Soil and Agricultural Compliance Statement for the proposed Valley Tailings Storage Facility (TSF) Project

Welkom, Free State Province, South Africa

Report Date: August 2023

CLIENTS

EIMS | ENVIRONMENTAL IMPACT MANAGEMENT SERVICES

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Submitted to	EIMS ENVIRONMENTAL IMPACT MANAGEMENT SERVICES
Statement Contributor / Reviewer	**Matthew Mamera** Matthew Mamera is a Cand. Sci Nat registered (116356) in natural and agricultural sciences recognized 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 peers reviewed scientific publications in international journals. He is a holder of a PhD in soil science, hydropedology, water and sanitation obtained at the University of the Free State, Bloemfontein. Matthew completed his M.Sc. in soil science, hydropedology and water management at the University of Fort Hare, Alice. Matthew is also a member of the Soil Science Society of South Africa (SSSSA).
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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 principles of science.

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1 Introduction

The Biodiversity Company was appointed to undertake an agricultural potential assessment for the proposed Valley TSF Expansion Project, Harmony Gold Mining Company Limited (Harmony) own and operate a number of Gold Mines and Plants located in Welkom, Free State province. Harmony currently deposit tailings onto the Free State South (FSS) 2 Tailings Storage Facility (TSF), St. Helena 4 TSF, St. Helena 123 TSF, Dam 23 TSF, Brand D TSF and Target 1&2 TSF. The current planned Life of Mine (LOM) of the Free State Operations exceed the available deposition capacity of these TSFs and Harmony is undertaking a feasibility assessment to construct the new Valley TSF.

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). The National Web based Environmental Screening Tool (DEFF, 2023) has characterised the agricultural theme sensitivity of the project area as predominantly “Medium”, with a key consideration of this assessment being the determination of agricultural theme sensitivities for the project.

This report aims to present and discuss the findings from the soil resources identified within the 50 m buffered 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 photovoltaic project.

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, enabling informed decision making, as to the ecological viability of the proposed project.

1.1 Design Description

The following is the executive summary as provided by Geotheta in the Design Report (2023):

Geotheta was appointed by Harmony Gold to complete the design of the proposed new Valley Tailings Storage Facility (TSF) in Welkom, South Africa.

Key Parameters of the Valley TSF design are:

- Maximum final height: 36m
- Footprint area: 163.5 Ha
- Total capacity: 56.8 million tons
- Deposition period at 600 000 tons per month: 8 years
- Maximum rate of rise (Basin): 4.12m/year
- Maximum rate of rise (Embankment): 3.99m/year
- Deposition method: Cyclone

The Valley TSF provides a storage capacity of 56.8 million tons over a deposition period of 8.0 years at the target deposition rate of 600 000tpm with a maximum rate of rise of 4.12m/year (basin) and 3.99m/year (embankment). This rate of rise will be achieved by cyclone deposition.

Valley TSF will be developed with an intermediate outer slope of 1V:3H between benches. The overall slope with benches is 1V:4H. The inter-bench height is 8.0m and the benches are 8.0m wide.

The maximum toe wall embankment height is 3m with a 3m wide crest, outer slope of 1V:1.5H and 1V:2H inner slope. The toe wall embankment will be constructed in 150mm layers to 95% Proctor density at 0% to +2% Optimum Moisture Content (OMC). The toe wall material will be obtained from the basin of the facility.

The cyclone walls will be constructed 50m away from the toe wall on the northwest, eastern and southern flanks of the Valley TSF. The other flanks butt up against the dormant FSN1 and FSN2 facilities and no cyclone deposition will occur from these flanks. Spigotting or open-end deposition will be done for pool control only when required.

These cyclone walls will provide an elevated platform to allow for overflow tailings deposition. The cyclone wall is 3m high with a 3m wide crest, outer slope of 1V:2H and 1V:2H inner slope.

According to GISTM, the Valley TSF has a Very High Consequence Classification rating.

Based on SANS 10286, the Valley TSF has a High Hazard classification rating.

The minimum Factor of Safety against failure, based on the Limit Equilibrium method of stability analysis, is 2.0 under drained conditions, 1.6 under undrained conditions, 1.2 under post seismic, post liquefaction or residual conditions and 1.3 under pseudo static conditions. These Factors of Safety comply with the local legislation and international slope stability standards.

Most dormant up-stream deposited facilities, including FSN1 and FSN2, do not meet new legislated Factor of Safety requirements. To ensure the entire complex complies at closure, remedial works for FSN1 and FSN2 may be incorporated into the Valley TSF closure plan. Conceptual-level work has been carried out to assess the required remedial work based on the limit equilibrium method for stability calculations. This work will be updated once the proposed stability assessments using finite element analyses are conducted on Harmony's dams.

The gold tailings material classified as a Type 3 waste according to the waste classification report by Jones and Wagner. This necessitates a Class C barrier system. However, as per an independent review by Legge and Associates, an 'inverted barrier' system can be used. The inverted barrier reduces seepage by changing the flow through the liner from Bernoulli flow at discontinuities to D'Arcian flow controlled by the tailings permeability at these points. The stability of the TSF is also improved by omitting lower strength compacted clay layers and the geomembrane cushion layer (replaced by tailings). The inverted barrier system is used in the design of the Valley TSF barrier system.

The Valley TSF barrier system has two different areas. Liner area 1 is within the central area of the dam basin. This liner system comprises (from top down), a 300mm thick layer of tailings, above liner drains, 1.5mm smooth HDPE liner underlain by a 300mm ripped and recompacted in-situ base layer.

Liner area 2 is present at the outer walls of the facility where high liner stresses exist and a 150T geogrid (or similar approved) is required. The geogrid (or similar approved) will be placed from the toe wall inwards for 50m. This liner system comprises (from top down), a 300mm thick layer of tailings, a 150T size geogrid (or similar approved), a 300mm thick layer of tailings, above liner drains, 1.5mm double textured HDPE liner underlain by a 300mm ripped and recompacted in-situ base layer.

The TSF underdrainage system is provided above the liner to intercept seepage through the facility. The above liner drains lower the phreatic surface, thereby improving the overall stability of the facility. The above liner drains comprise of blanket drains and herringbone drains.

The herringbone drains pipes comprise of 160mm slotted Drainex HDPE pipes surrounded in 19mm stone which is enclosed in a geofabric. These drains are spaced 100m apart. The blanket drains comprise of 160mm slotted Drainex HDPE pipes surrounded in 19mm stone overlain by a layer of 6mm stone and graded filter sand which is enclosed in a geofabric.

All above liner drains in the south-east section discharge into the solution trench located to the south of Valley TSF and water will flow to the existing Return Water Dam (RWD). The above liner drains on the north-western section discharge into the solution trench located to the north-west of Valley TSF and will flow to the new RWD.

The under-liner leakage detection drains on the Valley TSF comprise of 160mm slotted Drainex HDPE pipes surrounded in 19mm stone which is enclosed in a geofabric. Similarly to the above-liner drains, the south-eastern under liner drains flow to the existing RWD and the north-western section discharges into the new RWD.

A 150mm thick reinforced concrete lined solution trench is provided along the north-west, south and south-eastern sections of the TSF. The trapezoidal solution trench is 1m deep with side slopes of 1V:1.5H and a base width of 1m. The solution trench on the north-western section of the TSF will accommodate the maximum peak discharge from the penstock of 1.02m3/sec and flows into the new RWD. The solution trench on the south and south-eastern sections of the TSF will accommodate drain flow only of 46.14m3/day and flows into the existing RWD.

A hydrotechnical assessment was done to determine climatic and meteorological data. This data was used to size the new RWD situated north-west of the TSF and the associated water infrastructure. A capacity assessment was carried out on the existing RWD, situated south-west of the TSF.

The new Return Water Dam has a total storage capacity of 220 000m3 which is sufficient to ensure that it does not spill more than once every 50 years with the inflow from the penstock and underdrains on the north-west of the TSF, when operated at a level of 0.3m.

The new Return Water Dam liner system comprises 200mm high geocells filled with 20Mpa concrete, underlain by a 1.5mm thick smooth HDPE liner and a 300mm in-situ base preparation layer. The underdrainage comprises 160mm slotted HDPE pipes encased in 19mm washed stone. The stone will be wrapped in geofabric.

A concrete lined spillway is provided at the new RWD to safely discharge excess water without overtopping of the RWD embankment walls. The RWD spillway has a freeboard of 800mm and has been designed to discharge the 1:10 000 24-hour Probable Maximum Flood volume of 9.9m3/sec.

A silt trap is installed upstream of the new RWD. The silt trap includes infrastructure to enable cleaning. The silt trap allows solids to settle out of the water before entering the RWD, thereby minimising sedimentation in the RWD. The silt trap is a 2.0m deep reinforced concrete water retaining structure with a concrete spillway to route de-silted water to the RWD.

A capacity assessment was done on the existing RWD, which has a capacity of 300 000m3. The inputs to this dam are low, as only drain water and rainfall will flow to the RWD. Due to evaporation and seepage, the dam is not expected to hold more than 50 000m3 and easily accommodates the expected inputs.

Concrete poles with warning signs will be installed around the TSF. A 5m wide access road is provided around the facility for operational and monitoring requirements.

The facility is to be constructed and operated to ensure that the future designed outer slope profile is achieved and to ensure the safe, efficient and environmentally responsible management of the Valley TSF and associated infrastructure.

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1.2 Project Area

The proposed Valley TSF project and associated infrastructure is located in Welkom town. The project is found within the Matjhabeng and Lejweleputswa District Municipality in the Free State Province. The project area is found approximately 2,7 km south of the R34 road, 2 km north of R710 regional road and 0-7 km west of the R30 regional road (Figure 1-1). The surrounding land use includes watercourses, agricultural activities (Crop and livestock), game farms and mining.

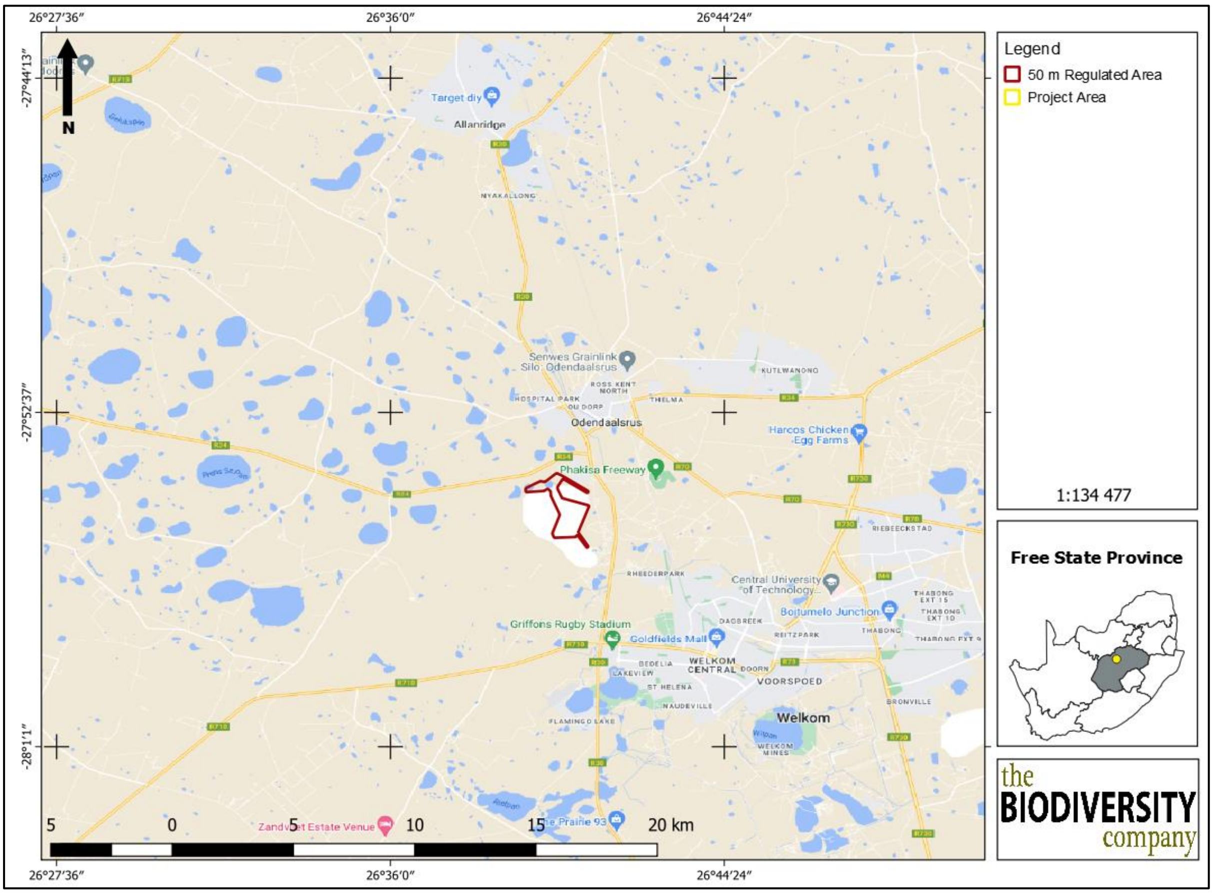

Figure 1-1 The location of the project area

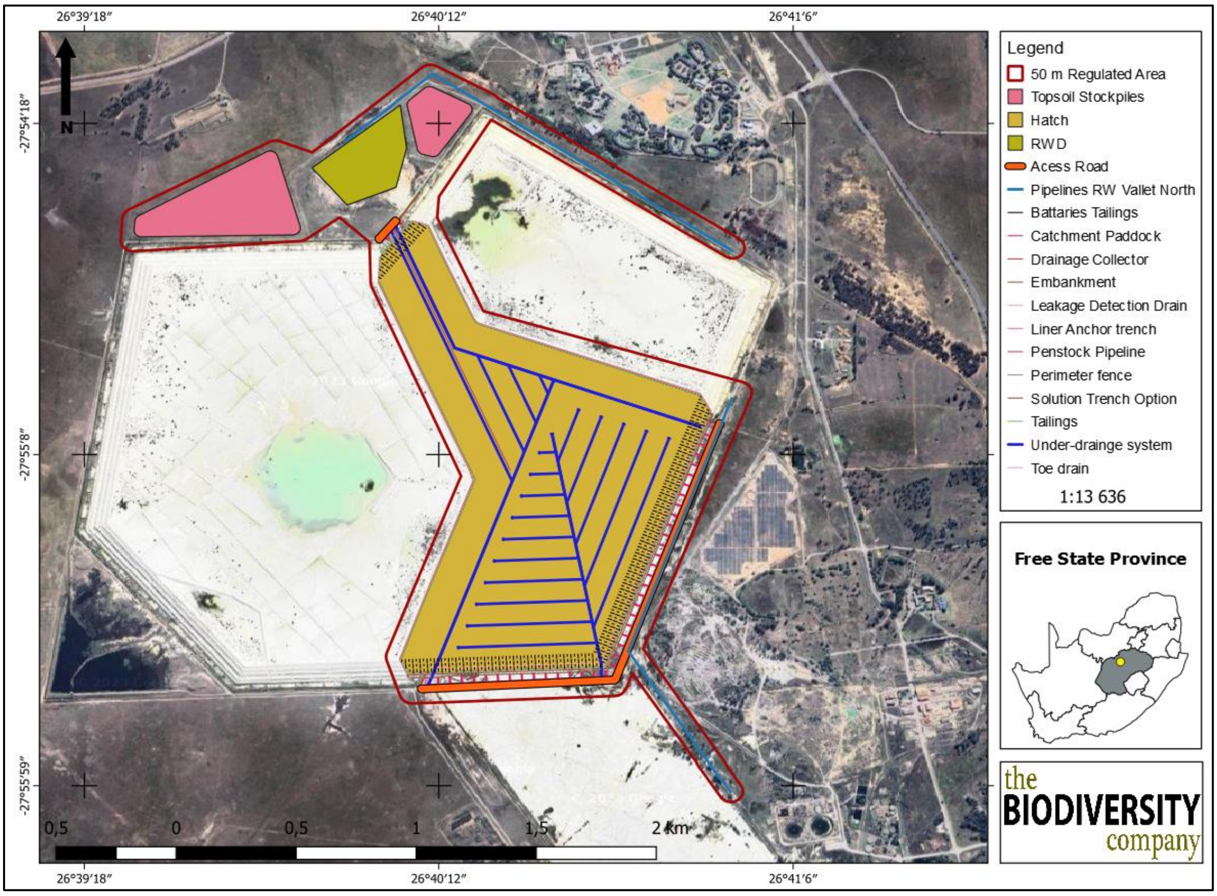

Figure 1-2 The layout of the project area.

1.3 Scope of Work

In addition to the requirements stipulated in GNR 320, the following Terms of Reference, as stipulated by Aristida (Pty) Ltd, apply to the Agricultural Compliance Statement:

- Ensure a thorough assessment, that includes both the desktop assessment of databases and aerial photography; a description of the on-site verification of the agricultural potential of the area; and the soil forms present in the development area;
- Identify and assess potential impacts on both agricultural potential and soil resulting from the proposed project;
- Identify and describe potential cumulative soil, agricultural potential and land capability impacts resulting from the proposed project in relation to proposed and existing developments in the surrounding area; and
- Recommend mitigation, management and monitoring measures, to minimise impacts and/or optimise benefits associated with the proposed project.

2 Key Legislative Requirements

The report follows the protocols as stipulated for agricultural assessment in Government Notice 320 of 2020 (GNR 320). 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) (NEMA).

The above mentioned are supported by additional legislation that aims to manage the impact of development on the environment and the natural resource base of the country. Related legislation to this effect includes:

- Conservation of Agricultural Resources Act (Act 43 of 1983);
- Environment Conservation Act (Act 73 of 1989);
- National Environmental Management Act (Act 107 of 1998); and
- National Water Act (Act 36 of 1998).

2.1 Legislative Framework

In line with the protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial biodiversity, as per Government Notice 320 published 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" – the following has been assumed:

- An applicant intending to undertake an activity identified in the scope of this protocol on a site identified on the screening tool as being of:
  - "low & medium sensitivity" for agriculture, must submit an Agricultural Compliance Statement.

An Agricultural Compliance Statement must contain the information as presented in Table 2-1 below.

Table 2-1 Agricultural Compliance Statement information requirements as per the relevant protocol, including the location of the information within this report

Information to be Included (as per GN 320, 20 March 2020)	Report Section
details and relevant expertise as well as the SACNASP registration number of the soil scientist or agricultural specialist preparing the statement including a curriculum vitae	Pg I / Appendix B
a signed statement of independence by the specialist	Appendix A
a map showing the proposed development footprint (including supporting infrastructure) with a 50 m buffered development envelope, overlaid on the agricultural sensitivity map generated by the screening tool	6 / Figure 6-1
confirmation from the specialist that all reasonable measures have been taken through micro-siting to avoid or minimise fragmentation and disturbance of agricultural activities	6
a substantiated statement from the soil scientist or agricultural specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not, of the proposed development	6.2
any conditions to which this statement is subjected	6.3
in the case of a linear activity, confirmation from the agricultural specialist or soil scientist, that in their opinion, based on the mitigation and remedial measures proposed, the land can be returned to the current state within two years of completion of the construction phase	N/A
where required, proposed impact management outcomes or any monitoring requirements for inclusion in the EMPr	6.1
a description of the assumptions made and any uncertainties or gaps in knowledge or data	3.4

A signed copy of the compliance statement must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.

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 March 2023. 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 0.5 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

Land capability and agricultural potential will 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

The land capability of the proposed footprint will be compared to the National Land Capability which was refined in 2014- 2016. The National Land Capability methodology is based on a spatial evaluation modelling approach and a raster spatial data layer consisting of fifteen (15) land capability evaluation values (Table 3-4), usable on a scale of 1:50 000 – 1:100 000 (DAFF, 2017). The previous system is based on a classification approach, with 8 classes (Table 3-1). Land capability and land potential will also be determined in consideration of the screening tool to ultimately establish the accuracy of the land capability sensitivity from (DAFF, 2017).

Table 3-4 National Land Capability Values (DAFF,2017)

Land Capability Evaluation Value	Land Capability Description
1	Very low
2	
3	Very Low to Low
4	
5	Low
6	Low to Moderate
7	
8	Moderate
9	Moderate to High
10	
11	High
12	High to Very High

13	Very High
14	
15	

3.4 Limitations

The following limitations are relevant to this agricultural potential assessment:

- 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;
- 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; and
- Soil fertility analysis was not conducted for this report.

4 Receiving Environment

4.1 Climate

The project area is characterised by summer rainfall peaking between November to March. According to Mucina & Rutherford (2006), the mean annual precipitation (MAP) is at 450 mm. There is frequent frost that occurs in winter, due to cool temperate conditions. The area has mean daily maximum and minimum temperatures of 17ºC and below 0ºC for February and July, respectively (see Figure 4-1).

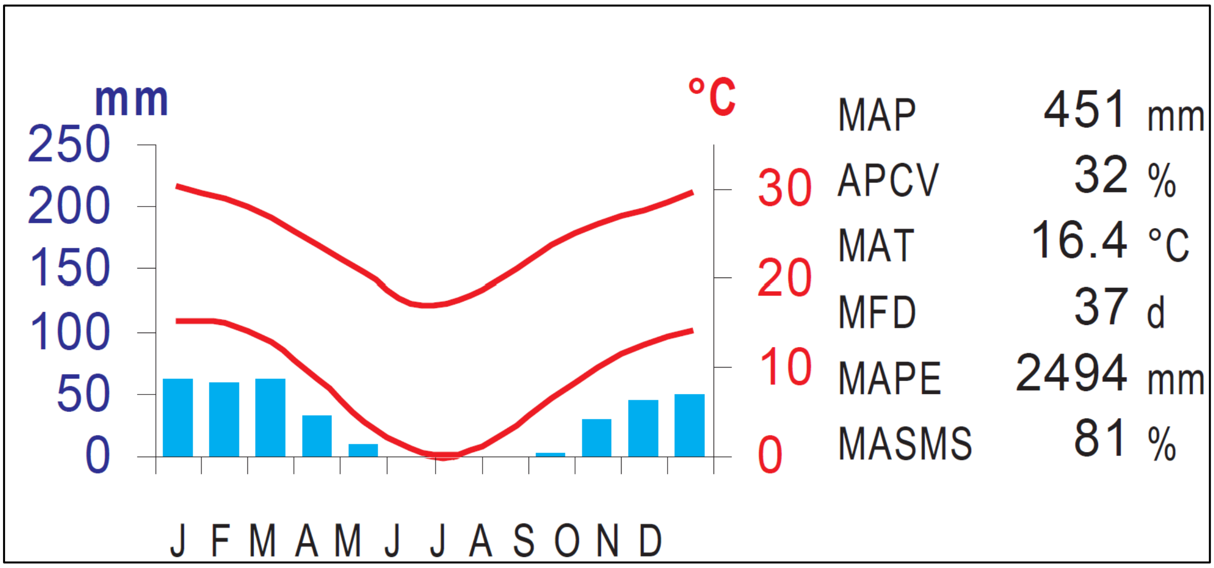

Figure 4-1 Climate diagram for the region (Mucina & Rutherford, 2006).

4.2 Soil and Geology

The geology of the area is characterised with Sandstone, mudstone, dolerite and shale (Volksrust formation, Ecca group). According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by the Dc 9 land type (see Figure 4-3). The Dc 9 land type is mainly characterised with Hutton, Swartland and Willowbrook soil forms according to the Soil classification working group, (1991), with the occurrence of other soils and rocky areas within the landscape. The Dc land types commonly has prismacutanic and pedocutanic diagnostic horizons. Other horizons associated to the landscape includes vertic, melanic and red structure diagnostic horizons. The land terrain units for the featured Dc 9 land type are illustrated in Figure 4-2 with the expected soils listed in Table 4-1.

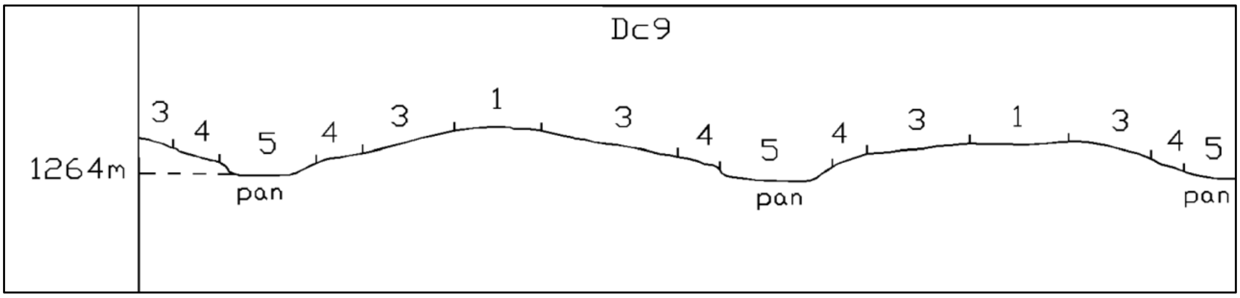

Figure 4-2 ***Illustration of land type Dc 9 terrain unit (Land Type Survey Staff, 1972 - 2006)***

Table 4-1 ***Soils expected at the respective terrain units within the Dc 9 land type (Land Type Survey Staff, 1972 - 2006)***

Terrain Units							
1 (10%)		**3 (27%)**		**4 (41%)**		**5 (22%)**	
Hutton	100%	Hutton	88%	Swartland	28%	Willowbrook	91%
		Clovelly	11%	Valsrivier	23%	Valsrivier	5%
		Oakleaf	11%	Sterkspruit	17%	Arcadia	2%
				Arcadia	4%	Sterkspruit	1%
				Estcourt	3%	Estcourt	1%
				Mispah	1%		

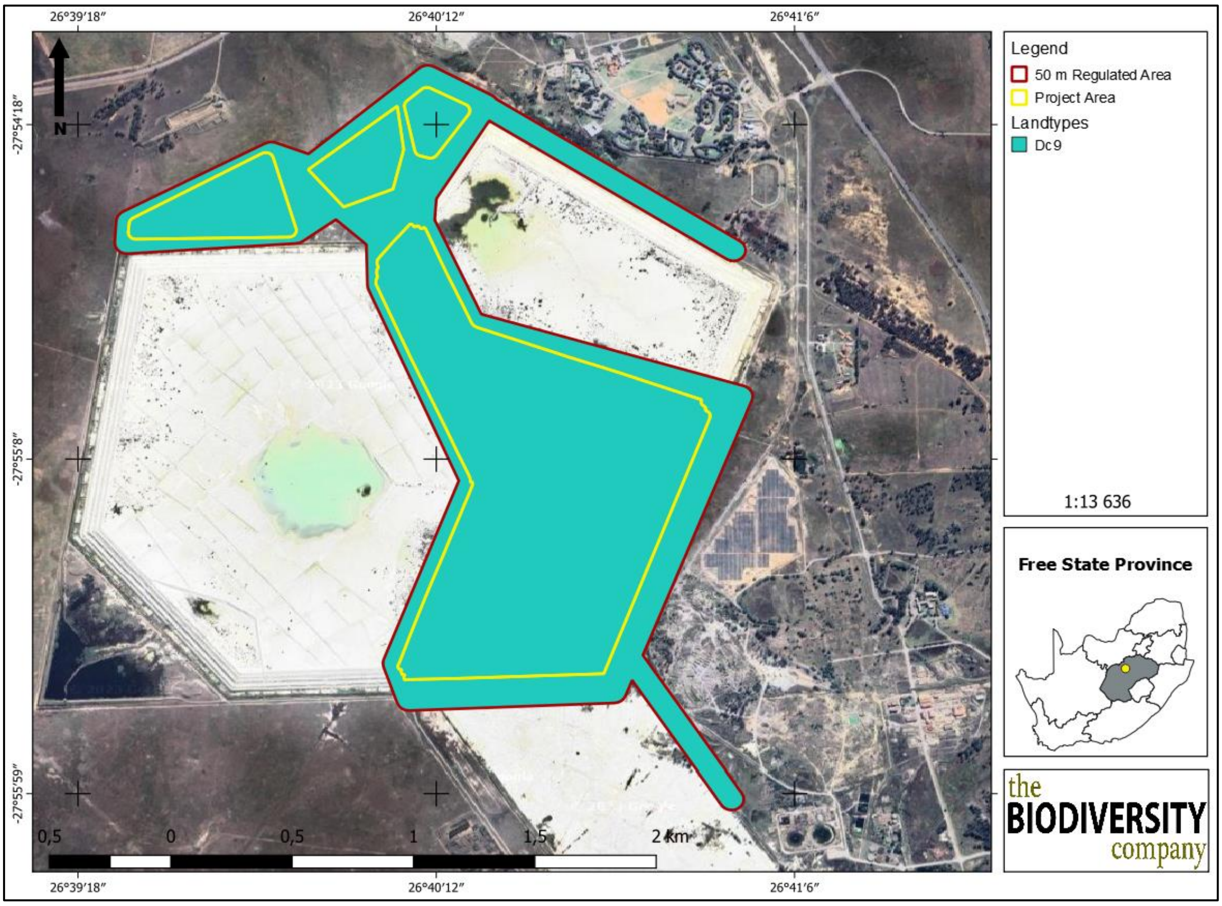

Figure 4-3 ***Illustration of land type uses associated with the proposed project area.***

4.3 Terrain

The slope percentage of the project area has been calculated and is illustrated in Figure 4-4. Most of the project area is characterised by a slope percentage between 0 and 20%, with some patches within the project area characterised by a slope percentage ranging from 20 to 65%. This illustration indicates irregularities in the topography in scattered areas the majority of the area being characterised by non-uniform slopes. The DEM of the project area (Figure 4-5) indicates an elevation of 1 321 to 1 377 Metres Above Sea Level (MASL).

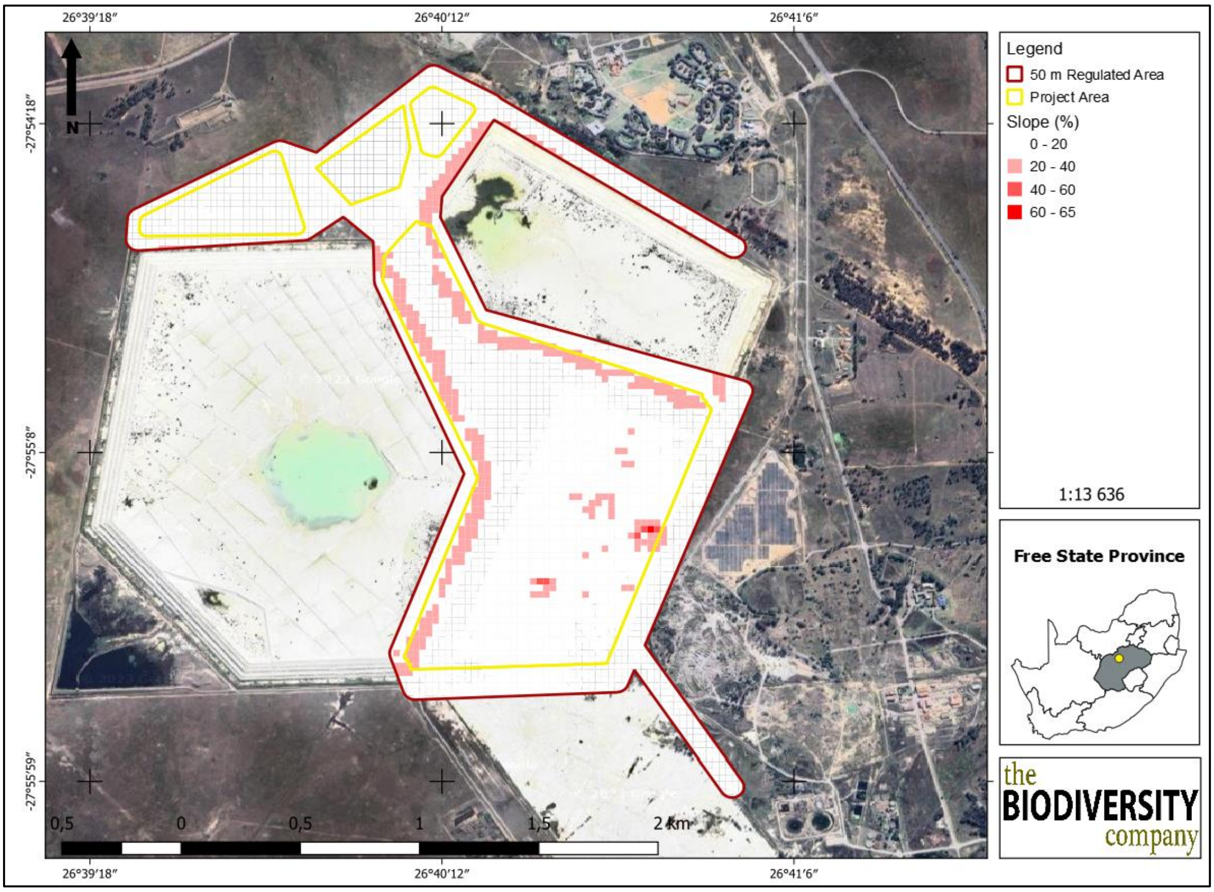

Figure 4-4 The slope percentage calculated for the project area.

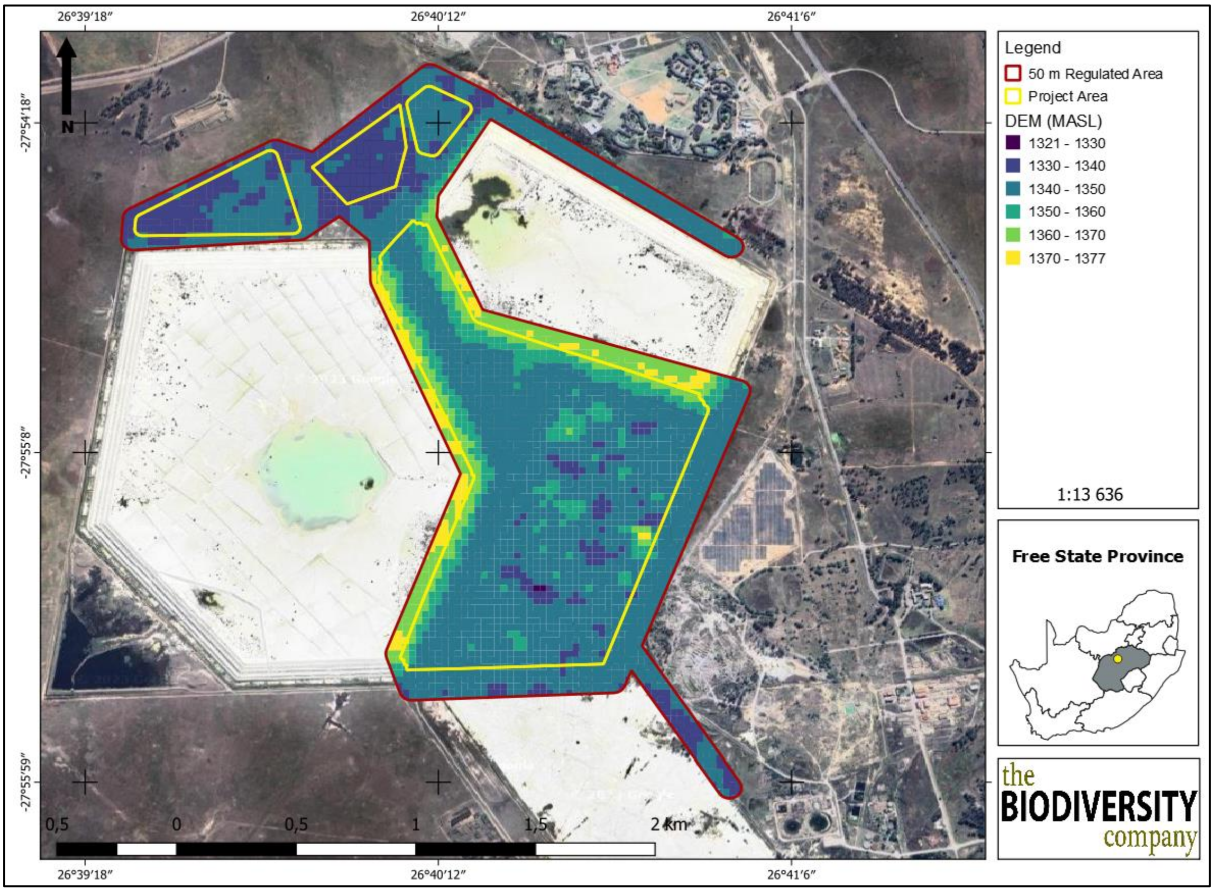

Figure 4-5 The DEM generated for the project area.

5 Results and Discussion

5.1 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:

- Orthic topsoil horizon;
- Yellow-Brown apedal horizon;
- Soft plinthic horizon;
- Gley horizon; and
- Transported Technosols horizon;

5.1.1 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).

5.1.2 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 (Soil Classification Working Group, 2018).

5.1.3 Soft Plinthic Horizon

The accumulations of iron (and in some cases manganese) as hydroxides and oxides with the presence of high chroma striations and concretions with black matrixes are associated with the Soft Plinthic horizon. This diagnostic horizon forms due to fluctuating levels of saturation. The iron and manganese concentration result in soft marks within the soil matrix which transform in concretions with high consistencies (Soil Classification Working Group, 1991).

5.1.4 Transported Technosols Horizon

Transported Technosols are soil materials intentionally transported by human intentionally transported with human activity. The newly moved materials may include ex-natural soils or particulate anthropogenic material, where the nature of the material below the transported material is also recognized within the classification class.

5.1.5 Gley horizon

Gley horizons that are well developed and have homogenous dark to light grey colours with smooth transitions. Stagnant and reduced water over long periods is the main factor responsible for the formation of a gley horizon and could be characterised by green or blue tinges due to the presence of a mineral called Fougerite which includes sulphate and carbonate complexes. Even though grey colours are dominant, yellow and/or red striations can be noticed throughout a gley horizon. The structure of a gley horizon mostly is characterised as strong pedal, with low hydraulic conductivities and a clay texture, although sandy gley horizons are known to occur. The gley soil form commonly occurs at the toe of hillslopes (or benches) where lateral water inputs (sub-surface) are dominant and the underlaying geology is characterised by a low hydraulic conductivity. The gley horizon usually is second in diagnostic sequence in shallow profiles yet is known to be lower down in sequence and at greater depths (Soil Classification Working Group, 2018).

Figure 5-1 ***Dominant soils identified during the site assessment: A) Orthic topsoil with a Yellow-Brown apedal subsurface horizon. B) Gley horizon below.***

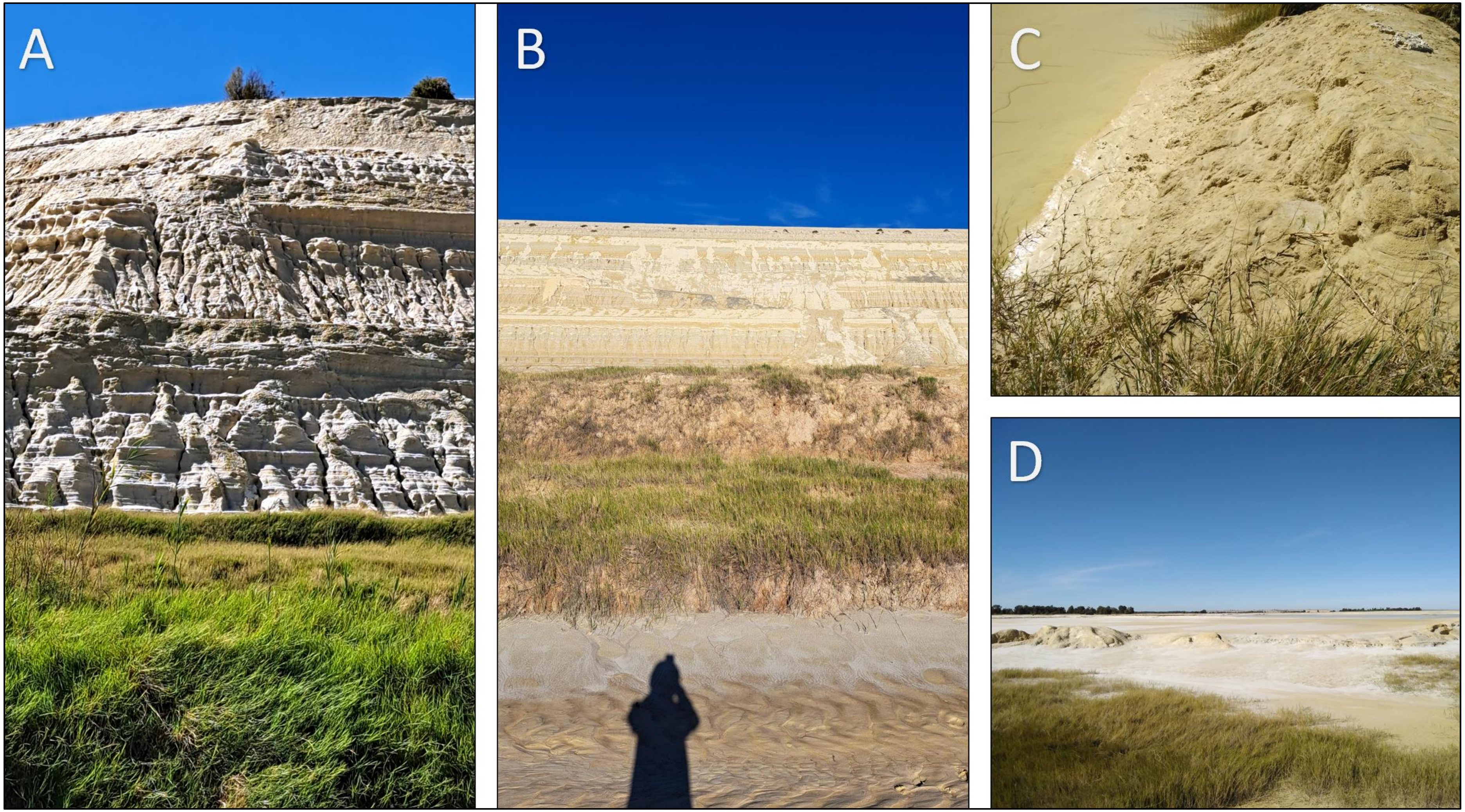

Figure 5-2 Example of Transported Technosols identified during the site assessment A-D) Witbank soil forms.

5.2 Description of Soil Forms and Soil Families

During the site assessment various soil forms were identified. These soil forms are described in Table ***5-1*** 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 5-2.

Table 5-1 Summary of soils identified within the project area.

	Topsoil					Subsoil B1				Subsoil B2			
	Depth (mm)	**Clay (%)**	**Signs of wetness**	**Rock %**	**Surface crusting**	**Depth (mm)**	**Clay (%)**	**Signs of wetness**	**Rock %**	**Depth (mm)**	**Clay (%)**	**Signs of wetness**	**Rock %**
Avalon 2320 (15)	0-100	0-15	None	0	None	300-600	15-30	None	0	600-750	15-30	Mottles	10
Katspruit 2220 (15)	0-300	0-15	None	0	None	300-950	15-30	Mottles	0	950+	15-30	Mottles	0
Witbank 1300 (15)	0-1200+	0-15	None	0	None	+1200	0-15	None	0	-	-	-	-

Table 5-2 Description of soil family characteristics

Soil Form/Family	Topsoil Colour	Base Status	Textural Contrast
Avalon 2320 (15)	Chromic Topsoil	Eutrophic	Luvic
Katspruit 2220 (15)	Dark Topsoil	Mesotrophic	Luvic
Witbank 1300 (15)	-	-	Aluvic

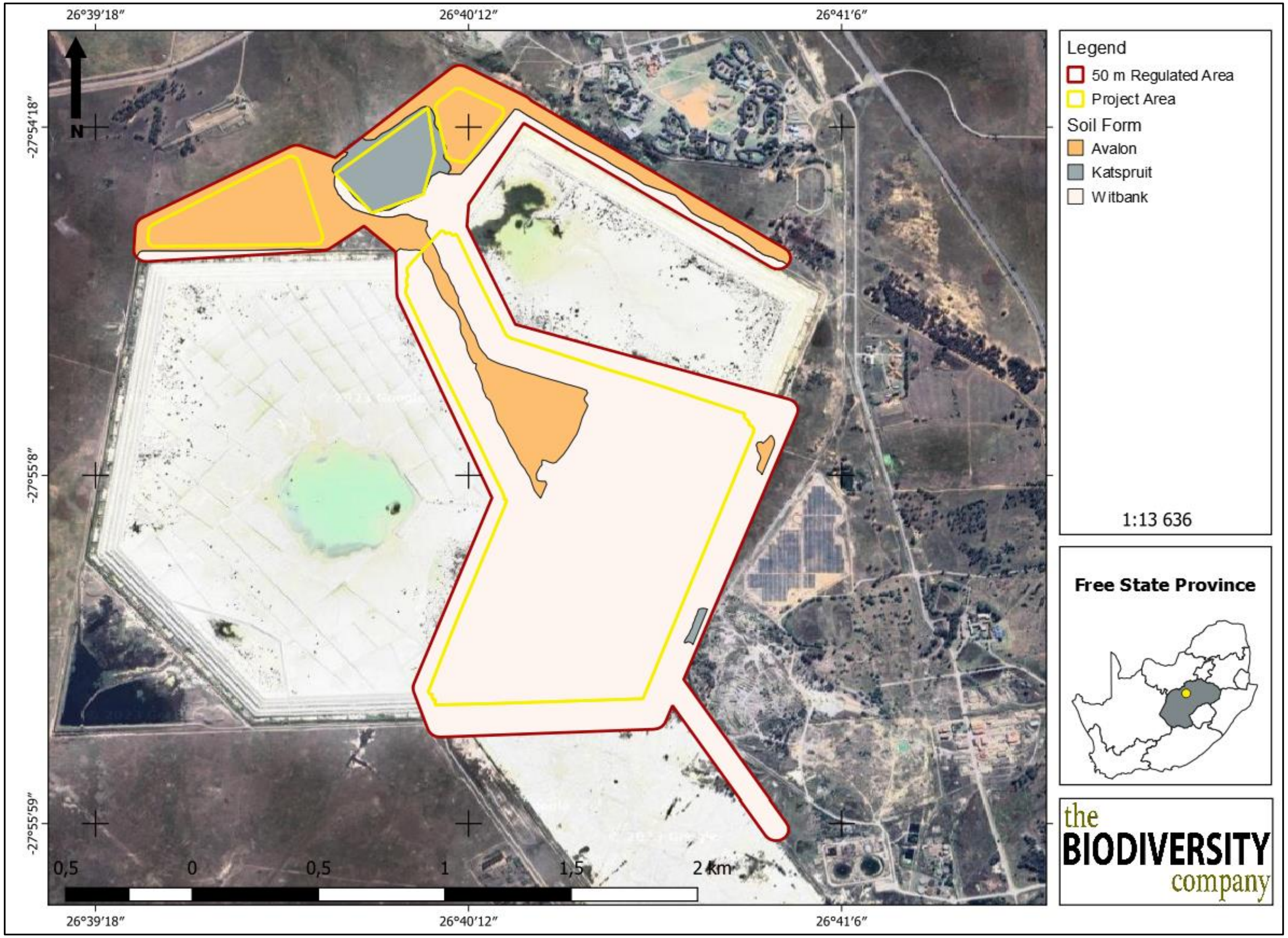

Figure 5-3 Dominant soil forms distribution identified in the project area during the site assessment.

5.3 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.

5.4 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 5-3).

Table 5-3 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 “C8” for the project area, no further steps will be taken to refine the climate capability.

5.5 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 and 4 classes.

Table 5-4 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

5.6 Land Potential

The methodology in regard to the calculations of the relevant land potential levels are illustrated in Table 5-5 and Table 5-6. From the two land capability classes, the 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 levels L6 due to climatic limitations.

Table 5-5 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 5-6 Land potential for the soils within the project area (Guy and Smith, 1998)

Land Potential	Description of Land Potential Class	Sensitivity
6	**Very Restricted potential.** Regular and/or severe limitations due to soil, slope, temperatures or rainfall. Non-arable.	Low
Disturbed	N/A	None

5.7 Agricultural Sensitivity

A combination of desktop data and collated baseline information has been considered to determine the overall sensitivity for the project area. The "L6" land potential is characterised by restricted potential and classes as non-arable, with a "Low" sensitivity.

Fifteen land capabilities have been digitised by DAFF (2017) across South Africa, of which ten 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 to Moderate Sensitivity); and

- Land Capability 9 to 10 (Moderate High Sensitivity),

The land capability dataset (DAFF, 2017) indicates a varied range throughout the project area, which is predominantly covered with “Very Low” to “Moderate” categories. A small portion is characterized by “Moderate High” (see **Error! Reference source not found.** and **Error! Reference source not found.**) capability

There are crop field boundaries, which were identified by means of the Screening Tool (2022), which are characterized by “High” sensitivities, within the project area (see **Error! Reference source not found.**). Despite portions of the project area coinciding with delineated crop field areas, it was apparent from the assessment that these areas are not actively cultivated. Further to this, no irrigation infrastructure, such as centre pivots or drip irrigation are present within the project area and irrigated agricultural is currently not practiced in the area.

Considering the soil properties, agricultural potential as well as the current land use of the project area, the area has a “Low” agricultural sensitivity. The following serves to motivate this:

- Most selected areas demarcated by the Screening Tool as “Moderate Low or Moderate High” can be categorised as “Very Low” and “Low” with soils like the Witbank characterised with a low land capability..

Based on the confirmed sensitivities, the overall sensitivity of the proposed project area can be categorized as “Low”. The allocated sensitivities for the theme are either disputed or validated in Table 5-7 below.

Table 5-7 Summary of the screening tool vs specialist assigned sensitivities

Screening Tool Theme	Screening Tool	Specialist	Tool Validated or Disputed by Specialist - Reasoning
Agricultural Theme	**High**	**Medium**	Disputed – Crop fields not actively cultivated. Land potential is restricted, low sensitivity.
	Medium	**Low**	Disputed – Land potential is restricted, low sensitivity.
	Low	**Low**	Confirmed – Land potential is restricted, low sensitivity.

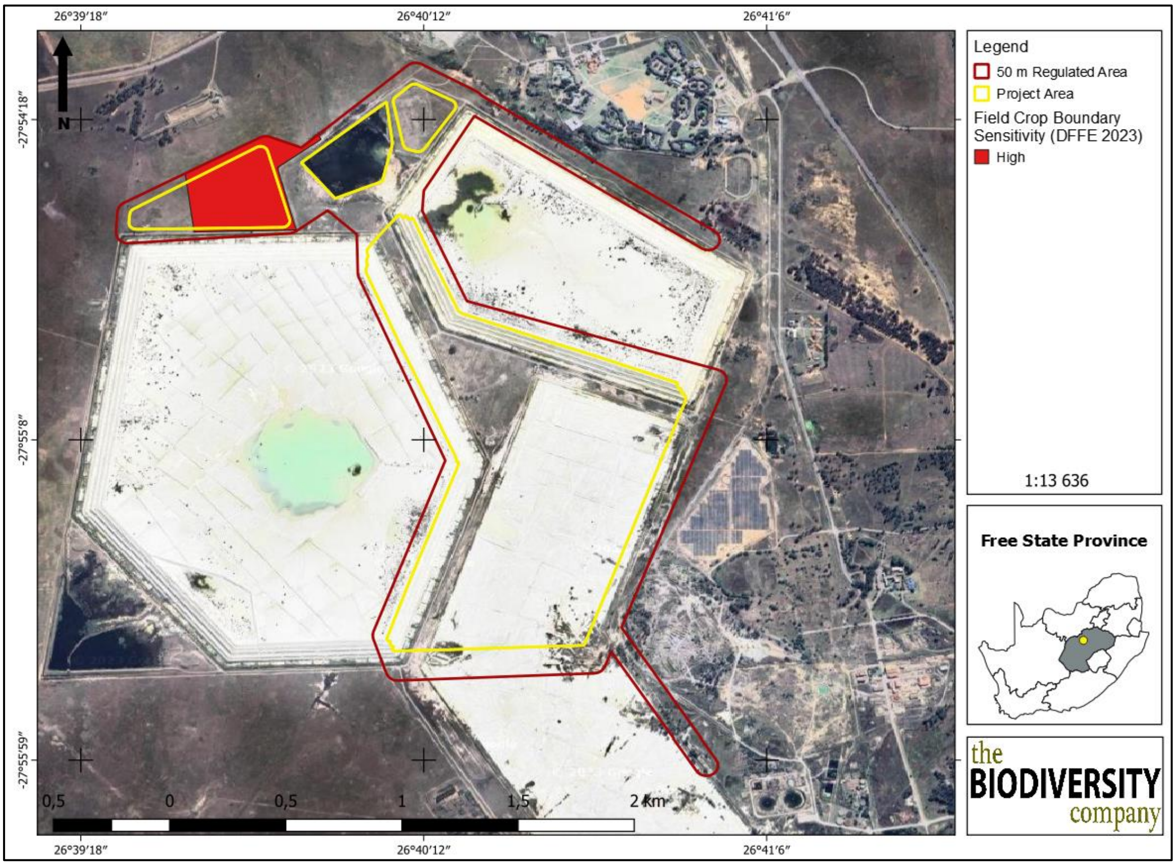

Figure 5-4 The crop field boundary sensitivity for the Valley TSF Project (DEA, 2023)

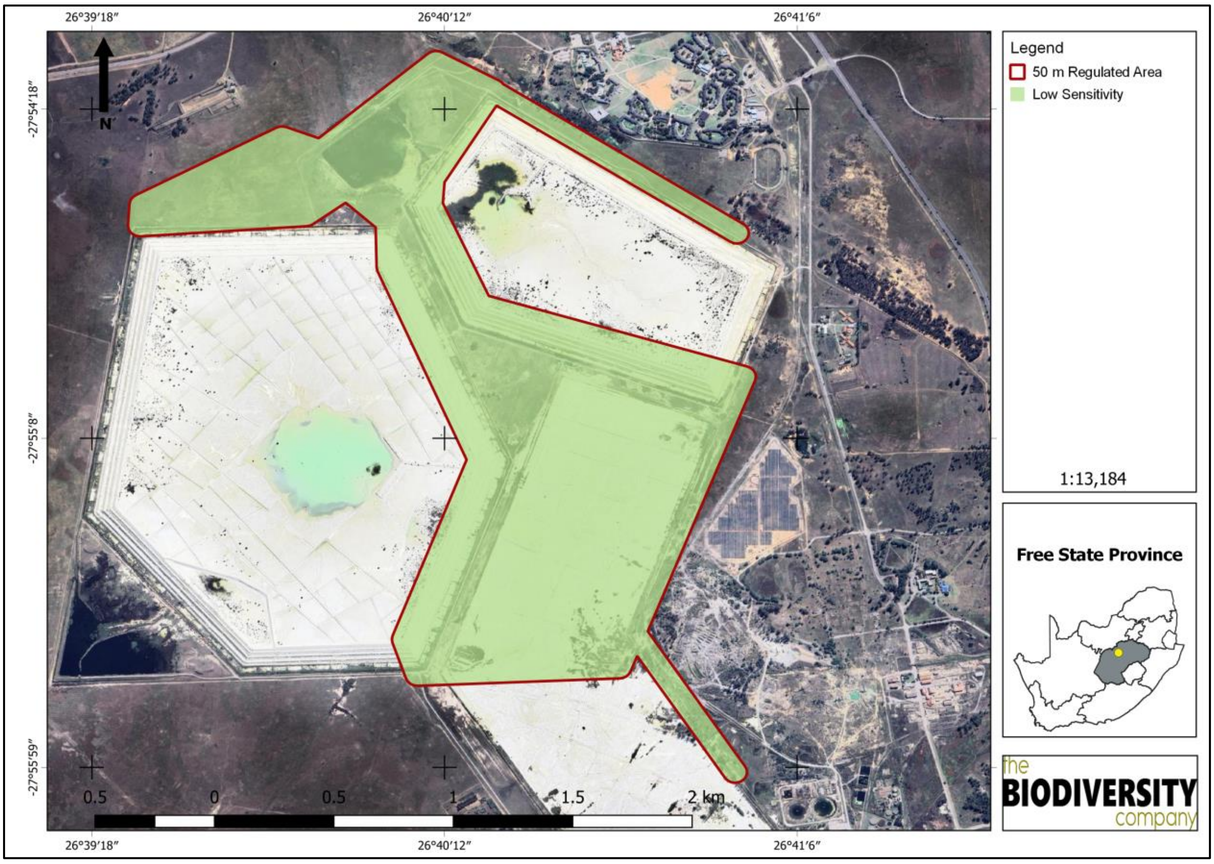

Figure 5-5 The agricultural sensitivity for the Valley TSF project

6 Conclusion

The proposed Valley TSF project is assigned an overall "Low" land potential, which is regarded to be very restrictive with a low sensitivity. Considering the soil properties, agricultural potential as well as the current land use of the area, the area has an overall "Low" agricultural sensitivity.

The project will not result in the segregation of any potentially high land capability areas. The project will have an overall acceptable residual impact on the agricultural production for the affected area. The final layout of the proposed project is illustrated in Figure 6-1, indicating low sensitive areas for the area.

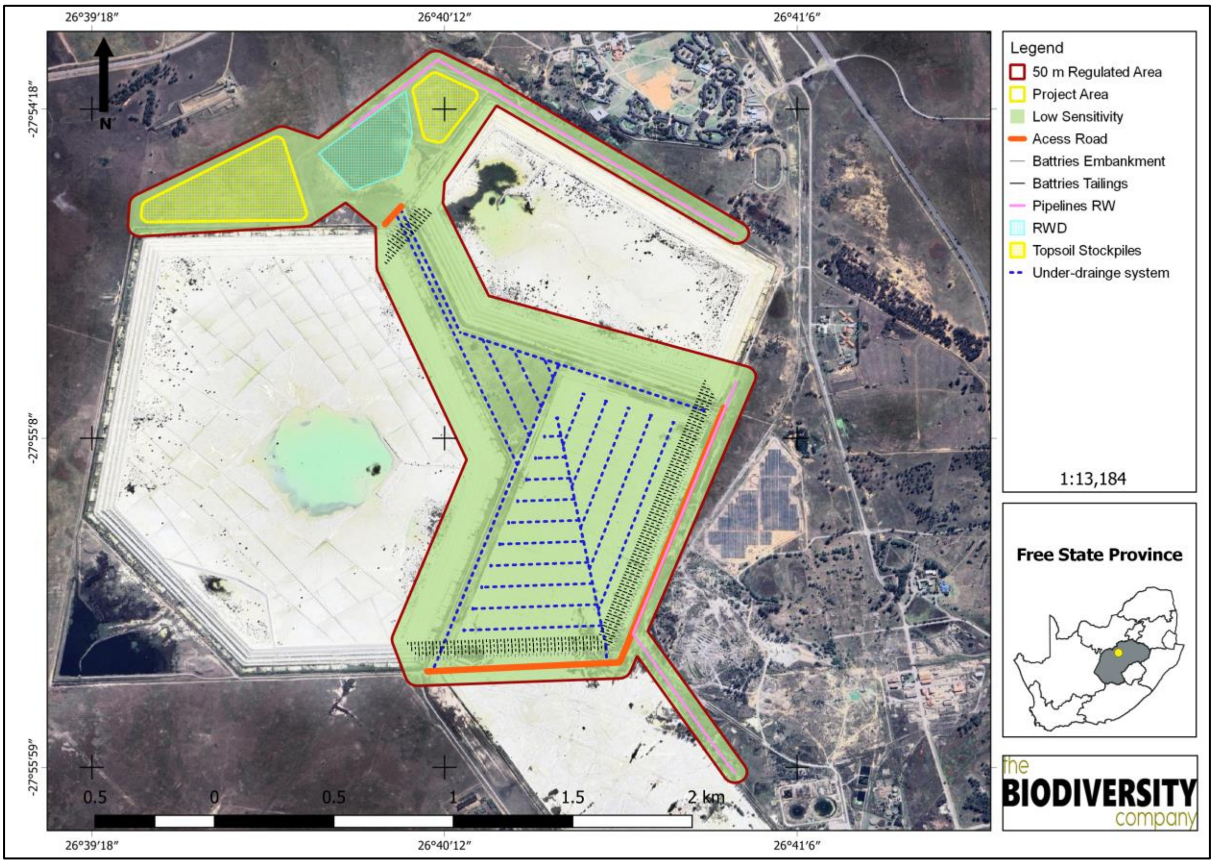

Figure 6-1 ***Final layout of the proposed project in relation to the overall sensitivity of the proposed project area***

6.1 Management Measures

An Agricultural Compliance Statement is not required to complete an impact assessment, but where required, proposed impact management outcomes or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr) must be provided.

Table 6-1 presents the mitigation measures and the respective timeframes, targets and performance indicators. The mitigations within this section have been taken into consideration during the impact assessment in cases where the post-mitigation environmental risk is lower than that of the pre-mitigation environmental risk. Additionally, the implementation of these strategies will improve the possibility of restoring degraded soil resources, which are likely to be impacted upon the construction and operational phases, respectively.

Table 6-1 ***Mitigation measures, including requirements for timeframes, roles and responsibilities.***

Action plan				
Phase	**Management Action**	**Timeframe for implementation**	**Responsible party for implementation**	**Responsible party for monitoring /audit/review**
Construction	Vegetate or cover all stockpiles after stripping/removing soils	During construction phase	Contractor	ECO
	Storage of potential contaminants should be undertaken in bunded areas	During construction phase	Contractor	ECO
	All contractors must have spill kits available and be trained in the correct use thereof.	During construction phase	Contractor	ECO
	All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping".	During construction phase	Environmental Officer (EO)/Contractor	ECO
	No cleaning or servicing of vehicles, machines and equipment may be undertaken in water resources.	During construction phase	Contractor	ECO
	Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the aquatic systems.	During construction phase	Contractor	ECO
Operation	Continuously monitor erosion on site	During the timeframe assigned for the life of the TSF and Stockpiles	Operator	dEO
	Monitor compaction on site	During the timeframe assigned for the life of the TSF and Stockpiles	Operator	dEO

6.2 Specialist Statement

The proposed project area will have an acceptable negative impact on the agricultural production capability of the area. The proposed development can be favourably considered for authorisation. The following serves to substantiate this statement:

- The agricultural potential of the area is restricted;
- The delineated crop fields for the area are not cultivated; and
- The agricultural sensitivity for the area is low.

6.3 Statement Conditions

The conclusion of this assessment on the acceptability of the proposed project and the recommendation for its approval is not subject to any conditions.

7 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.

8 Appendix A Specialist declarations

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 Scientist

The Biodiversity Company

August 2023

9 Appendix A Curriculum vitae

Matthew Mamera

PhD Soil Science (*Cand Nat Sci*)

Cell: +27 785 772 668

Email: matthew@thebiodiversitycompany.com

Identity Number: 8810315983183

Date of birth: 31 October 1988

Profile Summary

Working experience throughout South Africa

Specialist experience with pedology and agriculture.

Specialist expertise include hydropedology, pedology, land contamination, agricultural potential, land rehabilitation, rehabilitation management and wetlands resources.

Experience hydropedological modelling

Areas of Interest

Mining, Farming, Soil and Water quality contamination, Soil Sanitation management, Soil Carbon, Sustainability and Conservation.

Key Experience

- Environmental Impact Assessments (EIA)
- Environmental Management Programmes (EMP)
- Wetland delineations
- Rehabilitation Plans
- Soil taxonomic classification (SA forms and WRB groups)
- Soil Hydropedology assessments
- Agriculture potential assessments
- Land contamination assessments

Country Experience

South Africa: All Provinces

Zambia - Kitwe and Mufulira

Nationality

South African Permanent Residence

Languages

English – Proficient

Ndebele, Xhosa, Shona – Proficient

Qualifications

- PhD (University of the Free States)- Soil Science (Hydropedology, Sanitation and Water quality management)
- MSc (University of Fort Hare) – Soil Science (Hydropedology, Sanitation and Water quality management)
- BSc Honours *Cum laude* (University of Fort Hare) – Soil Science (Hydropedology, wetlands delineation and rehabilitation)
- BSc Agricultural Soil Science
- Cand Nat Sci 116356
- SSSSA- SSSSA 201