SCOPING REPORT

On contract research for

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Environmental Screening Investigation for the proposed Karoshoek Solar Valley Concentrated Solar Power Project in the Upington District, Northern Cape - Ilanga 7, Ilanga 8 and Ilanga 9 Sites

Soils and Agricultural Potential

By

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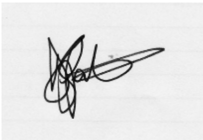
DECLARATION

I hereby declare that I am qualified to compile this report as a registered Natural Scientist and that I am independent of any of the parties involved and that I have compiled an impartial report, based solely on all the information available.



D G Paterson

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1. TERMS OF REFERENCE

The ARC-Institute for Soil, Climate and Water (ARC-ISCW) was contracted by Savannah Environmental (Pty) Ltd to undertake a soil investigation near Upington, in the Northern Cape Province. The purpose of the investigation is to contribute to the scoping phase of the Environmental Impact assessment (EIA) process for proposed solar thermal energy facilities (Sites 7, 8 and 9), within the Karoshoek Solar Valley development.

Scoping Report

The scoping report must include:

» a description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project

» a description and evaluation of environmental issues and potential impacts (including direct, indirect and cumulative impacts) that have been identified

» Direct, indirect and cumulative impacts of the identified issues must be evaluated within the Scoping Report in terms of the following criteria:

☐ the nature, which shall include a description of what causes the effect, what will be affected and how it will be affected;

☐ the extent, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international

» a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts

»

» identification of potentially significant impacts to be assessed within the EIA phase and details of the methodology to be adopted in assessing these impacts.

The objectives of the study are;

- To obtain all existing soil information and to produce a soil map of the specified area as well as

- To assess broad agricultural potential.

2. SITE CHARACTERISTICS

2.1 Location

The broad study area is located approximately 30 km south-east of the town of Upington, in the Northern Cape Province (see Figure 1 below). The area consists of the following farm portions: Lot 944 Karos Settlement, Portion 2 of Matjiesrivier 41; Portion 3 of Matjiesrivier (Annashoek) 41; and Portions 4 and 20 of Trooilaps Pan 53. The area lies between 28° 24' and 28° 41' S and between 21° 25' and 21° 40' E.

Within the broad area, three developments are proposed. These are named **Ilanga 7** (CSP Tower project, shown in yellow on Figure 1), **Ilanga 8** (CSP Tower project, shown in red) and **Ilanga 9** (CSP Parabolic Trough project, shown in green). Ilanga 7 comprises an area of 1 519 ha, Ilanga 8 is 1 475 ha while Ilanga 9 is 700 ha.

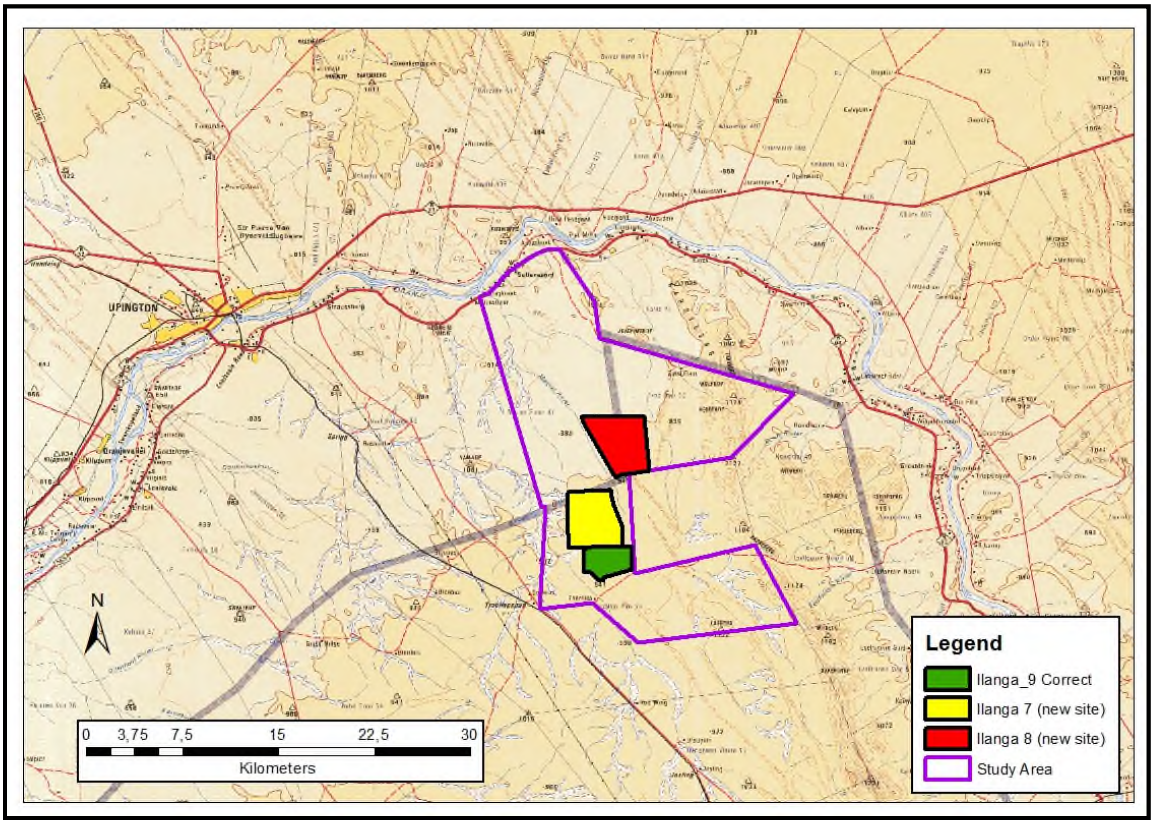

Figure 1 Locality map

Within the three sites and immediate vicinity, little or no agricultural infrastructure is present, and the prevailing land use is extensive grazing with natural shrub and grass vegetation.

2.2 Terrain

The area is generally flat to gently undulating and lies at a height of approximately 830-1 000 metres above sea level, sloping towards the Gariep River in the north. However, some steeper hills, rising to around 1 130 meters, are present in the east of the area. Dunes occur in the south-east.

2.3 Climate

The climate of the study area (Koch & Kotze, 1986) can be regarded as warm to hot with occasional rain in summer and dry winters. The long-term average annual rainfall in this region of the Northern Cape is only 175 mm, of which 142 mm, or 81%, falls from November to April. Rainfall is erratic, both locally and seasonally and therefore cannot be relied on for agricultural practices. The average evaporation is 2 375 mm per year, peaking at 11.2 mm per day in December.

Temperatures vary from an average monthly maximum and minimum of 35.0°C and 18.7°C for January to 20.8°C and 3.3°C for July respectively. The extreme high temperature that has been recorded is 43°C and the extreme low –7.9°C. Frost occurs most years on 6 days on average between mid-June and mid-August.

2.4 Parent Material

The geology of the area (Figure 2) comprises a mixture of various types of igneous rocks (for Ilanga 8) along with Quaternary sediments (for Ilanga 7 and Ilanga 9) (Geological Survey, 1988).

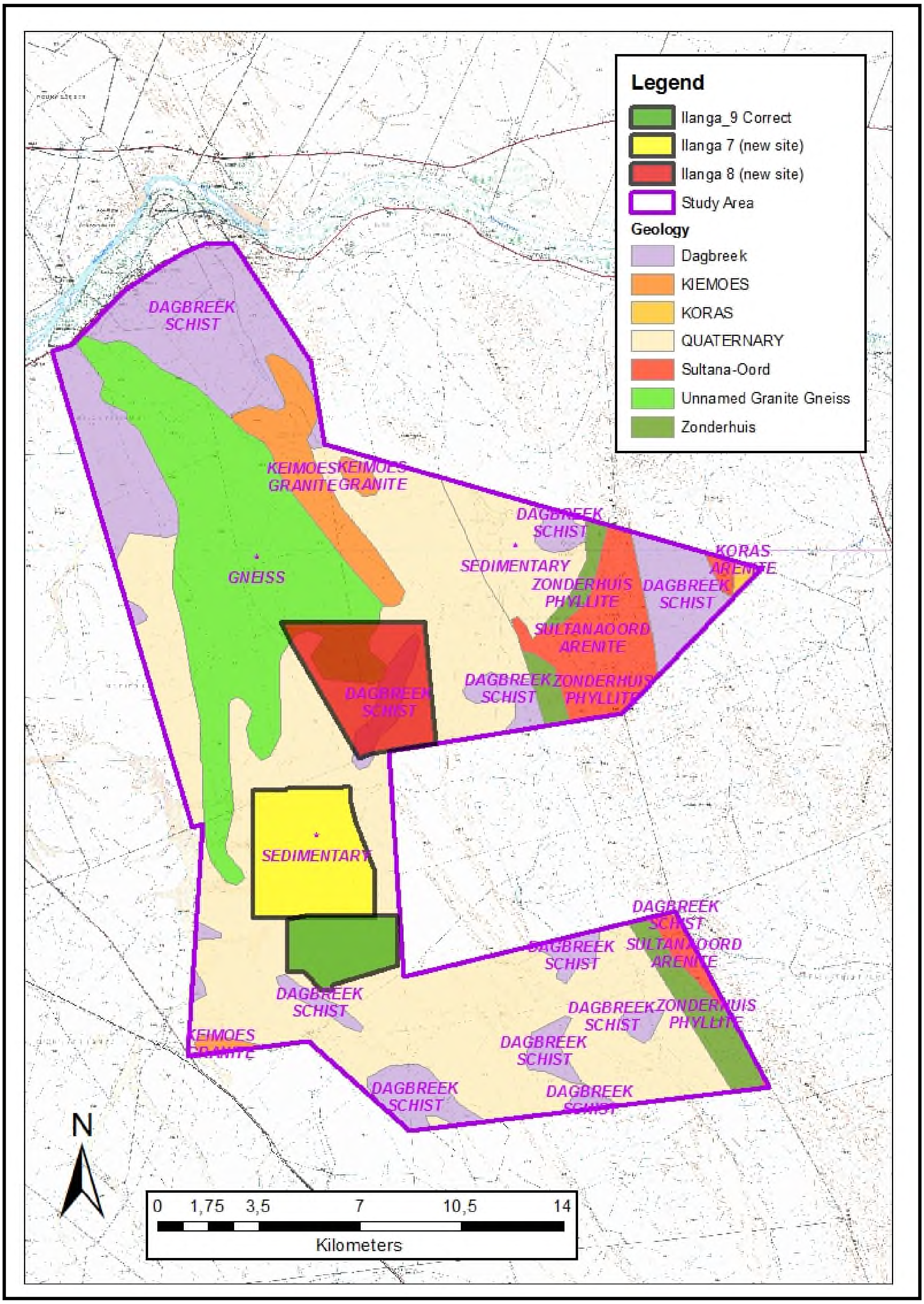

Figure 2 Geological units in study area

3. METHODOLOGY

Existing information was obtained from the map sheet 2820 Upington (Eloff, Bennie, Dietrichsen & Geers, 1983) from the national Land Type Survey, published at a scale of 1:250 000. A land type is defined as an area with a uniform terrain type, macroclimate and broad soil pattern. The soils are classified according to MacVicar *et al* (1977).

The broad study area is covered by the following seven land types, as shown on the map in the Appendix, namely:

- **Ae11, Ae111** (Red, freely-drained, structureless soils, high base status)
- **Af25** (Red, freely-drained, structureless soils, high base status, ***with dunes***)
- **Ag4, Ag5** (Shallow, red, freely-drained, structureless soils, high base status)
- **Ia2** (Alluvial soils)
- **Ic156** (Very rocky areas with shallow soils)

It should be clearly noted that, since the information contained in the land type survey is of a reconnaissance nature, only the general dominance of the soils in the landscape can be given, and not the actual areas of occurrence within a specific land type. Also, other soils that were not identified due to the scale of the survey may also occur. **The site was not visited during the course of this study, and so the detailed composition of the specific land types has not been ground-truthed.**

A summary of the dominant soil characteristics of each land type is given in Table 2 below (the colours correspond to those used in the map in the Appendix).

The distribution of soils with high, medium and low agricultural potential within each land type is also given, with the dominant class shown in **bold type**.

4. SOILS

A summary of the dominant soil characteristics is given in **Table 2** below.

Table 2 Land types occurring (with soils in order of dominance)

Land Type	Depth (mm)	Dominant soils	Percent of land type	Characteristics	Agric. Potential (%)
Ae11	450-1000 100-250	Hutton 30/33 Mispah 10/22 + Rock	49% 45%	Red, sandy soils (3-8% clay), occasionally on hardpan calcrete Red-brown, sandy topsoils (2-6% clay) plus hard rock and calcrete	High: 0.0 Mod: 48.8 **Low: 51.2**
Ae111	450-1200 75-300	Hutton 34/35/44/45 Hutton 34/35/44/45	45% 36%	Red, sandy soils (6-15% clay), occasionally on hardpan calcrete Red, sandy topsoils (6-15% clay) on hard rock and calcrete	High: 0.0 Mod: 45.0 **Low: 55.0**
Af25	>1200 450-1200	Hutton 30/31 Hutton 34/35/44/45	44% 25%	Deep red, sandy ***dune*** soils (2-6% clay) on hard rock and calcrete Red, sandy soils (6-15% clay), occasionally on hardpan calcrete	High: 0.0 Mod: 25.0 **Low: 75.0**
Ag4	100-400 100-400	Hutton 30/33/34 Mispah 10/12/20/22	35% 23%	Red, sandy soils (6-10% clay) on hard rock and calcrete Red-brown, sandy topsoils (6-10% clay) plus hard rock and calcrete	High: 0.0 Mod: 11.0 **Low: 89.0**
Ag5	100-400 100-400	Hutton 34/35/44/45 Mispah 10/12/20/22	43% 26%	Red, sandy soils (6-15% clay) on hard rock and calcrete Red-brown, sandy topsoils (4-12% clay) plus hard rock and calcrete	High: 0.0 Mod: 12.9 **Low: 87.1**
Ia2	>1200 >1200	Dundee 10 Oakleaf 36/46/47	50% 29%	Deep, brown, stratified alluvial sandy loam soils (10-35% clay) Deep, brown, alluvial sandy clay loam soils (15-35% clay)	**High: 79.0** Mod: 0.0 Low: 21.0
Ic156	- 30-250	Rock Mispah 10	85% 6%	Exposed rock outcrops Red, sandy soils (4-12% clay), occasionally on hardpan calcrete	High: 0.0 Mod: 8.1 **Low: 91.4**

1. Agricultural Potential, as shown in the right-hand column, refers to soil characteristics only and no climatic or other restrictions are taken into account.
2. The scale of the land type survey does not allow detailed soil distribution to be shown, so there is no detailed soil map available, or any co-ordinates of soil survey points, as no site visit was conducted.

5. AGRICULTURAL POTENTIAL

The eight-class land capability system from Klingebiel & Montgomery which was drafted in 1961 (reflected in Table 3) provides a way in which agricultural potential data for the country can be measured on a macro scale, grouping similar areas together. The available data was adapted for use with GIS in South Africa and made available by the Land Type Survey Staff under the ISCW.

Table 3: Land Type Survey Staff: Land capability/Agricultural Potential

Class	**Concepts**
I	Land in Class I has few limitations that restrict its use; it may be used safely and profitably for cultivated crops; the soils are nearly level and deep; they hold water well and are generally well drained; they are easily worked, and are either fairly well supplied with plant nutrients or are highly responsive to inputs of fertilizer; when used for crops, the soils need ordinary management practices to maintain productivity; the climate is favourable for growing many of the common field crops.
II	Land in Class II has some limitations that reduce the choice of plants or require moderate conservation practices; it may be used for cultivated crops, but with less latitude in the choice of crops or management practices than Class I; the limitations are few and the practices are easy to apply.
III	Land in Class III has severe limitations that reduce the choice of plants or require special conservation practices, or both; it may be used for cultivated crops, but has more restrictions than Class II; when used for cultivated crops, the conservation practices are usually more difficult to apply and to maintain; the number of practical alternatives for average farmers is less than that for soils in Class II.
IV	Land in Class IV has very severe limitations that restrict the choice of plants, require very careful management, or both; it may be used for cultivated crops, but more careful management is required than for Class III and conservation practices are more difficult to apply and maintain; restrictions to land use are greater than those in Class III and the choice of plants is more limited.
V	Land in Class V has little or no erosion hazard but has other limitations which are impractical to remove that limit its use largely to pasture, range, woodland or wildlife food and cover. These limitations restrict the kind of plants that can be grown and prevent normal tillage of cultivated crops; it is nearly level; some occurrences are wet or frequently flooded; others are stony, have climatic

Class	Concepts
	limitations, or have some combination of these limitations.
VI	Land in Class VI has severe limitations that make it generally unsuited to cultivation and limit its use largely to pasture and range, woodland or wildlife food and cover; continuing limitations that cannot be corrected include steep slope, severe erosion hazard, effects of past erosion, stoniness, shallow rooting zone, excessive wetness or flooding, low water-holding capacity; salinity or sodicity and severe climate.
VII	Land in Class VII has very severe limitations that make it unsuited to cultivation and that restrict its use largely to grazing, woodland or wildlife; restrictions are more severe than those for Class VI because of one or more continuing limitations that cannot be corrected, such as very steep slopes, erosion, shallow soil, stones, wet soil, salts or sodicity and unfavourable climate.
VIII	Land in Class VIII has limitations that preclude its use for commercial plant production and restrict its use to recreation, wildlife, water supply or aesthetic purposes; limitations that cannot be corrected may result from the effects of one or more of erosion or erosion hazard, severe climate, wet soil, stones, low water-holding capacity, salinity or sodicity.

The entire study area falls within **Land Class VII** – very severe limitations that make it unsuited to cultivation and which restrict its use mainly to grazing and habitat for wildlife. Restrictions are more severe than those for Class VI because of one or more continuing limitations that cannot be corrected. The main restrictions present in this area are the low rainfall and high sun intensity.

Much of the area comprises red, sandy soils, many of which are shallow to moderately deep and only a limited portion of deep soils (as can be seen from the information contained in Table 2). In addition, the very low rainfall in the area (Section 2.3) means that the only means of cultivation would be by irrigation and the Google Earth image of the area (Figure 3) shows absolutely no signs of any agricultural infrastructure and certainly none of irrigation, as is clearly evident along the Gariep River.

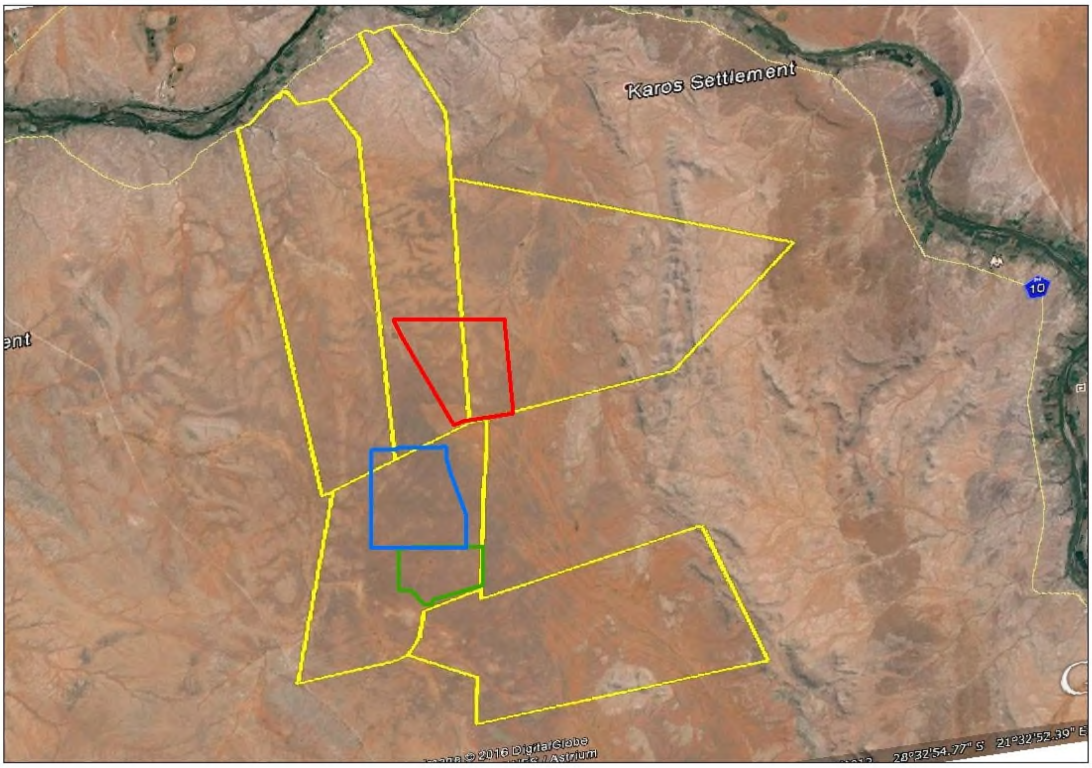

Figure 3 Google Earth image of study area

The climatic restrictions mean that this part of the Northern Cape is suited at best for grazing and here the grazing capacity is very low, around 40-50 ha/large stock unit (ARC-ISCW, 2004).

For the three proposed CSP sites (Ilanga 7, Ilanga 8 and Ilanga 9), the dominant class of agricultural potential in all three sites is **low**. All three sites fall within a portion of land type **Ag5** (shallow red soils) and land type **Af25** (mixed depth red soils plus dunes), although the dune areas seem to occur to the south-east of the three sites. The climatic restrictions mean that the potential impacts (see below) will be relatively similar for all three sites, from the viewpoint of soils or agricultural potential. Using the latest land cover data, no areas classed as degraded (such as erosion areas) were present in the vicinity.

6. SUSCEPTIBILITY TO EROSION

The soils in the study area are somewhat susceptible to wind erosion and are largely classified under category 2a where sands are strongly dominant. The measure as to how easy soil may erode by means of wind transportation is given below:

- Fine silt and clay (<0.01 mm) offer strong resistance to movement.

- Coarse silt and very fine sand (0.01-0.1 mm) are lost in suspension.
- Very fine to medium sand (0.1-0.5 mm) is subjected to saltation.
- Coarse sand (0.5-1.0 mm) moves as surface creep

The soils are moderately susceptibility to water erosion which varies across the site. The general assumption is that the erosion susceptibility increases with an increase in the slope angle and/if the slope length is constant.

7. IMPACTS

The two major potential impacts on the natural resources of the study area would be: 1) the loss of arable land due to the construction of the various types of infrastructure and 2) potential increased risk of soil erosion. However, these impacts (if properly mitigated) would in all probability be of limited significance and would be local in extent. At the end of the project life, it is anticipated that removal of the structures would enable the land to be returned to more or less a natural state following rehabilitation, with little residual impact, especially given the low prevailing agricultural potential.

The impacts can be summarized as follows:

Table 4 Impact significance

Nature of impact: Loss of agricultural land Land that is no longer able to be utilized due to construction of infrastructure. The impact will be confined to areas within the site where infrastructure will be located and will cease once operation of the activity ceases. The significance of the impact is low due to low potential of area, as well as the nature of the infrastructure.		
	Without mitigation	**With mitigation**
Extent	Local (2)	N/A
Duration	Long-term (4)	N/A
Magnitude	Minor (2)	N/A
Probability	Highly Probable (4)	N/A
Significance	**Low (16)**	N/A
Status (positive or negative)	Negative	N/A
Reversibility	Irreversible	N/A
Irreplaceable loss of resources?	No	N/A
Can impacts be mitigated?	Yes	N/A
Mitigation:		

» None.
Residual Impacts: No mitigation possible so same as impacts without mitigation

The very low rainfall and hot conditions in the area, coupled with the sandy and/or rocky soils, mean that the prevailing agricultural potential is very low, so any impacts on this will be minimal.

Table 5 Impact significance

Nature of impact: Wind erosion Removal of topsoil by the action of wind due to removal of vegetation. The impact will possibly occur in areas surrounding the project site. The impact will cease when operation of activity ceases. The significance and severity of the impact is low, mainly due to low potential of the area and the nature of infrastructure. Especially if mitigation measures are put in place and applied.		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Minor (2)
Probability	Highly Probable (4)	Probable (3)
Significance	**Low (30)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Reversible
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: » Ensure that the footprint for vegetation removal is restricted to as small an extent as possible. In addition, appropriate soil conservation measures to combat wind erosion (windbreaks, geotextiles on the soil surface and immediate re-establishment of vegetation) should be implemented and monitored on at least a six-monthly basis.		
Residual Impacts: None.		

Due to the predominance of very sandy soils, often with a fine grade of sand, the hazard of ***wind erosion*** when the topsoil is disturbed may be significant, as these areas are mapped as "highly susceptible" (ARC-ISCW, 2004).

Table 6 Impact significance

Nature of impact: Cumulative impacts on wind erosion potential in the area (resulting in transfer of topsoil sediments by wind action).		
	Without mitigation	**With mitigation**

Extent	Local (2)	Local (2)
Duration	Long Term (4)	Long Term (4)
Magnitude	Low (4)	Minor (2)
Probability	Highly Probable (4)	Improbable (2)
Significance	**Low (16)**	**Low (16)**
Status	Negative	Negative
Reversibility	Irreversible	Reversible
Irreplaceable loss of resources?	Possible	Possible
Can impacts be mitigated?	Yes	Yes
Mitigation: Mitigation measures as defined in the table above. In addition: regular consultation and reporting by responsible officers for any and all developments in the area, as improper management at one site could well cause problems at other site, due to unpredictable and possibly widespread sediment transport by wind, especially under the prevailing dry climate.		

The main potential cumulative impact would be soil removal due to wind erosion caused by developments off site. Due to the nature of the soil removal process, once topsoil is taken up into the atmosphere, wind action can deposit it over a large area and at a considerable distance, depending on the strength and duration of the wind acting upon the soils. Where a large number of developments occur in close proximity to one another, some sort of co-ordinated mitigation plan would be required to ensure that poor soil management procedures on one site do not lead to impacts on another site that actually has implemented mitigation measures correctly.

Conclusion

The majority of the solar power applications in this area of the Northern Cape comprise some of the lowest agricultural potential that one will find anywhere in South Africa, with **very hot, dry conditions** and usually shallow soils with rock outcrops and sandy soils, often with dunes (which is the case with this application). A site visit would only confirm this situation. There might well be a soil erosion hazard regarding wind erosion, but that is mentioned in the report (see Table 4 and Table 5) with a range of mitigation measures specified, and a site visit would also not add significant value to that assessment.

Where a specialist soil investigation for an environmental impact assessment is concerned, if there is any possibility of medium or high potential agricultural soils, or if there is any other specific situation that justifies a site visit that would definitely be recommended in the report, but this is not the case for the Karoshoek area.

Due mainly to the prevailing unfavorable climatic conditions for arable agriculture, as well as the prevalence of soils with limited depth, it is not envisaged that any more detailed soil investigation will be required.

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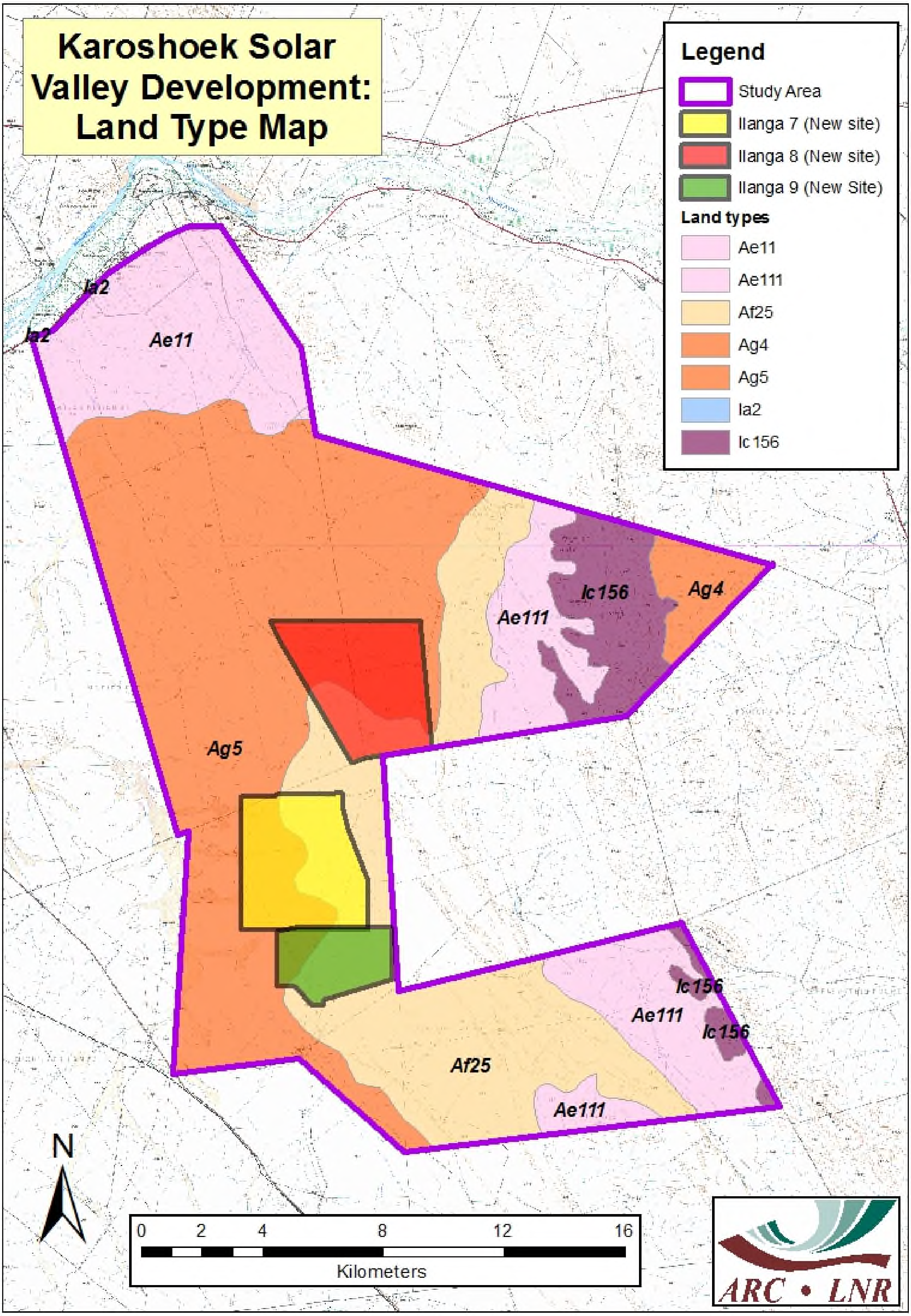
APPENDIX

MAP OF LAND TYPES



Karoshoek Solar Valley Development: Land Type Map
Legend
Study Area
Ilanga 7 (New site)
Ilanga 8 (New site)
Ilanga 9 (New Site)
Land types
Ae11
Ae111
Af25
Ag4
Ag5
Ia2
Ic156
Ia2
Ia2
Ae11
Ic156
Ag4
Ae111
Ag5
Ic156
Ae111
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Af25
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0
2
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Kilometers
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