Agricultural Potential Assessment for the proposed Mafadi Photovoltaic (PV) Facility

Bandelierkop, Limpopo Province, South Africa

November 2022

Client

ENVIRONAMICS

Prepared by:

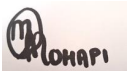
The Biodiversity Company

Cell: +27 81 319 1225

Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany.com

Report Name	**Agricultural Potential Assessment for the proposed Mafadi Photovoltaic (PV) Facility**
Reference	Mafadi Solar PV
Submitted to	ENVIRONAMICS
Report Reviewer	**Andrew Husted**  Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 13 years' experience in the environmental consulting field.
Report Writer	**Maletsatsi Mohapi**  Maletsatsi Mohapi is a Soil scientist in the field of Natural and Agricultural sciences. Maletsatsi is a soil and wetland specialist, with an experience in soil identification, soil classification, wetland delineation and wetland monitoring. Maletsatsi completed her MSc in Agriculture at the University of the Free State in 2021. Maletsatsi is also a member of the Soil Science Society of South Africa (SSSSA).
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

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Document Guide

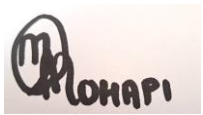
According to the Government Notice 320 dated 20 March 2020 and the procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for environmental authorisation, the following criteria is applicable to that of an agricultural compliance statement.

Requirement	Reference
Specialist Details and CV	Appendix A
Locality of the proposed activity	Section 2
Sensitivity verification	Section 5.2
Acceptability of impacts towards agricultural production capability associated with proposed activities	Section 6
Declaration of specialist(s)	Page vi
Project components with 50 m regulated area superimposed to that of the agricultural sensitivities of the screening tool	Section 5.2
Confirmation from specialist that mitigation to avoid fragmentation has been considered	Section 6
Statement from specialist regarding the acceptability and approval of proposed activities	Section 6
Conditions to acceptability of proposed activities	
Probability of land being returned to current state after decommissioning	N/A
Monitoring requirements and/or any inclusions into EMPr	N/A
Assumptions and uncertainties	Section 3.4

DECLARATION

I, **Maletsatsi Mohapi** 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 71 and is punishable in terms of Section 24F of the Act.



Maletsatsi Mohapi

Soil Scientist

The Biodiversity Company

November 2022

1 Introduction

1.1 Background

The Biodiversity Company was appointed by Environamics Pvt Ltd to undertake a basic soil and agricultural potential assessment for the Mafadi solar photovoltaic (PV) facility project near Bandelierkop in the Limpopo Province. The project area is found approximately 2.4 km south of Bandelierkop town and 35 km south of Louis Trichardt/Makhado.

The approach adopted for the assessment has taken cognisance of the recently published Government Notice 320 in terms of NEMA dated 20 March 2020: “Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation”.

This report aims to present and discuss the findings from the soil resources identified within the 50 m regulated area. The report will also identify the soil suitability and land potential of these soils, the land uses within the assessment area and the risks associated with the proposed solar renewable development project.

1.2 Technical Information

According to Environamaics the key components of the proposed project include the following:

- PV Panel Array - To produce up to 150MW, the proposed facility will require numerous linked cells placed behind a protective glass sheet to form a panel. Multiple panels will be required to form the solar PV arrays which will comprise the PV facility. The PV panels will be tilted at a northern angle in order to capture the most sun or using one-axis tracker structures to follow the sun to increase the Yield;

- Wiring to Inverters - Sections of the PV array will be wired to inverters. The inverter is a pulse width mode inverter that converts direct current (DC) electricity to alternating current (AC) electricity at grid frequency;

- Connection to the grid - Connecting the array to the electrical grid requires transformation of the voltage from 480V to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation will be required. Output voltage from the inverter is 480V and this is fed into step up transformers to 132kV. An onsite substation will be required on the site to step the voltage up to 132kV, after which the power will be evacuated into the national grid via the proposed power line. It is expected that generation from the facility will connect to the national grid via the existing Eskom Tabor 275/132kV MTS Substation or via a Li-Lo line to the existing Louis Trichardt - Tabor 132kv Overhead Line or the Tabor - Flurian Tee 132kV Overhead Line. The grid connection route will be assessed within a 200m wide (up to 900m wide in some instances) corridor. The Project will inject up to 150MW into the National Grid. The installed capacity will be approximately 200MW;

- Electrical reticulation network – An internal electrical reticulation network will be required and will be lain ~2-4m underground as far as practically possible;

- Supporting Infrastructure – The supporting infrastructure such as the auxiliary buildings and laydown areas will be situated in an area measuring up to 5 ha;

- Battery storage – A Battery Storage Facility with a maximum height of 8m and a maximum volume of 1,740 m^3 of batteries and associated operational, safety and control infrastructure;

- Roads – Access will be obtained via the R36 regional road to the south of the site. An internal site road network will also be required to provide access to the solar field and associated infrastructure. The access and internal roads will be constructed within a 25-meter corridor; and

- Fencing - For health, safety and security reasons, the facility will be required to be fenced off from the surrounding farm. Fencing with a height of 2.5 meters will be used.

1.3 Scope of Work

According to the National Web based Environmental Screening Tool, the proposed development is located within the "Low to Medium" sensitivity land capability area. The protocols for minimum requirements (DEA, 2020)[1] stipulates that in an event that a proposed development is located within "Low" or "Medium" sensitivities, an agricultural compliance statement will be sufficient. It is worth noting that according to these protocols, a site inspection will still need to be conducted to determine the accuracy of these sensitivities. After acquiring baseline information pertaining to soil, terrain and climate features within the 50 m regulated areas, it is the specialist's opinion that the soil forms and associated land capabilities concur with the sensitivities stated by the screening tool. Therefore, only an agricultural compliance statement will be compiled. This includes:

- The feasibility of the proposed activities;
- Confirmation about the "Low" and "Medium" sensitivities;
- The effects that the proposed activities will have on agricultural production in the area;
- A map superimposing the proposed footprint area, a 50 m regulated area as well as the sensitivities pertaining to the screening tool;
- Confirmation that no agricultural segregation will take place and that all options have been considered to avoid segregation;
- The specialist's opinion regarding the approval of the proposed activities; and
- Any potential mitigation measures described by the specialist to be included in the EMPr.

1.4 Expertise of the Specialists

1.4.1 Andrew Husted

Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 13 years' experience in the environmental consulting field.

1.4.2 Maletsatsi Mohapi

Maletsatsi Mohapi is a Soil scientist in the field of Natural and Agricultural sciences. Maletsatsi is a soil and wetland specialist, with an experience in soil identification, soil classification, wetland delineation and wetland monitoring. Maletsatsi completed her MSc in Agriculture at the University of the Free State in 2021. Maletsatsi is also a member of the Soil Science Society of South Africa (SSSSA).

2 Project Area

The proposed Mafadi PV project area is located along the N1 national road, approximately 2.4 km south of Bandelierkop town in the Limpopo Province, South Africa. The project area is also found north of R36

[1] A site identified by the screening tool as being of 'High" or "Very High" sensitivity for agricultural resources must submit a specialist assessment unless the impact on agricultural resources is from an electricity pylon (item 1.1.2).

regional road and approximately 1.5 km west of A Macha @ Africa lodge (Figure 2-1). The surrounding land use includes watercourses, livestock and game farming.

According to Environamics (2022) three layout alternatives have been identified for the Mafadi SSP which relate mainly to associated infrastructure including the substation, BESS, O&M, Laydown and construction camp. This is due to the uncertainties of whether Eskom will approve the grid connection via the existing Tabor 275/132kV MTS Substation or via a Loop-in Loop-out line to the existing Louis Trichardt - Tabor 132kV Overhead Line or the Tabor - Flurian Tee 132kV Overhead Line.

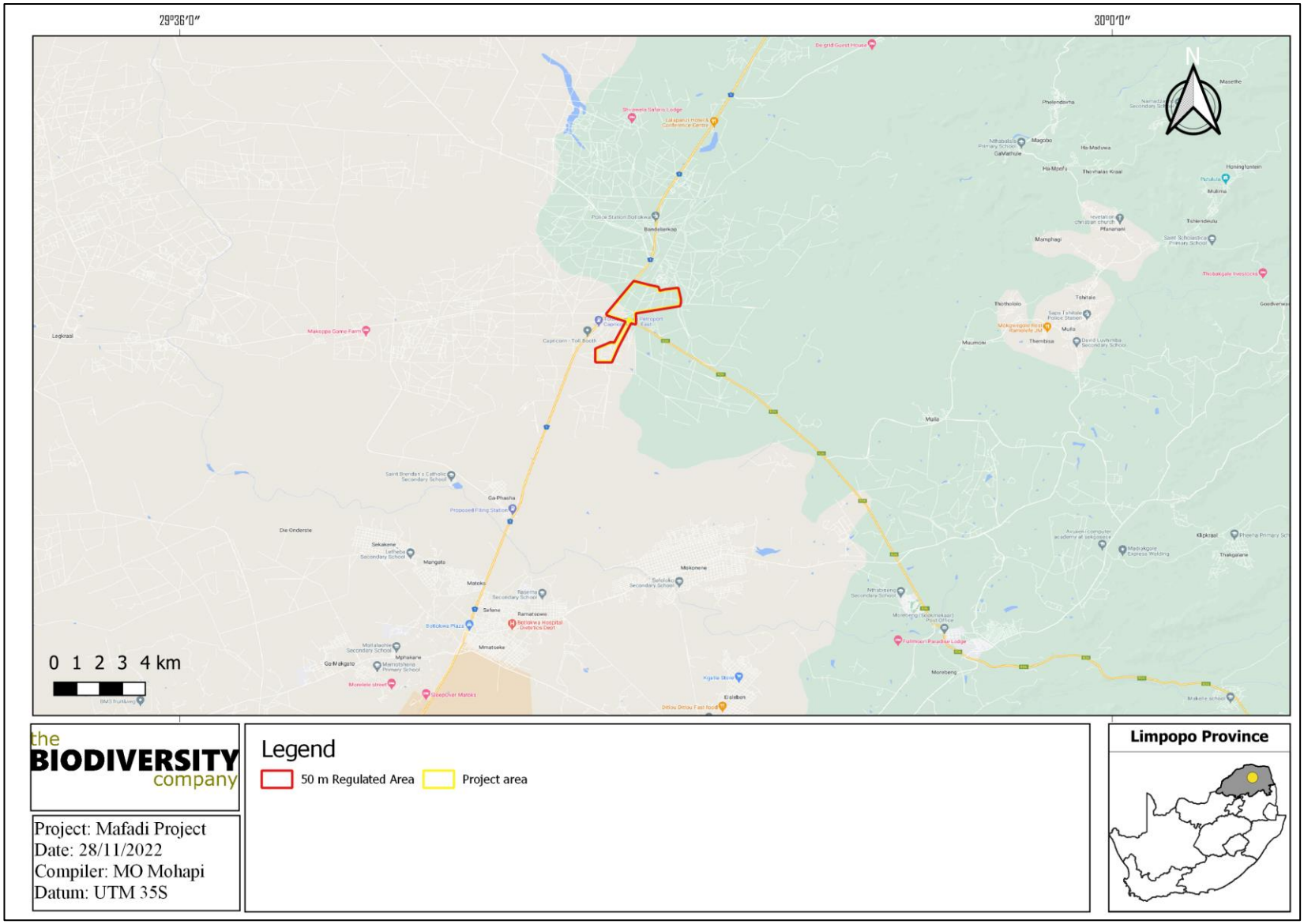


Figure 2-1 Locality map of the project area

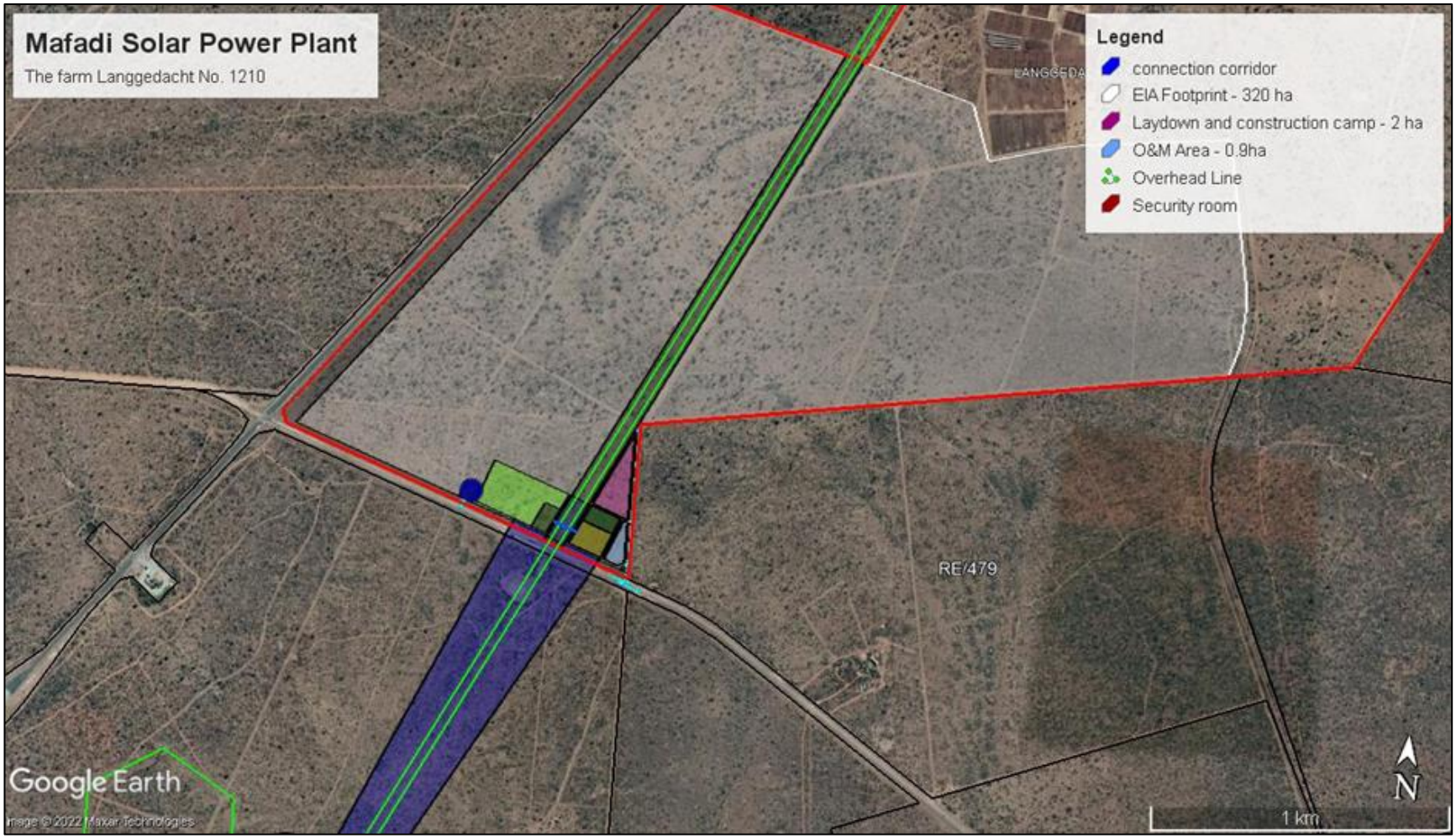


Figure 2-2 Map illustration layout option 1

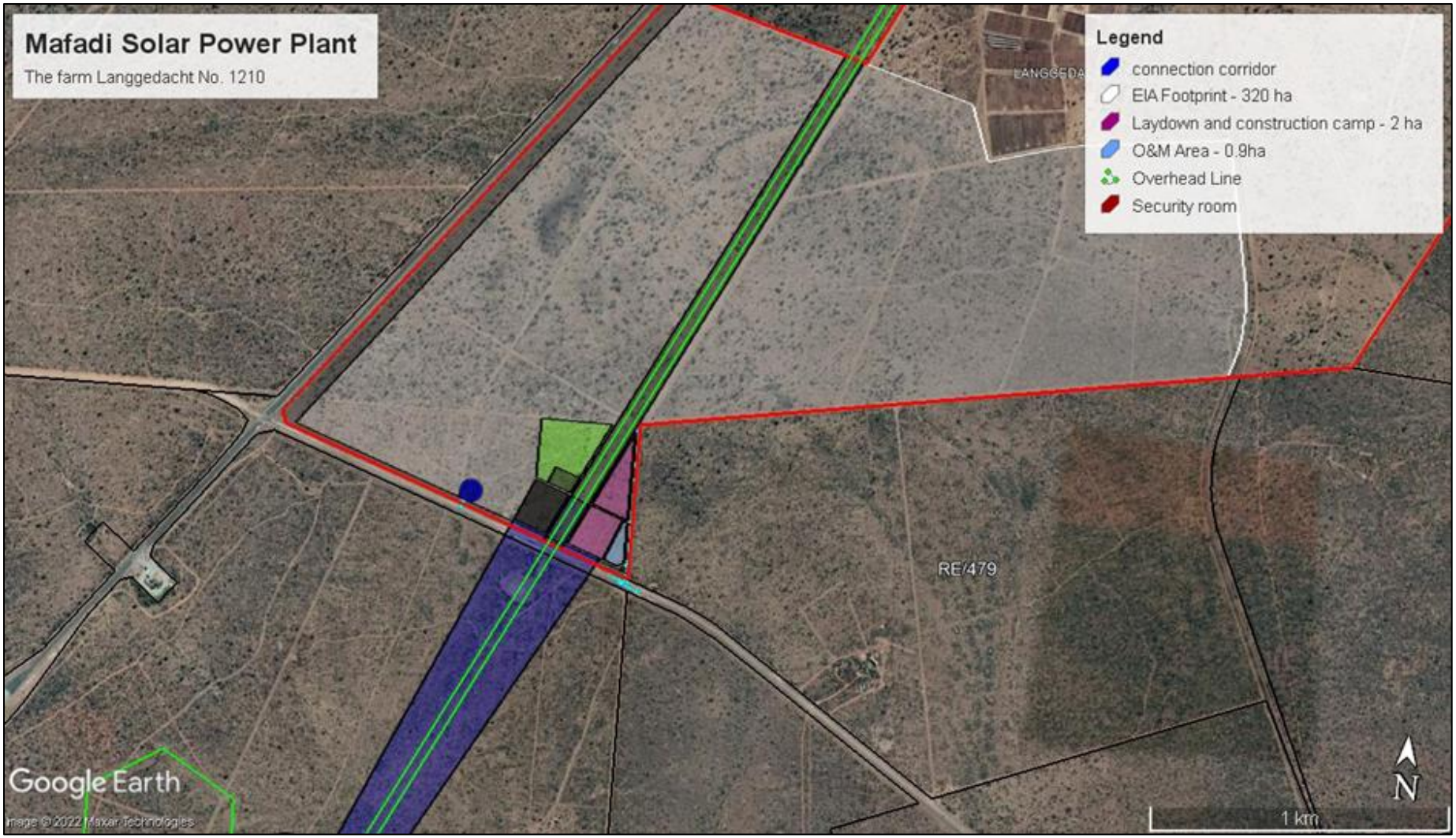


Figure 2-3 Map illustration layout option 2

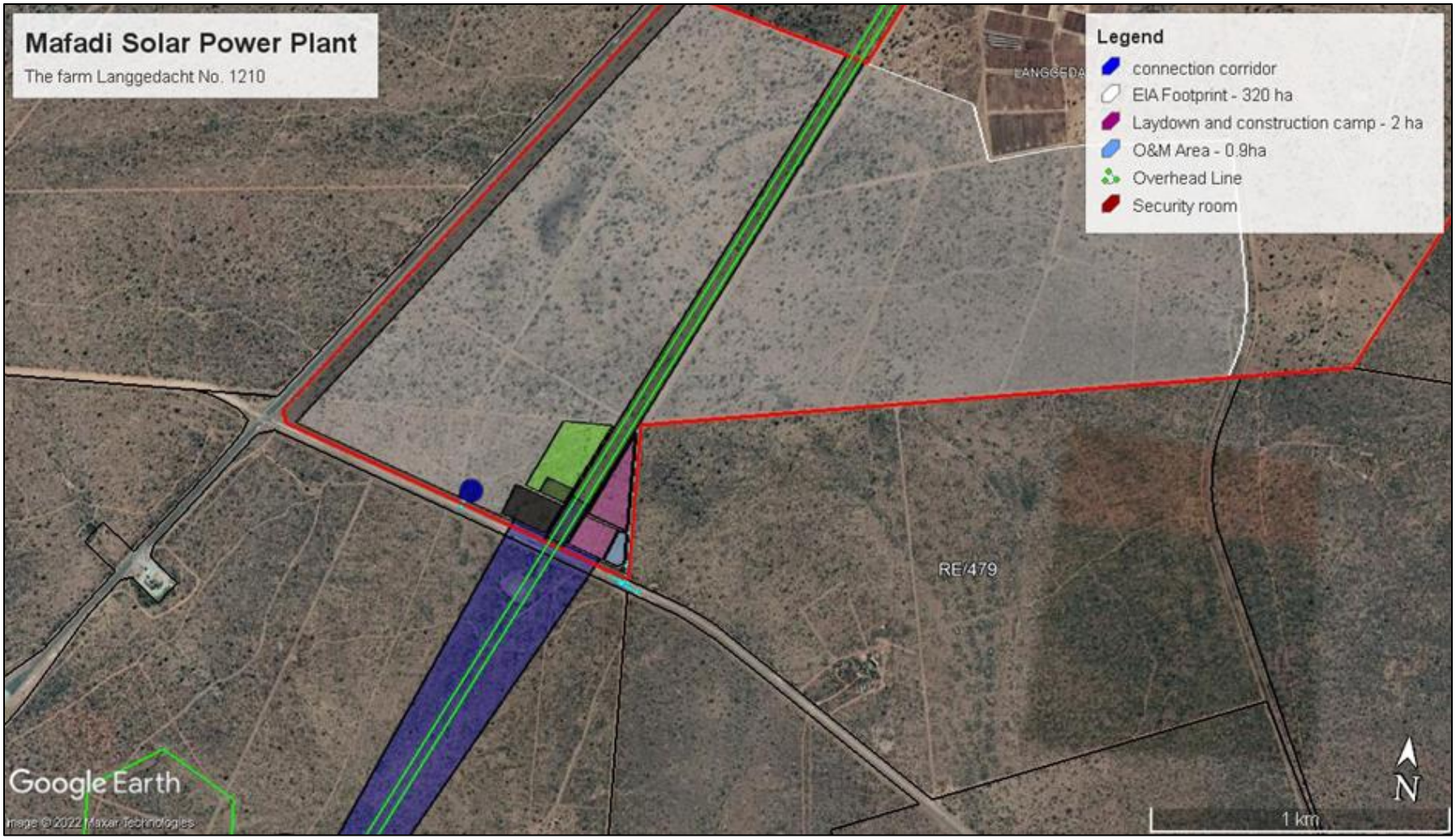


Figure 2-4 Map illustration layout option 3

3 Methodology

3.1 Desktop Assessment

As part of the desktop assessment, baseline soil information was obtained using published South African Land Type Data. Land type data for the site 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 comprises of the division of land into land types. In addition, a Digital Elevation Model (DEM) as well as the slope percentage of the area was calculated by means of the NASA Shuttle Radar Topography Mission Global 1 arc second digital elevation data by means of QGIS and SAGA software.

3.2 Field Survey

An assessment of the soils present within the project area was conducted during the field survey in October 2022. The site was traversed on foot. A soil auger was used to determine the soil form/family and depth. The soil was hand augured to the first restricting layer or 1,5 m. Soil survey positions were recorded as waypoints using a handheld GPS. Soils were identified to the soil family level as per the “Soil Classification: A Taxonomic System for South Africa” (Soil Classification Working Group, 2018). Landscape features such as existing open trenches were also helpful in determining soil types and depth.

3.3 Land Capability

Given the nature of the compliance statement and the fact that baseline findings correlate with the screening tool’s sensitivities, land capability was solely determined by means of the National Land Capability Evaluation Raster Data Layer (DAFF, 2017). Land capability and land potential will also briefly be calculated to match to that of the screening tool to ultimately determine the accuracy of the land capability sensitivity from the DAFF, (2017) sensitivities.

Land capability and agricultural potential will briefly be determined by a combination of soil, terrain and climate features. Land capability is defined by the most intensive long-term sustainable use of land under rain-fed conditions. At the same time an indication is given about the permanent limitations associated with the different land use classes.

Land capability is divided into eight classes, and these may be divided into three capability groups. Table 3-1 shows how the land classes and groups are arranged in order of decreasing capability and ranges of use. The risk of use increases from class I to class VIII (Smith, 2006).

Table 3-1 Land capability class and intensity of use (Smith, 2006)

Land Capability Class	Increased Intensity of Use									Land Capability Groups
I	W	F	LG	MG	IG	LC	MC	IC	VIC	Arable Land
II	W	F	LG	MG	IG	LC	MC	IC		
III	W	F	LG	MG	IG	LC	MC			
IV	W	F	LG	MG	IG	LC				
V	W	F	LG	MG						Grazing Land
VI	W	F	LG	MG						
VII	W	F	LG							
VIII	W									Wildlife

W - Wildlife		**MG - Moderate Grazing**			**MC - Moderate Cultivation**					
F- Forestry		**IG - Intensive Grazing**			**IC - Intensive Cultivation**					
LG - Light Grazing		**LC - Light Cultivation**			**VIC - Very Intensive Cultivation**					

The land potential classes are determined by combining the land capability results and the climate capability of a region as shown in Table 3-2. The final land potential results are then described in Table 3-3.

Table 3-2 The combination table for land potential classification

Land capability class	Climate capability class							
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**
I	L1	L1	L2	L2	L3	L3	L4	L4
II	L1	L2	L2	L3	L3	L4	L4	L5
III	L2	L2	L3	L3	L4	L4	L5	L6
IV	L2	L3	L3	L4	L4	L5	L5	L6
V	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei
VI	L4	L4	L5	L5	L5	L6	L6	L7
VII	L5	L5	L6	L6	L7	L7	L7	L8
VIII	L6	L6	L7	L7	L8	L8	L8	L8

Table 3-3 The Land Potential Classes.

Land potential	Description of land potential class
L1	Very high potential: No limitations. Appropriate contour protection must be implemented and inspected.
L2	High potential: Very infrequent and/or minor limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
L3	Good potential: Infrequent and/or moderate limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
L4	Moderate potential: Moderately regular and/or severe to moderate limitations due to soil, slope, temperatures or rainfall. Appropriate permission is required before ploughing virgin land.
L5	Restricted potential: Regular and/or severe to moderate limitations due to soil, slope, temperatures or rainfall.
L6	Very restricted potential: Regular and/or severe limitations due to soil, slope, temperatures or rainfall. Non-arable
L7	Low potential: Severe limitations due to soil, slope, temperatures or rainfall. Non-arable
L8	Very low potential: Very severe limitations due to soil, slope, temperatures or rainfall. Non-arable

3.4 Limitations

The following limitations are relevant to this agricultural compliance statement:

- The handheld GPS used potentially could have inaccuracies up to 5 m. Any and all delineations therefore could be inaccurate within 5 m; and
- No heavy metals have been assessed nor fertility been analysed for the relevant classified soils.

4 Project Area

4.1 Soils and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006) the project assessment area footprint falls within the Bc 48, Bd 51 and Ca 102 land types. The Bc, Bd and Ca land types are characterised with plinthic catena soils that have presence of red soils that are undifferentiated and widespread. It is expected that dominant soil forms in the crest and midslope for all the land types will include Hutton, Avalon, Westleigh, Glenrosa and Clovelly soil forms. Furthermore, the soils that are expected to dominate the foot slope and valley bottom are Mispah, Oakleaf, Dundee and Valsrivier soil forms with also the possibility of other soils occurring throughout, following the South African soil classification working group (1990). The terrain units and expected soils for the Bc 48 land type are presented in **Error! Reference source not found.** and Table 4-1, Bd 15 in Figure 4-2 and Table 4-2 , and Ca 102 in Figure 4-3 and Table 4-3 respectively.

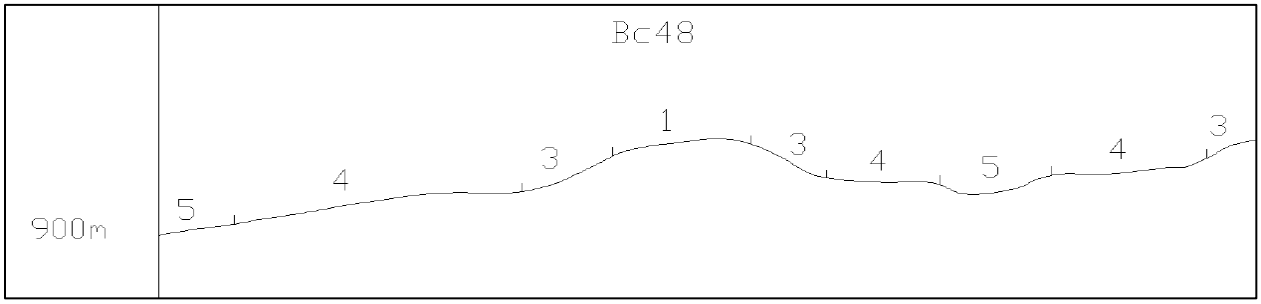


Figure 4-1 Illustration of land type Bc 48 terrain units (Land Type Survey Staff, 1972 – 2006)

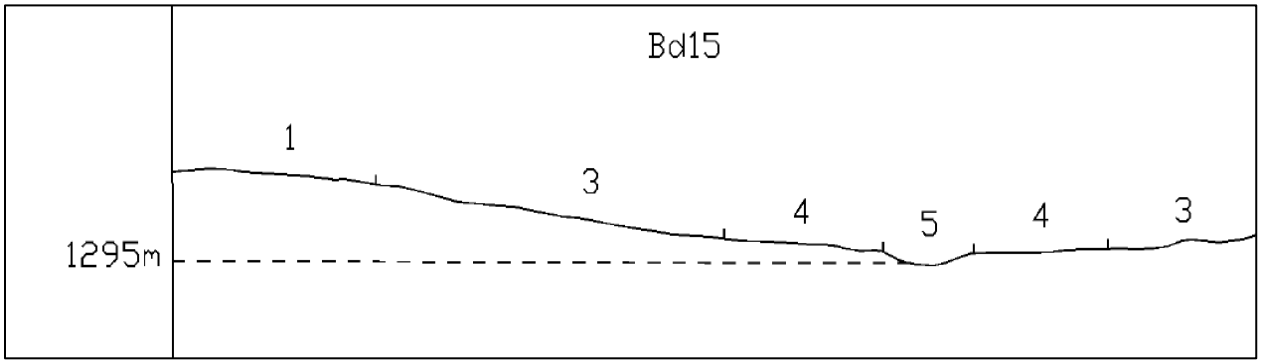


Figure 4-2 Illustration of land type Bd 15 terrain units (Land Type Survey Staff, 1972 – 2006)

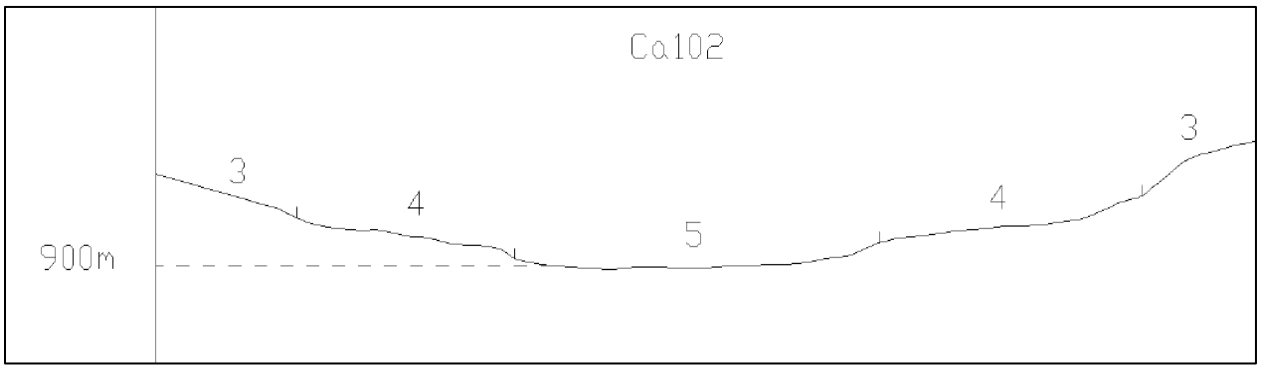


Figure 4-3 Illustration of land type Ca 102 terrain units (Land Type Survey Staff, 1972 – 2006)

Table 4-1 Soils expected at the respective terrain units within the Bc 48 land type (Land Type Survey Staff, 1972 - 2006)

1 (20%)		3 (25%)		4 (47%)		5(8%)	
Hutton	32%	Hutton	52%	Hutton	28%	Mispah	36%
Bare Rock	30%	Clovelly	12%	Clovelly	25%	Oakleaf	22%
Glenrosa	25%	Bare Rock	10%	Glenrosa	15%	Westleigh, Longlands	15%
Mispah	9%	Glenrosa	8%	Avalon, Pinedene	11%	Avalon, Pinedene	12%
Clovelly	4%	Mispah	5%	Westleigh, Longlands	5%	Clovelly	11%
		Bainsvlei	4%	Oakleaf	4%	Bare Rock	2%
		Avalon, Pinedene	3%	Bainsvlei	4%	Valsrivier, Swartland	2%
		Westleigh, Longlands	3%	Glencoe	3%		
		Valsrivier, Swartland	2%	Bare Rock	2%		
		Avalon, Bainsvlei	1%	Avalon, Bainsvlei	2%		
				Valsrivier, Swartland	1%		

Table 4-2 Soils expected at the respective terrain units within the Bd 15 land type (Land Type Survey Staff, 1972 - 2006)

1 (33%)		3 (50%)		4 (11%)		5(6%)	
Avalon	74%	Westleigh	42%	Swartland	56%	Dundee	67%
Westleigh	24%	Avalon	41%	Sterkspruit	26%	Bonheim	17%
Glencoe	2%	Swartland	14%	Westleigh	9%	Swartland	13%
		Sterkspruit	2%	Bonheim	9%	Sterkspruit	3%
		Glenrosa	1%				

Table 4-3 Soils expected at the respective terrain units within the Ca 102 land type (Land Type Survey Staff, 1972 -2006)

3 (30%)		4 (40%)		5(30%)	
Hutton	65%	Hutton	20%	Valsrivier	40%
Swartland	13%	Valsrivier	20%	Avalon	25%
Clovelly	10%	Westleigh	16%	Oakleaf	15%
Glenrosa	5%	Avalon	12%	Dundee	10%
Bare Rock	5%	Swartland	12%	Bainsvlei, Bonheim, Pinedene	8%
Bainsvlei, Bonheim, Pinedene	2%	Oakleaf	7%	Bare Rock	2%
		Bainsvlei, Bonheim, Pinedene	6%		
		Clovelly	6%		
		Bare Rock	1%		

4.2 Terrain

The slope percentage of the project area has been calculated and is illustrated in Figure 4-4. Most of the regulated area is characterised by a slope percentage between 0 to 6% with some irregularities in areas with slopes reaching 10%. This illustration indicates a non-uniform topography with occurrence of some sloping areas being present. The Digital Elevation Model (DEM) of the project area (Figure 4-5) indicates an elevation of 1 106 to 1 153 Metres Above Sea Level (MASL).

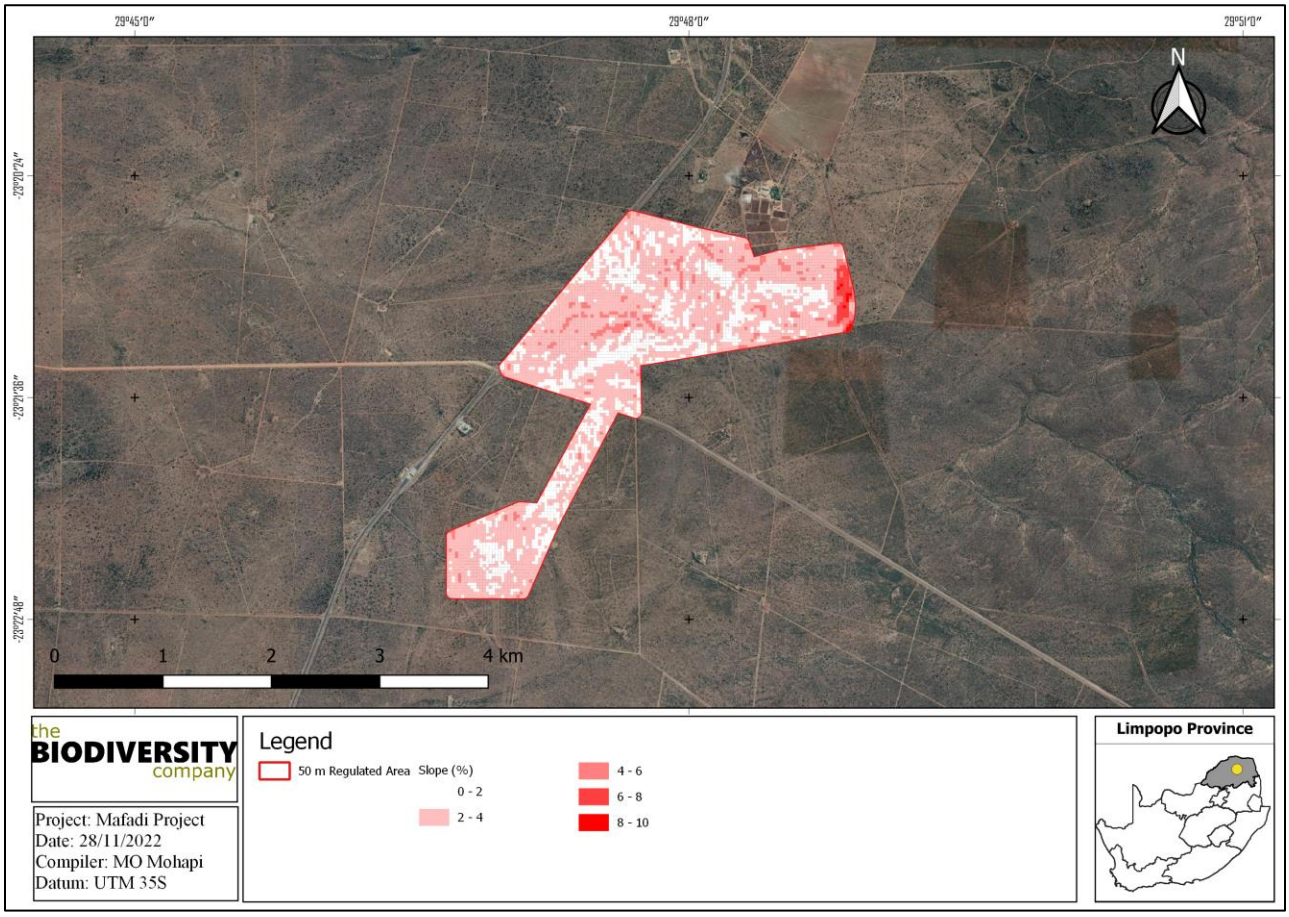


Figure 4-4 Slope percentage map for the project area

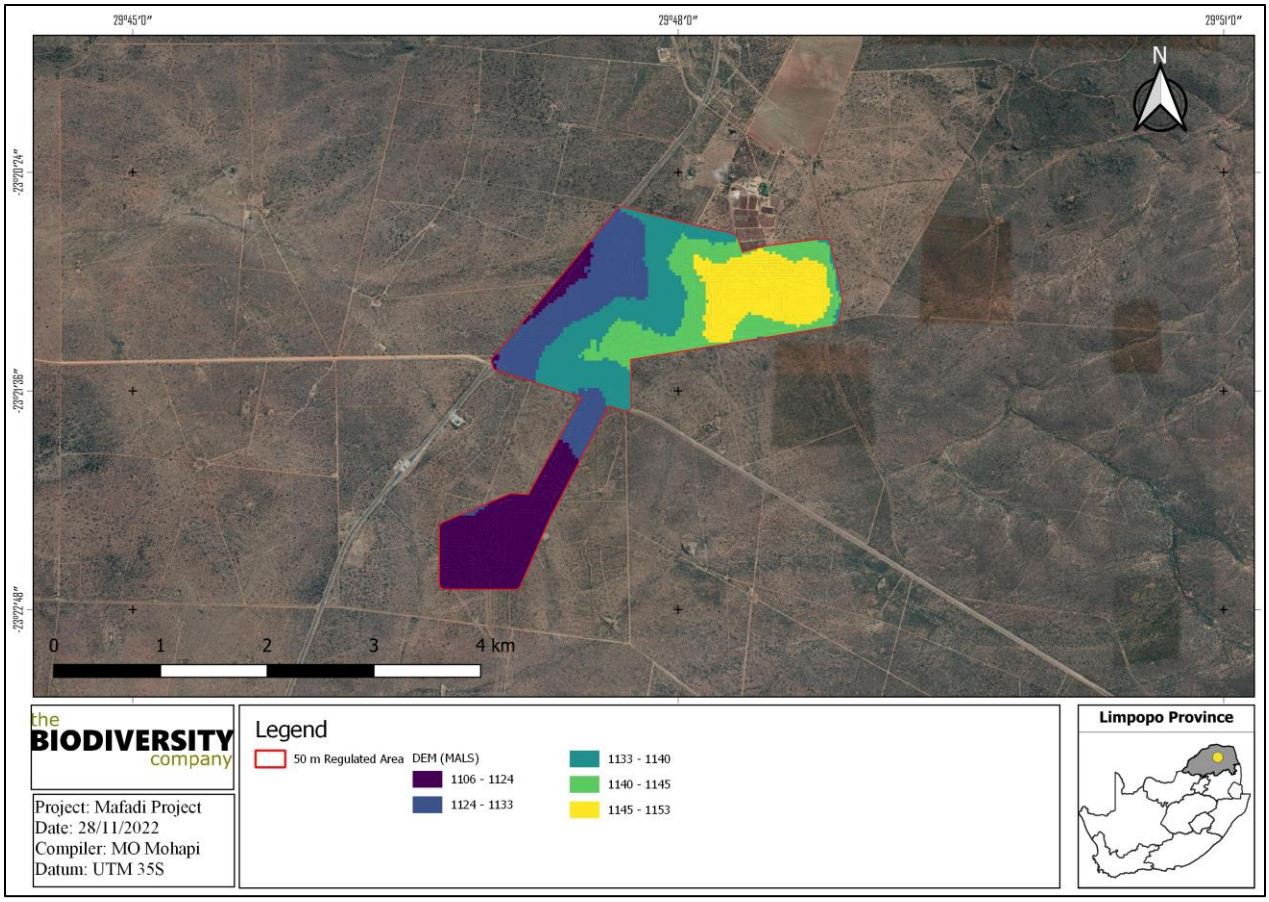


Figure 4-5 Digital Elevation Model of the project area (metres above sea level)

5 Results and Discussion

5.1 Baseline Findings

The dominant soil forms identified within the project area are the Katspruit, Glenrosa and Mispah. The Katspruit soil form consists of an orthic topsoil on top of a gley subsoil horizon. The Glenrosa soil form consists of an orthic topsoil on top of a saprolithic subsoil horizon, and Mispah soil form consist of an orthic topsoil on top of a hard rock (see Figure 5-1). The identified soil forms are characterised with low agricultural potential due to the presence of dense clay in gley soils, fractured and hard rocks in the saprolithic and hard rock subsoils. Moreover, the lithic and hard rock horizons are limit water movements and are highly susceptible to erosion.

The land capability of the above-mentioned soils has been determined to have a land capability class of “III” with a climate capability level 8 given the low Mean Annual Precipitation (MAP) and the high Mean Annual Potential Evapotranspiration (MAPE) rates. The combination between the determined land capabilities and climate capabilities results in land potential “L7”. The “L7” land potential level is characterised by a *low potential. Regular and/or severe limitations that occur due to soil, slope, temperatures or rainfall*. *These areas are non-arable*. The “L7” land potential is characterized with a “Low to Moderate sensitivity” following the soil baseline findings.

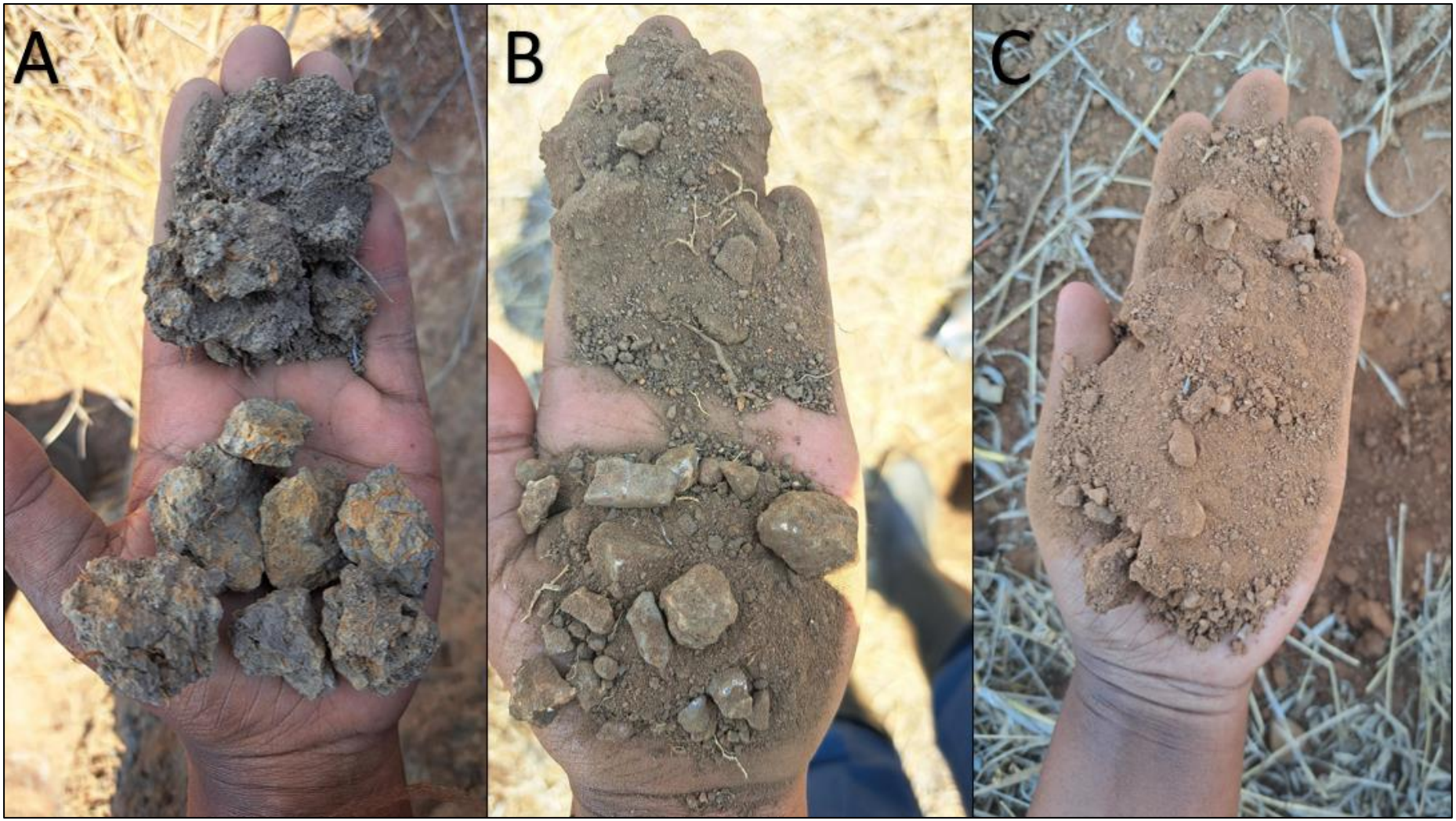


Figure 5-1 ***Soil forms found within the study area; A) Katspruit soil form with a dry gleying subsoil horizon above a hard rock, B) Glenrosa soil form with saprolithic subsoil horizon ,and C) Mispah soil form with an orthic topsoil on top of a hard rock.***

5.2 Sensitivity Verification

The following land potential level has been determined;

- Land potential level 7 (this land potential level is characterised by a low potential. Regular and/or severe limitations occur due to soil, slope, temperatures or rainfall. Non arable).

Fifteen land capabilities have been digitised by (DAFF, 2017) across South Africa, of which three potential land capability classes are located within the project area assessed for development, including;

- Land Capability 6 to 8 (Low/Moderate to Moderate Sensitivity).

The baseline findings and the sensitivities as per the Department of Agriculture, Forestry and Fisheries (DAFF, 2017) national raster file concur with one another. The proposed Mafadi Solar PV Project is mostly characterised with “Low” to “Moderate” land capability sensitivities (see Figure 5-2). Most common soils identified within the project area are shallow and rocky which can limit most cropping practices. It therefore is the specialist’s opinion that the land capability and land potential of the resources in the assessment area is characterised by “Low” to “Moderate” sensitivities (see Figure 5-2), which conforms to the requirements of an agricultural compliance statement only. However, the DEA 2022 screening tool (2022) shows that there are some crop fields with “High” sensitivity within the assessment area (see Figure 5-3). This may require the development footprint area to be moved to a less sensitive crop field or to negotiate with the landowners to compensate for the loss of high crop fields. The proposed Mafadi Solar PV facility will have negligible impacts on the available land resources in the area.

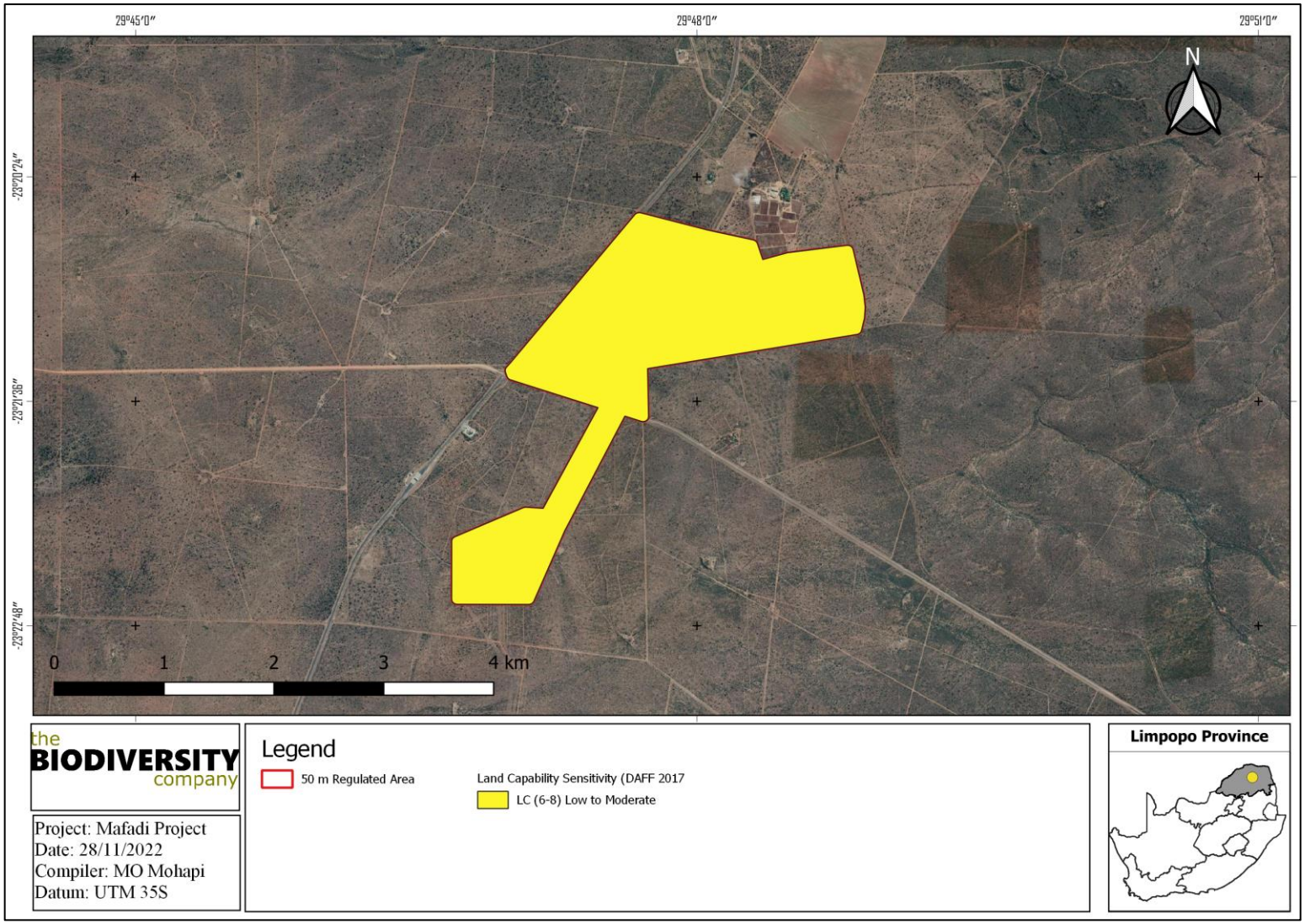


Figure 5-2 Land Capability Sensitivity (DAFF, 2017)

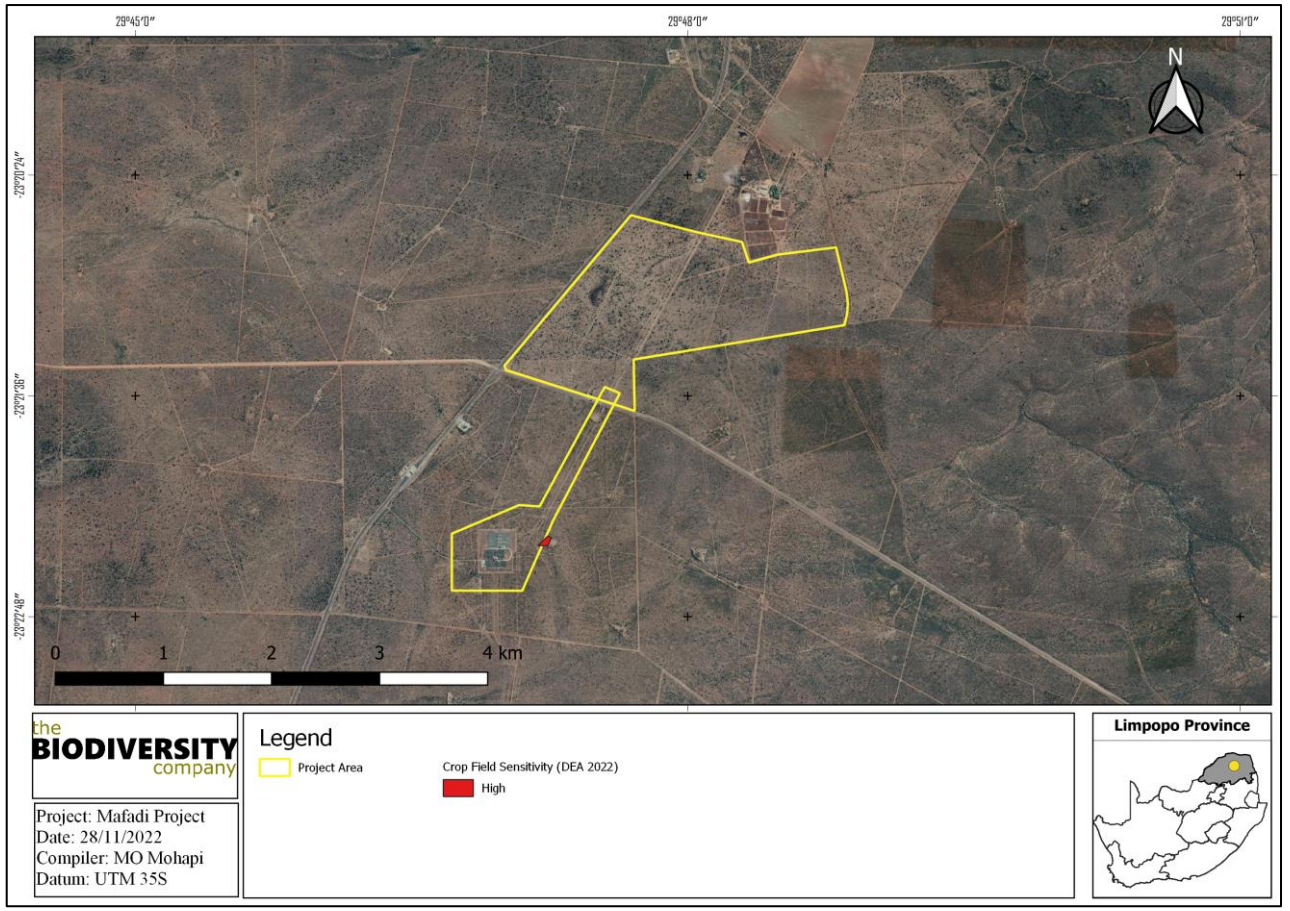


Figure 5-3 Crop field boundary sensitivity (DEA, 2022)

6 Conclusion

The dominant soil forms identified within the project area are Katspruit, Glenrosa and Mispah soil forms. The identified soils are characterised with clay texture in gley soils, fractured and hard rocks in Glenrosa and Mispah soil forms. The land capability sensitivities (DAFF, 2017) indicate land capabilities with “Low to Moderate” sensitivities, which correlates with the findings from the baseline assessment. The overall sensitivity of the assessment area is categorized as “Medium” which also conforms to the DEA, (2022) agricultural sensitivity themes.

The project area is associated with non-arable lands. The available climate limits crop production significantly. The harsh climatic conditions are associated with low annual rainfall and high evapotranspiration potential demands of the area, which consequently result into a very restricted choice of crops due to the heat and moisture stress. The area is not favourable for most cropping practices, which corresponds to the current livestock and game farming activities in the area.

It is the specialist’s opinion that the proposed Mafadi Solar PV project and associated infrastructure will have negligible impacts on the agricultural production ability of the land. However, with regard to crop fields with “High” sensitivity within the proposed project area (following the DEA screening tool, 2002), the development footprint area can be adjusted to avoid the crop field, or the landowner/s can be compensated for this loss. It is, therefore, the specialist`s opinion that the proposed Mafadi Solar PV project and associate infrastructure may be favourably considered for development with no considerable impacts to agricultural potential expected to occur.

7 References

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