Soil And Agricultural Potential Assessment Report For The Proposed Harmony Nooitgedacht Tailings Storage Facility (TSF) And Proposed Pipeline Project

Welkom, Free State Province, South Africa

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EIMS ENVIRONMENTAL IMPACT MANAGEMENT SERVICES

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Report Name	**Soil And Agricultural Potential Assessment Report For The Proposed Harmony Nooitgedacht Tailings Storage Facility (TSF) And Proposed Pipeline Project**
Submitted to	EIMS Environmental Impact Management Services
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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 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.

Dr Matthew Mamera

Soil Scientist

The Biodiversity Company

June 2025

1 Introduction

The Biodiversity Company (TBC) was appointed to undertake an agricultural potential assessment for the proposed Nooitgedacht Tailings Storage Facility (TSF) expansion and proposed slurry pipeline project, located in Welkom, Free State province. Harmony Gold Mining Company Limited (Harmony) own and operate a number of Gold Mines and Plants, and currently deposit tailings onto the Free State South (FSS) 2 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 Nooitgedacht TSF with associated slurry pipelines.

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.

1.1 Project Description

A reserve reclamation study which looked at the reclamation and treatment of the 774Mt of tailings contained in reserve status in TSFs in the Free State through the sequentially reprocessing of tailings through Target Plant and Harmony One Plant, as Run of Mine Ore is depleted, will require deposition space in future. The Nooitgedacht TSF was identified as a deposition site for residue from the reclamation of tailings during Project Saints in 2007. The properties, Goedgedacht 53, Nooitgedacht 50 and Jacobsdal 37 were subsequently purchased with the intention of constructing a new Tailings Storage Facility on this site. Harmony commenced with feasibility assessment for the Nooitgedacht Tailings Deposition Project that of the project is to secure future deposition capacity for Harmony Free State Operations for residue from both Run of Mine and Tailings Reclamation operations. The following are proposed for the project:

- Infrastructure will include the TSF and associated infrastructure including possible access roads and water management infrastructure including pipelines and a return water dam;
- The infrastructure will cover a total area of up to 895 hectares. Topsoil stockpile will be 3 m;
- Tailing deposition method to be used: cyclone deposition. TSF side slope gradient of 1:3;
- The height of the TSF is still being determined through the engineering designs however current design scope of the Nooitgedacht TSF is based on a height of 100m at 1426 mamsl; and
- The TSF barrier system will be determined in consultation with the authorities and will be in compliance with relevant norms and standards for determination of liner requirements.

The following pipelines are being proposed:

- One 10 km long slurry lines from Harmony One Plant to the St Helena Booster Pump Station;

- One 16 km long slurry line from Brand A TSF to the St Helena Booster Pump Station; and
- One 17 km slurry line from the St Helena Booster Pump Station to FSN 1 TSF.

The proposed pipelines traverse the following farm portions:

- Vlakplaats 125 Ptn 3, 4 and 5;
- Mijannie RE/66 Ptn 0;
- Toronto RE/115 Ptn 7 and 0;
- Rietpan 17 Ptn 0;
- Rietkuil 28 Ptn 0;
- Rheeders Dam 31 Ptn 0;
- Farm 41 Ptn 20;
- Ouders Gift 48 Ptn 0;
- Nooitgedacht 50 Ptn 0; and
- Goedgedacht.

The pipelines will be flanged steel pipelines of over 0.36 m in diameter and installed above-ground on pre-cast concrete plinths. A 3.5m wide access road, adjacent to the pipelines, will be cleared/graded to provide access for construction, maintenance and inspections.

1.1.1 Design Description Update

The Free State Reclamation (FSR) Project seeks to increase tailings reclamation at Harmony's Free State operations from 800ktpm to 2000ktpm, with residue deposited at the new 800Ha Nooitgedacht TSF. A low-pressure (LP) water supply system, comprising two above-ground concrete storage tanks, will support the operation by storing up to 40 megalitres of return water, treated effluent, borehole water, and plant overflow. The selected tank configuration offers a compact footprint, optimal pump suction conditions, and is designed in accordance with DWS and SANS guidelines.

1.2 Project Area

The proposed Nooitgedacht TSF expansion and proposed slurry pipeline project 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 to Figure 1-3). The surrounding land use includes watercourses, agricultural activities (Crop and livestock), game farms and mining.

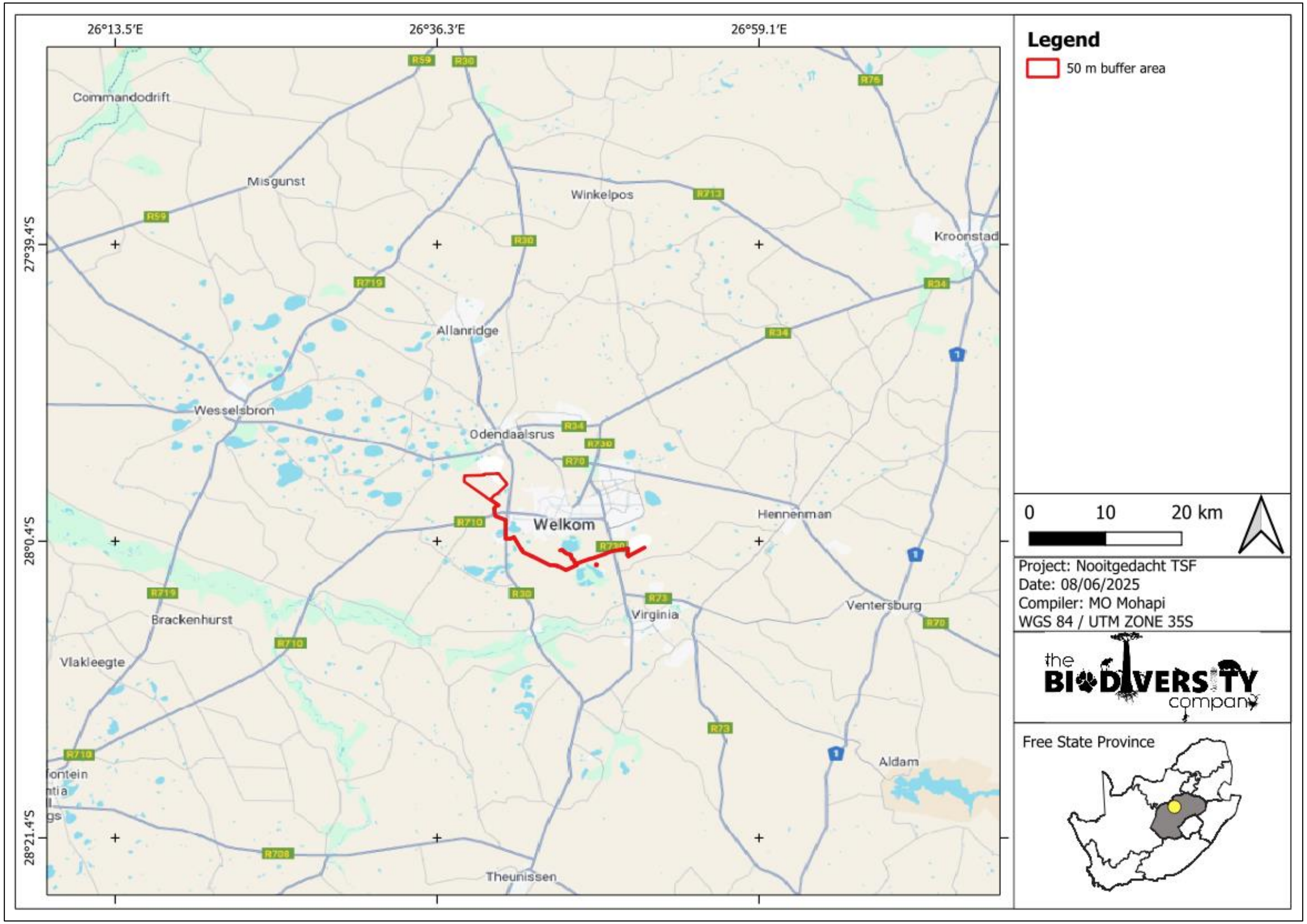


Figure 1-1 The location of the project area

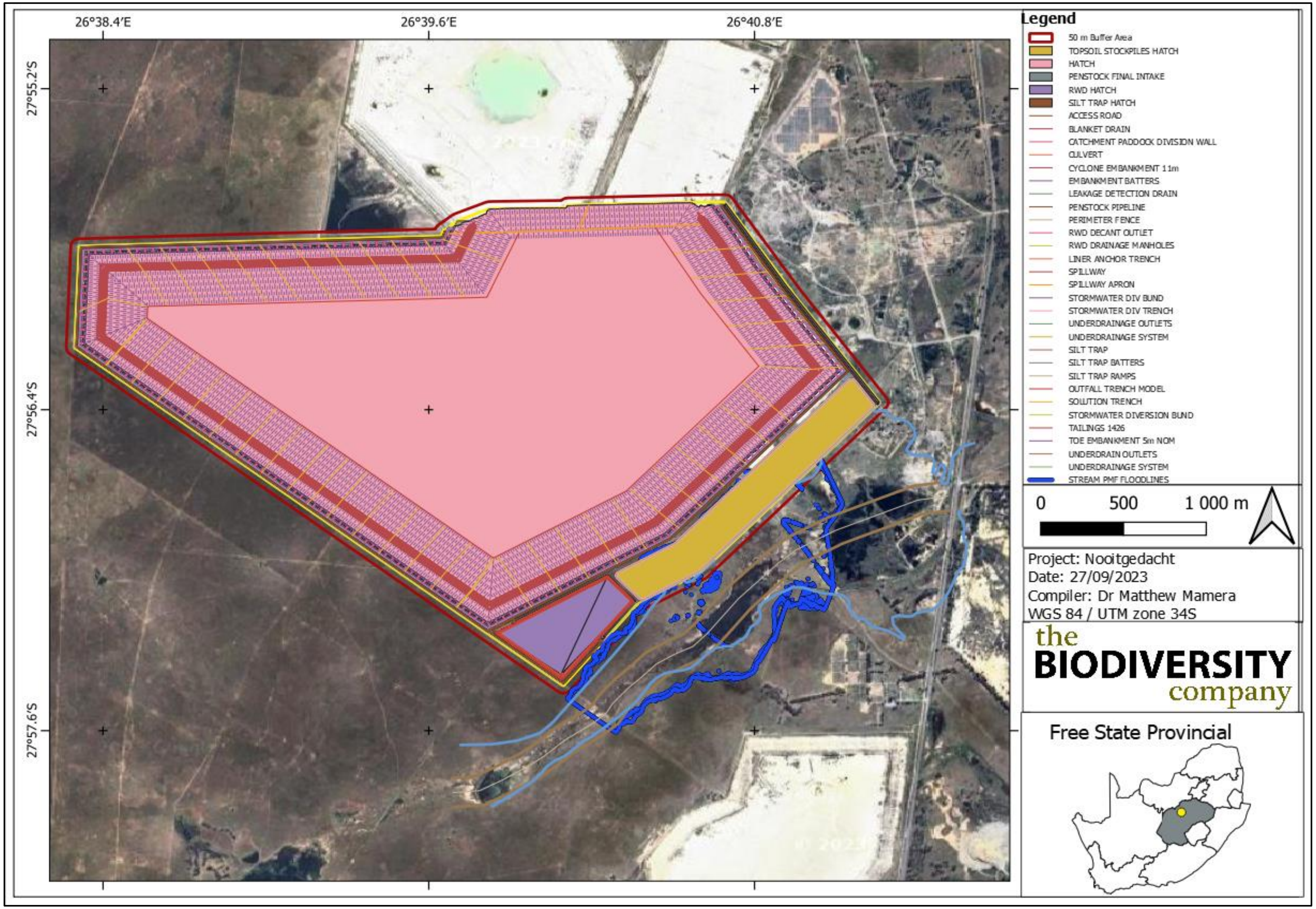


Figure 1-2 Map illustrating the proposed layout of the TSF

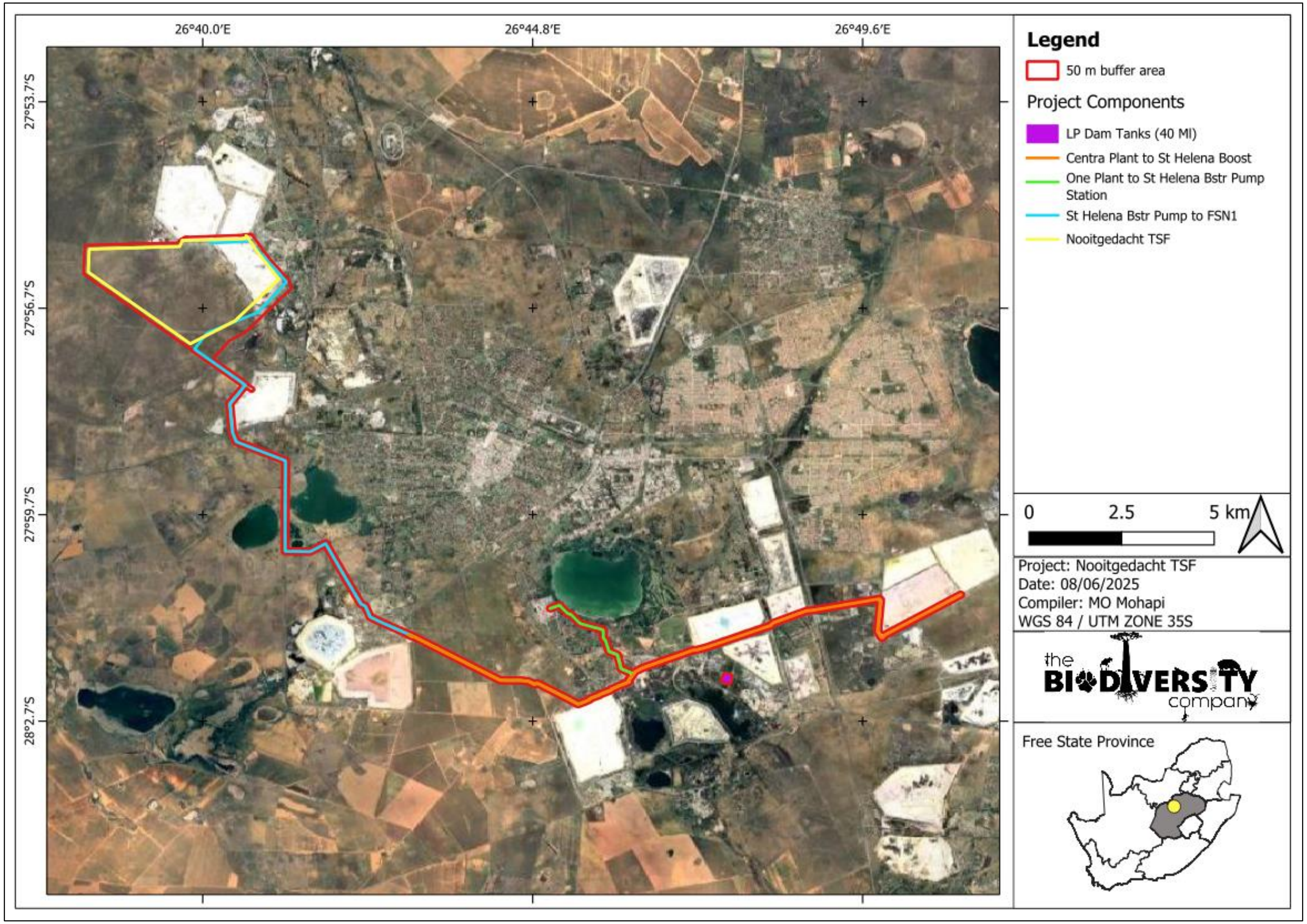


Figure 1-3 Map illustrating the proposed layout of the TSF

1.3 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 the Assessment Protocol, a site inspection was conducted to determine the accuracy of these sensitivities following the generation of the site sensitivity report. 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;
- Assessment must be undertaken on the preferred site and within the proposed development footprint.
- 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 management programme.

2 Methodology

2.1 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.

2.2 Field Survey

An assessment of the soils present within the project area was conducted during a field survey in 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 1,5 m. Soil survey positions were recorded as waypoints using a handheld Global Positioning System (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.

[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).

2.3 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 2-1, with the final erosion classes illustrated in Table 2-2.

Table 2-1 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

Table 2-2 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

2.4 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 the DAFF, (2017) sensitivities.

[2] The soil erodibility index

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 2-3 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 2-3 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 2-4. The final land potential results are then described in Table 2-5.

Table 2-4 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 2-5 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.

Land potential	Description of land potential class
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 was 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 2-6), 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 2-3).

Table 2-6 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	
14	Very High
15	

2.5 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.
- 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.
- Soil fertility analysis was not conducted on-sites for this report.

3 Project Area

3.1 Climate

The project area falls predominantly under the Vaal-Vet Sandy Grassland and Western Free State Clay Grassland vegetation. The project area is characterised as a warm temperate climate, with high summer rainfalls which are concentrated from November to March, and severe frost occurrence in winter (37 days per year on average). According to Mucina & Rutherford (2006), the mean annual precipitation (MAP) is at 530 mm (see Figure 3-1).

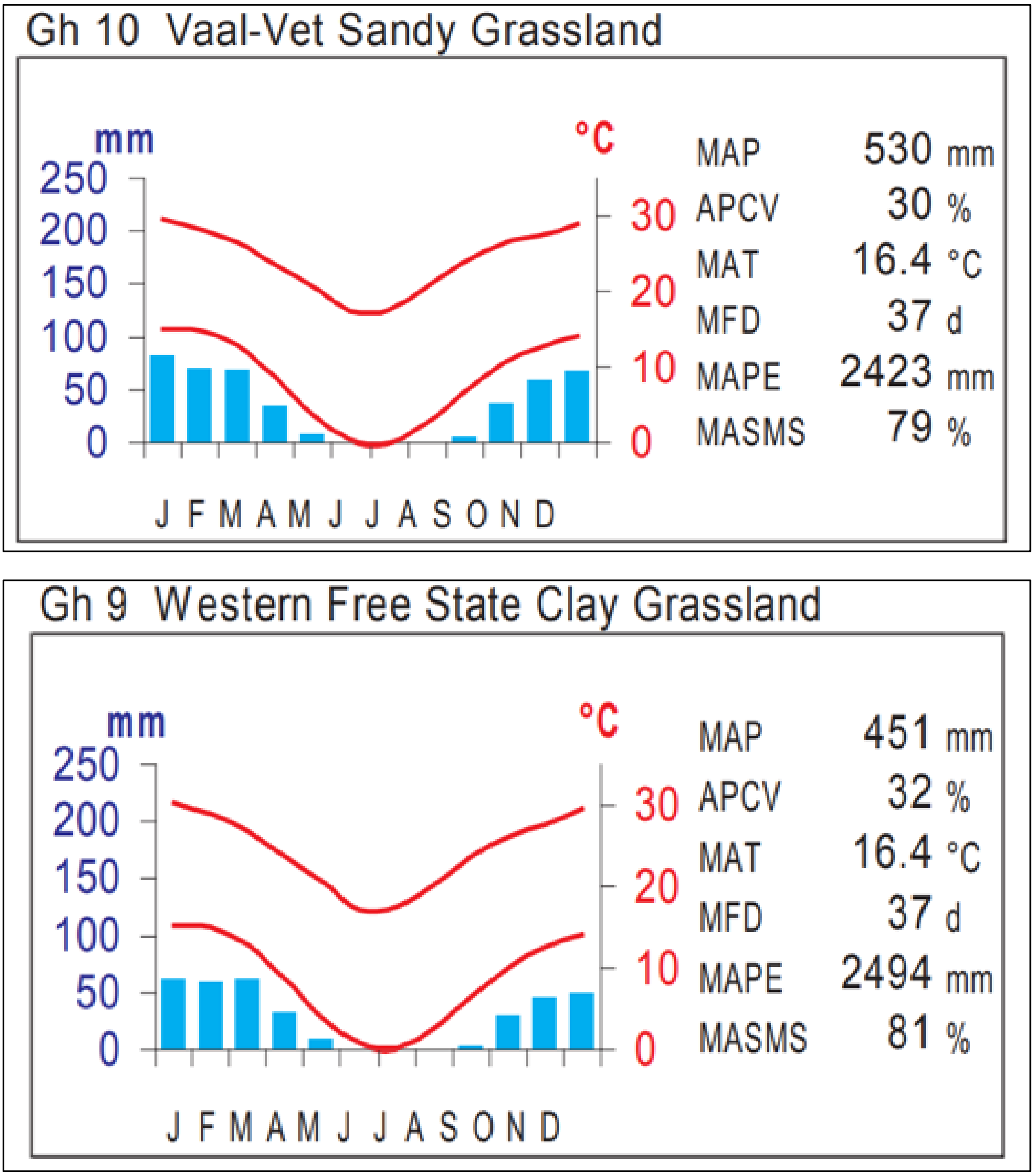


Figure 3-1 **Climate diagram for the region (Mucina & Rutherford, 2006).**

3.2 Soil and Geology

The geology of the area is characterised with Sandstone, shale, mudstone, sandstone, dolerite and shale (Volksrust formation, Ecca and Beaufort group). Aeolian and possibly colluvial sand overlies the rock. According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by the Bd 20 and Dc 9 land type (see Figure 3-4). The Bd 20 land type is mainly characterised with Clovelly, Hutton and Valsrivier soil forms according to the Soil classification working group, (1991), and with occurrence of other soils within the landscape. The Bd land type commonly has plinthic catena: upland duplex and margalitic soils rare; Eutrophic, red soils not widespread. 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 have 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 Bd 20 land type are illustrated in Figure 3-2 with the expected soils listed in Table 3-1, and Dc 9 land type in Figure 3-3 and Table 3-2.

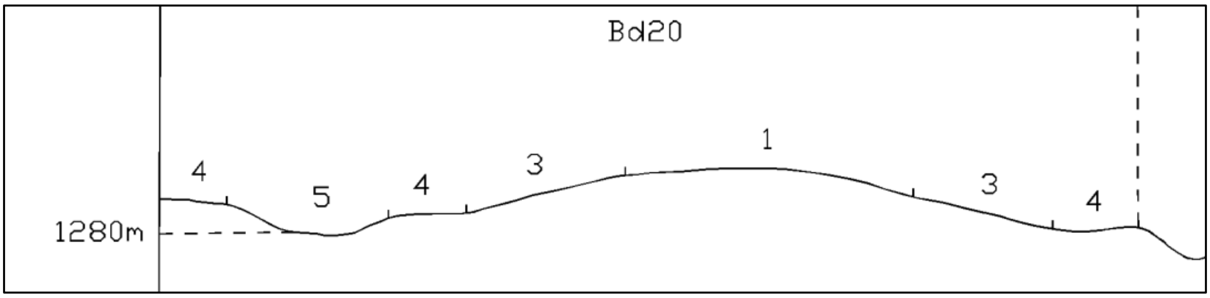


Figure 3-2 Illustration of land type Bd 20 terrain unit (Land Type Survey Staff, 1972 - 2006)

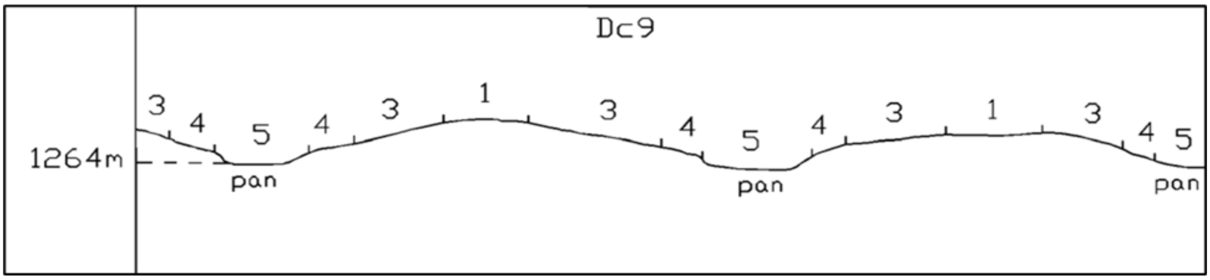


Figure 3-3 Illustration of land type Dc 9 terrain unit (Land Type Survey Staff, 1972 - 2006)

Table 3-1 Soils expected at the respective terrain units within the Bd 20 land type (Land Type Survey Staff, 1972 - 2006)

Terrain Units							
1 (55%)		3 (40%)		4 (3%)		5 (2%)	
Clovelly	65%	Clovelly	45%	Hutton	60%	Valsrivier	55%
Avalon	30%	Hutton	25%	Valsrivier	18%	Arcadia, Rensburg	20%
Valsrivier	3%	Avalon	20%	Avalon	10%	Katspruit	15%
Katspruit	1%	Valsrivier	8%	Clovelly	5%	Oakleaf	10%
Arcadia, Rensburg	1%	Katspruit	1%	Oakleaf	5%		
		Arcadia, Rensburg	1%	Katspruit	1%		
				Arcadia, Rensburg	1%		

Table 3-2 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%		

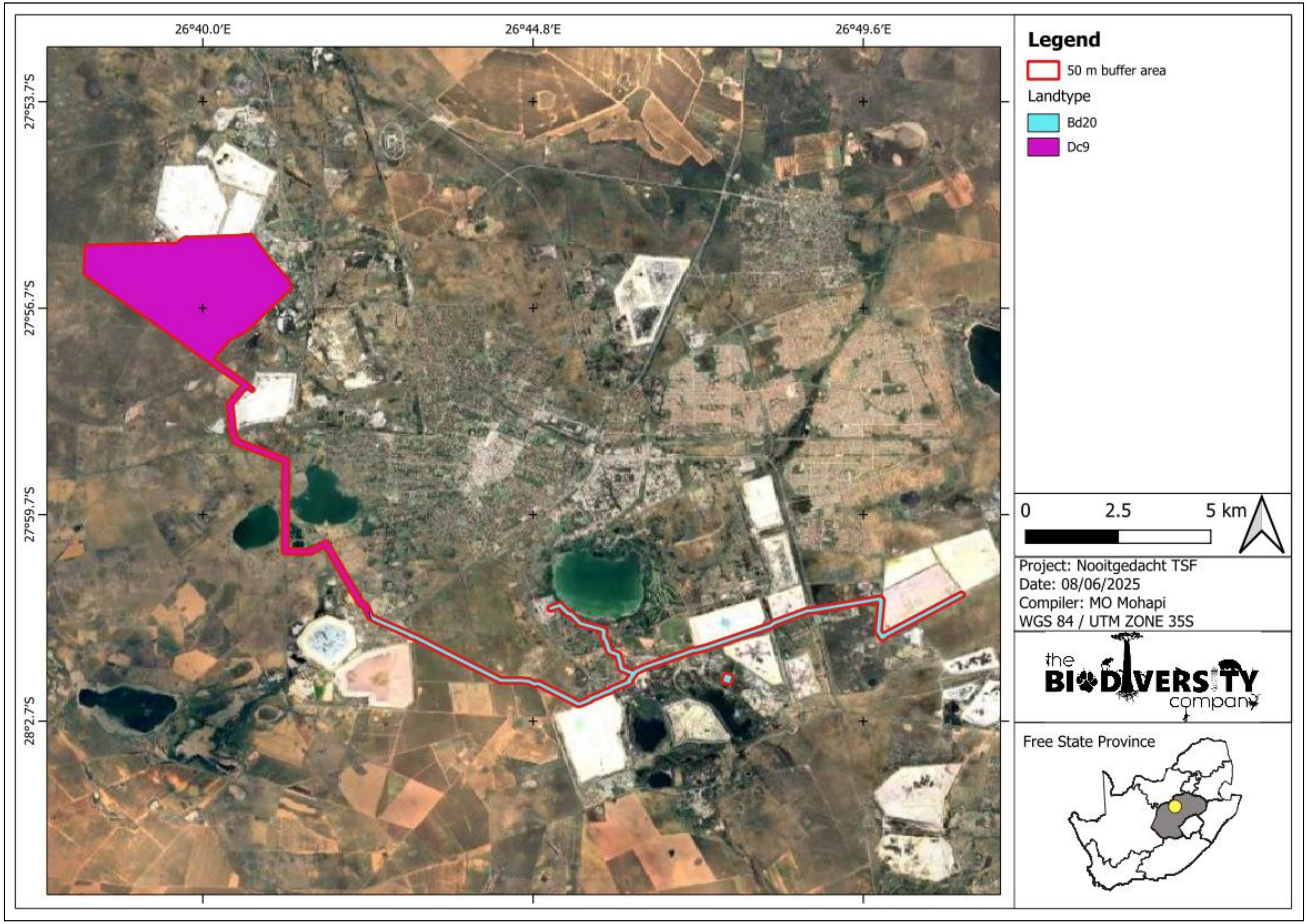


Figure 3-4 Illustration of land type uses associated with the proposed project area

4 Results and Discussion

4.1 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;
- Neocutanic horizon;
- Soft carbonate horizon;
- Yellow-Brown apedal horizon;
- Soft plinthic horizon;
- Pedocutanic horizon;
- Gley horizon
- Lithic horizon and;
- Transported Technosols horizon;

4.1.1 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).

4.1.2 Neocutanic Horizon

The horizon is a young weakly-structured 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 colour differences in the neocutanic horizon are usually caused by illuvial material that coats weak structural units.

4.1.3 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 (Soil Classification Working Group, 2018).

4.1.4 Pedocutanic horizon

Pedocutanic horizons are characterised with moderately to strongly developed structure, with distinct to prominent cutans (shinny clay skins due to illuviation) on the ped surfaces. The common feature of a pedocutanic is clear textural contrast with a sandier surface topsoil underlain to a higher clay subsurface horizon. This is common in groups of soils referred to as duplex soils. The aggregates usually exhibit brown to dark brown matrix colours with also some occurrence of yellowish to brownish colour variations within ped interiors permitted. Red pedocutanic horizons inherent the colour from the underlying parent material mostly from red to maroon shales and mudstones (Soil Classification

Working Group, 2018). Pedocutanic horizons have restricted vertical flows due to the clays and mostly lateral flow paths are common.

4.1.5 Soft Carbonate horizon

Soft carbonate horizons are characterised with a weakly developed structure subsoil horizon composed of calcium and or magnesium carbonates to the extent that the morphology of this layer is dominated by carbonates with white to pale yellow colours. The layer is associated with lower slope positions in the terrain under arid to semi-arid climatic conditions.

4.1.6 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).

4.1.7 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.

4.1.8 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.

4.1.9 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 4-1 ***Dominant soils identified during the site assessment: A) Orthic topsoil with a Yellow-Brown apedal subsurface horizon. B) Soft plinthic subsurface horizon. C) Yellow-Brown apedal with a Gley horizon below. D-G) Soft Carbonate subsurface horizon. E) Neocutanic horizon. F) Pedocutanic horizon. H) Gley horizon below.***

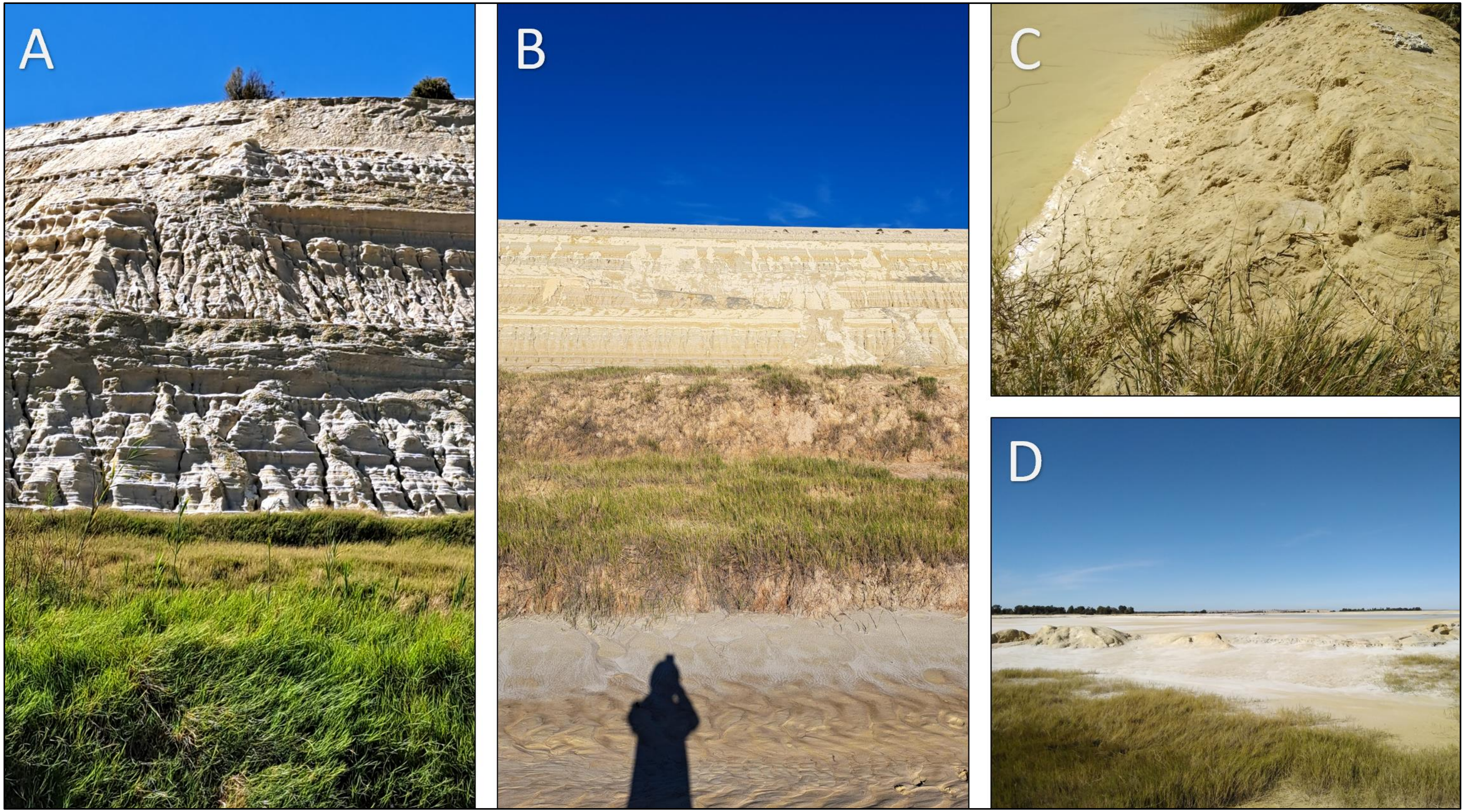


Figure 4-2 Example of Transported Technosols identified during the site assessment A-D) Witbank soil forms.

Figure 4-3 ***Example of Transported Technosols identified during the site assessment (Witbank soil forms).***

4.2 Description of Soil Forms and Soil Families

During the site assessment various soil forms were identified. These soil forms are described in Table 4-1 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 4-2.

Table 4-1 ***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
Pinedene 2220 (15)	0-300	0-15	None	0	None	300-600	15-30	None	0	600-700	15-30	Mottles	10
Clovelly 2220 (15)	0-300	0-15	None	0	None	300-750	15-30	Nome	0	750-1200	0-15	-	30
Molopo 2200 (15)	0-250	0-15	None	0	None	250-700	15-30	None	0	700-900	15-30	-	0
Etosha 1120 (15)	0-150	0-15	None	0	None	150-400	15-30	None	0	400-850	15-30	-	0
Sepane 1120 (30)	0-150	0-15	None	0	None	150-450	30-45	None	0	450-850	30-45	Mottles	0
Glenrosa 1110 (15)	0-50	0-15	None	5	None	50-100	0-15	None	30	100+	0-15	-	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 4-2 ***Description of soil family characteristics***

Soil Form/Family	Topsoil Colour	Base Status	Textural Contrast
Avalon 2320 (15)	Chromic Topsoil	Eutrophic	Luvic
Pinedene 2220 (15)	Chromic Topsoil	Mesotrophic	Luvic
Clovelly 2220 (15)	Chromic Topsoil	Mesotrophic	Luvic
Molopo 2200 (15)	Chromic Topsoil	Mesotrophic	Luvic
Etosha 1120 (15)	Dark Topsoil	Mesotrophic	Luvic
Sepane 1120 (30)	Dark Topsoil	Mesotrophic	Luvic
Glenrosa 1110 (15)	Dark Topsoil	Mesotrophic	Luvic
Katspruit 2220 (15)	Dark Topsoil	Mesotrophic	Luvic
Witbank 1300 (15)	-	-	Aluvic

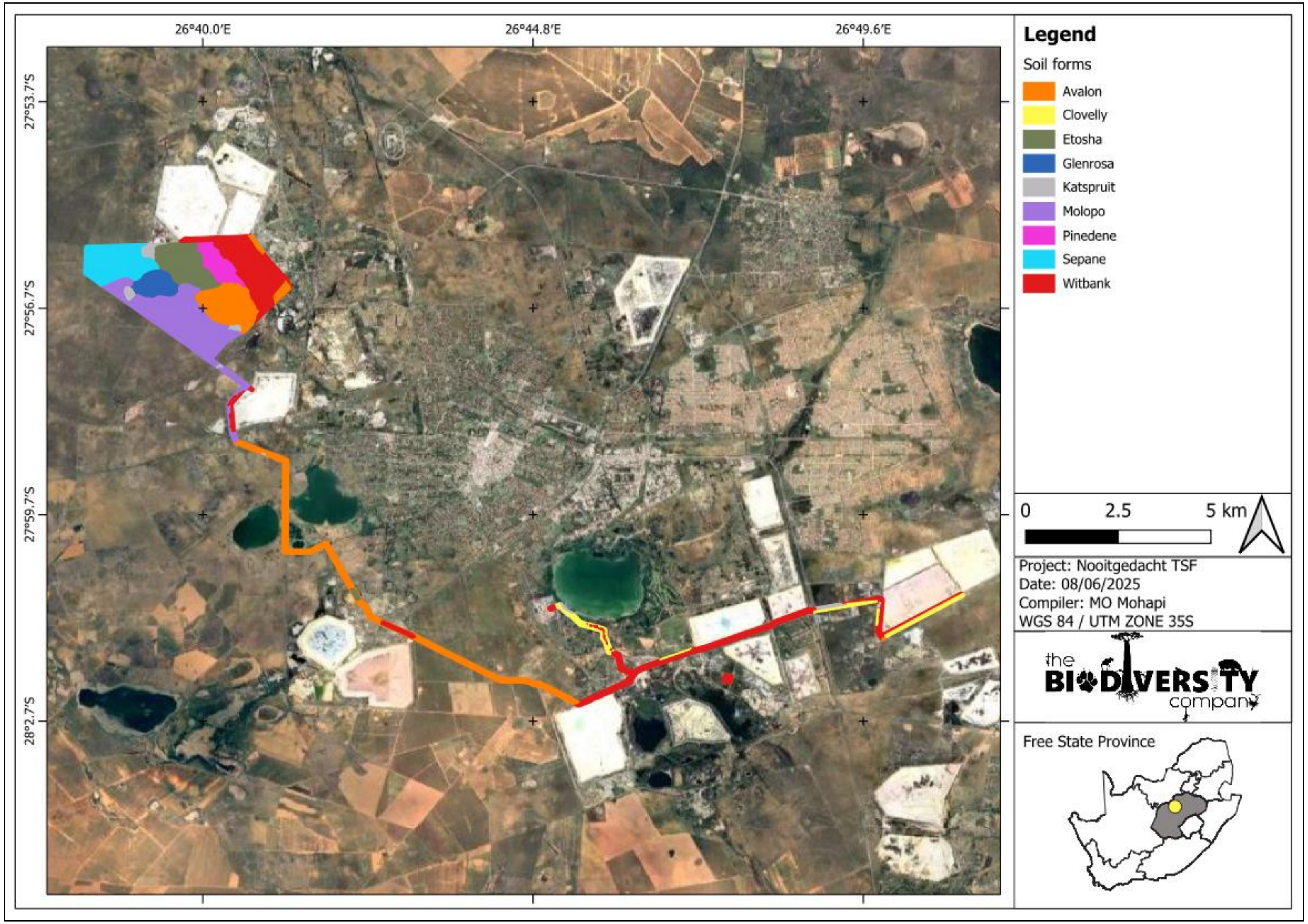


Figure 4-4 Dominant soil forms distribution identified in the project area during the site assessment

4.3 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.

4.4 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 4-3).

Table 4-3 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.

4.5 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.

Table 4-4 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 bodies	Improved pastures and suitable for wildlife	Arable	Moderate
6	Limitation preclude cultivation. Suitable for perennial vegetation.	Protection measures for establishment, e.g., sod-seeding	Veld, pasture and afforestation	Non-arable	Low
8	Extremely severe limitations. Not suitable for grazing or afforestation	Total protection from agriculture	Wildlife	Non-arable	Low

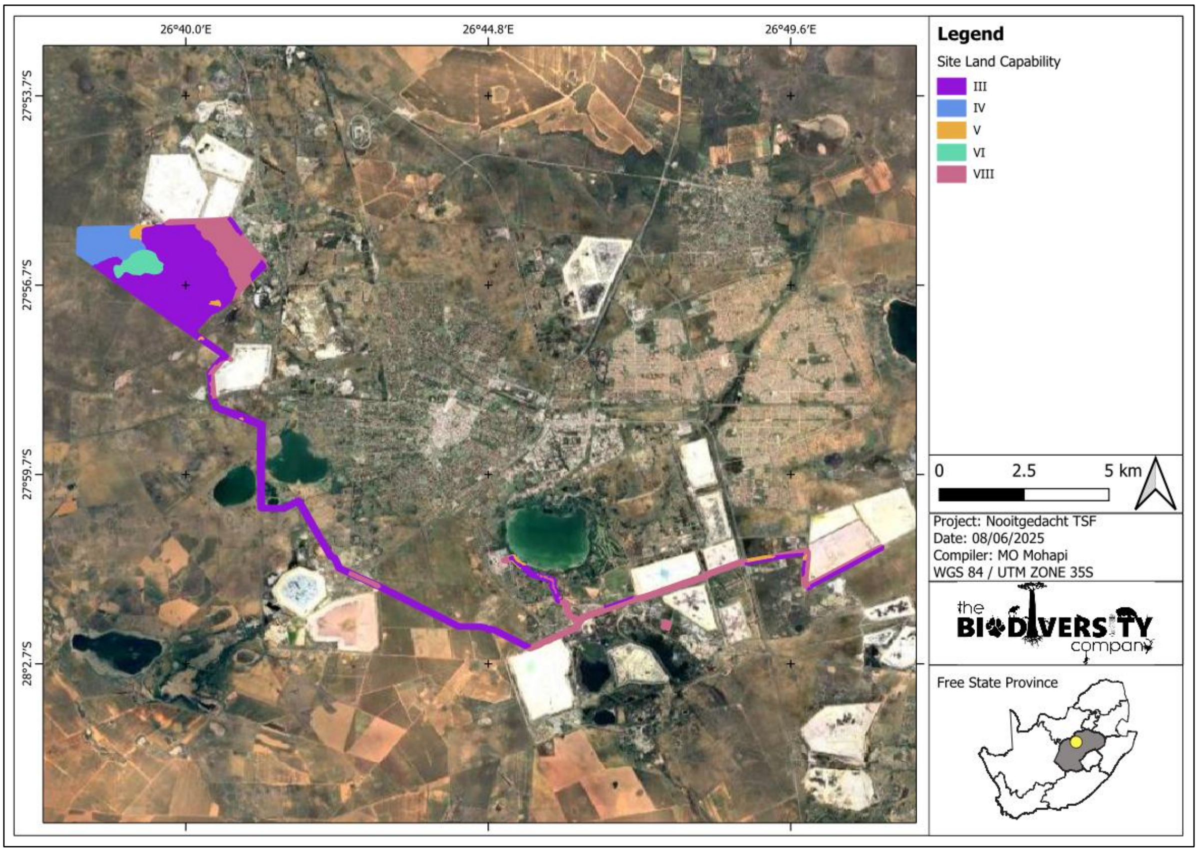


Figure 4-5 Site land capability of the dominant soil forms identified in the project area.

4.6 Land Potential

The methodology in regard to the calculations of the relevant land potential levels are illustrated in Table 4-5 and Table 4-6. 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, IV, V, VI and VIII have been reduced to a land potential levels L6, L7, Vlei and L8 due to climatic limitations.

Table 4-5 ***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 4-6 ***Land potential for the soils within the project area (Guy and Smith, 1998)***

Land Potential	Description of Land Potential Class
6	**Very Restricted potential.** Regular and/or severe limitations due to soil, slope, temperatures or rainfall. Non-arable.
7	**Low potential.** Severe limitations due to soil, slope, temperatures or rainfall. Non-arable.
8	**Very low potential.** very severe limitations due to soil, slope, temperatures or rainfall. Non-arable.
Disturbed	N/A

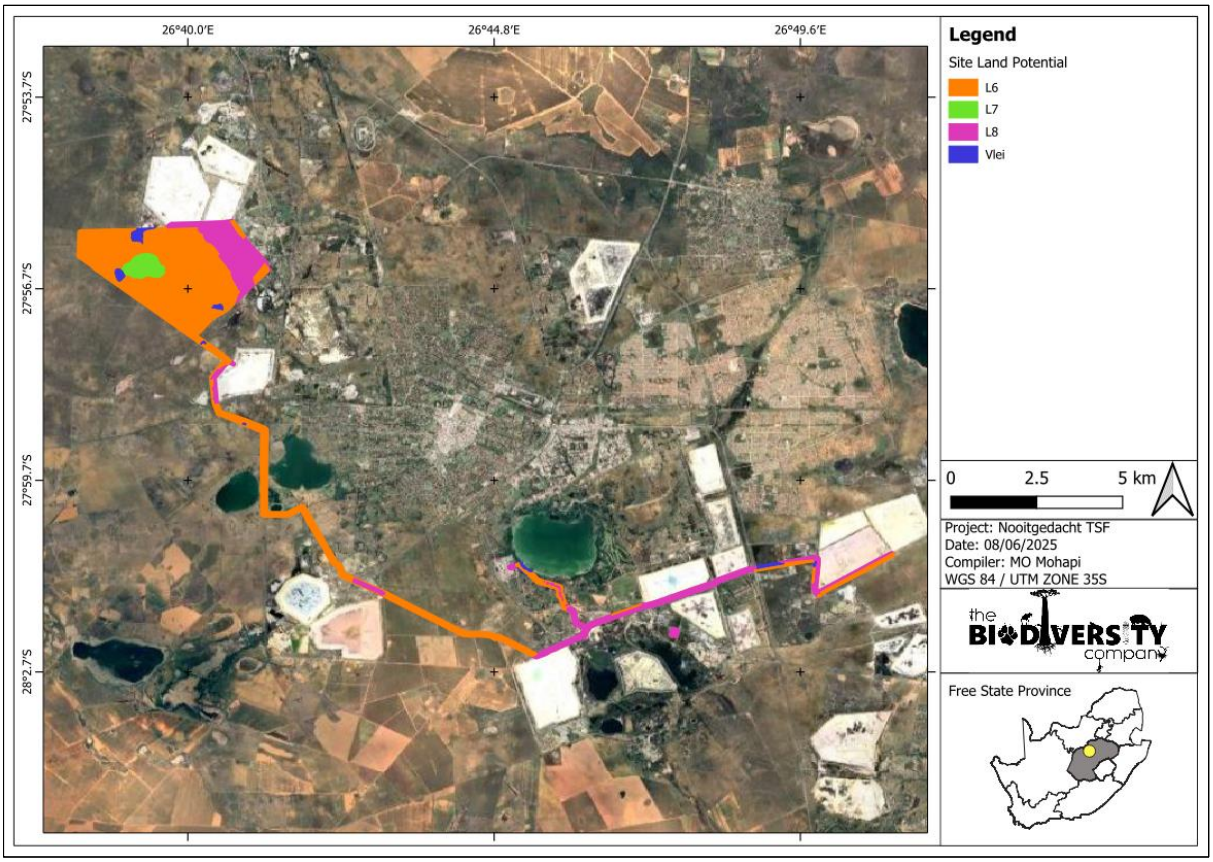


Figure 4-6 ***Site land capability of the dominant soil forms identified in the project area.***

4.7 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.

4.7.1 Avalon

Table 4-7 illustrates the values relevant to the erosion potential of the Avalon soil forms. The final erosion potential score has been calculated at 4.0, which indicates a "Moderate" potential for erosion.

Table 4-7 Erosion potential calculation for the Avalon 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

4.7.1 Pinedene

Table 4-8 illustrates the values relevant to the erosion potential of the Pinedene soil forms. The final erosion potential score has been calculated at 4.0, which indicates a "Moderate" potential for erosion.

Table 4-8 Erosion potential calculation for the Pinedene 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

4.7.2 Clovelly

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

Table 4-9 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

4.7.3 Molopo

Table 4-10 illustrates the values relevant to the erosion potential of the Molopo soil forms. The final erosion potential score has been calculated at 4.0, which indicates a “Moderate” potential for erosion.

Table 4-10 Erosion potential calculation for the Molopo 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**	

4.7.1 Etosha

Table 4-11 illustrates the values relevant to the erosion potential of the Etosha soil forms. The final erosion potential score has been calculated at 4.0, which indicates a “Moderate” potential for erosion.

Table 4-11 Erosion potential calculation for the Etosha 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

4.7.2 Sepane

Table 4-12 illustrates the values relevant to the erosion potential of the Sepane soil forms. The final erosion potential score has been calculated at 3.0, which indicates a "High" potential for erosion.

Table 4-12 Erosion potential calculation for the Sepane 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	

4.7.1 Glenrosa

Table 4-13 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 4-13 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			

4.7.2 Witbank

Table 4-14 illustrates the values relevant to the erosion potential of the Witbank soil forms. The final erosion potential score has been calculated at 3.0, which indicates a “High” potential for erosion.

Table 4-14 Erosion potential calculation for the Witbank 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			

4.7.3 Hydromorphic soils

4.7.3.1 Katspruit

Table 4-15 illustrates the values relevant to the erosion potential of the Katspruit soil forms. The final erosion potential score has been calculated at 2.5, which indicates a "High" potential for erosion.

Table 4-15 Erosion potential calculation for the Katspruit 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	

5 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. Low potential. The "L7" land potential has severe limitations due to soil, slope, temperatures or rainfall. Non-arable, with also a "Low" sensitivity. The "L8" land potential has a very low potential due to soil, slope, temperatures or rainfall. Non-arable, with "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 3 to 5 (Very Low to Low Sensitivity).
- Land Capability 6 to 8 (Low to Moderate Sensitivity); and
- Land Capability 9 to 10 (Moderate to High Sensitivity).

The land capability sensitivity (DAFF, 2017) indicates a range of sensitivities expected throughout the project area, which is predominantly covered with “Moderate-High” sensitivities. Less area is characterized by sensitivities with “Very Low to Low” and “Moderate-Low to Moderate” sensitivity (Figure 5-1). Furthermore, crop field boundaries, were identified by means of the Screening Tool (2024), which are predominantly characterized by “High” sensitivities, within the project buffer zone of proposed new tailing St Helena to FSN1 and the central plant to St Helena Bstr pump station pipelines (see Figure 5-1). According to the Government Gazette 43110, for a linear activity impacts on the agricultural resource are expected to be temporary and can be returned to the current land capability within two years of the completion of the construction phase.

Based on site baseline findings, the specialist concurs with the Screening Tool sensitivities in most areas with “Moderate High” sensitivities which were demarcated for soil forms (i.e., Avalon and Pinedene soil forms) with a moderate-high land capability potential to an extent. Selected areas demarcated by the Screening Tool as “Moderate Low or High” can be categorised as “Very Low” and “Low” with soils like the Glenrosa and Witbank characterised with a low poor land capability. Furthermore, the Clovelly, Etosha, Molopo, and Sepane soil forms are characterised with a low to moderate land capability. Actively cultivated areas with high productivity crop fields can be avoided to preserve them in the project where feasible. If rearranging the project around them or avoidance is not possible, stakeholder engagement can be done with owners of such crop fields for an appropriate compensation. Therefore, it is the specialist`s opinion and recommendation that, the project maybe favourably considered as have been planned.

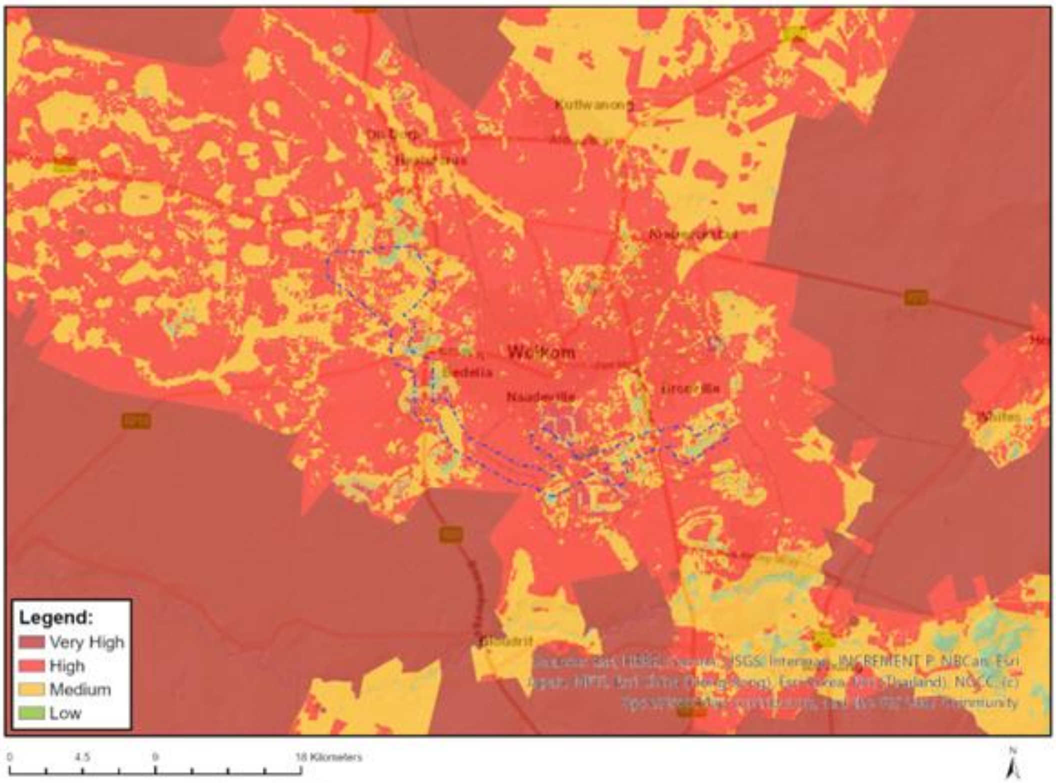
Considering the soil properties, agricultural potential as well as the current land use of the project area, the area has agricultural sensitivity ranging from “Medium to High.”

The allocated sensitivities for the theme are either disputed or validated in Table 5-1 below.

Table 5-1 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**	**Moderate High**	Validated – Land capability Moderate High, presence of moderate high water table soils with good soil water storage capacity such as Avalon and Pinedene.
	High	**Moderate High**	Validated – Land capability Moderate High, presence of active crop fields and moderate high potential soil such as Avalon form.
	Medium	**Low-Moderate to Moderate**	Validated– Land capability Low-Moderate to Moderate, presence of moderate potential soils such as Clovelly, Etosha, Sepane and Molopo form, with deep soil profile with subsequent moderate water holding capacity.
	Low	**Very Low to Low**	Validated – Land capability Very-Low to Low, the presence of very-low to low agricultural potential soils such as Glenrosa and Witbank.

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
High	Old_Fields
High	Rainfed Annual Crop Cultivation / Planted Pastures
High	08. Moderate
High	09. Moderate-High
High	10. Moderate-High
Low	03. Low-Very low
Low	04. Low-Very low
Low	05. Low
Medium	06. Low-Moderate
Medium	07. Low-Moderate
Very High	Horticulture
Very High	Pivot_Irrigation

Figure 5-1 The land capability sensitivity (DAFF, 2017)

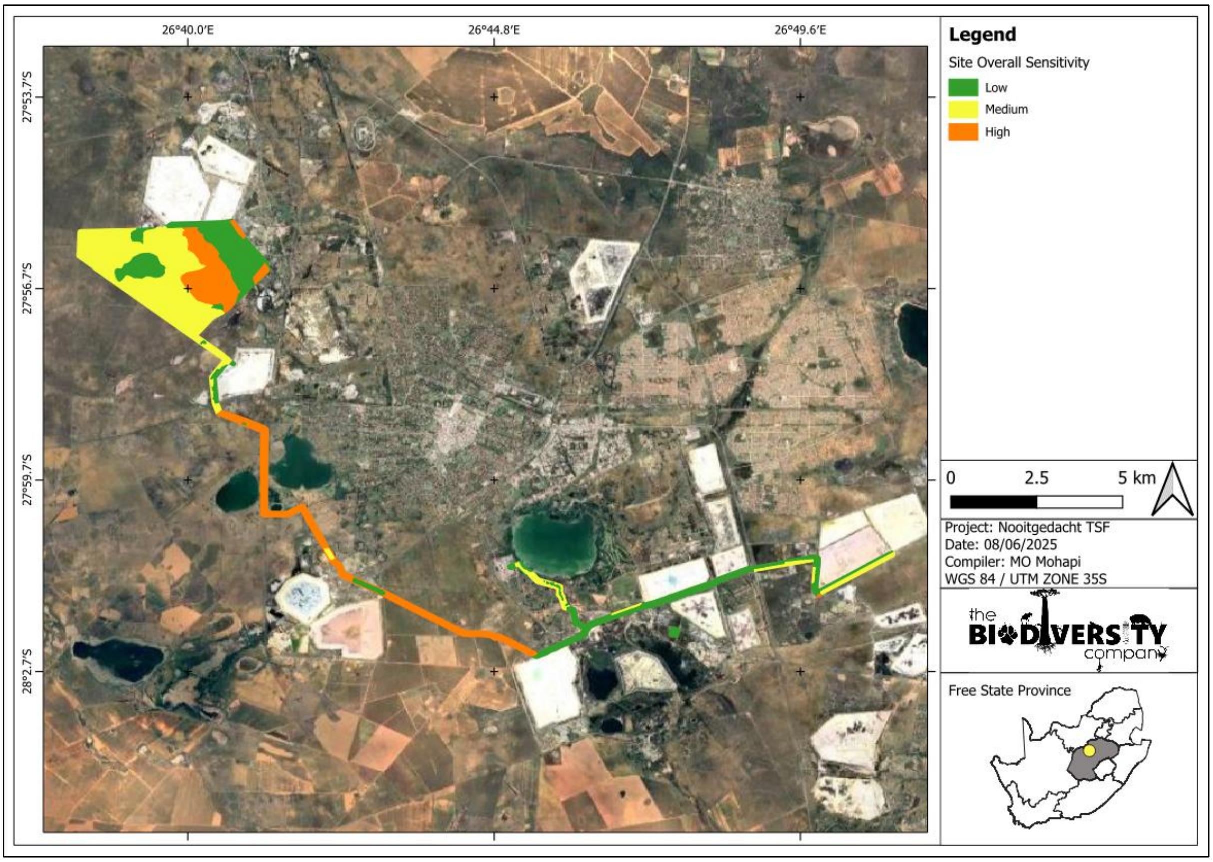


Figure 5-2 Site verified overall land capability sensitivity.

6 Impact Assessment

Infrastructure within the Nooitgedacht Tailings Storage Facility (TSF) expansion and proposed slurry pipeline project and associated infrastructure project area assigned to the available land includes new infrastructure and pipelines, top stockpile area, TSF expansion area, pipelines and access roads. The proposed activities` buffer area often impede into "High" sensitivity crop fields. These sensitivities are associated with some arable land potential and capability conditions (i.e., Soil status), *therefore high land capability areas will be impacted on by the TSF expansion and slurry pipelines.*

Impacts were assessed in terms of the proposed TSF expansion and slurry pipeline project and associated infrastructure, operational and decommissioning phases. Mitigation measures were only applied to impacts deemed relevant.

6.1 Anticipated Activities

The proposed activities associated with the TSF expansion and slurry pipelines project can be seen overlaid with the overall sensitivity (**Error! Reference source not found.**). The following activities will take place:

- The TSF expansion area, topsoil stockpile;
- Slurry pipelines and;
- Water management infrastructure (Stormwater drains and pipelines) and access roads.

6.1.1 Alternatives Considered

In terms of the feasibility of the project various alternatives were considered within the assessment area for the proposed projects.

6.1.2 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 6-1 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 6-1 Summary of unplanned events influencing the agricultural potential.

Unplanned Event	Potential Impact	Mitigation
Hydrocarbon and tailings spill into the surrounding environment	Contamination of soil as well as water resources associated with spillage. This will have secondary impacts to flora and both aquatic and terrestrial fauna.	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.

6.1.3 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.

6.2 TSF Expansion and slurry pipeline, topsoil stockpiling and associated infrastructure Impacts

6.2.1 Construction Phase

The project will result in the stripping of topsoil related to the construction of the TSF and slurry pipeline and alterations to the existing land uses. The changes in the land use will be from natural or semi-agricultural to mining activities development (or transformed). It will impact on areas expected to have high agricultural land capability potential (in some areas) even though they currently not actively cultivated, with some aspects affecting “Moderate High” sensitivity areas. It is possible that suitable agricultural land with a potential to be used for cropping practices could become fragmented, resulting in these portions no longer being deemed feasible to farm in the future.

During the construction phase, topsoil often will be cleared, stripped and topsoil stockpiled. Access roads will be created with trenches being dug for the installation of relevant cables and pipelines. The erection of infrastructure where relevant to the current existing TSF structures and slurry pipelines will occur. 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 Sepane, Katspruit and Glenrosa soil forms. The removal of 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 soil forms suitable for agriculture and these soils will deposit in downslope areas such as the local watercourses, negatively affecting these ecologically sensitive ecosystems. Soil compaction can also result due to increased traffic on site along the proposed project area. The disturbed soil profiles will change from the original natural condition even through proper stockpiles will be stored. Disturbed soils can result in further water and nutrient losses from the soil matrix.

Table 6-2 Impact assessment related to the loss of the land capability for the TSF Expansion and slurry pipeline, stockpiling and associated infrastructure planning, construction, operation, decommissioning and rehabilitation phases.

		Pre-Mitigation							Post Mitigation								Priority Factor Criteria			
Impact	**Phase**	**Nature**	**Extent**	**Duration**	**Magnitude**	**Reversibility**	**Probability**	**Pre-mitigation ER**	**Nature**	**Extent**	**Duration**	**Magnitude**	**Reversibility**	**Probability**	**Post-mitigation ER**	**Confidence**	**Cumulative Impact**	**Irreplaceable loss**	**Priority Factor**	**Final score**
Loss of land capability, Soil compaction, Soil erosion, Land degradation, Nutrient and water storage	Planning	-1	1	1	1	2	1	-1,25	-1	1	1	1	1	1	-1	Low	1	1	1,00	-1
	Construction	-1	3	4	4	3	4	-14	-1	2	3	3	3	3	-8,25	High	2	3	1,38	-11,34
	Operation	-1	3	3	3	3	3	-9	-1	2	3	2	3	2	-5	Medium	2	3	1,38	-6,88
	Decommissioning	-1	2	2	2	3	3	-6,75	-1	2	2	1	3	2	-4	Low	2	2	1,25	-5
	Rehab and closure	-1	2	2	2	2	2	-4	-1	2	2	1	2	1	-1,75	Low	1	2	1,13	-1,97

6.2.1.1 Mitigation

Mitigations are required given the fact that the pre-mitigation significance rating has been scored as **"High – Negative"** and the post-mitigation significance rating being scored as **"Medium – Negative"** which have cumulative effects in the proposed project with post-mitigation measures. Further mitigation is also detailed in Table 6-3. The following specific measures are intended to secure a Medium residual risk:

- Avoidance of any actively cultivated and productive areas located within the project buffer area. Where avoidance is not feasible stakeholder engagement should occur to discuss reasonable compensation of any affected persons for any proven loss of livelihoods;

- Make use of existing roads or upgrade these 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;

- Topsoil stockpiles should be managed and stripped soils properly demarcated according to their proper layers especially the topsoil. Also prevent and minimise erosion (e.g., use of embedded geotextile controls) and contamination from the stockpile.

- 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.

6.2.2 Operational Phase

During the operational phase, limited impacts are foreseen. Only the footprint area will be disturbed, and this will 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, infrastructure maintenance 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.

6.2.2.1 Infrastructure

The operational phase of the TSF Expansion and slurry pipeline (Constructed Infrastructure) includes anthropogenic movement and activities. The relevant infrastructure will be maintained 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. Monitoring of soil erosion and compaction is important during this stage. The spread of alien invasive species will be a risk, predominantly adjacent to developed aeras (edge effect).

6.2.2.2 Mitigation

Without mitigation measures, the impacts will have high significance in the project footprint and extend to the surrounding area. Mitigation is required given the fact that the pre-mitigation significance rating has been scored as **"Medium – Negative"** and the post-mitigation significance rating being scored as **"Low – Negative."** Further mitigation is however detailed in Table 6-3.

- Adhere to the project footprint buffers as much as possible to minimise soil effects on the land capability of surrounding soils and prevent the effects.

- TSF stockpiling operations activities should be restricted to the defined limits of the project footprint.

6.2.3 Decommissioning, Rehabilitation and closure Phases

The cumulative decommissioning, rehabilitation and closure impacts post-mitigation have been scored "Low," indicating that the potential incremental, interactive, sequential, and synergistic impacts are limited. It is probable that the impact will result in spatial and temporal cumulative change.

6.2.3.1 Mitigation

Limited mitigation is required given the fact that the pre-mitigation significance rating has been scored as **"Medium – Negative"** and the post-mitigation significance rating being scored as Negligible **"Low – Negative."** Further mitigation is however detailed in Table 6-3.

6.3 Specialist Management Plan

Table 6-3 presents the recommended 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 6-3 Mitigation measures including requirements for the timeframes, roles and responsibilities for this report.

OBJECTIVE: Prevent the further loss of the land capability, increase in soil erosion, soil compaction and alteration of the topography

Project component/s	**Project area**
Potential Impact	**Soil erosion, soil compaction and an increase in surface runoff**
Activity/risk source	**Land clearing, excavations, and dust**
Mitigation: Target/Objective	**Avoidance / minimisation of the disturbance and degradation of the soil and vegetation within the project area and surrounding areas**

Mitigation: Action/control	**Responsibility**	**Timeframe**
• Vegetate or cover all stockpiles after stripping/removing soils. • Storage of potential contaminants should be undertaken in bunded areas. • All contractors must have spill kits available and be trained in the correct use thereof. • 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". • No cleaning or servicing of vehicles, machines and equipment may be undertaken in water resources. • Have action plans on site, and training for contractors and employees in the event of spills, leaks, and other impacts to the aquatic systems. • Continuously monitor erosion on site. • Monitor vegetation growth and recovery on site; and • Monitor compaction on site.	Project manager, Environmental Officer	Planning, Construction and Operation phase
Performance Indicator	Disturbance restricted to 'allowable' areas and dust generated areas.	
Monitoring	Daily monitoring during the construction phase and quarterly monitoring during the operational phase	

6.4 Specialist Recommendation

The results indicate “Medium” post-mitigation significance score ratings for the projects. It is therefore clear that the project is expected to have a low impact on land potential resources. It is worth noting that some “High” sensitivity crop field areas were identified in the Screening Tool in the project area buffer zone. The specialist agrees with the Screening Tool sensitivities in most areas with “Moderate High” sensitivities based on the site-verified soil forms (i.e., Avalon and Pinedene soil forms) with a high land capability potential associated to these areas. If avoidance of such areas is not feasible - stakeholder engagement should occur to discuss reasonable compensation of any affected persons for any proven loss of livelihoods.

7 Conclusion and Impact Statement

Two sensitive soil forms were identified within the project area, namely the Avalon and Pinedene forms characterised with Moderate-High sensitivity. The other moderate sensitive soil forms identified within the project area, namely, Clovelly, Molopo, Etosha, Sepane and Katspruit which are characterised by Low-Moderate to Moderate sensitivity. The Glenrosa and Witbank soil forms were also identified within the proposed project area and are characterised Very Low to Low sensitivity. The DAFF (2017) data indicates land capabilities with “Very Low” to “Moderate high” sensitivities. Based on the site-verification of the soil baseline findings, the specialist agrees with most areas which were identified with “Moderate High” land capability sensitivities. However, some areas categorized as “Moderate Low “to “Moderate High” have been disputed as they are associated with soils with a “Low” land capability like Glenrosa and Witbank soil forms. The project area has an overall sensitivity ranging from “Medium to High.”

The project area is associated with arable soils. However, the available climatic conditions of low annual rainfall and high evapotranspiration potentially limits crop production for the area, resulting in land capabilities with “Moderate” ratings. The land capabilities associated with the assessment area are suitable for livestock grazing and rainfed cropping, which aligns with current land uses.

The Nooitgedacht TSF expansion and slurry pipeline project will result in the loss of some soils with a good land capability potential. However, the potential loss associated with most areas of the project area is more limited as these areas are not being actively cultivated. The project will result in the segregation of some potentially high land capability lands within the proposed buffer zone. Despite this, the project will have an overall limited residual impact on the agricultural production ability for the affected area.

Active crop fields under rainfed conditions were only confirmed within the proposed central plant to St. Helena Boost and the New tailings St. Halena to FSN 1 pipeline areas and consent is needed from landowners to develop such areas. According to the Government Gazette 43110, for a linear activity impacts on the agricultural resource are expected to be temporary and can be returned to the current land capability within two years of the completion of the construction phase.

It is, therefore, the specialist`s recommendation that the project may be favourably considered for development with implementation of mitigation measures.

8 References

Department of Agriculture, Forestry and Fisheries, 2017. National land capability evaluation raster data: Land capability data layer, 2017. Pretoria.

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.

National Environmental Screening Tool. 2024. National Environmental Screening Tool, 2024. Available from the Department of Forestry, Fisheries and the Environmental website: https://screening.environment.gov.za/screeningtool/index.html#/pages/welcome.

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.