BASIC ASSESSMENT

ASSESSMENT OF THE SOILS AND AGRICULTURAL POTENTIAL FOR THE PROPOSED STEYNSRUS 10 MW PV SOLAR ENERGY FACILITY

TO BE LOCATED ON THE FARMS WELTEVREDE NO. 2151 & ARBEID NO. 2154, MOQHAKA LOCAL MUNICIPALITY, FREE STATE PROVINCE

JANUARY 2023

PREPARED FOR:

CRRENEWABLES (PTY) LTD

PREPARED BY:
DR L G DU PISANI
P O BOX 641
BETHLEHEM 9700
TEL: 082 – 773 9778

BASIC ASSESSMENT

I, Louis George du Pisani, hereby confirm my independence as specialist and declare that I have no interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which I was appointed other than fair remuneration for work performed on this project.

______________________________ 23 January 2023

L G du Pisani **Date**

Dr L G du Pisani (B.Sc. Agric., Hons B.Sc. Agric., M.Sc. Agric., Ph.D. Agric.)
Pr. Sci. Nat. 400178/2012

Summary of Expertise

>>More than 40-year experience in pasture and natural resource management in the arid & semi-arid regions of the Northern Cape, Eastern Cape and Free State

>>Author or co-author of 20 publications in international and national journals and papers

>>Presented 5 papers at International Conferences, as well as 2 at Regional and 10 at National Conferences

>>Was a member of 13 National Committees of the Department of Agriculture

>>Completed several agricultural potential studies in South Africa, Namibia and Argentina

>>Conducted 30 environmental impact assessments for solar and wind energy Facilities in the Eastern Cape, Northern Cape and Free State

>>Registered as professional member of The South African Council for Natural Scientific Professions (SACNASP) (Agricultural Science), with registration number 400178/2012

consent of the author. **The client, on acceptance of any submission by the author and on condition that the client pays to the author the full fee for the work as agreed, shall be entitled to use them for its own benefit and for the specified project only.**

Conditions relating to this report: The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The author reserves the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation. This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

EXECUTIVE SUMMARY

Site name and location:

Steynsrus PV Solar Energy Site: A site of ~30ha located on the Farms Weltevrede No. 2151 and Arbeid No.2154.

The site is situated in the Moqhaka Local Municipality (Free State Province), ~10km north-west of the town of Steynsrus. A commercial photovoltaic solar energy facility of 10MW and a sub-station are planned for the site.

Purpose of the study: To carry out a basic assessment of the soil and agricultural potential of the site for the establishment of a solar energy facility, including a sub-station, and to provide a professional opinion on (i) whether the proposed site is of such high agricultural potential that the proposed development would lead to a significant loss of agricultural potential in the area the property is situated upon, (ii) whether the sites are situated within agricultural sensitive areas and (iii) to assess the direct, indirect and cumulative impacts of the proposed development on the soil and agricultural resources.

The Solar Power Plant is proposed to accommodate the following infrastructure:

- » Arrays of photovoltaic (PV) panels with an installed capacity of up to 10MW;
- » Inverter/Transformer enclosures;
- » On-site sub-station;
- » Grid connection to substation and overhead power lines;
- » Mounting structure to be either rammed steel piles or piles with pre-manufactured concrete footing to support the PV panes;
- » Cabling between the project components, to be positioned underground where practical;
- » Internal access roads; fencing and
- » Workshop area for maintenance, storage and offices.

Specialist: Dr L G du Pisani (B.Sc. Agric., Hons B.Sc. Agric., M.Sc. Agric., Ph.D. Agric.) Pr. Sci. Nat. 400178/2012

Date of Report: 23 January 2023

FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

1 The prevailing climatic conditions over the study area makes it suitable for dryland cultivation, with maize and sunflower the primary crops which can be produced.

2 The study area is dominated by duplex, vertic and melanic soils. The clay contents are high and the soils are relatively shallow which put them in a category of "**marginal potential arable land - not suitable for cultivation**". Therefore, although the climate is suited for dryland cultivation, the soils are not. There are a few lands on the study area. They are clayey and shallow and should never have been ploughed. They should preferably be taken out of cultivation and be established with perennial grasses to be used for grazing purposes. The lands on the study area are **not** to be regarded as No-Go areas due to its low production potential and none are situated within the proposed development footprints.

3 The duplex, vertic and melanic soils present on the study area are prone to crusting and are highly erodible. The specific rainfall regime over the study area with the incidence of high intensity thunderstorms of 125mm to 150mm rainfall on a single day increases the erosion hazard over the study area. Nevertheless, little soil erosion is actually prevalent in the study area. This is ascribed to the good vegetation cover of the veld and the conservation cultivation practised on the cultivated lands. It is therefore concluded that the two most important factors to be taken into account to minimize the soil erosion hazard are (i) to maintain a healthy soil cover between the solar arrays, specifically a good grass cover, and (ii) to employ conservation practices similar to the conservation cultivation when planning the arrangement of the PV arrays, i.e.; in strips of land on the contour of the land, with buffer zones of grass between the development strips and the channelling of runoff water from the development strips into stable grass covered waterways or outlets.

4 The slope of the study area is less than 5% and is therefore not an impediment to the development of the site as a PV Solar energy facility.

5 There are several drainage lines on the study area, which should be avoided when deciding on the final placement of the chosen PV Solar site locality. One of the drainage lines starts within the footprint of the proposed PV-site.

It is recommended that this site should be moved slightly to locate it outside of this drainage line.

6 There are fences on the study area. There are also two windmills and three water reservoirs on the study area. None of this infrastructure is situated within the footprint of the PV-arrays to be placed.

There are contour strips present on the lands. None of them will be interfered with.

Apart from the above infrastructure there are no other agricultural important infrastructure, i.e.; silos, irrigation lines, irrigation centre pivot points, channels and feeding structures that will be interfered with on the study area.

7 The best agricultural use for the study area is livestock farming with beef cattle, where the grazing takes place on the veld and lands established with perennial planted pastures.

The current veld grazing capacity of the study area is estimated at 5 ha/LSU. A ~30ha PV Energy site can therefore carry ~6 large stock units (LSU's) or 4 medium framed beef cows, which is negligible in terms of agricultural production and/or food security.

The size of the land type in which the study area is located is 366 057ha. The ~30ha proposed PV Energy site is therefore negligible in terms of agricultural production in the region and nationally.

8 The study area does not consist of unique agricultural land and its conservation status is regarded as vulnerable.

9 The development of the ~30ha site is supported provided the proposed Environmental Management Program is followed.

TABLE OF CONTENTS

1. INTRODUCTION

The consultant had the following brief:

1.1 To conduct a basic assessment of the soil and agricultural potential of a study area consisting of a site located on a broader study area consisting of the Farms Weltevrede No. 2151 and Arbeid No.2154, which is situated in the Moqhaka Local Municipality (Free State Province), ~10km north-west of the town of Steynsrus.

See Appendix 1 for a map for the location of the study area and the proposed site location.

1.2 To compile a report and provide a professional opinion on (i) whether the proposed site is of such high agricultural potential that the proposed development would lead to a significant loss of agricultural potential in the area, (ii) whether the site is situated within agricultural sensitive areas and (iii) to assess the direct, indirect and cumulative impacts of the proposed development on the soil and agricultural resources.

2. BACKGROUND INFORMATION

The Department of Agriculture, Forestry and Fisheries (DAFF) (2010) published "Regulations for the evaluation and review of applications pertaining to wind farming on agricultural land''. This report states that "*it is important to conduct land use in a way that it optimally adheres to the potential of the land. Consequently, it is imperative that all available land with the potential for producing sustained high crop yields, thus land with a high agricultural production potential, as well as land with a potential carrying capacity for livestock, be effectively utilized and protected for agricultural use. Agricultural production or the use of land for any other purpose should nevertheless not be conducted in a way that it could result in the degradation or loss of the available natural resources. This especially has reference in ensuring that high potential and unique agricultural land is preserved for current and future production thereby ensuring sustainable utilization of the country's natural resource base and adhering to food security*.''

This report by DAFF (November 2010) provides a draft list of guidelines that must be taken into account and be adhered to before permission will be granted for the establishment of Wind Farms on agricultural land (for the purpose of this study it is assumed that the same set of guidelines are relevant to solar farms). They are:

2.1 No development will be allowed on high potential or unique agricultural land.

2.2 No development will be allowed on areas currently being cultivated (cultivated fields/ production areas) or on fields that have been cultivated in the last ten years. This is relevant to cultivated land utilized for dry land production as well as land under any form of irrigation.

2.3 No development will be allowed should it intervene with or impact negatively on existing or planned production areas (including grazing land) as well as agricultural infrastructure (silos, irrigation lines, pivot points, channels, feeding structures, dip tanks, grazing camps, animal housing, farm roads etc.).

2.4 No development will be allowed should it result in the degradation of the natural resource base of the farm or surrounding areas. These include, but are not limited to, soil degradation or soil loss through erosion or any manner of soil degradation, the degradation of water resources (both quality and quantity) and the degradation of vegetation (composition and condition of both natural or established vegetation). It also includes establishment on or impacting on:

2.4.1 *Wetlands (land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*). No development is allowed on a wetland, vlei, pan or any other water body unless otherwise approved by DAFF.

2.4.2 Flow pattern of runoff water. No structure shall in any manner divert any runoff water from a water course to any other watercourse or obstruct the natural flow pattern of runoff water.

2.4.3 Utilization and protection of vegetation. Every care should be taken to protect the vegetation and veld condition against deterioration and destruction.

2.5 No development will be allowed should it result in a degradation of existing soil conservation work. This includes but are not limited to:

2.5.1 Contour banks.

2.5.2 Waterways/Watercourses

2.6 No development will be allowed on slopes (*the vertical difference in height between the highest and the lowest points of that portion of land, expressed as a percentage of the horizontal distance between those two points*) of more than 20%.

3. METHODOLOGY FOLLOWED WITH THE STUDY

The consultant collected all the available published data concerning the soil and agricultural potential of the broader study area. Data sources included publications, maps and satellite images. The data collected was collated to assist in the preparation of a professional opinion. The consultant also visited the site personally, traversed it on foot and vehicle while listing, assessing and verifying the agricultural attributes.

The information collected from the published data, as well as during the verification visit to the site, was used to prepare a professional opinion on whether any of the DAFF-guidelines (as was discussed in paragraph 2 of this report) will be contravened upon, after which an impact assessment of the proposed development on the agricultural resources of the study area was conducted.

4. STUDY AREA AND SITE INFORMATION

The study area is located on the Farms Weltevrede No. 2151 and Arbeid No.2154, which is situated in the Moqhaka Local Municipality (Free State Province), ~ 10km north-west of the town of Steynsrus. The site is identified as Steynsrus PV Solar Energy Site - a site of ~30ha.

See Appendix 1 for a map for the location of the study area and the proposed site location.

5. SPECIALIST INFORMATION

Dr L G du Pisani (B.Sc. Agric., Hons B.Sc. Agric., M.Sc. Agric., Ph.D. Agric. - all in Pasture Science)
Pr. Sci. Nat. 400178/2012

6. ASSESSMENT OF THE SOILS AND AGRICULTURAL POTENTIAL OF THE STUDY AREA

6.1 Climate

The climate of the area is typical of the Highveld Climatic Region as was defined by Schulze (1980). In this climatic region the average annual precipitation varies from about 900mm on its eastern border to about 650mm in the west. According to Mucina & Rutherford (2006) the mean annual precipitation over the study area is 590mm, while the owner of the property, Mr Boy Saaiman's 32-year rainfall record, calculates the long-term annual rainfall as 620mm (see also Appendix 3). This puts the study area in a category of "**suitable for dryland cultivation"**.

Precipitation is almost exclusively due to showers and thunderstorms and falls mainly in the summer from October to March with the peak of the rainfall season occurring in January. Heavy rainfall showers of 125mm to 150mm occasionally fall in a single day, which put the soils at **risk of water erosion** if not sufficiently protected from high volumes of fast flowing runoff water.

The average daily maximum temperature is 27°C in January and 17°C in July, while the average daily minimum temperatures are 13°C in January and 0°C in July. The period during which frost is likely to form lasts on the average for 120 days from May to September. The temperature and rainfall regime over the study limits it to the **production of primarily sunflower and maize**, with crops like dry beans also possible but on a much smaller scale. Climate alone is not sufficient to make a final recommendation regarding the suitability of an area for dryland cultivation. Soil parameters also play an important role.

6.2 Geology, land types and soils

According to the Land Type Survey Staff (1976 - 2006) the study area's geology can be categorized as mainly Adelaide and Tarkastad Subgroups mudstone, shale and sandstone, with Burgersdorp Formation mudstone, shale and sandstone present in the south east, and Ecca shale, mudstone, sandstone and grit in the far north. Dolerite sills are common, with crests and scarps on dolerite or sandstone.

The study area is situated within the Dc land type (Land Type Survey Staff, 1976 - 2006) (see Appendix 4). The Dc land type consists of duplex soils with either prismacutanic and/or pedocutanic diagnostic horizons dominant, while one or more vertic, melanic or red structured diagnostic horizons may be prevalent (Land Type Survey Staff, 1976 - 2006). Soils with marked clay accumulation, strongly structured and with a non-reddish colour are to be expected (Department of Agriculture, Forestry & Fisheries - www.agis.agric.za). These soils are generally shallow and the effective depth varies between 100mm and 1200mm, while the clay content varies between 15% and 50% in the A-horizon, and between 15% and 55% in the B21-horizon (Land Type Survey Staff, 1976 - 2006). Due to the high clay content and shallowness of the soils expected in the study area, the area is categorised as being "**marginal potential arable land**" (see Appendix 5).

The soil forms that can be expected on the site are listed in Appendix 2.

During reconnaissance of the study area several drill core samples were taken. Mainly two soil forms occur on the higher lying areas, namely Swartland (Orthic A/Pedocutanic B/Saprolite – MacVicar *et al,* 1991) and Valsrivier (Orthic A/Pedocutanic B/Unconsolidated Material - MacVicar *et al,* 1991), both which are duplex soils (Fey, 2010). On the lower lying areas (= drainage lines) two soil forms dominate, i.e.; Bonheim (Melanic A/Pedocutanic B – MacVicar *et al,* 1991) and Arcadia (Vertic A/Unspecified – MacVicar *et al,* 1991). All of the identified soils are well structured and display high clay content values. The clay content of the A-horizons is on average 20% while the clay content of the B-horizons is on average 45%. The soils are generally shallow with an average effective depth of less than 200mm, even on the cultivated lands.

The soils occurring on the study area (even the cultivated lands) are considered as "**not suitable for cultivation**" due to the fact that they are shallow and clayey.

6.3 Soil erosion

The Department of Agriculture, Fisheries & Forestry – www.agis.agric.za categorise the study area as somewhat susceptible to wind erosion and low to moderately susceptible to water erosion, with the over-all soil loss potential categorised as being low to very low although individual soils may have a high water erosion hazard (see Appendix 6, 7 and 8).

Contrary to the above statements by the Department of Agriculture, Fisheries & Forestry – www.agis.agric.za the duplex, vertic and melanic soils present on the site are prone to crusting and generally highly erodible (Fey, 2010), specifically when exposed to increased water runoff volumes and rates.

Runoff rate is the product of several factors, including soil cover, rainfall intensity and quantity, the slope of the land and the water holding capacity and water infiltration rate of the soil. Three of these contributing factors are prevalent. They are the inherent **erosivity of the soils** present, the specific **rainfall regime** (specifically the occurrence of **high intensity thunderstorms**) and the **low infiltration rate** of the soils. Despite the expected high soil erosion hazard, little soil erosion was observed on the study area. Mucina & Rutherford (2006) made the same observation and reported that 65% of the biome in which the study area is located display very low to low soil erosion, with 30% displaying moderate soil erosion.

This low prevalence of soil erosion on the study site can be ascribed to two factors. In the case of the veld it is the good vegetation cover of the soil. On the lands it is accredited to the conservation cultivation practices employed, which consist of (i) cultivating in strips on the contour of the land, (ii) the use of buffers trips of dense vegetation cover between the cultivated strips and (ii) the channelling of runoff water from the cultivated strips into stable grass covered waterways or outlets. The cultivated strips are not terraced (=levelled) as the soils are too shallow to allow for terracing. The width and length of the cultivated strips and buffer strips, as well as the measurements and number of outlets are dependent upon the erodibility of the soils present, the slope and rainfall regime, and is designed with the assistance of an agricultural engineer.

It is concluded that the most important factors to be taken into account to minimize the soil erosion hazard are (i) to maintain a healthy soil cover between the solar arrays, preferably a good grass cover, and (ii) to employ conservation practices similar to the conservation cultivation practised when arranging the PV arrays, namely in strips of land on the contour of the land, with buffer zones of grass between the development strips and the channelling of runoff water from the development strips into stable grass covered waterways or outlets.

Where it is not possible to maintain a healthy grass cover, i.e.; on internal roads and the buffer zones of buildings, it is recommended that due diligence is observed in terms of storm water drainage management to minimize the concentration of runoff water and the resultant soil erosion.

The wind erosion hazard of the soils present on the site is low.

6.4 Land-use and land capability

The study area falls within an area categorized as having mainly "marginal potential arable land" (see Appendix 5) due to the high clay content and shallowness of the soils prevalent. This fact was verified during the consultant's visit to the site (see paragraph 6.2).

According to the Department of Agriculture, Fisheries & Forestry – www.agis.agric.za the study area is considered as marginal for maize production and moderate for sunflower production (see Appendix 9 & 10). The 20 and 80 percentiles of potential maize yield varies between 0.6 ton/ha and 2.4 ton/ha (see Appendix 11 & 12), which is too low for economic maize production. The cultivated lands on the study area conform to the above findings of the Department of Agriculture, Fisheries & Forestry – www.agis.agric.za and display a low production potential for cash crops and should preferably have never been cultivated. The "best use" for these marginal lands on the study area is to establish it with perennial planted pastures (see Appendix 13) to be used for fodder production for beef cattle grazing.

The study area falls within Veld Type 49 (Transitional *Cymbopogon*-Themeda Veld) (Acocks, 1988) and Biome Gh6 (Dry Highveld Grassland –

Central Free State Grassland) (Mucina & Rutherford, 2006). This biome occurs on undulating flats, is dominated by *Themeda triandra* while *Eragrostis curvula* and *Eragrostis chloromelas* become dominant in degraded habitats, dwarf karoo bushes establish on severely degraded clayey bottomlands and overgrazed and trampled low-lying areas with heavy clayey soils are prone to *Acacia karoo* enchroachment (Mucina & Rutherford, 2006). During verification of the natural resources present on the study site, it was established that the vegetation is dominated by *Themeda triandra* with *Eragrostis curvula* and *Eragrostis chloromelas* the second most important grasses. Small numbers of dwarf karoo bushes (i.e.; *Felicia muricata)* are present in some areas of the study area.

It is concluded that the best agricultural use for the agricultural resources of the study area can be described as livestock farming with cattle grazing from the veld and on planted pastures (established on marginal lands). The study area is currently used for cattle farming with one of the cultivated fields planted with soybeans for the production of cattle feed. The rest of the lands are either lying fallow or are established with Smutsfinger grass.

The grazing capacity of the area where the site is located varies between 8 ha/LSU and 10 ha/LSU (Dept. Agric., Forestry & Fisheries – www.agis.agric.za) (see Appendix 2 & 14). The current grazing capacity of the veld is estimated by the consultant to be 5 ha/LSU. The current grazing capacity of the one land established with Smutsfinger grass is estimated to be 2.5 ha/LSU. Based on these estimates the ~30ha size of the proposed PV Energy site can therefore carry ~6 large stock units (LSU's) or 4 medium framed beef cows, which is negligible in terms of agricultural production and/or food security.

The land type in which the study area is located is 366 057ha in size (see Appendix 2). The relative size of the ~30ha PV Energy site is therefore negligible in terms of the total agricultural production potential of the land type.

The conservation status of the biome within which the site is located, is regarded as "vulnerable" (Mucina & Rutherford, 2006).

6.5 Slope

The slope of the land is less than 5% (see Appendix 15).

6.6 Agricultural sensitive areas or areas of high agricultural value (i.e.; lands, wetlands and watercourses)

There are several drainage lines present on the study area (see Appendix 16). They are generally in a good ecological condition with few areas of soil erosion visible. One of the drainage lines starts within the footprint of the proposed PV-site. **It is recommended that this site be moved slightly to locate its footprint outside of this drainage line**.

6.7 Cultivated fields

There are several cultivated lands on the farms where the development of the two PV facilities are proposed (see Appendix 16). None of these lands are situated within the footprint of the study area or the proposed development site.

6.8 Agricultural infrastructure

There are stock fences on the study area, as well as two windmills and three water reservoirs. None of this infrastructure is situated within the footprint of the proposed arrays area to be developed.

There are contour strips present on the lands. None of them will be interfered with.

Apart from the above infrastructure there are no other agricultural important infrastructure, i.e.;, silos, irrigation lines, irrigation centre pivot points, channels and feeding structures that will be interfered with on the study area.

6.9 Groundwater, soil and geological stability of the study area

	YES	NO
Shallow water table (less than 1.5m deep)		X
Dolomite, sinkhole, or doline areas		X
Seasonally wet soils (often close to water bodies)	X	
Unstable rocky slopes or steep slopes with loose soil		X

Dispersive soils (soils that dissolve in water)		X
Soils with high clay content (clay fraction more than 40%)	X	
Any other unstable soil or geological feature		X
An area sensitive to erosion	X	

6.10 Access and internal roads

The identified site is accessible via the R76 between Steynsrus and Kroonstad.

There are several internal access roads on the study area and the proposed site is easily accessible via these roads. The condition of the roads is generally good.

6.11 Site suitability and preference

The proposed PV-site is suitable for the development of a 10MW solar energy facility.

7 ASSESSMENT OF IMPACTS

7.1 Assessment method and criteria

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

» The **nature**, which include a description of what causes the effect, what will be affected and how it will be affected.
» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 is assigned as appropriate (with 1 being low and 5 being high):
» The **duration**, wherein it is indicated whether:
* the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;

- ∗ the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
- ∗ medium-term (5–15 years) – assigned a score of 3;
- ∗ long term (> 15 years) - assigned a score of 4; or
- ∗ permanent - assigned a score of 5;

» The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

» The **probability** *of occurrence*, which describe the likelihood of the impact actually occurring. Probability is estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).

» the **significance**, is determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and

» the **status**, which is described as either positive, negative or neutral.

» the degree to which the impact can be reversed.

» the degree to which the impact may cause irreplaceable loss of resources.

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

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

S=(E+D+M)P, where

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

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

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

7.2 Activities that may have an impact

- Solar facility footprint (i.e.; an array of PV panels, mounting structures to be either rammed steel piles or piles with pre-manufactured concrete footings to support the PV panels and fencing)
- Construction and positioning of internal access roads
- Construction and positioning of the underground cabling between project components
- Construction and positioning of an on-site workshop area for maintenance, storage, and offices
- Use of potential sources of contaminants on the site (i.e.; oil, petrol, diesel and other substances used by the vehicles and equipment and for the cleaning of the PV arrays)

7.3 Agricultural resources that may be impacted upon

- **Impact 1**: Soil (degradation due to wind and water erosion, as well as by contamination with oil, petrol, diesel and other contaminants used by the construction vehicles and equipment)
- **Impact 2**: Vegetation and grazing capacity (degradation due to a decrease in species composition and vegetation cover and a loss of grazing capacity)
- **Impact 3**: Underground water (degradation due to contamination by oil, petrol, diesel and other contaminants used by the construction vehicles and equipment and for the cleaning of the PV arrays)
- **Impact 4**: Livestock production systems (interference with farm and livestock management activities and a decline in the long term food production).

7.4 Assessment of the identified impacts

7.4.1 Solar facility footprint

Impact 1 Soil

The duplex, vertic and melanic soils present on the study area are all susceptible to soil erosion. This is augmented by the rainfall regime for the area, specifically the occurrence of high intensity thunder storms of between 125mm and 150mm precipitation in a 24-hour period possible, as well as the low infiltration rate of the soils.

a) Nature: Soil erosion on construction sites and adjacent areas during and after the construction phase due to decreased vegetation cover and concentrated water runoff		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**50 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Care must be taken with the ground cover during and after construction on the site. If it is not possible to retain a good plant cover during construction, technologies should be employed to keep the soil covered by other means, i.e.;; straw, mulch, erosion control mats, etc., until a healthy plant cover is established again. Care should also be taken to control and contain storm water runoff and not to concentrate its runoff, specifically under the solar arrays. Rehabilitate construction sites with indigenous grasses like *Eragrostis curvula, Digitaria eriantha, Panicum maximum* and *Chloris gayana* or mixtures thereof. It is also recommended that conservation practices similar to the conservation cultivation practiced in the area are employed with the arrangement of the PV arrays, i.e.; in strips of land on the contour of the land, with buffer zones of grass between the development strips and the channelling of runoff water from the development strips into stable grass covered waterways or outlets (see paragraph 6.3). The development strips are not to be terraced (=levelled) as the soils are too shallow to allow for terracing. The width and length or the development strips and buffer strips, as well as the measurements and number of outlets are dependent upon the erodibility of the soils present, the slope and rainfall regime, and should be designed with the assistance of an agricultural engineer.		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

b) Nature: Dust production and dust pollution

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**21 (Low)**	**10 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: Apply dust control measures, i.e.; water spraying.		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

Impact 2 Vegetation and grazing capacity

The construction activities will lead to areas where the soil will be denuded of vegetation.

Nature: Denudation of the soil due to construction activities and loss of carrying capacity		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Medium-term (3)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Definite (5)
Significance	**40 (Medium)**	**25 (Low)**
Status	Negative	Negative
Reversibility	Medium	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Rehabilitate construction sites by establishing it with indigenous grasses like *Eragrostis curvula, Digitaria eriantha, Panicum maximum* and *Chloris gayana* or mixtures thereof.		
Cumulative Impacts: Little with the necessary mitigation in place. The maintenance of a dense grass cover may lead to an increased grazing and carrying capacity of the site.		
Residual Impacts: Little with the necessary mitigation in place		

Impact 3 Underground water

No impact expected.

Impact 4: **Livestock production systems**

During the construction phase there will be an impact on the normal day-to-day management of the livestock and the veld management system.

The long term impact on food production will be negligible due to the small size of the site. If grazing is allowed after the construction phase and the grass cover is restored due to rehabilitation of construction sites with grasses the impact on grazing capacity and food production is expected to be even smaller.

Nature: Interference with the day-to-day management of the livestock and veld due to construction and other activities on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**35 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: When farming infrastructure, i.e.; fences, water pipelines, water troughs, etc., is removed or damaged, it should be replaced as soon as possible. Construction and other activities must be communicated and co-ordinated with the land owner to put him in a position to properly plan his management activities.		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

7.4.2 Construction and positioning of internal access roads

Impact 1 Soil

There are internal access roads to the site. Internal access roads within the PV facility have to be constructed where no access roads occur. Soil erosion on the roads themselves as well as adjacent areas is a possibility if the storm water runoff from these roads is not controlled and managed properly.

Nature: Soil erosion due to increased and concentrated storm water runoff from road surfaces		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Improbable (2)
Significance	**50 (Medium)**	**10 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: Care should be taken to put gravel on access road surfaces to protect the soil against wind and water erosion. Cross mounds and other storm water dispersing and drainage techniques must be employed to decrease the speed and force of the storm water properly from road surfaces.		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

Impact 2 Vegetation and grazing capacity

New roads will contribute to the loss of vegetation and carrying capacity, although the impact is considered to be negligible taking into account the small area the roads will cover.

Nature: Loss of vegetation and carrying capacity		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Definite (5)	Definite (5)
Significance	**40 (Medium)**	**40 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No

Can impacts be mitigated?	Yes
Mitigation: Minimize the number of roads.	
Cumulative Impacts: Little, as long as the roads are not an additional source of erosion and storm water	
Residual Impacts: Permanent	

Impact 3 Underground water

No impact expected.

Impact 4: **Livestock production systems**

During the construction phase there will be an impact on the normal day-to-day management of the livestock and the veld management system.

Nature: Interference with the day-to-day management of the livestock and veld due to construction and other activities on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**35 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: Construction and other activities must be communicated and co-ordinated with the land owner in order for him to properly plan his management activities.		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

7.4.3 Construction and positioning of underground cabling between project components

Impact 1 Soil

The trenches dug for the laying of the internal cabling will disturb the soils as well as denude it of vegetation which could lead to soil erosion.

Nature: Soil erosion along the trenches dug during and after the construction phase due to decreased vegetation cover and increased water runoff		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**50 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Care must be taken with the ground cover during and after construction on the site. If it is not possible to retain a good plant cover during construction, technologies should be employed to keep the soil covered by other means, i.e.; straw, mulch, erosion control mats, etc., until a healthy plant cover is again established. Care should also be taken to control and contain storm water runoff. Rehabilitate construction sites with indigenous grasses like *Eragrostis curvula, Digitaria eriantha, Panicum maximum* and *Chloris gayana* or mixtures thereof.		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

Impact 2 Vegetation and grazing capacity

The trenches dug for the internal cabling will denude the soil of its vegetation which will lead to a loss of grazing capacity although the expected impact will be minor.

a) Nature: Loss of vegetation and carrying capacity		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Medium term (3)	Short-term (2)
Magnitude	Minor (2)	Minor (2)
Probability	Definite (5)	Definite (5)
Significance	**30 (Medium)**	**25 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: Rehabilitate construction sites with indigenous grasses like *Eragrostis curvula, Digitaria eriantha, Panicum maximum* and *Chloris gayana* or mixtures thereof.		

Cumulative Impacts: Little, as long as the roads are not an additional source of erosion and storm water
Residual Impacts: Permanent

Impact 3 Underground water

No impact expected.

Impact 4: **Livestock production systems**

During the construction phase there will be an impact on the normal day-to-day management of the livestock and the veld management system.

Nature: Interference with the day-to-day management of the livestock and veld due to construction and other activities on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**35 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: Construction and other activities must be communicated and co-ordinated with the land owner in order for him to properly plan his management activities.		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

7.4.4 Construction and positioning of a new on-site substation

Impact 1 Soil

The buffer zone surrounding the substation and the storm water runoff from the substation infrastructure, i.e.; terraces and roofs, may be agents of increased water runoff and water erosion.

Nature: Soil erosion in the area surrounding the substation		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)

Duration	Permanent (5)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**50 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Care must be taken with the ground cover during and after construction on the site and the buffer zone surrounding it. During construction, technologies should be employed to keep the soil covered with agent like straw, mulch, erosion control mats, etc. After construction the buffer zone around the building should be covered with gravel. Care should also be taken to control and distribute the storm water runoff from the roof of the building in such a manner that it does not lead to water erosion of the surrounding soil.		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

Impact 2 Vegetation and grazing capacity

Very little impact expected as it will only cover a very small area of land.

Nature: Invasion of alien and indigenous invader plants after construction		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Improbable (2)
Significance	**50 (Medium)**	**10 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: Control invader plants recruiting on the construction site.		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

Impact 3 Underground water

No impact expected.

Impact 4: **Livestock production systems**

During the construction phase there will be an impact on the normal day-to-day management of the livestock and the veld management system.

Nature: Interference with the day-to-day management of the livestock and veld due to construction and other activities on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**35 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: Construction and other activities must be communicated and co-ordinated with the land owner in order for him to properly plan his management activities.		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

7.4.5 Construction and positioning of an on-site workshop area

Impact 1 Soil

The buffer zone surrounding the workshop area and the storm water runoff from the roof/s may be agents of increased water runoff and water erosion.

Nature: Soil erosion in the area surrounding the workshop area		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**50 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation: Care must be taken with the ground cover during and after construction on the site and the buffer zone surrounding it. During construction, technologies should be employed to keep the soil covered with agent like straw, mulch, erosion control mats, etc. After construction the buffer zone around the building should be covered with gravel. Care should also be taken to control and distribute the storm water runoff from the roof of the building in such a manner that it does not lead to water erosion of the surrounding soil.
Cumulative Impacts: Little with the necessary mitigation in place
Residual Impacts: Little with the necessary mitigation in place

Impact 2 Vegetation and grazing capacity

Very little impact expected as it will only cover a very small area of land.

Impact 3 Underground water

No impact expected.

Impact 4: **Livestock production systems**

During the construction phase there will be an impact on the normal day-to-day management of the livestock and the veld management system.

Nature: Interference with the day-to-day management of the livestock and veld due to construction and other activities on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**35 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: Construction and other activities must be communicated and co-ordinated with the land owner in order for him to properly plan his management activities.		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

7.4.6 Use of potential contaminants

They are oil, petrol, diesel and other contaminants used by the vehicles and equipment and for the cleaning of the PV arrays.

Impact 1 Soil

Nature: Contamination and degradation of the soil due to spillages of oil, petrol, diesel and other contaminants used by vehicles and equipment on the site or stored on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**30 (Medium)**	**20 (Low)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Vehicles and equipment must be serviced regularly and maintained in a good running condition. Storage of contaminants must be limited to low quantities and done under strict industry standards. There must be strict control over the safe usage of vehicles and equipment to minimise vehicle accidents and damage to vehicles by rocks and boulders which may cause spillages. Clean the solar arrays with water only. The use of soaps or detergents should not be allowed.		
Cumulative Impacts: None		
Residual Impacts: Spillages of contaminants will have a long residual effect on the natural resources, specifically to the soil and vegetation, and possibly the underground water depending on the quantum of the spillage.		

Impact 2 Vegetation and grazing capacity

Nature: Contamination and degradation of the soil & vegetation due to spillages of oil, petrol, diesel and other contaminants used by vehicles and equipment on the site or stored on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**30 (Medium)**	**20 (Low)**
Status	Negative	Negative
Reversibility	Low	Low

Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Vehicles and equipment must be serviced regularly and maintained in a good running condition. Use of drip trays and spill kits. Storage of contaminants must be limited to low quantities and done under strict industry standards. There must be strict control over the safe usage of vehicles and equipment to minimise vehicle accidents and damage to vehicles by rocks and boulders which may cause spillages. Clean the solar arrays with water only. The use of soaps or detergents should not be allowed.		
Cumulative Impacts: None		
Residual Impacts: Spillages of contaminants will have a long residual effect on the natural resources, specifically to the soil and vegetation, and possibly the underground water depending on the quantum of the spillage.		

Impact 3 Underground water

Nature: Contamination and degradation of the soil due to spillages of oil, petrol, diesel and other contaminants used by vehicles and equipment on the site or stored on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Very improbable (1)
Significance	**20 (Medium)**	**10 (Low)**
Status	Negative	Negative
Reversibility	Unlikely	Unlikely
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Vehicles and equipment must be serviced regularly and maintained in a good running condition. Use of drip trays and spill kits. Storage of contaminants must be limited to low quantities and done under strict industry standards. There must be strict control over the safe usage of vehicles and equipment to minimise vehicle accidents and damage to vehicles by rocks and boulders which may cause spillages. Clean the solar arrays with water only. The use of soaps or detergents should not be allowed.		
Cumulative Impacts: None		
Residual Impacts: Spillages of contaminants will have a long residual effect on the natural resources, specifically to the soil and vegetation, and possibly the underground water depending on the quantum of the spillage.		

.

Impact 4: **Livestock production systems**

No impact expected.

7.5 Summary of identified impacts

Activity	Impact summary	Significance	Proposed mitigation
Alternative 1 (Option 1)			
PLANNING AND DESIGN PHASE			
Use of vehicles on the study site	**Direct impacts:**		
	Damage to roads and vegetation	Low	Use only existing roads
	Indirect impacts:		
	N/A		
	Cumulative impacts:		
	N/A		
CONSTRUCTION PHASE			
Site clearing and construction of development footprint infrastructure, i.e.; solar arrays, inverter/transformer enclosures, on-site substation, cabling between project components, internal access roads, fencing and workshop area for maintenance, storage and offices	**Direct impacts:**		
	Removal of vegetation and soil erosion	Medium	Care must be taken with the ground cover during and after construction on the site. If it is not possible to retain a good plant cover during construction, technologies should be employed to keep the soil covered by other means, i.e.; straw, mulch, erosion control mats, etc., until a healthy plant cover is established again. Care should also be taken to control and contain storm water runoff and not to concentrate its runoff, specifically under the solar arrays. Rehabilitate construction sites with indigenous grasses like *Eragrostis curvula, Digitaria eriantha, Panicum maximum* and *Chloris gayana* or mixtures thereof. It is also recommended that conservation practices similar to the conservation cultivation practiced in the area are employed with the arrangement of the PV arrays, i.e.; in strips of land on the contour of the land, with buffer zones of grass between the development strips and the channelling of

Activity	Impact summary	Significance	Proposed mitigation
			runoff water from the development strips into stable grass covered waterways or outlets (see paragraph 6.3). The development strips are not to be terraced (=levelled) as the soils are too shallow to allow for terracing. The width and length or the development strips and buffer strips, as well as the measurements and number of outlets are dependent upon the erodibility of the soils present, the slope and rainfall regime, and should be designed with the assistance of an agricultural engineer. Care should be taken to put gravel on access road surfaces to protect the soil against wind and water erosion. Cross mounds and other storm water dispersing and drainage techniques must be employed to decrease the speed and force of the storm water properly from road surfaces.
	Dust production and dust pollution	Low	Apply dust control measures, i.e.; water spraying.
	Interference with the day-to-day management of the grazing and livestock	Medium	When farming infrastructure, i.e.; fences, water pipelines, water troughs, etc., is removed or damaged, it should be replaced as soon as possible. Construction and other activities must be communicated and co-ordinated with the land owner to put him in a position to properly plan his management activities.
	Indirect impacts:		
	Loss of agricultural potential	Low	Stop soil erosion at the source and rehabilitate the vegetation on construction sites.
	Cumulative impacts:		

Activity	Impact summary	Significance	Proposed mitigation
	Siltation down stream	Medium	Stop soil erosion at the source (see above recommendations)
Use of potential contaminants on the site (i.e.; oil, petrol, diesel, etc.)	**Direct impacts:**		
	Contamination of the soil, underground water and vegetation	Medium	Vehicles and equipment must be serviced regularly and maintained in a good running condition. Use of drip trays and spill kits. Storage of contaminants must be limited to low quantities and done under strict industry standards. There must be strict control over the safe usage of vehicles and equipment to minimise vehicle accidents and damage to vehicles by rocks and boulders which may cause spillages.
	Indirect impacts:		
	N/A		
	Cumulative impacts:		
	N/A		
OPERATION PHASE			
Cleaning of solar arrays with water, detergents and soaps	**Direct impacts:**		
	Soil erosion	Low	Practice proper runoff control and ensure good vegetation cover of the soil
	Soil and water contamination	Low	Use water only for cleaning of solar arrays
	Indirect impacts:		
	Water and soil contamination downstream	Low	Use water only for cleaning of solar arrays
	Cumulative impacts:		
	Water and soil contamination	Low	Use water only for cleaning of solar arrays
Movement of vehicles and personnel to and on the site and the sub-station for maintenance purposes	**Direct impacts:**		
	Indirect impacts:		
	Cumulative impacts:		
DECOMMISSIONING AND CLOSURE PHASE			
	Direct impacts:		

Activity	Impact summary	Significance	Proposed mitigation
Disassemble footprint infrastructure	Removal of vegetation and soil erosion	Medium	Care must be taken with the ground cover during and after construction on the site. If it is not possible to retain a good plant cover during construction, technologies should be employed to keep the soil covered by other means, i.e.; straw, mulch, erosion control mats, etc., until a healthy plant cover is established again. Care should also be taken to control and contain storm water runoff and not to concentrate its runoff, specifically under the solar arrays. Rehabilitate construction sites with indigenous grasses like *Eragrostis curvula, Digitaria eriantha, Panicum maximum* and *Chloris gayana* or mixtures thereof.
	Dust production and dust pollution	Low	Apply dust control measures, i.e.; water spraying.
	Interference with the day-to-day management of the grazing and livestock	Medium	When farming infrastructure, i.e.; fences, water pipelines, water troughs, etc., is removed or damaged, it should be replaced as soon as possible. Construction and other activities must be communicated and co-ordinated with the land owner to put him in a position to properly plan his management activities.
	Indirect impacts:		
	N/A		
	Cumulative impacts:		
	Siltation of watercourses downstream	Low	Stop soil erosion at the source

7.6 Measures for inclusion in the draft environmental management programme

a) OBJECTIVE: Limit soil erosion		
Project component/s	Maintenance of soil cover, minimizing of storm water runoff concentration from roads, roofs and construction sites and the correct placement of footprint infrastructure	
Potential Impact	Increased water runoff, soil degradation due to water erosion and sediment generation	
Activity/risk source	Complete denudation of the soil, poor placement of the site and poor planning of storm water runoff control	
Mitigation: Target/Objective	Prevention and control of water erosion on the site Care must be taken with the ground cover during and after construction on the site. If it is not possible to retain a good plant cover during construction, technologies should be employed to keep the soil covered by other means, i.e.; straw, mulch, erosion control mats, etc., until a healthy plant cover is established again. Care should also be taken to control and contain storm water runoff and not to concentrate its runoff, specifically under the solar arrays. Rehabilitate construction sites with indigenous grasses like *Eragrostis curvula, Digitaria eriantha, Panicum maximum* and *Chloris gayana* or mixtures thereof. It is also recommended that conservation practices similar to the conservation cultivation practiced in the area are employed with the arrangement of the PV arrays, i.e.; in strips of land on the contour of the land, with buffer zones of grass between the development strips and the channelling of runoff water from the development strips into stable grass covered waterways or outlets (see paragraph 6.3). The development strips are not to be terraced (=levelled) as the soils are too shallow to allow for terracing. The width and length or the development strips and buffer strips, as well as the measurements and number of outlets are dependent upon the erodibility of the soils present, the slope and rainfall regime, and should be designed with the assistance of an agricultural engineer	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Plan and implement proper soil cover measures and storm water drainage mechanisms	Engineer and construction personnel	Duration of the construction phase
Performance Indicator	Minimum soil surface erosion Immediate action should be taken when negative impacts are experienced	
Monitoring	Monitor erosion rates and erosion sites on a weekly basis and after each storm water event.	

b) OBJECTIVE: Limit construction and vehicle impact on dust production and wind erosion	
Project component/s	Covering all access and construction routes with gravel Control of water runoff from road surfaces Proper placement of new roads

Potential Impact	Soil degradation due to increased wind erosion and dust production Soil degradation due to water erosion caused by poor water runoff control from roads		
Activity/risk source	Poor road construction and maintenance		
Mitigation: Target/Objective	Proper road construction and maintenance Apply dust control measures		
Mitigation: Action/control		**Responsibility**	**Timeframe**
Plan and implement proper soil cover measures and storm water drainage mechanisms		Engineer and construction personnel	Duration of the project
Performance Indicator	Minimum dust formation and water erosion along roadsides and construction sites Immediate action should be taken when negative impacts are experienced		
Monitoring	Monitor roads and construction sites on a regular basis		

c) OBJECTIVE: Prevent contamination of the soil, vegetation and underground water by oil, diesel, petrol and other contaminants use by vehicles and construction equipment			
Project component/s	Preventing spills of contaminants on any part of the site		
Potential Impact	Contamination of soil, vegetation and underground water		
Activity/risk source	Vehicles and construction equipment on the site		
Mitigation: Target/Objective	Vehicles and equipment must be serviced regularly and maintained in a good running condition. Vehicles must be fitted with spill skills. Storage of contaminants must be limited to low quantities and done under strict industry standards. There must be strict control over the safe usage of vehicles and equipment to minimise vehicle accidents and damage to vehicles by rocks and boulders which may cause spillages. Contingency plans must be in place to deal with spillages. The solar arrays should only be cleaned with water and soaps and detergents should not be allowed.		
Mitigation: Action/control		**Responsibility**	**Timeframe**
Plan and implement proper usage and maintenance of vehicle and construction equipment. Plan and document contingency plans and train personal to contain spillages when and where they take place. Keep quantity of contaminants stored on the site to a minimum. Use of drip trays and spill kits.		Engineer and construction personnel	Duration of the construction phase
Performance Indicator	Zero spillages of contaminants Immediate action should be taken when spillages take place to contain damage to agricultural resources		

Monitoring	Monitor contaminants storage facilities and the condition and maintenance of vehicles/equipment on a regular basis

8. SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

8.1 The prevailing climatic conditions over the study area makes is suitable for dryland cultivation, with maize and sunflower the primary crops which can be produced.

8.2 The study area is dominated by duplex, vertic and melanic soils. The clay contents are high and the soils are relatively shallow which put them in a category of "**marginal potential arable land - not suitable for cultivation**". Therefore, although the climate is suited for dryland cultivation, the soils are not. There are a few lands on the study area. They are clayey and shallow and should never have been ploughed. They should preferably be taken out of cultivation and be established with perennial grasses to be used for grazing purposes. The lands on the study area are **not** to be regarded as No-Go areas due to its low production potential and none are situated within the proposed development footprint.

8.3 The duplex, vertic and melanic soils present on the study area are prone to crusting and are highly erodible. The specific rainfall regime over the study area with the incidence of high intensity thunderstorms of 125mm to 150mm rainfall on a single day increases the erosion hazard over the study area. Nevertheless, little soil erosion is actually prevalent in the study area. This is ascribed to the good vegetation cover of the veld and the conservation cultivation practised on the cultivated lands. It is therefore concluded that the two most important factors to be taken into account to minimize the soil erosion hazard are (i) to maintain a healthy soil cover between the solar arrays, specifically a good grass cover, and (ii) to employ conservation practices similar to the conservation cultivation when planning the arrangement of the PV arrays, i.e.;; in strips of land on the contour of the land, with buffer zones of grass between the development strips and the channelling of runoff water from the development strips into stable grass covered waterways or outlets.

8.4 The slope of the study area is less than 5% and is therefore not an impediment to the development of the site as a PV Solar energy facility.

8.5 There are several drainage lines on the study area, which should be avoided when deciding on the final placement of the chosen PV Solar site locality. One of the drainage lines starts within the footprint of the proposed PV-site. It is recommended that this site should be moved slightly to the outside of this drainage line.

8.6 There are fences on the study area, as well as two windmills and three water reservoirs. None of this infrastructure is situated within the footprint of the site to be developed.

There are contour strips present on the lands. None of them will be interfered with.

Apart from the above infrastructure there are no other agricultural important infrastructure, i.e.; silos, irrigation lines, irrigation centre pivot points, channels and feeding structures that will be interfered with on the study area.

8.7 The best agricultural use for the study area is livestock farming with beef cattle, where the grazing takes place on the veld and lands established with perennial planted pastures.

The current veld grazing capacity of the study area is estimated at 5 ha/LSU. A ~30ha PV Energy site can therefore carry ~6 large stock units (LSU's) or 4 medium framed beef cows, which is negligible in terms of agricultural production and/or food security.

The size of the land type in which the study area is located is 366 057ha. The ~30ha proposed PV Energy site is therefore negligible in terms of agricultural production in the region and nationally.

8.8 The study area does not consist of unique agricultural land and its conservation status is regarded as vulnerable.

8.9 The development of the ~30ha sites is supported provided the proposed Environmental Management Program is followed.

9. REFERENCES

ACOCKS, J.P.H., 1988. *Veld types of South Africa*. Mem. of the Bot. Survey of SA. No. 57, Bot. Res. Inst., Dept. Agriculture & Water Supply, South Africa.

DEPARTMENT AGRICULTURE, FORESTRY & FISHERIES, 2010. Regulations for the evaluation and review of applications pertaining to wind farming on agricultural land. Unpublished report – November 2010.

FEY, M. 2010. *Soils of South Africa. Their distribution, properties, classification, genesis, use and environmental significance*. Cambridge University Press.

LAND TYPE SURVEY STAFF, 1976 - 2006. *Land Types of South Africa*. ARC-Institute for Soil, Climate & Water, Pretoria.

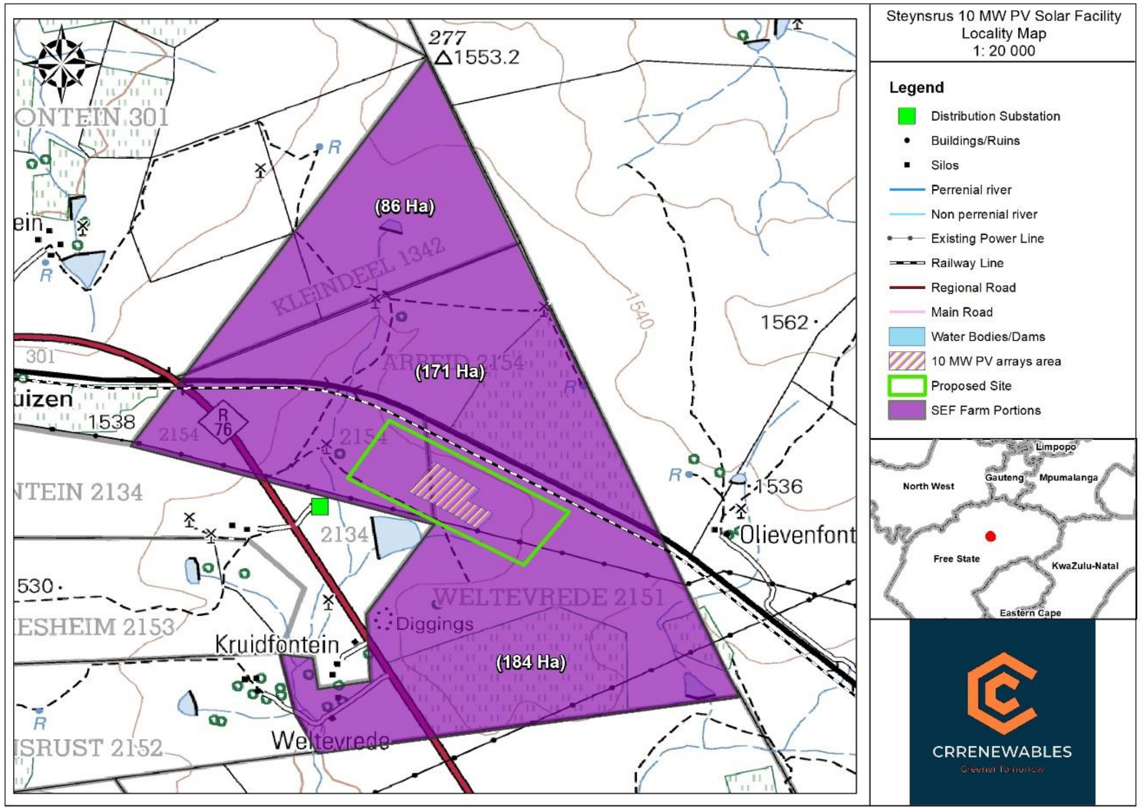
MACVICAR, C.N., et al. 1977. *Soil Classification – A binomial system for South Africa.* Res. Inst. for Soil & Irr., Dept. Agriculture Tech Services, South Africa.

MACVICAR, C.N., et al. 1991. *Soil Classification – A taxonomic system for South Africa.* Mem. Agric. Nat. Resources of Sth. Afr. No. 15. Inst. Soil, Climate & Water, Pretoria.

MUCINA L. & RUTHERFORD M.C. (EDS) 2006. *The Vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

SCHULZE, B.R., 1980. *Climate of South Africa – General Survey*. Weather Bureau, Dept. Transport, South Africa.

Appendix 1 Locality map of the proposed Steynsrus PV Solar Energy Facility (10MW)

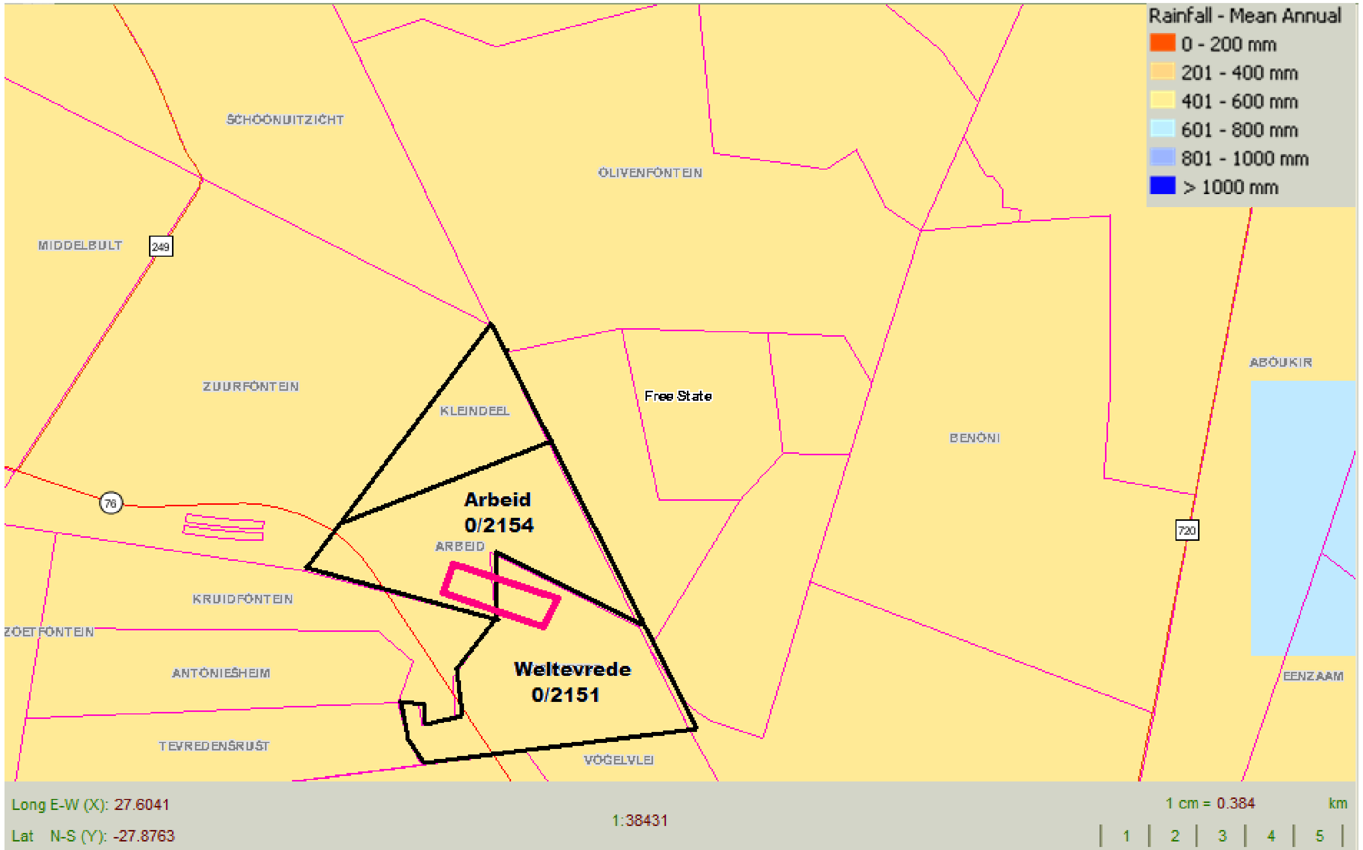


APPENDIX 2 Compendium of the agricultural characteristics of the study area of the proposed Steynsrus PV Solar Energy Facility of 10MW

Land Types Expected (Land Type Survey Staff, 1976 - 2006; Agis Website, Dept. Agric., Forestry & Fisheries - www.agis.agric.za)	Dc10
Area covered by Land Types Expected	366 057ha
Most prominent plant species expected (Acocks, 1988; Mucina & Rutherford, 2006)	*Themeda triandra, Eragrostis curvula, Eragrostis chloromelas, dwarf Karoo shrubs, Acacia karoo*
Climatic Region (Schultze, 1980) Dept. Agric. Dev., 1991)	Highveld (H)
Average Rainfall (mm per annum) (Schulze, 1980; Mucina & Rutherford, 2006)	590mm
Main Rainfall Season (Schulze, 1980)	January
Average Annual Temperature (°C) (Schulze, 1980)	15 – 17,5
Prevalence of Snowfalls (Schulze, 1980)	Irregular
Geology Expected (Land Type Survey Staff, 1976 - 2006; Dept. Agric., Forestry & Fisheries - www.agis.agric.za; Mucina & Rutherford, 2006)	Primarily Adelaide and Tarkastad Subgroups mudstone, shale and sandstone, with Burgersdorp Formation mudstone, shale and sandstone present in the south east, and Ecca shale, mudstone, sandstone and grit in the far north. Dolerite sills are common, with crests and scarps on dolerite or sandstone.
General Soil Patterns Expected (Dept. Agric. Dev., 1991; Agis Website, Dept. Agric., Forestry & Fisheries - www.agis.agric.za)	Soils with a marked clay accumulation, strongly structured and a non-reddish colour Duplex soils with either prismacutanic and/or pedocutanic diagnostic horizons dominant, while one or more vertic, melanic or red structured diagnostic horizons may be prevalent
Soil Forms Expected (Land Type Survey Staff, 1976 - 2006; MacVicar, et al, 1977; Agis Website, Dept. Agric., Forestry & Fisheries – www.agis.agric.za)	Arcadia, Rensburg, Swartland, Valsrivier, Dundee, Kroonstad, Milkwood, Mayo, Sterkspruit, Mispah, Glenrosa, Oakleaf, Shortlands, Estcourt, Inhoek
Susceptibility of Soils to Water Erosion (Agis Website, Dept. Agric., Forestry & Fisheries – www.agis.agric.za)	Land with low to moderate water erosion susceptibility Some soils occurring on the site may have a high water erosion hazard
Susceptibility of Soils to Wind Erosion (Agis Website, Dept. Agric., Forestry & Fisheries – www.agis.agric.za)	Somewhat susceptible
Veld Type (Acocks, 1988) **Biome** (Mucina & Rutherford, 2006	Veld Type 49 (Transitional *Cymbopogon – Themeda* Veld) Biome Gh6 (Dry Highveld Grassland)
Grazing Capacity (ha/LSU) (Agis Website, Dept. Agric., Forestry & Fisheries – www.agis.agric.za)	8 – 10
Best Agricultural Use	Mixed farming with crop production on high potential lands and grazing with beef cattle on marginal lands established with planted pastures and on veld

Appendix 3 Mean annual rainfall

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



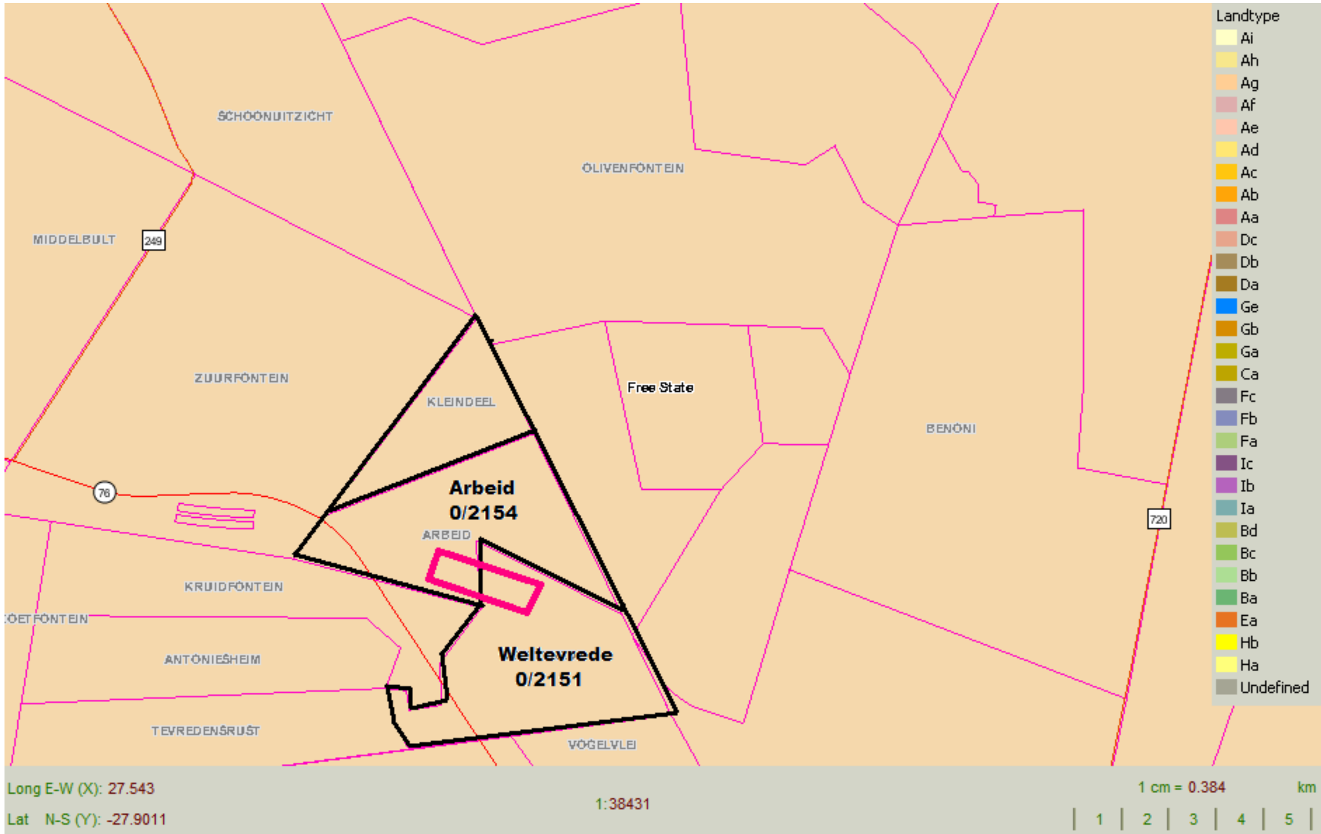
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 4 Land Types

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



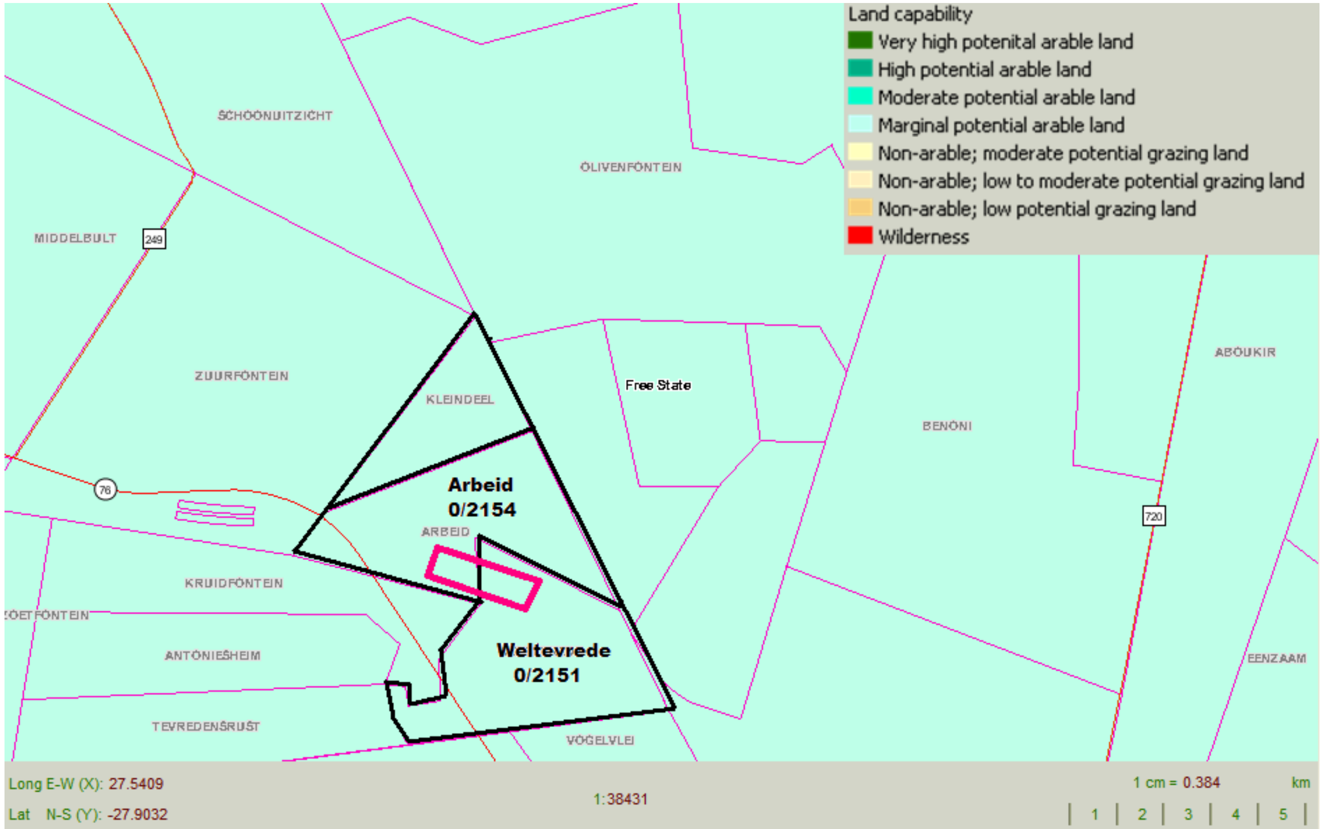
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 5 Land capability

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



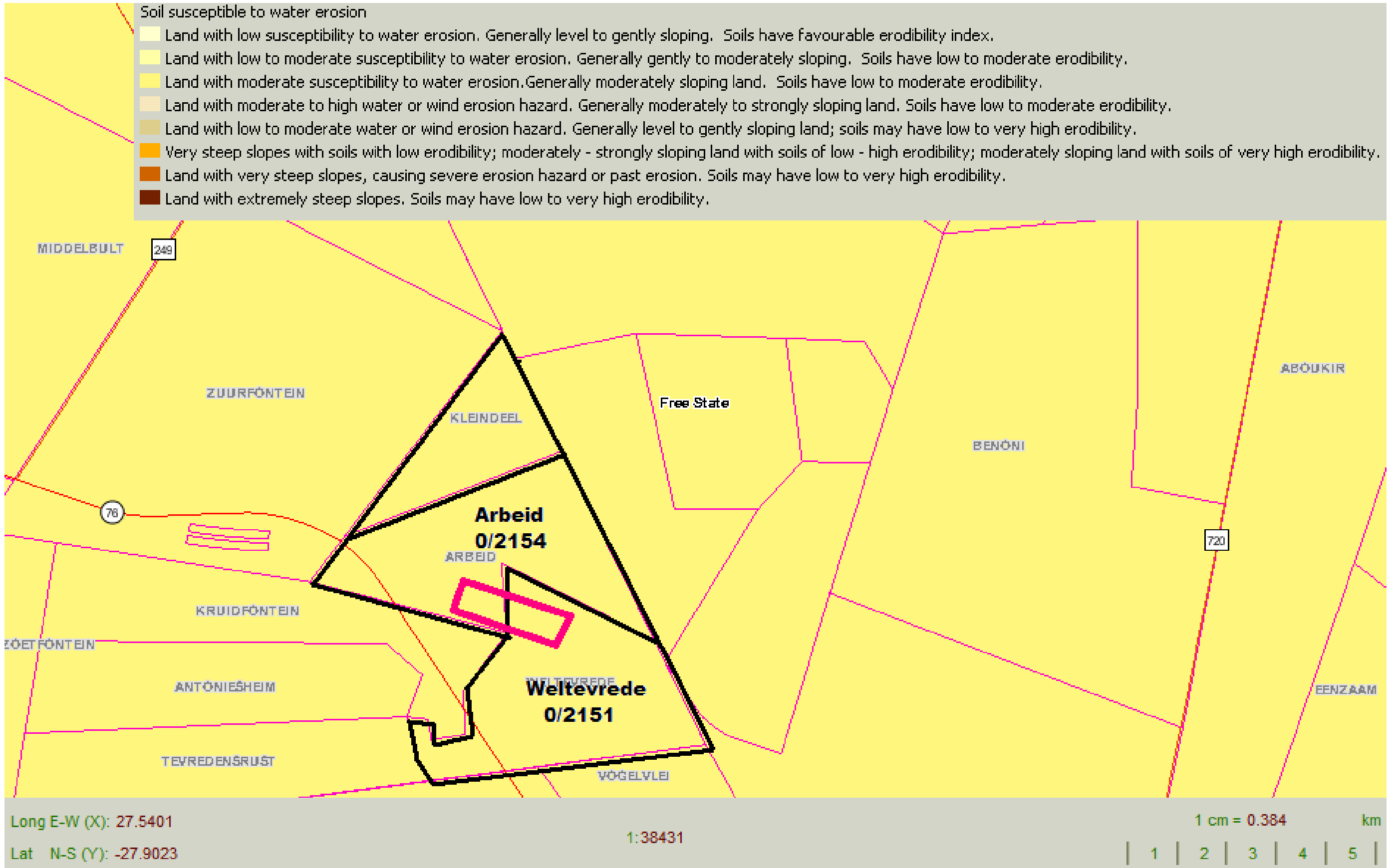
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 6 Soil susceptibility to water erosion

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



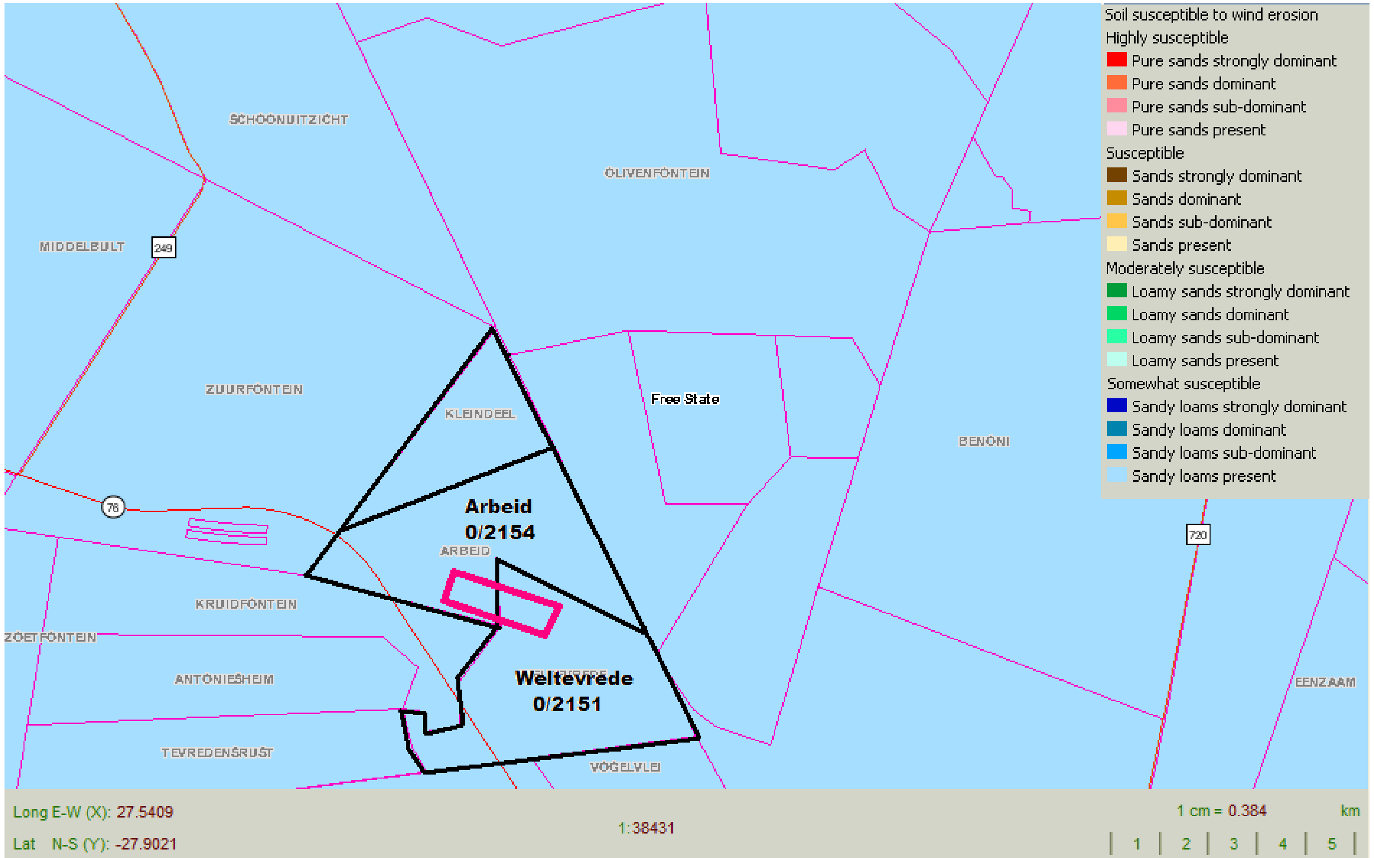
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 7 Soil susceptibility to wind erosion

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



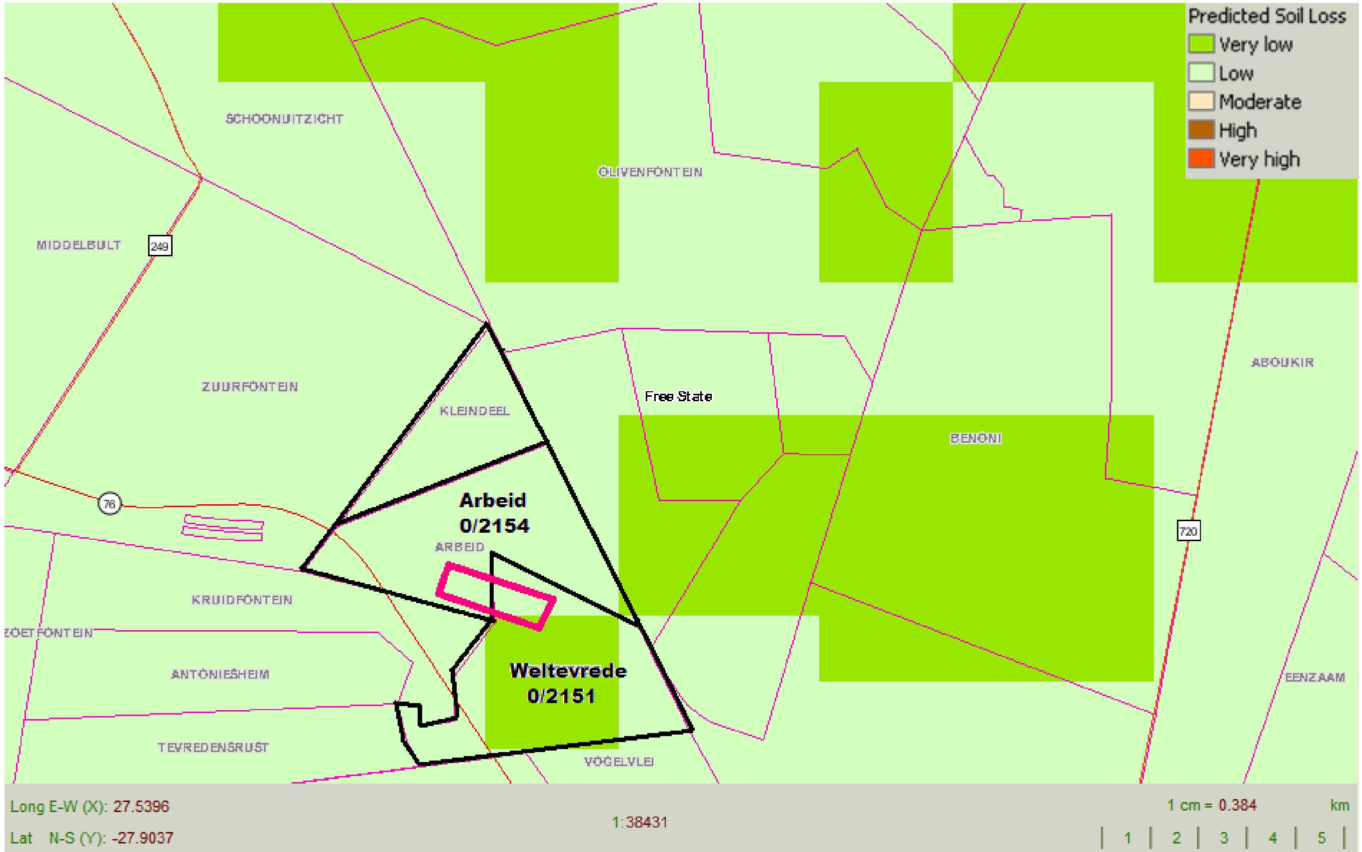
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 8 Predicted soil loss

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



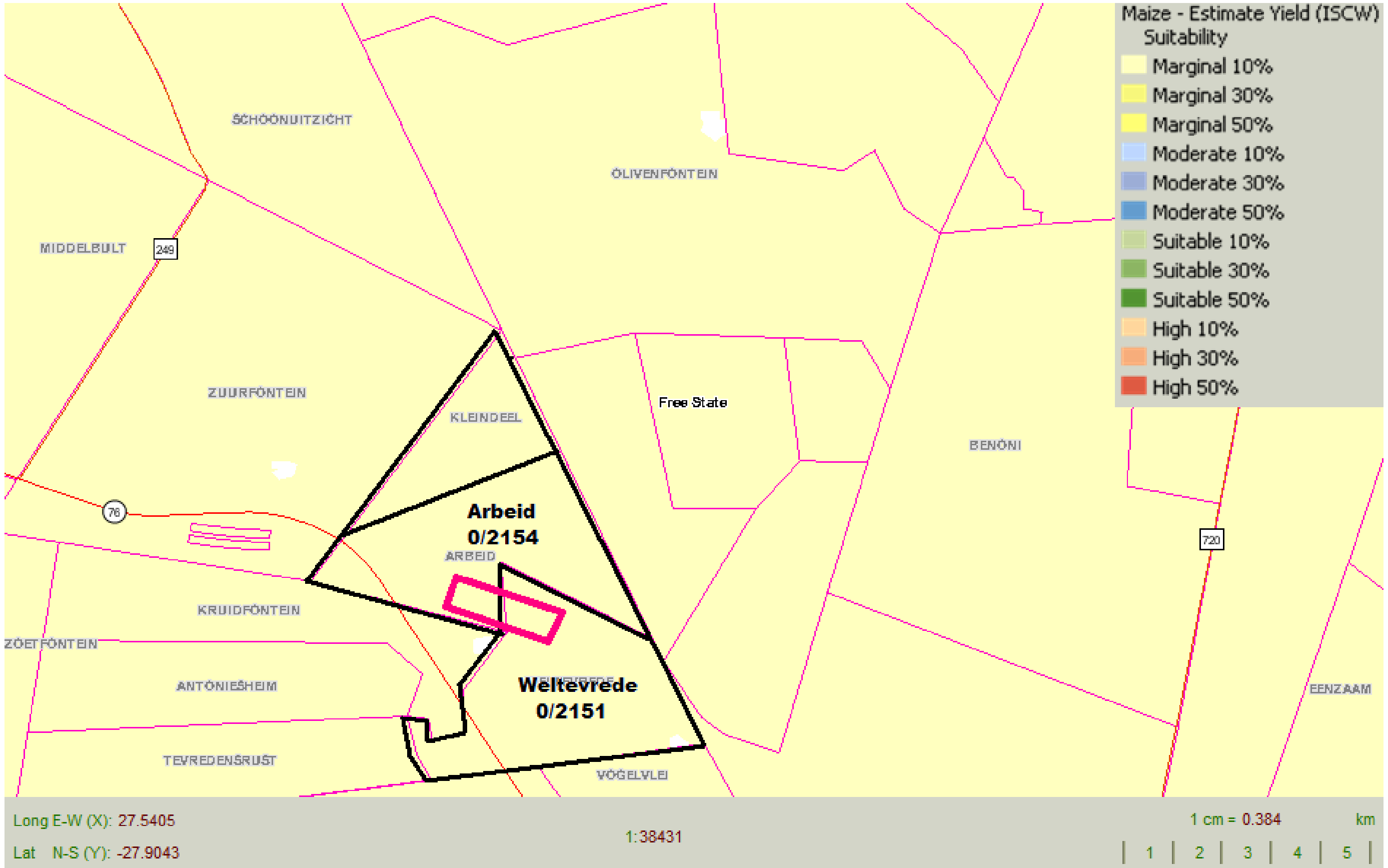
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 9 Maize estimated yield

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



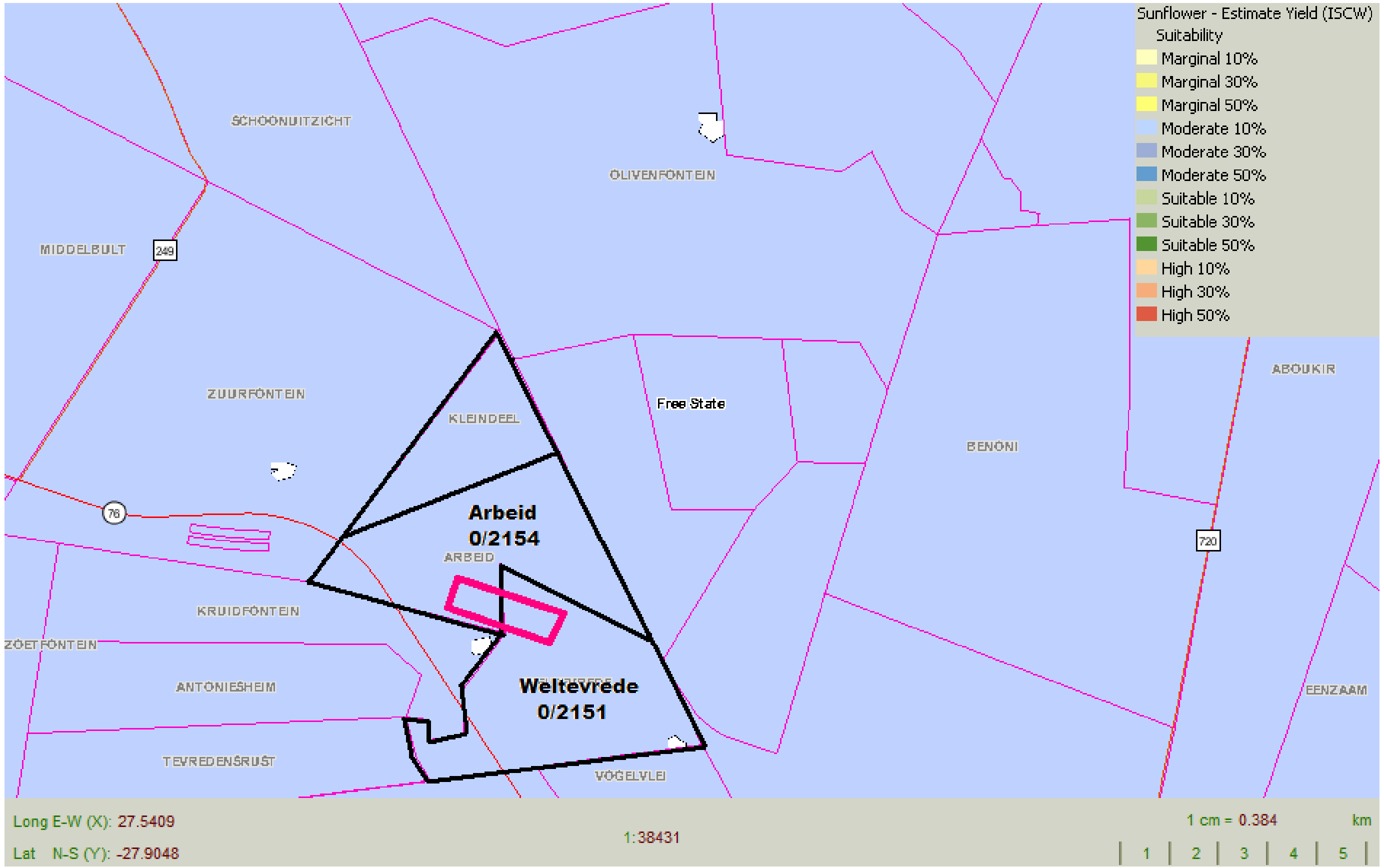
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 10 Sunflower estimated yield

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



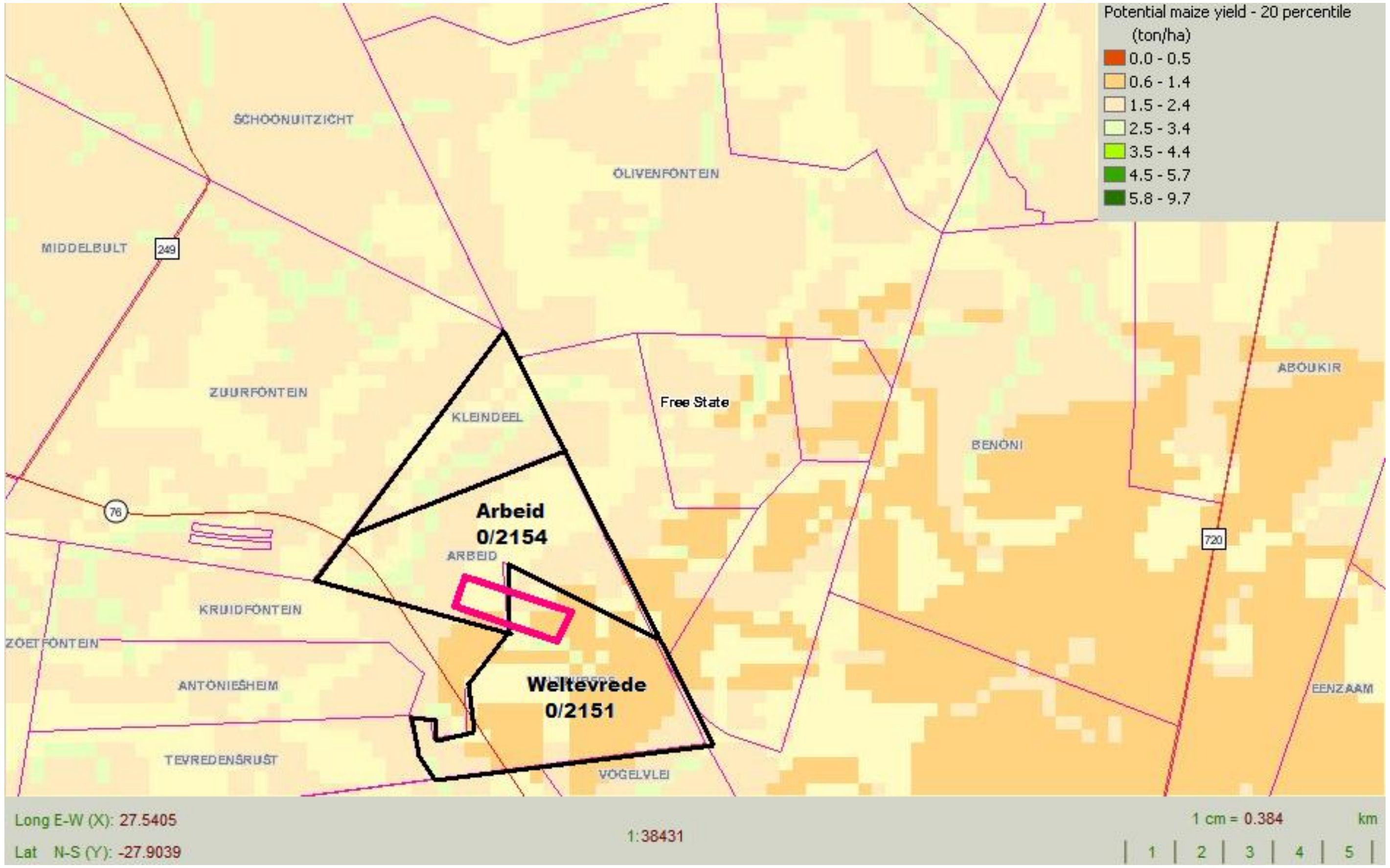
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 11 Predicted maize yield (20 percentile)

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



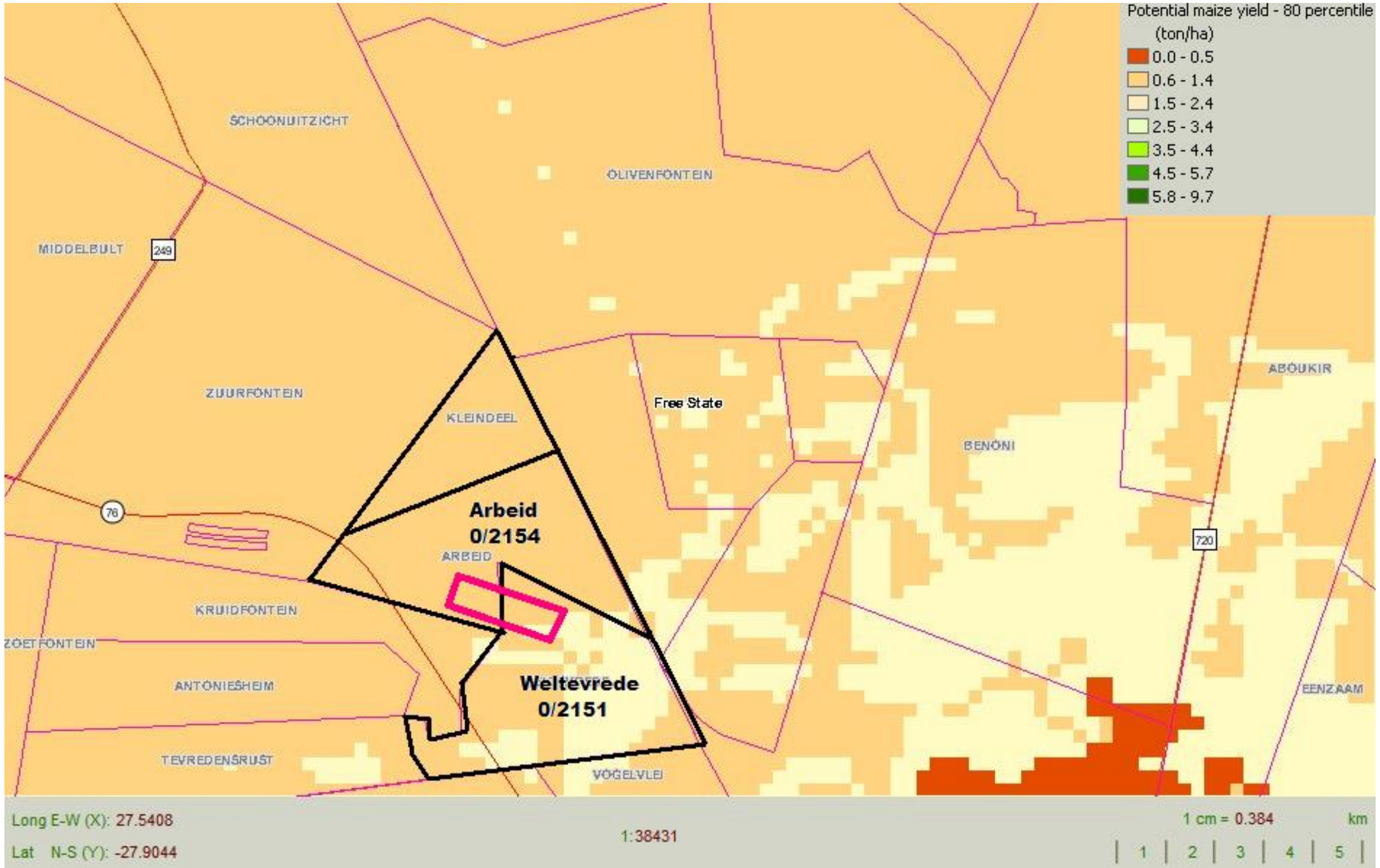
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 12 Predicted maize yield (80 percentile)

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



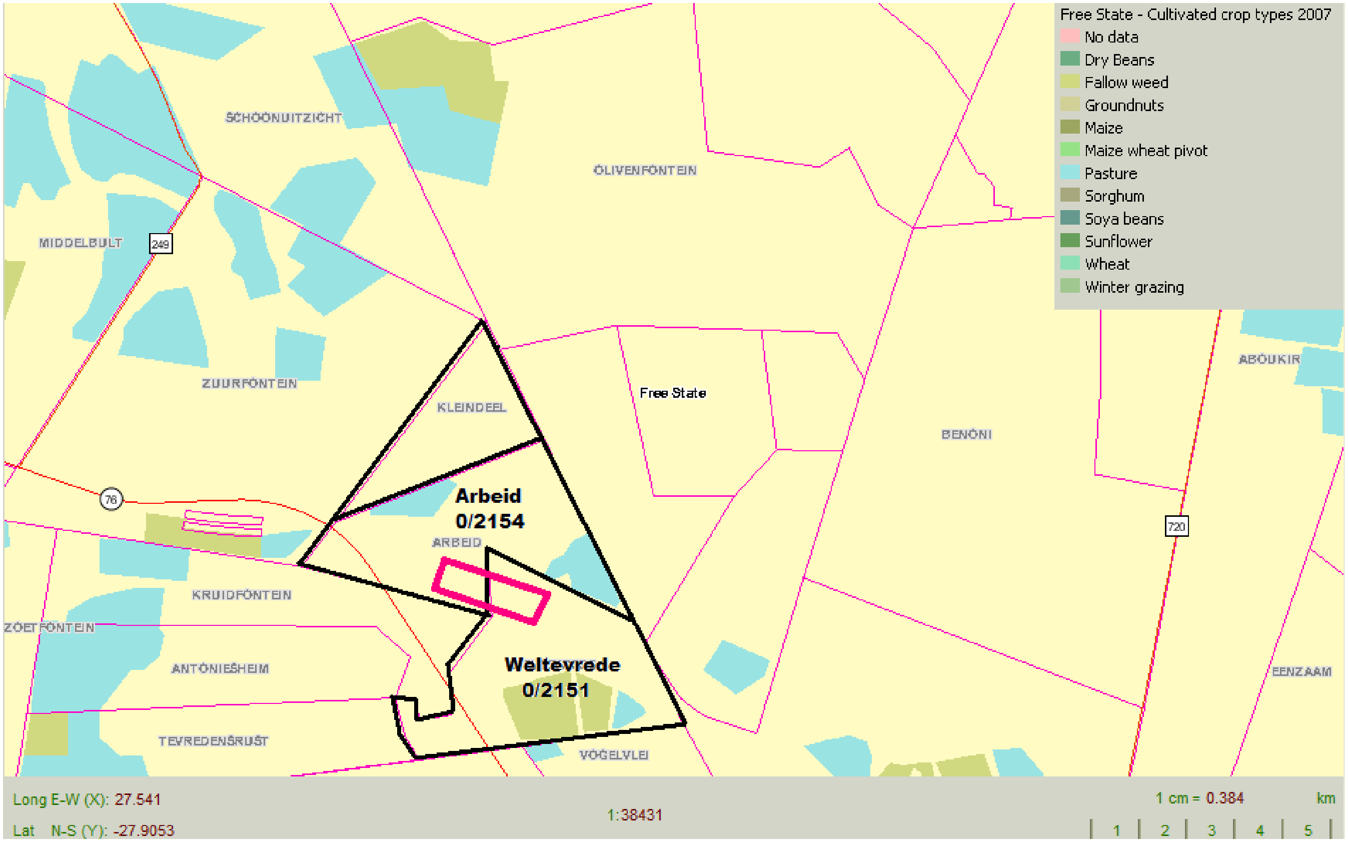
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 13 Crops cultivated on lands

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



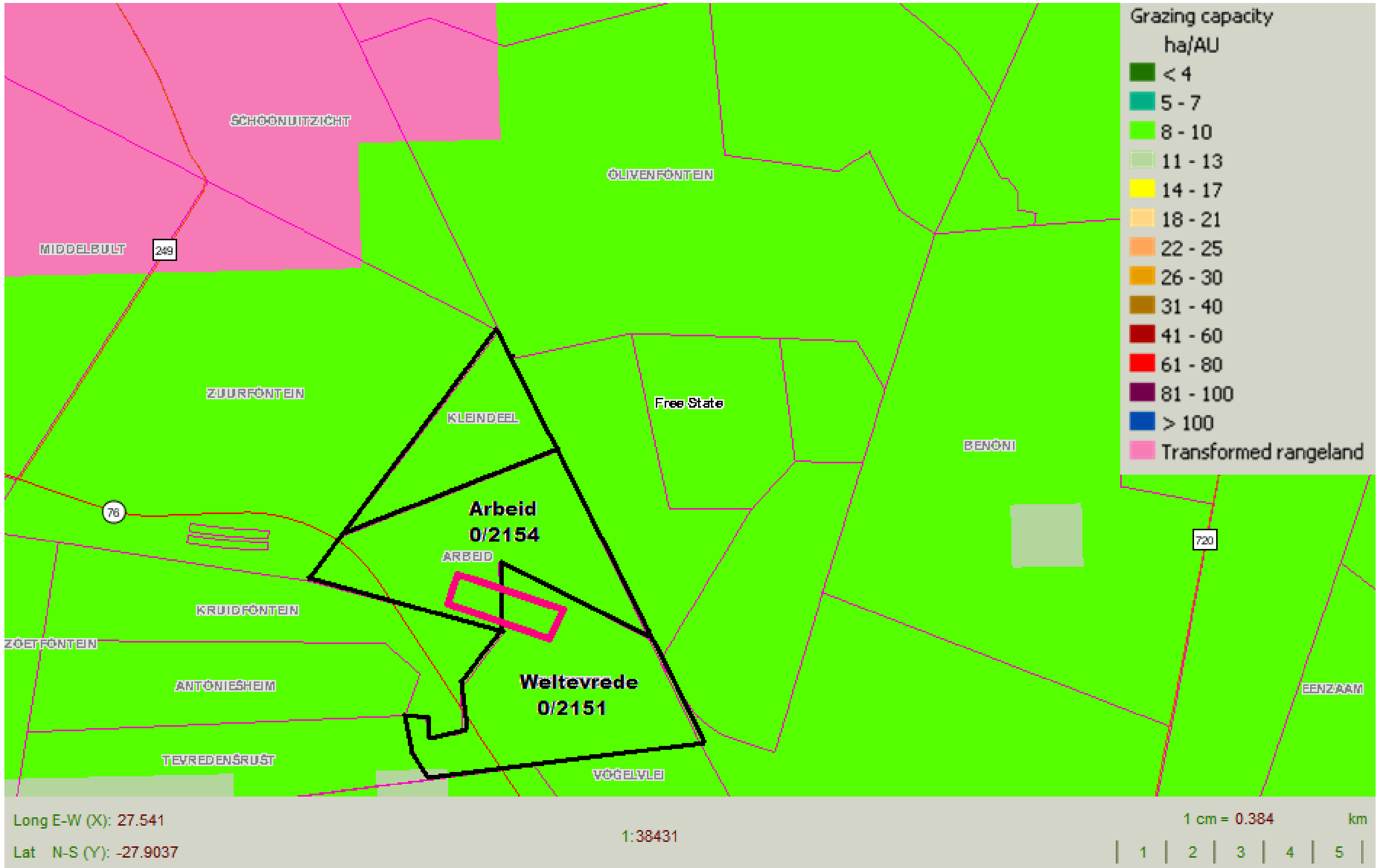
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 14 Grazing capacity

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



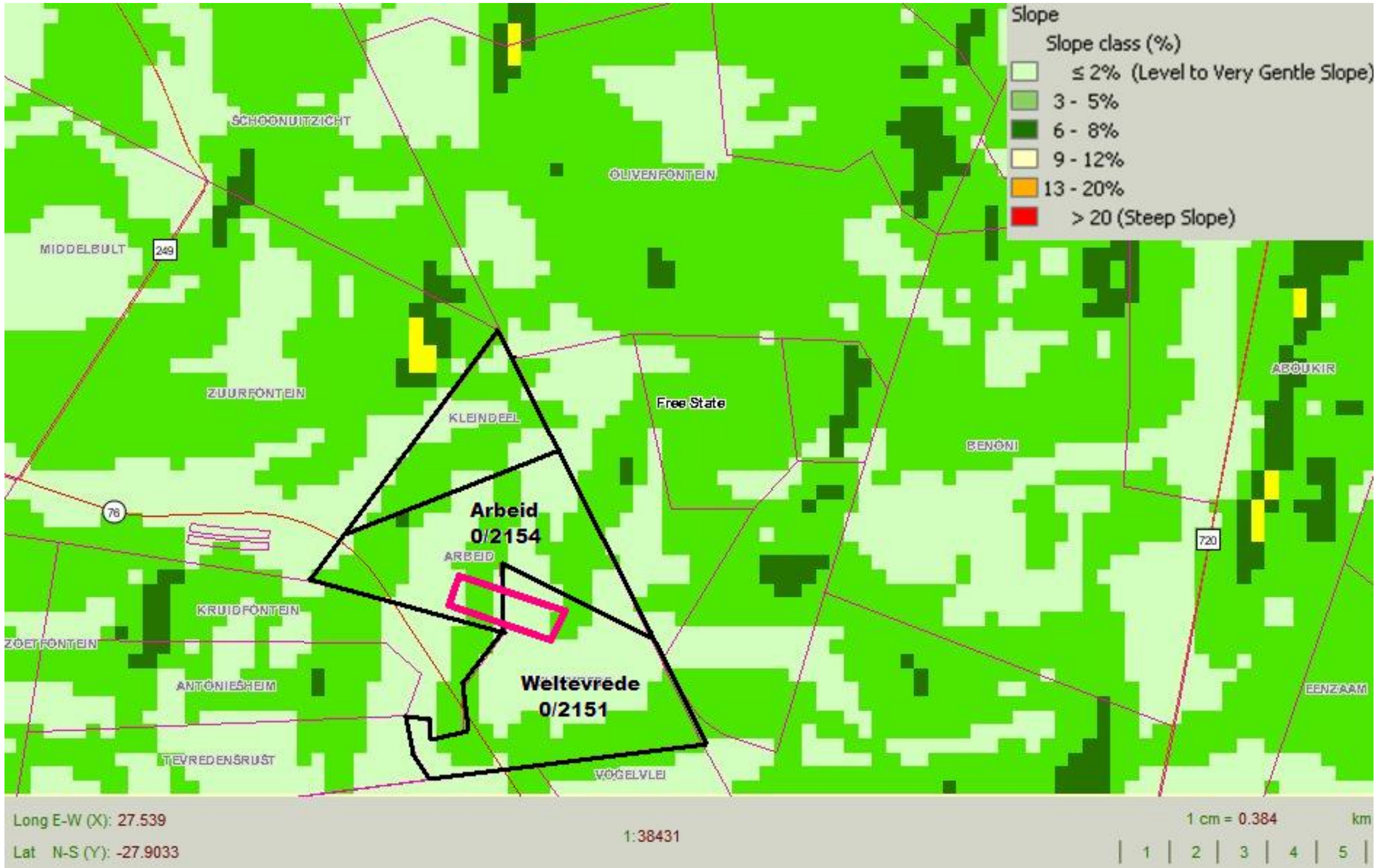
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 15 Slope

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



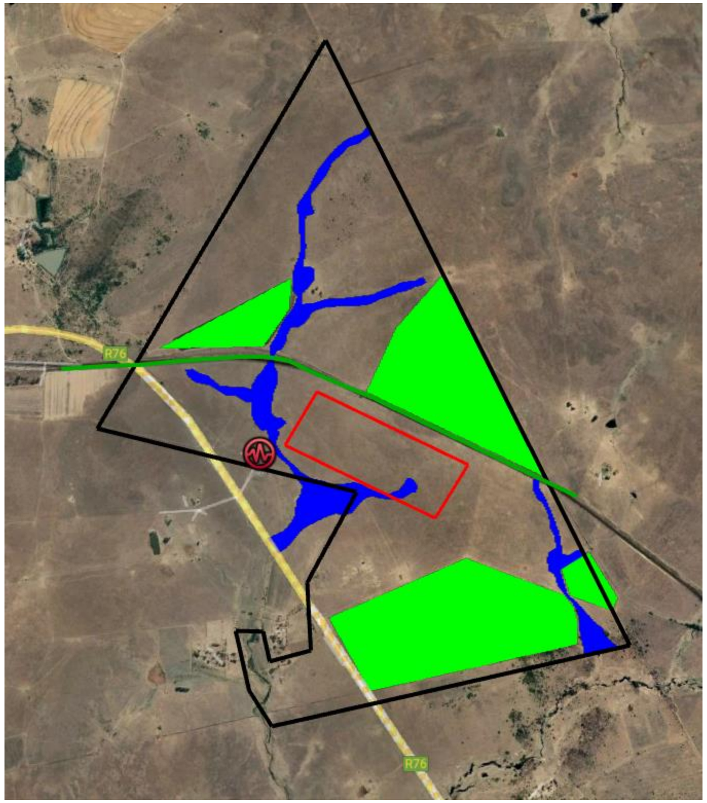
Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778

Appendix 16 Crop field boundaries and drainage lines

Source: Google Earth



Steynsrus PV Solar Energy Facility Study Area

Proposed PV Site
Lands
Drainage Lines
Sub-station

Dr L G du Pisani
P O Box 641
BETLEHEM
9700
082-773 9778