Soil and Agricultural Assessment Report for the proposed Transalloys Solar Photovoltaic (PV) Facility

Emalahleni, Mpumalanga Province

August 2022

CLIENT

savannah environmental

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Report Name	**Soil and Agricultural Assessment Report for the proposed Transalloys Solar Photovoltaic (PV) Facility**
Reference	**Transalloys Solar Photovoltaic (PV) Facility**
Submitted to	savannah environmental
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Report Writer / 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 12 years' experience in the environmental consulting field.
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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DECLARATION

I, Matthew Mamera, 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.

Matthew Mamera

Soil Pedologist

The Biodiversity Company

August 2022

1 Introduction

1.1 Background

The Biodiversity Company was appointed by Savannah Environmental (Pty) Ltd (Savannah) to undertake a soil and agricultural potential assessment for the development of a Solar Photovoltaic (PV) Energy Facility with a capacity of up to 55 MW at Transalloys, Mpumalanga Province. The project area is located approximately 10 km west of Emalahleni, in the Mpumalanga Province.

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the published Government Notices (GN) 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” (Reporting Criteria).

This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities and enable informed decision making. This report aims to also present and discuss the findings from the soil resources identified within the regulated 50 m, the soil suitability and land potential of these soils, the land uses within the regulated area and also the risk associated with the proposed project.

1.2 Project Description

Transalloys (Pty) Ltd propose to develop PV Energy Facility with a capacity of up to 55 MW and associated infrastructure on Portion 34 and 35 of the Farm Elandsfontein 309 JS and Portion 20 and 24 of the Farm Schoongezicht 308 JS within the Emalahleni Local Municipality. The subject property is located adjacent to the Transalloys existing smelter complex on Clewer Road 1034 in Emalahleni and the site is within the Emalahleni Renewable Energy Development Zone (REDZ 9). The purpose of this Solar PV Energy Facility is to partially meet Transalloys current electricity demands and future expansion requirements. The plant will be a captive generating plant from which generated electricity will be fed directly into the existing Transalloys’ smelter complex for direct consumption.

The Solar PV Energy Facility will include the following infrastructure:

- Solar PV array comprising PV modules and mounting structures (Bifacial panels with single axis tracking system);
- Inverters and transformers;
- Cabling between the project components;
- 33 kV underground powerline;
- On-site facility substation and power lines to connect the solar PV facility to the existing Transalloys substation;
- Security office, operations and control, and maintenance and storage laydown areas; and
- Access roads, internal distribution roads.

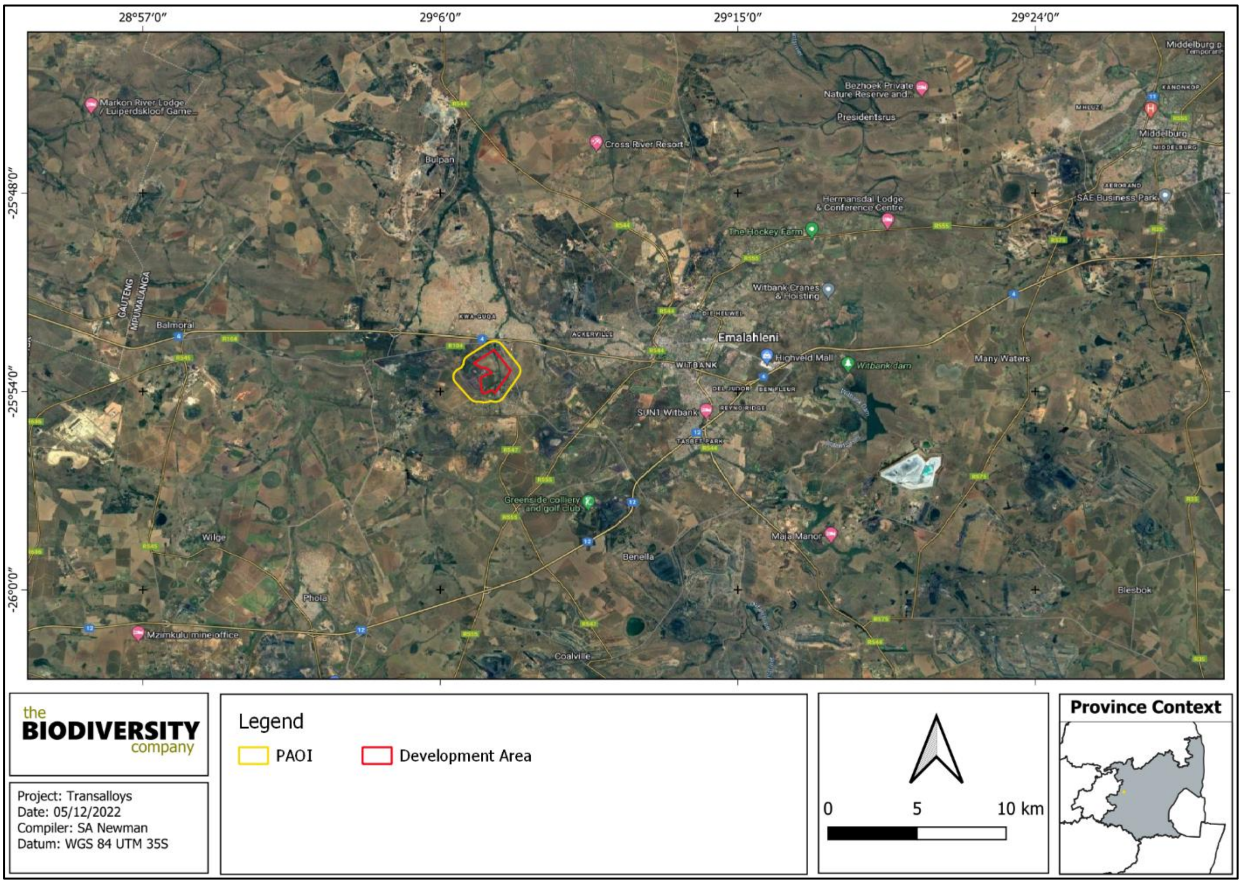

Figure 1-1 Proposed location of the project area in relation to the nearby towns

2 Project Area

The proposed Transalloys Solar Photovoltaic project will be located approximately 10km west of Emalahleni, in the Mpumalanga Province of South Africa (see Figure 2-1). The project area is also found approximately 0.6 km north of the R104 road and 0.8 km north of the N4 road. The focus area is also located 2 km north of the town of Kwa-Guqua The surrounding land use includes watercourses, residential areas, coal mining and predominantly agricultural activities.

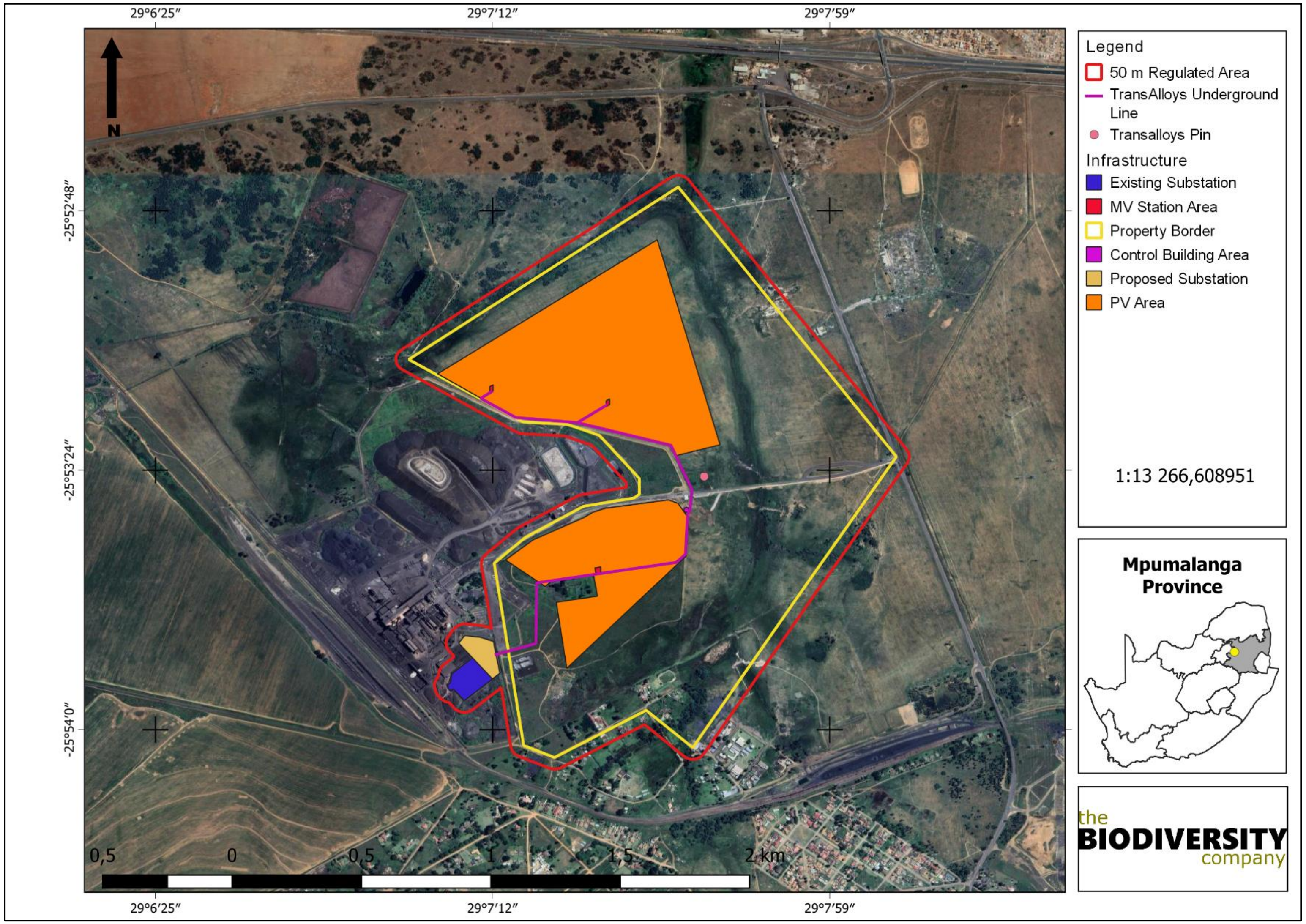

Figure 2-1 Map illustrating the details of the development area

2.1 Scope of Work

According to the National Web based Environmental Screening Tool, the proposed development is located within a "High" sensitivity land capability area. The protocols for minimum requirements (DEA, 2020)[1] stipulates that in the event that a proposed development is located within "High" sensitivities, an agricultural EIA statement should be carried out. 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 resources 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, an agricultural EIA statement will be compiled. This includes:

- The feasibility of the proposed activities;
- Confirmation about the "Low" and "High" sensitivities;
- The effects that the proposed activities will have on agricultural production in the area;
- A map superimposing the proposed footprint areas, 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.

3 Expertise of the Specialists

3.1 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 12 years' experience in the environmental consulting field.

3.2 Matthew Mamera

Matthew Mamera is a Cand. Sci Nat registered (116356) in natural and agricultural sciences, recognition in soil science. Matthew is a soil and hydropedology specialist with experience in soil pedology, hydropedology, water and sanitation management and land contamination and has field experience and numerous scientific publications in international peer reviewed journals. Matthew completed his MSc in soil science, hydropedology and water management at the University of Fort Hare, Alice. He is also a holder of a PhD in soil science, hydropedology, water and sanitation obtained at the University of the Free State, Bloemfontein. Matthew is also a member of the Soil Science Society of South Africa (SSSSA).

4 Methodology

4.1 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

[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).

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.

4.2 Field Survey

An assessment of the soils present within the project area was conducted during a field survey in July 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.

4.3 Erosion Potential

Erosion has been calculated by means of the (Smith, 2006) methodology. The steps in calculating the Fb[2] ratings relevant to erosion potential is illustrated in Table 4-1 with the final erosion classes illustrated in Table 4-2.

Table 4-1 Fb ratings relevant to the calculating of erosion potential (Smith, 2006)

Step 1- Initial value, texture of topsoil horizon				
Light (0-15% clay)		**Medium (15-35% clay)**		**Heavy (>35% clay)**
Fine sand	Medium/coarse sand	Fine Sand	Medium/coarse sand	All sands
3.5	4.0	4.5	5.0	6.0
Step 2- Adjustment value (permeability of subsoil)				
Slightly restricted		Moderately restricted		Heavily restricted
-0.5		-1.0		-2.0
Step 3- Degree of leaching (excluding bottomlands)				
Dystrophic soils, medium and heavy textures		Mesotrophic soils		Eutrophic or calcareous soils, medium and heavy textures
+0.5		0		-0.5
Step 4- Organic Matter				
Organic topsoil			Humic Topsoil	
+0.5			+0.5	
Step 5- Topsoil limitations				
Surface crusting			Excessive sand/high swell-shrink/self-mulching	
-0.5			-0.5	
Step 6- Effective soil depth				
Very shallow (<250 mm)			Shallow (250-500 mm)	
-1.0			-0.5	

2 The soil erodibility index

Table 4-2 Final erosion potential class

Erodibility	Fb Rating (from calculation)
Very Low	>6.0
Low	5.0 - 5.5
Moderate	3.5 – 4.5
High	2.5 – 3.0
Very High	<3.0

4.4 Land Capability

Given the nature of the assessment 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 (DAFF, 2017).

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 4-3 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 4-3 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 4-4. The final land potential results are then described in Table 4-5.

Table 4-4 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 4-5 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

4.5 Limitations

- The information contained in this report is based on auger points taken and observations on site. There may be variations in terms of the delineation of the soil forms across the area;
- Due to the size of the proposed area only the key areas where infrastructure is located were focused on, the remaining areas were predominantly delineated through means of desktop; and
- The GPS used for delineations is accurate to within five meters. Therefore, the delineation plotted digitally may be offset by at least five meters to either side.

5 Project Area

5.1 Soil and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by the Bb 13 land type. The Bb land type is characterised with Clovelly, Avalon and Katspruit soil forms according to the Soil classification working group, (1991), with other associated soil forms also occur in the terrains. The Bb land type is characterised by plinthic catena with upland duplex and margalitic soils being rare within the terrain. The terrains are characterised by dystrophic and/or mesotrophic base status. Red soils are not widespread in the terrain. The land terrain units for the featured Bb 13 land type are illustrated in Figure 5-1 with the expected soils listed in Table 5-1.

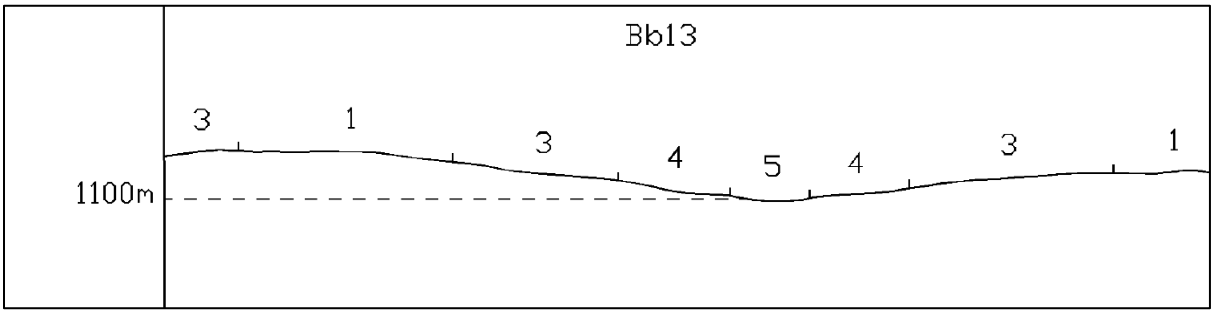

Figure 5-1 Illustration of land type Bb 13 terrain unit (Land Type Survey Staff, 1972 - 2006)

Table 5-1 Soils expected at the respective terrain units within the Bb 13 land type (Land Type Survey Staff, 1972 - 2006)

Terrain Units							
1 (40%)		3 (45%)		4 (10%)		5 (5%)	
Clovelly	45%	Clovelly	35%	Avalon	30%	Katspruit	40%
Glencoe	35%	Avalon	35%	Longlands	25%	Kroonstad	30%
Hutton	15%	Glencoe	15%	Kroonstad	15%	Fernwood	20%
Avalon	15%	Clovelly	10%	Fernwood	10%	Longlands	10%
		Longlands	5%	Wasbank	10%		

5.2 Terrain

The slope percentage of the project area has been calculated and is illustrated in Figure 5-2. Most of the project area is characterised by a slope percentage between 0 and 10%, with some smaller patches within the project area characterised by a slope percentage ranging from 10 to 28%. This illustration indicates a non-uniform topography in scattered areas the majority of the area being characterised by a gentle slope. The DEM of the project area (Figure 5-3) indicates an elevation of 1 472 to 1 542 Metres Above Sea Level (MASL).

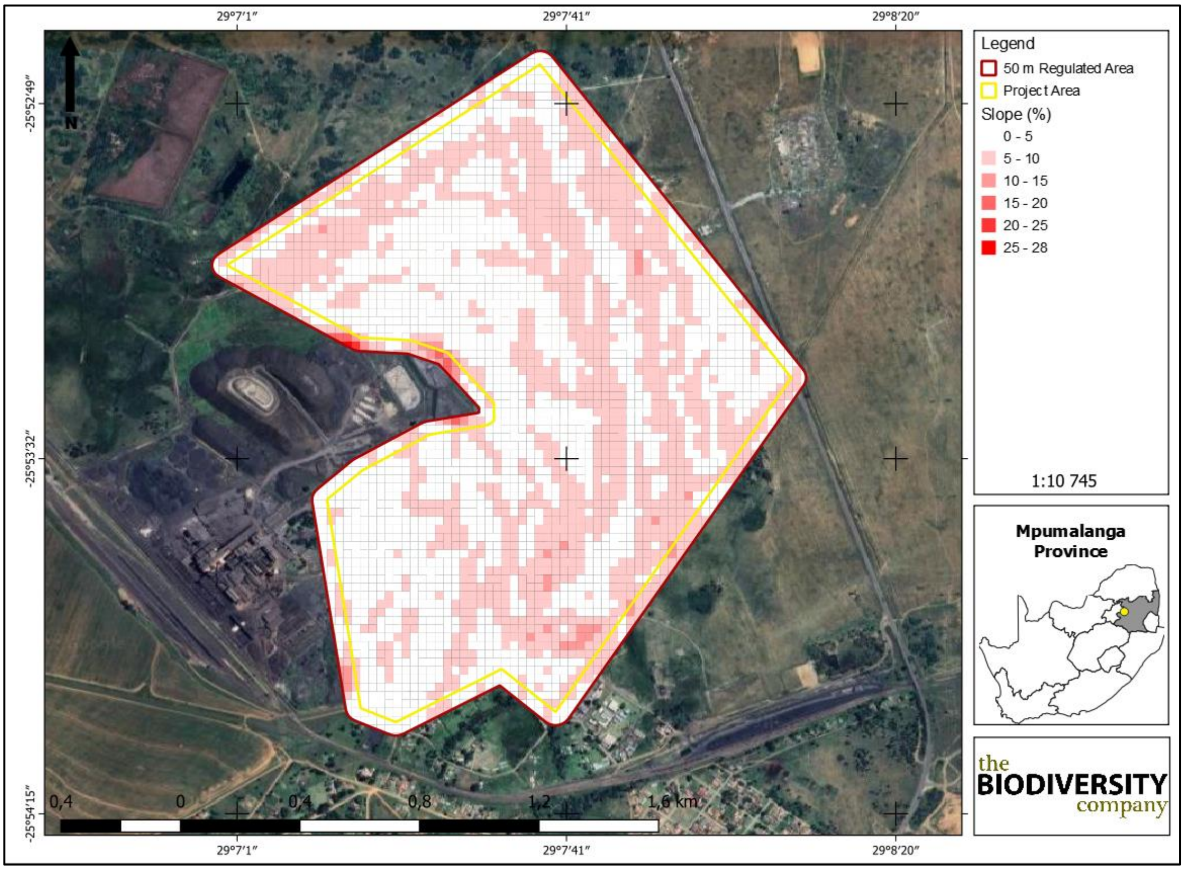

Figure 5-2 The slope percentage calculated for the project area

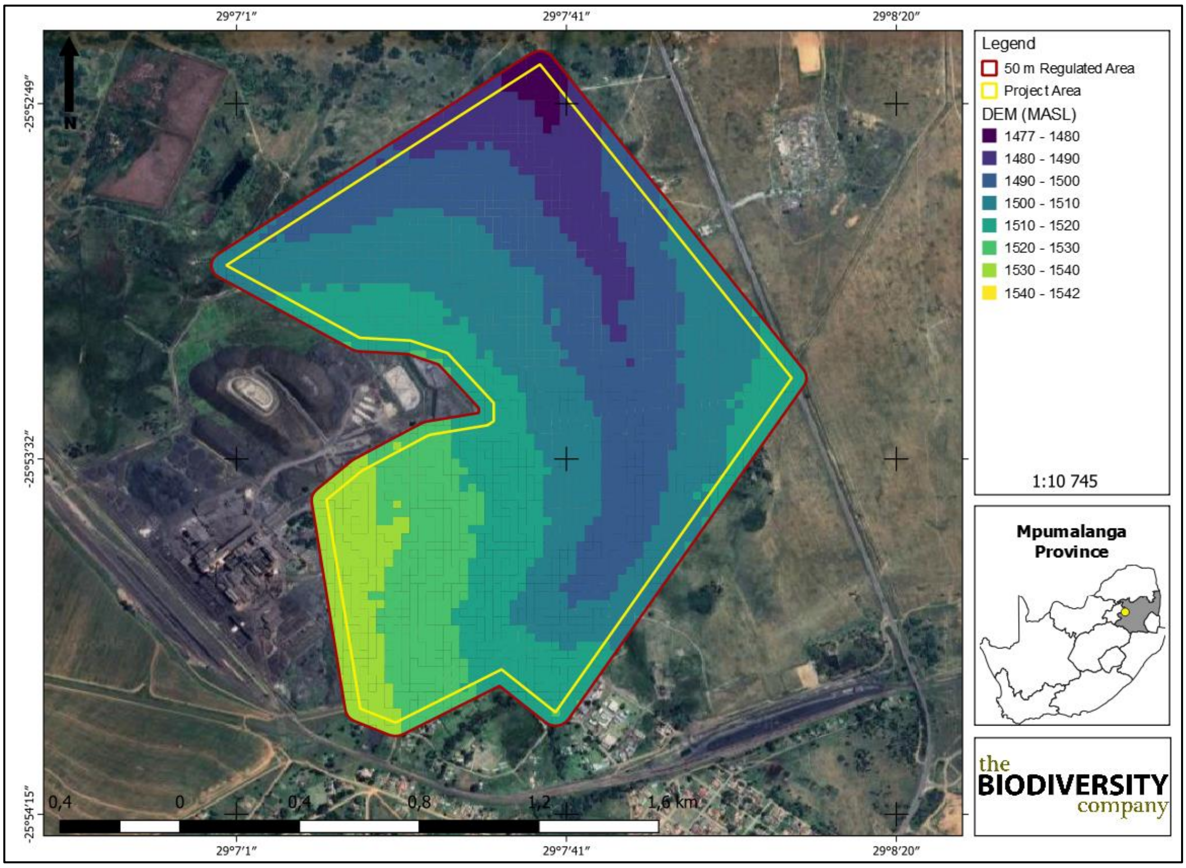

Figure 5-3 The DEM generated for the project area

6 Results and Discussion

6.1 Description of Soil Profiles and Diagnostic Horizons

Soil profiles were studied up to a depth of 1.2 m to identify specific diagnostic horizons which are vital in the soil classification process as well as determining the agricultural potential and land capability. The most sensitive soil forms have been considered. The following diagnostic horizons were identified during the site assessment (also see Figure 6-1):

- Orthic topsoil;
- Lithic horizon;
- Hard rock horizon
- Neocutanic horizon
- Yellow-Brown apedal
- Red apedal horizon
- Albic horizon; and
- Alluvial horizon.

6.1.1 Orthic Topsoil

Orthic topsoil are mineral horizons that have been exposed to biological activities and varying intensities of mineral weathering. The climatic conditions and parent material ensure a wide range of properties differing from one Orthic A topsoil to another (i.e., colouration, structure etc) (Soil Classification Working Group, 2018).

6.1.2 Neocutanic Horizon

The horizon is a young weakly-structed subsurface layer with variations in the soil matrix. The horizon is commonly associated to the processes of transportation of materials usually colluvial or alluvial origins in the valley bottoms or flats terrains and river terraces that have been subjected to an intermediate stage of pedogenic changes. The color differences in the neocutanic horizon are usually caused by illuvial material that coats weak structural units.

6.1.3 Yellow-Brown Apedal Horizon

The yellow-brown apedal horizon is similar to that of the Red Apedal horizon in all aspects except for the colour and the iron-oxide processes involved with the colouration thereof. This diagnostic soil horizon rarely occurs in parent rock high in iron-oxides and will rather be associated with Quartzite, Sandstone, Shale and Granites.

6.1.4 Red Apedal Horizon

The red apedal diagnostic soil horizon has no well-formed peds, but rather small porous aggregates. The poor structure associated with this diagnostic profile is a result of weathering processes under well drained oxidising conditions. Iron-oxide precipitations form on the outside of soil particles (hence the red colour) and non-swelling clays dominate the clay particles. This diagnostic soil horizon is widely spread across South Africa and can be associated with any parent material expected (Soil Classification Working Group, 1991).

6.1.5 Albic horizon

Albic horizons are characterised with unform colours due to the dominance of grey to whitish colouration of clay particles. These colours form because of the exposed quartz particles that usually range from a whitish to pale yellow colouration. Albic horizons mostly have a sand to sandy loam texture. Some can also have the occurrence of sandy clay loam and finer textures. The prominent characteristic of an albic horizon is the soil matrix bleaching. This feature occurs due to the redox and ferrolysis chemical reactions, due to eluviation and in instance from podzolization. This horizon has been traditionally identified by a loss of colloidal material, silicate clay, sesquioxide and humus with low clay contents. Most albic horizons have more clay contents than the overlying topsoil horizons. Albi horizons can also occur at deeper layers and receive lateral flows of water from hillslope water accumulations expected (Soil Classification Working Group, 1991).

6.1.6 Lithic horizon

A lithic horizon is subsurface horizon with morphological expression of pedogenic alteration that range from strong weathering of the underlying country rock, with friable soil-like structure. The soil material is intimately mixed with partially weathered to hard rock fragments. Evidence of gleying in the form of reduction of iron minerals in the soil matrix or in the partially weathered fragments may be present in the wetter variants. However, redo-morphological properties are absent in drier conditions.

6.1.7 Hard Rock Horizon

Hard rock horizon comprises of hard rock characterised with primarily physical weathering ranging from fractured and solid rock lacking soil development between the fractures. The underlain parent material includes igneous, sedimentary and metamorphic rocks. The horizon restricts most root penetrations of plants except for some selected annual trees and shrubs which can grow through the fractured sections in specialized ecological niche environments.

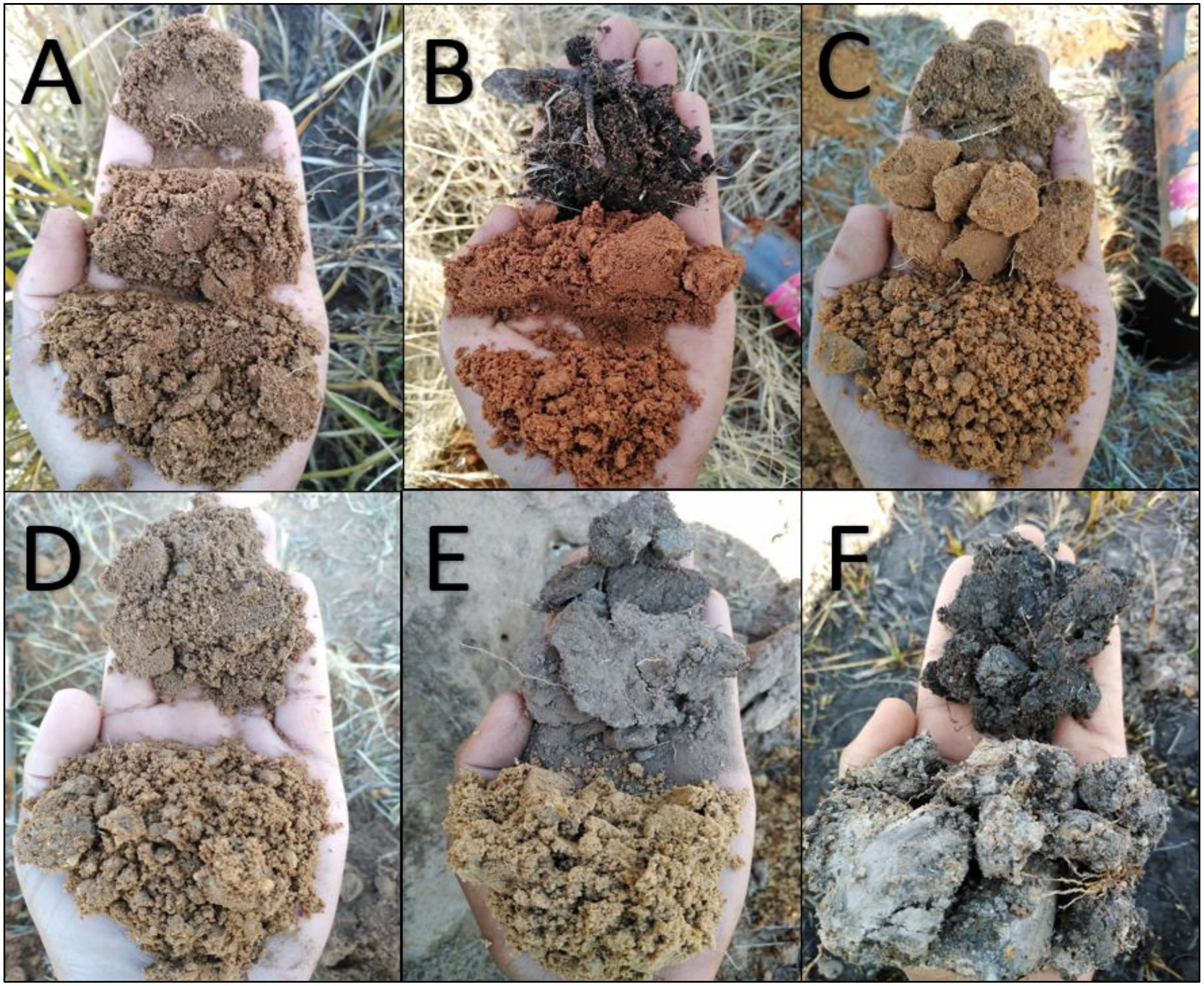

Figure 6-1 ***Dominant soils identified during the site assessment. A) Neocutanic horizon. B) Red apedal horizon C) Orthic on top of yellow-brown apedal, underlined by lithic). D) Lithic subsurface horizon. E) Alluvial subsurface horizon. F) Albic subsurface horizon***

6.2 Description of Soil Forms and Soil Families

During the site assessment various soil forms were identified. These soil forms are described in Table 6-1 according to depth, clay percentage, indications of surface crusting, signs of wetness and percentage rock. The soil forms are followed by the soil family and in brackets the maximum clay percentage of the topsoil. Soil family characteristics are described in Table 6-2.

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Table 6-1 Summary of soils identified within the project area

	Topsoil					Subsoil A				Subsoil B			
	Depth (mm)	**Clay (%)**	**Signs of wetness**	**Rock %**	**Surface crusting**	**Depth (mm)**	**Clay (%)**	**Signs of wetness**	**Rock %**	**Depth (mm)**	**Clay (%)**	**Signs of wetness**	**Rock %**
Clovelly 1221(15)	0-50	0-15	None	0	None	50-250	15-30	None	10	250-500	15-30		40
Tubatse 1121(15)	0-150	0-15	None	0	None	150-300	15-35	None	3	300-450	15-30	N/A	30
Nkonkoni 1221(15)	0-50	0-15	None	0	None	50- 400	0-15	None	0	400- 500	15-30	N/A	30
Dundee 1112 (15)	0-300	0-15	None	0	None	300- 900	0-15	Present	0				
Glenrosa 1110 (15)	0-100	0-15	None	5	None	100-400	0-15	None	30	400+	-	-	60+
Iswepe 1120 (15)	0-100	0-15	Present	0	None	100-350	0-15	Present/Bleached	5	350+	-	-	60+

Table 6-2 Description of soil family characteristics

Soil Form/Family	Topsoil Colour	Base Status	Textural Contrast
Clovelly 1221 (15)	Dark Topsoil	Mesotrophic	Luvic
Tubatse 1121 (15)	Dark Topsoil	Mesotrophic	Luvic
Nkonkoni 1221 (15)	Dark Topsoil	Mesotrophic	Luvic
Dundee 1112 (15)	Dark Topsoil	Mesotrophic	Luvic
Glenrosa 1110 (15)	Dark Topsoil	Mesotrophic	Luvic
Iswepe 1120 (15)	Dark Topsoil	Dystrophic	Luvic

6.3 Agricultural Potential

Agricultural potential is determined by a combination of soil, terrain and climate features. Land capability classes reflect the most intensive long-term use of land under rain-fed conditions.

The land capability is determined by the physical features of the landscape including the soils present. The land potential or agricultural potential is determined by combining the land capability results and the climate capability for the region.

6.4 Climate Capability

The climatic capability has been determined by means of the Smith (2006) methodology, of which the first step includes determining the climate capability of the region by means of the Mean Annual Precipitation (MAP) and annual Class A pan (potential evaporation) (see Table 6-3).

Table 6-3 Climatic capability (step 1) (Scotney et al., 1987)

Central Sandy Bushveld region				
Climatic Capability Class	**Limitation Rating**	**Description**	**MAP: Class A pan Class**	**Applicability to site**
C1	None to Slight	Local climate is favourable for good yields for a wide range of adapted crops throughout the year.	0.75-1.00	
C2	Slight	Local climate is favourable for a wide range of adapted crops and a year-round growing season. Moisture stress and lower temperature increase risk and decrease yields relative to C1.	0.50-0.75	
C3	Slight to Moderate	Slightly restricted growing season due to the occurrence of low temperatures and frost. Good yield potential for a moderate range of adapted crops.	0.47-0.50	
C4	Moderate	Moderately restricted growing season due to the occurrence of low temperatures and severe frost. Good yield potential for a moderate range of adapted crops but planting date options more limited than C3.	0.44-0.47	
C5	Moderate to Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops at risk of some yield loss.	0.41-0.44	
C6	Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops that frequently experience yield loss.	0.38-0.41	
C7	Severe to Very Severe	Severely restricted choice of crops due to heat and moisture stress.	0.34-0.38	✔
C8	Very Severe	Very severely restricted choice of crops due to heat and moisture stress. Suitable crops at high risk of yield loss.	0.30-0.34	

According to Smith (2006), the climatic capability of a region is only refined past the first step if the climatic capability is determined to be between climatic capability 1 and 6. Given the fact that the climatic capability has been determined to be “C7” for the project area, no further steps will be taken to refine the climate capability.

6.5 Land Capability

The land capability was determined by using the guidelines described in "The farming handbook" (Smith, 2006). The delineated soil forms were clipped into the four different slope classes (0-3%, 3-7%, 7-12% and >12%) to determine the land capability of each soil form. Accordingly, the most sensitive soil forms associated with the project area are restricted to land capability 3, 4 and 5 classes.

Table 6-4 Land capability for the soils within the project area

Land Capability Class	Definition of Class	Conservation Need	Use-Suitability	Land Capability Group	Sensitivity
3	Moderate limitations. Some erosion hazard	Special conservation practice and tillage methods	Rotation crops and ley (50%)	Arable	High
4	Severe limitations. Low arable potential.	Intensive conservation practice	Long term leys (75%)	Arable	Moderate
5	Water course and land with wetness limitations	Protection and control of water table	Improved pastures, suitable for wildlife	Grazing	Low

6.6 Land Potential

The methodology in regard to the calculations of the relevant land potential levels are illustrated in Table 6-5 and Table 6-6. From the three land capability classes, two land potential levels have been determined by means of the Guy and Smith (1998) methodology. Land capability III and IV have been reduced to a land potential level L5 due to climatic limitations. The land capability V has been allocated a land potential "Vlei" considering its hydromorphic characteristics.

Table 6-5 Land potential from climate capability vs land capability (Guy and Smith, 1998)

Land Capability Class	Climatic Capability Class							
	C1	C2	C3	C4	C5	C6	C7	C8
LC1	L1	L1	L2	L2	L3	L3	L4	L4
LC2	L1	L2	L2	L3	L3	L4	L4	L5
LC3	L2	L2	L2	L2	L4	L4	L5*	L6
LC4	L2	L3	L3	L4	L4	L5	L5*	L6
LC5	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei
LC6	L4	L4	L5	L5	L5	L6	L6	L7
LC7	L5	L5	L6	L6	L7	L7	L7	L8
LC8	L6	L6	L7	L7	L8	L8	L8	L8

*Land potential level applicable to climatic and land capability

Table 6-6 Land potential for the soils within the project area (Guy and Smith, 1998)

Land Potential	Description of Land Potential Class	Sensitivity
5	**Very restricted potential.** Regular and/or severe limitations due to soil, slope, temperatures or rainfall. Non-arable.	Low
Vlei	Wetland (grazing and wildlife)	Low
Disturbed	N/A	None

6.7 Erosion Potential

The erosion potential of the identified soil forms has been calculated by means of the (Smith, 2006) methodology. In some cases, none of the parameters are applicable, in which case the step was skipped.

6.7.1 Clovelly

Table 6-7 illustrates the values relevant to the erosion potential of the Clovelly soil forms. The final erosion potential score has been calculated at 3.0, which indicates a "High" potential for erosion.

Table 6-7 Erosion potential calculation for the Clovelly soil forms

Step 1- Initial Value, Texture of Topsoil				
Light (0-15% Clay)		**Medium (15-35% Clay)**		**Heavy (>35% Clay)**
3.5	4.0	4.5	5.0	6.0
Step 2- Adjustment Value (Permeability of Subsoil)				
Slightly Restricted		**Moderately Restricted**		**Heavily Restricted**
-0.5		-1.0		-2.0
Step 3- Degree of Leaching (Excluding Bottomlands)				
Dystrophic Soils, Medium and Heavy Textures		**Mesotrophic Soils**		**Eutrophic or Calcareous Soils, Medium and Heavy Textures**
+0.5		0		-0.5
Step 4- Organic Matter				
Organic Topsoil			**Humic Topsoil**	
+0.5			+0.5	
Step 5- Topsoil Limitations				
Surface Crusting			**Excessive Sand/High Shrink/Self-Mulching**	
-0.5			-0.5	
Step 6- Effective Soil Depth				
Very Shallow (<250 mm)			**Shallow (<250-500 mm)**	
-1.0			-0.5	

6.7.2 Tubatse

Table 6-8 illustrates the values relevant to the erosion potential of the Tubatse soil forms. The final erosion potential score has been calculated at 4.0, which indicates a "Moderate" potential for erosion.

Table 6-8 Erosion potential calculation for the Tubatse soil forms

Step 1- Initial Value, Texture of Topsoil				
Light (0-15% Clay)		**Medium (15-35% Clay)**		**Heavy (>35% Clay)**
3.5	**4.0**	4.5	5.0	6.0
Step 2- Adjustment Value (Permeability of Subsoil)				
Slightly Restricted		**Moderately Restricted**		**Heavily Restricted**
-0.5		-1.0		-2.0

Step 3- Degree of Leaching (Excluding Bottomlands)		
Dystrophic Soils, Medium and Heavy Textures	**Mesotrophic Soils**	**Eutrophic or Calcareous Soils, Medium and Heavy Textures**
+0.5	0	-0.5
Step 4- Organic Matter		
Organic Topsoil		**Humic Topsoil**
+0.5		+0.5
Step 5- Topsoil Limitations		
Surface Crusting		**Excessive Sand/High Shrink/Self-Mulching**
-0.5		-0.5
Step 6- Effective Soil Depth		
Very Shallow (<250 mm)		**Shallow (<250-500 mm)**
-1.0		-0.5

6.7.3 Nkonkoni

Table 6-9 illustrates the values relevant to the erosion potential of the Nkonkoni soil forms. The final erosion potential score has been calculated at 3.5, which indicates a “Moderate” potential for erosion.

Table 6-9 Erosion potential calculation for the Nkonkoni soil forms

Step 1- Initial Value, Texture of Topsoil				
Light (0-15% Clay)		**Medium (15-35% Clay)**		**Heavy (>35% Clay)**
3.5	4.0	4.5	5.0	6.0
Step 2- Adjustment Value (Permeability of Subsoil)				
Slightly Restricted		**Moderately Restricted**		**Heavily Restricted**
-0.5		-1.0		-2.0
Step 3- Degree of Leaching (Excluding Bottomlands)				
Dystrophic Soils, Medium and Heavy Textures		**Mesotrophic Soils**		**Eutrophic or Calcareous Soils, Medium and Heavy Textures**
+0.5		0		-0.5
Step 4- Organic Matter				
Organic Topsoil			**Humic Topsoil**	
+0.5			+0.5	
Step 5- Topsoil Limitations				
Surface Crusting			**Excessive Sand/High Shrink/Self-Mulching**	
-0.5			-0.5	
Step 6- Effective Soil Depth				
Very Shallow (<250 mm)			**Shallow (250-500 mm)**	
-1.0			-0.5	

6.7.4 Dundee

Table 6-10 illustrates the values relevant to the erosion potential of the Dundee soil forms. The final erosion potential score has been calculated at 4.5, which indicates a “Moderate” potential for erosion.

Table 6-10 Erosion potential calculation for the Dundee soil forms

Step 1- Initial Value, Texture of Topsoil				
Light (0-15% Clay)		Medium (15-35% Clay)		Heavy (>35% Clay)
3.5	4.0	4.5	5.0	6.0
Step 2- Adjustment Value (Permeability of Subsoil)				
Slightly Restricted		Moderately Restricted		Heavily Restricted
-0.5		-1.0		-2.0
Step 3- Degree of Leaching (Excluding Bottomlands)				
Dystrophic Soils, Medium and Heavy Textures		Mesotrophic Soils		Eutrophic or Calcareous Soils, Medium and Heavy Textures
+0.5		0		-0.5
Step 4- Organic Matter				
Organic Topsoil			Humic Topsoil	
+0.5			+0.5	
Step 5- Topsoil Limitations				
Surface Crusting			Excessive Sand/High Shrink/Self-Mulching	
-0.5			-0.5	
Step 6- Effective Soil Depth				
Very Shallow (<250 mm)			Shallow (<250-500 mm)	
-1.0			-0.5	

6.7.5 Glenrosa

Table 6-10 illustrates the values relevant to the erosion potential of the Glenrosa soil forms. The final erosion potential score has been calculated at 3.0, which indicates a “High” potential for erosion.

Table 6-11 Erosion potential calculation for the Glenrosa soil forms

Step 1- Initial Value, Texture of Topsoil				
Light (0-15% Clay)		Medium (15-35% Clay)		Heavy (>35% Clay)
3.5	4.0	4.5	5.0	6.0
Step 2- Adjustment Value (Permeability of Subsoil)				
Slightly Restricted		Moderately Restricted		Heavily Restricted
-0.5		-1.0		-2.0
Step 3- Degree of Leaching (Excluding Bottomlands)				
Dystrophic Soils, Medium and Heavy Textures		Mesotrophic Soils		Eutrophic or Calcareous Soils, Medium and Heavy Textures
+0.5		0		-0.5

Step 4- Organic Matter	
Organic Topsoil	**Humic Topsoil**
+0.5	+0.5
Step 5- Topsoil Limitations	
Surface Crusting	**Excessive Sand/High Shrink/Self-Mulching**
-0.5	-0.5
Step 6- Effective Soil Depth	
Very Shallow (<250 mm)	**Shallow (<250-500 mm)**
-1.0	-0.5

6.8 Hydromorphic Soils

6.8.1 Iswepe

Table 6-10 illustrates the values relevant to the erosion potential of the Iswepe soil forms. The final erosion potential score has been calculated at 2.5, which indicates a “Very High” potential for erosion.

Table 6-12 Erosion potential calculation for the Iswepe soil forms

Step 1- Initial Value, Texture of Topsoil				
Light (0-15% Clay)		**Medium (15-35% Clay)**		**Heavy (>35% Clay)**
3.5	4.0	4.5	5.0	**6.0**
Step 2- Adjustment Value (Permeability of Subsoil)				
Slightly Restricted		**Moderately Restricted**		**Heavily Restricted**
-0.5		**-1.0**		-2.0
Step 3- Degree of Leaching (Excluding Bottomlands)				
Dystrophic Soils, Medium and Heavy Textures		**Mesotrophic Soils**		**Eutrophic or Calcareous Soils, Medium and Heavy Textures**
+0.5		0		-0.5
Step 4- Organic Matter				
Organic Topsoil			**Humic Topsoil**	
+0.5			+0.5	
Step 5- Topsoil Limitations				
Surface Crusting			**Excessive Sand/High Shrink/Self-Mulching**	
-0.5			-0.5	
Step 6- Effective Soil Depth				
Very Shallow (<250 mm)			**Shallow (<250-500 mm)**	
-1.0			-0.5	

6.9 Sensitivity Verification

The following land potential level has been determined;

- Land potential level 3 (this land potential level is characterised by a good potential. Infrequent and/or moderate limitations due to soil, slope temperatures or rainfall. Appropriate contour protection must be implemented and inspected; and
- Land potential level 4 (this land potential level is characterised by a moderate potential. Moderate regular and/or severe to moderate limitations occur due to soil, slope, temperatures or rainfall).

Fifteen land capabilities have been digitised by (DAFF, 2017) across South Africa, of which nine potential land capability classes are located within the proposed footprint area's assessment corridor, including;

- Land Capability 1 to 5 (Very Low to Low Sensitivity);
- Land Capability 6 to 8 (Low/Moderate to Moderate Sensitivity) and;
- Land Capability 9 to 10 (Moderate High Sensitivity).

The land capability sensitivity (DAFF, 2017) indicates a range of sensitivities expected throughout the project focus area, which is predominantly covers "Moderately Low" to "Moderate" sensitivities. Smaller patches are characterised by sensitivities up to "Moderately High" (Figure 6-2). Furthermore, various crop field boundaries were identified by means of the DEA Screening Tool (2022), which are predominantly characterised by "High" sensitivities with one area being classified as "Very High" sensitivity (see Figure 6-3). It is the specialist`s recommendation that such high potential crop fields be avoided for the project. In a case relocating of the project is not feasible, intensive mitigation measures should be applied.

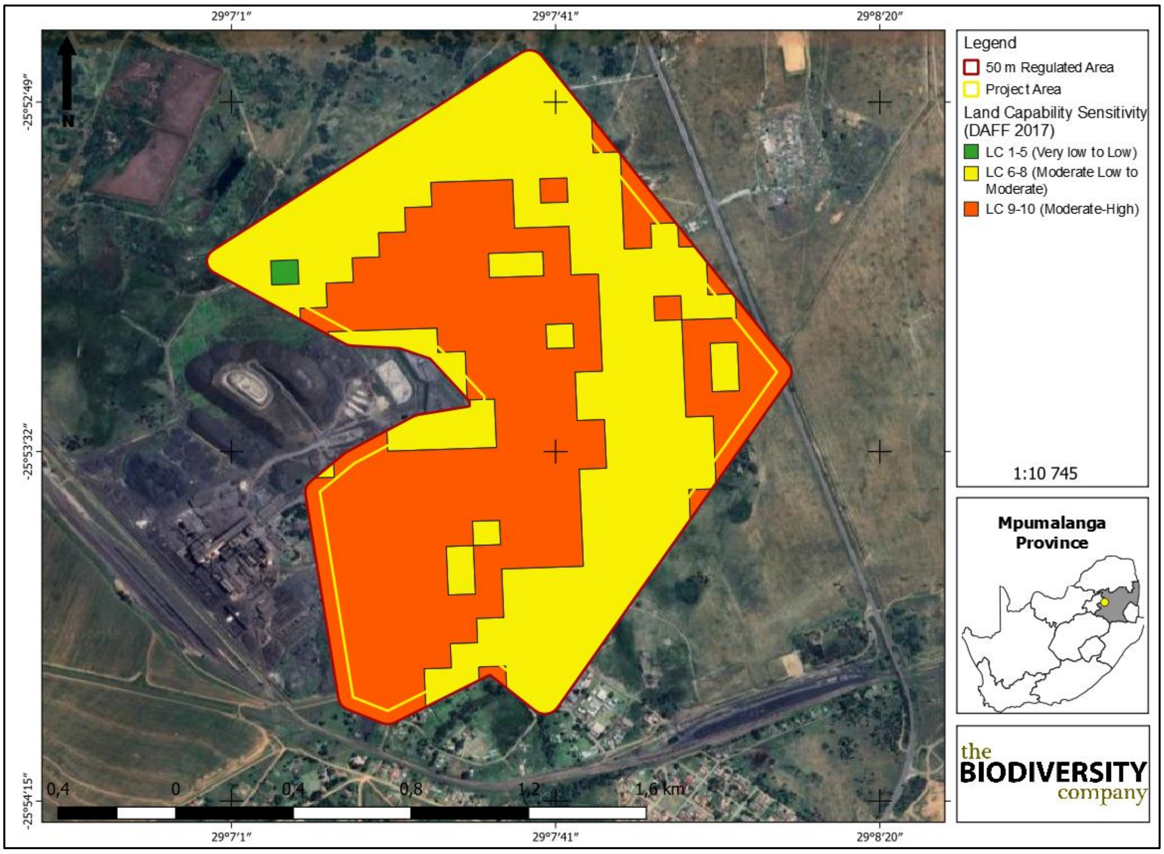

Figure 6-2 The land capability sensitivity (DAFF, 2017)

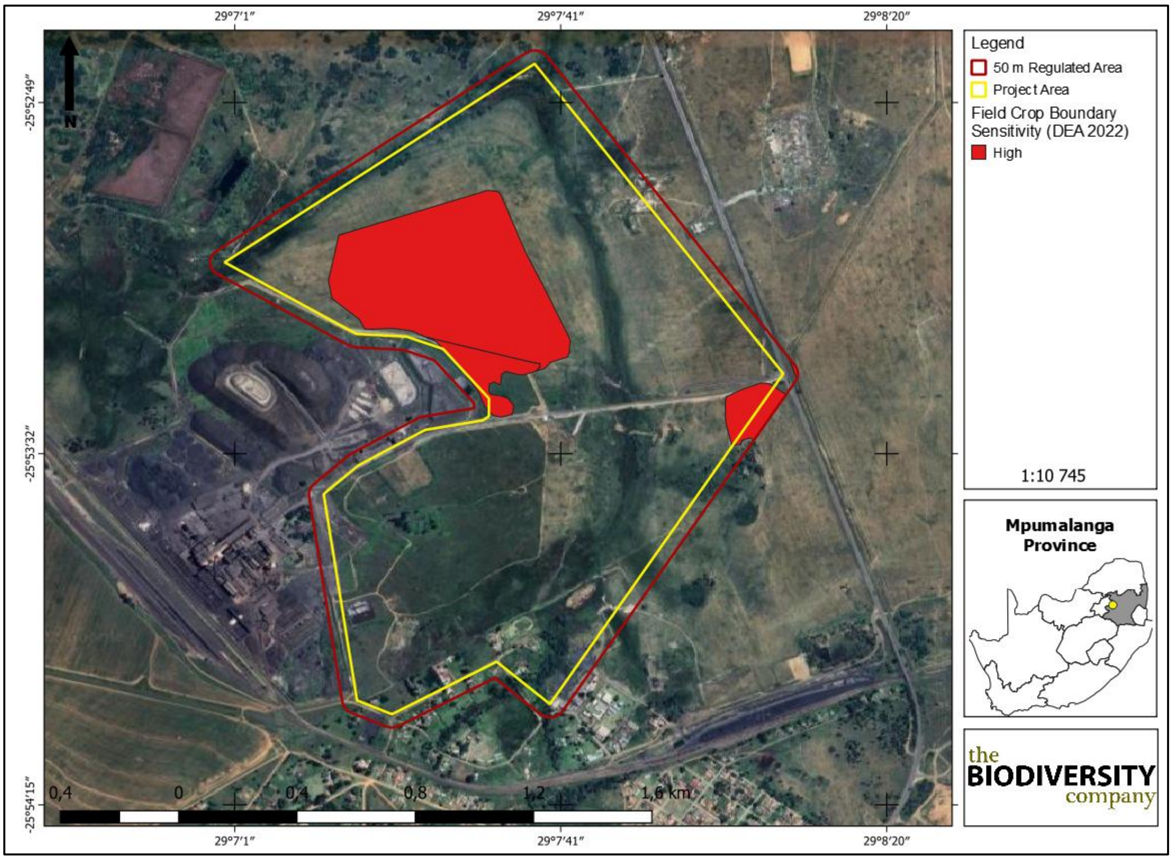

Figure 6-3 Crop boundary sensitivity (DEA Screening Tool, 2022)

7 Impact Assessment

Infrastructure within the project area assigned to the available land includes PV modules and mounting structure, collector substation, transmission loops and access roads. The proposed activities often impede into "High" sensitivity crop fields. Even though these sensitivities are not associated with arable land potential conditions, high production agricultural activities will be impacted on.

Impacts were assessed in terms of the construction, operational and decommissioning phases. Mitigation measures were only applied to impacts deemed relevant.

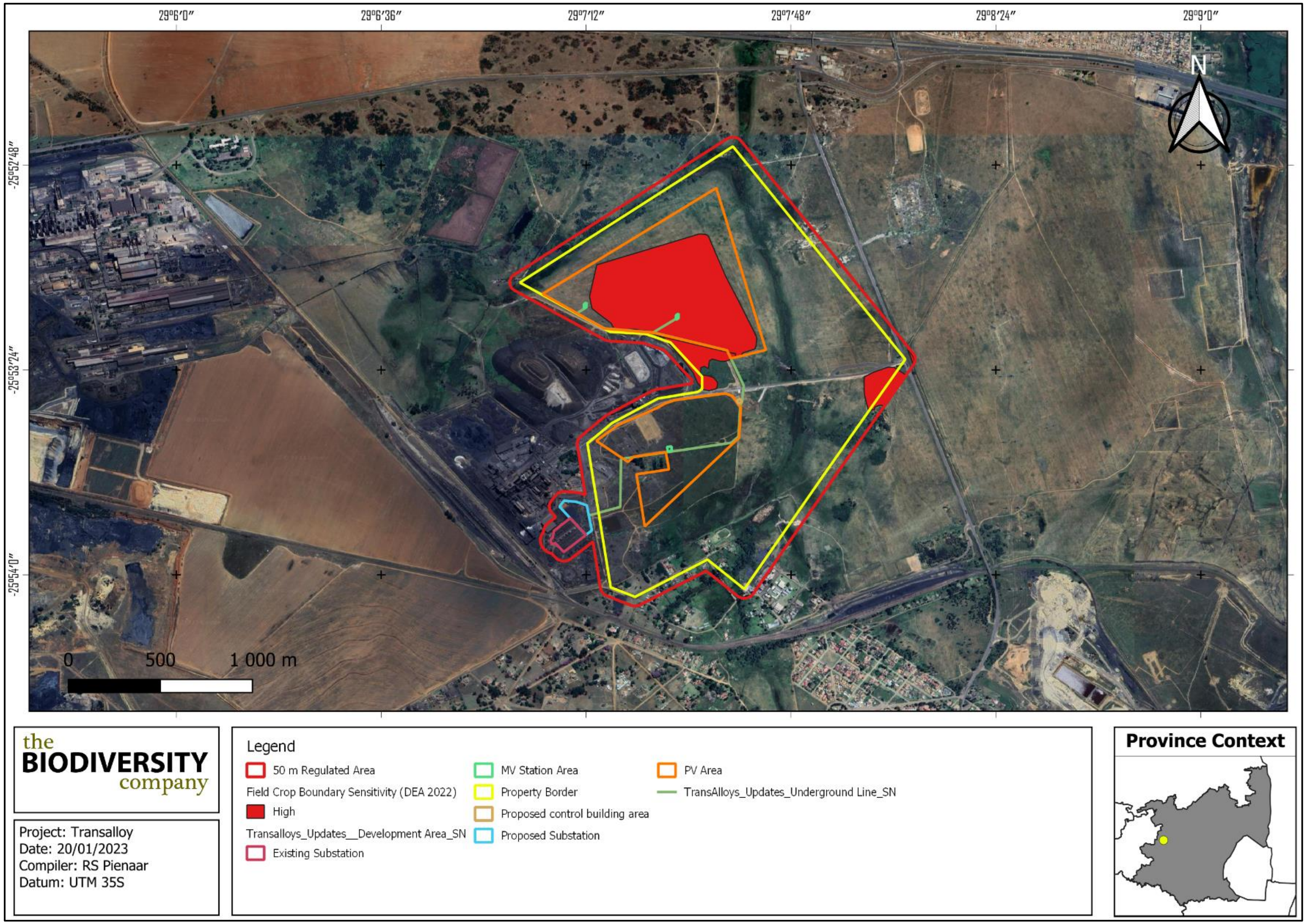

Figure 7-1 Infrastructure within proximity to sensitive crop fields

7.1 Anticipated Activities

The proposed activities associated with the Solar PV renewable project can be seen overlaid with the overall sensitivity (Figure 7-1). The following activities will take place;

- PV modules and mounting structures with a capacity of 55MW and dependent on optimization and cost;
- Inverters and transformers;
- Onsite collector substation;
- Cabling between project components;
- Laydown and O&M hub (approximately 300 m x 300 m):
  - Construction compound (temporary); and
  - Maintenance office.

7.1.1 Unplanned Events

The planned activities will have anticipated impacts as discussed; however, unplanned events may occur on any project and may have potential impacts which will need management. Table 7-1 is a summary of the findings of an unplanned event assessment from an agricultural potential perspective. Note, not all potential unplanned events may be captured herein, and this must therefore be managed throughout all phases according to recorded events.

Table 7-1 Summary of unplanned events for terrestrial biodiversity

Unplanned Event	Potential Impact	Mitigation
Hydrocarbon spills into the surrounding environment	Contamination of soil as well as water resources associated with spillage.	A spill response kit must be available at all times. The incident must be reported on and if necessary, a biodiversity specialist must investigate the extent of the impact and provide rehabilitation recommendations.

7.1.2 Planning Phase Impacts

The planning phase activities are considered a low risk as they typically involve desktop assessments and initial site inspections. This would include preparations and desktop work in support of waste management plans, environmental and social screening assessments, finalising well sites and facilities and consultation with various contractors involved with a diversity of proposed project related activities going forward.

7.1.3 Construction Phase

The proposed development will result in the stripping of topsoil and alterations to the existing land uses. The changes in the land use will be from agricultural to renewable development (or transformed). The proposed activities will impact on areas expected to be high agricultural production (in some areas), with some aspects affecting covers “Moderately Low” to “Moderate” sensitivity areas. It is possible that suitable agricultural land could become fragmented, resulting in these smaller portions no longer being deemed feasible to farm

During the construction phase, foundations will be cleared with topsoil often being stripped and stockpiled. Access roads will be created with trenches being dug for the installation of relevant cables/pipelines. Construction of substation sites will take place together with the erection of transmission lines where relevant. Contractor and laydown yards will also be cleared with construction material being transported to laydown yards. Potential erosion is expected during the construction phase due to some erodable soils within the footprint assessment area, such as the Vaalboos and

Tukulu soil forms. The removal vegetation and changes to the local topography could result in an alteration to surface run-off dynamics. Erosion of the area could result in further loss of topsoil, and soil forms suitable for agriculture.

Table 7-2 Impact assessment related to the loss of the land capability during the construction phase of the proposed Transalloys solar photovoltaic facility project

Nature: Loss of land capability		
	Without mitigation	With mitigation
Extent	Local area (3)	Footprint & surrounding areas (2)
Duration	Moderate Term (3)	Moderate Term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Low (2)
Significance	Medium (36)	Low (18)
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
***Mitigation:* See Section 9**		
Residual Impacts:		
Limited residual impacts will be associated with these activities, assuming that all prescribed mitigation measures be strictly adhered to.		

7.1.1 Operational Phase

During the operational phase, limited impacts are foreseen. Concrete areas will be equiped with drains to reduce soil erosion on exposed areas. Only the footprint area will be disturbed to minimise soil and vegetation disturbance of the surrounding area. Revegetation will be carried out on exposed surrounding areas to avoid surface erosion. Maintenace of vegetation, wind and solar PV infrastructure structure will have to be carried out throughout the life of the project. It is expected that these maintenance practices can be undertaken by means of manual labour.

7.1.1.1 Infrastructure

The operational phase of the renewable project (Constructed Infrastructure) includes anthropogenic movement and activities. The relevant infrastructure will be occupied by professionals throughout the lifetime of the operation. Besides compaction and erosion caused by increased traffic and surface water run-off for the area, few aspects are expected to be associated with this phase. The spread of alien invasive species will be a risk, predominantly adjacent to developed aeras (edge effect).

Table 7-3 Impact assessment related to the loss of land capability during the operational phase of the proposed Transalloys solar photovoltaic facility project

Nature: Loss of land capability		
	Without mitigation	With mitigation
Extent	Footprint & surrounding areas (2)	Site specific (1)
Duration	Long Term (4)	Moderate Term (3)
Magnitude	Moderate (6)	Low (4)

Probability	Probable (3)	Low (2)
Significance	Medium (36)	Low (16)
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
***Mitigation:* See Section 9**		
Residual Impacts:		
Limited residual impacts will be associated with these activities, assuming that all prescribed mitigation measures be strictly adhered to.		

7.1.2 Cumulative Impacts

The proposed project area measures approximately 67.9 ha (48 ha North, 19.9 ha South) and falls within a development area of 100 ha, which is situated on a 235 ha property. It is proposed that ~55MW WTG (49.280 MVA (AC) and 52.807 MWp (DC) layout with solar PV will be developed.

The cumulative impacts have been scored "Medium," indicating that the potential incremental, interactive, sequential, and synergistic cumulative impacts. It is probable that the impact will result in spatial and temporal cumulative change.

Table 7-4 Impact assessment related to the loss of land capability due to cumulative impacts of the proposed Transalloys solar photovoltaic facility project

Nature: Loss of land capability		
	Without mitigation	With mitigation
Extent	Local (3)	Footprint and surrounding areas (2)
Duration	Long term (4)	Moderate term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (39)**	**Low (18)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
***Mitigation:* See Section 9**		
Residual Impacts:		
Limited residual impacts will be associated with these activities, assuming that all prescribed mitigation measures be strictly adhered to.		

8 Mitigation

8.1 Mitigation Measures

The following specific measures are intended to secure a low residual risk:

- Avoidance of all high agricultural production land and other actively cultivated areas;

- Make use of existing roads or upgrades tracks before new roads are constructed. The number and width of internal access routes must be kept to a minimum;
- A stormwater management plan must be implemented for the development. The plan must provide input into the road network and management measures;
- Solar panels and infrastructure foundations must be (preferably) located in already disturbed areas that are not actively cultivated; and
- Rehabilitation of the area must be initiated from the onset of the project. Soil stripped from infrastructure placement can be used for rehabilitation efforts; and
- An alien invasive plant species and control programme must be implemented from the onset of the project.

8.2 General Mitigation

General mitigations will ensure the conservation of all soil resources, regardless of the sensitivity of resources and the intensity of impacts.

- Only the proposed access area and roads should be disturbed to reduce any unnecessary compaction;
- Prevent any spills from occurring. Machines must be parked within hard park areas and must be checked daily for fluid leaks;
- Proper invasive plant control must be undertaken;
- All excess soil (soil that are stripped and stockpiled to make way for foundations) must be stored, continuously rehabilitated to be used for rehabilitation of eroded areas; and
- If a spill occurs, it is to be cleaned up immediately and reported to the appropriate authorities.

8.3 Restoration of Vegetation Cover

Restoring vegetation cover is the first step to successful rehabilitation. Vegetation cover decreases flow velocities and minimises erosion.

8.3.1 Ripping Compacted Areas

All areas outside of the footprint areas that will be degraded (by means of vehicles, laydown yards etc.) must be ripped where compaction has taken place. According to the Department of Primary Industries and Regional Development (Agriculture and Food) (2017), ripping tines must penetrate to just below the compacted horizons (approximately 300 – 400 mm) with soil moisture being imminent to the success of ripping. Ripping must take place within 1-3 days after seeding, and also following a rain event to ensure a higher moisture content.

To summarise;

- Rip all compacted areas outside of the developed areas that have been compacted;
- This must be done by means of a commercial ripper that has at least two rows of tines; and
- Ripping must take place between 1 and 3 days after seeding and following a rainfall event (seeding must therefore be carried out directly after a rainfall event).

8.3.2 Revegetate Degraded Areas

Vegetation within the footprint areas will be cleared in most areas to accommodate the ground disturbance activities coupled with the proposed footprint areas' foundations. This impact will degrade soil resources, ultimately decreasing the land capability of resources and increasing erosion especially in shallow soil profiles. According to Russell (2009), areas characterised by a loss of soil resources should be revegetated by means of vegetation with vigorous growth, stolons or rhizomes that more or less resembles the natural vegetation in the area.

It is recommended that all areas surrounding the development footprint areas that have been degraded by traffic, laydown yards etc. must be ripped and revegetated by means of indigenous grass species. Mixed stands or monocultures will work sufficiently for revegetation purposes. Mixed stands tend to blend in with indigenous vegetation species and are more natural. Monocultures however could achieve high productivity. In general, indigenous vegetation should always be preferred due to various reasons including the aesthetical presence thereof as well as the ability of the species to adapt to its surroundings.

Plant phase plants which are characterised by fast growing and rapid spreading conditions. Seed germination, seed density and seed size are key aspects to consider before implementing revegetation activities. The number of seed should be limited to ensure that competition between plants is kept to a minimum. During the establishment of seed density, the percentage of seed germination should be taken into consideration. *E curvula* is one of the species recommended due to the ease of which it germinates. This species is also easily sown by means of hand propagation and hydro seeding.

The following species are recommended for rehabilitation purposes;

- *Eragrostis teff;*
- *Cynodon species* (Indigenous and altered types);
- *Chloris gayana;*
- *Panicum maximum;*
- *Digitaria eriantha;*
- *Anthephora pubescens; and*
- *Cenchrus ciliaris.*

8.4 Specialist Recommendation

The final results indicate ""Low" post-mitigation significance score ratings for the proposed components. It is therefore clear that the proposed activities are expected to have a low impact on land potential resources. It is worth noting that some "High" sensitivity crop field areas were identified by means of the DEA Screening tool (2022), it is recommended these are to be avoided throughout the life of the operation. If avoidance is not feasible, stakeholder engagement must be undertaken to compensate landowners for high crop field land use areas where necessary.

9 Conclusion and Impact Statement

Three main sensitive soil forms were identified within the assessment area, namely the Nkonkoni, Clovelly and Tubatse soil forms. The land capability sensitivities (DAFF, 2017) indicate land capabilities with "Low" and "Moderate high" sensitivities, which correlates with the "Moderate" sensitivities finding from the baseline assessment associated with land potential 3 and 4.

The assessment area is associated with arable soils. However, the available climatic conditions of low annual rainfall and high evapotranspiration potential severely limits crop production significantly resulting in land capabilities with “Low” and “Moderate high” sensitivities. Moreover, most soil profiles in the assessment area are shallow, which also limit field crop root penetrations. Depth limitations can also expose most of the soils to the effect of erosion. The land capabilities associated with the assessment area are suitable for livestock grazing, however limitations in the profile depth can restrict some of the cropping practices hence its use for mining activities which corresponds with the current land use.

It is the specialist’s opinion that the proposed developments will have an overall low residual impact on the agricultural production ability of the land. The proposed activities will result in the segregation of some high production agricultural land. However, most of the available high sensitivity crop fields identified following the DEA Screening Tool, (2022) have a low sensitivity and land potential due to the shallow and limited profiles observed from the soils observed on-site in the assessment area. It is recommended that the location of infrastructure avoid areas of high agricultural production. In the portions where the crop field sensitivities and baseline findings concur as high, such high agricultural areas can be treated as no-go areas, to preserve them. If avoidance is not feasible, stakeholder engagement must be undertaken to compensate landowners for high crop field land use areas where necessary.

10 References

Land Type Survey Staff. (1972 - 2006). Land Types of South Africa: Digital Map (1:250 000 Scale) and Soil Inventory Databases. Pretoria: ARC-Institute for Soil, Climate, and Water.

Mucina, L. & Rutherford, M.C. (Eds.). (2006). The vegetation of South Africa, Lesotho and Swaziland. Strelizia 19. South African National Biodiversity Institute, Pretoria South African.

Smith, B. (2006). The Farming Handbook. Netherlands & South Africa: University of KwaZulu-Natal Press & CTA.

Soil Classification Working Group. (1991). Soil Classification A Taxonomic system for South Africa. Pretoria: The Department of Agricultural Development.

Soil Classification Working Group. (2018). Soil Classification A Taxonomic system for South Africa. Pretoria: The Department of Agricultural Development.