Appendix D: Specialist reports

Appendix D1	Agricultural
Appendix D2	Biodiversity
Appendix D3	Heritage
Appendix D3a	Archaeological
Appendix D3b	Palaeontological
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Appendix D4	Socio-Economic

Appendix D1 Agricultural

BASIC ASSESSMENT LEVEL REPORT

SOIL, LAND USE, LAND CAPABILITY AND AGRICULTURAL POTENTIAL SURVEY:

PROPOSED KAKAMAS SOLAR ENERGY FACILITY: KAKAMAS, NORTHERN CAPE PROVINCE

March 20th, 2012

Compiled by:
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DECLARATION

I, Johan Hilgard van der Waals, declare that I –

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

J.H. VAN DER WAALS
TERRA SOIL SCIENCE

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» Good enough internal and external (out of profile) drainage if irrigation practices are considered. Drainage is imperative for the removal (leaching) of salts that accumulate in profiles during irrigation and fertilization.

In addition to soil characteristics, climatic characteristics need to be assessed to determine the agricultural potential of a site. The rainfall characteristics are of primary importance and in order to provide an adequate baseline for the viable production of crops rainfall quantities and distribution need to be sufficient and optimal. The combination of the above mentioned factors will be used to assess the agricultural potential of the soils on the site.

2.3 Survey Area Boundary

The site lies between 28° 47' 04" and 28° 47' 23" south and 20° 36' 08" and 20° 36' 31" east immediately south of the town of Kakamas in the Northern Cape Province (**Figure 1**).

2.4 Survey Area Physical Features

The survey area lies on relatively flat terrain between 680 and 700 m above mean sea level with a general north-westerly aspect. The geology of the area varies with the dominance of migmatite, gneiss and granite with the occasional occurrence of ultrametamorphic rock of the Namaqualand Metamorphic Complex. The morphology of the landscape is dominated by a very dense subdendritic drainage and dissection pattern with the occasional occurence of lime nodules and calcrete (Land Type Survey Staff, 1972 – 2006).

3. SOIL, LAND CAPABILITY, LAND USE SURVEY AND AGRICULTURAL POTENTIAL SURVEY

3.1 Method of Survey

The Basic Assessment level soil, land capability, land use and agricultural potential surveys were conducted in three phases.

3.1.1 Phase 1: Land Type Data

Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (MacVicar, C.N. et al. 1991).

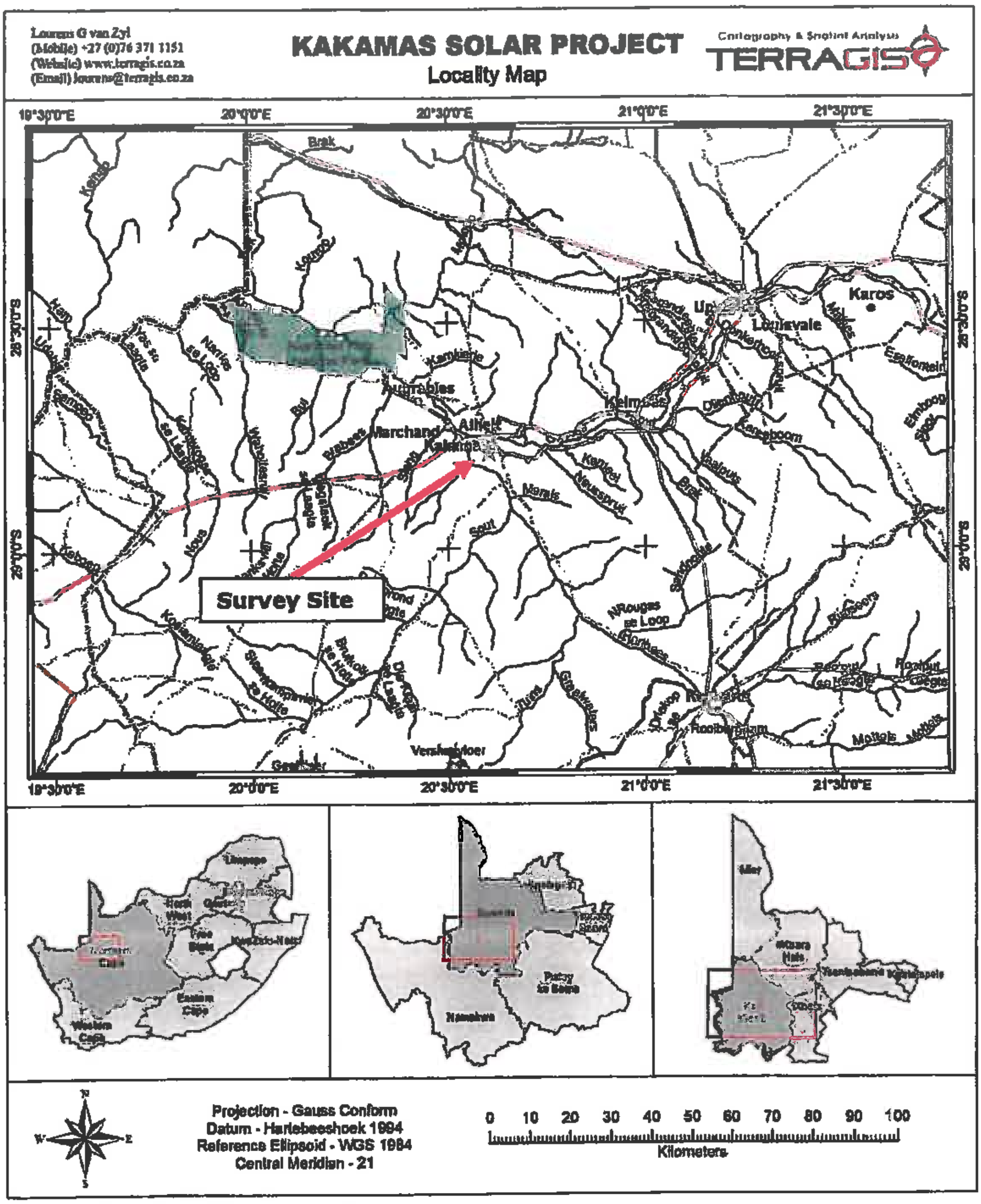

Figure 1 Locality of the survey site

3.1.2 Phase 2: Aerial Photograph Interpretation and Land Use Mapping

The most up to date aerial photographs of the site were obtained from Google Earth. The image was used to interpret aspects such as land use and land cover.

3.1.3 Phase 3: Site Visit and Soil Survey

A site visit was conducted on the 24h of November, 2011, during which a soil survey was conducted. The site was traversed on foot with the aim of ascertaining as much of the soil variability as possible. Soils were described and photographs were taken of pertinent soil, landscape and land use characteristics.

3.2 Survey Results

3.2.1 Phase 1: Land Type Data

The site falls into the **Ag2** land type (Land Type Survey Staff, 1972 - 2006). (Refer to **Figure 2** for the land type map of the area). Below follows a brief description of the land type in terms of soils, land capability, land use and agricultural potential.

<u>Land Type Ag2</u>
<u>Soils</u>: Shallow apedal (structureless) with regular occurrences of rock outcrops and lime in the soil profiles. The soils are typical of arid environment soils in that distinct soil formation is lacking and the soils exhibit only signs of physical weathering processes of parent materials. In drainage features varying thickness layers of sand have accumulated that are altered after every heavy rainfall event.
<u>Land capability and land use</u>: Mainly extensive grazing due to climatic and soil constraints. Crop production is only possible with very intensive preparation, in the form of ripping and land form shaping, and if water is supplied through irrigation. The preparation and establishment costs are such that it is only considered if a long term plan, with adequate market research and funding, has been drawn up.
<u>Agricultural potential</u>: Very low in the natural state due to soil and climate (rainfall – **Figure 3**) constraints with the potential of improvement in the case of land preparation, provision of water through irrigation and intensive management of water, salts, pests and markets. The typical crops for this area are table grapes and raisins.

3.2.2 Phase 2: Aerial Photograph Interpretation and Land Use/Capability Mapping

The interpretation of aerial photographs yielded one dominant land use namely extensive grazing (**Figure 4**). The carrying capacity of the site is very low as rainfall and soils are limiting with regards to biomass production. Additional feeding of animals and proper grazing management (camps) are imperative for the sustainable production of the livestock.

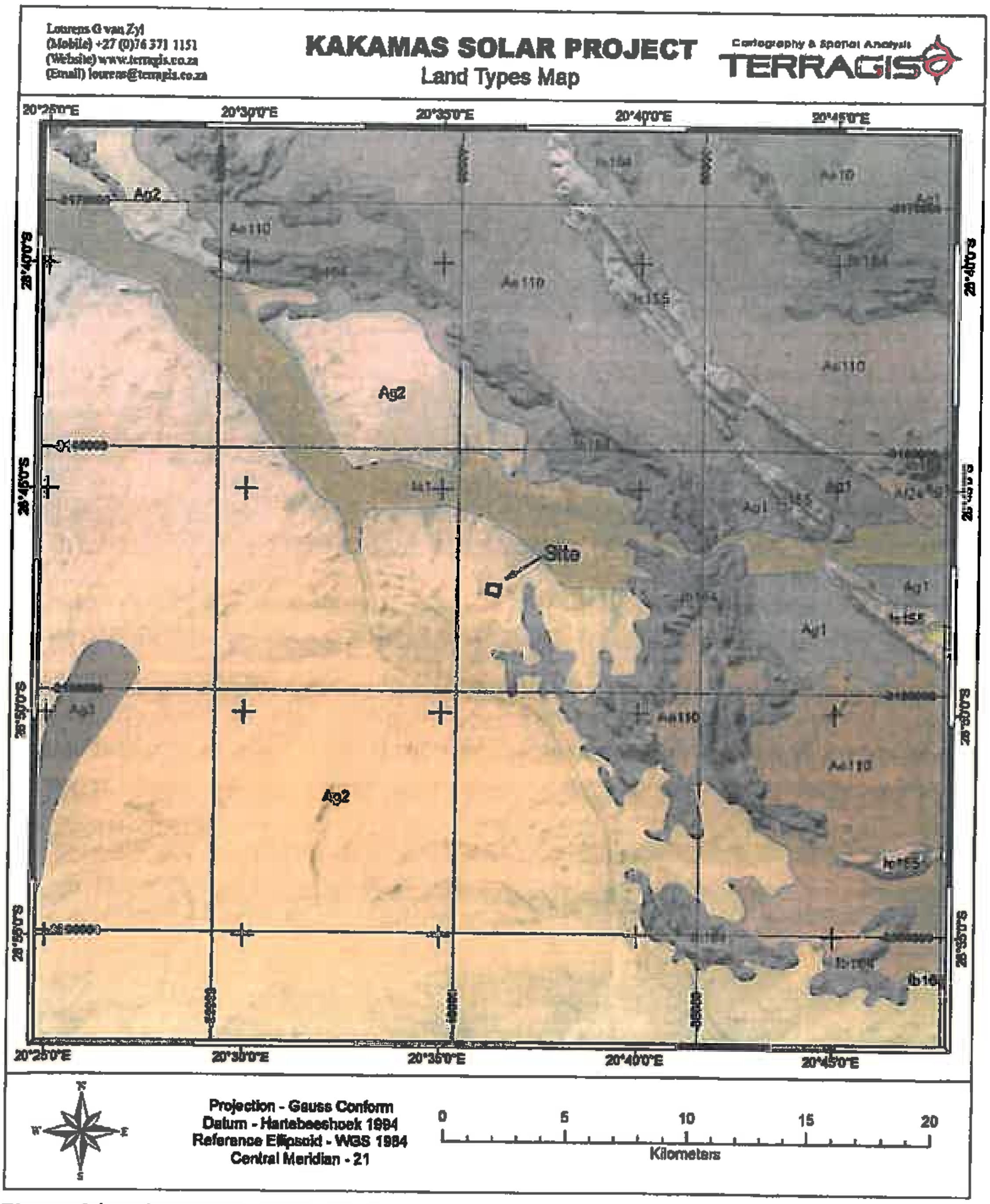

Figure 2 Land type map of the survey area

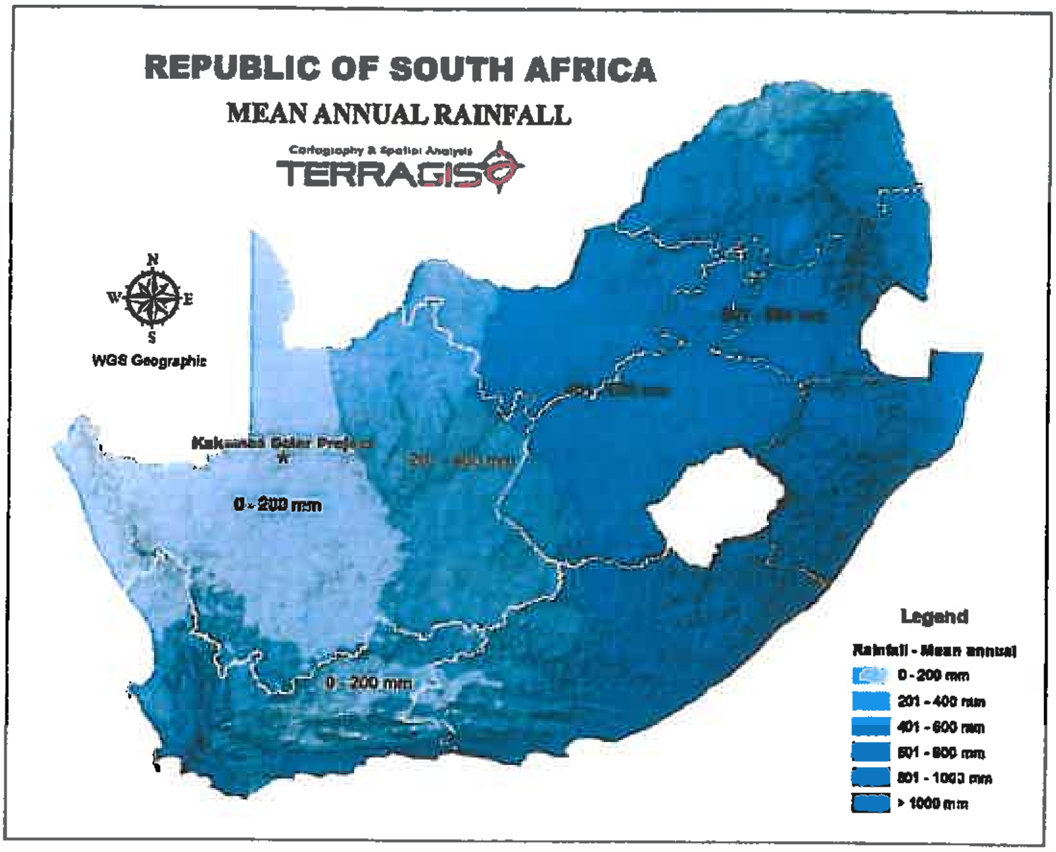

Figure 3 Rainfall map of South Africa indicating the survey site

3.2.3 Phase 3: Site Visit and Soil Survey

The soil survey revealed that the site consists of shallow rocky soils dominantly of the Mispah (Orthic A-horizon / Hard Rock) and Glenrosa (Orthic A-horizon / Lithocutanic B-horizon) forms. The classification of these soil forms is general as a range of other soil forms can occur on the site. These soils, however, occur sporadically due to nuances in the topography and differences in the rock outcrops and underlying rock topography. The soils that occur with the Mispah and Glenrosa forms include shallow Hutton (Orthic A-horizon / Red Apedal B-horizon / Unspecified – usually hard or weathering rock on this site), Dundee (Orthic A-horizon /Stratified Alluvium), Brandvlei (Orthic A-horizon / Soft Carbonate B-Horizon), Coega (Orthic A-horizon / Hardpan Carbonate Horizon) and Knersvlakte (Orthic A-horizon / Dorbank Horizon) forms. These soils are typical of arid environments and predominantly exhibit signs of physical weathering processes. Chemical weathering processes are not very pronounced but these are probably best exhibited in the accumulation of lime in a number of different subsoil horizons and weathering rock. The soils on the entire site are covered with pebbles (often quartz) and rocks leading to the near impossibility of auguring of holes with a hand soil auger (**Figures 5** to **7**). Erosion channels occur throughout the site and these are filled with recently transported soil material (Dundee soil form) (**Figure 8**).

The agricultural use of the soils is very limited due to their physical limitations. In order to establish vineyards these soils have to be ripped and the surface levelled – leading to massive establishment costs.

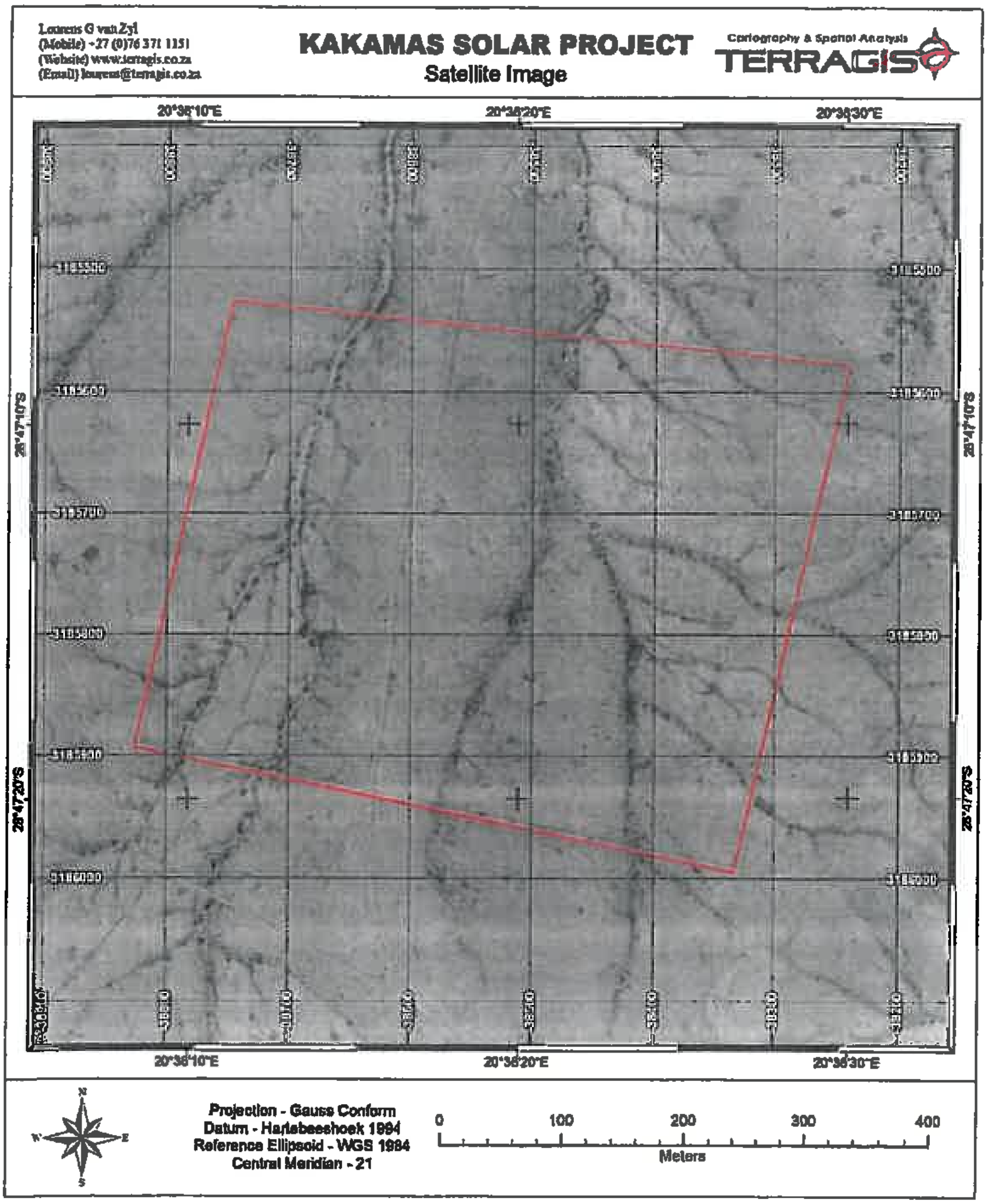

Figure 4 Satellite map of the general and the survey area


Figure 5 Shallow and rocky soils on the site


Figure 6 Shallow and rocky soils on the site

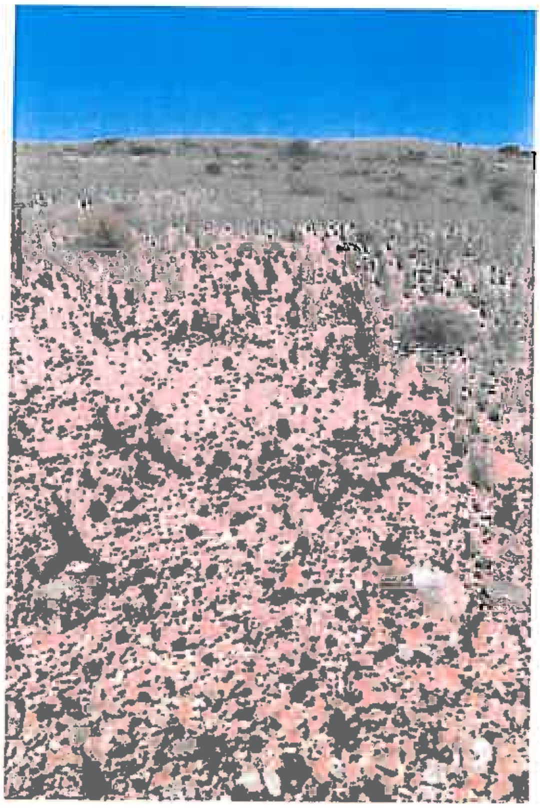

Figure 7 Shallow and rocky soils on the site

Figure 8 Physically weathered and transported material in alluvial features on the site

4. INTERPRETATION OF SOIL, LAND CAPABILITY AND LAND USE SURVEY RESULTS

The interpretation of the land use and land capability results yielded a number of aspects that are of importance to the project.

4.1 Agricultural Potential

The agricultural potential of the site is very low due to climatic constraints as well as the shallow and rocky soils. The improvement of the agricultural potential is dependent on extensive soil preparation and establishment of irrigation infrastructure – a very intensive and costly exercise. During the current economic climate many of the farmers or farming enterprises along the Gariep River have faced financial ruin. Under such conditions the investment into additional irrigated agriculture in this area is considered unsound.

4.2 Overall Soil and Land Impacts

Due to the low agricultural potential of the site as well as the low rainfall the impacts on soils and agriculture is expected to be low – provided that adequate storm water management and erosion prevention measures are implemented. These measures should be included in the layout and engineering designs of the development.

5. ASSESMENT OF IMPACT

5.1 Assessment Criteria

The following assessment criteria (**Table 1**) will be used for the impact assessment.

Table 1 Impact Assessment Criteria

[illegible]	DESCRIPTION OF DEFINITION
Direct, indirect and cumulative impacts	In relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.
Nature	A description of the cause of the effect, what will be affected and how it will be affected.
Extent (Scale) • 1 • 2 • 3 • 4 • 5	The area over which the impact will be expressed – ranging from local (1) to regional (5).

CATEGORY	DESCRIPTION OF DEFINITION
Duration • 1 • 2 • 3 • 4 • 5	Indicates what the lifetime of the impact will be. • Very short term: 0 – 1 years • Short-term: 2 – 5 years • Medium-term: 5 – 15 years • Long-term: > 15 years • Permanent
Magnitude • 2 • 4 • 6 • 8 • 10	This is quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
Probability • 1 • 2 • 3 • 4 • 5	Describes the likelihood of an impact actually occurring. • Very Improbable • Improbable • Probable • Highly probable • Definite
Significance	The significance of an impact is determined through a synthesis of <u>all</u> of the above aspects. S = (E + D + M)*P S = Significance weighting E = Extent D = Duration M = Magnitude
Status • Positive • Negative • Neutral	Described as either positive, negative or neutral
Other	• Degree to which the impact can be reversed • Degree to which the impact may cause irreplaceable loss of resources • Degree to which the impact can be mitigated

5.2 List of Activities for the Site

Table 2 lists the anticipated activities for the site. The last two columns in the table list the anticipated forms of soil degradation and geographical distribution of the impacts.

5.3 Assessment of the Impacts of Activities

Many of the impacts are generic and their impacts will remain similar for most areas on the site. The generic activity will therefore be assessed. The impacts associated with the different activities have been assessed below for each activity. These impacts have been summarized in **Table 8**. **Note:** The impacts listed below indicate that no mitigation is possible. It is important to note that any soil impact in the form of drastic physical disturbance (as with construction activities) is a permanent one and no mitigation is possible. The mitigation that can be applied is the restriction of off-site effects due to developments through adequate implementation of environmental management measures (discussed later in the report).

Table 2 List of activities and their associated forms of soil degradation

Activity	Form of Degradation	Geographical Extent	Comment (Section described)
Construction Phase			
Construction of solar panels and stands	Physical degradation (surface)	Two dimensional	Impact small due to localised nature (Section 5.3.1)
Construction of buildings and other infrastructure	Physical degradation (compound)	Two dimensional	(Section 5.3.2)
Construction of roads	Physical degradation (compound)	Two dimensional	(Section 5.3.3)
Construction and Operational Phase Related Effects			
Vehicle operation on site	Physical and chemical degradation (hydrocarbon spills)	Mainly point and one dimensional	(Section 5.3.4)
Dust generation	Physical degradation	Two dimensional	(Section 5.3.5)

5.3.1 Construction of Solar Panels and Stands

Table 3 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of solar panels and stands.

Table 3 Construction of solar panels and stands

Criteria	Description	
Cumulative Impact	The cumulative impact of this activity will be small as it is constructed on land with low agricultural potential.	
Nature	This activity entails the construction of solar panels and stands with the associated disturbance of soils and existing land use.	
	Without Mitigation	With Mitigation
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed
Duration	5 – Permanent (unless removed)	5 – Permanent (unless removed)
Magnitude	2	2
Probability	4 (highly probable due to inevitable changes in land use)	4 (highly probable due to inevitable changes in land use)
Significance of impact	S = (1 + 5 + 2)*4 = 32 (low)	S = (1 + 5 + 2)*4 = 32 (low)
Status	Negative	Negative
Mitigation	None possible. Limit footprint to the immediate development area	None possible. Limit footprint to the immediate development area

5.3.2 Construction of Buildings and Other Infrastructure

Table 4 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of solar panels and stands.

Table 4 Construction of buildings and other infrastructure

Criteria	Description	
Cumulative Impact	The cumulative impact of this activity will be small as it is constructed on land with low agricultural potential.	
Nature	This activity entails the construction of buildings and other infrastructure with the associated disturbance of soils and existing land use.	
	Without Mitigation	With Mitigation
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed
Duration	5 – Permanent (unless removed)	5 – Permanent (unless removed)

Magnitude	2	2
Probability	4 (highly probable due to inevitable changes in land use)	4 (highly probable due to inevitable changes in land use)
Significance of impact	S = (1 + 5 + 2)*4 = 32	S = (1 + 5 + 2)*4 = 32 (low)
Status	Negative	Negative
Mitigation	None possible. Limit footprint to the immediate development area	None possible. Limit footprint to the immediate development area

5.3.3 Construction of Roads

Table 5 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of roads.

Table 5 Construction of roads

Criteria	Description	
Cumulative Impact	The cumulative impact of this activity will be small as it is linear and limited in geographical extent.	
Nature	This activity entails the construction of roads with the associated disturbance of soils and existing land use.	
	Without Mitigation	With Mitigation
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed along the road	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed along the road
Duration	5 – Permanent (unless removed)	5 – Permanent (unless removed)
Magnitude	2	2
Probability	4 (highly probable due to inevitable changes in land use)	4 (highly probable due to inevitable changes in land use)
Significance of impact	S = (1 + 5 + 2)*4 = 32 (low)	S = (1 + 5 + 2)*4 = 32 (low)
Status	Negative	Negative
Mitigation	None possible. Limit footprint to the immediate development area and keep to existing roads as far as possible	None possible. Limit footprint to the immediate development area and keep to existing roads as far as possible

5.3.4 Vehicle Operation on Site

It is assumed that vehicle movement will be restricted to the construction site and established roads. Vehicle impacts in this sense are restricted to spillages of lubricants and petroleum products. **Table 6** presents the impact criteria and a description with respect to soils, land capability and land use for the operation of vehicles on the site.

Table 6 Assessment of impact of vehicle operation on site

Criteria	Description	
Cumulative Impact	The cumulative impact of this activity will be small if managed.	
Nature	This activity entails the operation of vehicles on site and their associated impacts in terms of spillages of lubricants and petroleum products	
	Without Mitigation	With Mitigation
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed
Duration	2 – Short-term	2 – Short-term
Magnitude	2	2
Probability	4	2 (with prevention and mitigation)
Significance of impact	S = (1 + 2 + 2)*4 = 20	S = (1 + 2 + 2)*2 = 10 (with prevention and mitigation)
Status	Negative	Negative
Mitigation	Maintain vehicles, prevent and address spillages	Maintain vehicles, prevent and address spillages

5.3.5 Dust Generation

Generated dust can impact large areas depending on environmental and climatic conditions. **Table 7** presents the impact criteria and a description with respect to soils, land capability and land use for dust generation on the site.

Table 7 Assessment of impact of dust generation on site

Criteria	Description	
Cumulative Impact	The cumulative impact of this activity will be small if managed but can have widespread impacts if ignored.	
Nature	This activity entails the operation of vehicles on site and their associated dust generation	
	Without Mitigation	With Mitigation
Extent	2 - Local: The impact is diffuse (depending on environmental and climatic conditions) and will probably be limited to within 3 – 5 km of the site	2 - Local: The impact is diffuse (depending on environmental and climatic conditions) and will probably be limited to within 3 – 5 km of the site
Duration	2 – Short-term	2 – Short-term
Magnitude	2	2
Probability	4	2 (with mitigation and adequate management)

Significance of impact	S = (2 + 2 + 2)*4 = 24	S = (2 + 2 + 2)*2 = 12 (with mitigation and adequate management)
Status	Negative	Negative
Mitigation	Limit vehicle movement to absolute minimum, construct proper roads for access	Limit vehicle movement to absolute minimum, construct proper roads for access

Table 8 Summary of the impact of the development on agricultural potential and land capability

Nature of Impact	*Loss of agricultural potential and land capability owing to the development*	
	Without mitigation	With mitigation
Extent	Low (1) – Site	Low (1) – Site
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (2)	Low (2)
Probability	Highly probable (4)	Highly probable (4)
Significance*	32 (Low)	32 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	No
Mitigation: The loss of agricultural land is a long term loss and there are no mitigation measures that can be put in place to combat this loss.		
Cumulative impacts: Soil erosion may arise owing to increased surface water runoff. Adequate management and erosion control measures should be implemented.		
Residual Impacts: The loss of agricultural land is a long term loss. This loss extends to the post-construction phase. The agricultural potential is very low though.		

5.4 Environmental Management Plan

Tables 9 to 11 provide the critical aspects for inclusion in the EMP.

Table 9 Measures for erosion mitigation and control

Objective: Erosion control and mitigation		
Project components	Soil stabilisation, construction of impoundments and erosion mitigation structures	
Potential impact	Large scale erosion and sediment generation	
Activity / risk source	Poor planning of rainfall surface runoff and storm water management	
Mitigation: Target / Objective	Prevention of eroded materials and silt-rich water running off the site	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Plan and implement adequate erosion control measures	Construction team and engineer	Throughout project
Performance indicator	Assessment of storm water structures and erosion mitigation measures. Measurement of actual erosion and sediment generation.	
Monitoring	Monitor and measure sediment generation and erosion damage	

Table 10 Measures for limiting vehicle operation impacts on site (spillages)

Objective: Erosion control and mitigation		
Project components	Maintenance of vehicles and planning of vehicle service areas	
Potential impact	Oil, fuel and other hydrocarbon pollution	
Activity / risk source	Poor maintenance of vehicles and poor control over service areas	
Mitigation: Target / Objective	Adequate maintenance and control over service areas	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Service vehicles adequately	Construction team and engineer	Throughout project
Maintenance of service areas, regular cleanup	Construction team and engineer	Throughout project
Performance indicator	Assessment number and extent of spillages on a regular basis.	
Monitoring	Monitor construction and service sites	

Table 11 Measures for limiting dust generation on site

Objective: Dust generation suppression			
Project components	Limit and address dust generation on site linked to construction activities		
Potential Impact	Large scale dust generation on site		
Activity / risk source	Inadequate dust control measures, excessive vehicle movement on unpaved roads		
Mitigation: Target / Objective	Minimise generation of dust		
Mitigation: Action/control		Responsibility	Timeframe
Implement dust control strategy including dust suppressants and tarring of roads		Construction team and engineer	Throughout project
Limit vehicle movement on unpaved areas to the absolute minimum		Construction team and engineer	Throughout project
Performance Indicator	Assessment of dust generated on site		
Monitoring	Monitor construction site and surrounds		

6. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the proposed development of a photovoltaic facility on the site will not have large impacts due to the low agricultural potential of the site. The low agricultural potential of the site is the result of a dominance shallow and rocky soils as well as the very low rainfall of the area.

It is imperative though that adequate storm water management measures be put in place as the soils on the site have no cohesion due to inherent soil properties as well as lack of plant roots. The main impacts that have to be managed on the site are:

1. Erosion must be controlled through adequate mitigation and control structures.
2. Impacts from vehicles, such as spillages of oil and hydrocarbons, should be prevented and mitigated.
3. Dust generation on site should be mitigated and minimised as the dust can negatively affect the quality of pastures as well as sheep production.

The impacts on the site need to be viewed in relation to the opencast mining of coal in areas of high potential soils – such as the Eastern Highveld. With this comparison in mind the impact of a solar energy facility is negligible compared to the damaging impacts of coal mining – for a similar energy output. Therefore, in perspective, the impacts of the proposed facility can be motivated as necessary in decreasing the impacts in areas where agriculture potential plays a more significant role.

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Appendix D2 Biodiversity

PB Consult
Ecological & Botanical management services

KAKAMAS

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 13, 2012

PREPARED BY: PB Consult

PREPARED FOR: ENVIROAFRICA CC

REQUESTED BY: KEREN ENERGY HOLDINGS (Pty) Ltd

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SUMMARY - MAIN CONCLUSIONS

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MAIN VEGETATION TYPES	**Bushmanland Arid Grassland** Described as an open, shrubby thornveld characterized by a dense shrub layer, often lacking a tree layer, with a sparse grass layer. **Least Threatened** But only 4% formally protected (Augrabies Falls National Park)
LAND USE AND COVER	The study area is situated on an Erf within the urban edge of Kakamas, but with little development or agricultural practices (apart from small Municipal works). Natural vegetation forms a sparse cover over the entire area of the study area. The Kakamas waste disposal site as well as sewerage works are located on the same property. Various non-perennial watercourses or drainage lines criss-cross the larger property.
RED DATA PLANT SPECIES	None encountered or expected Protected Trees: Two individuals of the tree *Boscia albitrunca* (Witgat) are located within the boundaries of the final proposed site location (associated with the dry watercourses or drainage lines).
IMPACT ASSESSMENT	Development without mitigation: Sig. rating = 31% Development with mitigation Significance = 5% Where values of ≤15% indicate an insignificant environmental impact and values >15% constitute ever increasing environmental impact.

RECOMMENDATION

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

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

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

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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 next to the town of Kakamas (Northern Cape Province, Kai !Garib Local Municipality). The facility will be established on an area of approximately 20 ha, on a portion of Erf 1654 (Kakamas), located adjacent and south-west of Kakamas. 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 DESCRIPTION

Keren Energy Holdings is proposing the establishment of a 10 MW concentrated photovoltaic solar energy facility near the town of Kakamas (Northern Cape Province, Kai !Garib Local Municipality). The facility will be established on a 20 ha portion of Erf 1654 (Kakamas), adjacent and south-west of Kakamas.

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 the N14 or from Hofmeyer road (within Kakamas), using existing secondary roads. However, additional temporary access roads will have to be established on site. Site preparation will include clearance of vegetation at the footprint of the following infrastructure:

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

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

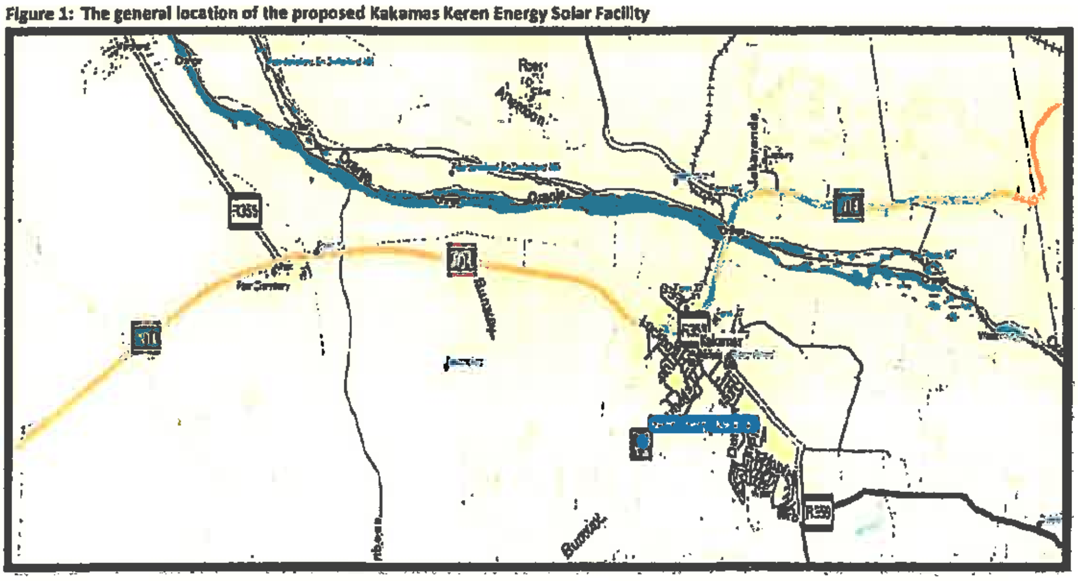
DESCRIPTION OF ENVIRONMENT

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

LOCATION & LAYOUT

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

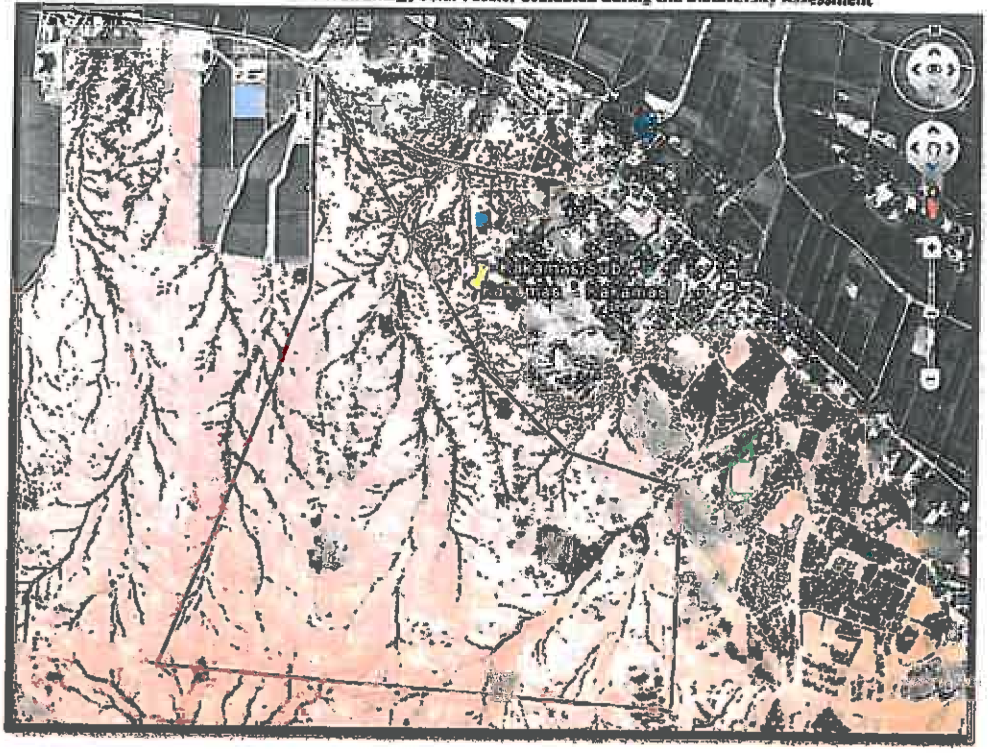
Figure 1: The general location of the proposed Kakamas Keren Energy Solar Facility



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

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

Figure 2: The broader area of the Kakamas Keren Energy Solar Facility evaluated during the Biodiversity Assessment



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

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

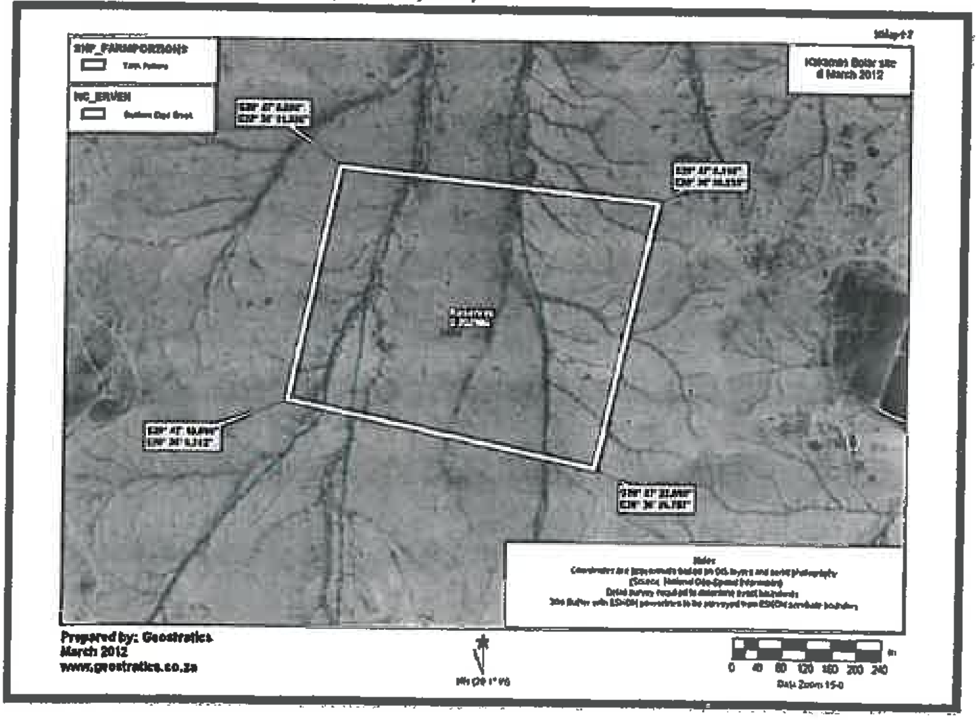


Table 1: GPS coordinates describing the boundaries of the proposed final solar site location (WGS 84 format)

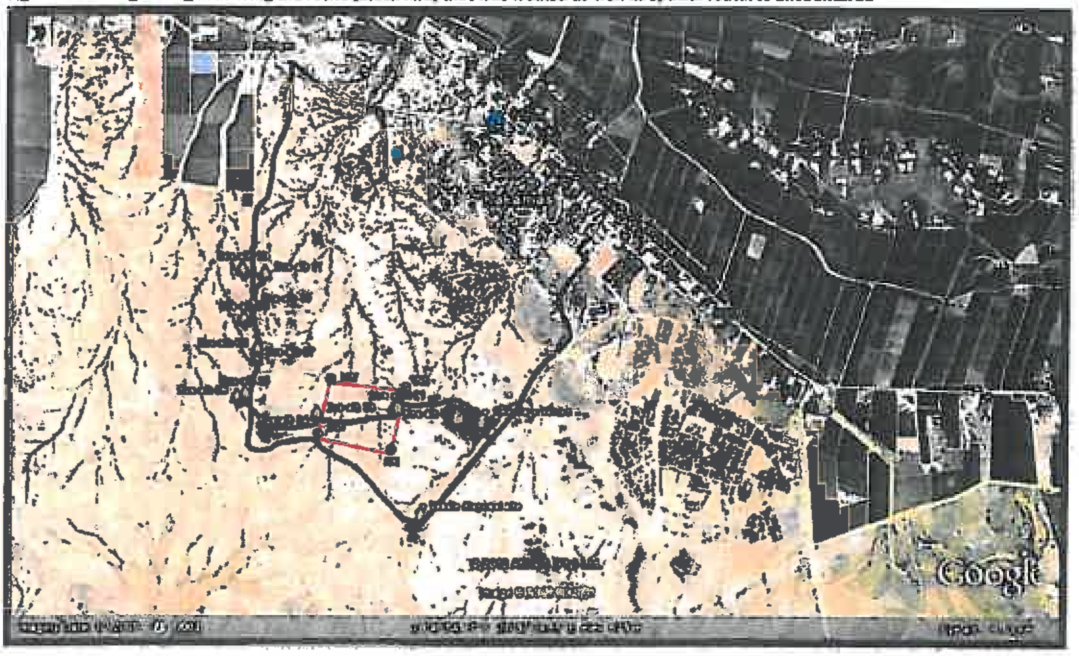
DESCRIPTION	LATITUDE AND LONGITUDE	ALTITUDE
North-west corner	S28 47 06.6 E20 36 11.3	681 m
North-east corner	S28 47 08.4 E20 36 30.2	691 m
South-east corner	S28 47 22.1 E20 36 26.7	694 m
South-west corner	S28 47 18.7 E20 36 08.2	693 m

METHODS

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

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

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

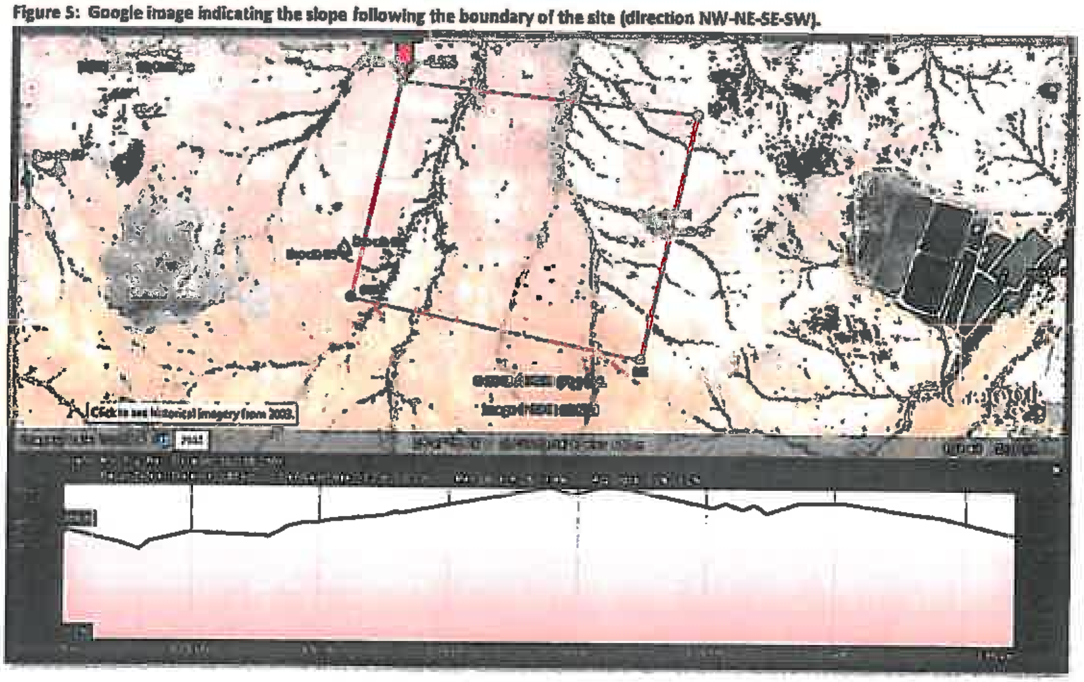


The site visit was also used to inform the client and EAP of potential conflicting areas (e.g. rivers/streams and plant species) in the larger site. This information together with engineering reasoning and other specialist studies was used to tweak the final proposed location indicated by the red block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

TOPOGRAPHY

The proposed final site is located on a relative flat, slightly undulating natural area. The elevation data given in Table 1 as well as in Figure 1 indicates an average slope of only 1.1%. It also shows that the site slopes slightly from the highest point (the south-east corner) to the north-west (the lowest corner) in the direction of the Orange River. Watercourses and drainage lines all drains roughly towards the north-west in the direction of the Orange River. However, the natural drainage lines does reach the Orange River directly (as it would originally have done), but is dispersed into a system of formal drainage channels once it reach the intensively cultivated (vines) area next to the Orange River.

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



CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. This area normally receives about 106 mm of rain per year (the climate is therefore regarded as arid to very arid). Kakamas normally receives about 62mm of rain per year, with most of its rainfall occurring during autumn. It receives the lowest rainfall (0 mm) in June and the highest (19 mm) in March. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Kakamas range from 20°C in July to 33°C in January. The region is the coldest during July when the mercury drops to 3.1°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)

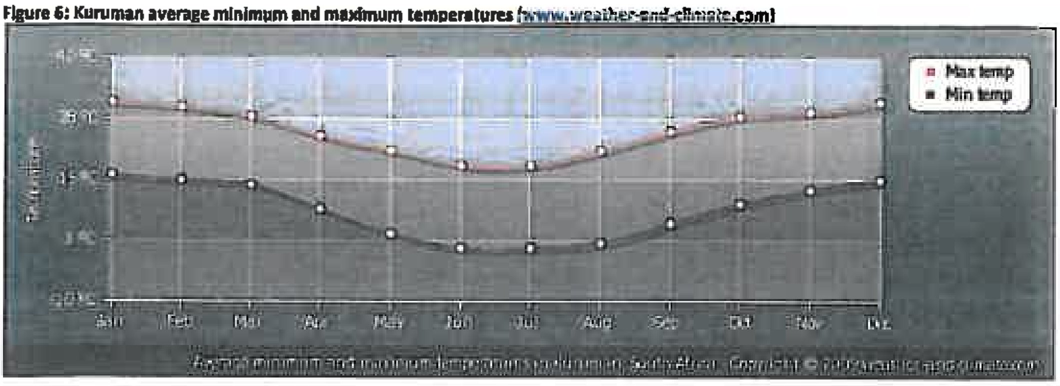


Figure 7: Kuruman average monthly precipitation over the year (www.weather-and-climate.com)

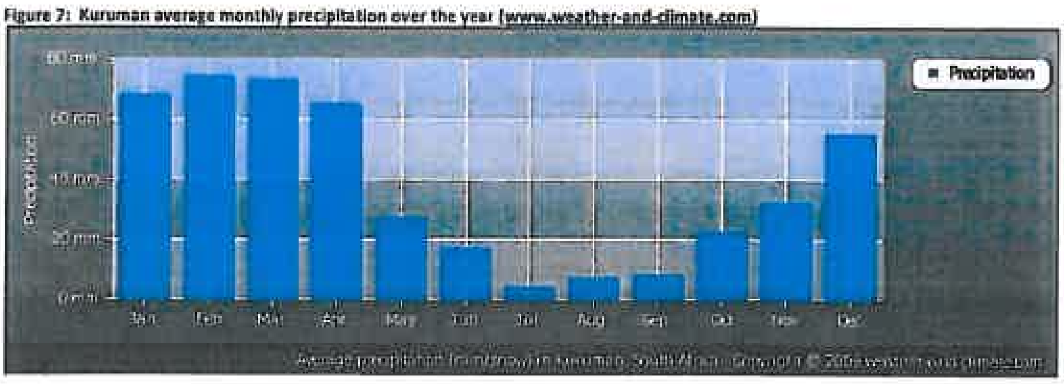


Figure 8: Kuruman average monthly hours of sunshine over the year (www.weather-and-climate.com)

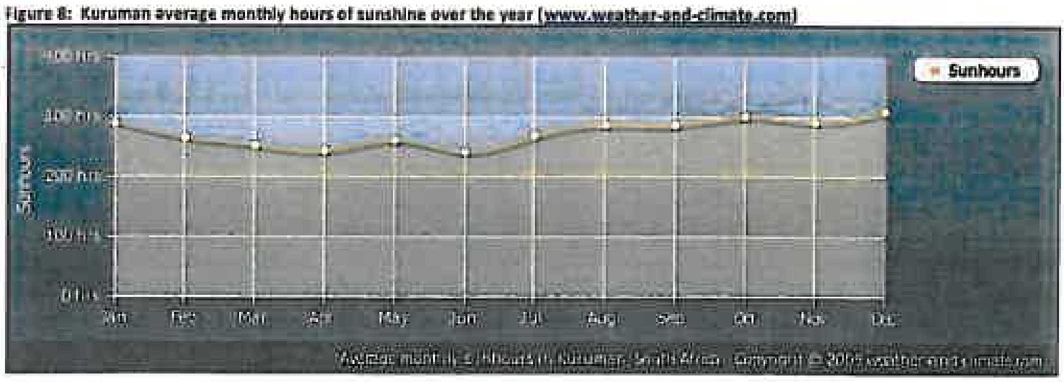
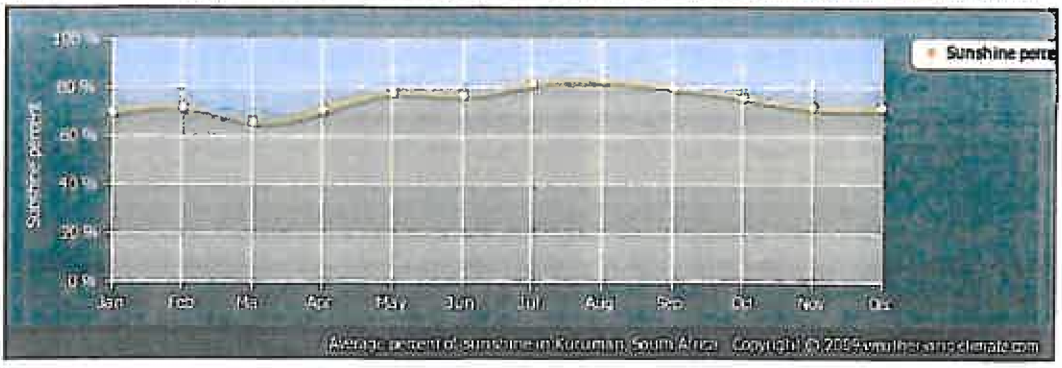


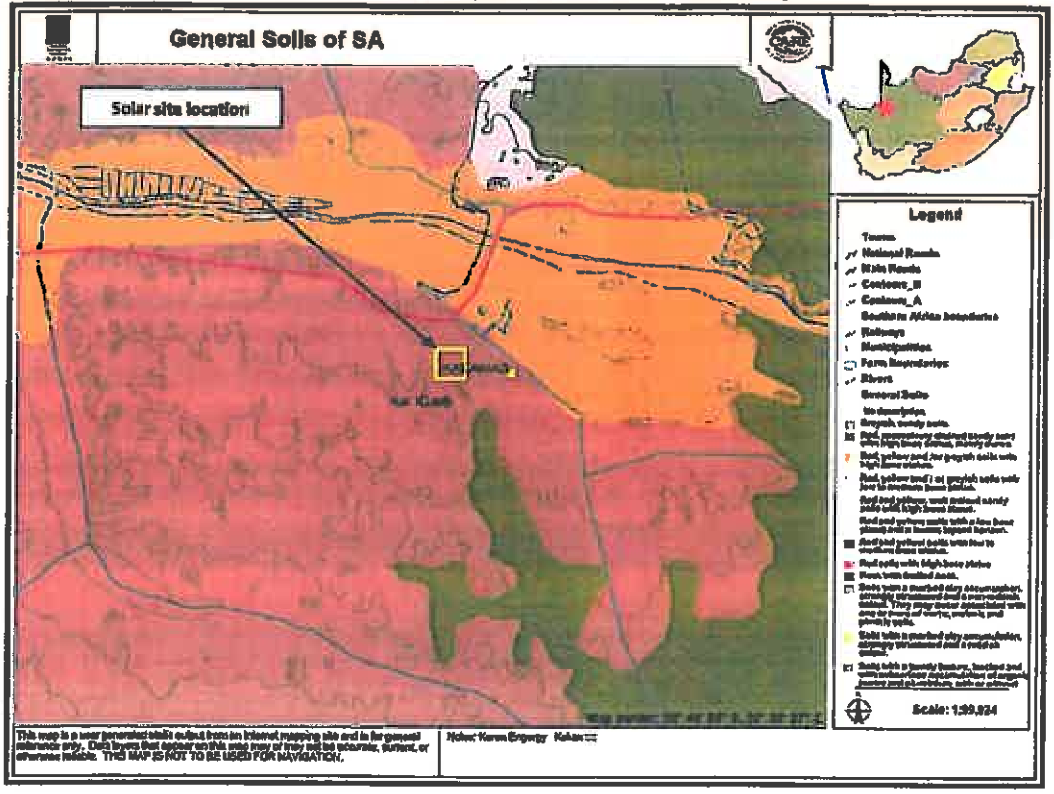
Figure 9: Kuruman average percent of sunshine over the year (mean % of sun hours during the day) (www.weather-and-climate.com)



GEOLOGY & SOILS

Geology is dominated by mudstones and shales of the Ecca Group (Prince Albert and Volksrust Formations) and Dwyka tillites, both of the early Karoo age. About 20% of rock outcrops are formed by Jurassic intrusive dolerite sheets and dykes. Soils (Refer to Figure 10) are described as soils with minimal development, usually shallow on hard or weathering rock, Glenrosa and Mispah forms, with lime generally present in the entire landscape (Fc land type) and, to a lesser extent, red-yellow apedal, freely drained soils with a high base status and usually <15% clay (Ah and Ai land types) are also found. The salt content in these soils is very high (Mucina & Rutherford, 2006).

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



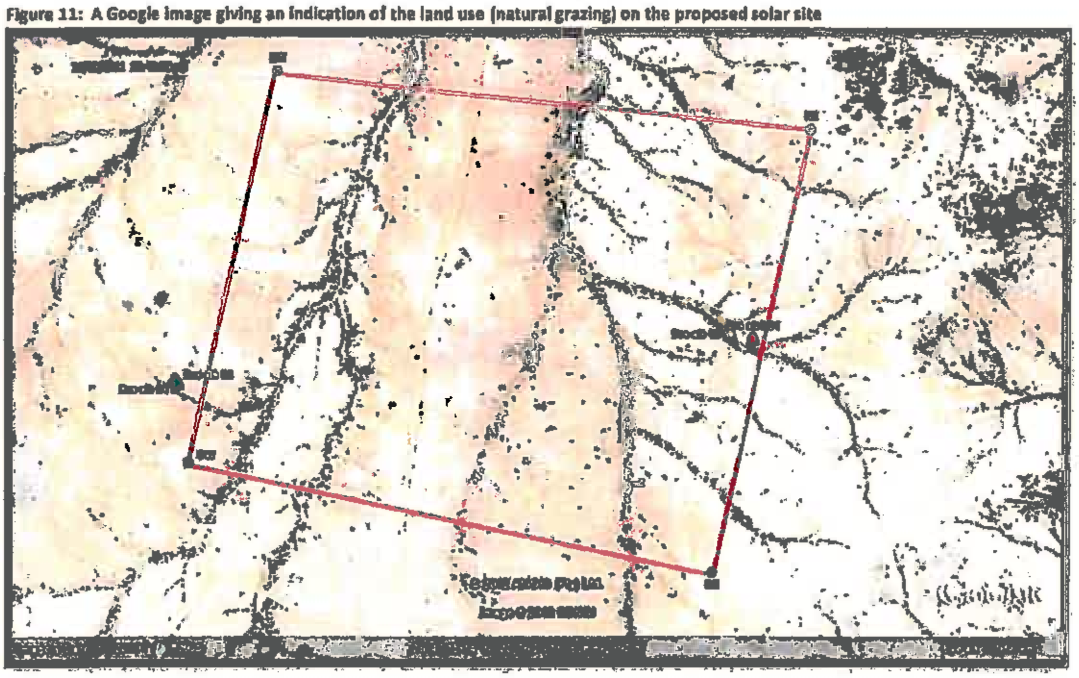
Please note that small areas littered with surface quartz stones have been observed, but they were not extensive and are not regarded as Quartz patches. Quartz patches are usually associated with arid or semi-arid habitats, characterised by concentrations of quartz stones on the surface an in the upper soil layers. Often these patches are cooler than surrounding vegetation and generally dominated by succulent "stone-plants", many of which are endemic. In the study area the quartz stones were found on the surface only and the concentration not such that it dominated any one patch, in fact the scale subsoil mostly still dominated the characteristics of the vegetation. The vegetation did not differ markedly from the surrounding areas and no succulent "stone-plants" were observed. These areas were thus not considered true quartz patches or special habitats of significance.

LANDUSE AND COVER

The study area is situated on Erf 1654, within the urban edge of the town of Kakamas. At present it is used for natural and/or communal grazing and for small Municipal works (the Municipal waste disposal site as well as the Sewerage works is also located on this Erf). To the north of the property, the Municipal Traffic Department test terrain is found, while low cost housing used to be located in this vicinity as well (being removed at present).

The final proposed location for the solar facility is located on a 20 ha portion of Erf 1654, just west of the sewerage works and north-west of the waste disposal site. This portion of the Erf is only used for natural or communal grazing (Refer to Figure 11). Natural vegetation forms a sparse cover over the entire remainder of the Erf. Please note that a number of watercourses and drainage lines criss-cross the Erf (which include the portion of the Erf chosen for the location of the solar site). Unfortunately, due to the distribution of these watercourses and drainage lines it would be impossible to locate a single 20 ha block within the larger Erf without encountering any such watercourse. As a result the final location was chosen to minimise the impact on the major water courses and to con-inside with the flattest terrain.

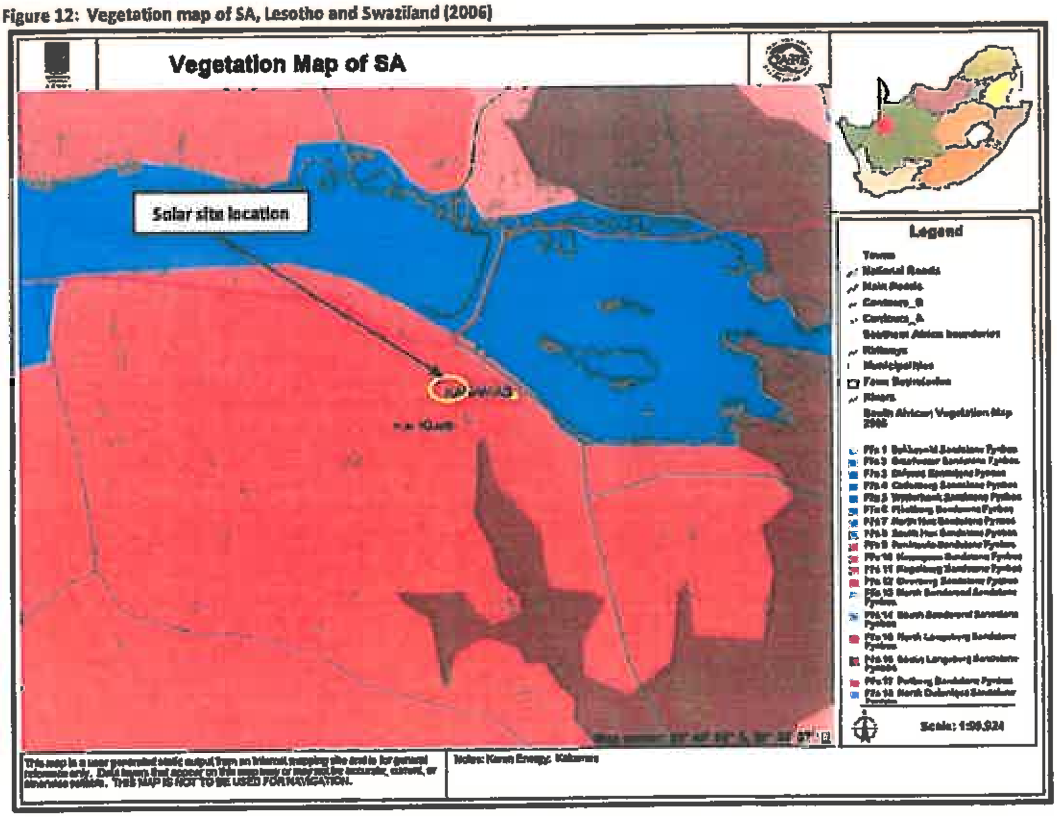
Figure 11: A Google image giving an indication of the land use (natural grazing) on the proposed solar site



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 Bushmanland Arid Grassland (Light red in Figure 12). This vegetation type was classified as "Least Threatened" during the 2004 National Spatial Biodiversity Assessment (NSBA). More than 99% of this vegetation still remains in its natural state, but at present only 4% is formally protected (Augrabies Falls National Park) throughout South Africa. Recently the *National list of ecosystems that are threatened and in need of protection* (GN 1002, December 2011), was promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004. According to this National list, Bushmanland Arid Grassland, remains classified as Least Threatened.

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



Bushmanland Arid Grassland is found in the Northern Cape Province spanning about one degree of latitude from around Aggeneys in the west to Prieska in the east. The southern border of the unit is formed by edges of the Bushmanland Basin while in the north-west this vegetation unit borders on desert vegetation (north-west of Aggeneys and Pofadder).

The northern border (in the vicinity of Upington) and the eastern border (between Upington and Prieska) are formed with often intermingling units of Lower Gariep Broken Veld, Kalahari Karroid Shrubland and Gordonia Duneveld. Most of the western border is formed by the edge of the Namaqualand hills. Altitude varies from 600 – 1 200 m (Mucina & Rutherford, 2006).

BUSHMANLAND ARID GRASSLAND

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

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

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

Photo 1: Natural veld in the study area (*Galenia africana* prominent), showing some of the drainage lines in the background

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

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

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

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

VEGETATION ENCOUNTERED

The sparse vegetation encountered conforms to that of Bushmanland Arid Grassland. The dominant vegetation is a grassy, dwarf shrubland. Grasses tend to be more common in depressions and on sandy soils, and less abundant on clayey soils. Most of the larger study area was sparsely but fairly uniformly covered by the same vegetation composition and was mostly associated with shallow soils/rocky shales soils. The non-perennial watercourses and drainage lines were mostly associated with slightly deeper soils with slightly denser riparian vegetation (Refer Error! Reference source not found.to Photo 3). Permanent drainage from the sewerage works into some of these water courses has led to significantly denser riparian vegetation in these areas (e.g. south-east of the works).

The shallow soils (covering most of the proposed final location as well as the larger terrain) supports a very sparsely covered grassy/shrub bottom layer with shrub small tree top layer sometimes present (Refer to Photo 2).

Photo 2: An overview of the vegetation on the proposed solar site location (*Euphorbia* sp and *Galenia africana* visible)

The grassy layer includes *Stipagrostis* species, *Aristida* species, *Eragrostis* species, *Schimdtia* species and *Eragrostis* species amongst other. Shrubs included amongst other: *Aloe* species, *Aptosimum spinescens*, *Delosperma sp.*, *Eriocephalus* species, *Euphorbia* cf. *mauritanica*, *Euphorbia spinea*, *Galenia africana*, *Lycium cinereum*, *Rhigozum trichotomum and Zygophyllum* cf. *microphyllum*. Small trees (mostly, associated with the riparian vegetation along dry drainage lines) included: *Acacia mellifera*, *Boscia foetida*, *Boscia albitrunca*, *Parkinsonia africana* and *Ziziphus mucronata*.

The upper drainage lines were typically associated with slightly denser vegetation than found in the immediate surroundings, with a much more prominent small tree cover (Refer to Photo 3).

Photo 3: Typical vegetation associated with the upper drainage lines (*Acacia mellifera* prominent)

The tree layer included, *Acacia mellifera* (Swarthaak), *Boscia albitrunca* (Witgat), *Boscia foetida*, *Gymnosporia heterophylla*, *Parkinsonia africana*, *Rhus lancea* and *Ziziphus mucronata* (Blinkblaar wag-'n-bietjie).

Next to the sewerage works a watercourse with much denser riparian vegetation was encountered (Refer to Photo 4). The reason for this much denser vegetation most probably is associated with the fact that overflow from the sewerage works results in almost permanent water run-off encountered in this area. The riparian vegetation becomes much denser (and the trees significantly larger) and includes the following species: *Acacia mellifera* (dominant), *Gymnosporia heterophylla*, *Lycium cinereum*, *Parkinsonia africana*, *Prosopis* sp., *Rhus lancea* and *Ziziphus mucronata* with mistletoe *Moquinella rubra* sometimes present in some of the trees or shrubs.

Photo 4: Dense riparian vegetation encountered next to the sewerage works

ENDEMIC OR PROTECTED PLANT SPECIES

Endemic taxa which might be encountered include: *Dinteranthus pole-evansii, Larryleachia dinteri, L marlothii, Ruschia kenhardtensis, Lotononis oligocephala* and *Nemesia maxi.* None of these species was encountered.

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.

During the site visit, a number of *Boscia albitrunca* trees were encountered in the larger area of Erf 1654. All of these trees encountered were marked with GPS coordinates (Refer to Table 3) and plotted on a map (Refer to Figure 4). It was also very clear that the location of these trees almost always co-insides with the location of a watercourse or drainage lines. In other words, they were almost always only encountered next to a watercourse or drainage line. Please note, that by locating the solar pylons away from the major watercourses, the impact on any of these trees can be negated.

Table 3: A list of *Boscia albitrunca* trees, and their GPS co-ordinates, encountered during the site visit

NO	SPECIES NAME	LOCATION
1.	*Boscia albitrunca*	S28 47 15.2 E20 36 28.2
2.	*Boscia albitrunca*	S28 47 15.1 E20 36 27.3
3.	*Boscia albitrunca*	S28 47 16.5 E20 36 07.7
4.	*Boscia albitrunca*	S28 47 16.6 E20 36 07.8
5.	*Boscia albitrunca*	S28 47 12.2 E20 35 49.5
6.	*Boscia albitrunca*	S28 47 12.8 E20 35 47.5
7.	*Boscia albitrunca*	S28 47 04.4 E20 35 52.3
8.	*Boscia albitrunca*	S28 47 02.4 E20 35 52.4
9.	*Boscia albitrunca*	S28 46 55.8 E20 35 49.1
10.	*Boscia albitrunca*	S28 46 52.5 E20 35 51.2
11.	*Boscia albitrunca*	S28 46 45.6 E20 35 54.3
12.	*Boscia albitrunca*	S28 46 44.7 E20 35 48.5

MAMMAL AND BIRD SPECIES

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

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

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

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

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

RIVERS AND WETLANDS

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

Various non-perennial or dry watercourses and drainage lines have been observed, criss-crossing most of Erf 1654 (Kakamas), which include the portion of the Erf chosen for the location of the solar site. Unfortunately, due to the distribution of these watercourses and drainage lines it would be impossible to locate a single 20 ha block within the larger Erf without encountering any such watercourse. As a result the final location was chosen to minimise the impact on the major water courses and to con-inside with the flattest terrain. By being sensitive with the placement of the access roads and pylons for the solar panels, significant impact on these features can be further minimised.

INVASIVE ALIEN INFESTATION

Most probably because of the aridity of the area, invasive alien rates are generally very low for most of this area. Problem areas are usually associated with river systems and other wetland areas.

Single Prosopis trees have been observed in the wetter area next to the Kakamas sewerage, but not on the rest of the property (Refer to Photo 5).

Photo 5: ***Prosopis glandulosa*** **encountered within the riparian vegetation next to the Kakamas sewerage works**

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, Kakamas and their possible significance

BIODIVERSITY ASPECT	SHORT DESCRIPTION	SIGNIFICANCE RATING
Geology & soils	Geology & soils are seemingly similar almost throughout the property.	No special features have been encountered on the final solar location (e.g. true quartz patches or broken veld). With regards to quartz patches please Refer to Geology & Soils on page 10.
Land use and cover	Mostly sparsely covered natural veld, possibly used for grazing.	Although it is suspected that the property might be used for natural and communal grazing only evidence of smaller game was observed.
Vegetation types	Bushmanland Arid Grassland and riparian vegetation along the myriad watercourses and drainage lines.	Bushmanland Arid Grassland is considered "Least threatened". However, the remaining natural veld shows good connectivity with the surrounding areas, while the riparian vegetation in combination with the watercourses is considered a biodiversity feature of at least medium significance.
Endemic or protected plant species	No endemic species was observed, but a number of the protected tree *Boscia albitrunca* was observed (Table 3).	The placement of the final proposed solar site location within the larger Erf, avoid almost all of these trees. Should the watercourses be avoided the impact to any of these trees can be negated.
Mammal or bird species	Small game is expected and droppings of such game have been observed.	The size and location of the solar facility within Erf 1654 is not expected to have a significant impact on the movement of any game species found on the larger property. Most of the game species encountered (dassies and klipspringer) tend to take shelter within the small rocky outcrops away from the proposed solar site location.
Rivers & wetlands	Watercourses and drainage lines criss-crosses the whole of the Erf.	The main watercourses represent one of the most significant biodiversity features of the property, even though the normal drainage lines have been compromised next to the Orange River.
Invasive alien infestation	Very low alien infestation rates have been observed.	The *Prosopis* trees encountered next to the some of the watercourses must be removed.

In summary, although all natural 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 on the specific location will have very little effect on any significant biodiversity feature or put pressure on regional conservation targets. The impact on populations of individual species is regarded as very low, the impact on sensitive habitats is regarded as very low, the impact on ecosystem function is regarded as very low, cumulative impact on ecology is regarded as very low and finally the impact on economic use of the vegetation is regarded as very 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 dry ecosystem would be variations in soil type (e.g. soil depth, moisture capacity, rockiness, mineral composition and acidity), and could largely determine plant community composition and occurrence of rare species. Grazing, especially by small resident antelope may be an important factor in regulating competitive interaction between plants (*Acacia mellifera* encroachment is often a sign of overgrazing or bad veld management). Certain species can act as important "nursery" plants for smaller species and are also important for successional development after disturbance. Tortoises and mammals can be important seed dispersal agents.

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

THREATENED OR PROTECTED ECOSYSTEMS

The vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered within the 20 ha final solar site location (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

However, various non-perennial or dry watercourses and drainage lines have been observed, criss-crossing most of Erf 1654 (Kakamas), which include the 20 ha portion of the Erf chosen for the location of the solar site. Watercourses and drainage lines are particularly vulnerable to alien plant invasion, agricultural transformation and or physical disturbance, those found on site should be regarded as at least of medium significance in terms of biodiversity. Unfortunately, due to the distribution of these watercourses and drainage lines it would be impossible to locate a single 20 ha block within the larger Erf without encountering any such watercourse. As a result the final location was chosen to minimise the impact on the major water courses and to con-inside with the flattest terrain. However, by being sensitive with the placement (within the chosen site) of the access roads and pylons for the solar panels and good environmental control during the construction phase, significant impact on these features can be much reduced or negated.

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

SPECIAL HABITATS

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

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

CORRIDORS AND OR CONSERVANCY NETWORKS

Looking at the larger site and its surroundings it shows excellent connectivity with remaining natural veld in almost all directions. Corridors and natural veld networks are still relative unscathed (apart from through-road networks). Watercourses and drainage lines on site are still almost pristine, although, these non-perennial drainage lines do not support a major difference in species composition (more a structural difference). In addition these drainage lines drain towards the Orange River, where it is almost totally compromised by intensive agricultural practices next to the river.

Since large areas with good connectivity remains and the site is located in the general area of most disturbance on the Erf (sewerage works and waste disposal site), the 20 ha Keren Energy solar facility development is not expected to a have a significant impact on connectivity of the remaining natural veld. The impact is rated as low.

EVALUATION OF SIGNIFICANT SPECIES

The site visit was performed during November 2011, an area which normally receives some rain from October. At the time of the study the Kakamas area had not received any rains of significance and as a result only the hardened drought resistant plant species were observed, herbs, bulbs and annuals were mostly absent. This might mean that some of the local endemic species were not in growth or could not be identified. However, the author is of the opinion that in the larger context it will not constitute a significant contribution.

THREATENED OR ENDANGERED SPECIES

No threatened or endangered species are recorded for this vegetation type. However, a few local endemic species are associated with the broader vegetation type. During the site visit no such species were observed and in the regional context the author is of the opinion that the development of the 20 ha solar facility will not lead to irreversible species loss. With good environmental control (e.g. topsoil removal, storage and re-distribution) and rehabilitation after construction (leaving the remaining area as natural as possible) the possibility of such an impact occurring could be almost negated.

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

PROTECTED SPECIES

Three protected tree species have a distribution which could overlap with the general site location of the solar facility namely: *Acacia erioloba* (Camel thorn) *Boscia albitrunca* (Witgat) and *Acacia haematoxylon* (Grey camel thorn). Of these 3 species only *Boscia albitrunca* was observed on the larger property, usually associated with the dry watercourses or drainage lines. (All of the trees observed were referenced by GPS and are indicated on Figure 4 and in Table 3). The final site location was specifically chosen to avoid as much of these watercourses as possible. However, 2 individuals of *Boscia albitrunca* will still be located within the proposed final 20 ha location (Refer to the GPS co-ordinates of the trees marked 1 & 2 in Table 3) and two more species on the fringes of the final location (Refer to the GPS co-ordinates for the trees marked as 3 & 4 in Table 3).

With good environmental control and careful placement of the solar pylons and the maintenance roads any disturbance or impact to these trees could be negated, the possibility of such an impact occurring will then be rated as low.

Mitigation: All *Boscia albitrunca* trees and its immediate surroundings (at least a 10 m radius) should be regarded as no-go areas.

PLACEMENT AND CONSTRUCTION METHOD

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

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

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

DIRECT IMPACTS

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

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

- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to construction and operational activities. (Refer to page 22).
- Loss of local biodiversity and threatened plant species (Refer to page 22)
- Loss of ecosystem connectivity (Refer to page 23)

LOSS OF VEGETATION AND ASSOCIATED HABITAT

One broad vegetation type is expected in the study area, namely Bushmanland Arid Grassland (Refer to Vegetation encountered on page 14). Bushmanland Arid Grassland was classified as "Least Threatened", but "Poorly Protected" during the 2004 National Spatial Biodiversity Assessment. Within the more recent "*National list of ecosystems that are threatened and in need of protection*" (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004, the status of Bushmanland Arid Grassland are still regarded as least threatened. Although only 0.4% of this vegetation type is formally protected, more than 99% of this vegetation type is still found in a relative natural state. Thus the vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

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

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

- Pylons should be placed at least 32 m away from the main watercourses on the property. Care should also be taken to protect drainage lines (by controlling the pylons placement).
- All *Boscia albitrunca* trees and its immediate surroundings (at least a 10 m radius) should be regarded as no-go areas. Any additional significant plant species that may be encountered must be identified and located (e.g. *Acacia erioloba*) and all efforts made to avoid damage to such species.
- Only existing access roads should be used for access to the terrain (solar site).
- The internal network of service roads (if needed) must be carefully planned to minimise the impact on the remaining natural veld on the site. The number of roads should be kept to the minimum and should be only two-track/twee spoor roads (if possible). 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. Bushmanland Arid Grassland was classified as "Least Threatened", but "Poorly Protected" during the 2004 National Spatial Biodiversity Assessment. Within the more recent *"National list of ecosystems that are threatened and in need of protection"* (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004, the status of Bushmanland Arid Grassland is still regarded as least threatened. Although only 0.4% of this vegetation type is formally protected, more than 99% of this vegetation type is still found in a relatively natural state. Thus the vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

Even if all of the 20 ha is transformed (such as for intensive cultivation), the impact on the regional status of this vegetation type and associated <u>biodiversity features would likely still be only medium-low</u>. 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. <u>However, all mitigation measures should still be implemented in order to further minimise the impact of the construction and operation of the facility</u>.

THE NO-GO OPTION

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

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

QUANTIFICATION OF ENVIRONMENTAL IMPACTS

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

NO DEVELOPMENT

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

DEVELOPMENT WITHOUT MITIGATION

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

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

$S = [(1.5 + 1.5 + 1.5 + 1 + 1) \times (1 + 1 + 1 + 1 + 1) \times 0.95] = 31\ \%$

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.

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

$S = [(1.5 + 1 + 1 + 1 + 1) \times (0 + 0 + 0 + 1 + 0) \times 0.95] = 5\ \%$

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

RECOMMENDATIONS & IMPACT MINIMIZATION

From the information discussed in this document it is clear to see that the Kakamas 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-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.

Photo 7: *Boscia albitrunca* on the larger property

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

Photo 8: Euphorbia spinea

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

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

IMPACT MINIMIZATION

GENERAL

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must be developed by a suitably experienced Environmental Assessment Practitioner.
- A suitably qualified Environmental Control Officer must be appointed to monitor the construction phase of the solar plant in terms of the EMP and the Biodiversity study recommendations as well as any other conditions which might be required by the Department of Environmental Affairs.
- An integrated waste management system must be implemented during the construction phase.
- All rubble and rubbish (if applicable) must be collected and removed from the site to a suitable registered waste disposal site.
- All alien vegetation should be removed from the larger property.
- Adequate measures must be implemented to ensure against erosion.

SITE SPECIFIC

- Pylons should be placed at least 32 m away from any of the main watercourses on the property. Care should also be taken to protect drainage lines (by controlling the pylon placement).
- All *Boscia albitrunca* trees and its immediate surroundings (at least a 10 m radius) should be regarded as no-go areas. Any additional significant plant species that may be encountered must be identified and located (e.g. *Acacia erioloba*) and all efforts made to avoid damage to such species.
- Only existing access roads should be used for access to the terrain (solar site).
- The internal network of service roads (if needed) must be carefully planned to minimise the impact on the remaining natural veld on the site. The number of roads should be kept to the minimum and should be only two-track/ twee-spoor roads (if possible). If possible the construction of 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.

Appendix D3 Heritage

Appendix D3a **Archaeological**

Appendix D3b **Palaeontological**

Appendix D3c **Visual**

Appendix D3a Archaeological

ARCHAEOLOGICAL IMPACT ASSESSMENT
THE PROPOSED KEREN ENERGY KAKAMAS SOLAR FARM ON ERF 1654 KAKAMAS NORTHERN CAPE PROVINCE

Prepared for:

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On behalf of:

KEREN ENERGY KAKAMAS (PTY) LTD

By

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MARCH 2012

Executive summary

The Agency for Cultural Resource Management was commissioned to conduct an Archaeological Impact Assessment (AIA) for the proposed construction and operation of a 10 Mega Watt (MW) commercial Concentrated Photovoltaic (CPV) Energy Generation Facility on Erf 1654 in Kakamas in the Northern Cape.

Kakamas is situated alongside the Orange River, about 80 kms west of Upington. The site for the proposed solar farm is located south of the town and just to the west of the Waste Water Treatment Works. The land is owned by the Kai Garib local municipality and is currently zoned for Agriculture use. The proposed 20 ha footprint area is fairly flat and slopes gently north toward the town. It is surrounded by hill slopes in the east. Several drainage channels intersect the site, draining south toward the town. The proposed footprint area is quite severely degraded. There is very little natural vegetation on the site. It is overgrazed, heavily sheet washed and covered in quartz gravel.

In terms of Section 38 (1) (c) (iii) of the National Heritage Resources Act 1999 (Act 25 of 1999), an Archaeological Impact Assessment of the proposed project is required if the footprint area of the proposed development is more than 5000 m².

The AIA forms part of the Environmental Basic Assessment process that is being conducted by EnviroAfrica cc.

The aim of the study is to locate and map archaeological sites/remains that may be impacted by the proposed project, to assess the significance of the potential impacts and to propose measures to mitigate the impacts.

A 1-day, foot survey of the proposed 20 ha footprint area, and a proposed ± 1 km long overhead powerline was undertaken by the archaeologist on 1 March 2012.

The following observations were made:

- 41 single, isolated archaeological occurrences were documented and mapped with a hand held GPS unit. The tools are spread very thinly and unevenly over the surrounding landscape. Most of the lithics (about 70%) are assigned to the Later Stone Age and the remainder to the Middle Stone Age. No Early Stone Age implements were found. The majority (78%) of the tools are in banded ironstone, with the remainder in indurated shale, quartzite, silcrete and quartz. Quartz gravel is prolific over the site making it difficult to detect such tools. No evidence of any factory or workshop site, or the result of any human settlement was identified. No organic remains such as bone, pottery, or ostrich eggshell were found.

  Most of the tools comprise flakes and chunks which are utilised and/or retouched. Several flake blades in banded ironstone and indurated shale were also found. At least 10 cores/minimal cores and chunks (with one or more flake scars) were counted. This amounts to 24% of the stone artefact assemblage, indicating a relatively high level of stone fabrication on the site. One large quartzite hammerstone was also found.

Frequencies of formal retouched tools are very low; one MRP/convex scraper, one flat convex quartz scraper and one side scraper were found. Six miscellaneous retouched pieces were found, including one MSA pointed flake with a retouched tip.

There are no graves on the affected property.

In terms of the built environment, no old buildings, structures, or features, old equipment, public memorial or monuments occur in or beyond the footprint area.

As archaeological sites are concerned, the occurrences are lacking in context and no organic remains such as bone, pottery or ostrich eggshell was found. There is no spatial patterning to the distribution of finds. The fairly small numbers and isolated and disturbed context in which they were found means that the archaeological remains on Erf 1654 have been rated as having low archaeological (Grade 3C) significance.

The results of the study indicate that the proposed development of the Keren Energy Kakamas Solar Farm will not have an impact of great significance on these and potentially other archaeological remains.

Indications are that in terms of archaeological heritage, the proposed activity (i. e. the construction of a solar energy farm) is viable and no fatal flaws have been identified.

With regard to the proposed development of the Keren Energy Kakamas Solar Farm on Erf 1654, the following recommendations are made:

1. No further archaeological mitigation is required.

2. Should any unmarked human burials/remains or ostrich eggshell water flask caches be uncovered, or exposed during construction activities, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resources Agency (SAHRA) (Att Ms Mariagrazia Galimberti 021 462 4502). Burials, etc must not be removed or disturbed until inspected by the archaeologist.

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1. INTRODUCTION

1.1 Background and brief

Keren Energy Kakamas (Pty) Ltd, commissioned the Agency for Cultural Resource Management to conduct an Archaeological Impact Assessment (AIA) for the proposed construction and operation of a 10 MW Concentrated Photovoltaic (CPV) Energy Generation Facility on Erf 1654 in Kakamas in the Northern Cape (Figures 1 & 2). The proposed development is situated within the Kai Garib municipality. Erf 1654 is zoned for Agriculture and is owned by the local authority.

The Northern Cape has the highest levels of Solar Irradiance in South Africa, which makes the location of the proposed development ideal for solar energy generation. The renewable energy industry is currently experiencing an explosive growth worldwide. In South Africa, while such energy sources are not expected to replace the country's traditional reliance and dependency on coal-generated power, the National Energy Regulator of South Africa (NERSA) has published a favourable feed-in tariff structure for renewable energy that allows for independent clean energy producers to invest in renewable energy resources. The growing alternative energy industry is considered to be of national importance in anticipation of its contribution to electricity supply and reduced reliance of non-renewable energy sources.

It is in this context that the applicant proposes to construct and operate a commercial solar energy facility in Kakamas. The proposed activity entails the construction of about 140 CPV solar panels covering a footprint area of about 20 ha. The CPV panels will be mounted on pedestals drilled and set into the ground. Extensive bedrock excavations are not envisaged, but some vegetation may need to be cleared from the site. Associated infrastructure includes single track internal access roads, trenches for underground cables, transformer pads, a switching station, a maintenance shed, and a temporary construction camp. The electricity generated from the project will be fed directly into the national grid via a proposed ± 1 km overhead powerline linking to the Eskom Kakamas substation which is situated northwest of the proposed facility.

The AIA forms part of the Environmental Basic Assessment process that is being conducted by EnviroAfrica cc.

The aim of the study is to locate and map archaeological sites/remains that may be impacted by the proposed project, to assess the significance of the potential impacts and to propose measures to mitigate the impacts.

2. HERITAGE LEGISLATION

The National Heritage Resources Act (Act No. 25 of 1999) makes provision for a compulsory Heritage Impact Assessment (HIA) when an area exceeding 5000 m² is being developed. This is to determine if the area contains heritage sites and to take the necessary steps to ensure that they are not damaged or destroyed during development.

The NHRA provides protection for the following categories of heritage resources:

- Landscapes, cultural or natural (Section 3 (3))

- Buildings or structures older than 60 years (Section 34);
- Archaeological sites, palaeontological material and meteorites (Section 35);
- Burial grounds and graves (Section 36);
- Public monuments and memorials (Section 37);
- Living heritage (defined in the Act as including cultural tradition, oral history, performance, ritual, popular memory, skills and techniques, indigenous knowledge systems and the holistic approach to nature, society and social relationships) (Section 2 (d) (xxi)).

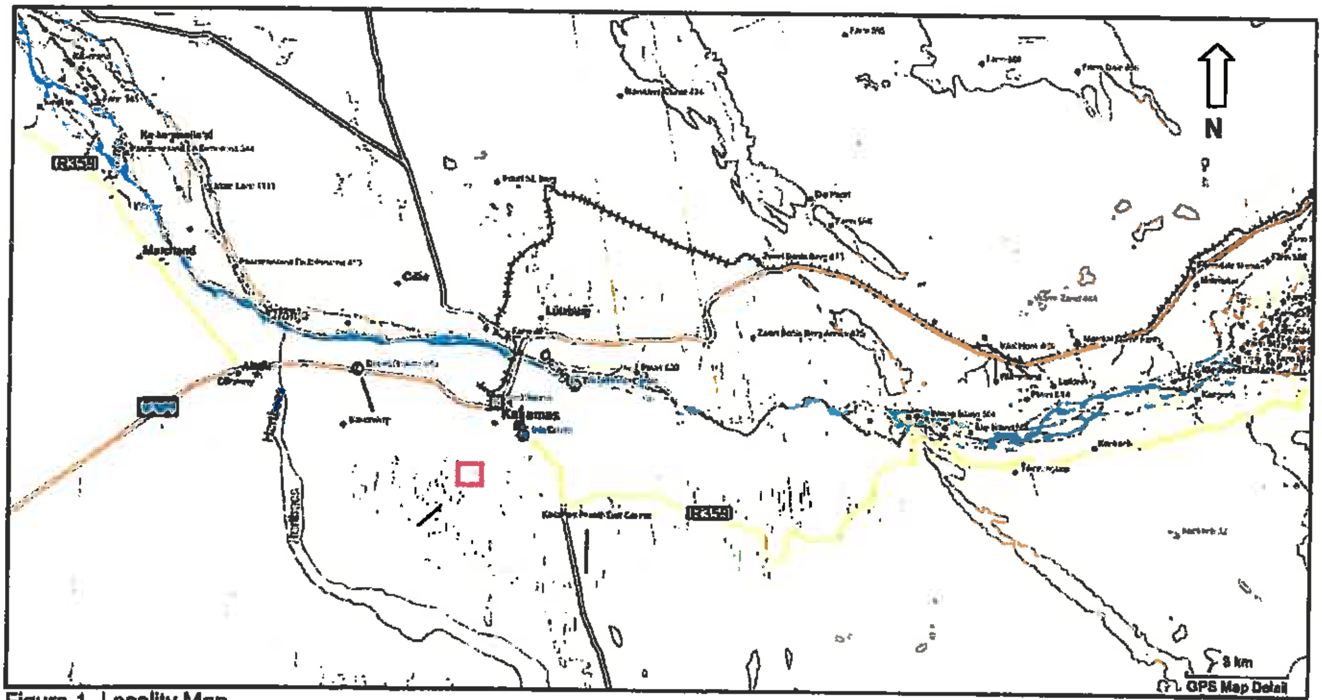

Figure 1. Locality Map

Study site

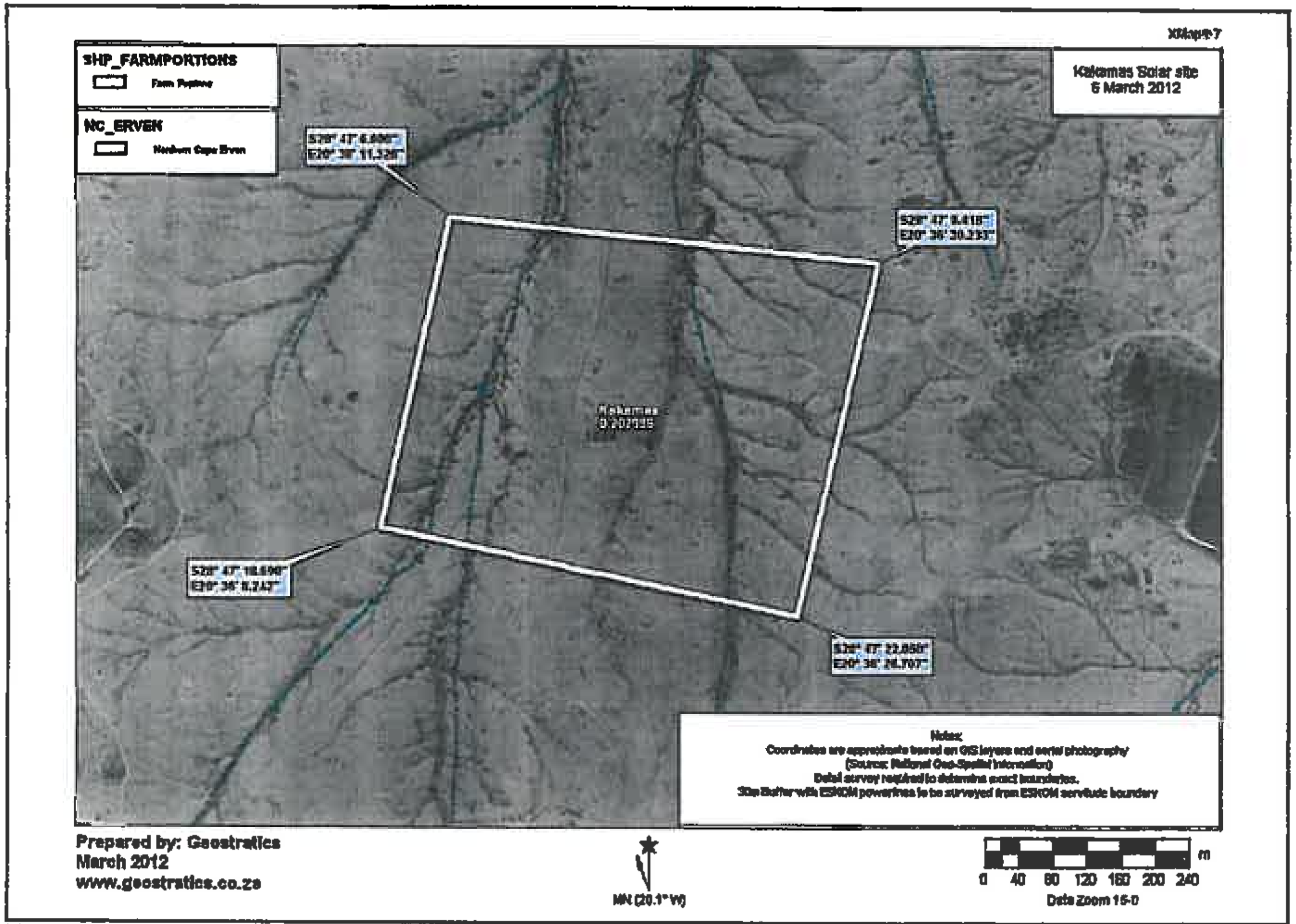

Figure 2. Aerial photograph of the footprint area for the proposed Kakamas solar energy farm

3. TERMS OF REFERENCE

The terms of reference for the study were to.

- Determine whether there are likely to be any important archaeological resources that may potentially be impacted by the proposed project, including the erection of the solar panels, internal access roads, trenches for underground cables, and any other associated infrastructure;
- Indicate any constraints that would need to be taken into account in considering the development proposal;
- Identify potentially sensitive archaeological areas, and
- Recommend any further mitigation action.

4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

An aerial photograph indicating the location site of the proposed Keren Energy Kakamas Solar Energy Farm is illustrated in Figure 3.

Kakamas is located alongside the Orange River, about 80 kms west of Upington on the N14. The site (Erf 1654) for the proposed solar farm is located south of the town and just to the west of the Waste Water Treatment Works. The proposed 20 ha footprint area is fairly flat and slopes gently north toward the town. It is surrounded by hill slopes in the east. Several drainage channels intersect the site, draining south toward the town. The proposed footprint area is quite severely degraded. Apart from fairly dense vegetation alongside the drainage channels, there is very little natural vegetation occurring on the proposed site. It is overgrazed, heavily sheet washed and covered in quartz gravel (Figures 4-7).

The route for the proposed ± 1 km long overhead powerline has not yet been established but it would cross several drainage channels and an undulating landscape, and could be aligned alongside a gravel road that leads all the way to the existing Kakamas sub station. The receiving environment is fairly severely degraded.

There are no old buildings, structures or features or any old equipment on the proposed site.

There are no public memorials or monuments on the site.

There are no visible graves on the proposed site, or within the proposed footprint area of the proposed solar farm.

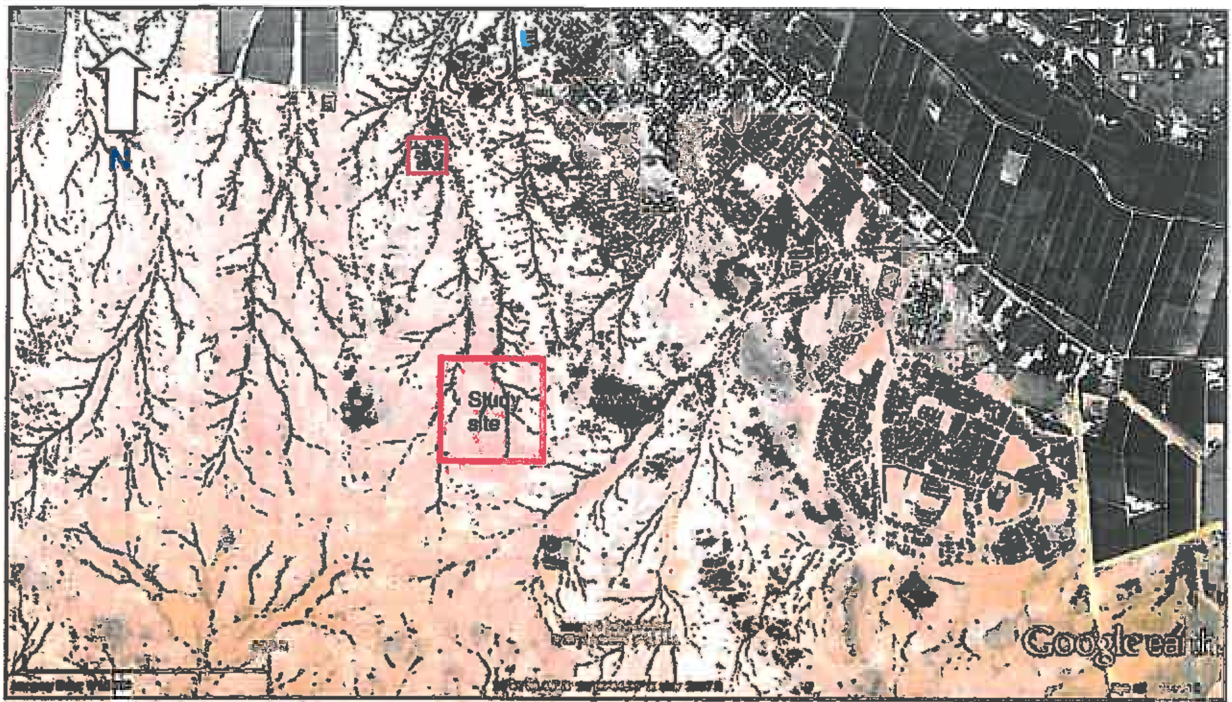

Figure 3. Aerial photograph of the proposed site for Kakamas Solar Energy Farm. Note the Kakamas substation (s/s) north west of the study site.

Figure 4. View overlooking the study site facing west

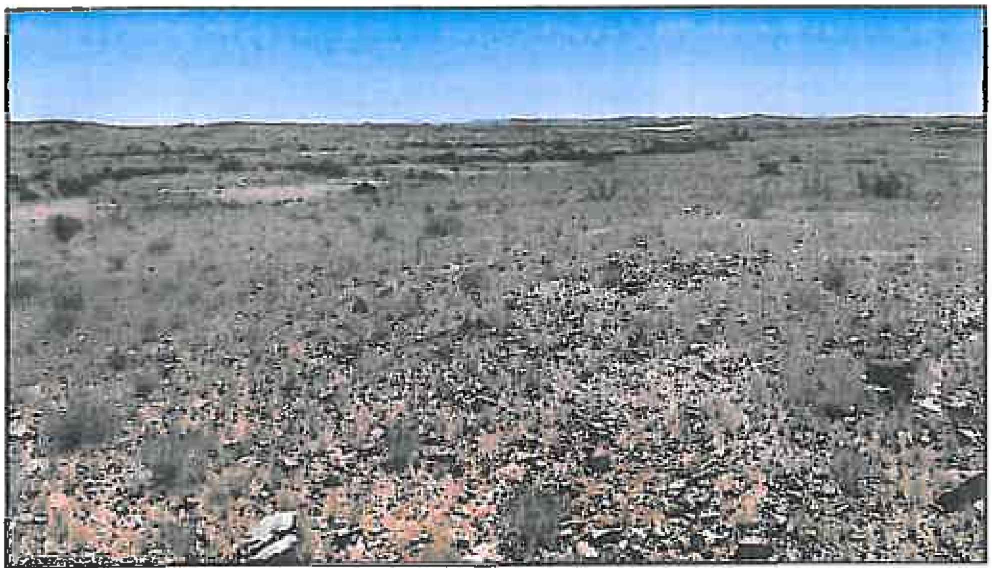

Figure 5. View of the proposed site facing north west

Figure 6. View of the proposed site facing north west. Not the heavy sheet wash and quartz stone

Figure 7. View of the proposed site facing north. Note the heavy sheet wash

5. STUDY APPROACH

5.1 Method of survey

A detailed and controlled survey of the proposed footprint area, and the proposed ± 1 km long overhead powerline was undertaken by J Kaplan on 1 March, 2012. The survey was undertaken on foot. Unfortunately, a GPS track path was not logged. All archaeological occurrences documented during the study were mapped in-situ using a hand-held Garmin Oregon 300 GPS unit set on the map datum WGS 84 (refer to Figure 11 & 12 in Appendix I). A collection of tools were also photographed. A desk top study was done.

5.2 Constraints and limitations

There were no constraints or limitations associated with the study. Overall, archaeological visibility was very good.

5.3 Identification of potential risks

Pre-colonial archaeological heritage (i. e. stone implements) will be impacted by the proposed development, but the numbers are very small and they occur in a severely disturbed and degraded context.

Apart from trenches for underground cabling, limited bedrock excavations are envisaged. The solar panels will be raised about 2 m above ground and mounted on small footings drilled and set into the ground. The excavations for the footings are about 1-1.5 m in diameter and so the actual ground disturbance will be quite limited and contained. Much of the top soils have already been washed away due to heavy sheet wash and erosion.

5.4 Results of the desk top study

The archaeology of the Northern Cape is rich and varied covering long spans of human history. According to Beaumont et al (1995:240) "thousands of square kilometres of Bushmanland are covered by a low density lithic scatter". Very little archaeological work has been done in Kakamas. Stone artefacts in banded ironstone and indurated shale were documented in the road reserve during a survey for a water pipeline between Kakamas and Kenhardt (Kaplan 2008). Orton (2012) recently recorded very low density scatters of LSA and MSA tools in quartz, indurated shale and banded ironstone during a survey for a proposed solar farm near the Augrabies Falls National Park. Orton (2012) also describes an archaeological sequence in the Augrabies Falls region based on the work of others which spans the Early, Middle and Later Stone Age pre-colonial history in the region. Much of the information has been generated by excavations of open scatters of stone artefacts, pottery and ostrich eggshell, as well as excavations of several small shelters near the Augrabies Falls and the town of Augrabies.

Orton (2012) also notes that many skeletons, most dating to the 18th and 19th Centuries have been exhumed from the area between Augrabies and Upington in the late 1930s. Historical sites and remains (such as forts) relating to events such as the Anglo Boer War are also well preserved in the region, including the presence of war graves in Kakamas, Pofadder and Keimoes. Orton (2012) also notes that the water related infrastructure in the Kakamas area was important for agricultural development and several water wheels and excavated tunnels and leiwaters/furrows in Kakamas have been declared Provincial Heritage Sites.

6. FINDINGS

Forty-one single, isolated archaeological occurrences were documented and mapped with a hand held GPS unit. A description of the archaeological finds located during the study is presented in Table A in Appendix I.

All the tools documented are spread very thinly and unevenly over the surrounding landscape. There is no spatial integrity to any of the finds. Most of the lithics (about 70%) are assigned to the Later Stone Age and the remainder to the Middle Stone Age. No Early Stone Age implements were found. The majority (78%) of the tools are in banded ironstone, with the remainder in indurated shale, quartzite, silcrete and quartz. Banded ironstone is known to have been a favoured raw material for making stone artefacts and occurs on a number of sites that have been documented by the archaeologist and others throughout the Northern Cape. Quartz gravel is prolific over the site making it difficult to detect such tools. No evidence of any factory or workshop site, or the result of any human settlement was identified. No organic remains such as bone, pottery, or ostrich eggshell were found.

Most of the tools comprise flakes and chunks which are utilised and/or retouched. Several flake blades in banded ironstone and indurated shale were also counted. At least 10 cores/minimal cores and flaked chunks (with one or more flake scars) were counted. This amounts to 24% of the stone artefact assemblage, indicating a relatively high level of stone fabrication on the site. One quartzite hammerstone (005) was found.

Frequencies of formal retouched tools are very low; one MRP/convex scraper (008), one flat convex quartz scraper (012) and one side scraper (026) were found. Six miscellaneous retouched pieces were found, including one MSA pointed flake with a retouched tip (040).

There are no graves on the affected property.

No old buildings, structures, or features, old equipment, public memorial or monuments occur in the footprint area.

No other colonial heritage resources were noted during the study.

A collection of tools documented during the study are illustrated in Figures 8-10.


Figure 8. Quartzite hammerstone (005). Note the pecking on the tip of the cobble


Figure 9. Collection of tools from Erf 1654. Scale is in cm

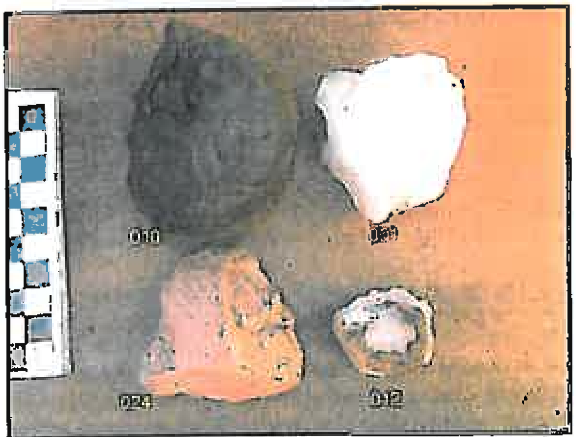
Figure 10. Collection of tools from Erf 1654. Scale is in cm

6.1 Significance of the archaeological remains

All of the lithics documented during the study comprise isolated occurrences that are spread thinly and unevenly over the surrounding landscape, No evidence of any factory or workshop site, or the result of any human settlement was identified. As archaeological sites are concerned, the occurrences are lacking in context as no organic remains such as bone, pottery or ostrich eggshell was found. The receiving environment is also degraded.

The relatively small numbers isolated and disturbed context in which they were found means that the archaeological remains have been rated as having low archaeological (Grade 3C) significance.

7. ASSESSMENT OF IMPACTS

In the case of the proposed Keren Energy Kakamas Solar Energy Farm it is expected that the overall impact on important archaeological resources will be low (Table 1).

Potential impacts on archaeological heritage	
Extent of impact:	Site specific
Duration of impact;	Permanent
Intensity	Low
Probability of occurrence:	Probable
Significance without mitigation	Low
Significance with mitigation	Negative
Confidence:	High

Table 1. Assessment of archaeological impacts.

8. CONCLUSION

Development of the proposed Keren Energy Kakamas solar energy facility on Erf 1654 will have a very limited impact on archaeological heritage resources.

The study has identified no significant impacts to pre-colonial archaeological material that will need to be mitigated prior to development activities commencing.

Indications are that in terms of archaeological heritage, the proposed activity is viable and no fatal flaws have been identified.

9. RECOMMENDATIONS

With regard to the proposed construction and operation of a 10 MW solar energy facility on Erf 1654 in Kakamas, the following recommendations are made:

1. No further archaeological mitigation is required.

2. Should any unmarked human burials/remains or ostrich eggshell water flask caches be uncovered, or exposed during construction activities, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resources Agency (SAHRA) (Att Ms Mariagrazia Galimberti 021 462 4502). Burials must not be removed or disturbed until inspected by the archaeologist.

10. REFERENCES

Beaumont, P.B. & Vogel, J.C. 1984. Spatial patterning of the ceramic Later Stone Age in the Northern Cape Province, South Africa. In: Hall, M., Avery, G., Avery, D.M., Wilson, M.L. & Humphreys, A.J.B. (Eds) Frontiers: southern African archaeology today: 80-95. Oxford: British Archaeological Reports International Series 207.

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Orton, J. 2012. Heritage Impact Assessment for the proposed Augrabies Solar Energy Facility, Kenhardt Magisterial District, Northern Cape. Report prepared for Rosenthal Environmental. Archaeology Contracts Office, University of Cape Town.

Archaeological study proposed solar energy farm near Kakamas

Appendix I

Name of Site	Name of Farm	Lat/Long	Finds
	Erf 1654 Kakamas		
001		S28 47.127 E20 36.484	Round quartz **core**
002		S28 47.094 E20 36.437	Indurated shale blade **(MSA)**
003		S28 47.025 E20 36.437	Pink quartz chunk
004		S28 47.095 E20 36.428	Snapped/broken utilized chunk, & weathered flake
005		S28 47.101 E20 36.438	Large round quartzite **hammerstone**
006		S28 47.123 E20 36.436	Weathered retouched and utilized **MSA** flake blade
007		S28 47.131 E20 36.423	Utilized, retouched cortex chunk/**min core**
008		S28 47.159 E20 36.430	MRP/?**scraper**
009		S28 47.172 E20 36.426	Quartz chunk
010		S28 47.160 E20 36.436	Weathered indurated shale chunk
011		S28 47.397 E20 36.425	Round **core**
012		S28 47.240 E20 36.431	Flat pink quartz ?**convex scraper**
013		S28 47.311 E20 36.424	Butt end of broken flake
014		S28 47.314 E20 36.426	Weathered flaked chunk
015		S28 47.404 E20 36.426	Weathered cobble chunk/cortex
016		S28 47.441 E20 36.427	Cobble **core**
017		S28 47.251 E20 36.402	Large flake & weathered indurated shale **core**
018		S28 47.179 E20 36.371	Utilised & misc retouched flake
019		S28 47.233 E20 36.388	**MSA** flake
020		S28 47.295 E20 36.411	Snapped quartzite flake blade (?**MSA**)
021		S28 47.300 E20 36.419	Parallel flaked chunk/**core**
022		S28 47.318 E20 36.410	Pink quartz ?**core**
023		S28 47.360 E20 36.405	Chunk
024		S28 47.405 E20 36.413	Chunky **silcrete MSA** flake
025		S28 47.383 E20 36.360	Weathered cobble/chunk
026		S28 47.335 E20 36.346	Burnished **side scraper**
027		S28 47.334 E20 36.342	Large quartz chunk
028		S28 47.333 E20 36.318	Weathered cobble
029		S28 47.348 E20 36.312	Pointed side retouched **MSA** flake
030		S28 47.427 E20 36.336	Flat retouched/utilized flake
031		S28 47.404 E20 36.304	Retouched flake & chunk/**min core**
032		S28 47.324 E20 36.316	Snapped **MSA** double sided retouched quartzite flake
033		S28 47.242 E20 36.364	Chunky **silcrete MSA** flake
034		S28 47.307 E20 36.361	Large round quartz **core**
035		S28 47.326 E20 36.298	Large chunky **MSA** quartzite flake/blade
036		S28 47.385 E20 36.292	Large **silcrete** chunk
037		S28 47.327 E20 36.290	Weathered and chunky quartzite **MSA** flake
038		S28 47.318 E20 36.270	?**MSA** flake
039		S28 47.344 E20 36.218	Split quartzite cobble flake
040		S28 47.283 E20 36.251	Triangular shaped **MSA** pointed flake with retouched tip
041		S28 47.232 E20 36.425	Cobble **core**

Table A. Spreadsheet of waypoints and description of archaeological finds. Unless otherwise stated, all implements are in locally available banded iron stone

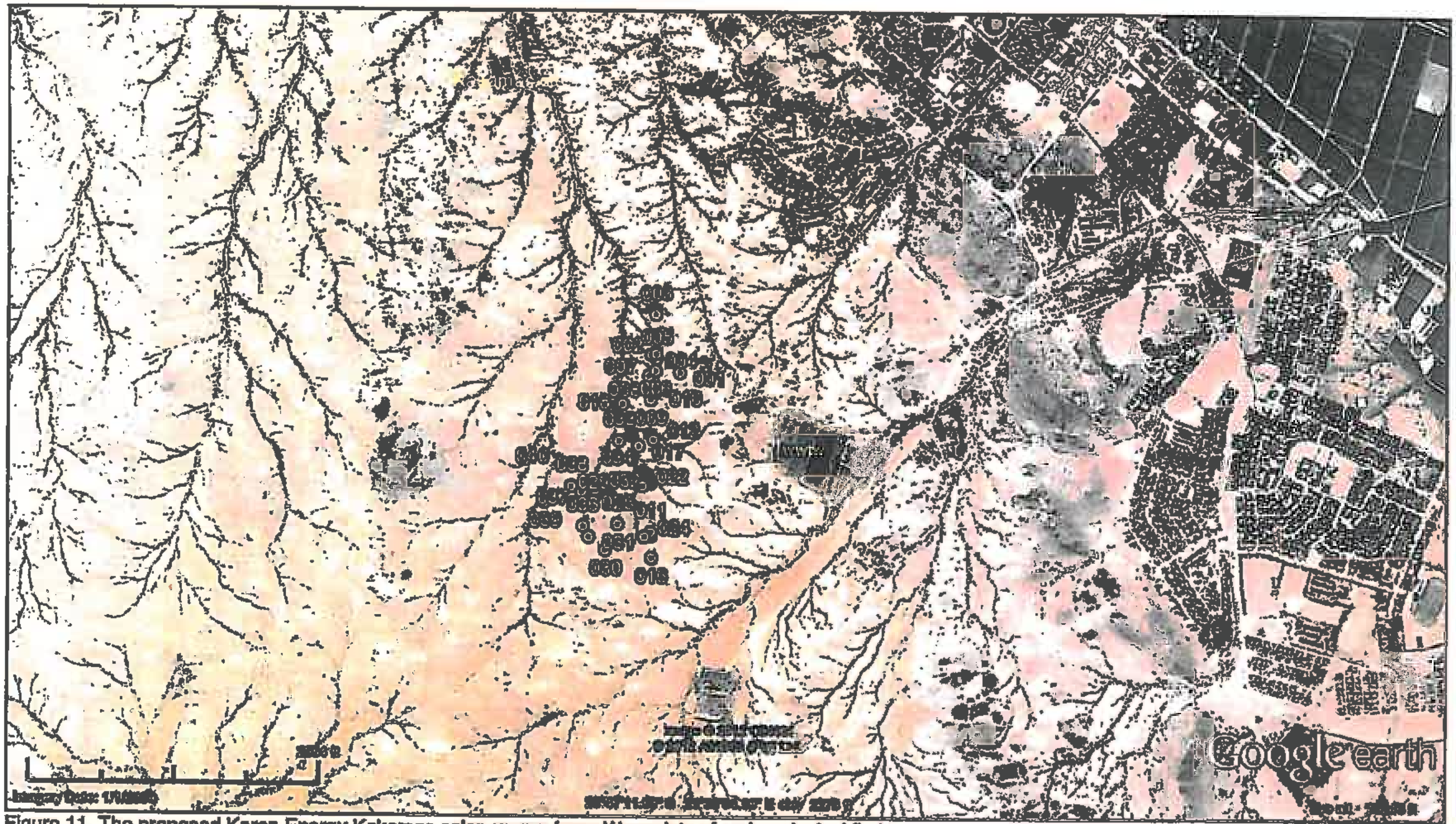

Figure 11. The proposed Keren Energy Kakamas solar energy farm: Waypoints of archaeological finds

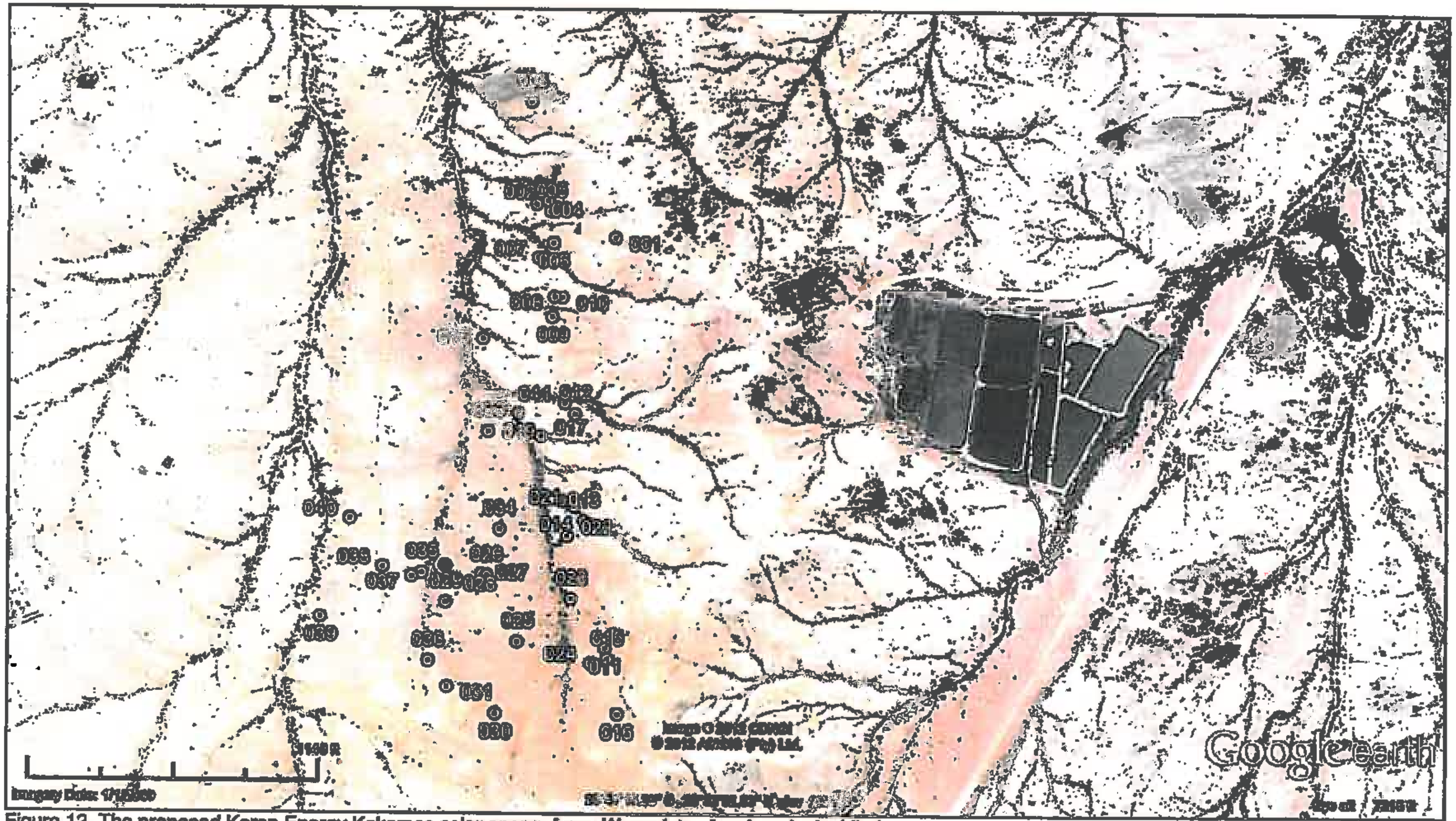

Figure 12. The proposed Keren Energy Kakamas solar energy farm: Waypoints of archaeological finds

Appendix D3b Palaeontological

RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES & MITIGATION:

PROPOSED KAKAMAS KEREN SOLAR PLANT ON ERF 1654 KAKAMAS, KAI GARIB MUNICIPALITY, NORTHERN CAPE

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March 2012

1. OUTLINE OF DEVELOPMENT

Keren Energy Kakamas (Pty) Ltd is proposing to construct a 10 MW Concentrating Photovoltaic (CPV) Energy Generation Facility on Kakamas (suid) Erf 1654, Kakamas, Kai Garib Municipality, in the Northern Cape (Fig. 2). Erf 1654 is currently zoned for agriculture and is owned by the local authority.

The proposed activity entails the construction of about 140 CPV solar panels with a footprint of about 20 ha. The CPV panels will be mounted on pedestals drilled and set into the ground. Extensive bedrock excavations are not envisaged, but some vegetation will need to be cleared from the site. Associated infrastructure includes a perimeter access road, single track internal access roads, trenches for underground cables, 2 to 4 transformer pads, a switching station, a maintenance shed, and a temporary construction camp.

The present palaeontological heritage comment has been commissioned by EnviroAfrica cc, Somerset West as part of a comprehensive Heritage Impact Assessment of the proposed development (Contact details: Mr Bernard de Witt, EnviroAfrica cc, P. O. Box 5367, Helderberg, 7135; 29 St James St, Somerset West; mobile: +27 82 4489991; tel: +27 21 851 1616; fax: 086203308).

2. GEOLOGICAL BACKGROUND

The proposed solar plant study area (28° 46' S, 20° 35' E) is situated on arid, gravelly terrain at 690m amsl on the south-western outskirts of the town of Kakamas, some 4 km south of the Orange River (Fig. 2). The area is traversed by several shallow, dendritic stream systems that intermittently drain northwards into the Orange River. The N14 trunk road runs 1.8 km to the north.

The geology of the study area near Kakamas is shown on the 1: 250 000 geology map 2820 Upington (Council for Geoscience, Pretoria; Fig. 1 herein). A comprehensive sheet explanation for this map has been published by Moen (2007). The proposed Kakamas Keren solar plant is underlain by ancient Precambrian basement rocks – the **Riemvasmaak granite-gneiss (Mrm)** – that belong to the **Namaqua-Natal Province** of Mid Proterozoic (Mokolian) age (Cornell *et al.* 2006, Moen 2007). These basement rocks are approximately two to one billion years old and entirely unfossiliferous (Almond & Pether 2008).

The Precambrian basement rocks within the study area are mantled with a spectrum of other coarse to fine-grained **superficial deposits** such as rocky soils, downwasted gravels, colluvium (slope deposits), sheet wash, calcrete hardpans and alluvium of intermittently flowing streams. These deposits are generally young (Quaternary to Recent) and largely unfossiliferous.

The study site is some 4 km away from the present course of the Orange River and elevated perhaps 40m or more higher that this above mean sea level. According to Moen (2007) ancient river terrace gravels occur "all along the river" within 2km of the present banks and at elevations of up to 45 m (rarely as high as 85m) above the present flood plain. It is considered unlikely that significant deposits of Late Tertiary **Orange River alluvial gravels** are present within this area, and none are mapped here on the 1: 250 000 Upington geology sheet.

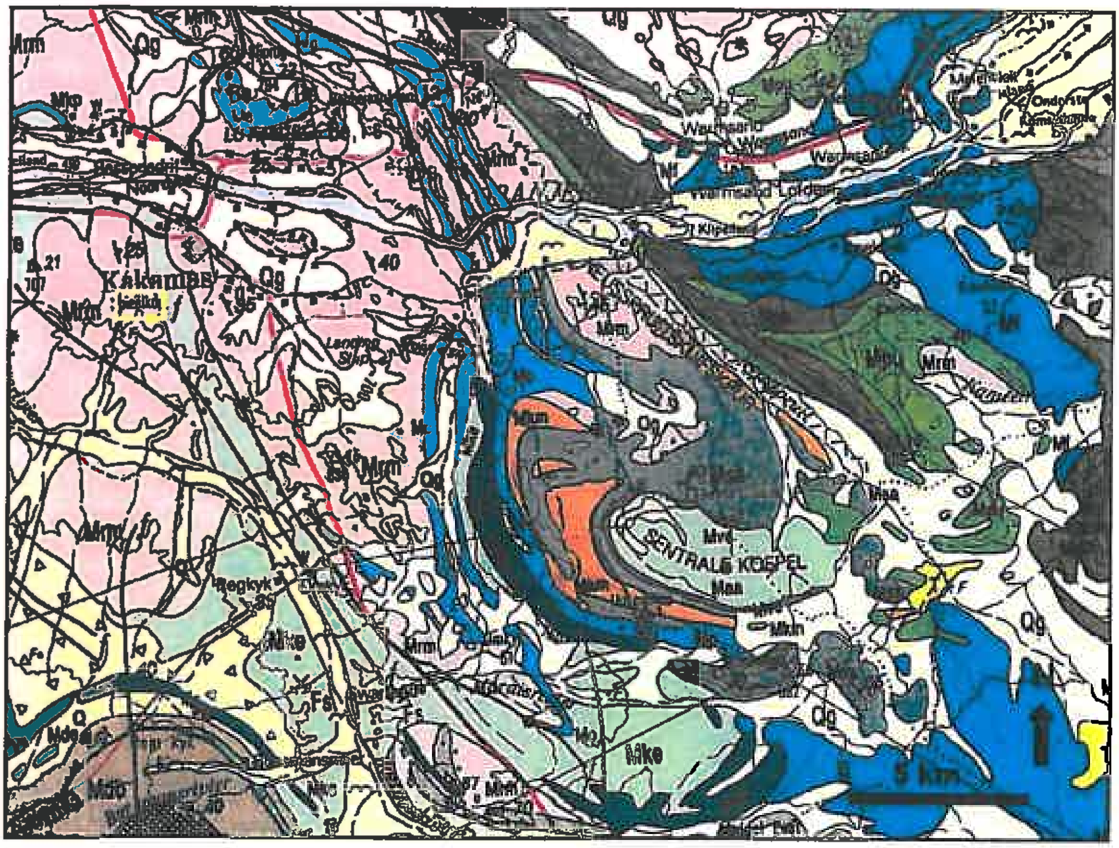

Fig. 1. Extract from 1: 250 000 geological map 2820 Upington (Council for Geoscience, Pretoria) showing approximate location of proposed Kakamas Keren Solar Plant study area on the south-western outskirts of Kakamas, Northern Cape Province (small yellow rectangle). The study area is underlain by unfossiliferous Precambrian (Middle Proterozoic / Mokolian) basement rocks of the Namaqua-Natal Metamorphic Province, principally the Riemvasmaak granite-gneiss (Mrm, pink).

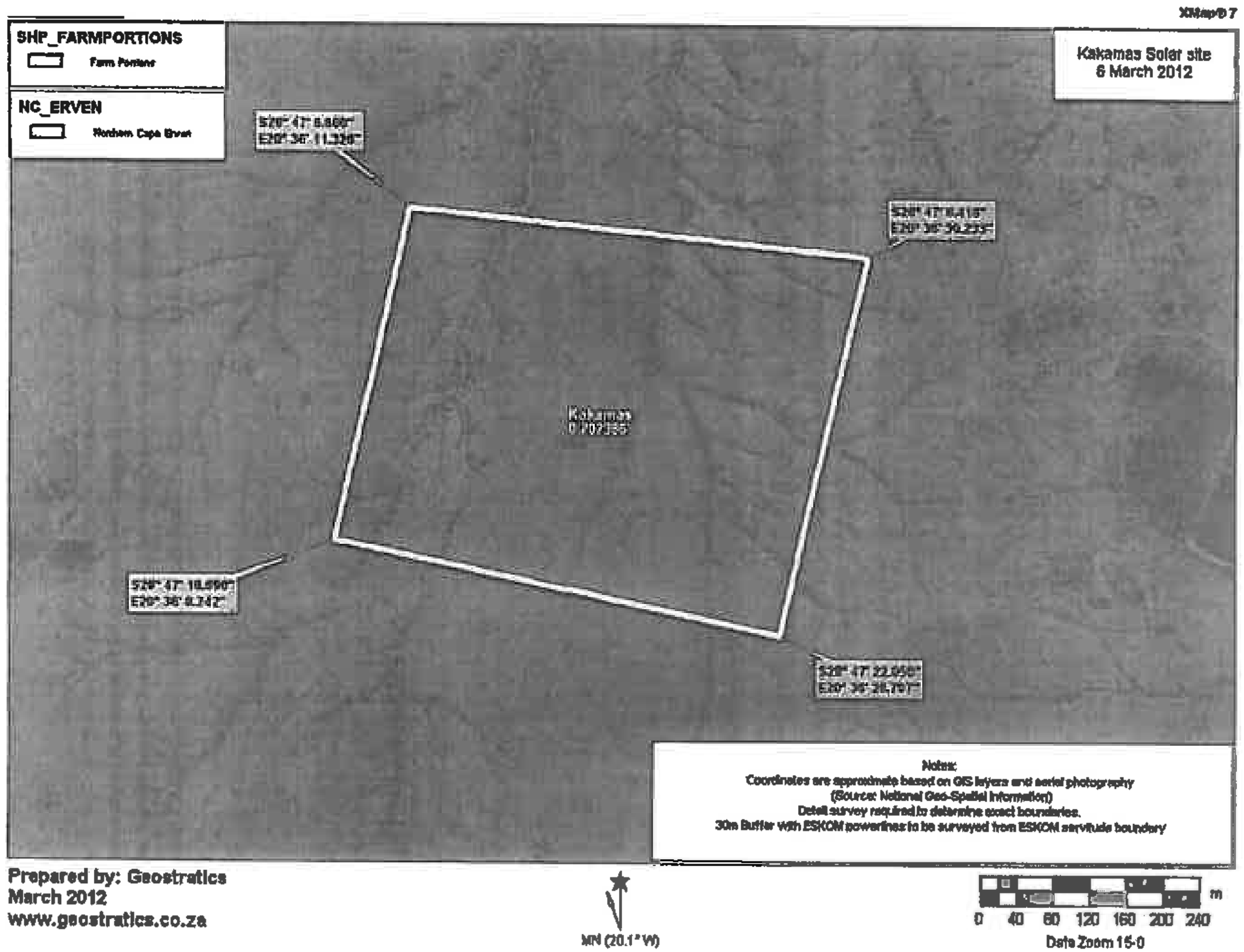

Fig. 2. Satellite image showing the study area for the Kakamas Keren solar plant on Erf 1654 on the south-western outskirts of Kakamas, Northern Cape (Image prepared by Geostratics 2012).

3. PALAEONTOLOGICAL HERITAGE

The Precambrian metamorphic and igneous basement rocks of the Namaqua-Natal Metamorphic Province in the study area are entirely unfossiliferous.

Alluvial gravels of the Orange River of Miocene and younger age are locally highly fossiliferous (*e.g.* Hendy 1984, Schneider & Marias 2004, Almond 2009 and extensive references therein) but, as argued above, these are *not* mapped within the study area.

The palaeontological sensitivity of the Kakamas solar plant study area is assessed as LOW.

4. CONCLUSIONS & RECOMMENDATIONS

The overall impact significance of the proposed Kakamas Keren solar plant development is considered to be LOW because:

- Most of the study area is underlain by unfossiliferous metamorphic basement rocks (granite-gneisses *etc*) or mantled by superficial sediments of low palaeontological sensitivity;
- Extensive, deep excavations are unlikely to be involved in this sort of solar park project.

It is therefore recommended that exemption from further specialist palaeontological studies and mitigation be granted for this solar plant development.

Should any substantial fossil remains (*e.g.* vertebrate bones and teeth, shells, petrified wood) be encountered during excavation, however, these should be reported to SAHRA for possible mitigation by a professional palaeontologist.

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6. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape under the aegis of his Cape Town-based company *Natura Viva* cc. He is a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape as well as Limpopo, Free State and Gauteng for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

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