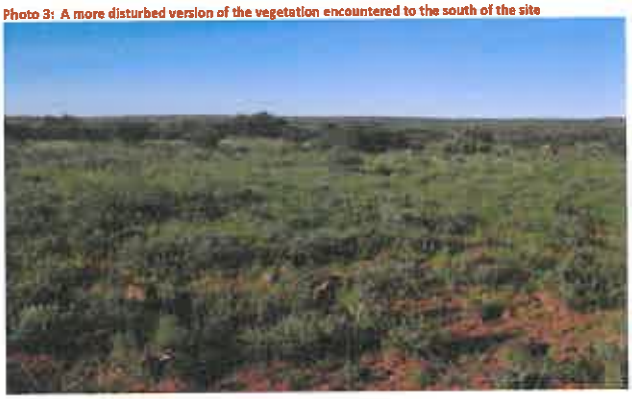


Photo 4: One of the more magnificent Boscia albitrunca individual encountered (Waypoint 005)

Within the site the shrub layer was absolutely dominated by *Senegalia mellifera*, but also included the following species: *Boscia albitrunca, Lycium cinereum, Rhigozum trichotomum* and *Tarchonanthus camporatus.* The herbaceous and grassy layer included the following: *Aptosimum lineare, Aptosimum spinescens, Aristida congesta, Asparagus retrofractus, Asparagus suaveolens, Chrysocoma ciliata, Cucumis africanus, Eragrostis obtusa, Fingerhuthia africana, Geigeria ornativa, Helichrysum obtusum, Justicia incana, Justicia spartioides, Limeum argute-carinatum, Limeum* species, *Nerine laticoma, Ornithoglossum* species, *Peliostomum leucorrhizum, Pentzia incana, Pteronia incana, Roepera* cf. *foetida, Rushia intricata, Salsola kali, Sesamum capense, Stipagrostis uniplumis, Thesium* cf. *lineatum, Trachyandra* cf. *laxa and Tragus racemosus.*

Please note that the original document did not list plant species within its own table (which has been added in this document – Table 1). In addition the South African National Biodiversity Institute's biodiversity website added the function of being able to download plant species checklists per vegetation type. This checklist was also added as Appendix 1.

5.1 GRIQUALAND WEST CENTRE OF ENDEMISM

Figure 2: GWC taken from Van Wyk & Smith 2001

The Griqualand west centre (GWC) of endemism was named after the Griqua people (who used to live there) and is found in the Hay- and part of the Barkley West districts (Refer to Figure 2) of the Northern Cape Province (Van Wyk & Smith, 2001). The proposed Disselfontein Solar site is located between Kuruman and Hotazel, which falls within this centre of endemism. According to Van Wyk & Smith (2001) the GWC is best described in geological terms, with its core area mostly linked to surface outcrops of the Ghaap Group (notably limestone and dolomite) and those of the Olifantshoek Supergroup (notably quartzite). However, in floristic terms the outer boundaries of the centre are rather diffuse as floristic elements can spill over onto related substrates, especially alkaline substrates rich in calcium. The GWC separates the Kalahari basin from the sediments of the Karoo Supergroup further south and floristically the GWC is sometimes described as a Kalahari-Highveld transition zone (White, 1983).

The proposed Disselfontein site does not fall within the Griqualand West Centre of Endemism (Refer to Figure 2).

5.2 FLORA ENCOUNTERED (UPDATED)

Please note that this study never intended to be full botanical assessment. However, a scan of significant species was done during the site visit, and even though the author does not claim that all species encountered were identified, all efforts were made to do just that. Table 1 gives an updated list of the species encountered within the study area (for both site visits) as well as their status and further actions needed where applicable.

Table 1: List of flora encountered on the property

No.	Species name	FAMILY	Status Red list, NFA, NCNCA	Alien & invader species (AIS)	Legal requirements
1.	*Aptosimum lineare*	SCROPHULARIACEAE			
2.	*Aptosimum spinescens*	SCROPHULARIACEAE			
3.	*Asparagus retrofractus*	ASPARAGACEAE			
4.	*Asparagus suaveolens*	ASPARAGACEAE			
5.	*Boscia albitrunca*	BRASSICACEAE	NCNCA, Schedule 2 Protected (all species in this Genus)		Apply for a NFA Tree permit (DAFF) Apply for a NCNCA Flora permit (DENC)
6.	*Chrysocoma ciliata*	ASTERACEAE			
7.	*Cucumis africanus*	CURCUBITACEAE			
8.	*Fingerhuthia africana*	POACEAE			
9.	*Gelgeria ornativa*	ASTERACEAE			
10.	*Helichrysum obtusum*	ASTERACEAE			
11.	*Justicia incana (=Monechma incanum)*	ACANTHACEAE			
12.	*Justicia spartioides*	ACANTHACEAE			
13.	*Limeum argute-carinatum*	LIMEACEAE			
14.	*Limeum species*	LIMEACEAE			
15.	*Lycium cinereum*	SOLANACEAE			
16.	*Nerine laticoma*	AMARYLLIDACEAE	NCNCA, Schedule 2 Protected (all species in this Family)		Apply for a NCNCA Flora permit (DENC)
17.	*Ornithoglossum species*	COLCHIACACEAE			
18.	*Oxalis obtusa*	OXALIDACEAE	NCNCA, Schedule 2 Protected (all species in this Family)		Apply for a NCNCA Flora permit (DENC)
19.	*Peliostomum leucorrhizum*	SCROPHULARIACEAE			
20.	*Pentzia incana*	ASTERACEAE			
21.	*Pteronia incana*	ASTERACEAE			
22.	*Rhigozum trichotomum*	BIGONACEAE			
23.	*Roepera cf. foetida*	ZYGOPHYLLACEAE			
24.	*Rushia intricata*	AIZOACEAE	NCNCA, Schedule 2 Protected (all species in this Family)		Apply for a NCNCA Flora permit (DENC)
25.	*Salsola kali*	AMARANTHACEAE			
26.	*Senegalia mellifera (=Acacia mellifera)*	FABACEAE			
27.	*Sesamum capense*	PEDALIACEAE			

No.	Species name	FAMILY	Status Red list, NFA, NCNCA	Alien & invader species (AIS)	Legal requirements
28.	*Stipagrostis uniplumis*	POACEAE			
29.	*Tarchonanthus camporatus*	ASTERACEAE			
30.	*Thesium cf. lineatum*	SANTALACEAE			
31.	*Trachyandra cf. laxa*	ASPODELACEAE	NCNCA, Schedule 2 Protected (all species in this Family)		Apply for a NCNCA Flora permit (DENC)
32.	*Tragus racemosus*	POACEAE			

5.3 THREATENED AND PROTECTED PLANT SPECIES

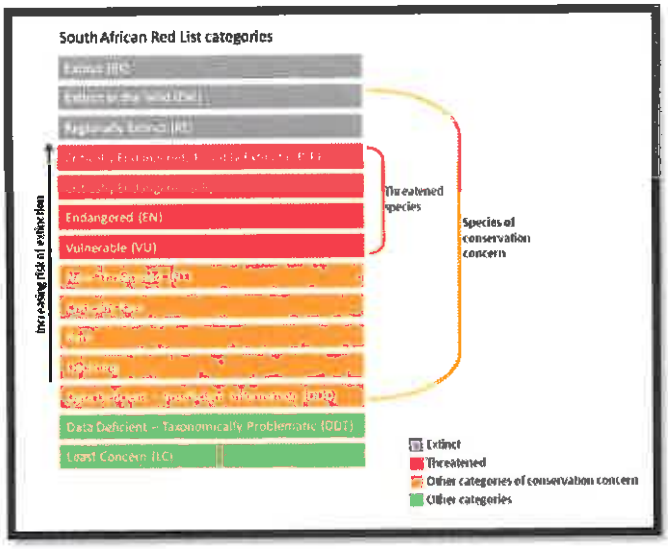
South Africa has become the first country to fully assess the status of its entire flora. Major threats to the South African flora are identified in terms of the number of plant taxa Red-Listed as threatened with extinction as a result of threats like, habitat loss (e.g. infrastructure development, urban expansion, crop cultivation and mines), invasive alien plant infestation (e.g. outcompeting indigenous plant species), habitat degradation (e.g. overgrazing, inappropriate fire management etc.), unsustainable harvesting, demographic factors, pollution, loss of pollinators or dispersers, climate change and natural disasters (e.g. such as droughts and floods). South Africa uses the internationally endorsed IUCN Red List Categories and Criteria in the Red List of South African plants. However, due to its strong focus on determining risk of extinction, the IUCN system does not highlight species that are at low risk of extinction, but may nonetheless be of high conservation importance. As a result a SANBI uses an amended system of categories in order to highlight species that may be of low risk of extinction but are still of conservation concern (SANBI, 2015).

In the Northern Cape, species of conservation concern are also protected in terms of national and provincial legislation, namely:

- The National Environmental Management: Biodiversity Act, Act 10 of 2004, provides for the protection of species through the *"Lists of critically endangered, endangered, vulnerable and protected species"* (GN. R. 152 of 23 February 2007).
- National Forest Act, Act 84 of 1998, provides for the protection of forests as well as specific tree species through the *"List of protected tree species"* (GN 1602 of 23 December 2016).
- Northern Cape Nature Conservation Act, Act of 2009, provides for the protection of *"specially protected species"* (Schedule 1), *"protected species"* (Schedule 2) and *"common indigenous species"* (Schedule 3).

Figure 3: Showing the location on site of the Sheppard's trees (marked in blue) as referred to in Table 4

5.3.1 RED LIST OF SOUTH AFRICAN SPECIES



The Red List of South African Plants online provides up to date information on the national conservation status of South Africa's indigenous plants (SANBI, 2015). The South African red list categories are given in Figure 4.

Figure 4: South African red list categories (SANBI, 2015)

5.3.1.1 *Definitions of the national Red List categories*

Categories marked with [N] are non-IUCN, national Red List categories for species not in danger of extinction, but considered of conservation concern (Refer to Table 2). The IUCN equivalent of these categories is Least Concern (LC) (SANBI, 2015).

Table 2: Definitions of the South African national red list categories (SANBI, 2015)

Extinct (EX): A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
Extinct in the Wild (EW): A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
Regionally Extinct (RE): A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
Critically Endangered, Possibly Extinct (CR PE): Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered.
Critically Endangered (CR): A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
Endangered (EN): A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.
Vulnerable (VU): A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
Near Threatened (NT): A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.
[N]Critically" Rare A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
[N]Rare: A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria. The four criteria are as follows: ➢ Restricted range: Extent of Occurrence (EOO) <500 km2, OR ➢ Habitat specialist: Species is restricted to a specialized microhabitat so that it has a very small Area of Occupancy (AOO), typically smaller than 20 km2, OR ➢ Low densities of individuals: Species always occurs as single individuals or very small subpopulations (typically fewer than 50 mature individuals) scattered over a wide area, OR ➢ Small global population: Less than 10 000 mature individuals.

"Declining: A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.
Least Concern (LC): A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
Data Deficient - Insufficient Information (DDD): A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.
Data Deficient - Taxonomically Problematic (DDT): A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of risk of extinction is not possible.
Not Evaluated (NE): A species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given a national Red List status. However, some species included in Plants of southern Africa: an online checklist are species that do not qualify for national listing because they are naturalized exotics, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

5.3.1.2 *Red listed plant species encountered*

According to the Red List of South African Plants (version 2017.1., www.redlist.sanbi.org, accessed on 2017/03/22) no listed plant species is associated with Vaalbos Rocky Shrubland namely:

No red list plant species was encountered or are expected on the proposed site.

5.3.2 NEM: BA PROTECTED SPECIES

The National Environmental Management: Biodiversity Act, Act 10 of 2004, provides for the protection of species through the "Lists of critically endangered, endangered, vulnerable and protected species" (GN. R. 152 of 23 February 2007).

No species protected in terms of NEM: BA was encountered.

5.3.3 NFA PROTECTED SPECIES

The National Forests Act (NFA) of 1998 (Act 84 of 1998) provides for the protection of forests as well as specific tree species their List of Protected tree species, updated on a yearly basis. The latest list on which this evaluation is based was published on the 23rd of December 2016 (GN 1602). One species protected in terms of the NFA was observed (refer to Table 3). Please refer to Table 4, underneath, giving their coordinates and Figure 3, which show their locations on the site (Camelthorn in red and Sheppard's tree in green).

Table 3: NFA protected species encountered within the footprint and immediate surroundings

NO.	SPECIES NAME	COMMENTS	RECOMENDATIONS
1.	*Boscia albitrunca*	5 individuals encountered including 1 beautiful large specimen	No mitigation possible (Root system normally to extensive for transplanting).

Table 4: A list of protected trees encountered during the site visit and their GPS co-ordinates

NO	SPECIES NAME	COMMON NAME	NUMBER OF TREES	LOCATION
1.	*Boscia albitrunca*	Sheppard's tree	1 Medium large (2m)	S29° 28' 33.0" E23° 54' 48.8"
2.	*Boscia albitrunca*	Sheppard's tree	1 Small (1.8m)	S29° 28' 31.7" E23° 54' 50.8"
3.	*Boscia albitrunca*	Sheppard's tree	1 Small (1,2m)	S29° 28' 31.7" E23° 54' 52.0"
4.	*Boscia albitrunca*	Sheppard's tree	1 Small (1.3m)	S29° 28' 30.4" E23° 54' 54.0"
5.	*Boscia albitrunca*	Sheppard's tree	1 Large (3.5m)	S29° 28' 39.7" E23° 54' 45.5"

In total 5 *Boscia albitrunca* (Sheppard's trees) were encountered ranging from small to large trees, all located within the footprint.

For impact evaluation purposes it was assumed that all trees within the footprint will be impacted (removed). However, the actual development footprint will only occupy approximately half of the 20 ha site, so micro-adjustments of the layout in order to minimise or even avoid impacts on protected trees should be possible.

5.3.4 NCNCA PROTECTED SPECIES

The Northern Cape Nature Conservation Act 9 of 2009 (NCNCA) came into effect on the 12th of December 2011, and also provides for the sustainable utilization of wild animals, aquatic biota and plants. Schedule 1 and 2 of the act give extensive lists of specially protected and protected fauna and flora species in accordance with this act. NB. Please note that all indigenous plant species are protected in terms of Schedule 3 of this act (e.g. any work within a road reserve).

The following species (Refer to Table 5) protected in terms of the NCNCA were encountered. Recommendations on impact minimisation also included.

Table 5: Plant species protected in terms of the NCNCA encountered within the study area

NO.	SPECIES NAME	COMMENTS	RECOMENDATIONS
1.	*Boscia albitrunca* **Schedule 2 protected.**	Approximately 5 trees observed, ranging from small to large trees. Likely to be impacted	No mitigation possible.
2.	*Rushia intricata* **Schedule 1 protected**	Locally common.	Topsoil conservation and re-use may allow for seed preservation.
3.	*Nerine laticoma* **Schedule 2 protected**	One patch of approximately 4 individuals observed to the east of the site.	Search & rescue bulbs and topsoil conservation for seedbed protection.
4.	*Trachyandra cf. laxa* **Schedule 2 protected**	Occasionally observed	Topsoil conservation and re-use may allow for seed and bulb preservation.
5.	*Oxalis obtusa* **Schedule 2 protected**	Occasionally observed	Topsoil conservation and re-use may allow for seed and bulb preservation.

5.4 CRITICAL BIODIVERSITY AREAS

At present there are not fine scale conservation maps for the ZF Mgcawu (previously Siyanda) District Municipality available. However, following the criteria used for typical biodiversity categories (as given below)

the author tried to anticipate whether the proposed footprint is likely to be included in potential CBA's or ESA's (Refer to Heading 5.4.2, underneath).

5.4.1 BIODIVERSITY CATEGORIES FOR LAND-USE PLANNING

Critical biodiversity areas (CBA's) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). The primary purpose of CBA's is to inform land-use planning in order to promote sustainable development and protection of important natural habitat and landscapes. CBA's can also be used to inform protected area expansion and development plans. The CBA's underneath is based on the definition laid out in the guideline for publishing bioregional plans (Anon, 2008):

- **Critical biodiversity areas (CBA's)** are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.
- **Ecological support areas (ESA's)** are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.

From a land-use planning perspective it is useful to think of the difference between CBA's and ESA's in terms of where in the landscape the biodiversity impact of any land-use activity action is most significant:

- For CBA's the impact on biodiversity of a change in land-use that results in a change from the desired ecological state is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g. loss of a populations or habitat).
- For ESA's a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway (e.g. removing a corridor results in a population going extinct elsewhere or a new plantation locally results in a reduction in stream flow at the exit to the catchment which affects downstream biodiversity).

5.4.2 POTENTIAL CRITICAL BIODIVERSITY AREAS ENCOUNTERED

Of importance in terms of consideration for inclusion into a critical biodiversity area (CBA) or ecological support area (ESA) will be the following:

- The site is still covered by natural veld (subject to grazing by livestock (cattle), which shows signs of impact as a result of grazing, some areas (notably along the south boundary) shows signs of disturbance;
- The site does not fall within the Griqualand West Centre of Endemism;
- Vaalbos Rocky Shrubland is classified as "*Least Threatened*" with more than 98% still remaining in its natural state, but only 1.7% of this vegetation type is formally protected;
- The site is enclosed by two small seasonal streams flowing along its northern and southern boundaries, draining towards the Orange River, but the proposed layout should not impact encroach within 32m of these streams;
- The proposed site contains 5 Boscia albitrunca individuals as well as 5 NCNCA protected plant species.
- The site is also located near the Orange River (1.2km) but is not expected to impact on its ecological support area.

It is considered unlikely that the proposed footprint would be included into a CBA or ESA on strength of its floristic value, but it might have connectivity value, which might warrant its inclusion within a potential ESA associated with the Orange River (although it is probably not likely because of the distance separating the two features). In addition, the small size of the proposed development is unlikely to have any significant impact on connectivity within the larger area.

5.5 INVASIVE ALIEN PLANTS

Alien and invasive plant (AIP) species were introduced into South Africa more than 1 000 years ago *via* trading routes from other countries in southern Africa (Alberts & Moolman, 2013). Since the arrival of settlers from Europe these numbers have increased dramatically. At present, AIPs are encountered on large portions of land in South Africa (10 million hectares) and it is reportedly consuming nearly 330 million cubic meters of water annually, or 7% of the annual run-off. But what is really scary is that this water consumption levels are increasing rapidly and could reach 50% of the mean annual run-off in the not too distant future (Alberts & Moolman, 2013). The aggressive behaviour of the AIPs in their unnatural habitat is a direct threat to the vast wealth of biodiversity in South Africa. South Africa is a relatively small country that comprises only 2% of the total surface of the Earth, but it contains 10% of the plant species, 7% of the vertebrates, and is home to three biodiversity hotspots.

In South Africa, there are currently three pieces of national legislation that relate to the control of Alien and Invasive Species (AIS) namely:

- Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947), administered by the Department of Agriculture, forestry and Fisheries.

- List of weeds and invader plants declared in terms of Regulations 15 and 16 (as Amended, March 2001) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) administered by the Department of Agriculture, Forestry and Fisheries (DAFF);
- Alien and invasive species list 2016 (GN R. 864 of 29 July 2016) promulgated in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of the National Environmental Management, Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA), administered by the Department of Environmental Affairs (DEA).

5.5.1 FERTILIZER, FARM FEEDS, AGRICULTURAL REMEDIES AND STOCK REMEDIES ACT

According to Government Notice No. 13424 dated 26 July 1992, it is an offence to "acquire, dispose, sell or use an agricultural or stock remedy for a purpose or in a manner other than that specified on the label on a container thereof or on such a container".

Contractors using herbicides need to have a valid Pest Control Operators License (limited weeds controller) according to the Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947).

5.5.2 CONSERVATION OF AGRICULTURAL RESOURCES ACT

The **CARA** sets out the regulations (amended March 2001) regarding the control of weeds and invasive plants and provides a list of declared plants. The amended regulations make provision for four groups of invader plants. The first three groups consist of undesirable alien plants and are covered by Regulation 15, namely:

- **Category 1** declared weeds (Section 15A of the amended act) are prohibited plants that will no longer be tolerated on land or on water surfaces, neither in rural or urban areas. These plants may no longer be planted or propagated, and all trade in their seeds, cuttings or other propagative material is prohibited. Plants included in this category because their harmfulness outweighs any useful properties or purpose they may have.
- **Category 2** declared plant invaders (Section 15B of the amended act) are plants with a proven potential of becoming invasive, but which nevertheless have certain beneficial properties that warrant their continued presence in certain circumstances. May be grown in demarcated areas provided that there is a permit and that steps are taken to prevent their spread.
- **Category 3** declared plant invaders (Section 15C of the amended act) are undesirable because they have the proven potential of becoming invasive, but most of them are nevertheless popular ornamentals or shade trees that will take a long time to replace. May no longer be planted. Existing plants may be retained as long as all reasonable steps are taken to prevent the spreading thereof, provided they are not within 30 metres of the 1:50 year flood line of a river, stream, lake or other type of inland water body. The "executive officer" can impose further conditions on Category 3 plants already in existence, which might include removing them if the situation demands it.

- **Bush encroachers**, which are indigenous plants that require sound management practices to prevent them from becoming problematic, are covered separately by Regulation 16.

Refer to heading 5.5.5 for listed weeds and invader species encountered in terms of CARA.

5.5.3 NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT

NEMBA aims to provide the framework, norms, and standards for the conservation, sustainable use, and equitable benefit-sharing of South Africa's biological resources. The purpose of NEMBA as it relates to Alien and Invasive Species (AIS) is to prevent the unauthorised introduction and spread of such species to ecosystems and habitats where they do not naturally occur; manage and control such species to prevent or minimise harm to the environment and to biodiversity in particular; and to eradicate alien invasive species from ecosystems and habitats where they may harm such ecosystems or habitats. The Regulations on Alien and Invasive Species, referred to as the **"AIS Regulations"** combine invasive species already listed in the CARA, with two new lists relating to invasive species and prohibited species.

The AIS Regulations list 4 different categories of invasive species that must be managed, controlled or eradicated from areas where they may cause harm to the environment, or that are prohibited to be brought into South Africa, namely:

- **Category 1a:** invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway. These species need to be controlled on your property, and officials from the Department of Environmental Affairs must be allowed access to monitor or assist with control.
- **Category 1b**: invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway. Category 1b species are major invaders that may need government assistance to remove. All Category 1b species must be contained, and in many cases they already fall under a government sponsored management programme.
- **Category 2**: These are invasive species that can remain in your garden, but only with a permit, which is granted under very few circumstances.
- **Category 3:** These are invasive species that can remain in your garden. However, you cannot propagate or sell these species and must control them in your garden. In riparian zones or wetlands all Category 3 plants become Category 1b plants.

Refer to heading 5.5.5 for listed alien and invasive species encountered in terms of NEM: BA.

5.5.4 NORTHERN CAPE NATURE CONSERVATION ACT

Although provinces have a mandate to implement and enforce national legislation (such as CARA or NEM:BA), provincial authorities can also add further to legislation in the form of provincial ordinances, whereby each province can further prohibit certain species should the authorities feel that a species poses a potential risk or threat to the province's ecosystems or biodiversity.

In the Northern Cape Schedule 6 of the Northern Cape Nature Conservation Act, Act 9 of 2009 list additional invasive species that must be controlled. Schedule 6 list includes all species listed as weeds in CARA as well as an additional 36 species (none of which has been observed during this study).

Refer to heading 5.5.5 for listed invasive species encountered in terms of NCNCA. *Please note that all species categorized as Category 1 plants in terms of CARA are automatically listed in terms of the NCNCA (Refer to Table 1).*

5.5.5 ALIEN AND INVASIVE PLANTS ENCOUNTERED

No alien plant species was observed within the proposed footprint area (Refer to Table 6).

Table 6: List of alien and invasive species encountered within the larger footprint

SPECIES	CARA	NEM: BA	NCNCA	MANAGEMENT RECOMMENDATIONS

There are various means of managing alien and invasive plant species, which can include mechanical-, chemical- and biological control methods or a combination of these. Control methods prescribed by the author are usually based on used by the Working for Water Programme (Bold, 2007) and or the CapeNature alien control guideline (Martens *et. al.*, 2003).

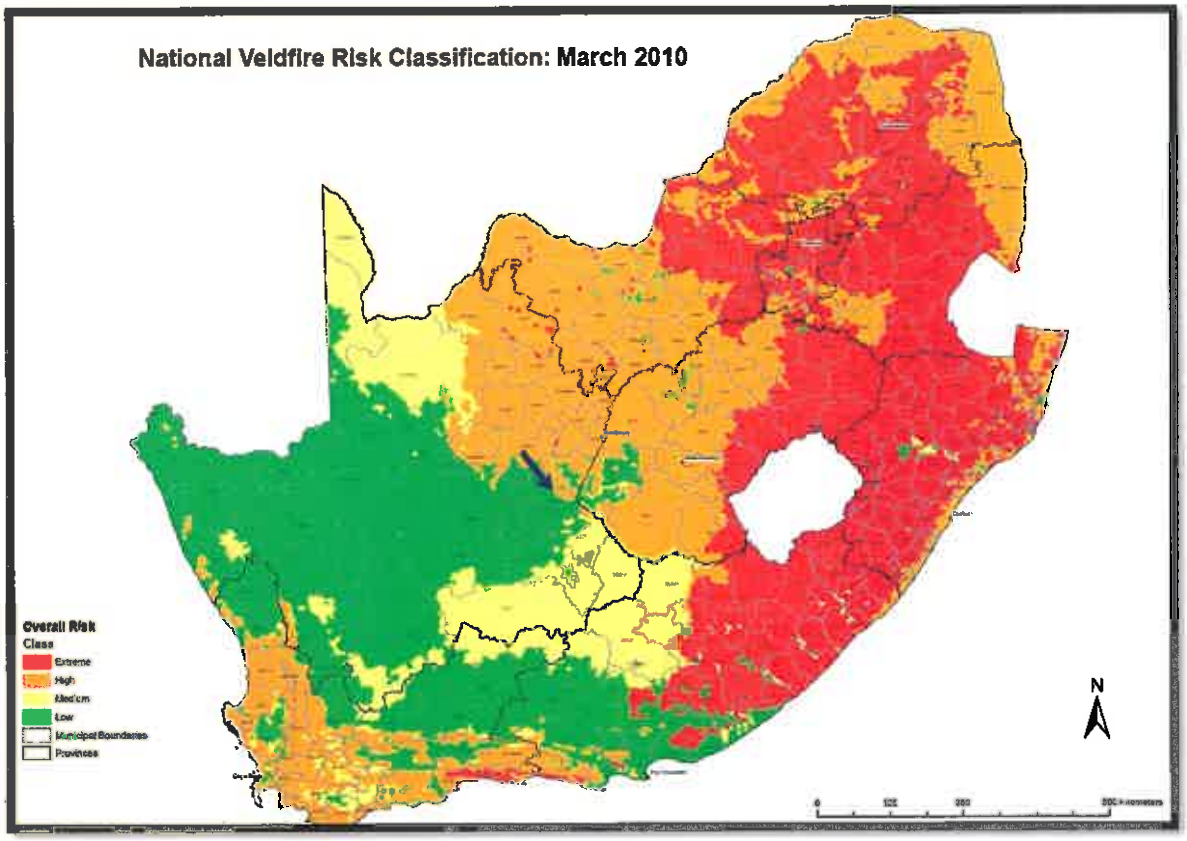
5.6 VELD FIRE RISK

The revised veldfire risk classification (Forsyth, 2010) in terms of the National Veld and Forest Fire Act 101 of 1998 was promulgated in March 2010. The purpose of the revised fire risk classification is to serve as a national framework for implementing the National Veld and Forest Fire Act, and to provide a basis for setting priorities for veldfire management interventions such as the promotion of and support to Fire Protection Associations. In the fire-ecology types and municipalities with High to Extreme fire risk, comprehensive risk management strategies are needed.

The proposed site is located in an area supporting medium-high shrubland which has been classified with a **High fire risk classification** (Refer to Figure 5). It is thus important that during construction and operation the

site must adhere to all the requirements of the local Fire Protection Association (FPA) if applicable, or must adhere to responsible fire prevention and control measures.

Figure 5: South African National Veldfire Risk Classification (March 2010)



6. IMPACT ASSESSMENT METHOD

The concept of environmental impact assessment in terms of the National Environmental Management Act, Act 107 of 1998 (NEMA) and the Environmental Impact Assessment (EIA) was developed to identify and evaluate the nature of potential impact in order to determine whether an activity is likely to cause significant environmental impact on the environment. The concept of significance is at the core of impact identification, evaluation and decision making, but despite this the concept of significance and the method used for determining significance remains largely undefined and open to interpretation (DEAT, 2002).

6.1 DETERMINING SIGNIFICANCE

Determining impact significance from predictions of the nature of the impact has been a source of debate and will remain a source of debate. The author used a combination of scaling and weighting methods to determine significance based on a simple formula. The formula used is based on the method proposed by Edwards (2011). However, the criteria used were adjusted to suite its use for botanical assessment. In this document significance rating was evaluated using the following criteria.

Significance = Conservation Value x (Likelihood + Duration + Extent + Severity) (Edwards 2011)

6.1.1 CRITERIA USED

Conservation value: Conservation value refers to the intrinsic value of an attribute (e.g. an ecosystem, a vegetation type, a natural feature or a species) or its relative importance towards the conservation of an ecosystem or species or even natural aesthetics. Conservation status is based on habitat function, its vulnerability to loss and fragmentation or its value in terms of the protection of habitat or species (Refer to Table 7 for categories used).

Table 7: Categories used for evaluating conservation status

CONSERVATION VALUE	
Low (1)	The attribute is transformed, degraded not sensitive (e.g. Least threatened), with unlikely possibility of species loss.
Medium/low (2)	The attribute is in good condition but not sensitive (e.g. Least threatened), with unlikely possibility of species loss.
Medium (3)	The attribute is in good condition, considered vulnerable (threatened), or falls within an ecological support area or a critical biodiversity area, but with unlikely possibility of species loss.
Medium/high (4)	The attribute is considered endangered or, falls within an ecological support area or a critical biodiversity area, or provides core habitat for endemic or rare & endangered species.
High (5)	The attribute is considered critically endangered or is part of a proclaimed provincial or national protected area.

Likelihood refers to the probability of the specific impact occurring as a result of the proposed activity (Refer to Table 8, for categories used).

Table 8: Categories used for evaluating likelihood

LIKELIHOOD	
Highly Unlikely (1)	Under normal circumstances it is almost certain that the impact will not occur.
Unlikely (2)	The possibility of the impact occurring is very low, but there is a small likelihood under normal circumstances.
Possible (3)	The likelihood of the impact occurring, under normal circumstances is 50/50, it may or it may not occur.
Probable (4)	It is very likely that the impact will occur under normal circumstances.
Certain (5)	The proposed activity is of such a nature that it is certain that the impact will occur under normal circumstances.

Duration refers to the length in time during which the activity is expected to impact on the environment (Refer to Table 9).

Table 9: Categories used for evaluating duration

DURATION	
Short (1)	Impact is temporary and easily reversible through natural process or with mitigation. Rehabilitation time is expected to be short (1-2 years).
Medium/short (2)	Impact is temporary and reversible through natural process or with mitigation. Rehabilitation time is expected to be relative short (2-5 years).
Medium (3)	Impact is medium-term and reversible with mitigation, but will last for some time after construction and may require ongoing mitigation. Rehabilitation time is expected to be longer (5-15 years).
Long (4)	Impact is long-term and reversible but only with long term mitigation. It will last for a long time after construction and is likely to require ongoing mitigation. Rehabilitation time is expected to be longer (15-50 years).
Permanent (5)	The impact is expected to be permanent.

Extent refers to the spatial area that is likely to be impacted or over which the impact will have influence, should it occur (Refer to Table 10).

Table 10: Categories used for evaluating extent

EXTENT	
Site (1)	Under normal circumstances the impact will be contained within the construction footprint.
Property (2)	Under normal circumstances the impact might extent outside of the construction site (e.g. within a 2 km radius), but will not affect surrounding properties.
Surrounding properties (3)	Under normal circumstances the impact might extent outside of the property boundaries and will affect surrounding land owners or –users, but still within the local area (e.g. within a 50 km radius).
Regional (4)	Under normal circumstances the impact might extent to the surrounding region (e.g. within a 200 km radius), and will regional land owners or –users.
Provincial (5)	Under normal circumstances the effects of the impact might extent to a large geographical area (>200 km radius).

Severity refers to the direct physical or biophysical impact of the activity on the surrounding environment should it occur (Refer to Table 11).

Table 11: Categories used for evaluating severity

SEVERITY	
Low (1)	It is expected that the impact will have little or no affect (barely perceptible) on the integrity of the surrounding environment. Rehabilitation not needed or easily achieved.
Medium/low (2)	It is expected that the impact will have a perceptible impact on the surrounding environment, but it will maintain its function, even if slightly modified (overall integrity not compromised). Rehabilitation easily achieved.
Medium (3)	It is expected that he impact will have an impact on the surrounding environment, but it will maintain its function, even if moderately modified (overall integrity not compromised). Rehabilitation easily achieved.
Medium/high (4)	It is expected that the impact will have a severe impact on the surrounding environment. Functioning may be severely impaired and may temporarily cease. Rehabilitation will be needed to restore system integrity.
High (5)	It is expected that the impact will have a very severe to permanent impact on the surrounding environment. Functioning irreversibly impaired. Rehabilitation often impossible or unfeasible due to cost.

6.2 SIGNIFICANCE CATEGORIES

The formal NEMA EIA application process was developed to assess the significance of impacts on the surrounding environment (including socio-economic factors), associated with any specific development proposal in order to allow the competent authority to make informed decisions. Specialist studies must advise the environmental assessment practitioner (EAP) on the significance of impacts in his field of specialty. In order to do this, the specialist must identify all potentially significant environmental impacts, predict the nature of the impact and evaluate the significance of that impact should it occur.

Potential significant impacts are evaluated, using the method described above, in order to determine its potential significance. The potential significance is then described in terms of the categories given in Table 12. Mitigation options are evaluated and comparison is then made (using the same method) of potential significance before mitigation and potential significance after mitigation (to advise the EAP).

Table 12: Categories used to describe significance rating (adjusted from DEAT, 2002)

SIGNIFICANCE	DESCRIPTION
Insignificant or Positive (4-22)	There is no impact or the impact is insignificant in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or the impact may be positive.
Low (23-36)	An impact barely noticeable in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or will be of very short-term or is unlikely to occur. Impact is unlikely to have any real effect and no or little mitigation is required.
Medium Low (37-45)	Impact is of a low order and therefore likely to have little real effect. Mitigation is either easily achieved. Social, cultural and economic activities can continue unchanged, or impacts may have medium to short term effects on the social and/or natural environment within site boundaries.
Medium (46-55)	Impact is real, but not substantial. Mitigation is both feasible and fairly easily possible, but may require modification of the project design or layout. Social, cultural and economic activities of communities may be impacted, but can continue (albeit in a different form). These impacts will usually result in medium to long term effect on the social and/or natural environment, within site boundary.
Medium high (56-63)	Impact is real, substantial and undesirable, but mitigation is feasible. Modification of the project design or layout may be required. Social, cultural and economic activities may be impacted, but can continue (albeit in a different form). These impacts will usually result in medium to long-term effect on the social and/or natural environment, beyond site boundary within local area.
High (64-79)	An impact of high order. Mitigation is difficult, expensive, time-consuming or some combination of these. Social, cultural and economic activities of communities are disrupted and may come to a halt. These impacts will usually result in long-term change to the social and/or natural environment, beyond site boundaries, regional or widespread.
Unacceptable (80-100)	An impact of the highest order possible. There is no possible mitigation that could offset the impact. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt. The impact will result in permanent change. Very often these impacts are un-mitigatable and usually result in very severe effects, beyond site boundaries, national or international.

7. BIODIVERSITY ASSESSMENT

The Savanna Biome has a relatively low species diversity ration, which is even lower in the southern Kalahari part of this biome (Rutherford et. al., 2006). Soil type and rainfall gradients often define vegetation type. Within Savanna, the co-dominance of tree-to-grass mixture is considered inherently unstable and is likely to be driven by soil type, rainfall patterns, fire and grazing pressure (herbivore), which in turn can largely determine plant community composition. Larger tree (canopies) is considered important micro-habitats and there can be major differences in the herbaceous layer under canopies and the areas between canopies. Grazing has for long been considered an important factor in regulating competitive interaction between plants (e.g. *Senegalia mellifera = Acacia mellifera* encroachment is often ascribed to 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.

The site visit showed no significant geographical features such as watercourses, wetlands, upland- down land gradients or vegetation boundaries on the site or limited to the site. The vegetation itself showed signs of being heavily grazed (especially to the south), but the significance there-off is hard to determine.

7.1 BIOPHYSICAL ENVIRONMENT

No special habitats, geology or soils were encountered. In terms of land-use, the site is in not in pristine condition, which might be the result of heavy grazing. In the Kalahari dense stands of *Senegalia mellifera* ("Swarthaak") and *Rhigozum trichotomum* ("Drie-doring") is sometimes ascribed to overgrazing or bad veld management. In terms of the larger property, the proposed development should have little impact on available grazing land.

7.2 THREATENED OR PROTECTED ECOSYSTEMS

The Vaalbos Rocky Shrubland vegetation type is not considered vulnerable or threatened with more 98% of this vegetation still remaining in its natural state. However, at present little of this vegetation type is formally conserved in South Africa. It is thus important the viable areas are considered for inclusion into Conservation areas or CBA's or ESA's. The site is not located within the Griqualand West Centre of Endemism. It is also considered unlikely that the proposed footprint would intrude onto any future CBA or ESA on strength of its floristic value or location. The small size of the proposed development makes it further unlikely to have any significant impact on connectivity within the larger area.

No Red list species was encountered (Heading 5.3.1), or species protected in terms of NEMBA (Heading 5.3.2), but 5 individuals of *Boscia albitrunca* (Sheppard's tree) protected in terms of the NFA (Heading 5.3.3) and five (5) species protected in terms of the NCNCA (Heading 5.3.4) was encountered. Of these, the most noteworthy

is the presence of the 5 Sheppard's trees. These trees are unlikely to survive transplantation. However, since the actual development footprint only need to compromise about 50% of the total site, it is likely that with micro adjustment of the layout within the site, at least some of these trees can be saved. One species was recommended for search & rescue and topsoil (with its seedbank) protection and re-use will allow seed preservation and thus species distribution/relocation.

No watercourses or wetlands were observed on the property and because of its current landuse (cattle grazing) and small size, it is considered unlikely that the proposed development will have any significant impact on any single fauna or avi-fauna species. No invasive alien plant species was observed. The potential veld fire risk is high, and good fire management protocols will have to be implemented.

7.3 CUMMULATIVE IMPACTS

The Department of Environmental Affairs requires that specialist evaluates the accumulative impacts of all other renewable energy sites within a 30 km radius of the proposed development. According to the information obtained from the Department of Environmental Affairs renewable energy database website for South Africa (https://dea.maps.arcgis.com/apps/webappviewer), there are potentially four renewable energy sites within a 30 km radius of the proposed Disselfontein site (Figure 6), not including the Keren Disselfontein site, which refers to this application.

The proposed Slypsteen South Hydroelectric power scheme is located on the adjacent property (just north) of Disselfontein, while two sites are located towards Hopetown (to the south) and one site is located to the north of the Disselfontein site. Of the four sites two sites (Site 1 and 2 Figure 7) can also potentially impact on the same vegetation type as the proposed Disselfontein solar site. The Zoetgat and Moletzi sites are not expected to impact on Vaalbos Rocky Shrubland (this will not compete with national conservation targets within the 30km radius of Disselfontein).

Name	Type	MW	Vegetation type
1. Slypsteen South Hydroelectric Power Scheme	Hydroelectric	Not listed	Upper Gariep Alluvial Vegetation or Vaalbos Rocky Shrubland
2. Group Mounted Solar Farm	Solar PV	300	Vaalbos Rocky Shrubland, Kimberley Thornveld or Northern Upper Karoo
3. Solar Power site on Prt. 3 of Farm Zoetgat no. 84	Solar PV	10	Kimberley Thornveld or Northern Upper Karoo
4. Moletzi Solar Plant on Farm Locatie Van Maliezie no. 606	Solar PV	75	Northern Upper Karoo & Kimberley Thornveld

Figure 6: Indicating approved renewable energy sites within 30km radius of the proposed Disselfontein Solar site

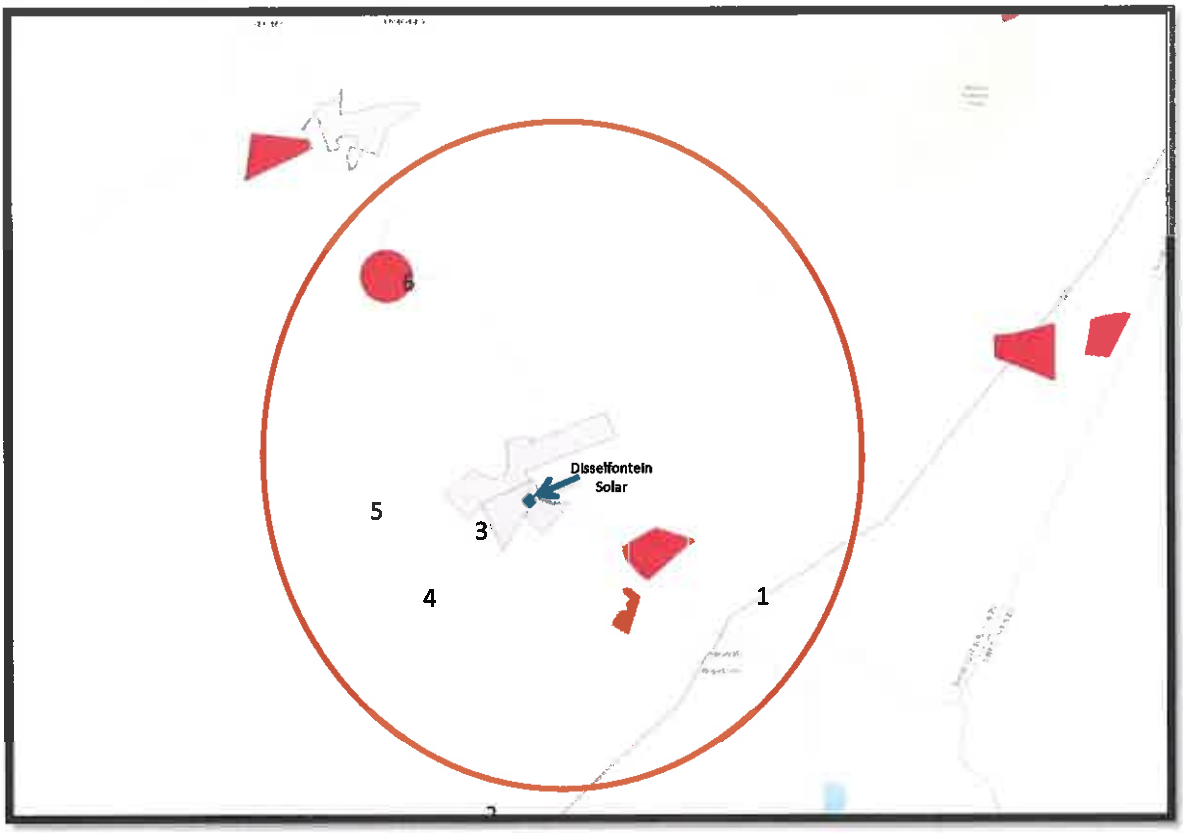
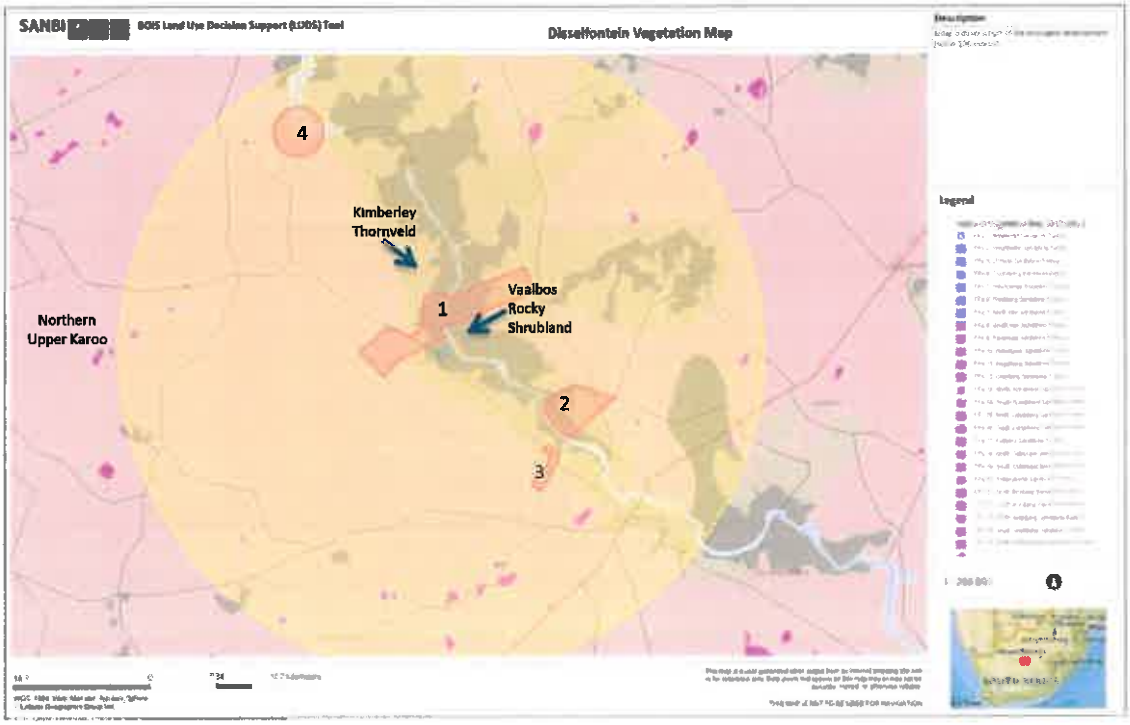


Figure 7: The vegetation map of South Africa (2012, beta version) showing the vegetation associated with the RE sites within 30km



The proposed Disselfontein development is small (<20ha) and will impact on Vaalbos Rocky Shrubland. Vaalbos Rocky Shrubland vegetation type is not considered vulnerable or threatened with more 98% still

remaining in its natural state. Ecological connectivity is still very good for most of the Disselfontein area (the veld being mainly natural grazing land). Since there is no fine scale mapping for this area available, it means that ecological corridors and provincial conservation targets had not yet been defined.

Because of the small size of the proposed footprint is unlikely to have any significant impact on connectivity and it is considered unlikely to have any significant impact on any future CBA or ESA. Floristically, the most significant potential impact will be on the five Sheppard's trees on site. In the case of the Disselfontein Solar site, the only other solar sites within 30km that will impact on the same resource will be Site 1 and 2 in Figure 6 & Figure 7.

Cumulative impacts for this project was calculated taking into account the small size of the proposed development, the impact of similar developments within a 30km radius on the same vegetation type, connectivity, potential critical biodiversity areas or ecological support areas and the impact on protected tree species (which can potentially be negated) as well as land-use, geology and soils, fauna and avi-fauna (Refer to Table 13).

7.4 IMPACT EVALUATION

Table 13 rates the significance of environmental impacts associated with the proposed development. It also evaluates the expected accumulative effect of the proposed development as well as the No-Go option.

Table 13: Significant rating of impacts associated with the proposed development (including the No-Go option)

Aspect	Short description	CV	Lik	Dur	Ext	Sev	Sig. before Mit	CV	Lik	Dur	Ext	Sev	Sig. after Mit	Short discussion
Geology & soils	Possible impact on special habitats	1	1	3	1	1	6	1	1	3	1	1	6	No special features encountered (e.g. true quartz patches). The impact on geology and soils is expected to be very low. No mitigation required.
Landuse and cover.	Possible impact on socio-economic activities as a result of the physical footprint or associated activities.	1	2	3	1	2	8	1	2	3	1	2	8	The proposed development will impact on a small area used for grazing by the landowner. Loss of grazing will be barely perceptible within the larger property.
Vegetation type	Possible loss of vegetation and associated habitat.	1	1	3	1	2	7	1	1	3	1	1	6	More than 98% of this vegetation remains in its natural state, but none formally conserved. Mitigation - Minimise impact on large indigenous trees and minimise footprint.
Connectivity	Possible loss of ecosystem function as a result of habitat fragmentation.	1	2	3	1	2	8	1	1	3	1	1	6	Permanent impact, but with small footprint, unlikely to impact on overall connectivity. Mitigation - minimise impact on large indigenous trees and minimise footprint.
Corridors and conservation priority areas	Possible loss of identified terrestrial and aquatic critical biodiversity areas, ecological support areas or ecological corridors.	2	2	3	1	2	16	2	1	3	1	1	12	CBA's and ECA's not yet defined, but unlikely to impact on any priority sites. Mitigation - minimise footprint.
Watercourses and wetlands	Possible impact on natural water resources and its associated ecosystem.	0	0	0	0	0	0	0	0	0	0	0	0	No watercourses or wetlands encountered.
Flora	Possible loss of threatened or protected species.	3	4	3	1	3	33	3	2	3	1	1	21	Protected species of high significance. But impact can be minimised through protection indigenous tree species and footprint minimisation.
Fauna	Possible impact on species as well as potential loss of threatened or protected species.	1	1	2	1	1	5	1	1	2	1	1	5	Unlikely to impact significantly on any single species. No mitigation required.
Avi-fauna	Possible impact on species as well as potential loss of threatened or protected species.	1	2	2	1	1	6	1	2	2	1	1	6	Unlikely to impact significantly on any single species, but birds associated with larger trees. Mitigation - minimise footprint and impact on protected trees.

Aspect	Short description	CV	Lik	Dur	Ext	Sev	Sig. before Mit.	CV	Lik	Dur	Ext	Sev	Sig. after Mit.	Short discussion
Invasive alien species	Possible alien infestation as a result of activities.	0	0	0	0	0	0	0	0	0	0	0	0	No AIS observed.
Veld fire	The risk of veld fires as a result of the proposed activities.	2	4	3	3	2	24	2	2	3	2	2	18	Veld fire risk is high and can lead to impacts on the surroundings. Fire protection high priority.
Accumulative	Accumulative impact associated with the proposed activity.	3	4	3	3	3	39	3	3	3	2	2	30	Cumulative impact can be reduced through mitigation measures.
No-Go alternative	Potential environmental impact associated with the no-go alternative.	1	1	1	1	1	4	1	1	1	1	1	4	The above impacts will not occur, but the site will remain subject to slow degradation as a result of informal grazing and urban footprint creep.

Significance before mitigation:

The impact assessment suggests that the proposed Disselfontein development is expected to have a **Medium-Low cumulative** impact, with the most significant aspect being the potential impact on the protected trees encountered within the site and to a lesser degree potential accidental veld fires.

Significance after mitigation:

Since the proposed development footprint needs only be approximately 50% of the 20ha, there is great potential for micro-adjustment of the final layout plans. It should be possible to reduce the direct impact on large protected trees significantly (e.g. avoiding trees on the outskirts of the site and minimising the actual development footprint wherever possible). The impact on the regional status of the vegetation type and associated biodiversity features (e.g. corridor function or special habitats) will also be minimised through the above mitigations. Apart from the potential impact on protected tree species no further irreversible species-loss, habitat-loss, connectivity or associated impact can be foreseen from locating and operating the solar facility on the proposed site. With mitigation the impact on biodiversity features can be reduced to **Low**.

The NO-GO option: 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" on the site. 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 remains a much cleaner and more sustainable option for electricity production.

8. RECOMMENDATIONS

Having evaluated and discussed the various biodiversity aspects associated with the project it is clear that the most significant impacts are expected to be associated with the impacts on:

- protected plant species, especially the potential impact on larger Sheppard's trees;
- possible accidental veld fires; and

However, there is potential of minimising the impacts significantly, after which it should be unlikely that the proposed project will contribute significantly to any of the following:

- Significant loss of vegetation and associated habitat in terms of local or national conservation targets;
- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to development and operational activities;
- Significant loss of local biodiversity and threatened plant species;
- Significant loss of ecosystem connectivity (e.g. corridor function).

Lastly it is felt that good environmental planning and control during construction, the appointment of a suitably qualified ECO and the implementation of an approved EMP, could significantly reduce environmental impact.

With the available information to the author's disposal it is recommended that project be approved since it is not associated with irreversible environmental impact, provided that mitigation is adequately addresses.

9. IMPACT MINIMIZATION

There are numerous possibilities for mitigation measures to lessen the direct impact during construction (and operational) phases, of which the overriding goal should be to clearly define the final layout which must aim at minimising the impact on protected tree species and minimising the disturbance footprint.

- 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 in terms of the EMP and the Biodiversity study recommendations as well as any other conditions pertaining to other specialist studies and requirements of the DENC or DAFF.
- **Permits must be obtained in terms of the NFA, for the removal of any protected trees**. But final layout plans must aim at minimising the direct impact on all protected tree species (especially larger individuals).
- An **application must be made to DENC for a flora permit in terms of the NCNCA** with regards to search and rescue and other impacts on species protected in terms of Schedule 1 and 2 of the act.
- Before any work is done the footprint must be clearly demarcated. The demarcation must aim at minimum footprint and minimisation of disturbance.
- Topsoil (the top 15-20 cm) must be removed and protected and re-used for rehabilitation purposes of suitable areas on site or within the immediate surroundings (Seedbed protection).
- Before construction the footprint must be scanned by a botanist or suitably qualified ECO in order to identify the plants listed for Search & Rescue. The Botanist must advise on the best way for search & rescue and must also take the following into account:
    - These plants must be transplanted outside of the disturbance footprint, but within the same vegetation type (preferably the immediate surroundings of the site).
    - A watering program must be implemented for transplanted plants.
- Before construction the footprint must be approved by a botanist or suitably qualified ECO in order to ensure that impacts on protected plant species (especially protected tree species) are minimised.
- All efforts must be made to protect other large mature indigenous trees where possible.
- Lay-down areas or construction camp sites must be located within areas already disturbed or areas of low ecological value and must be pre-approved by the ECO.
- Indiscriminate clearing of any area outside of these footprints may not be allowed.
- All construction areas must be suitably rehabilitated on completion of the project.
    - This includes the removal of all excavated material, spoil and rocks, all construction related material and all waste material.
    - This must include re-using the protected as well as shaping the area to represent the original shape of the environment.

- An integrated waste management approach must be implemented during construction.
    - Construction related general and hazardous waste may only be disposed of at approved waste disposal sites.
    - Clean spoil from excavation work should be used as fill where possible.
    - All rubble and rubbish should be collected and removed from the site to a Municipal approved waste disposal site.

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APPENDIX 1

Plant species checklist for Vaalbos Rocky Shrubland (SANBI: BGIS)

FAMILY NAME	GROWTH FORM	SPECIES NAME
HYACINTHACEAE	Geophytic Herbs	*Albuca setosa*
ASPHODELACEAE	Succulent Herbs	*Aloe grandidentata*
POACEAE	Graminoids	*Aristida adscensionis*
POACEAE	Graminoids	*Aristida congesta*
ASPARAGACEAE	Low Shrubs	*Asparagus suaveolens*
CAPPARACEAE	Small Trees	*Boscia albitrunca*
BUDDLEJACEAE	Tall Shrubs	*Buddleja saligna*
CAPPARACEAE	Tall Shrubs	*Cadaba aphylla*
VERBENACEAE	Herbs	*Chascanum pinnatifidum*
PTERIDACEAE	Geophytic Herbs	*Cheilanthes eckloniana*
CRASSULACEAE	Succulent Shrubs	*Cotyledon orbiculata var. orbiculata*
CRASSULACEAE	Succulent Shrubs	*Crassula nudicaulis*
ARALIACEAE	Small Trees	*Cussonia paniculata*
POACEAE	Graminoids	*Digitaria eriantha*
EBENACEAE	Tall Shrubs	*Diospyros austro-africana*
EBENACEAE	Tall Shrubs	*Diospyros lycioides subsp. lycioides*
BORAGINACEAE	Tall Shrubs	*Ehretia rigida subsp. rigida*
POACEAE	Graminoids	*Elionurus muticus*
POACEAE	Graminoids	*Enneapogon scoparius*
POACEAE	Graminoids	*Eragrostis lehmanniana*
POACEAE	Graminoids	*Eragrostis obtusa*
EBENACEAE	Tall Shrubs	*Euclea crispa subsp. crispa*
POACEAE	Graminoids	*Eustachys paspaloides*
POACEAE	Graminoids	*Fingerhuthia africana*
CELASTRACEAE	Tall Shrubs	*Gymnosporia polyacanthus*
AMARYLLIDACEAE	Geophytic Herbs	*Haemanthus humilis subsp. humilis*
PEDALIACEAE	Herbs	*Harpagophytum procumbens subsp. procumbens*
MALVACEAE	Low Shrubs	*Hermannia comosa*
POACEAE	Graminoids	*Heteropogon contortus*
MALVACEAE	Herbs	*Hibiscus pusillus*
POACEAE	Graminoids	*Hyparrhenia hirta*
CRASSULACEAE	Succulent Shrubs	*Kalanchoe paniculata*
VERBENACEAE	Low Shrubs	*Lantana rugosa*
SOLANACEAE	Succulent Shrubs	*Lycium cinereum*
SOLANACEAE	Low Shrubs	*Lycium pilifolium*
OLEACEAE	Tall Shrubs	*Olea europaea subsp. africana*
PTERIDACEAE	Geophytic Herbs	*Pellaea calomelanos*
ASTERACEAE	Low Shrubs	*Pentzia globosa*
BIGNONIACEAE	Tall Shrubs	*Rhigozum obovatum*
ANACARDIACEAE	Tall Shrubs	*Rhus burchellii*
ANACARDIACEAE	Low Shrubs	*Rhus ciliata*
ANACARDIACEAE	Small Trees	*Rhus lancea*
APOCYNACEAE	Succulent Herbs	*Stapelia grandiflora*
POACEAE	Graminoids	*Stipagrostis uniplumis*
ASTERACEAE	Tall Shrubs	*Tarchonanthus camphoratus*
POACEAE	Graminoids	*Themeda triandra*
RHAMNACEAE	Tall Shrubs	*Ziziphus mucronata*

Appendix D2: Biodiversity Assessment and Botanical Scan (Original report)

DISSELFONTEIN

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 28, 2012

PREPARED BY: PB Consult

PREPARED FOR: ENVIROAFRICA CC

REQUESTED BY: KEREN ENERGY HOLDINGS (Pty) Ltd

Peet Botes (Pr.Sci.Nat: 400184/05) Registered Professional Environmental and Ecological Scientist
Cell: 082 921 5949; Fax 086 514 8595; Email: pbconsult@vodamail.co.za; 22 Buitekant Street, Bredasdorp, 7280.

SUMMARY - MAIN CONCLUSIONS

PREPARED BY:	PREPARED FOR:
PB Consult 22 Buitekant Street Bredasdorp 7280	EnviroAfrica CC PO Box 5367 Helderberg 7135
CONTACT PERSON	**CONTACT PERSON**
Peet Botes Cell: +(27)82 – 921 5949 Fax: +(27)86 – 415 8595 Email: pbconsult@vodamail.co.za	Mr. Bernard de Witt Tel: +(27) 21 – 851 1616 Fax: +(27) 86 – 512 0154 Email: bernard@enviroafrica.co.za

MAIN VEGETATION TYPES	**Vaalbos Rocky Shrubland** occurs on slopes and elevated hills and ridges within plains of mainly Kimberley Thornveld but also in the vicinity of Northern Upper Karoo. It is described as evergreen shrub communities dominated by *Tarchonanthus camphoratus*, *Olea europaea* subsp. *africana*, *Euclea crispa*, *Diospyros lycioides*, *Rhus burchelli* and *Buddleja saligna*. **Least Threatened:** Although more than 98% of this vegetation type remains, very little is formally conserved.
LAND USE AND COVER	The study area is situated on agricultural farmland mainly used for stock grazing. An Eskom substation is also located on the same property.
RED DATA PLANT SPECIES	None encountered or expected Protected Trees: A number of *Boscia albitrunca* trees were observed located along the south-western fence of the proposed site location. It is recommended that the lay-out of the final proposed site is altered slightly in order to avoid having to remove or damage any of these trees.
IMPACT ASSESSMENT	Development without mitigation: Significance = 36% Development with mitigation Significance = 7% 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 proposed final Disselfontein site location was fairly well chosen from a biodiversity viewpoint. With mitigation 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 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 at the author's disposal it is recommended that the project be approved, but that all mitigation measures described in this document is implemented and that a botanist or suitably qualified ECO be appointed during the initial layout of the structures in order to minimise/negate the impact on significant biodiversity features (e.g. watercourses) and the protected tree species.

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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 on the remainder of the Farm Disselfontein No. 77, Hopetown (Northern Cape Province, Thembelihle Local Municipality). The facility will be established on an area of approximately 20 ha, on a portion of Farm 77, located approximately 26 km north-north-west of Hopetown just. 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 on the remainder of the Farm Disselfontein, No. 77, Hopetown (Northern Cape Province, Thembelihle Local Municipality). The facility will be established on an area of approximately 20 ha, on a portion of Farm Disselfontein no. 77, located approximately 26 km north-north-west of Hopetown.

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 can be accessed from an existing secondary leading north-north-west from Hopetown following the Orange River which eventually connects to the R357. 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

The proposed Disselfontein Solar Site is located in the Northern Cape Province (Thembelihle Local Municipality), on the Remainder of the Farm Disselfontein, No. 77, Hopetown. The facility will be established on an area of approximately 20 ha, on a portion of Farm 77, located approximately 26 km north-north-west of Hopetown (Refer to Figure 1).

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

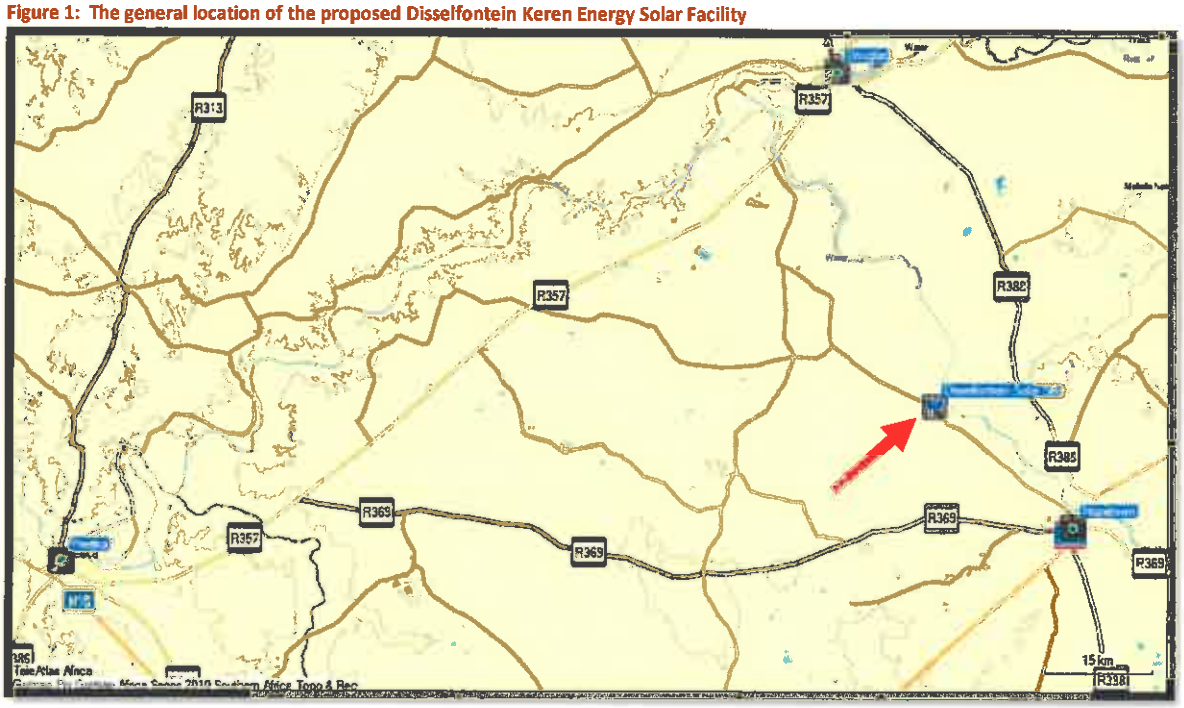


Figure 2 gives an artist view of what the solar site might look like (please note that the layout does not conform to the final proposed layout) which is shown in Figure 3 indicates the proposed final site location.

Figure 2: Proposed final site location (showing an overlay of the proposed solar units)

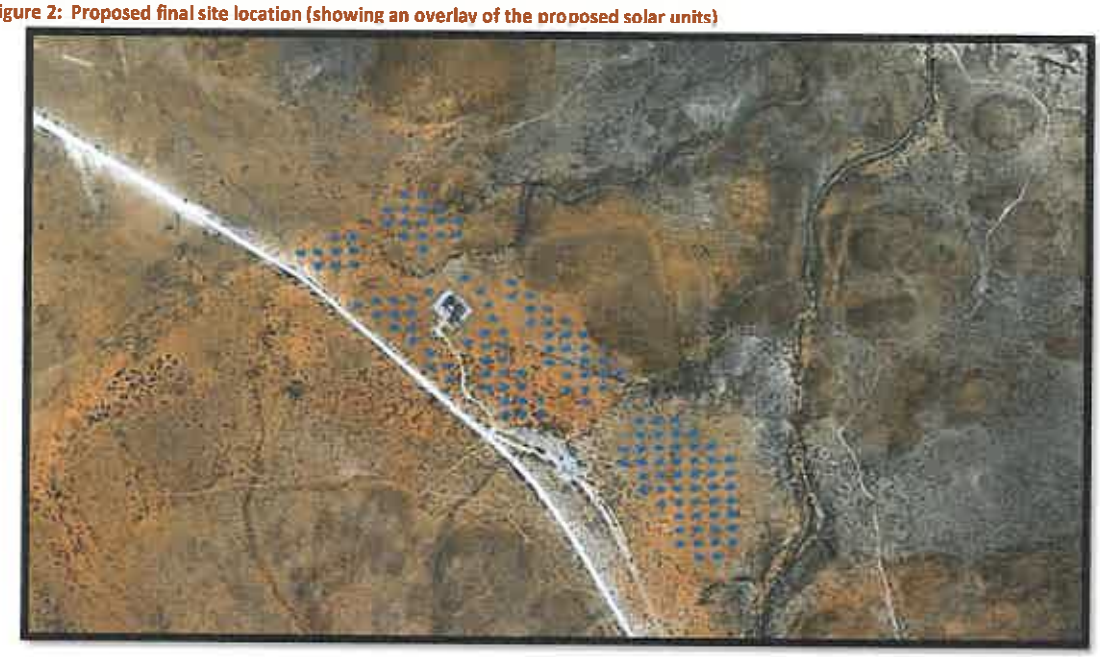


Figure 3: Final solar site location (approximately 20 ha)

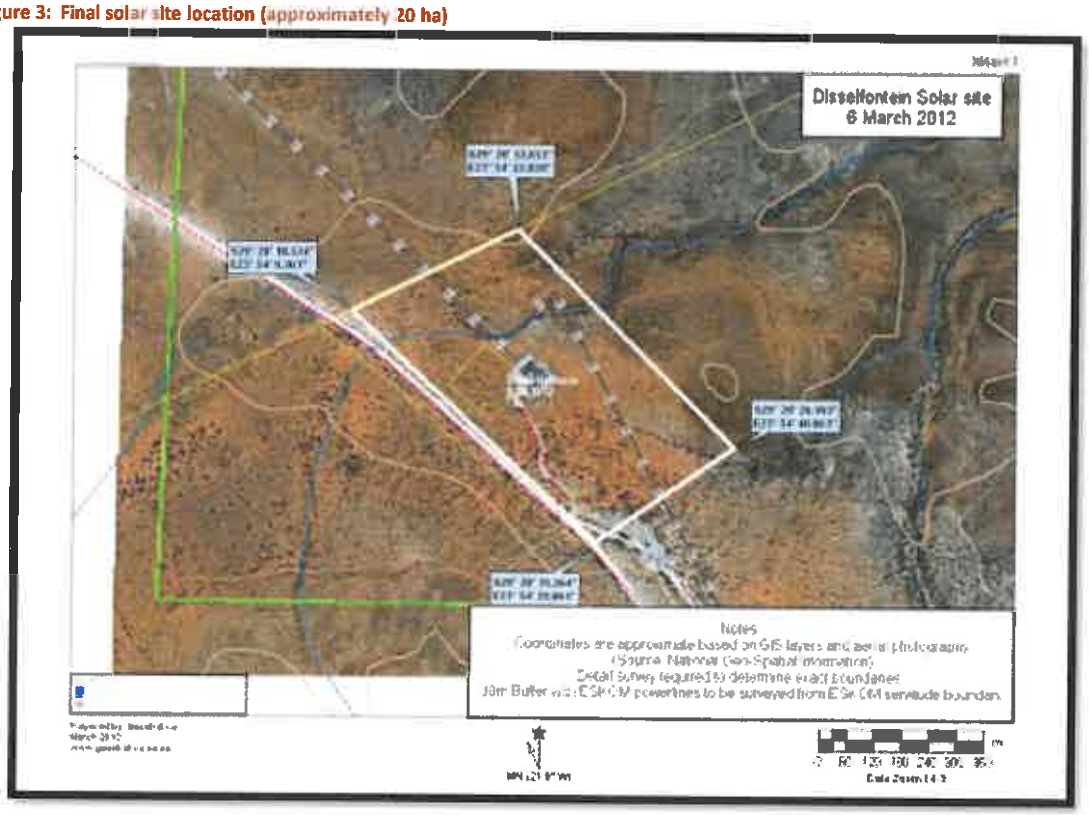


Table 1: GPS coordinates describing the boundaries of the final proposed solar site location (WGS 84 format)

DESCRIPTION	LATITUDE AND LONGITUDE	ALTITUDE
North-west corner	S29 28 18.5 E23 54 09.4	1083 m
North-east corner	S29 28 12.7 E23 54 22.9	1081 m
South-east corner	S29 28 28.1 E23 54 40.9	1071 m
South-west corner	S29 28 35.4 E23 54 29.1	1082 m

METHODS

Various desktop studies were conducted, coupled by a physical site visit at the end of January 2012 and further desktop studies. The timing of the site visit was 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 (white line) that was walked as well as special features encountered

* *B. albitrunca* = *Boscia albitrunca* (Sheppard's tree, Witgatboom)

TOPOGRAPHY

The solar site is located on an almost level area on a slightly undulating landscape, just west of the Orange River (north-north-west of Hopetown). Elevation data in Table 1 and Figure 5, shows that the site slopes very slightly from the north-east towards the south-west (towards the Orange River). Elevation varies from 1083 m (north-west corner) towards the south-east at 1071 m with an average slope of 1.0% and an elevation loss of approximately 9.8 m.

Two minor dry watercourses or drainage lines was observed on the property, one running west to east in the north-east corner of the site and one running south-south-east in the southern part of the proposed location.

Figure 5: Google image showing the difference in elevation from the NE towards the SW corner of the proposed location

CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. Hopetown normally receives about 199 mm of rain per year, with most rainfall occurring during autumn. It receives the lowest rainfall (0 mm) in July and the highest (48 mm) in March. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Hopetown range from 17.7°C in June to 32°C in January. The region is the coldest during July when the mercury drops to 1°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)

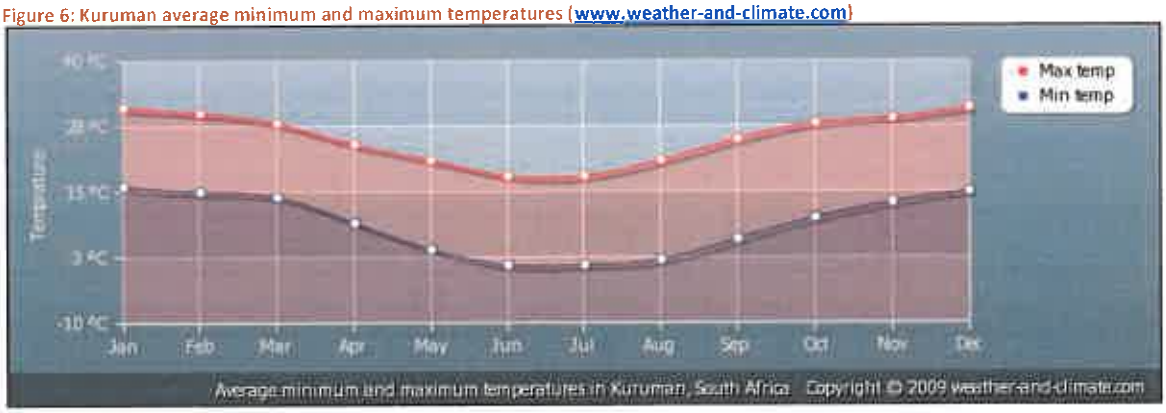


Figure 7: Kuruman average monthly precipitation over the year (www.weather-and-climate.com)

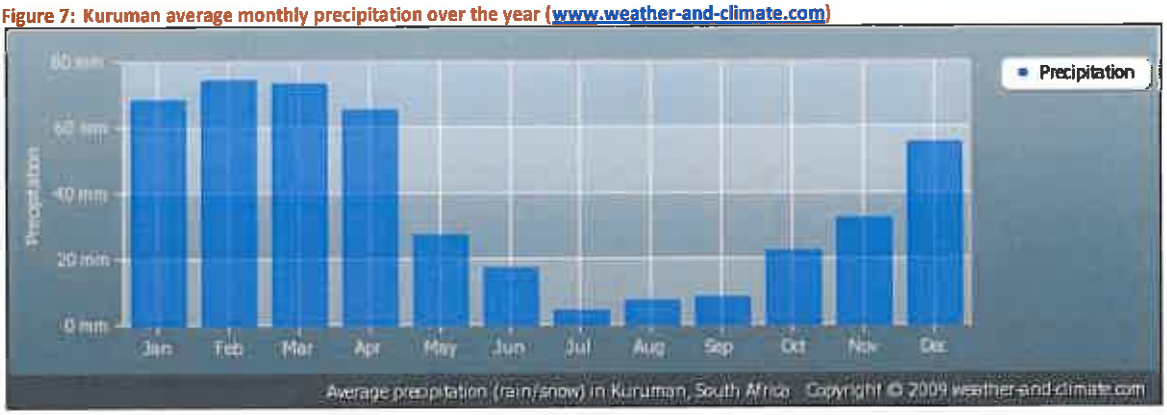


Figure 8: Kuruman average monthly hours of sunshine over the year (www.weather-and-climate.com)

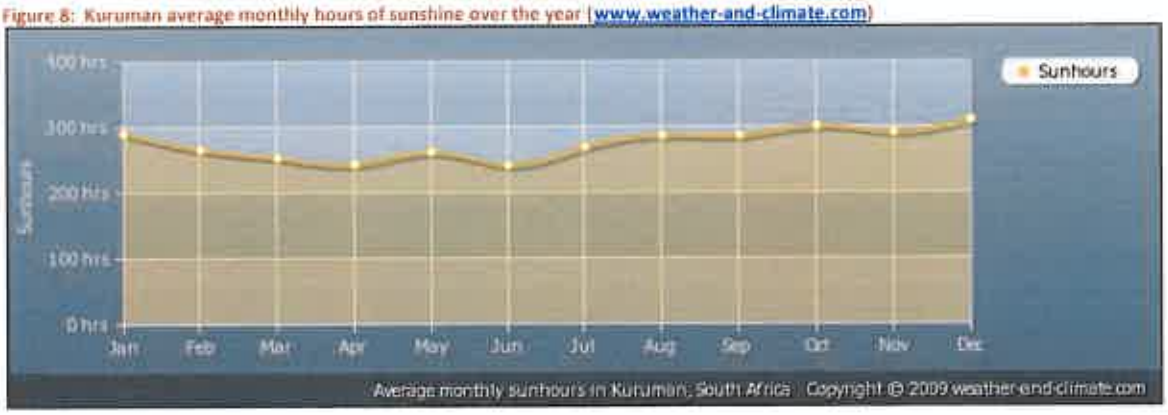
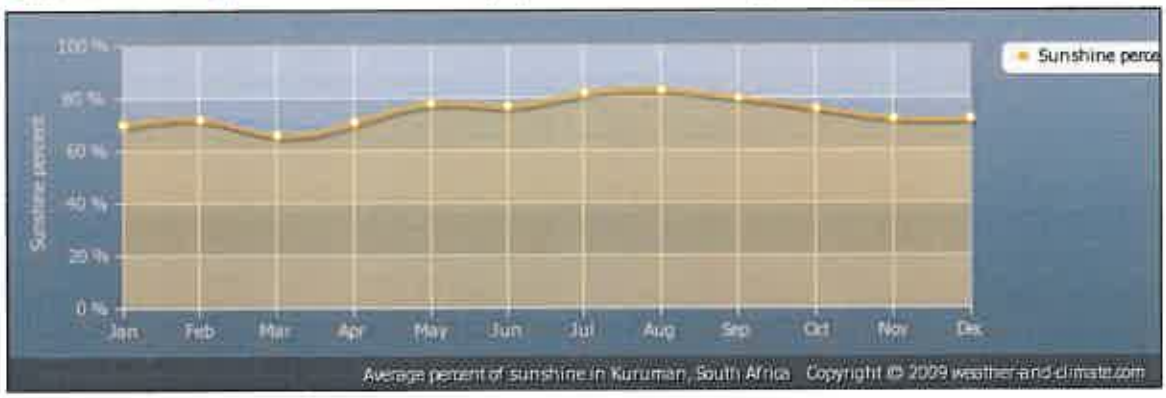


Figure 9: Kuruman average percent of sunshine over the year (mean % of sun hours during the day) (www.weather-and-climate.com)

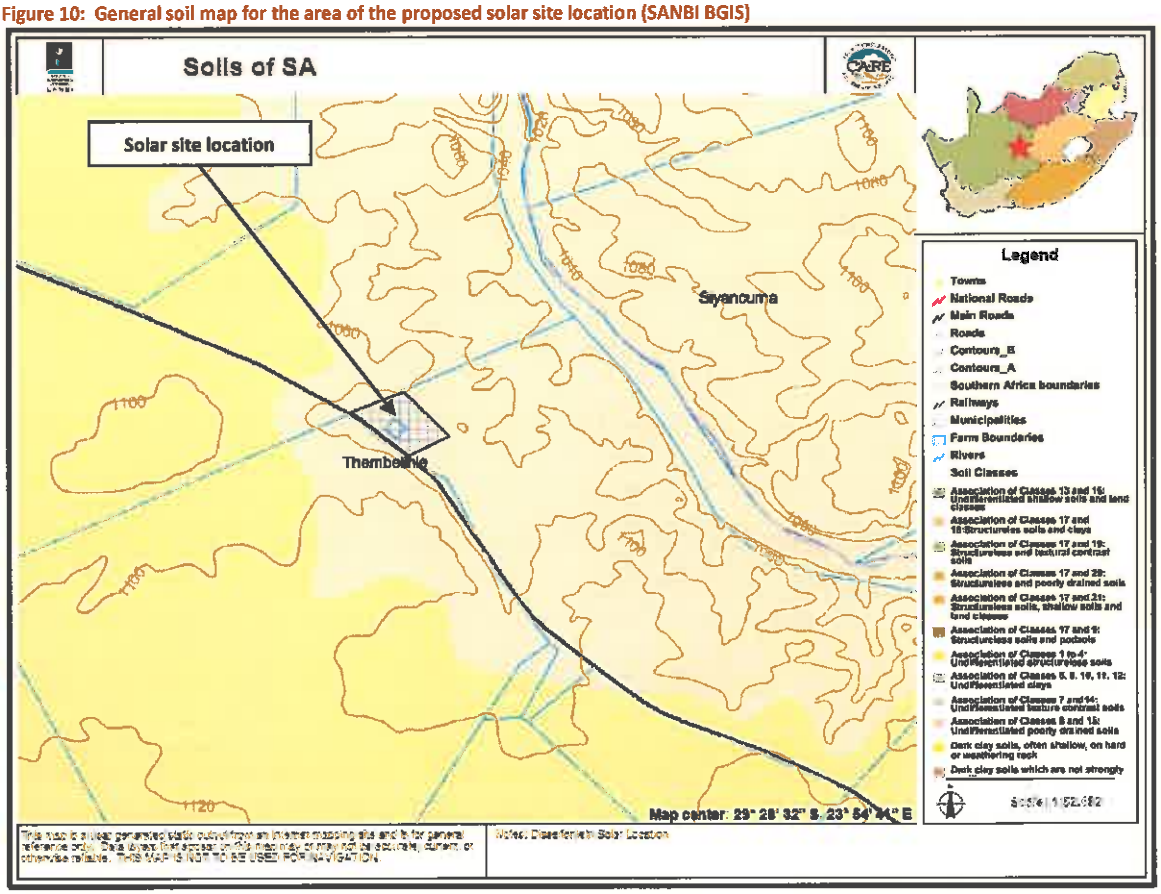


GEOLOGY & SOILS

According to Mucina and Rutherford (2006) and the SANBI Biodiversity Geographical Information System, the geology is described as a highly fragmented area on Ecca and Dwyka Group sediments and Karoo dolerites as well as on Ventersdorp Supergroup lavas (Allanridge Formation). Extensive dolerite sills which form ridges, and plateaus and slopes of koppies and small escarpments mark the erosion terraces. These dolerite sills cover alternating layers of mudstone and sandstone of sedimentary origin. The Ib land type is typical of these rock- and boulder-covered slopes. Prominent soil forms are stony Mispah and gravel-rich Glenrosa forms derived from the Jurassic dolerite, while calcrete-rich soils cover the lowlands. The soils (Refer to Figure 10)

show minimal development, usually shallow on hard weathered rock with or without intermittent diverse soils, with lime generally present (Mucina & Rutherford, 2006).

Figure 10: General soil map for the area of the proposed solar site location (SANBI BGIS)



No special soils or geology features (e.g. quartz patches or broken veld), which could support special botanical features, were observed during the site visit (or are expected).

LANDUSE AND COVER

The study area is situated on an almost level area in a slightly undulating landscape on the farm Disselfontein, adjacent and to the west of the Orange River or (north-north-west of Kuruman). The property zoned as agriculture and used for stock grazing. Smaller game species is still expected in the larger area (refer to Figure 11).

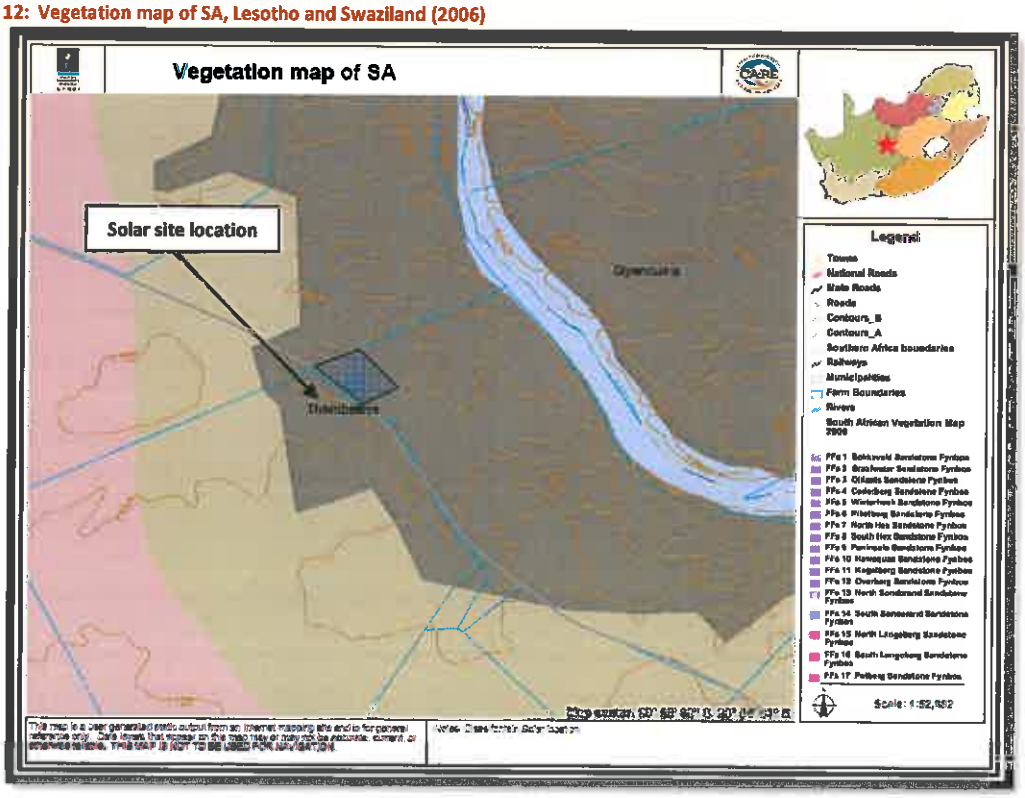
Natural vegetation forms an open shrub layer (up to 2 m in height) over a shorter grassy/shrub layer (up to 0.5 m) over the entire property. The vegetation showed signs of regular grazing. Small areas show pockets encroached by dense stands of *Acacia mellifera* while the watercourses are usually associated with denser woody vegetation. *Tarchonanthus camphoratus*, *Ziziphus mucronata*, *Grewia flava* and *Acacia karroo* are also prominent. During the site visit the main biodiversity feature of significance observed, was the remaining natural veld, the presence of a number of the protected tree *Boscia albitrunca*, as well as dry watercourses or drainage situated within the proposed solar site location.

Figure 11: A Google image giving an indication of the land use on the proposed solar 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 Vaalbos Rocky Shrubland (Darker brown in Figure 12). The site visit confirmed that only Vaalbos Rocky Shrubland is present in the larger study area.

Figure 12: Vegetation map of SA, Lesotho and Swaziland (2006)



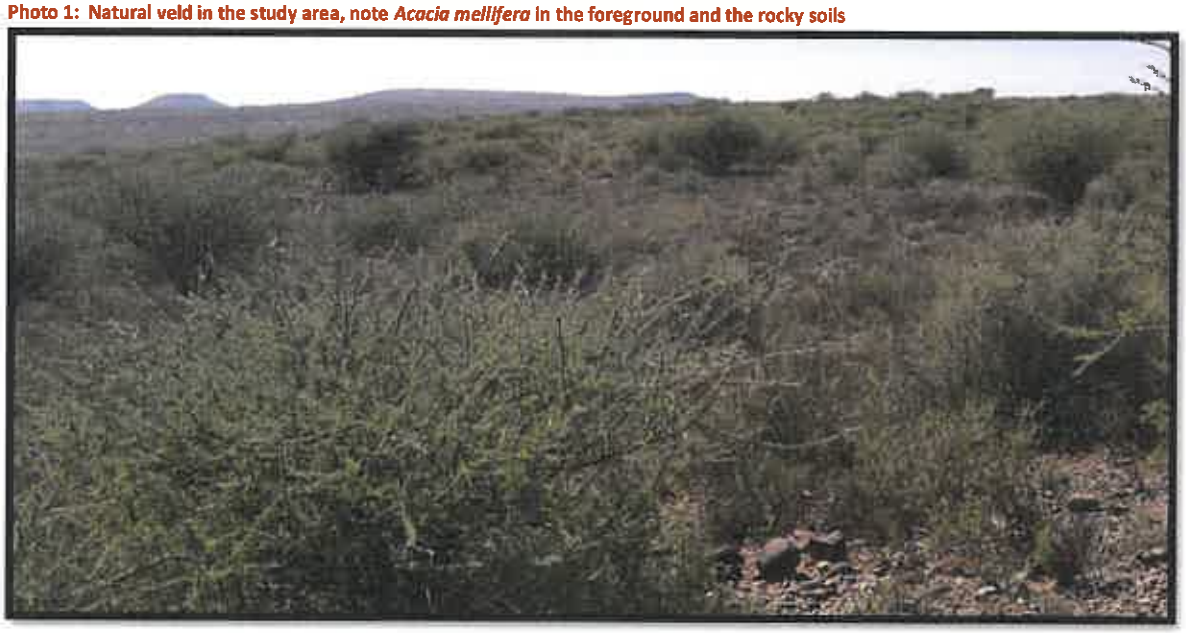
Vaalbos Rocky Shrubland was classified as "Least Threatened" during the 2004 National Spatial Biodiversity Assessment (NSBA). More than 98% of this vegetation still remains in its natural state, but only 1.7% of this vegetation type is formally protected throughout South Africa. Recently the *National 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, **Vaalbos Rocky Shrubland, remains classified as Least Threatened**.

Mucina & Rutherford (2006) noted that Vaalbos Rocky Shrubland is found in the Northern Cape and Free State Provinces along solitary hills and scattered ridges east of the confluence of the Orange and the Vaal Rivers, mainly in the Kimberley and Herbert District and west of a line bounded by the western Free State towns of Luckhoff, Petrusburg, Dealesville, Bultfontein and Hertzogville at altitudes varying from 1 000 -1 400 m.

VAALBOS ROCKY SHRUBLAND

Vaalbos Rocky Shrubland is described as occurring on slopes and elevated hills and ridges within plains of mainly Kimberley Thornveld, but also in the vicinity of Northern Upper Karoo (Mucina & Rutherford, 2006). It is described as evergreen shrub communities dominated by *Tarchonanthus camphoratus*, *Olea europaea* subsp. *africana*, *Euclea crispa*, *Diospyros lycioides*, *Rhus burchelli* and *Buddleja saligna*. On the foot slopes of dolerite hills, where calcium rich soils occur, shrub and small trees of *Acacia tortilis* and *Ziziphus mucronata* can be dominant. Photo 1 gives an indication of the vegetation found on site.

Photo 1: Natural veld in the study area, note *Acacia mellifera* in the foreground and the rocky soils



Acocks (1953) described this vegetation as Kalahari Thornveld invaded by Karoo or as False Orange River Broken Veld while Low & Rebelo (1996) described this vegetation as Kimberley Thorn Bushveld or Orange River Nama Karoo.

According to Mucina & Rutherford (2006) important taxa for this vegetation type includes the following:

Small trees: *Boscia albitrunca, Cussonia paniculata* and *Searsia lancea.*

Tall shrubs: *Euclea crispa, Olea europaea, Tarchonanthus camphoratus, Ziziphus mucronata, Buddleja saligna, Cadaba aphylla, Diospyros austro-africana, D. lycioides, Ehretia rigida, Gymnosporia polyacantha, Rhigozum obovatum* and *Searsia burchelli.*

Low shrubs: *Asparagus suaveolens, Hermannia comosa, Lantana rugosa, Lycium pilifolium, Pentzia globosa* and *Searsia ciliata.*

Succulent shrubs: *Cotyledon arbiculata, Crassula nudicaulis, Kalanchoe paniculata* and *Lycium cinereum.*

Graminoides: *Aristida adscensionis, A. congesta, Digitaria eriantha, Elionurus muticus, Enneapogon scoparius, Eragrostis lehmanniana, E. obtusa, Eustachys paspaloides, Fingerhuthia africana, Heteropogon contortus, Hyparrhenia hirta, Stipagrostis uniplumis* and *Themeda triandra.*

Herbs: *Chascanum pinnatifidum, Hibiscus pusillus* and *Harpagophytum procumbens.*

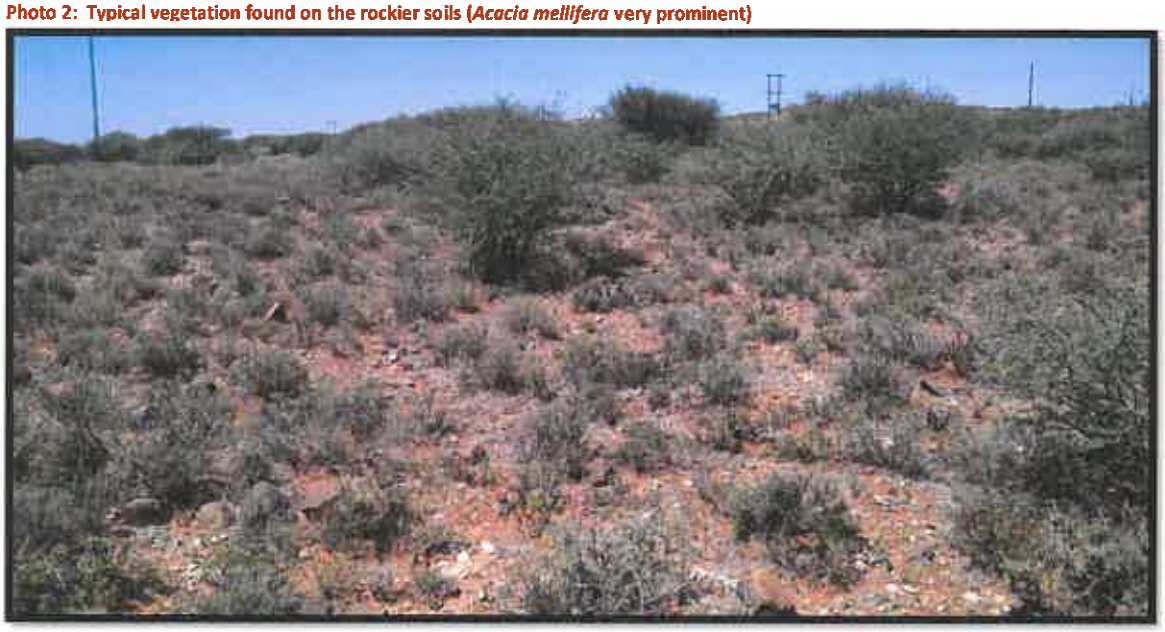
Geophytic Herbs: *Albuca setose, Cheilanthes eckloniana, Haemanthus humilis* and *Pallaea calomelanos.*

Succulent Herbs: *Aloe grandidentata* and *Stapelia grandiflora.*

VEGETATION ENCOUNTERED

The vegetation encountered conforms to that of Vaalbos Rocky Shrubland and supported an open shrubland with two layers normally present, namely a lower shrub layer up to 0.5 m and a sparse woody shrub/small tree top layer (varying between 1-2 m in height) with open patches in between (Photo 2). A third layer (reaching up to 4 m) in the form of *Boscia albitrunca* or *Acacia tortilis* was also occasionally encountered.

Photo 2: Typical vegetation found on the rockier soils (*Acacia mellifera* very prominent)



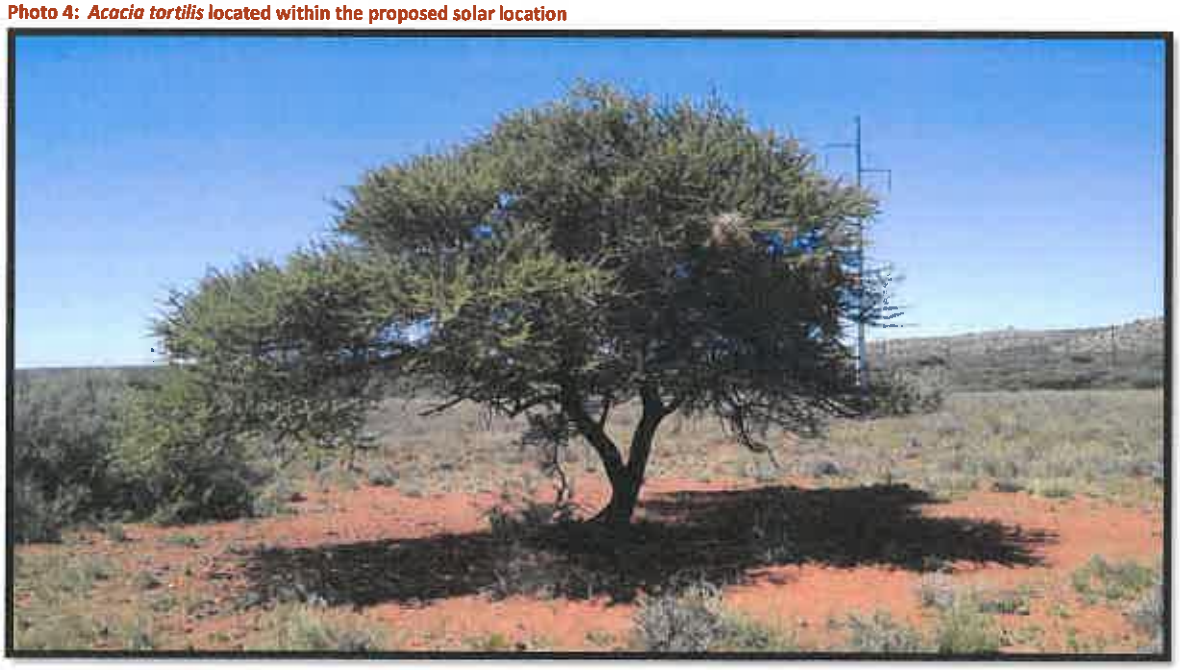
Where the soils are rockier, grasses are almost absent and the two vegetation layers consisted mainly of a shrub bottom layer with a woody/shrub top layer (Photo 2). In the sandier areas (seemingly slightly deeper red soils) grasses were more common and *Boscia albitrunca* was also sometimes present (Photo 3). Note that

Boscia albitrunca was only observed along the western boundary of the site (associated with the slightly deeper less rocky soils), west of the Eskom substation (Refer to Figure 11). The differences in soil/soil depth led to variations in vegetation composition. Vegetation cover in general was between 50-65%.

Photo 3: The vegetation encountered on slightly deeper soils (note *Boscia albitrunca* in the background)

The shrub top layer was usually dominated by *Acacia mellifera* with *Acacia karroo*, *Ziziphus mucronata*, *Rhigozum trichotomum*, *Grewia* cf *flava*, *Lycium cinereum*, *Asparagus retrofractus*, *Asparagus burchelli*, *Tarchonanthus camphoratus* and *Euphorbia* spp. also present. In slightly deeper sandy soils, *Acacia tortilis* (Photo 4) and *Boscia albitrunca* was also encountered.

Photo 4: *Acacia tortilis* located within the proposed solar location



The bottom layer was usually dominated by hardy shrubs like, *Aptosimum spinescens*, *Aptosimum* spp., *Argemone ochroleuca*, *Dianthus* spp., *Eberlanzia ferox*, *Felicia hirsuta*, *Galenia sarcophylla*, *Geigeria filifolia*, *Ifloga glomerata*, *Lycium hirsutum*, *Lycium prunus-spinosa*, *Monechma incanum*, *Pentzia* cf. *spinescens*, *Polygala asbestina*, *Tetragonia* spp., *Zygophyllum* cf. *lichtensteinianum*. Grass species like, Schmidtia spp., Fingerhuthia spp., *Aristida* spp., *Enneapogon* spp., and *Eragrostis* spp. amongst others was also found on sandier areas.

ENDEMIC OR PROTECTED PLANT SPECIES

According to Mucina & Rutherford (2006), there is no endemic taxon associated with this vegetation type. However, 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 (Refer to Table 2).

Table 2: Protected tree species with a geographical distribution that may overlap 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.

Photo 5: *Boscia albitrunca* tree on site (*A. mellifera* to the left)

During the site visit, a number of *Boscia albitrunca* were encountered (mostly associated with the slightly deeper sandy soils to the west of the proposed site location). All trees encountered were marked with GPS coordinates (Table 3, underneath) and plotted on a map (Refer to Figure 13), which, also gives a good indication of the distribution of these trees in relation to the larger site.

Please note that the Sheppard's trees are only found on a fairly small portion of the solar site, clumped together towards the western side of the boundary. It should make sense to shift the solar site slightly towards the east or south in order to avoid having to remove or damage any of these trees. Also note that this area is also the area in which slightly deeper soils were encountered, which mean that this area will always be able to support slightly larger trees (which might interfere with the workings of the solar site in the long run). It might thus make practical sense to consider not placing any solar panels in this specific area. A variation of the distribution of the solar panels as shown in the lay-out Figure 2, but avoiding the green area shown in Figure 13, might even be considered.

Figure 13: Google image showing the location (green area) of the protected trees encountered on the site

Table 3, underneath, gives a list of the protected trees encountered on the property with their GPS location as well as the number of trees associated with each marked location.

Table 3: A list of protected trees encountered during the site visit and their GPS co-ordinates

NO	SPECIES NAME	COMMON NAME	NUMBER OF TREES	LOCATION
1.	*Boscia albitrunca*	Sheppard's tree	1 mature	S29 28 30.2 E23 54 28.1
2.	*Boscia albitrunca*	Sheppard's tree	1 mature + 3 young	S29 28 30.6 E23 54 27.1
3.	*Boscia albitrunca*	Sheppard's tree	1mature	S29 28 28.4 E23 54 25.2
4.	*Boscia albitrunca*	Sheppard's tree	1 young	S29 28 26.2 E23 54 21.9
5.	*Boscia albitrunca*	Sheppard's tree	2 mature	S29 28 26.2 E23 54 21.9
6.	*Boscia albitrunca*	Sheppard's tree	1 young	S29 28 26.7 E23 54 20.4

MAMMAL AND BIRD SPECIES

The farm is zoned agriculture and used for livestock grazing. However, it is expected that the property still supports a number of game species, birds and other fauna. It was noted that the area in which the final proposed site is to be located seems to have been grazed over a long period of time. However, viewed in the larger context of the farm, the 20 ha solar facility will not pose a significant loss of grazing and the proposed solar site facility is not expected to have a major impact on regional biodiversity and with mitigating and good environmental control during construction the impact could be minimised.

According to the Sanparks website (www.sanparks.org.za/parks/mokala), the nearby Mokala National Park is host to a varied spectrum of birds which adapted to the transition zone between Kalahari and Karoo biomes. Birds that can be spotted are the Kalahari species, black-chested prinia and its Karoo equivalent rufous-eared warbler as well as melodious lark. In rocky hillocks attract species such as freckled nightjar (vocal at night), short-toed rock thrush and cinnamon-breasted bunting. There are also a number of birds making use of the

artificial man-made habitat around accommodations, such as mousebirds, martins, robin-chats, thrushes, canaries and flycatchers. Animal species such as Black Rhino, White Rhino, Buffalo, Tsessebe, Roan Antelope, Mountain Reedbuck, Giraffe, Gemsbok, Eland, Zebra, Red Hartebeest, Blue Wildebeest, Black Wildebeest, Kudu, Ostrich, Steenbok, Duiker and Springbok are also present in the Mokala National Park. The trees associated with the riverbeds provide locally rare nesting and roosting habitat to birds.

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.

Figure 14: A Google overview of the proposed site location, indicating the drainage lines encountered on site

Two dry watercourses or upper drainage lines were observed on the property (Refer to Figure 14), one draining from west to east in the north-western portion of the proposed solar location (Photo 6) and one draining from the middle of the proposed solar location towards the south-south-west (Photo 7). Although they are not considered major watercourses they are well established and support denser woody riparian vegetation (defining the watercourse). Both of these drainage lines drain towards the Orange River, east of the proposed site location.

The woody riparian vegetation in both instances is dominated by *Acacia mellifera*, with *Acacia karroo*, and *Ziziphus mucronata* also sometimes present.

Photo 6: A photo of the drainage line to north-east of the site location (note the denser riparian vegetation)

Photo 7: A photo of the watercourse to the south-east of the property

INVASIVE ALIEN INFESTATION

Most probably because of the aridity of the area, invasive alien rates are generally very low for most of this area and no problem plants were observed within the study area (apart from some bush encroachment by the indigenous *Acacia mellifera*).

SIGNIFICANT BIODIVERSITY FEATURES ENCOUNTERED

The table underneath gives a summary of biodiversity features encountered during the site visit and a short discussion of their possible significance in terms of regional biodiversity targets.

Table 4: Summary of biodiversity features encountered on Erf 1654, Disselfontein and their possible significance

BIODIVERSITY ASPECT	SHORT DESCRIPTION	SIGNIFICANCE RATING
Geology & soils	The soils are mostly similar throughout the study area, although varying in depth.	No special features have been encountered on the final solar location (e.g. true quartz patches or broken veld).
Land use and cover	Agricultural land	Agricultural land used for grazing.
Vegetation types	Vaalbos Rocky Shrubland.	Vaalbos Rocky Shrubland is considered "Least threatened". However, the remaining natural veld shows good connectivity with the surrounding areas.
Endemic or protected plant species	No endemic species was observed, but a number of protected tree species was observed (Refer to Table 3).	A number of *Boscia albitrunca* trees were observed located along the south-western fence of the proposed site location. It is recommended that the lay-out of the final proposed site is altered slightly in order to avoid having to remove or damage these trees.
Mammal or bird species	The farm is used for agricultural grazing, although small game species are still expected.	The size and location of the solar facility is not expected to have a significant impact on total grazing or the movement of game species found on the larger area.
Rivers & wetlands	Two watercourses or upper drainage lines were encountered on the site.	It is recommended that the lay-out and final placement of the solar infrastructure take the location of these watercourses into consideration, with the intent of minimising impacts on these features (e.g. staying at least 32 m away from the edge of the watercourse wherever possible or at least protecting the integrity of the watercourse and riparian vegetation).
Invasive alien infestation	No alien invasive trees were observed.	No impact.

In summary, all areas with remaining natural vegetation, especially when these features show good connectivity with the surrounding natural veld (e.g. corridors) should be considered as significant. However, the placement of a 20 ha solar site in this location is not expected to have significant impact on any biodiversity feature or put pressure on regional conservation targets. The impact on populations of individual species is regarded as low (so long as *Boscia albitrunca* could be conserved), the impact on sensitive habitats is regarded as medium-low (mitigation with regards to watercourses will reduce the impact), the impact on ecosystem function is regarded as very low, cumulative impact on ecology is regarded as medium-low (rivers and protected trees) and finally the impact on economic use of the vegetation is regarded as low.

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 vegetation type would be soil type and depth and grazing pressure (herbivore), and could largely determine plant community composition and occurrence of rare species. Grazing 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. Although upper drainage lines was observed on the property no other, wetlands, upland- down land gradients or vegetation boundaries were observed during the site visit (associated with the final proposed solar site location). It was also not evident to what extent the fire regime has been altered in order to improve grazing (if at all).

THREATENED OR PROTECTED ECOSYSTEMS

The site visit confirmed that the vegetation conforms to Vaalbos Rocky Shrubland (Refer to Figure 12). This vegetation type was classified as "Least Threatened" during the 2004 National Spatial Biodiversity Assessment (NSBA). More than 98% of this vegetation still remains in its natural state, but at present none of this vegetation type is formally protected 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, **Vaalbos Rocky Shrubland, remains classified as Least Threatened**.

The impact on threatened or protected ecosystems is regarded as being low.

Mitigation:

- Good environmental control during the construction phase will ensure further mitigation.

SPECIAL HABITATS

The vegetation itself is not considered to belong to a threatened or protected ecosystem. Apart from the two watercourses or upper drainage lines, no special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems. It is recommended that the lay-out and final placement of the solar infrastructure take the position of these watercourses into consideration, with the intent of minimising impacts on these features (e.g. staying at least 32 m away from the edge of the watercourse wherever possible or at least protecting the integrity of the watercourse and riparian vegetation). If this could be achieved the impact will be much reduced.

Overall the development of the 20 ha Keren Energy solar facility at Disselfontein is not expected to a have a significant impact on any special habitat apart from the river systems. If the watercourses could be protected (e.g. staying at least 32 m away from the edge of the watercourse wherever possible, or at least protecting the integrity of the watercourse and riparian vegetation), impact on special habitats can be rated as low, however, without mitigation the impact would be rated as medium-low.

Mitigation:

- Stay at least 32 m away from the edge of any watercourse or at least protect the integrity of the watercourse and riparian vegetation.

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 road networks), also take note of the minor riparian corridors along the watercourses (which must be protected wherever possible).

Since large areas with good connectivity remains, the 20 ha Disselfontein Keren Energy solar facility development is not expected to a have a significant impact on connectivity with regards to surrounding natural veld (especially if mitigation with regards to the riparian vegetation can be implemented). The impact is rated as low to medium-low.

Mitigation:

- Stay at least 32 m away from the edge of any watercourse or at least protect the integrity of the watercourse and riparian vegetation.

EVALUATION OF SIGNIFICANT SPECIES

The site visit was performed at the end of February (2012). At the time of the study the veld in the Disselfontein area was generally in very good condition and most of the species was visible/identifiable. The author is of the opinion that in the larger context almost all significant species were observed and mapped.

THREATENED OR ENDANGERED SPECIES

No threatened or endangered species were recorded during the site visit, however, this does not rule out their presence as they may be subject to seasonable rainfall and may not have been observable during the time of the site visit. The composition of the herbaceous layer fluctuates with seasonal rainfall (Van Rooyen *et. all*,

1984, *vide* Mucina & Rutherford, 2006). It must be noted that the vegetation type is considered "Least Threatened" (Mucina & Rutherford, 2006) and that this classification is based on plant species diversity and turnover as well as habitat transformation. The number of species per broad geographical levels for the savannah biome is relative low (Van Rooyen, 1988, *vide* Mucina & Rutherford, 2006). It is therefore very unlikely that any red data species will be confined to this site alone.

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.

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

Mitigation:

- 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 will become insignificant.

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 *Boscia albitrunca* (Witgat) was observed on the proposed site. (All of the trees observed were referenced by GPS and are indicated on Figure 4 and in Table 3).

The current final solar site location as shown in Figure 3, will impact on a number of mature *Boscia albitrunca* trees. However, since these trees are all located along the south-west boundary of the proposed final location (clumped together) a slight alteration of the layout (e.g. shifting the solar infrastructure slightly east in that specific area) could totally negate the impact. Still it is important that if this development is approved good environmental control should be exercised and that a botanist or an ECO with suitable experience should be appointed during the initial lay-out of the site. With good environmental control and careful placement of the solar pylons and the maintenance roads any further possible impact to such trees within the final site location can be greatly reduced or minimised.

With mitigation implemented the impact can be negated, without mitigation the severity of the impact is rated as medium to medium-low.

Mitigation:

- Consider moving the final layout of the proposed solar site, e.g. shifting the solar infrastructure slightly east in the specific area populated by *Boscia albitrunca* trees to avoid these trees.

- A botanist or suitably experienced ECO must be appointed to oversee the initial layout of the construction site, with the aim to identify and minimise the impact on any protected trees. The placement of roads and solar structures should endeavour to avoid any of these tree species.
- If any of these trees must be removed, permit approval must be obtained beforehand.
- It is also proposed that at least two plants of the same species be replanted for every single tree removed.

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 (Refer to Photo 8). 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 8: 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 23).
- Loss of local biodiversity and threatened plant species (Refer to page 23)
- Loss of ecosystem connectivity (Refer to page 24)

LOSS OF VEGETATION AND ASSOCIATED HABITAT

One broad vegetation type is expected in the study area, namely Vaalbos Rocky Shrubland (Refer to Vegetation encountered on page 13). Vaalbos Rocky Shrubland was classified as "Least Threatened" 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 Vaalbos Rocky Shrubland are still regarded as least threatened. More than 98% 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 can be much reduced.

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

- Also include the mitigation actions under the heading: Protected species (page 25).
- 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). The construction of hard surfaces should be minimised or avoided.
- Access roads and the internal road system must be clearly demarcated and access must be tightly controlled (deviations may 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. Vaalbos Rocky Shrubland was classified as "Least Threatened", 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 Vaalbos Rocky Shrubland is still regarded as least threatened. More than 98% 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 (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. However, minor watercourses or upper drainage lines and a number of protected tree species will remain undisturbed.

The site visit and desktop studies described and evaluated in this document led to the conclusion that the "No-Go" alternative will not result in significant gain in regional conservation targets, the conservation of rare & endangered species or gain in connectivity, however, a number of protected tree species will be conserved (which, with mitigation, could be achieved even if the development is approved). 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, biodiversity friendly, and more sustainable long term 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.

$$S = [(fd + int + sev + ext + loc) \times (leg + gcp + pol + ia + str) \times P] \text{ (as adapted)}$$

$$S = [(1.5 + 1.5 + 2 + 1 + 1.5) \times (1 + 1 + 1 + 1 + 1) \times 0.95] = 36\ \%$$

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.

$$S = [(fd + int + sev + ext + loc) \times (leg + gcp + pol + ia + str) \times P] \text{ (as adapted)}$$

$$S = [(1.5 + 1.5 + 2 + 1 + 1.5) \times (0 + 1 + 0 + 1 + 0) \times 0.95] = 7\ \%$$

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 Disselfontein final location was relatively 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 (e.g. watercourses and drainage lines) would likely still be only medium. With mitigation, 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.

Photo 9: *Polygala asbestina* encountered on site

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, however, a number of protected tree species will be conserved (please note that this could also be achieved with mitigation as proposed in this document). 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.

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 (and the need for building more) 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 and that a botanist or suitably qualified ECO be appointed during the initial layout of the structures in order to minimise/negate the impact on significant biodiversity features (e.g. watercourses) and the protected tree species.

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 larger property.
- Adequate measures must be implemented to ensure against erosion.

SITE SPECIFIC

- Consider altering the final layout of the proposed solar site, through shifting the solar infrastructure slightly east in the specific area populated by *Boscia albitrunca* trees to avoid these trees (Refer to Figure 15).
- A botanist or suitably experienced ECO must be appointed to oversee the initial layout of the construction site, with the aim to identify and minimise the impact on any protected trees. The placement of roads and solar structures should endeavour to avoid any of these tree species.
- If any of these trees must be removed, permit approval must be obtained beforehand. It is also proposed that at least two plants of the same species be replanted for every single tree removed.
- Stay at least 32 m away from the edge of any watercourse or at the very least the integrity of all watercourses and its associated riparian vegetation must be protected (since it can be regarded as minor watercourses) (Refer to Figure 15).
- 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 any hard surfaces should be minimised or avoided.
- During construction 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 may 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 approved access and maintenance tracks to allow the vegetation to re-establish over the excavated areas.

Figure 15: A visual summary of the proposed mitigation areas, showing areas to be avoided in yellow