ANNEXURE C
SPECIALIST REPORTS

C1: Agriculture Impact Assessment

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ANNEXURE C1

SPECIALIST ASSESSMENTS

- Agricultural Impact Assessment

AURECON SOUTH AFRICA (PTY) LTD

Proposed PV2-11 Photovoltaic Energy Plants on Farm Hoekplaas near Copperton, Northern Cape

Agricultural Impact Assessment

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Author:	Kurt Barichievy (Pr.Sci.Nat.)
Revision Number:	# 1.2
Checked by:	Tarryn Curtis
Approved:	Kurt Barichievy (Pr.Sci.Nat.)
Signature:	
For:	SiVEST Civil Engineering Division

Declaration

I, Kurt Barichievy, declare that I –

- act as an independent specialist consultant for Agricultural Impact Assessment for **the Proposed PV2-PV7 Photovoltaic Energy Plants on Farm Klipgats Pan near Copperton, Northern Cape;**
- 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 2010 Environmental Impact Assessment Regulations;
- 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 2010 Environmental Impact Assessment Regulations; 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.

Mr. K.R. Barichievy (Pr. Sci. Nat.)
Scientist
SiVEST

AURECON SOUTH AFRICA

PROPOSED PV2-11 PHOTOVOLTAIC ENERGY PLANTS ON FARM HOEKPLAAS

AGRICULTURAL IMPACT ASSESSMENT

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1 INTRODUCTION AND TERMS OF REFERENCE

Aurecon South Africa (Pty) Ltd (Aurecon) on behalf of **Mulilo Renewable Energy** (Pty) Ltd (Mulilo) requested an agricultural impact assessment for the area affected by the proposed solar energy facility on the farm Hoekplaas near the town of Copperton, in the Northern Cape Province (**Figure 1**). The primary objective of this assessment is to provide specialist agricultural, soil and land use input for the overarching Environmental Impact Assessment (EIA) 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.

An original soil and agricultural report was undertaken by SiVEST for Hoekplaas (Remainder of Farm No. 146) in February 2012 (**SiVEST, 2012**). Environmental Authorisation for a 100 MW Photovoltaic (PV) solar energy facility, known as Hoekplaas PV1, and associated infrastructure was granted for this project in January 2013. Mulilo is now investigating an additional ten (10) PV plants of 75 MW AC each on the Hoekplaas farm. Alternatively, three PV plants of 225 MW AC, 290 MW AC and 500 MW AC, respectively, are proposed on the same farm (**Aurecon, 2013**).

This assessment intends to supplement the previous soil and agricultural study, and along with the other specialist studies, hopes to minimise the predicted potential impacts on the receiving environment. The terms of reference of this study are to:

- Update the original soil and agricultural assessment using the new layouts, additional activities and project information;
- Undertake a soil and agricultural impact assessment; and
- Compile a soil management plan.

1.2 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 (**2013**).

1.2.1 PV Power plants

The proposed PV plants would convert shortwave radiation (sunlight) directly into electricity via cells through a process known as the Photovoltaic Effect. The PV cells are made of silicone which acts as a semi-conductor. The cells absorb light energy which energizes the electrons to produce electricity. Individual solar cells can be connected and packed into standard modules behind a glass sheet to protect the cells from the environment while obtaining the 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 (**Aurecon, 2013**).

As previously mentioned Mulilo proposes to construct an additional 10 PV plants with a generation capacity of approximately 75 MW AC each on the farm Hoekplaas (Remainder of Farm No. 146) near

Copperton in the Northern Cape (preferred) (**Figure 2**). The preferred layouts take cognisance of the 75 MW Department of Energy (DoE) cap and the environmentally sensitive areas that were identified in the 2012 EIA process for the Hoekplaas Farm. The total extent of the 10 proposed facilities would be approximately 2,497 ha as set out in **Table 1,** below:

Table 1: Footprints, capacities and coordinates of the proposed PV plants (preferred) (**Aurecon, 2013**).

Plant	Footprint (ha)	Capacity (MW)	Mid-Point Co-Ordinates
PV2	230	75	30° 0'35.24"S 22°20'23.96"
PV3	322	75	29°59'29.95"S 22°21'20.22"E
PV4	222	75	30° 0'53.42"S 22°21'18.53"E
PV5	350	75	30° 0'52.48"S 22°22'43.72"
PV6	203	75	30° 0'57.36"S 22°25'25.68"E
PV7	223	75	30° 1'20.45"S 22°24'55.54"E
PV8	205	75	30° 1'32.91"S 22°24'9.96"E
PV9	263	75	30° 2'19.54"S 22°24'9.45"E
PV10	249	75	30° 2'27.53"S 22°23'7.85"E
PV11	230	75	30° 3'50.97"S 22°22'46.49"E

Alternatively three PV plants with generation capacities of 225 MW (Alternative PV2A), 290 MW (Alternative PV3A) and 500 MW (Alternative PV4A) are proposed (**Figure 3**). The alternative site layout was developed by extending and combining some of the proposed 75 MW AC plants. This alternative is thus not limited to the DoE's 75 MW cap per project. The benefit of developing larger plants relates to the reduction of associated development and construction costs which in turn reduces lending rates and essentially lower the tariff of electricity sold (**Aurecon, 2013**). The total extent of the three alternative PV plants would be approximately 2,770 ha (see **Table 2**).

Table 2: Footprints, capacities and coordinates of the alternative PV plants (**Aurecon, 2013**).

Plant	Footprint (ha)	Capacity (MW)	Mid-Point Co-Ordinates
PV2A	670	225	29°59'51.09"S 22°20'58.84"E
PV3A	800	290	30° 0'46.10"S 22°22'18.47"E
PV4A	1300	500	30° 2'20.39"S 22°24'13.52"E

Each of the proposed PV plants would consist of the following:

- **Solar energy plant:** A photovoltaic component, comprising of numerous arrays of PV panels and associated support infrastructure, to generate up to 75 MW AC per plant, through the photovoltaic effect.
- **Transmission lines:** 132 kV overhead transmission lines to connect each facility to the central onsite substation or an existing Eskom substation (i.e. Kronos or Cuprum).
- **Substations:** An onsite 132 kV, 3 bay substation per project and two central mulitbay 132 kV substations with a maximum of six incoming bays and two outgoing.
- **Boundary fence:** Each 75 MW AC facility will have an electrical fence for safety and security reasons (**Aurecon, 2013**).

It is also proposed that the following infrastructure be shared among the 10 PV plants to limit the impact on the surrounding environment, as well as reduce costs:

- **Central substation:** One central 132 kV substation and connection to Eskom grid. This central substation will connect the PV plants with Eskom's Kronos (preferred) or Cuprum (alternative) substation via new 132 kV transmission lines.
- **Roads:** Main access road and internal access roads for servicing and maintenance of the site (existing roads will be use where possible).
- **Water supply infrastructure:** Surplus water that has been allocated to PV1 from the Alkantpan pipeline will be used for the proposed plants. Requests for additional water will be submitted to Alkantpan and the local municipality for consideration.
- **Stormwater infrastructure:** Including drainage channels, berms, detention areas and kinetic energy dissipaters.
- **Buildings:** Buildings would likely include onsite substations, a connection building, control building, guard cabin and solar resource measuring substation (**Aurecon, 2013**).

1.2.1 Transmission lines and substations

It is envisaged that each PV would require an onsite substation specific to each PV plant i.e. 10 onsite substations. These substations would feed into one of two central onsite substations by means of onsite overhead 132 kV transmission lines. Two potential routing alternatives for transmission lines will be considered:

Routing Alternative 1 (preferred)

It is envisaged that each PV plant would have an onsite substation. These substations would feed into one of two central onsite multibay substations by means of onsite overhead 132 kV transmission lines before connecting to the Kronos Substation. The shortest routes were identified for the proposed transmission lines to limit the visual impact and area of disturbance, as well as reduce costs (**Aurecon, 2013**).

Routing Alternative 2

Alternatively the transmission lines could connect to the Cuprum Substation should the Kronos Substation not have sufficient capacity. A corridor of approximately 6.3 km in length (measured from the farm boundary) and 180 m wide has therefore been identified for the transmission lines (**Aurecon, 2013**).

1.2.2 Additional infrastructure

An additional access road leading from the R357 will be required. Internal access roads (gravel) would lead from the main access roads to connect the 10 PV plants. These roads would coincide with the existing dirt tracks where possible. Three laydown areas have been identified and would be used during the construction phases of all 10 proposed PV plants. Septic tanks would be constructed at the site offices and serviced by the municipality on a monthly basis (**Aurecon, 2013**).

The natural water flow of the site would be interrupted by the proposed roads, and therefore stormwater infrastructure would be required to facilitate surface water flow and to prevent erosion channels from developing (**Aurecon, 2013**).

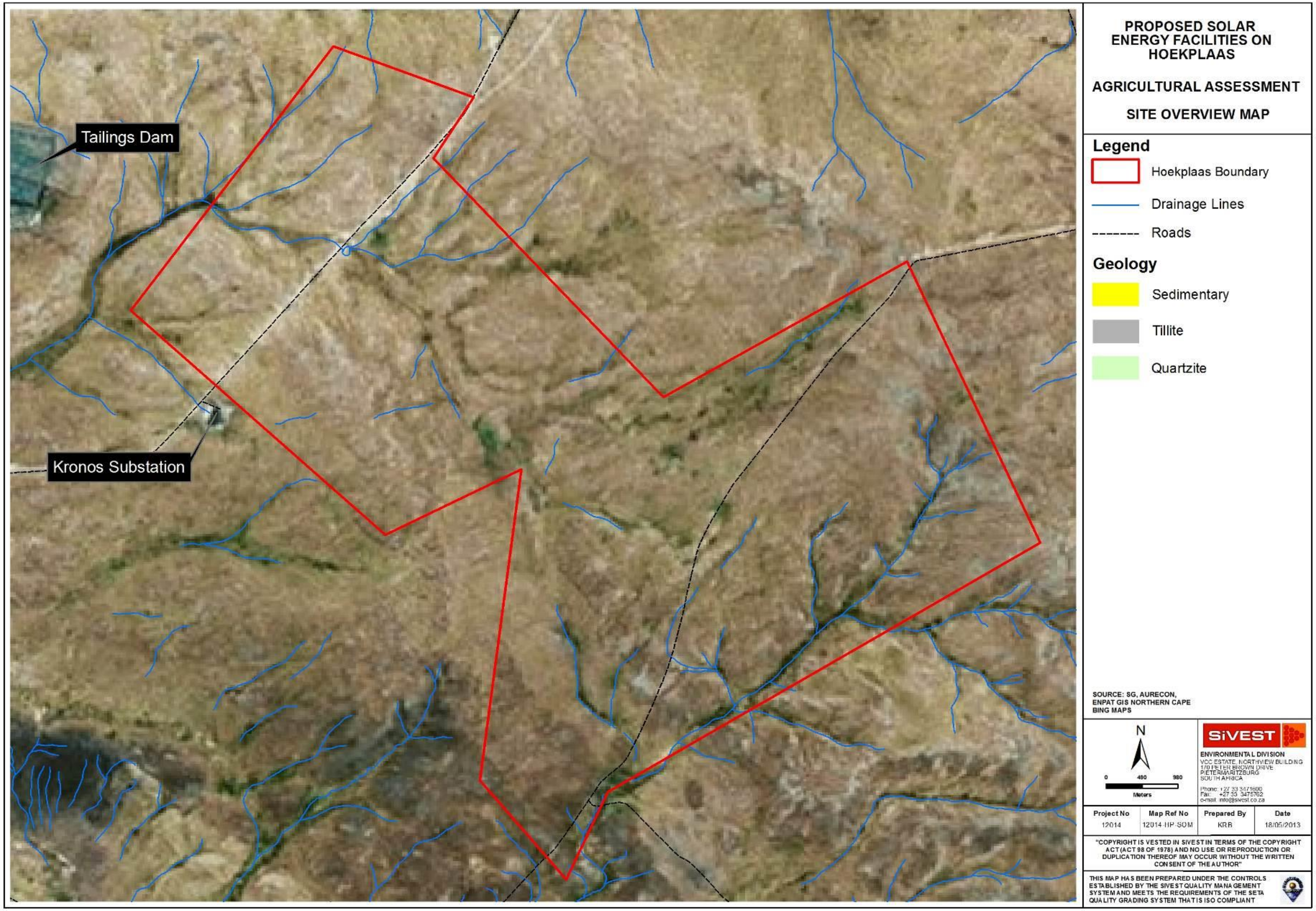

Figure 1: Site Overview Map (All background imagery is sourced from Bing Maps, 2013)

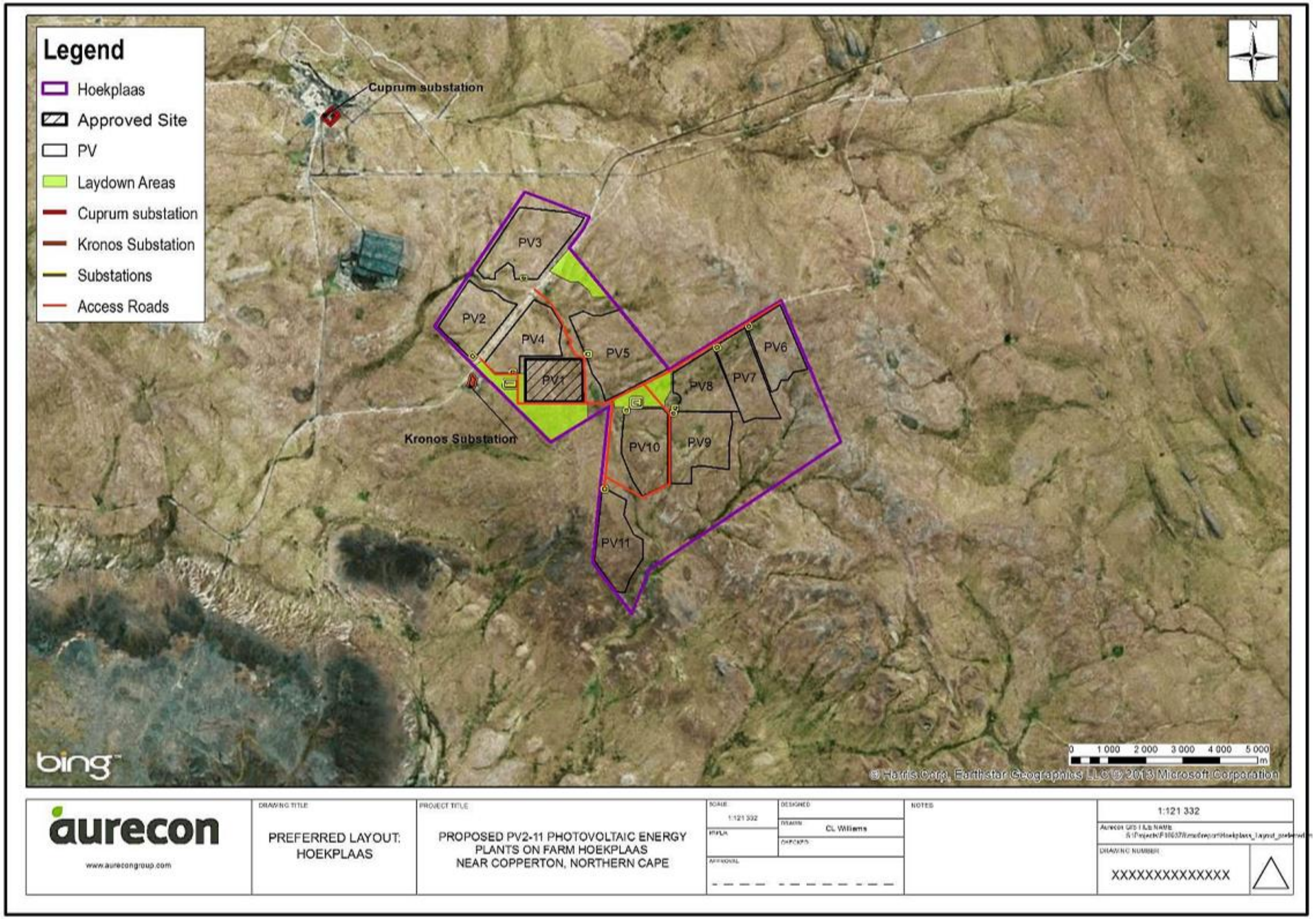

Figure 2: Preferred Hoekplaas Layout (**Source: Aurecon, 2013**)

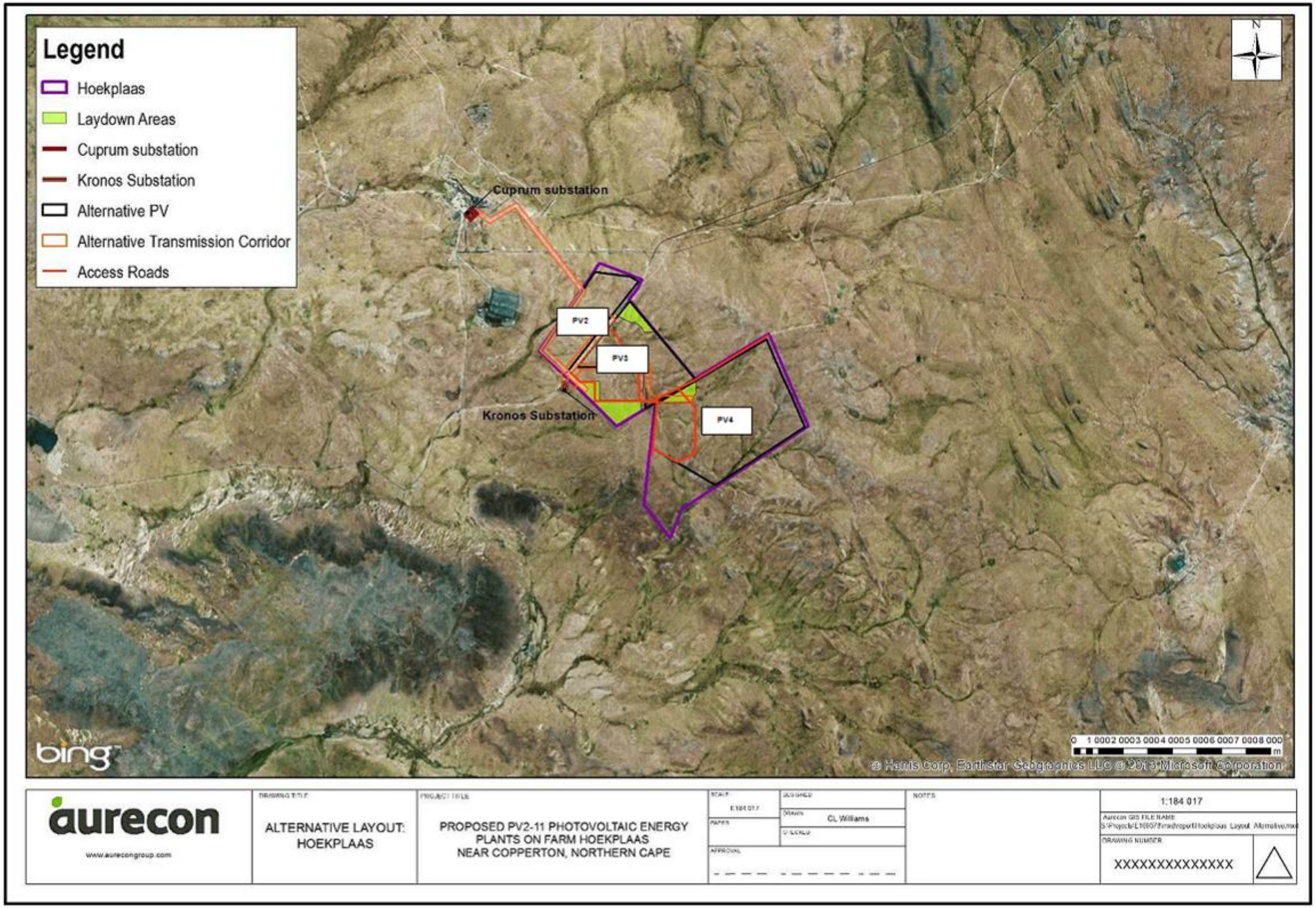

Figure 3: Alternative Hoekplaas Layout (**Source: Aurecon, 2013**)

2 DESKTOP AGRICULTURAL ASSESSMENT

The objective of the desktop assessment is to provide broad soil and agriculturally related characteristics of the project area. It should be clearly noted that, since the spatial information used to drive this portion of the assessment is of a reconnaissance nature, only large scale climate, land use and soil details are provided.

In order to ascertain the broad soil and agricultural potential characteristics of the project area 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 resources, one is able to broadly assess the site, receiving environment, and its ability to accept change, in the form of development. More agriculturally relevant spatial information was obtained from the Agricultural Geo-Referenced Information System (AGIS Database) **(*http://www.agis.agric.za,*** accessed 15/05/2013).

2.1 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**).

Mean Annual Precipitation of 176 mm is deemed extremely low as 500 mm 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°C and average winter night time temperature of approximately 1°C.

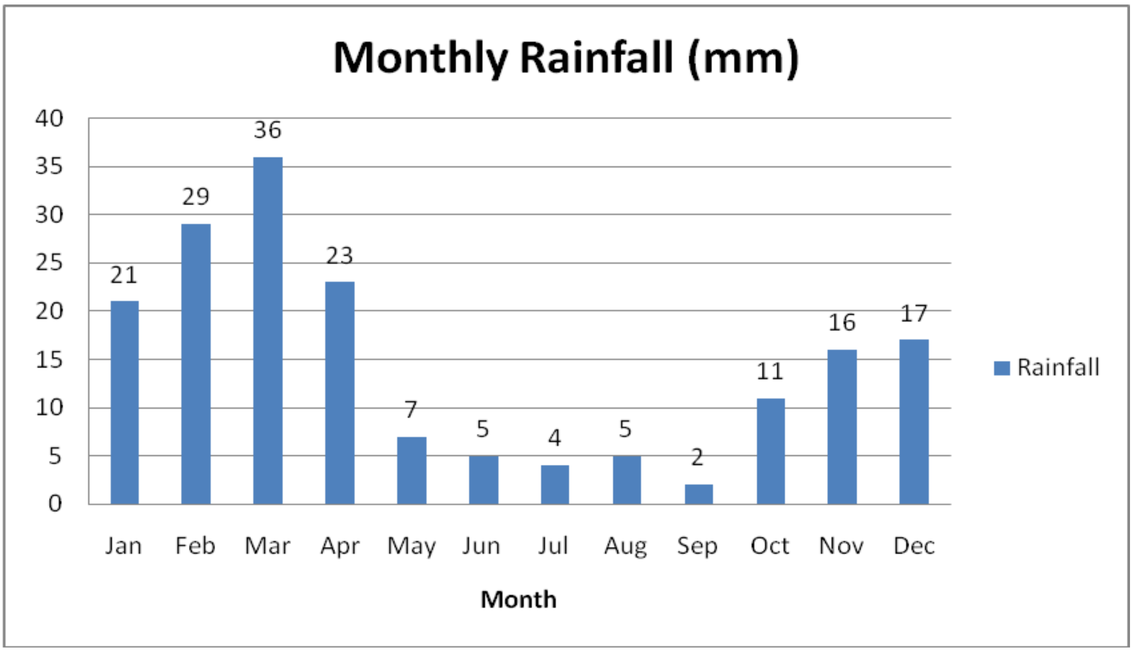

Figure 4: Mean Monthly Rainfall Graph for the Copperton Area (Source: Daily Rainfall Extraction Utility, **Lynch 2003**)

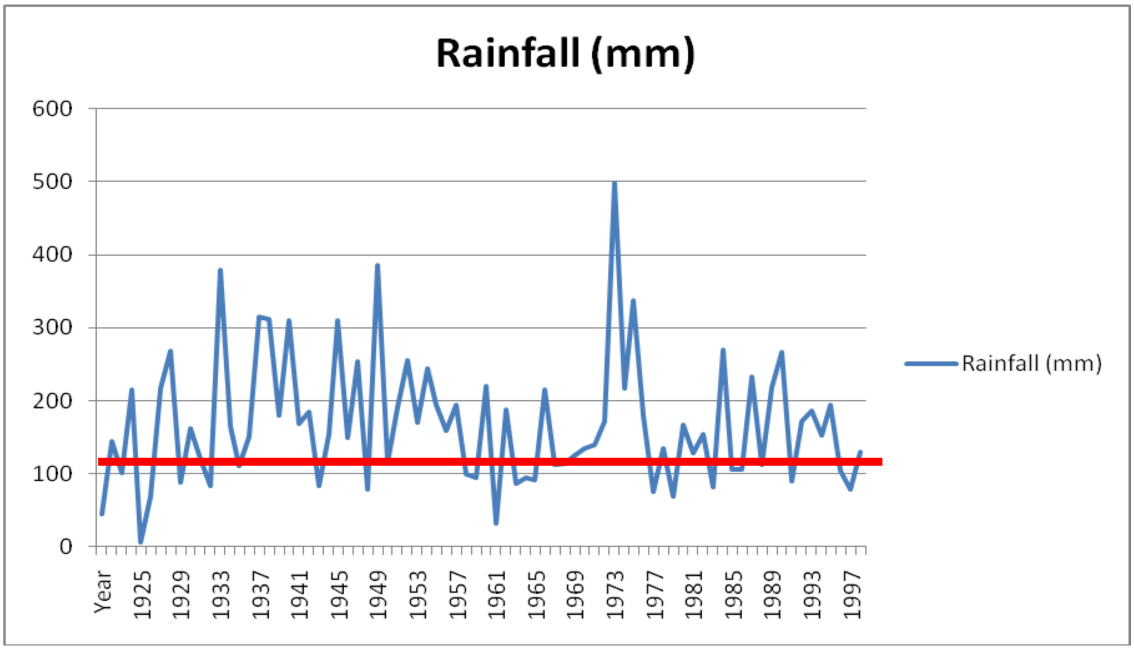

Figure 5: Long term annual rainfall (1922 – 1999) for the study area and long term average (indicated by the red line) (Source: The Daily Rainfall Extraction Utility, **Lynch 2003**)

2.2 Geology

The study area is underlain by a two primary parent materials namely sedimentary and tillite (**Figure 6**). Tillite geologic material dominates virtually the entire site. Tillite consists of consolidated masses of unweathered blocks and unsorted glacial till. Non-descript sedimentary geologic materials are found in the northern and north eastern tips of the Hoekplaas Site.

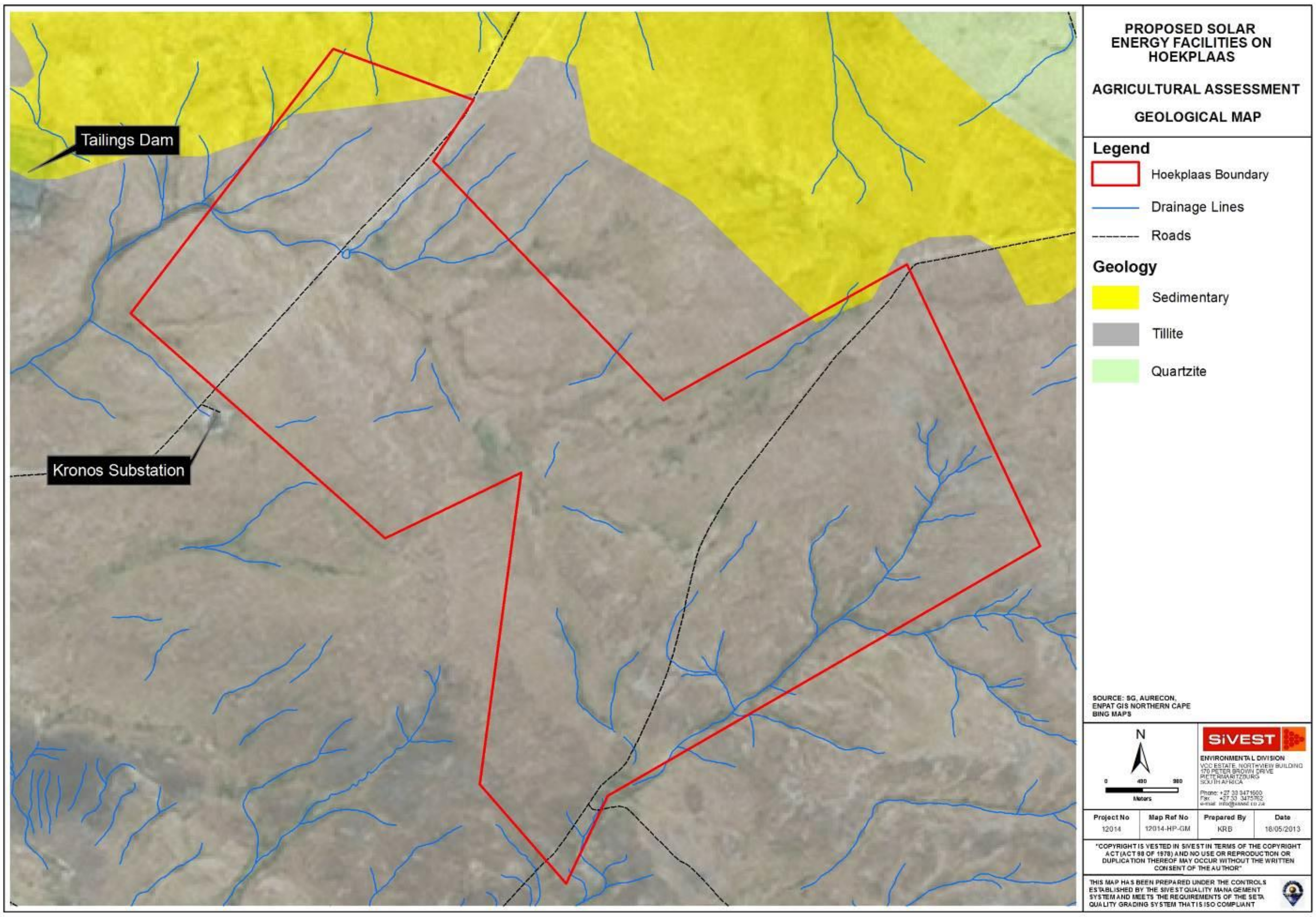

Figure 6: Geological Map

2.3 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 would allow for minimal earthworks and site preparation.

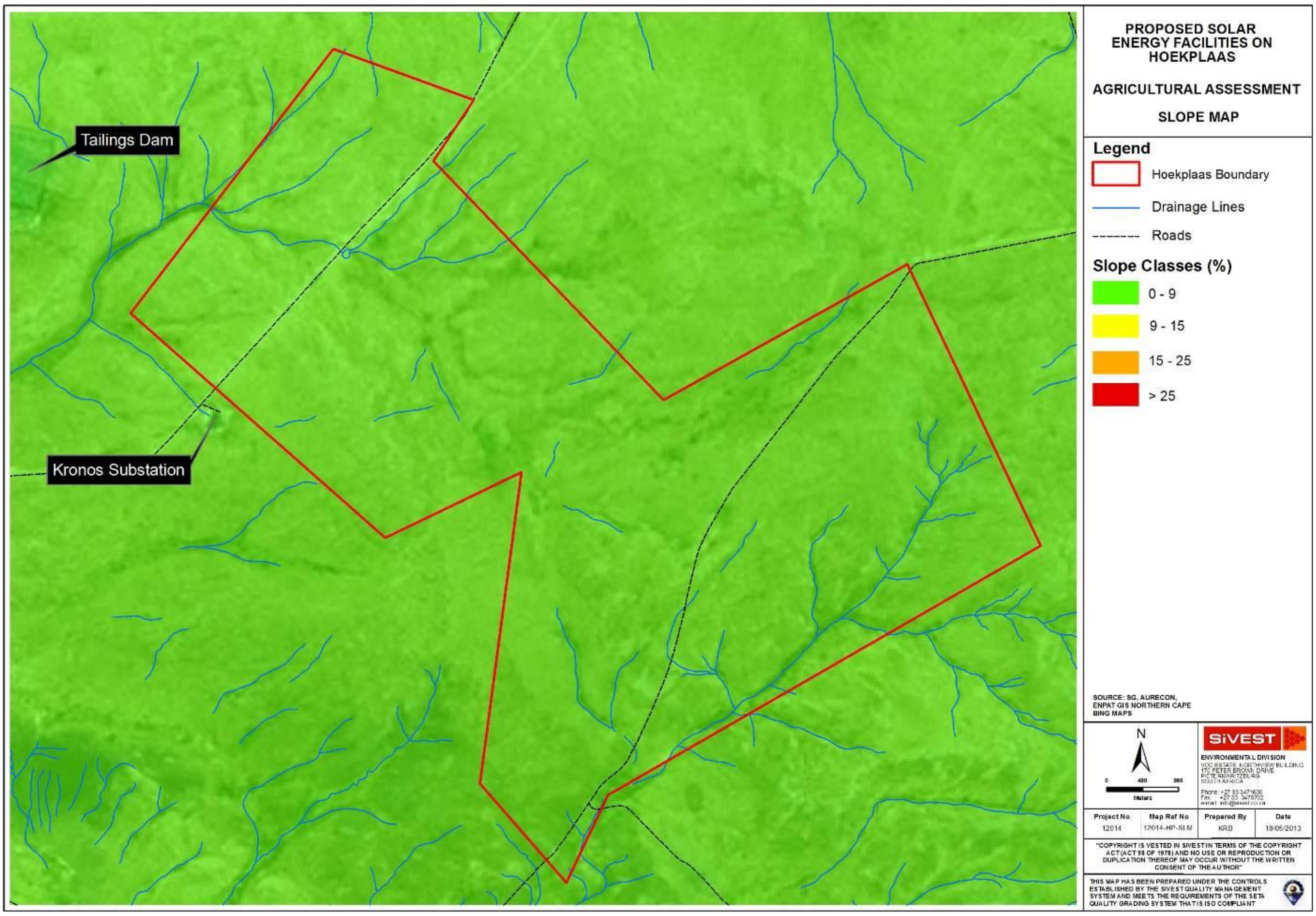

Figure 7: Slope Map

Figure 8: Typical topography encountered on the Hoekplaas Site

2.4 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 proposed development area consists of a mix of natural veld and vacant land which is used as general grazing land for livestock (**Figures 9,** and **10**). Vast un-improved grazing land is interspersed by non-perennial stream beds. Stocking rates for the region are estimated at one small animal unit per six hectares and one large animal unit per 35 hectares. According to the land use data there are no signs of formal agricultural fields or cultivation on Hoekplaas Site.

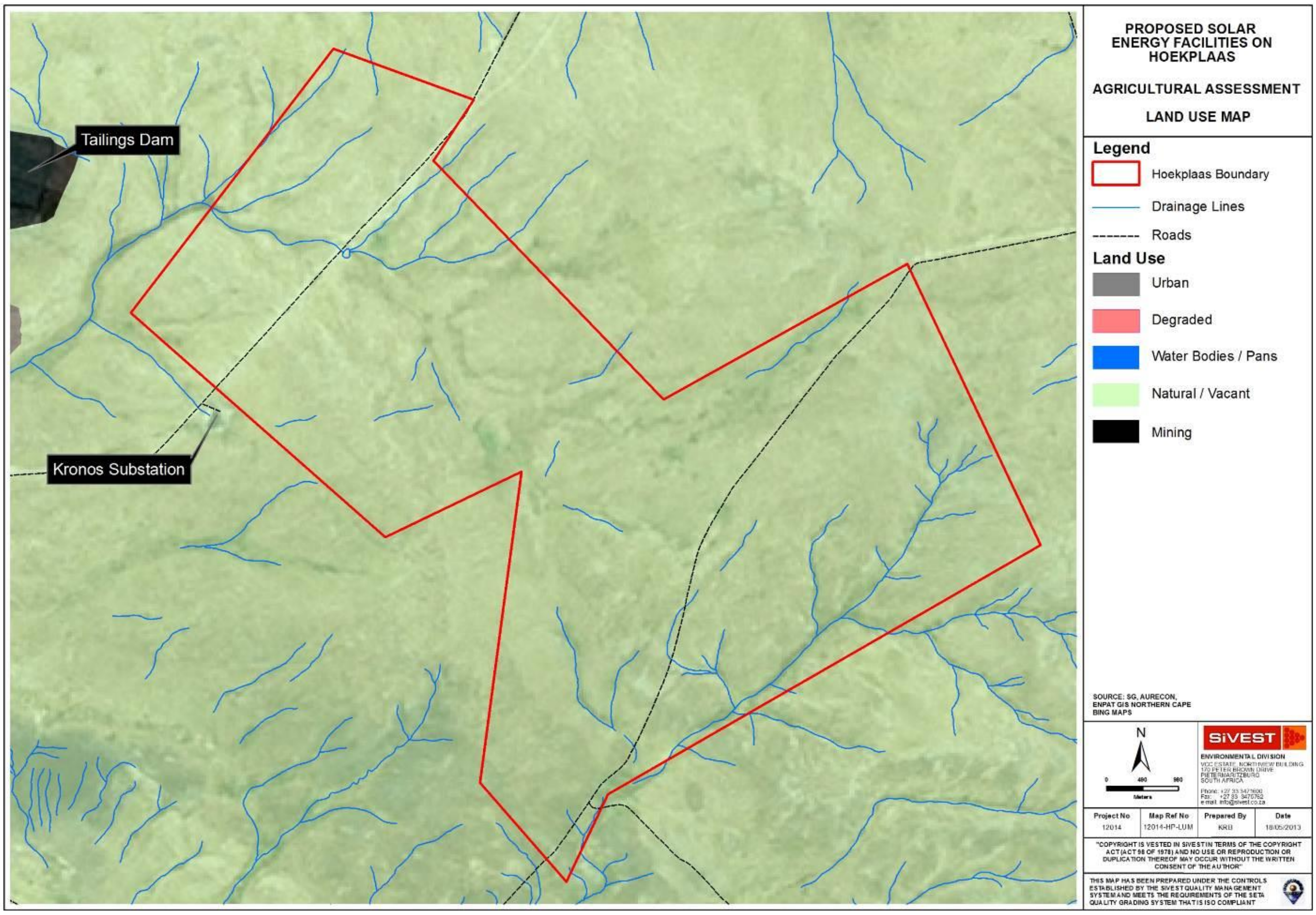

Figure 9: Land Use Map

Figure 10: Grazing land identified on Hoekplaas Site (**Source: Aurecon, 2011**)

2.5 Soil Characteristics and Soil Potential

According to the ENPAT database Hoekplaas is dominated by apedal soil types (**Figure 11**). 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 farm is underlain by 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 12, 13 and 14**). According to the AGIS database the soils on Hoekplaas are associated with soils with a low water holding capacity, high pH and low organic matter content.

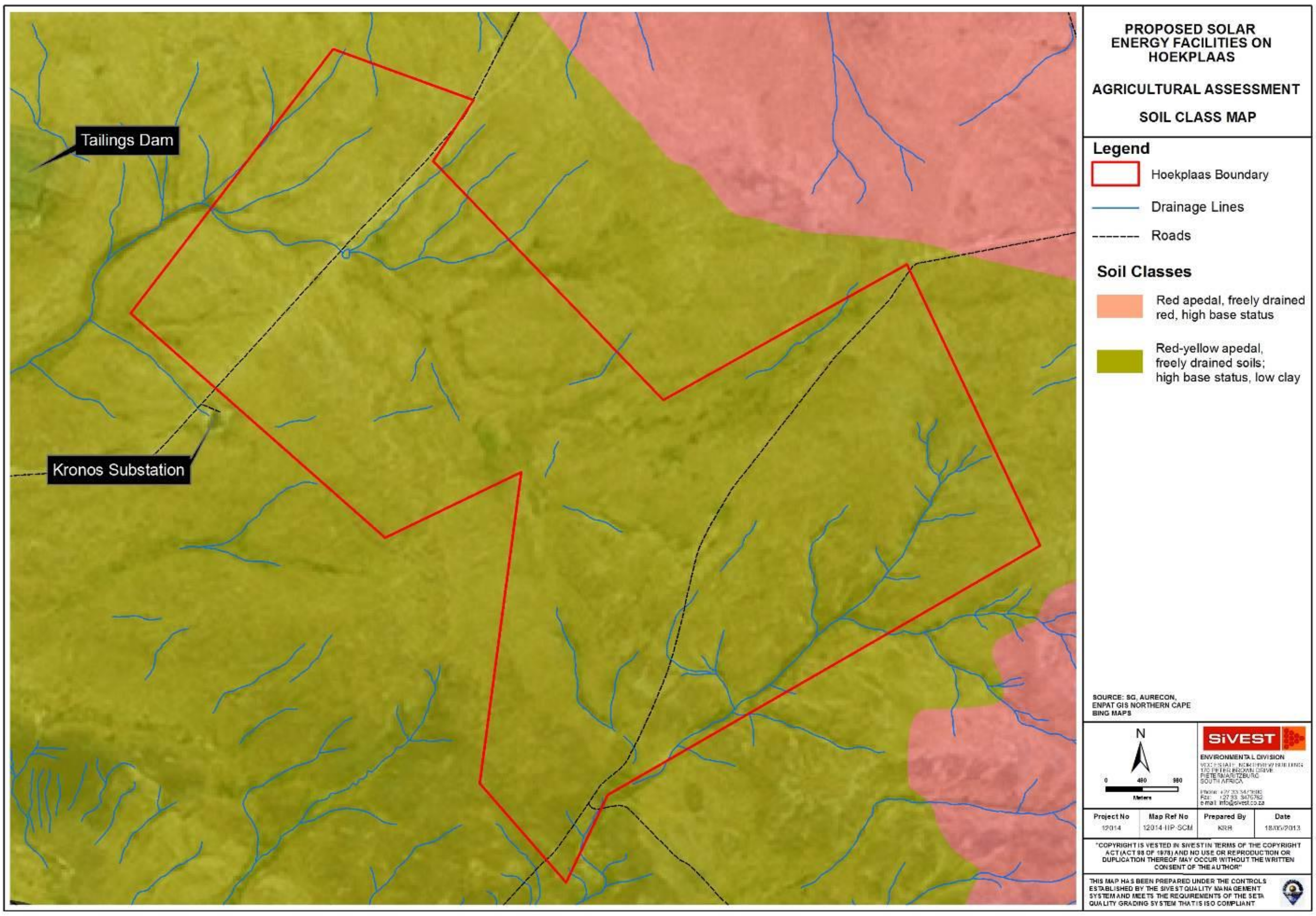

Figure 11: Soil Map

Figure 12: A shallow apedal soil identified near the Site. Soils, similar to the above photo, are expected to dominate the majority of the Hoekplaas Site

Figure 13: An example of the land surface conditions within the study area

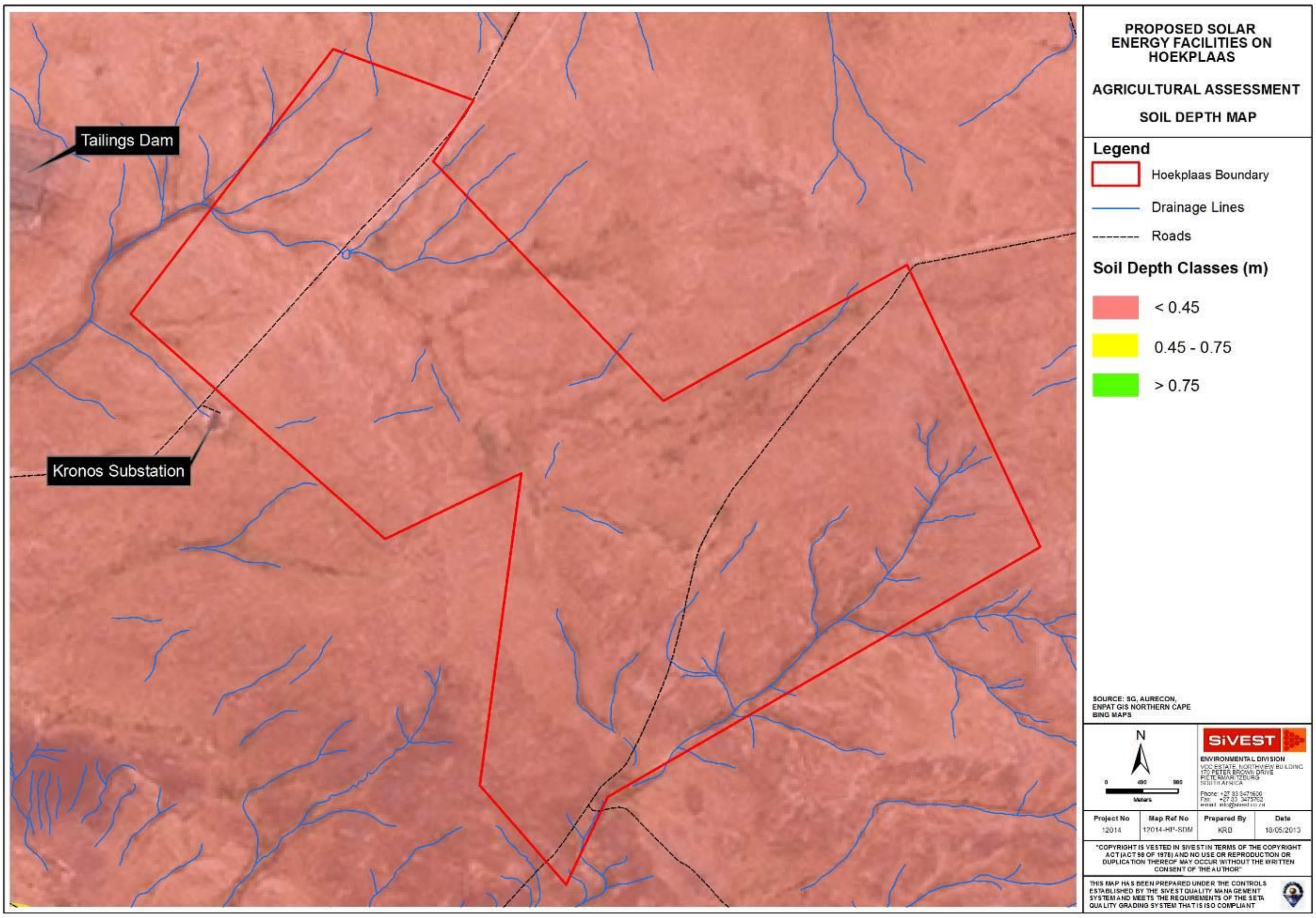

Figure 14: Soil Depth Map

The ENPAT Database also provides an overview of the study area's agricultural potential based on its soil characteristics, although it should be noted that 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 15**). Restrictive climate characteristics, due to the strong summer rainfall regime, moisture stress and low winter temperatures, further reduce the agricultural potential of the site.

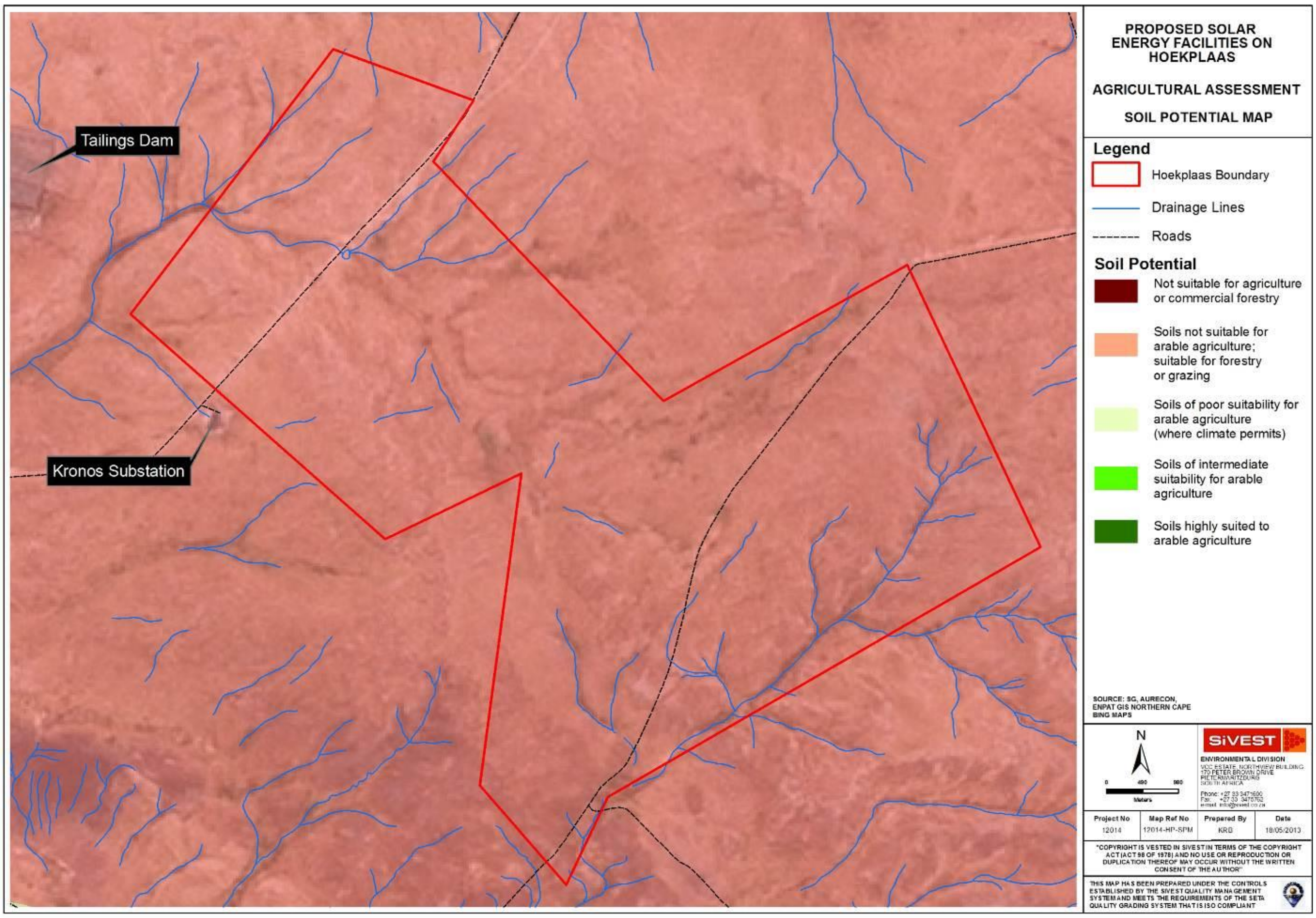

Figure 15: Soil Potential Map

2.6 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.

3 AGRICULTURAL IMPACT ASSESSMENT

From an agricultural perspective the loss of high value farm land and / or food security production, as a result of the proposed activities, is the primary concern of this assessment. In South Africa there is a scarcity of high potential agricultural land, with less than 14% of the total area being suitable for dry land crop production (**Smith, 2006**). Consequently areas which can sustainably accommodate dry land production need to be protected from non-agricultural land uses. The desktop assessment (**Sections 2)** has already shown that the study area is unsuitable for crop production and is dominated by unimproved grazing land.

The results of the desktop agricultural assessment indicate that the Hoekplaas has low agricultural value and is replaceable when assessed within the context of the proposed development. Consequently, the overall impact of the proposed PV plants on the study area's agricultural potential and production will be low, due to the site's low inherent agricultural potential and value. There are no centre pivots, irrigation schemes or active agricultural fields which will be influenced by the proposed development. As such, when considering the agricultural assessment as a standalone specialist study, there are no problematic or fatal flaw areas that exist for the proposed plants.

3.1 Impact of the proposed PV plants

3.1.1 Construction Phase

The proposed development's primary impact on agricultural activities includes the construction of the solar fields and associated infrastructure, which entails the clearing of vegetation and levelling of the site. This would effectively eliminate the impacted land's agricultural potential in terms of crop production (or in this case grazing) during the construction phase, which is estimated to last between 12 and 18 months per 75 MW PV facility. The construction of the solar fields would influence a portion of each of the farms total area. The remaining land would continue to function as it did, prior to the development; 2329 ha (47%) for the preferred layout or 1371 ha (28%) for the alternative layout. Furthermore, facilities on the farm would be phased and constructed consecutively, depending on whether the projects are approved by the DoE and Department of Environmental Affairs (**Aurecon, 2013**). Stocking rates would need to be temporarily reduced during the construction phase in order to reduce the risk of overgrazing the remaining land portions. The larger the proposed PV footprint the greater this impact would be, thus many small PV sites is favoured when utilising this phased approach.

3.1.2 Operational Phase

After construction the land will need to be rehabilitated, which includes re-vegetating the PV fields. It is recommended that more palatable grass species are planted to enable faster stocking initiation. It is unlikely that typical vegetation species (Karoo shrubs) will return to the PV fields. Additional shading and water, used for cleaning the panels, could also influence the vegetation characteristics within the PV fields over time. Unfortunately there is no local baseline facility to infer results from and thus long term monitoring will improve understanding of these variables. A possible positive impact would be the additional electrical fencing, which could result in a decrease in stock theft.

In order to further mitigate the potential impacts it is highly recommended that periodic grazing of small stock (sheep and goats) is permitted within the PV fields. This mitigation minimises the loss of grazing land and reduces the overall impact on agricultural production. Unfortunately, cattle grazing would not be permitted within the PV fields as the animals could damage the PV panels. It is recommended that the PV sites are used as rotational grazing camps. The remaining, un-impacted land can continue to function as un-improved grazing land, its current use.

A simplified and generic phased construction approach and related mitigations are illustrated in **Figure 16**, where:

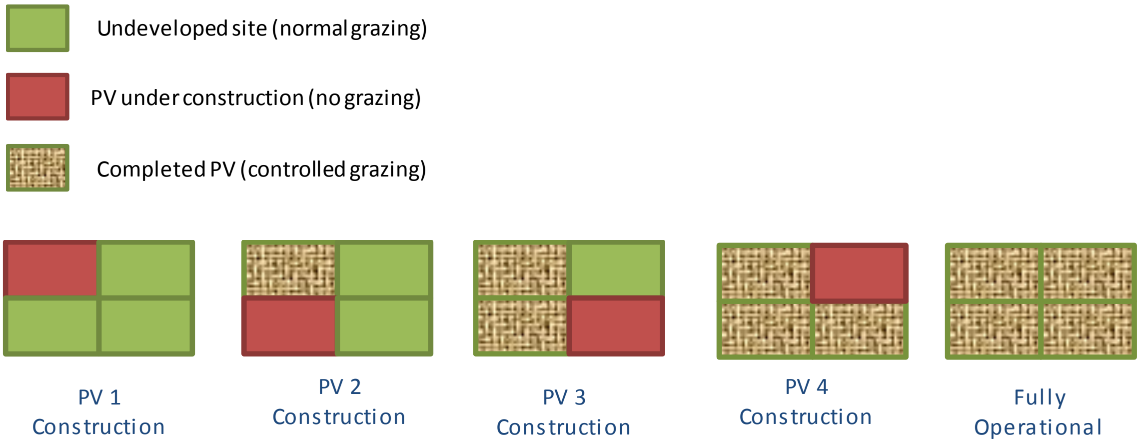

Figure 16: The proposed phased construction approach and grazing schedule (This simplified example is based on the construction of 4 PV facilities but can be adapted to any number of proposed PV facilities)

3.1.3 Cumulative Impacts

A number of solar and renewable energy projects have been proposed in the Copperton area, and thus, the cumulative impact of these developments on surrounding farms could become detrimental to local agricultural resources if the loss of usable grazing land is not taken into account when determining optimum herd size. A phased approach in combination with erosion control and land rehabilitation, within each farm, will reduce this impact. The inherently low agricultural potential of the region also reduces the overall cumulative impact and thus is considered to be of low significance.

3.1.4 Decommissioning Phase Impacts

Significant Loss of agricultural land and / or production is not envisioned during this phase of the project. However, standard soil erosion mitigation measures should be implemented during decommissioning. These measures are outlined in **Section 4** of this report.

3.2 Impact of the Transmission Lines and Associated Infrastructure

New 132 kV transmission lines would be constructed in order to connect the new solar PV facilities to the Eskom grid. Two routing alternatives have been proposed. According to spatial Land Use data and in-field verification, these routes are dominated by unimproved grazing land and natural veld. Owing to this, the crossing of this land by these power lines would have a very limited impact on agricultural production. Where the lines do cross farm land, normal grazing can still take place under the power lines. The only loss of agricultural land would be directly below the tower's footprint.

The remaining supporting infrastructure, *inter alia* road and water pipe line construction, is envisioned to have a negligible impact on agricultural resources and production.

3.3 Determination of Impact Significance: Methodology

Significance is determined through a synthesis of impact characteristics which include the context and the intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global) whereas Intensity is defined by the severity of the impact (e.g. the magnitude of deviation from background or baseline conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence). Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The rating system used in this assessment is based on **Aurecon's Methodology** and is summarised below:

For each impact, the EXTENT (spatial scale), MAGNITUDE and DURATION (time scale) would be described. These criteria would be used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place.

The tables below indicate the scale used to assess these variables, and defines each of the rating categories.

Table 3: Assessment criteria for the evaluation of impacts

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**Regional**	Beyond a 10 km radius of the candidate site.
	Local	Within a 10 km radius of the candidate site.
	Site specific	On site or within 100 m of the candidate site.
Magnitude of impact (at the indicated spatial scale)	**High**	Natural and/ or social functions and/ or processes are *severely* altered
	Medium	Natural and/ or social functions and/ or processes are *notably* altered
	Low	Natural and/ or social functions and/ or processes are *slightly* altered
	Very Low	Natural and/ or social functions and/ or processes are *negligibly* altered
	Zero	Natural and/ or social functions and/ or processes remain *unaltered*
Duration of impact	**Construction period**	Up to 4 years if PV facilities are constructed consecutively
	Short Term	Up to 5 years after construction
	Medium Term	5-15 years after construction
	Long Term	More than 15 years after construction

The SIGNIFICANCE of an impact is derived by taking into account the temporal and spatial scales and magnitude. The means of arriving at the different significance ratings is explained in **Table 4**.

Table 4: Definition of significance ratings

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
High	• High magnitude with a regional extent and long term duration • High magnitude with either a regional extent and medium term duration or a local extent and long term duration • Medium magnitude with a regional extent and long term duration
Medium	• High magnitude with a local extent and medium term duration • High magnitude with a regional extent and construction period or a site specific extent and long term duration • High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration • Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Low magnitude with a regional extent and long term duration
Low	• High magnitude with a site specific extent and construction period duration • Medium magnitude with a site specific extent and construction period duration • Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Very low magnitude with a regional extent and long term duration

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
Very low	• Low magnitude with a site specific extent and construction period duration • Very low magnitude with any combination of extent and duration except regional and long term
Neutral	• Zero magnitude with any combination of extent and duration

Once the significance of an impact has been determined, the PROBABILITY of this impact occurring as well as the CONFIDENCE in the assessment of the impact, would be determined using the rating systems outlined in **Table 5** and **Table 6** respectively. It is important to note that the significance of an impact should always be considered in concert with the probability of that impact occurring. Lastly, the REVERSIBILITY of the impact is estimated using the rating system outlined in **Table 7**.

Table 5: Definition of probability ratings

PROBABILITY RATINGS	CRITERIA
Definite	Estimated greater than 95 % chance of the impact occurring.
Probable	Estimated 5 to 95 % chance of the impact occurring.
Unlikely	Estimated less than 5 % chance of the impact occurring.

Table 6: Definition of confidence ratings

CONFIDENCE RATINGS	CRITERIA
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Table 7: Definition of reversibility ratings

REVERSIBILITY RATINGS	CRITERIA
Irreversible	The activity will lead to an impact that is in all practical terms permanent.
Reversible	The impact is reversible within 2 years after the cause or stress is removed.

3.4 Impact Summaries: Solar Energy Plants (Construction and Operational)

This impact summary investigates the construction and operational phase of the two layout options (preferred and alternative) tabled for Hoekplaas.

Table 8: Impact rating table for the loss of agricultural land and degradation of soil resources during the construction phase (**Preferred Layout)**

Preferred Layout: Construction Phase		
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	**Site specific**	**Site specific**
Magnitude	**Med**	**Low**
Duration	**Construction**	**Construction**
Significance rating	**Low**	**Low**
Probability	**Definite**	**Definite**
Confidence	**Sure**	**Sure**
Reversibility	**Irreversible**	**Reversible**
Mitigation measures	▪ A planned phased approach must be adopted. ▪ Allow normal agricultural activities to continue in unaffected areas. ▪ Stocking rates will need to be temporarily reduced during the construction phase in order to reduce the risk of overgrazing the remaining land portions. ▪ Initiate land rehabilitation and re-vegetation as soon as possible. ▪ Due to the overarching site characteristics, and the nature of the proposed development, the remaining viable mitigation measures are limited and will most likely revolve around erosion control: ➢ The provided soil erosion plan and associated recommendations should be employed. ➢ Clearing activities should be kept to a minimum. ➢ In the unlikely event that heavy rains are expected, activities should be put on hold to reduce the risk of erosion. ➢ If additional earthworks are required, any steep or large embankments that are expected to be exposed during the 'rainy' months should be armoured with fascine like structures[1]. ➢ If earth works are required then storm water control and wind screening should be undertaken to prevent soil erosion.	

➢ [1] A fascine structure usually consists of a natural wood material and is used for the strengthening of earthen structures or embankments.

Table 9: Impact rating table for the loss of agricultural land and degradation of soil resources during the construction phase (**Alternative Layout)**

Alternative Layout: Construction Phase		
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	**Site specific**	**Site specific**
Magnitude	**Med**	**Low**
Duration	**Construction**	**Construction**
Significance rating	**Low**	**Low**
Probability	**Definite**	**Definite**
Confidence	**Sure**	**Sure**
Reversibility	**Irreversible**	**Reversible**
Mitigation measures	▪ A planned phased approach must be adopted. ▪ Allow normal agricultural activities to continue in unaffected areas. ▪ Stocking rates will need to be temporarily reduced during the construction phase in order to reduce the risk of overgrazing the remaining land portions. ▪ Initiate land rehabilitation and re-vegetation as soon as possible. ▪ Due to the overarching site characteristics, and the nature of the proposed development, the remaining viable mitigation measures are limited and will most likely revolve around erosion control: ➢ The provided soil erosion plan and associated recommendations should be employed. ➢ Clearing activities should be kept to a minimum. ➢ In the unlikely event that heavy rains are expected, activities should be put on hold to reduce the risk of erosion. ➢ If additional earthworks are required, any steep or large embankments that are expected to be exposed during the 'rainy' months should be armoured with fascine like structures. ➢ If earth works are required then storm water control and wind screening should be undertaken to prevent soil erosion.	

Table 10: Impact rating table for the loss of agricultural land and degradation of soil resources during the operational phase (**Preferred Layout)**

Preferred Layout: Operational Phase		
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	**Site specific**	**Site specific**
Magnitude	**Medium**	**Very Low**
Duration	**Long Term**	**Long Term**
Significance rating	**Medium**	**Very Low**
Probability	**Definite**	**Definite**
Confidence	**Sure**	**Sure**
Reversibility	**Irreversible**	**Reversible**
Mitigation measures	▪ Initiate land rehabilitation and re-vegetation as soon as possible and continue to monitor land for early signs of degradation and erosion. ▪ It is recommended that more palatable species form part of the re-vegetation plan to enable faster stocking initiation. Pertinent plant species should be obtained from a vegetation specialist when the site specific EMP is compiled. ▪ Allow normal agricultural activities to continue in unaffected areas. ▪ Allow periodic grazing within the PV fields (sheep and goats). The stocking rates within the PV fields will need to be determined on a seasonal basis, depending on the vegetation characteristics and carrying capacity of each PV field. This mitigation will minimise the loss of grazing land and reduce the impact on agricultural production. It is recommended that the proposed PV Fields are used as rotational grazing camps.	

Table 11: Impact rating table for the loss of agricultural land / production and degradation of soil resources during the operational phase (**Alternative Layout)**

Alternative layout: Operational Phase		
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	**Site specific**	**Site specific**
Magnitude	**Medium**	**Very Low**
Duration	**Long Term**	**Long Term**
Significance rating	**Medium**	**Very Low**
Probability	**Definite**	**Definite**
Confidence	**Sure**	**Sure**
Reversibility	**Irreversible**	**Reversible**
Mitigation measures	▪ Initiate land rehabilitation and re-vegetation as soon as possible and continue to monitor land for early signs of degradation and erosion. ▪ It is recommended that more palatable species form part of the re-vegetation plan to enable faster stocking initiation. Pertinent plant species should be obtained from a vegetation specialist when the site specific EMP is compiled. ▪ Allow normal agricultural activities to continue in unaffected areas. ▪ Allow periodic grazing within the PV fields (sheep and goats). The stocking rates within the PV fields will need to be determined on a	

	seasonal basis, depending on the vegetation characteristics and carrying capacity of each PV field. This mitigation will minimise the loss of grazing land and reduce the impact on agricultural production. It is recommended that the proposed PV Fields are used as rotational grazing camps.

3.5 Impact Assessment: 132kV Transmission Lines (Construction and Operational)

Due to the nature of the development, the construction and operational phases have been combined for this particular activity.

Table 13: Impact rating table for construction and operation of a 132 kV Transmission Lines (**Route 1 Preferred: Kronos Substation**)

Route 1: Preferred		
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	**Local**	**Local**
Magnitude	**Very Low**	**Very Low**
Duration	**Long Term**	**Long Term**
Significance rating	**Very Low**	**Very Low**
Probability	**Definite**	**Definite**
Confidence	**Certain**	**Certain**
Reversibility	**Reversible**	**Reversible**
Mitigation measures	▪ Due to the overarching route characteristics, and the nature of the proposed development, viable mitigation measures are limited and will most likely revolve around erosion control: ➢ Clearing activities should be kept to a minimum. ➢ In the unlikely event that heavy rains are expected, activities should be put on hold to reduce the risk of erosion. ➢ If additional earthworks are required, any steep or large embankments that are expected to be exposed during the 'rainy' months should be armoured with fascine like structures. ▪ If earth works are required then storm water control and wind screening should be undertaken to prevent soil erosion. ▪ Interact with landowners during the routing process.	

Table 14: Impact rating table for construction and operation of a 132 kV Transmission Lines (**Route 2 Alternative: Cuprum Substation**)

Route 2: Alternative		
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	**Local**	**Local**
Magnitude	**Very Low**	**Very Low**
Duration	**Long Term**	**Long Term**
Significance rating	**Very Low**	**Very Low**
Probability	**Definite**	**Definite**
Confidence	**Certain**	**Certain**
Reversibility	**Reversible**	**Reversible**
Mitigation measures	▪ Due to the overarching route characteristics, and the nature of the proposed development, viable mitigation measures are limited and will most likely revolve around erosion control: ➢ Clearing activities should be kept to a minimum. ➢ In the unlikely event that heavy rains are expected, activities should be put on hold to reduce the risk of erosion. ➢ If additional earthworks are required, any steep or large embankments that are expected to be exposed during the 'rainy' months should be armoured with fascine like structures. ▪ If earth works are required then storm water control and wind screening should be undertaken to prevent soil erosion. ▪ Interact with landowners during the routing process.	

3.6 Preferred Alternatives

It is evident that should the mitigation measures outlined above are implemented, then the proposed activities would have a low impact on current agricultural production and soil resources. From an agricultural perspective the entire site is suitable for the proposed development, as no high potential agricultural land will be impacted. A visual comparison between the PV layouts (preferred and alternative) and transmission line routings (preferred and alternative) is provided in **Figures 17 – 20**.

From an agricultural perspective the post-mitigation impact scores are similar for the preferred and alternative layouts. However, the **Preferred Layout** is more desirable. The preferred layout influences around 53% of the total farm area (4971 ha), compared to the 72% coverage of the alternative layout. The preferred layout would also allow normal agricultural activities to continue for longer and on greater portions of the remaining farm. A possible positive impact would be the additional electrical fencing, which could result in a decrease in stock theft. The proposed phased approach would also reduce cumulative impacts and should also allow for easier site management, rehabilitation and grazing scheduling. The preferred layout further precludes the major drainage lines and pans, which are associated with the highest grazing potential.

The land use data indicates that both Alignment Alternatives (1 and 2) share virtually identical agricultural potential and value, and are both suitable to accommodate the proposed transmission lines. However, **Route 1** (preferred) is recommended as it represents the shortest proposed power line route, which will minimise disturbance.

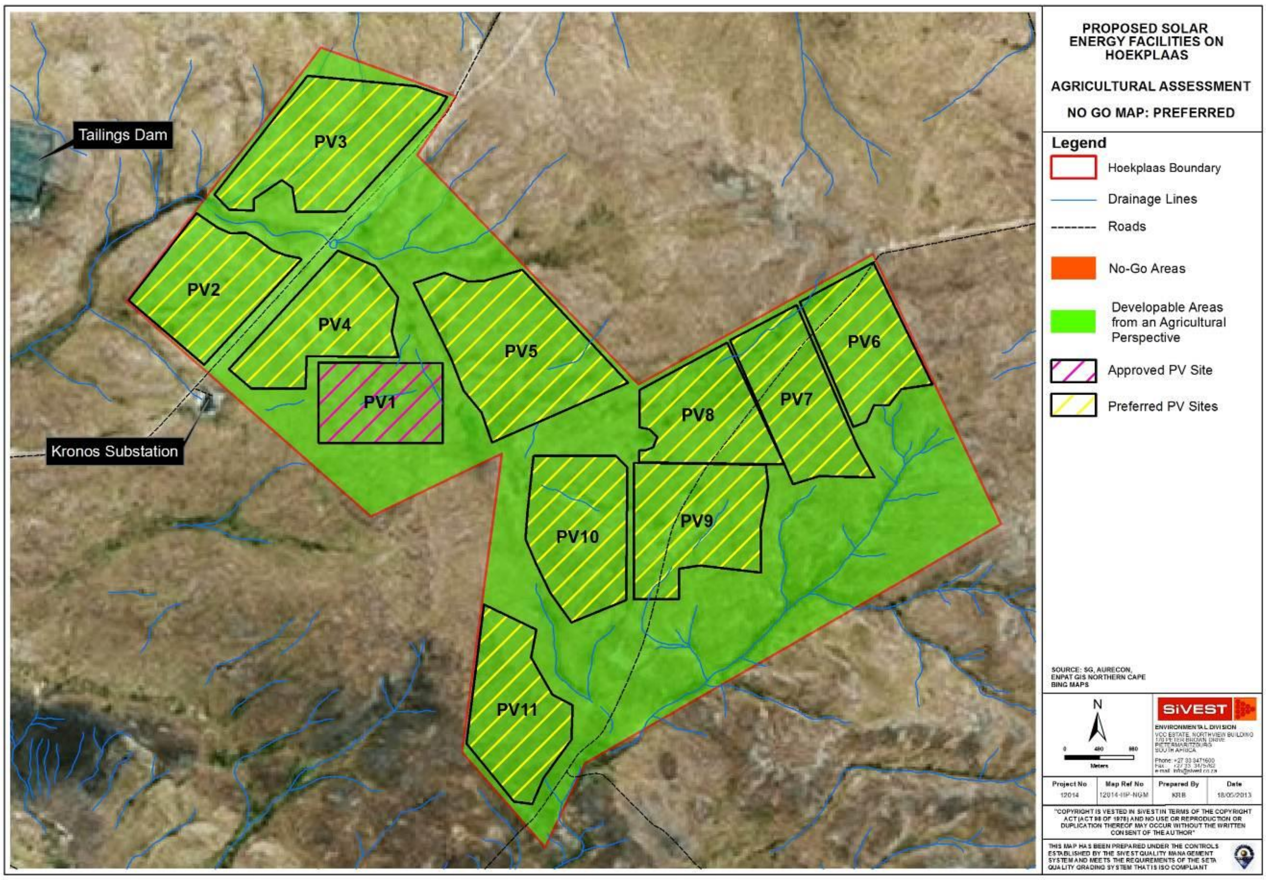

Figure 17: No Go Map with preferred layout

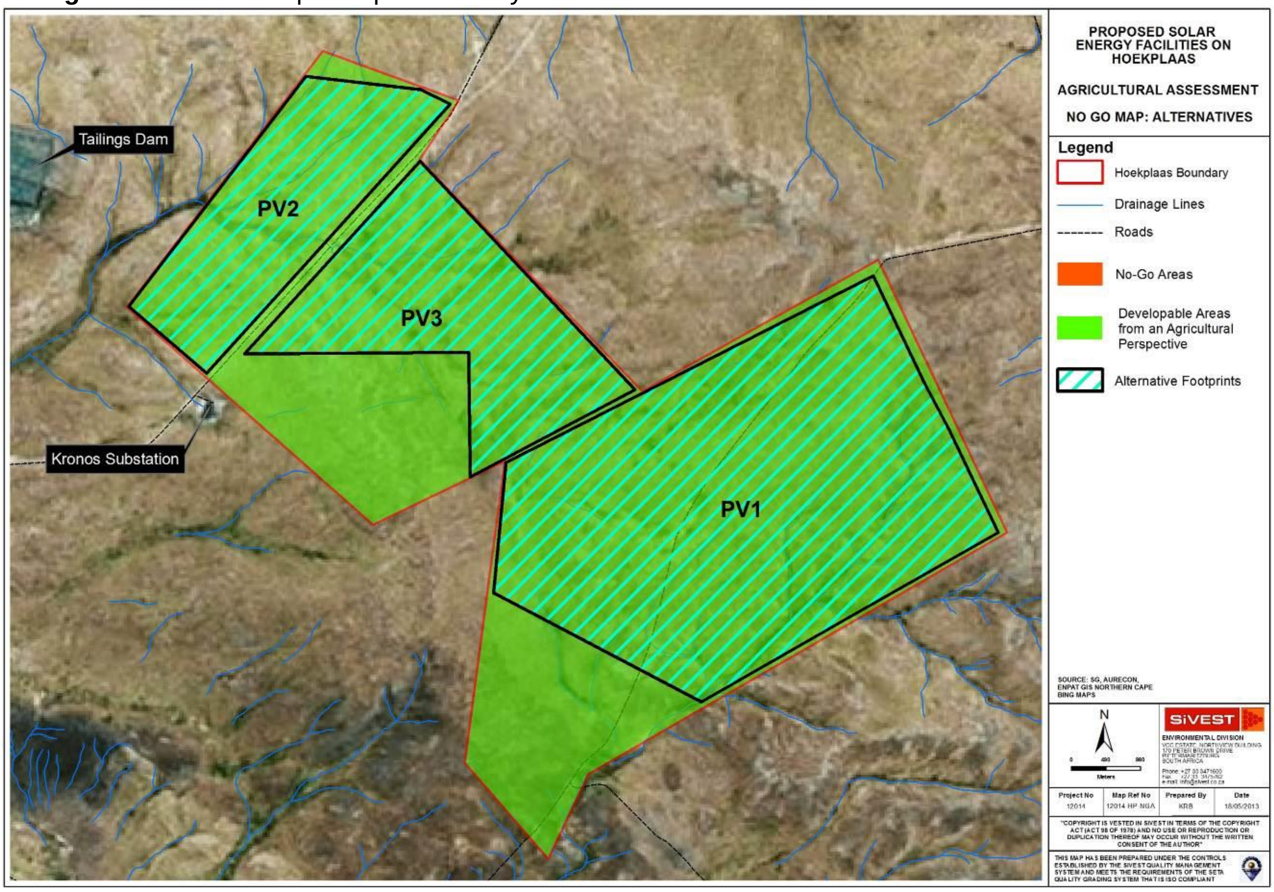

Figure 18: No Go Map with Alternative Layout

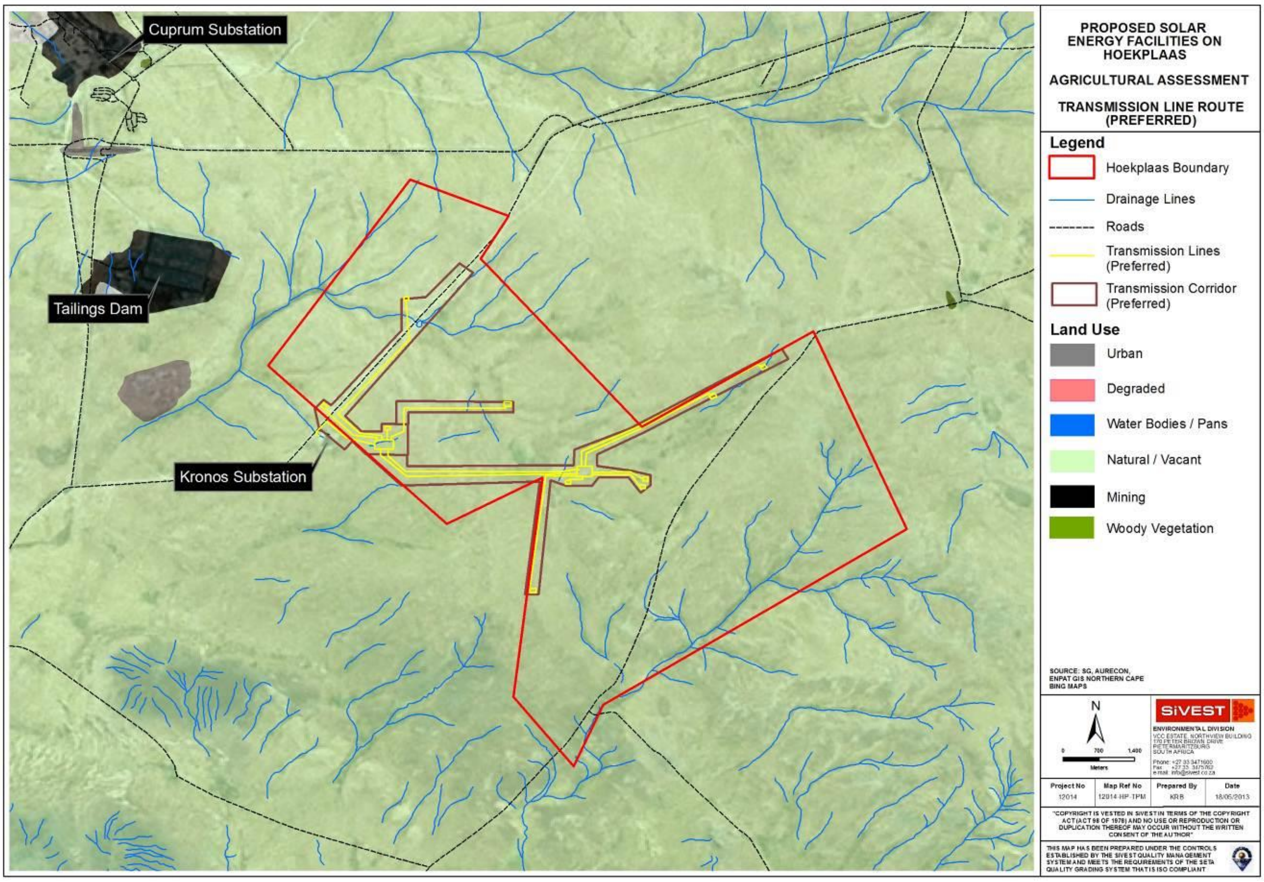

Figure 19: Preferred 132 kV transmission line route

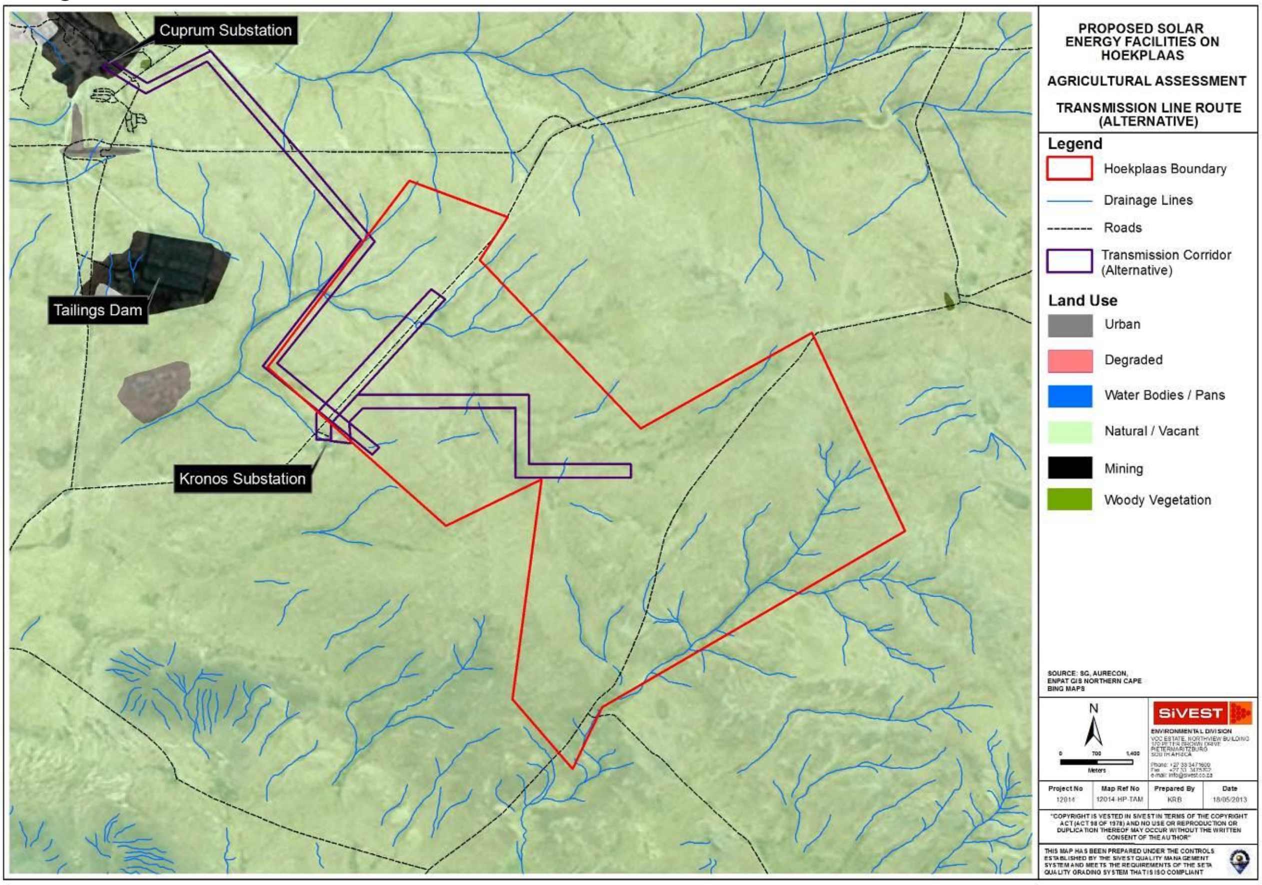

Figure 20: Alternative 132 kV transmission line route

4. EROSION MANAGEMENT PLAN

Soil is a natural resource, is non-renewable in the short term and is expensive either to reclaim or improve following degradation (**van Lynden & Oldeman, 1997**). Even though the areas directly affected by the proposed developments have low agricultural value and capability, the activities still have the potential to negatively impact the immediate and surrounding soil and land resources. The ***International Soil Reference and Information Centre*** **(ISRIC)**, the producers of the World Map of Human-Induced Soil Degradation, recognises two categories of human-induced soil degradation processes.

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

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

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

A single or combination of the aforementioned degradations leads to a decrease in soil quality/health, which in turn influences land capability ratings (**ISRIC, 1990**). Due to the proposed activities this management plan focuses primarily on soil erosion however generic soil contamination mitigations are provided in **Section 7.3**.

4.1 Soil Erosion Monitoring

Due to the size of the site and without rigorous scientific methods and equipment, soil erosion would need to be monitored visually by the appointed Environmental Control Officer (ECO)[2] during the construction phase. Soil erosion is a natural process, whose rate and intensity can be anthropogenically increased. Excessive erosion can lead to land degradation and the reduction of the area's carrying capacity. It is recommended that areas around roads, stockpiles and PV panels are visually monitored during audits. A photographic record of the on-site conditions would also aid in the identification of erosion problems. Signs of rill and gully erosion should be remediated as soon as possible. Typical remediation techniques are provided in **Section 4.2**, below.

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

4.2 Proposed Soil Erosion Mitigatory Measures

Clearing activities should be kept to a minimum and must only be undertaken during agreed working times, as well as permitted weather conditions. If heavy rains are expected clearing activities should be put on hold. In this regard, the contractor must be aware of weather forecasts. Unnecessary removal of groundcover vegetation from slopes must be prevented, especially on steep slopes (greater than 10%). Following the clearing of an area, the surfaces of all exposed slopes must be roughened to retain water and increase infiltration (especially important during the wet season). Any steep or large embankments that are expected to be exposed during the 'rainy' months should either be armoured with fascine like structures or vegetated. If a cleared area is not going to be built on immediately, the top layer (nominally 150 mm) of soil should be removed and stockpiled in a designated area approved by the ECO. Vegetation shall be stripped in a sequential manner as the work proceeds so as to reduce the time that stripped areas are exposed to the elements. Top-soiling and re-vegetation shall start immediately after the completion of an activity and at an agreed distance behind any particular work front. It is highly recommended that existing farm roads are used as much as possible, while the additional creation of access roads should be kept to a minimum.

Storm water control and wind screening should be undertaken to prevent soil loss from the site. All embankments shall be protected by a cut off drain to prevent water from running down the face of the embankment, resulting in soil erosion. Typical erosion control measures such as the installation of silt fences, hay bales, EcoLogs™ and Bio Jute™ are recommended if erosion problems are noted during construction and operation phases (**Figure 20**).

Figure 21: Typical soil erosion mitigatory measure: BioJute Installtion (**top left**); a silt fence protecting a stockpile (**top right**) and pegged hay bale wall used to reduce runoff velocities (**bottom**)

4.3 Proposed Groundwater and Soil Contamination Mitigatory Measures

Every precaution must be taken to ensure that chemicals and hazardous substances do not contaminate the soil or groundwater on site.

For this purpose the Contractor must:

- Ensure that the mixing /decanting of all chemicals and hazardous materials should take place on a tray or impermeable surface.
- Dispose of any generated waste at a registered landfill site.
- Ensure all storage tanks are designed and managed in order to prevent pollution of drains, groundwater and soils.
- Construct separate storm water collection areas and interceptors at storage tanks, and other associated potential pollution activities.
- Ensure control of fuels and chemicals in order to prevent spillage and potential ground leaching. Adequate spillage containment measures shall be implemented, such as cut off drains, etc. Fuel and chemical storage containers shall be set on a concrete plinth. The containment capacity shall be equal to the full amount of material stored, plus 10%.
- Appoint appropriate contractors to remove any residue from spillages from site. Handling, storage and disposal of excess or containers of potentially hazardous materials shall be in accordance with the requirements of pertinent Regulations and Acts (e.g. Hazardous Substances Act, Number 15 of 1973; National Water Act, Number 36 of 1998)
- Ensure that used oils/lubricants are not disposed of on/near the site, and that contractors purchasing these materials understand the liability under which they must operate. The ECO will be responsible for reporting the storage/use of any other potentially harmful materials to the relevant authority.
- Ensure that potentially harmful materials are properly stored in a dry, secure environment, with concrete or sealed flooring. The ECO will ensure that materials storage facilities are cleaned/maintained on a regular basis, and that leaking containers are disposed of in a manner that allows no spillage onto the bare soil or surface water. The management of such storage facilities and means of securing them shall be agreed upon.
- Site staff shall not be permitted to use any stream, river, other open water body or natural water source adjacent to or within the designated site for the purposes of bathing, washing of clothing or for any other construction or related activities. Municipal water or another source approved by the ECO should rather be used for all activities such as washing of equipment, dust suppression, concrete mixing and compacting.

4.4 Stockpile Management

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

Subsoil and topsoil stockpiles shall be moved to areas of final utilisation as soon as possible to avoid unnecessary erosion. Any stockpile(s) not utilised within three months of the initial stripping process (or prior to the onset of seasonal rains) shall be seeded with appropriate grass seed mixes, including indigenous grasses, to further avoid possible erosion.

4.5 Land Rehabilitation

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

After construction the land shall need to be rehabilitated, which includes a re-vegetation plan. It is recommended that more palatable species are planted to enable the faster stocking initiation.

5. SUMMARY AND RECOMMENDATIONS

Aurecon on behalf of Mulilo requested an agricultural impact assessment for the area affected by the proposed solar energy facility on the farm Hoekplaas 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 Impact Assessment (EIA) 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.

An original soil and agricultural report was undertaken for Hoekplaas (Remainder of Farm No. 146) in February 2012. Environmental Authorisation for a 100 MW Photovoltaic (PV) solar energy facility, known as Hoekplaas PV1, and associated infrastructure was granted for this for this project in January 2013. Mulilo is now investigating an additional ten PV plants of 75 MW AC each on farm Hoekplaas. Alternatively, three PV plants of 225 MW AC, 290 MW AC and 500 MW AC, respectively, are proposed on the same farm.

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.

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

From an agricultural perspective the post-mitigation impact scores are similar for the preferred and alternative layouts. However, the **Preferred Layout** is more desirable. The preferred layout influences around 53% of the total farm area (4971 ha), compared to the 72% coverage of the alternative layout. The preferred layout would also allow normal agricultural activities to continue for longer and on greater portions of the remaining farm. The proposed phased approach would also reduce cumulative impacts and should allow for easier site management, rehabilitation and grazing scheduling. The preferred layout further precludes the major drainage lines, which are associated with the highest grazing potential.

The land use data indicates that both Alignment Alternatives (1 and 2) share virtually identical agricultural potential and value, and are both suitable to accommodate the proposed transmission lines. However, **Route 1** (preferred) is recommended as it represents the shortest proposed power line route, which would minimise disturbance.

<u>If the suggested mitigation measures and erosion management plan are correctly implemented there is no reason why the proposed solar energy facilities and supporting infrastructure cannot be accommodated on the farm Hoekplaas.</u>

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