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Agricultural Agro-Ecosystem Assessment for proposed Ilikwa Solar PV Facility

Submitted by TerraAfrica Consult cc

Mariné Pienaar

11 September 2021

DOCUMENT AND QUALITY CONTROL

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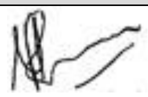
Draft for Comment	Mariné Pienaar	Report Author		11/09/2021

Specialist Declaration

I, Mariné Pienaar , declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

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Mariné Pienaar

TerraAfrica Consult CC

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1. Introduction

Terra-Africa Consult cc was appointed by SLR Consulting (South Africa) (Pty) Ltd (SLR) to conduct the Agricultural Agro-Ecosystem Assessment for the proposed Ilikwa Solar PV Facility. The report is part of the studies required for the Environmental Impact Assessment process required for the Environmental Authorisation (EA) of renewable energy projects. The applicant of the project is South Africa Mainstream Renewable Power Developments (Pty) Ltd. The proposed project will consist of the construction and operation of a $150MW_{ac}$ Photovoltaic (PV) Solar Energy Facility, Battery Energy Storage System (BESS) and associated infrastructure. The solar facility will have a contracted capacity of up to $150MW_{ac}$ and will be connected to a grid connection that is subject to a different authorisation process.

The project site is 280.5 ha in extent and located on Portion 5 of the farm Proceederfontein 100. Within the identified project site, the proposed development footprint will be constructed on 162 ha of land. The project site is located around 19 km north-east of Parys and 19 km west of Sasolburg (refer to Figure **1**) and falls within Ward 7 of the Ngwathe Local Municipality of the Free State Province. It is located south of the Vaal River and the N1 national road is located east of it. Access to the project site is provided via an unnamed road gravel road that connects to the Boundary Road.

The site falls within an area that has been identified as the Central Strategic Transmission Corridor, a node for the development and expansion of large-scale electricity and grid connection infrastructure, i.e., power lines and substations, etc. The proposed Ilikwa Solar PV is one of four PV facilities that will collectively be referred to as the Scafell Cluster project. The Scafell Cluster project will also include grid connection infrastructure including four on-site substations (each located within the project site of a PV facility) as well as 132kV power lines that will connect each of these substations to the Scafell Main Transmission Substation (MTS).

2. Details of the specialist

Mariné is a scientist registered with the South African Council for Natural Scientific Professions (SACNASP) and is specialised in the fields of Agricultural Science and Soil Science. Her SACNASP Registration Number is 400274/10. Mariné holds a BSc. degree in Agricultural Science (with specialisation in Plant Production) from the University of Pretoria and a MSc. Degree in Environmental Science from the University of the Witwatersrand. She has consulted in the subject fields of soil, agriculture, pollution assessment and land use planning for the environmental sector of several African countries including Botswana, Mozambique, Democratic Republic of Congo, Liberia, Ghana and Angola. She has also consulted on the soil and agricultural assessment of a gas infrastructure project in Afghanistan. Her contact details are provided in Appendix 1 attached.

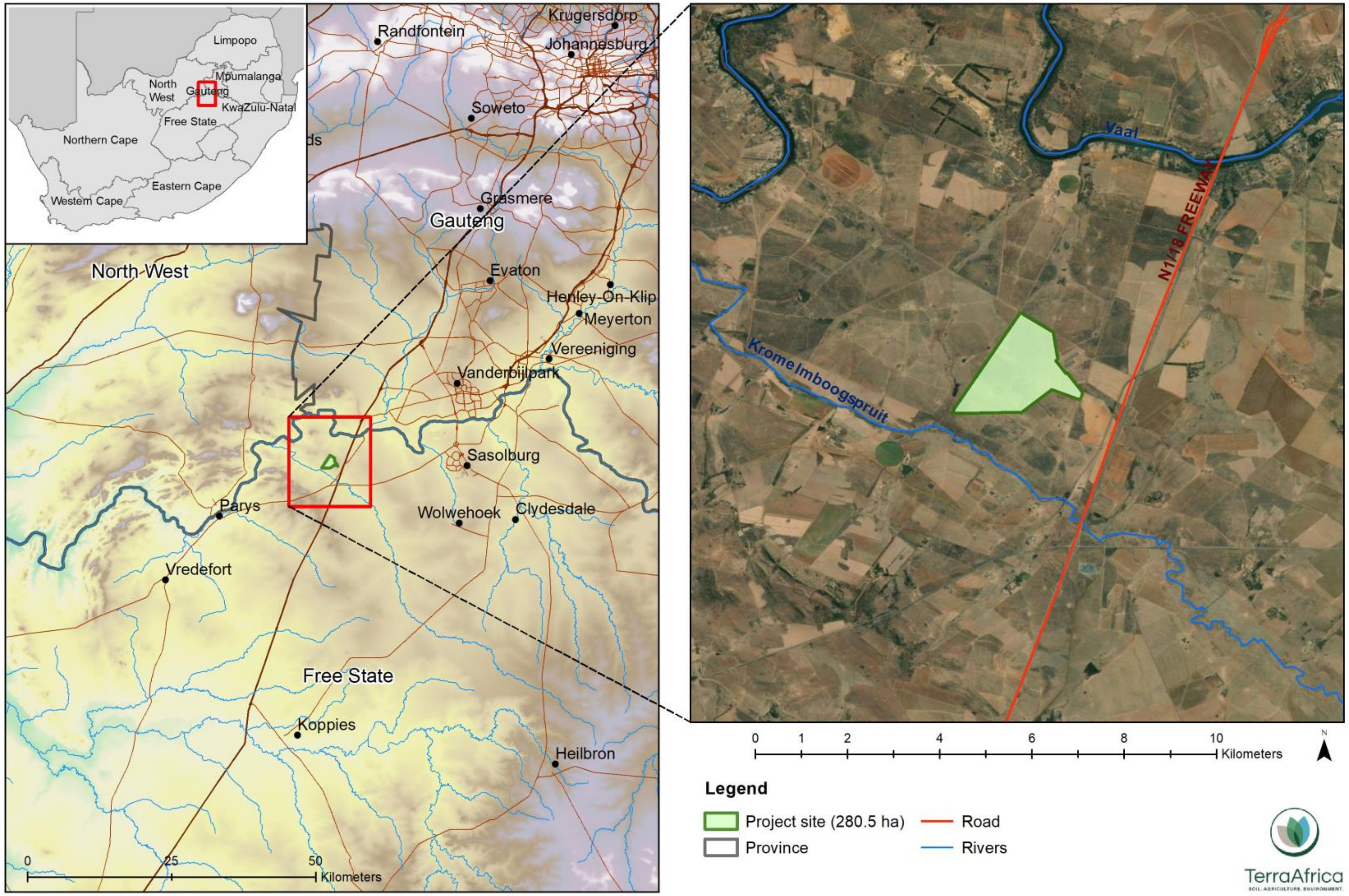

Figure 1 Locality of the proposed Ilikwa PV Facility

3. Project description

The Scafell Cluster project will consist of four individual projects located on four different land parcels. The layout of the proposed projects are illustrated in Figure **2**. Each of these facilities will also include an on-site substation of approximately four hectares that will be located within the development area of the facility. The energy generated at each facility will feed into the national electricity grid through an overhead powerline Scafell Main Transmission Substation (MTS) that is located south of the Scafell Solar PV Facility and east of the Ilikwa Solar PV Facility.

The Ilikwa project site forms the southern part of the Scafell Cluster project's total area. The proposed Ilikwa Solar PV Facility's development footprint will include the following infrastructure:

- Up to 154 440 PV panels with panel height up to 3 m and total capacity of up to $150MW_{ac}$;
- Battery Energy Storage System (BESS) of up to 1 ha in extent. The batteries will either be Solid State or Redox Flow Batteries;
- Laydown area of up to 3 ha
- Temporary construction camp
- Offices
- Operations and Control Centre
- Substation with a capacity of up to 33 / 132 kV and a footprint of up to 2.5 ha
- Substation Building
- Operation and Maintenance Area / Warehouse / Workshop
- Ablution Facilities
- Security and Guard House
- Perimeter Fence and Lighting
- Lightening protection infrastructure
- Telecommunication infrastructure

Supporting infrastructure will include a main access road of 2.5 km long and up to 8 m wide as well as a network of internal access roads with a length of 12 km and 5 m wide.

4. Purpose and objectives of the assessment

The overarching purpose of the Agricultural Agro-Ecosystem Specialist Assessment (from here onwards also referred to as the Agricultural Assessment) that will be included in the final Environmental Impact Assessment Report, is to ensure that the sensitivity of the site to the proposed land use change (from agriculture to renewable energy generation) is sufficiently considered. Also, that the information provided in this report, enables the Competent Authority to come to a sound conclusion on the impact of the proposed project on the food production potential of the site.

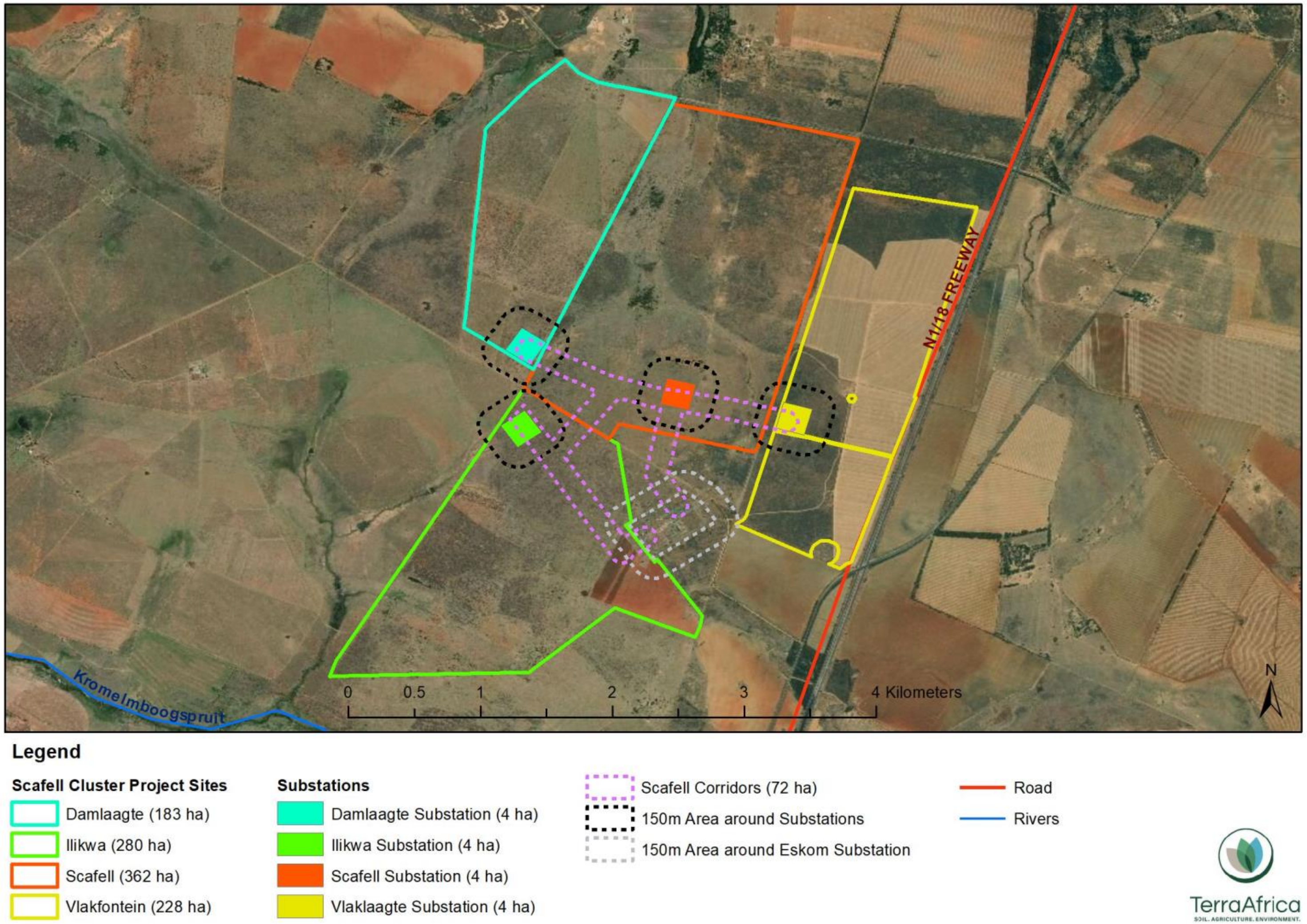

Figure 2: Position of the Ilikwa PV Facility in relation to the other project sites of the proposed Scafell Cluster project

To meet this objective, site sensitivity verification must be conducted of which the results must meet the following objectives:

- It must confirm or dispute the current land use and the environmental sensitivity as was indicated by the National Environmental Screening Tool.
- It must contain proof of the current land use and environmental sensitivity pertaining to the study field.
- All data and conclusions are submitted together with the Environmental Impact Assessment report for the proposed Ilikwa Solar PV Facility.

According to GN320, the Agricultural Agro-Ecosystem Assessment that is submitted must meet the following requirements:

- It must identify the extent of the impact of the proposed development on the agricultural resources.
- It has to indicate whether or not the proposed development will have an unacceptable impact on the agricultural production capability of the site, and in the event where it does, whether such a negative impact is outweighed by the positive impact of the proposed development on agricultural resources.

The following checklist is supplied as per the requirements of GNR 320, detailing where in the report the various requirements have been addressed:

GNR 320 requirements of an Agricultural Agro-Ecosystem Statement (High to Very High Sensitivity)	**Reference in this report**
Details and relevant experience as well as the SACNASP registration number of the soil scientist or agricultural specialist preparing the assessment including a curriculum vitae;	Page ii and Appendix 1
A signed statement of independence by the specialist;	Page ii
The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 8.2
A description of the methodology used to undertake the on-site assessment inclusive of the equipment and models used, as relevant;	Section 8.2
A map showing the proposed development footprint (including supporting infrastructure) with a 50m buffered development envelope, overlaid on the agricultural sensitivity map generated by the screening tool;	Section 5, Figure **3**
An indication of the potential losses in production and employment from the change of the agricultural use of the land as a result of the proposed development;	Section 10
An indication of possible long term benefits that will be generated by the project in relation to the benefits of the agricultural activities on the affected land;	Section 10.2
Additional environmental impacts expected from the proposed development based on the current status quo of the land including erosion, alien vegetation, waste, etc.;	Section 12
Information on the current agricultural activities being undertaken on adjacent land parcels;	Section 9.4

A motivation must be provided if there were development footprints that were identified as having a "medium" or "low" agriculture sensitivity and that were not considered appropriate;	Sections 11.1 and 11.2
Confirmation from the soil scientist or agricultural specialist that all reasonable measures have been considered in the micro-siting of the proposed development to minimise fragmentation and disturbance of agricultural activities;	Section 11
A substantiated statement from the soil scientist or agricultural specialist with regards to agricultural resources on the acceptability or not of the proposed development and a recommendation on the approval or not of the proposed development;	Section 14
Any conditions to which this statement is subjected;	Sections 12 and 14
Where identified, proposed impact management outcomes or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr);	Section 13
A description of the assumptions made and any uncertainties or gaps in knowledge or data;	Section 7
Calculations of the physical development footprint area for each land parcel as well as the total physical development footprint area of the proposed development (including supporting infrastructure);	Table 5
Confirmation whether the development footprint is in line with the allowable development limits set in Table 1 above, including where applicable any deviation from the set development limits and motivation to support the deviation, including: a) Where relevant, reasons why the proposed development footprint is required to exceed the limit; b) Where relevant, reasons why this exceedance will be in the national interest; and c) Where relevant, reasons why there are no alternative options available including evidence of alternatives considered; and	Section 11.3, Table 6
A map showing the renewable energy facilities within a 50km radius of the proposed development.	Section 13, Figure **23**

5. Legislative framework for the assessment

The report follows the protocols as stipulated for the Agricultural Assessment in Government Notice 320 of 2020 (GN320). This Notice provides the procedures and minimum criteria for reporting in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (No. 107 of 1998) (from here onwards referred to as NEMA). It replaces the previous requirements of Appendix 6 of the Environmental Impact Assessment Regulations of NEMA.

In addition to the specific requirements for this study, the following South African legislation is also considered applicable to the interpretation of the data and conclusions made with regards to environmental sensitivity:

- The Conservation of Agricultural Resources (Act 43 of 1983) states that the degradation of the agricultural potential of soil is illegal. This Act requires the protection of land against soil erosion and the prevention of water logging and salinisation of soils by means of suitable soil conservation works to be constructed and maintained. The utilisation of marshes, water sponges and watercourses are also addressed.

- Section 3 of the Subdivision of Agricultural Land Act 70 of 1970 may also relevant to the development.
- In addition to this, the National Water Act (Act 36 of 1998) deals with the protection of water resources, including wetlands. This legislation is considered for the purpose of identifying hydric soils with wetland functionality within the study area (should it be present).

6. Agricultural Sensitivity

For the purpose of the assessment, the project site of the Ilikwa Solar PV Facility, was screened for agricultural sensitivity using the National Environmental Screening Tool (www.screening.environment.gov.za). The screening report was generated by SLR on 6 May 2021 and presented as Figure 3. The requirements of GN320 stipulates that a 50m buffered development envelope must be assessed with the screening tool. While the development areas were used for the screening, the surrounding area is also visible in each map (which shows a buffered area of 1km or more around the development area boundary).

According to Figure 3, the Ilikwa development area consists largely of land with Medium agricultural sensitivity. Three separate areas that run in northwest-southeast direction, has High sensitivity while the south-western corner of the site has Low sensitivity.

Approximately three-quarters of the area has High sensitivity while the most southern part has Medium sensitivity. The areas directly west, south, north-east of north of the project site, is land with Medium sensitivity with interspersed with blocks of land with High sensitivity.

7. Assumptions, uncertainties and information gaps

The following assumptions and limitations are associated with this report:

- It is assumed that the development footprint will remain within the property boundaries of the development area.
- Although a preliminary layout of the PV infrastructure has been provided, it is assumed that further technical studies of the area that will be undertaken, may influence the final micro-siting of infrastructure. However, the size of the development footprint will not change and will not exceed the project site boundaries.

No other information gaps or uncertainties are identified.

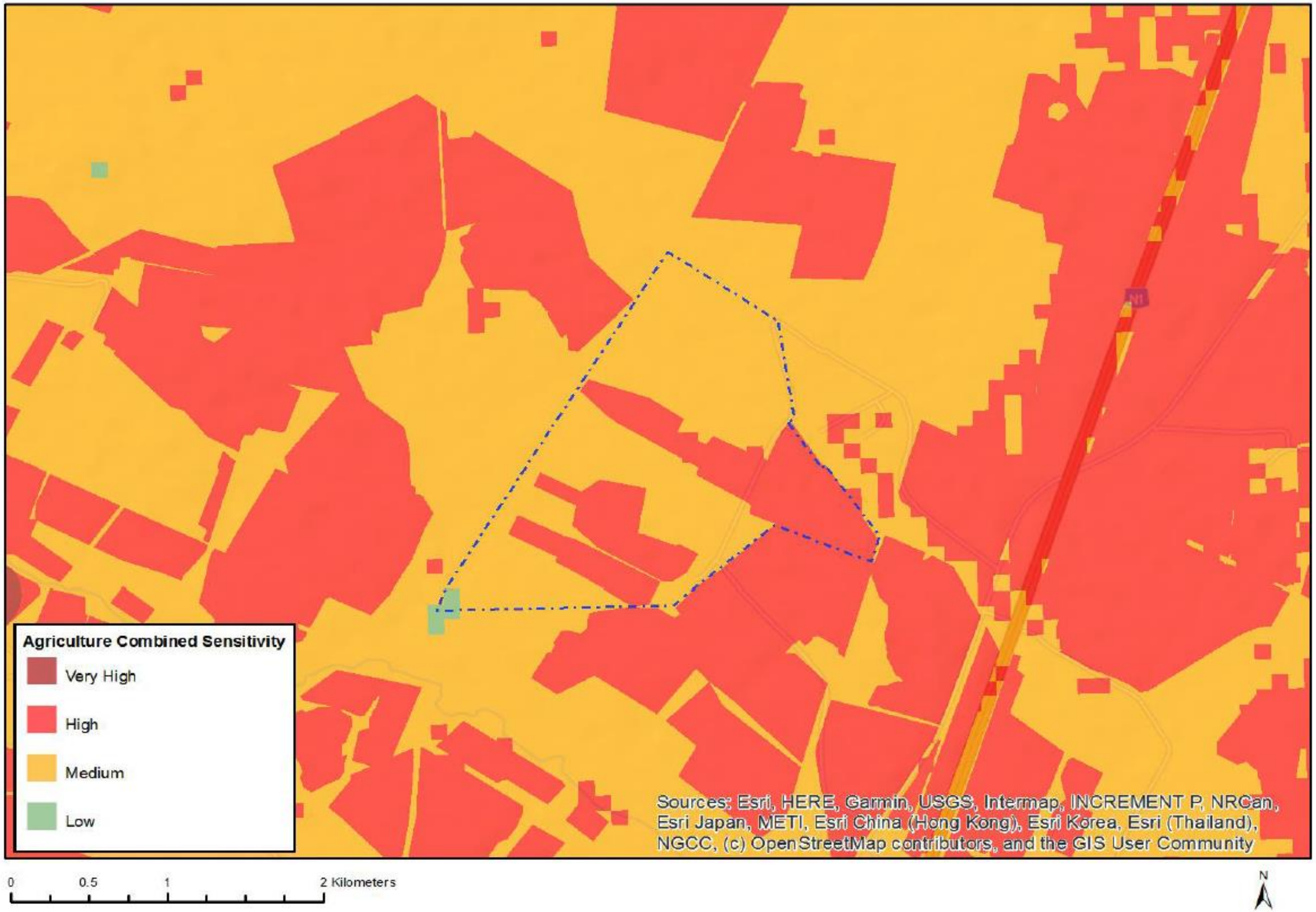

Figure 3 Relative Agricultural Sensitivity from DFFE's Screening Tool of the Ilikwa Solar PV Facility area (generated by SLR, 06 May 2021)

8. Methodology

8.1 Desktop analysis of satellite imagery and other spatial data

The most recent aerial photography of the area available from Google Earth was obtained. The satellite imagery was analysed prior to the site visit to determine any areas of existing impacts and land uses within the Ilikwa project site as well as the surrounding areas. It was also scanned for any areas where crop production and farming infrastructure may be present. To get a comprehensive overview of the natural resources that contribute to the agro-ecosystem of the proposed project site, the following spatial data was analysed:

- The climate capability data layer that is part of the land capability data layer (a sub-set) that shows the climate capability evaluation values of an area (DALRRD, 2016). The data used as input for the climate capability layer was obtained from the South African Atlas of Agro-Hydrology and Climatology (Schulze, 2007).
- The National Land Capability Evaluation Raster Data Layer was obtained from the DAFF to determine the land capability classes of the project area according to this system. The data was developed using a spatial evaluation modelling approach (DAFF, 2017).
- The long-term grazing capacity for South Africa 2018 was analysed for the area and surrounding area of the project assessment zone. This data set includes incorporation of the RSA grazing capacity map of 1993, the Vegetation type of SA 2006 (as published by Mucina L. & Rutherford M.C.), the Land Types of South Africa data set as well as the KZN Bioresource classification data. The values indicated for the different areas represent long term grazing capacity with the understanding that the veld is in a relatively good condition.
- The Free State Field Crop Boundaries (November 2019) was analysed to determine whether the proposed project assessment zone falls within the boundaries of any crop production areas. The crop production areas may include rainfed annual crops, non-pivot and pivot irrigated annual crops, horticulture, viticulture, old fields, small holdings and subsistence farming.
- Land type data for the project assessment zone was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC) (Land Type Survey Staff, 1972 – 2006). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units.

8.2 Site assessment

The development area was visited twice. The first site visit was on 3 and 4 March 2021 (autumn) as well as on 24 and 25 June 2021 (winter). The site assessment included a soil classification survey, the collection of soil samples as well as the collection of photographic evidence about the current land uses. The season has no effect on the outcome of the assessment. The soil profiles were examined to a maximum depth of 1.5 m or the point of refusal using a hand-held soil auger. Observations were made regarding soil texture, structure, colour and soil depth at each survey point. A cold 10% hydrochloric acid solution was used on site to test for the presence of carbonates in the soil. The soils are described using the S.A. Soil Classification: A Natural and Anthropogenic System for South Africa (Soil Classification Working Group, 2018). For soil mapping of the areas assessed in detail, the soils were grouped into classes with relatively similar soil characteristics. The locality of each of the survey points, are indicated in Figure 4 below. Photographic evidence of soil properties, current land uses and other evidence were taken with a digital camera.

8.3 Analysis of samples

Four topsoil samples were collected at four of the survey points. The soil was stored and sealed in a clean sampling bag and submitted to Van's Lab in Bloemfontein for analysis. Samples were analysed for the following parameters:

- pH (using potassium chloride);
- Major cationic plant nutrients (calcium, magnesium, potassium, sodium) using ammonium acetate;
- Plant-available phosphorus (using Bray 1 extract); and
- Texture (using the three-sieve technique to determine the particle size distribution).

8.4. Agricultural income and employment

The development area, is used for extensive livestock farming only and has been used for this purpose at least the last five years, as was evident by the analysis of historical aerial imagery. Therefore, the spatial data layer of the long-term grazing capacity of the area (DAFF, 2018), was used for the calculations of the potential agricultural gross income of the land as well as the agricultural employment opportunities that it provides.

8.5. Impact assessment methodology

Below are the tables with the steps followed to do the impact rating according to the methodology prescribed by SLR.

PART A: DEFINITIONS AND CRITERIA*		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of intensity, spatial extent and duration**
Criteria for ranking of the INTENSITY of environmental impacts	**VH**	Severe change, disturbance or degradation. Associated with severe consequences. May result in severe illness, injury or death. Targets, limits and thresholds of concern continually exceeded. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs.
	H	Prominent change, disturbance or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits and thresholds of concern regularly exceeded. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place.
	M	Moderate change, disturbance or discomfort. Associated with real but not substantial consequences. Targets, limits and thresholds of concern may occasionally be exceeded. Likely to require some intervention. Occasional complaints can be expected.

	L	Minor (Slight) change, disturbance or nuisance. Associated with minor consequences or deterioration. Targets, limits and thresholds of concern rarely exceeded. Require only minor interventions or clean-up actions. Sporadic complaints could be expected.
	VL	Negligible change, disturbance or nuisance. Associated with very minor consequences or deterioration. Targets, limits and thresholds of concern never exceeded. No interventions or clean-up actions required. No complaints anticipated.
	VL+	Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range.
	L+	Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits.
	M+	Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits.
	H+	Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support.
	VH+	Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected.
Criteria for ranking the DURATION of impacts	**VL**	Very short, always less than a year. Quickly reversible
	L	Short-term, occurs for more than 1 but less than 5 years. Reversible over time.
	M	Medium-term, 5 to 10 years.
	H	Long term, between 10 and 20 years. (Likely to cease at the end of the operational life of the activity)
	VH	Very long, permanent, +20 years (Irreversible. Beyond closure)
Criteria for ranking the EXTENT of impacts	**VL**	A part of the site/property.
	L	Whole site.
	M	Beyond the site boundary, affecting immediate neighbours
	H	Local area, extending far beyond site boundary.
	VH	Regional/National

PART B: DETERMINING CONSEQUENCE							
			EXTENT				
			A part of the site/property	Whole site	Beyond the site, affecting neighbours	Local area, extending far beyond site.	Regional/ National
			VL	**L**	**M**	**H**	**VH**
			INTENSITY = VL				
DURATION	Very long	**VH**	**Low**	**Low**	**Medium**	**Medium**	**High**
	Long term	**H**	**Low**	**Low**	**Low**	**Medium**	**Medium**
	Medium term	**M**	**Very Low**	**Low**	**Low**	**Low**	**Medium**
	Short term	**L**	**Very low**	**Very Low**	**Low**	**Low**	**Low**
	Very short	**VL**	**Very low**	**Very Low**	**Very Low**	**Low**	**Low**
			INTENSITY = L				
DURATION	Very long	**VH**	**Medium**	**Medium**	**Medium**	**High**	**High**
	Long term	**H**	**Low**	**Medium**	**Medium**	**Medium**	**High**

	Medium term	M	Low	Low	Medium	Medium	Medium
	Short term	L	Low	Low	Low	Medium	Medium
	Very short	VL	Very low	Low	Low	Low	Medium
			INTENSITY = M				
DURATION	Very long	VH	Medium	High	High	High	Very High
	Long term	H	Medium	Medium	Medium	High	High
	Medium term	M	Medium	Medium	Medium	High	High
	Short term	L	Low	Medium	Medium	Medium	High
	Very short	VL	Low	Low	Low	Medium	Medium
			INTENSITY = H				
DURATION	Very long	VH	High	High	High	Very High	Very High
	Long term	H	Medium	High	High	High	Very High
	Medium term	M	Medium	Medium	High	High	High
	Short term	L	Medium	Medium	Medium	High	High
	Very short	VL	Low	Medium	Medium	Medium	High
			INTENSITY = VH				
DURATION	Very long	VH	High	High	Very High	Very High	Very High
	Long term	H	High	High	High	Very High	Very High
	Medium term	M	Medium	High	High	High	Very High
	Short term	L	Medium	Medium	High	High	High
	Very short	VL	Low	Medium	Medium	High	High

PART C: DETERMINING SIGNIFICANCE							
PROBABILITY (of exposure to impacts)	Definite/ Continuous	VH	Very Low	Low	Medium	High	Very High
	Probable	H	Very Low	Low	Medium	High	Very High
	Possible/ frequent	M	Very Low	Very Low	Low	Medium	High
	Conceivable	L	Insignificant	Very Low	Low	Medium	High
	Unlikely/ improbable	VL	Insignificant	Insignificant	Very Low	Low	Medium
			VL	L	M	H	VVH
			CONSEQUENCE				

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
Very High	Potential fatal flaw unless mitigated to lower significance.
High	It must have an influence on the decision. Substantial mitigation will be required.
Medium	It should have an influence on the decision. Mitigation will be required.
Low	Unlikely that it will have a real influence on the decision. Limited mitigation is likely to be required.
Very Low	It will not have an influence on the decision. Does not require any mitigation
Insignificant	Inconsequential, not requiring any consideration.

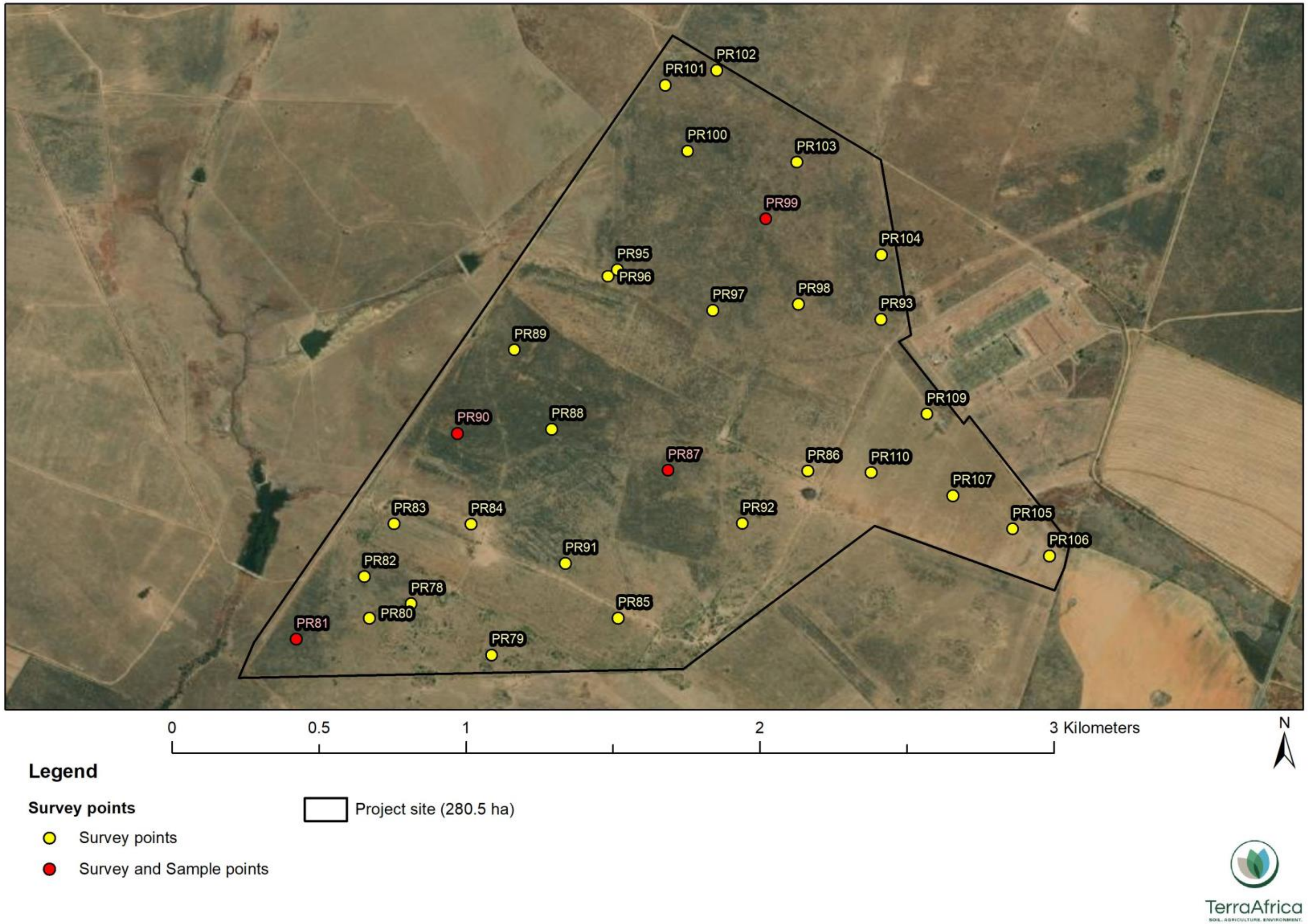

Figure 4 Locality of the survey and sample collection points within the Ilikwa project site

9. Baseline description of the agro-ecosystem

9.1 Climate

The modelled climate data for Sasolburg (as modelled and presented by Meteoblue, 2021) was used to describe the climate of the development areas as Sasolburg is located 19km away. The climate data is depicted in Figure 5.

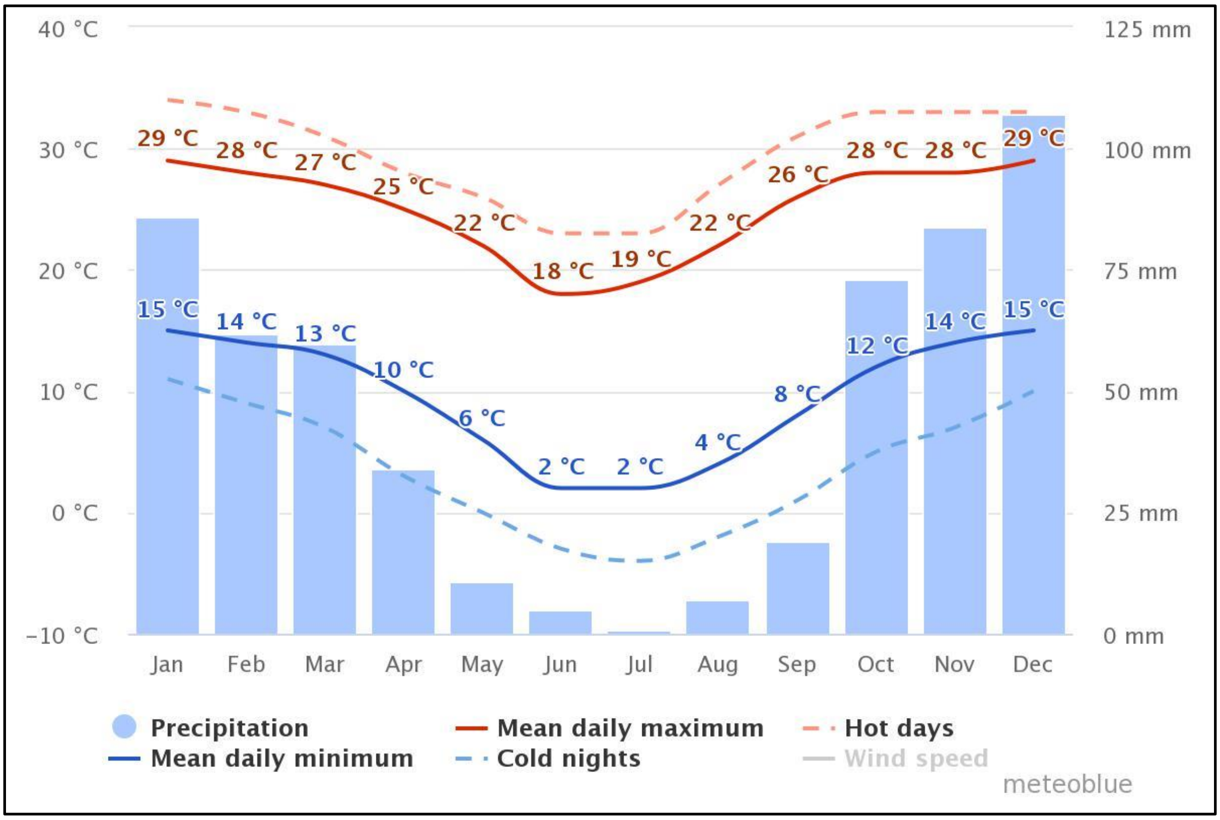

Figure 5 Climate data for Sasolburg (source: Meteoblue, 2021)

The mean daily maximum temperatures for Sasolburg ranges between 18°C June and 29°C in summer (the hottest months are December and January). The mean daily minimum temperatures range between 2°C in June and July and 15°C in December and January. The area has summer rainfall with the onset of the dry winter months from May through to September. The highest precipitation is in December with an average of 107 mm, with the months of November and January having the second highest average precipitation rate of 84 and 86 mm, respectively. The lowest average precipitation rate is from June to August with monthly averages of 1 to 7 mm.

The Department of Agriculture, Forestry and Fisheries (2017) compiled an updated description of the agricultural suitability of South African climatic conditions, accompanied by a raster data layer of the entire country. The description of climate capability refers to a definition by Strydom (2014) that defines it as the “capability of a geographic area to grow an agricultural crop under existing climatic conditions” (DAFF, 2017). The climate capability includes three parameters i.e., moisture supply capacity, physiological capacity, and climatic constraints. The climate capability classes range from 1 (the lowest or worst) to 9 (the highest or best climate for agricultural production).

According to the climate capability raster data, the entire development area has Moderate (Class 05) climate capability (refer to Figure 7). This indicates that the climate of the area is suitable for rainfed crop production although the area also experiences climate limitations such as periods of drought during the summer months, frost during winter months and the possibility of hail that presents hazards to rainfed crop production. This classification is in alignment with the modelled climate data shown in Figure 5.

9.2 Land type classification

Following the land type data, the Ilikwa project site consists only of Land Type (Figure 8). Land Type Ba39 consists of five terrain units (refer to Figure 6) with approximately 50% of the total land type area consisting of mid-slopes (Terrain unit 3). The mid-slopes have slight slope (2 to 6%) and long slope lengths of 1000 to 1500 m. The dominant soil form of the mid-slopes is the Hutton form and soil depths range between 0.9 and 1.1 m. The mid-slopes also include soil of the Avalon form that is underlain by soft plinthite at depths of 0.8 to1.0 m. Approximately 11% of the mid-slopes consist of shallow Mispah soils which are between 0.1 and 0.2 m deep.

The second most prevalent terrain form are crests (Terrain unit 1) that consists of a mixture of rock, shallow topsoil on rock (the Mispah form) and deeper red apedal soils of the Hutton form. Around 10% of the total land type area consists of toe-slopes (Terrain unit 4) consisting of a large variety of soil forms such as the Avalon, Glenrosa, Westleigh, Sterkspruit, Glencoe, Wasbank and Clovelly forms. The valley bottoms (Terrain unit 5) are characterised by soil with higher clay content and stronger structure. Soil forms include hydric soils of the Willowbrook and Rensburg forms as well as soil with a thick vertic horizon (Arcadia form).

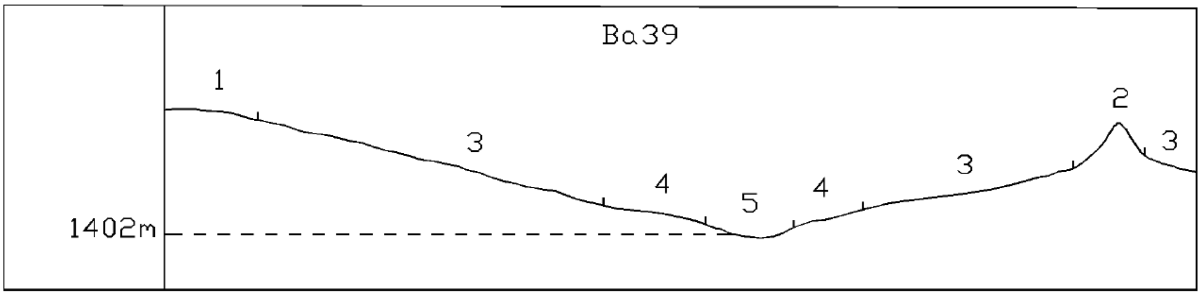

Figure 6 Terrain form sketch of Land Type Ba39

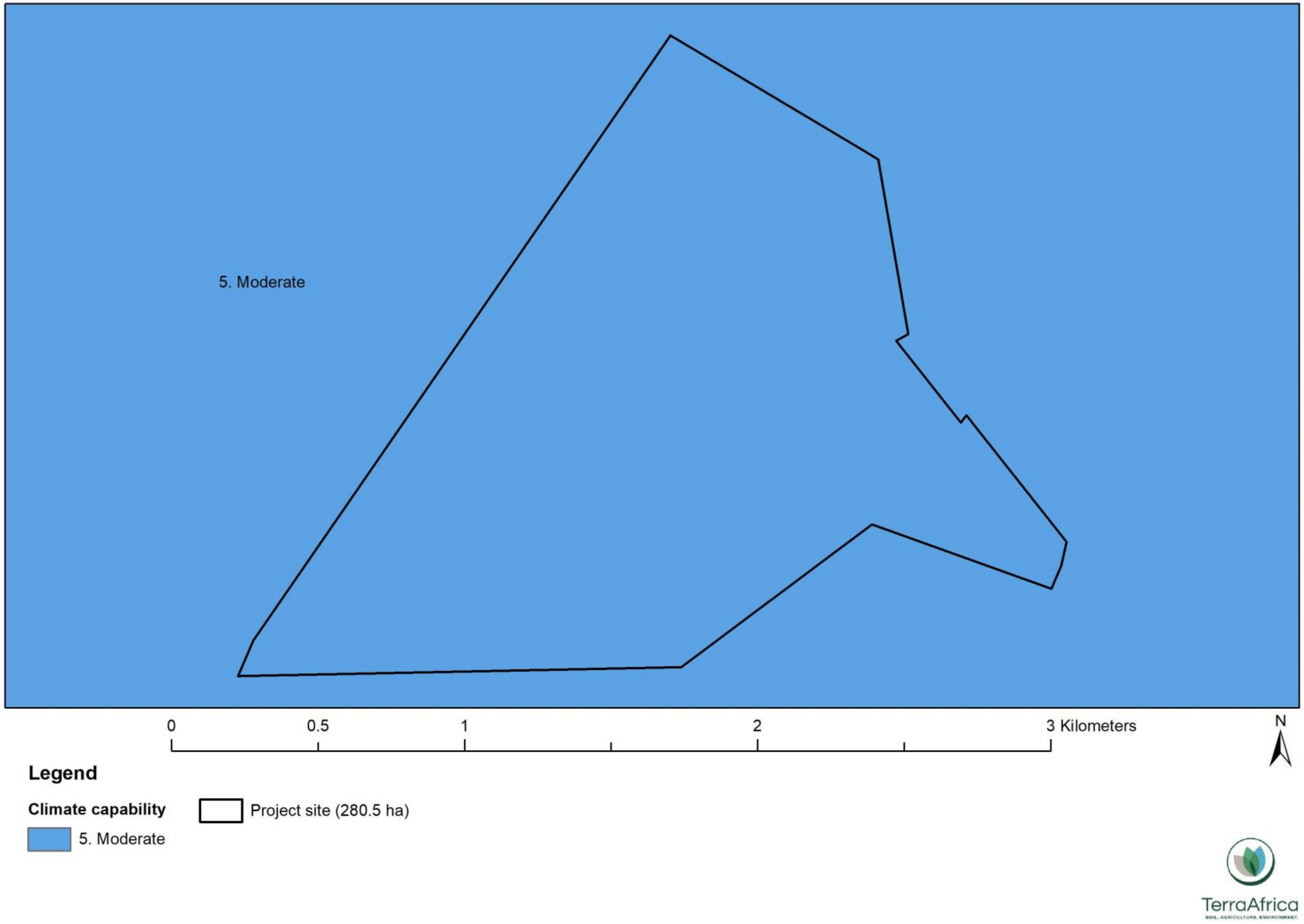

Figure 7 Climate capability rating of the Ilikwa project site and surrounding area

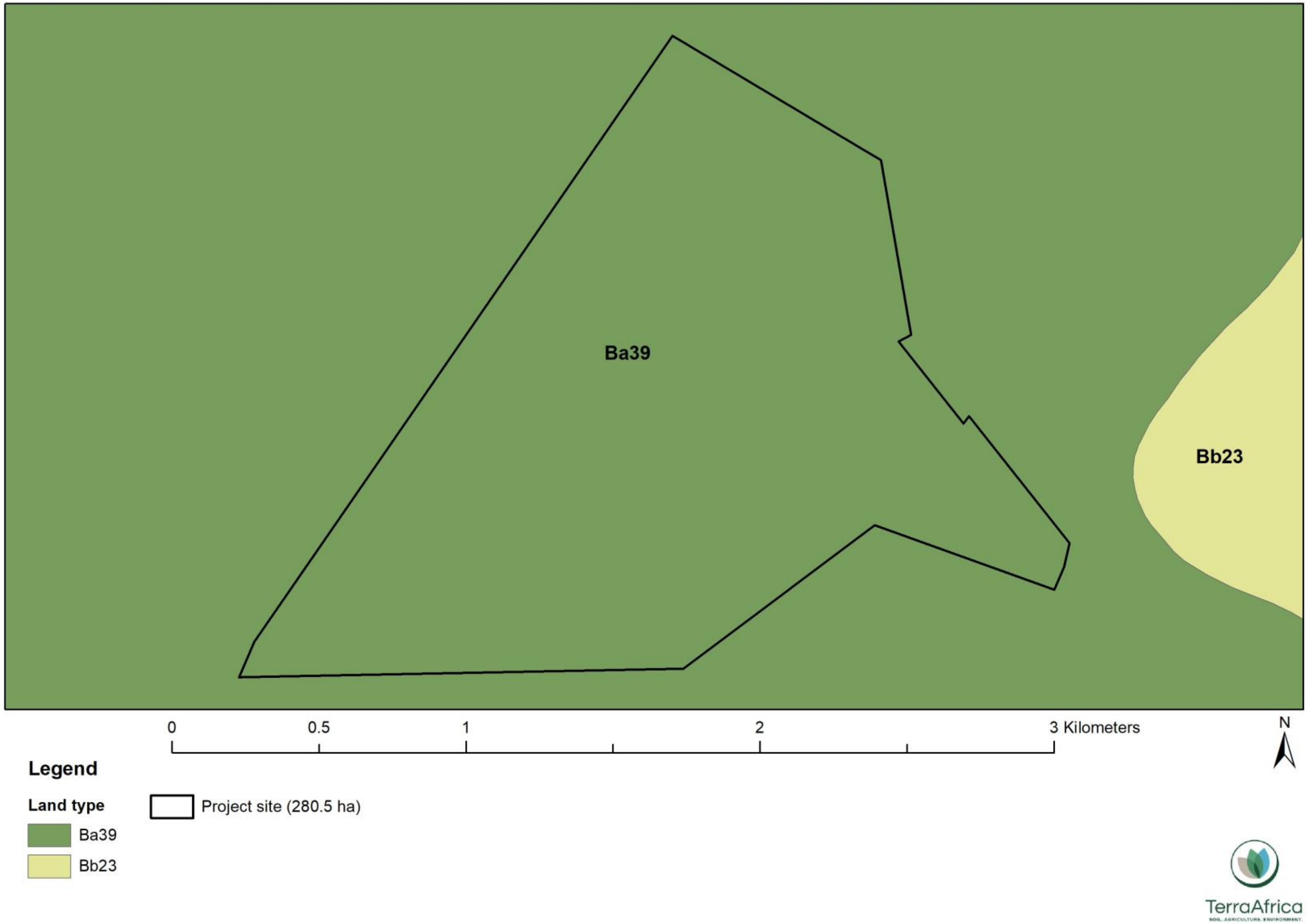

Figure 8 Land type map of theIlikwa project site and surrounding area

9.3 Soil properties

9.3.1 Soil forms

The different soil forms are present within the Ilikwa project site (see Figure 9). The area of each soil form as well as the horizon organisation and depths, are summarised in Table **1**. The soils in the survey area are dominated by soils of the Glenrosa form (119.6 ha) while the second most prevalent soil form, is the Mispah form (40.5 ha). Both are shallow soil forms with effective depth between 0.15 and 0.30 m. The other soil forms identified within the project site boundaries include Bainsvlei, Clovelly, Dundee, Griffin, Hutton, Kransfontein, Mispah, Nkonkoni and Pinedene forms (see **Error! Reference source not found.**). Below follows a description of each of these soil forms.

Table 1 Summary of the soil properties of the soils at the Ilikwa project site

Soil form	**Family**	**Depth (m)**	**Area within the Ilikwa project site (ha)**
Bainsvlei	2210	Orthic (0.2m) Red apedal (0.14m) Soft plinthite (1.50m)	4.6
Clovelly	2211	Orthic (0.2m) Yellow-brown apedal (0.7) Lithic (1.1)	30.9
Dundee	2112	Orthic (0.2) Alluvial (1.5)	4.2
Glenrosa	2110	Orthic (0.15) Lithic (0.30)	119.6
Griffin	2210	Orthic (0.25) Yellow-brown apedal (0.70) Red apedal (1.50)	18.3
Hutton	2210	Orthic (0.20) Red apedal (1.50)	22.1
Kransfontein	2210	Orthic (0.20) Yellow-brown apedal (0.70) Albic (1.50)	8.3
Mispah	2120	Orthic (0.15) Fractured rock / Rock	40.5
Nkonkoni	2111	Orthic (0.2) Red apedal (1.3) Lithic (1.5)	20.7
Pinedene	3220	Orthic (0.2) Yellow-brown apedal (0.4) Gleyic material (1.5)	11.3

Dundee:

The Dundee soils are present in a small section of 4.2 ha (or 1.50% of the project site) along the western boundary of the project site. The Dundee form has orthic topsoil overlying a thick layer of alluvial material that reaches deeper than 1.5 m. There is no abrupt colour or structural transition between the topsoil and subsoil horizons. The Dundee soils are found in a small depression in the landscape and the deep profiles make it suitable for irrigated and rainfed crop production and has arable land capability.

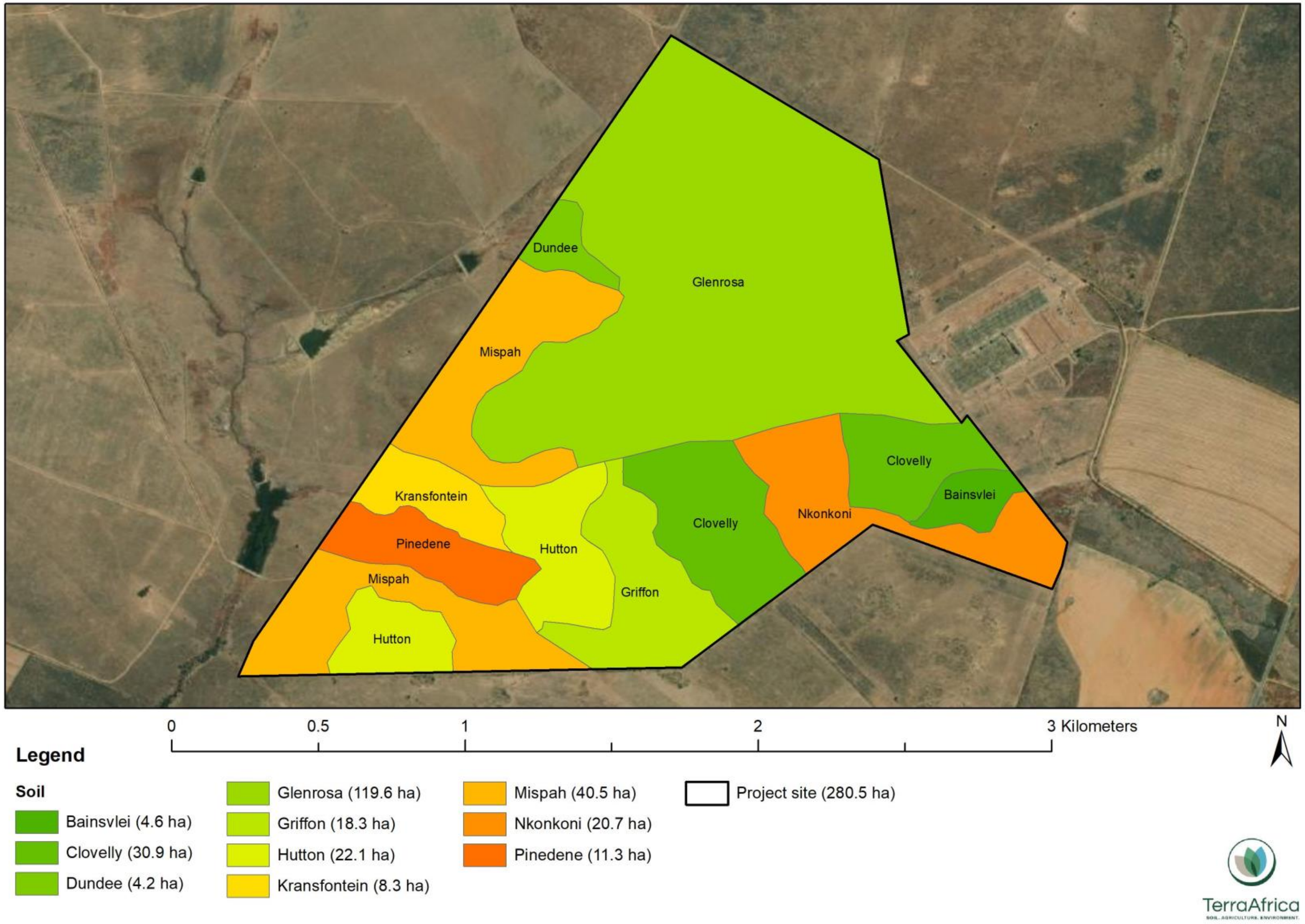

Figure 9 Soil classification map of the Ilikwa project site

Bainsvlei:

The Bainsvlei soils are present in the eastern part of the project site. The total area of Bainsvlei soils is 4.6 ha (1.64% of the project site). These soils consist of orthic topsoil that overlies red apedal subsoil that reaches to depth of 1.4 m. The red apedal subsoil is underlain by soft plinthic material that is 0.1 m thick (see Figure 10). The Bainsvlei soils are productive and is suitable for both rainfed and irrigated crop production. These soils have arable land capability.

Figure 10 Example of the soft plinthic horizon of the Bainsvlei soils at 1.4 m deep

Glenrosa:

The Glenrosa soils in one large area that consists the northern part and a large section of the middle of the Ilikwa project site. The Glenrosa soils are present at 119.6 ha (43.2% of the site). These soils contain saprolithic rock between soil particles. The topsoil of the Glenrosa soils is chromic topsoil the lithic B horizons are non-calcareous. The depths of the Glenrosa rarely exceeded 0.3 m. The saprolithic material present in the subsoil horizon of the Glenrosa soils limit the water-holding capacity and effective depth of the soil. The area of the Glenrosa soils on site is considered suitable for livestock farming and not for rainfed crop production.

Clovelly:

The Clovelly soils are present in two areas within the project site, both along the eastern boundary of the project site. The two Clovelly areas are separated by the Nkonkoni soils. The total area of Clovelly soils within the project site is 30.9 ha (or 11.02% of the project site). The Clovelly form has chromic orthic topsoil overlying yellow-brown apedal subsoil. The average thickness of the topsoil ranges between 0.2 m while the yellow-brown apedal horizon is 0.5 m thick (Figure 11). The yellow-brown colours of the apedal horizon is mostly uniform throughout the profiles with no abrupt colour transition. The yellow-brown apedal horizon is underlain by lithic material (consisting of country rock in different stages of weathering). The Clovelly soil form is suitable for irrigated and rainfed crop production and has arable land capability.

Figure 11 Example of the Clovelly soils within the Ilikwa project site

Griffin:

The Griffin soils are present in one area of 18.3 ha (or 6.52% of the project site) along the southern boundary of the project site. The Griffin form has chromic orthic topsoil (0.2m thick) overlying yellow-brown apedal subsoil that is 0.7 m deep. From 0.7 m, the yellow-brown apedal horizon is underlain by a red apedal horizon to depths of 1.5 m or more. The Griffin soil form is suitable for irrigated and rainfed crop production and has arable land capability.

Hutton:

The Hutton soils are present in two areas in the southern part of the project site and combinedly, it covers an area of 22.1 ha (or 7.88% of the project site). The Hutton form has chromic orthic topsoil overlying red apedal subsoil. The topsoil thickness is 0.2 m while the red apedal horizon is 1.3 m thick or thicker. The red colours of the apedal horizon is mostly uniform throughout the profiles with no abrupt colour transition. The Hutton soil form is suitable for irrigated and rainfed crop production and has arable land capability.

Pinedene:

The Pinedene soils are present in a horizontal strip of 11.3 ha (or 4.03% of the project site) along the western boundary of the project site. The Pinedene form has chromic orthic topsoil overlying yellow-brown apedal subsoil. The average thickness of the topsoil ranges between 0.2 m while the yellow-brown apedal horizon is also 0.2 m thick. The yellow-brown apedal horizon is underlain by gleyic material that reaches to a depth of 1.5 m. The Pinedene soil form is suitable for irrigated and rainfed crop production and has arable land capability. During years with higher rainfall, these soils may more readily become saturated and result in reduced oxygen availability to crop roots.

Nkonkoni:

The Nkonkoni soils are present in one area of 70.7 ha along the eastern boundary of the Ilikwa project site. The Nkonkoni form has chromic orthic topsoil overlying red apedal subsoil. The average thickness of the topsoil ranges between 0.2 m while the red apedal horizon is 1.1 m thick. The red colours of the apedal horizon is mostly uniform throughout the profiles with no abrupt colour transition. The red apedal horizon is underlain by lithic material (consisting of country rock in different stages of weathering (see Figure 12). The Nkonkoni soil form is suitable for irrigated and rainfed crop production and has arable land capability.

Figure 12 Nkonkoni soils within the Ilikwa project site

Kransfontein:

The Kransfontein soils are present in a similar shape than the Pinedene soils, directly north of it. This area is 8.3 ha in extent (or 2.96% of the project site). The Kransfontein form has similar horizon organisation and depths than that of the Pinedene form, except for the nature of the underlying material. While the Pinedene form is underlain by gleyic material, the Kransfontein form is underlain by an albic horizon.

The yellow-brown colours of the apedal horizon is mostly uniform throughout the profiles with no abrupt colour transition while grey soil colours dominate the matrix of the albic horizon with yellow mottling visible in the grey matrix. Both the yellow-brown apedal and the albic horizons have sandy-loam texture. The Kransfontein soil form is suitable for irrigated and rainfed crop production and has arable land capability.

Mispah:

The Mispah soils have been classified in the south-western corner of the Ilikwa project site in an area of 40.5 ha (or 14.44% of the project area). The Mispah soils consist of orthic topsoil overlying hard rock. The hard rock can either be solid or fractured rock. The production of the soil is limited by shallow soil depth and the presence of rock makes cultivation difficult. The area of Mispah soils have suitability for livestock grazing but not for rainfed crop production.

Figure 13 Shallow Mispah soil (0.1 to 0.15 m deep) within the Ilikwa project site

9.3.2 Soil texture

The soil texture of the soil forms present within the proposed development area, was calculated by using the results of the particle size analysis for the soil texture triangle formulas as provided on the website of the United States Department of Agriculture's under Natural Resource Conservation Services (Soil) (www.nrcs.usda.gov). The results of the particle size analysis of the soil samples as well as the soil texture class into which results translate, are presented in Table **2** below. Following the results, the soils within the project site, has Sandy Loam (PR81, PR90 and PR99) and Sandy Loam (PR87) texture.

Table 2 Summary of particle size distribution and soil texture classes of the soil samples analysed

Sample no:	Particle size distribution (%)			Texture class
	Sand	Silt	Clay	
PR81	73,0	9,7	17,9	Sandy Loam
PR87	84,5	4,4	11,2	Loamy Sand
PR90	76,7	6,2	18,0	Sandy Loam
PR99	73,8	9,4	17,2	Sandy Loam

9.3.3 Soil fertility parameters

The results of the soil fertility parameters that were determined for the soil samples, are presented in Table **3**.

Table 3 Soil analysis results

Sample no:	pH(KCl)	P (Bray 1) (mg/kg)	Ca (mg/kg)	Mg (mg/kg)	K (mg/kg)	Na (mg/kg)
PR81	4,83	18,12	338,77	111,61	221,16	370,36
PR87	4,59	3,72	26,86	43,74	76,86	468,77
PR90	5,31	4,82	117,84	40,45	82,76	262,33
PR99	5,43	5,38	665,54	103,73	235,67	146,76

From the perspective of the soil fertility parameters analysed, the soil has high sodium concentrations and in all the samples analysed, except PR99, it is the dominant cation. This may indicate that previous application of fertilizer or another soil ameliorant, has resulted in the higher sodium levels. High sodium levels can result in soil sodicity and negatively affect soil structure that limits water infiltration into soils. The sodium levels range between 146.76 for sample PR 99 to 468.77 mg/kg for sample PR87.

The soil pH(KCl) values range between very strongly acidic (pH 4.59) and strongly acidic (pH 5.43). For the purpose of crop production, pH values above 4.5 is recommended to prevent aluminium toxicities, prevent phosphate fixation, and allow for optimal nutrient uptake by crop roots. However, should the soil have been used for crop production, the soil pH levels are suitable and can be raised through the addition of agricultural lime.

The calcium levels range between deficient (26.86 mg/kg in Sample PR87) to sufficient for crop production (665.54 mg/kg in Sample PR99). The magnesium levels are the lowest in Sample PR90 (40.45 mg/kg) and highest in Sample PR81 (111.61 mg/kg). The potassium levels range between a low of 76.86 mg/kg in Sample PR87 and 235.67 mg/kg in Sample PR99. The cation concentrations (calcium, magnesium and potassium) are present at sufficient to deficient levels and can be supplemented with fertilizer addition. However, the high concentration of sodium present may inhibit the uptake of nutrients such as calcium and potassium.

The plant-available phosphorus levels are low in all samples analysed and range between 3.72 and 18,12 mg/kg. The low phosphorus levels are an indication that previous crop production within the project site has been abandoned a number of years ago and that the higher phospohurs concentration at the area of PR81, is the area where the most recent fertilizer application took place. Low soil phosphorus concentrations are typical of soils under natural vegetation (and without the addition of fertilizer) in South Africa.

9.3 Land capability and agricultural potential

9.3.1 Land capability

The land capability as determined by Department of Agriculture, Land Reform and Rural Development (DALRRD) through a spatial delineation process, was shown by overlying the project site boundary on the land capability raster data (DALRRD, 2016). The results are depicted in Figure 14. According to DALRRD (2016), land capability is defined as the most intensive long-term use of land for the purpose of **rainfed farming** determined by the interaction of climate, soil and terrain.

Moderate (Class 08) land capability is found in the middle section of the Ilikwa project site while land with Low-Moderate (Class 07) land capability is mostly found along the boundaries of the project site. These two land capability classes are the predominant land capability classes of the project site. The project site also has small, isolated patches with Moderate-High (Class 09) land capability in the middle of the project site and Low-Moderate (Class 06) and Low (Class 05) land capability along the western boundary.

9.3.2 Agricultural potential

Agricultural potential is defined as a measure of potential productivity per unit area and unit time achieved with specified management inputs and for a given crop or veld type and level of management, largely determined by the interaction of soil climate and terrain (DALRRD, 2016). For the proposed Ilikwa PV project site, the agricultural potential was derived from the soil classification of the site and its potential for rainfed production of grain crops, especially maize.

Following the soil classification and analysis, it was concluded that the site has High, Moderate and Low agricultural potential for the rainfed production of grain crops (see Figure 15). Two areas have High agricultural potential and both of these are located in a horizontal strip along the western boundary of the project site. The High potential areas are associated with the Dundee and Kransfontein soils. The High potential soils are present in a total area of 12.5 ha.

Soil with Moderate agricultural potential is present in the southern third of the Ilikwa project site. This area includes the Bainsvlei, Clovelly, Griffin, Hutton, Nkonkoni and Pinedene forms. The total area of with Moderate agricultural potential is 110.3 ha. Land with low agricultural potential is present in three areas that together measure 157.6 ha. This area includes soil of the Mispah and Glenrosa forms and dominate the norther part of the Ilikwa project site.

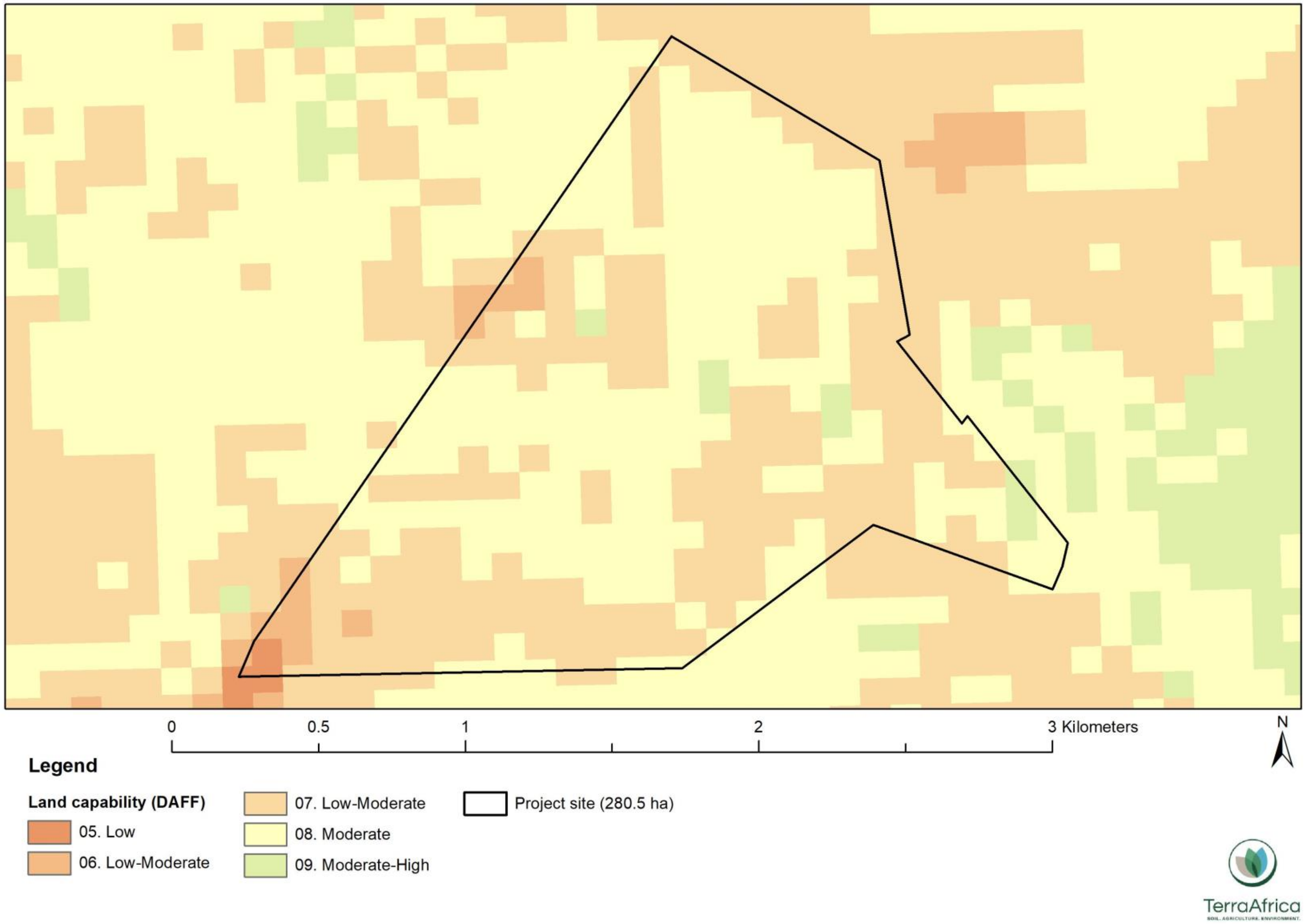

Figure 14 Land capability map of the Ilikwa project site (DALRRD, 2016)

Figure 15 Agricultural potential of the Ilikwa project site

9.4 Land use

9.4.1 Current land use and surrounding land uses

The only land use of the Ilikwa project site is extensive livestock farming. The livestock that is farmed with is cattle. The cattle is a mixture of breeds and animals are bred for the purpose of commercial sales. During the site visit it was established that no annual grain crops are currently produced within the Ilikwa project site although the old disturbances of previous historical cultivation of crop fields, were observed (see Figure 16).

Once crop production was abandoned in the three areas were crop fields were, pioneer species established themselves. These areas now consist of a mixture of grass species, lower shrubs and trees including *Vachellia spp.* and *Ziziphus mucronata*.

Figure 16 The terrain still exhibits signs of historical cultivation in the areas of old crop fields

The surrounding land uses of the larger area around the Ilikwa site, are farming, mainly rainfed crop production as well as livestock production. The closest irrigated field is located 500 m north of the northern boundary of the Damlaagte site. The Bon-Af Berry Farm is located approximately 4 km south-east of the Ilikwa project site. The larger area around the project sites also include accommodation facilities and a wedding venue (Pont de Val) on the banks of the Vaal River.

9.5.2 Land use change over time

To understand how crop fields have been converted to grazing land within the Ilikwa project site, Google Earth aerial imagery from 2004 to 2020, was analysed. The imagery of November 2004 shows that there were crop fields that were cultivated in the eastern section of the project site as well as in the middle of the site where fields were located both north and south of an area with natural veld (Figure 17).

Figure 17 Land uses (specifically field cultivation) of the Ilikwa project site in November 2004

Between November 2004 and March 2016, all the crop fields were left fallow and grasses and shrubs have established in the area (refer to Figure 18). None of the old crop fields were planted with pastures. The land cover remained unchanged between March 2016 and May 2020 (Figure 19).

This type of land use change is seen in many areas in the summer rainfall region of South Africa, especially in areas which experience cyclical periods of drought and where the El Niño phenomenon can result in warm, dry conditions during the growing season. As farmers have suffered significant financial losses during periods of drought, many farmers decided to allow grain crop fields, especially those with marginal yield potential, to convert back to grazing land. This conversion availed larger areas for livestock farming, a farming enterprise with smaller financial risk than grain crop production.

It is interesting to note that the areas where the old crop fields were, could be seen more clearly in the May 2020 imagery than that of the March 2016 imagery. As image quality improves over time, it becomes possible to see the long-term impact of soil cultivation even years after natural vegetation has established itself.

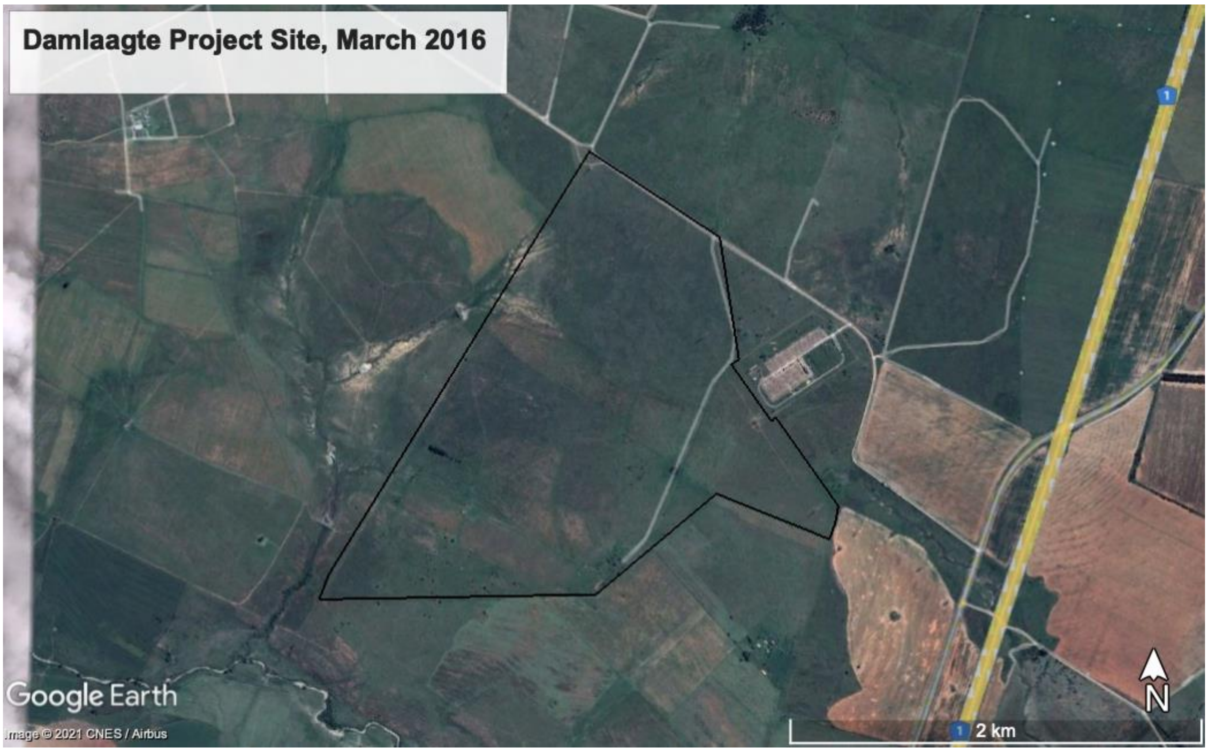

Figure 18 Vegetation cover of the Ilikwa project site during March 2016

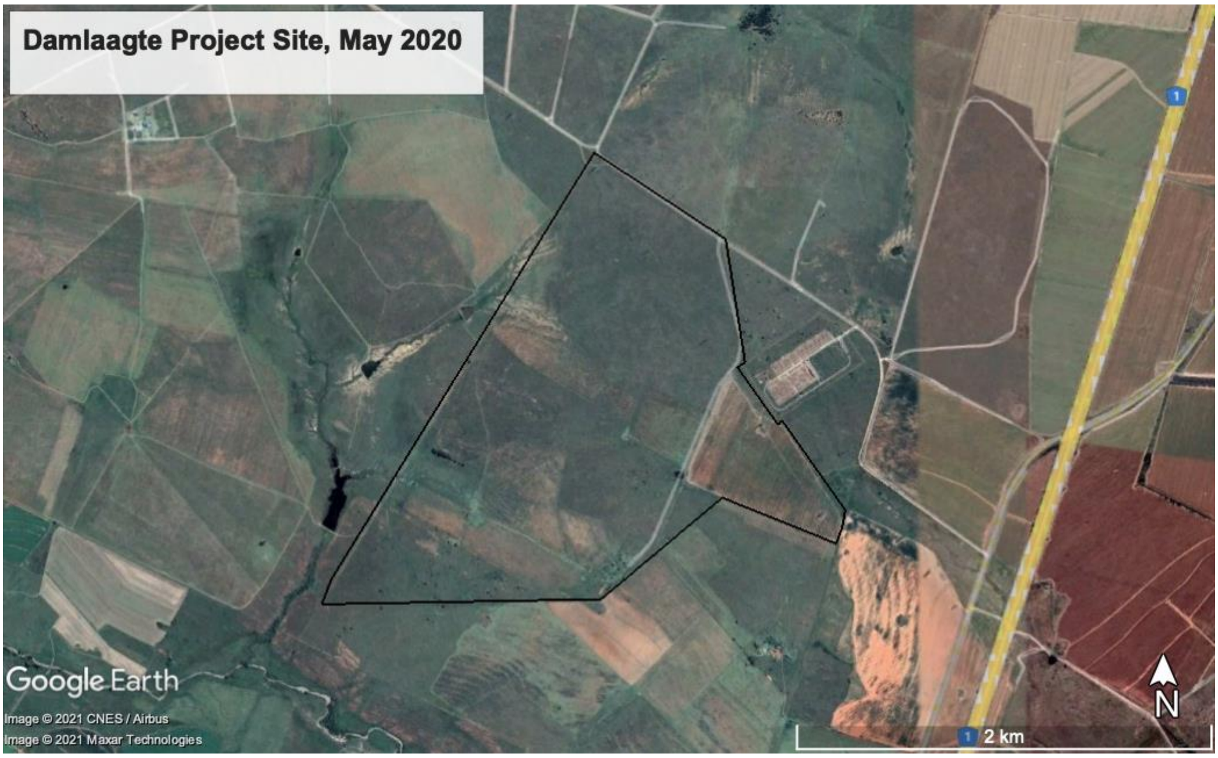

Figure 19 Land uses and vegetation cover of the Ilikwa project site during May 2020

10. Agricultural production and employment

10.1 Agricultural income and employment

The potential gross income that can be generated from the land annually, was calculated by using the long-term average grazing capacity of the area that will be affected by the proposed project. The following assumptions have been made in the calculations:

- The construction of the Ilikwa Solar PV facility infrastructure will include fencing off the development footprint. This will exclude any cattle farming activities from the fenced-off area.
- Following the current infrastructure layout provided, a few small narrow strips of land will remain between the western boundary of the project site and a larger area to the north of the development footprint.
- Since the infrastructure layout is not finalised and may go through more rounds of micro-siting that includes the findings of other specialist reports, it is assumed that livestock farming may be able to continue on the area north of the development footprint and that the development footprint of 162 ha, is the area that will be excluded from livestock farming once the project commences.
- There are no feedlots on the farm and therefore the long-term grazing capacity of the area provides an indication of the forage available within the Ilikwa project site.
- At a long-term average grazing capacity of 5 hectare per Large Stock Unit (/ha/LSU) (DAFF, 2018), the area of 162 ha (development footprint), provide forage to 32 head of cattle.
- The herd is considered to have an 80% weaning rate which is considered an optimistic figure and does not take any potential losses from stock theft into consideration. This allows for the sale of around 26 weaners per annum.
- The average weight of a Bonsmara weaner is estimated at 220 kg and the average auction price for live weight (or “hoof weight”) the past year, was R39.50/kg. The calculated total live weight that are produced within the Ilikwa project site and sold annually, is 5720 kg.

The total gross income that could possibly be generated by livestock farming in the area the past year, is therefore estimated to be R225 940.00 per annum.

Following the requirements of GN320, the potential gross income loss from agricultural activities in the area for the next five years, must also be considered. For this estimation, it was assumed that there will be a price increase of 6% per annum for live weight of cattle. The estimates for four years as well as the total gross income lost from agricultural production, is presented in the table below.

Table 4 Gross livestock income forecast for the proposed development footprint

Year	Price of live weight (R/kg)	Gross annual income (R)
2021/2022	39.50	R225 940.00
2022/2023	41.87	R239 496.40
2023/2024	44.38	R253 853.60
2024/2025	47.04	R269 068.80
2025/2026	49.86	R285 199.20

Estimated total gross income from livestock production between 2021 and 2026	**R1 273 558.00**

The labour requirement of the livestock farming within the development area requires one to two people to assist with animal herding, disease management and general farm maintenance. For the calculation of the employment expenditure, a salary of R6 000 per month was used (more than the minimum wage for farm workers in South Africa). Assuming the monthly salary, the annual expenditure for labour will range between R72 000.00 and R144 000.00.

10.2 Comparative benefit analysis

At this stage of the report (Draft for Comments by Applicant), no gross or nett income figures associated with the proposed Ilikwa Solar PV Facility, were provided. Therefore, no comparison between the financial benefits of the proposed renewable energy development and the existing land use (livestock farming), can be made.

The employment benefits of the proposed Ilikwa project can be compared to the current employment numbers of the farming operations on the project site. Following the project description provided by SLR, the construction phase of the Ilikwa Solar PV Facility will employ at least 230 at one time and at least 17 people during the operation phase. The proposed project provides significantly more employment opportunities than the current livestock farming which employs no more than two people to tend to the livestock.

11. Agricultural sensitivity of the site

11.1 Sensitivity rating of current development footprint layout

Following the consideration of all the baseline and desktop data discussed in the sections above, the project site has been classified into three different categories of agricultural sensitivity i.e. High, Medium and Low. The proposed Ilikwa Solar PV facility development area includes areas from all three sensitivity classes. The largest part of the project site has Low sensitivity (157.6 ha) and of this, 83.7 ha will be affected by the proposed development footprint.

The area with Medium sensitivity is present at 110.3 ha of which 73.7 ha is included in the current development footprint. The two areas with High sensitivity together measure 12.5 ha of which 4.1 ha is included in the development footprint.

To illustrate the extent of the proposed land use change from agriculture to renewable energy, the development footprint (as received from the applicant), was superimposed on the agricultural sensitivity map and the areas measured that will be affected. The results are depicted in Figure 20 and summarised in Table 5.

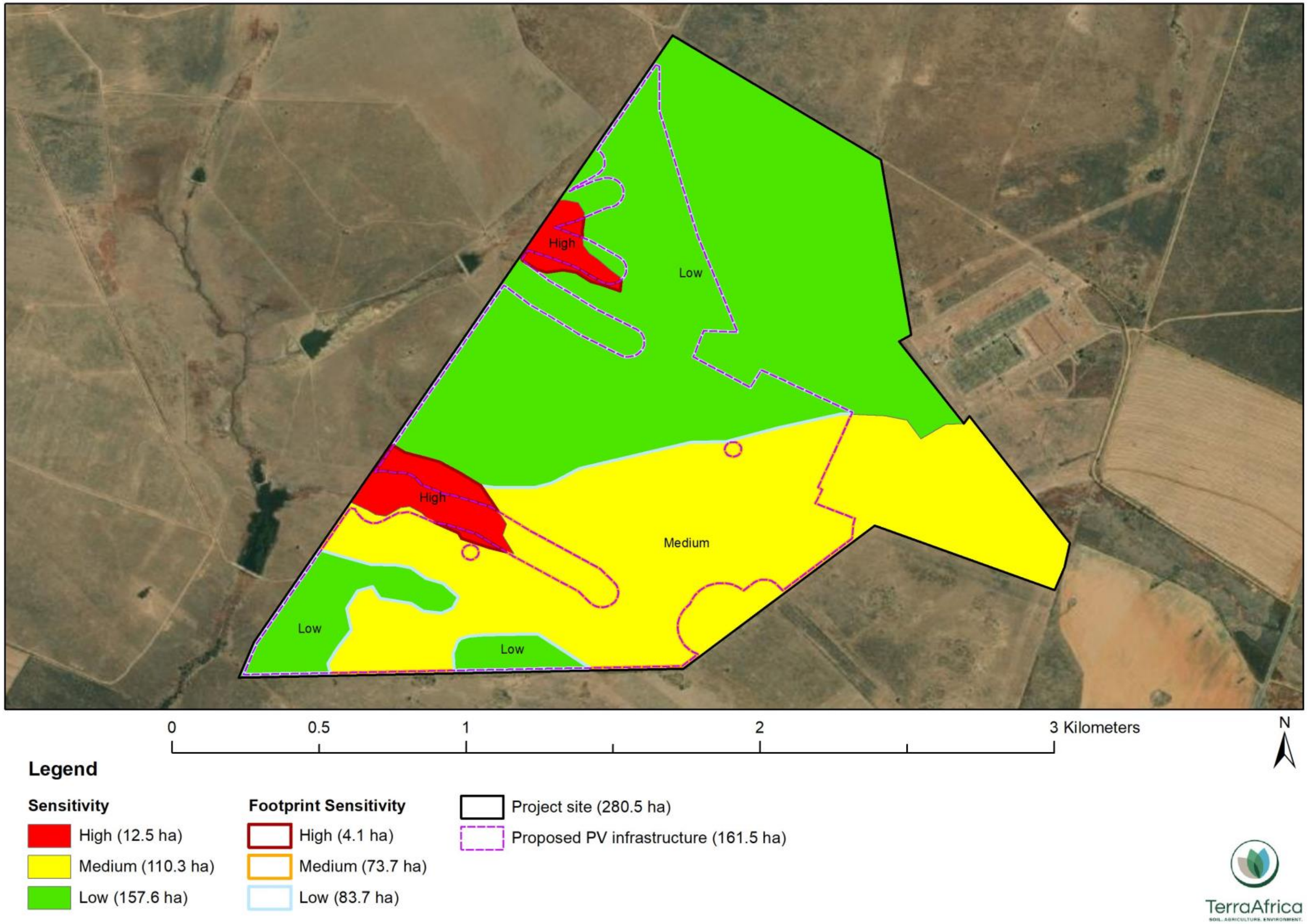

Figure 20 Sensitivity rating of the Ilikwa project site and the proposed infrastructure development footprint

Table 5 Summary of the impact of the development footprint on the agricultural sensitivity of the site

Sensitivity class	Soil form	Area within project site (ha)	Area that will be affected by development footprint (ha)
High	Dundee, Kransfontein	12.5	4.1
Medium	Clovelly, Nkonkoni, Avalon	110.3	73.7
Low	Glenrosa, Mispah	157.6	83.7

11.2 Consideration of Alternatives

11.2.1 Consideration of alternative infrastructure layouts and micro-siting

Only one layout for the development footprint's infrastructure has been provided at this stage for consideration (refer to Figure **20**). The current layout impact on 4.1 ha of land with high agricultural sensitivity. However, even though the areas with High sensitivity consist of soil with high yielding potential, these areas have not been used for crop farming the past five years. It is therefore not anticipated that another change in layout is required as it will not change the significance of the impacts on soil and agriculture.

It is assumed that the current layout aims to conserve preferential surface water flow paths in the landscape and although it will result in fragmentation of grazing veld, this is considered a negligible impact. Should the layout it be revised again, it can be beneficial for livestock grazing to use the entire area in the southern part of the site, thereby increasing the northern part of the site that will remain unaffected by the development footprint. This will allow for a larger area where livestock grazing may continue.

11.2.2 Consideration of technology alternatives

Technology alternatives have been identified and assessed for the battery energy storage systems, monofacial and bifacial PV panel modules and PV panel mounting technologies. Each of the alternatives have been considered and assessed in the impact assessment and are described in detail below.

Photovoltaic Panels / Modules

Three types of photovoltaic panels / modules are being considered and would be utilised for the proposed Project. These include the following:

- **Monocrystalline Modules** are made from pure silicon crystal ingots melted down and drawn out into a solid silicon crystal. The cells are then cut from the silicon crystal. The cells are rigid and mounted on a rigid frame. The modules are covered in glass to protect the cells from being damaged. The advantages and disadvantages of monocrystalline modules are made from pure silicon. The advantage of monocrystalline modules is that the modules are highly efficient. The disadvantage is that they are expensive to produce.

- **Polycrystalline Modules** are made with silicon along with added impurities. It is melted down and cut up into wafers which make up the blocks in a module. The cells are then cut from the silicon crystal with added impurities. The cells are rigid and mounted on a rigid frame. The modules are covered in glass to protect the cells from being damaged. The advantages of polycrystalline modules are that they are silicon-based, however, they contain impurities. The advantage of this is that the modules are cheaper to produce. The disadvantage is that they are not as efficient as monocrystalline modules.
- **Thin Film Modules** are cells manufactured from a chemical ink compound that has similar properties to that of silicon cells. The ink compound gets printed onto a sheet metal to form the base of the module. This sheet is heated to turn into a semiconductor (like silicon). A layer of glass is also added to cover the cell surface. This allows thin-film modules to match the lifespan of silicon modules, allowing them to be competitive with silicon-based module technologies. The main advantage of thin-film modules is that, due to the manufacturing process of the modules, they are cheaper to produce and therefore cheaper to purchase compared to silicon-based modules. The disadvantage of thin-film modules is that they are slightly less efficient than silicon-based modules.

Photovoltaic Panel Type

Mainstream is considering the use of **Monofacial** and **Bifacial PV panel modules** for the proposed solar PV facilities. Monofacial PV panel modules generate electricity from one side of the module, whereas bifacial PV panel modules generate electricity from the front and rear side of the module thus providing more output. Bifacial PV panel modules are regarded as having a higher energy yield in comparison to monofacial PV panel modules. Thus, the utilisation of bifacial PV panel modules will require the placement of reflective material beneath the PV panel module such as concrete to enhance the albedo effect from the rear surface of the module.

Mounting Structures

Mainstream is considering the use of either fixed tilt or dual tracking (single or dual axis) mounting structures for the proposed solar PV facilities. The mounting structures alternatives are described below:

- **Single-axis tracking –** this system has a single degree of flexibility that serves as an axis of rotation and is usually aligned along a North-South path. The advantages of this system are that it is cheaper, more reliable, and has a longer lifespan than dual-axis systems. The disadvantages are that the system has a lower energy output and fewer technological advancements.
- **Dual-axis tracking** – this system allows for two degrees of flexibility, offering a wider range of motion. The primary and secondary axes work together to allow these trackers to point the solar panels at specific points in the sky. The advantages of the dual axis include a higher degree of flexibility, allowing for a higher energy output and a higher degree of accuracy in directional pointing. The disadvantages of this system are that

the system is mechanically complex making it more likely for something to go wrong, has a lower lifespan and reliability, and is unreliable during cloudy or overcast weather. Directions moves on a dual axis, meaning it can move in two different directions.

- **Fixed axis** – a fixed-tilt system positions the modules at a "fixed" tilt and orientation.

Battery Energy Storage Systems
Mainstream is considering the use of either Solid State or Redox Flow Batteries for the Battery Energy Storage Systems (BESS) for each of the solar PV facilities. Each of the BESS-type technologies are described in detail below:

Solid State Batteries
Solid State Batteries are energy storage units that are associated with a range of containerised systems ranging from 500 kWh to 4 MWh. For a 150 MW_{ac} renewable energy facility, a total footprint area of up to 1 ha will be required for the placement of containerised solid-state batteries within each footprint of the proposed solar PV facilities. In general, solid-state batteries consist of numerous battery cells that collectively form modules. Each cell contains an anode, cathode, and an electrolyte. The modules will be assembled and packed inside shipping-size containers (i.e., 17 m long, 3.5 m wide and 4 m high) and delivered to the study area for placement within each of the solar PV facilities proposed for the Scafell Cluster Project. Each container will be placed on a raised concrete plinth of up to 30 cm and may be stacked on top of each other to a maximum height of approximately 15 m. Additional infrastructure associated with the modules include inverters and temperature control equipment which will be positioned inside the containers.

Redox Flow Batteries
Redox Flow Batteries (RFB) are also being considered as an alternative for the proposed solar PV facilities. For this technology, energy is stored as an electrolyte in the flow cells. Specific options include Sodium polysulfide / bromine (PSB) flow batteries, Vanadium Redox (VRB) flow batteries, and Zinc-Bromine (ZNBR) flow batteries which would be contained in small bunded areas. RFBs generally consist of two half-cells containing liquid electrolyte systems. Once supplied with electrical energy a reduction - oxidation (redox) reaction between ions of the two electrolytes, separated by a membrane, charge the electrodes (i.e., cathode and anode) with energy. Energy discharge from an RFB is achieved by a reversed redox reaction between ions resulting in the potential for electrical energy to be drawn from the electrodes. The footprint of a RFB system is approximately 150 x 100 m, with a height of 15 m. The system consists of two electrolyte storage tanks that are contained within a 2.5 m high berm wall which prevents leakage of the electrolyte chemical into the surrounding environment.

Following the description of the technology alternatives above, the alternatives are considered equal and the preferred alternative will not result in impacts on soil and agriculture with higher significance. The main impacts on soil and agriculture of the proposed Ilikwa project, is associated with the construction of the PV facility and the area where land use change will occur and not with the technology that will be used.

11.2.3 Consideration of the 'No-go' alternative
The 'No-go' alternative will not result in any land use change from livestock farming to the generation of renewable energy. There will be no additional impacts on soil properties and the

current soil quality will remain as it is, permitting that the livestock farming do not result in soil degradation.

11.3 Allowable development limits

11.3.1 Allowable development limits according to DALRRD spatial data

GN320 provides Allowable Development Limits for renewable energy generation developments of 20MW or more. The limits are based on the spatial delineation of land capability (Figure 14), field crop boundaries and the priority rating of any high value agricultural areas (Figure 22) by DALRRD (DALRRD 2016, 2019, 2021).

Figure 21 Field crop boundaries of the Ilikwa project site (DALRRD, 2019)

According to Figure 21, the Ilikwa project site includes three paralell sections of crop fields that run from the western to the eastern boundary of the project site. Following DALRRD (2019), these fields consist of either rainfed annual crops or planted pastures. The analysis of historical Google Earth aerial imagery, showed that these field crops still existed in 2004 but has reverted to natural vegetation by 2016 (refer to Section 9.5.2).

DALRRD has also released data showing delineated High Potential Agricultural Areas in 2021 (DALRRD, 2021). Following this data, the Ilikwa project site falls outside of such an area and borders on a Category B Rainfed High Potential Agricultural Area along its northern and north-eastern boundaries (Figure 22).

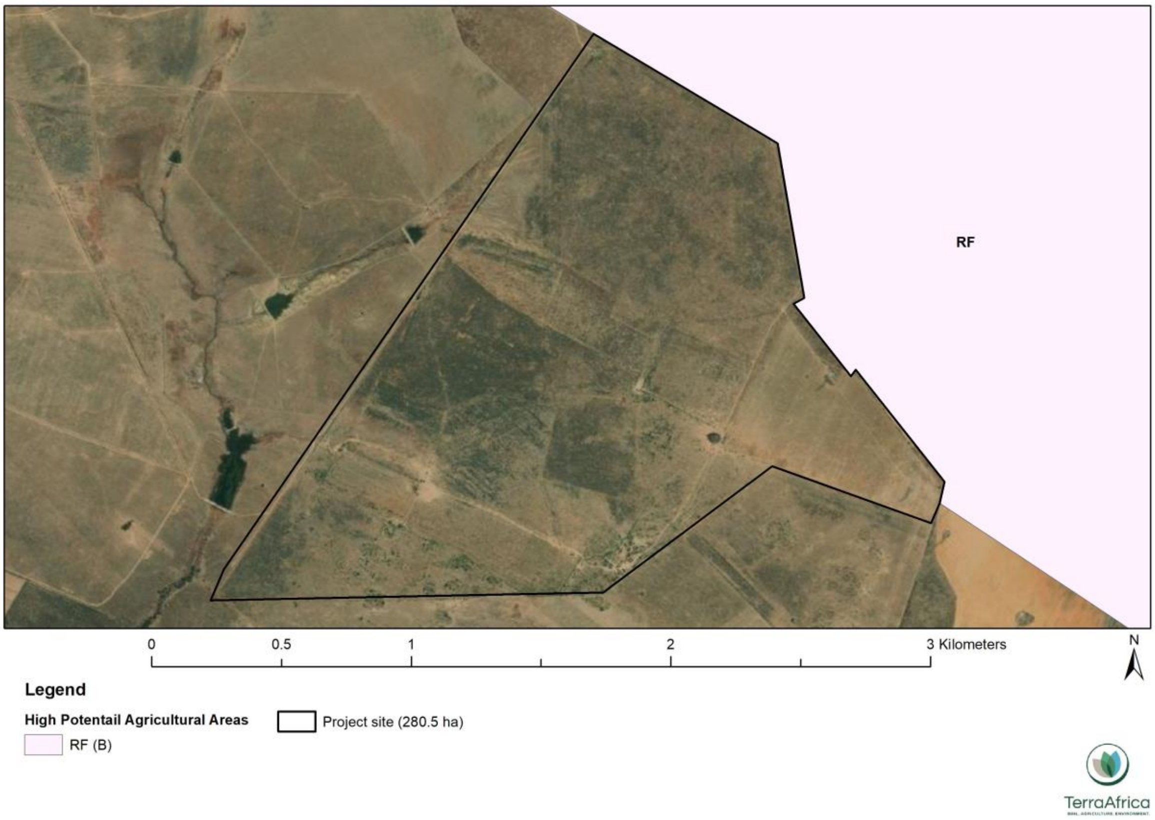

Figure 22 High Potential Agricultural Areas (HPAAs) at the Ilikwa project site (DALRRD, 2021)

11.3.2 Allowable development limits following site assessment

Although the field crop boundaries data layer of DALRRD (DALRRD 2019) indicate that there are crop fields in the area, the data gather during the site visit, do not agree with these delineations. Following aerial imagery analysis as well as a discussion with the current land owner, crop fields have already been converted to grazing veld since 2006. The conversion to grazing was not an active process through the cultivation of planted pastures and instead, the fields were left uncultivated and pioneer species established themselves and over time, resulted in ecological succession. Since the project site do not have crop fields anymore, and hasn't had crop fields for the past five years, the allowable development limit for areas outside of crop fields for land with High, Medium and Low Agricultural Sensitivity, will be used for the calculations. The results of the calculations are provided in Table 6 below.

Table 6 Calculated allowable development limits according to the confirmed project site senstivity

Sensitivity class	Area that will be affected by development footprint (ha)	Allowable limit (ha/MW)	Area allowed for a 75MW development (ha)	Area that exceeds allowable limit (ha)
High	4.1	0.35	26.25	0
Medium	73.7	2.50	187.50	0

Low	83.7	2.50	187.50	0

12. Impact assessment

The following sub-sections will describe and rate the significance of impacts on soil and agriculture as a result of the proposed Ilikwa Solar PV Facility. The proposed project will be carried out in the following four phases:

- Development and planning phase;
- Site preparation;
- Construction phase;
- Operational phase; and
- Decommissioning phase.

Since the development and planning phase will only consist of layout refining, environmental and other permitting and geotechnical investigations, no impacts on soil and agriculture are anticipated for this phase. The activities and impacts of the other four phase are described below together with mitigation measures that will reduce the significance of the impacts.

12.1 Site preparation phase

The site preparation phase will include the clearance of vegetation, installation of perimeter fencing and levelling of the site and preliminary earthworks. Thereafter the project site will be marked out, a construction camp set up and the access road to the site be constructed. The clearance of vegetation is not anticipated to be site wide and will depend on the detailed layout of the proposed project.

12.1.1 Change in land use from livestock farming to energy generation

Once the vegetation is cleared and the perimeter fence installed, livestock farming will be excluded from the project site. The land use change will be prominent (High intensity) and last for the proposed project life of 20 years or more, if the infrastructure is not decommissioned (High duration). The area that will be affected is the entire development footprint of 162 ha (Low extent). This impact will definitely occur (Very High probability). The significance of this impact is rated as High (without mitigation).

When mitigation measures are implemented, the intensity and duration of the land use change will remain High and the probability of the impact is still definite (Very High) but the extent of the impact can be reduced from the entire project site (Low) to only a part of the project site (Very Low) where the development footprint will be. The impact of land use change in the mitigated scenario, has Medium significance. Table 7 presents the ranking of the impact significance of the mitigated and unmitigated scenarios.

Table 7 Significance rating of land use change of the Ilikwa Solar PV Facility before and after the implementation of mitigation measures

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	H	H	VL	M	M

The following mitigation measures must be implemented to reduce the significance of this impact:

- Vegetation clearance must be restricted to areas where infrastructure is constructed.
- No materials transported to the project site must be allowed to be dumped in nearby livestock farming areas.
- Prior arrangements must be made with the landowners to ensure that livestock are moved to areas where they cannot be injured by vehicles traversing the area.
- Ensure that construction workers do not establish informal settlements on the property or neighbouring properties.
- No boundary fence must be opened without the landowners' permission.
- No open fires made by the construction teams are allowable during the construction phase.

12.1.2 Disturbance of natural soil profiles that reduce biophysical soil functionality

Vegetation clearance, site levelling and preliminary earthworks will impact on the current soil functionality of the development footprint and affect nutrient cycling, rainwater infiltration and physical stability of the soil. The reduction in the biophysical functionality of the soil will be prominent (High intensity) and last for the proposed project life of 20 years or more if left unmitigated. In the unmitigated scenario, the disturbance of soil and its functionality will affect the entire development footprint of 162 ha (Low extent). It is probable that his impact will occur (High probability). The significance of this impact without mitigation is rated as High.

When mitigation measures are implemented, the intensity of the impact can be reduced to a Moderate change that although real, may not have substantial consequences. In areas where no permanent infrastructure will be present, mitigation measures can reduce the duration of the impact to medium-term (Medium duration). The extent of the impact can also be reduced from the entire project site (Low) to only a part of the project site (Very Low) where the development footprint will be. The impact of soil profile disturbance that reduce biophysical soil functionality in the mitigated scenario, has Medium significance. Table **7** presents the ranking of the impact significance of the mitigated and unmitigated scenarios.

Table 8 Significance rating of soil disturbance during the site preparation phase of the Ilikwa Solar PV Facility before and after the implementation of mitigation measures

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	M	M	VL	M	M

The following mitigation measures must be implemented to reduce the significance of this impact:

- Land clearance must only be undertaken immediately prior to construction activities and only within the development footprint;
- Unnecessary land clearance must be avoided;
- Levelling of soil must be restricted to areas where it is necessary for construction;
- Any topsoil that remain on the surface after levelling, must be incorporated into areas of disturbance and not allowed to remain as stockpiles on the surface where it will be prone to soil erosion.
- Restrict earthworks to only that which is essential for the construction phase of the project.

12.1.3 Soil erosion

Vegetation clearance, site levelling, preliminary earthworks and the construction of an access road, will expose soil surfaces to both wind and water. Soil erosion results in the removal of soil particles from the area that becomes eroded. Soil erosion during the site preparation phase will result in a Moderate disturbance with real but not substantial consequences (Moderate intensity). Soil erosion, without the implementation of mitigation measures, will be permanent (Very High duration) and can affect areas outside of the development footprint (Low extent). In the unmitigated scenario, the impact will probably occur (High probability). Soil erosion is considered an impact with High significance in the unmitigated scenario.

With the implementation of mitigation measures, the intensity of soil erosion can be reduced to a minor disturbance (Low intensity) that will still be an irreversible loss of soil particles (Very high duration) but that can be limited to small areas within the development footprint (Very low extent). In this scenario, it is conceivable that erosion may occur (Low duration). With the implementation of mitigation measures, the soil erosion impact of the site preparation phase, can be reduced to Low significance. Table 9 presents the ranking of the impact significance of the mitigated and unmitigated scenarios.

Table 9 Significance rating of soil erosion during the site preparation phase of the Ilikwa Solar PV Facility before and after the implementation of mitigation measures

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	M	VH	L	H	H
Mitigated	L	VH	VL	M	VL

The following mitigation measures must be implemented to reduce the significance of this impact:

- Vegetation clearance during the site preparation phase must only be undertaken immediately prior to the activities of the construction phase;
- Vegetation clearance, site levelling and earthworks must only be undertaken within the development footprint;
- Unnecessary land clearance must be avoided;

- Level any remaining soil that remained on the surface after site preparation instead of allowing small stockpiles of soil to remain on the surface;
- Design and implement a Stormwater Management System / Plan where run-off from the access road is expected;
- Where possible, conduct the site preparation activities outside of the rainy season; and
- Regularly monitor areas where vegetation removal and earthworks took place, for early signs of soil erosion.
- If early signs of soil erosion is detected, it must be addressed immediately with active rehabilitation of the areas.

12.1.4 Soil compaction

The clearing and levelling of land as well as the construction of the access road, will result in soil compaction. In the area where the access road will be constructed, topsoil will be removed, and the remaining soil material will be deliberately compacted to ensure a stable road surface. Soil compaction will result in a moderate disturbance of the soil quality and without any mitigation measures, will remain permanent (Very High Duration). Without mitigation measures, the extent of the impact may affect the entire site (Low Extent). With the implementation of mitigation measures, the extent can be limited to only the development footprint. This impact will definitely occur, both in the mitigated and unmitigated scenarios. The rating criteria of this impact is presented in Table 10.

The significance of soil compaction can be reduced from High significance to Medium significance through the implementation of the following mitigation measures:

- Minimise the areas of activity to that indicated in the infrastructure layout (refer to Figure **20**).
- The activities of construction contractors or employees will be restricted to the planned areas.
- Roads that will carry heavy-duty traffic should be designed in areas previously disturbed rather than clearing new areas, where relevant.

Table 10 Significance rating of soil compaction before and after the implementation of mitigation measures

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	M	VH	L	H	H
Mitigated	M	H	VL	M	M

12.1.5 Soil chemical pollution

During the site preparation phase, construction workers will access the land for the preparation of the terrain and the construction of the access road. Both potential spills and leaks from construction vehicles and equipment as well as waste generation on site, can result in soil pollution. The intensity of soil pollution is considered a moderate deterioration during the construction phase (Medium intensity) that will remain for a long term and may affect an area outside of the development footprint (Low extent). It is probable that this impact will occur in the mitigated and unmitigated scenarios. Thus, this impact will have Medium significance for the unmitigated scenario.

When mitigation measures are implemented, the impact can be reduced to a negligible nuisance with minor consequences (Very low intensity) that can be reversed over a period of less than 5 years. Soil pollution can also be managed to only affect a part of the site (Very low extent). It is possible that the impact will occur, and the mitigated scenario has Very low significance. The ranking criteria of both the unmitigated and mitigated scenarios are presented in **Error! Reference source not found.**.

During the site preparation phase, soil chemical pollution must be minimised through implementation of the following mitigation measures:

- Losses of fuel and lubricants from the oil sumps and steering racks of vehicles and equipment should be contained using a drip tray with plastic sheeting filled with absorbent material;
- Using biodegradable hydraulic fluids, using lined sumps for collection of hydraulic fluids, recovering contaminated soils, and treating them off-site, and securely storing dried waste mud by burying it in a purpose-built containment area;
- Avoiding waste disposal at the site wherever possible, by segregating, trucking out, and recycling waste at licensed waste disposal / recycling facilities;
- Containing potentially contaminating fluids and other wastes; and
- Cleaning up areas of spillage of potentially contaminating liquids and solids.

Table 11 Significance rating of soil chemical pollution before and after the implementation of mitigation measures

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	L	H	L	M	M
Mitigated	VL	L	VL	L	VL

12.2 Construction Phase

The construction phase of the proposed project will be initiated following the completion of the site preparation activities. The construction phase of the proposed project will be for a period of up to 12 – 18 months. The construction phase will include the following:

- Excavation of cable trenches;
- Ramming or drilling of the mounting structure frames;
- Installation of the PV modules onto the frames;
- Installation of measuring equipment;
- Laying of cables between the module rows to the inverter stations;
- Optionally laying of gravel or aggregate from nearby quarries placed in the rows between the PV panel array for enhanced reflection onto the panels, assisting in vegetation control and drainage;
- Construction of foundations for the inverter stations and installation of the inverters;

- Construction of the substation and BESS foundations and installation of the substation components and placement of BESS;
- Construction of operations and maintenance buildings;
- Undertaking of rehabilitation on cleared areas where required;
- Testing and commissioning; and
- Removal of equipment and disassembly of construction camp.

The construction phase will not have any further impacts on the current land use (livestock farming and agricultural employment) and only impacts on soil quality are expected during this phase.

12.2.1 Disturbance of natural soil profiles that reduce biophysical soil functionality

Excavation of cable trenches, construction of BESS and inverter station foundations and the maintenance buildings, will impact on the current soil functionality of the development footprint and affect nutrient cycling, rainwater infiltration and physical stability of the soil. The reduction in the biophysical functionality of the soil will be prominent (High intensity) and last for the proposed project life of 20 years or more if left unmitigated. In the unmitigated scenario, the disturbance of soil and its functionality will affect the entire project site of 162 ha (Low extent). It is probable that his impact will occur (High probability). The significance of this impact is rated as High for the unmitigated scenario.

When mitigation measures are implemented, the intensity of the impact can be reduced to a Moderate change that although real, may not have substantial consequences. In areas where no permanent infrastructure will be present, mitigation measures can reduce the duration of the impact to medium-term (Medium duration). The extent of the impact can also be reduced from the entire project site (Low) to only a part of the project site (Very Low) where the development footprint will be. The impact of soil profile disturbance that reduce biophysical soil functionality in the mitigated scenario, has Medium significance. Table 12 presents the ranking of the impact significance of the mitigated and unmitigated scenarios.

Table 12 Significance rating of soil disturbance during the construction phase of the Ilikwa Solar PV Facility before and after the implementation of mitigation measures

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	M	M	VL	M	M

The following mitigation measures must be implemented to reduce the significance of this impact:

- Land clearance must only be undertaken immediately prior to construction activities and only within the development footprint;
- Unnecessary land clearance must be avoided;
- Levelling of soil must be restricted to areas where it is necessary for construction;
- Any topsoil that remain on the surface after levelling, must be incorporated into areas of disturbance and not allowed to remain as stockpiles on the surface where it will be prone to soil erosion.

- Restrict earthworks to only that which is essential for the construction phase of the project.

12.2.2 Soil erosion

Excavation of cable trenches, construction of BESS and inverter station foundations and the maintenance buildings will expose soil surfaces to both wind and water. Soil erosion results in the removal of soil particles from the area that becomes eroded. Soil erosion during the site preparation phase will result in a Moderate disturbance with real but not substantial consequences (Moderate intensity). Soil erosion, without the implementation of mitigation measures, will be permanent (Very High duration) and can affect areas outside of the development footprint (Low extent). In the unmitigated scenario, the impact will probably occur (High probability). Soil erosion is considered an impact with High significance in the unmitigated scenario.

With the implementation of mitigation measures, the intensity of soil erosion can be reduced to a minor disturbance (Low intensity) that will still be an irreversible loss of soil particles (Very high duration) but that can be limited to small areas within the development footprint (Very low extent). In this scenario, it is conceivable that erosion may occur (Low duration). With the implementation of mitigation measures, the soil erosion impact of the site preparation phase, can be reduced to Low significance. Table 13 presents the ranking of the impact significance of the mitigated and unmitigated scenarios.

Table 13 Significance rating of soil erosion during the construction phase of the Ilikwa Solar PV Facility before and after the implementation of mitigation measures

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	M	VH	L	H	H
Mitigated	L	VH	VL	M	VL

The following mitigation measures must be implemented to reduce the significance of this impact:

- Vegetation clearance during the construction phase must only be undertaken immediately prior to the building of infrastructure;
- Vegetation clearance must be kept within the development footprint;
- Unnecessary land clearance must be avoided;
- Level any remaining soil that remained on the surface after site preparation instead of allowing small stockpiles of soil to remain on the surface;
- Design and implement a Stormwater Management System / Plan where run-off from the access road is expected;
- Where possible, conduct the site preparation activities outside of the rainy season;
- Regularly monitor areas where vegetation removal and earthworks took place, for early signs of soil erosion; and
- Vegetation establishment during the construction phase must be monitored to see whether it was successful and provide sufficient coverage for bare soil surface.

12.2.3 Soil compaction

Excavation of cable trenches and the construction of BESS, inverter station foundations and maintenance buildings, will result in soil compaction. In some areas, such as where the foundations will be constructed, soil material will be deliberately compacted to ensure a stable road surface. Soil compaction will result in a moderate disturbance of the soil quality and without any mitigation measures, will remain permanent (Very High Duration). Without mitigation measures, the extent of the impact may affect the entire site (Low Extent). With the implementation of mitigation measures, the extent can be limited to only the development footprint. This impact will definitely occur, both in the mitigated and unmitigated scenarios. The rating criteria of this impact is presented in Table 10.

The significance of soil compaction can be reduced from High significance to Medium significance through the implementation of the following mitigation measures:

- Minimise the areas of activity to that indicated in the infrastructure layout (refer to
- The activities of construction contractors or employees will be restricted to the planned areas.
- Roads that will carry heavy-duty traffic should be designed in areas previously disturbed rather than clearing new areas, where relevant.

Table 14 Significance rating of soil compaction during the construction phase before and after the implementation of mitigation measures

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	M	VH	L	H	H
Mitigated	M	H	VL	M	M

12.2.4 Soil chemical pollution

During the construction phase, construction workers will mix cement, assemble solar panels, dig trenches and assemble BESS and substation components. This can result in spills of diesel and oil by machinery and equipment as well as the generation of domestic waste and containment breaches related to the battery units and any inadvertent chemical exposure therefrom.

The intensity of soil pollution is considered a moderate deterioration during the construction phase (Medium intensity) that will remain for a long term and may affect an area outside of the development footprint (Low extent). It is probable that this impact will occur and in the unmitigated scenario, this impact will have Medium significance.

When mitigation measures are implemented, the impact can be reduced to a negligible nuisance with minor consequences (Very low intensity) that can be reversed over a period of less than 5 years. Soil pollution can also be managed to only affect a part of the site (Very low extent). It is possible that the impact will occur and the mitigated scenario has Very low significance. The ranking criteria of both the unmitigated and mitigated scenarios are presented in Table **15**.

During the construction phase, soil chemical pollution must be minimised through implementation of the following mitigation measures:

- Losses of fuel and lubricants from the oil sumps and steering racks of vehicles and equipment should be contained using a drip tray with plastic sheeting filled with absorbent material;
- Using biodegradable hydraulic fluids, using lined sumps for collection of hydraulic fluids, recovering contaminated soils and treating them off-site, and securely storing dried waste mud by burying it in a purpose-built containment area;
- Avoiding waste disposal at the site wherever possible, by segregating, trucking out, and recycling waste at licensed waste disposal / recycling facilities;
- Containing potentially contaminating fluids and other wastes; and
- Cleaning up areas of spillage of potentially contaminating liquids and solids.

Table 15 Significance rating of soil chemical pollution before and after the implementation of mitigation measures

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	L	H	L	M	M
Mitigated	VL	L	VL	L	VL

12.3 Operation Phase

The proposed project will be operated on a 24 hour, 7 days a week basis. The operation phase of the proposed project will comprise the following activities:

- Regular cleaning of the PV modules by trained personnel;
- Vegetation management under and around the PV modules to allow maintenance and operation at full capacity;
- Maintenance of all components including PV modules, mounting structures, trackers, inverters, substation transformers, BESS, and equipment;
- Office management and maintenance of operations and maintenance buildings;
- Supervision of the solar PV facility operations; and
- Site security monitoring.

12.3.1 Soil chemical pollution

During the operation phase, PV modules will be cleaned regularly, and vegetation will be managed under and around the PV modules. Vegetation management will likely include the use of herbicides. Maintenance work will also be done on the PV modules, trackers, BESS and inverters and transformers. This can result in spills of oil and diesel, handling of herbicides on site as well as left-over materials after repair work is done.

The intensity of soil pollution is considered a moderate deterioration during the construction phase (Medium intensity) that will remain for a long term and may affect an area outside of the development footprint (Low extent). It is probable that this impact will occur and in the unmitigated scenario, this impact will have Medium significance.

When mitigation measures are implemented, the impact can be reduced to a negligible nuisance with minor consequences (Very low intensity) that can be reversed over a period of less than 5 years. Soil pollution can also be managed to only affect a part of the site (Very low extent). It is possible that the impact will occur, and the mitigated scenario has Very low significance. The ranking criteria of both the unmitigated and mitigated scenarios are presented in Table **16**.

During the construction phase, soil chemical pollution must be minimised through implementation of the following mitigation measures:

- Losses of fuel and lubricants from the oil sumps and steering racks of vehicles and equipment should be contained using a drip tray with plastic sheeting filled with absorbent material;
- Using biodegradable hydraulic fluids, using lined sumps for collection of hydraulic fluids, recovering contaminated soils, and treating them off-site, and securely storing dried waste mud by burying it in a purpose-built containment area;
- Avoiding waste disposal at the site wherever possible, by segregating, trucking out, and recycling waste at licensed waste disposal / recycling facilities;
- Containing potentially contaminating fluids and other wastes; and
- Cleaning up areas of spillage of potentially contaminating liquids and solids.

Table 16 Significance rating of soil chemical pollution before and after the implementation of mitigation measures

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	L	H	L	M	M
Mitigated	VL	L	VL	L	VL

12.4 Decommissioning Phase

The proposed project is expected to operate for at least 20 years. Once the solar PV facility reaches the end of its life, the facility will be decommissioned or continue to operate following the issuance of a new Power Purchase Agreement (PPA) by Eskom. If decommissioned, all components will be removed, and the site rehabilitated. Where possible all materials will be recycled, otherwise they will be disposed of in accordance with local regulations and international best practice.

12.4.1 Soil compaction

Soil compaction during the decommissioning phase will occur as a result of the heavy vehicles and equipment moving over the soil surface. The shaping of the surfaces to be rehabilitated into the final landform, will further result in soil compaction. It is considered a moderate disturbance of the soil quality and without any mitigation measures, will remain permanent (Very High Duration). Without mitigation measures, the extent of the impact may affect the entire site (Low Extent). With the implementation of mitigation measures, the extent can be limited to only the development footprint. This impact will definitely occur, both in the mitigated and unmitigated scenarios.

The significance of soil compaction can be reduced through the implementation of the following mitigation measures:

- Minimise the areas of activity to that indicated in the infrastructure layout (refer to
- The activities of construction contractors or employees will be restricted to the planned areas.
- Roads that will carry heavy-duty traffic should be designed in areas previously disturbed rather than clearing new areas, where relevant.

Table 17 Significance rating of soil compaction before and after the implementation of mitigation measures

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	M	VH	L	H	H
Mitigated	M	H	VL	M	M

12.4.2 Soil chemical pollution

During the decommissioning phase, buildings will be dismantled and materials removed from their current position. Vehicles and equipment will move around in the area to decommission infrastructure and shape the surface into the final landforms. Without mitigation measures implemented, soil pollution is considered a severe degradation of soil quality that may result in environmental and human health impacts. Without deliberate rehabilitation, the impact may last for a long period of time and may affect the entire site. Also, without implementation of preventative mitigation measures, there is a high probability that the impact will occur.

- Losses of fuel and lubricants from the oil sumps and steering racks of vehicles and equipment should be contained using a drip tray with plastic sheeting filled with absorbent material;
- Using biodegradable hydraulic fluids, using lined sumps for collection of hydraulic fluids, recovering contaminated soils and treating them off-site, and securely storing dried waste mud by burying it in a purpose-built containment area;
- Avoiding waste disposal at the site wherever possible, by segregating, trucking out, and recycling waste at licensed waste disposal / recycling facilities;
- Containing potentially contaminating fluids and other wastes; and
- Cleaning up areas of spillage of potentially contaminating liquids and solids.

Table 18 Significance rating of soil chemical pollution before and after the implementation of mitigation measures

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	L	H	L	M	M
Mitigated	VL	L	VL	L	VL

13. Cumulative impact assessment

13.1 Assessment of the Scafell Cluster

The Scafell Cluster will consist of four Solar PV Facilities and four grid connection projects that will feed the electricity generated by the PV facilities, into the Scafell Main Transmission Substation. Each of these facilities will also include an on-site substation that will be located within the development area of the facility (see Figure 2). Each of the projects of the Scafell Cluster will result in the following cumulative impacts:

- The land capability and current land use (livestock grazing and pasture production on the Vlakfontein project site) will change to that of renewable energy generation. The change will be prominent and last for a long period of time (at least 20 years). While the development footprint of each project will only affect a portion of the project site, the land use change will affect a total area of 724 ha. The cumulative impact of land use change for the entire Scafell Cluster, is an impact of High Significance as it will definitely occur and mitigation measures will not be able to reverse the land use change.
- Cumulative impacts on soil include the increased risk of soil erosion as a large area will be affected by vegetation clearance, soil levelling and earthworks. The cumulative impact of soil erosion is considered of Medium Significance and mitigation measures must be implemented to avoid the spreading of soil erosion impacts outside the property boundaries.
- Soil compaction is another cumulative impact that cannot be prevented since access roads, building foundations and substation foundations requires deliberate compaction of the soil surface for structural stability. This will result in a cumulative impact of Medium significance as it will result in a moderate disturbance of soil functionality that will last for a long period of time and will affect the entire site where the Scafell Cluster will be. Soil compaction will definitely occur, even when all mitigation measures are implemented.
- The organisation of the soil horizons of the natural soils within the Scafell Cluster's project sites, will result in affecting the biophysical functionality of the soils. This impact will be a moderate disturbance that will last for a long period time and that will occur across the entire area wherever trenches will be dug, and foundations and access roads be constructed. This impact has Medium significance, even with the implementation of mitigation measures at all the Scafell project sites.
- Soil chemical pollution will be a risk at all of the project sites of the Scafell Cluster. Where some of the other impacts on soil cannot be avoided such as soil compaction and soil horizon disturbance, soil pollution can be prevented and kept to a minimal extent, with the rigorous implementation of mitigation measures. The implementation of regular monitoring and checks on vehicles and equipment to avoid oil and fuel spills, as well as diligent waste removal from all of the project sites, the significance of the cumulative impact of soil pollution, can be limited to Very Low significance.

13.2 Cumulative assessment of any other projects within a 50 km radius

Other renewable energy projects in the area can also result in cumulative impacts on soil and agriculture. The presence of other renewable energy projects within a 50 km radius around the Scafell Cluster (that includes the Ilikwa project site), is depicted in Figure 23. The map shows that three other renewable energy projects occur west, north and east of the Scafell Cluster's project sites.

The cumulative impact of other renewable energy projects in the larger area around the site, will include the following:

- An increase in the areas that experience land use change from agriculture to renewable energy development;
- Increased risk of soil erosion where surfaces that were previously covered in vegetation, are stripped from vegetation for the construction of renewable energy infrastructure;
- An increase in the areas where natural soil profiles will be disturbed for the installation of infrastructure and the construction of stations and buildings that will support the operation phases of these projects;
- More areas where soil will be deliberately compacted such as where access roads and buildings will be. An increase in areas with compacted soil, will reduce water infiltration into soil in these areas.
- An increased risk that soil may be polluted by the vehicles and equipment that will traverse these sites as well as the materials that will used and the waste that will be generated.

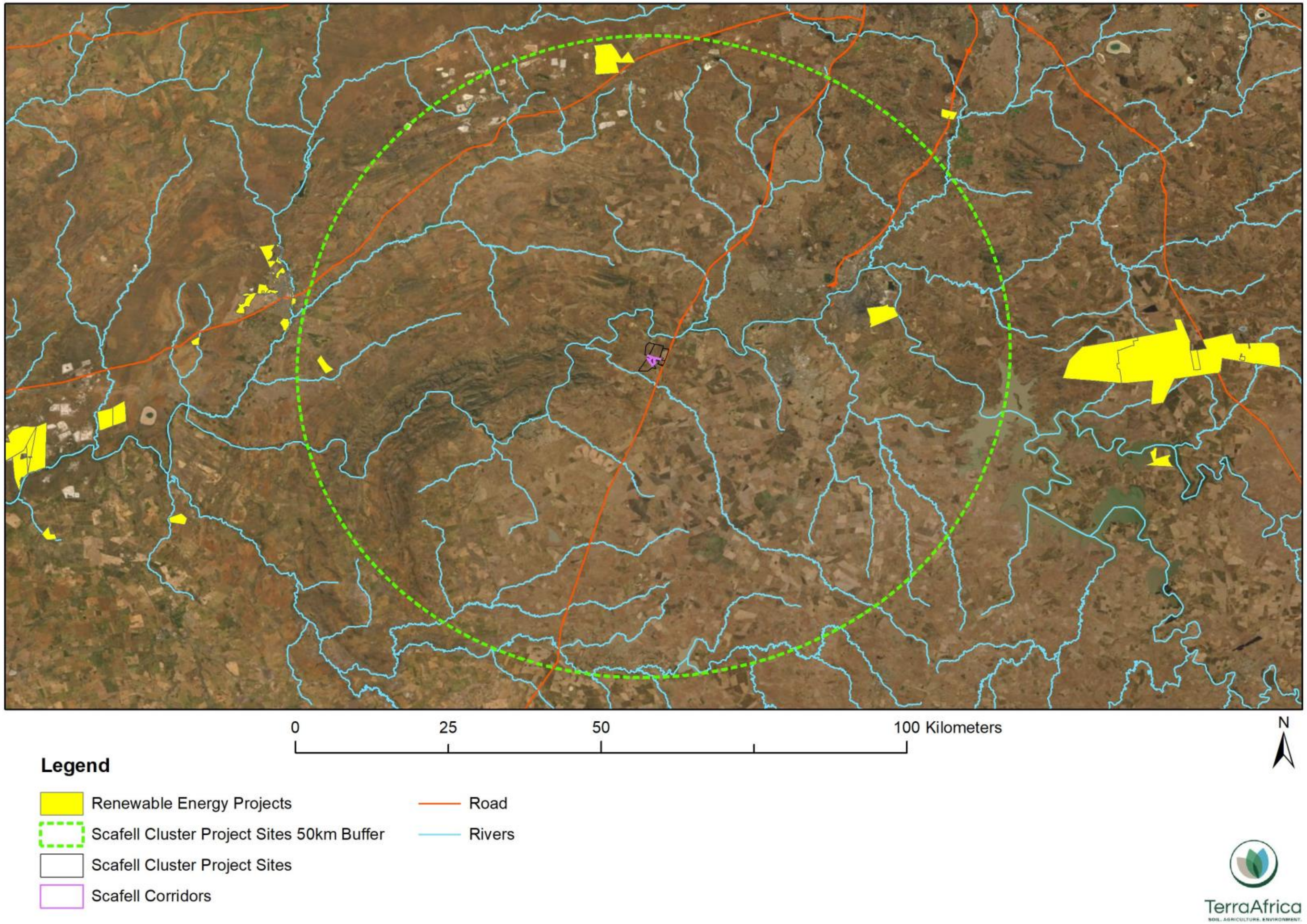

Figure 23 Other renewable energy projects within 50 km of the Ilikwa project site that may result in cumulative impacts

14. Conclusion and recommendations

The soil and agricultural properties and sensitivities of the proposed Ilikwa solar PV facility development was the subject of the Agricultural Agro-Ecosystem Assessment conducted. The study found that the area consists of ten different natural soil forms, ranging from 0.10 m to 1.5 m or deeper in effective soil depth. The soil forms identified are Bainsvlei, Clovelly, Dundee, Glenrosa, Griffin, Hutton, Kransfontein, Mispah, Nkonkoni and Pinedene. The soil textures are Sandy Loam and Loamy Sand. The soil chemical analysis indicates pH levels between very strongly acidic to strongly acidic. It also shows that sodium is the dominant cation adsorbed to the cation exchange complex of the samples analysed. High sodium concentrations may result in nutrient imbalances, should the soil have been used for crop production.

The largest area of the Ilikwa project site consists of land with either Moderate (Class 08) or Low-Moderate (Class 07) land capability. Moderate (Class 08) land capability is found in the middle section of the Ilikwa project site while land with Low-Moderate (Class 07) land capability is mostly found along the boundaries of the project site. These two land capability classes are the predominant land capability classes of the project site. The project site also has small, isolated patches with Moderate-High (Class 09) land capability in the middle of the project site and Low-Moderate (Class 06) and Low (Class 05) land capability along the western boundary.

The sensitivity rating of the site was based on the soil classification of the project site. Approximately 12.5 ha has High agricultural sensitivity, 110.3 ha has Medium sensitivity and 157.6 ha has Low sensitivity. The development footprint includes areas of all three sensitivity categories. The development footprint that has been provided by the applicant shows that the development footprint will 4.1 ha of High sensitivity, 73.7 ha of Medium and 83.7 ha of Low sensitivity areas. The calculation of the Allowable Development Limits for the Ilikwa solar PV facility (a 75MW project), indicates that none of the development limits are exceeded by the current development footprint.

Other alternatives provided include technology alternatives. However, the different technology alternatives do not influence the impacts of the project on soil and agricultural potential. The ‘No-go’ alternative will result in no impacts on soil and agricultural and the only impacts of this alternative will be that of livestock on the agricultural resources, which is minimal, unless the grazing capacity is exceeded.

It is anticipated that the construction and operation of the Ilikwa solar PV facility will have impacts on soil and livestock farming that range from high to medium. The impacts include a change in land use from livestock farming to renewable energy generation, soil erosion, soil compaction, the disturbance of natural soil profiles and soil chemical pollution. Through the consistent implementation of the recommendation mitigation measures, most of impacts can all be reduced to very low. Since the area around the development footprint will be fenced off, it is not anticipated that the impact on livestock farming can be mitigated as this area will now be excluded from livestock farming.

Considering that the infrastructure components, including the proposed substation, will be placed in close proximity to each other, I confirm that as far as I know, all reasonable measures have been taken to avoid or minimize fragmentation and disturbance of agricultural activities, provided that the mitigation measures provided in this report are implemented.

It is my professional opinion that this application be considered favourably. The area has not been used for crop production since 2016 (according to aerial imagery). The farm is currently used for commercial cattle production of 26 weaners annually and can at most provide employment for two farmworkers.

In contrast to that, the proposed Ilikwa solar PV project will contribute a significant amount of expenditure to the area and employ up to 230 workers during the construction phase and up to than 17 workers during the operational phase. In the light of the high number of employment opportunities that will be created per hectare of land, and the contribution of the project to the local economy, the proposed Ilikwa solar PV facility is considered an acceptable land use change.

In light of the above, the project is considered acceptable permitting that the mitigation measures stipulated in this report are followed to prevent soil erosion and soil pollution and to minimise impacts on the veld quality of the farm portions that will be affected. The project infrastructure should also remain within the proposed footprint boundaries that will be fenced off and the construction corridor around the access road must be as narrow as possible.

15. Reference list

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Land Type Survey Staff, 1972 – 2006. *Land Types of South Africa data set*. ARC – Institute for Soil, Climate and Water. Pretoria.

South Africa (Republic), 2018. *Long-term grazing capacity for South Africa*: Data layer. Government Gazette Vol. 638, No. 41870. 31 August 2018. Regulation 10 of the Conservation of Agricultural Resources Act (CARA): Act 43 of 1983. Pretoria. Government Printing Works.

The Soil Classification Working Group, 2018. *Soil Classification – Taxonomic System for South Africa.* Dept. of Agric., Pretoria.

APPENDIX 1 – CURRICULUM VITAE OF SPECIALIST

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Wolmaransstad,
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EXPERTISE

Soil Quality Assessment

Soil Policy and Guidelines

Agricultural Agro-Ecosystem Assessment

Sustainable Agriculture

Data Consolidation

Land Use Planning

Soil Pollution

Hydropedology

EDUCATION

MASTER'S DEGREE
Environmental Science
University of Witwatersrand
2010 – 2018

BACHELOR'S DEGREE
Agricultural Science
University of Pretoria
2001 – 2004

PROFESSIONAL PROFILE

I contribute specialist knowledge on agriculture and soil management to ensure long-term sustainability of projects in Africa. For the past thirteen years, it has been my calling and I have consulted on more than 200 projects. My clients include environmental and engineering companies, mining houses, and project developers. I enjoy the multi-disciplinary nature of the projects that I work on and I am fascinated by the evolving nature of my field of practice. The next section provide examples of the range of projects completed. A comprehensive project list is available on request.

PROJECT EXPERIENCE

Global Assessment on Soil Pollution

Food and Agricultural Organisation (FAO) of the United Nations (UN)

Author of the regional assessment of Soil in Sub-Saharan Africa. The report is due for release in February 2021. The different sections included:

- Analysis of soil and soil-related policies and guidelines for each of the 48 regional countries
- Description of the major sources of soil pollution in the region
- The extent of soil pollution in the region and as well as the nature and extent of soil monitoring
- Case study discussions of the impacts of soil pollution on human and environmental health in the region
- Recommendations and guidelines for policy development and capacitation to address soil pollution in Sub-Saharan Africa

Data Consolidation and Amendment

Range of projects: Mining Projects, Renewal Energy

These projects included developments where previous agricultural and soil studies are available that are not aligned with the current legal and international best practice requirements such as the IFC Principles. Other projects are expansion projects or changes in the project infrastructure layout. Tasks on such projects include the incorporation of all relevant data, site verification, updated baseline reporting and alignment of management and monitoring measures.

Project examples:

- Northam Platinum's Booysendal Mine, South Africa
- Musonoi Mine, Kolwezi District, Democratic Republic of Congo
- Polihali Reservoir and Associated Infrastructure, Lesotho
- Kaiha 2 Hydropower Project, Liberia
- Aquarius Platinum's Kroondal and Marikana Mines

PROFESSIONAL MEMBERSHIP

South African Council for Natural Scientific Professions (SACNASP)

Soil Science Society of South Africa (SSSSA)

Soil Science Society of America (SSSA)

Network for Industrially Contaminated Land in Africa (NICOLA)

LANGUAGES

English (Fluent)

Afrikaans (Native)

French (Basic)

PRESENTATIONS

There is spinach in my fish pond
TEDx Talk
Available on YouTube

♦

Soil and the Extractive Industries
Session organiser and presenter
Global Soil Week, Berlin (2015)

♦

How to dismantle an atomic bomb
Conference presentation (2014)
Environmental Law Association (SA)

PROJECT EXPERIENCE (Continued)

Agricultural Agro-Ecosystem Assessments

Range of projects: Renewable Energy, Industrial and Residential Developments, Mining, Linear Developments (railways and power lines)

The assessments were conducted as part of the Environmental and Social Impact Assessment processes. The assessment process includes the assessment of soil physical and chemical properties as well as other natural resources that contributes to the land capability of the area.

Project examples:

- Mocuba Solar PV Development, Mozambique
- Italthai Railway between Tete and Quelimane, Mozambique
- Lichtenburg PV Solar Developments, South Africa
- Manica Gold Mine Project, Mozambique
- Khunab Solar PV Developments near Upington, South Africa
- Bomi Hills and Mano River Mines, Liberia
- King City near Sekondi-Takoradi and Appolonia City near Accra, Ghana
- Limpopo-Lipadi Game Reserve, Botswana
- Namoya Gold Mine, Democratic Republic of Congo

Sustainable Agriculture

Range of projects: Policy Development for Financial Institutions, Mine Closure Planning, Agricultural Project and Business Development Planning

Each of the projects completed had a unique scope of works and the methodology was designed to answer the questions. While global indicators of sustainable agriculture are considered, the unique challenges to viable food production in Africa, especially climate change and a lack of infrastructure, in these analyses.

Project examples:

- Measurement of sustainability of agricultural practices of South African farmers – survey design and pilot testing for the LandBank of South Africa
- Analysis of the viability of avocado and mango large-scale farming developments in Angola for McKinsey & Company
- Closure options analysis for the Tshipi Borwa Mine to increase agricultural productivity in the area, consultation to SLR Consulting
- Analysis of risks and opportunities for farm feeds and supplement suppliers of the Southern African livestock and dairy farming industries
- Sustainable agricultural options development for mine closure planning of the Camutue Diamond Mine, Angola

PROFESSIONAL DEVELOPMENT

Contaminated Land Management 101 Training
Network for Industrially Contaminated Land in Africa
2020

Intensive Agriculture in Arid & Semi-Arid Environments
CINADCO/MASHAV R&D Course, Israel
2015

World Soils and their Assessment Course
ISRIC – World Soil Information Centre, Netherlands
2015

Wetland Rehabilitation Course
University of Pretoria
2010

Course in Advanced Modelling of Water Flow and Solute Transport in the Vadose Zone with Hydrus
University of Kwazulu-Natal
2010

Environmental Law for Environmental Managers
North-West University Centre for Environmental Management
2009

PROJECT EXPERIENCE (Continued)

Soil Quality Assessments

Range of projects: Rehabilitated Land Audits, Mine Closure Applications, Mineral and Ore Processing Facilities, Human Resettlement Plans

The soil quality assessments included physical and chemical analysis of soil quality parameters to determine the success of land rehabilitation towards productive landscapes. The assessments are also used to understand the suitability for areas for Human Resettlement Plans

Project examples:

- Closure Planning for Yoctolux Colliery
- Soil and vegetation monitoring at Kingston Vale Waste Facility
- Exxaro Belfast Resettlement Action Plan Soil Assessment
- Soil Quality Monitoring of Wastewater Irrigated Areas around Matimba Power Station
- Keaton Vanggatfontein Colliery Bi-Annual Soil Quality Monitoring

REFERENCES

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