PEDOLOGY SCOPING REPORT FOR THE PURE SOURCE SAND MINING OPERATION

DATE

November 2018

Prepared for:

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Report Name	**PEDOLOGY SCOPING REPORT FOR THE WOODLANDS 407 MRA PROJECT**
Submitted to	Shango Solutions
Report Reviewer	**Andrew Husted** Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field. Andrew has completed numerous wetland training courses, and is an accredited wetland practitioner, recognised by the DWS, and also the Mondi Wetlands programme as a competent wetland consultant.
Report Writer	**Wayne Jackson** Wayne Jackson is a Soils Scientist & Hydrologist, and has 10 years' experience in the classification of soils, both nationally and internationally. Wayne completed a B.Sc. degree (Soil Science and Hydrology) from the University of KwaZulu-Natal and has 8 years of consulting experience. Wayne specialises in soil surveying using the South African taxonomic classification system, Soil sample analysis, Fertilizer recommendations, rehabilitation strategies, land contamination assessments, water resources analyses, drainage designs, water reticulation systems (Bulk & infield), crop water demand assessments, Compliance Monitoring and Integrated Waste Management Plans. Wayne has gained experience working throughout Africa specifically Liberia, Tanzania, Cameroon, and DRC.
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.

DECLARATION

I, Wayne Jackson, 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.

Wayne Jackson

Soil Specialist

The Biodiversity Company

July 2018

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1 Introduction

The Biodiversity Company (TBC) was appointed to compile a soil, land use and land capability scoping report, and visual impact (risk) assessment for the Pure Source Mining project. These specialist studies are completed to meet the requirements of a Mining Right Application (MRA) and the associated environmental authorisations for a proposed open pit mine.

The proposed project will involve the development of various open pit mines, a processing plant and associated infrastructure. Commodities to be mined will include sand, gravel and diamond (alluvial). The Life of Mine (LoM) is envisaged to last 30 years. Northern, central and southern portions of the project area are proposed for aggregate mining and one central and eastern portion are proposed for sand mining.

The proposed project area is situated about 20 km northeast of Parys, on the border of the Vaal River in the Free State Province of South Africa. The Applicant has a Prospecting Right over the proposed Mining Right Application area. This area is approximately 859 hectares in extent and is the remaining extent of Portion 1 and Portion 3 of Woodlands 407 (District Parys) in respect of which a prospecting right has being issued in terms of Section 18 of the Minerals and Petroleum Reserve Development Act (N.P.R.D.A.), 2002 (Law 28 OF 2002). Approximately 401.67 ha of the property will be mined for aggregate and 283.1 ha for sand.

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 the resource through erosion and destabilisation of the natural systems. In addition, loss of high potential agricultural land due to land use changes is currently a big concern in South Africa.

Soil can be seen as the foundation for ecological function as shown in Figure 1. 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 an area. Land capability and land potential is then determined from these results. The objective of determining the land capability/potential is to find and identify the most sustainable use of the soil resource without degrading the system.

Soil mapping is essential to determine the types of soils present, their depths, their land capability and land potential. These results will then be used to provide practical recommendations on preserving and managing the soil resource.

Figure 1: The relationship between soil and above-ground ecological succession.

This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP), enabling informed decision making as to the ecological viability of the proposed development and to provide an opinion on the whether any environmental authorisation process or licensing is required for the proposed development.

2 Project Area

The proposed project area is situated about 20 km northeast of Parys, on the border of the Vaal River in the Free State Province of South Africa. The north-eastern and north-western portions of the project area border on the Gauteng and North West Provinces respectively. The Applicant has a Prospecting Right over the proposed Mining Right Application area covering approximately 859 hectares. The land uses surrounding the project area consist mainly of agricultural land, natural areas, existing sand mining operations, the urban area of Vaal Oewer with associated houses, livestock and game farming. Infrastructure such as secondary tar roads, gravel roads and homesteads, occur within the proximity of the project area. The Vaal river forms the northern boundary of the proposed project area.

The infrastructure for the proposed development will only impact on a small portion of the overall MRA area and will consist of the development of a water supply line, access road, cut-off trench, fuel storage, processing plant, a pollution control dam and 2.5MVA power supply line. The total footprint of the proposed infrastructure is estimated to be approximately 32.4 hectares in extent.

Figure 1 shows the layout of the proposed project area property and some of the infrastructure footprint areas.

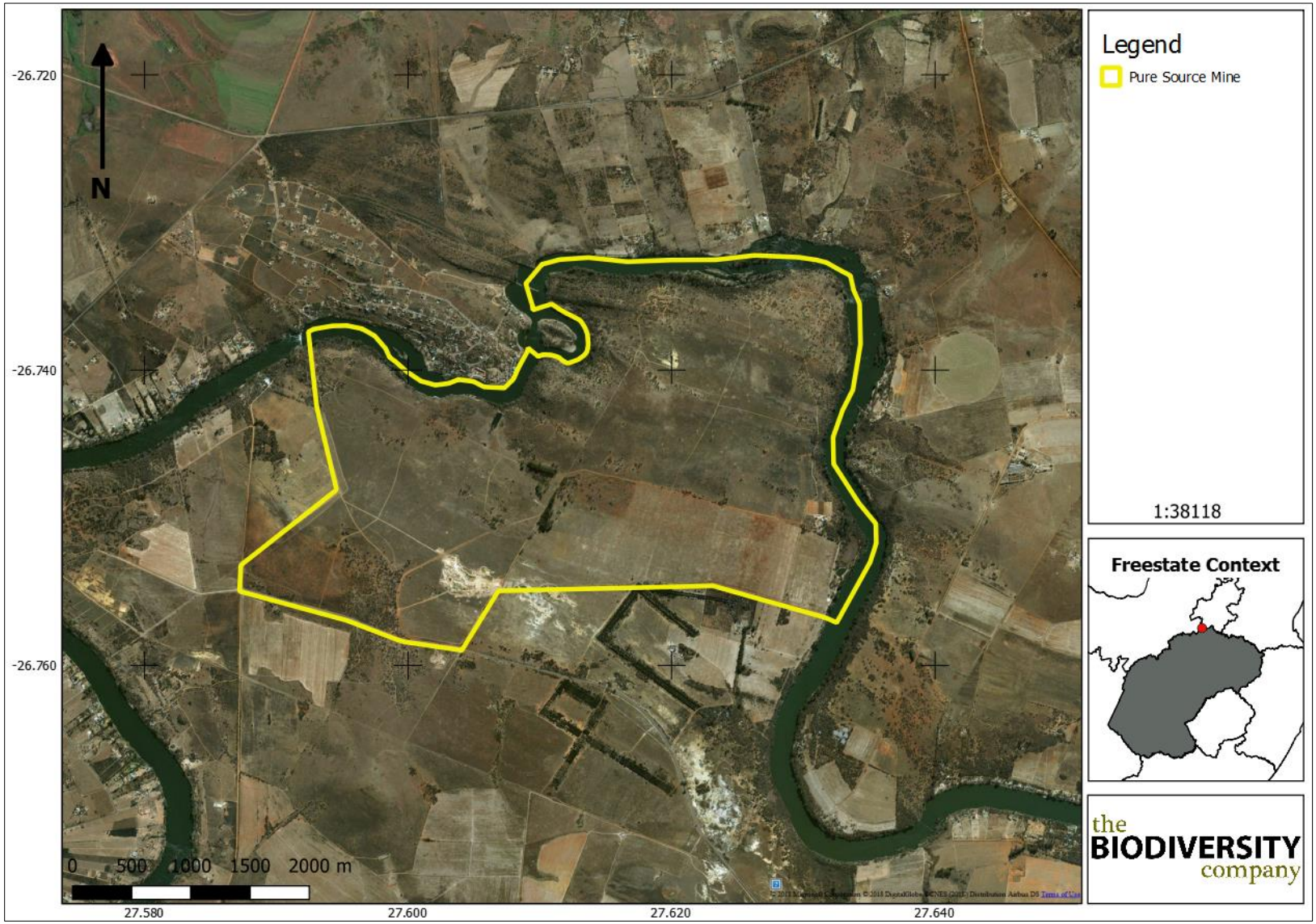

Figure 1: General layout of the project area

3 Key Legislative Requirements

Currently, various pieces of legislation and related policies exist that guide and direct the land user in terms of land use planning both on a national and provincial level. This legislation includes, but is not limited to:

- The Constitution of the Republic of South Africa (Act 108 of 1996);
- Sub-division of Agricultural Land Act (Act 70 of 1970);
- Municipal Structures Act (Act 117 of 1998);
- Municipal Systems Act (Act 32 of 2000); and
- Spatial Planning and Land Use Management Act, 16 of 2013 (not yet implemented).

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

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

4 Methodologies

The agricultural assessment was conducted using the Provincial and National Departments of Agriculture recommendations. The assessment was divided into two phases. Phase 1 is a desktop assessment to determine the following:

- Historic climatic conditions;
- The terrain features using 5m contours;
- The base soils information from the land type database (Land Type Survey Staff, 1972 - 2006);
- The geology for the proposed development site; and
- Phase 2 EIA methodology included 7.1.

5 Limitations

This scoping level assessment was conducted as a desktop study exercise only, no site inspections have been completed. The scoping study has therefore assumed that all information provided for the study is correct.

6 Results & Discussion

6.1 Terrain

The project area was assessed by using 5m contour terrain data. The contours were used to create a digital elevation model (DEM). The DEM was then used to create a relief map (Figure 2), a slope percentage map (Figure 3), and a slope aspect map (Figure 4).

The relief map: The project area is undulating with hilltops and valley bottoms, with the maximum and minimum elevations being between 1470m and 1410m above sea level.

The slope map: The southern portion of the project area is relatively flat with slopes less than 4%. The northern portion has slopes ranging from 3% to greater than 35%.

The aspect map: The map shows that the site is mostly north facing with a small portion being south facing.

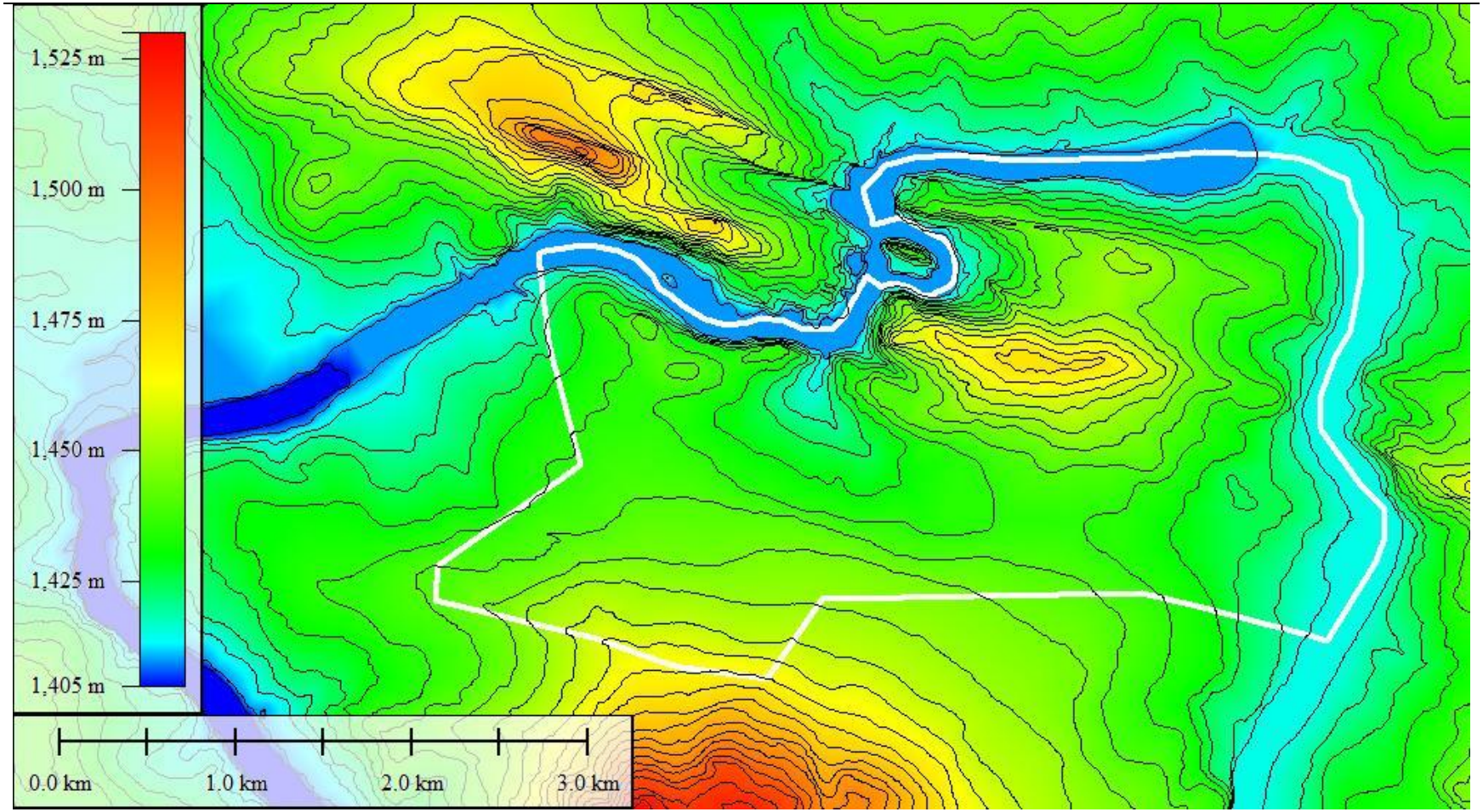

Figure 2: The relief map for the project area.

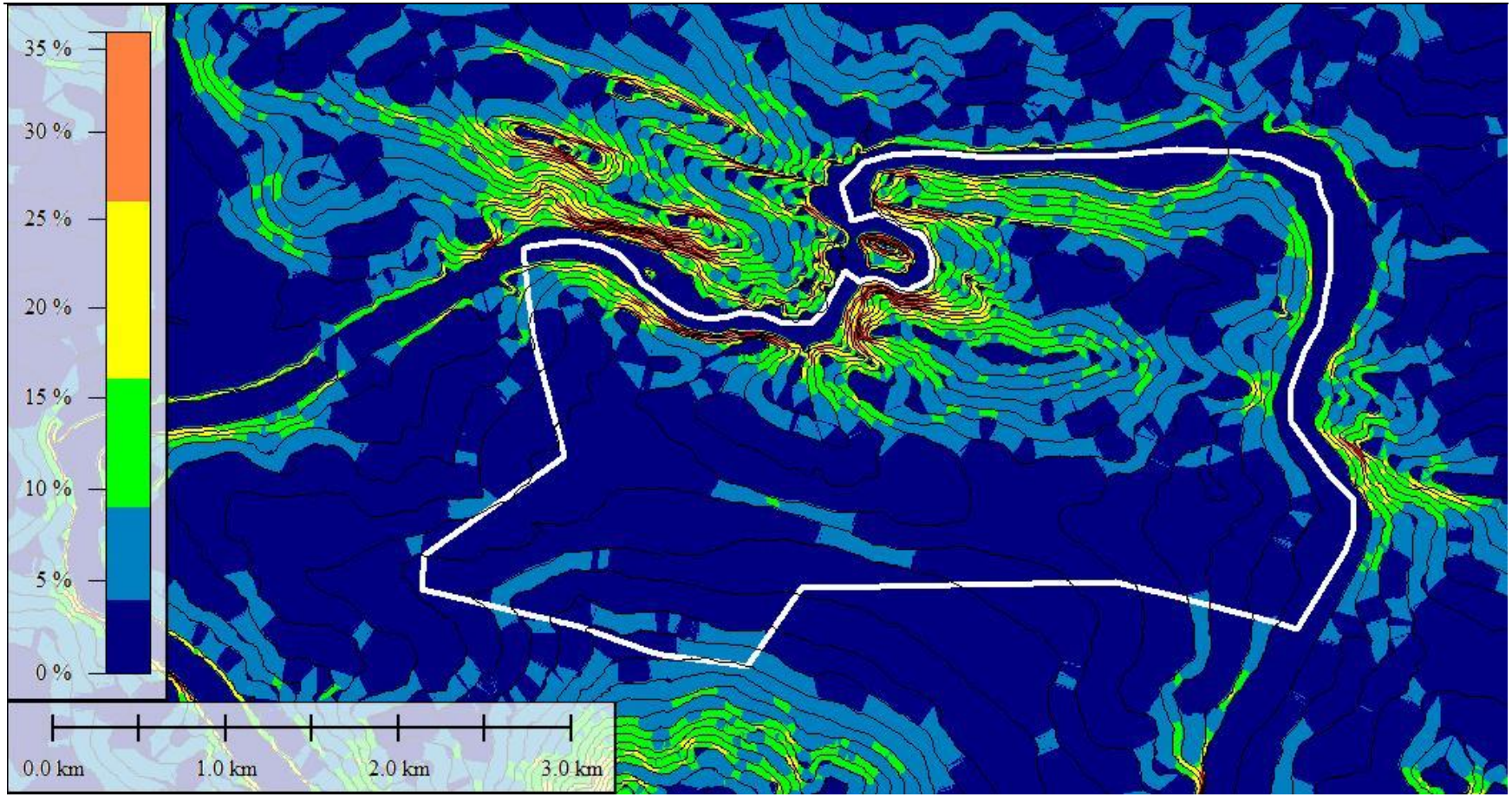

Figure 3: The Slope Percentage map for project area.

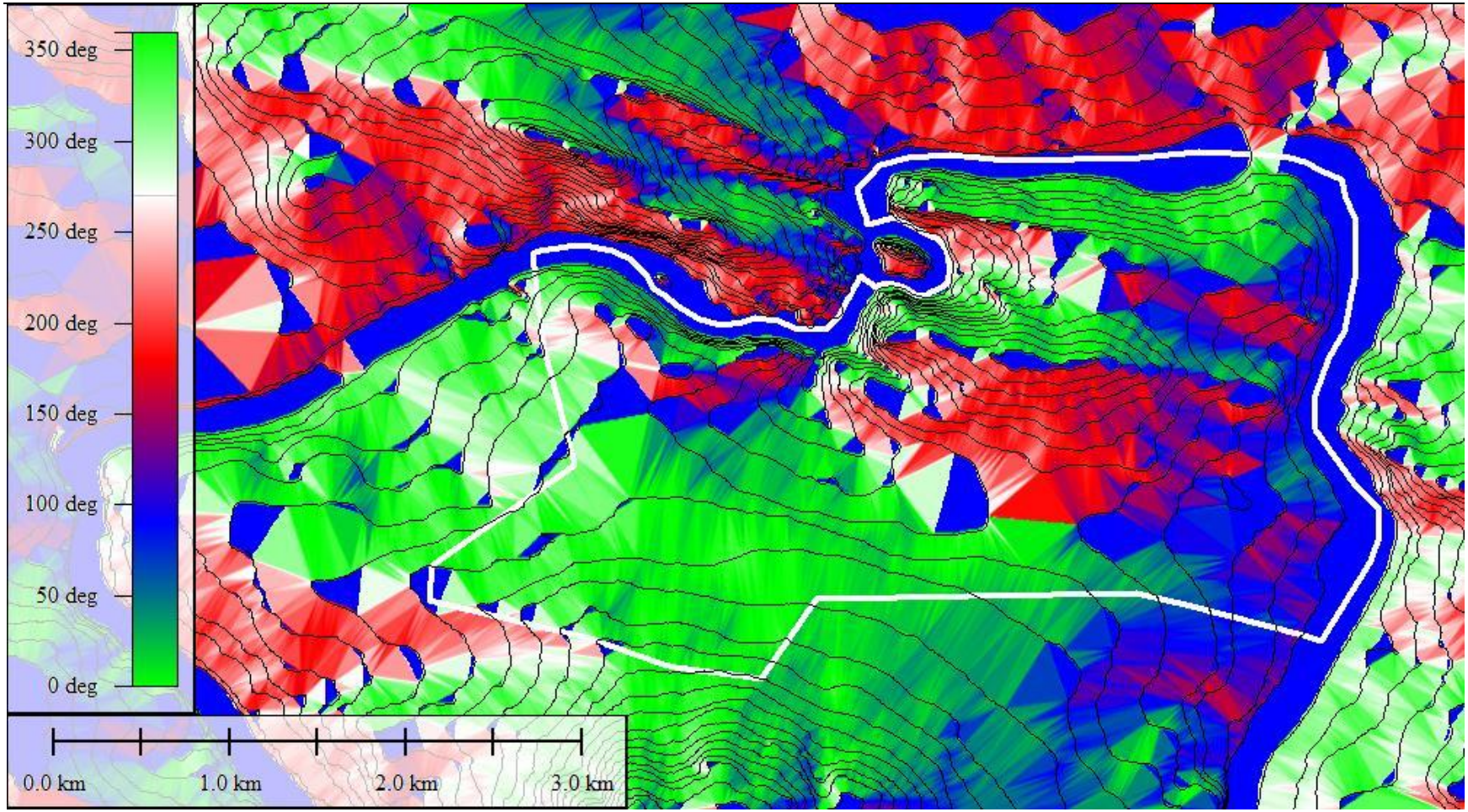

Figure 4: The Slope Aspect map for project area.

6.2 Geology & Soils

The geology of the area is mainly shale, slate and quartzite of the Pretoria Group; Hekpoort lava; many diabase sills; sporadic occurrence of dolomite and chert, Ventersdorp lava and Ecca shale and sandstone in the south-east. Quartzite usually forms crests and scarps. Footslopes usually on shale, slate and diabase.

According to the land type database (Land Type Survey Staff, 1972 - 2006) the project falls within the Bc36 land type and a small portion of the Ba39 land type. It is expected that, the dominant soils in the crest position will be shallow Mispah and Glenrosa soils. The midslope position will be soils of the Hutton and Avalon forms. The soils that dominated the footslopes and the valley bottoms are the Rensburg and Westleigh soil forms.

The average land capability for the land type is Class III (moderate cultivation). Class III land would pose moderate limitations to agriculture with some erosion hazard, and would require special conservation practice and tillage methods. The farming method for this capability would require the rotation of crops and ley (50%).

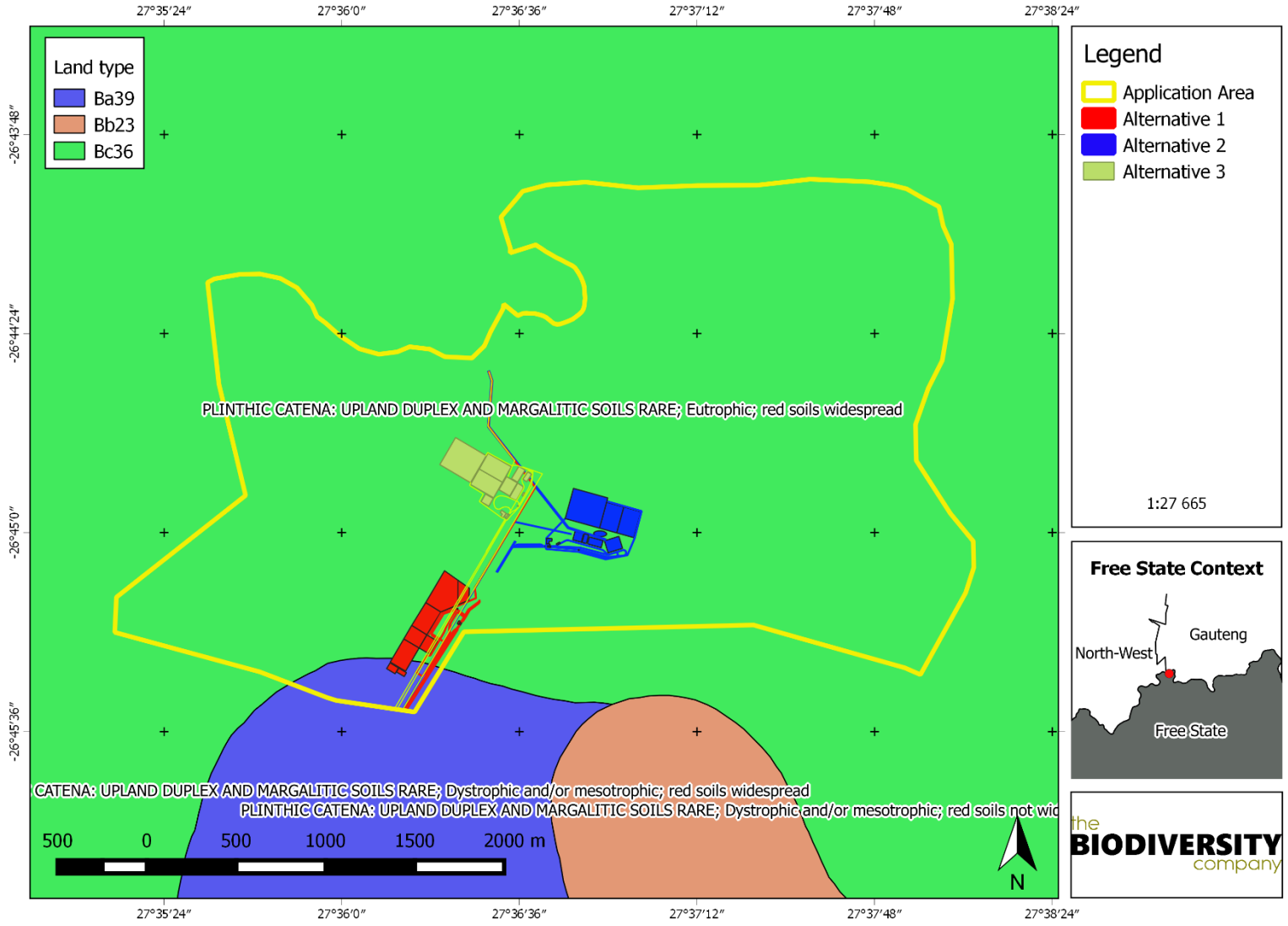

Figure 5: Land type map for the project area

6.3 Desktop Vegetation

The project area is situated within the grassland biome. This biome is centrally located in southern Africa, and adjoins all except the desert, fynbos and succulent Karoo biomes (Mucina & Rutherford, 2006). Major macroclimatic traits that characterise the grassland biome include:

a) Seasonal precipitation; and
b) The minimum temperatures in winter (Mucina & Rutherford, 2006).

The grassland biome is found chiefly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. The topography is mainly flat and rolling but includes the escarpment itself. Altitude varies from near sea level to 2 850 m above sea level.

Grasslands are dominated by a single layer of grasses. The amount of cover depends on rainfall and the degree of grazing. The grassland biome experiences summer rainfall and dry winters with frost (and fire), which are unfavourable for tree growth. Thus, trees are typically absent, except in a few localized habitats. Geophytes (bulbs) are often abundant. Frosts, fire and grazing maintain the grass dominance and prevent the establishment of trees.

Vegetation Types

The grassland biome comprises many different vegetation types. The project area is situated within a single vegetation type, namely the Soweto Highveld Grassland (Gs4) vegetation type according to Mucina & Rutherford (2006).

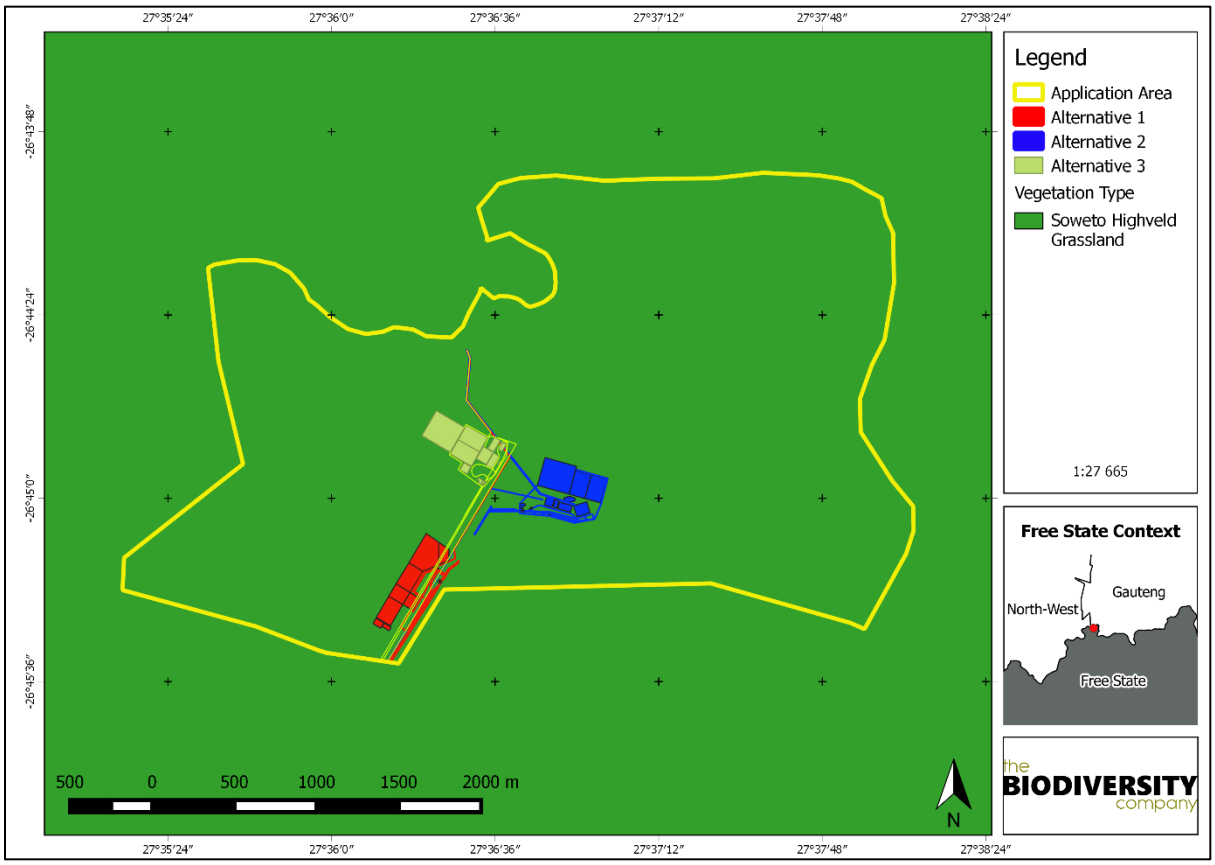

Figure 6: The project area showing the vegetation type based on the Vegetation Map of South Africa, Lesotho & Swaziland (BGIS,2017)

Soweto Highveld Grassland

The Soweto Highveld Grassland vegetation type is found in Mpumalanga, Gauteng and to a little extent also in neighbouring Free State and North-West Provinces. This vegetation type typically comprises of an undulating landscape on the Highveld plateau supporting short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra* and accompanied by a variety of other grasses such as *Elionurus muticus, Eragrostis racemosa, Heteropogon contortus* and *Tristachya leucothrix*. Scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover (Mucina & Rutherford, 2006).

6.4 General Land Use and Cover

The land uses surrounding the project area consist of agricultural land, natural areas, existing sand mining operations, the urban area of Vaal Oewer with associated houses, livestock and game farming. Infrastructure such as secondary tar roads, gravel roads and homesteads, occur within the proximity of the project area. The Vaal river forms the northern boundary of the proposed project area.

The following infrastructure exists within the project area and surroundings:

- Historical diamond mining and sand mining activities (open cast and underground), other sand mining activities are on-going on neighbouring farms;
- Certain portions of the project area are currently being used for agriculture, maize monocultures at present;
- Game farming – the majority of the central and northern portions of the property are currently being used for large game farming and a number of species are currently stocked including Springbok, Waterbuck and Zebra, amongst others;
- A number of farm dams have been constructed on the property;
- Large excavations have been made across much of the property presumably to test the quality of the sand and aggregate, the majority of which have not been back-filled and pose a threat to wildlife;
- Farm housing / dwellings;
- Various secondary gravel access roads; and
- Electrical infrastructure, especially a major Eskom transmission line which bisects the property.

7 Discussion

The areas with slopes exceeding 16% is dominated by shallow Mispah and Glenrosa soils. The Hutton, Clovelly, and Oakleaf (freely drained soils) soil forms dominate the southern flatter portions. Areas where water accumulates were dominated by the Westleigh, Longlands and Fernwood soil forms. The overall land capability of these soils is that of a Class III or less. Class III land would pose moderate limitations to agriculture with some erosion hazard, and would require special conservation practice and tillage methods. The farming method for this capability would require the rotation of crops and ley (50%).

The land capability would be verified in the Impact Assessment Phase however the potential impacts that could arise from the development are shown in *Table 1*.

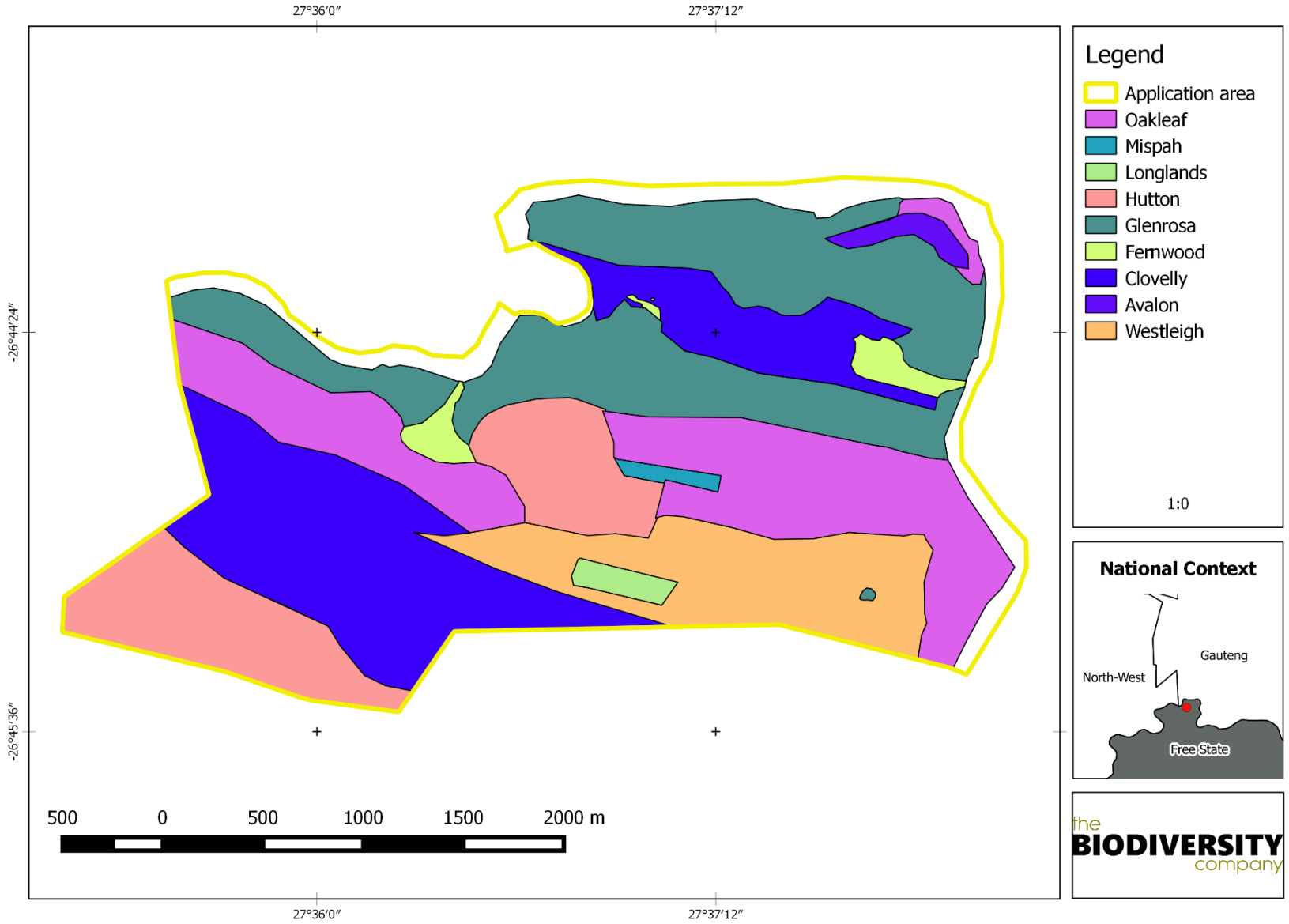

Figure 7: Preliminary soil delineation for the project area

Table 1: Potential impacts expected for the proposed development

Impact	Description	Mitigation
Loss of agricultural land and / or loss of agricultural potential as a result of the proposed activity	• Potential disturbances include compaction, physical removal and potential pollution. The exposed soil surfaces have the potential to erode easily if left uncovered which could lead to the loss of the soil resource. • Soil that are excavated for the installation of foundations will have their physical and chemical states altered negatively; • Potential loss of stockpiled topsoil and other materials through erosion if not protected properly; • Insufficient stormwater control measures may result in localised high levels of soil erosion, possibly creating dongas or gullies, which may lead to decreased water quality in surrounding watercourses; • Increased erosion could result in increased sedimentation which could impact on ecological processes; • The additional hardened surfaces created during construction could increase the amount of stormwater runoff, which has the potential to cause erosion; • Physical disturbance of the soil and plant removal may result in soil erosion/loss; and • Erosion and potential soil loss from cut and fill activities and areas where naturally dispersive soils occur.	• Soil erosion prevention measures should be implemented such as gabions, sand bags etc. while energy dissipaters should be constructed at any surface water outflow points. The site should be monitored weekly for any signs of off-site siltation. All areas impacted by earth-moving activities should be re-shaped post-construction to ensure natural flow of runoff and to prevent ponding. All exposed earth should be rehabilitated promptly with suitable vegetation to stabilise the soil; • The areas surrounding watercourse crossings must be regularly checked for signs of erosion. If erosion is evident, corrective action must be taken; • Any exposed earth should be rehabilitated promptly with suitable vegetation to protect the soil. Vigorous grasses planted with fertiliser are very effective at covering exposed soil. It is important to note, that the use of fertilisers, must be undertaken with caution and must not be allowed, in any circumstances, to run into drainage lines, rivers, wetlands or the dams, to avoid any possible Eutrophication impacts. • Special care and erosion prevention measures must be taken when working in areas where naturally dispersive soils occur. Final designs must take into account specialised recommendations made by the geotechnical engineers for sensitive areas which may be naturally prone to soil erosion.

Table 2: A summary of potential issues, impacts and likely No-Go areas identified for the study

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Opencast mining will result in the loss of Agricultural potential	Loss of non-renewable soil resource Erosion and sedimentation Loss of natural vegetation cover	Local	The Class III land capability would need to be confirmed.
Gaps: No layout alternatives or project descriptions were made available for the scoping study, therefore the likely extent and significance of impacts is based on expected impacts only and is not an accurate indication for this stage of the project.			

7.1 Field Verification Methodology for Phase 2 EIA

A soil auger will be used to determine the soil form/family and depth. The soil will be hand augured to the first restricting layer or 1.5 m. Soil survey positions will be recorded as waypoints using a handheld GPS. Soils will be identified to the soil family level as per the "Soil Classification: A Taxonomic System for South Africa" (Soil Classification Working Group, 1991). Landscape features such as existing open trenches will also be helpful in determining soil types and depth.

Agricultural Potential Assessment

Land capability and agricultural potential is 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 (Smith, 2006)

Land capability is divided into eight classes and these may be divided into three capability groups. Table 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 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		LG	MG						**Grazing Land**
VI	W	F	LG	MG						
VII	W	F	LG							

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

The land potential classes are determined by combining the land capability results and the climate capability of a region as shown in Table 4. The final land potential results are then described in Table 5.

Table 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 5: The Land Potential Classes.

Land potential	**Description of land potential class**
L1	Very high potential: No limitations. Appropriate contour protection must be implemented and inspected.
L2	High potential: Very infrequent and/or minor limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
L3	Good potential: Infrequent and/or moderate limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
L4	Moderate potential: Moderately regular and/or severe to moderate limitations due to soil, slope, temperatures or rainfall. Appropriate permission is required before ploughing virgin land.

L5	Restricted potential: Regular and/or severe to moderate limitations due to soil, slope, temperatures or rainfall.
L6	Very restricted potential: Regular and/or severe limitations due to soil, slope, temperatures or rainfall. Non-arable
L7	Low potential: Severe limitations due to soil, slope, temperatures or rainfall. Non-arable
L8	Very low potential: Very severe limitations due to soil, slope, temperatures or rainfall. Non-arable

8 References

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

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