BASIC ASSESSMENT REPORT

On contract research for

SAVANNAH ENVIRONMENTAL

Upington Ilanga Solar Park Project, Northern Cape - Site 1 (100 MW PV and associated infrastructure)

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

January 2020

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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 basic assessment phase of the Environmental Impact assessment (EIA) process for proposed solar thermal energy facilities, within the Upington Ilanga Solar Park Project.

Basic Assessment Report

The report must include:

» an indication of the methodology used in determining the significance of potential environmental impacts
» a description of all environmental issues that were identified during the environmental impact assessment process
» an assessment of the significance of direct, indirect and cumulative impacts in terms of the following criteria:
  * the *nature* of the impact, which shall include a description of what causes the effect, what will be affected and how it will be affected
  * the *extent* of the impact, indicating whether the impact will be local (limited to the immediate area or site of development), regional, national or international
  * the *duration* of the impact, indicating whether the lifetime of the impact will be of a short-term duration (0–5 years), medium-term (5–15 years), long-term (> 15 years, where the impact will cease after the operational life of the activity) or permanent
  * the *probability* of the impact, describing the likelihood of the impact actually occurring, indicated as improbable (low likelihood), probable (distinct possibility), highly probable (most likely), or definite (impact will occur regardless of any preventative measures)
  * the *severity/beneficial scale*, indicating whether the impact will be very severe/beneficial (a permanent change which cannot be mitigated/permanent and significant benefit, with no real alternative to achieving this benefit), severe/beneficial (long-term impact that could be mitigated/long-term benefit), moderately severe/beneficial (medium- to long-term impact that could be mitigated/ medium- to long-term benefit), slight or have no effect
  * the *significance*, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high
  * the *status*, which will be described as either positive, negative or neutral
  * the *degree* to which the impact can be reversed
  * the *degree* to which the impact may cause irreplaceable loss of resources
  * the *degree* to which the impact can be *mitigated*

» a description and comparative assessment of all alternatives identified during the environmental impact assessment process
» recommendations regarding practical mitigation measures for potentially significant impacts, *for inclusion in the Environmental Management Programme (EMPr)*
» an indication of the extent to which the issue could be addressed by the adoption of mitigation measures
» a description of any assumptions, uncertainties and gaps in knowledge
» an environmental impact statement which contains:
   * a summary of the key findings of the environmental impact assessment;
   * an assessment of the positive and negative implications of the proposed activity.

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 broader project 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 lies mainly on the following farms: Matjiesrivier 41, Trooilaps Pan 53 and Zand Dam 52. The area lies between 28° 29’ and 28° 36’ S and between 21° 26’ and 21° 33’ E.

Within the broad area, several developments are proposed, as shown in Figure 1. This report deals specifically with Site 1, which is denoted by the **light green** block in Figure 1.

The project will be known as Ilanga PV1 and will be one of 9 solar PV facilities which are collectively known as the Upington Ilanga Solar Park.

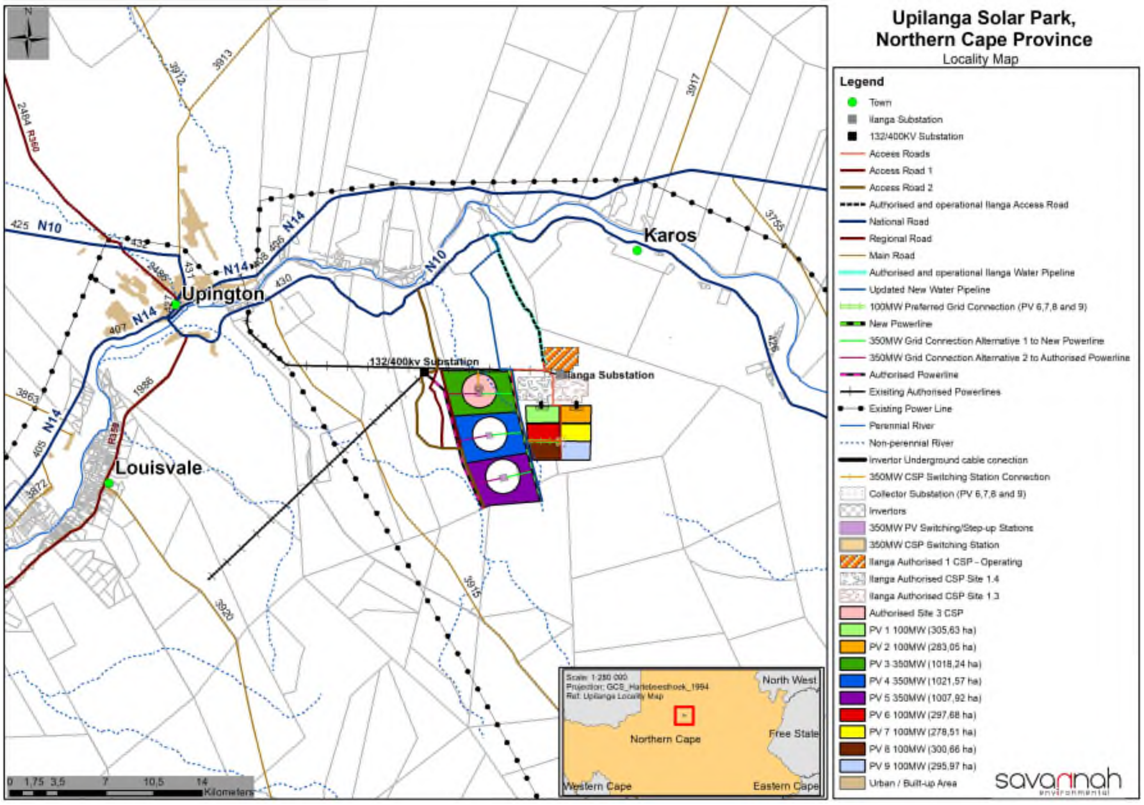


Figure 1 Locality map

The project and associated infrastructure is proposed within Portion 3 of the farm Matjesrivier 41 and Lot 944 and will form part of the Upington Ilanga Solar Park located approximately 30 km east of Upington. The site falls within the jurisdiction of the Dawid Kruiper and the greater ZF Mgcawu District Municipality.

The proposed project will have a contracted capacity of up to 100 MW, and will make use of PV solar technology for the generation of electricity. The project will comprise the following key infrastructure and components:

» Solar PV panels with a maximum height of 5m utilising Single axis tracking; Fixed axis tracking; Dual axis tracking or Fixed Tilt mounting structures made of galvanised steel and aluminium.
» Grid alternatives using underground cables to connect to the on-site substation at authorised site 1.4 and ultimately to the existing the Ilanga substation
» A step-up facility (inverter) to step up the electricity current from 11kV/22kV/33kVto 132kV.
» A temporary laydown area.
» Cabling between the panels, to be laid underground where practical, connecting the PV arrays to the inverter stations, O&M building and collector substation.

- An access road to the development area no more than 6m wide.
- Internal access roads within the PV panel array area with a maximum width of 4m.
- Perimeter security fencing around the development area.
- Operation and Maintenance buildings including a gate house and security building, control centre, offices, warehouses, a workshop and visitors centre.

The electricity current from the Upilanga PV1 PV facility will be converted and evacuated via an inverter and with the aid of underground cables connect to the authorised Ilanga CSP site 1.4 on-site substation (DEA Ref:. 14/12/16/3/3/2/299). The onsite substation at site 1.4 will connect to the existing Ilanga substation which ultimately feeds into the national grid via the following possible alternatives that were assessed in this report

1.) On-site inverter (step up facility) to convert power from Direct Current (DC) to an Alternative (AC) and step up the electricity current from 33kV to 132kV that will connect to the on-site substation at authorised site 1.4 via underground cables. The electricity will be evacuated via the authorised grid connection (DEA Ref:. 14/12/16/3/3/2/299) to the existing Ilanga substation.
2.) An onsite 11kV/22kV/33kV collector substation to receive, convert and step up electricity from the PV facility directly to the existing 132kV Ilanga Substation via underground cables (The on-site collector substation at authorised site 1.4 connects to the Ilanga substation).
3.) Loop in and loop out the 132kV lines connecting the existing Ilanga Substation to Gordonia Substation

From Google Earth and other satellite imagery, little or no agricultural infrastructure is present, and the prevailing land use is extensive grazing with natural shrub and grass vegetation.

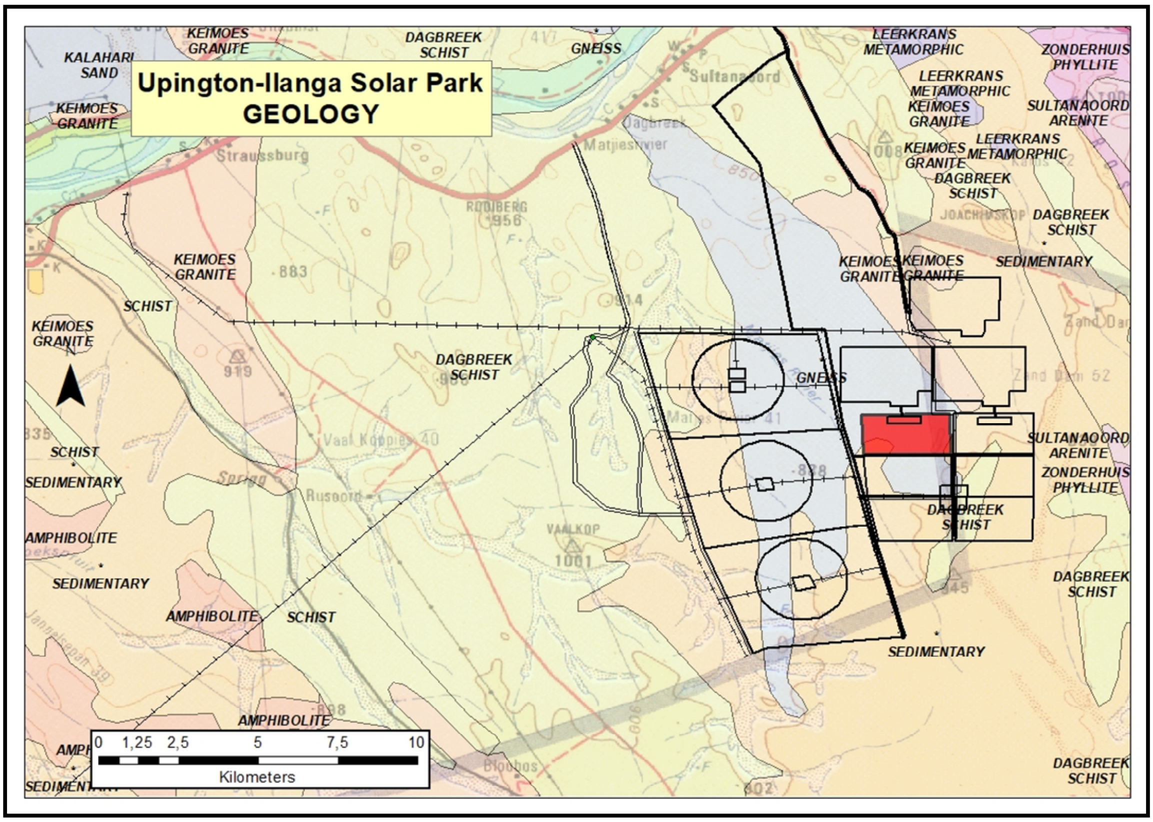
2.2 Terrain

The area is generally flat to gently undulating and lies at a height of approximately 800-900 metres above sea level, sloping gradually towards the Gariep River in the north. 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 35.0ºC and 18.7ºC for January to 20.8ºC and 3.3ºC for July respectively. The extreme high temperature that has been recorded is 43ºC and the extreme low –7.9ºC. 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 (mainly gneiss and schist), along with sandy sedimentary materials (Geological Survey, 1988).

The location of all of the proposed infrastructure is shown in Figure 2. Site 1, shown in red, lies mainly within an area of underlying schist.

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).

While the broad study area is covered by the several land types, Site 1 occurs within the following land type unit, namely:

- **Ag5** (Shallow, red, freely-drained, structureless soils, high base status)

This is shown in the land type map in the Appendix, with the various land type boundaries shown **in green** and Site 1 again shown as the red block.

> 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 the land type is given in Table 1 below.

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 1** 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 (%)
Ag5	100-400	Hutton 34/35/44/45	43%	Red, sandy soils (6-15% clay) on hard rock and calcrete	High: 0.0 Mod: 12.9 **Low: 87.1**
	100-400	Mispah 10/12/20/22	26%	Red-brown, sandy topsoils (4-12% clay) plus hard rock and calcrete	
	900-1200	Hutton 34/35/44/45	12%	Red, sandy soils (6-15% clay) on hard rock and calcrete	

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 area occupied by Site 1 comprises red, sandy soils, many of which are shallow with only a limited portion of moderately deep to deep soils (as can be seen from the information contained in Table 1). 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 remote sensing (satellite) image of the area (Figure 3) shows absolutely no signs of any agricultural infrastructure and certainly none of irrigation (the red area denotes Site 1).

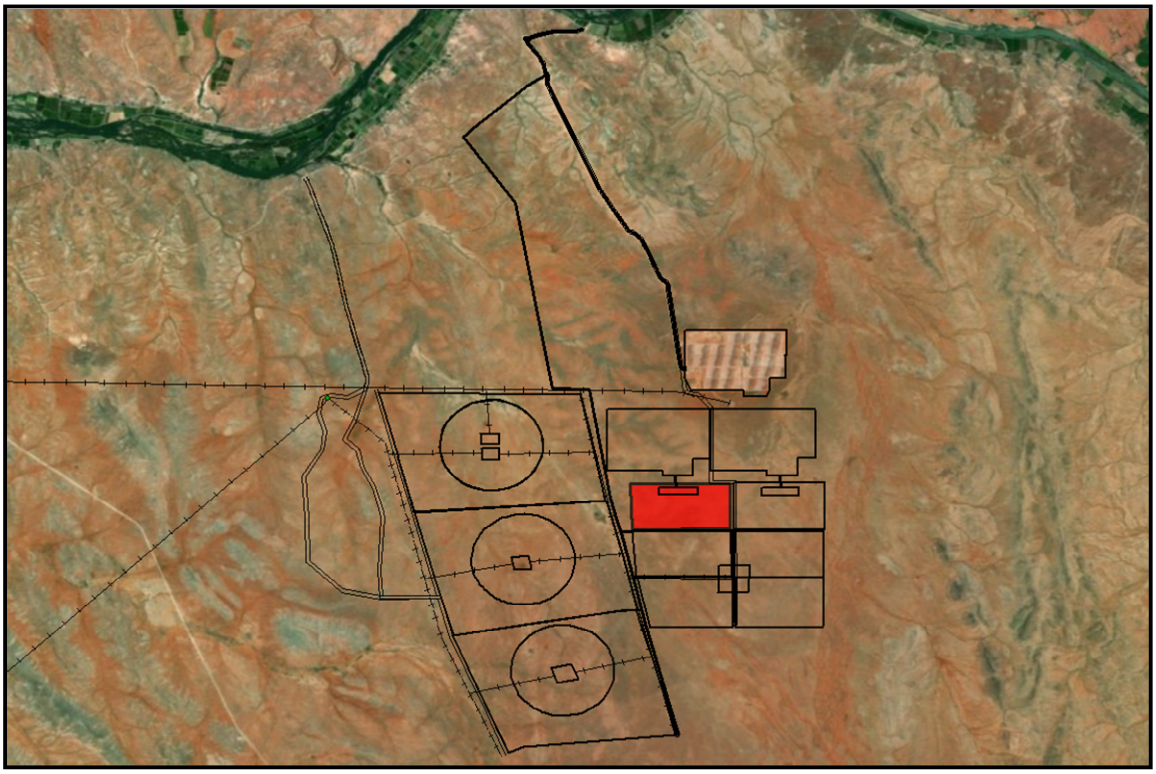


Figure 3. Satellite image of study area

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 Site 1 as assessed in this report, the dominant class of agricultural potential is **low**. The site falls within a portion of land type **Ag5** (shallow red soils). The climatic restrictions mean that the potential impacts (see below) will be relatively low, 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. IMPACTS

Assessment of Impacts

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

- » The **nature**, which includes a description of what causes the effect, what will be affected and how it will be affected.
- » The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- » The **duration**, wherein it is indicated whether:
  - ∗ the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - ∗ the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - ∗ medium-term (5–15 years) – assigned a score of 3;
  - ∗ long term (> 15 years) - assigned a score of 4; or
  - ∗ permanent - assigned a score of 5;
- » The **consequences (magnitude)**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- » The **probability** *of occurrence*, which describes the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- » the **significance**, which is determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- » the **status**, which is described as either positive, negative or neutral.
- » the degree to which the impact can be reversed.
- » the degree to which the impact may cause irreplaceable loss of resources.

» the *degree* to which the impact can be *mitigated.*

The **significance** is calculated by combining the criteria in the following formula:

S = (E+D+M) x P

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

The two major potential impacts on the natural resources of the Upington-Ilanga 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 2 Loss of agricultural land, Site 1

Nature: Loss of potentially productive agricultural land *(both construction and operation phase)*		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance (E+D+M) x P	**Low (18)**	**Low (14)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: The main mitigation measures would be: • To minimise the footprint of construction as much as possible.		
Cumulative impacts: likely to be low, as all soil-related aspects will be confined to the site, and the prevailing agricultural potential in the area is low.		
Residual Risks: likely to be low, since the implementation of the appropriate mitigation measures will enable more or less complete rehabilitation during and after the life of the project.		

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 3 Soil erosion, Site 1

Nature: Increased soil erosion hazard by wind *(construction and operation phase)*		
	Without mitigation	**With mitigation**
Extent	Local to regional (3)	Local (1)
Duration	Permanent (5)	Short-term (2)
Magnitude	High (8)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance (E+D+M) x P	**High (64)**	**Low (10)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	Very possible	No
Can impacts be mitigated?	Yes	
Mitigation: The main mitigation measures would be: • To minimise the footprint of construction as much as possible. • Where soil is removed/disturbed, ensure it is stored for rehabilitation and re-vegetated as soon as possible. • Implement all appropriate soil conservation measures, including contouring, culverts etc. (for road construction), geotextiles and slope stabilisation (for all infrastructure).		
Cumulative impacts: likely to be high, as wind erosion can carry soil particles for a considerable distance, depending on wind strength and direction, as well as soil texture.		
Residual Risks: if mitigation is not carried out, long-term wind erosion, with results such as loss of valuable topsoil, may occur.		

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).

These impacts will also be valid for the proposed alternative grid connections to connect the development to the existing power network. Since these connections (whichever alternative is chosen) will be by underground cable, the mitigation and impacts will be as stated in tables 2 and 3 above.

6.1 Cumulative Impacts

The likelihood of cumulative impacts for wind erosion may be significant, if not mitigated. This is because concurrent developments are proposed relatively close to the Upington-Ilanga 1 project site investigated in this report, as shown in Figure 6. The impacts are summarised in Table 4 below.

When considering the other renewable energy developments within the surrounding area (within a 30 km radius from the development area), it is assumed that the impact of erosion and appropriate mitigation measures at a site-specific level for each of the facilities has been considered and the mitigation measures recommended are sufficient for the management and mitigation of erosion. Therefore, considering that the impact of erosion at each facility will be low in extent, subject to the implementation of the recommended mitigation measures, and managed for each facility separately, the cumulative impact for erosion is considered to be low. Under these circumstances, the loss associated with erosion is therefore considered to be acceptable loss, without detrimental consequences.

If there is large scale development of renewable energy facilities in the area, any failure to prevent wind erosion of topsoil on one project could lead to that material being deposited on any or all neighbouring properties.

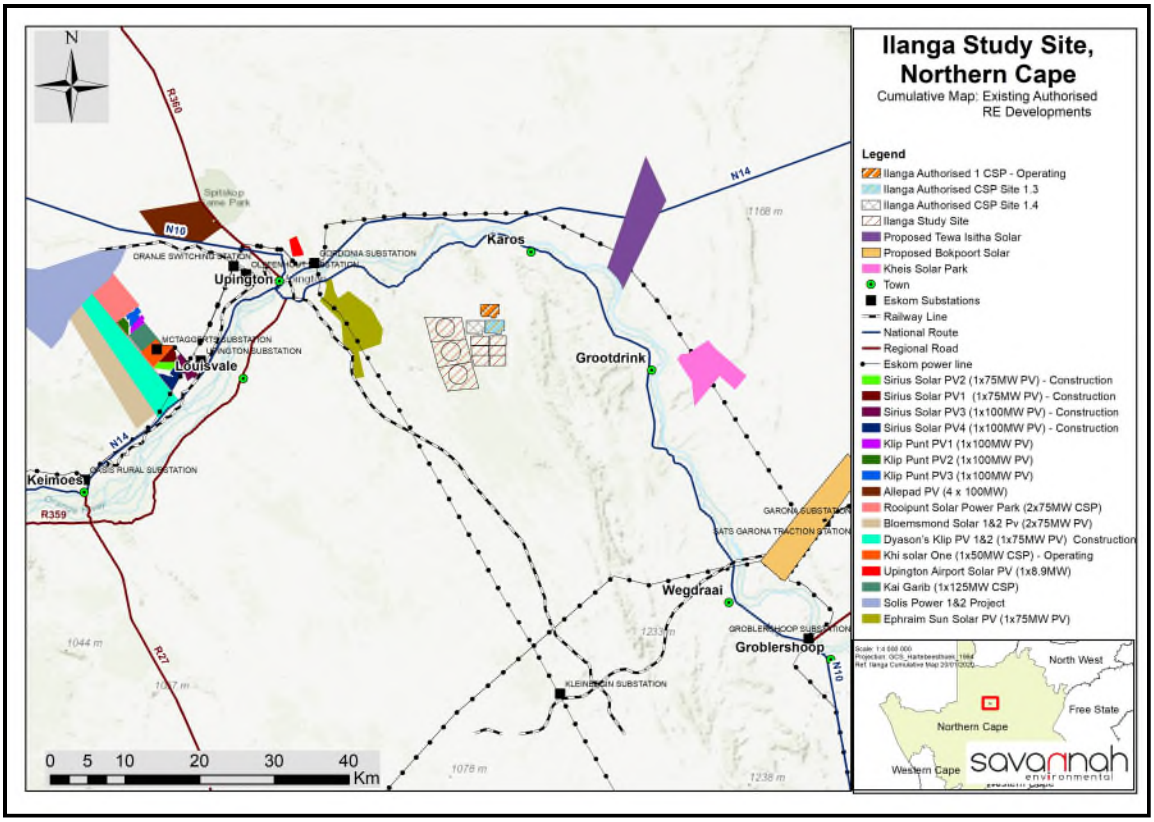


Figure 6 Map showing Renewable Energy projects in the vicinity of Upington-Ilanga

The cumulative impacts are summarised in Table 4 below.

Table 4 Cumulative Impacts

Nature: Cumulative impact of the Proposed Development in terms of wind erosion		
	Overall impact of the proposed project considered in isolation[1]	**Cumulative impact of the project and other projects in the area[2]**
Extent	Local (1)	Local (2)
Duration	Short-term (2)	Short-term (2)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance (E+D+M)x P	**Low (10)**	**Low (12)**
Status (positive/negative)	Negative	Negative
Reversibility	High	High
Loss of resources?	No	No
Can impacts be mitigated?	Yes	
Confidence in findings: High.		
Mitigation: The main mitigation measures would be: • To minimise the footprint of construction for each facility as much as possible. • Where soil is removed/disturbed, ensure it is stored for rehabilitation and re-vegetated as soon as possible. • Implement all appropriate soil conservation measures, including contouring, culverts etc. (for road construction), geotextiles and slope stabilisation (for all infrastructure). • Ensure that equal responsibility and co-operation is accepted if more than one facility will be using the same access road, or if the possibility exists of sediment transfer (by wind or water) from one site to another		
Residual Risks: Significant risk of accelerated soil erosion by wind if mitigation measures of each facility are not applied correctly.		

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.

[1] It is assumed that the appropriate mitigation measures have been implemented.

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 3 and Table 4) 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.

7 CONCLUSION AND RECOMMENDATIONS

The main recommendation is that care should be taken within all aspects of the construction phase to ensure that erosion is managed and mitigated appropriately. The Upington-Ilanga project site is a dry area, with fragile vegetation and sandy topsoils and will be susceptible to uncontrolled topsoil removal by wind. The long-term effects of ignoring this aspect could be severe, both for the project and for the surrounding environment.

[2] It is assumed that the appropriate mitigation measures have been implemented.

7.1 Measures for inclusion in the draft Environmental Management Programme

OBJECTIVE: Conservation, as far as possible, of the existing soil resource, both on site and in adjoining areas.	
Project component/s	Construction of all infrastructure where topsoil will be disturbed
Potential Impact	Loss of topsoil leading to wind erosion
Activity/risk source	Construction activities
Mitigation: Target/Objective	To retain all topsoil with a stable soil surface

Mitigation: Action/control	Responsibility	Timeframe
• Storage of all topsoil that is disturbed (maximum height 2 m; maximum length of time before re-use 18 months).	Construction Engineer	Construction
• Immediate replacement of topsoil after the undertaking of construction activities within an area	Construction Engineer	Construction
• Soil conservation measures must be put in place to ensure soil stabilisation	Construction Engineer	Post-Construction

Performance Indicator	No indications of visible topsoil loss
Monitoring	Visual inspection every 6 months (minimum) of all areas where disturbance has taken place (for both the construction phase and the duration of the project). Responsibility: Project site manager If soil loss is suspected, acceleration of soil conservation and rehabilitation measures must be implemented (as specified above).

Considering the findings of the report and the current soils environment within which Upington-Ilanga is proposed, it is the opinion of the specialist that the proposed activities should be authorised, subject to the implementation of the recommended mitigation measures. The activities proposed are considered to be acceptable from a soil perspective considering the characteristics and potential of the soils present within the project site.

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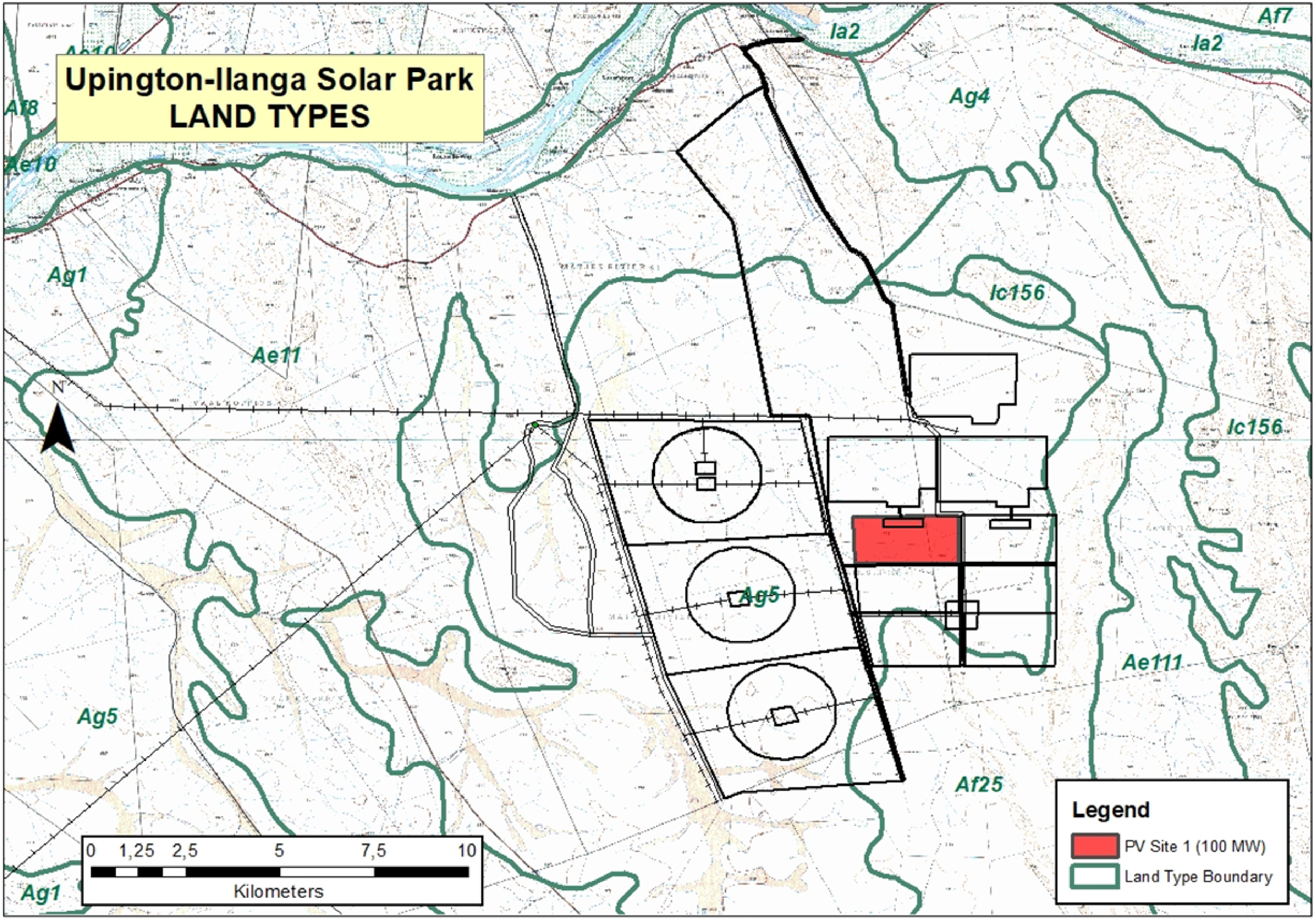
APPENDIX

MAP OF LAND TYPES


Upington-Ilanga Solar Park
LAND TYPES
Af7
Ia2
Ia2
Af8
Ae10
Ag4
Ag1
Ic156
Ae11
Ic156
Ag5
Ae111
Ag5
Af25
Ag1
0 1,25 2,5 5 7,5 10
Kilometers
Legend
PV Site 1 (100 MW)
Land Type Boundary