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SOIL, LAND USE AND LAND CAPABILITY ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT (EIA) AND AUTHORISATION PROCESS FOR THE PROPOSED SOLAR PHOTOVOLTAIC (PV) FACILITIES AND ASSOCIATED SURFACE DEVELOPMENTS ON VARIOUS PORTIONS OF THE HALFGEWONNEN FARM, IN THE MPUMALANGA PROVINCE.

Prepared for

CABANGA environmental

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EXECUTIVE SUMMARY

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use and land capability assessment as part of the environmental assessment and authorisation process for the proposed Solar Photovoltaic (PV) facilities and associated surface developments on various portions of the Halfgewonnen Farm, in the Mpumalanga Province (hereafter referred to as the study area unless referring to the proposed developments individually).

High agricultural potential land is a scarce non-renewable resource, which necessitates an Agricultural Potential assessment prior to land development, particularly for purposes other than agricultural land use, as per Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983). High potential agricultural land is defined as land having ''the soil and terrain quality, growing season and adequate available moisture supply to sustain crop production when treated and managed according to best possible farming practices" (Land Capability report ARC, 2006). Land Capability Classes (LCC) are used to determine the agricultural potential of soils within the study area due to the positive correlation between the agricultural potential and Land Capability Classification. Land Capability Classification is measured on a scale of I to VIII, with the classes of I to III considered as prime agricultural soils and classes V to VIII not suitable for cultivation.

Based on the observations during the site assessment, the dominant land uses within the study area are grazing, cultivation, mining and related activities.

Large portions of the Study area is dominated by soils of Dresden, Glencoe, Mispah/Glenrosa, Cartref, Hutton and Witbank forms. The sub-dominant soils include Kroonstad/ Cartref, Avalon, Lichtenburg, Fernwood and Klapmut forms.

The majority of the soils (Dresden, Glencoe, Hutton, Avalon and Lichternburg) are considered ideal for cultivation due to:

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

Table A below indicates the dominant soils occurring within the footprint areas(PV panels and associated infrastructure), together with the associated land capability and the area covered in hectares (ha).

Table A summary of the soil forms and land capability data

Soil Form	Land capability	Area (ha)	Percentage (%)
Avalon	Arable (Class II)	10.5	7
Lichtenburg		3.10	2
Hutton		21.32	15
Hutton/Lichtenburg		8.06	6
Glencoe/Avalon	Arable (Class II/Class III)	7.60	5
Dresden	Arable (Class III)	34.35	24
Glencoe		5.37	4
Klapmuts	Grazing (Class V)	0.8	1
Cartref		0.88	1
Wetland		0.19	0.1
Dresden (Pan)		3.9	3
Fernwood		0.29	0
Mispah/Glenrosa	Grazing (Class VI)	32.69	22
Witbank	Wilderness (Class VIII)	16.29	11
Total Enclosed Area		**145.34**	100.0

The proposed development is likely to affect significant portions of the arable soils (90.3 ha out of 145.34). Considering the given potential of the soils, the level of disturbance and current cultivation and grazing taking place at the time of site assessment, the loss from a soil and land capability point of view is anticipated to be of Moderate significance. Thus, the proposed activities may potentially have a negative impact on agricultural production on a local and regional and scale. The protection of agricultural resources should be prioritised as far as practically possible while considering the need for sustainable development and the need for conversion to greener energy production in South Africa.

Areas outside and adjacent to the study area that were highlighted as "Medium Sensitivity" for the Agricultural Sensitivity Theme by the National Web Based Environmental Screening Tool were investigated as alternatives to reduce the risk to the receiving environment but were deemed unsuitable due to the various technical reasons below:

- Property where land-use and access agreements have not been reached between the developer and landowner;
- Areas already approved for expansion of the Halfgewonnen Mine;
- Current Halfgewonnen coal processing plant - incompatible with solar PV development due to dust and land availability; and
- Previously mined areas deemed not suitable to develop the PV array.

It is evident that the location of the proposed Solar PV cannot be changed due to the above-mentioned reasons and thus portions of the high potential arable soils can be considered for development provided that the possibility of any agricultural activity occurring concurrently with the solar generation is investigated in order to minimise the impacts on these soils.

Key mitigation measures to minimise impacts on the soil regime include but are not limited to:

- The project operations be kept within the demarcated footprint areas which must be well defined;
- Bare soils within the access roads can be regularly dampened with water to suppress dust during the construction phase, especially when strong wind conditions are predicted according to the local weather forecast; and
- In effort to conserve as much arable land as possible and thus ensure as much future agricultural production as possible on the farms situated within the greater mining area it is recommended that areas historically disturbed due to the mining activities be targeted for renewable energy production.

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

DOCUMENT GUIDE

This report was compiled according to the following information guidelines for a specialist report in terms of the Environmental Impact Assessment (EIA) Regulation 982 of the National Environmental Management Act (NEMA), as summarised on the Table below.

Table 1: Document guide according to Regulation (No. R. 982) as amended.

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix B
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix B
b)	A declaration that the specialist is independent	Appendix B
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
cA)	An indication of the quality and age of base data used for the specialist report	Section 3
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 4 and 5
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 3
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 site alternative	Section 4
g)	An identification of any areas to be avoided, including buffers	Section 4
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 4
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 1.1
j)	A description of the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Section 4 and 5
k)	Any mitigation measures for inclusion in the EMPr	Section 5.2
l)	Any conditions for inclusion in the environmental authorisation	Section 4.1
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 and 6
(iA)	Regarding the acceptability of the proposed activity or activities	Section 6
(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 4 and 5
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	Undertaken by EAP
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Refer to main EIA Report
q)	Any other information requested by the competent authority	None

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GLOSSARY OF TERMS

Albic	Grey colours, apedal to weak structure, few mottles (<10 %)
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.
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.
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.
Ferralic:	Having a ferralic horizon starting ≤150 cm of the soil surface.
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.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Hard Plinthic	Accumulative of vesicular Fe/Mn mottles, cemented
Hydrophytes:	Plants that are adaptable to waterlogged soils
Lithic	Dominantly weathering rock material, some soil will be present.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the “background colour” referred to as the matrix and the spots or blotches of colour referred to as mottles.
Plinthic Catena	South African plinthic catena is characterised by a grading of soils from red through yellow to grey (bleached) soils down a slope. The colour sequence is ascribed to different Fe-minerals stable at increasing degrees of wetness
Red Apedal	Uniform red colouring, apedal to weak structure, no calcareous
Runoff	Surface runoff is defined as the water that finds its way into a surface stream channel without infiltration into the soil and may include overland flow, interflow and base flow.
Orthic	Maybe dark, chromic or bleached
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.
Sodicity:	High exchangeable sodium Percentage (ESP) values above 15% are indicative of sodic soils. Similarly, the soil dispersion.
Soil Map Unit	A description that defines the soil composition of a land, identified by a symbol and a boundary on a map
Soft Plinthic	Accumulation of vesicular Fe/Mn mottles (>10%), grey colours in or below horizon, apedal to weak structure
Witbank	Man-made soil deposit with no recognisable diagnostic soil horizons, including soil materials which have not undergone paedogenesis (soil formation) to an extent that would qualify them for inclusion in another diagnostic horizon

ACRONYMS

AGIS	Agricultural Geo-Referenced Information Systems
°C	Degrees Celsius.
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ET	Evapotranspiration
IUSS	International Union of Soil Sciences
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GPS	Global Positioning System
m	Meter
MAP	Mean Annual Precipitation
NWA	National Water Act
PSD	Particle Size Distribution
SACNASP	South African Council for Natural Scientific Professions
ZRC	Zimpande Research Collaborative
SOTER	Soil and Terrain
NEMA	National Environmental Management Act
CARA	Conservation of Agricultural Resources Act
LCC	Land Capability Classes

1. INTRODUCTION

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use and land capability assessment as part of the environmental assessment and authorisation process for the proposed Solar Photovoltaic (PV) facilities and associated surface developments on various portions of the Halfgewonnen Farm, in the Mpumalanga Province (hereafter referred to as the study area unless referring to the proposed developments individually).

The study area is located approximately 20km southwest of the town Hendrina and approximately 30km north of the town Bethal; within the Govan Mbeki Local Municipality of the Gert Sibande District Municipality, Mpumalanga Province. Refer to Figure 1 and 2 below.

High agricultural potential land is a scarce non-renewable resource, which necessitates an Agricultural Potential assessment prior to land development, particularly for purposes other than agricultural land use, as per Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983). High potential agricultural land is defined as land having ''*the soil and terrain quality, growing season and adequate available moisture supply to sustain crop production when treated and managed according to best possible farming practices" (*Land Capability report ARC, 2006*).* Land Capability Classes (LCC) are used to determine the agricultural potential of soils within the study area due to the positive correlation between the agricultural potential and Land Capability Classification. Land Capability Classification is measured on a scale of I to VIII, with the classes of I to III considered as prime agricultural soils and classes V to VIII not suitable for cultivation. Furthermore, the climate capability is also measured on a scale of 1 to 8, as illustrated in Appendix A.

1.1 Project Description

The applicant (Dreamworks Haven Investments Pty Ltd) proposes to develop the Halfgewonnen Solar Photovoltaic (PV) Facilities which will generate approximately 80 Mega Watts (MW) of power for distribution into the National Grid, specifically for the benefit of mining and farming communities, located closer the proposed development.

The proposed Halfgewonnen Solar PV project comprises of two components:

1. Solar PV 1 will generate approximately 20 MW and will address the electricity requirements for the immediately surrounding and adjacent consumers. Construction is expected to take approximately 10 months. The total proposed development footprint will not exceed 30 hectares (Ha).

2. Solar PV 2 will generate approximately 60 MW, forming part of the Department of Mineral Resources and Energy (DMRE) renewable energy independent power producer procurement programme (REIPPP). Construction is expected to take approximately 12 months. The total footprint of the proposed development is expected to comprise approximately 60 Ha.

Surface developments will thus, include the PV 1 (anticipated 30 Ha) and PV 2 panels (anticipated 60 Ha), the main substation (± 0.3 Ha), additional buildings (± 0.3 Ha), and the battery storage area (± 3.3 Ha). Linear developments for the project include the main pipelines running between the solar panels, as well as a high-voltage line (± 6.2 km) that is recommended to connect the main substation to the Ysterkop substation. Figure 3 depicts the locality of the proposed block layout plan.

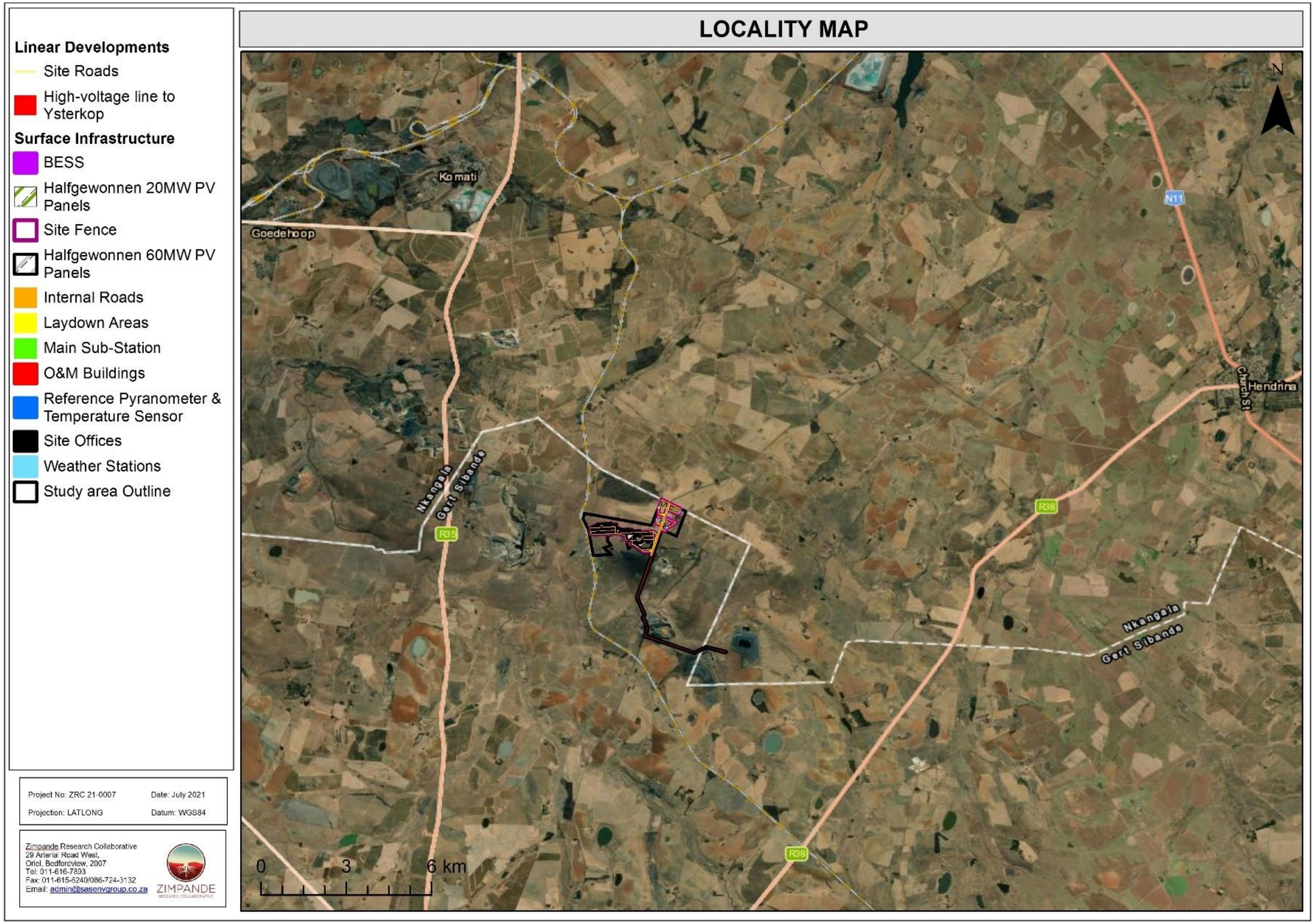

Figure 1: Digital satellite imagery depicting the locality of the study area in relation to the surrounding area.

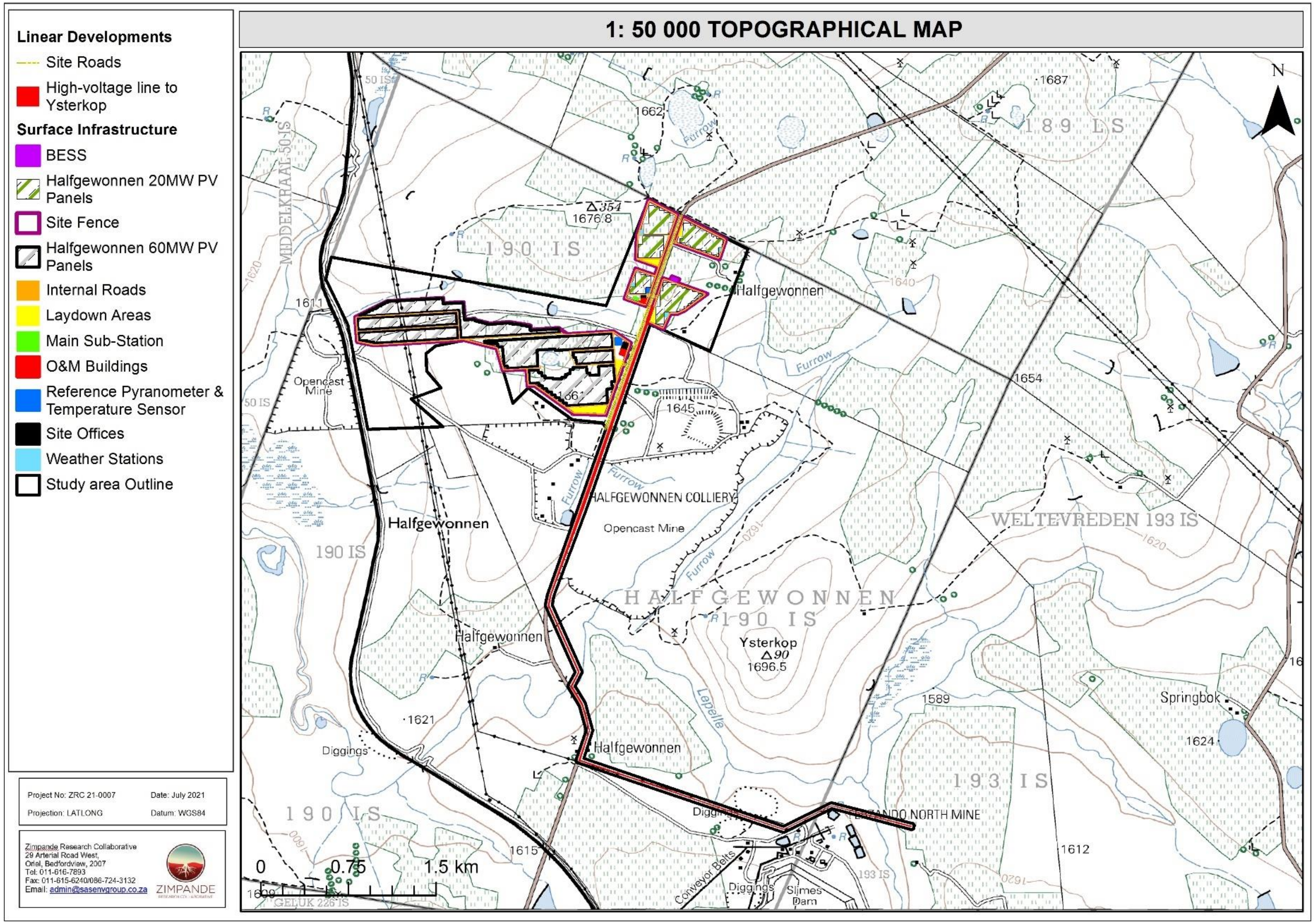

Figure 2: Location of the study area depicted on a 1:50 000 topographic map in relation to surrounding area.

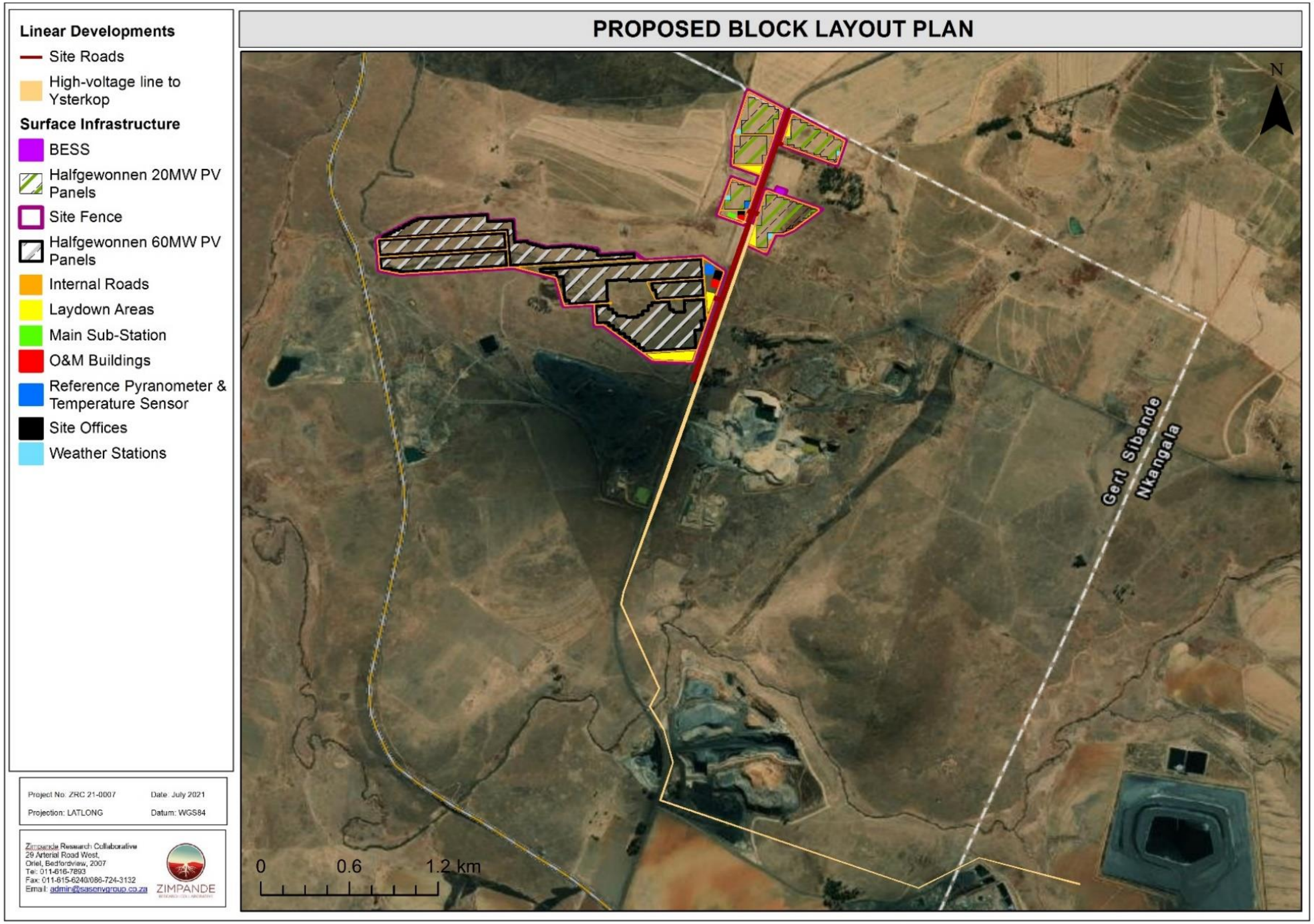

Figure 3: Locality of the proposed block layout plan.

1.2 Terms of Reference and Scope of Work

The Environmental Authorisation process of the soil, land use and land capability assessment entailed the following aspects:

- As part of the desktop study various data sets were consulted which includes but not limited to: Soil and Terrain dataset (SOTER), land type and capability maps and soil 2001, to establish broad baseline conditions and sensitivity of study area both on environmental and agricultural perspective;
- Compile various maps depicting the on-site conditions based on desktop review of existing data;
- Classification of the climatic conditions occurring within the study area;
- Conduct a soil classification survey within the study area;
- Assess the spatial distribution of various soil types within the study area and classify the dominant soil types according to the South African Soil Classification System: A Natural and Anthropogenic System for South Africa (Soil Classification Working Group, 2018);
- Identify restrictive soil properties on land capability under prevailing conditions;
- Identify and assess the potential impacts in relation to the proposed development using pre-defined impact assessment methodology; and
- Compile soil, land use and land capability report under current on-site conditions based on the field finding data.

1.3 Assumptions and Limitations

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

- The soil survey conducted as part of the land capability assessment was confined within the study area outline. This includes linear and surface infrastructure. Consideration was however given to adjacent agricultural activities;
- 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 Halfgewonnen Solar Photovoltaic (PV) Facilities and associated infrastructure.

2. METHOD OF ASSESSMENT

2.1 Literature and Database Review

Prior to commencement of the field assessment, a background study, including a literature review, was conducted to collect the pre-determined soil, land use and land capability data in the vicinity of the investigated study area. Various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources as listed under references were utilised to fulfil the objectives for the assessment.

2.2 Soil Classification and Sampling

A soil survey was conducted in February 2021, at which time the identified soils within the study area classified into soil forms according to the Soil Classification System: A Natural and Anthropogenic System for South Africa Soil Classification System (2018). This survey period is deemed appropriate since seasonality does not have an effect on the soil characteristics. 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.

2.3 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 below; with Classes I to III classified as prime agricultural land that is well suited for annual cultivated crops, whereas, Class IV soils may be cultivated under certain circumstances and specific or intensive management practices, and Land Classes V to VIII are not suitable to cultivation. Furthermore, the climate capability is also measured on a scale of C1 to C8, as illustrated in Table 2 below. The land capability rating is therefore adjusted accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating. The anticipated impacts of the proposed land use on soil and land capability were assessed in order to inform the necessary mitigation measures.

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 3 below presents the land potential classes, whilst Table 4 presents a description thereof, according to Guy and Smith (1998).

Table 3: Table of Land Potential Classes (Smith, 2006).

Land Capability Class	Climate Capability Class							
	C1	C2	C3	C4	C5	C6	C7	C8
I	L1	L1	L2	L2	L3	L3	L4	L4
II	L1	L2	L2	L3	L3	L4	L4	L5
III	L2	L2	L3	L3	L4	L4	L5	L6
IV	L2	L3	L3	L4	L4	L5	L5	L6
V	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei
VI	L4	L4	L5	L5	L5	L6	L6	L7
VII	L5	L5	L6	L6	L7	L7	L7	L8
VIII	L6	L6	L7	L7	L8	L8	L8	L8

Table 4: The Land Capability Classes Description (Smith, 2006).

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.

2.4 Consideration of DEA Screening Tool

The Agricultural Agro-Ecosystem Assessment protocol provides the criteria for the assessment and reporting of impacts on agricultural resources for activities requiring environmental authorisation. The assessment requirements of this protocol are associated with a level of environmental sensitivity determined by the national web-based environmental screening tool which for agricultural resources is based on the most recent land capability evaluation values as provided by the Department of Agriculture, Forestry and Fisheries. The national web-based environmental screening tool can be accessed at: https://screening.environment.gov.za/screeningtool .

The main purpose of the Agricultural Agro-Ecosystem Assessment is to ensure that the sensitivity of the site to the proposed land use change (from agriculture to proposed Solar Photovoltaic (PV) facilities) is sufficiently considered. The information provided in this report aims to enable the Competent Authority to come to a sound conclusion on the impact of the proposed Solar Photovoltaic (PV) facilities on the food production potential of the site.

To meet this objective, site sensitivity verification must be conducted of which the results must meet the following objectives:

- It must confirm or dispute the current land use and the environmental sensitivity as was indicated by the National Environmental Screening Tool;
- It must contain proof (e.g., photographs) of the current land use and environmental sensitivity pertaining to the study area;
- All data and conclusions are submitted together with the main report for the proposed Solar Photovoltaic (PV) facilities;
- It must indicate whether or not the proposed Solar Photovoltaic (PV) facilities will have an unacceptable impact on the agricultural production capability of the site, and in the event where it does, whether such a negative impact is outweighed by the positive impact of the proposed development on agricultural resources; and
- The report is prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

The report is thus compiled in a manner that meets the minimum report content requirements for impacts on agricultural resources by solar photovoltaic energy generation facilities where the electricity output is 20 megawatts or more.

2.5 Soil Analyses

All sampled soils were sent to NviroTek Labs (Pty) Ltd. as a SANAS accredited laboratory for selected soil chemical analyses. The chemical analyses included the following selected constituents, micronutrients and contaminants of potential concern (CPCs) to determine the need for amelioration:

- pH;
- Exchangeable cations;
- Organic carbon;
- Particle size distribution; and
- Bulk density.

2.6 Soil Data Analysis and interpretation

Analytical data was interpreted quantitatively, as mass of contaminant per mass of dry weight (DW) of soil (mg/kg), pH values and/or milli-Siemens per meter (µS/cm) for electrical conductivity (EC). Table 5 below was used as reference guide to interpret pH results in terms of acidity.

Table 5: pH classification with reference to common foods and other substances

pH range	Description	pH range of common foods and other substances	
<4,5	Extremely acid	Battery acid	<2.0
4,5 – 5,0	Very strongly acid	Lemon juice	2.0-2.6
5,1 – 5,5	Strongly acid	Vinegar	2.4-3.4
5,6 – 6,0	Medium acid	Wine	4-5
6,1 – 6,5	Slightly acid	Normal rain	5-6
6,6 – 7,3	Neutral	Distilled water	7
7,4 – 7,8	Mildly alkaline	Baking soda	8-9
7,9 – 8,4	Moderately alkaline	Soap	9-10
8,5 – 9,0	Strongly alkaline	Ammonia	10-12
>9,0	Very strongly alkaline	Lye	12-14

Note: pH Values of Common Foods and Ingredients obtained from (Bridges and Mattice 1939).

This assessment of chemical properties was conducted to assess the current status of the soils in relation to agricultural potential.

3. DESKTOP ASSESSMENT RESULTS

**It should be noted that most of the database used in this assessment were compiled from different databases obtained from the Agricultural Geo-referenced Information System (AGIS). Thus, inaccuracies may exist in the data present. However, the data presented gives useful information of the surrounding soils.*

The following data is applicable to the study area, according to various data sources including but not limited to the Agricultural Geo-referenced Information System (AGIS).

- The Mean Annual Precipitation (MAP) is estimated to range between 601 – 800 mm per annum. These conditions have a fair yield potential for a moderate range of adapted crops but planting date options are limited for supporting rain fed agriculture;
- The mean annual evaporation ranges between 1601-1800 mm per annum. The high evaporation rates pose risks to plant yield due possible plant permanent wilting resulting desiccation and lack of adequate soil moisture;
- According to the Council of Geoscience Geological map of South Africa (2001), the geology associated with the study area is considered to form part of the Arenite Granite and Rhynolite formation geological types (Figure 4);

- The Landform type occurring within the study area is classified as a Plain Landform on the western bit of the PV2 site and southwestern portions of the powerline and a medium-gradient hill on the eastern and northeastern portions, which means the terrain is suitable to allow agricultural activities (Figure 5);
- The landuses associate with the study area are cultivation, small patches of blue gum trees as forestry and vacant and/or unspecified based on the Soil (2001) database. This is purely based on the existing database consulted, however this may not the case for all the areas during the field verification exercise (Figure 6);
- The Soil and Terrain (SOTER) database indicates that the western portion is characterized by lithic leptosols and the eastern portion of the study area is characterized by the presence of plinthic acrisols (Figure 7);
- In terms of the desktop land capability the western portion is characterised by non-arable land suitable for grazing, woodland or wildlife. The eastern and north-eastern portions are characterised by high potential arable land (Figure 8);
- According to the AGIS database, the soil medium occurring on the northern portion of the study area is not considered to be saline or sodic. However, the southern portion of the southern portion is characterised by slightly saline soils (Figure 9);
- According to the AGIS database(Grazing capacity, 1993), the livestock grazing capacity potential for the majority of the study area is estimated to be 5 hectares per livestock Unit (ha/LSU), for the remaining portion it is estimated to be 3 hectares per livestock Unit (ha/LSU) (Figure 10);
- According to the database, soils with beneficial water retaining characteristics without the risk of waterlogging are present on the eastern and north-eastern portion. Soils with absent water retaining characteristics are present on the western portion of the study area (Figure 11);
- The clay content in the soils associated with the entire study area is between 15% to 35% according to the Mpumalanga Soils Database;
- The soil pH of soil occurring within the study area are slightly acidic to neutral with pH range of 5.5 - 7.4 which means that most nutrients will be available for plant uptake; , as interpolated from topsoil pH values obtained from the National Soil Profile Database (AGIS database);
- The predicted soil loss for the study area is considered low; and
- The screening tool results indicate a high to medium sensitivity to agriculture. (Figure 12).

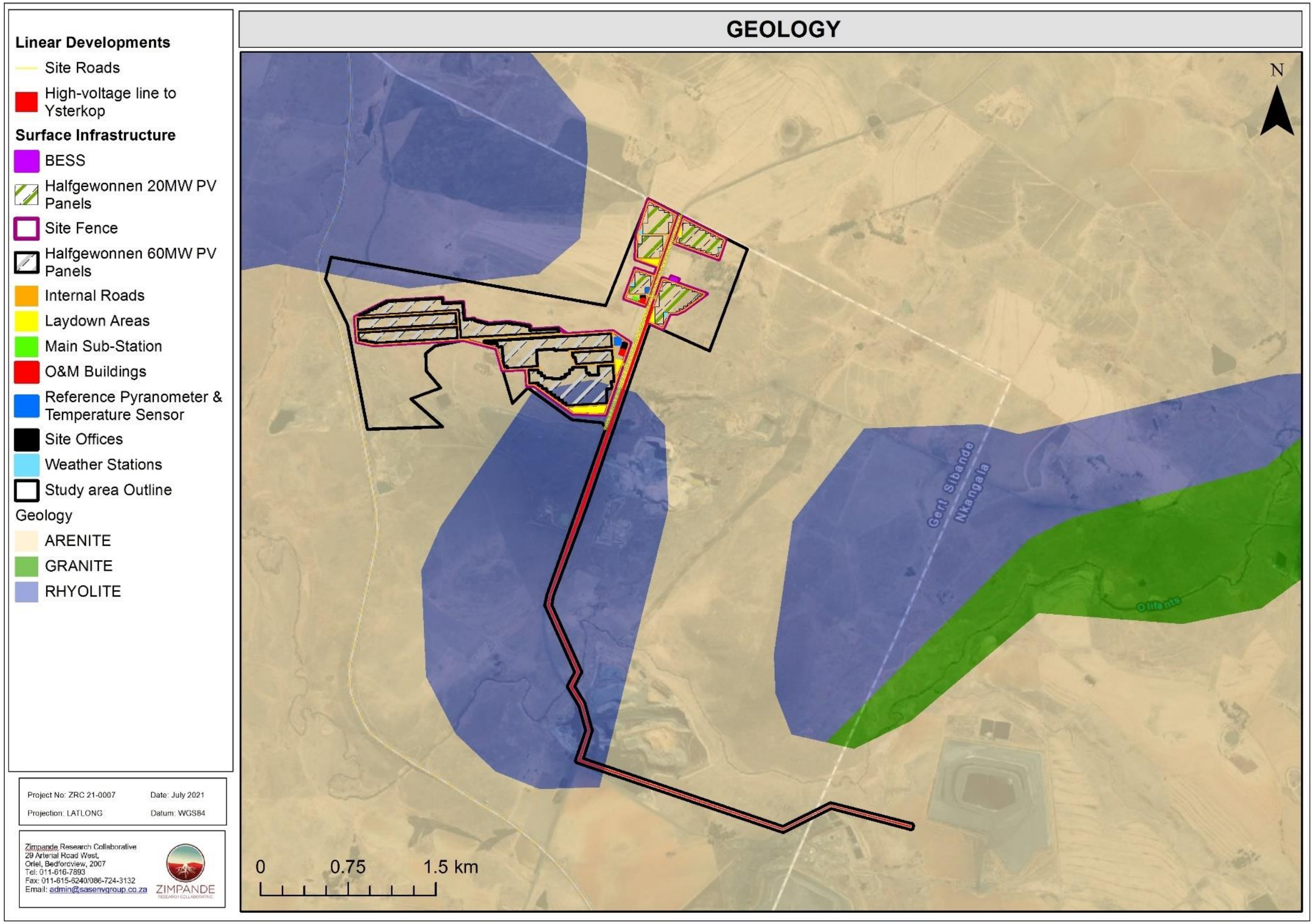

Figure 4: Geological types associated with the study area.

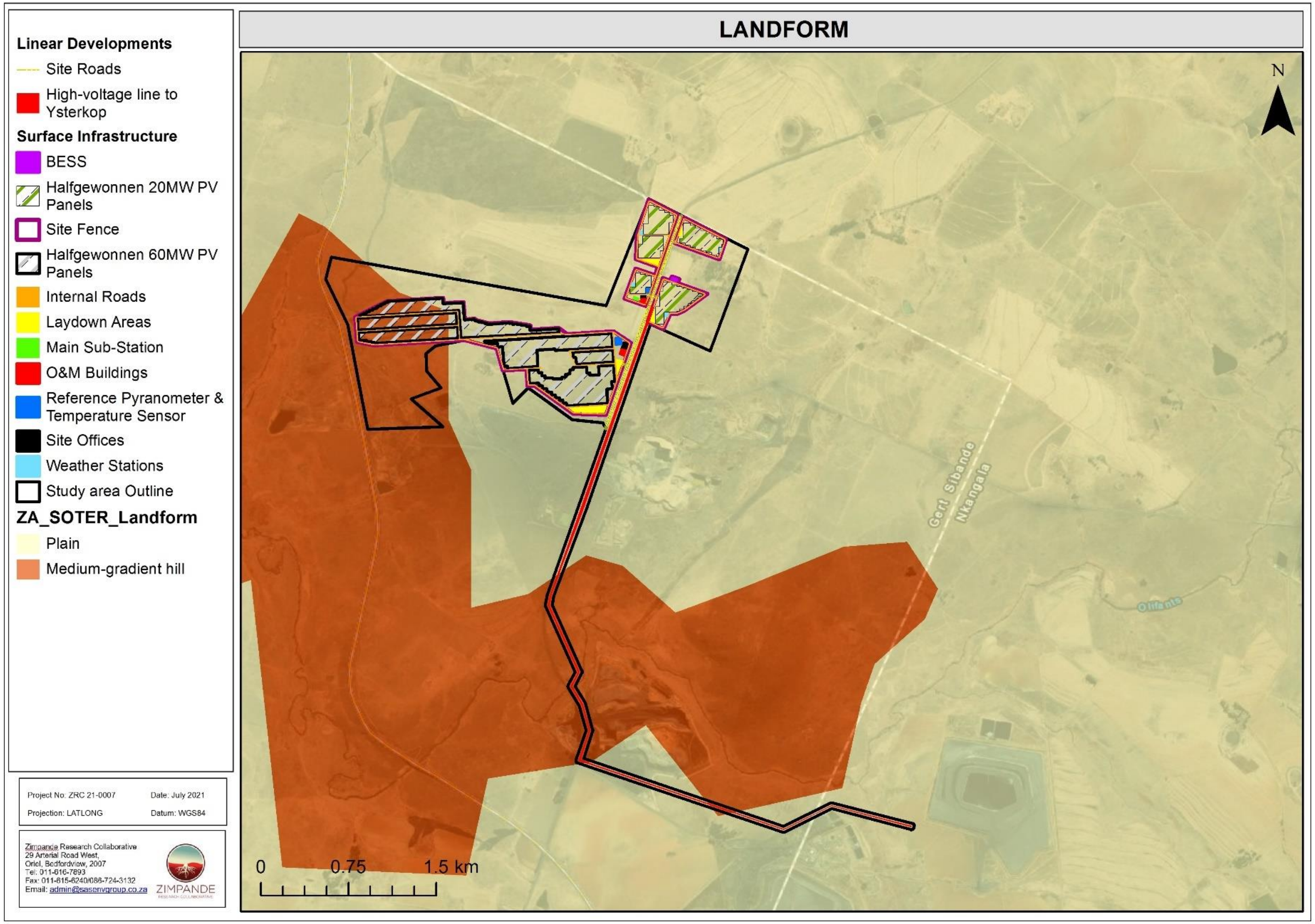

Figure 5: Description of the landform associated with the study area according to the Soil and Terrain Database.

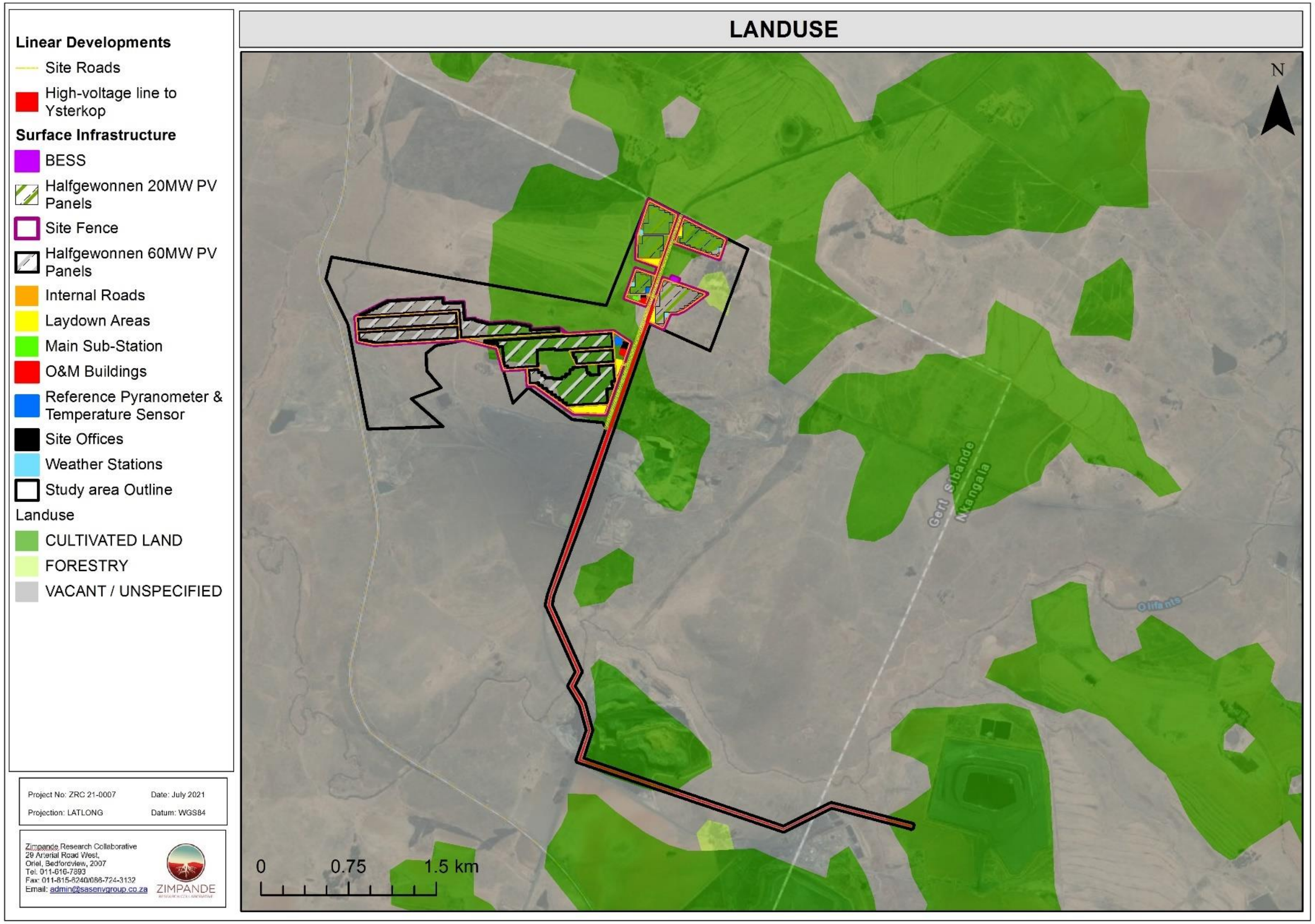

Figure 6: Landuses associated with the study area.

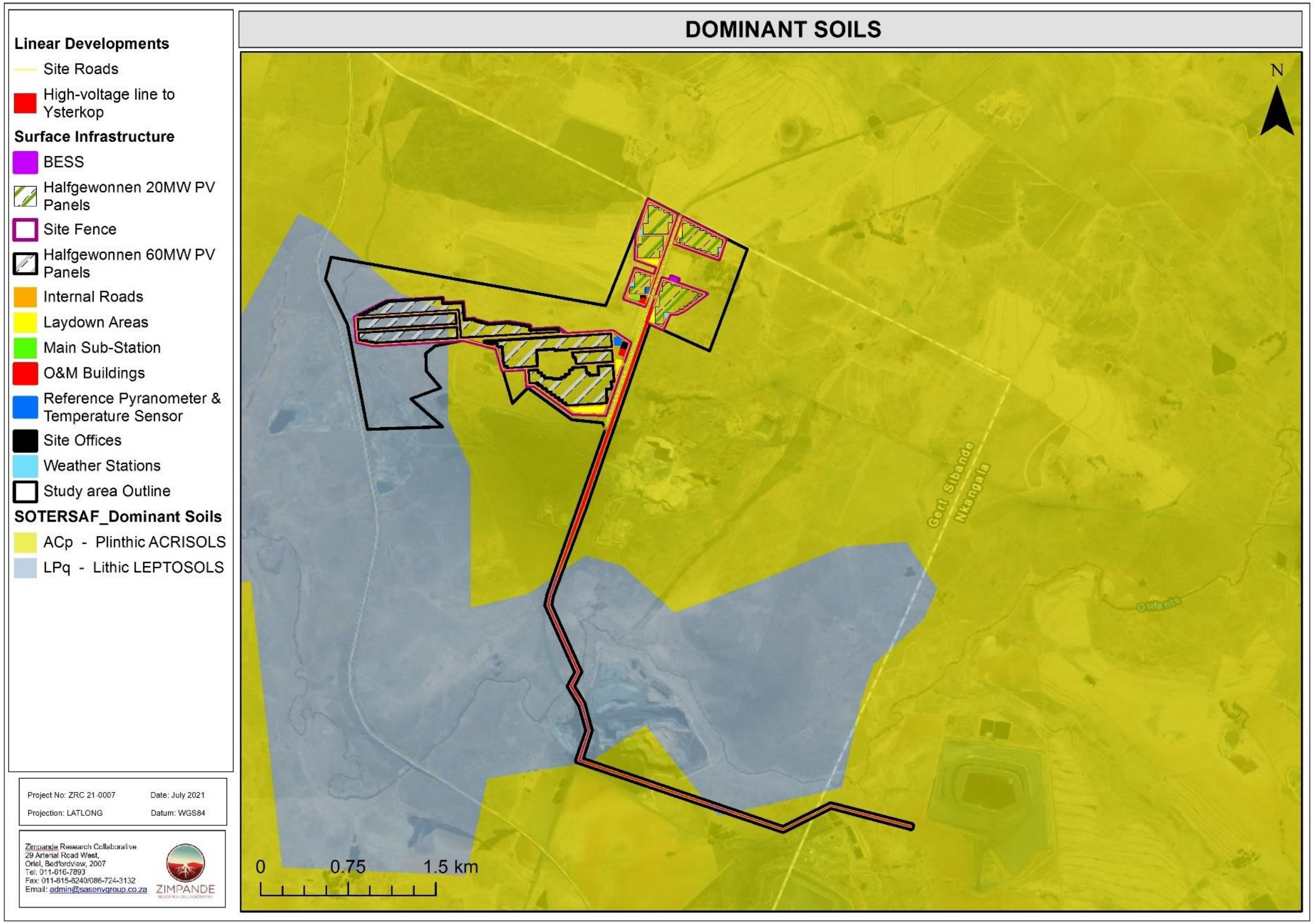

Figure 7: Dominant soils associated with study area (based on existing SOTER database).

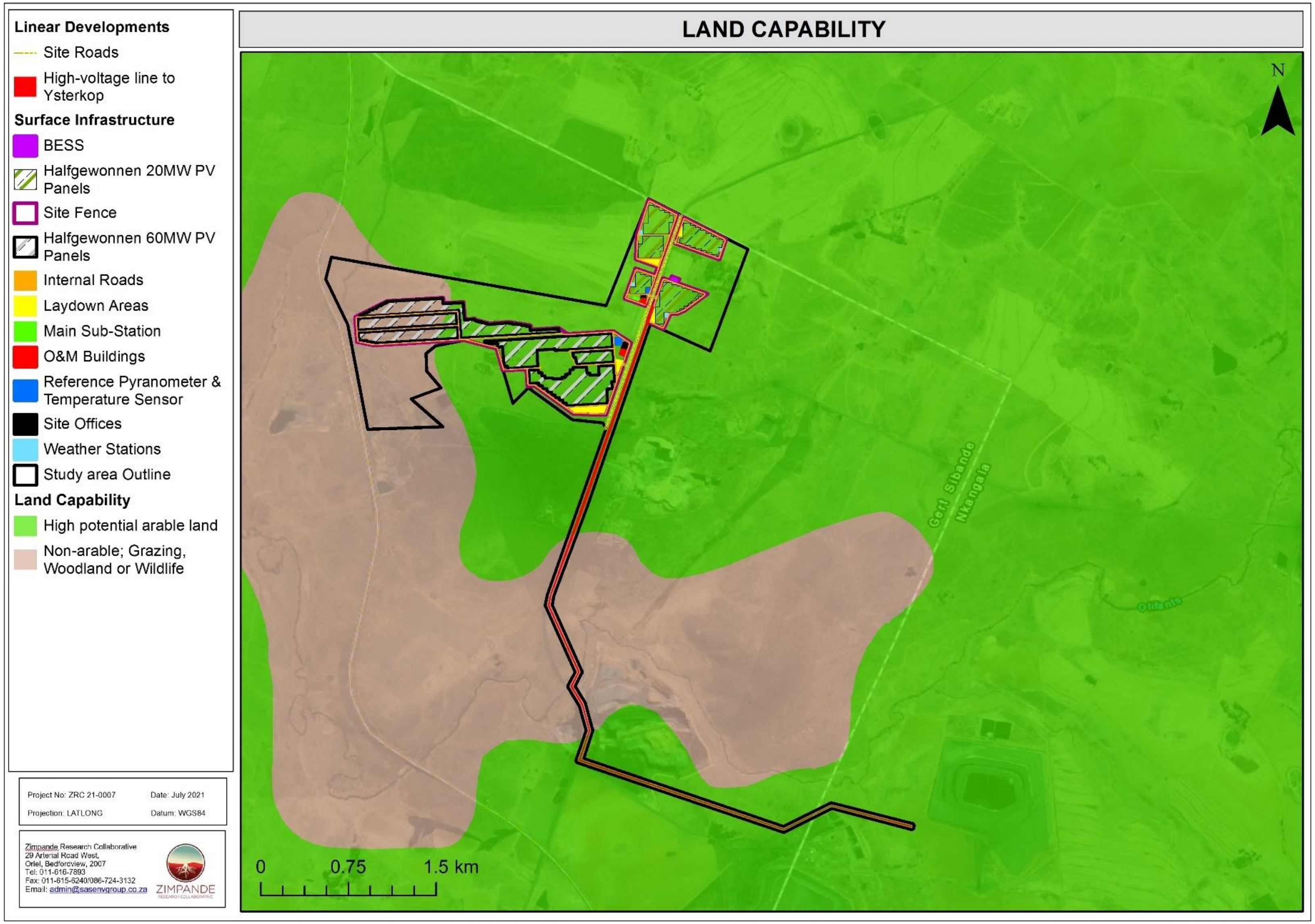

Figure 8: Land capability associated with the soils occurring within the study area.

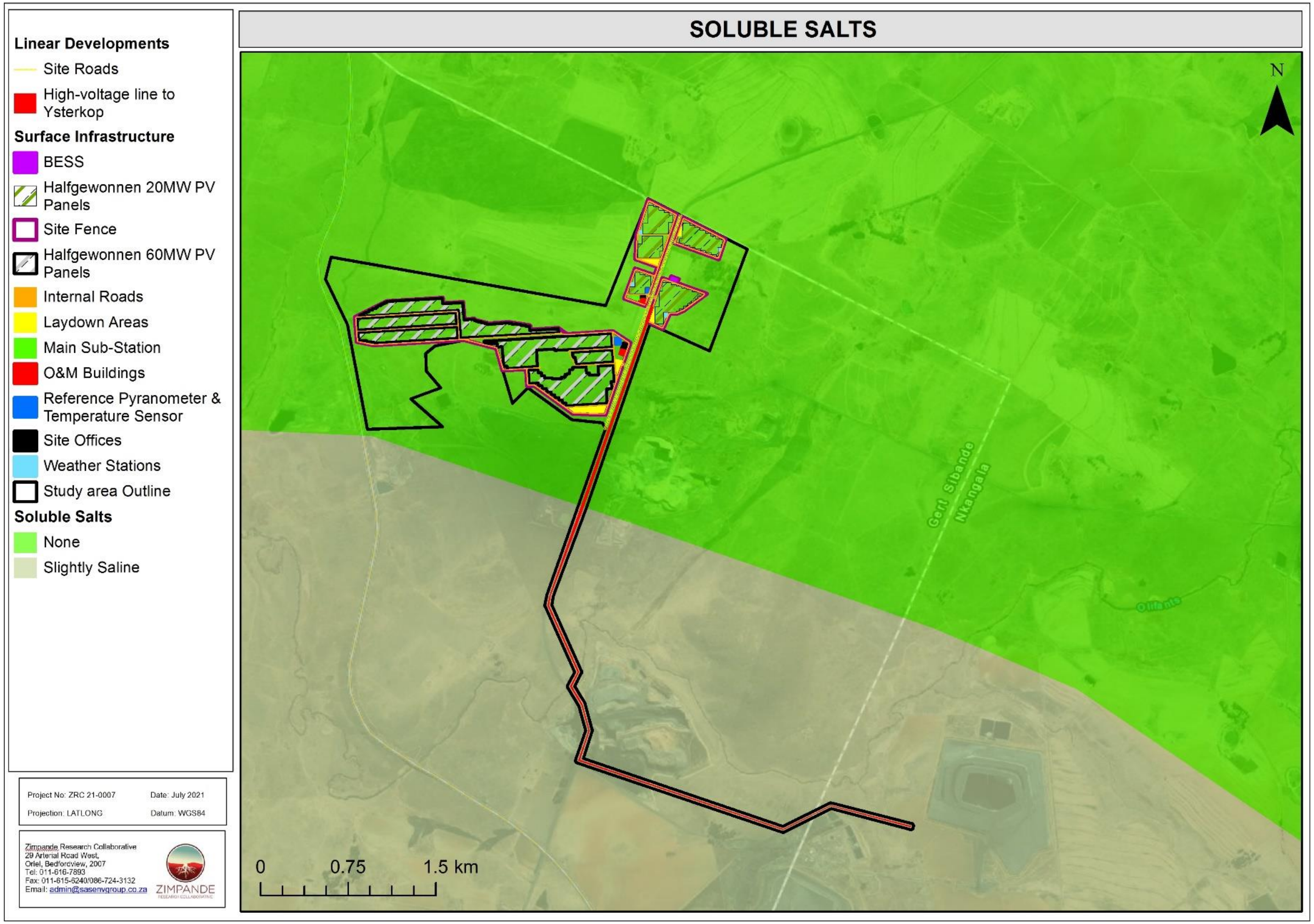

Figure 9: Soluble salts associated with the soil medium occurring within the study area.

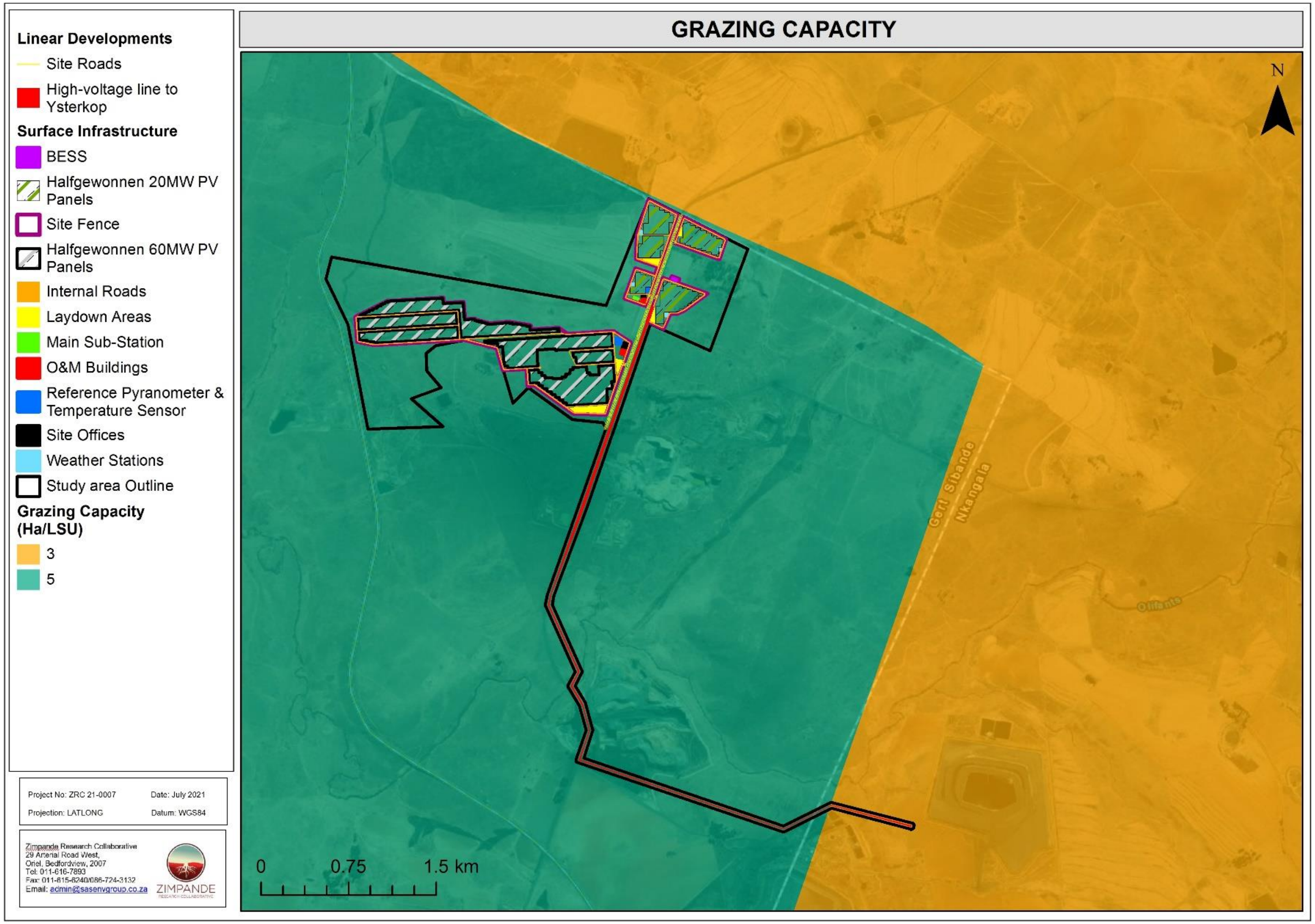

Figure 10: Grazing capacity associated with the study area.

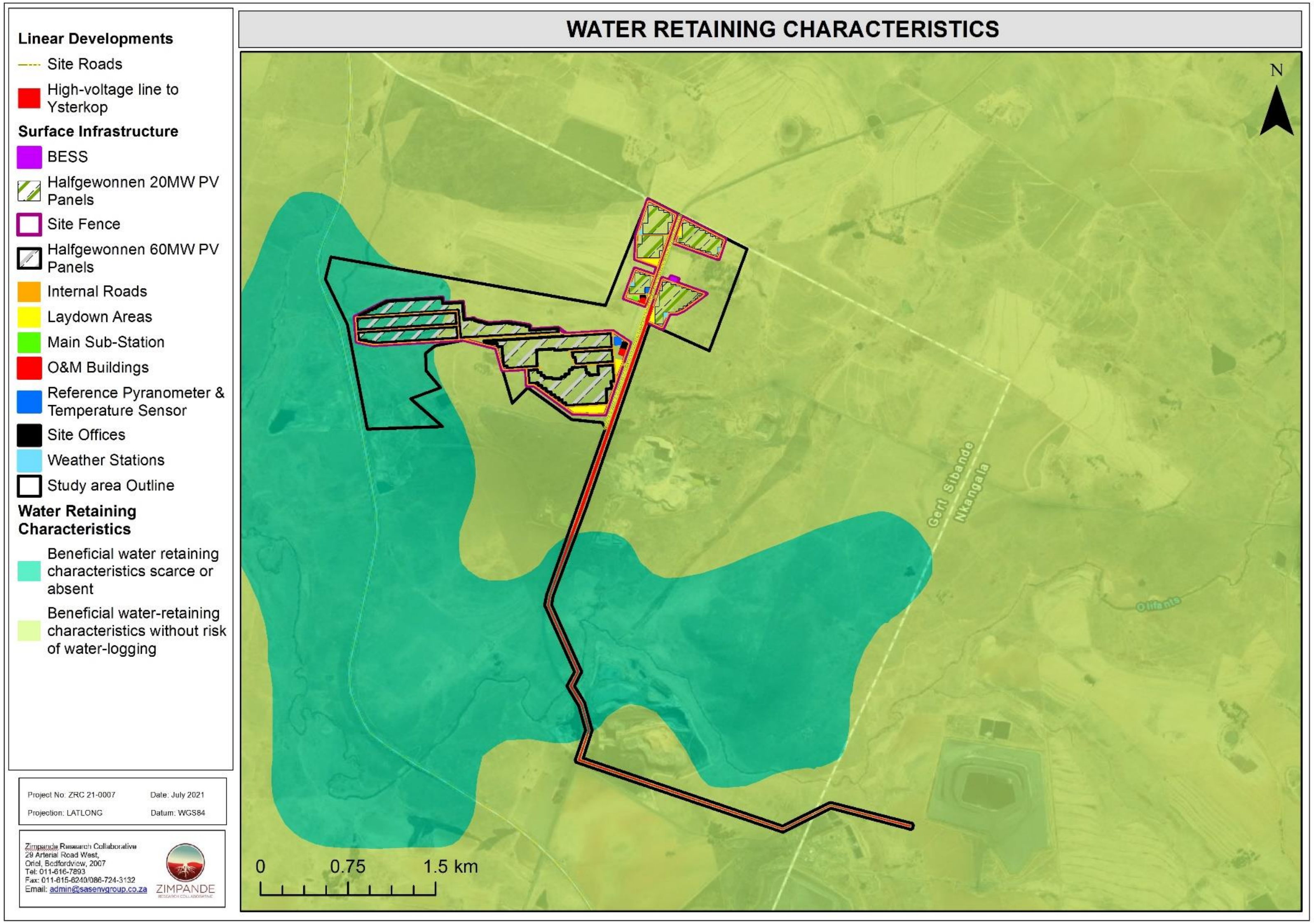

Figure 11: Water retaining characteristics associated with the study area.

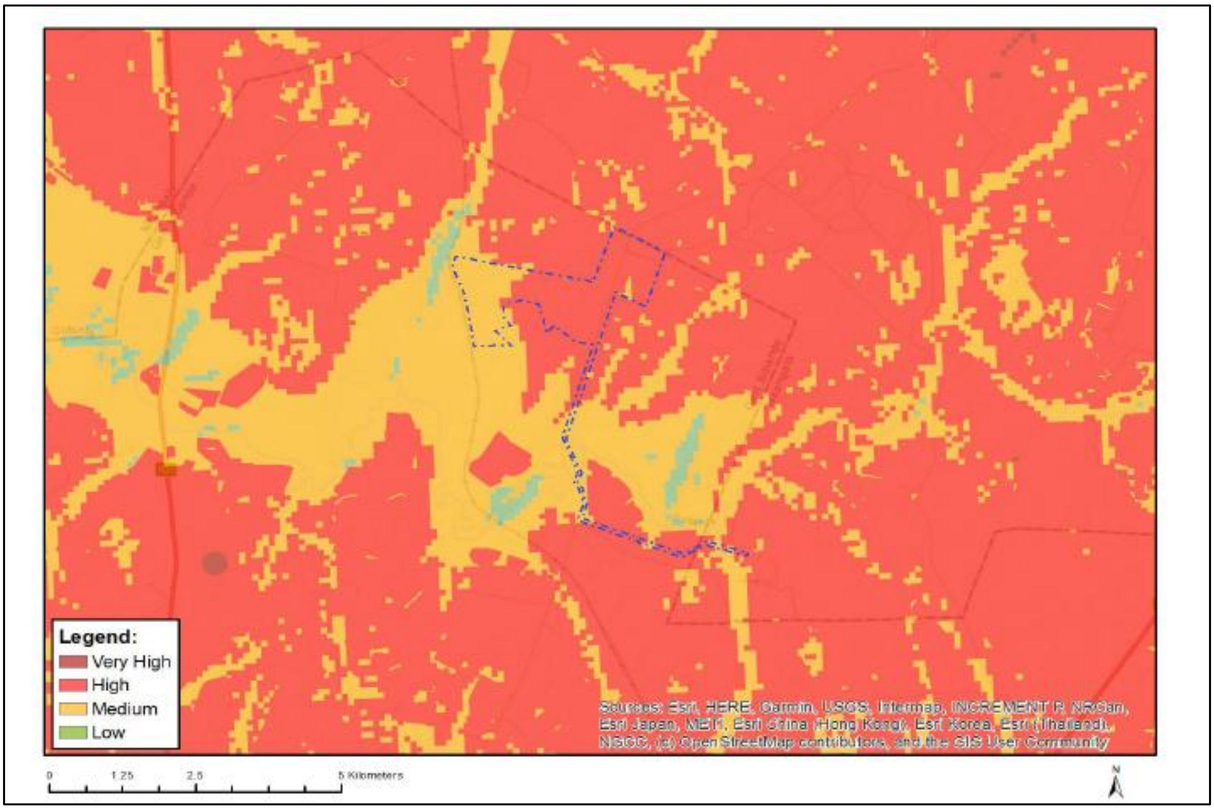

Figure 12:Screening tool analysis for environmental sensitivity.

4. ASSESSMENT RESULTS

4.1 Current Land Use

Based on the observations during the site assessment, the dominant land use within the study area is grazing, cultivation, mining and related activities. Figure 13 presents images of the mining and related activities associated with the study area.

Figure 13: Photographs illustrating the dominant land uses within the study area.

4.2 Dominant Soil Forms

The dominant soil identified within the study area are Dresden, Glencoe, Mispah/Glenrosa, Cartref, Hutton and Witbank forms. The sub-dominant soils include Kroonstad/Cartref, Avalon, Lichtenburg, Fernwood and Klapmut forms. Figures 14, 15 and 16 depicts maps of the dominant soils forms occurring within the study area.

The soils within the footprint areas for the proposed developments can be broadly classified as ideal for agricultural cultivation practices (with minor limitations) were climate permits as, grazing activities as well as wildlife/wilderness. These ideal soil forms include Hutton, Lichtenburg , Avalon, and Glencoe. Table 6 below show the dominant soils forms within the study area and their respective diagnostic horizons.

Table 6: Dominant soil forms within the study area.

Soil Form	Code	Diagnostic Horizon Sequence
Avalon	Av	Orthic A/ Yellow Brown Apedal B/ Soft Plinthic B
Cartref	Cf	Orthic A/Albic/ Lithic
Dresden	Dr	Orthic A/ Hard Plinthic B
Dresden (Pan)	Dr	Orthic A/ Hard Plinthic B
Fernwood	Fw	Orthic A/Albic (Thick)
Glencoe	Gc	Orthic A/Yellow Brown Apedal B/Hard Plinthic B
Glencoe/Avalon	Gc/Av	Orthic A/ Yellow Brown Apedal B/ Soft Plinthic B or Hard Plinthic B
Hutton	Hu	Orthic A/Red Apedal B
Hutton/Lichtenburg	Hu/Lc	Orthic A/Red Apedal B and/or Hard Plinthic B
Klapmuts	Km	Orthic A/Albic/Pedocutanic
Kroonstad/Catref	Kd/Cf	Orthic A/Albic/Gley or Lithic
Lichtenburg	Lc	Orthic A/Red Apedal B
Mispah/Glenrosa	Ms/Gs	Orthic A/Hard Rock or Lithic
Wetland	G	Gley
Witbank	Wb	Transported Technosols/Disturbed soils

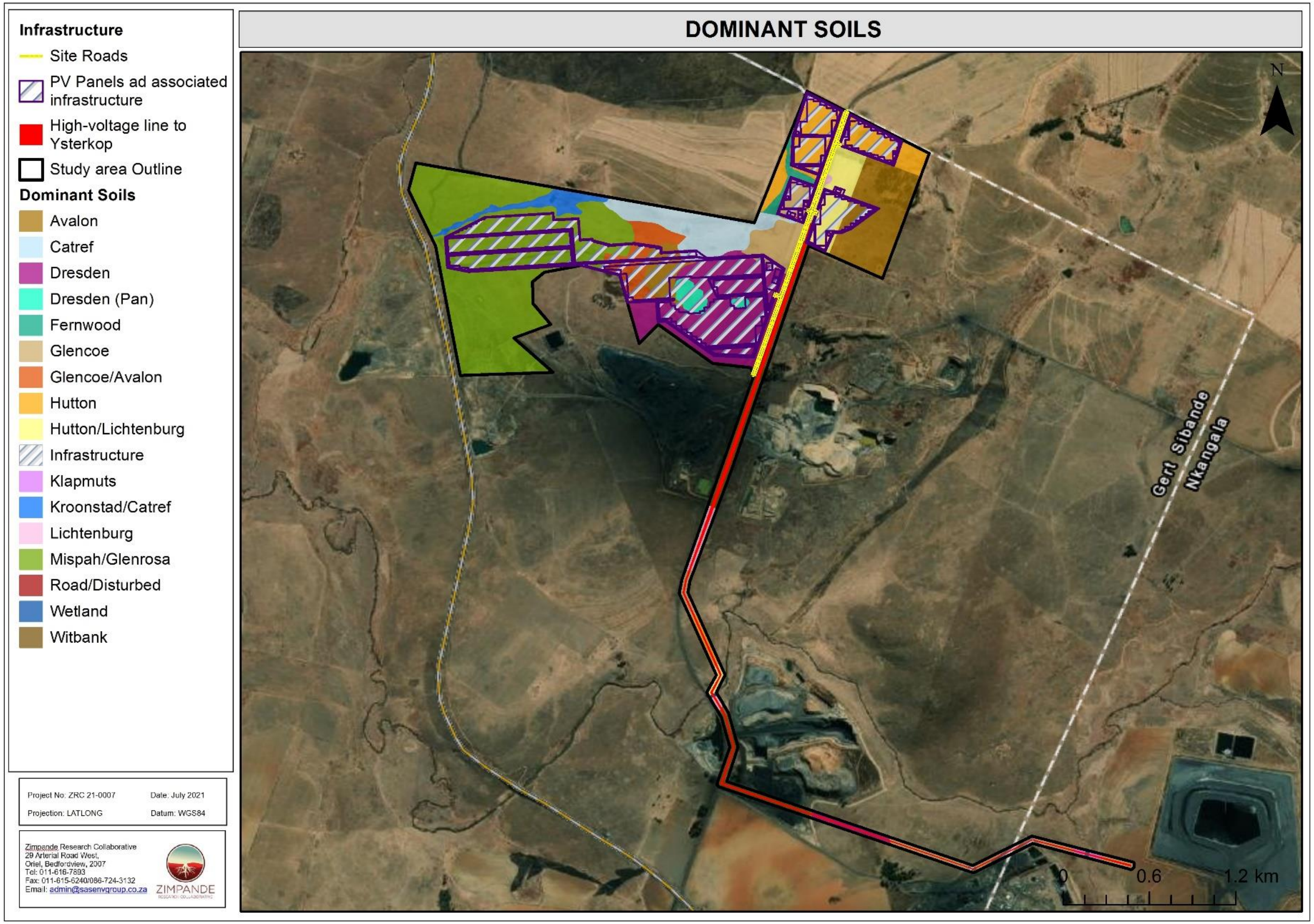

Figure 14: Dominant soils forms within the study area outline.

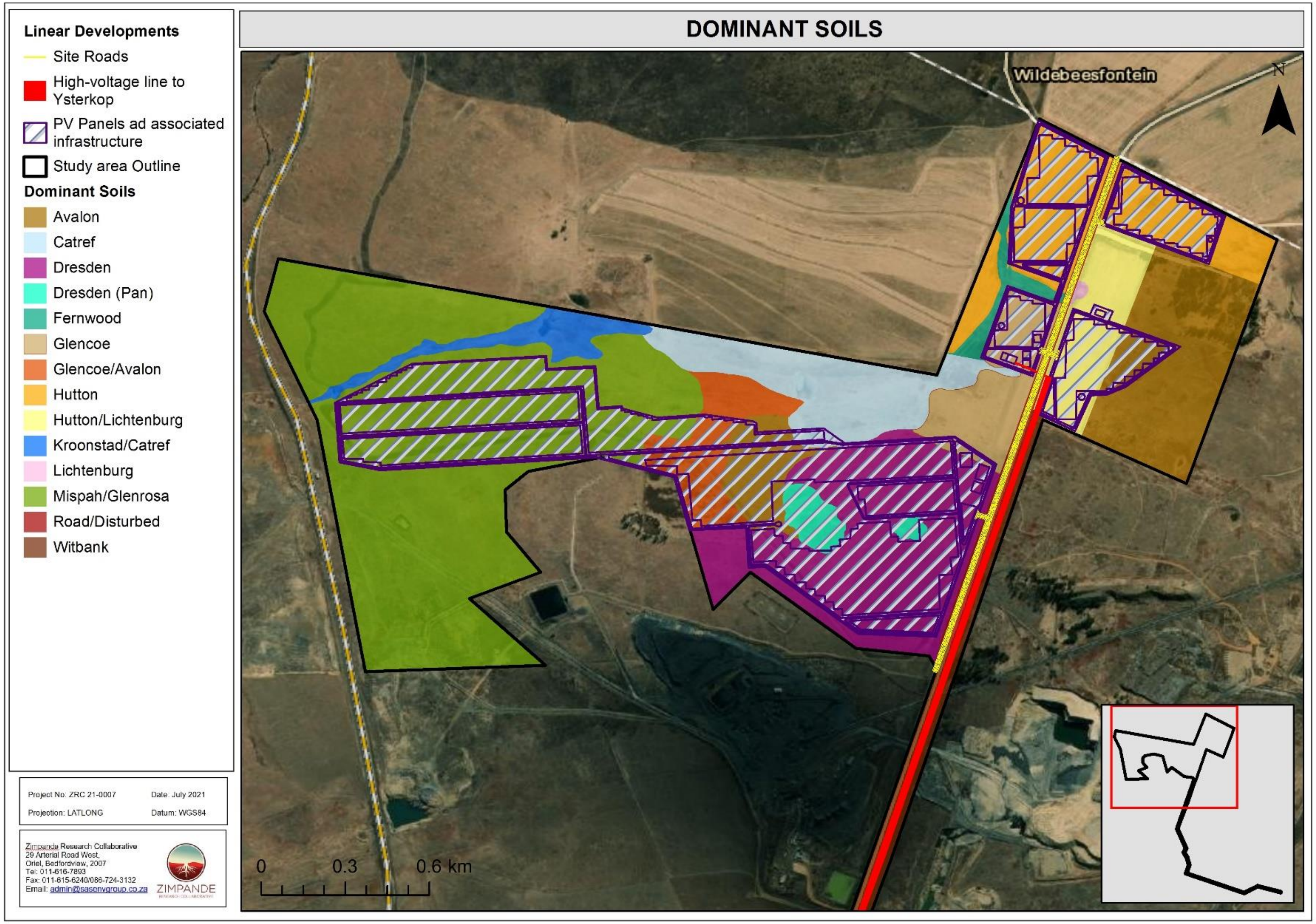

Figure 15: Dominant soils forms within the north of the study area outline.

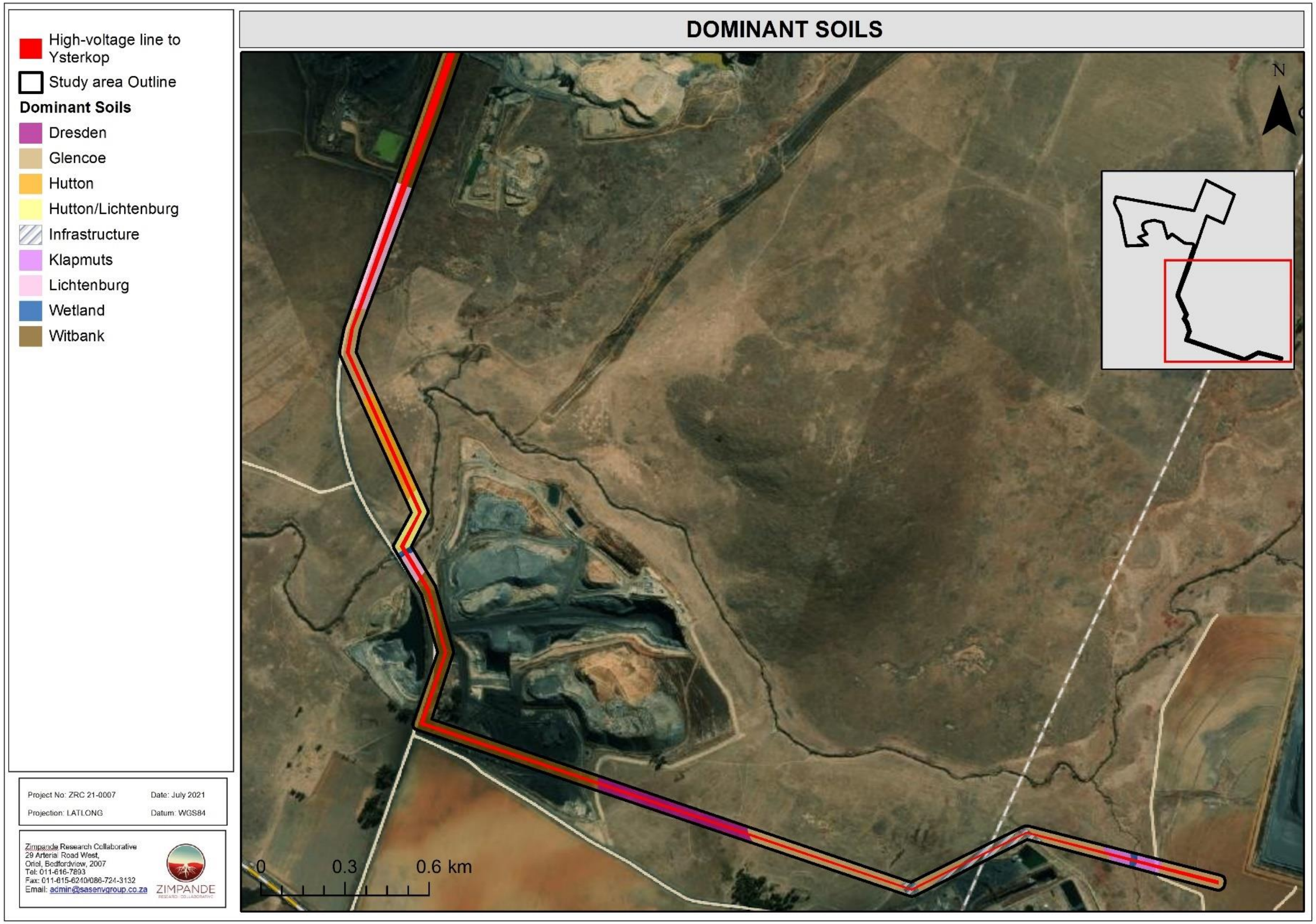

Figure 16: Dominant soils forms within the south of the study area outline.

4.3 Land Capability Classification

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 study area falls into Climate Capability Class 3 due to seasonal temperatures variation with good yield potential for a moderate range of adapted crops.

The identified soils were classified into land capability and land potential classes using the Scotney *et. al*, and Smith Classification system (Scotney *et al.,* 1987; Smith, 2006), as presented from Figures **17, 18 and 19** below. The identified land capability limitations for the identified soils are discussed in comprehensive "dashboard style" summary tables presented from Tables **8, 9, 10, 11 and 12** below. The dashboard reports aim to present all the pertinent information in a concise and visually appealing fashion. **Table 7** below presents the dominant soil forms and their respective land capability as well as areal extent expressed as hectares as well as percentages. The agricultural sensitivity of the identified soil forms is presented from Figures **20, 21 and 22**.

Table 7:Identified soil forms within the footprint areas(PV panels and associated infrastructure) and their respective land capability.

Soil Form	Land capability	Area (ha)	Percentage (%)
Avalon	Arable (Class II)	10.5	7
Lichtenburg		3.10	2
Hutton		21.32	15
Hutton/Lichtenburg		8.06	6
Glencoe/Avalon	Arable (Class II/Class III)	7.60	5
Dresden	Arable (Class III)	34.35	24
Glencoe		5.37	4
Klapmuts	Grazing (Class V)	0.8	1
Cartref		0.88	1
Wetland		0.19	0.1
Dresden (Pan)		3.9	3
Fernwood		0.29	0
Mispah/Glenrosa	Grazing (Class VI)	32.69	22
Witbank	Wilderness (Class VIII)	16.29	11
Total Enclosed Area		**145.34**	**100.0**

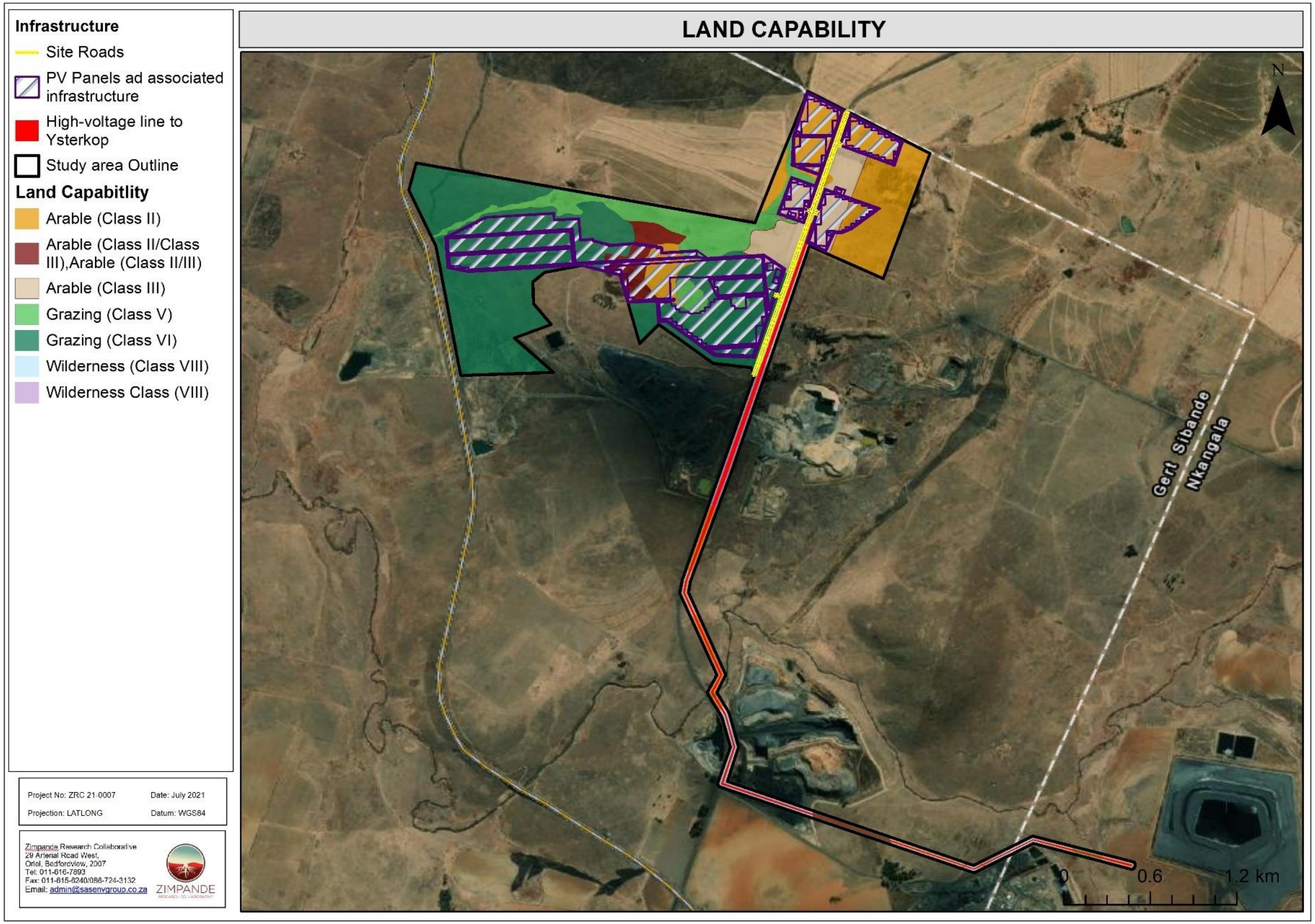

Figure 17: Map depicting Land capability of soils occurring within the study area.

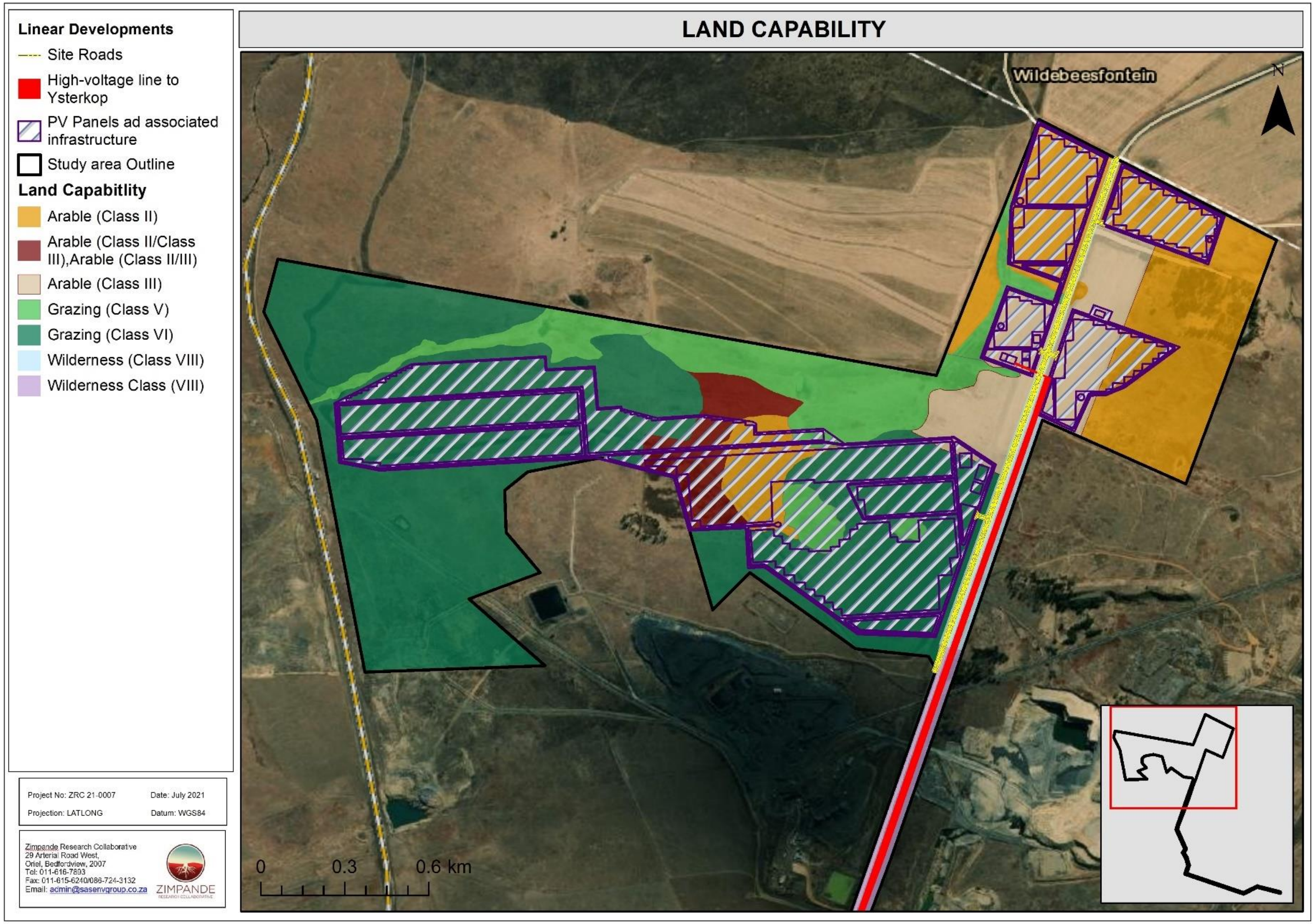

Figure 18: Map depicting Land capability of soils occurring within the north of the study area.

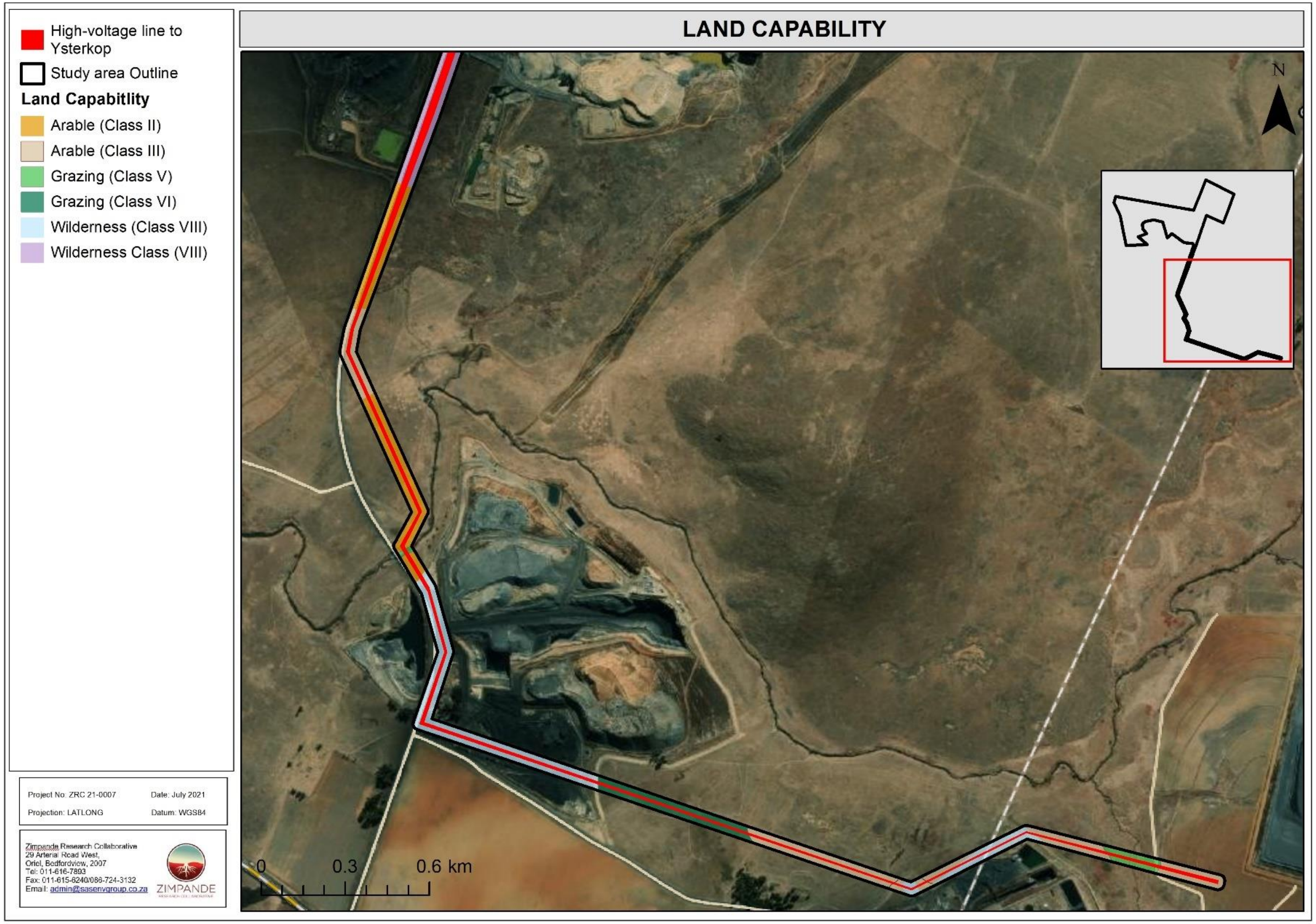

Figure 19: Map depicting Land capability of soils occurring within the south of the study area.

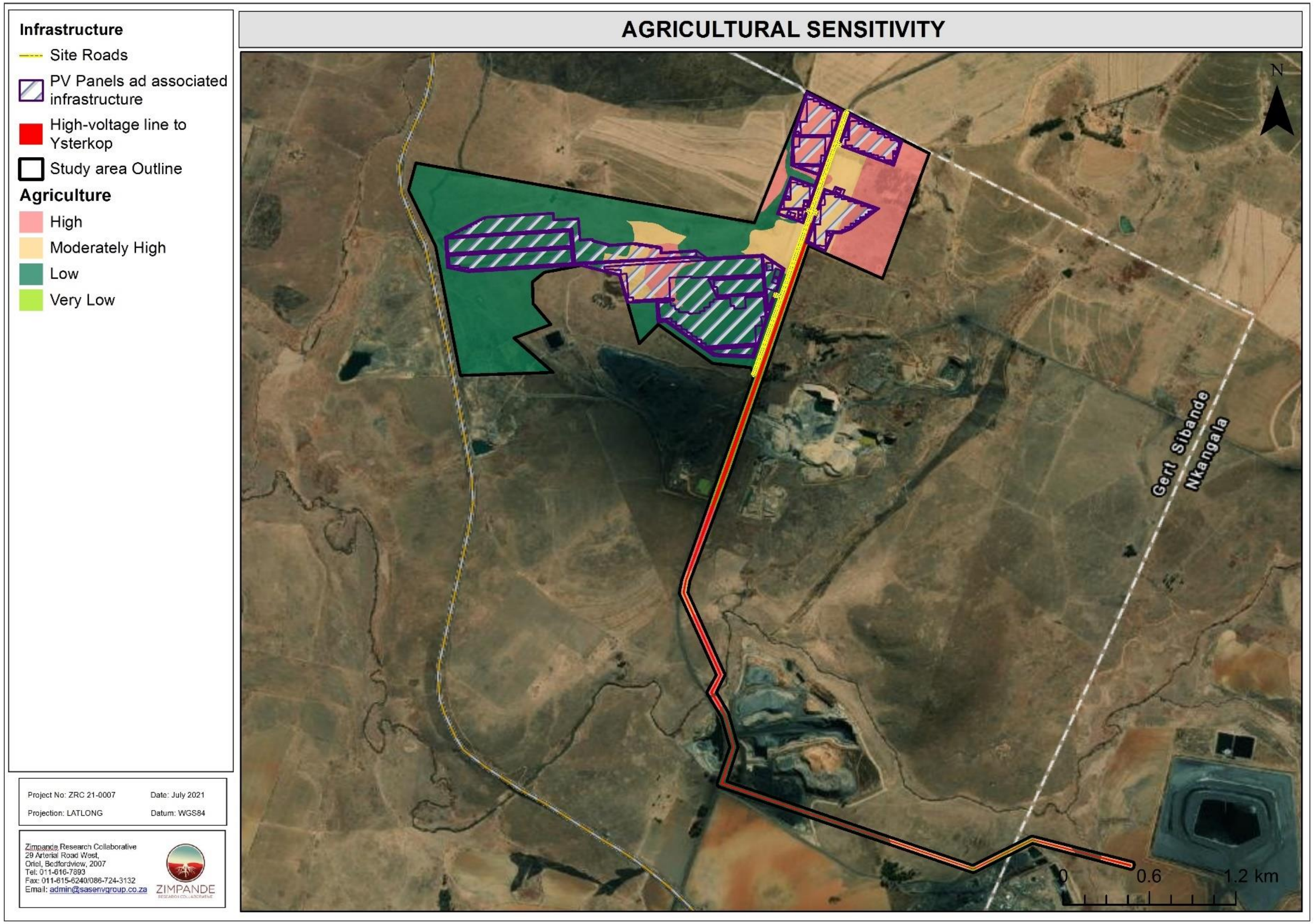

Figure 20: Map depicting the agricultural sensitivity of soils occurring within the study area.

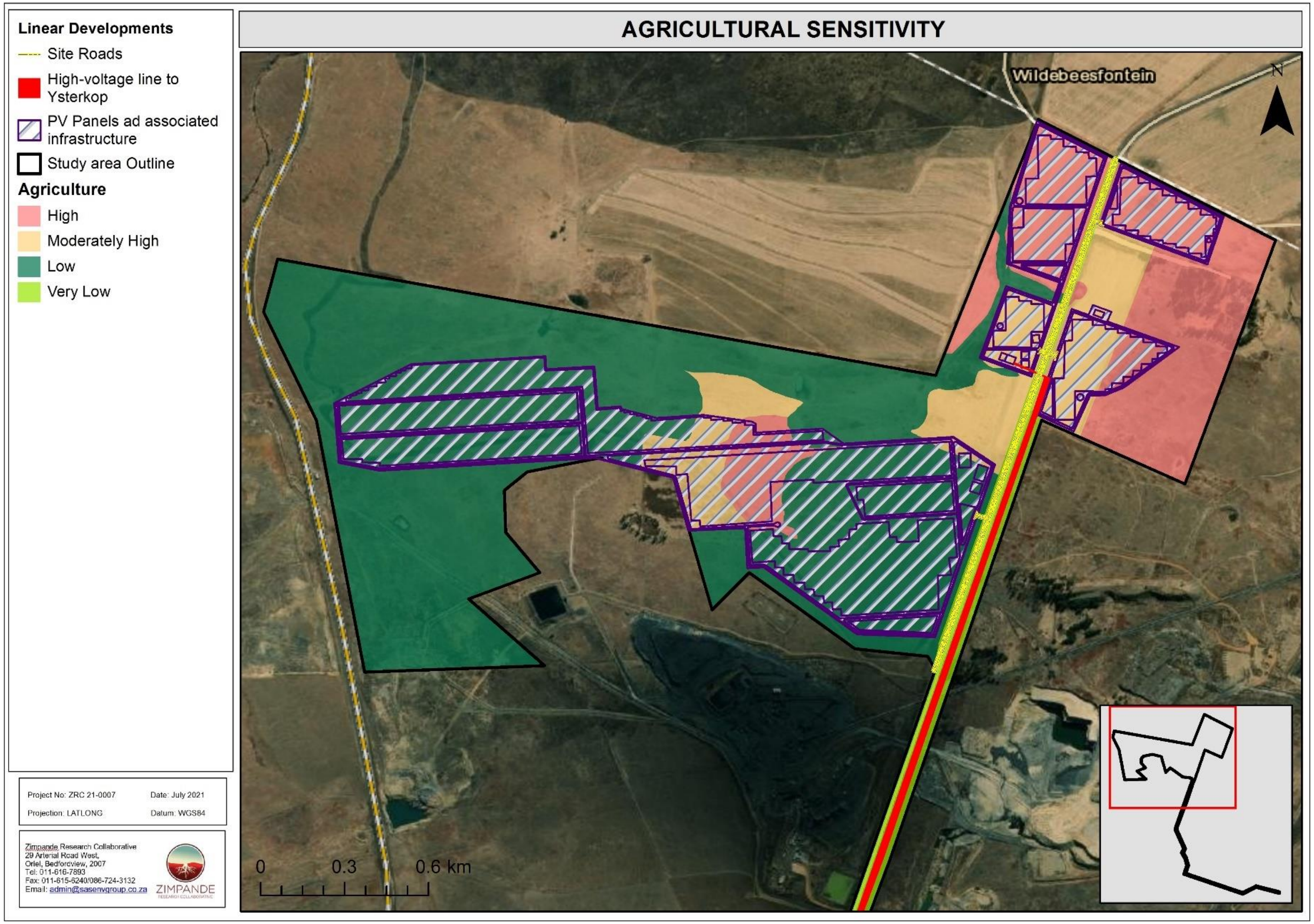

Figure 21: Map depicting the agricultural sensitivity of soils occurring within north of the study area.

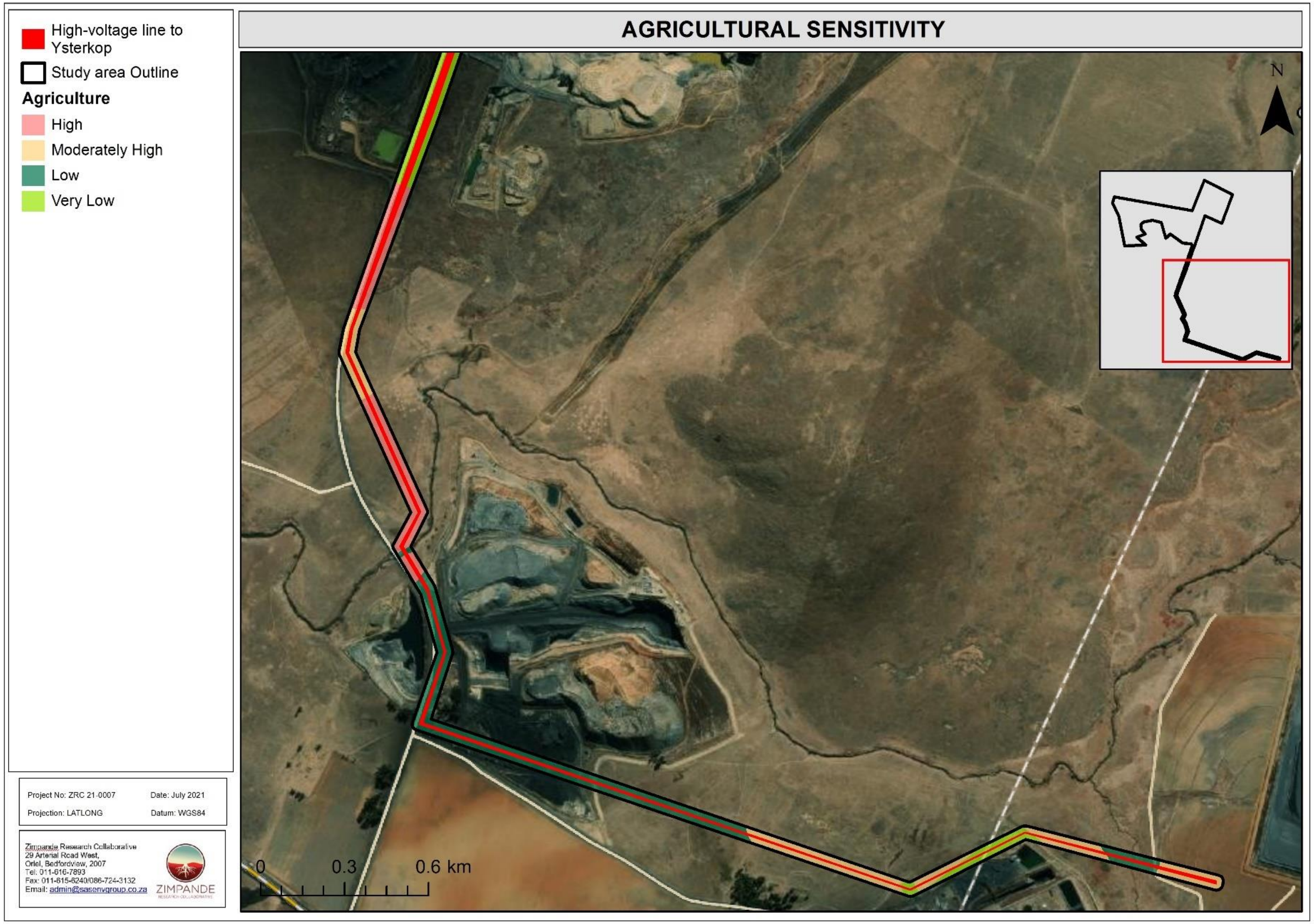

Figure 22: Map depicting the agricultural sensitivity of soils occurring within south of the study area.

Table 8: Summary discussion of the arable (Class II) land capability class.

<table>
<tr><th colspan="5">Land Capability: Arable (Class II) and High potential land potential</th></tr>
<tr><td colspan="5">   </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Gently sloping landscapes of < 0.5% slope gradient</td><td>Photograph notes</td><td>View of the red and yellow brown apedal, soft plinthic and hard plinthic soil horizons associated with the Hutton, Avalon and Lichtenburg</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Hutton/Avalon/Lichtenburg</td><td>Area Extent</td><td>42.98 ha (30%)</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">None. These soils have enough depth for most cultivated crops and good drainage characteristics.</td><td colspan="2" rowspan="2">Land Capability and Land Potential
These soil forms are considered high potential agricultural soils with high (Class II) land capability, suitable for arable agricultural land use with minimal management interventions. Therefore, these soils are considered suitable for use for crop cultivation, and are 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.</td></tr>
<tr><td>Land Potential</td><td colspan="2">L2: Very infrequent and/or minor limitations due to soil, slope, temperatures or rainfall.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact of the proposed Photovoltaic (PV) Facilities and voltage line development on land capability and land potential is anticipated to be Medium (M) prior to mitigation measures and Low (L) post mitigation, due to the inherently high land capability of the identified dominant soil forms. The proposed Solar Photovoltaic (PV) Facilities will result in a permanent change of land use. Thus, the loss of agricultural soils and agriculturally productive land will be somewhat significant considering the scarcity of arable soils in South Africa.</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
Considering the land capability and the land potential of the area, these soils are of a high agricultural value and thus can potentially contribute towards the local and regional agricultural sphere. Hence, the protection of natural agricultural resources such as high potential soils and maintenance of the production potential of land is deemed important according to the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983). Henceforth, the proposed Solar Photovoltaic (PV) Facilities development within the study area should take note of the requirements of CARA and aim to minimise the impact on these high potential soils and their loss to agricultural production. If at all possible the opportunity for agricultural activity of suitable crops concurrently with solar generation should be investigated.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 9: Land Capability: Arable (Class III) and High potential land potential

<table>
<tr><th colspan="5">Land Capability: Arable (Class III) and High potential land potential</th></tr>
<tr><td colspan="5"> </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Relatively flat to gently sloping land of <1% slope</td><td>Photograph notes</td><td>View of the yellow brown and hard plinthic horizons associated with the Glencoe and Dresden soil forms.</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Glencoe/Dresden</td><td>Area Extent</td><td>47.32 ha (33%)</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 Glencoe and Dresden soil forms 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">L2: Very infrequent and/or minor 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>M</td><td rowspan="2">The overall impact of the proposed Photovoltaic (PV) Facilities and voltage line development on land capability and land potential is anticipated to be Medium (M) prior to mitigation and Low (L) after mitigation both with and without mitigation measures in place, due to the inherently high land capability of the identified dominant soil forms. The proposed Solar Photovoltaic (PV) Facilities will result in a permanent change of land use. Thus, the loss of agricultural soils and agriculturally productive land will be somewhat significant considering the scarcity of arable soils in South Africa.</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
Considering the land capability and the land potential of the area, these soils are of a high agricultural value and thus can potentially contribute towards the local and regional agricultural sphere. Hence, the protection of natural agricultural resources such as high potential soils and maintenance of the production potential of land is deemed important according to the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983). Henceforth, the proposed Solar Photovoltaic (PV) Facilities development within the study area should take note of the requirements of CARA and aim to minimise the impact on these high potential soils and their loss to agricultural production. If at all possible the opportunity for agricultural activity of suitable crops concurrently with solar generation should be investigated. The soil fragmentation within the study area may potentially result in reduced agricultural production, increased land degradation, soil erosion and reduction in landscape quality and stability. This may potentially affect the food production and economic viability of the farm. CARA aims to minimise the impact on these high potential soils and their loss to agricultural production.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 10: 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">Relatively flat to gently sloping land of <1% slope</td><td>Photograph notes</td><td>View of the identified albic and clay enriched gleyic horizons and pans associated with the Kroonstad, Klapmuts, Cartref, Wetland, Dresden (Pan) and Fernwood soil forms.</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Kroonstad, Klapmuts, Cartref, Wetland, Dresden (Pan) and Fernwood.</td><td>Areal Extent</td><td>6.06 ha (4%)</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">These soils have limitations in terms of water storage and nutrient holding capacity due to high sand content and the susceptibility to waterlogged conditions.</td><td colspan="2" rowspan="2">Land Capability
The identified soils are of poor (Class V) land capability due to wetness limitations during the rainy season associated with the underlying semi-impermeable soft plinthic material. These soils, at best are suitable for grazing but are sometimes ploughed for subsistence farming due to their limiting factors such as poor nutrient holding capacity. Thus, require intensive management practices. These soils are therefore not considered to contribute significantly to provincial and/or national agricultural productivity.</td></tr>
<tr><td>Land Potential</td><td colspan="2">Vlei: Due to the signs of wetness</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>L</td><td rowspan="2">The overall impact of the proposed Photovoltaic (PV) Facilities and voltage line development on land capability and land potential is anticipated to be Low (L) both with and without mitigation measures in place, due to the inherently poor land capability of the identified dominant soil forms. The proposed Solar Photovoltaic (PV) Facilities in this instance will not impact on high potential soils and will be somewhat significant considering the scarcity of arable soils in South Africa.</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
While these soils are not considered prime agricultural production soils, historical cultivation activities have occurred as well as livestock grazing which has therefore qualified these soils for cultivation under intensive management.</td></tr>
<tr><td>Overall impact significance post to mitigation</td><td>L</td></tr>
</table>

Table 11: Summary discussion of the grazing (Class VI) land capability class

<table>
<tr><th colspan="5">Land Capability: Grazing (Class VI)</th></tr>
<tr><td colspan="5">


</td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Gently sloping land of <1% slope</td><td>Photograph notes</td><td>View of the identified rock outcroppings associated with the Mispah and Glenrosa soil forms.</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Mispah and Glenrosa</td><td>Areal Extent</td><td>32.69 ha (22%)</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">These soils have limitations in terms of water storage, depth and nutrient holding capacity due to limited rock weathering.</td><td colspan="2" rowspan="2">Land Capability
The identified soils are of poor (Class VI) land capability due the soil depth of this class is very shallow and moderately sloping. These limitations generally makes these soils unsuited to cultivation and limit their use largely to pastures or wood land.</td></tr>
<tr><td>Land Potential</td><td colspan="2">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>L</td><td rowspan="2">The overall impact of the proposed Photovoltaic (PV) Facilities and voltage line development on land capability and land potential is anticipated to be Low (L) both with and without mitigation measures in place, due to the inherently poor land capability of the identified dominant soil forms. The proposed Solar Photovoltaic (PV) Facilities in this instance will not impact on high potential soils and will be somewhat significant considering the scarcity of arable soils in South Africa.</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
While these soils are not considered prime agricultural production soils. Some soils in class VI can be safely used for the common crops, provided unusually intensive management is used.</td></tr>
<tr><td>Overall impact significance post to mitigation</td><td>L</td></tr>
</table>

Table 12: 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>Terrain Morphological Unit (TMU)</td><td colspan="2">Not applicable; highly disturbed areas</td><td>Photograph notes</td><td>View of the identified Witbank soil forms</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Witbank (Anthrosols)</td><td>Area Extent</td><td>16 ha (11%)</td></tr>
<tr><td>Diagnostic Horizon Sequence</td><td colspan="2">Not applicable; highly disturbed soils</td><td colspan="2" rowspan="2">Land Capability
These identified Witbank soils have very poor (class VIII) land capability due to the significant disturbance that has occurred as a result of mining activities. This has led to the long-term alteration of the soil physical chemical properties such that these soils are no longer viable for agriculture. These soils are therefore not considered to make a significant contribution to agricultural productivity even on a local scale.</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">Comprises of significantly disturbed areas due from anthropogenic activities to an extent that no recognisable diagnostic soil horizon properties could be identified. These soils are characterised by various limitations, primarily the absence of appropriate soil to provide a growth medium</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>L</td><td rowspan="2">The overall impact of the proposed development on the land capability of these soils is anticipated to be low due to their very poor land capability</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
The current state of these soils requires significant rehabilitation already. These areas should be targeted for development so as to avoid disturbance of natural soils and landscapes. These areas can be rehabilitated holistically at closure of the surrounding mines.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

5. SOIL CHEMICAL ANALYSIS

While soil functionality cannot be directly measured, physio-chemical parameters such as pH and Electrical Conductivity (EC) are sensitive to disturbance and responsive to management practices. These parameters can be used as indicators of the response of the soil, and ecosystem to current (and/or former) management practices. Soil pH measurement is useful since it is a predictor of various chemical activities within the soil. The soil chemistry is likely to be altered during the development of the Solar Photovoltaic (PV) Facilities and these soil-lab results can be used to assess the current status of the soil conditions. Potential impacts include:

- Soil quality deterioration including:
  - Changes in chemical characteristics;
  - Loss of fertility characteristics;
  - Loss of moisture holding capability and organic carbon;
- Soil contamination

The sections below present a discussion of the various parameters analysed. The sampling localities are illustrated on Figure 23 below.

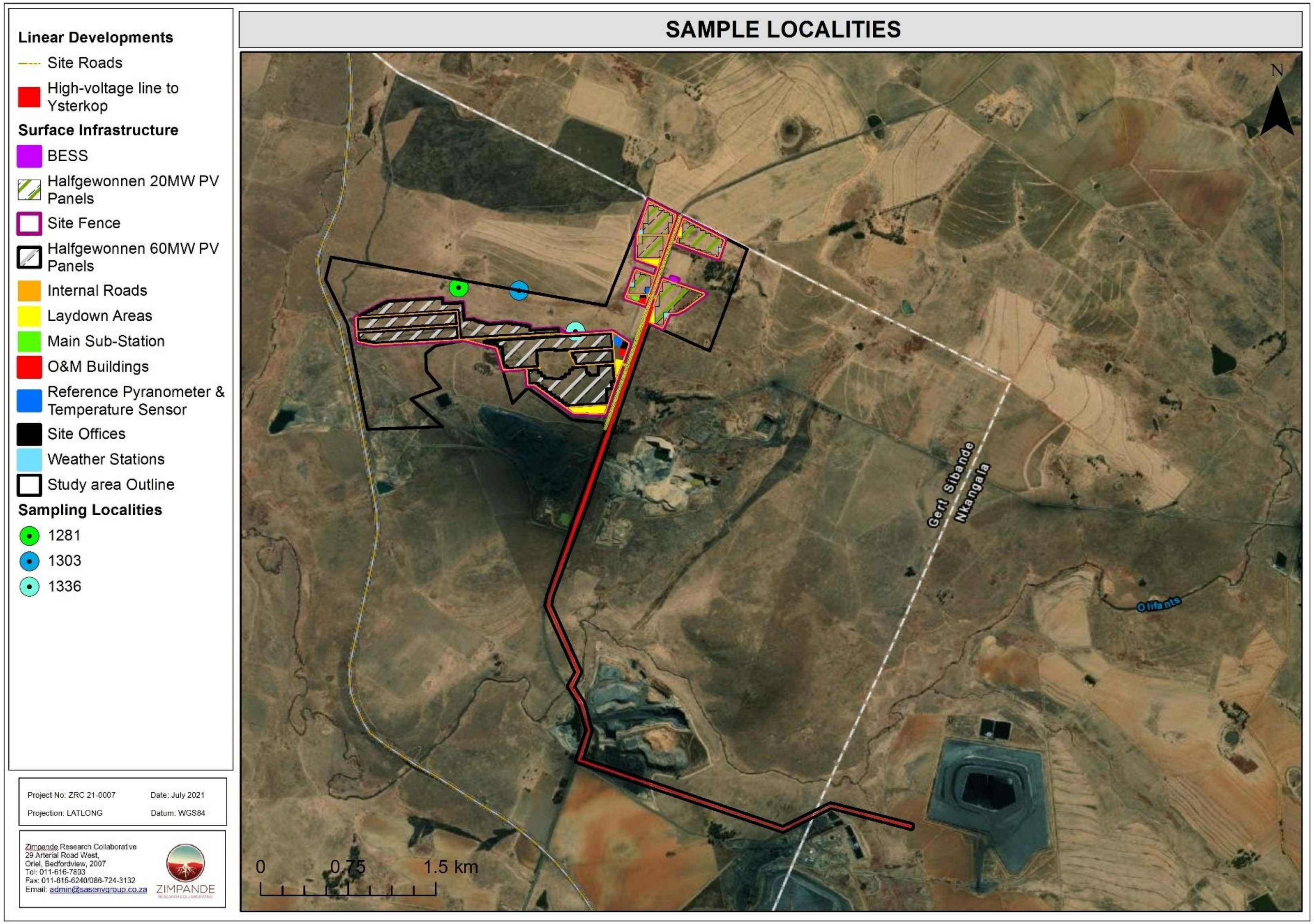

Figure 23: Location of sampling points.

pH Analysis

Based on the laboratory result analysis, Sample 1281, 1303 and 1336 had a soil pH of 4.7 and 5.0 and 5.1 respectively, indicating that the natural pH of the surrounding soils is strongly acidic following the pH interpretations depicted on Figure 24 below. The strongly acidic pH can be a consequence of the samples being located in the seep wetlands and adjacent to the seep wetlands. In these soils there is removal of colloidal matter and thus reduction in the pH values can be expected due to the leaching factor.

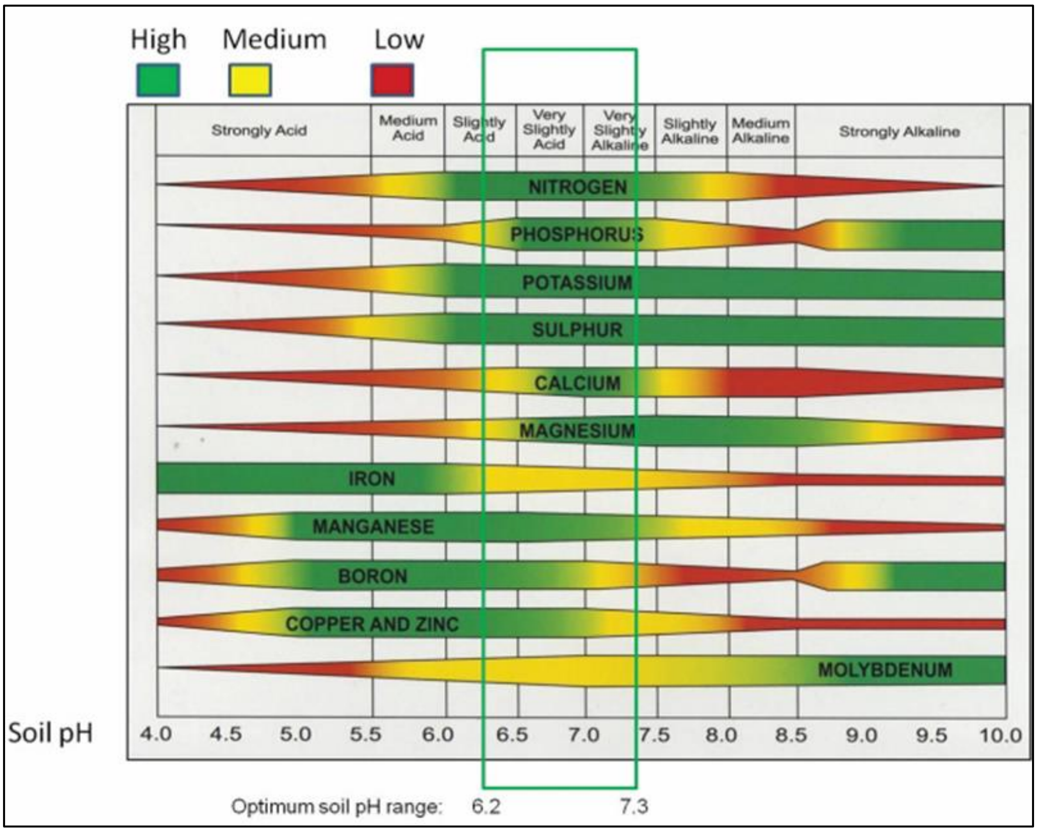

Figure 24: Influence of soil pH on nutrient availability.

Macronutrients Analysis

Macronutrients are required in relatively large quantities by plants; however, plants also show a great deal of variation in their requirements of these elements. These elements are critical to numerous plant components including proteins, nucleic acids and chlorophyll, and are essential for processes such as energy transfer and the functioning of enzymes (Fertilizer Society of South Africa, 2007). The Macronutrients considered in this report are phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg).

Plant available P is often low in soils and unlike nitrogen, phosphorus is highly immobile and only the portion which is in the immediate vicinity of the plant root can be taken up by the plant. P content less than 15 mg/kg is considered very low for grain and vegetable production. Sample 1281, 1303 and 1336 had a soil P concentration of 4, 3 and 73 mg/kg respectively. High acidity of the soils is likely the cause of the low phosphate concentration for samples 1281 and 1303. This can be rectified by the accumulation of phosphates in the soil through additional fertilisation. Rectifying the soil phosphorus concentration would be beneficial as adequate phosphate levels promote root growth and winter hardiness, stimulate tillering, and hasten maturity.

Potassium (K) is an essential plant nutrient and is required in large amounts for proper growth and reproduction of plants. Potassium is considered second only to nitrogen, when it comes to nutrients needed by plants, and is commonly considered as the "quality nutrient". In Photosynthesis, potassium regulates the opening and closing of stomata, and therefore regulates CO2 uptake. It also plays a major role in the regulation of water in plants (osmo-regulation). Both uptake of water through plant roots and its loss through the stomata are affected by potassium. The most common symptom of potassium deficiency is an area of yellowed tissue around some leaf edges. Potassium deficiency can also cause entire leaves to develop a light green colour. A potassium concentration of 40 mg/kg is considered very low for cultivation. Although a potassium content between 80 mg/kg and 160 mg/kg is considered optimal for most cultivated crops and vegetables. Sample 1281, 1303 and 1336 had a soil K concentration of 54, 118 and 156 mg/kg, respectively. All samples fell above the lower limit for available K concentration.

Calcium promotes protein formation and is essential for cell growth. It plays a role in the quality and keeping quality of fruits and vegetable. A calcium concentration below 200 mg/kg is considered low for the cultivation of most crops. Sample 1281, 1303 and 1336 had a soil Ca concentration of 142, 187, and 357 mg/kg respectively. Sample 1281 and 1303 fell below 200 mg/kg and can be attributed to the leaching factor of the seep wetlands.

Magnesium (Mg) is also an essential plant nutrient. It plays an important role in the photosynthesis process, as it is a building block of the Chlorophyll, which makes leaves appear green. Magnesium deficiencies on acidic, sandy soils are common occurrence. Magnesium concentration below 50 mg/kg is considered low for cultivation of most crops. Sample 1281, 1303 and 1336 had a soil Mg concentration of 42, 45 and 62 mg/kg. Sample 1281 and 1303 fell below 50 mg/kg and can also be attributed to the leaching factor of the seep wetlands.

Table 13: Summary results of the macronutrient analysis

Sample Number	1281	1303	1336
Phosphorus (mg/kg)	4	3	73
Potassium (mg/kg)	54	118	156
Calcium (mg/kg)	142	187	357
Magnesium (mg/kg)	42	45	62

Organic Carbon (%)

South African soils have in general a low organic matter content of virgin soils. Only 4% of the soils contain more than 2% of organic carbon and 58% contain less than 0.5% organic carbon. The remaining 38% of soils contain between 0.5 and 2% organic carbon (Fertilizer Society of South Africa, 2007). Sample 1281, 1303 and 1336 had a soil organic carbon of 1.29, 1.35 and 0.81%. The slightly elevated organic carbon content of sample 1281 and 1303 can be attributed to wetland conditions occurring in the immediate vicinity.

Table 14: Summary results of the organic carbon analysis.

Sample Number	1281	1303	1336
Organic Carbon (%)	1.29	1.35	0.81

Particle Size Analysis (Texture)

Soil consists of an assembly of ultimate soil particles (discrete particles) of various shapes and sizes. The objective of a particle size analysis is to group these particles into separate ranges of sizes and so determine the relative proportion by weight of each size range and thus determine the textural class of the soil. The soils are largely dominated by sand fraction and thus can be classified as loamy sand and sandy loam. These soils have a good water holding potential and thus can be used for cultivation.

Table 15: Summary results of the particle size analysis and textural class.

Sample Number	1281	1303	1336
Clay (%)	12	16	14
Silt (%)	13	11	11
Sand (%)	75	73	75
Textural Class	Loamy Sand	Sandy Loam	Sandy Loam

6. IMPACT ASSESSMENT AND MITIGATION MEASURES

In the initial stages of the project, the proposed Halfgewonnen Solar Photovoltaic (PV) Project was planned with a large portion of the footprint of the PV array in the wetland system. Once this became evident, the project layout was revisited to reduce the risk to the receiving environment; based on recommendations from STS and Scientific Aquatic Services CC (SAS). Areas outside and adjacent to the study area that were highlighted as "Medium Sensitivity" for the Agricultural Sensitivity Theme by the National Web Based Environmental Screening Tool were investigated as alternatives but were deemed unsuitable due to the various technical reasons below:

- Property where land-use and access agreements have not been reached between the developer and landowner;
- Areas already approved for expansion of the Halfgewonnen Mine;
- Current Halfgewonnen coal processing plant - incompatible with solar PV development due to dust and land availability; and
- Previously mined areas deemed not suitable to develop the PV array.

The final layout prepared was thus put forward as the only alternative, noting that some impacts on agriculturally sensitive soils cannot be avoided any further. This layout thus forms the basis of the impact assessment of this study.

Proposed Activity Description:

The proposed infrastructure development will cover approximately ±100 ha in total and entails the following:

- Solar PV 1 (30 ha);
- Solar PV 2 (60 ha);
- Additional buildings (± 0.3 ha) and the battery storage area (± 3.3 ha); and
- Linear developments such as the main pipeline and the high voltage line (± 6.2 km)

The soils are anticipated to be exposed to erosion, dust emission, and potential soil contamination impacts during the construction phase of the proposed development; and these impacts may persist for the duration of the operational phase if not mitigated adequately. The significance of the impacts is summarised on Tables presented below the proposed development.

6.1 Activities and Aspect Register

The impact assessment rating is applicable to the following activities:

Table 16: Activities associated with proposed development during different phases.

ACTIVITIES AND ASPECTS REGISTER
Pre-Construction Phase
- Planning and design of the footprint areas. - Preparation for the construction activities. - **Impact**: Vegetation clearance within the footprint area. Increased soil erosion and loss of agriculturally important soils.
Construction Phase
- Land and footprint clearing. - **Impact:** Increased soil erosion and subsequent soil loss
- Establishment of surface infrastructure, pipelines and electrical powerlines - **Impact:** Spillage of hydrocarbons leading to soil contamination Vehicle/equipment movement causing soil erosion, soil compaction and ultimately loss of agriculturally productive soils.
Operational and Maintenance Phases
- Operation of the surface infrastructure. - **Impact:** Increased soil erosion, compaction and spillage of hydrocarbons

6.1.1 Soil Erosion

Soil erosion is largely dependent on land use and soil management and is generally accelerated by anthropogenic activities. In the absence of detailed South African guidelines on erosion classification, the erosion potential and interpretation are based on field observations as well as observed soil profile characteristics. In general, soils with high clay content have a high-water retention capacity, thus less prone to erosion in comparison to sandy textured soils, which in contrast are more susceptible to erosion.

The proposed development footprint is located on a moderately sloping terrain, which increases the erosion hazard. While the identified soils display a moderate susceptibility to erosion under current conditions, their susceptibility to erosion is likely to increase once the land is cleared for construction activities, and the soils will inevitably be exposed to wind and stormwater. Refer to Table 17 for the impact significance ratings.

Impact Register

Pre-Construction	Construction	Operational
Potential poor planning leading to excessive or unnecessary placement of the proposed solar pv plants on high potential agricultural soils	Site clearing, removal of vegetation, and associated disturbances to soils, leading to, increased runoff, erosion and consequent loss of land capability in cleared areas.	Constant disturbances of soils, resulting in risk of erosion
	Potential frequent movement of digging machinery within lose and exposed soils, leading to excessive erosion	

Table 17: Summary of the impact significance on potential soil erosion for the study area.

	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Unmanaged								
Pre-Construction phase	5	4	3	4	2	9	9	81 (Medium-High)
Construction phase	4	4	3	3	3	8	9	72 (Medium-Low)
Operational phase	4	3	3	3	4	7	10	70 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Pre-Construction phase	5	4	3	3	1	9	7	63 (Medium Low)
Construction phase	5	3	3	2	3	7	8	56 (Medium Low)
Operational phase	4	2	2	2	4	6	8	48 (Low)

6.1.2 Impact: Soil compaction

Heavy equipment traffic during construction and activities is anticipated to cause soil compaction. The severity of this impact is anticipated to be moderately high for most soils under cultivation and moderately low for soils characterised by the presence of rocky outcrops. Refer to Table 18 for the impact significance ratings. Soil compaction will potentially lead to:

- Increased bulk density and soil strength reduced aeration and lower infiltration rate;
- Consequently, it lowers crop performance via stunted aboveground growth coupled with reduced root growth;
- Destroyed soil structure, causing it to become more massive with fewer natural voids with a high possibility of soil crusting. This situation can lead to stunted, drought-stressed plants as a result of restricted water and nutrient uptake, which results in reduced crop yields; and
- Soil biodiversity is also influenced by reduced soil aeration. Severe soil compaction may cause reduced microbial biomass. Soil compaction may not influence the quantity, but the distribution of macro fauna that is vital for soil structure including earthworms due to reduction in large pores.

Impact Register

Pre-Construction	Construction	Operational
Potential poor planning leading to excessive or unnecessary placement of the proposed solar pv plants on high potential agricultural soils.	Site clearing, removal of vegetation, and associated disturbances to soils, leading to, increased runoff, soil compaction and consequent loss of land capability in cleared areas.	Constant disturbances of soils, resulting in risk of compaction.
	Potential frequent movement of digging machinery within lose and exposed soils, leading to excessive soil compaction.	

Table 18: Summary of the impact significance on soil compaction for the study area.

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Pre-Construction phase	4	4	4	4	2	8	10	80 (Medium-High)
Construction phase	4	3	3	3	3	7	9	63 (Medium-Low)
Operational phase	3	3	2	3	3	6	8	48 (Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Pre-Construction phase	4	3	3	3	1	7	7	49 (Medium Low)
Construction phase	5	3	3	3	3	7	9	63 (Medium Low)
Operational phase	4	2	2	2	4	6	8	48 (Low)

6.1.2 Potential Soil Contamination

Contamination sources are mostly unpredictable and often occur as incidental spills or leaks during both the construction and operational phase. Thus, all the identified soils are considered equally predisposed to potential contamination. The significance of soil contamination is considered to be medium for all identified soils without mitigation, largely depending on the nature, volume and/or concentration of the contaminant of concern as well as the rate at which contaminants are transported by water in the soil. Therefore, strict waste management protocols as well as product stockpile management and activity specific Environmental Management Programme (EMP) and monitoring guidelines should be adhered to during the construction and operational activities. Refer to Table 19 for the impact significance ratings. If the management protocols are not well managed this will more likely lead to:

- Contaminants leaching into the soil and thus potentially rendering the soil sterile. reducing the yield potential of soils.
- Potential reduction of water quality used for irrigation and for livestock use.

Impact Register

Pre-Construction	Construction	Operational
Potential poor planning leading to excessive or unnecessary placement of the proposed solar pv plants on high potential agricultural soils	Spillage of petroleum hydrocarbons during construction of associated infrastructure	Leaching of hydrocarbons chemicals into the soils, leading to alteration of the soil chemical status as well as contamination of ground water
	Disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil.	Disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil.

Table 19: Summary of the impact significance on soil contamination for the study area.

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Pre-Construction phase	5	3	3	2	3	8	8	64 (Medium-Low)
Construction phase	4	3	3	2	4	7	9	72 (Medium-Low)
Operational phase	4	3	3	2	3	6	8	56 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Pre-Construction phase	3	2	3	2	2	5	7	35 (Low)
Construction phase	3	3	3	3	2	6	8	48 (Low)
Operational phase	3	2	2	2	4	5	8	40 (Low)

6.1.3 Loss of Agricultural Land Capability

At present most of the soils associated with the study area can be broadly classified as soils suitable for cultivation and grazing. The majority of the area is most suitable for grazing, pasture or woodland. Henceforth, the loss of land capability is anticipated to be Medium Low because stripping of topsoil and site clearing will potentially result in loss of fertile topsoil and soil erosion. The Low impact with mitigation measures takes in to account the recommendation that the possibility for any agricultural activity concurrently with solar generation was investigated. Table 20 below depicts the impact significance on loss of agricultural capability. An example of such activity is illustrated on Figure 25 below.

Table 20: Summary of the impact significance on loss of agricultural capability for the study area.

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Pre-Construction phase	4	4	3	3	3	8	9	72 (Medium-Low)
Construction phase	4	4	4	3	3	8	10	80 (Medium-High)
Operational phase	3	3	4	3	4	6	11	66 (Medium-Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Pre-Construction phase	3	3	3	3	3	6	9	54 (Medium-Low)
Construction phase	3	3	3	3	2	6	8	48 (Low)
Operational phase	3	2	3	3	2	5	8	40 (Low)

Figure 25: Depicts an agrivoltaics or agrophotovoltaics systems used to co-develop the same area of land for both solar photovoltaic power as well as for agriculture in order to possibly reduce the loss of land capability and land potential.

6.1.4 Cumulative Impacts

The proposed development is likely to affect significant portions of the arable soils (90.3 ha out of 145.34 ha). Considering the given potential of the soils, the level of disturbance and current cultivation and grazing taking place at the time of site assessment, the loss from a soil and land capability point of view is anticipated to be of Moderate significance. Thus, the proposed activities may potentially have a negative impact on agricultural production on a local and regional and scale. The protection of agricultural resources should be prioritised as far as practically possible while considering the need for sustainable development and the need for conversion to greener energy production in South Africa.

6.2 Integrated Mitigation Measures

Based on the findings of the soil, land use and land capability assessment, mitigation measures have been developed to minimise the impact on the soil resources of the area, should the proposed project proceed:

6.2.1 Soil Erosion and Dust Emission Management

- Bare soils within the access roads can be regularly dampened with water to suppress dust during the construction phase, especially when strong wind conditions are predicted according to the local weather forecast;
- All disturbed areas adjacent to the proposed development areas should be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, to minimise soil erosion and dust emission;
- Temporary erosion control measures should be used to protect the disturbed soils during the construction phase until adequate vegetation has established.

6.2.2 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 at all times 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 contamination; and

- Burying of any waste including domestic waste, empty containers on the site should be strictly prohibited and all construction rubble waste must be removed to an approved disposal site.

6.2.3 Loss of Land Capability Management

- The proposed Solar Photovoltaic (PV) Facilities development within the study area should aim to minimise the impact on high potential soils by investigating the possibility for agricultural activity of suitable crops concurrently with solar generation.
- The developer, landowner and current land user (farmer) must reach agreement on timing / commencement of activities so that any activity by the developer does not clash with any agricultural activities (i.e., the developer does not start with footprint clearing a week before harvest time, for example).
- Landowner may investigate the feasibility to lease available land as alternatives to the current farming activities.

7. CONCLUSION

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use and land capability assessment as part of the environmental assessment and authorisation process for the proposed Solar Photovoltaic (PV) facilities and associated surface developments on various portions of the Halfgewonnen Farm, in the Mpumalanga Province.

Based on the observations during the site assessment, the dominant land uses within the study area are grazing, cultivation, mining and related activities. Large portions of the Study area is dominated by soils of Dresden, Glencoe, Mispah/Glenrosa, Cartref, Hutton and Witbank forms. The sub-dominant soils include Kroonstad/ Cartref, Avalon, Lichtenburg, Fernwood and Klapmut forms.

The majority of the soils (Dresden, Glencoe, Hutton, Avalon and Lichtenburg) are considered ideal for cultivation due to:

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

Table A below indicates the dominant soils occurring within the footprint areas(PV panels and associated infrastructure), together with the associated land capability and the area covered in hectares (ha).

Table A: Soil form and land capability data.

Soil Form	Land capability	Area (ha)	Percentage (%)
Avalon	Arable (Class II)	10.5	7
Lichtenburg		3.10	2
Hutton		21.32	15
Hutton/Lichtenburg		8.06	6
Glencoe/Avalon	Arable (Class II/Class III)	7.60	5
Dresden	Arable (Class III)	34.35	24
Glencoe		5.37	4
Klapmuts	Grazing (Class V)	0.8	1
Cartref		0.88	1
Wetland		0.19	0.1
Dresden (Pan)		3.9	3
Fernwood		0.29	0
Mispah/Glenrosa	Grazing (Class VI)	32.69	22
Witbank	Wilderness (Class VIII)	16.29	11
Total Enclosed Area		**145.34**	100.0

The proposed development is likely to affect significant portions of the arable soils (90.3 ha out of 145.34). Considering the given potential of the soils, the level of disturbance and current cultivation and grazing taking place at the time of site assessment, the loss from a soil and land capability point of view is anticipated to be of Moderate significance. Thus, the proposed activities may potentially have a negative impact on agricultural production on a local and regional and scale. The protection of agricultural resources should be prioritised as far as practically possible while considering the need for sustainable development and the need for conversion to greener energy production in South Africa.

Alternative areas of low sensitivity have been investigated as alternatives but was deemed unsuitable due to the reasons below:

- Property to which the developer does not have access;
- Areas already approved for expansion of the Halfgewonnen Mine;
- Current Halfgewonnen coal processing plant - incompatible with solar PV development due to dust and land availability;
- Previously mined areas deemed not suitable to build on; and
- Previously assessed areas were excluded based on the freshwater findings .

It is evident that the location of the proposed Solar PV cannot be changed due to the above-mentioned reasons and thus portions of the high potential arable soils can be considered for development provided that the possibility of any agricultural activity occurring concurrently with the solar generation is investigated in order to minimise the impacts on these soils.

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

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APPENDIX A: ASSESSMENT METHODOLOGY

Desktop Screening

Prior to commencement of the field assessment, a background study, including a literature review, was conducted in order to collect the pre-determined soil and land capability data in the vicinity of the investigated area Various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources as listed under references were used for the assessment.

Soil Classification and Sampling

A soil survey was conducted from 24 February 2020 by a qualified soil specialist, at which time the identified soils within the infrastructure areas and associated access roads were classified into soil forms according to the Soil Classification Working Group for South Africa (2018). Subsurface soil observations were made using a manual hand auger in order to assess individual soil profiles, which entailed evaluating physical soil properties and prevailing limitations to various land uses.

Land Capability Classification

Agricultural potential is directly related to Land Capability, as measured on a scale of I to VIII, as presented in Table **A1** below; with Classes I to III classified as prime agricultural land that is well suitable for annual cultivated crops. Whereas, Class IV soils may be cultivated under certain circumstances and management practices, whereas Land Classes V to VIII are not suitable to cultivation. Furthermore, the climate capability is also measured on a scale of 1 to 8, as illustrated in Table **A2** below. The land capability rating is therefore adjusted accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating. The anticipated impacts of the proposed land use on soil and land capability were assessed in order to inform the necessary mitigation measures.

Table A1: Land Capability Classification (Smith, 2006)

Land Capability Class	Increased Intensity of Use									Land Capability Groups
I	W	F	LG	MG	IG	LC	MC	IC	VIC	**Arable land**
II	W	F	LG	MG	IG	LC	MC	IC		
III	W	F	LG	MG	IG	LC	MC	IC		
IV	W	F	LG	MG	IG	LC				
V	W		LG	MG						**Grazing land**
VI	W	F	LG	MG						
VII	W	F	LG							
VIII	W									**Wildlife**

W- Wildlife	MG- Moderate grazing	MC- Moderate cultivation
F- Forestry	IG- Intensive grazing	IC- Intensive cultivation
LG- Light grazing	LC- Light cultivation	VIC- Very intensive cultivation

Table A2: 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 land potential and knowledge of the geographical distribution within an area of interest. This is of importance for making an informed decision about land use. **Table A3** below presents the land potential classes, whilst Table 4 presents description thereof, according to Guy and Smith (1998).

Table A3: Land Potential Classes (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	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei
VI	L4	L4	L5	L5	L5	L6	L6	L7
VII	L5	L5	L6	L6	L7	L7	L7	L8
VIII	L6	L6	L7	L7	L8	L8	L8	L8

Table A4: 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.

APPENDIX B: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

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

Stephen van Staden M.Sc. (Environmental Management) (University of Johannesburg)

Braveman Mzila B.Sc. (Hons) Environmental Hydrology University of KwaZulu-Natal

Tshiamo Setsipane M.Sc. Soil Science (University of the Free State)

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

Company of Specialist:	Zimpande Research Collaborative		
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 Specialist

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

I, Braveman Mzila, 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 Specialist

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

I, Tshiamo Setsipane, 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

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SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource discipline lead, Managing member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

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 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
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2013
Short Courses	
Certificate – Department of Environmental Science in Legal context of Environmental Management, Compliance and Enforcement (UNISA)	2009
Introduction to Project Management - Online course by the University of Adelaide	2016
Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017

AREAS 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 Leona
Central Africa – Democratic Republic of the Congo

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Protected Tree and Floral Marking and Reporting
- Biodiversity Offset Plan

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant species and Landscape Plan
- Freshwater Offset Plan
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Soil Monitoring
- Soil Mapping

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments
- View Shed Analyses
- Visual Modelling

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF BRAVEMAN MZILA

PERSONAL DETAILS

Position in Company	Wetland Ecologist and Soil Scientist
Joined SAS Environmental Group of Companies	2017

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Soil Science Society (SASSO)

Member of the Gauteng Wetland Forum (GWF)

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, Free State, North West, Limpopo, Northern Cape, Eastern Cape, KwaZulu-Natal

KEY SPECIALIST DISCIPLINES

Hydropedological Assessments:

- Soil Survey
- Soil Delineation
- Hydrological hillslope classification
- Hydropedological loss Quantification
- Hydropedological impact assessment
- Scientific buffer determination

Soil, Land use, Land Capability and Agricultural Potential Studies

- Soil Desktop assessment
- Soil classification
- Agricultural potential
- Agricultural Impact Assessments