



**LAND USE, LAND CAPABILITY AND AGRICULTURE IMPACT
ASSESSMENT FOR THE PROPOSED TOWNSHIP ESTABLISHMENT ON
REMAINING EXTENT OF PORTION 46 AND PORTION 58 & 59 OF THE
FARM ELANDSHEUVEL 436 IQ IN THE GRIMBEEK PARK AREA WITHIN
JB MARKS LOCAL MUNICIPALITY, NORTH WEST PROVINCE**



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29/05/2025

Signature of the Specialist

Date



EXECUTIVE SUMMARY

Great Warthog Geo-Environmental (Pty) Ltd was appointed by Vhuluvhi Group (Pty) Ltd on behalf of the JB Marks Local Municipality to conduct a Land use, Land Capability and Agriculture impact assessment for the proposed Grimbeek Township Establishment.

The study area is predominately an active agricultural area, with cultivation covering the large part and livestock grazing with the r

The soil study has indicated the most dominating soil types were Tukulu, Westleigh, Sepane, Katspruit, and Glenrosa. There were concretions and stones on the surface which didn't show impact on the infiltration rate of either fertilizers or water since they were not part of the soil profile. Water was also overlying on the soil surface in some parts of the field as a sign of poor drainage. Hence the hydropedology of the area was essential.

The primary agricultural land capability impact of concern is therefore the presumably permanent inaccessibility of land for agricultural use, since residential land use settings do not have a foreseeable decommissioning and closure date. The proposed township development is therefore anticipated to have a moderately high land capability impact.

In addition, soil erosion, soil compaction, and contamination impacts are anticipated to be adequately mitigated by the recommended mitigation measures, which should be implemented accordingly, particularly during the construction phase.

The proposed township development will physically hinder agricultural activities such as cultivation and/or grazing within the study area. High clay contents on the subsoils of most soils needs special care not to bring bad subsoil to the surface during soil tillage or ridging, such clay properties will cause dispersion and severe surface crusting will occur. Crusting will cause poor water infiltration and runoff. Signs of wetness will reduce soil aeration in the topsoil and encourage diseases.

The identification of soil types and its properties assists in soil management and other land utilization. Therefore, the impact of soils in this farm will commonly be associated with soil water movement and rainfall pattern. The ideal management is dependent on soil physical strength for socio-economic development or any environmental studies.



The loss of land use and land capability is not reversible, the proposed township establishment will lead to total loss of agricultural land use and ultimately loss of potential economic and social impact of agriculture within the site and regional.

GLOSSARY OF TERMS

Anthrosol:	Man-made soil deposit with no recognisable diagnostic soil horizons, including soil materials which have not undergone pedogenesis to an extent that would qualify them for inclusion in another diagnostic horizon.
Catena:	A sequence of soils of similar age, derived from similar parent material, and occurring under similar macroclimatic condition, but having different characteristics due to variation in relief and drainage.
Contaminant:	A substance that has a potential to cause harm to human health and/or the environment.
<i>In-situ:</i>	Implies taking place "locally", or "on site", or "on the premises".
Soil Map Unit:	A description that defines the soil composition of a land, identified by a symbol and a boundary on a map.
Waste:	Any substance that is surplus, unwanted, rejected, discarded, abandoned or disposed of which the generator has no further use of for the purposes of production that must be treated or disposed of. Alternatively defined as "an inorganic or organic element or compound that, may exercise detrimental acute or chronic impacts on human health and the environment due to its toxicological, physical, chemical or persistency properties".



ACRONYMS

AGIS	Agricultural Geo-Referenced Information Systems
EMPr	Environmental Management Programme
IUSS	International Union of Soil Sciences
GWGE	Great Warthog Geo-Environmental (Pty) Ltd.
SACNASP	South African Council for Natural Scientific Professions
SOTER	Soil and Terrain



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I. BACKGROUND INTRODUCTION

I.1 Background

The conservation of South Africa's limited soil resources is essential. In the past misuse and poor management of the soil resource has led to the loss of these resources through erosion and destabilisation of the natural systems. In addition, loss of high potential agricultural land due to land use changes is a big concern presently in South Africa.

Soils can be seen as the foundation for ecological function, without a healthy soil system for microbes to thrive in, both flora and fauna would be negatively impacted, which in turn feeds the natural soil system with organics and nutrients.

To identify soils accurately, it is necessary to undertake a soil survey. The aim is to provide an accurate record of the soil resources of the proposed project area. The objective of determining the land capability is to find and identify the most sustainable use of the soil resource without degrading the system.

I.2 Introduction

JB Marks proposed to establish a township located within Grimbeek Area. Great Warthog Geo-Environmental was appointed by Vhuluvhi Group on behalf of JB Marks Local Municipality, to conduct an Land use, Land Capability and Agriculture impact assessment for the proposed township development.

A soil survey was conducted on 5th May 2025 to identify the dominant soil types within the study area, in order to infer their agricultural land capability. Subsurface soil observations were made using a manual hand auger to assess individual soil profiles.

2. OBJECTIVES OF THE STUDY

The objective of the Soil, Land Use and Land Capability study is to fulfil the requirements of the most recent South African Environmental Legislation with reference to the assessment and management of these natural resource aspects. The main purpose of the study is to determine and describe the baseline soil properties and the land capabilities and land uses associated with the proposed project's direct and indirect areas of influence from on-site investigations and data currently available. It also assists with the identification of gaps in

information. Once these conditions have been established, the anticipated impacts of the project on these soil properties can be determined. Mitigation and management measures will be recommended to minimise negative impacts and maximise land rehabilitation success towards successful closure at the end of the project life.

2.1 Scope of work

The assessment entailed evaluating physical soil properties and their respective limitations to agricultural use.

As such, this assessment was guided by the following terms of reference:

- Verify current land uses within the study area;
- Record local topographic features of the landscape, as estimated slope gradient;
- Identify master and diagnostic horizons to a depth of restricting layer;
- Describe potential soil limitations/restrictions to land capability;
- Classify soil into soil forms according to the Taxonomic Soil Classification System for South Africa (1991);
- Assess the spatial distribution of various soil types within the study area and compile a soil map depicting the demarcated soil boundaries; and
- Compile an agricultural land capability map under current conditions based on the acquired data;
- Assess anticipated impacts of the proposed development on the agricultural land capability of the identified soil types;
- Provide mitigation measures and recommendations to alleviate the anticipated impacts; and
- Compile a comprehensive Land use, Land Capability, Agricultural Impact Assessment Report, detailing the aforementioned information based on the assessment results

2.2 Assumptions and limitations

For the purpose of this study, the following assumptions and limitations are applicable:

- The soil survey conducted as part of the land capability assessment was confined within the project area, which is considered adequate for the purpose of this investigation;

- Sampling by definition means that not all areas are assessed, and therefore some aspects of soil and land capability may have been overlooked in this assessment. However, it is the opinion of the specialist that this assessment was carried out with sufficient sampling and in sufficient detail to enable the proponent, the Environmental Assessment Practitioner (EAP) and the regulating authorities to make an informed decision regarding the proposed mining activities;
- Land Capability was classified according to current soil restrictions, with respect to prevailing climatic conditions on site; however, it is virtually impossible to achieve 100% purity in soil mapping, the delineated soil map units could include other soil type(s) as the boundaries between the mapped soils are not absolute but rather form a continuum and gradually change from one type to another. Soil mapping and the findings of this assessment were therefore inferred from extrapolations from individual observation points;
- Since soils occur in a continuum with infinite variances, it is often problematic to classify any given soils as one form, or another. for this reason, the classifications presented in this report are based on the "best fit" to the soil classification system of South Africa;
- Soil chemical analyses has not yet taken place since the data will be used for baseline purposes and hence chemical analyses will take place once final layouts have been developed to ensure optimal sampling locality choices to allow for the best utilisable baseline soil chemistry data; and
- Soil fertility status was not considered a limitation, seeing as inherent nutrient deficiencies and/or toxicities would be rectified by appropriate liming and/or fertilization prior to cultivation.

3. ABOUT THE PROJECT AND STUDY AREA

3.1 About the study area

The study area for proposed township establishment is the remaining extent of portion 46 and portion 58 & 59 of the farm Elandsheuveld 436 IQ in the Grimbeek Park Area, within the jurisdiction of JB Marks Local Municipality, North-West province. (refer figure 1 for the locality map).

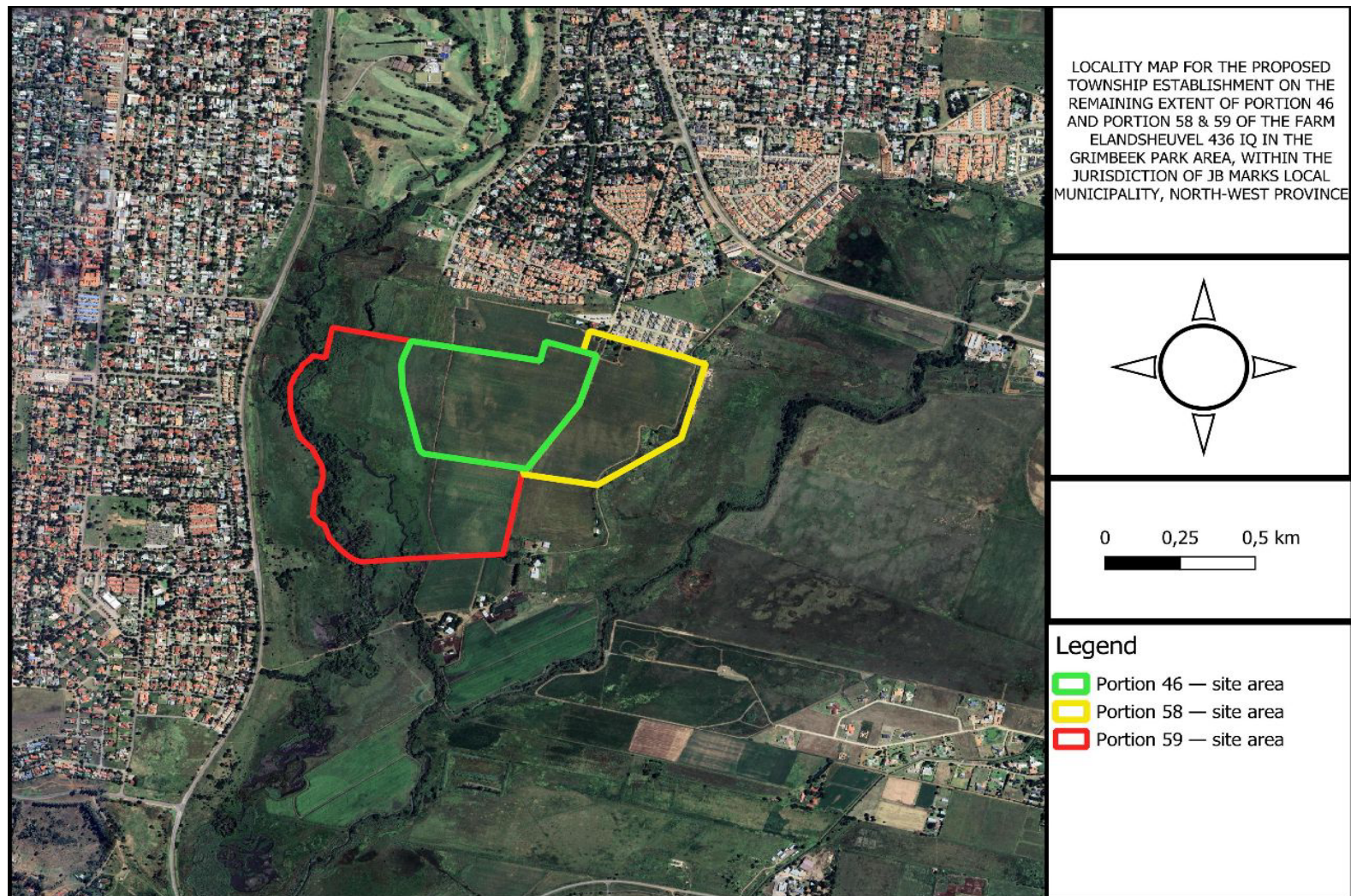


Figure 1: Locality Map

3.2 Project Description

JB Marks Local Municipality proposes township establishments which will consists of 520 stands of residential, business, public space and institutional areas in land covering 85,2015 ha.

4. METHOD OF ASSESSMENT

This section presents a description of the methods followed to gather and process the data for this study.

4.1 Literature Review

A desktop study was compiled from various data sources including but not limited to the Agricultural GeoReferenced Information System (AGIS) and other sources as listed under references.

4.2 Desktop Screening

A background study including a literature review was conducted prior to commencement of the field assessment. This is done in order to gather the pre-determined soil and land capability data within the study area. The different data sources that are listed under reverences were used for the assessment, including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources.

4.3 Soil Classification and Sampling

- A soil survey was conducted on 5th May 2025 by a qualified soil specialist at which time the identified soils within the proposed infrastructure areas were classified into soil forms according to the Taxonomic Soil Classification System for South Africa (2018).
- Subsurface soil observations were made using a manual hand auger in order to assess individual soil profiles, which entailed evaluating physical soil properties and prevailing limitations to various land uses.
- Dominant soil types were classified according to the South African Soil Classification System (Soil Classification Working Group, 2018). A Global Positioning System (GPS) was used to record assessed survey and sampling points. The Figure 2 below shows the project team sampling soils from the study area.

- It was also the objective of the assessment to provide recommended mitigation measures and management practices to implement in order to comply with applicable articles of legislation.



Figure 2: Showing a team collecting soil classification data using a soil auger

4.4 Land Capability Classification

Agricultural potential is directly related to Land Capability, as measured on a scale from I to VIII, as presented in **Table 1** below. Classes I to III are classified as prime agricultural land that is well suitable for annual cultivated crops. Class IV soils may be cultivated under certain circumstances and management practices, whereas Land Classes V to VIII are not suitable for cultivation. Furthermore, the climate capability is also measured on a scale from 1 to 8, as illustrated in **Table 2** below. Therefore, the land capability rating may be adjusted, depending on the prevailing climatic conditions as indicated by the respective climate capability rating.

Table 1: Land Capability Classification (Scotney et al., 1987)

Land Capability Group	Land Capability Class	Increased intensity of use	Limitations
Arable	I	W F LG MG IG LC MC IC VIC	No or few limitations. Very high arable potential. Very low erosion hazard. Slight limitations. High arable potential. Low erosion hazard. Moderate limitations. Some erosion hazards Severe limitations. Low arable potential. High erosion hazard.
	II	W F LG MG IG LC MC IC -	
	III	W F LG MG IG LC MC - -	
	IV	W F LG MG IG LC - - -	
Grazing	V	W - LG MG - - - - -	Water course and land with wetness limitations. Limitations preclude cultivation. Suitable for perennial vegetation. Very severe limitation. Suitable only for natural vegetation.
	VI	W F LG MG - - - - -	
	VII	W F LG - - - - -	
Wildlife	VIII	W - - - - - - - -	Extremely severe limitations. Not suitable for grazing or afforestation.

W - Wildlife

F- Forestry

LG -Light grazing

MG - Moderate grazing

IG – Intensive grazing

LC – Light cultivation

MC - Moderate

IC – Intensive cultivation

VIC – Very Intensive cultivation

Table 2: Climate Capability Classification (Scotney et al., 1987)

Climate Capability Class	Limitation Rating	Description
C1	None to slight	Local climate is favourable for good yield for a wide range of adapted crops throughout the year.
C2	Slight	Local climate is favourable for good yield for a wide range of adapted crops and a year-round growing season. Moisture stress and lower temperatures increase risk and decrease yields relative to C1.
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.
C4	Moderate	Moderately restricted growing season due to low temperatures and severe frost. Good yield potential for a moderate range of adapted crops but planting date options more limited than C3.
C5	Moderate to severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.
C6	Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops for which frequently experience yield loss.
C7	Severe to very severe	Severely restricted choice of crops due to heat, cold and/or moisture stress.
C8	Very severe	Very severely restricted choice of crops due to heat and moisture stress. Suitable crops at high risk of yield loss.

4.5 Impact Assessment Methodology

The identified impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed.

The impact assessment for the proposed project was conducted using the impact assessment methodology, the impact assessment methodology was adopted in the Scoping Report compiled by Vhuluvhi Group.

OCCURENCE		SEVERITY	
Probability of occurrence	Duration of occurrence	Scale/Extent of impact	Magnitude of impact

The following five ranking scales used to assess the magnitude and duration of impacts:

Table 3: Scales used to assess the magnitude and duration of impacts

MAGNITUDE	DURATION
5 - Very High	5 – Permanent (more than 10 years)
4 – High	4 – Long term (7 – 10 years impact ceases after site closure)
3 – Moderate	3 – Medium term (3 months – 7 years, impact ceases after operation span)
2 – Low	2 – Short term (0 – 3 months, impact ceases after construction phase)
1 – Minor	1 – Immediate
SCALE	PROBABILITY
5 - International	5 – Definite/Unknown
4 – National	4 – High Probability
3 - Regional	3 – Medium Probability
2 – Local	2 – Low Probability
1 – Site Only	1 – Improbable
0 - None	0 – None
KEY LEGEND:	

- ❖ Magnitude is a measure of the degree of change in a measurement or analysis (e.g., the area of pasture or the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none/negligible, low, moderate or high. The categorisation of the impact magnitude may be based on a set of criteria (e.g. health risk levels, ecological concepts and professional judgement) pertinent to each of the discipline areas and key questions analysed. The specialist study must attempt to quantify the magnitude and outline the rationale used. Appropriate, widely recognised standards are to be used as a measure of the level of impact;
- ❖ Scale/Geographic extent refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international;
- ❖ Duration refers to the length of time over which an environmental impact may occur i.e. immediate/transient, short-term (0 to 7 years), medium-term (8 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project), or permanent; and
- ❖ Probability of occurrence is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur)

Once these factors are ranked for each impact, the significance of the two aspects, occurrence and severity, is assessed using the following formula:

Significance Points= (Magnitude + Duration + Scale) x Probability.

The maximum value is 60 significance points (SP). The impact significance will then be rated as follows:

Table 4: Significance rating and colour coding

POINTS	SIGNIFICANCE	DESCRIPTION	COLOUR CODE
More than 30	High Environmental Significance	An impact which could influence the decision about whether or not to	

		proceed with the project regardless of any positive mitigation	
11 – 30	Moderate Environmental Significance	An impact or benefit which sufficiently important to require management, and which have an influence on the decision unless it is mitigated	
Less than 10	Less Environmental Significance	Impact with little real effect and which will not have an influence on or require modifications	
+	Positive impact	An impact that is likely to result in positive consequences/effects.	

5. RESULTS AND DISCUSSION

5.1 Historic and Current Land Use

The majority of the study area was cultivated during the site survey, as substantiated by the satellite imagery on the locality map **Figure 1**; and the surrounding land use is dominated by arable agriculture (cultivated fields) and disused, previously cultivated land, with residential properties on the east of the study area.



Figure 3: Picture showing general overview of the study area

5.2 Dominant Soil

The soil study has indicated the most dominating soil types were Tukulu, Westleigh, Sepane, Katspruit, and Glenrosa. There were concretions and stones on the surface which didn't show impact on the infiltration rate of either fertilizers or water since they were not part of the

soil profile. Water was also overlying on the soil surface in some parts of the field as a sign of poor drainage. Hence the hydropedology of the area was essential.

5.2.1 Hydropedological response of soils

The below table (Table 5) has shown that there 3 classes found at the area of interest: Interflow shallow, Interflow slow, and responsive wet.

Table 5: Soil types and their GPS points

Sample	GPS Coordinates	Soil codes	Soil types or form	Hydropedology class
1	26°43'51"S, 27°06'54"E	Tu3/6/12	Tukulu	Interflow slow
2	26°43'51"S, 27°06'50"E	Tu3/7/12	Tukulu	Interflow slow
3	26°43'51"S, 27°06'46"E	Tu3/7/12	Tukulu	Interflow slow
4	26°43'51"S, 27°06'42"E	Tu3/7/12	Tukulu	Interflow slow
5	26°43'51"S, 27°06'38"E	Tu3/7/12	Tukulu	Interflow slow
6	26°43'51"S, 27°06'35"E	Tu3/6/12	Tukulu	Interflow slow
7	26°43'51"S, 27°06'31"E	Tu3/6/12	Tukulu	Interflow slow
8	26°43'51"S, 27°06'28"E	We3/8	Westleigh	Responsive wet
9	26°43'54"S, 27°06'28"E	G2/6(8)c	Glenrosa	Interflow shallow
10	26°43'54"S, 27°06'32"E	Tu3/6/12	Tukulu	Interflow slow
11	26°43'55"S, 27°06'35"E	Tu3/6/12	Tukulu	Interflow slow
12	26°43'55"S, 27°06'38"E	Tu3/5/12	Tukulu	Interflow slow
13	26°43'55"S, 27°06'43"E	Tu3/5/12	Tukulu	Interflow slow
14	26°43'55"S, 27°06'46"E	Tu3/7/12	Tukulu	Interflow slow
15	26°43'55"S, 27°06'50"E	Tu3/7/12	Tukulu	Interflow slow
16	26°43'54"S, 27°06'54"E	We3/9	Westleigh	Responsive wet
17	26°43'57"S, 27°06'47"E	We3/9	Westleigh	Responsive wet
18	26°43'58"S, 27°06'43"E	We3/10	Westleigh	Responsive wet
19	26°43'58"S, 27°06'39"E	Tu3/7/12	Tukulu	Interflow slow
20	26°43'58"S, 27°06'35"E	Tu3/6/12	Tukulu	Interflow slow
21	26°43'58"S, 27°06'32"E	Tu3/6/12	Tukulu	Interflow slow
22	26°43'58"S, 27°06'27"E	Se3/5/8	Sepane	Interflow slow
23	26°44'01"S, 27°06'27"E	Ka2/6	Katspruit	Responsive wet
24	26°44'01"S, 27°06'32"E	Tu3/5/12	Tukulu	Interflow slow
25	26°44'02"S, 27°06'35"E	Tu3/5/12	Tukulu	Interflow slow
26	26°44'01"S, 27°06'39"E	We3/9	Westleigh	Responsive wet

Sample	GPS Coordinates	Soil codes	Soil types or form	Hydropedology class
27	26°44'01"S, 27°06'43"E	We3/9	Westleigh	Responsive wet
28	26°44'01"S, 27°06'47"E	We3/9	Westleigh	Responsive wet
29	26°44'04"S, 27°06'43"E	We3/9	Westleigh	Responsive wet
NB: c = presence of stones/rocks/concretions, sap = presence of saprolite, R = presence of bedrocks, (2) or (7), etc = 20% or 70% of stones/rocks/concretions				

Interflow (shallow) are soils marked by vertical anisotropy in hydraulic conductivity where a permeable topsoil overlies a restricting subsoil layer. These soils are also termed 'interflow (A/B)'. Lateral flow is generated by specific rain events and the duration of lateral flow in 'interflow (shallow)' soils is relatively short.

Interflow (slow) group comprises soils with high clay contents at the soil/bedrock interface. Although they could be saturated for long periods, their contribution to streamflow is relatively small because of the low hydraulic conductivity. In some cases, they act primarily as a store of water and not a conduit.

Responsive (wet) soils are marked by saturation close to the surface layers for extended periods, especially during the wet season. Additional precipitation will not infiltrate but overland flow will be generated. These soils respond quickly to rain events, resulting in high peak flows.

The study has somehow identified the strengths and limitations of soils by outlining their behaviour in correspondence to soil properties

Table 6: Soil types, their effective depths and agricultural potential

Sample point	Soil codes	Effective soils depths (cm)	Agricultural potential	Depth of water table (cm)	Risk of waterlogging	Risk of water surface run-off
1	Tu3/6/12	60	Medium	40	High	Moderate
2	Tu3/7/12	70	Medium	60	Moderate	Moderate
3	Tu3/7/12	70	Medium	70	Moderate	Moderate
4	Tu3/7/12	70	Medium	70	Moderate	Moderate
5	Tu3/7/12	70	Medium	70	Moderate	Moderate
6	Tu3/6/12	60	Medium	60	High	Moderate
7	Tu3/6/12	60	Medium	60	High	Moderate

8	We3/8	30	Low	40	Very high	Very high
9	G2/6(8)c	20	Low	20	High	High
10	Tu3/6/12	60	Medium	50	High	Moderate
11	Tu3/6/12	60	Medium	50	High	Moderate
12	Tu3/5/12	50	Low-Medium	50	High	High
13	Tu3/5/12	50	Low-Medium	50	High	High
14	Tu3/7/12	70	Medium	60	High	Moderate
15	Tu3/7/12	70	Medium	50	High	Moderate
16	We3/9	10	Low	2	Very high	Very high
17	We3/9	30	Low	40	Very high	Very high
18	We3/10	40	Low-Medium	60	Very high	Very high
19	Tu3/7/12	70	Medium	70	Moderate	Moderate
20	Tu3/6/12	60	Medium	60	High	Moderate
21	Tu3/6/12	60	Medium	50	High	Moderate
22	Se3/5/8	50	Low-Medium	20	Very high	Very high
23	Ka2/6	40	Low	2	Very high	Very high
24	Tu3/5/12	50	Low-Medium	50	High	High
25	Tu3/5/12	50	Low-Medium	50	High	High
26	We3/9	30	Low	20	Very high	Very high
27	We3/9	30	Low	20	Very high	Very high
28	We3/9	30	Low	30	Very high	Very high
29	We3/9	30	Low	40	Very high	Very high

5.2.2 Description of the Soils within the study area

Glenrosa

The soil consists of horizons such as Orthic topsoil and Lithic subsoil. This soil form has a significant limiting layer (rock) that limit root development severely. The rock layer also limit water drainage and water tables can form. Waterlogging can develop under high rainfall conditions. With good effective depths of over 40cm and the construction of ridges, the soil can be used for crop production, especially vegetables. In this farm of interest, the soil had a gleylic subsoil which was wet and reduced the soil effective depth.

Westleigh

The Orthic topsoil was 30 cm thick in all soils. The colour varies between dark brown to grey. The clay content of the soft plinthic subsoil was high (>25%). Hence the soil was easily waterlogged with poor drainage. The soft plinthic subsoil had a clay with multi-coloured red, yellow, and black spots and concretions in some cases. These colours develop through fluctuating water tables in the sub-soil. It is literally a process in which the iron in the soil rusts and changes colour. The soft plinthic horizon can store large amounts of water. These soils are therefore of high yielding potential if they are deep enough. When these soils are shallow, they are prone to waterlogging. Westleigh soil is mostly found in lower laying areas, and they receive water from higher up in the land. This soil should not be cultivated deeply.

Tukulu

The Orthic had 30cm thick topsoil with dark brown colour. The neocutanic horizon is characterized by slight (very) polychromatic, pressure level and cutanic features such as dark root canals etc. These soils are formed through wind or water deposition or because of young erosive soils. They are often well drained, and the prevention layers imply that water can be stored efficiently. With shallow layers that are saturated with water, these soils can be waterlogged, and its agricultural potential is reduced. Depending on the effective depth (80 cm), these soils are suitable for irrigation and is also good as fallow soils. Usually, these soils have good clay content, and it is accompanied by the effective degree of structure that sometimes occur, which implies that these soils are less prone to compaction. It is better to plough these soils deep because unstable neocutanic horizons to the ground surface cause quenching and crusting. Tukulu grounds generally have a better N transferring ability as for example Apedal soils with the same clay content.

Sepane

The soil consists of horizons such as Orthic topsoil, Pedocutanic and Gleyic subsoil. It is known by its loose brittle block structures. The pedocutanic B horizon consists of medium to strong developed clay block structures. Cracks on the surface of these soils are typical when they dry out. The high clay content implies a slow infiltration tempo. A lot of water can be lost through runoff on these soils. The soils are suitable for minimum or no-tillage systems. The pedocutanic is unstable and great damage can occur when it is wrongfully ploughed. (Erosion and crust formation). Sepane soils are better suited for sunflower and sorghum than for maize production because of the stronger root systems of these crops. The soils are

normally fertile. When being irrigated care should be taken that drainage is sufficient on these soils.

Katspruit

The Orthic topsoil in this soil mostly 10-40 cm thick and frequently light grey with a bleached looked. In this farm th topsoil was 20 cm thick_ very shallow. The Gleyic horizon is grey in colour, high clay density with blue/green colours as mottles, that's an indication of extreme waterlogging and absence of oxygen in the soil. The soil was found at the lower lying area of the farm towards floodplains. With over-fertilizer and poor management of agricultural inputs, the impact can damage water bodies nor cause eutrophications. Katspruit soils have poor drainage and are saturated with a high salinity tendency. Even though it is low potential soils, crops like Sunflower is better suited than Maize or Soya, external drainage will probably be required. These soils are not suited for irrigation.

5.2.3 Overview and summary of soils found at Grimbeek Farm Project

The soil potential in terms of agriculture for the farm was dominated by medium classes, it was affected by shallow watertable and signs of wetness in almost all areas. Risks of surface run-off during heavy rains is high possible. To reduce impact of water surface run-offs, internal drainage is high recommended or increase of plant density. High agricultural potential of soils is encouraged by deeper effective depths (>60 cm) and optimal soil clay contents (15 to 30%). Good soils in the area with medium agricultural potential can accommodate crops such as but not limited to, sunflower, soybeans, maize, and vegetables. It will be highly recommended to monitor the cultivation strategy when ploughing the soils to avoid wet subsoils which will reduce aeration on the topsoils. Wetness can be utilized for crop establishments, but irrigation management and cultivar selection will be essential. Wet soils normally encourage crop disease and the further utilization of chemicals for crop protection will need to be part of cropping programs.

High clay contents on the subsoils of most soils needs special care not to bring bad subsoil to the surface during soil tillage or ridging, such clay properties will cause dispersion and severe surface crusting will occur. Crusting will cause poor water infiltration and runoff. Signs of wetness will reduce soil aeration in the topsoil and encourage diseases.

The identification of soil types and its properties assists in soil management and other land utilization. Therefore, the impact of soils in this farm will commonly be associated with soil water movement and rainfall pattern. The ideal management is dependent on soil physical strength for socio-economic development or any environmental studies.

5.3 Land Capability Classification

In South Africa, agricultural land capability is generally restricted by climatic conditions, particularly water availability. However, even within similar climatic zones, different soil types typically have different land use capabilities attributed to their inherent characteristics. High potential agricultural land is defined as having the soil and terrain quality, growing season and adequate available moisture supply needed to produce sustained economically high crop yields when treated and managed according to best possible farming practices (Scotney et al., 1987).

For the purposes of this assessment, land capability was inferred from physical soil properties and prevailing climatic conditions. Climate capability (measured on a scale of 1 to 8) was therefore considered in the overall agricultural potential classification. The surveyed area is considered to fall within Climate Capability Class 4, with a good yield potential for a selected range of adapted crops under cautious planting date selection. The identified soils were classified into four land capability classes as presented in **Figure 4** below. The identified land capability limitations for the identified soils are discussed in comprehensive dashboard summary reports presented in **Table 7** to **Table 9** above, with respective spatial extents of all the classified land capability classes and soil forms.

6. IMPACT ASSESSMENT RESULTS

6.1 Potential Impacts

The main envisaged activities during construction and operation, include the following:

- Construction of the access roads, which includes the clearing vegetation
- Vegetation clearance for purpose of demarcation of proposed erf within the study area and;
- Movement of vehicles including heavy machinery.

The site preparation activities are disruptive to the natural soil horizon distribution and will impact on the current soil hydrological properties and functionality of soil. The following anticipated impacts have been assessed.

- Soil erosion is anticipated due to slope and vegetation clearance. The impacts of soil erosion are both direct and indirect. The direct impacts are the reduction in soil quality which results from the loss of nutrient-rich upper layers of the soil and the reduced water-holding capacity of severely eroded soils. The off-site indirect impacts of soil erosion include the disruption of riparian ecosystems and sedimentation.
- Soil chemical pollution as a result of storage of hazardous chemicals, concrete mixing, temporary sanitary facilities and potential oil and fuel spillages from vehicles. This impact will be localised within the township boundary.
- In areas of permanent changes such as roads and the erection of infrastructure, the current land capability and land use will be lost permanently. This impact will also be localised within the township boundary, as well as the main access roads providing access to the township.

All infrastructure and activities required for the operation phase will be established during the construction phase. Once the construction phase is completed, a number of impacts remain during the operation phase. During the operation phase the impacts related to loss of land use and land capability will stay the same. Areas under permanent infrastructure are no longer susceptible to erosion, but hard surfaces will increase run-off during rain storms onto bare soil surfaces.

Soil chemical pollution during the operation phase will be minimal. Possible sources are oil that need to be replaced and fuel spillage from maintenance vehicles. This impact will be localised within the residential land use.

Although wind erosion may have an impact before revegetation on adjacent bare areas, the loss of soil as a resource is restricted to the actual footprint of the township area. The only impact that may have effects beyond the footprint area is erosion which may cause the sedimentation of the adjacent watercourses.

7.2 Cumulative impacts

The following cumulative impacts are likely to occur in the surrounding area, should the proposed township development be approved within the study area:

- Inaccessibility of potentially arable land;
- Loss of grasslands for livestock grazing
- Loss of seasonal wetland(s) for ecological conservation; and
- Soil compaction

7.3 Impact significance Rating and Mitigation Measures

7.3.1 Chemical pollution due to the construction activities

Nature of the Activity

The following construction activities can result in the chemical pollution of the soil:

- Hydro-carbon spills by machinery and vehicles during earthworks and the mechanical removal of vegetation during site clearing.
- Spills from vehicles transporting workers, equipment and construction material to and from the construction site.
- The accidental spills from temporary chemical toilets used by construction workers.
- The generation of domestic waste by construction and operational workers.
- Spills from fuel storage tanks during construction.
- Polluted water from wash bays and workshops during the construction phase.
- Accidental spills of other hazardous chemicals used and stored on site.
- Pollution from concrete mixing.

Table 7: Chemical pollution due to the construction activities

IMPACT	BEFORE MITIGATION						AFTER MITIGATION
	Magnitude	Extent	Duration	Probability	Reversibility	Significance	Significance
Ecological sensitivity							
Chemical pollution	High	Local	Long term	Definite	Reversible	High	High
Cumulative Impact	High	Local	Long term	Definite	Reversible	High	Medium

7.3.2 Loss of Land capability

Nature of the Activity

The land capability of the development footprint of the discard facility where soil layers are changed and construction of infrastructure is done, will be lost. The impact remains present through the operation phase. The following activities can result in the loss of land capability within the discard facility development footprint:

- The removal of vegetation during site clearing;
- Earthworks which destroy the natural layers of the soil profiles; and
- The construction of access roads, collector substations and power line infrastructure which will cover soil surfaces.

Table 8: Loss of land capability

IMPACT	BEFORE MITIGATION						AFTER MITIGATION
	Magnitude	Extent	Duration	Probability	Reversibility	Significance	Significance
Ecological sensitivity							
Loss of land capability	High	Regional	Long term	Definite	Not Reversible	High	High
Cumulative Impact	High	Regional	Long term	Definite	Not Reversible	High	Medium

7.3.3 Soil Contamination

All the identified soils are considered to be equally predisposed to contamination, as contamination sources are generally unpredictable and typically occur as incidental spills or leaks during construction projects. The soil contamination impact is therefore largely dependent on the nature, volume and/or concentration of the contaminant of concern. The significance of this impact is considered to be high for all the Westleigh soil forms, due to their well-drained upper column, through which contaminants can be transmitted. The Arcadia/Rensburg soils on the other hand are anticipated to have a medium impact, due to their inherently dense, slowly permeable structure that can effectively hinder contaminant percolation into the soil.

Table 9: Soil contamination

IMPACT	BEFORE MITIGATION						AFTER MITIGATION
	Magnitude	Extent	Duration	Probability	Reversibility	Significance	Significance
Ecological sensitivity							
Loss of land capability	High	Local	Long term	Definite	Reversible	High	Medium
Cumulative Impact	Medium	Local	Long term	Definite	Reversible	Medium	Low

7.3.4 Soil compaction

Heavy equipment and vehicular traffic during construction activities is anticipated to cause significant soil compaction on the identified soils. High clay contents on the subsoils of most soils needs special care not to bring bad subsoil to the surface during soil tillage or ridging, such clay properties will cause dispersion and severe surface crusting will occur. Crusting will cause poor water infiltration and runoff. Signs of wetness will reduce soil aeration in the topsoil and encourage diseases.

Table 10: Soil compaction

IMPACT	BEFORE MITIGATION						AFTER MITIGATION
	Magnitude	Extent	Duration	Probability	Reversibility	Significance	Significance
Ecological sensitivity							

Loss of land capability	High	Local	Long term	Definite	Reversible	High	Medium
Cumulative Impact	Medium	Local	Long term	Definite	Reversible	Medium	Low

7.4 Proposed Mitigation Measures

The measures to be employed in order to manage, control and avoid impacts identified are outlined in table 12 below.

It must be acknowledged that there will be very limited opportunity to mitigate the identified impacts during the operational phase, and this can only be effectively implemented in the event that the proposed development is decommissioned for closure. However, similar to most residential land uses, the proposed township development is considered to remain operational for the foreseeable future. As such, the impacts and mitigation for the decommissioning and/or closure phase are not considered applicable in this scenario.

Table 11: Proposed Mitigation Measures

CONSTRUCTION PHASE		
ACTIVITY	POTENTIAL IMPACTS	PROPOSED AVOIDANCE AND MITIGATION MEASURES
Construction and associated infrastructure	Land withdrawal from cultivation; Land withdrawal from grazing;	• Schedule construction works such that there are no unprecedented delays such that the soil exposure duration is reduced to absolute minimum. • Avoid clearing the vegetation cover all at once; the study area can be divided into subsections that will be progressively cleared only when required according to the construction schedule. • Strictly limit vegetation clearance and earthworks to the pre-determined development areas within the study area. • Vegetation clearance and construction activities should preferably commence on the upgradient section of the study area, and gradually progress down gradient, such that the undeveloped portion can continuously serve as a natural erosion control, sediment retention, and stormwater attenuation mechanism. • Vegetation clearance and earthworks should be preferably scheduled during the dry (low rainfall) season when chances of runoff and water erosion are minimal, and soil moisture content is also minimal, in order to avoid excessive soil erosion through stormwater runoff.

	Destruction of seasonal wetland habitat(s); Soil contamination; Soil erosion and sediment losses	• Should any of the soils be excavated as part of the construction activities e.g. foundation setting, these soils can be re-spread on adjacent areas prior to re-vegetation, instead of stockpiling to minimise soil exposure to erosion and dust emission. • Re-vegetate the undeveloped areas with indigenous grass species as soon as practically possible areas as an erosion control mechanism such that the interval between clearing and re-vegetation is kept to an absolute minimum in order to limit run-off and to mitigate dust emission. • Vehicular movement should be strictly restricted within the designated roads during the operational phase, in order to avoid large compaction footprint. • Re-vegetation may be carried out by manual hand seeding or hydro-seeding according to the existing Environmental Management Plan (EMP) protocols for the greater MRA. • Bare soils can be regularly dampened with water to suppress dust during the construction phase, especially when strong wind conditions are predicted according to the local weather forecast. • A regulated speed limit of ≤ 40 km per hour can be maintained to minimise dust emission. • Strict waste management protocols and activity-specific EMP guidelines should be adhered to throughout all the project phases. • Contamination prevention measures should be addressed in the EMP for the proposed activity, and this should be implemented and made available and accessible at all times to the contractors and construction crew. • A spill prevention and emergency spill response plan, as well as dust suppression, and fire prevention plans should also be compiled and incorporated to the safety protocols to guide the construction works.
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		• The spill prevention plan should adequately address clean-up measures, to mitigate ingress of contaminants into the soils and potential leaching of contaminants into groundwater in the event of a spill and/or a leak of potentially hazardous substances within the study area. • Burying of waste, including rubble, domestic waste, or empty containers on the site should be strictly prohibited. • Inert uncontaminated building rubble can be reused within the study area e.g. on road surfaces, or alternatively removed to an authorised disposal site. • Soil compaction (where encountered) can be alleviated by ripping the soils to at least 45 cm below ground surface using appropriate tillage implements to physically loosen the soil, during decommissioning and closure phase, where applicable.
Operational Phase	Land withdrawal from cultivation; Land withdrawal from grazing;	• Provide adequate ablution facilities for the proposed township residents, and these should be regularly serviced and operational at all times. • A suitably engineered sewer design with sufficient capacity to accommodate the anticipated township residents should be installed to avoid discharge of unprocessed sewerage or water into the environment. • Ensure that sufficient containers are provided to contain litter, and provide waste collection service to ensure appropriate disposal in an environmentally safe manner. Efforts should be made to reclaim all the associated facilities and infrastructure as soon as they are no longer in use, to prevent complex accumulated impacts.

	Loss of wetland habitat(s); Soil erosion Soil compaction Soil contamination	Burying of waste should be strictly prohibited, and all waste should be managed in accordance with the relevant legislative requirements. Inert (uncontaminated) rubble waste may be re-used in the vicinity of the study area where needed e.g. on road surface. Completely demolish all the hard surface building materials as soon as they are no longer in use, and lightly rip the underlying soils to at least 45 cm beneath the surface following infrastructure decommissioning; and re-vegetate with a suitable indigenous pioneer grass species.
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7.5 Conclusion of findings

The proposed township development will physically hinder agricultural activities such as cultivation and/or grazing within the study area. High clay contents on the subsoils of most soils needs special care not to bring bad subsoil to the surface during soil tillage or ridging, such clay properties will cause dispersion and severe surface crusting will occur. Crusting will cause poor water infiltration and runoff. Signs of wetness will reduce soil aeration in the topsoil and encourage diseases.

The identification of soil types and its properties assists in soil management and other land utilization. Therefore, the impact of soils in this farm will commonly be associated with soil water movement and rainfall pattern. The ideal management is dependent on soil physical strength for socio-economic development or any environmental studies.

The loss of land use and land capability is not reversible, the proposed township establishment will lead to total loss of agricultural land use and ultimately loss of potential economic and social impact of agriculture within the site and regional.

8. SOIL, LAND USE AND LAND CAPABILITY MANAGEMENT PLAN

This sections presents the management plan for the management of all identified potential impacts related to the proposed Township Establishment.

8.1 About Soil Management Plan

The purpose of the Soil Management Plan (SMP) is to ensure the protection of soils and maintenance of the terrain of the proposed discard facility development during the construction and operational phases. The plan contains methods that will be used to prevent adverse effects as well as a monitoring plan to assess potential effects during construction and operation.

8.1.1 Construction Phase Soil Management

From the perspective of conserving the soil properties that will aid rehabilitation of areas around houses after completion, the key factors to consider during the preparation for the construction phase of the project are to minimise the area affected by the development, minimise potential future contact of toxic or polluting materials with the soil environment and

to maximise the recovery and effective storage of soil material that will be most useful during the rehabilitation process after construction and roads is completed. Some of these measures will minimise a combination of impacts simultaneously while other measures are specific to one impact.

- Minimise Area of Compaction

During construction use should be made of existing routes to construction areas where possible. Approved vehicle turning areas should be constructed in areas that are not ecologically sensitive or prone to be easily compacted like wetland areas. Construction staff should only use authorised paths and roads. If two-way traffic movement is to take place, demarcated passing bays are to be used to prevent detours into the surrounding areas.

- Management and supervision of construction teams

The activities of construction contractors or employees will be restricted to the planned areas. Instructions must be included in contracts that will restrict construction work and construction workers to the clearly defined limits of the construction site. In addition, compliance to these instructions must be monitored.

- Location of stockpiles

Locate all topsoil stockpiles in areas where they will not have to be relocated prior to replacement for final rehabilitation. The ideal is to handle topsoil twice only – once to strip and stockpile and secondly to replace, level, shape and scarify. Stockpiles should be placed in such locations that it will not be blown or washed away.

- Topsoil stripping

Wherever possible, stripping and replacing of soils should be done in a single action. This is both to reduce compaction and also to keep micro-organisms alive which are contained in the stripped surface soil horizons.

- Stockpiling of topsoil

To minimise compaction associated with stockpile creation, it is recommended that the height of stockpiles be restricted between of 4 – 5 metres maximum. For extra stability and erosion

protection, the stockpiles may be benched except if the clay content is sufficient for stockpiles to remain relatively stable without benching.

- Demarcation of topsoil stockpiles

Ensure all topsoil stockpiles are clearly and permanently demarcated and located in defined no-go areas. These areas should be maintained for rehabilitation purposes around buildings as soon as construction is completed and topsoil should never be used as a filling material for new roads, etc.

- Prevention of stockpile contamination

Topsoil stockpiles can be contaminated by dumping waste materials next to or on the stockpiles or by using contaminated water for dust suppression. This should be avoided at all cost and if it occurs, should be cleaned up immediately.

- Terrain stability to minimise erosion potential

Management of the terrain for stability by using the following measures will reduce the risk of erosion significantly:

- Stripping of topsoil should not be conducted earlier than required (maintain vegetation cover for as long as possible) in order to prevent the erosion (wind and water) of organic matter, clay and silt.
- Reducing slope gradients as far as possible along road cuts and disturbed areas to gradients at or below the angle of repose of those disturbed surfaces; and
- Using drainage control measures and culverts to manage the natural flow of surface runoff.
- Soil stockpiles must be sampled, ameliorated (if necessary) and re-vegetated as soon as possible. This is in order to limit raindrop and wind energy, as well as to slow and trap runoff, thereby reducing soil erosion.

In order to ensure that soil erosion is prevented, the Storm Water Management Plan (SWMP) that is developed for this project, must be followed. Areas where run-off can cause soil erosion, such as from surfaced roads, should be monitored regularly to ensure that there are

no signs of soil erosion. Should any soil erosion have occurred, the SWMP must be revised to remediate the situation and the eroded areas must be rehabilitated and revegetated.

- Management of access roads to the construction sites

Existing established roads should be used wherever possible. Where possible, roads that will carry heavy-duty traffic should be designed in areas previously disturbed rather than clearing new areas, where possible. The moisture content of access road surface layers must be maintained through routine spraying or the use of an appropriate dust suppressant.

- Prevention of soil contamination

During the construction phase, chemical soil pollution should be minimised as follows:

- Losses of fuel and lubricants from the oil sumps of vehicles and equipment should be contained using a drip tray with plastic sheeting filled with absorbent material;
- All maintenance and repair work should be carried out at the main construction camp within an area designated for this purpose, equipped with necessary pollution containment measures;
- Avoiding waste disposal at the site wherever possible, by segregating, trucking out, and recycling waste;
- Containing potentially contaminating fluids and other wastes; and
- Cleaning up areas of spillage of potentially contaminating liquids and solids.

9. RECOMMENDED MITIGATION STRATEGY

The Mining and Biodiversity Guideline document (DEA et al., 2013) provides a range of “best practice” guidelines and mitigation hierarchy, which were adapted for this assessment. The following mitigation measures were compiled in line with the aforementioned mitigation hierarchy, which constitutes avoidance of adverse impacts on environmental resources as a first option (the “no-go alternative”) prior to any other development alternative; and in circumstances where avoidance is not feasible, the potential impacts should be mitigated accordingly following the mitigation hierarchy.

9.1 The No-Go Alternative

The “no-go” alternative implies that the proposed development is not implemented within the study area as an avoidance of the identified impacts, and maintain the status quo. However, maintaining the status quo is not likely to improve the agricultural potential of the study area since no agricultural activities are actively in place. It is therefore recommended that the proposed development can be considered, provided that the following mitigation measures are effectively implemented throughout the project, since no severe and/or irreversible impacts are anticipated as far as the agricultural land capability aspect is concerned.

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