AURECON SOUTH AFRICA

Proposed Solar Energy Facility on Farm Klipgats Pan, Near Copperton, Northern Cape

Desktop Agricultural Assessment for Site PV 4, Klipgats Pan

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Declaration

I, Kurt Barichievy, declare that I –

- act as an independent specialist consultant in the fields of Soil Science and Agricultural Potential for the **Desktop Agricultural Assessment for the Proposed Solar Energy Facility near Copperton, Northern Cape (PV4 Klipgats Pan)**;
- 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
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AURECON SOUTH AFRICA

PROPOSED SOLAR ENERGY FACILITY: KLIPGATS PAN (PV4)

DESKTOP AGRICULTURAL ASSESSMENT

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1 INTRODUCTION

Aurecon South Africa (Pty) Ltd (Aurecon) on behalf of Mulilo Renewable Energy (Pty) Ltd (Mulilo) requested a desktop agricultural assessment for the area affected by the proposed solar energy facility on the Farm Klipgats Pan, near the town of Copperton, in the Northern Cape Province. The primary objective of this assessment is to provide specialist agricultural, soil and land use input for the overarching Environmental Assessment Report. In order to achieve this objective a study of the climate, soils, terrain, aspect, land capability, geology and current agricultural practices was carried out. This report serves to summarise such a study and present the relevant results.

The proposed project (preferred alternative) includes the construction of 100 MW photovoltaic (PV) plant on the farm Klipgats Pan (Remainder of No. 146) (**Figure 1**). An alternative 100 MW site to the south of the R357 is also being considered within this application. The Klipgats Pan Farm is approximately 2 620 ha in size and is split into two portions by the R357. The preferred and alternative 100 MW plants would have a footprint of 300 ha and connect to the Kronos substation by means of a new 132 kV transmission line (**Aurecon**, **2011**).Klipgats Pan Farm is located south of Copperton, and is used as grazing land for livestock (**Figure 2**). It is hoped that this assessment, along with the other specialist studies, will inform the solar field positioning and transmission line routing process and thus minimise the predicted impacts on the receiving environment.

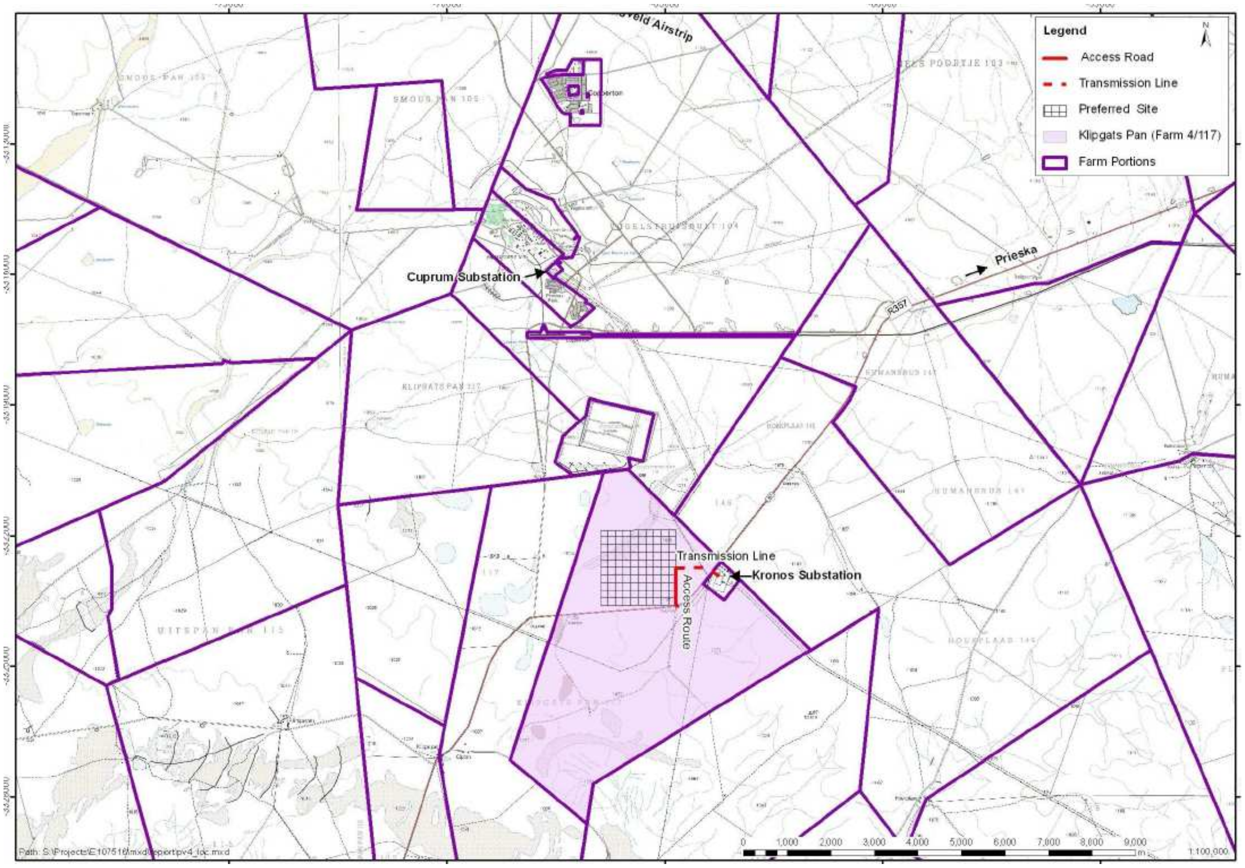

Figure 1: Locality Map for Klipgats Pan (PV 4) (**Source: Aurecon, 2011**)

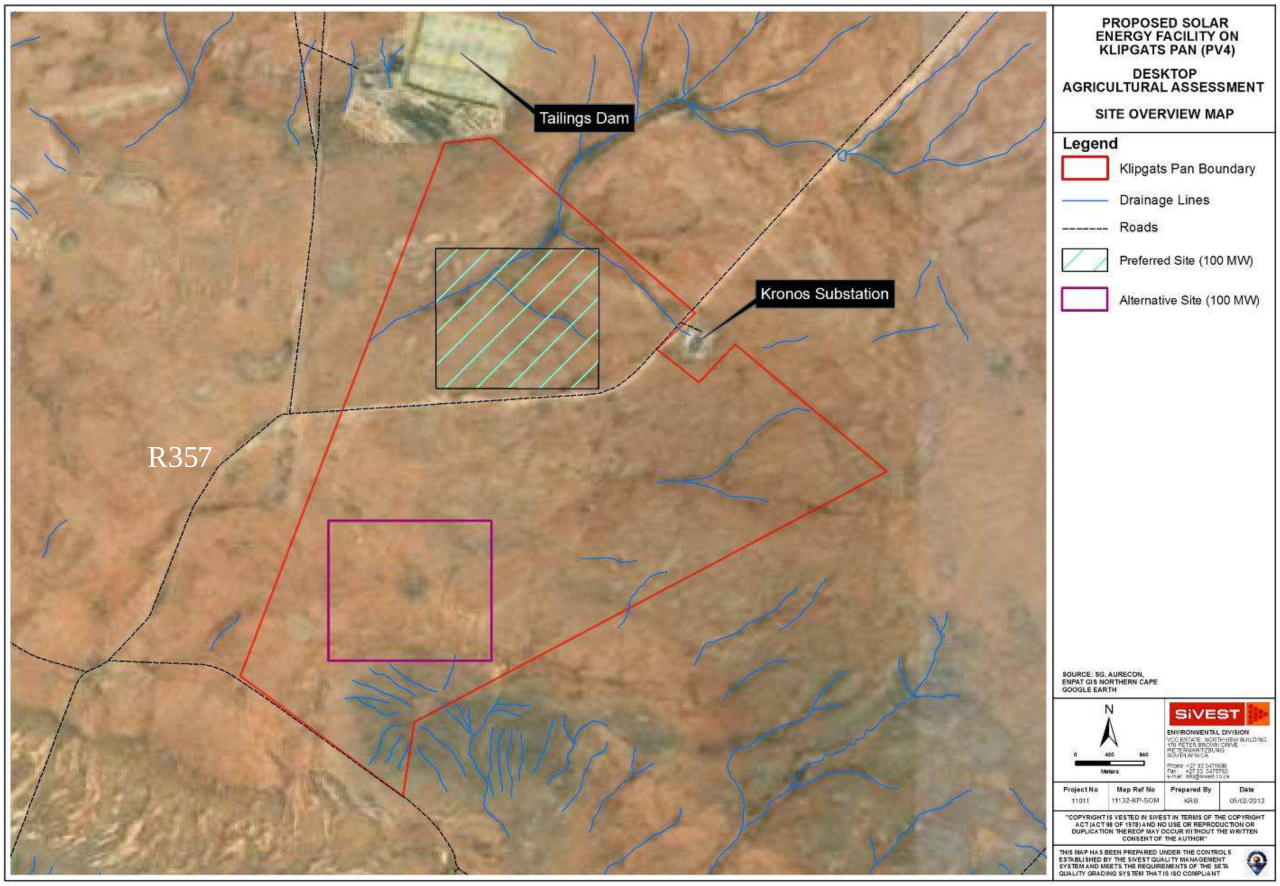

Figure 2: Site Overview Map for Klipgats Pan showing existing roads and drainage lines

1.1 Study Objectives

1.1.1 Compile a detailed desktop 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, and in most cases this potential is benchmarked against crop production. Thus the objective of this desktop study is to broadly assess the agricultural potential of the affected land by interrogating relevant climate, topographic, landuse and soil datasets. By combining these relevant data sets one is able to broadly assess the agricultural potential of the affected land.

The terms of reference for the study were as follows:

- Compile a detailed desktop assessment for the proposed development areas;
- Broadly assess the soil and agricultural potential of the sites and receiving environment by interrogating relevant spatial and numerical climate, topographic, land use and soil datasets;
- Identify major soil and agricultural impacts related to the proposed developments; and
- Recommend whether a full agricultural impact assessment would be required.

1.1.2 Undertake an agricultural constraint analysis and initial impact assessment

The constraint analysis utilises the desktop to indicate, from an agricultural perspective, any potential fatal flaws which could result from the proposed activities. This section will outline predicted impacts on agricultural resources, highlight problematic areas and specify 'no-go zones'.

1.2 Assumptions and Limitations

This desktop assessment is used to identify any major agricultural impacts relating to the proposed development. It should be clearly noted that, since the spatial information used in portions of this report is of a reconnaissance nature, only broad/large scale climate, land use and soil details are provided.

2 DESCRIPTION OF PROPOSED ACTIVITIES AND TECHNICAL DETAILS

The technical details provided in this section are primarily extracted from the Draft Scoping Report produced by Aurecon (**2011**) .

Mulilo proposes to construct a PV plant to generate approximately 100 MW (both alternatives) on the farm Klipgats Pan (Portion 4 of Farm No. 117). The proposed PV alternative plants would cover an area of approximately 300 ha, which is currently used for livestock grazing.

In terms of associated infrastructure, the following would be required:

- Upgrade of existing internal farm roads and construction of new roads to accommodate the construction vehicles and access the site.
- Construction of a 132 kV transmission line to connect the proposed PV plant with Eskom's grid via the Kronos substation.
- Electrical fence to prevent illegal trespassing, as well as keeping livestock from roaming between the solar arrays and causing accidental damage.
- Other infrastructure includes an office, connection centre and a guard cabin.

The proposed PV plant would convert shortwave radiation (sunlight) directly into electricity via cells through a process known as the PV Effect. The PV cells are made of silicone which acts as a semi-conductor. The cells absorb light energy which energises the electrons to produce electricity. Individual solar cells can be connected and packed into standard modules behind a glass sheet to protect the cells from the environment while obtaining desired currents and voltages. These modules are grouped together to form a panel and can last up to 25 years due to the immobility of parts, as well as the sturdiness of the structure. However, the Power Purchase Agreement (PPA) is only valid for a period of 20 years after which the plant would most likely be decommissioned and the site rehabilitated.

Grid-connected PV Power Systems (PVPS) are made up of a variety of components, which aside from the PV modules, include conductors, fuses, disconnect controls, trackers, and power conditioning units (i.e. inverters). The PVPS requires transmission infrastructure to feed electricity into the grid, unlike the Stand-alone PV Power System that requires batteries to store electricity for use later. The electricity is generated from solar energy which is transformed by the PV modules (arranged in arrays). The maximum power point tracker (MPPT) ensures that power coming from the PVs are maximised by determining the current that the inverter should draw from the PV panel. The inverter converts the direct current (DC) to an alternating current (AC) to allow the electricity to be fed into the grid. **Figure 3,** below illustrates the components of the process of generating electricity from solar energy (sun) (**Aurecon, 2011**).

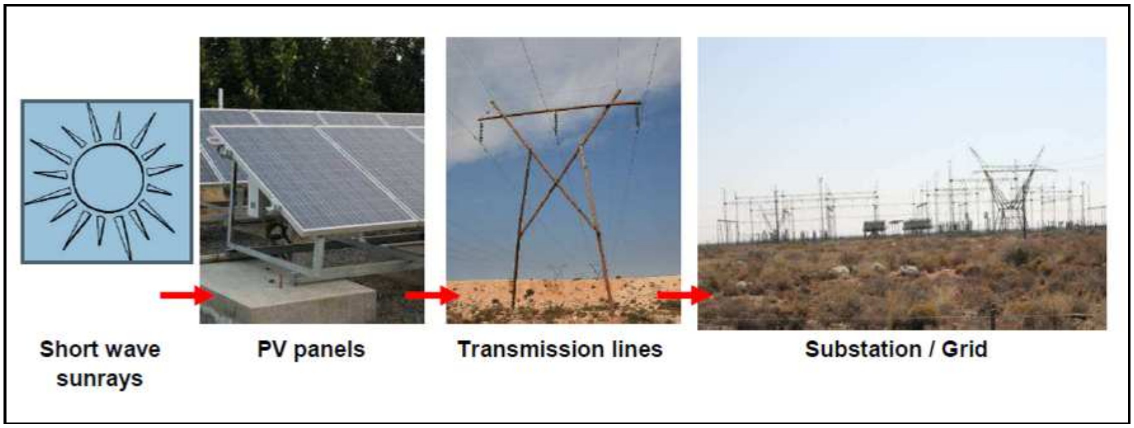

Figure 3: Basic PV system layout (**Aurecon, 2011**)

3 DESKTOP AGRICULTURAL ASSESSMENT

The objective of the desktop agricultural assessment is to provide broad soil and agriculturally related characteristics of the study area. In order to ascertain these characteristics relevant climate, topographic, landuse and soil datasets were sourced and interrogated.

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. By combining the aforementioned data sources one is able to broadly assess the site alternatives, receiving environment, and its ability to accept change, in the form of development. More agriculturally relevant spatial information was obtained from the AGIS Database.

3.1 Climate

The study area has an arid continental climate with a summer rainfall regime i.e. most of the rainfall is confined to summer and early autumn. The rainfall data for the study area was sourced from the Daily Rainfall Extraction Utility (**Lynch, 2003**). This utility is essentially a database which contains long term rainfall records from 11 269 South African rainfall stations. According to this database the Mean

Annual Precipitation (MAP) for the project area is approximately 176 mm per year with 62% of this falling between January and April (**Figure 4**).

An MAP of 176 mm is deemed extremely low as 500mm is considered the minimum amount of rain required for sustainable dry land farming (**Smith, 2006**) (**Figure 5**). Thus without some form of supplementary irrigation natural rainfall for the study area is insufficient to produce sustainable harvests. The low rainfall is reflected in the lack of dry land crop production within the study area. The region typically experiences hot days and cold nights with the average summer temperature of approximately 33 ^{o}C and average winter night time temperature of approximately 1 ^{o}C.

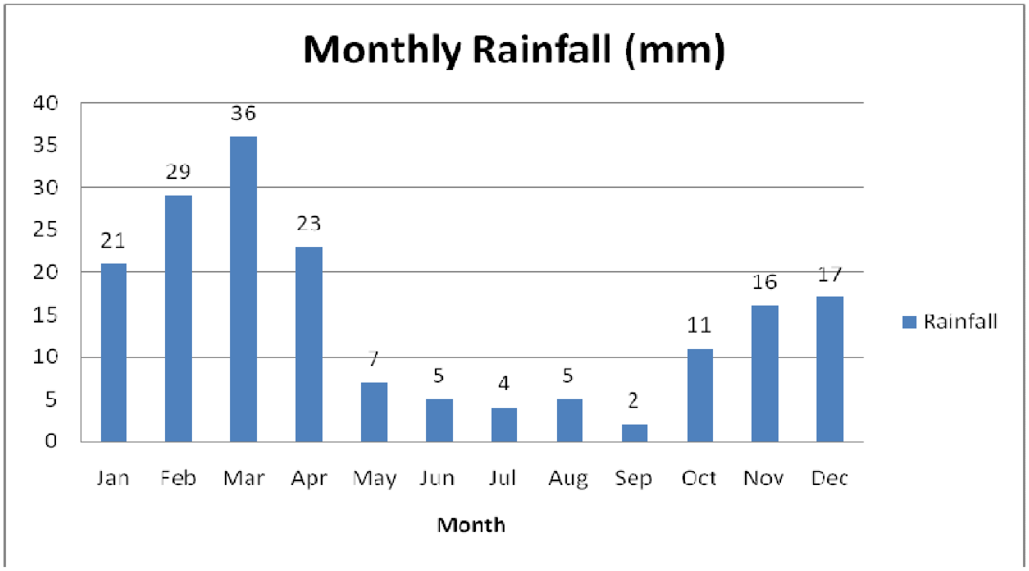

Figure 4: Mean Monthly Rainfall Graph for the Copperton Area (Source: Daily Rainfall Extraction Utility, Lynch 2003)

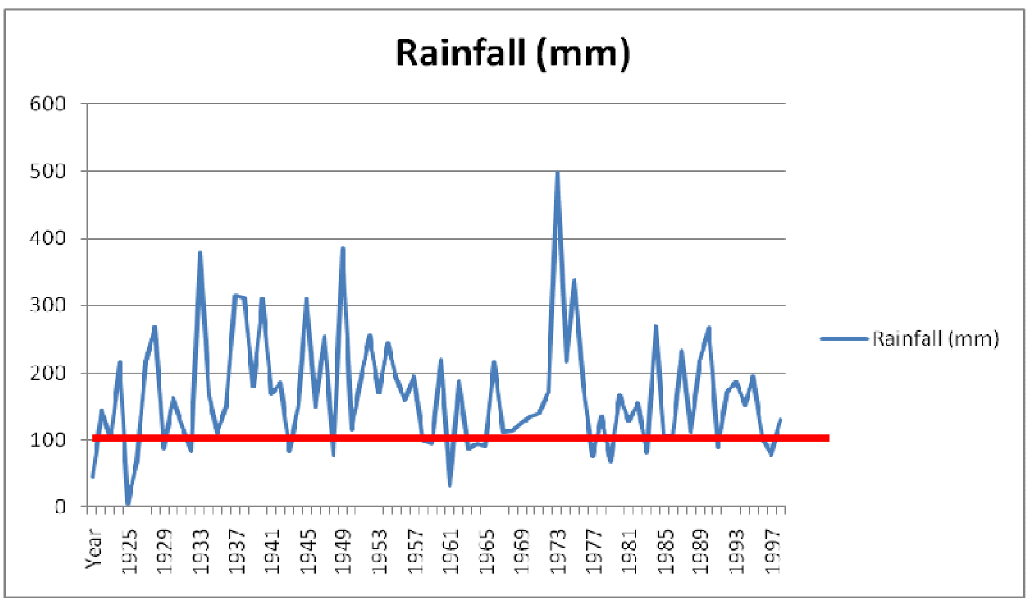

Figure 5: Long term annual rainfall (1922 – 1999) for the study area and long term average (indicated by the red line) (Source: The Daily Rainfall Extraction Utility, Lynch 2003)

3.2 Geology

The study area is underlain completely by tillite geologic materials (**Figure 6**). Tillite consists of consolidated masses of unweathered blocks and unsorted glacial till. The Preferred and Alternative sites, like the encompassing site, are completely underlain by tillite.

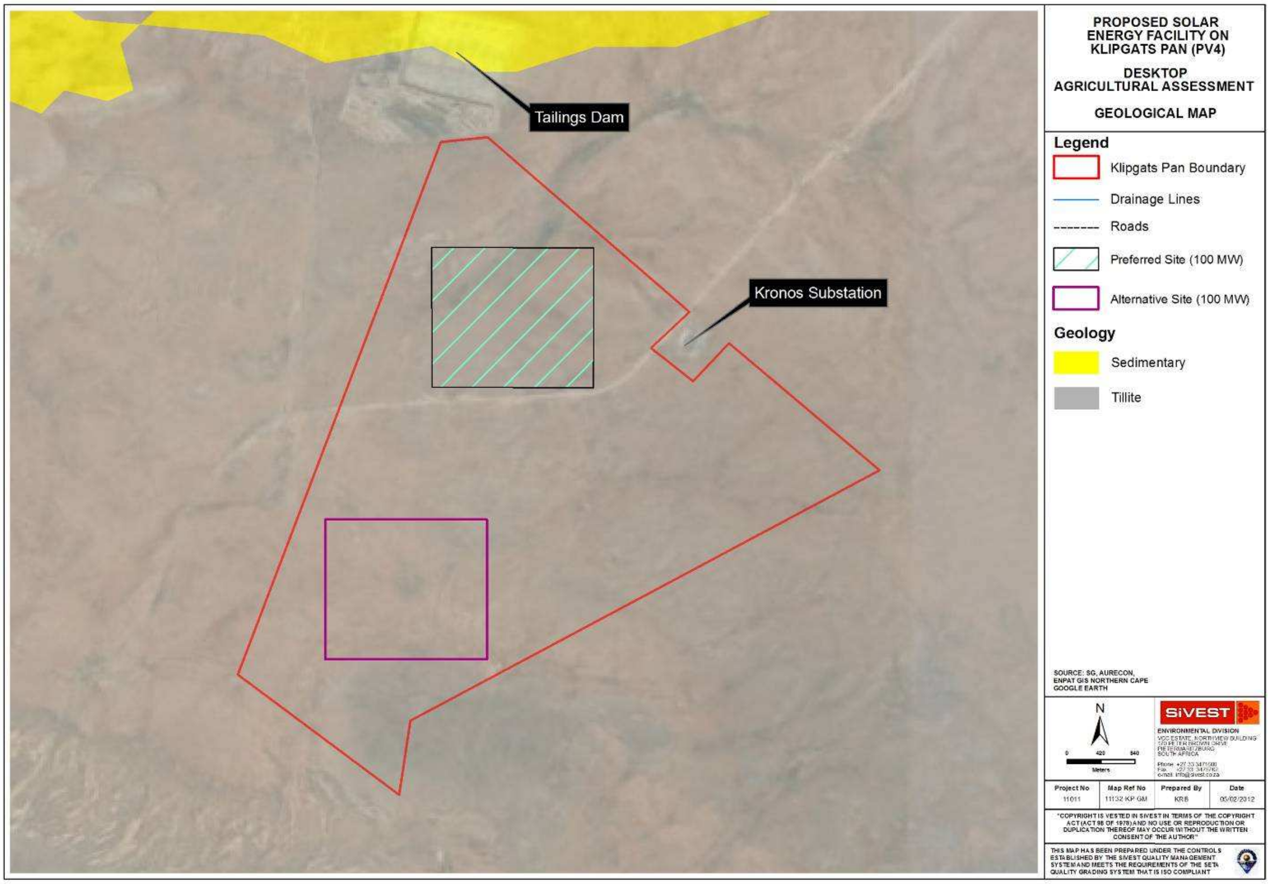

Figure 6: Geological Map

3.3 Slope

The study area is characterised by flat and gently sloping topography with an average gradient of less than 10% (**Figures 7** and **8**) making this area ideal for intensive agriculture, with high potential for large scale mechanisation. The topography is thus not a limiting factor for either agriculture or the proposed development. The flat topography will also allow for minimal earthworks and site preparation.

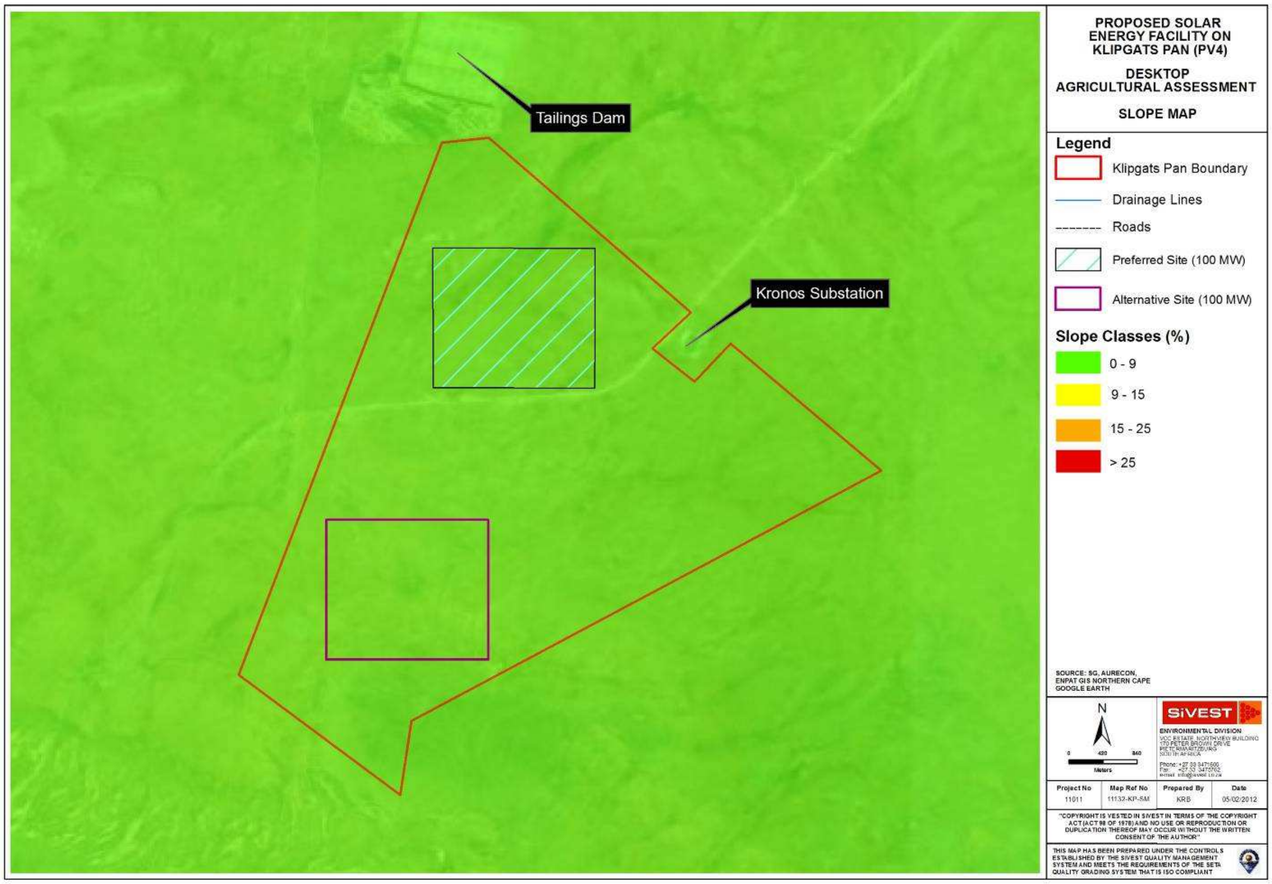

Figure 7: Slope Map


Figure 8: Typical topography encountered on Klipgats Pan

3.4 Land Use

According to **Mucina** and **Rutherford** (**2006**) the site lies within the Bushmanland Basin Shrubland vegetation type in the Nama-Karoo biome (**Aurecon 2010**). The Klipgats Pan Farm consists of a mix of natural veld and vacant land which is used as general grazing land for livestock (**Figures 9, 10** and **11**). Vast un-improved grazing land is interspersed by non-perennial stream beds. Stocking rates for the region are estimated at 1 small animal unit per 6 hectares and 1 large animal unit per 35 hectares. According to the land use data there are no signs of formal agricultural fields or cultivation on the site.

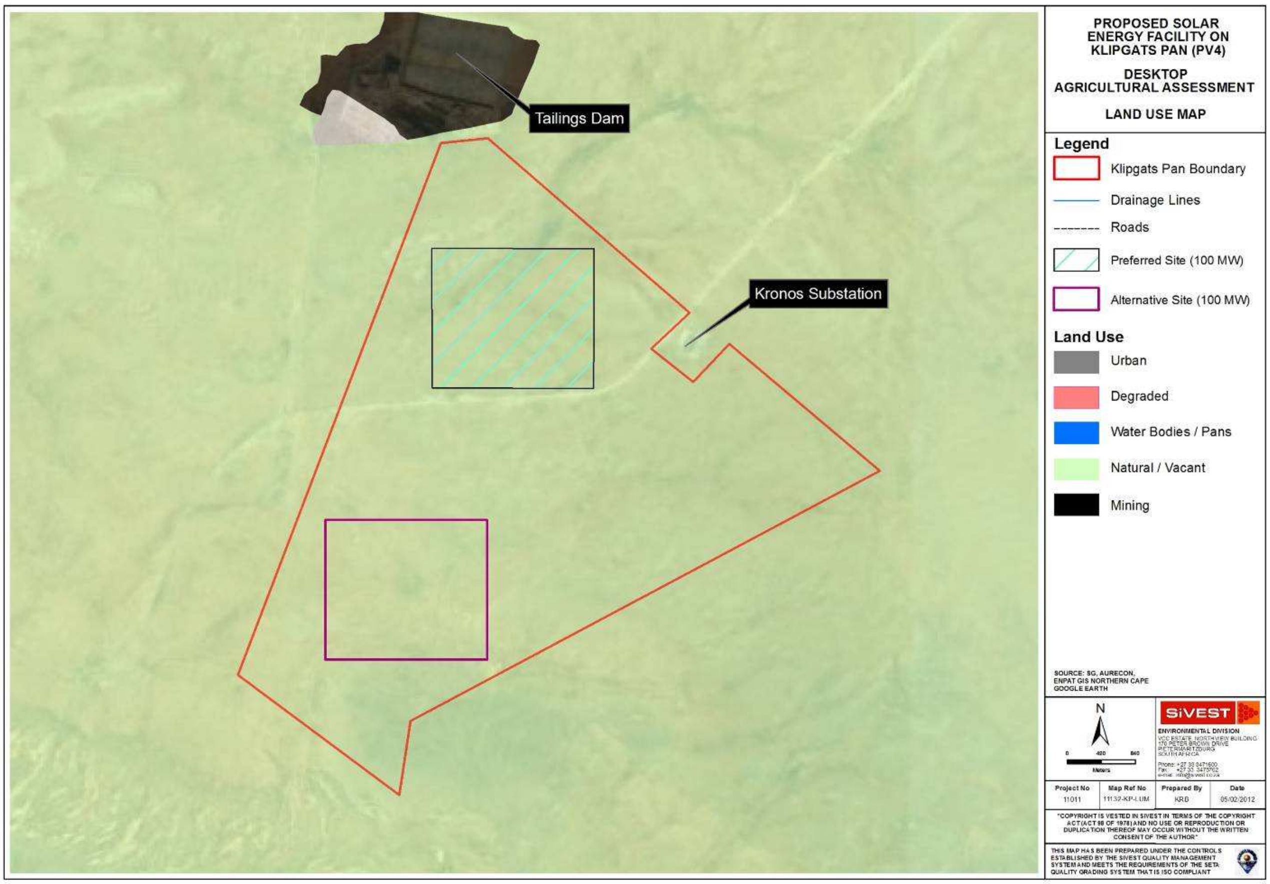

Figure 9: Land Use Map

Figure 10: Grazing land identified on Klipgats Pan (**Source: Aurecon, 2011**)

Figure 11: Typical land cover within the site (**Google Earth, imagery date 2008**)

3.5 Soil Characteristics and Soil Potential

According to the ENPAT database the Klipgats Pan site is dominated by apedal soil types (**Figure 12**). Apedal soils lack well formed peds, other than porous micro-aggregates, and are weakly structured. Apedal soils tend to be freely drained, and due to overriding climate conditions, these soils will tend to be Eutrophic (high base status). The entire site contains a mix of both red and yellow apedal soils.The study area is 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 (**Figures 13, 14 and 15**). According to the AGIS database the soils on Klipgats Pan Farm are associated with saline soils with a low water holding capacity, high pH and low organic matter content.

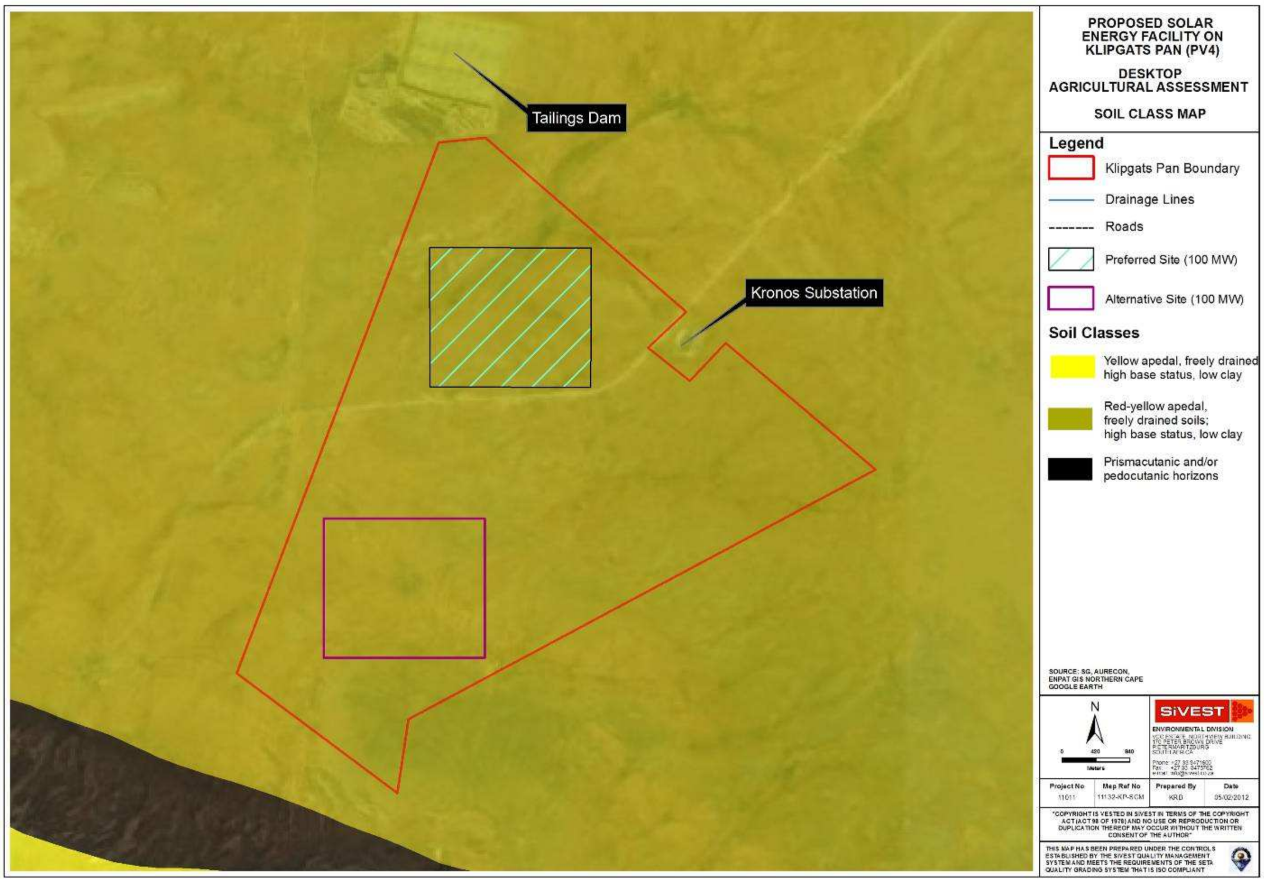

Figure 12: Soil Map

Figure 13: A shallow apedal soil identified near the site. Soils, similar to the above photo, are expected to dominate the majority of the Klipgats Pan Farm

Figure 14: An example of the rocky surface conditions found within the study area (**Source: Aurecon 2011**)

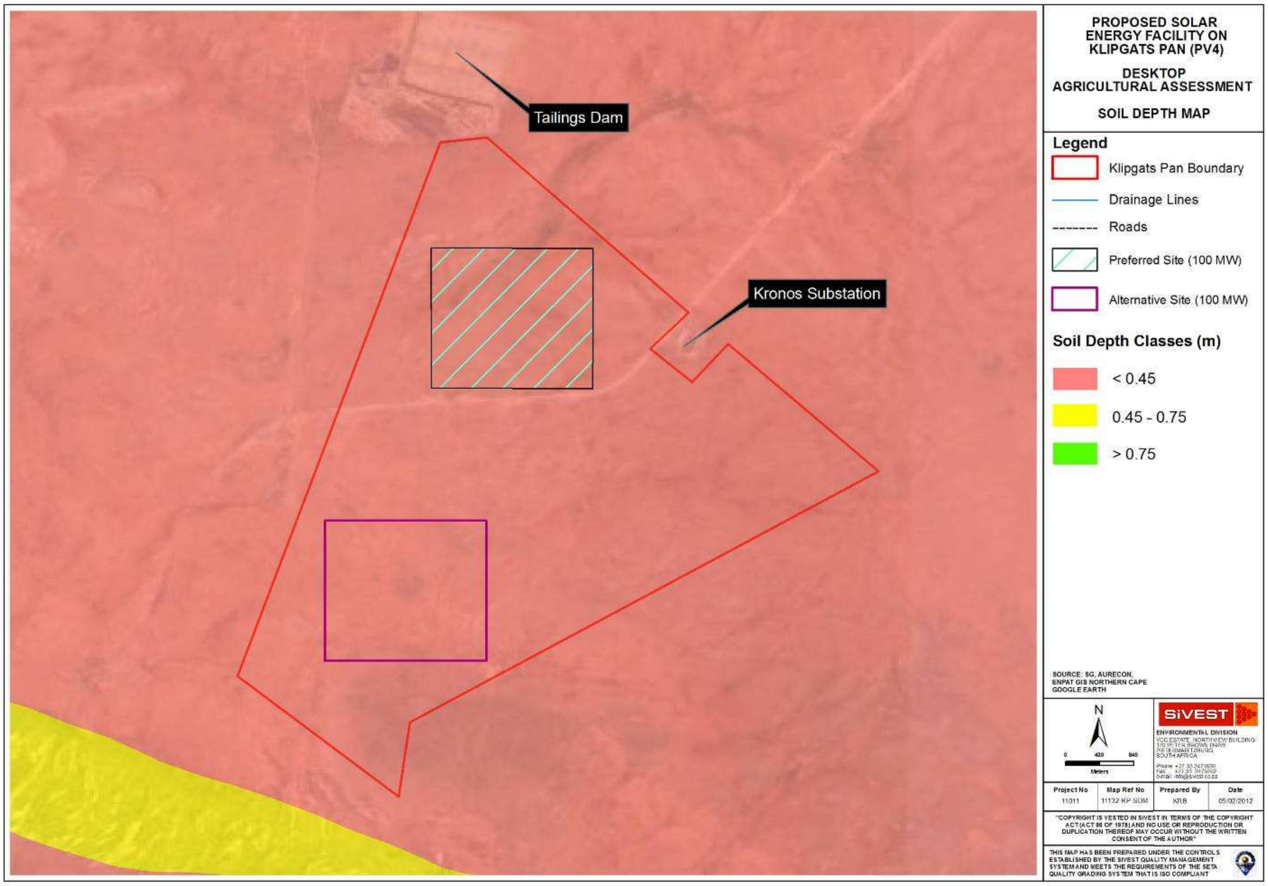

Figure 15: Soil Depth Map

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 study area is dominated by soils which are not suited for arable agriculture but which can still be used as grazing land (**Figure 16**). Restrictive climate characteristics, due to the strong summer rainfall regime, moisture stress, and low winter temperatures, further reduce the agricultural potential of the site.

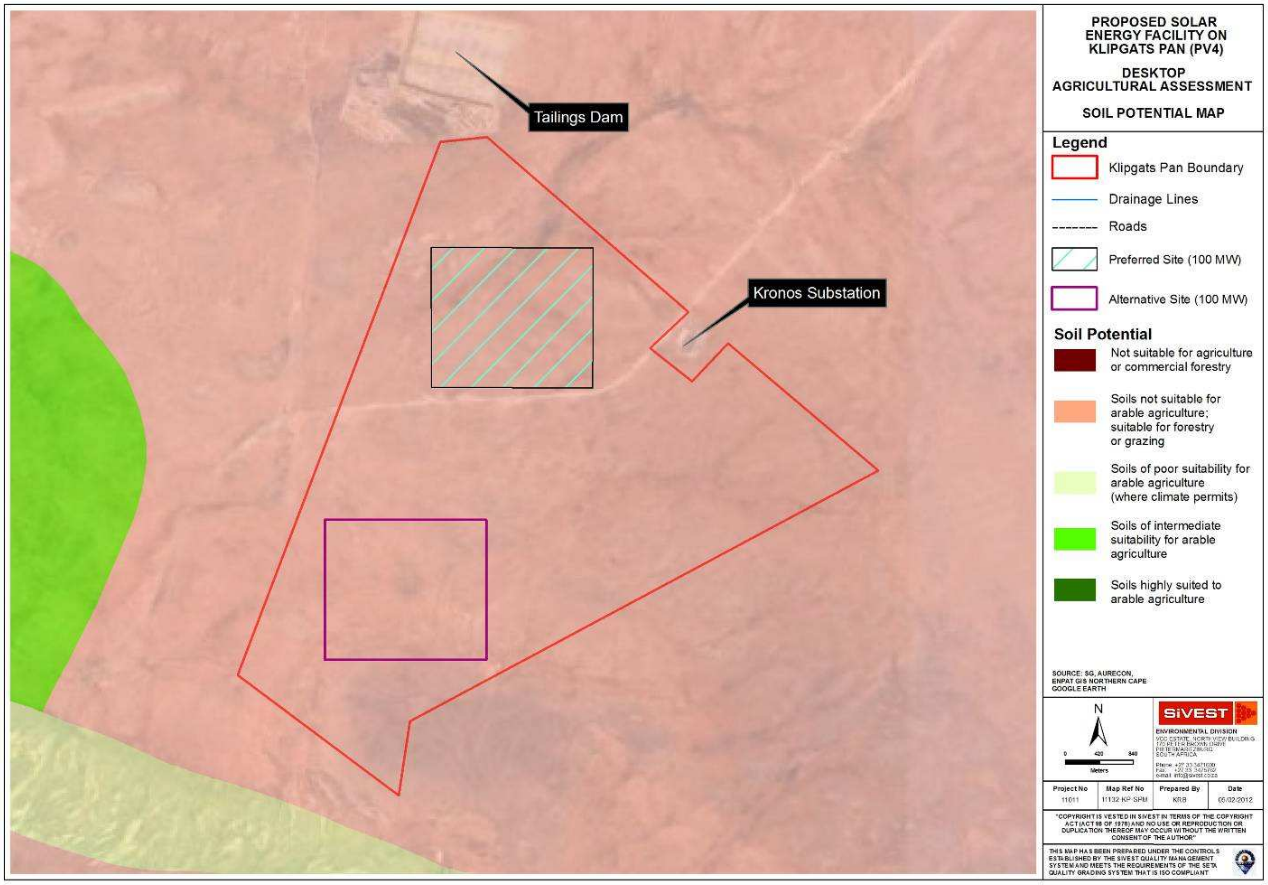

Figure 16: Soil Potential Map

3.6 Desktop Agricultural Assessment: Result 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 moderate to moderately low for grazing. This poor agricultural potential rating is primarily due to restrictive climatic characteristics and soil depth limitations. The site is not classified as high potential, nor is it a unique dry land agricultural resource.

4 CONSTRAINT ANALYSIS AND INITIAL IMPACT ASSESSMENT

The primary aim of the constraint analysis is to highlight problematic areas and 'no-go zones' in terms of agricultural production and potential. In terms of this study, agricultural potential is described as an area's suitability and capacity to sustainably accommodate an agricultural land use, and in most cases this potential is benchmarked against crop production. The desktop assessment (**Section 3**) has already shown that the study area is unsuitable for crop production and is dominated by unimproved grazing land.

The proposed development's primary impact on agricultural activities will involve the construction of the solar facilities and associated infrastructure. This will entail the clearing of vegetation and leveling of the site. This will effectively eliminate the lands agricultural potential in terms of crop production and grazing for as long the development persists. The construction of the solar field will only influence a portion of the farms total area. The remaining land will continue to function as they did prior to the development.

The site can be classified as having a 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 negligible due to the site's low inherent agricultural potential. 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 Klipgats Pan Site (**Figure 17**). **Table 1** summarises the potential impacts on agricultural potential at Klipgats Pan. Due to the homogenous nature of the site the summary is applicable for both site alternatives.

Table 1: Summary of potential impacts on agricultural potential at Klipgats Pan

ISSUE	Loss of agricultural land and production.
DISCUSSION	Loss of agricultural land due to the construction of the solar and associated infrastructure.
EXISTING IMPACT	N/A
PREDICTED IMPACT	The proposed development's primary impact on agricultural activities will involve the construction of the solar fields and associated infrastructure. This will entail the clearing of vegetation and levelling of the site. This will effectively eliminate the lands agricultural potential in terms of crop production and grazing for as long the development persists. However, the agricultural potential of the land is considered to be extremely low for crop production, and moderate to moderately low for grazing. The construction of the solar field will also only influence a portion of the farms total area. The remaining land will continue to function as they did prior to the development. It is predicted that the impact severity on the local agricultural production and soil resources

	will be of local extent, low magnitude and long term and therefore of low significance[1].
EIA INVESTIGATION REQUIRED	A full EIA investigation should not be necessary unless the reconnaissance nature of this desktop report is found to have not described all the potential impacts sufficiently.
CUMULATIVE EFFECT	The reduction in usable grazing owing to various solar projects (one approved and three, including this proposal, proposed) planned in and around Copperton could place increased pressure on adjacent land. However, the potential impact of this increased pressure is considered to be of low significance.

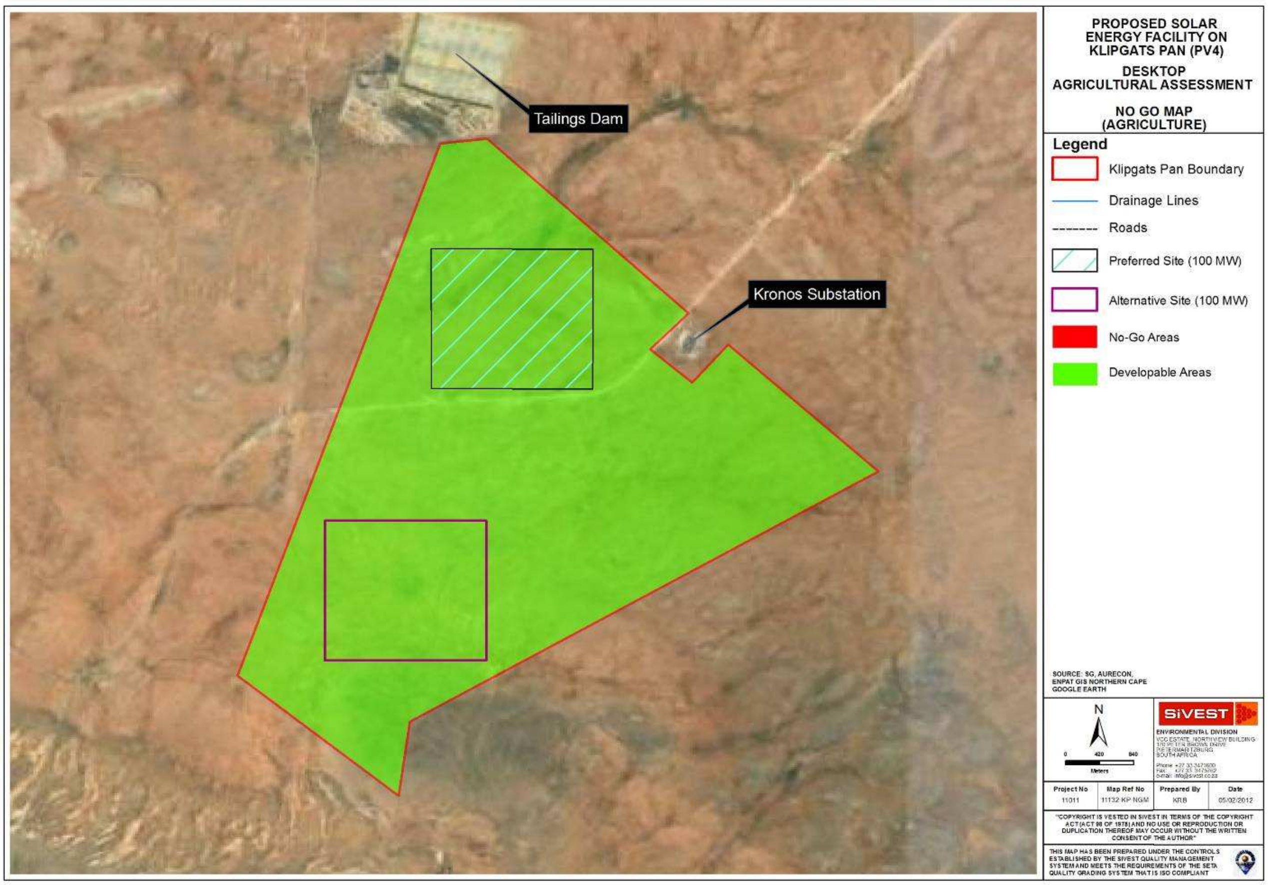

Figure 17: Developable and no-go areas from an agricultural perspective on Klipgats Pan site

[1] The assessment methodology is that provided in Chapter 5 of **Aurecon** (**2011**).

5 CONCLUSIONS AND RECOMMENDATIONS

SiVEST were appointed by Aurecon to undertake a desktop agricultural assessment for the area affected by a proposed solar energy facility on the farm Klipgats Pan near the town of Copperton in the Northern Cape of South Africa.

By taking all the site characteristics (climate, geology, land use, slope and soils) into account, the agricultural potential for the study area is classified as being extremely low in terms of crop production, while moderate to moderately low for grazing. This poor agricultural potential rating is due to severe climatic limitations and marginal soil characteristics.

The Klipgats Pan site is dominated by grazing land, and this land use can characterised by having a low sensitivity when assessed within the context of the proposed development. 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 site. From an agricultural potential perspective, there is no difference between the two Alternative PV field locations. A full agricultural assessment in the EIA phase of the environment process should not be necessary unless the reconnaissance nature of this desktop report is found to have not described the pertinent site characteristics or potential impacts sufficiently.

6 REFERENCES

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