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SOIL, LANDUSE AND LAND CAPABLITY ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED DEVELOPMENT OF A NEW TAILINGS STORAGE FACILITY AND FUEL STORAGE AREAS AT THE DWARS RIVER CHROME MINE, LIMPOPO PROVINCE

Prepared for

Envirogistics (Pty) Ltd

September 2021

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Report Reference:	**SAS 218222**
Date:	**September 2021**

SAS Environmental Group of Companies

EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a soil, land use and land capability assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed five new projects within the existing Dwars River Chrome Mine Mining Rights Area, as specified below:

- Project 1: the proposed development of a new Tailings Storage Facility (TSF);
- Project 2: diesel and emulsion batching;
- Project 3: main parking extension;
- Project 4: widening of access road between South Shaft / Main Offices and Plant; and
- Project 5: Access Crossing between Plant and North Mine.

The local climate can be broadly classified as somewhat favourable for good yield for selective adapted crops. The Mean Annual Rainfall (MAR) Associated with the MRA is estimated to range between 401 and 600mm per annum. Under these climatic conditions some crops may require irrigation to supplement water shortages to prevent permanent wilting which might ultimately affect the crop yield.

All of the footprint areas earmarked for the various projects are not under current cultivation and have never been utilised for agricultural purposes except for the TSF area which has previously been cultivated (for subsistence purposes) but has since been laid to fallow. Scrutiny of the satellite imagery was made, and it was evident that the dominant land uses in the surrounding areas are mining and wilderness, with very few residential areas northeast of the MRA. No cultivated agriculture was observed within the immediate vicinity of the MRA.

The findings of this assessment suggest that the relevant limiting factors within the project site for land capability and land use potential include the following:

- Shallow effective rooting depth due to shallow indurated bedrock of the Coega, Mispah and Glenrosa. As such, these soils are not considered to contribute significantly to agricultural productivity; and
- Limited rainfall throughout the year, excessive heat leading to crop permanent wilting, and lack of irrigation options for irrigated agriculture; and
- High temperatures occurring in this area which are likely to cause crop permanent wilting, thus affecting crop yield.

Overall, the footprint areas comprise of relatively small areas where arable soils with a moderate potential for agriculture, whilst the rest of the footprint area is comprised on very shallow soils not considered suitable for agricultural production. The extent of arable Bonheim soils therefore cannot be considered sufficient for viable cultivated small commercial farming. In addition, lack of rainfall (less than 600 mm per annum) further disqualifies the area from being ideal for agricultural production. Furthermore, high temperatures occurring in this area are also likely to cause crop permanent wilting, thus affecting crop yield. Given these constraints the extent of the high productivity soils is not considered sufficient for viable cultivated commercial farming. Based on the above-mentioned limiting factors the proposed project is anticipated to have a relatively low cumulative loss of arable land and medium low cumulative loss of natural grasslands for grazing and/or ecological conservation.

Livestock commercial farming is not considered an optimum land use for the footprint areas due to the veld being classified as having a grazing capacity of 6 ha Per Large Animal Unit. This can be attributed to the scarcity of vegetation as well as lack of palatable grasses.

From a soil, land use and land capability point of view, this project is not regarded as being fatally flawed due to various natural constraints posed by the local soil types and climate for commercial agricultural production, however mitigation measures and recommendations outlined in this document need to be strongly considered and implemented accordingly in efforts to conserve soil resources and general pedological processes important in terms of sustainable development.

The proposed Project 2 will most likely result in the clearance of vegetation as part of the construction phase which will lead to loss of soil through erosion and subsequent loss of land capability. Given the small footprint of this project, the loss of land capability is not anticipated to be significant, provided that the project occurs within the demarcated areas and mitigation measures are implemented during all phases of development. The extent of the access road required for this project will be limited since this project is located adjacent the current TRP mines new TSF pipeline and service road. The TSF maintenance road will serve as the main access road and as such the impact of the access road will be negligibly low.

The proposed projects (3,4 & 5) are located within the existing mine operational footprint where soils have already been subjected to significant disturbance associated with mining and related infrastructure. The extension of the existing infrastructure will not lead to a significant losses of land capability given the disturbance that has occurred on the surrounding soils. Impact such as soil erosion, compaction and soil contamination will likely occur during the construction phase which will lead to further degradation of the surrounding soils and the subsequent loss of land capability. However, the overall impact significance of the proposed project will be negligibly low, after mitigation measures have been put in place during all phases of development.

It is the opinion of the specialist therefore that this study provides the relevant information to ensure that appropriate consideration of the agricultural resources in the project site will be made in support of the principles of Integrated Environmental Management (IEM) and sustainable development.

DOCUMENT GUIDE

NEMA Regulations (2017) - Appendix 6	Relevant section in report
(1) A specialist report prepared in terms of these Regulations must contain -	
(a) details of -	
(i) the specialist who prepared the report; and	Appendix A
(ii) the expertise of that specialist to compile a specialist report, including a curriculum vitae;	Appendix A
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix A
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2
(cB) a description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying alternatives;	Section 4
(g) an identification of any areas to be avoided, including buffers;	Section 4
(h) a map superimposing the activity, including the associated structures and infrastructure on the environmental sensitivities of the site, including areas to be avoided, including buffers;	none
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.2
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment or activities;	Section 4
(k) any mitigation measures for inclusion in the EMPr;	Section 4
(l) any conditions for inclusion in the environmental authorisation;	Section 5
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	none
(n) a reasoned opinion -	
(i) as to whether the proposed activity, activities or portions thereof should be authorised;	Section 5
(iA) regarding the acceptability of the proposed activity or activities; and	Section 5
(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 5
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report	none
(p) a summary and copies, if any, comments received during any consultation process and, where applicable all responses thereto; and	none
(q) any other information requested by the competent authority.	None during the scoping phase

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY OF TERMS

AGIS	Agricultural Geo-Referenced Information Systems
Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Chromic:	Having within ≤150 cm of the soil surface, a subsurface layer ≥30 cm thick, that has a Munsell colour hue redder than 7.5YR, moist.
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.
Catchment	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Chroma	The relative purity of the spectral colour which decreases with increasing greyness.
Evapotranspiration	The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants
Ferralic horizon	A subsurface horizon resulting from long and intense weathering, with a clay fraction that is dominated by low-activity clays and contains various amounts of resistant minerals such as Fe, Al, and/or Mn hydroxides.
Ferralic	Having a ferralic horizon starting ≤150 cm of the soil surface.
IEM	Integrated Environmental Management
IUSS	International Union of Soil Sciences
Lithic	Having continuous rock or technic hard material starting ≤10 cm from the soil surface.
MRA	Mining Right Application
SACNASP	South African Council for Natural Scientific Professions
Salinity	High Sodium Adsorption Ratio (SAR) above 15% are indicative of saline soils. The dominance of Sodium (Na) cations in relation to other cations tends to cause soil dispersion (deflocculation), which increases susceptibility to erosion under intense rainfall events.
SAS	Scientific Aquatic Services
Sodicity	High exchangeable sodium Percentage (ESP) values above 15% are indicative of sodic soils. Similarly, the soil dispersion.
SOTER	Soil and Terrain
Watercourse	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks

ACRONYMS

°C	Degrees Celsius.
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ET	Evapotranspiration
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GPS	Global Positioning System
m	Meter
MAP	Mean Annual Precipitation
MPRDA	Minerals and Petroleum Resources Development Act, Act 28 of 2002
NEMA	National Environmental Management Act
NWA	National Water Act
PSD	Particle Size Distribution
SACNASP	South African Council for Natural Scientific Professions
SAS	Scientific Aquatic Services
subWMA	Sub-Water Management Area
WMA	Water Management Areas
WULA	Water Use Licence Application

1. INTRODUCTION

Scientific Aquatic Services (SAS) was appointed to conduct a soil, land use and land capability assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed five new projects within the existing Dwars River Chrome Mine Mining Rights Area, as specified below:

- Project 1: the proposed development of a new Tailings Storage Facility (TSF);
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- Project 5: Access Crossing between Plant and North Mine.

The town of Steelpoort is located approximately 13km northeast of the MRA, with the R555 located approximately 7.5 km east of the MRA. The MRA is further situated approximately 5.5km west of the Mpumalanga/Limpopo border, within the Greater Tubatse Local Municipality, and the Greater Sekhukhune District Municipality, within the Limpopo Province. Figure 1 and 2 depict the locality of the MRA as well as the footprint areas in relation to the surrounding areas.

It is the objective of this study to investigate the soil types within the proposed footprint areas and classify them according to their capability to support cultivated agriculture. It was also the objective of this study, from a soil and land capability perspective, to recommend the key mitigation measures to minimise the impact on the agricultural resources to ensure that the agricultural resources are conserved as per the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983).

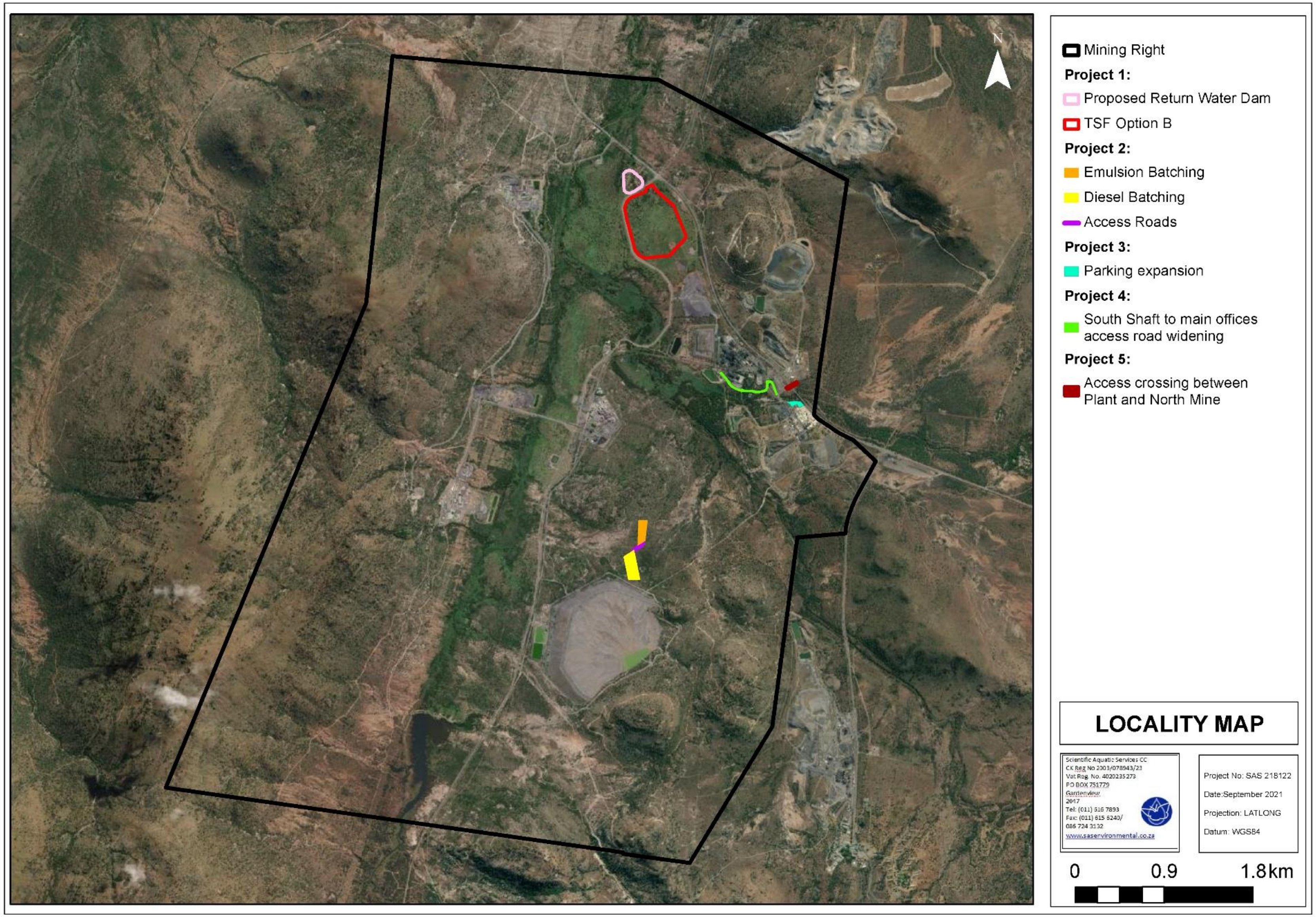

Figure 1: Digital satellite imagery depicting the MRA and footprint areas in relation to the surrounding areas.

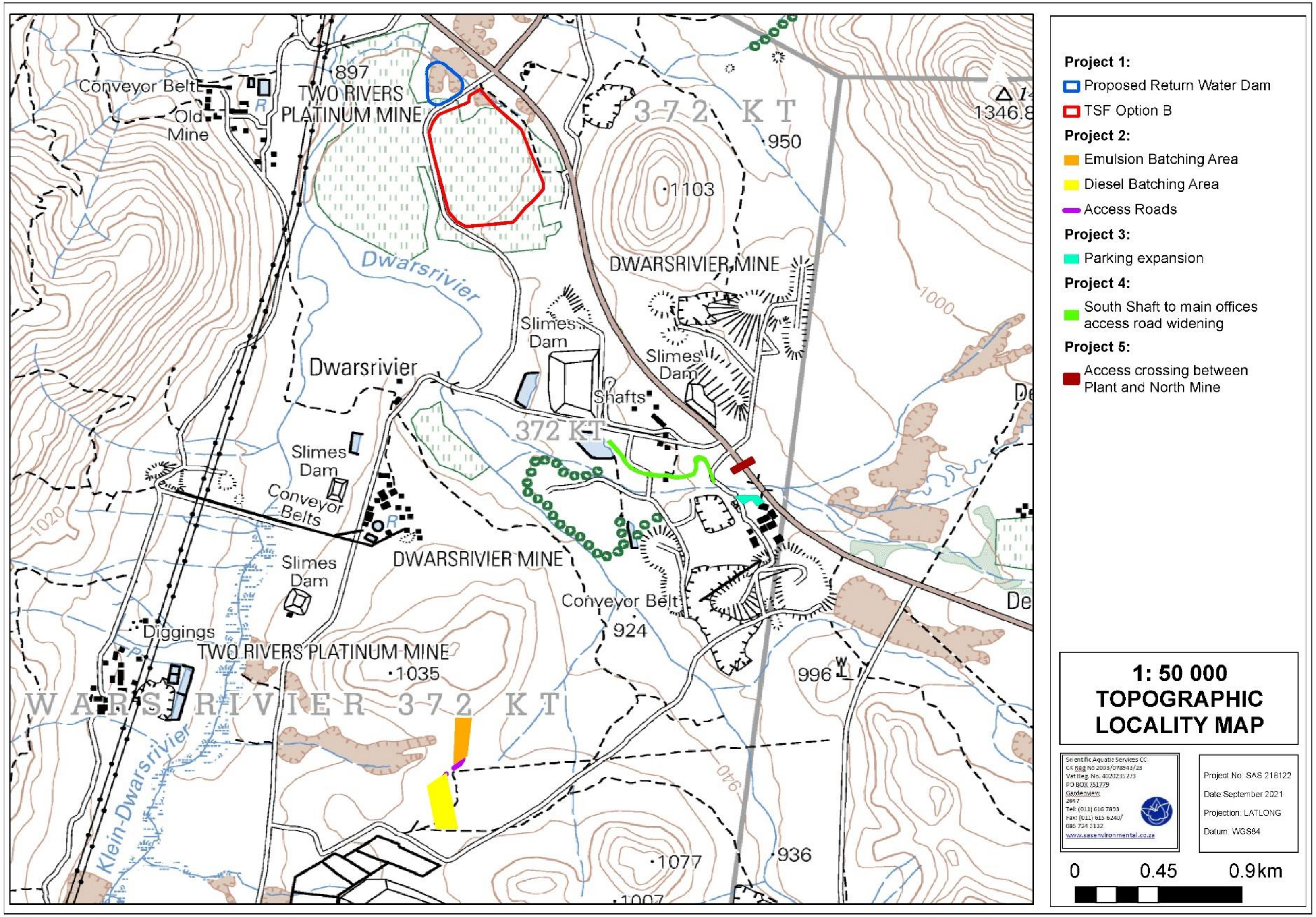

Figure 2: Location of the MRA depicted on a 1:50 000 topographical map in relation to surrounding area

1.1 *Project description*

A brief description of each of the five proposed projects is provided below. It must be noted that the project description was obtained from the report "Dwarsrivier Chrome Mine (Pty) Ltd Environmental Authorisation Application Form for new Capital Projects and the proposed new Khulu Tailings Storage Facility and associated infrastructure (4th Draft) prepared by Envirogistics (Pty) Ltd, as received by the specialist on 2nd June 2021. SAS therefore takes no responsibility for the accuracy of the information presented in this section. The localities of the five proposed projects are presented in Figures 1 and 2 following the project descriptions.

Project 1: Tailings Storage Facility

Dwarsrivier is currently depositing at the existing North Tailings Storage Facility (NTSF) at the eastern side of their process plant on the remaining portion of the Farm Dwarsrivier 372. It is anticipated that the existing active NTSF will reach its full capacity relatively sooner than anticipated due to tonnage ramp ups and additional tonnages from other sites.

The mine identified seven (7) potential TSF options initially, which have subsequently been reduced to four (4) (Option B, C, D and F). During the 2019 Site Selection Process, Option D was the preferred site for the mine. Based on the initial view by the Environmental Assessment Practitioner, Option B was fatally flawed due to the potential future Eskom substation, for which an EIA has been approved and negotiations in terms of land use between the mine and Eskom have commenced. However, subsequent to the 2019 Site Selection Process, further geotechnical studies were undertaken, which identified potential concerns for Option D, which also included the proximity of the non-perennial tributary of the Dwarsrivier River. In addition to this, the Eskom substation is no longer planned, which has reintroduced Option B into the overall assessment.

The areas are as follows:

- B: 24ha;
- C:21ha;
- D:19ha; and
- F:17ha

The heights currently anticipated of each of the facilities will be 37m, 29m, 49m and 50m respectively. The project will not involve typical tailings deposition techniques but will involve the piping of tailings to a filter press facility from where the filter cake will be trucked to the new TSF. A life of mine of about 20 years are currently considered as part of the design.

Option B was selected as the go forward TSF alternative although it was not the preferred option from a soil and land capability point of view. The decision was informed by other specialist studies such as the Freshwater assessment compiled by SAS (2021) which indicated that site was more favourable compared to the other alternatives.

Project 2: Diesel and Emulsion Batching

The mine plans to erect two (2) respective diesel and emulsion batching areas, to supply diesel and emulsion to the underground mining operations. The location of this area is to the north-east of the old Two Rivers Platinum Mine (TRP), just north of the new TRP TSF Pipeline.
The project will include:

- Construction of an approximate 80 m access road to the diesel batching area;
- Parking Area, with security office at both areas (no dangerous good storage planned at any time);
- At the Diesel Batching area the following tanks will be present: 23 m^3 Diesel + 23 m^3 Engine Oil + 23 m^3 Hydraulic Oil;
- At the Emulsion Batching area a 60 m^3 emulsion tank will be placed; and
- Feed into pipeline for underground used at both areas.

Clearance of indigenous vegetation will be required in the order of approximately 1.3ha.

Project 3: Main Parking Extension

The Mine requires the expansion of the existing parking area at the Main Offices. The current parking area is about 0.8 ha with the parking bays not sufficient to cater for the number of vehicles. The current parking bay comprises a tarred surface area and steel roof parking bays. The same principle will be applied at the expanded area. No new entrances will be required. The planned parking bay expansion will be located about 20 m from the Springkaanspruit.

Clearance of indigenous vegetation will be required in the order of approximately 4 900 m^2.

Project 4: Widening of Access Road between South Shaft/Main Offices and Plant

An existing road provides access between the Main Office Buildings and the Plant. The current width of the road ranges between 5-6 m. To accommodate for larger vehicles such as Trucks, the mine is planning on increasing a section of 700m of this road to a width of 16 m (two way traffic).

Clearance of indigenous vegetation will be required in the order of approximately 3 311 m^2.

Project 5: Access Crossing between Plant and North Mine

To ensure more optimal logistical management of traffic between the South Mine and the North Mine, and to reduce the number of vehicles on the regional road, the mine is planning on constructing a road under the regional road bridge to allow for access between the two areas. Clearance of indigenous vegetation will be required in the order of approximately 1 700 m^2.

1.2 *Scope*

The primary objective of this report is to:

- Conduct a desktop review of existing land type maps, to establish broad baseline conditions and areas of environmental sensitivity and sensitive agricultural areas;
- Classify the soil types within the footprint areas according to the new Soil Classification System: A Natural and Anthropogenic System for South Africa (2018);
- Group the identified soil types according to their capability to support cultivated agriculture;
- Outline the current land use within, and in close proximity to the proposed footprint areas;
- Define the limitations for agriculture on the proposed footprint areas; and
- Compile a report presenting the results of the desktop study and a description of the findings during the field assessment
- Provide recommendations and project specific mitigation measures including stockpiling guidelines.

1.3 *Assumptions and Limitations*

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

- The soil and land capability assessment was confined within the footprint areas and a 20m zone of influence which was applied on project 1 and 2 infrastructure areas, and this was considered adequate for the purpose of this investigation. Areas in the immediate vicinity were however considered as part of the desktop assessment where existing soil studies were consulted;
- 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 TSF development;
- 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. Therefore 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" approach to the soil classification system of South Africa; and
- Soil fertility status was not considered a limitation, as inherent nutrient deficiencies and/or toxicities could be rectified by appropriate liming and/or fertilisation prior to cultivation.

1.4 *Legislative Requirements*

The following legislative requirements were considered during the assessment:

- National Environmental Management Act 1998 (Act 107 of 1998) (NEMA);
- Conservation of Agricultural Resources Act 1983 (CARA, Act 43 of 1983);
- Minerals and Petroleum Resource Development Act 2002 (Act 28 of 2002) (MPRDA); and
- Limpopo Environmental Management Act 2003 (Act 7 of 2003) (LEMA).

2. METHOD OF ASSESSMENT

2.1 *Literature and Database Review*

A desktop study was compiled from various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources as listed in this report under References.

2.2 *Desktop Screening*

A background study including a literature review was conducted prior to commencement of the field assessment. This was done in order to gather the pre-determined soil and land capability data within the MRA and footprint areas. The different data sources that are listed under References were used for the assessment, including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources. Furthermore, existing soil studies conducted by SAS (2018) as part of the Dwars River Expansion and Exploration project were consulted to understand the soils and land capability within the MRA.

2.3 *Soil Classification and Sampling*

- A soil survey was conducted by a qualified soil specialist at which time the identified soils within the proposed footprint areas were classified into soil forms;
- 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 new Soil Classification System: A Natural and Anthropogenic System for South Africa (2018); and
- A Global Positioning System (GPS) was used to record assessed survey and sampling points.

2.4 *Land Capability Classification*

Agricultural potential is directly related to Land Capability, as measured on a scale of I to VIII as presented in Table 1; with Classes I to III classified as high potential agricultural land that is well suited to cultivation of annual 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 measured on a scale of 1 to 8, as illustrated in Table 2. The land capability rating is therefore adjusted accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating.

Table 1: Land Capability Classification (Smith, 2006)

Land Capability Class	Increased Intensity of Use									Land Capability Groups	Limitations
I	W	F	LG	MG	IG	LC	MC	IC	VIC	**Arable land**	No or few limitations
II	W	F	LG	MG	IG	LC	MC	IC			Slight limitations
III	W	F	LG	MG	IG	LC	MC	IC			Moderate limitations
IV	W	F	LG	MG	IG	LC					Severe limitations
V	W	F	LG	MG						**Grazing land**	Water course and land with wetness limitations
VI	W	F	LG	MG							Limitations preclude cultivation. Suitable for perennial vegetation
VII	W	F	LG								Very severe limitations. Suitable only for natural vegetation
VIII	W									**Wildlife**	Extremely severe limitations. Not

			suitable for grazing or afforestation.
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	

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.

The land potential assessment entails the combination of climatic, slope and soil condition characteristics to determine the agricultural land potential of the investigated area. The classification of agricultural land potential and knowledge of the geographical distribution of agricultural viable land within an area of interest. This is of importance for making an informed decision about land use. Table 4 below presents the land potential classes, whilst Table 5 presents a description thereof, according to Guy and Smith (1998).

Table 3: Table of Land Potential Classes (Adapted from Guy and Smith, 1998)

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	(L3) Wetland	(L3) Wetland	(L4) Wetland	(L4) Wetland	(L5) Wetland	(L5) Wetland	(L6) Wetland	(L6) Wetland
VI	L4	L4	L5	L5	L5	L6	L6	L7
VII	L5	L5	L6	L6	L7	L7	L7	L8
VIII	L6	L6	L7	L7	L8	L8	L8	L8

Table 4: The Land Capability Classes Description (Guy and Smith, 1998)

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, temperature or rainfall. Appropriate permission is required before ploughing virgin land.
L5	**Restricted potential:** Regular and/or moderate to severe limitations due to soil, slope, temperature or rainfall.
L6	**Very restricted potential:** Regular and/or severe limitations due to soil, slope, temperature or rainfall. Non-arable.
L7	**Low potential:** Severe limitations due to soil, slope, temperature or rainfall. Non-arable.
L8	**Very low potential:** Very severe limitations due to soil, slope, temperature or rainfall. Non-arable.

3. DESKTOP ASSESSMENT RESULTS

**The background data was accessed for the entire MRA, and where necessary, specifics pertaining to the specific proposed projects are emboldened where considered relevant.*

The following data is applicable to the MR, according to various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS):

- The Mean Annual Precipitation (MAP) experienced within the entire footprint areas is estimated to range between 401 and 600mm per annum;
- According to the Soils 2001 Dataset, the footprint areas within the MRA are situated within the soils classified as prismacutanic and pedocutanic diagnostic horizons dominant;
- The natural soil pH within the entire MRA is estimated to range between 6.5 and 7.4, indicating that the soils are anticipated to be slightly acidic to neutral, as interpolated from topsoil pH values obtained from the National Soil Profile Database (AGIS database);
- According to the Soil-Terrain (SOTER) database and the 1:250 000 geological map of South Africa, the footprint areas are underlain by Pyroxenite rock formations;
- According to the Geology (2001) Dataset the footprint areas area underlain by Norite geological formation;
- The desktop assessment indicates that the soils associated with the footprint areas have a moderate potential arable land capability (class III); and
- According to the AGIS database, the livestock grazing capacity potential of the entire MRA is estimated to be approximately 6 hectares per large animal unit (Morgenthal *et al.*, 2005).

4. ASSESSMENT RESULTS

4.1 *Current Land Use*

The local climate can be broadly classified as somewhat favourable for good yield for selective adapted crops. The Mean Annual Rainfall (MAR) Associated with the MRA is estimated to range between 401 and 600mm per annum. Under these climatic conditions some crops may require irrigation to supplement water shortages to prevent permanent wilting which might ultimately affect the crop yield.

All of the footprint areas earmarked for the various projects are not under current cultivation, and have never been utilised for agricultural purposes except for the TSF area which has previously been cultivated (for subsistence purposes) but has since been laid to fallow. Scrutiny of the satellite imagery was made, and it was evident that the dominant land uses in the surrounding areas are mining and wilderness, with very few residential areas northeast of the MRA. No cultivated agriculture was observed within the immediate vicinity of the MRA. Figure 3 below presents images of some of the landuses within the project area.

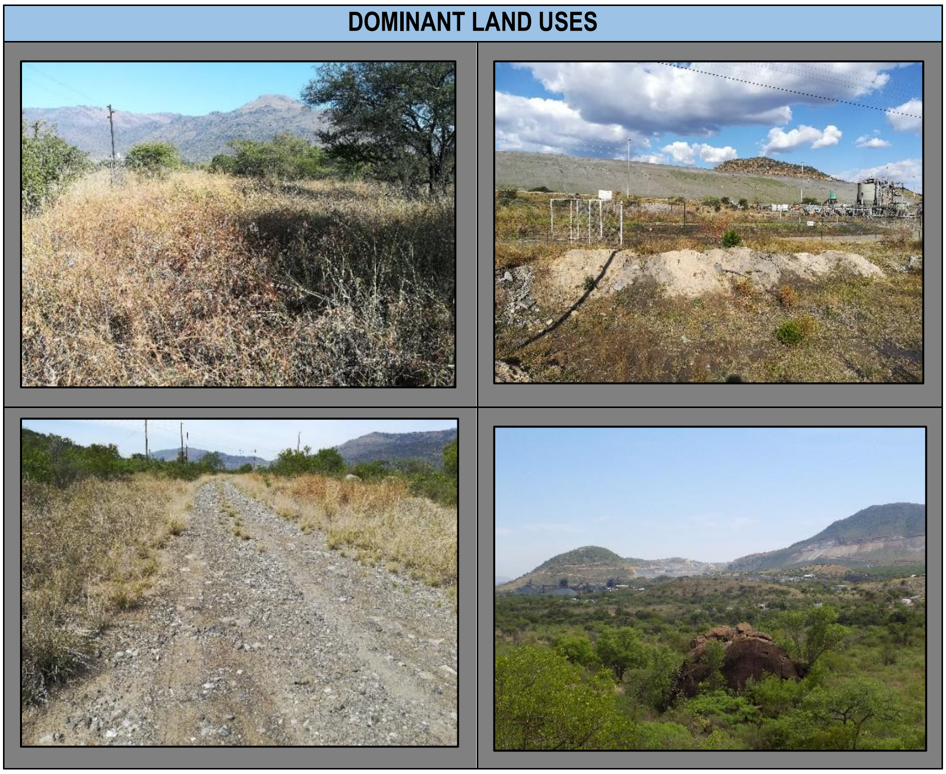

Figure 3: Images depicting the current landuses associated with the proposed development

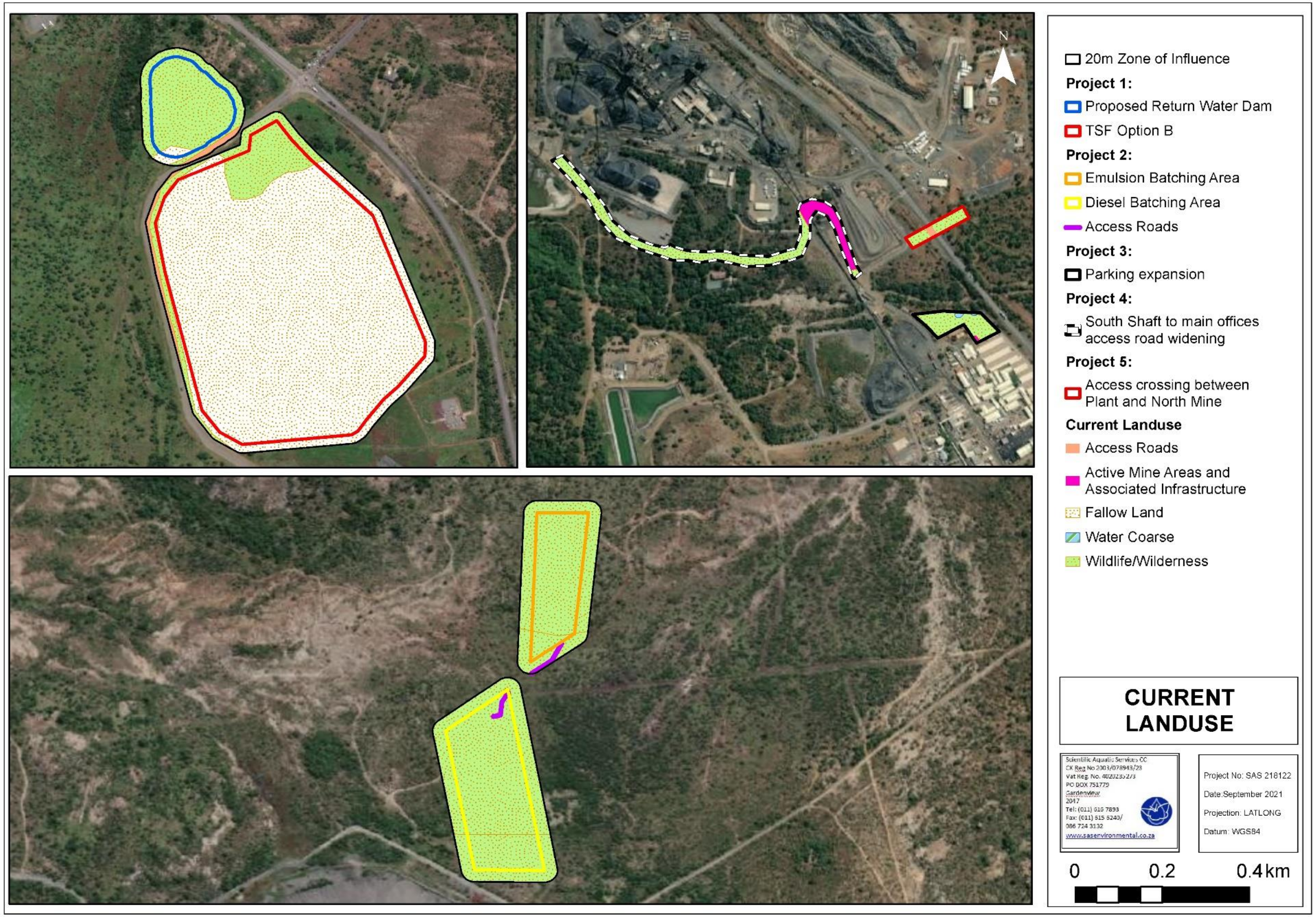

Figure 4: Map depicting the current Landuses associated with the proposed development

4.2 *Dominant Soil Forms*

The dominant soil form occurring within the footprint area is Bonheim, which is associated with the TSF area. The Bonheim soil form is considered ideal for agricultural cultivation due to:

- Deep well drained soil characteristics;
- Texture and structure allowing for effective rooting depth;
- Good water holding/storage capacity; and
- Good nutrient holding capacity.

The remaining footprint areas are characterised by soils by which are not considered suitable for cultivation, and these include Mispah, Outcrops, Mayo, Glenrosa, Etosha and Gamoep. These soils have a limitation in terms of the effective depth and the water holding or storage capacity. Consequently, these soils are not suitable for most cultivated crops.

The Witbank (Anthrosols) soil forms associated with the widening of access roads have been subjected to physical disturbance because of mining and related activities. As a result, these soils are not ideal for agricultural cultivation. Figure 6 below presents the soil forms identified within the footprint areas.

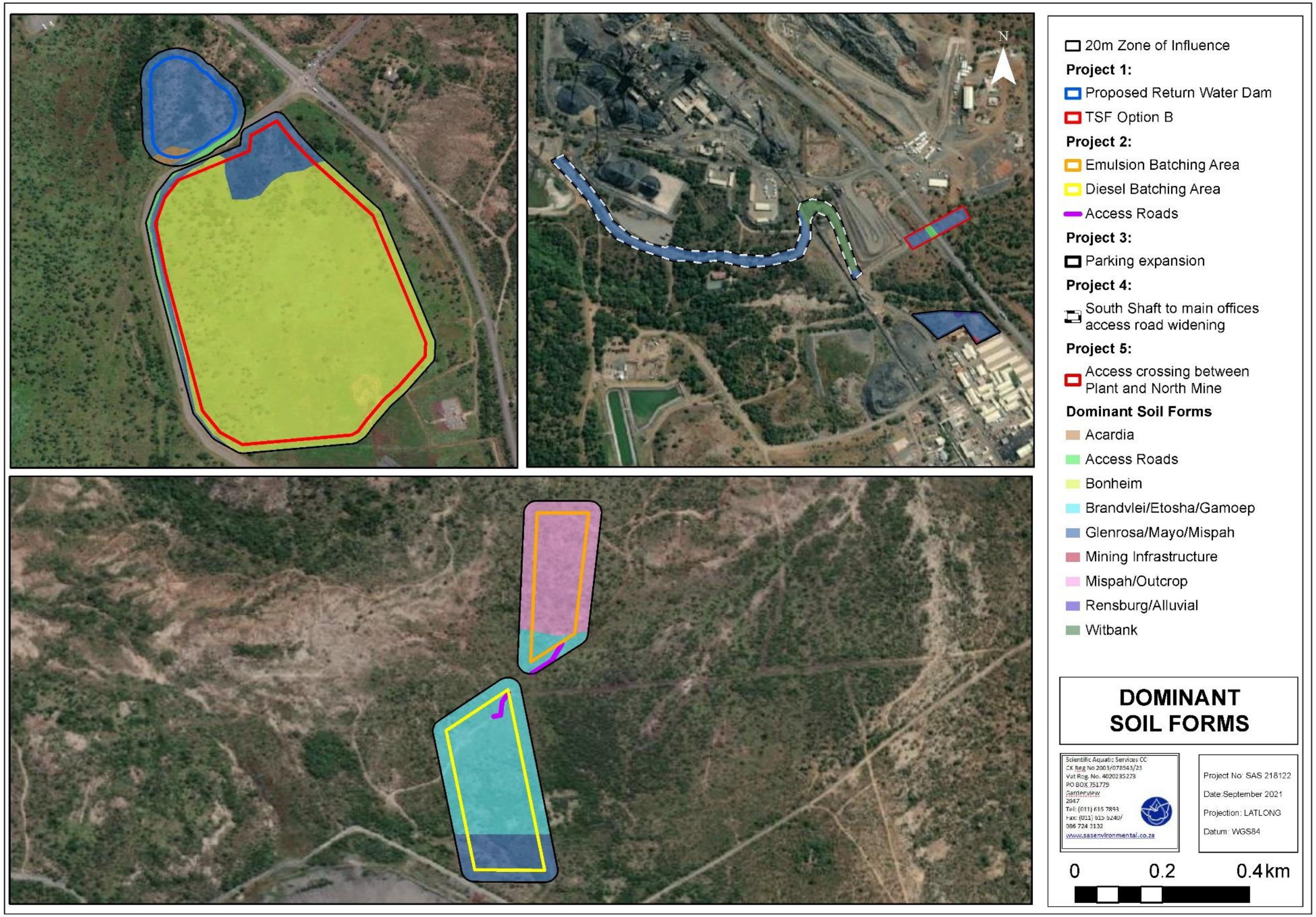

Figure 5: Map depicting the dominant soil forms associated with the proposed development

4.3 *Land Capability Classification*

**The dashboards presented below represent the land capability of all the soil forms associated with the footprint areas for the various projects. The implications of each project on the soil and land capability will be discussed individually in the subsections below.*

Agricultural land capability in South Africa is generally restricted by climatic conditions, with specific mention to water availability (Rainfall). 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 crops yields when treated and managed according to best possible farming practices (Scotney *et al*., 1987).

For the purpose of this assessment, land capability was inferred in consideration of observed limitations to land use due to physical soil properties and prevailing climatic conditions. Climate Capability (measured on a scale of 1 to 8) was therefore considered in the agricultural potential classification. The MRA falls into Climate Capability Class 5, with moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.

The identified soils were classified into land capability and land potential classes using the Camp *et. al*, and Guy and Smith Classification system (Camp *et al.,* 1987; Guy and Smith, 1998), as presented from Figure **6** below. The identified land capability limitations for the identified soils are discussed in comprehensive “dashboard style” summary tables presented in Tables **6** to **9** below. The dashboard reports aim to present all the pertinent information in a concise and visually appealing manner.

Table 5: Identified soil forms within the project area and their respective land capability.

<table>
<tr><th>Soil Form</th><th>Land capability</th><th>Area (ha)</th><th>Land Potential</th><th>Percentage</th></tr>
<tr><td>Bonheim</td><td>Arable (Class III)</td><td>28.73 ha</td><td>L4: Moderate Potential</td><td>65.5</td></tr>
<tr><td>Arcadia</td><td>Grazing (Class V)</td><td>0.24 ha</td><td rowspan="5">L5: Restricted potential</td><td>0.5</td></tr>
<tr><td>Mispah</td><td rowspan="4">Grazing (Class VI)</td><td rowspan="4">13.98ha</td><td rowspan="4">30.8</td></tr>
<tr><td>Mispah/Outcrop</td></tr>
<tr><td>Etosha</td></tr>
<tr><td>Gamoep</td></tr>
<tr><td>Witbank</td><td>Wilderness (Class VIII)</td><td>2.47ha</td><td>L8: Very low potential</td><td>5.4</td></tr>
<tr><td>Total Enclosed Area</td><td></td><td>45.42*</td><td></td><td>100*</td></tr>
</table>

***infrastructure accounts for 0.9*ha of the investigated footprint area**

Table 6: Summary discussion of the Arable (Class III) land capability class (High potential with moderate limitations)

<table>
<tr><th colspan="5">Land Capability: Arable (Class III) and High potential with moderate limitations</th></tr>
<tr><td colspan="5">  </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2"><0.3% Relatively flat</td><td>Photograph notes</td><td>View of the yellow brown apedal, soft plinthic and hard plinthic horizons associated with the Bonheim soils occurring within the project area</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Bonheim</td><td>Area Extent</td><td>28.73 ha (65.5%)</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">The occurrence an impermeable layer at somewhat shallow depth is the primary land capability limitation of the Bonheim soil form as this horizon cannot be cut with a spade even when wet.</td><td colspan="2" rowspan="2">Land Capability and Land Potential
The identified soil forms are of moderate (Class III) land capability, and suitable for arable agricultural land use with restrictions. Therefore, these soils are considered to make a moderate contribution to agricultural productivity on a regional and national scale.</td></tr>
<tr><td>Land Potential</td><td colspan="2">L3: Good potential: Infrequent and/or moderate limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>MH</td><td rowspan="2">The identified Bonheim soil forms are considered somewhat suitable for cultivation (class III). Therefore, these soils are considered to have the potential contribute to reginal and provincial agricultural production grid if managed properly, and are essentially also well-suited for other less intensive land uses such as grazing, forestry, etc. However, emphasis is directed to their agricultural crop productivity due to the scarcity of such soil resources on a national scale and food security concerns.

Although no agricultural activities were identified with the proposed TSF area, this area has been historically used for cultivation, thus indicating its suitability for cultivation. This can be attributed to the soil effective rooting depth which was found to be somewhat deep. The clay content however increases in the subsoil, thus limiting rooting growth for most crops.</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
These soils are regarded ideal for cultivated agriculture of selective crops, however the viability of agricultural crop cultivation of these soils in area is low due to land fragmentation by current mining and associated activities in the surrounding areas. In addition, these soils also cover a small area which is not sufficient for commercial agricultural production However, mitigation measures should be implemented accordingly.

The impact of the proposed TSF development on the land capability of these soils is anticipated to be within acceptable levels, given the lack of high potential agricultural soils as well as the limiting climatic conditions (MAP less than 600 mm). Although the identified soils are not considered as prime agricultural soils, these soils may be important for potential small-scale grazing opportunities.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>ML</td></tr>
</table>

Table 7: Summary discussion of the Grazing (Class V) land capability class

<table>
<tr><th colspan="5">Land Capability: Grazing - Class V</th></tr>
<tr><td colspan="5">  </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Gently sloping terrain and valley bottom landscapes of < 1% slope gradient</td><td>Photograph notes</td><td>View of the identified Acardia soil form</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Arcadia (Ar)</td><td>Areal Extent</td><td>0.24 ha (0.5%)</td></tr>
<tr><td>Diagnostic Horizon Sequence</td><td colspan="2">0-22 cm: Vertic A
≥ 22 cm: Unspecified</td><td colspan="2" rowspan="3">Land Capability
The identified Arcadia soil form is considered a poor (class V) land capability soil, which is generally not considered suitable to arable agricultural land use. The inherently high natural fertility of these soils is considered of significant value for grazing purposes. Traditionally these soils are ploughed for subsistence farming for shallow rooted arable crops like vegetables under resource-poor circumstances, due to their limiting factors such as high clay content which tightly holds soil water such that it is not readily available for plant uptake.</td></tr>
<tr><td>Land Potential</td><td colspan="2">L5 (Restricted potential): Regular and/or moderate to severe limitations due to soil, slope, temperature, or rainfall.</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">Vertic soils inherently have some very significant management constraints attributed to excessive stickiness when wet and hardening when dry due to high smectitic (expandable) clay minerals and high plasticity index values.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>ML</td><td rowspan="2">The overall impact of the proposed mining and related activities on the land capability of these soils is anticipated to be moderate (M). While these soils are not considered prime agricultural soils, historical cultivation activities have occurred as well as livestock grazing which has therefore qualified these soils for cultivation under intensive management. With mitigation measure the impact will effectively be reduced to a low level, so as to ensure that the local and regional food production supply is not disrupted.</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
The susceptibility of these soils to shrink under dry conditions and expand under moist conditions should also be considered and avoided where possible as this may cause undesired damage on the structural integrity of the surface infrastructure. Furthermore, these soils are highly sensitive and can be severely impacted by long-term stockpiling and their structural integrity is anticipated to deteriorate during stockpiling while awaiting rehabilitation.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 8: Summary discussion of the Grazing (Class VI) land capability class

<table>
<tr><th colspan="5">Land Capability: Grazing (Class VI) and Restricted land potential.</th></tr>
<tr><td colspan="5">  </td></tr>
<tr><td colspan="2">Terrain Morphological Unit (TMU)</td><td>Gently landscapes of < 0.5% slope gradient</td><td>Photograph notes</td><td>View of the Glenrosa/Mispah horizon occurring within the soil profiles of watercourse/wetland related soil forms</td></tr>
<tr><td colspan="2">Soil Form(s)</td><td>Immerpan/Mispah</td><td>Area Extent</td><td>13.98ha (30.8%)</td></tr>
<tr><td colspan="2">Physical Limitations</td><td>Effective rooting depth is the primary limitation of the land capability of the Mispah soil forms, due to the occurrence of a rocky layer at relatively shallow depth. Arcadia soils inherently have serious management constraints attributed to excessive stickiness when wet and hardening when dry due to high smectitic (expandable) clay minerals and high plasticity index values. Immerpan soils were found to be highly weathered and have a high erosion hazard, particularly the topsoil layer. All identified soil forms are, at best, suited for grazing and/or wilderness practices.</td><td colspan="2" rowspan="2">Land Capability and Land Potential
The Lithic soils (Glenrosa/Mispah) are also considered to be of poor (Class VI) land capability and are not suitable for arable agriculture. These soils are therefore considered to have restricted land potential.</td></tr>
<tr><td colspan="2">Land Potential</td><td>L5 (Restricted potential): Regular and/or moderate to severe limitations due to soil, slope, temperature, or rainfall.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>ML</td><td rowspan="2">The overall impact of the proposed development and related activities on the land capability of these soils is anticipated to be relatively medium-low with mitigation due to their inherently poor land capability. If this area is clearly demarcated the impact could potentially be reduced to low since the adjacent area could potentially be used as grazing land by subsistence farmers in the neighbouring communities.</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
The identified soils are generally not considered to be of significant agricultural productivity. These soils, at best are suited for grazing. The proposed mining development is viable on these soils due to their low agricultural potential although their importance in terms of biodiversity support must be considered. Mitigation measures should this put in place to minimise further disruption of other adjacent soils which can potentially be used for grazing.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 9: Summary discussion of the Wildlife/Wilderness (Class VIII) land capability class

<table>
<tr><th colspan="5">Land Capability: Wildlife/Wilderness (Class VIII)</th></tr>
<tr><td colspan="5"> </td></tr>
<tr><td colspan="2">Terrain Morphological Unit (TMU)</td><td>These soils are largely dominant in the crest to the medium gradient mountains</td><td>Photograph notes</td><td>View of the morphology of the identified Mispah/Outcrop soil forms</td></tr>
<tr><td colspan="2">Soil Form(s)</td><td>Mispah/Outcrop</td><td>Area Extent</td><td>2.47ha (5.4)</td></tr>
<tr><td colspan="2">Diagnostic Horizon Sequence</td><td>0-35 cm: Orthic A/exposed rock
≥ 35 cm: Miscellaneous hard rocky material</td><td colspan="2" rowspan="3">Land Capability
The identified Mispah/Outcrop soil forms are of poor (class VIII) land capability and are not suitable for arable agricultural land use. Theses soils are, at best, suitable for wildlife and wilderness. Therefore, these soils are not considered to contribute to agricultural production.</td></tr>
<tr><td colspan="2">Land Potential</td><td>L5 (Restricted potential): Regular and/or moderate to severe limitations due to soil, slope, temperature, or rainfall.</td></tr>
<tr><td colspan="2">Physical Limitations</td><td>No soil and shallow depth of these soils hinders penetration of plant roots.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>L</td><td rowspan="2">The overall impact of the proposed mining activities on the land capability of these soils is anticipated to be Low (L) due to the limited potential grazing opportunities. These soils are however not ideal for cultivated agriculture due to their low yield contribution to regional and provincial agricultural production</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
These soils, at best, suited for wildlife/wilderness practices. This is due to the exposed bedrock/ and/or relatively shallow parent rock material. The impact of the proposed mining and related activities on the land capability of these soils is anticipated to be low after mitigation. As much as these soils are not considered ideal for agriculture, these soils are important for potential light grazing opportunities and biodiversity support. Therefore, implementation of rehabilitation and the proposed integrated mitigation measures is recommended to reinstate the natural topography of the area post mining.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>VL</td></tr>
</table>

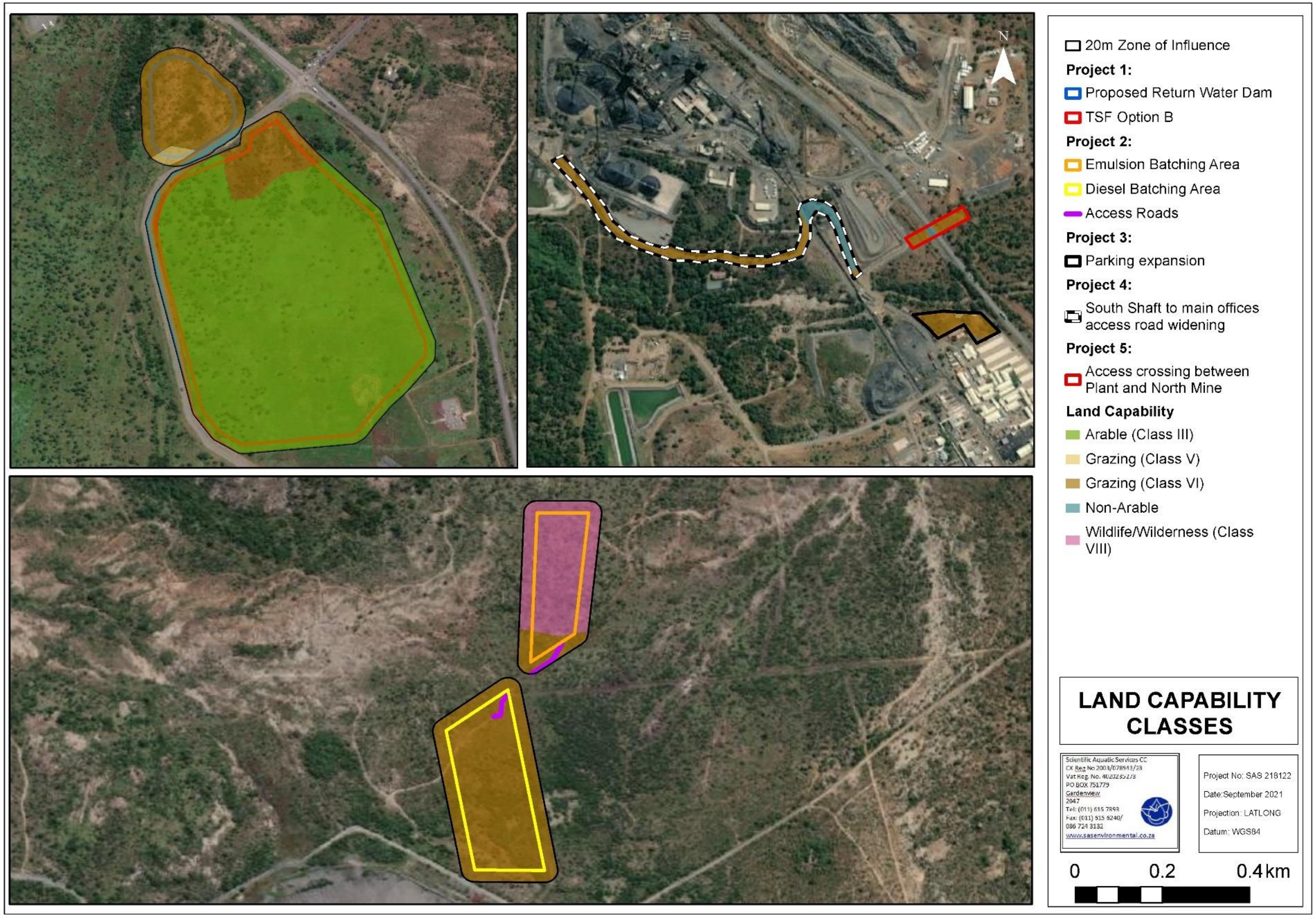

Figure 6: Map depicting the land capability classes of the soils associated with the proposed development

4.3.1 Project 1: New Tailings Storage Facility

The TSF and Return Water Dam area is largely dominated by arable soils which have been historically subjected to cultivation but have since been laid to fallow. It is evident that these soils are capable of supporting agriculture. It should however be noted that the extent of these soils is small to support commercial scale cultivated agriculture. The best suited farming scale in this instance is subsistence farming or grazing. The overall impact of project 1 on the local, regional, provincial and national scale is anticipated to be limited given that the soils occur in a small patch and that they are not actively being used for agriculture.

4.3.2 Project 2: Diesel Storage and Emulsion Batching Site

The diesel storage and emulsion batching sites are located within shallow soils which were classified as Glenrosa/Mispah soil forms. These soils are of poor (class VII) land capability and are not suitable for arable agricultural land use. At best, these soils are suitable for natural pastures for light grazing.

The proposed Project 2 will most likely result in the clearance of vegetation as part of the construction phase which will lead to loss of soil through erosion and subsequent loss of land capability. Given the small footprint of this project, the loss of land capability is not anticipated to be significant, provided that the project occurs within the demarcated areas and mitigation measures are implemented during all phases of development. The extent of the access road required for this project will be limited since this project is located adjacent the current TRP mines new TSF pipeline and service road. The TSF maintenance road will serve as the main access road and as such the impact of the access road will be negligibly low.

4.3.3 Projects 3, 4 and 5: Main Parking Extension, Widening of Access Road between South Shaft/Main Offices and Plant, and Access Crossing between Plant and North Mine respectively

The proposed projects are located within the existing mine operational footprint where soils have already been subjected to significant disturbance associated with mining and related infrastructure. The extension of the existing infrastructure will not lead to a significant losses of land capability given the disturbance that has occurred on the surrounding soils. Impact such as soil erosion, compaction and soil contamination will likely occur during the construction phase which will lead to further degradation of the surrounding soils and the subsequent loss of land capability. However, the overall impact significance of the proposed project will be negligibly low, after mitigation measures have been put in place during all phases of development.

5. IMPACT ASSESSMENT AND MITIGATION MEASURES

All of the footprint areas earmarked for the various projects are not under current cultivation, and have never been utilised for agricultural purposes except for the TSF area which has previously been cultivated (for subsistence purposes) but has since been laid to fallow. Low impact is foreseen on these soils from a land capability point of view after mitigation measures have been carefully implemented during all phases of development. The dominant soils have little bearing on agricultural productivity, with limited to no contribution to the local, regional, provincial as well as national food production.

Several potential risks to the receiving environment by the proposed expansion of the TSF have been identified and are presented in the bullets below:

- Vegetation clearing within the proposed TSF areas as part of site preparation prior to commencement mining and related of activities, leading to soil disturbances and risk of erosion of exposed soils;
- Potential risk of soil erosion and disposal of waste on soil resources, leading to altered soil chemistry and quality;
- Contamination resulting from spillages of hydrocarbons and heavy metals; and
- Movement of heavy machinery / construction vehicles off existing/demarcated roads, leading to soil compaction.

5.1 *Mining Activities*

The potential impact triggers at various phases of the proposed development are presented in Table 10 below.

Table 10: Summary of the anticipated Activities for the proposed development

Phase	Activities
Construction	- Land and footprint clearing; - Topsoil stripping and stockpiling; and - Establishment of surface infrastructure.
Operational	- Operation of infrastructure
Closure	- Rehabilitation of footprint areas - Dismantling and decommissioning of infrastructure; and - Earth moving, shaping, and ripping of ground.

5.1.1 Impact: soil erosion

Parameters determining the extent and severity of soil erosion are highly complex, with water and wind as the main geomorphic agents, and soil erosion is largely dependent on land use and soil management and is generally accelerated by human activities such as tillage practices.

The MRA is characterised by steep and gradual slopes, consisting of shallow and moderately deep soils respectively. The areas where the infrastructure is proposed are mostly gradual, however the exploration activities will be located among the mountainous setting and this is where erosion is considered moderately high. The natural and undisturbed soils will become more vulnerable to erosion once the vegetation is cleared for construction activities, and the soils will inevitably be exposed to wind and some surface runoff during intensive rainfall events. The significance of this impact is anticipated to be moderate and will be reduced to moderately low impact if mitigation measures outlined in this document are adhered to, as illustrated on the impact rating table below.

Aspects and activities register

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potential poor planning leading to excessive placement of infrastructure outside of the demarcated infrastructure areas.	Site clearing, removal of vegetation, and associated disturbances to soils, leading to, increased runoff, erosion and consequent sedimentation of down gradient receiving environment, and loss of land capability in cleared areas.	Constant disturbances of soils, resulting in reduced soil quality and land capability, and risk of erosion, attributed to mining and exploration activities.	Disturbance of soils as part of demolition activities as well as backfilling, which may lead to further loosening of soil in undisturbed areas and the formation of Witbank soils (Anthrosols) which reduce long term land capability.
Potential poor planning and control mechanisms leading to excessive vegetation clearance within infrastructure	Stockpiling of topsoil material on sloping areas leading to increased runoff and erosion.	Potential ineffective rehabilitation may lead to terrestrial habitat transformation, which will ultimately lead to lower soil quality	Decommissioning activities may lead to habitat transformation and increased alien plant species proliferation, and potential changing the nutrient status of the soils.

Impact assessment results for Project 1 (the proposed development of a new Tailings Storage Facility)

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	3	2	4	9	9	81 (Medium-high)
Operational phase	5	4	3	1	4	9	9	81 (Medium-high)
Decommissioning and Closure	5	4	2	1	4	9	7	63 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	3	2	2	6	7	42 (Low)
Operational phase	3	3	3	1	2	6	6	30 (Low)
Decommissioning and Closure	3	2	3	1	2	5	6	30 (Low)

Impact assessment results for Project 2 (diesel and emulsion batching)

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	3	2	2	4	8	8	64 (Medium-Low)
Operational phase	4	2	2	2	4	6	8	56 (Medium-Low)
Decommissioning and Closure	4	2	2	2	4	6	8	56 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	3	2	2	6	7	42 (Low)
Operational phase	3	2	3	1	2	5	6	30 (Low)
Decommissioning and Closure	3	2	3	1	2	5	6	30 (Low)

Impact assessment results for Project 3,4 & 5 (main parking extension, widening of access road between south shaft/Main offices and plant; and access crossing between plant and north Mine)

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	3	2	2	4	8	8	64 (Medium-Low)
Operational phase	5	3	2	2	4	8	8	64 (Medium-Low)
Decommissioning and Closure	4	3	2	2	4	7	8	56 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	2	2	2	6	6	36 (Low)
Operational phase	2	2	2	2	2	4	6	24 (Very Low)
Decommissioning and Closure	3	2	2	2	2	5	6	30 (Low)

5.1.2 Impact: Soil compaction

Heavy equipment traffic during construction and exploration activities is anticipated to cause soil compaction. The severity of this impact is anticipated to be medium-high for Acardia soils due to clayey texture. Whereas soils with a relatively shallow bedrock and lithocutanic character (partly weathered rock material) such as the Glenrosa/Mispah soil forms are anticipated to be less impaired due to the resistance offered by the underlying bedrock.

Aspects and activities register

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potential poor planning leading to excessive or unnecessary placement of infrastructure, laydown areas on compaction prone soil resources	Topsoil stockpiling on to high clay content soils such as Acardia s (black turf) soils, leading to compaction of underlying soil material	Ongoing disturbances to soils, resulting from mining and related activities, leading to further soil compaction and subsequent impact on soil structure	Disturbance of soils as part of demolition activities and backfilling.
	Earthworks laid on the soil surface leading to increased soil compaction and crusting of topsoil.	Ineffective rehabilitation may lead to significant soil transformation leading to lower infiltration rate, and consequently increased surface	Decommissioning activities may lead to further soil compaction and increased runoff.

Impact assessment results for Project 1 (the proposed development of a new Tailings Storage Facility)

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	3	2	4	9	9	81 (Medium-high)
Operational phase	5	4	3	1	4	9	9	81 (Medium-high)
Decommissioning and Closure	5	4	2	1	4	9	7	63 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	3	2	2	6	7	42 (Low)
Operational phase	3	3	3	1	2	6	6	30 (Low)
Decommissioning and Closure	3	2	3	1	2	5	6	30 (Low)

Impact assessment results for Project 2 (diesel and emulsion batching)

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	3	2	2	4	8	8	64 (Medium-Low)
Operational phase	4	2	2	2	4	6	8	56 (Medium-Low)
Decommissioning and Closure	4	2	2	2	4	6	8	56 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	3	2	2	6	7	42 (Low)
Operational phase	3	2	3	1	2	5	6	30 (Low)
Decommissioning and Closure	3	2	3	1	2	5	6	30 (Low)

Impact assessment results for Project 3,4 & 5 (main parking extension, widening of access road between south shaft/Main offices and plant; and access crossing between plant and north Mine

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	3	2	2	4	8	8	64 (Medium-Low)
Operational phase	5	3	2	2	4	8	8	64 (Medium-Low)
Decommissioning and Closure	4	2	2	2	4	6	8	38 (Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	2	2	2	1	2	4	5	20 (Very Low)
Operational phase	2	2	2	1	3	4	6	24 (Very Low)
Decommissioning and Closure	1	2	2	1	3	3	6	18 (Very Low)

5.1.3 Impact: Potential Soil Contamination

All the identified soils are considered equally predisposed to potential contamination (i.e. hydrocarbons), as contamination sources are generally unpredictable and often occur as incidental spills or leak for construction developments. The significance of soil contamination is medium-high for all identified soils, largely depending on the nature, volume and/or concentration of the contaminant of concern. Therefore, strict waste management protocols and activity specific Environmental Management Programme (EMP) guidelines should be adhered to during the construction activities.

Aspects and activities register

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potential poor planning leading to excessive or unnecessary placement of infrastructure high potential agricultural soils	Spillage of petroleum hydrocarbons during construction of new facilities	Ongoing disturbances to soils, resulting in increased leaching of soil nutrients and risk of erosion, attributed to mining activities.	Contamination of soils during demolition activities.
	Soil contamination through leakages of hydrocarbons resulting from construction machinery	Seepage and runoff from mining infrastructure (e.g. overburden) to the surrounding soils.	Decommissioning activities may lead to soil transformation and increased alien plant species proliferation, which will ultimately alter the chemical composition of the soil.

Impact assessment results for Project 1 (the proposed development of a new Tailings Storage Facility)

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	3	2	4	9	9	81 (Medium-high)
Operational phase	5	4	3	2	4	9	9	81 (Medium-high)
Decommissioning and Closure	5	4	2	1	4	9	7	63 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	3	2	2	6	7	42 (Low)
Operational phase	3	3	3	1	2	6	6	30 (Low)
Decommissioning and Closure	3	2	3	1	2	5	6	30 (Low)

Impact assessment results for Project 2 (diesel and emulsion batching)

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	3	2	2	4	8	8	64 (Medium-Low)
Operational phase	4	2	2	2	4	6	8	56 (Medium-Low)
Decommissioning and Closure	4	2	2	2	4	6	8	56 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	3	2	2	6	7	42 (Low)
Operational phase	3	2	3	1	2	5	6	30 (Low)
Decommissioning and Closure	3	2	3	1	2	5	6	30 (Low)

Impact assessment results for Project 3,4 & 5 (main parking extension, widening of access road between south shaft/Main offices and plant; and access crossing between plant and north Mine

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	3	2	2	4	8	8	64 (Medium-Low)
Operational phase	5	3	2	2	4	8	8	64 (Medium-Low)
Decommissioning and Closure	4	2	2	2	4	6	8	38 (Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	2	2	2	1	2	4	5	20 (Very Low)
Operational phase	2	2	2	1	3	4	6	24 (Very Low)
Decommissioning and Closure	1	2	2	1	3	3	6	18 (Very Low)

5.1.4 Impact: Loss of Agricultural Land Capability

The land capability loss is anticipated to range between medium low for Bonheim due to the limited areal extent of these soils, and low for Mispah and Glenrosa as these soils are not considered ideal for cultivation, attributable to their shallow nature and high erosion hazard. From a land capability perspective, Witbank (Anthrosols) soils have no bearing on agricultural production, and as such the impacts on these soils is anticipated to be low.

Aspects and activities register

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potential poor planning leading to excessive or unnecessary placement of infrastructure high potential agricultural soils	Site clearing, the removal of vegetation, and associated disturbances to soils, leading to increased nutrient leaching, runoff and erosion and consequent sedimentation	Ongoing disturbances to soils, resulting in increased leaching of soil nutrients and risk of erosion, attributed to mining activities.	Compaction and contamination of soils during demolition activities and backfilling.
	Loss of topsoil as a growth medium inadequate rehabilitation efforts.	Soil surface crusting and sealing of exposed soils, particularly high clay content soils	Decommissioning activities may lead to soil transformation and increased alien plant species proliferation, which will ultimately alter the chemical composition and nutrient status of the soil.

Impact assessment results for Project 1 (the proposed development of a new Tailings Storage Facility)

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	4	3	2	4	9	9	81 (Medium-high)
Operational phase	5	4	3	2	4	9	9	81 (Medium-high)
Decommissioning and Closure	5	4	2	1	4	9	7	63 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	3	2	2	6	7	42 (Low)
Operational phase	3	3	3	1	2	6	6	30 (Low)
Decommissioning and Closure	3	2	3	1	2	5	6	30 (Low)

Impact assessment results for Project 2 (diesel and emulsion batching)

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	3	2	2	4	8	8	64 (Medium-Low)
Operational phase	4	2	2	2	4	6	8	56 (Medium-Low)
Decommissioning and Closure	4	2	2	2	4	6	8	56 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	3	2	2	6	7	42 (Low)
Operational phase	3	2	3	1	2	5	6	30 (Low)
Decommissioning and Closure	3	2	3	1	2	5	6	30 (Low)

Impact assessment results for Project 3,4 & 5 (main parking extension, widening of access road between south shaft/Main offices and plant; and access crossing between plant and north Mine

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	5	3	2	2	4	8	8	64 (Medium-Low)
Operational phase	5	3	2	2	4	8	8	64 (Medium-Low)
Decommissioning and Closure	4	2	2	2	4	6	8	38 (Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	2	2	2	1	2	4	5	20 (Very Low)
Operational phase	2	2	2	1	3	4	6	24 (Very Low)
Decommissioning and Closure	1	2	2	1	3	3	6	18 (Very Low)

5.2 *Topsoil Stripping and Stockpile Management*

- The available topsoil at the TSF is up to 80cm. Topsoil should be stripped to a maximum without impacting the integrity of the facility;
- The topsoil associated with the RWD infrastructure should be stripped to 30cm or in manner that does not compromise the design and will not lead to infrastructural damage;
- Excavation and long-term stockpiling of soil should be undertaken within the demarcated areas and stockpiles clearly labelled as topsoil where access is restricted;
- Restrict the amount of mechanical handling, as far as possible, as each handling event increases that compaction level and the changes to the soil structure. Wherever possible, the 'cut and cover' technique (where the stripped soils is immediately placed in an area already prepared for rehabilitation, thus avoiding stockpiling) should be used;
- Stockpile height should be restricted to that which can deposited without additional traversing by machinery. Stockpiles should be treated with temporary soil stabilisation methods, such as the application of organic matter to promote soil aggregate formation, leading to increased infiltration rate, thereby reducing soil erosion.
- The use of lime to stabilise soil pH levels will be required in some instances;
- Soil erosion should be controlled on stockpiles by having control measures to reduce erosion risk such as erosion control blankets;
- Temporary berms can be installed, around stockpile areas whilst vegetation cover has not established to avoid soil loss through erosion; and
- The recovered soils should be re-used to rehabilitate the mine footprint following mine closure.

5.3 *Estimation of Available Topsoil*

This section aims to provide indication of the available soft material (soil medium) for rehabilitation phase. It should be noted the volumes of soil provided below are estimated, hence the calculations were based on the average depth of the occurring soils. The following approach was used:

$$\textbf{Soil Volume} = \textbf{Area} \times \textbf{Average Depth}$$

Table 11: Estimation of available soft material for soils to be directly impacted by the proposed open cast pits

Soil Form	Land capability	Area (m2)	Average Depth (m)	Volume (m3)	Level of Confidence (%)
Bonheim	Arable (Class III)	287300	0.9	258 570	80
Arcadia	Grazing (Class V)	2400	0.8	1 920	80

Mispah Mispah/Outcrop Etosha Gamoep	Grazing (Class VI)	139800	0.35	48 930	70
Witbank	Wilderness (Class VIII)	24700	1	24700	50
Total Area and volumes		**454200**	**0.8**	**334120**	**70**

6. MITIGATION MEASURES

Soil Erosion and Dust Emission Management

- The footprint areas should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint as far as practically possible;
- Bare soils can be regularly dampened with water to suppress dust, especially when strong wind conditions are predicted according to the local weather forecast; and
- All disturbed areas adjacent to the footprint areas can be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, to minimise soil erosion and dust emission.

Soil Compaction management

- All vehicular traffic should be restricted to the existing service roads and the selected road servitude as far as practically possible; and
- Compacted soils adjacent to the mining blocks and associated infrastructure footprint can be lightly ripped to at least 25 cm below ground surface to alleviate compaction prior to re-vegetation.

Soil Contamination Management

- Contamination prevention measures should be addressed in the Environmental Management Programme (EMP) for the proposed development, and this should be implemented and made available, and accessible always to the contractors and construction crew conducting the works on site for reference;
- A spill prevention and emergency spill response plan, as well as dust suppression, and fire prevention plans should also be compiled to guide the construction works;
- An emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur, as well as preventative measures to prevent ingress; and
- Burying of any waste including rubble, domestic waste, empty containers on the site should be strictly prohibited and all construction rubble waste must be removed to an approved disposal site.

Loss of Natural Topography and Drainage Pattern Management

- Footprint areas should be accessed through existing road network, where feasible to avoid unnecessary excavation;
- Excavation and long-term stockpiling of soil should be limited within the demarcated areas as far as practically possible;
- Restrict the amount of mechanical handling, as each handling event increases that compaction level and the changes to the soil structure. Wherever possible, the 'cut and cover' technique (where the stripped soils is immediately placed in an area already prepared for rehabilitation, thus avoiding stockpiling) should be used;

Stockpile Management

- Excavation and long-term stockpiling of soil should be limited within the demarcated areas;
- Ensure all stockpiles (especially topsoil) are clearly and permanently demarcated and located in defined no-go areas;
- Restrict the amount of mechanical handling, as each handling event increases that compaction level and the changes to the soil structure. Wherever possible, the 'cut and cover' technique (where the stripped soils is immediately placed in an area already prepared for rehabilitation, thus avoiding stockpiling) should be used;
- Separate stockpiling of different soil to obtain the highest post-mining land capability;
- Stockpile height should be restricted to that which can deposited without vehicles moving over previously dumped topsoil. Typically this would be a maximum height that can be achieved by the model of vehicles moving and dumping the topsoil. This guideline should be juxtaposed with the impact of an increased topsoil dump footprint created due to reducing the height of the dump and the associated impact on agriculture and/or biodiversity The stockpile should be treated with temporary soil stabilisation methods; such as the application of organic matter to promote soil aggregate formation, leading to increased infiltration rate, thereby reducing soil erosion. Also, the use of lime to stabilise soil pH levels;
- Stockpiled soils should be stored for a maximum of 3-5 years to ensure that the soil quality does not deteriorate. In addition, concurrent rehabilitation must strongly be considered to reduce the duration of stockpile storage to ensure that the quality of stored soil material does not deteriorate excessively; especially with regard to leaching and acidification

- Soil erosion should be controlled on stockpiles by having control measures to reduce erosion risk such as erosion control blankets, soil binders, revegetation, contours, diversion banks and spillways;
- The topsoil stockpile should be vegetated and while vegetating, measures will be needed to contain erosion of the stockpile during rain events; and
- The recovered soils should be re-used to rehabilitate the mine footprint following mine closure.

Loss of Land Capability Management

- Direct surface disturbance of soils should be avoided where possible;
- The footprint as well as areas affected by edge effect should be ripped to alleviate compaction;
- Stored topsoil should be replaced (if any) and ameliorated according to soil chemical analysis;
- The recovered soils should be re-used to rehabilitate the mine footprint following mine closure.

7. CONCLUSION

Scientific Aquatic Services (SAS) was appointed to conduct a soil, land use and land capability assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed five new projects within the existing Dwars River Chrome Mine Mining Rights Area.

All of the footprint areas earmarked for the various projects are not under current cultivation, and have never been utilised for agricultural purposes except for the TSF area which has previously been cultivated (for subsistence purposes) but has since been laid to fallow. Scrutiny of the satellite imagery was made, and it was evident that the dominant land uses in the surrounding areas are mining and wilderness, with very few residential areas northeast of the MRA. No cultivated agriculture was observed within the immediate vicinity of the MRA.

The findings of this assessment suggest that the relevant limiting factors within the project site for land capability and land use potential include the following:

- Shallow effective rooting depth due to shallow indurated bedrock of the Coega, Mispah and Glenrosa. As such, these soils are not considered to contribute significantly to agricultural productivity; and

- Limited rainfall throughout the year, excessive heat leading to crop permanent wilting, and lack of irrigation options for irrigated agriculture; and
- High temperatures occurring in this area which are likely to cause crop permanent wilting, thus affecting crop yield.

Overall, the footprint areas comprise of relatively small areas where arable soils with a moderate potential for agriculture, whilst the rest of the footprint area is comprised on very shallow soils not considered suitable for agricultural production. The extent of arable Bonheim soils therefore cannot be considered sufficient for viable cultivated small commercial farming. In addition, lack of rainfall (less than 600 mm per annum) further disqualifies the area from being ideal for agricultural production. Furthermore, high temperatures occurring in this area are also likely to cause crop permanent wilting, thus affecting crop yield. Given these constraints the extent of the high productivity soils is not considered sufficient for viable cultivated commercial farming. Based on the above-mentioned limiting factors the proposed project is anticipated to have a relatively low cumulative loss of arable land and medium low cumulative loss of natural grasslands for grazing and/or ecological conservation.

Livestock commercial farming is not considered an optimum land use for the footprint areas due to the veld being classified as having a grazing capacity of 6 ha Per Large Animal Unit. This can be attributed to the scarcity of vegetation as well as lack of palatable grasses.

From a soil, land use and land capability point of view, this project is not regarded as being fatally flawed due to various natural constraints posed by the local soil types and climate for commercial agricultural production, however mitigation measures and recommendations outlined in this document need to be strongly considered and implemented accordingly in efforts to conserve soil resources and general pedological processes important in terms of sustainable development.

The proposed Project 2 will most likely result in the clearance of vegetation as part of the construction phase which will lead to loss of soil through erosion and subsequent loss of land capability. Given the small footprint of this project, the loss of land capability is not anticipated to be significant, provided that the project occurs within the demarcated areas and mitigation measures are implemented during all phases of development. The extent of the access road required for this project will be limited since this project is located adjacent the current TRP mines new TSF pipeline and service road. The TSF maintenance road will serve as the main access road and as such the impact of the access road will be negligibly low.

The proposed projects (3,4 & 5) are located within the existing mine operational footprint where soils have already been subjected to significant disturbance associated with mining and related infrastructure. The extension of the existing infrastructure will not lead to a significant losses of land capability given the disturbance that has occurred on the surrounding soils. Impact such as soil erosion, compaction and soil contamination will likely occur during the construction phase which will lead to further degradation of the surrounding soils and the subsequent loss of land capability. However, the overall impact significance of the proposed project will be negligibly low, after mitigation measures have been put in place during all phases of development.

It is the opinion of the specialist therefore that this study provides the relevant information to ensure that appropriate consideration of the agricultural resources in the project site will be made in support of the principles of Integrated Environmental Management (IEM) and sustainable development.

8. REFERENCES

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Morgenthal, T.L., Newby, T., Smith, H.J.C., and Pretorius, D.J. (2004). Developing and refinement of a grazing capacity map for South Africa using NOAA (AVHRR) satellite derived data. Report GW/A/2004/66. ARC Institute for Soil, Climate and Water, Pretoria.

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Scientific Aquatic Services, 2018. Soil, Land Use and Land Capability Assessment as Part of The Environmental Assessment and Authorisation Process for The Proposed Exploration and Expansion at Dwarsriver Chrome Mine, Limpopo Province.

APPENDIX A: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Braveman Mzila BSc (Hons) Environmental Hydrology (University of KwaZulu-Natal)

Stephen van Staden MSc (Environmental Management) (University of Johannesburg)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	2007	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

1. (b) A declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, 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 relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, 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

Signature of the Project Manager

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist with focus on Freshwater Ecology
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust and emerald Management Trust

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP);
Accredited River Health practitioner by the South African River Health Program (RHP);
Member of the South African Soil Surveyors Association (SASSO);
Member of the Gauteng Wetland Forum;
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc (Environmental Management) (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000
Tools for Wetland Assessment short course Rhodes University	2016

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leone
Central Africa – Democratic Republic of the Congo

PROJECT EXPERIENCE (Over 2500 projects executed with varying degrees of involvement)

1 Mining: Coal, Chrome, PGM's, Mineral Sands, Gold, Phosphate, river sand, clay, fluorspar
2 Linear developments
3 Energy Transmission, telecommunication, pipelines, roads
4 Minerals beneficiation
5 Renewable energy (wind and solar)
6 Commercial development
7 Residential development
8 Agriculture
9 Industrial/chemical

REFERENCES

- Terry Calmeyer (Former Chairperson of IAIA SA)
  Director: ILISO Consulting Environmental Management (Pty) Ltd
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- Marietjie Eksteen
  Managing Director: Jacana Environmental
  Tel: 015 291 4015

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF AMANDA MILESON

PERSONAL DETAILS

Position in Company	Ecologist
Date of Birth	15 February 1978
Nationality	Zimbabwean
Languages	English
Joined SAS	2013

MEMBERSHIP IN PROFESSIONAL SOCIETIES

South African Wetland Society

Gauteng Wetland Forum

Society of Wetland Scientists

EDUCATION

Qualifications	
N.Dip Nature Conservation (UNISA)	2017
Tools for Wetland Assessment (Rhodes University)	2017
Wetland Rehabilitation (University of the Free State)	2015

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Free State, North West, Limpopo, Northern Cape, Eastern Cape

Zimbabwe

SELECTED PROJECT EXAMPLES

Wetland Assessments

- Baseline Aquatic and Freshwater Assessment as part of the Environmental Assessment and Authorisation Process for the N11 Ring Road, Mokopane, Limpopo Province.
- Freshwater Resource Ecological Assessment as part of the Water Use License Application Requirements for the Proposed Upgrades to the Klippan Pump Station Near Welkom, Free State Province.
- Freshwater Resource Ecological Assessment as part of the Water Use License Application Requirements for the Proposed Urania-Bronville 11kv and 132kv Powerline Corridor Near Welkom, Free State Province.
- Freshwater Assessment for the Proposed Rietrug, Distribution Line: Basic Assessment for the proposed Construction of Electrical Grid Infrastructure to support the proposed (split) Rietrug Wind Energy Facility, near Sutherland, in the Northern Cape and Western Cape Provinces.
- Freshwater Assessment for the Proposed Sutherland 2 Distribution Line: Basic Assessment for the proposed Construction of Electrical Grid Infrastructure to support the proposed (split) Sutherland 2 Wind Energy Facility, near Sutherland, in the Northern Cape and Western Cape Provinces.

- Freshwater Assessment for the Proposed Sutherland Distribution Line: Basic Assessment for the proposed Construction of Electrical Grid Infrastructure to support the proposed (split) Sutherland Wind Energy Facility, near Sutherland, in the Northern Cape and Western Cape Provinces.
- Freshwater resource delineation and ecological assessment as part of the proposed expansion of the Kudumane Mining Project, Northern Cape Province.
- Freshwater assessment as part of the environmental assessment and authorisation process for associate electrical infrastructure and a proposed pipeline for the Rooipunt Solar Thermal Power Park Project near Upington, Northern Cape.
- Present Ecological State of the Wetlands Report: Jukskei and Klip River Catchments: Monitoring and Managing the Ecological State of the Wetlands in the City of Johannesburg Metropolitan Area.
- Wetland assessment as part of the environmental assessment and authorisation process for the proposed Leandra underground coal mine.
- Freshwater ecological assessment as part of the water use licence application process for the proposed waste rock dump expansion for Impala Platinum Mine in Rustenburg, North-West Province.
- Wetland assessment as part of the water use licence application process for the Marula Platinum Mine, Limpopo Province.
- Wetland assessment as part of the environmental authorisation process for the Anglo Platinum Der Brochen Project, Limpopo Province.
- Wetland assessment as part of the environmental authorisation process for the proposed Yzermyn Coal Mining Project near Dirkiesdorp, Mpumalanga.
- Wetland assessment as part of the environmental authorisation process for the Mzimvubu Water Project, Eastern Cape.
- Wetland assessment as part of the proposed water management process at the Assmang Chrome Machadodorp Works, Mpumalanga.
- Wetland ecological assessment as part of the Section 24G application process for the Temba Water Purification Plant.

Terrestrial Assessments

- Investigation of specialist biodiversity aspects required by GDARD in the vicinity of the Apies River, downstream of the proposed construction of new outlet works at the Kudube (Leeuwkraal) Dam in Temba, Gauteng
- Terrestrial Ecological Scan as part of the environmental authorisation process for three proposed bridge upgrades near Edenvale, Gauteng
- Terrestrial Ecological Scan as part of the environmental authorisation process for the proposed Dalpark Ext 3 filling station development, Gauteng

Rehabilitation Projects

- Freshwater Resource Rehabilitation and Management Plan as part of the Environmental Authorisation Process for the Proposed Urania-Bronville 11kv and 132kv Powerline Corridor Near Welkom, Free State Province.
- Rehabilitation Plan as part of the Water Use License Application Requirements for the Proposed Upgrade of the Thabazimbi Wastewater Treatment Works (WWTW) Sewer Line, Limpopo Province.
- Wetland rehabilitation and management plan for The Hills EcoEstate, Midrand, Gauteng.
- Riparian rehabilitation and management plan for The Diepsloot River, Riversands, Gauteng.
- Riparian rehabilitation and management plan for the Apies River in the vicinity of the proposed construction of new outlet works at the Kudube (Leeuwkraal) Dam in Temba, Gauteng.

Environmental Control Officer

- Monthly specialist Environmental Control Officer (ECO) function for the monitoring of riparian crossings at Riversands Country Estate Development, Gauteng province.
- Weekly specialist Environmental Control Officer (ECO) function for the monitoring of emergency desilting and rehabilitation of existing stormwater retention dams on ERF 836 Kosmosdal ext 1, and portion 5 of ERF 115 Kosmosdal ext 4, near Centurion, Gauteng Province.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION
CURRICULUM VITAE OF BRAVEMAN MZILA

PERSONAL DETAILS

Position in Company	Wetland Ecologist and Soil Scientist
Date of Birth	03 January 1991
Nationality	South African
Languages	IsiZulu, English
Joined SAS	2017

EDUCATION

Qualifications

BSc (Hons) Environmental Hydrology (University of Kwazulu-Natal)	2013
BSc Hydrology and Soil Science (University of Kwazulu-Natal)	2012

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Kwa-Zulu Natal, Eastern Cape

SELECTED PROJECT EXAMPLES

Freshwater Resource Assessment

Freshwater Ecological Assessments

- Freshwater ecological assessment as part of the water use authorisation relating to stormwater damage of a tributary of the Sandspruit, Norwood, Gauteng province.
- Wetland verification as part of the environmental assessment and authorization process for the proposed development in Crowthorne extension 67, Gauteng province.
- Freshwater assessment as part of the section 24g rectification process for unauthorised construction related activities that took place on erf 411, Ruimsig extension 9, Gauteng province
- Baseline aquatic and freshwater assessment as part of the environmental assessment and authorisation process for the N11 Ring Road, Mokopane, Limpopo Province
- Wetland Resource Scoping Assessment as Part of the Environmental Assessment and Authorisation Process for the Kitwe TSF Reclamation Project, Kitwe, Zambia
- Wetland delineation as part of the environmental assessment and authorization process for the proposed development in Boden Road, Benoni, Ekurhuleni Metropolitan Municipality, Gauteng Province.

Soil, Land Use and Land Capability Assessments

- Soil, Land Use and Land Capability Assessment as part of the environmental assessment and authorisation process for the proposed Witfontein Railway Siding Project Near Bethal, Mpumalanga Province
- Soil, Land Use and Land Capability Assessment as part of the environmental assessment and authorisation process for the proposed Heuningkranz Mine, Postmasburg, Northern Cape Province
- Soil, Land Use and Land Capability Assessment as Part of The Environmental Assessment and Authorisation Process for The Proposed Kanakies Mining Project, Near Loeriesfontein, Northern Cape

Hydropedological Wetland Impact Assessments

- Hydropedological Assessment as Part of the Environmental Assessment and Authorisation Process for the proposed Vandyksdrift Central Dewatering Project

- Hydropedological Assessment for the Proposed Evander Gold Elikhulu Tailings Storage Facility (TSF) Expansion, Mpumalanga Province
- Hydropedological Assessment as part of the environmental assessment and authorisation process for the proposed Palmietkuilen Mine, Springs, Gauteng Province
- Hydropedological Assessment as part of the environmental assessment and authorisation process for the proposed Uitkomst Colliery Mine expansion, Newcastle, KwaZulu-Natal Province
- Hydropedological Assessment for The Proposed Khutala Water Treatment Plant and Kendal 5 Seam Underground Mine Dewatering at Khutala Colliery, Near Ogies, Mpumalanga Province

Soil Rehabilitation Assessments

Soil rehabilitation plan, a water resource assessment and develop a management plan in support of the water use license for the Driefontein operations, Carletonville, Gauteng