AURECON SOUTH AFRICA

Proposed Kangnas Wind and Solar Energy Facilities near Springbok

Final Soil and Agricultural Assessment Report

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Declaration

I, Kurt Barichievy, declare that I –

- act as an independent specialist consultant in the field of Soil Science and Agricultural Potential for the **soil and agricultural assessment report for the proposed Kangnas Wind and Solar Energy Facilities near Springbok, Northern Cape Province**;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2006;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2006; and
- will provide the competent authority with access to all information at our disposal regarding the application, whether such information is favourable to the applicant or not.

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Scientist
SiVEST Civil Engineering Division

CONTENTS

LIST OF FIGURES

1 INTRODUCTION AND TERMS OF REFERENCE

Aurecon South Africa (Pty) Ltd (Aurecon) on behalf of **Mainstream Renewable Power (Pty) Ltd** (Mainstream) requested a baseline assessment of the soil, land use and agricultural characteristics for the area affected by the proposed Kangnas Wind and Solar Energy Facility, near Springbok in the Northern Cape Province of South Africa. The primary objective of this assessment is to provide specialist soil and agricultural input into the overarching EIA Report. In order to achieve this objective a study of the climate, soils, terrain, land capability, geology, current agricultural practices and agricultural potential was carried out. This report serves to summarise such a study, present the relevant results and mitigate the predicted impacts on local soil and agricultural resources.

During the preliminary phase of the environmental process a desktop agricultural study was undertaken, to flag any agriculturally related issues that may prevent the proposed development from going ahead. This EIA phase assessment and report intends to build on this previous study. The terms of reference, as provided by Aurecon, are to:

- Undertake a detailed soil assessment of the sites, incorporating a radius of 50 m surrounding the site, on a scale of 1:10 000 or finer. The soil assessment should include:
  - Identification of the soil forms present on sites;
  - The size of the area where a particular soil form is found;
  - GPS readings of soil survey points;
  - The depth of the soil at each survey point;
  - Soil colour;
  - Limiting factors;
  - Clay content
  - Size of the site
  - Slope of the sites; and
  - A detailed map indicating the locality of the soil forms within the specified areas.
- Provide the exact locality of the site
- Describe current activities on the sites, developments and buildings;
- Describe surrounding developments/ land uses and activities in a radius of 500 m of the sites, access routes and the condition thereof, the current status of the land (including erosion, vegetation and a degradation assessment) and possible land use options for the sites;
- Describe water availability, source and quality (if available);
- Detailed descriptions of why agriculture should or should not be the land use of choice;
- Undertake an assessment of the potential impacts on agriculture at the site in terms of the scale of impact (local, regional, national), magnitude of impact (low, medium or high) and the duration of the impact (construction, up to 10 years after construction, more than 10 years after construction). The assessment is to indicate the potential cumulative impacts;
- Describe potential mitigation measures to reduce or eliminate the potential agricultural impacts identified; and
- Provide a shape file containing the soil forms and relevant attribute data as depicted on the map.
- Provide an erosion management plan for monitoring and rehabilitating of erosion events associated with the facility.

Mainstream proposes to develop a 750 Megawatt (MW) wind energy facility, a 250 MW solar Photovoltaic (PV) and / or Concentrated Photovoltaic (CPV) energy facility and substation on a number of farm portions near the town Springbok in the Northern Cape. The proposed wind and solar energy facilities are located approximately 48 km east of Springbok and can be accessed via the N14 highway and connecting farm roads (**Aurecon, 2012**). The study area is approximately 46 543 hectares (ha) in extent and influences 5 farm portions of 4 farms (**Figure 1**).

In order to avoid duplication of information, the proposed wind and solar energy facilities and associated activities are assessed in a single Agricultural Assessment Report. It is hoped that this assessment, along with the other specialist studies, will indicate which areas to avoid due to high environmental sensitivity, and thus minimise the predicted impacts on the receiving environment.

1.1 Brief Description of the Project and Study Area

The purpose of this section is to provide basic site information for later reference. Please note that a more detailed description of the site's characteristics are provided in **Sections 4 through 7** of this report.

The Northern Cape Province is considered to be one of the most suitable regions for the establishment of wind farms and PV / CPV facilities due to the overriding climatic and environmental conditions. Accordingly, land portions located outside of Springbok have been identified as a potential site. As indicated, the overarching project contains a wind, solar and substation subproject, which will be constructed adjacent to each other. The wind energy facility could potentially consist of between 185 and 500 wind turbines, with maximum capacity of 750 MW. Once operational the solar subproject will have a capacity of 250 MW. Thus, the total capacity of the entire project will be 1000 MW. The power generated by the two proposed facilities would be transmitted to the national grid via transmission lines and nearby satellite substations (**Aurecon, 2012**).

The proposed development area is situated in the Namakwa District Municipality. The development influences a number of farm portions and the influenced landowners have entered into a long term agreement with Mainstream (**Table 1**).

Table 1: Farm and land owner details for the study area

Farm	Land Owner	Farm Centroid	Area (ha)
Kangnas (Farm No. 77 Portion 3)	Mr W van Niekerk	29^o 35' 39" S 18^o 22' 39" E	11 685
Kangnas (Farm No. 77 Portion Remainder)	Mr W van Niekerk	29^o 33' 24" S 18^o 26' 32" E	8 785
Koeris (Farm No. 78 Portion 1)	Mr W van Niekerk	29^o 38' 12" S 18^o 28' 46" E	8 868
Smorgen Schaduwe (Farm 127 Remainder)	Mr J Kennedy	29^o 34' 37" S 18^o 16' 44" E	9 558
Areb (Farm No. 75, Remainder)	Mr F Agenbag	29^o 30' 30" S 18^o 13' 54" E	7 647

Due to the sheer size of the project (totalling approximately 46 543 ha) a concise description of the general topography is difficult. However, the assessed area can be summarised as being dominated by vast plains with sporadic steep rocky outcroppings and ridges. The farms are dominated by arid shrub vegetation and non-perennial streams. The study area is zoned as agricultural land, and is used as grazing land for sheep, cattle, goats and game. The veld is in average condition and there are some signs of overgrazing and erosion. The surrounding land is comparable to the study area and is dominated by agricultural grazing land. Other than scattered homesteads, storage sheds and kraals there is very little in terms of agricultural infrastructure.

Access to the sites is obtained via the N14 and inter-connecting farm roads. The internal roads are in a reasonable condition and most of the study area can be accessed via motor vehicle. Water is the major limiting factor to local agricultural enterprises and the assessed area contains no perennial rivers and nor does the project area border a perennial river.

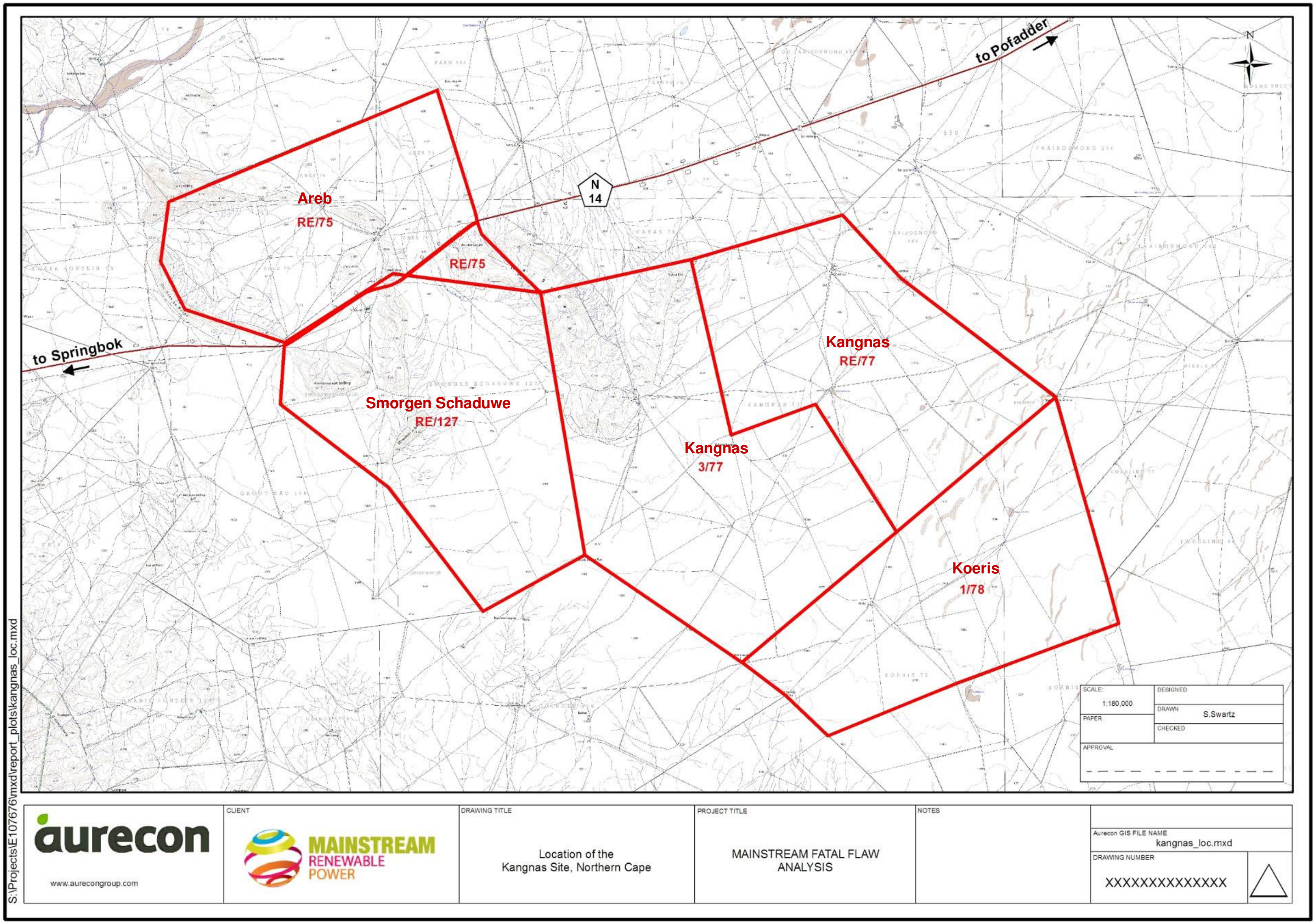

Figure 1: Kangnas study area and influenced farm portions (**Source: Aurecon, 2012**)

2 DESCRIPTION OF PROPOSED ACTIVITIES AND TECHNICAL DETAILS

The technical details provided in this Section are primarily extracted from previous projects and the Final Scoping Report produced by **Aurecon** (**2012**). The proposed development includes the construction of both a wind and solar energy facility.

2.1 Wind Energy Facility

The proposed wind energy facility would consist out of approximately 185 - 500 turbines of 1.5-4 MW capacity each and would have a maximum total installed capacity of 750 MW. A wind turbine is a rotary device that extracts energy from the wind. If the mechanical energy is used directly by machinery, such as for pumping water, cutting lumber or grinding stones, the machine is called a windmill. If the mechanical energy is instead converted to electricity, the machine is called a wind turbine. **Figure 2** shows a wind energy facility in Texas, United States of America (**Aurecon, 2012**).

2.1.1 Components of a wind turbine

Wind turbines can rotate about either a horizontal or a vertical axis. Turbines used in wind farms for commercial production of electricity are usually horizontal axis, three-bladed and pointed into the wind by computer-controlled motors, as is proposed for this project. These have high tip speeds of over 320 km/hour, high efficiency, and low torque ripple, which contribute to good reliability (**Aurecon, 2012**).

The main components a wind turbine is made up are listed and described below:

- Rotor and blades;
- Nacelle;
- Generator;
- Tower; and
- Foundation.

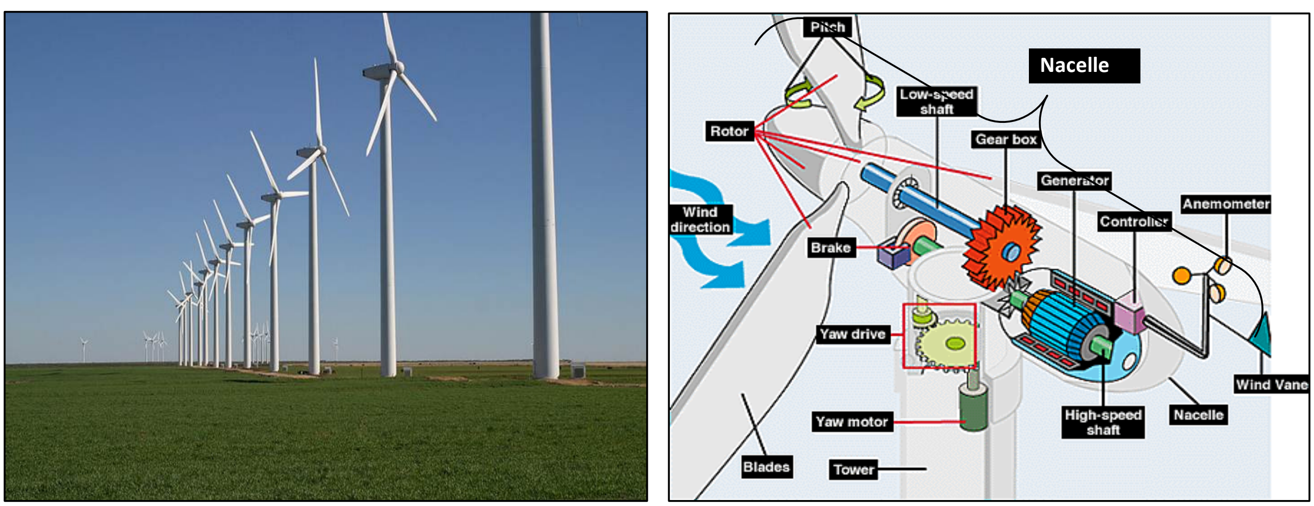

Figure 2: Brazos Wind Ranch located in Texas, USA (left) and Typical components of a horizontal axis wind turbine (right) (Source: **Wikipedia, 2012a**; cited in **Aurecon, 2012**).

- **Rotor and blades**

The rotor has three blades that rotate at a constant speed, approximately 6-15 revolutions per minute (rpm) in the case of the turbines being considered at Kangnas. The blades are usually coloured light grey and, in the case of the proposed project, would be approximately 40 – 60 m long (80 – 120m rotor diameter) (**Aurecon, 2012**).

- **Nacelle**

Larger wind turbines are typically actively controlled to face the wind direction measured by a wind vane situated on the back of the nacelle. By reducing the misalignment between wind and turbine pointing direction (yaw angle), the power output is maximised and non-symmetrical loads minimised. The nacelle can turn the blades to face into the wind ('yaw control'). All turbines are equipped with protective features to avoid damage at high wind speeds. By turning the blades into the wind ('furling') the turbine ceases its rotation, accompanied by both electromagnetic and mechanical brakes. This would typically occur at very high wind speeds, typically over 72 km/h (20 m/s). The wind speed at which shut down occurs is called the cut-out speed. The cut-out speed is a safety feature which protects the wind turbine from damage. Normal wind turbine operation usually resumes when the wind drops back to a safe level. The turbine controls the angle of the blades ('pitch control') to make optimal use of the available wind and avoid damage at high wind speeds. The nacelle also contains the generator, control equipment, gearbox and wind speed measure (anemometer) in order to monitor the wind speed and direction (**Aurecon, 2012**).

- **Generator**

The generator converts the turning motion of the blades into electricity. A gear box is commonly used for stepping up the speed of the generator. Inside the generator, wire coils rotate in a magnetic field to produce electricity. Each turbine has a transformer that steps up the voltage to match the transmission line frequency and voltage for electricity evacuation/distribution (**Aurecon, 2012**).

- **Tower**

The tower is constructed from tubular steel and supports the rotor and nacelle. For the proposed project the tower would be either 60 or 120 m tall, depending on the selected turbine. Wind has greater velocity at higher altitudes, therefore increasing the height of a turbine increases the expected wind speeds (**Aurecon, 2012**).

- **Foundation**

Foundations are designed to factor in both weight (vertical load) and lateral wind pressure (horizontal load). Considerable attention is given when designing the footings to ensure that the turbines are adequately grounded to operate safely and efficiently. The final foundation design of the proposed turbines is dependent on a geotechnical investigation; however it is likely that the proposed turbine foundations would be made of reinforced concrete. The foundations would be approximately 20 m x 20 m and an average of 3 m deep. The foundation would be cast *in situ* and could be covered with top soil to allow vegetation growth around the 6 m diameter steel tower (**Aurecon, 2012**).

2.1.2 Construction and operation of the proposed wind energy facility

The turbine tower comprises sections, the first is bolted to the concrete foundation and subsequent sections are lifted on site by a crane, manoeuvred into position and bolted together. A permanent hard standing made of compacted gravel of approximately 20 m x 50 m would be constructed adjacent to each turbine location for the crane. The preliminary area within which turbines of the proposed wind energy facility would be located is indicated in **Figure 3**. Gravel surface access roads of approximately 6-10 m wide would also be required between each turbine. Cables connecting each turbine would interconnect and ultimately become a new overhead transmission line. The underground cables will run next to the wind turbine connection roads as far as possible. Each turbine would have a transformer that steps up the voltage from 690 Volt to a medium voltage +/- 33 kilovolt (kV). This transformer is housed within each turbine tower or immediately outside the turbine.

The electricity distribution infrastructure would comprise of one transmission line (132 or 220 kV). The proposed project could connect to the grid via up to four satellite substations that would link sectors of the facilities to a main substation which would connect to an overhead line. The proposed route to the substation is approximately 20 km long. At the substation (100 m x 100 m) the voltage would be increased and evacuated via the 220 kV Eskom power line crossing the northern portion of the site.

A preliminary approximation of the water requirements for the construction phase of the proposed wind energy facility is 1500 cubic meters (m^3) of water per month. Mainstream has indicated that water could be sourced from underground sources (if available) depending on legal agreements and compensation with the landowners. Water might also have to be permitted by DWA. Both digger loaders and/or bulldozers would be required for land clearing and for the assembly of the facility.

Turbines are designed to operate continuously, unattended and with low maintenance for more than 20 years or greater than 120 000 hours of operation. Once operating, the proposed wind energy facilities would be monitored and controlled remotely, with a mobile team for maintenance, when required. There would be basic operation and maintenance including storage facilities on site.

A number of jobs during the construction phases and operational phases of the proposed wind facility would be created. The proposed project would make use of local labour as much as possible, and jobs would be preserved for local people as far as possible keeping in mind skills required of the jobs would be filled by people local to the community (**Aurecon, 2012**).

2.1.3 Decommissioning of the proposed wind energy facility

The proposed projects have a project lifespan of approximately 20 - 35 years, based on the mechanical characteristics of the turbines. However, as all the infrastructure, such as roads, transmission, substations and foundations would already be established, and the energy source (wind) is a renewable one the proposed projects would continue to be operated after 20 years. Turbines would be upgraded to make use of the latest technology available. All redundant equipment that was replaced would be removed from site and would be sold off or recycled (**Aurecon, 2012**).

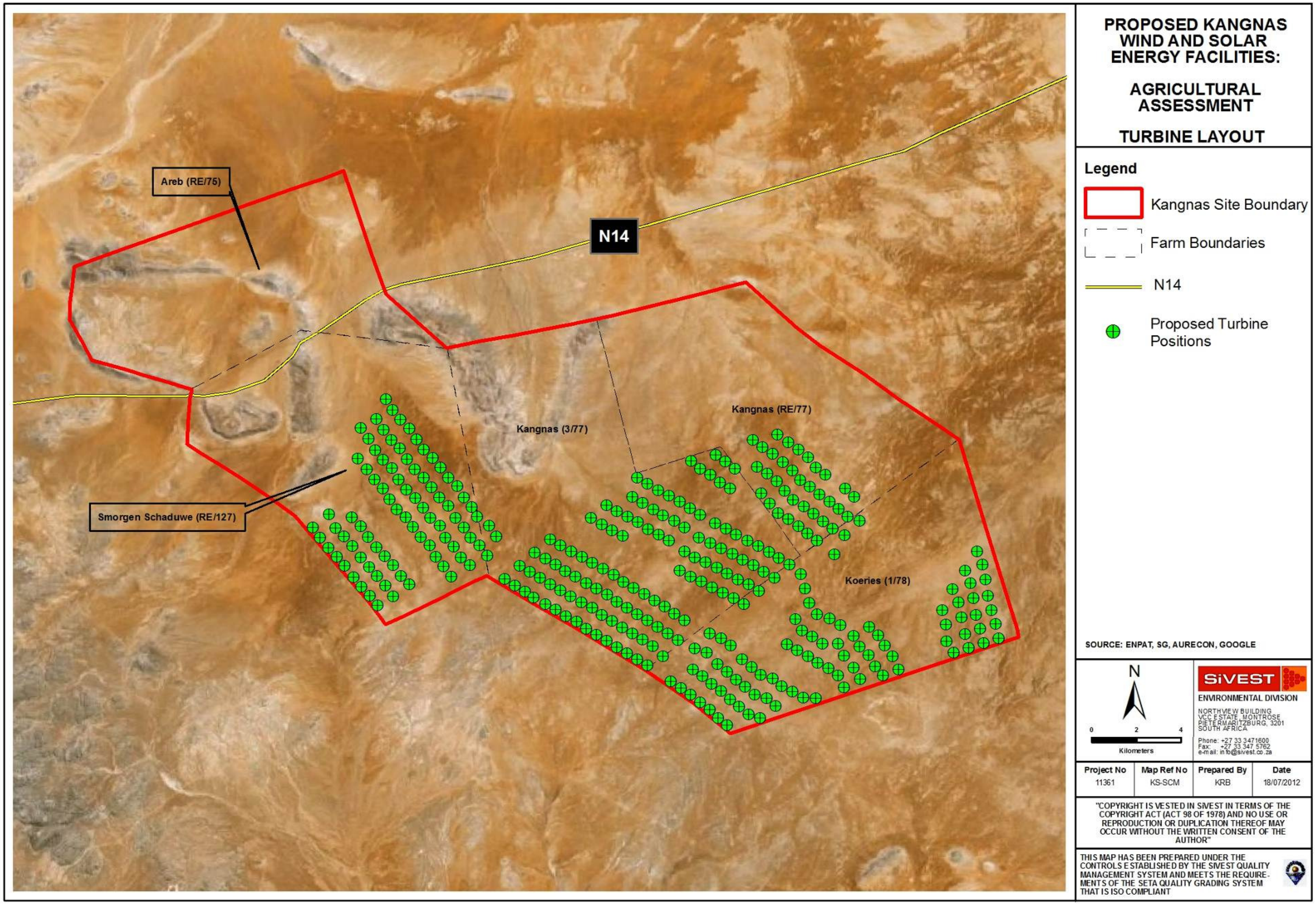

Figure 3: Proposed Turbine Layout

2.2 Solar Energy Facility

A 250 MW solar energy facility with an approximate footprint of 1000 ha, is also proposed for the Kangnas study area. The proposed technology, to be used at the solar facility has not been finalised at this of stage the project. However, the facility will use Photovoltaic (PV) and/or Concentrated Photovoltaic (CPV) technology.

PV systems convert sunlight into energy. The smallest unit of a PV installation is a cell. The PV cells are made of silicone which acts as a semi-conductor. The cells absorb light energy which energizes the electrons to produce electricity. A number of solar cells electrically connected to each other and mounted in a support structure or frame, behind a glass sheet to protect the cells from the environment, is called a PV module. A number of cells form a module and a number of modules form an array (**Figure 4**). Modules are arranged in section sizes of approximately 40x5m called tables and are installed on racks which are made of aluminum or steel. Modules are designed to supply electricity at a certain voltage. The current produced is directly dependent on how much light strikes the module. The arrays are arranged into rows that form the solar field (**Aurecon, 2012**).

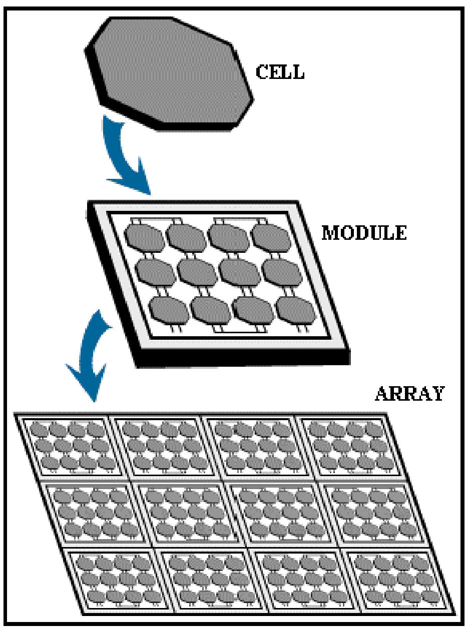

Figure 4: Components of PV technology: (i) Solar cell, (ii) module and (iii) array (Source: **Nasa, 2002** cited in **Aurecon, 2012**).

Figure 5 below illustrates the components of the process of generating electricity from solar energy (sun) and fed into the grid. The fundamental difference between PV and CPV technology is that CPV uses optics such as lenses to concentrate a large amount of sunlight onto a small area of solar PV materials to generate electricity. The arrays and racks are founded into the ground through either concrete, screw or pile foundations (**Figure 6**). The arrays are wired to inverters that convert direct current (DC) into alternate current (AC) that can be fed into a national grid system (**Aurecon, 2012**).

It is argued that CPV technology can reduce overall cost by using more advanced technologies with higher efficiencies. Using CPV technology does require tracking systems to ensure the sunlight is focused on the small cell. Tracking systems do increase the capital cost and maintenance cost of the project (**Aurecon, 2012**).

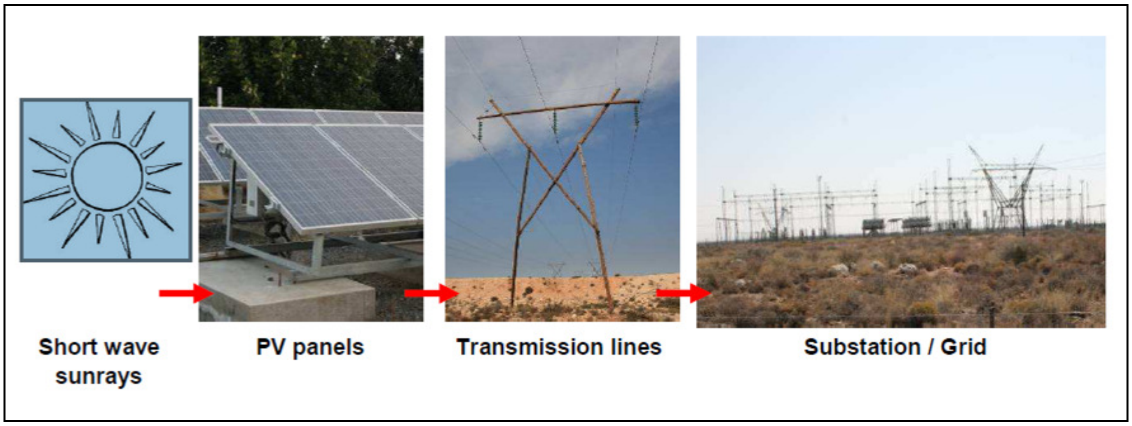

Figure 5: Basic PV system layout (Source: **Aurecon, 2012**)

Figure 6: Sheep grazing under a PV Ground Mounted system (Source: **Wikipedia, 2012b**; cited in **Aurecon, 2012**).

PV Panels can also be mounted on tracking systems which follow the path of the sun to maximize the benefit of each ray of sunlight and allowing for the land underneath to be utilised as well (**Figure 7**). Shade crops can be cultivated under solar panels, increasing the diversity of crops that can be cultivated in sunny regions (**Aurecon, 2012**).

Figure 7: CPV energy facilities in the southern area of Spain (Source: **Ecofriend.com** cited in **Aurecon, 2012**)

2.2.1 Construction and operation of the proposed solar energy facility

The preliminary focus area of the proposed solar energy facility is illustrated in **Figure 8** and has expected development footprint of approximately 1000 ha. Cables connecting the arrays would interconnect with overhead transmission lines that will follow the route of the access roads. The electricity distribution infrastructure would comprise of one transmission line (220 kV) traversing the site. The proposed project would connect to the grid via an onsite substation. The proposed route to the substation is approximately 1 km long. At the substation the voltage would be increased and evacuated via the 220 kV Eskom power line crossing the northern portion of the site (**Aurecon, 2012**).

Mainstream has indicated that water could be obtained from underground water sources depending on the legal agreements and compensation with the landowners. Water might also have to be extracted and permitted by DWA. The facility would be designed to operate continuously, unattended and with low maintenance for more than 20 years. Once operating, the proposed solar energy facilities would be monitored and controlled remotely, with a mobile team for maintenance, when required. The construction period is anticipated to last 24 months for the solar energy facility and 36 months for the wind energy facility months (**Aurecon, 2012**).

2.2.2 Decommissioning phase of the proposed solar energy facility

The PV site could be decommissioned at the end of the 20 year agreement, from the date of commissioning. The decommissioning is expected to take 6 months for the solar energy facility and 12 months for the wind energy facility. The module components would be removed and recycled as the silicon and aluminum can be re-used in the production of new modules (**Aurecon, 2012**).

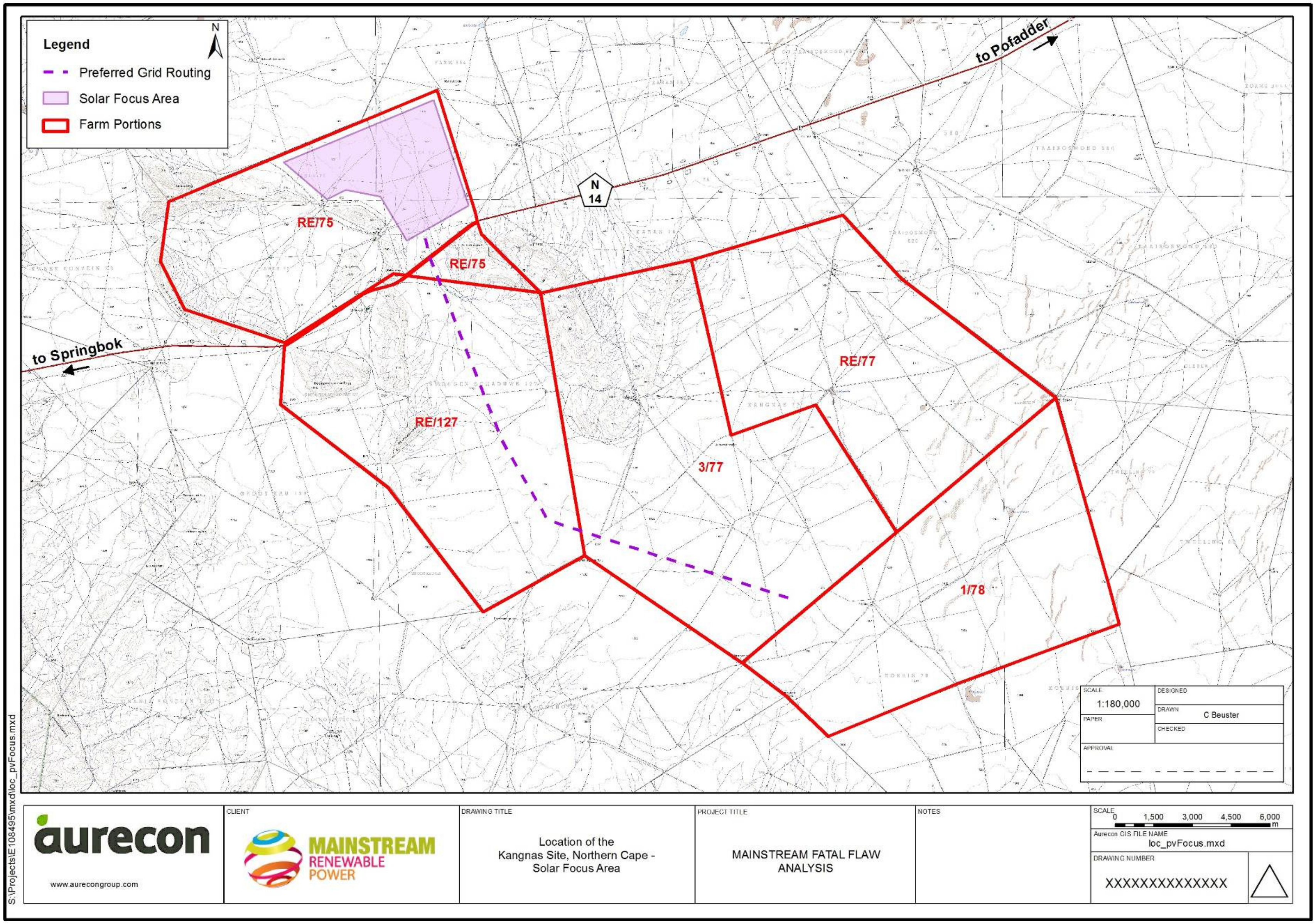

Figure 8: Proposed location of the solar energy facility on Farm Areb (Source: **Aurecon, 2012**)

3. METHODOLOGY

The following methodology was followed in order to ascertain the *status quo* of soil and agricultural resources within the study area. Further, this study will outline the predicted impacts resulting from the proposed development and activities in the study area.

3.1 Desktop Study

A detailed desktop assessment was undertaken for the project area, this includes previously scoped and unscoped areas. The objective of this study is to broadly evaluate the soil and land use of the sites and receiving environment by interrogating relevant climate, topographic, land use and soil datasets. By utilising these data resources one is able to broadly assess the current soil, agricultural and land use characteristics and provide a basis for a more detailed and spatially relevant assessment.

3.2 Soil Survey

A detailed soil survey was conducted for the study area. At each sample point a hand auger was used to identify and describe the diagnostic horizons to form and family level according to "Soil Classification - A Taxonomic System for South Africa" as well as noting relevant soil characteristics such as depth, texture and limiting layers. At each auger point the relevant soil and land use data was recorded and the location of the auger point captured using a handheld GPS. This information was combined to produce detailed soil polygon maps.

3.4 Agricultural Potential Assessment

In terms of this study, agricultural potential is described as an area's suitability and capacity to sustainably accommodate an agricultural land use. The soil information gained from the survey, along with the land use assessment is combined with climate, water resource, crop information and topographic data in order to provide a spatial classification of the land based on its agricultural potential. A study of local agricultural practices was also carried out.

3.5 Impact Assessment

The impact assessment utilises the findings of the soil survey and agricultural potential assessment in order to determine reference conditions of the soil and agricultural resources. Potential soil and agricultural impacts, as a result of the proposed activities, are described in this section and any major impacts/fatal flaws will be identified for consideration by the pertinent authorities.

4. DESKTOP AGRICULTURAL POTENTIAL ASSESSMENT

The objective of the desktop component of this assessment is to provide broad soil and agriculturally related characteristics of the project area. It should be clearly noted that, since the spatial information used to drive this portion of the assessment is of a reconnaissance nature, only large scale climate, land use and soil details are provided. More detailed and site specific information for the study area are provided in subsequent Sections of this report (**Sections 5, 6 and 7**).

Existing high level GIS data was sourced from National GIS Datasets as well as the Environmental Potential Atlas for South Africa (ENPAT) Database for the Northern Cape Province of South Africa, compiled by the Department of Environmental Affairs and Tourism (**DEAT**, **2001**). The main purpose of ENPAT is to proactively indicate potential conflicts between development plans and critical, endangered or sensitive environments. More agriculturally relevant spatial information was obtained from the AGIS Database **(*http://www.agis.agric.za,*** accessed 18/03/2012).

4.1 Climate

The study area has an arid climate with a winter rainfall regime i.e. most of the rainfall is confined to winter and early autumn. The rainfall data for the study area was sourced from the **Rainfall Atlas for South Africa** (**2006**). According to this database the Mean Annual Precipitation (MAP) for the project area is approximately 195 mm per year with 68% of this falling between April and August (**Figure 9**). A MAP of 195 mm is deemed extremely low as 500 mm is considered the minimum amount of rain required for sustainable dry land farming (**Smith, 2006**). Thus, without some form of supplementary irrigation, natural rainfall for the study area is insufficient to produce sustainable harvests. The low rainfall and moisture availability is reflected in the lack of dry land crop production within the study area.

The region typically experiences hot days with an average mid-day temperature of 28^0C in summer, with average night time temperatures dropping to around 4^0C during winter (**http://www.saexplorer.co.za**). Evaporation for the region is estimated at between 2000 and 2200 mm per annum.

In summary the climate for the study area is highly restrictive to arable agriculture, which is primarily attributed to low, unpredictable and seasonal rainfall along with severe moisture availability restrictions.

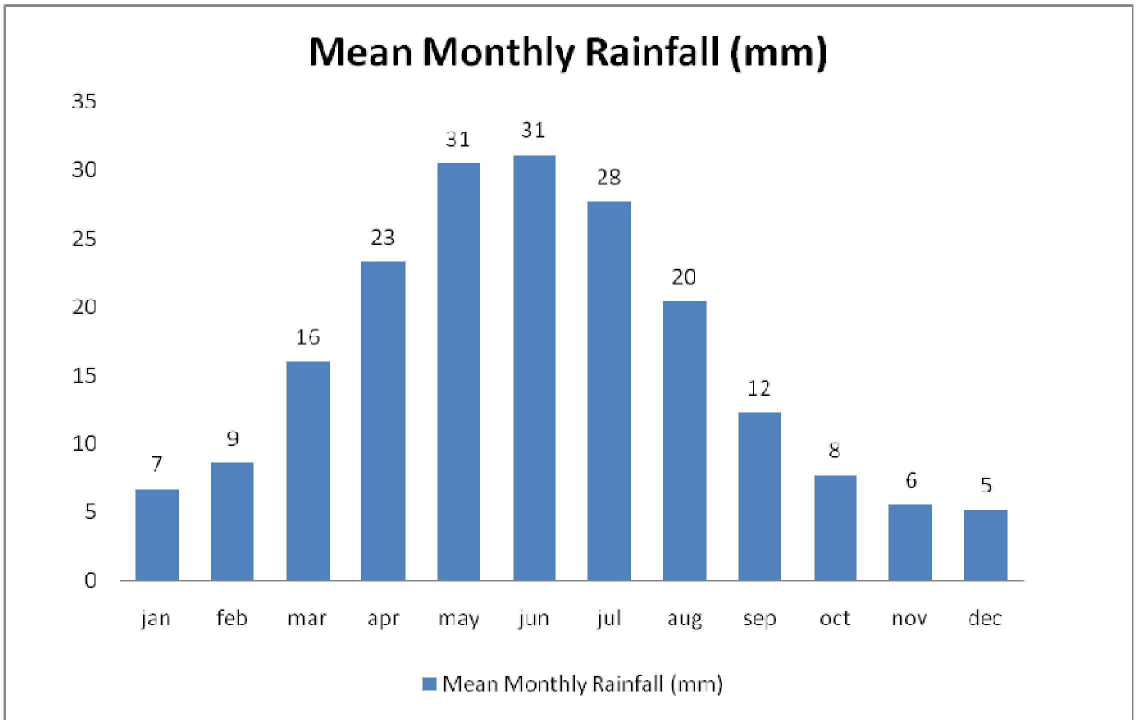

Figure 9: Mean monthly rainfall graph for the Kangnas project area (**Source: South African Rainfall Atlas**)

4.2 Geology

The study area is underlain by a variety of geologic materials including, Sedimentary, Gneiss, Quartzite and Tillite (**Figure 10**). Non-descript sedimentary geologic materials dominate much of the Kangnas site, and this material is found on all 5 farm portions. Tillite, consisting of consolidated masses of unweathered blocks and unsorted glacial till, is found in non-contiguous zones throughout the study area and particularly on the remainder of Farm Kangnas (No.77)

Gneiss, a coarse grained metamorphic rock which is characterised by alternating light and dark bands, differing in mineral composition, is found along the western boundary of Farm Smorgen Schaduwe and Farm Areb. A ring of Quartzite, a medium grained metamorphic rock, underlies the north eastern portion of the study area and is formed from recrystallised sandstone with the fusion of sedimentary quartz grains.

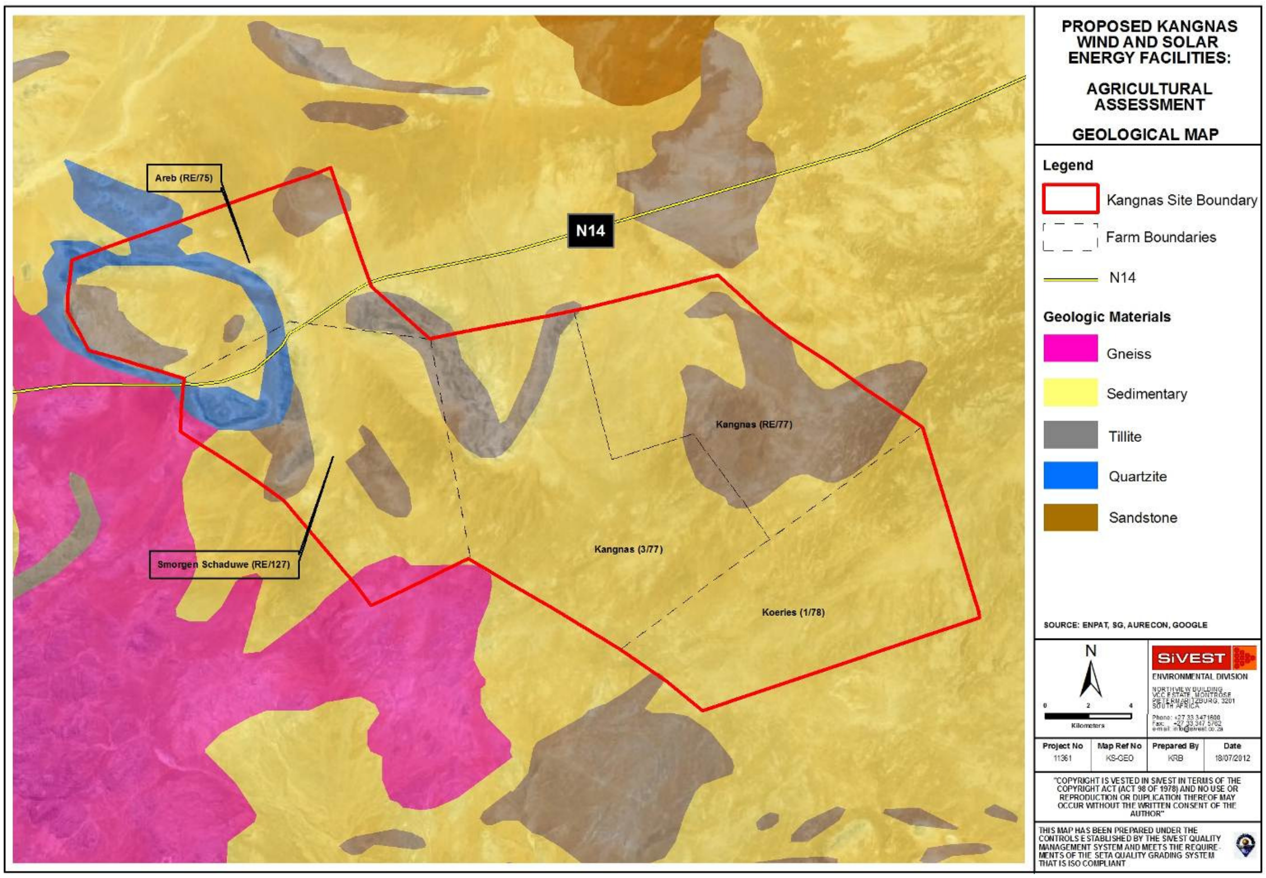

Figure 10: Geological map

4.3 Terrain

Slope or terrain is used to describe the lie of the land. Terrain influences climate and soil characteristics and thus plays a dominant role in determining whether land is suitable for agriculture. In most cases sloping land is more difficult to cultivate and is usually less productive than flatland, and is subject to higher rates of water runoff and soil erosion (**FAO, 2007**).

The majority of the study area is characterised by flat plains and gently sloping topography with an average gradient of less than 5% (**Figure 11**). These plains are ideal areas for intensive agriculture, with a high potential for large scale mechanisation. From a developmental perspective, the flat topography will also allow for minimal earthworks and site preparation. The study area does, however, contain sporadic steep rocky outcroppings and ridges particularly on Farm Arab, Farm Smorgen Schaduwe and the northern areas of Portion 3 of the Farm Kangnas (No.77). These outcrops and ridges are limiting to arable agriculture and due to the extreme topography and associated engineering constraints these areas are excluded from the preliminary development layouts (**Figures 3** and **8**).

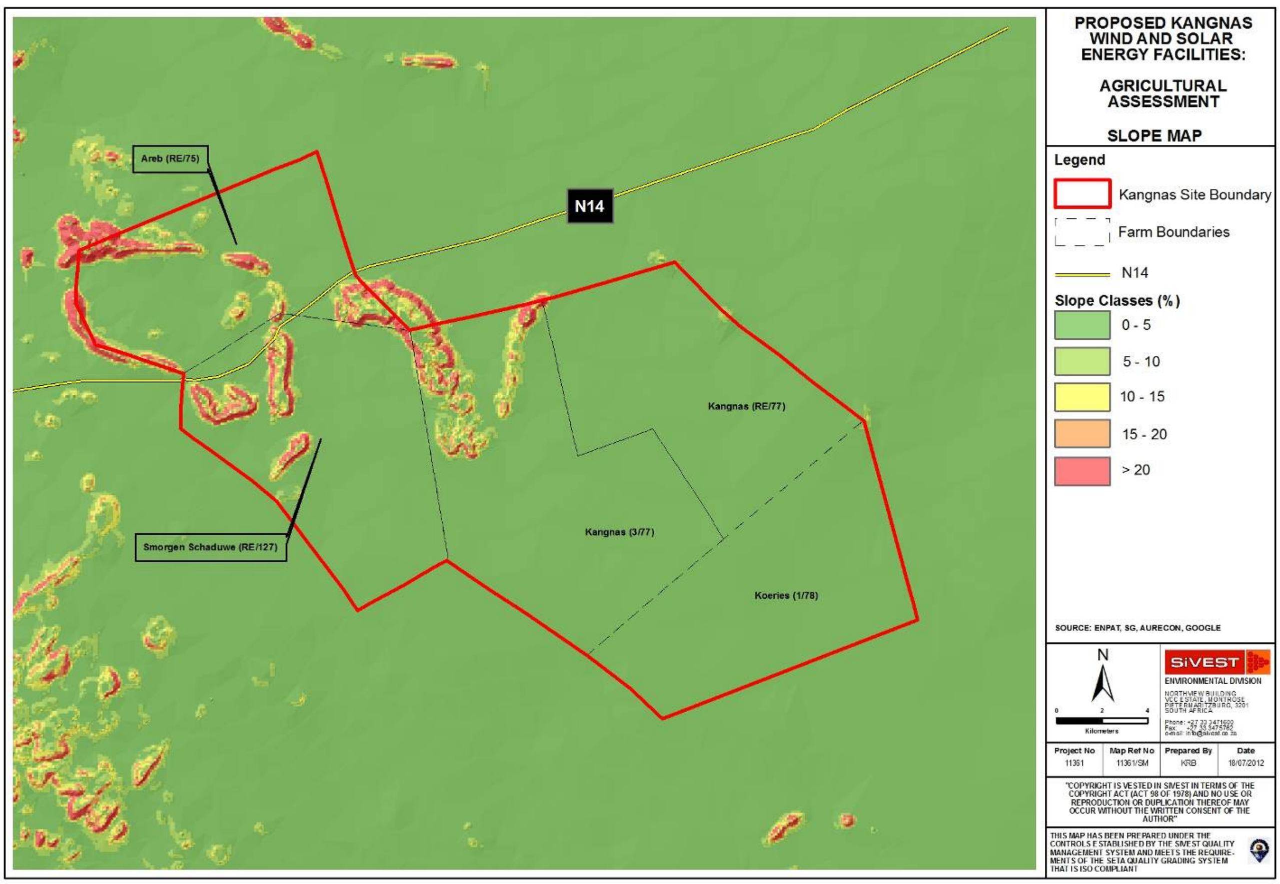

Figure 11: Digital Terrain Model and Slope Analysis of the study area

4.4 Land Cover / Use

According to Mucina and Rutherford (**2006**), the flat plains are classified as the *Bushman Arid Grassland (Nama-karoo biome)* vegetation type, while the ridges and high spots are classified as Bushman Inselberg Shrubland (Succulent-karoo biome). According to the ENPAT Database and 2010 land cover data the study area consists of a mix of natural veld and unimproved shrubland which is used as grazing land for sheep, goats and cattle (**Figure 12**). Vast grazing land is interspersed with non-perennial stream beds which flow intermittently and seasonal pans dot the landscape. According to the spatial databases there are no cultivated fields or irrigated lands which could be detrimentally impacted upon by the proposed development. The land uses surrounding the assessment area are virtually identical to the site itself and included grazing land for livestock and game.

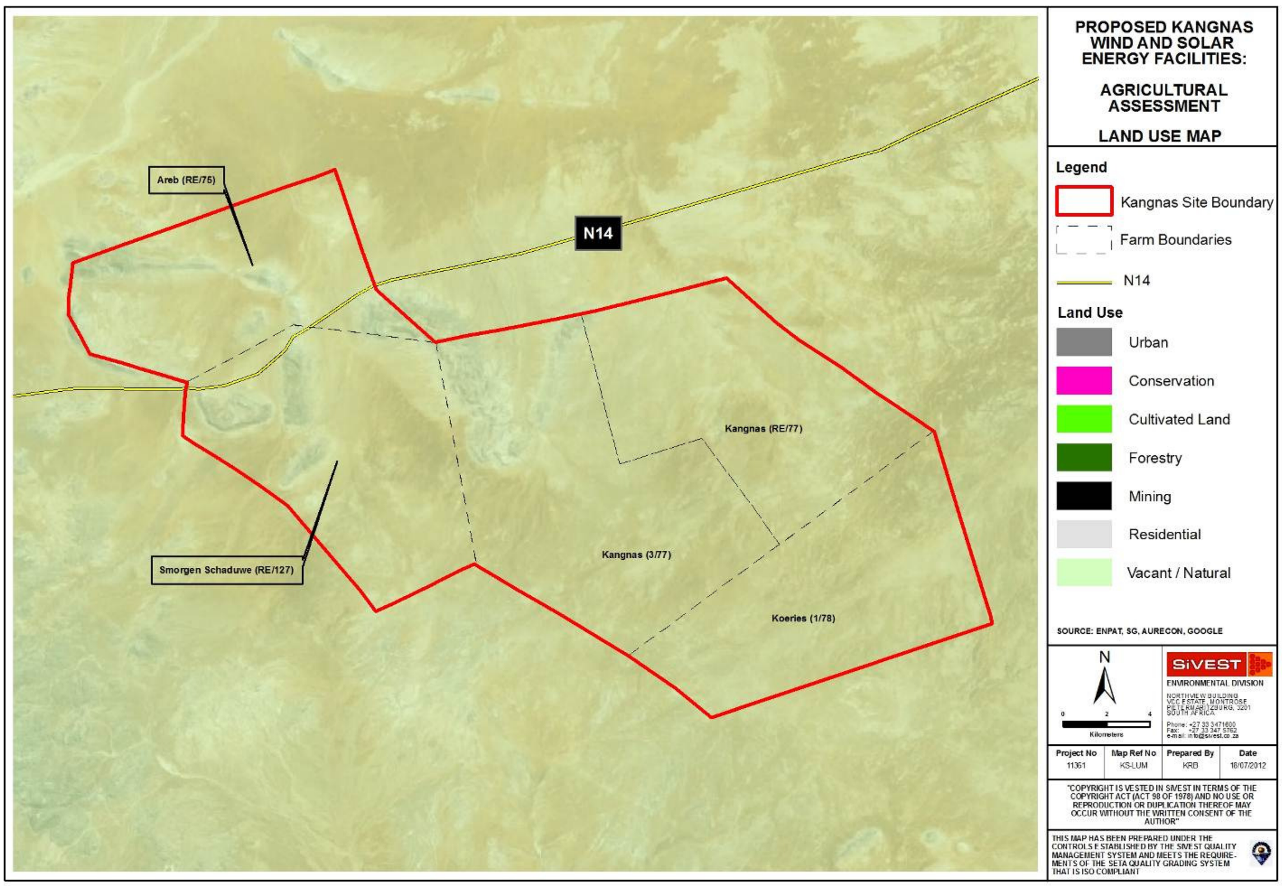

Figure 12: Land Cover Map

4.5 Soil Characteristics

According to the ENPAT database the Kangnas site is dominated by red apedal soil types (**Figure 13**). Apedal soils lack well formed peds, other than porous micro-aggregates, and are weakly structured. As expected shallow, rocky soils correspond to the steeper slopes, ridges and high spots. These rocky areas are enveloped by shallow red apedal soils. Due to the overriding climatic conditions Calcium carbonate is expected to be present throughout the landscape. According to the AGIS database the soils on Kangnas Site are associated with a low water holding capacity and should drain freely. The southern and eastern portions of study area are classified as having an effective soil depth (depth to which roots can penetrate the soil) of less than 0.45 m deep, which is a limiting factor in terms of sustainable crop production (**Figure 14**). Marginally deeper soils are found on the northern portions of the site[1] and particularly on Farm Areb.

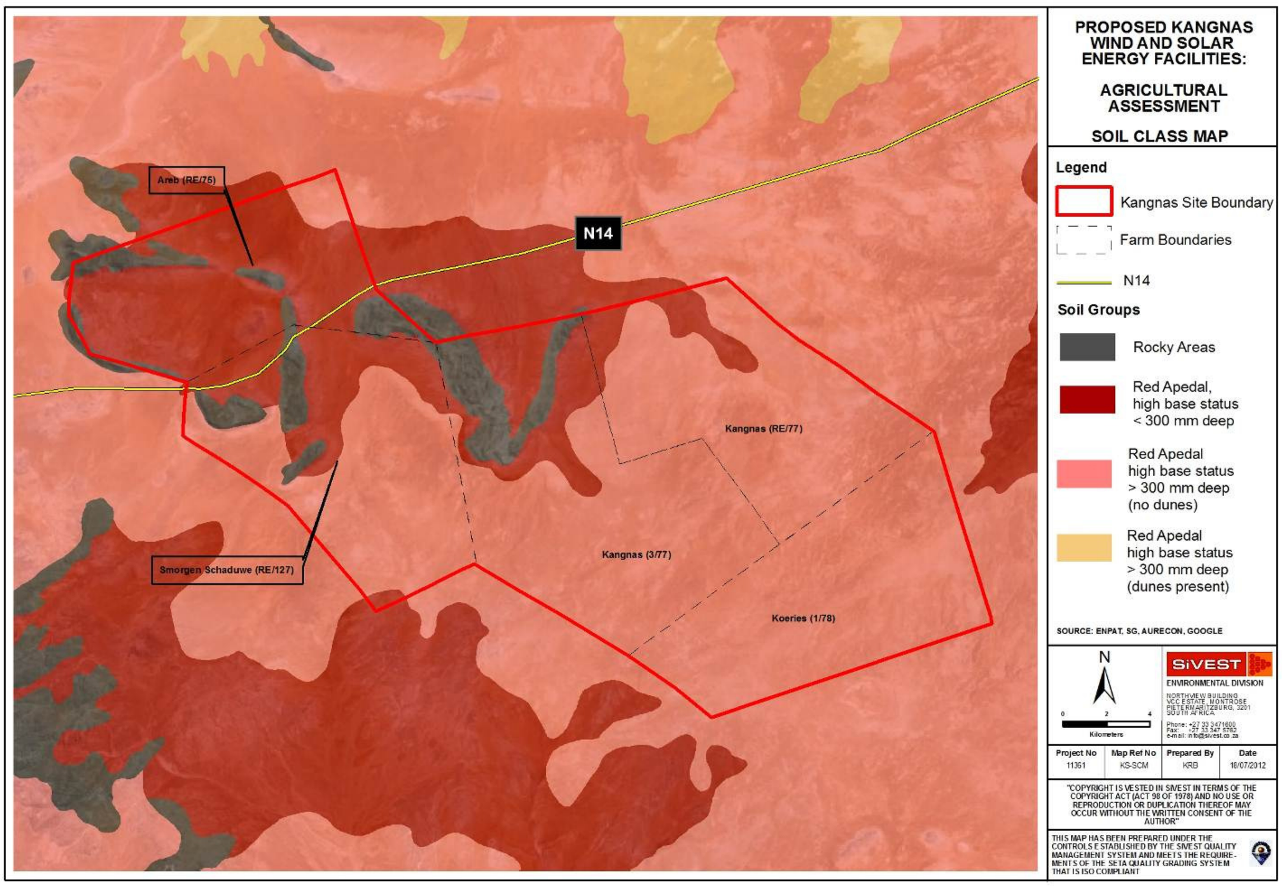

Figure 13: Broad soil type map

[1] There seems to be a contradiction between the soil description and soil depth information within the ENPAT data set for the red apedal soils in northern portions of the study area. The soil description suggest a soil profile of less than 0.3 m while the soil depth map gives a depth of between 0.45 – 0.75 m for the same area. A verified soil depth map is provided in **Section 5**.

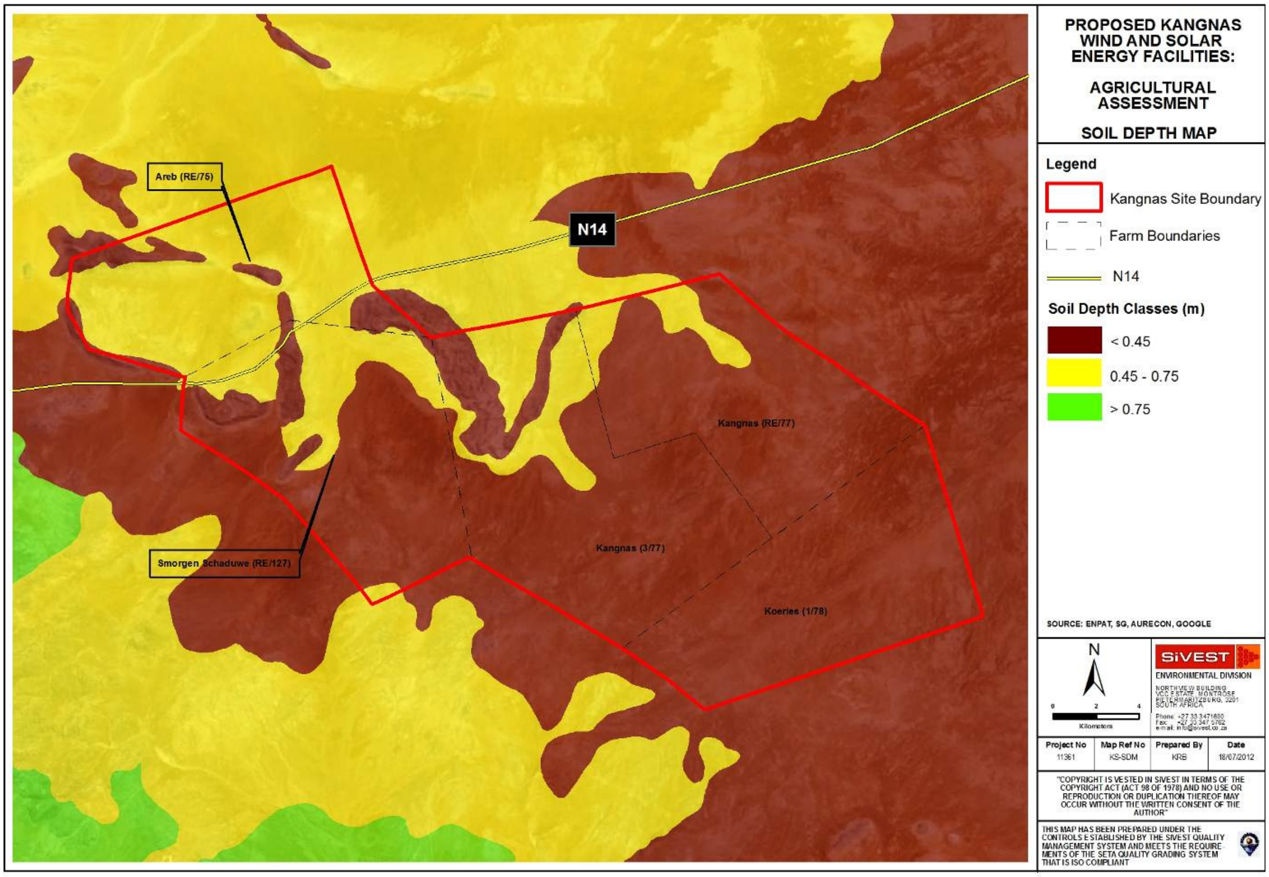

Figure 14: Soil depth map

The ENPAT Database also provides an overview of the study area's agricultural potential based on its soil characteristics, although it should be noted this spatial dataset does not take *prevailing climate into account*. According to the ENPAT agricultural dataset the south eastern portion of the the study area is dominated by soils which have a poor suitability for arable agriculture but which can still be used as grazing land (**Figure 15**). This area includes Farm Koeris, the majority of the remainder of Farm Kangnas (No. 77) as well as the southern portions of Portion 3 of Farm Kangnas (No. 77) and Farm Smorgen Schaduwe (No.127).

Again the ridges and high spots are not suitable for agriculture, grazing or forestry due to rocky soils and rough topography. These areas are enveloped areas which are, not suitable for arable agriculture, but still remain suitable for grazing. Highly restrictive climate characteristics dramatically reduce the agricultural potential of the site.

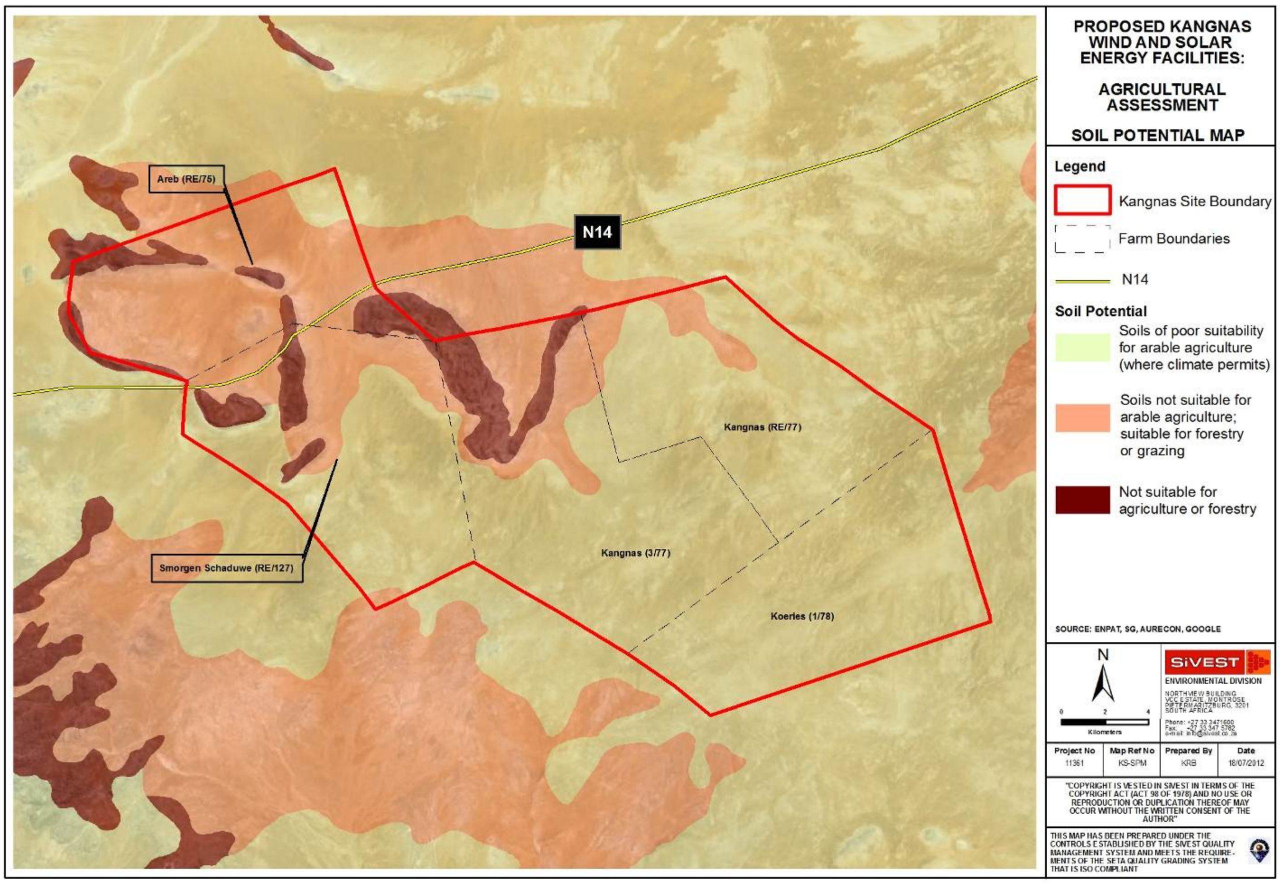

Figure 15: Soil Potential Map

4.6 Desktop Agricultural Assessment: Results Summary

By taking all the site characteristics (climate, geology, land use, slope and soils) into account, the agricultural potential for the majority of the study area is classified as being extremely low for crop production while moderately low for grazing. This poor agricultural potential rating is primarily due to highly restrictive climatic characteristics and soil related limitations. The site is not classified as high potential nor is it a unique dry land agricultural resource.

5. SOIL SURVEY AND FIELD VERIFICATION

A detailed soil survey was undertaken for the entire project area using a hand auger and GPS to record the location of each of the auger points. At each survey point the soil was described to form and family level according to "Soil Classification - A Taxonomic System for South Africa" (**Soil Classification Working Group, 1991**) and the following properties were noted:

- Estimation of ‘A’ horizon clay content,
- Permeability of upper B horizon,
- Effective rooting depth and pedological depth,
- Limiting layers,
- Soil Colour via the Munsell Soil Colour Charts,
- Signs of wetness,
- Surface rockiness,
- Surface crusting,
- Vegetation cover, and
- Detailed description of the particular area such as slope.

5.1 Soil Descriptions

This Section lists the **major soil forms** encountered during the soil survey along with a site-specific description of each soil form. Other soils encountered during the field verification, which were recorded sparsely across the site and therefore not fully described include:

- **Trawal** (Orthic A, Neocarbonate B, Dorbank)
- **Augrabies** (Orthic A, Neocarbonate B)

5.1.1 Mispah Form

Soil Family: Mostly 1100 (Non-bleached, non-calcareous), limited bleached and/or calcareous
Diagnostic Horizons and Materials:
A-Horizon: Orthic
B-Horizon: Hard Rock

Site Specific Description:
The Mispah soil form falls within the lithic soil group. Lithic soils are associated with shallow soils where hard rock is found close to the soil surface. The Mispah soil form dominates the steeper slopes, outcrops and kopjes. The Orthic A was sandy and virtually structureless; an infield test indicated that the clay content of the A-horizon was less than 10%. The A-horizon varied from brown to ivory in colour and was generally 5 - 20 cm deep, directly overlying various hard rock materials. On the steeper slopes and crests, surface rocks are clearly visible (**Figure 16**).

Land Use Capability:
This soil has an extremely low agricultural potential due to the distinct lack of rooting depth and water penetration. From a site specific perspective these soils are further compromised by severe slope limitations. Owing to these restrictions these soils are generally utilised for low potential grazing land

and conservation. These soils also exhibit high soil erosion hazard ratings thus soil conservation practices such as minimum tillage and trash blankets should be employed.

Figure 16: Shallow, rocky soils dominate the ridges and high spots

5.1.2 Knersvlakte Form

Soil Family: Mostly 1100 (Non-Calcareous A), limited calcareous
Diagnostic Horizons and Materials:
A-Horizon: Orthic
Sub-Horizon: Dorbank

Site Specific Description:
The Knersvlakte soil form falls within the silicic soil group whose profiles are cemented by silica. The distribution of silicic soils is associated exclusively with arid landscapes (**Fey, 2010**). The Knersvlakte form is characterised by containing dorbank on the surface or directly below an Orthic A-horizon. Dorbank is a hard subsurface horizon cemented by silica which does not slake in either water or acid.
During field verification it was noted that dorbank was often exposed at the surface and thus was classified as a truncated[2] member of the Knersvlakte form (**Figures 17** and **18**). The dorbank horizon was generally brown, extremely hard and limiting to plant growth. Silic soils are more prominent in the north western portions of the study area. When not exposed at the surface, the Orthic A-horizon was pale brown in colour and lacked structure (<10% clay). A thin red Apedal A-horizon is not

[2] A truncated soil is a genetic soil that has lost part of its upper horizon(s) by erosion (adapted from the **Soil Classification Working Group, 1991**)

accommodated in the Knersvlakte form (See Garies Form, **Section 5.1.3**). However large portions of the project area contained non-contiguous areas of surface Dorbank and a thin red Apedal surface horizon which lead to these areas being classified as a Knersvlakte and Garies complex[3].

Agricultural Potential:
The use of silicic soils in South Africa is limited due to the overriding climatic conditions in which these soils are found. The limitations of these soils include shallow depth, excessively high pH and low water holding capacity (**Fey, 2010**). When encountered on site this form generally had an effective depth of less than 0.2 m and thus is limiting to root growth. In order to be cultivated successfully the dorbank would need to be physically broken up, or perhaps even removed. In the context of this assessment this soil form has an extremely low agricultural potential but can be used for low intensity grazing land.

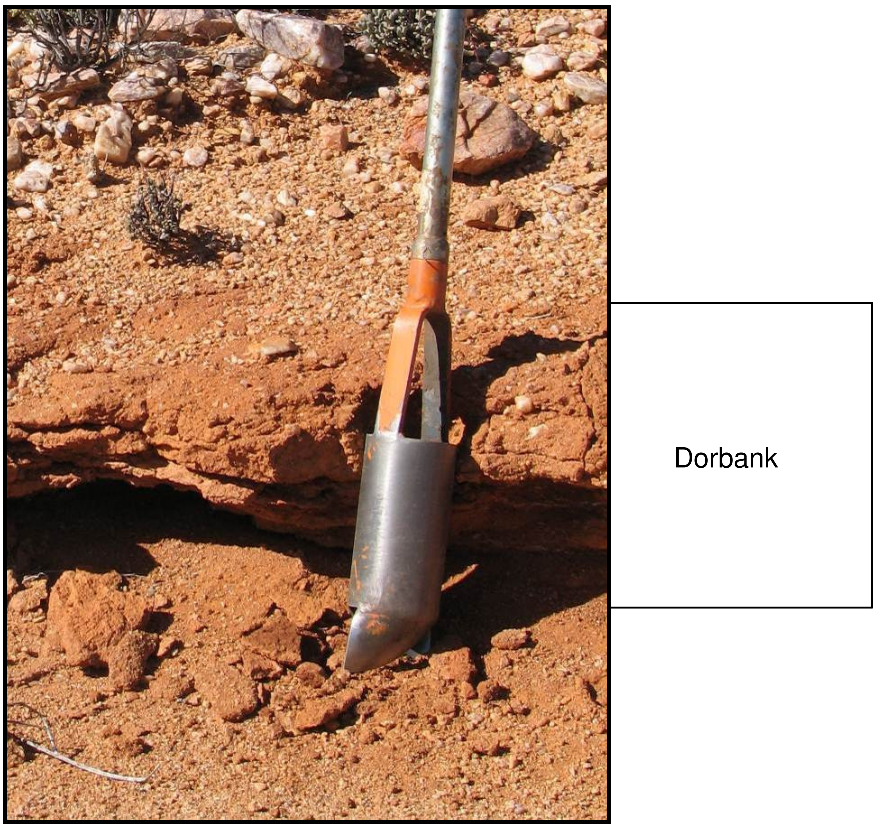

Figure 17: An example of a shallow Knersvalkte form encountered on farm Areb

[3] A soil complex is a map unit used in soil surveys for two or more taxonomic unit which are so intimately mixed geography that is impractical to separate them (adapted from the **Soil Classification Working Group, 1991**)

Figure 18: An exposed dorbank horizon identified near the N14 highway

5.1.3 Garies Form

Soil Family: 1000
Diagnostic Horizons and Materials:
A-Horizon: Orthic
B-Horizon: Red Apedal B
C-Horizon: Dorbank

Site Specific Description:
Like the Knersvlakte soil form, the Garies form falls within the silicic soil group. During field verification it was noted that the only difference between the Knersvlakte and the Garies forms is that the latter contained a red apedal surface horizon. The red apedal horizon was often found at the soil surface and contained a very low organic matter content directly overlying Dorbank. The red A-horizon was generally 10-15 cm deep and sandy. The underlying dorbank was generally brown, non-calcareous, extremely hard and limiting to plant growth **(Figure 19**). Large portions of the project area contained a mix of surface Dorbank and a shallow Red Apedal surface horizon overlying Dorbank, which lead to these areas being classified as a Knersvlakte and Garies complex.

Agricultural Potential:
This form carries the same agricultural potential characteristics and recommendations as the Knersvlakte form. The limitations of these soils include shallow depth, excessively high pH and low water holding capacity (**Fey, 2010**). When encountered in the study this form generally had an effective depth of less than 0.3 m and thus is limiting to root growth. In order to be cultivated successfully the dorbank would need to be physically broken up, and perhaps even removed. In the

context of this assessment this soil form has a low agricultural potential but can be utilised as low intensity grazing land.

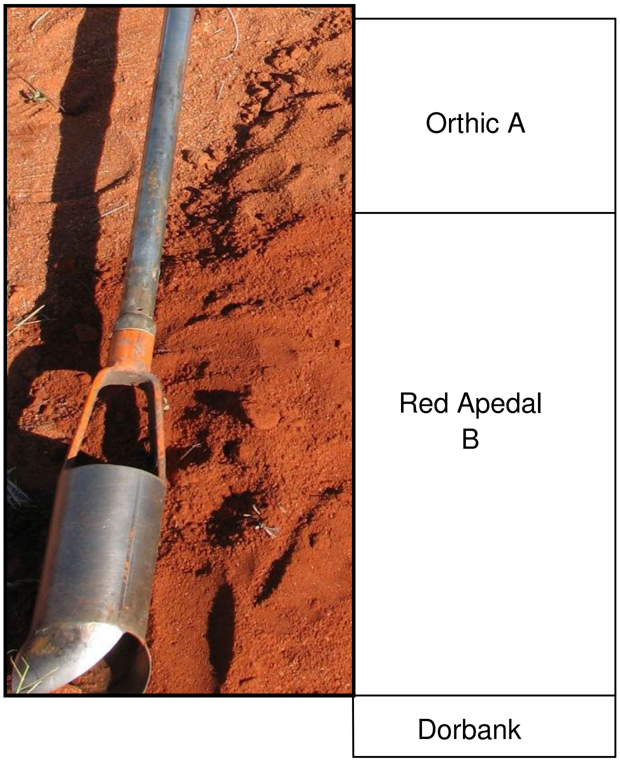

Figure 19: An example of typical Garies form, the underlying Dorbank (not shown) is impenetrable with a standard bucket auger

Figure 20: An example of a Garies and Knersvalkte complex

5.1.4 Coega Form

Family: 1000 / 2000 (Non-Calcareous and Calcareous A Horizon)
Diagnostic Horizons and Materials:
A-Horizon: Orthic
B-Horizon: Hardpan Carbonate

Site Specific Description:
The Coega soil form is an example of a calcic soil, whose profile contains at least one carbonate-rich horizon. Carbonate retention in the soil profile is a result of an arid climate where evaporation far exceeds rainfall. When encountered during the soil survey the A-horizon of this soil form was brown, thin and weakly structured (less than 10% clay). This Orthic A-horizon overlies a hard pan carbonate which was limiting to plant growth. The effective soil depth was generally less than 0.2 m (**Figure 21**). A soil complex of the Coega and Plooysburg forms was often noted during the soil survey and was mapped as such.

Agricultural Potential:
Calcic soils are associated with arid regions and thus the agricultural use of these carbonate rich soils in South Africa is limited. Limitations in terms of sustainable agricultural use include shallow rooting depth, high pH, high salinity and low plant Phosphorus availability (**Fey, 2010**). Such limitations restrict calcic soils to extensive grazing unless irrigation is available. These soils also exhibit high soil erosion hazard ratings thus soil conservation practices such as minimum tillage and trash blankets should be employed.

Figure 21: Shallow and surface hardpan carbonate is common in the south eastern areas

5.1.5 Plooysburg

Family: 1000 (Non Luvic B1)
Diagnostic Horizons and Materials:
A-Horizon: Orthic
B-Horizon: Red Apedal
C-Horizon: Hard Pan Carbonate

Site Specific Description:
The Plooysburg form is another example of a calcic soil whose profile contains at least one carbonate-rich horizon. When encountered on the PDA the A-horizon of this soil form was red in colour and sandy. This Orthic A-horizon merges directly in a Red Apedal B-horizon which lacked structure other than the porous micro-aggregates and had a uniform red colour (**Figure 22**). The soil form was non-luvic[4] and was generally in the south eastern portions of the study area. The entire profile did not test positive to the presence of carbonates[5] when treated with cold 10% hydrochloric acid. A soil complex of the Coega and Plooysburg forms was often noted during the soil survey and was mapped as such. Shallow Hard Pan Carbonate was generally encountered within 0.3m of the soil surface and was limiting to plant roots.

Agricultural Potential:
This form carries the same agricultural potential characteristics and recommendations as the Coega form. When encountered in the study area this form generally had an effective depth of less than 0.3m and thus is limiting to root growth. The limitations in terms of sustainable agricultural use also include high pH and high salinity (**Fey, 2010**). Such limitations restrict this form to extensive grazing unless irrigation is available. These soils also exhibit high soil erosion hazard ratings thus soil conservation practices such as minimum tillage and trash blankets should be employed.

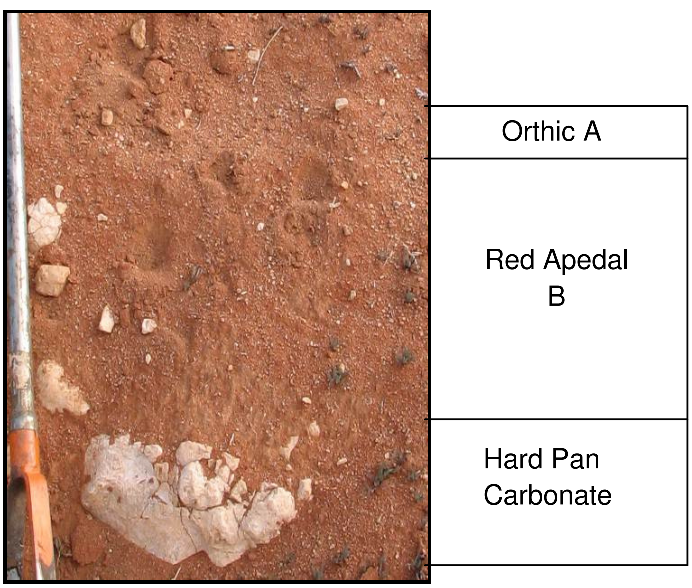

Figure 22: An example of a Plooysburg Form encountered on Farm Kangnas

4 Clay content did not increase with soil depth.
5 Soil profiles which contain carbonates effervesce visibly when treated with cold 10% hydrochloric acid.

5.2 Soil Summary

The soils identified on eastern half of the study area (Farm Koeris and south eastern portions of the Farm Kangnas) are predominantly calcic with a low agricultural potential (**Figure 23** and **24**). These soils are generally shallow with Hard Pan Carbonate being encountered within 0.3m of the soil surface. Calcic soils cover approximately 54% of the study area with Coega and Plooysburg soils being the dominant forms encountered.

Silic soils cover approximately 30% of the surveyed area and are more prominent in the northern and western parts of the study area (Farm Areb and Farm Smorgen Schaduwe). The dominant soil forms encountered were the Garies and Knersvlakte forms.

Rocky soils (Mispah) cover 16% of the surveyed area and dominate the rocky ridges, kopjes and high spots. Virtually all the soil encountered in the study area contained a layer that was limiting to plant growth and these layers included rock, hard pan carbonate and dorbank. The soils showed limited signs of anthropogenic degradation. However, the steeper slopes and ridges are susceptible to soil erosion and signs of erosion were noted during the field visit.

The location and description of the sample points are provided in **Appendix A: Soil Properties**. This information was used to create a verified soil map showing homogeneous soil bodies for the study area (**Figure 23**). Combining the effective depth information (i.e. depth to root limiting layer) and Inverse Distance Weighting one is able to obtain a generalised soil depth (**Figure 25**). Soils with an effective depth of greater than 20 cm were rarely observed during the soil survey.

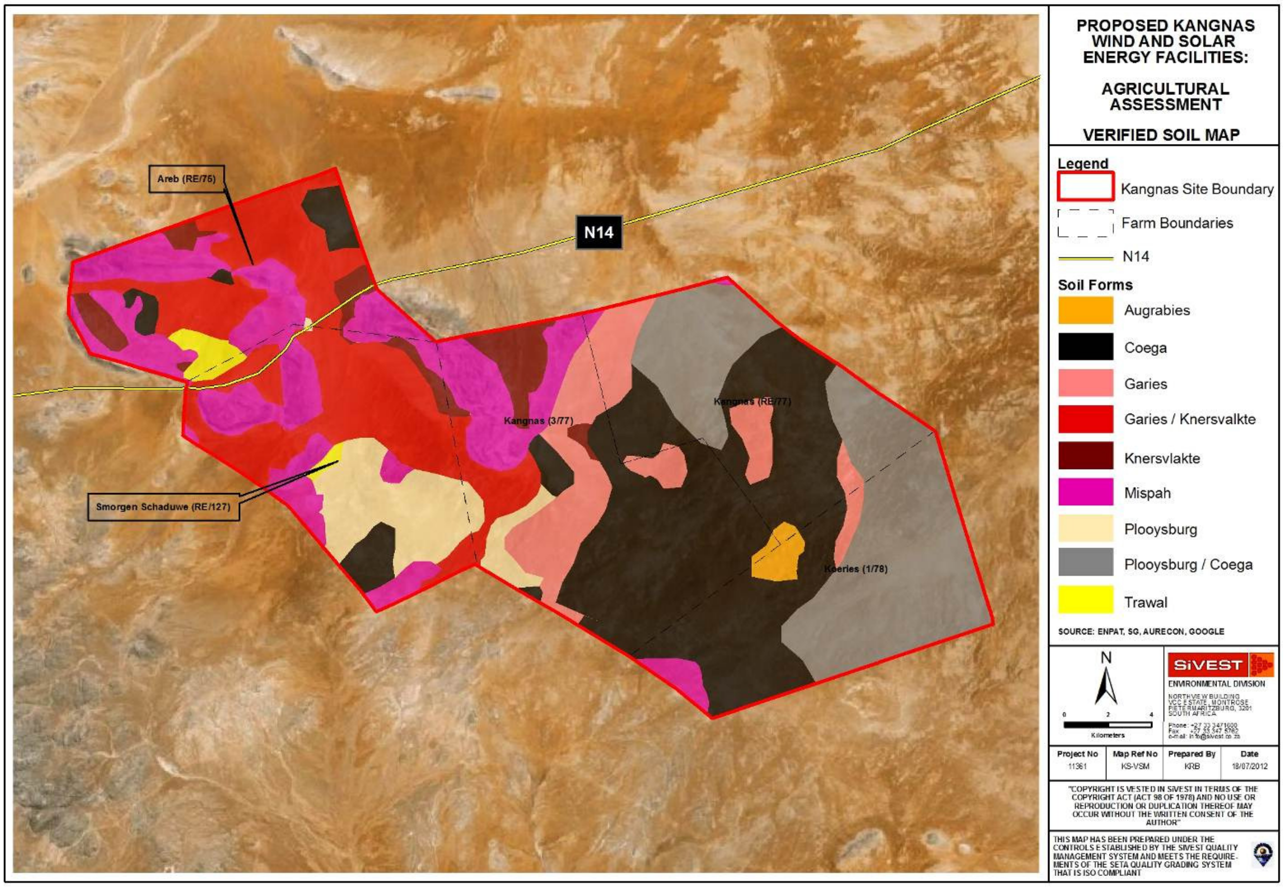

Figure 23: Verified Soil Map for the Kangnas Site

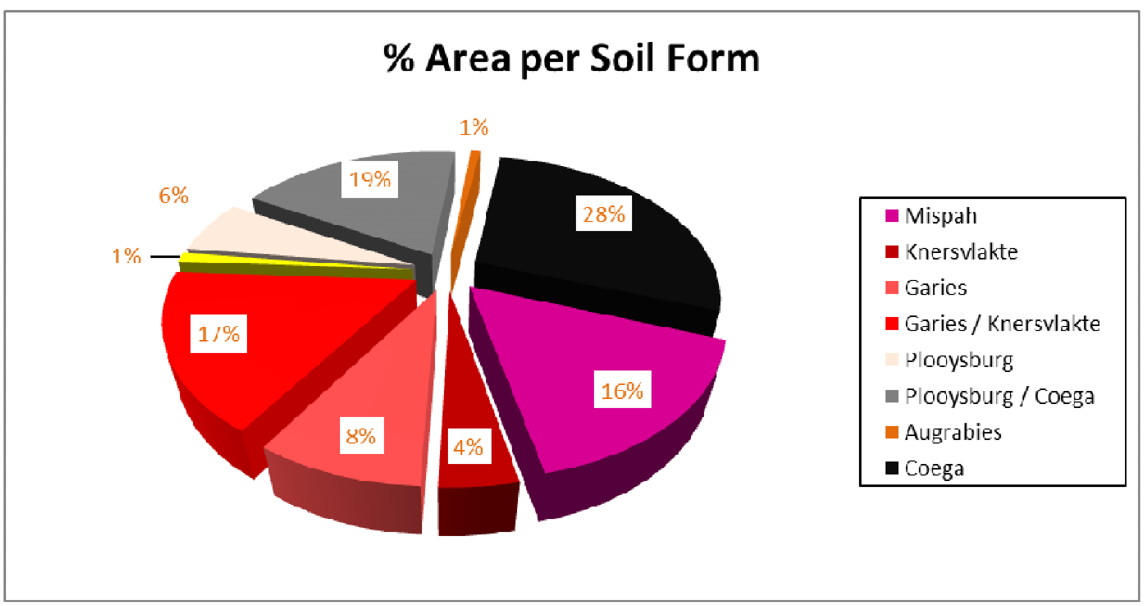

Figure 24: Graph showing the percentage area per soil form for the Kangnas Site

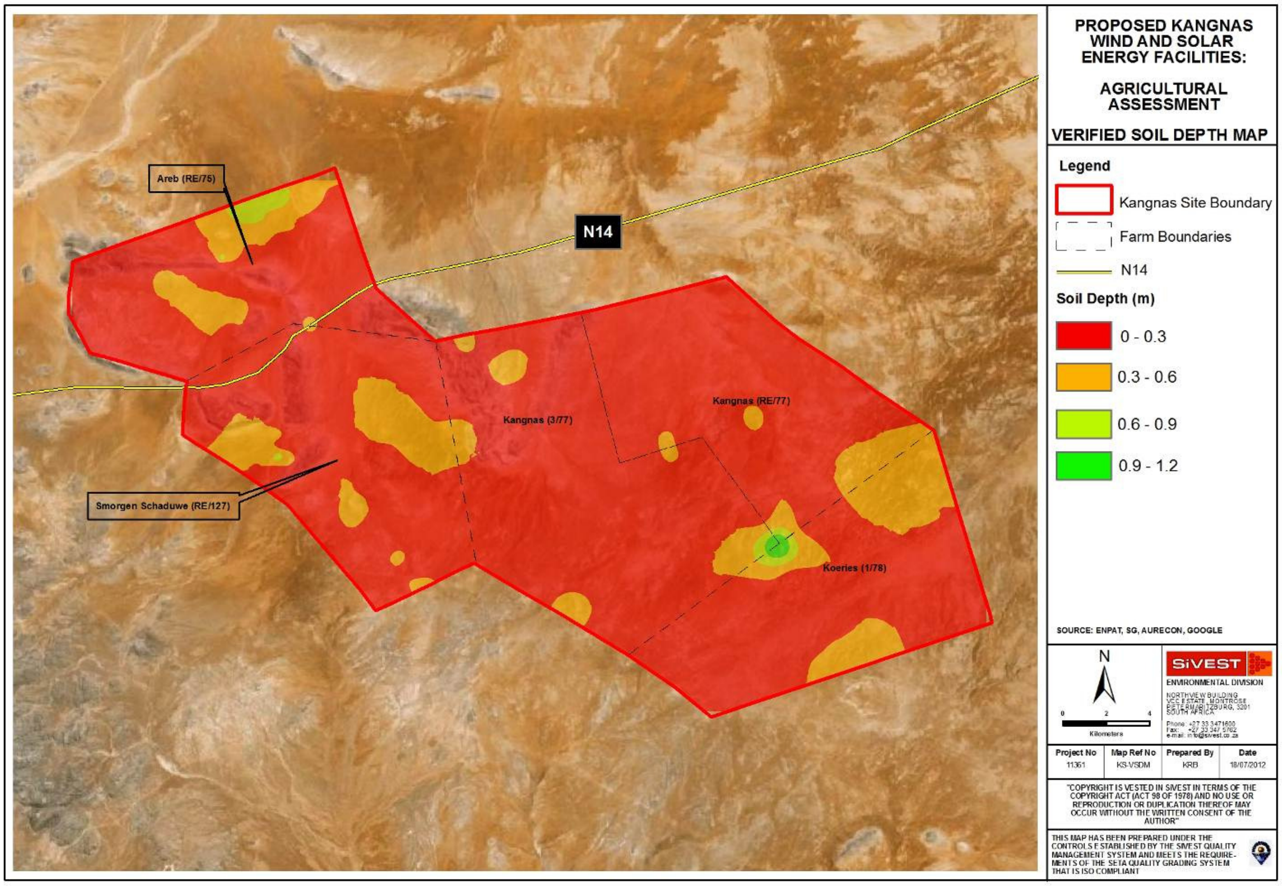

Figure 25: Verified Soil Depth Map

6. AGRICULTURAL POTENTIAL ASSESSMENT

In terms of this study, agricultural potential is described as an area's suitability and capacity to sustainably accommodate an agricultural land use, with this potential usually being benchmarked against crop production.

6.1 Current Situation

The farms which constitute the Kangnas Project Area are predominately used as extensive grazing land for free range sheep production (**Figure 26**). After discussions with the various land owners the stocking rates are estimated at around 1 SSM (small stock unit) per 10 hectares (low density). There is a single, small herd of cattle on Farm Koeris, as well as small numbers of goat, usually around the homesteads (**Figure 27**). Water is the major limiting factor to local agricultural enterprises and the farms do not contain, nor do they border, a perennial river / freshwater impoundment which could be used as a source of irrigation water. The areas impacted by the current development layout do not currently accommodate any centre pivots, irrigation schemes or active agricultural fields. Seasonal pans tend to have the highest grazing potential due to the increased plant available water. Drinking water for the animals is sourced from the groundwater resources.

In terms of buildings there are scatted homesteads and sheds throughout the study area and these will be precluded from the development layout. The larger homesteads tend to be located near a reliable borehole.

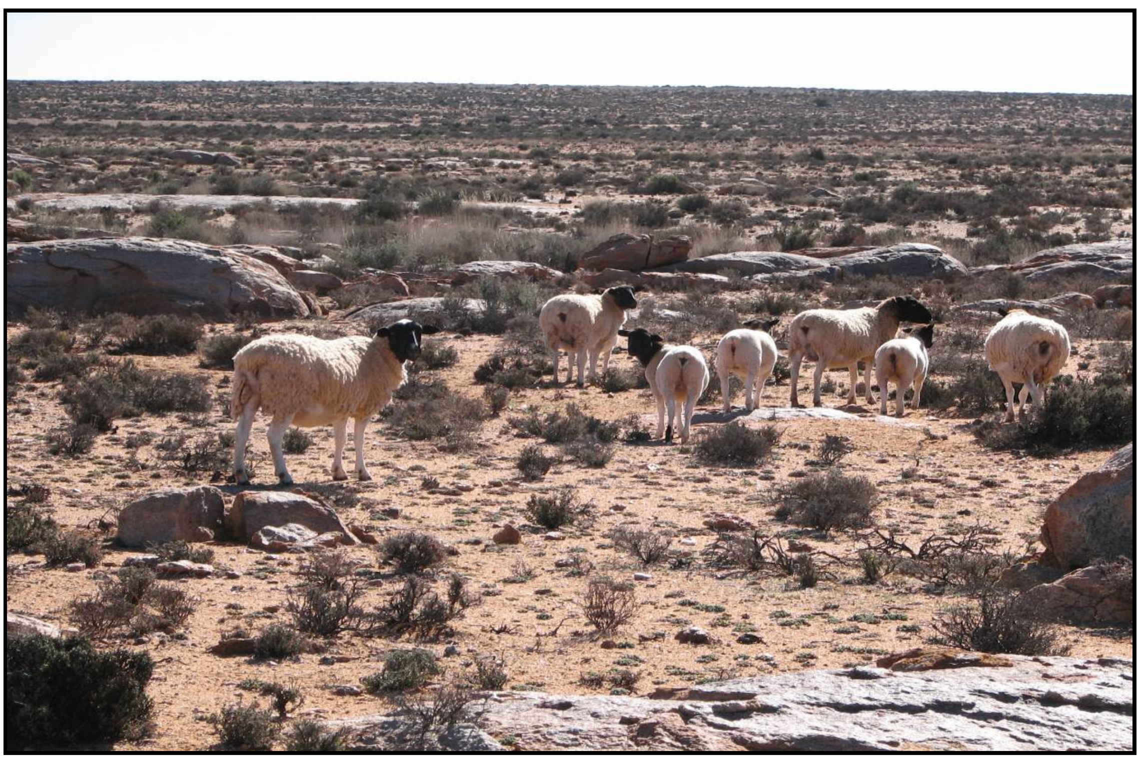

Figure 26: A flock of sheep grazing on the Kangnas Site

Figure 27: A small herd of cattle on Farm Koeris (these were the only cattle encountered during field verification)

5.2 Verified Agricultural Potential

Overall agricultural potential of the site is based on assessing a number of inter-related factors including climate, topography, soil type, soil limitations and current land use. Climate is the overriding and major limiting factor for agricultural potential at both sites. The combination of low, unpredicatble rainfall and a severe moisture deficit means that sustainable arable agriculture cannot take place without some form of irrigation. The sites do not contain, nor are they bounded by a reliable surface water irrigation resource, and the use of borehole water for this purpose does not seem agriculturally and economically feasible. This is due to the high cost of borehole installation, the sheer volume of water required for irrigation purposes and the brackish nature of the local groundwater.

Sporadic steep, rocky outcroppings and ridges further reduce the agricultural potential of the study area (**Figure 28**). Away from these rocky areas the land is generally flat with an average gradient of less than 5%, these flatter areas are associated with a higher potential for grazing. Shallow calcic, sillic and lithic soils dominate the surveyed area. Virtually all the soil encountered in the study area contained a layer, close to the soil surface, that was limiting to plant growth and these layers included rock, hard pan carbonate and dorbank. Effective soil depth rarely exceeded 30 cm. The physical and chemical limitations associated with the dominant forms restrict these soils to extensive and low density grazing land. A map indicating the agricultural potential for the Kangnas Site is provided in **Figure 29**. Overall the site has been classified as having a very low potential for crop production, due to an arid climate and highly restrictive soil characteristics. All the farm portions assessed are not classified as having high agricultural potential and are also not unique dry land agricultural resources. The Kangnas study area is considered to have a moderately low value when utilised as grazing land, its current use.

Figure 28: An example of a rocky ridge encountered during the soil survey

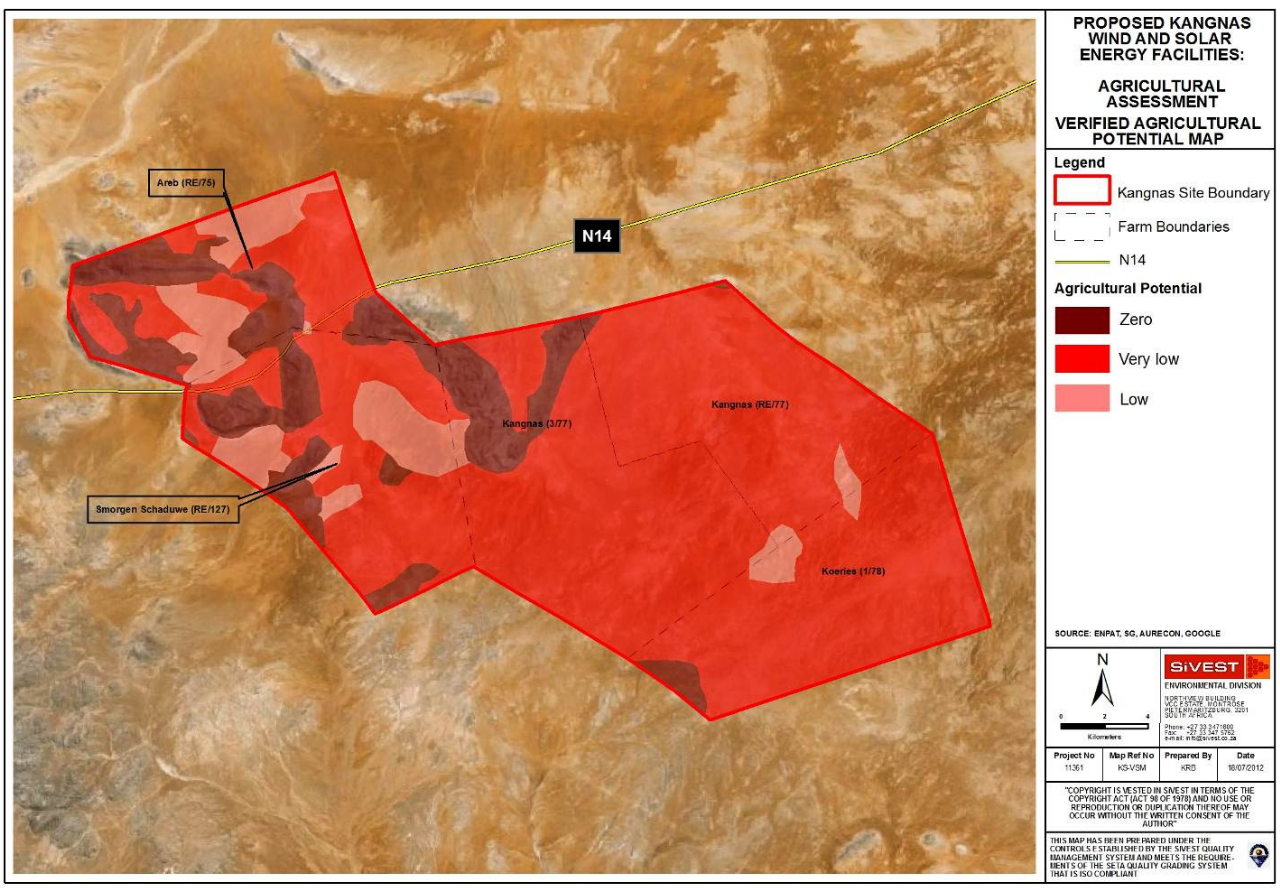

Figure 29: Agricultural Potential Map for the Kangnas Site

7. AGRICULTURAL IMPACT ASSESSMENT

From an agricultural perspective the loss of high value farm land and / or food security production, as a result of the proposed activities, is the primary concern of this assessment. In South Africa there is a scarcity of high potential agricultural land, with less than 14% of the total area being suitable for dry land crop production (**Smith, 2006**). Consequently areas which can sustainably accommodate dry land production need to be protected from non-agricultural land uses. The desktop assessment, field verification and agricultural potential assessment (**Sections 3, 4 and 5**) has already shown that the study area is unsuitable for sustainable, dry land crop production and is dominated by unimproved grazing land.

The proposed development's primary impact on agricultural activities will involve the construction of a wind energy facility, a solar energy facility, a main substation and associated infrastructure. The construction of these facilities will only influence a portion of the assessed area. An agricultural impact assessment was performed for both the wind and solar energy facilities and associated infrastructure. The methodology and results of this assessment are provided below.

7.1 Wind Energy Facility: Predicted Impacts on Agriculture

The proposed wind energy facility would consist out of approximately 185-500 turbines of 1.5-4 MW capacity each and would have a maximum total installed capacity of 750 MW.

The construction entails the clearing of vegetation around the footprint of the turbine and the crane hardstand, as well as creating service roads (**Section 1.2**). Normal grazing (the primary agricultural activity) will be permitted around the turbines. The entire study area is dominated by grazing land and this activity is considered non-sensitive when assessed within the context of the proposed development. Consequently, the impact of the proposed development on the study area's agricultural potential will be extremely low. The hardstand, turbine and associated infrastructure such as roads and substations footprint of typical wind energy facility generally covers approximately 1% of the impacted area. Again, this <u>loss is considered inconsequential</u> within the context of this assessment. The remaining land will continue to function as they did prior to the development.

There are no centre pivots, irrigation schemes or active agricultural fields which will be influenced by the current wind turbine layout. Therefore, from an agricultural perspective, there are no fatal flaw areas for the wind energy facility. It is assumed and recommended that a non-developmental buffer will be placed around occupied homesteads. The land influenced by the proposed linking power lines, is dominated by unimproved grazing land. Owing to this the proposed power lines will have a very limited impact on agricultural production, as grazing can still take place under the power lines. The only loss of agricultural land will be directly below the tower's footprint, which is insignificant.

7.2 Solar Energy Facility: Predicted Impacts on Agriculture

The proposed construction of a PV/CPV solar energy facility is planned for the north eastern portion of the Farm Areb. The proposed development's primary impact on agricultural activities will involve the construction of the solar fields and associated infrastructure. This will entail the initial clearing of vegetation and levelling of the site. Unless grazing is permitted within the PV/CPV site, the proposed solar development will effectively eliminate the lands agricultural potential, for as long as the development persists (worst case scenario). However, the construction of the 250 MW solar field and associated infrastructure will only influence a small portion of the total farm area (approximately 1000 ha). The remaining land will continue to function as it did prior to the development (approximately 7 647 ha or 87%). In order to further mitigate the potential impact it is highly recommended that periodic grazing of sheep within the PV fields is allowed. This mitigation will minimise the loss of grazing land and allow agricultural production to remain virtually unaffected.

The results of this assessment indicate that the Areb Farm has low agricultural value and is replaceable when assessed within the context of the proposed development. Consequently, the overall impact of the Solar Energy Facility on the study area's agricultural potential and production will be low, due to the site's low inherent agricultural potential and value. There are no centre pivots, irrigation schemes or active agricultural fields which will be influenced by the proposed development, and as such there are no problematic or fatal flaw areas for the proposed solar energy facility

The proposed linking power lines, from the PV field to the substation, are dominated by unimproved grazing land. Owing to this the proposed power lines will have a very limited impact on agricultural production, as grazing can still take place under the power lines. The only loss of agricultural land will be directly below the tower's footprint, which is insignificant.

7.3 Cumulative Impacts

The proposed developments are not expected to have any cumulative impact due to minor loss of agricultural land.

7.4 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include the context and the intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global) whereas Intensity is defined by the severity of the impact (e.g. the magnitude of deviation from background or baseline conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence). Significance is calculated as per the example shown in **Section 7.5.1.**

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

7.5 Impact Rating System Methodology

Impact assessments must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental).

7.5.1 Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).

REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).

3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.

4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.** The summation of the different criteria will produce a non weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

7.5.2 Impact Summaries

Once rated, the impacts are summarised and a comparison made between pre- and post-mitigation phases. The rating of environmental issues associated with different parameters prior to and post mitigation of a proposed activity will be averaged. A comparison is then made to determine the effectiveness of the proposed mitigation measures and identify critical issues related to the environmental parameters. No significant impacts have been envisioned for the planning and decommission, while the construction and operation phases have been lumped into a single impact summary table for each of the proposed renewable energy facilities.

- ***Impact Summary Wind Energy Facility***

Table 2: Overarching impact rating table for the loss of agricultural land and degradation of soil resources (**Wind Energy Facility**)

IMPACT TABLE (WIND ENERGY FACILITY)		
Environmental Parameter	***Soil and Land Use Resources***	
Issue/Impact/Environmental Effect/Nature	***Loss of agricultural land and / or production as a result of the proposed activities***	
Extent	***Site****: Impacts will be restricted to the site.*	
Probability	***Definite****: A small loss of grazing land will definitely occur.*	
Reversibility	***Completely Reversible****: The land can be returned to grazing after the project has been decommissioned.*	
Irreplaceable loss of resources	***No Loss****: If the homesteads are avoided, then the construction of the turbines and associated infrastructure, will not result in any irreplaceable agricultural resources being lost.*	
Duration	***Long Term****: The impact and its effects will continue or last for the entire operational life of the development. The life span of the development is greater than 20 years.*	
Cumulative effect	**Negligible Cumulative Impact**	
Intensity/magnitude	***Low***	
Significance Rating	The anticipated impact will have negligible negative effects and will require little to no mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-11 (**low negative**)	-11 (**low negative**)

Mitigation measures	▪ Due to the overarching site characteristics and the nature of the proposed development viable mitigation measures are limited and will most likely revolve around erosion control: ➢ Clearing activities should be kept to a minimum (turbine and road footprint). ➢ In the unlikely event that heavy rains are expected activities should be put on hold to reduce the risk of erosion. ➢ If additional earthworks are required, any steep or large embankments that are expected to be exposed during the 'rainy' months should either be armoured with fascine like structures. A fascine structure usually consists of a natural wood material and used for the strengthening an earthen structures or embankments. ▪ Avoid homesteads and interact with land owners with regards to the final turbine positioning. ▪ If earth works are required then storm water control and wind screening should be undertaken to prevent soil loss from the site. See Erosion Management Plan for more details (**Section 8**).

➢ ***Impact Summary Solar Energy Facility***

Table 3: Pre-mitigation impact rating table for the loss of agricultural land and degradation of soil resources (**Solar Energy Facility**)

IMPACT TABLE (Pre-Mitigation)	
Environmental Parameter	***Soil and Land Use Resources***
Issue/Impact/Environmental Effect/Nature	***Loss of agricultural land and / or production as a result of the proposed activities***
Extent	***Site**: Impacts will be restricted to the site.*
Probability	***Definite**: Loss of grazing land will definitely occur.*
Reversibility	***Completely Reversible**: The land can be returned to grazing after the project has been decommissioned.*
Irreplaceable loss of resources	***Marginal Loss**: The construction of the solar PV field and associated infrastructure will result in a very marginal loss of agricultural land, production and viability.*
Duration	***Long Term**: The impact and its effects will continue or last for the entire operational life of the development. The life span of the development is greater than 20 years.*
Cumulative effect	**Negligible Cumulative Impact**
Intensity/magnitude	***Low:*** Impact affects the quality, use and integrity of the agricultural value / production in a way that is barely perceptible.
Significance Rating	The anticipated impact will have negligible negative effects and will require little to no mitigation.

Table 4: Post-mitigation impact rating table for the loss of agricultural land and degradation of soil resources (**Solar Energy Facility**)

IMPACT TABLE (Post-Mitigation)	
Environmental Parameter	***Soil and Land Use Resources***
Issue/Impact/Environmental Effect/Nature	***Loss of agricultural land and / or production as a result of the proposed activities***
Extent	***Site**: Impacts will be restricted to the site.*
Probability	***Unlikely**: If season grazing is accepted as a mitigation measure then the chance of the losing significant agricultural resources is low.*
Reversibility	***Completely Reversible**: The land can be returned to grazing after the project has been decommissioned.*
Irreplaceable loss of resources	***No Loss**: If periodic grazing is approved, as a viable mitigation measure, no irreplaceable agricultural resources will be lost.*
Duration	***Long Term**: The impact and its effects will continue or last for the entire operational life of the development. The life span of the development is greater than 20 years.*
Cumulative effect	**Negligible Cumulative Impact**
Intensity/magnitude	***Low:*** Impact affects the quality, use and integrity of the agricultural value / production in a way that is barely perceptible.
Significance Rating	The anticipated impact will have negligible negative effects and will require little to no mitigation.

Table 5: Pre- and Post-Mitigation impact ratings and proposed mitigation measures (**Solar Energy Facility**)

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	1
Reversibility	1	1
Irreplaceable loss	2	1
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-12 (**low negative**)	-8 (**low negative**)
Mitigation measures	▪ Allow periodic grazing within the PV fields (sheep and wildlife). This mitigation will minimise the loss of grazing land and allow agricultural production to remain virtually unaffected. ▪ Due to the overarching site characteristics and the nature of the proposed development viable mitigation measures are limited and will most likely revolve around erosion control: ➢ Clearing activities should be kept to a minimum (panel and road footprint). ➢ In the unlikely event that heavy rains are expected activities should be put on hold to reduce the risk of erosion. ➢ If additional earthworks are required, any steep or large embankments that are expected to be exposed during the 'rainy' months should either be armoured with fascine like structures (unlikely scenario). ▪ If earth works are required then storm water control and wind	

	screening should be undertaken to prevent soil loss from the site (**Section 8**).

It is clear that even without mitigation measures the proposed activities will have a very low impact on current agricultural production, soil resources, agricultural potential and overall farm viability. From an agricultural perspective the vast majority of the entire site is suitable for the proposed development. Small areas surrounding existing homesteads have been declared No Go Zones from an Agricultural Perspective (**Figure 30**). These areas are currently precluded in the latest development layout.

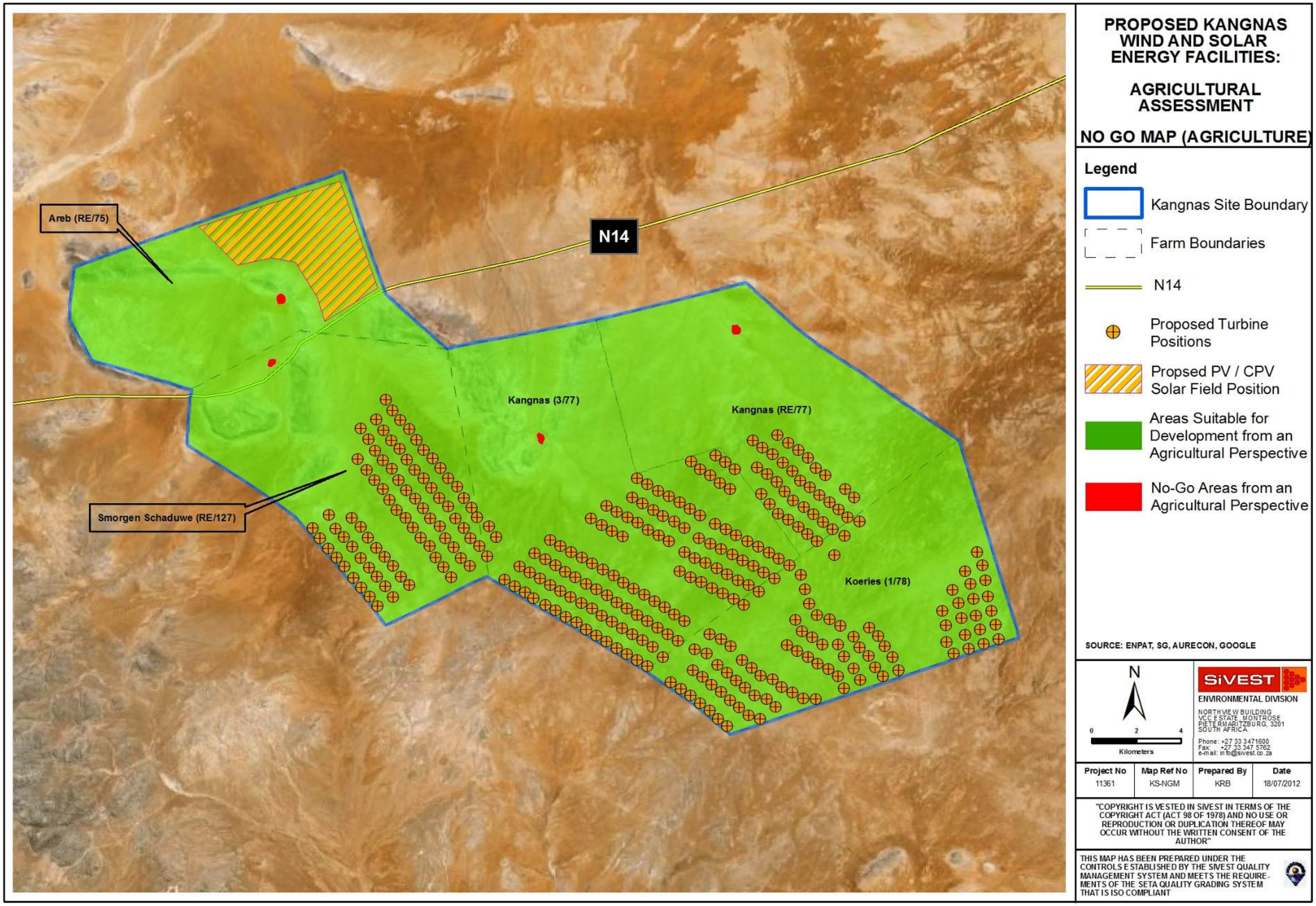

Figure 30: No Go Map from an agricultural perspective and current development layout

8. EROSION MANAGEMENT PLAN

Soil is a natural resource, is non-renewable in the short term and is expensive either to reclaim or improve following degradation (**van Lynden & Oldeman, 1997**).

Even though the areas directly affected by the proposed developments have low agricultural value and capability, the activities still have the potential to have negative implications on the immediate and surrounding soil and land resources. The ***International Soil Reference and Information Centre*** **(ISRIC)**, the producers of the World Map of Human-Induced Soil Degradation, recognises two categories of human-induced soil degradation processes.

The **first category** deals with soil degradation by displacement of soil material mainly through water and wind erosion. Soil erosion causes land degradation through a reduction in agricultural potential in many parts of South Africa. The major issues surrounding soil erosion are the loss of the top soil layer required for plant growth, reduction of soil nutrients, siltation of aquatic systems as well as the general land and ecosystem degradation.

The **second category** of soil degradation deals with in-situ soil physical and chemical and biological deterioration. In-situ soil degradation due to anthropogenic activities can be divided into various classes and subclasses:

- **Physical Degradation** (waterlogging, compaction, crusting, pore modification, etc.)
- **Chemical Degradation** (eutrophication, acidification, salinisation, heavy metal pollution, etc.)
- **Biological Degradation** (pathogen introduction, modification of microbial activity etc.)

A single or combination of the aforementioned degradations leads to a decrease in soil quality/health which in turn influences land capability ratings (**ISRIC, 1990**). Due to the proposed activities this management plan focuses primarily on soil erosion however generic soil contamination mitigations are provided in **Section 8.3**.

8.1 Soil Erosion Monitoring

Due to the size of the site and without rigorous scientific methods and equipment, soil erosion will need to be monitored visually by the appointed Environmental Control Officer (ECO)[6]. Soil erosion is a natural process, whose rate and intensity can anthropogenically increased. Excessive erosion can lead to land degradation and in the reduction of the area's carrying capacity. It is recommended that areas around the turbine footprint, crane hardstand and PV/CPV panels are visually monitored during audits. A photographic record of the on-site conditions will also aid in the identification of erosion problems. Signs of rill and gully erosion should be remediated as soon as possible. Typical remediation techniques are provided in **Section 8.2**, below.

[6] The person appointed will provide direction to the Contractor concerning the activities within the Construction Zone, and who will be responsible for conducting the Environmental Audit of the project during the construction and operational phases of the project.

8.2 Proposed Soil Erosion Mitigatory Measures

Clearing activities should be kept to a minimum and must only be undertaken during agreed working times as well as permitted weather conditions. If heavy rains are expected clearing activities should be put on hold. In this regard, the contractor must be aware of weather forecasts. The further unnecessary removal of groundcover vegetation from slopes must be prevented, especially on steep slopes.

Following the clearing of an area, the surfaces of all exposed slopes must be roughened to retain water and increase infiltration (especially important during the wet season). Any steep or large embankments that are expected to be exposed during the 'rainy' months should either be armoured with fascine like structures or vegetated. A fascine structure usually consists of a natural wood material and used for the strengthening an earthen structures or embankments. If a cleared area is not going to be built on immediately, the top layer (nominally 150 mm) of soil should be removed and stockpiled in a designated area approved by the ECO. Vegetation shall be stripped in a sequential manner as the work proceeds so as to reduce the time that stripped areas are exposed to the elements. Top-soiling and re-vegetation shall start immediately after the completion of an activity and at an agreed distance behind any particular work front. It is highly recommended that existing farm roads are used as much as possible, while the additional creation of access roads should be kept to a minimum. Where roads need to be created, a dual tyre track road should be used rather than clearing an entire road width, this is particularly important for the larger construction vehicles (**Figure 31**).

Figure 31: An example of a dual tyre track

Storm water control and wind screening should be undertaken to prevent soil loss from the site. All embankments shall be protected by a cut off drain to prevent water from running down the face of the embankment and resulting in erosion. Typical erosion control measures such as the installation of silt fences, hay bales, EcoLogs™ and Bio Jute™ are recommended if erosion problems are noted during construction and operation phases (**Figure 32**).

Figure 32: Typical soil erosion mitigatory measure: BioJute Installtion (**top left**); a silt fence protecting a stockpile (**top right**) and pegged hay bale wall used to reduce runoff velocities (**bottom**)

8.3 Proposed Groundwater and Soil Contamination Mitigatory Measures

Every precaution must be taken to ensure that any chemicals or hazardous substances do not contaminate the soil or groundwater on site.
For this purpose the Contractor must:

- Ensure that the mixing /decanting of all chemicals and hazardous materials should take place on a tray or impermeable surface.
- Waste generated from these should then be disposed of at a registered landfill site.
- Ensure all storage tanks are designed and managed in order to prevent pollution of drains, groundwater and soils.
- Construct separate storm water collection areas and interceptors at storage tanks, and other associated potential pollution activities.
- Ensure that use and storage of fuels and chemicals that could potentially leach into the ground be controlled. Adequate spillage containment measures shall be implemented, such as cut off drains, etc. Fuel and chemical storage containers shall be set on a concrete plinth. The containment capacity shall be equal to the full amount of material stored, plus 10%.

- Appoint appropriate contractors to remove any residue from spillages from site. Handling, storage and disposal of excess or containers of potentially hazardous materials shall be in accordance with the requirements of the above-mentioned Regulations and Acts.
- Ensure that used oils/lubricants are not disposed of on/near the site, and that contractors purchasing these materials understand the liability under which they must operate. The ECO will be responsible for reporting the storage/use of any other potentially harmful materials to the relevant authority.
- Ensure that potentially harmful materials are properly stored in a dry, secure environment, with concrete or sealed flooring. The ECO will ensure that materials storage facilities are cleaned/maintained on a regular basis, and that leaking containers are disposed of in a manner that allows no spillage onto the bare soil or surface water. The management of such storage facilities and means of securing them shall be agreed.
- Site staff shall not be permitted to use any stream, river, other open water body or natural water source adjacent to or within the designated site for the purposes of bathing, washing of clothing or for any other construction or related activities. Municipal water or another source approved by the ECO should rather be used for all activities such as washing of equipment, dust suppression, concrete mixing and compacting.

8.4 Stockpile Management

General requirements for stockpiles are that they should be situated in an area that should not obstruct the natural water pathways on site. Topsoil stockpiles will be kept separate from other stockpiles, shall not be compacted, and shall not exceed 2m in height. If they are exposed to windy conditions or heavy rain, they could either be protected by re-vegetation using an indigenous grass seed mix or cloth, depending on the duration of the project. The construction of a berm consisting of sand bags or a low brick wall can be placed around the base of the stockpile for retention purposes. They should be maintained free of alien vegetation and weeds by regular weeding. Stockpiles shall be kept free of any contaminants whatsoever, including paints, building rubble, cement, chemicals, oil, etc.

Subsoil and topsoil stockpiles will be moved to areas of final utilisation as soon as possible to avoid unnecessary erosion. Stockpiles not utilized within three months of the initial stripping process (or prior to the onset of seasonal rains) will be seeded with appropriate grass seed mixes, including indigenous grasses normally found in coastal grasslands or brush-packed to further avoid possible erosion.

8.5 Land Rehabilitation

All rubble is to be removed from the site to an approved landfill site as per construction phase requirements. No remaining rubble is to be buried on site. The site is to be free of litter and surfaces are to be checked for waste products from activities such as concreting or asphalting and cleared.

9. SUMMARY AND RECOMMENDATIONS

Aurecon on behalf of Mainstream Renewable Power requested a baseline assessment of the soil, land use and agricultural characteristics for the area affected by the proposed Kangnas Wind and Solar Energy Facilities, near Springbok in the Northern Cape Province of South Africa. The primary objective of this assessment is to provide specialist soil and agricultural input into the overarching EIA Report. The study area is zoned as agricultural land and is primarily used as grazing land for sheep. Water is the major limiting factor to local agricultural enterprises and the assessed area contains no perennial rivers and nor does the project area border a perennial river.

The study area has an arid climate with a winter rainfall regime i.e. most of the rainfall is confined to winter and early autumn. MAP is approximately 195 mm per year. The low rainfall and moisture availability is reflected in the lack of dry land crop production within the study area. The climate for the study area is highly restrictive to arable agriculture, which is primarily attributed to low, unpredictable and seasonal rainfall along with severe moisture availability restrictions. The majority of the study area is characterised by flat plains and gently sloping topography with an average gradient of less than 5%. These plains are ideal areas for intensive agriculture, with a high potential for large scale mechanisation. From a developmental perspective, the flat topography will also allow for minimal earthworks and site preparation. The study area does, however, contain sporadic steep rocky outcroppings and ridges particularly on Farm Areb (No.75), Farm Smorgen Schaduwe (No.127) and the northern areas of Portion 3 of the Farm Kangnas (No.77). These outcrops and ridges are limiting to arable agriculture and due to the extreme topography and engineering constraints are excluded from the preliminary development layouts.

The soils identified on eastern half of the study area (Farm Koeris and south eastern portions of the Farm Kangnas) are predominantly calcic with a low agricultural potential. These soils are generally shallow with Hard Pan Carbonate being encountered within 30cm of the soil surface. Calcic soils cover approximately 54% of the study area with Coega and Plooysburg soils being the dominant forms encountered. Silic soils cover approximately 30% of the surveyed area and are more prominent in the northern and western parts of the study area (Farm Areb and Farm Smorgen Schaduwe). The dominant soil forms encountered were the Garies and Knersvlakte forms. Rocky soils (Mispah) cover 16% of the surveyed area and dominate the rocky ridges, kopjes and high spots. Virtually all the soil encountered in the study area contained a layer, close to the soil surface, that was limiting to plant growth and these layers included rock, hard pan carbonate and dorbank. Effective soil depth rarely exceeded 30 cm. The physical and chemical limitations associated with the dominate forms restrict these soils to extensive grazing.

Overall the site has been classified as having a very low potential for crop production, due to an arid climate and highly restrictive soil characteristics. While, it is considered to have a moderately low value when utilised as grazing land, its current use.

The proposed wind energy facility would consist out of approximately 185 - 500 turbines with a maximum total installed capacity of 750 MW. Normal grazing (the primary agricultural activity) will be permitted around the turbines. The hardstand and turbine footprint of typical wind energy facility generally covers approximately 1% of the impacted area. This <u>loss is considered inconsequential</u> within the context of this assessment. The remaining land will continue to function as they did prior to the development. There are no centre pivots, irrigation schemes or active agricultural fields which will be influenced by the current wind turbine layout. Therefore, from an agricultural perspective, if there are no fatal flaw areas for wind energy facility. It is assumed and recommended that a non-developmental buffer will be placed around occupied homesteads. A 300 m buffer should be sufficient but this distance should be finalised in consultation with the current land owners.

The proposed construction of a PV/CPV solar energy facility is planned for the north eastern portion of the Farm Areb. The proposed development's primary impact on agricultural activities will involve the construction of the solar fields and associated infrastructure. The construction of the 250 MW solar field and associated infrastructure will only influence a small portion of the total farm area (approximately 1000 ha). The remaining land will continue to function as it did prior to the development (approximately 7 647 ha or 87%). In order to further mitigate the potential impact it is highly recommended that periodic grazing of sheep within the PV fields is allowed. This mitigation will minimise the loss of grazing land and allow agricultural production to remain virtually unaffected.

The proposed developments are not expected to have any cumulative impact due to minor loss of low value agricultural land. The post mitigation impact scores for both developments are classified as low negative. From an agricultural perspective the vast majority of the site is suitable for the proposed development. Small areas surrounding existing homesteads have been declared No Go Zones from an Agricultural Perspective. These areas are currently precluded in the latest development layout. If the suggested mitigation measures and erosion management plan are correctly implemented there is no reason why the proposed wind and solar energy facilities cannot be accommodated on the Kangnas Project Site.

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11. APPENDIX A: SOIL PROPERTIES

Auger Number	Soil Form	Soil Family	Effective Depth (m)	Limiting Layer	X	Y
1	Py	1000	0.2	HPC	18.4952	-29.5543
2	Cg	1000	0.1	HPC	18.4886	-29.5563
3	Cg	1000	0.1	HPC	18.4806	-29.5589
4	Cg	1000	0.1	HPC	18.4661	-29.5618
5	Cg	1000	0.1	HPC	18.4692	-29.5710
6	Cg	1000	0.1	HPC	18.4562	-29.5632
7	Gr	1000	0.4	Dorbank	18.4482	-29.5642
8	Py	1000	0.2	HPC	18.4319	-29.5660
9	Py	1000	0.2	HPC	18.4283	-29.5553
10	Cg	1000	0.1	HPC	18.4274	-29.5474
11	Cg	1000	0.1	HPC	18.4295	-29.5372
12	Py	1000	0.2	HPC	18.4310	-29.5262
13	Py	1000	0.2	HPC	18.4323	-29.5198
14	Py	1000	0.2	HPC	18.4348	-29.5123
15	Ms	1200	0.1	Rock	18.4352	-29.5068
16	Cg	1000	0.1	HPC	18.4284	-29.5200
17	Cg	1000	0.1	HPC	18.4241	-29.5137
18	Py	1000	0.2	HPC	18.4280	-29.5265
19	Py	1000	0.2	HPC	18.4192	-29.5320
20	Cg	1000	0.1	HPC	18.4088	-29.5388
21	Cg	1000	0.1	HPC	18.4039	-29.5418
22	Cg	1000	0.1	HPC	18.4001	-29.5386
23	Gr	1000	0.2	Dorbank	18.3923	-29.5493
24	Gr	1000	0.2	Dorbank	18.3857	-29.5532
25	Gr	1000	0.2	Dorbank	18.3729	-29.5607
26	Gr	1000	0.2	Dorbank	18.3689	-29.5634
27	Ms	1100	0.2	Dorbank	18.3601	-29.5683
28	Gr	1000	0.2	Dorbank	18.3615	-29.5690
29	Kn	1000	0.1	Dorbank	18.3725	-29.5693
30	Kn	1000	0.1	Dorbank	18.3753	-29.5692
31	Cg	1000	0.1	HPC	18.3817	-29.5684
32	Cg	1000	0.1	HPC	18.3869	-29.5678
33	Cg	1000	0.2	HPC	18.3959	-29.5627
34	Cg	1000	0.1	HPC	18.4043	-29.5574
35	Cg	1000	0.1	HPC	18.3803	-29.5706
36	Cg	1000	0.2	HPC	18.3891	-29.5744
37	Cg	1000	0.1	HPC	18.3911	-29.5827
38	Cg	1000	0.1	HPC	18.4050	-29.5782
39	Gr	1000	0.5	Dorbank	18.4116	-29.5762
40	Cg	1000	0.1	HPC	18.4643	-29.6332
41	Cg	1000	0.1	HPC	18.4676	-29.6458
42	Py	1000	0.5	HPC	18.4789	-29.6659

Auger Number	Soil Form	Soil Family	Effective Depth (m)	Limiting Layer	X	Y
43	Cg	1000	0.2	HPC	18.4714	-29.6577
44	Cg	1000	0.1	HPC	18.4611	-29.6543
45	Cg	1000	0.2	HPC	18.4540	-29.6494
46	Cg	1000	0.1	HPC	18.4473	-29.6414
47	Cg	1000	0.1	HPC	18.4342	-29.6541
48	Cg	1000	0.2	HPC	18.4285	-29.6594
49	Ms	1200	0.2	Rock	18.4212	-29.6660
50	Ms	1200	0.2	Rock	18.4169	-29.6699
51	Ms	1200	0.2	Rock	18.4105	-29.6726
52	Cg	1000	0.2	HPC	18.4003	-29.6583
53	Cg	1000	0.1	HPC	18.4069	-29.6535
54	Cg	1000	0.2	HPC	18.4058	-29.6405
55	Cg	1000	0.2	HPC	18.4038	-29.6328
56	Cg	1000	0.1	HPC	18.4004	-29.6202
57	Cg	1000	0.2	HPC	18.4012	-29.6094
58	Cg	1000	0.2	HPC	18.4130	-29.6040
59	Cg	1000	0.1	HPC	18.4252	-29.5986
60	Cg	1000	0.2	HPC	18.4330	-29.5951
61	Cg	1000	0.2	HPC	18.4392	-29.5923
62	Cg	1000	0.2	HPC	18.4424	-29.5955
63	Cg	1000	0.2	HPC	18.4459	-29.5999
64	Cg	1000	0.2	HPC	18.4492	-29.6043
65	Py	1000	0.4	HPC	18.5004	-29.5850
66	Py	1000	0.4	HPC	18.5004	-29.5924
67	Py	1000	0.4	HPC	18.4967	-29.5877
68	Gr	1000	0.5	Dorbank	18.4877	-29.5943
69	Cg	1000	0.2	HPC	18.4816	-29.5989
70	Cg	2000	0.1	HPC	18.4788	-29.6009
71	Cg	1000	0.2	HPC	18.4763	-29.6028
72	Cg	1000	0.2	HPC	18.4701	-29.6073
73	Ag	1110	1.2		18.4572	-29.6170
74	Cg	1000	0.2	HPC	18.4349	-29.5831
75	Cg	1000	0.1	HPC	18.4327	-29.5738
76	Cg	1000	0.2	HPC	18.4287	-29.5678
77	Cg	1000	0.2	HPC	18.4175	-29.5744
78	Gr	1000	0.2	Dorbank	18.3949	-29.5815
79	Gr	1000	0.1	Dorbank	18.3770	-29.5914
80	Gr	1000	0.2	Dorbank	18.3733	-29.5950
81	Gr	1000	0.1	Dorbank	18.3632	-29.6033
82	Gr	1000	0.2	Dorbank	18.3542	-29.6084
83	Gr	1000	0.2	Dorbank	18.3467	-29.6127
84	Gr	1000	0.1	Dorbank	18.3331	-29.6209
85	Py	1000	0.2	HPC	18.3426	-29.6079
86	Kn	2000	0.2	Dorbank	18.3475	-29.5972

Auger Number	Soil Form	Soil Family	Effective Depth (m)	Limiting Layer	X	Y
87	Kn	2000	0.2	Dorbank	18.3536	-29.5834
88	Kn	1000	0.1	Dorbank	18.3368	-29.5306
89	Kn	1000	0.4	Dorbank	18.3453	-29.5441
90	Kn	1000	0.1	Dorbank	18.3500	-29.5611
91	Cg	2000	0.2	HPC	18.3575	-29.5757
92	Cg	2000	0.2	HPC	18.3675	-29.5885
93	Py	1000	0.2	HPC	18.3386	-29.6281
94	Cg	1000	0.2	HPC	18.3519	-29.6362
95	Tr	1000	0.2	Dorbank	18.2092	-29.5294
96	Cg	1000	0.2	HPC	18.1944	-29.5234
97	Ms	1100	0.2	Rock	18.1880	-29.5255
98	Ms	1100	0.1	Rock	18.1861	-29.5247
99	Ms	1100	0.0	Rock	18.1834	-29.5208
100	Ms	1100	0.2	Rock	18.1850	-29.5160
101	Cg	1000	0.2	HPC	18.1904	-29.5139
102	Kn	1000	0.2	Dorbank	18.2331	-29.5072
103	Kn	1000	0.1	Dorbank	18.2374	-29.5090
104	Kn	1000	0.1	Dorbank	18.3191	-29.5533
105	Kn	1000	0.0	Dorbank	18.3199	-29.5588
106	Gr	1000	0.3	Dorbank	18.3022	-29.5472
107	Gr	1000	0.3	Dorbank	18.2877	-29.5360
108	Ms	1100	0.1	Rock	18.2801	-29.5283
109	Py	1000	0.4	Dorbank	18.2632	-29.5264
110	Kn	1000	0.0	Dorbank	18.2589	-29.5292
111	Ms	1100	0.1	Rock	18.2512	-29.5311
112	Gr	1000	0.3	Dorbank	18.2474	-29.5365
113	Gr	1000	0.2	Dorbank	18.2477	-29.5550
114	Ms	1100	0.1	Rock	18.2539	-29.5670
115	Kn	2000	0.0	Dorbank	18.2606	-29.5686
116	Kn	1000	0.1	Dorbank	18.2643	-29.5687
117	Gr	1000	0.3	Dorbank	18.2775	-29.5689
118	Gr	1000	0.4	Dorbank	18.2936	-29.5681
119	Gr	1000	0.5	Dorbank	18.3043	-29.5670
120	Tr	1110	0.3	Dorbank	18.2727	-29.5813
121	Ms	2100	0.1	Rock	18.2502	-29.5868
122	Gr	1000	0.7	Dorbank	18.2508	-29.5807
123	Kn	1000	0.0	Dorbank	18.2525	-29.5740
124	Gr	1000	0.5	Dorbank	18.2506	-29.5719
125	Gr	1000	0.4	Dorbank	18.2397	-29.5730
126	Gr	1000	0.3	Dorbank	18.2250	-29.5748
127	Ms	1100	0.1	Rock	18.2135	-29.5780
128	Gr	1000	0.4	Dorbank	18.2161	-29.5859
129	Gr	1000	0.4	Dorbank	18.2197	-29.5966
130	Gr	1000	0.3	Dorbank	18.2235	-29.6076

Auger Number	Soil Form	Soil Family	Effective Depth (m)	Limiting Layer	X	Y
131	Ms	2100	0.1	Rock	18.2115	-29.5725
132	Gr	1000	0.3	Dorbank	18.2123	-29.5568
133	Kn	1000	0.1	Dorbank	18.2164	-29.5513
134	Kn	1000	0.1	Dorbank	18.2293	-29.5484
135	Gr	1000	0.4	Dorbank	18.3687	-29.6464
136	Py	1000	0.2	HPC	18.3843	-29.6556
137	Gr	1000	0.2	Dorbank	18.3637	-29.6255
138	Cg	1000	0.1	HPC	18.3815	-29.6161
139	Kn	1000	0.1	Dorbank	18.3251	-29.6273
140	Gr	1000	0.5	Dorbank	18.3104	-29.6347
141	Ms	1100	0.2	Rock	18.3039	-29.6378
142	Ms	1100	0.2	Rock	18.2988	-29.6399
143	Ms	1100	0.1	Rock	18.2882	-29.6418
144	Ms	1100	0.1	Rock	18.3082	-29.6269
145	Py	1000	0.4	HPC	18.2995	-29.6215
146	Cg	1000	0.1	HPC	18.2965	-29.6184
147	Cg	1000	0.1	HPC	18.2870	-29.6258
148	Cg	1000	0.2	HPC	18.2948	-29.6098
149	Py	1000	0.3	HPC	18.2888	-29.6021
150	Py	1000	0.4	HPC	18.2810	-29.6027
151	Ms	1100	0.1	Rock	18.2675	-29.6045
152	Py	1000	0.3	HPC	18.2829	-29.5939
153	Py	1000	0.3	HPC	18.2750	-29.5893
154	Ms	1100	0.1	Rock	18.2600	-29.5911
155	Py	1000	0.2	HPC	18.2919	-29.5863
156	Ms	1100	0.1	Rock	18.2948	-29.5858
157	Ms	1100	0.1	Rock	18.2976	-29.5837
158	Gr	1000	0.5	Dorbank	18.3067	-29.5757
159	Gr	1000	0.5	Dorbank	18.3224	-29.5707
160	Gr	1000	0.3	Dorbank	18.3249	-29.5846
161	Py	1000	0.2	HPC	18.3267	-29.5936
162	Py	1000	0.2	HPC	18.3281	-29.6016
163	Py	1000	0.2	HPC	18.3289	-29.6065
164	Gr	1000	0.3	Dorbank	18.3304	-29.6144
165	Gr	1000	0.3	Dorbank	18.3729	-29.5948
166	Gr	1000	0.4	Dorbank	18.3287	-29.5302
167	Ms	1100	0.1	Rock	18.2518	-29.5279
168	Ms	1100	0.1	Rock	18.2510	-29.5139
169	Ms	1100	0.1	Rock	18.1888	-29.4953
170	Ms	1100	0.1	Rock	18.1925	-29.4913
171	Ms	1100	0.1	Rock	18.1983	-29.4893
172	Kn	1000	0.0	Dorbank	18.2070	-29.4853
173	Gr	1000	0.4	Dorbank	18.2207	-29.4803
174	Gr	1000	0.9	Dorbank	18.2358	-29.4751

Auger Number	Soil Form	Soil Family	Effective Depth (m)	Limiting Layer	X	Y
175	Gr	1000	0.7	Dorbank	18.2499	-29.4700
176	Gr	1000	0.4	Dorbank	18.2631	-29.4654
177	Gr	1000	0.4	Dorbank	18.2758	-29.4662
178	Cg	1000	0.2	HPC	18.2770	-29.4696
179	Cg	1000	0.1	HPC	18.2818	-29.4835
180	Gr	1000	0.3	Dorbank	18.2864	-29.4970
181	Kn	1000	0.0	Dorbank	18.2895	-29.5077
182	Kn	1000	0.1	Dorbank	18.2869	-29.5082
183	Kn	1000	0.0	Dorbank	18.2832	-29.5089
184	Kn	1000	0.1	Dorbank	18.2765	-29.5103
185	Gr	1000	0.3	Dorbank	18.2647	-29.5158
186	Gr	1000	0.3	Dorbank	18.2699	-29.5059
187	Gr	1000	0.1	Dorbank	18.2668	-29.4908
188	Gr	1000	0.2	Dorbank	18.2524	-29.4942
189	Gr	1000	0.3	Dorbank	18.2354	-29.4928
190	Gr	1000	0.7	Dorbank	18.2281	-29.4985
191	Ms	1100	0.1	Rock	18.2287	-29.5020
192	Ms	1100	0.1	Rock	18.2238	-29.5008
193	Cg	1000	0.1	HPC	18.2275	-29.5034
194	Gr	1000	0.3	Dorbank	18.2082	-29.5184
195	Gr	1000	0.3	Dorbank	18.2198	-29.5093
196	Gr	1000	0.4	Dorbank	18.2037	-29.5094
197	Cg	1000	0.1	HPC	18.1910	-29.5119
198	Kn	1000	0.0	Dorbank	18.1844	-29.5103
199	Kn	1000	0.0	Dorbank	18.1801	-29.5097
200	Gr	1000	0.2	Dorbank	18.1650	-29.5096
201	Kn	1200	0.1	Dorbank	18.1652	-29.5150
202	Kn	1000	0.0	Dorbank	18.1689	-29.5174
203	Kn	1000	0.1	Dorbank	18.1706	-29.5190
204	Kn	1000	0.0	Dorbank	18.1722	-29.5209
205	Kn	1000	0.0	Dorbank	18.1727	-29.5234
206	Kn	1000	0.0	Dorbank	18.1732	-29.5251
207	Kn	1000	0.1	Dorbank	18.1762	-29.5277
208	Kn	1000	0.2	Dorbank	18.1780	-29.5289
209	Kn	1000	0.1	Dorbank	18.1806	-29.5307
210	Kn	1000	0.2	Dorbank	18.1834	-29.5340
211	Ms	1100	0.1	Rock	18.1907	-29.5338
212	Ms	1100	0.1	Rock	18.1949	-29.5336
213	Ms	1100	0.1	Rock	18.1961	-29.5314
214	Ms	1100	0.1	Rock	18.2016	-29.5308
215	Ms	1100	0.1	Rock	18.2059	-29.5334
216	Ms	1000	0.1	Rock	18.2075	-29.5365
217	Ms	1100	0.1	Rock	18.2087	-29.5398
218	Kn	1000	0.1	Dorbank	18.2109	-29.5426

Auger Number	Soil Form	Soil Family	Effective Depth (m)	Limiting Layer	X	Y
219	Ms	1100	0.1	Rock	18.2138	-29.5474
220	Tr	1110	0.2	Dorbank	18.2192	-29.5439
221	Tr	1110	0.3	Dorbank	18.2285	-29.5376
222	Ms	1100	0.2	Rock	18.2311	-29.5309
223	Gr	1000	0.4	Dorbank	18.2340	-29.5191
224	Gr	1000	0.6	Dorbank	18.2213	-29.5194

11. APPENDIX A: SPECIALIST DECLARATION

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Proposed wind and solar (photovoltaic) energy facilities near Springbok, Northern Cape

Specialist:	Soil and Agricultural Potential		
Contact person:	Kurt Barichievy		
Postal address:	P.O. Box Msunduzi		
Postal code:	3201	Cell:	084 554 9442
Telephone:	033 347 1600	Fax:	033 347 5762
E-mail:	KurtB@sivest.co.za		
Professional affiliation(s) (if any)	Registered as a Professional Natural Scientist (*Pr. Sci Nat.*) with the South African Council for Natural Scientific Professions - Earth Science (Registration No. 400129/11)		

Project Consultant:	Aurecon South Africa (Pty) Ltd		
Contact person:	Louise Corbett/ Cornelia Steyn		
Postal address:	P.O. Box 494, Cape Town		
Postal code:	8000	Cell:	
Telephone:	021 526 6027	Fax:	+27 86 667 3532
E-mail:	Louise.corbett@aurecongroup.com / cornelia.steyn@aurecongroup.com		

4.2 The specialist appointed in terms of the Regulations_

I, Kurt Barichievy, declare that --

General declaration:

- 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.

Signature of the specialist:

SiVEST SA (Pty) Ltd

Name of company (if applicable):

15 August 2012

Date:

SiVEST Civil Engineering

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