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Soil Potential & Land capability Impact Assessment Report

A SPECIALIST REPORT ON THE SOILS, LAND USE, AGRICULTURAL POTENTIAL AND LAND CAPABILITY FOR THE PROPOSED STUDENT HOUSING DEVELOPMENT ON PORTION 191 OF THE FARM TWEEFONTEIN 915LS, LIMPOPO PROVINCE

JUNE 2020

Prepared for: KPD Property Development
Compiled by: Dr BJ Henning
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Declaration

I, Dr BJ Henning declare that -

- I act as the independent specialist;
- I will perform the work relating to the project in an objective manner, even if this results in views and findings that are not favourable to the project proponent;
- 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 project, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998; the Act), regulations and any guidelines that have relevance to the activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 18 of the NEMA EIA Regulations;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the project proponent 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 project; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority or project proponent;
- All the particulars furnished by me in this document are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the Act.

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SIGNATURE OF SPECIALIST

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LIST OF ABBREVIATIONS

Abbreviation	Description
ARC	Agricultural Research Council
C-Plan	Limpopo Conservation Plan
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DME	Department of Minerals and Energy Affairs
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPR	Environmental Management Programme Report
ENPAT	Environmental Potential Atlas
LEDET	Limpopo Department of Economic Development, Environment & Tourism
GIS	Geographic Information Systems
GPS	Geographical Positioning System
HGM	Hydro-Geomorphic
HFI	Hydrological Function and Importance
IHI	Index of Habitat Integrity
IUCN	World Conservation Union
MAE	Mean Annual Evaporation
MAMSL	Meter Above Mean Sea Level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
NEMA	National Environmental Management Act
PES	Present Ecological State
PESC	Present Ecological Status Class
PQ4	Priority Quaternary Catchment
QDS	Quarter Degree Square
SADC	Southern African Development Community
SANBI	South African National Biodiversity Institute
WMA	Water Management Area
WHO	World Health Organisation

1 ASSIGNMENT

AGES Limpopo (Pty) Ltd was appointed by KPD Property Development to conduct a soil potential and land capability study for the proposed student housing development situated on Portion 191 of the Farm Tweefontein 915 LS, Polokwane, Limpopo Province.

The main purpose of this study was solely to assess the agricultural potential and value of the soil types on the site. This assessment is essential as it will contribute to meeting the requirements of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) in compliance with Regulation 387 of 21 April 2006, promulgated in terms of Section 24 (5) of NEMA.

The assignment is interpreted as follows: Compile a study on the soil potential of the soil forms of the proposed development site according to guidelines and criteria set by the National Department of Agriculture. The study will include a detailed soil assessment and interpretation. In order to compile this, the following had to be done:

1.1 Information Sources

The following information sources were obtained:

- All relevant maps through GIS mapping, and information (previous studies and agricultural databases) on the land use, soils, agricultural potential and land capability of the area concerned;
- Requirements regarding the agricultural potential survey and prime or unique agricultural land as requested by the NDA;
- Obtain relevant information of land type, geology and soil types of the area. This includes information on the soil potential, clay percentage, soil depth and soil forms, as classified by the Environmental Potential Atlas of South Africa (Institute for Soil, Climate and Water, Agricultural Research Institute);
- Obtain information of the prevailing land use and agricultural activities being practiced in the larger area of the neighbouring properties;
- Obtain an aerial photograph of the area to help in the interpretation and identification of major soil types and land uses in the study area.

1.2 Regulations governing this report

1.2.1 National Environmental Management Act, 1998 (Act No. 107 of 1998) - Regulation No. R982

This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Gazette No. 38282 Government Notice R. 982. Appendix 6 – Specialist reports includes a list of requirements to be included in a specialist report:

1. A specialist report or a report prepared in terms of these regulations must contain:
   a. Details of
      i. The specialist who prepared the report; and
      ii. The expertise of that specialist to compile a specialist report, including a curriculum vitae;
   b. A declaration that the specialist is independent in a form as may be specified by the competent authority;
   c. An indication of the scope of, and purpose for which, the report was prepared;
   d. The date and season of the site investigation and the relevance of the season to the outcome of the assessment;
   e. A description of the methodology adopted in preparing the report or carrying out the specialized process;
   f. The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;
   g. An identification of any areas to be avoided, including buffers;
   h. A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;
   i. A description of any assumptions made and any uncertainties or gaps in knowledge;
   j. A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
   k. any mitigation measures for inclusion in the EMPr;
   l. any conditions for inclusion in the environmental authorisation;
   m. any monitoring requirements for inclusion in the EMPr or environmental authorisation
   n. a reasoned opinion –

i. As to whether the proposed activity or portions thereof should be authorised and

ii. If the opinion is that the proposed activity 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;

o. A description of any consultation process that was undertaken during the course of preparing the specialist report;

p. A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and

q. Any other information requested by the competent authority.

1.2.2 Other related legislation

The natural resources of South Africa constitute a national asset, which is essential for the economic welfare of present and future generations. Economic development and national food security depend on the availability of productive and fertile agricultural land, and are threatened by the demand for land for residential and industrial development. Urban and rural planning needs to be integrated rather than sectorial and fragmentary. The use of agricultural land for other purposes should therefore be minimised. Currently the retention of productive agricultural land is administrated through the SUBDIVISION OF AGRICULTURAL LAND ACT, 1970 (ACT NO. 70 OF 1970) which controls the subdivision of agricultural land and its use for purposes other than agriculture. In the near future the use of these scares resources will be regulated through the SUSTAINABLE UTILISATION of AGRICULTURAL RESOURCES BILL. One of the object of the new Bill is to provide for the use and preservation of agricultural land, especially “prime and unique agricultural land” by means of prescribe criteria in terms of which agricultural land may be used for purposes other than agriculture, in collaboration with principles as laid down in the Development Facilitation Act, 1995 (Act No. 67 of 1995) and also in collaboration with the Land Use Bill, 2001. The prescribe criteria shall relate to the importance of the continued use of those agricultural resources for agricultural purposes in general particularly taking into consideration the use of prime and unique agricultural land or its agricultural importance relative to a particular province or area. Different criteria may be prescribed from time to time and such criteria may differ from province and area.

1.3 Terms of reference

1.3.1 Objectives

The objectives of this report are as follows:

- Conduct a soil survey on the proposed development site and identify the different soil types / forms present on the site;
- From the soil survey results link the optimal land use and other potential uses and options to the agricultural potential of the soils by classifying the soils into different Agricultural Potential classes according to the requirements set by the Department of Agriculture, South Africa. From these results soils maps and an agricultural potential map will be compiled;
- Discussion of the agricultural potential and land capability in terms of the soils, water availability, grazing capacity, surrounding developments and current status of land.
- Identify potential impacts of the development on the soils and provide mitigation measures to manage these impacts.

1.3.2 Limitations and assumptions

- In order to obtain a comprehensive understanding of the dynamics of the soils of the study area, surveys should ideally be replicated over several seasons and over a number of years. However, due to project time constraints such long-term studies are not feasible;
- The large study area did not allow for the finer level of assessment that can be obtained in smaller study areas. Therefore, data collection in this study relied heavily on data from representative, homogenous sections of soils, as well as general observations, aerial photograph analysis, generic data and a desktop analysis;

2 METHODS

The assessment of agricultural potential and land capability of the study area was based on a combination of desktop studies to amass general information and then through site visit for status quo assessment, soil sampling and characterization, and also the validation of generated information from the desktop studies:

- Definition of parameters of land as stipulated by the Subdivision of Agricultural Land Act, No. 70 of 1970 and the Amended Regulation of Conservation of Agricultural Resources Act No. 43 of 1983;
- Classification of high potential agricultural land in South Africa compiled by the Agricultural Research Council (Schoeman, 2004) for the National Department of Agriculture;
- Long-term climatic data record of the study area, obtained from Weather SA.
- Geophysical features of the site using Geographical Information System;
- Moisture availability class, determined through seasonal rainfall and fraction of the potential evapotranspiration (ARC, 2002);
- Field visit to the project site for general observation, survey of the farm in terms of vegetation, soils, water resources, terrain type and infrastructural profile;
- Previous and current land use of the farm and that of the neighbourhood;
- Other agro-ecological factors prevailing in the area;
- Agricultural potential of the property;
- Possible crop productivity or value of the farm for grazing purposes.

2.1 Soil surveys

The site surveys were conducted during May 2020. After a thorough investigation of an aerial photograph of the area and visual assessment of the specific sites and areas surrounding the sites, the following was done:

- Field observations were randomly made in the accessible, with specific emphasis on the resource area;
- Since the soils do not qualify as high potential soils according to Department of Agriculture databases, only soil physical characteristics were used to verify the potential of the soils at small-scale and therefore no chemical analyses of the soils was considered necessary.
- Slopes were analysed to determine the viability to cultivate crops in specific areas.
- The following soil physical and chemical characteristics were analysed through

physical investigation:

- Soil Depth (soil auger used);
- Soil clay content (land type memoirs);
- Soil texture and general structure.

2.2 Data recorded of surveys included:

- A description of the soil types and profiles identified on the sites;
- Specific soil characteristics on the proposed development sites and areas surrounding the sites;
- Photographs of the soil profiles and associated vegetation were taken and are included as part of the photographic guide.

2.3 Data processing

A broad classification of the soil types on the farm was done. A soil map indicates the dominant soil types identified by using a Geographic Positioning System (GPS) to locate sampled points on the topographical map of the farm. Soils were classified according to the Taxonomic Soil Classification System for South Africa, 1991. The following attributes were recorded and taken into consideration at each of the sites where samples were collected:

- Soil Type;
- Soil Depth;
- Soil clay content;
- Estimated soil texture class and soil structure;
- Slope;
- Moisture availability;
- Agricultural potential.

The agricultural potential of the soils were determined by using the specified guidelines stated above. The actual soil depth, clay content, slope, moisture potential and soil form were evaluated to determine the agricultural potential status. The soil characteristics and norms used to determine the agricultural potential of the soils were obtained from the National Department of Agriculture, which created criteria for high potential agricultural land in South Africa (Schoeman, 2004) as stated in previous discussion in the report.

3 STUDY AREA

3.1 LOCATION AND DESCRIPTION OF ACTIVITY

The project is within the Capricorn District Municipality and Polokwane Local Municipality and is located east of the R81 road about 2 kilometers southwest of the Mall of the North (see figure 1). At present access to the site is gained directly from the R81 and Romulus Drive (see figure 1). The project entails the development of student housing on portion 191 of the farm Tweefontein 915 LS. The site located approximately 1340m above mean seal level (masl).The surrounding topography is generally slightly undulating plains. The aerial map of the site is presented in Figure 2.

Figure 1. Regional location Map of the project area

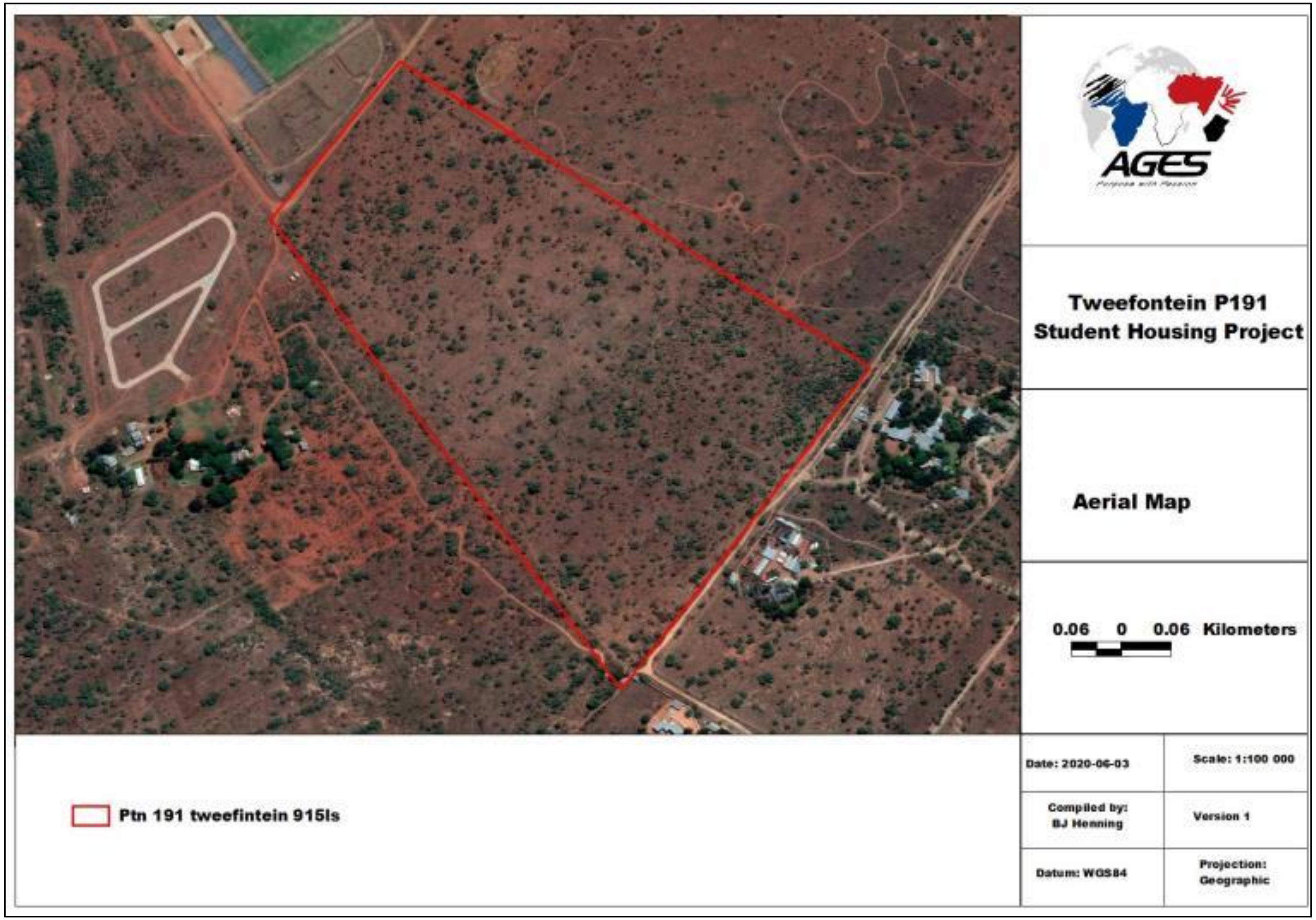

Figure 2. Aerial Map of the project area

3.2 Climate

Solar radiation, temperature, and precipitation are the main drivers of crop growth; therefore agriculture has always been highly dependent on climate patterns and variations. Since the industrial revolution, humans have been changing the global climate by emitting high amounts of greenhouse gasses into the atmosphere, resulting in higher global temperatures, affecting hydrological regimes and increasing climatic variability. Climate change is projected to have significant impacts on agricultural conditions, food supply, and food security.

The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987). Mean annual precipitation varies between 400 to 600mm. Furthermore, aspects like topography, slope and altitude may result in differences in precipitation and water availability to plants within the study area. Frost occurs fairly infrequent. Mean monthly maximum and minimum temperatures for Polokwane are 33.2˚C and 0.6˚C for October and June, respectively. The study area is located within the quaternary drainage region A71A.

3.3 Vegetation types

The development site lies within the Savanna biome which is the largest biome in Southern Africa. It is characterized by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs). The environmental factors delimiting the biome are complex and include altitude, rainfall, geology and soil types, with rainfall being the major delimiting factor. Fire and grazing also keep the grassy layer dominant. The most recent classification of the area by Mucina & Rutherford shows that the site is classified as Polokwane Plateau Bushveld.

The terrain morphology is slightly undulating plains. The indigenous flora of the Polokwane Plateau Bushveld (Mucina & Rutherford, 2006) has been degraded to a large extent as a result of agricultural activities and overgrazing. As a result very little pristine habitats exist in this sensitive ecosystem. The Polokwane Plateau Bushveld as an entity is however still classified as having a least threatened conservation status with about 9% statutorily conserved and more than 3% transformed, mainly by cultivation. The vegetation units of the site vary between open woodland to denser woodland associated with outcrops.

3.4 Geology and soil types

Geology is directly related to soil types and plant communities that may occur in a specific area (Van Rooyen &Theron, 1996). A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type unit represented within the study area include the Fa538 (Land Type Survey Staff, 1987) (ENPAT, 2001). The soil types in the study area are mostly determined by position on the landscape, and the most dominant soils on the development site are deep, red apedal soils of the Hutton soil form on the slightly undulating plains, while the shallower soils in between the deeper soils represent gravelly Glenrosa or very rocky Mispah soils.The land types, geology and associated soil types are presented in Table 1 below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2000).

Table 1.Landtypes, geology and dominant soil types of the proposed development site

Landtype	Soils	Geology
Fa538	Glenrosa and/or Mispah forms (other soils may occur), lime rare or absent in the entire landscape	Leucocratic migmatite and gneiss, grey and pink hornblende-biotite gneiss, grey biotite gneiss; minor muscovite-bearing granite, pegmatite and gneiss of the Mount River Gneiss. Grey and pink biotite granite of the Turfloop Granite.

3.5 Topography

The assessment of slope class in an area is an important determinant in land evaluation for crop production. Slope impacts the use of mechanical traction and together with soil textural classes, influences the rate of soil erosion. Field topography can also have a direct effect on crop growth and yield by redirecting pools of soil water. Indirectly, slope affects the distribution of certain chemical and physical properties such as organic matter content, base saturation, soil temperature, and particle size distribution (Franzmeier et al., 1969; Stone et al., 1985; Jiang, and Thelen, 2004).

When assessing the ecology of an area, it is important to know in which eco-region it is located. The study area forms part of the Northern Plateau Eco-region. According to the Environmental Potential Atlas of South Africa (ENPAT, 2000) the project area is classified as being “Dissected Plains”. The slopes of the study area are classified as being between 1 and 9 degrees. The project area is characterised by slightly undulating plains, with a rocky outcrop area in the southern section of the site. The topography across the site is slightly undulating with the average elevation of 1540 mamsl.

3.6 Drainage

The ecosystem integrity of surface waters has responded to different environmental impacts within the Limpopo Province and integrity scores range between poor and fair for the majority of systems studied within the Rivers Health Programme. Furthermore, it would seem that due to impacts on quality of water and flow regimes, the desired ecological state for the majority of systems could never again attain states higher than fair. Major rehabilitation of river banks, alien tree removal and removal of impoundments would be required to achieve this. The latter would not easily be attained due to the scarcity of water resources within the region and the critical need for water storage mechanisms.

At a basin or sub-basin scale, particularly in semi-arid and arid areas, priority is often placed on monitoring and management of water quantity. Equally important, however, is the monitoring and management of water quality (DWAF, 2004). Water quality is often characterised in terms of the concentration of different chemicals in the water (Hatfield, 2008). What determines “good” or “bad” water quality depends on the purpose of the assessment - for example, water with naturally elevated concentrations of some metals may be unsafe to drink, but still suitable for industrial uses. Assessment involves comparing measured chemical concentrations with natural, background, or baseline concentrations, and with guidelines established to protect human health or ecological communities.

The project area is situated within the quaternary catchments, A71A (small northern section) and A71B (remainder of the site). The Sand River is located to the west of the site. The study area is drained mainly by surface run-off (i.e. sheetwash) with surface water flowing into non-perennial streams of the study area. This water eventually drains into the Sand River. It must be noted that stream flow along the non-perennial drainage channels occurs only during and directly after heavy precipitation events, and may continue for a short period directly after a particularly good rainy season.

3.7 Moisture Availability

The moisture availability of soils is another aspect which recently has become an important factor to consider when cultivating crops under dry-land conditions.

Moisture and water availability will be affected by a temperature increase, regardless of any change in rainfall. Higher temperatures increase the evaporation rate, thus reducing the level of moisture available for plant growth, although other climatic elements are involved. A warming of 1°C, with no change in precipitation, may decrease yields of wheat and maize in the core cropping regions such as the US by about 5%. A very large decrease in moisture availability in the drier regions of the world would be of great concern to the subsistence farmers that farm these lands. Reduced moisture availability would only exacerbate the existing problems of infertile soils, soil erosion and poor crop yields. In the extreme case, a reduction in moisture could lead to desertification. The classes as classified for South Africa are shown in Table 2.

Table 2. Moisture availability classes as derived from seasonal rainfall and evaporation

Moisture availability class	Summer rain season (R/0.25PET)	Winter rain season (R/0.4PET)	Agricultural Potential
1	>34	>34	Conducive to rain-fed arable agriculture
2	27-34	25-34	Conducive to rain-fed arable agriculture
3	19-26	15-24	Conducive to rain-fed arable agriculture
4	**12-18**	**10-14**	**Marginal for rain-fed arable agriculture**
5	6-12	6-9	Conditions too dry for rain-fed arable agriculture
6	<6	<6	Conditions too dry for rain-fed arable agriculture

The soils on the proposed development site are classified as class 4, which suggest that climatic conditions are ,marginal for rain-fed arable agriculture.

3.8 Soil classification of the site from ARC databases

The Agricultural Research Institute uses specific soil characteristics to indicate the suitability of soils for arable agriculture. These characteristics for the site are as follows:

Structurally favourable soils:

- Soils with structure favouring arable land use if climate permits;

Soil association:

- Red, massive or weakly structured soils with high base status (association of well drained Lixisols, Cambisols, Luvisols);

Soil pH:

- 5.5-6.4

Prime agricultural activity for the area:

- Cattle.

Since the classification of the soil characteristics is based on a broad-scale desktop study of the general area, a thorough investigation of the soil types of the proposed development site is necessary for a more accurate classification of the soils. The main aim of the study is to identify the soil types on site and evaluate their specific characteristics to determine the agricultural potential of the soils. The study will thus reduce the scale at which soils for the area was previously mapped. A detailed discussion of the soil characteristics is included in the following section as part of the results.

4 GUIDELINES FOR AGRICULTURAL POTENTIAL

4.1 National assessment criteria

4.1.1 Agricultural Potential of soils in South Africa

The essence of identifying high potential agricultural land in South Africa is to retain prime area for agricultural development and to retain as much productive areas as possible for the future. South Africa is dominated by shallow soils which are predominantly sandy. This poses a severe inherent limitation to crop production. The poor quality of the soil is due to the influence of the parent material in which they were formed. According to Laker (2005), South Africa has only 13 % (approximately 14 million ha) arable land, of which only 3 % is considered to be high potential. Inferring from the international requirement of about 0.4 ha arable land to feed an individual person, South Africa could produce enough food to feed only 35 million people on the available 14 million hectares of arable land. In line with this goal, the Department of Agriculture has developed a set of criteria to define potential and prime areas for agricultural development in South Africa.

By definition, based on Part 1 of the Regulation of Conservation of Agricultural Resources Act 43 of 1983, an agricultural land in the Limpopo Province and specifically in the grid square (2329DC) in which the project site falls is considered high potential if the land:

- Is under permanent irrigation; or
- Can be classified into one of the following soil forms:
  - Avalon
  - Bainsvlei
  - Bloemdal
  - Clovelly
  - Glencoe
  - Hutton
  - Oakleaf
  - Pinedene
  - Shortlands
  - Tukulu;
- The effective soil depth is equal to or greater than 900mm; and
- Topsoil clay content between 10 and 35%.

High potential here means prime or unique. Prime refers to the best available land, mainly from the national perspective, suited to and capable of consistently producing acceptable yields of a wide range of crops (food, feed, forage, fibre and oilseeds), with acceptable expenditure of energy and economic resources and minimal damage to the environment. Unique agricultural land means land that is or can be used for producing specific high value crops.

Permanent irrigation means the availability for, and regular artificial application of, water to the soil for the benefit of growing crops. The application may be seasonal.

4.1.2 Land capability of soils in South Africa

Scotney et al. (1991) within the concept of land capability defines land capability as ―the extent to which land can meet the needs of one or more uses under defined conditions of management, without permanent damage. Land capability is an expression of the effect of physical factors (e.g. terrain form and soil type), including climate, on the total suitability and potential for use for crops that require regular tillage, for grazing, for forestry and for wildlife without damage. Land capability involves the consideration of (i) the risks of damage from erosion and other causes, (ii) the difficulties in land use caused by physical factors, including climate and (iii) the production potential‖ (Scotney et al., 1991).

The current land capability data set that is used as the national norm indicates that there are little or no soils in South Africa that are not subject to limitations. Most of the country‘s soils have moderate to severe limitations largely due to limited soil depth or moderate erodibility, caused by sandy texture or slopes.

It was determined that nowhere in South Africa do best soil and good climate classes coincide (Schoeman et al, 2002).

The land capability classes used for the South African Agricultural Sector are indicated in Table 3, while Table 4 indicate limitations and land use potential for the Land Capability classes.

Table 3. Land capability classes (Schoeman *et al.* 2002)

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

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

Table 4. Land capability Classes: Limitations & land use

Land Capability Class	Definition	Conservation Need	Use suitability
I	No or few limitations. Very high arable potential. Very low erosion hazard.	Good agronomic practice.	Annual cropping.
II	Slight limitations. High arable potential. Low erosion hazard.	Adequate run-off control.	Annual cropping with special tillage or ley (25%)
III	Moderate limitations. Some erosion hazards.	Special conservation practice and tillage methods.	Rotation of crops and ley (50 %).
IV	Severe limitations. Low arable potential. High erosion hazard.	Intensive conservation practice.	Long term leys (75 %)
V	Watercourse and land with wetness limitations.	Protection and control of water table.	Improved pastures or Wildlife
VI	Limitations preclude cultivation. Suitable for perennial vegetation.	Protection measures for establishment e.g. Sod-seeding	Veld and/or afforestation
VII	Very severe limitations. Suitable only for natural vegetation.	Adequate management for natural vegetation.	Natural veld grazing and afforestation
VIII	Extremely severe limitations. Not suitable for grazing or afforestation.	Total protection from agriculture.	Wildlife

From the databases of Department of Agriculture the site has the following land capability:

- Class VI: Non-arable; Grazing, Woodland or Wildlife

These aspects still need to be confirmed at ground level though.

Criteria for determining land capability of a piece of land are based on soil and land characteristics. These criteria related back to hazards or limitations to land use and are as follows:

- Slope %;
- Clay %;
- Effective rooting depth;
- Permeability;
- Signs of wetness;
- Rockiness;
- Soil surface crusting;

5 RESULTS

The proposed development site shows some variations in terms of soil characteristics and soil types identified during the survey. The classification of soils on the farm was based on land type description and the Binomial System for South Africa, which classifies soils into forms and families based on the diagnostic horizon of the soil profile. Exposed soil profile characteristics created by road cuttings in the field were also used in describing the local soil form. Soil identification and classification of the dominant soil type were done. The soil type and profile identified on the site will be discussed in detail in the following section.

The soils were classified into broad classes according to the dominant soil form and family as follows:

- Shallow Mispah soils / exposed bedrock
- Shallow red-yellow apedal soils of the Hutton / Glenrosa soil forms;
- Deep, red apedal soils of the Hutton soil form;

The geological formations and vegetation patterns showed a strong correlation to the major soil units mapped in the study area. The location of the soil forms in the landscape is presented in figure 6, while the land capability and agricultural potential maps are indicated in figure 8 and 9 respectively.

5.1 SHALLOW MISPAH SOILS / EXPOSED BEDROCK

Binominal Classification S.A.: Mispah / bedrock soil form

Description: The soils are generally shallow and derived from Gneiss in the project area. All these soil forms can be categorised in the international classification group of lithic soil forms. In lithic soil forms the solum is dominated by rock or saprolite (weathered rock). These soils have sandy to sandyloam texture, while topsoil structure is apedal and the profiles are very shallow. Exposed rocks and boulders is spread on the soil surface throughout the area.

The soil in this area is often weakly structured, sandy to loamy and forms a mosaic of exposed bedrock and very shallow rocky soils (Mispah soil form). The Mispah soils found on this section of the site are widespread and shallow in depth, although it has a low clay content.

Landscape: undulating plains / hills (Photograph 1)

Depth: 50-100mm

Texture: Sandy to sandy loam soils

Average Clay Content: 4-10%

Agricultural Potential: Low potential soils, due to the shallow nature of the soils and sloping terrain, making these areas not suitable for crop cultivation under arable conditions. The orthic A-horizon of the lithic soil group is unsuitable for annual cropping or forage plants (poor rooting medium since the low total available moisture causes the soil to be drought prone).

Land capability: The grazing potential of these areas is moderate-low. The most suitable and optimal utilization of the area would be grazing by small livestock or game species.

Photograph 1. Shallow Mispah soils and exposed bedrock in the project area

5.2 Shallow red-yellow apedal soils of the Hutton / Glenrosa soil form

Binominal Classification S.A.: Hutton / Glenrosa soil forms

Description: The shallow red-yellow Hutton or Glenrosa soil forms are the most dominant of the project site and has a medium to shallow depth. The soil in this area has a sandy-loam to loamy structure forms a mosaic of Hutton and Glenrosa soils. Hutton soils are identified on the basis of the presence of an apedal (structureless) “red” B-horizon.

Landscape: Undulating plains (Photograph 2)

Depth: 300-600mm

Texture: Medium coarse sandy loam to loamy soils

Average Clay Content: 7-15%

Agricultural Potential: Low potential soils, due to the climatic conditions and shallow gravelly nature of the soils, making these areas marginally suitable for crop cultivation under arable conditions.

Land capability: The grazing potential of these areas is moderate. The most suitable and optimal utilization of the area would be grazing by livestock or game species.

Photograph 2. Landscape associated with the shallow Hutton / Glenrosa soil forms in the project area

5.3 Deep red apedal soils of the Hutton soil form

Binominal Classification S.A.: Hutton soil form;

Description: Very deep soils of the Hutton soil form. Hutton soils are identified on the basis of the presence of an apedal (structureless) “red” B-horizon. The Hutton soils found on this section of the site are widespread and moderately deep, although it has a Moderate clay content.

Landscape: Slightly undulating plains (Photograph 3)

Depth: 600 - 1200mm;

Texture: Fine sandyloam soils;

Average Clay Content: 8-15%;

Agricultural Potential: Moderate potential soils– soils deep and often sandyloam structure that causes a medium water holding capacity, although the clay content of the soils is sufficient. Under the climatic conditions these soils would not sustain arable crop production. The most viable option for crop production on the soil form is under irrigation considering the variable rainfall and moisture availability due to higher day temperatures. Irrigation is not a common practice in the study area though and for any irrigation to be undertaken in the area, it will require the installation of a number of surface water impoundments as storage during the dry months. The limited water availability, high evaporation rates and high water demands by crops would therefore render crop cultivation not sustainable in the study area. The many old cultivated fields in the larger area confirm that crop cultivation over the longer term is not a financially viable option under the prevailing climatic conditions.

Land capability: Livestock and / or game grazing are viable due to the slightly higher nutrient and organic content of the topsoil in woodland areas that support a mixture of palatable and unpalatable species.

Photograph 3. Typical landscape associated with the deep Hutton soils

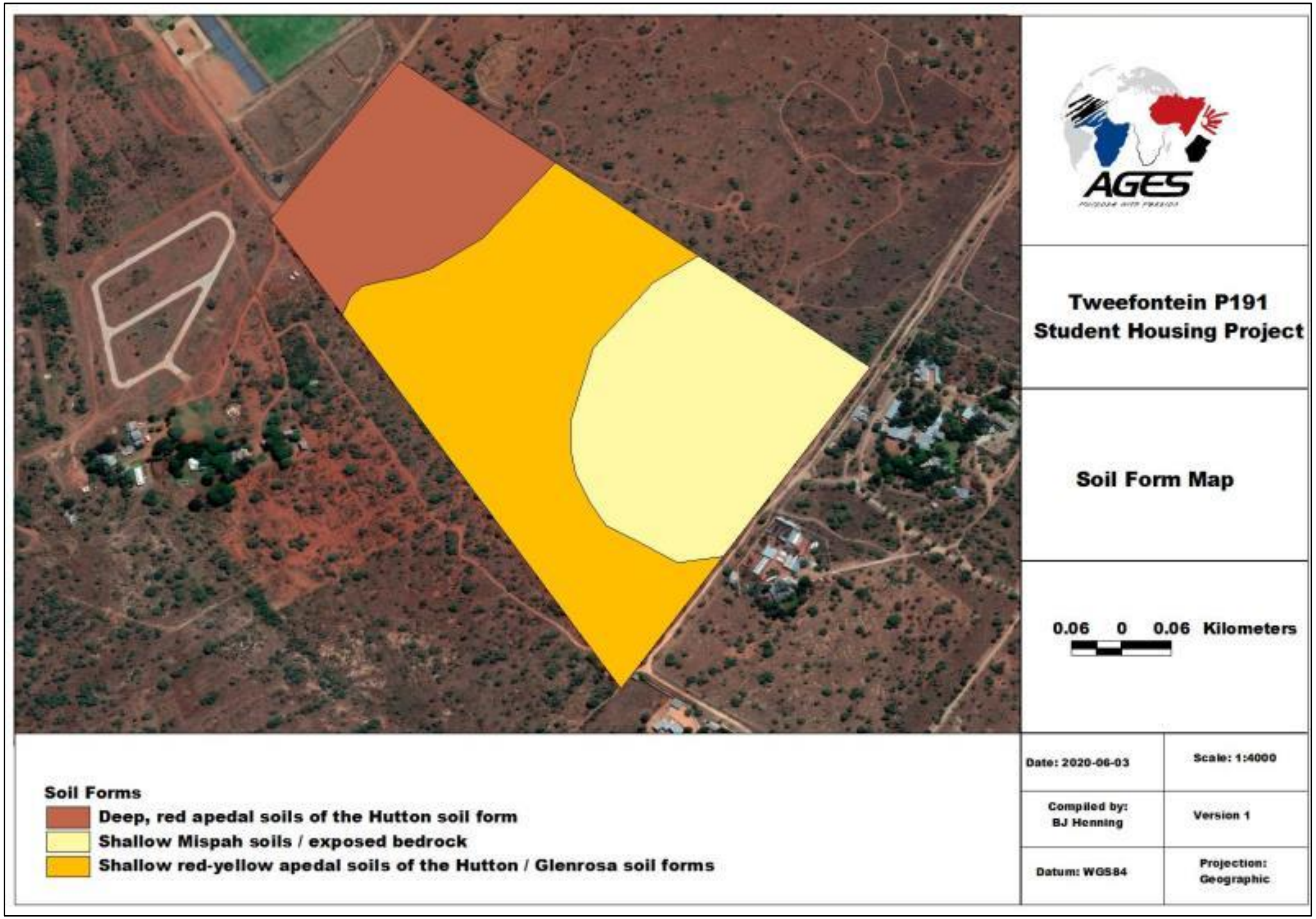

Figure 3. Soil Form Map

6 AGRO-ENTERPRISE AND LAND CAPABILITY

Land capability is a system that was developed by the U.S. Department of Agriculture in the 1950s. It separates soils into classes of increasing land use limitations. Criteria used in the original system related only to soil physical properties and not soil fertility. If land capability is to be utilised in the agricultural sector, soil fertility parameters alongside yield data need to be taken into account (Bouma, 2000). Increasingly this has been the case with the development of soil potential mapping. The land capability map of the area is indicated in Figure 8.

6.1 Arable land (crop production)

The proposed development site is composed of sandy to sandy-loam soils. From the soil textural analysis it can be concluded that the soil has a clay content varying between 4 and 10%. The soils are further predominantly shallow and gravelly, although the northern section of the site shows deeper, more fertile soils. The areas with shallow soils render these areas unfavourable for effective crop production which could result from high moisture demands by planted crops.

The farm is also expected to receive an annual total rainfall of about 500 mm which is relatively low and highly variable. In addition, the farm is considered to be located in an area which is marginal to dry for rain-fed arable crop production. Economically viable farming is thus, restrictive to irrigated cropping due the high risk that could be associated with dry-land farming. At present no irrigation or centre pivots occur on the property. Furthermore, higher day temperatures and evaporation rates in summer months may hamper soil moisture storage for crop use.

6.2 Grazing land (Livestock production)

The current vegetation at the proposed site of development consists mainly of isolated areas of native woody perennial species and unpalatable grasses (low quality grazing grass species) on the shallow, to gravelly soils. Mixed quality grazing (highly palatable and unpalatable grasses) occurs in the northern section of the site and these areas can support limited grazing by livestock and game species. The nature of the vegetation and size of the properties make the area marginal for extensive livestock production. Using planted pasture to supplement livestock production is also not an option considering the shallow nature of the soils.

The nature of the vegetation at the farm is therefore marginal for extensive livestock production. The low agricultural potential of the soils and the low to moderate grazing capacity is further confirmed by the Agricultural Maps below:

- Agricultural Potential Map - indicating that the project site is mostly classified as Low Agricultural Potential (Figure 4)
- Land Capability Map - site is classified as Non-arable – low potential grazing land (Figure 5).

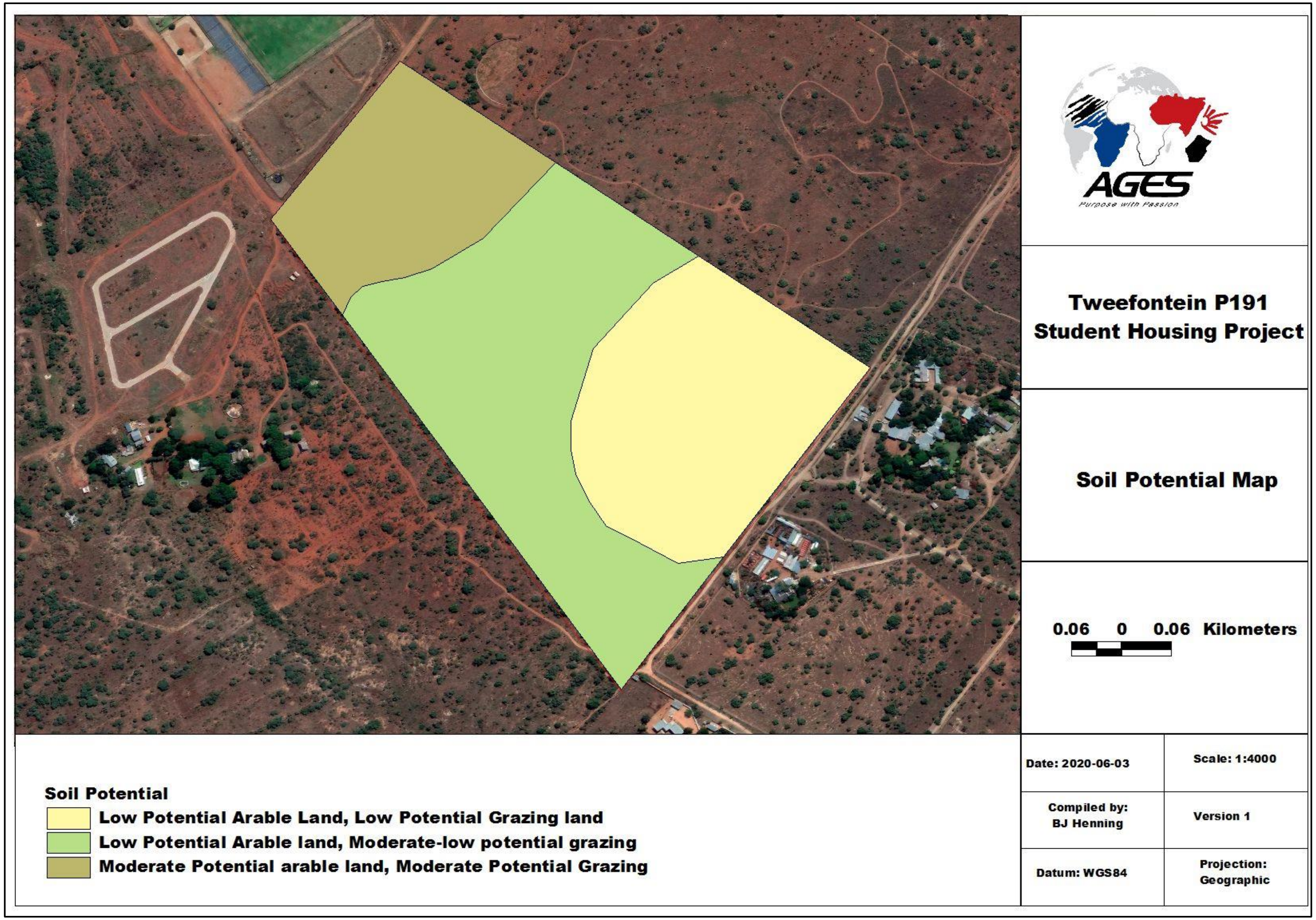

Figure 4. Soil Potential Map of the project area

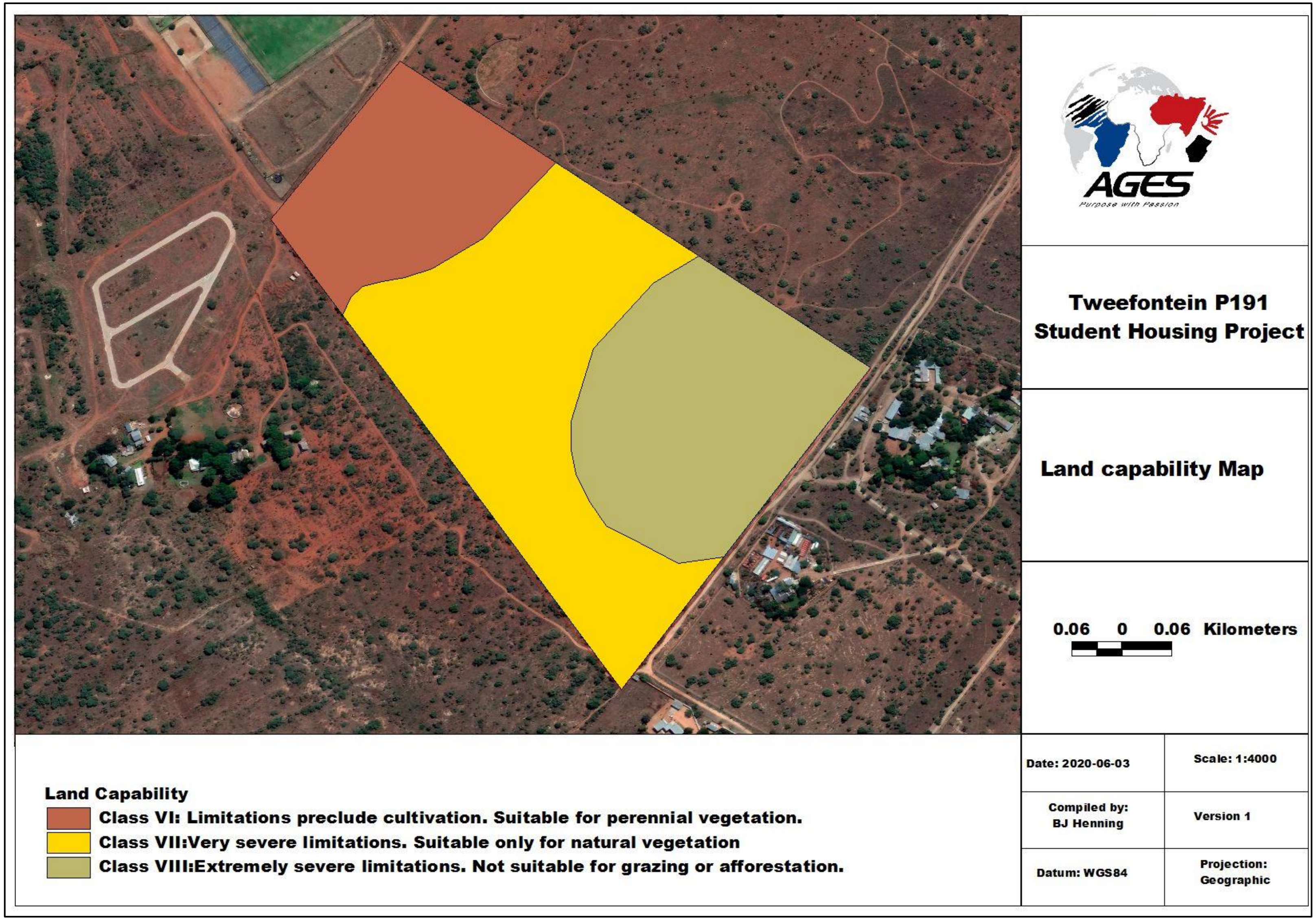

Figure 5. Land capability Map of the project area

7 ANTICIPATED SOIL IMPACTS

The impacts associated with the proposed development on the soils and land capability will depend on the specific area where the development will take place. If the activities take place along the slightly undulating terrain the impacts will be lower with only marginal erosion risks that can be managed though proper mitigation measures. The mitigation of the overall impacts on soils (compaction, erosion) will be easier on these flatter areas.

The following list of impacts is anticipated with the proposed developments on the soils and land capability in the area during the construction and operational phases:

- Disturbance of soils (Soil compaction, erosion and crusting);
- Sterilisation of soil (soil stripping);
- Soil contamination due to leaching of soluble chemical pollutants;
- Loss of current and potential agricultural land

8 MITIGATION MEASURES

8.1 Soil compaction

- Soil should be handled when dry during removal and placement to reduce the risk of compaction;
- Vegetation (grass and small shrubs) should not be cleared from the site prior to construction except if vegetation requires relocation as determined through an ecology assessment). This material is to be stripped together with topsoil as it will supplement the organic and possibly seed content of the topsoil stockpile depending on the time of soil stripping (whether plants are in seed or not); and
- Soil should be sampled and analysed prior to replacement during rehabilitation. If necessary, and under advisement from a suitably qualified restoration ecologist, supplemental fertilisation may be necessary.
- During construction, sensitive soils with high risk of compaction (e.g. clayey soils) must be avoided by construction vehicles and equipment, wherever possible, in order to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat

must not take place.

8.2 Soil erosion

- Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices. Control dust on construction sites and access roads using water-sprayers.
- Institute a storm water management plan;
- Have both temporary (during construction) and permanent erosion control plans.
    - Temporary control plans should include:
        - Short term seeding or mulching of exposed soil areas (particularly on slopes)
        - Limitations on access for heavy machinery and the storage of materials to avoid soil compaction.
    - Permanent erosion control plans should focus on the establishment of stable native vegetation communities.
- Other mitigation measures needed to prevent soil erosion include:
    - Ensure the amount of bare soil exposed is minimized by staging earthworks in phases and leaving as much ground cover intact as possible during construction.
    - Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas.

8.3 Soil pollution

- Chemicals to be stored on an impervious surface protected from rainfall and storm water run-off;
- Spill kits should be on-hand to deal with spills immediately;
- Spillages or leakages must be treated according to an applicable procedure as determined by a plan of action for the specific type of disturbance;
- All construction vehicles should be inspected for oil and fuel leaks regularly and

frequently. Vehicle maintenance will not be done on site except in emergency situations in which case mobile drip trays will be used to capture any spills. Drip trays should be emptied into a holding tank and returned to the supplier.

9 DISCUSSION & CONCLUSION

By definition, based on Part 1 of the Regulation of Conservation of Agricultural Resources Act 43 of 1983, the proposed area, earmarked for the development of the student housing on Portion 191 of the Farm Tweefontein 915 LS in the Limpopo Province can be classified as having Moderate to Low potential soils as a result of the following:

It is low potential because:

- The shallow and often sandy nature of the soil makes the potential to cultivate crops under arable conditions basically impossible, especially considering that the shallow soils would not allow ploughing of the topsoils. Therefore, the site should be classified as not suitable for arable agriculture due to its physical characteristics.
- The grazing capacity of the land would allow limited grazing of the area,

The results indicate that the agricultural potential of soils on the proposed development area is mostly low (shallow, soils or very sandy to sandyloam soils with limited suitability for grazing). The results obtained from the study were done after field observations were done to verify the soil potential classified by the Department of Agriculture on a small scale. The site should subsequently be considered as moderate to low potential grazing land with low potential for arable agriculture considering the climatic conditions, soil physical characteristics and size of land potentially available.

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APPENDIX A. CURRICULUM VITAE OF SPECIALIST

CURRICULUM VITAE

B J Henning

PhD Plant Ecology

PERSONAL DETAILS

Name:	BAREND JOHANNES HENNING
Date of Birth:	1976-09-06
Profession/Specialization:	Senior Ecologist
Years with Firm:	6 years (previously 2006-2012 & since May 2020)
Nationality:	South African
Years experience:	15 years

QUALIFICATIONS

University attended:	University of Pretoria, Pretoria (1995- 2002) PhD Plant Ecology, MSc (Botany), BSc (Hons.), BSc

COURSES

Advanced Wetland Course (UP CE, 2010)

Wetland Rehabilitation Course (UFS, 2015)

Course on wetland offsets (SANBI)

KEY QUALIFICATIONS AND EXPERIENCE

- Senior Ecologist for Ages Limpopo since September 2006 to 2012 and again since May 2020 involved in the following aspects:
    - Vegetation surveys, sensitivity and zoning analysis of development sites, including eco-estates, mines, residential developments, shopping centres, roads, water supply and other related infrastructure etc (Reference: Mr Johan Botha, AGES Limpopo; 0152911577, Mr Herman Gildenhuys, Exigo; 0127512160;)

- Faunal analysis and scoping reports (Reference: Mr Johan Botha, AGES Limpopo; 0152911577, Mr Herman Gildenhuys, Exigo; 0127512160)
- Agricultural potential and land capability studies of soils on farms. (Reference: Mr Johan Botha, AGES Limpopo; 0152911577, Mr Herman Gildenhuys, Exigo; 0127512160;)
- Avifauna studies related to solar plant and power line connection developments;
- Wetland delineations and functional capacity assessments (completed advanced wetland course of the Continued Education Department, University of Pretoria 2010 as well as Wetland rehabilitation course of the University of the Free State);
- Wildlife Management Plans and habitat assessment for rare and endangered game species;
- Spatial Development Frameworks;
- Strategic Development Area Frameworks for local municipalities
- GIS related functions;

- Senior Ecologist for Exigo (previously AGES Gauteng) November 2012 to April 2020. Involved in all of the abovementioned aspects;:
- Environmental Consultant for Envirodel Wildlife & Ecological Services cc and Dubel Integrated Environmental Services, Polokwane 2004 - 2006. Involved in the following aspects:
  - Wildlife management plans for game farms /reserves throughout the Limpopo Province
  - Environmental impact assessments (vegetation surveys and faunal scoping reports), habitat suitability analysis and report compilation.
  - Coordinating and performing grass monitoring surveys for the Limpopo Tourism and Parks Board
  - Soil potential studies.

- Environmental Consultant for Ficus – pro Environmental Services cc., Modimolle 2004 / 5. Involved mostly in fieldwork, report compilation or impact studies. Reference: Mr. R. Venter (0147173378)

- Subconsultant for AGES (Africa Geo-Environmental Services 2005-2006. Vegetation surveys and sensitivity zoning and analyses. Mr Johan Botha (0836449957)

- Eco-Agent environmental services cc, Pretoria 2002 - 2004. Involved in environmental impact studies. Prof G. J. Bredenkamp (0825767046), University of Pretoria.

- Enviroguard environmental services cc, Heidelberg 2002 - 2004. Involved in environmental impact studies. Prof L. R Brown (0825767046).

- GIS related aspects for all the abovementioned aspects on projects

POSITION AND DUTIES

Employed as Senior Ecological Specialist. Main duties and responsibilities include:

- Compilation of project proposals;
- Conducting specialist assessments
  - Ecological assessments
  - Soils and Land use potential studies;
  - Wetland assessments;
  - Wetland rehabilitation plans;
  - Ecological & wetland monitoring;
  - Biodiversity Action & Management Plans;
  - Agricultural assessments;
  - Avifauna assessments;
  - Wildlife Management Plans and assessments.
  - Rehabilitation Strategy & Implementation Programmes (RSIPs)
- Liaison with clients;
- GIS and map compilation;
- Project admin and management;
- Integration and interaction with the environmental consultants;
- Travelling.