

Rehab Green cc

Registration No: 2002/094339/23

PI Steenekamp
PO Box 12636
Queenswood
0121
Pretoria



Cell: 082 560 0592
Fax: 086 678 1690
E-mail: rehabgreen@ee-sa.com

Report No: RG/2014/03/10/1
Date: 14 April 2015
Status: Reviewed by client

REPORT

**Soil, land capability and land use assessment of
portion 79 of the farm Blesboklaagte 296 JS and the
remaining extent of the farm Leeuwpoot 283 JS,
situated north of eMalahleni, Mpumalanga Province**

Requested By

Shangoni Management Services (Pty) Ltd

Compiled By

Rehab Green Monitoring Consultants CC

Environmental and Rehabilitation Monitoring Consultant cc
P.I. Steenekamp (Cert.Sci.Nat.)

Declaration of Independence

In terms of Section 32 of the EIA Regulations 2010 published in terms of Chapter 5 of the National Environmental Management Act (Act 107 of 1998) specialists involved in Impact Assessment processes must declare their independence and furnish details of experience.

I, Piet Steenekamp, hereby declare that I have no conflict of interest related to the work of this report. Specially, I declare that I have no personal financial interests in the property and/or development being assessed in this report, and that I have no personal or financial connections to the relevant property owners, developers, planners, financiers or consultants of the development. I declare that the opinions expressed in this report are my own and a true reflection of my professional expertise.

A handwritten signature in black ink, appearing to read 'P. Steenekamp', with a stylized flourish at the end.

P.I. Steenekamp

Date: 14 April 2015

CONTENTS

	Page
1. INTRODUCTION	5
1.1 Project background	5
1.2 Scope of work	5
1.3 Assumptions	6
2. STUDY AIMS AND OBJECTIVES	6
3. SOIL STUDY AREA AND PROPOSED DEVELOPMENT FOOTPRINT	8
4. METHODOLOGY	8
4.1 Field preparation and procedures	8
4.2 Soil classification	8
4.3 Soil sampling and analyses	9
4.4 Land capability assessment	9
4.5 Dry land crop production potential	9
4.6 Wetland and riparian delineation	9
4.7 Land use mapping	10
4.8 Erodibility evaluation	10
4.9 Map compilations	10
4.10 Approach to impact assessment and management	10
4.10.1 Impact assessment methodology	11
4.10.2 Environmental Management Plan (EMP)	13
5. SURVEY RESULTS	14
5.1 Dominant soil types	14
5.1.1 Soil types within the proposed Development Area	15
5.1.2 Soil types within the soil study area	18
5.2 Soil chemistry	21
5.2.1 Soil fertility status	21
5.3 Land capability	22
5.3.1 Land capability of the proposed Development Area	22
5.3.2 Land capability of the soil study area	24
5.3.3 Wetland and riparian delineation	25
5.3.4 Derived dry land crop production potential and long term potential yields	27
5.4 Pre-mining land use	28
5.4.1 Land uses of the proposed Development Area	28

5.4.2	Land uses of the soil study area	30
6.	ENVIRONMENTAL IMPACT ASSESSMENT	32
7.	CONCLUSION	32
8.	RECOMMENDATIONS	33

REFERENCES

TABLES:

Table 1.1	Impact assessment criteria	11
Table 1.2	Definition of significance rating	12
Table 1.3	Mitigation prediction criteria	13
Table 2a	Soil legend – proposed development area	16
Table 2b	Soil legend – soil study area	19
Table 3	Soil chemical analyses	21
Table 4	Soil fertility compared to broad fertility guidelines	21
Table 5a	Land capability classes – proposed Development Area	23
Table 5b	Land capability classes – soil study area	25
Table 5c	Wetland soils within the proposed Development Area	25
Table 6	Derived dry land crop potential and long term potential yields	27
Table 7a	Pre-mining land uses – proposed Development Area	29
Table 7b	Pre-mining land uses – soil study area	31

Tables within appendices:

Table D1	Coordinates of soil sampling points	41
Table E1	Environmental impact assessment	42

FIGURES:

Figure 1	Regional setting of the remaining extent of Leeuwpoot 283 JS and portion 79 of Blesboklaagte 296 JS	5
Figure 2	Soil study area and proposed development area	7
Figure 3a	Detailed soil map of the proposed development area	15
Figure 3b	Detailed soil map of the remaining extent of the farm Leeuwpoot 283 JS and portion 79 of Blesboklaagte 296 JS	18
Figure 4a	Land capability map of the proposed Development Area	22
Figure 4b	Land capability map of the soil study area	24
Figure 4c	Wetland soil intersecting the proposed Development Area	26
Figure 5a	Pre-mining land use map of the proposed Development Area	28
Figure 5b	Pre-mining land use map of the soil study area	30

Figures within appendices:

Figure B1	Soil texture chart	37
-----------	--------------------	----

Appendices:

Appendix A	Soil classification system	35
Appendix B	Soil properties and characteristics	36
Appendix C	Wetland delineation	38
Appendix D	Coordinates of soil sampling and stake points	41

1. INTRODUCTION

1.1 Project background

Sarovic Investments CC is planning a residential development on the remaining extent of the farm Leeuwpoot 283 JS and portion 79 of the farm Blesboklaagte 296 JS. These farms are situated approximately 8km north of eMalahleni and 23 km west of Middelburg (Figure 1). The proposed project involves the development of Pine Ridge extensions 1 to 25 and entails the following:

- The establishment of a mixed residential township across two properties.
- It is expected that the development on portion 79 of the farm Blesboklaagte 296 JS will occur in four (4) phases.
- It is expected that the development on the remaining extent (portion 0) of the farm Leeuwpoot 283 JS will occur in ten (10) phases
- The development will include the provision of bulk services (electricity, water, stormwater and sewage systems) as well as the construction of roads.



Figure 1: Regional setting of the remaining extent of Leeuwpoot 283 JS and portion 79 of Blesboklaagte 296 JS

1.2 Scope of work

Rehab Green Monitoring Consultants cc was requested by Shangoni Management Services (Pty) Ltd (Shangoni) to conduct a detailed soil, land capability and land use assessment of the remaining extent of the farm Leeuwpoot 283 JS and portion 79 of the farm Blesboklaagte 296 JS.

The study provides input to requirements in terms of the National Environmental Management Act (NEMA), Act 107 of 1998.

1.3 Assumptions

The development layout was obtained from Shangoni in an electronic dwg file format, named "TE12-DF04.dwg", dated 12/09/2014. This was accepted as the latest available version.

2. STUDY AIMS AND OBJECTIVES

The study objectives were to:

- Conduct a detailed soil assessment of the remaining extent of the farm Leeuwpoot 283 JS and portion 79 of the farm Blesboklaagte 296 JS;
- Classify and map soil forms according to the South African Taxonomic Soil Classification System, 1991;
- Derive and map land capability based on soil properties;
- Identify soil properties related to wetness to enable the delineation of wetland or riparian zones based on guidelines of the Department of Water Affairs;
- Map all current land uses; and
- Determine all possible impacts by the proposed activities and provide associated mitigation measures.

3. SOIL STUDY AREA AND PROPOSED DEVELOPMENT FOOTPRINT

The remaining extent of the farm Leeuwpoot 283 JS and portion 79 of the farm Blesboklaagte 296 JS is indicated with solid red lines in Figure 2 and covers 460.02 ha and 47.19 ha respectively. These farm portions are referred to as the **Soil Study Area** and comprise a total of 507.21 ha.

The footprint that will directly be occupied by residential, business and industrial units as well as roads are referred to as the proposed **Development Area** and are indicated with dashed yellow lines in Figure 2. The Development Area consists basically of 2 blocks south of the power line and 3 blocks to the north of the power line and comprises a total of 348.4 ha.

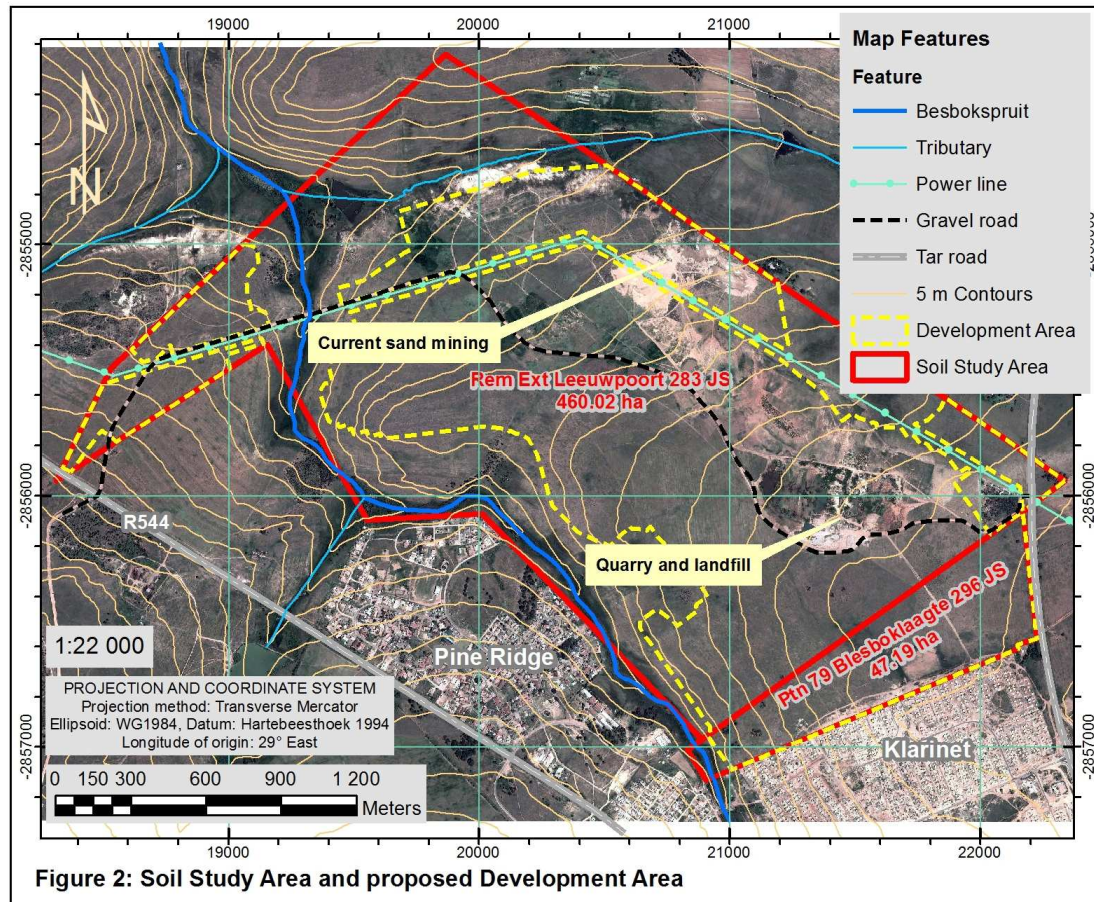
The Blesbokspruit, indicated as a solid dark blue line, intersects the Soil Study Area at the most southern corner and runs along the southwestern boundary. Two tributaries, indicated as light blue lines, intersect the study area from the southwest and northeast (Figure 2).

A gravel road and power line intersect the Soil Study Area more or less from east to west, indicated by a dashed black line and dotted solid turquoise line respectively. The R544 tar road intersects the most western corner of the Soil Study Area and an unnumbered tar road the most eastern corner (Figure 2).

The positions of current sand mining and a quarry and landfill are indicated in Figure 2. Extensive sand mining previously took place along the southern edge of the northern tributary of the Blesbokspruit.

The Soil Study Area is bordered by existing Pine Ridge and Klarinet settlements to the south (Figure 2).

Figure 2: Soil Study Area and proposed development area



4. METHODOLOGY

4.1 Field preparation and procedures

Geographic Information System (GIS) software from ESRI (Environmental Systems Research Institute) called ArcGIS-ArcMap was used to process all available data for accurate surveying and map compilations. The proposed development layout was obtained from Shangoni in an electronic dwg file format named "TE12-DF04.dwg", dated 12/09/2014.

A grid of field observation points were generated at a density of 150 m x 150 m across the Soil Study Area. The coordinates of the observation points were calculated and loaded on a Geographic Positioning System (GPS) to accurately locate the position of the observation points in the field. Large scale field maps (1:5000 scale) showing the project area and observation points on aerial photo background were printed to use during the field assessment.

4.2 Soil classification

The soils were investigated by means of auger holes to a depth of 1500 mm or to refusal. The soils were described and classified according to the South African Taxonomic Soil Classification System (Soil Classification Working Group, 2nd edition 1991). The system of soil classification is explained in Appendix A.

The following procedure was followed to note soil properties and classify soils accordingly:

i) Identify applicable diagnostic horizons by noting the physical properties such as:

- Effective depth (depth of soil suitable for root development);
- Colour (in accordance with Munsell colour chart);
- Texture (refers to the particle size distribution);
- Structure (aggregation of soil particles into structural units);
- Mottling (alterations due to continued exposure to wetness);
- Concretions (cohesion of minerals into hard fragments);
- Leaching (removal of soluble constituents by percolating water);
- Gleying (reduction of ferric oxides under anaerobic conditions, resulting in grey, low chroma soil colours); and
- Illuviation of colloidal matter from one horizon to another, resulting in the development of grey sandy E-horizons and grey clay G-horizons.

ii) Determine the appropriate soil Form and soil Family according to the above properties.

The soil properties that were used to map fairly homogeneous soil types are discussed in Appendix B.

4.3 Soil sampling and analyses

The A-horizons (0-250 mm) of the dominant soil types were sampled and analysed at the Institute for Soil, Climate and Water. The analyses were conducted according to methods set out in the Handbook of Standard Testing for Advisory Purposes (Soil Science Society of South Africa, 1990). The following analyses were conducted:

- Soil acidity (pH) in a 1:2.5 water solution;
- Extractable cations (Na, K, Ca and Mg) according to the ammonium acetate method; and
- Phosphorus status according to the Bray 1 method.

4.4 Land capability assessment

Land capability was assessed according to the definitions outlined in the guidelines for the rehabilitation of mined land by the Chamber of Mines of South Africa and Coaltech Research Association (2007). Soil types were classified into the following categories for areas that exclude wetlands:

- Arable land;
- Grazing land; and
- Wilderness.

4.5 Dry land crop production potential

The classification of dry land crop production potential of soils was based on physical soil properties noted during auger observations, such as effective soil depth, texture, terrain unit, slope, soil wetness and disturbances. The effective soil depth and texture class are the main soil characteristics that determined the dry land crop production potential. The criteria applied for the classification of the crop production potential of soils are as follows:

- **High** – well-drained and moderately well-drained loamy sand to sandy clay loam soils with an effective depth deeper than 900 mm.
- **Moderate** - well-drained and moderately well-drained loamy sand to sandy clay loam soils with an effective depth of 600- 900 mm.
- **Low** - well-drained and moderately well-drained sandy or clay soils.
- **Very low** – Imperfectly to poorly drained, grey, sandy soils showing evidence of periodic percolating water tables, or black and grey clay soils showing evidence of poor internal drainage, shallow rocky areas and eroded areas.

4.6 Wetland and riparian delineation

Wetland and riparian zones were delineated according to the practical field procedure for the identification and delineation of wetlands and riparian areas (Department of Water Affairs and Forestry, 2005). Four indicators were used in the study to delineate wetland and riparian zones, namely:

- Terrain unit;
- Soil form;
- Soil wetness; and
- Wetland and riparian vegetation.

Further details on the delineation of wetland areas are included in Appendix C.

4.7 Land use mapping

The localities and extents of land use practices were surveyed during the time of the soil assessment.

4.8 Erodibility evaluation

Erodibility was broadly assessed based on soil texture, slope and the inherent stability of the parent rock (geology) from which the soil originated.

Low: Soils with stable physical and chemical properties which occur on flat to gentle slopes to ensure low erosion susceptibility in the natural state. Few erosion protection measures are necessary.

Moderate: Soils with low to moderately unstable physical or chemical properties or soils occurring on moderate to steep slopes. Sheet and rill erosion often occur in the natural state but may become severe when these soils are disturbed or due to any misuse such as overgrazing. Erosion protection measures are necessary.

High: Soils with unstable physical and chemical properties or soils occurring on very steep slopes. Rill and donga erosion often occur in the natural state and will become severe during any disturbance or misuse. Specialised erosion protection measures are necessary.

4.9 Map compilations

The field data was captured in shapefile format (shp) and processed and stored in a Geographic Information System called ArcGIS. The maps are compiled in a map extendable document format (mxd) and exported to Jpeg format. The shapefiles can be exported to a dxf or dwg format for CAD users. The shapefiles, dxf and dwg formats are available on request.

The maps were generated in a projected coordinate system using the longitude of origin (LO) coordinate system based on the 29° East meridian, WG1984 Ellipsoid and Hartebeesthoek 1994 Datum.

4.10 Approach to impact assessment and management

The EIAMAP¹ is a comprehensive tool used to manage the negative environmental impacts associated with mining and related activities or any activity that impact on the environment and consists of two key aspects.

Firstly, the EIAMAP includes a full impact assessment according to activity (mining or mining-related), mining phase (construction, operational and decommissioning), and environmental component.

Secondly, an Environmental Management Programme (EMP) proposed for the expected impacts is also provided in the EIAMAP. This section of the EIAMAP includes proposed mitigation measures, time frames for implementation of the proposed mitigation measures and relative financial provisioning for the implementation of the proposed mitigation measure. These aspects comply with applicable legislation, as described in detail below.

¹EIAMAP: Environmental Impact Assessment and Management Action Plan.

4.10.1 Impact assessment methodology

Section 31(2)(k), Chapter 3 of the R. 543 (2010) in terms of the NEMA², 1998 requires an assessment of the extent, duration, probability and significance of the identified potential environmental impacts of the proposed activity. In order to comply with best practice principles, the evaluation of impacts was conducted in terms of the criteria presented in **Table 1.1**.

The significance of the current impacts, which exist even with mitigation measures in place, was determined using the methodology indicated below.

Table 1.1: Impact assessment criteria

Status		
Positive	+	Impact will be beneficial to the environment (a benefit).
Negative	-	Impact will not be beneficial to the environment (a cost).
Neutral	0	Where a negative impact is offset by a positive impact, or mitigation measures, to have no overall effect.
Magnitude		
Minor	2	Negligible effects on biophysical or social functions / processes. Includes areas / environmental aspects which have already been altered significantly, and have little to no conservation importance (negligible sensitivity).
Low	4	Minimal effects on biophysical or social functions / processes. Includes areas / environmental aspects which have been largely modified, and / or have a low conservation importance (low sensitivity).
Moderate	6	Notable effects on biophysical or social functions / processes. Includes areas / environmental aspects which have already been moderately modified, and have a medium conservation importance (medium sensitivity).
High	8	Considerable effects on biophysical or social functions / processes. Includes areas / environmental aspects which have been slightly modified and have a high conservation importance (high sensitivity).
Very high	10	Severe effects on biophysical or social functions / processes. Includes areas / environmental aspects which have not previously been impacted upon and are pristine, thus of very high conservation importance (very high sensitivity).
Extent		
Site only	1	Effect limited to the site and its immediate surroundings.
Local	2	Effect limited to within 3-5 km of the site.
Regional	3	Activity will have an impact on a regional scale.
National	4	Activity will have an impact on a national scale.
International	5	Activity will have an impact on an international scale.
Duration		
Immediate	1	Effect occurs periodically throughout the life of the activity.
Short term	2	Effect lasts for a period 0 to 5 years.
Medium term	3	Effect continues for a period between 5 and 15 years.
Long term	4	Effect will cease after the operational life of the activity either because of natural process or by human intervention.
Permanent	5	Where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

² NEMA: National Environmental Management Act, 1998 (Act no: 107 of 1998).

Probability of occurrence		
Improbable	1	Less than 30% chance of occurrence.
Low	2	Between 30 and 50% chance of occurrence.
Medium	3	Between 50 and 70% chance of occurrence.
High	4	Greater than 70% chance of occurrence.
Definite	5	Will occur, or where applicable has occurred, regardless or in spite of any mitigation measures.

Once the impact criteria were ranked for each impact, the significance of the impacts was calculated using the following formula:

$$\text{Significance} = (\text{Magnitude} + \text{Duration} + \text{Extent}) \times \text{Probability}$$

As is evident from the above equation, the extent (spatial scale), magnitude, duration (time scale) and the probability of occurrence of each identified impact were assigned a value according to the impact assessment criteria (presented in Table 1.1, above) and used to calculate the significance of each impact.

A Significance Rating was then calculated by multiplying the Severity Rating with the Probability, and is therefore a product of the probability and the severity of the impact. The maximum value that can be reached through the described impact evaluation process is 100 SP³. The scenarios for each environmental impact are rated as High (SP≥60), Moderate (SP 31-60) and Low (SP<30) significance as shown in **Table 1.2**.

Table 1.2: Definition of significance rating

Significance of predicted NEGATIVE impacts		
Low	0-30	Where the impact will have a relatively small effect on the environment and will require minimum or no mitigation.
Medium	31-60	Where the impact can have an influence on the environment and should be mitigated.
High	61-100	Where the impact will definitely influence the environment and must be mitigated, where possible.
Significance of predicted POSITIVE impacts		
Low	0-30	Where the impact will have a relatively small positive effect on the environment.
Medium	31-60	Where the positive impact will counteract an existing negative impact and result in an overall neutral effect on the environment.
High	61-100	Where the positive impact will improve the environment relative to baseline conditions.

Once the significance rating of an impact before mitigation has been determined, the reversibility of the impact, 'replaceability' of the affected resources and the potential of the impact to be further mitigated also need to be determined. These factors are explained in the table below, and play an important role in the determination of the level and type of mitigation performed or to be implemented. **Table 1.3** sets out the criteria that were used to assess the reversibility, loss of resources and potential for further mitigation.

³SP: Significant Points.

Table 1.3: Mitigation prediction criteria

Reversibility of impact		
Reversible	1	The impact on natural, cultural and / or social structures, functions and processes is totally reversible.
Partially	2	The impact on natural, cultural and / or social structures, functions and processes is partially reversible.
Irreversible	3	Where natural, cultural and / or social structures, functions or processes are altered to the extent that it will permanently cease, i.e. impact is irreversible.
Irreplaceable loss of resources		
Replaceable	1	The impact will not result in the irreplaceable loss of resources.
Partially	2	The Impact will result in a partially irreplaceable loss of resources.
Irreplaceable	3	The impact will result in the irreplaceable loss of resources.
Potential of impacts to be mitigated		
High	1	High potential to mitigate negative impacts to the level of insignificant effects, or to improve management to enhance positive impacts.
Medium	2	Potential to mitigate negative impacts. However, the implementation of mitigation measures may still not prevent some negative effects.
Low	3	Little or no mechanism exists to mitigate negative impacts.

The EIAMAP also provides a column in the table that identifies a specific impact as an I&AP⁴ concern and also indicates who raised the concern as well as cross referencing with the relevant public participation parts of this document for more detail

The impacts expected to occur as result of the activities that are anticipated to take place at the proposed Project site may combine with those resulting from surrounding activities and land uses to form cumulative impacts, or to contribute to cumulative impacts that already exist. These have been assessed in a separate EIAMAP.

4.10.2. Environmental Management Plan (EMP)

Appendix 4 of the EIA Regulations GN R.982 (2014) under the NEMA (1998) sets out the requirements for an EMP. To address these requirements, the EIA MAPs include the following aspects:

- **The mitigation management objectives and principles**– these have been identified to enable goals to be set for the environmental management of the proposed activity. Carefully planned management objectives and principles are the foundations of an effective EMP⁵.
- Design plays a large role in the mitigation process, thereby ensuring that the project takes a proactive stance to environmental management. Therefore, **mitigation by design** has also been discussed where applicable in the EIAMAP's.
- **Proposed mitigation measures**– some mitigation measures / recommendations have been proposed that, when implemented, would enable the project to achieve the identified environmental management goals / objectives. The mitigation measures identified will modify, remedy, control or stop any action, activity or process that is identified as possibly impacting adversely on the environment.

⁴I&AP: Interested and Affected Party/ies

⁵ EMP: Environmental Management Programme.

- **Time Frames**—an indication of the estimated timeframe for the implementation of the proposed mitigation measures has been identified, where possible.

5. SURVEY RESULTS

5.1 Dominant soil types

Soil types within the Soil Study Area were mapped based on soil information gathered by means of auger observations at a grid density of 150 x 150 meter. A total of 225 auger observations were made in order to locate and accurately map soil boundaries.

The extent and location of soil types are shown on the soil maps, Figures 3a and 3b which contains an abbreviated soil legend.

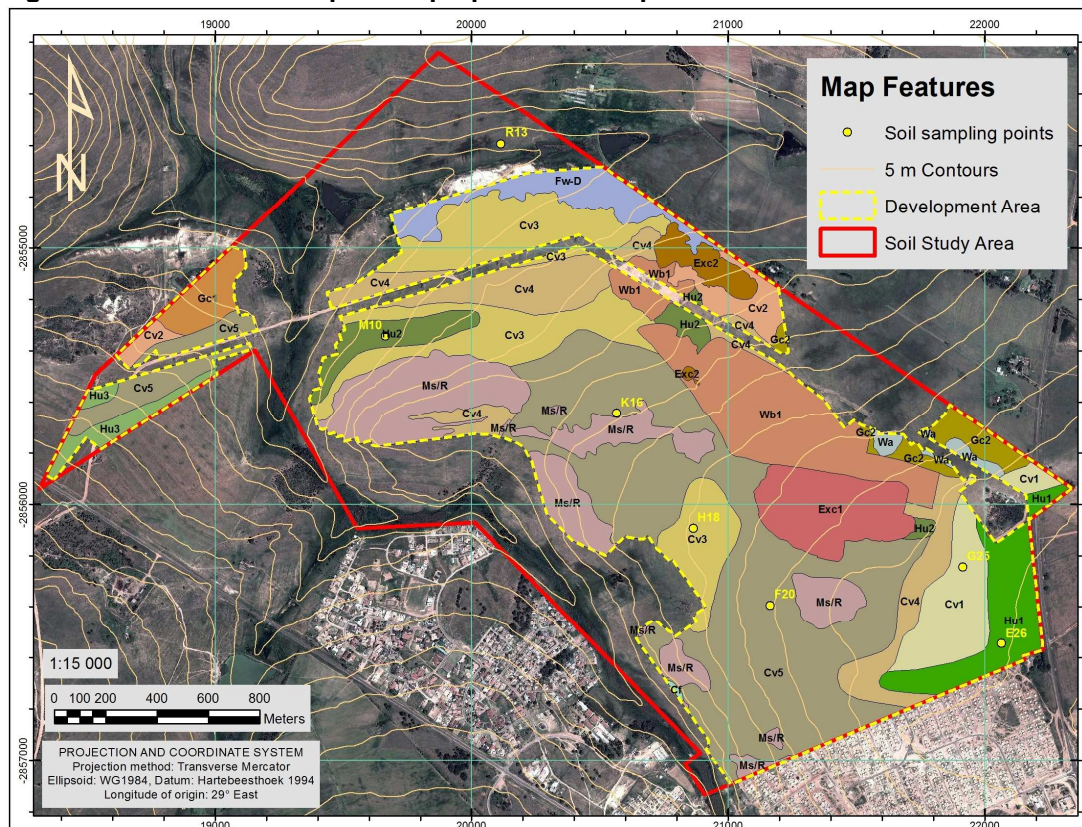
Detailed soil legends for the **Soil Study Area** and proposed **Development Area** are provided in Tables 2a and 2b which describes the soils in terms of the following aspects:

- Dominant soil forms and families and subdominant soil forms;
- The estimated clay content of the A and B or E or G-horizons;
- A broad description of the dominant soil form and terrain in terms of the effective soil depth, internal drainage, soil colour, soil texture class, terrain unit and average slope percentage range;
- A description of the soil horizon sequences;
- The derived erodibility class and dry land crop production potential;
- The land capability and wetland zone classification; and
- The area and percentage comprised by each soil type.

5.1.1 Soil types within the proposed Development Area

A total of 17 homogeneous soil units, based on dominant soil form, effective soil depth, internal drainage, terrain unit and slope percentage were identified during field observations and were symbolised as: Hu1, Hu2, Hu3, Gc1, Cv1, Cv2, Cv3, Cv4, Cv5, Gc2, Ms/R, Wa, Cf, Fw-D and Wb1. Two non soil related units were identified and symbolised as Exc1 and Exc2 which consist of excavated and partly excavated areas. The homogeneous units are referred to as soil types and are shown in Figure 3a which contains an abbreviated soil legend. A comprehensive soil legend is provided in Table 2a.

Figure 3a: Detailed soil map of the proposed Development Area



ABBREVIATED SOIL LEGEND (for full legend refer to Table 2 of the soil report)						
Soil Type Code	Dominant & subdominant Soil Form and Family	Summarized Description of Dominant Soil Forms in terms of effective depth, soil colour, soil texture and terrain unit	Land Capability	Wetland zone	Area (ha)	Area (%)
Hu1	*Hutton 1100	Very deep (1500+ mm), red, well-drained, loamy sand to sandy loam soils on midslopes (1-2% slopes).	Arable	Terrestrial	15.19	4.36
Hu2	*Hutton 1100	Deep (1200-1500 mm), red, well-drained, loamy sand to sandy loam soils underlain by weathered rock on midslopes (2-5% slopes).	Arable	Terrestrial	9.74	2.79
Hu3	*Hutton 1100	Moderately deep (600-900 mm), red, well-drained, loamy sand to sandy loam soils underlain by weathered rock on midslopes (2-4% slopes).	Arable	Terrestrial	5.05	1.45
Gc1	*Glencoe 1100; Clovelly 1100	Deep (900-1200 mm), brownish yellow, well-drained, loamy sand soils underlain by hard plinthite on mid and footslopes (2-5% slopes).	Arable	Terrestrial	5.86	1.68
Cv1	*Clovelly 1100	Very deep (1500+ mm), brownish yellow, well-drained, loamy sand soils on midslopes (1-2% slopes).	Arable	Terrestrial	14.99	4.30
Cv2	*Clovelly 1100; Avalon 1100	Deep (1200-1500 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered rock on midslopes (2-5% slopes).	Arable	Terrestrial	7.07	2.03
Cv3	*Clovelly 1100; Glencoe 1100, Avalon 1100	Moderately deep (600-900 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered rock on midslopes (2-4% slopes).	Arable	Terrestrial	45.57	13.09
Cv4	*Clovelly 1100; Glencoe 1100	Shallow (300-500 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered rock or hard rock on midslopes (3-5% slopes).	Grazing	Terrestrial	30.20	8.66
Cv5	*Clovelly 1100; Mispah 1100, Glenrosa 1211	Very shallow (100-300 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered or hard rock on midslopes with occasional scattered surface stones (2-6% slopes).	Grazing	Terrestrial	102.19	29.33
Gc2	*Glencoe 1100; Avalon 1100	Shallow (400-600 mm), brownish yellow, well-drained, loamy sand soils underlain by hard plinthite on midslopes (2-5% slopes).	Grazing	Terrestrial	6.26	1.79
Ms/R	*Mispah 1100; Glenrosa, Clovelly	Very shallow (100-300 mm), yellowish brown, well-drained, loamy sand soils in a complex association with exposed rock and stones covering 5-50% of the surface (5-10% slopes).	Grazing	Terrestrial	40.33	11.57
Wa	*Wasbank 1000; Longlands, Dresden, Fernwood	Temporary seepage zones on midslopes; Moderately deep, (600-800 mm), grey to greyish white, imperfectly to somewhat poorly drained, sandy soils on midslopes (2-5% slopes).	Grazing	Wetland	2.27	0.65
Cf	*Cartref 1200; Fernwood, Longlands, Wasbank	Seepage wetland on edge of Blesbokspuit, Shallow (200-400 mm), grey imperfectly to poorly drained (saturated), sandy soils on footslopes with story patches (4-10% slopes).	Wetland	Seasonal to permanent wetland	0.19	0.05
Fw-D	*Fernwood 2110; Longlands, Kroonstad	Largely excavated and disturbed seepage wetland on edge of Blesbokspuit; Patches of remaining grey to greyish white, imperfectly to poorly drained sandy soils on footslopes and valley bottom.	Wetland	Seasonal to permanent wetland	11.33	3.25
Wb1	*Witbank 1000	Previously excavated site, backfilled to some extent with mixed low quality subsoil material; Shallow to deep (100-900 mm), grey to yellowish and reddish brown, mixed sandy to clayey soil material (2-4% slopes).	Wilderness	Terrestrial	31.19	8.96
Exc1	*Witbank 1000	Excavated area, partly backfilled with varying terrestrial material consisting of subsoil, building rubble and domestic waste.	Wilderness	Terrestrial	15.95	4.58
Exc2	Excavated area (No soil)	Excavated area - no remaining soil horizons	Wilderness	Terrestrial	5.03	1.45
* Dominant soil form and family					Total	348.41 100.0

Figure 3a: Detailed soil map of the proposed Development Area situated on the remaining extent of the farm Leeuwpoot 283 JS and portion 79 of Blesboklaagte 296 JS

Table 2a: Detailed soil legend – proposed Development Area

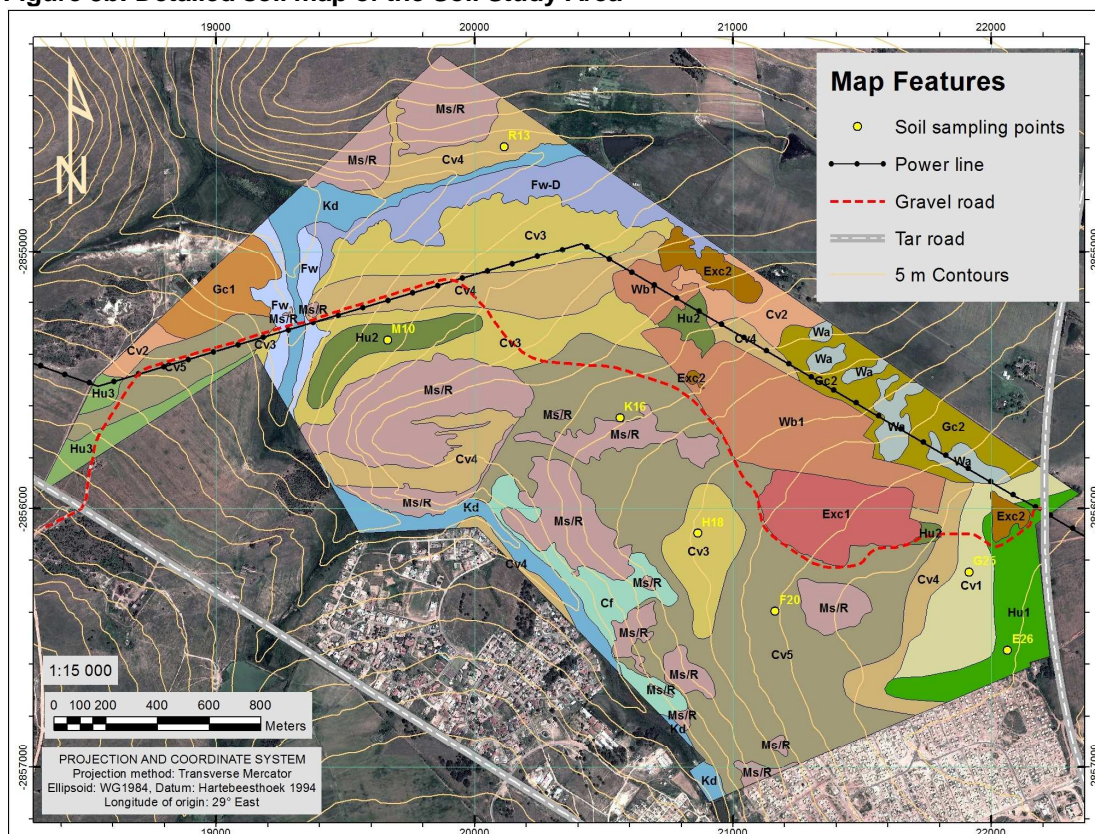
SOIL LEGEND										
Soil Type Code	Dominant & subdominant Soil Form and Family	% Clay per horizon A, E, G, B	Summarized Description of Dominant Soil Forms in terms of effective depth, soil colour, soil texture and terrain unit	Description of soil horizon sequences of dominant soil forms	Erodibility	Dry land crop production potential	Land Capability	Wetland zone	Area (ha)	Area (%)
Hu1	*Hutton 1100	A: 12-15 B: 14-20	Very deep (1500+ mm), red, well-drained, loamy sand to sandy loam soils on midslopes (1-2% slopes).	Reddish brown, loamy sand Orthic A-horizons underlain by orange red to red, loamy sand to sandy loam apedal B-horizons.	Low	Moderate-high	Arable	Terrestrial	15.19	4.36
Hu2	*Hutton 1100	A: 11-14 B: 12-18	Deep (1200-1500 mm), red, well-drained, loamy sand to sandy loam soils underlain by weathered rock on midslopes (2-5% slopes).	Reddish brown, loamy sand Orthic A-horizons underlain by orange red to red, loamy sand to sandy loam apedal B-horizons underlain by weathered rock.	Low	Moderate-high	Arable	Terrestrial	9.74	2.79
Hu3	*Hutton 1100	A: 11-14 B: 12-18	Moderately deep (600-900 mm), red, well-drained, loamy sand to sandy loam soils underlain by weathered rock on midslopes (2-4% slopes).	Reddish brown, loamy sand Orthic A-horizons underlain by orange red to red, loamy sand to sandy loam apedal B-horizons underlain by weathered rock.	Low	Moderate	Arable	Terrestrial	5.05	1.45
Gc1	*Glencoe 1100; Clovelly 1100	A: 10-12 B: 11-15	Deep (900-1200 mm), brownish yellow, well-drained, loamy sand soils underlain by hard plinthite on mid and footslopes (2-5% slopes).	Yellowish brown, loamy sand Orthic A-horizons, underlain by brownish yellow, loamy sand, apedal B-horizons underlain by hard plinthite.	Low	Moderate	Arable	Terrestrial	5.86	1.68
Cv1	*Clovelly 1100	A: 10-12 B: 11-15	Very deep (1500+ mm), brownish yellow, well-drained, loamy sand soils on midslopes (1-2% slopes).	Yellowish brown, loamy sand Orthic A-horizons, underlain by brownish yellow, loamy sand, apedal B-horizons.	Low	Moderate-high	Arable	Terrestrial	14.99	4.30
Cv2	*Clovelly 1100; Avalon 1100	A: 10-12 B: 11-15	Deep (1200-1500 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered rock on midslopes (2-5% slopes).	Yellowish brown, loamy sand Orthic A-horizons, underlain by brownish yellow, loamy sand, apedal B-horizons underlain by weathered rock.	Low	Moderate-high	Arable	Terrestrial	7.07	2.03
Cv3	*Clovelly 1100; Glencoe 1100, Avalon 1100	A: 10-12 B: 11-15	Moderately deep (600-900 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered rock on midslopes (2-4% slopes).	Yellowish brown, loamy sand Orthic A-horizons, underlain by brownish yellow, loamy sand, apedal B-horizons underlain by weathered rock.	Low	Moderate	Arable	Terrestrial	45.57	13.09
Cv4	*Clovelly 1100; Glencoe 1100	A: 10-12 B: 11-15	Shallow (300-500 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered rock or hard rock on midslopes (3-5% slopes).	Yellowish brown, loamy sand Orthic A-horizons, underlain by brownish yellow, loamy sand, apedal B-horizons underlain by weathered or hard rock.	Low-moderate	Low	Grazing	Terrestrial	30.20	8.66
Cv5	*Clovelly 1100; Mispah 1100, Glenrosa 1211	A: 10-12	Very shallow (100-300 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered or hard rock on midslopes with occasional scattered surface stones (2-6% slopes).	Yellowish brown, loamy sand Orthic A-horizons, directly underlain by weathered or hard rock or via a thin brownish yellow, loamy sand, apedal B-horizon.	Moderate	Very low	Grazing	Terrestrial	102.19	29.33
Gc2	*Glencoe 1100; Avalon 1100	A: 10-12 B: 11-15	Shallow (400-600 mm), brownish yellow, well-drained, loamy sand soils underlain by hard plinthite on midslopes (2-5% slopes).	Yellowish brown, loamy sand Orthic A-horizons, underlain by brownish yellow, loamy sand, apedal B-horizons underlain by hard plinthite.	Low-moderate	Low	Grazing	Terrestrial	6.26	1.79

Ms/R	*Mispah 1100; Glenrosa, Clovelly	A: 10-14	Very shallow (100-300 mm), yellowish brown, well-drained, loamy sand soils in a complex association with exposed rock and stones covering 5-50% of the surface (5-10% slopes).	Yellowish brown, sandy Orthic A-horizons underlain by hard rock.	Very high	Very low to none	Grazing	Terrestrial	40.33	11.57
Wa	*Wasbank 1000; Longlands, Dresden, Fernwood	A: 6-10 E: 2-5	Temporary seepage zones on midslopes; Moderately deep, (600-800 mm), grey to greyish white, imperfectly to somewhat poorly drained, sandy soils on midslopes (2-5% slopes).	Grey, sandy Orthic A-horizons underlain by grey to greyish white, sandy E-horizons underlain by hard plinthic B-horizons.	Low	Very low	Wetland	Temporary wetland	2.27	0.65
Cf	*Cartref 1200; Fernwood, Longlands, Wasbank	A: 8-10 E: 1-6	Seepage wetland on edge of Blesbokspuit; Shallow (200-400 mm), grey imperfectly to poorly drained (saturated), sandy soils on footslopes with stony patches (4-10% slopes).	Pale to dark grey, sandy Orthic A-horizons directly underlain by weathered or hard rock or via a grey to greyish white, sandy E-horizon.	Moderate to high	Very low to none	Wetland	Seasonal to permanent wetland	0.19	0.05
Fw-D	*Fernwood 2110; Longlands, Kroonstad	A: 6-10 E: 2-6	Largely excavated and disturbed seepage wetland on edge of Blesbokspuit; Patches of remaining grey to greyish white, imperfectly to poorly drained sandy soils on footslopes and valley bottom.	(Patches not excavated) Grey, sandy Orthic A-horizons underlain by pale yellow, grey or greyish white, sandy E-horizons.	Very high	Very low to none	Wetland	Seasonal to permanent wetland	11.33	3.25
Wb1	*Witbank 1000	A: 5-40	Previously excavated site, backfilled to some extent with mixed low quality subsoil material; Shallow to deep (100-900 mm), grey to yellowish and reddish brown, mixed sandy to clayey soil material (2-4% slopes).	Backfilled material consisting of varying discontinuing layers of grey sandy to yellowish and reddish brown, sandy loam to clayey subsoil material.	Very high	Very low to none	Wilderness	Terrestrial	31.19	8.96
Exc1	*Witbank 1000	-	Excavated area, partly backfilled with varying terrestrial material consisting of subsoil, building rubble and domestic waste.	Excavated area, partly backfilled with varying terrestrial material consisting of subsoil, building rubble and domestic waste.	Very high	Very low to none	Wilderness	Terrestrial	15.95	4.58
Exc2	Excavated area (No soil)	-	Excavated area - no remaining soil horizons	Excavated area - no remaining soil horizons	Very high	None	Wilderness	Terrestrial	5.03	1.45
* Dominant soil form and family			TOTAL						348.41	100.0

5.1.2 Soil types within the Soil Study Area

A total of 19 homogeneous soil units, based on dominant soil form, effective soil depth, internal drainage, terrain unit and slope percentage were identified during field observations and were symbolised as: Hu1, Hu2, Hu3, Gc1, Cv1, Cv2, Cv3, Cv4, Cv5, Gc2, Ms/R, Wa, Cf, Fw, Fw-D, Kd and Wb1. Two non soil related units were identified and symbolised as Exc1 and Exc2 which consist of excavated and partly excavated areas. The homogeneous units are referred to as soil types and are shown in Figure 3b which contains an abbreviated soil legend. A comprehensive soil legend is provided in Table 2b.

Figure 3b: Detailed soil map of the Soil Study Area



ABBREVIATED SOIL LEGEND (for full legend refer to Table 2 of the soil report)						
Soil Type Code	Dominant & subdominant Soil Form and Family	Summarized Description of Dominant Soil Forms in terms of effective depth, soil colour, soil texture and terrain unit	Land Capability	Wetland zone	Area (ha)	Area (%)
Hu1	*Hutton 1100	Very deep (1500+ mm), red, well-drained, loamy sand to sandy loam soils on midslopes (1-2% slopes).	Arable	Terrestrial	16.11	3.18
Hu2	*Hutton 1100	Deep (1200-1500 mm), red, well-drained, loamy sand to sandy loam soils underlain by weathered rock on midslopes (2-5% slopes).	Arable	Terrestrial	11.29	2.26
Hu3	*Hutton 1100	Moderately deep (600-900 mm), red, well-drained, loamy sand to sandy loam soils underlain by weathered rock on midslopes (2-4% slopes).	Arable	Terrestrial	6.77	1.34
Gc1	*Glencoe 1100; Clovelly 1100	Deep (900-1200 mm), brownish yellow, well-drained, loamy sand soils underlain by hard plinthite on mid and footslopes (2-5% slopes).	Arable	Terrestrial	9.18	1.81
Cv1	*Clovelly 1100	Very deep (1500+ mm), brownish yellow, well-drained, loamy sand soils on midslopes (1-2% slopes).	Arable	Terrestrial	16.51	3.25
Cv2	*Clovelly 1100; Avalon 1100	Deep (1200-1500 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered rock on midslopes (2-5% slopes).	Arable	Terrestrial	8.86	1.74
Cv3	*Clovelly 1100; Glencoe 1100; Avalon 1100	Moderately deep (600-900 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered rock on midslopes (2-4% slopes).	Arable	Terrestrial	55.68	10.98
Cv4	*Clovelly 1100; Glencoe 1100	Shallow (300-500 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered rock or hard rock on midslopes (3-5% slopes).	Grazing	Terrestrial	55.16	10.87
Cv5	*Clovelly 1100; Mispah 1100; Glenrosa 1211	Very shallow (100-300 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered or hard rock on midslopes with occasional scattered surface stones (2-6% slopes).	Grazing	Terrestrial	113.59	22.39
Gc2	*Glencoe 1100; Avalon 1100	Shallow (400-600 mm), brownish yellow, well-drained, loamy sand soils underlain by hard plinthite on midslopes (2-5% slopes).	Grazing	Terrestrial	16.37	3.23
Ms/R	*Mispah 1100; Glenrosa; Clovelly	Very shallow (100-300 mm), yellowish brown, well-drained, loamy sand soils in a complex association with exposed rock and stones covering 5-50% of the surface (5-10% slopes).	Grazing	Terrestrial	72.94	14.40
Wa	*Wasbank 1000; Longlands, Dresden, Fernwood	Temporary seepage zones on midslopes; Moderately deep, (600-800 mm), grey to greyish white, imperfectly to somewhat poorly drained, sandy soils on midslopes (2-5% slopes).	Wetland	Temporary wetland	8.48	1.67
Cf	*Cartref 1200; Fernwood, Longlands, Wasbank	Seepage wetland on edge of Blesbokspruit; Shallow (200-400 mm), grey imperfectly to poorly drained (saturated), sandy soils on footslopes with stony patches (4-10% slopes).	Wetland	Seasonal to permanent wetland	11.47	2.26
Fw	*Fernwood 2110; Longlands, Kroonstad	Seepage wetland on edge of Blesbokspruit; Deep (1200+ mm), grey to greyish white, imperfectly to poorly drained, sandy soils on footslopes and valley bottom (2-5% slopes).	Wetland	Seasonal to permanent wetland	8.12	1.60
Fw-D	*Fernwood 2110; Longlands, Kroonstad	Largely excavated and disturbed seepage wetland on edge of Blesbokspruit; Patches of remaining grey to greyish white, imperfectly to poorly drained sandy soils on footslopes and valley bottom.	Wetland	Seasonal to permanent wetland	18.13	3.57
Kd	*Kroonstad 1000; Katspruit, Longlands, Fernwood	Wetland - saturated riverbed and edges of the Blesbokspruit; Shallow (400-600 mm), dark grey to greyish white, poorly drained, sandy to clay soils in valley bottoms (1-3% slopes).	Wetland	Permanent wetland	22.36	4.42
Wb1	*Witbank 1000	Previously excavated site, backfilled to some extent with mixed low quality subsoil material; Shallow to deep (100-900 mm), grey to yellowish and reddish brown, mixed sandy to clayey soil material (2-4% slopes).	Wilderness	Terrestrial	33.48	6.60
Exc1	*Witbank 1000	Excavated area, partly backfilled with varying terrestrial material consisting of subsoil, building rubble and domestic waste.	Wilderness	Terrestrial	15.95	3.15
Exc2	Excavated area (No soil)	Excavated area - no remaining soil horizons	Wilderness	Terrestrial	6.74	1.33
* Dominant soil form and family					Total	507.19
						100.0

Figure 3b: Detailed soil map of the remaining extent of the farm Leeuwpoot 283 JS and portion 79 of Blesboklaagte 296 JS

Table 2b: Detailed soil legend – Soil Study Area

SOIL LEGEND										
Soil Type Code	Dominant & subdominant Soil Form and Family	% Clay per horizon A, E, G, B	Summarized Description of Dominant Soil Forms in terms of effective depth, soil colour, soil texture and terrain unit	Description of soil horizon sequences of dominant soil forms	Erodibility	Dry land crop production potential	Land Capability	Wetland zone	Area (ha)	Area (%)
Hu1	*Hutton 1100	A: 12-15 B: 14-20	Very deep (1500+ mm), red, well-drained, loamy sand to sandy loam soils on midslopes (1-2% slopes).	Reddish brown, loamy sand Orthic A-horizons underlain by orange red to red, loamy sand to sandy loam apedal B-horizons.	Low	Moderate-high	Arable	Terrestrial	16.11	3.18
Hu2	*Hutton 1100	A: 11-14 B: 12-18	Deep (1200-1500 mm), red, well-drained, loamy sand to sandy loam soils underlain by weathered rock on midslopes (2-5% slopes).	Reddish brown, loamy sand Orthic A-horizons underlain by orange red to red, loamy sand to sandy loam apedal B-horizons underlain by weathered rock.	Low	Moderate-high	Arable	Terrestrial	11.29	2.23
Hu3	*Hutton 1100	A: 11-14 B: 12-18	Moderately deep (600-900 mm), red, well-drained, loamy sand to sandy loam soils underlain by weathered rock on midslopes (2-4% slopes).	Reddish brown, loamy sand Orthic A-horizons underlain by orange red to red, loamy sand to sandy loam apedal B-horizons underlain by weathered rock.	Low	Moderate	Arable	Terrestrial	6.77	1.34
Gc1	*Glencoe 1100; Clovelly 1100	A: 10-12 B: 11-15	Deep (900-1200 mm), brownish yellow, well-drained, loamy sand soils underlain by hard plinthite on mid and footslopes (2-5% slopes).	Yellowish brown, loamy sand Orthic A-horizons, underlain by brownish yellow, loamy sand, apedal B-horizons underlain by hard plinthite.	Low	Moderate	Arable	Terrestrial	9.18	1.81
Cv1	*Clovelly 1100	A: 10-12 B: 11-15	Very deep (1500+ mm), brownish yellow, well-drained, loamy sand soils on midslopes (1-2% slopes).	Yellowish brown, loamy sand Orthic A-horizons, underlain by brownish yellow, loamy sand, apedal B-horizons.	Low	Moderate-high	Arable	Terrestrial	16.51	3.25
Cv2	*Clovelly 1100; Avalon 1100	A: 10-12 B: 11-15	Deep (1200-1500 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered rock on midslopes (2-5% slopes).	Yellowish brown, loamy sand Orthic A-horizons, underlain by brownish yellow, loamy sand, apedal B-horizons underlain by weathered rock.	Low	Moderate-high	Arable	Terrestrial	8.86	1.74
Cv3	*Clovelly 1100; Glencoe 1100, Avalon 1100	A: 10-12 B: 11-15	Moderately deep (600-900 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered rock on midslopes (2-4% slopes).	Yellowish brown, loamy sand Orthic A-horizons, underlain by brownish yellow, loamy sand, apedal B-horizons underlain by weathered rock.	Low	Moderate	Arable	Terrestrial	55.68	10.98
Cv4	*Clovelly 1100; Glencoe 1100	A: 10-12 B: 11-15	Shallow (300-500 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered rock or hard rock on midslopes (3-5% slopes).	Yellowish brown, loamy sand Orthic A-horizons, underlain by brownish yellow, loamy sand, apedal B-horizons underlain by weathered or hard rock.	Low-moderate	Low	Grazing	Terrestrial	55.16	10.87
Cv5	*Clovelly 1100; Mispah 1100, Glenrosa 1211	A: 10-12	Very shallow (100-300 mm), brownish yellow, well-drained, loamy sand soils underlain by weathered or hard rock on midslopes with occasional scattered surface stones (2-6% slopes).	Yellowish brown, loamy sand Orthic A-horizons, directly underlain by weathered or hard rock or via a thin brownish yellow, loamy sand, apedal B-horizon.	Moderate	Very low	Grazing	Terrestrial	113.59	22.39
Gc2	*Glencoe 1100; Avalon 1100	A: 10-12 B: 11-15	Shallow (400-600 mm), brownish yellow, well-drained, loamy sand soils underlain by hard plinthite on midslopes (2-5% slopes).	Yellowish brown, loamy sand Orthic A-horizons, underlain by brownish yellow, loamy sand, apedal B-horizons underlain by hard plinthite.	Low-moderate	Low	Grazing	Terrestrial	16.37	3.23

Ms/R	*Mispah 1100; Glenrosa, Clovelly	A: 10-14	Very shallow (100-300 mm), yellowish brown, well-drained, loamy sand soils in a complex association with exposed rock and stones covering 5-50% of the surface (5-10% slopes).	Yellowish brown, sandy Orthic A-horizons underlain by hard rock.	Very high	Very low to none	Grazing	Terrestrial	72.94	14.40
Wa	*Wasbank 1000; Longlands, Dresden, Fernwood	A: 6-10 E: 2-5	Temporary seepage zones on midslopes; Moderately deep, (600-800 mm), grey to greyish white, imperfectly to somewhat poorly drained, sandy soils on midslopes (2-5% slopes).	Grey, sandy Orthic A-horizons underlain by grey to greyish white, sandy E-horizons underlain by hard plinthic B-horizons.	Low	Very low	Wetland	Temporary wetland	8.48	1.67
Cf	*Cartref 1200; Fernwood, Longlands, Wasbank	A: 8-10 E: 1-6	Seepage wetland on edge of Blesbokspruit; Shallow (200-400 mm), grey imperfectly to poorly drained (saturated), sandy soils on footslopes with stony patches (4-10% slopes).	Pale to dark grey, sandy Orthic A-horizons directly underlain by weathered or hard rock or via a grey to greyish white, sandy E-horizon.	Moderate to high	Very low to none	Wetland	Seasonal to permanent wetland	11.47	2.26
Fw	*Fernwood 2110; Longlands, Kroonstad	A: 6-10 E: 2-6	Seepage wetland on edge of Blesbokspruit; Deep (1200+ mm), grey to greyish white, imperfectly to poorly drained, sandy soils on footslopes and valley bottom (2-5% slopes).	Grey, sandy Orthic A-horizons underlain by pale yellow, grey or greyish white, sandy E-horizons.	Moderate to high	Very low to none	Wetland	Seasonal to permanent wetland	8.12	1.60
Fw-D	*Fernwood 2110; Longlands, Kroonstad	A: 6-10 E: 2-6	Largely excavated and disturbed seepage wetland on edge of Blesbokspruit; Patches of remaining grey to greyish white, imperfectly to poorly drained sandy soils on footslopes and valley bottom.	(Patches not excavated) Grey, sandy Orthic A-horizons underlain by pale yellow, grey or greyish white, sandy E-horizons.	Very high	Very low to none	Wetland	Seasonal to permanent wetland	18.13	3.57
Kd	*Kroonstad 1000; Katspruit, Longlands, Fernwood	A: 10-20 E: 2-10 G: 20-35	Wetland - saturated riverbed and edges of the Blesbokspruit; Shallow (400-600 mm), dark grey to greyish white, poorly drained, sandy to clay soils in valley bottoms (1-3% slopes).	Grey to dark grey, loamy sand Orthic A-horizons directly underlain by grey, clay G-horizons or via a grey to greyish white sandy E-horizon.	Very high	Very low to none	Wetland	Permanent wetland	22.36	4.42
Wb1	*Witbank 1000	A: 5-40	Previously excavated site, backfilled to some extent with mixed low quality subsoil material; Shallow to deep (100-900 mm), grey to yellowish and reddish brown, mixed sandy to clayey soil material (2-4% slopes).	Backfilled material consisting of varying discontinuing layers of grey sandy to yellowish and reddish brown, sandy loam to clayey subsoil material.	Very high	Very low to none	Wilderness	Terrestrial	33.48	6.60
Exc1	*Witbank 1000	-	Excavated area, partly backfilled with varying terrestrial material consisting of subsoil, building rubble and domestic waste.	Excavated area, partly backfilled with varying terrestrial material consisting of subsoil, building rubble and domestic waste.	Very high	Very low to none	Wilderness	Terrestrial	15.95	3.15
Exc2	Excavated area (No soil)	-	Excavated area - no remaining soil horizons	Excavated area - no remaining soil horizons	Very high	None	Wilderness	Terrestrial	6.74	1.33
* Dominant soil form and family			TOTAL						507.19	100.0

5.2 Soil chemistry

The positions of the soil sampling points are shown on the soil maps of the proposed Development Area and Soil Study Area, Figures 3a and 3b and the coordinates are included in Appendix D, Table D1.

A sample of the A-horizon of the dominant soil types was taken at 5 localities and the analytical results are shown in Table 3. The averages were calculated and highlighted in orange.

Table 3: Soil chemical analyses

Samp Point	Soil Form	Hor	Depth	K	Ca	Mg	Na	*Titr.Acid	*Acid saturat.	R _s (resistance)	P (Bray1)	pH (H ₂ O)
				mg/kg	mg/kg	mg/kg	mg/kg					
				Ammonium acetate								
E26	Hu1100	A	0-250	37	28	2	0.79	0.7	73.6	7840	9.2	4.87
F20	Cv1100	A	0-250	35	23	0.15	1.4	0.95	82.2	7610	10.7	4.63
G25	Cv1100	A	0-250	22	27	7	2.7	0.76	75.3	8130	8.1	4.8
H18	Cv1100	A	0-250	31	105	26	11.7	0.69	45.8	5490	12.8	4.87
K16	Ms1100	A	0-250	66	38	7	6.5	0.78	65.2	6170	17.8	4.77
R13	Cv1100	A	0-250	61	65	11	0.12	0.52	47.7	7540	7.9	5.02
Averages				42	48	9	4	0.7	65	7130	11	4.8
*Analyses done when pH are below 5.5												

5.2.1 Soil fertility status

The averages of the cations (K, Ca, Mg and Na), phosphorus, pH and resistance (highlighted in orange, Table 3) were compared to general fertility guidelines in Table 4.

Table 4: Soil fertility compared to broad fertility guidelines

Element or measurement	Guidelines (mg/kg)						Fertility rating	
	Low			High			Average calculated in Table 3 (mg/kg)	Rating
Potassium (K)	<40			>250			42	Moderate to low
Calcium (Ca)	<200			>3000			48	Very low
Magnesium (Mg)	<50			>300			9	Very low
Sodium (Na)	<50			>200			4	Very low
Phosphorus (P)	<8			>30			11	Moderate to low
Resistance (R _s)	<200			>300			7130	High
Acid saturation %	<8			>40			65	High
pH(H ₂ O)	Very acid	Acid	Slightly acid	neutral	Slightly alkaline	Alkaline		
	<4.9	5-5.9	6-6.7	6.8-7.2	7.3-8	>8	4.8	Very acid

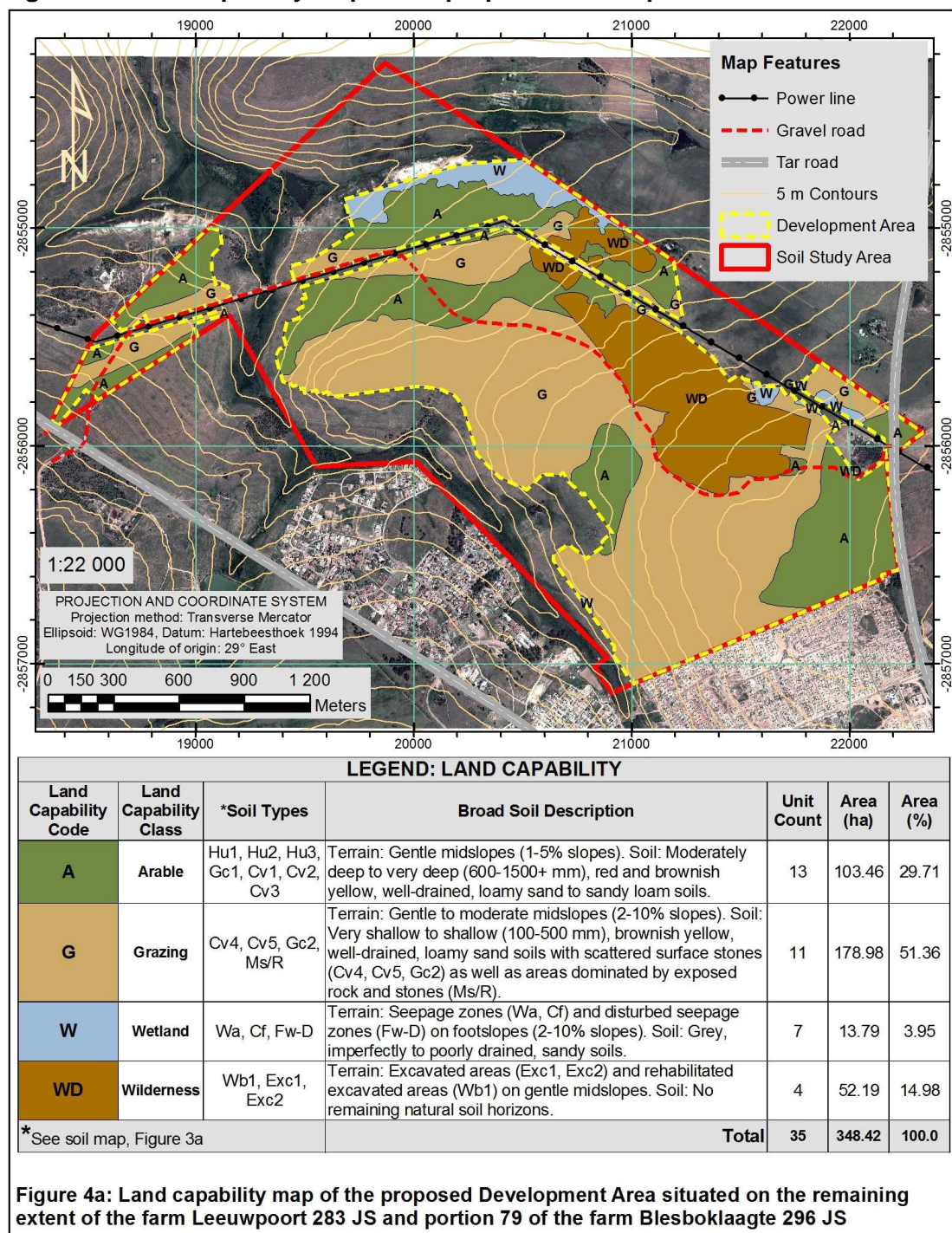
The averages of cations K, Ca and Mg are very low which indicate a general low fertility status (fertility rating in Table 4). The average of Na (4 mg/kg) is low and those of resistance (7130 ohm) high which indicates low concentrations of free salts and an absence of saline or sodic conditions. The average acid saturation percentage of 65 is high and indicates a low base status and high acidity which is confirmed by the low average pH value of 4.8 which indicate very acid soil conditions.

5.3 Land Capability

5.3.1 Land capability of the proposed Development Area

The location and extent of land capability classes within the proposed Development Area are shown in Figure 4a.

Figure 4a: Land capability map of the proposed Development Area



The land capability of the proposed Development Area is summarized in Table 5a which shows the soil types grouped into each land capability class, a broad description of the soil group, the number of units per land capability class, and the area and percentage

comprised by each land capability class.

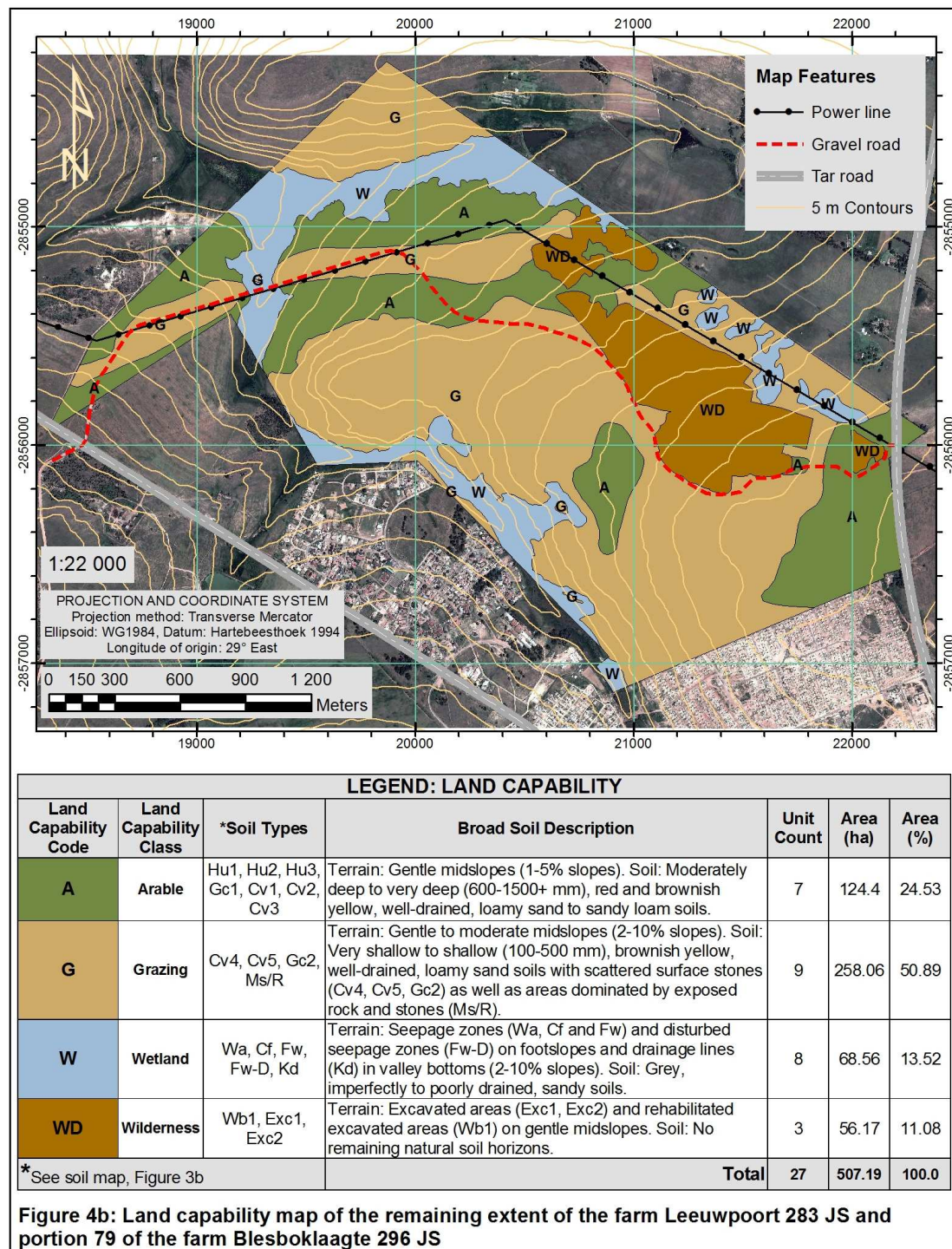
Table 5a: Land capability classes – proposed Development Area

LEGEND: LAND CAPABILITY						
Land Capability Code	Land Capability Class	*Soil Types	Broad Soil Description	Unit Count	Area (ha)	Area (%)
A	Arable	Hu1, Hu2, Hu3, Gc1, Cv1, Cv2, Cv3	Terrain: Gentle midslopes (1-5% slopes). Soil: Moderately deep to very deep (600-1500+ mm), red and brownish yellow, well-drained, loamy sand to sandy loam soils.	13	103.46	29.71
G	Grazing	Cv4, Cv5, Gc2, Ms/R	Terrain: Gentle to moderate midslopes (2-10% slopes). Soil: Very shallow to shallow (100-500 mm), brownish yellow, well-drained, loamy sand soils with scattered surface stones (Cv4, Cv5, Gc2) as well as areas dominated by exposed rock and stones (Ms/R).	11	178.98	51.36
W	Wetland	Wa, Cf, Fw-D	Terrain: Seepage zones (Wa and Cf) and disturbed seepage zones (Fw-D) on footslopes (2-10% slopes). Soil: Grey, imperfectly to poorly drained, sandy soils.	7	13.79	3.95
WD	Wilderness	Wb1, Exc1, Exc2	Terrain: Excavated areas (Exc1, Exc2) and rehabilitated excavated areas (Wb1) on gentle midslopes. Soil: No remaining natural soil horizons.	4	52.19	14.98
* See soil map, Figure 3a			Total	35	348.42	100.0

5.3.2 Land capability of the Soil Study Area

The location and extent of land capability classes within the Soil Study Area are shown in Figure 4b.

Figure 4b: Land capability map of Soil Study Area



The land capability of the Soil Study Area is summarized in Table 5b which shows the soil types grouped into each land capability class, a broad description of the soil group, the number of units per land capability class, and the area and percentage comprised by each land capability class.

Table 5b: Land capability classes – Soil Study Area

LEGEND: LAND CAPABILITY						
Land Capability Code	Land Capability Class	*Soil Types	Broad Soil Description	Unit Count	Area (ha)	Area (%)
A	Arable	Hu1, Hu2, Hu3, Gc1, Cv1, Cv2, Cv3	Terrain: Gentle midslopes (1-5% slopes). Soil: Moderately deep to very deep (600-1500+ mm), red and brownish yellow, well-drained, loamy sand to sandy loam soils.	7	124.4	24.53
G	Grazing	Cv4, Cv5, Gc2, Ms/R	Terrain: Gentle to moderate midslopes (2-10% slopes). Soil: Very shallow to shallow (100-500 mm), brownish yellow, well-drained, loamy sand soils with scattered surface stones (Cv4, Cv5, Gc2) as well as areas dominated by exposed rock and stones (Ms/R).	9	258.06	50.89
W	Wetland	Wa, Cf, Fw, Fw-D, Kd	Terrain: Seepage zones (Wa, Cf and Fw) and disturbed seepage zones (Fw-D) on footslopes and drainage lines (Kd) in valley bottoms (2-10% slopes). Soil: Grey, imperfectly to poorly drained, sandy soils.	8	68.56	13.52
WD	Wilderness	Wb1, Exc1, Exc2	Terrain: Excavated areas (Exc1, Exc2) and rehabilitated excavated areas (Wb1) on gentle midslopes. Soil: No remaining natural soil horizons.	3	56.17	11.08
*See soil map, Figure 3b			Total	27	507.19	100.0

5.3.3 Wetland and riparian delineation

Land capability was assessed in categories of arable land, grazing land, **wetlands** and wilderness land. The wetland zones were therefore delineated as part of the soil and land capability assessment based on soil properties by means of systematic auger observations towards wetland zones in order to locate the point where soil properties reflect signs of wetness within 500 mm from the surface or where soil, topography and vegetation combined, indicate the boundary of the wetland or riparian zone.

The soil types within the proposed Development Area which are associated with wetlands was extracted and shown in Figure 4c and summarized in Table 5c. (See Appendix C for details on soil properties related to wetland zones).

Table 5c: Wetland soils within the proposed Development Area

Wetland soils intersecting the proposed Development Area					
Soil Type Code	Wetland zone	Broad Soil Description	Unit Count	Area (ha)	Area (%)
Wa	Temporary	Temporary seepage zones on midslopes; Moderately deep, (600-800 mm), grey to greyish white, imperfectly to somewhat poorly drained, sandy soils on midslopes (2-5% slopes).	5	2.27	0.65
Cf	Temporary to seasonal	Seepage wetland on edge of Blesbokspruit; Shallow (200-400 mm), grey imperfectly to poorly drained (saturated), sandy soils on footslopes with stony patches (4-10% slopes).	1	0.19	0.05
Fw-D	Temporary to seasonal	Largely excavated and disturbed seepage wetland on edge of Blesbokspruit tributary; Patches of remaining grey to greyish white, imperfectly to poorly drained sandy soils on footslopes and valley bottom.	1	11.33	3.25
Total			7	13.79	3.95

Five small sections of soil type Wa, which reflects temporary wetness, intersect the proposed Development area to the east (Figure 4c). A small section of soil type Cf, reflecting temporary wetness, intersect the Development Area to the south. A larger section of soil type Fw-D, which reflects temporary to seasonal wetness, intersects the Development Area to the north. A large portion of this soil type unit is excavated along the southern edge of the tributary and sporadic disturbed spots occur in the remainder.

Figure 4c: Wetland soils intersecting the proposed Development Area

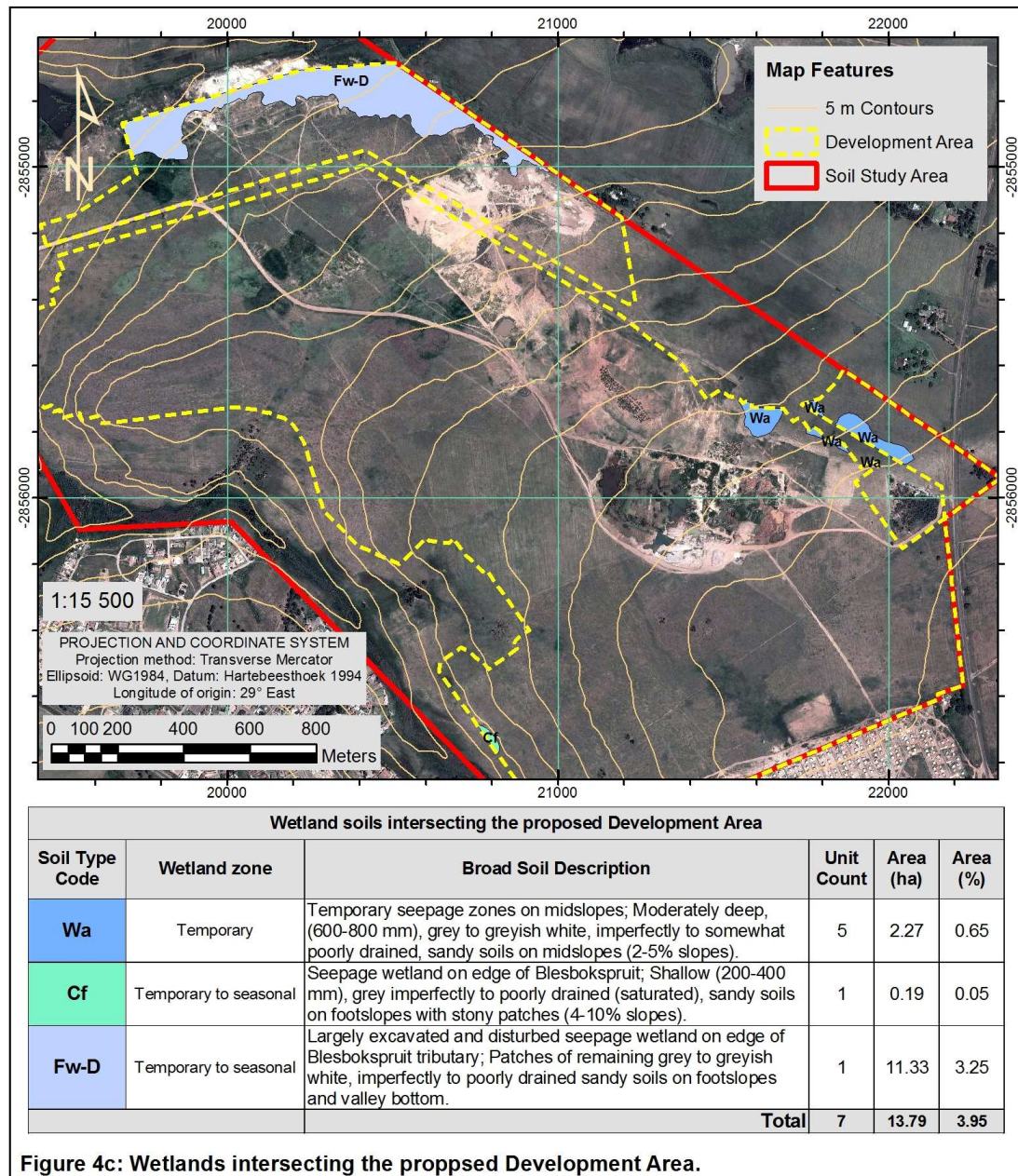


Figure 4c: Wetlands intersecting the proposed Development Area.

5.3.4 Derived dry land crop production potential and long term potential yields

The derived dry land crop production potential and potential crop yields was based on soil properties of the soil types within the proposed Development Area with considering of the annual rainfall and are summarised in Table 6.

Table 6: Derived dry land crop potential and long term potential yields

Table 3: Derived dry land crop potential and long term potential yields			
*Soil Type (Code)	Dry land crop production potential class	Potential long term yields for maize (t/ha/a)	Grazing capacity for cattle (ha/l su)
Hu1, Hu2, Cv1, Cv2	Moderate-high	3-5	5-10
Hu3, Gc1, Cv3	Moderate	2-3	
Cv4, Gc2	Low	Not recommended	
Cv5, Wa	Very low	Not suitable	
R/Ms, Cf, Fw, Fw-D, Kd, Wb1, Exc1, Exc2	Very low to None	Not suitable	
* See soil map Figure 3b			

5.4 Pre-mining land use

5.4.1 Land uses of the proposed Development Area

The localities and extents of pre-mining land uses within the proposed Development Area are shown in Figure 5a and are summarized in Table 7a.

Figure 5a: Pre-mining land use map of the proposed Development Area

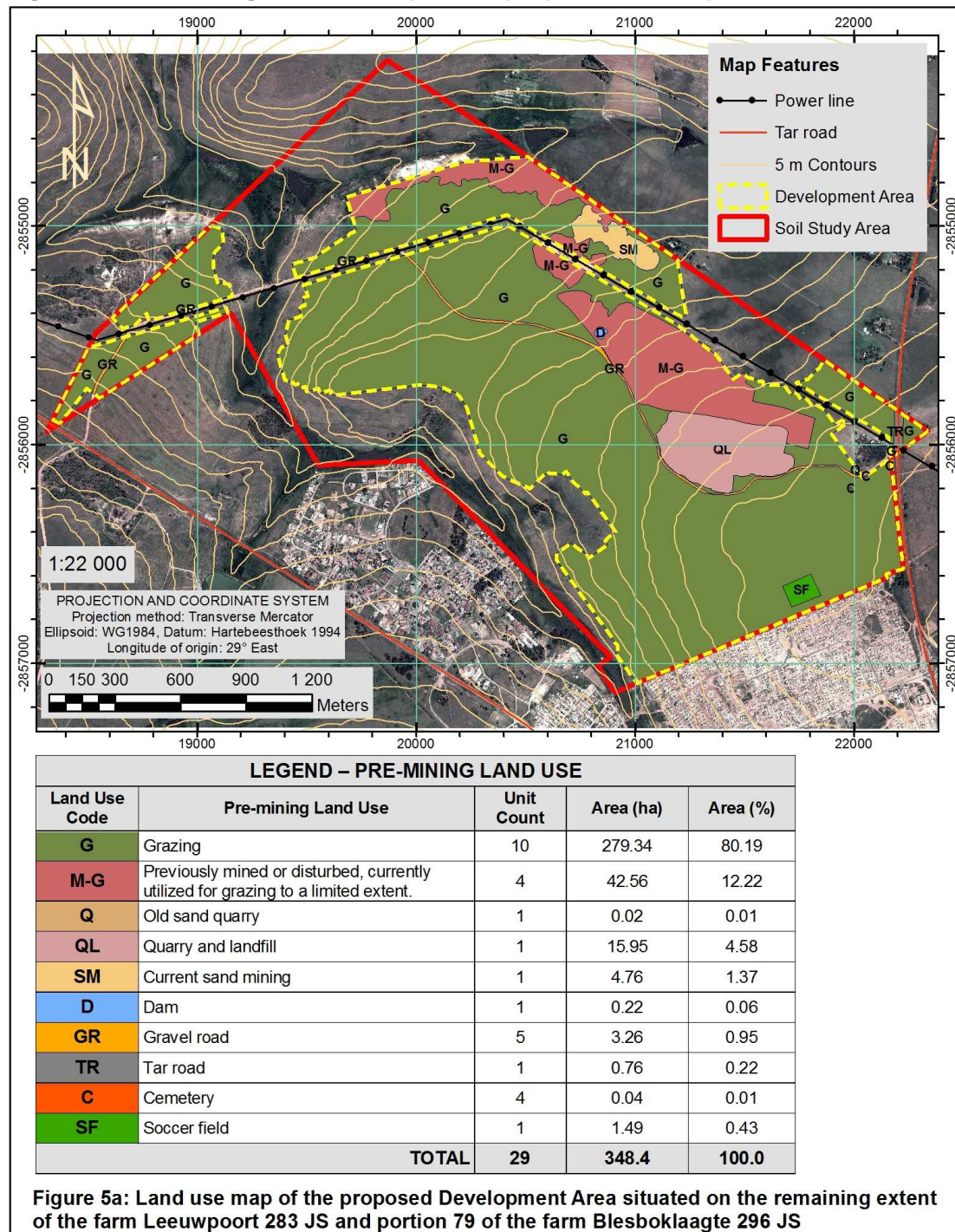


Figure 5a: Land use map of the proposed Development Area situated on the remaining extent of the farm Leeuwpoot 283 JS and portion 79 of the farm Blesboklaagte 296 JS

Table 7a: Pre-mining land uses – proposed Development Area

LEGEND – PRE-MINING LAND USE				
Land Use Code	Pre-mining Land Use	Unit Count	Area (ha)	Area (%)
G	Grazing	10	279.34	80.19
M-G	Previously mined or disturbed, currently utilized for grazing to a limited extent.	4	42.56	12.22
Q	Old sand quarry	1	0.02	0.01
QL	Quarry and landfill	1	15.95	4.58
SM	Current sand mining	1	4.76	1.37
D	Dam	1	0.22	0.06
GR	Gravel road	5	3.26	0.95
TR	Tar road	1	0.76	0.22
C	Cemetery	4	0.04	0.01
SF	Soccer field	1	1.49	0.43
TOTAL		29	348.4	100.0

5.4.2 Land uses of the Soil Study Area

The localities and extents of pre-mining and current land uses within the Soil Study Area are shown in Figure 5b and are summarized in Table 7b.

Figure 5b: Pre-mining land use map of the Soil Study Area

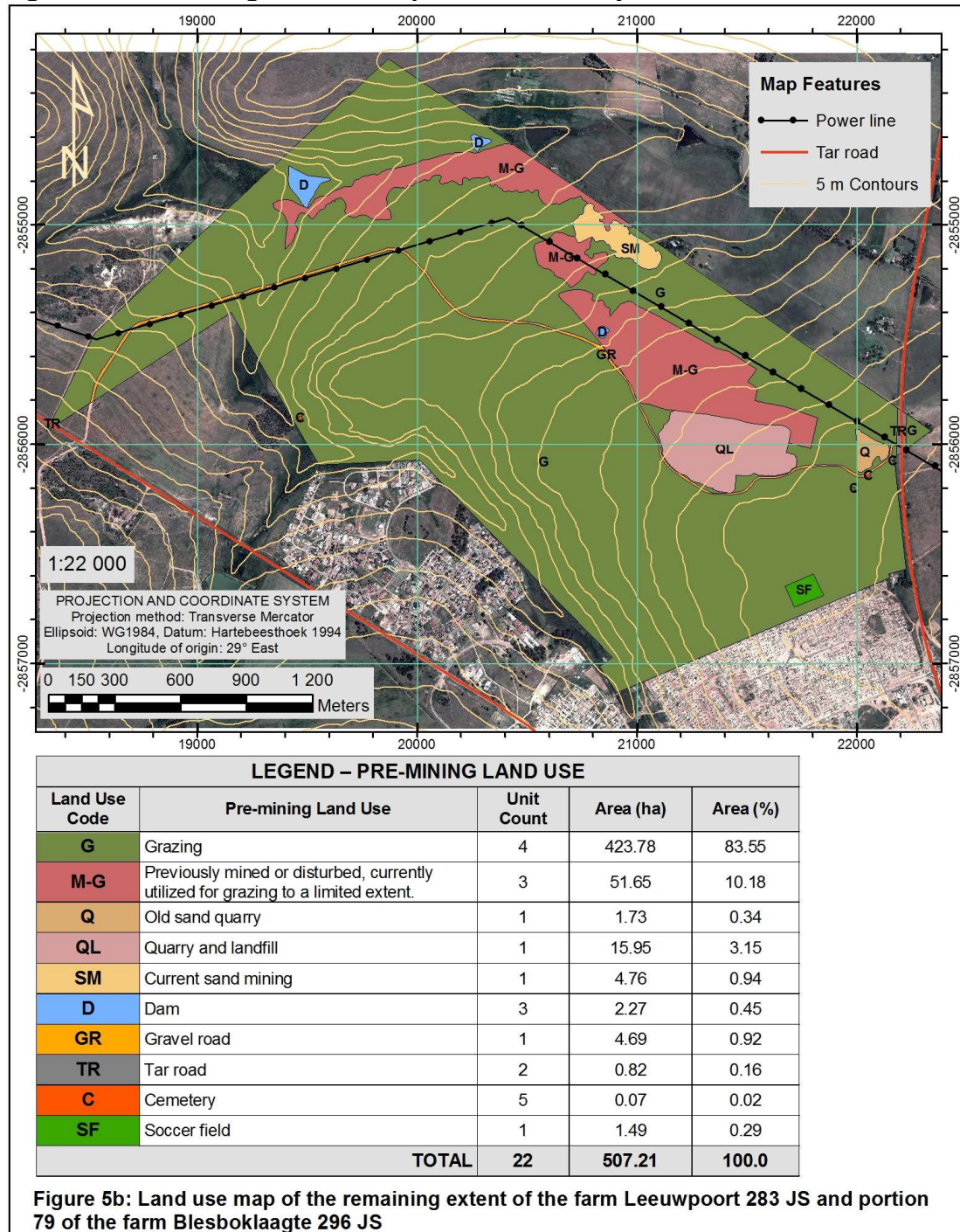


Table 7b: Pre-mining land uses – Soil Study Area

LEGEND – PRE-MINING LAND USE				
Land Use Code	Pre-mining Land Use	Unit Count	Area (ha)	Area (%)
G	Grazing	4	423.78	83.55
M-G	Previously mined or disturbed, currently utilized for grazing to a limited extent.	3	51.65	10.18
Q	Old sand quarry	1	1.73	0.34
QL	Quarry and landfill	1	15.95	3.15
SM	Current sand mining	1	4.76	0.94
D	Dam	3	2.27	0.45
GR	Gravel road	1	4.69	0.92
TR	Tar road	2	0.82	0.16
C	Cemetery	5	0.07	0.02
SF	Soccer field	1	1.49	0.29
TOTAL		22	507.21	100.0

6. ENVIRONMENTAL IMPACT ASSESSMENT

The environmental impact assessment in terms of soils, land capability and land use for the construction, operational and decommissioning phases including mitigation measures is provided in Appendix E, Table E1.

7. CONCLUSION

Soils and land capability (proposed Development Area)

Approximately 29.71% (103.46 ha) of the proposed Development Area is dominated by soils with **arable land capability**, consisting of red and brownish yellow, apedal, loamy sand to sandy loam soils. These arable soils are dominated by Hutton, Glencoe and Clovelly soil forms, symbolized as soil types Hu1, Hu2, Hu3, Gc1, Cv1, Cv2 and Cv3.

Approximately 51.36% (178.98 ha) of the proposed Development Area is dominated by soils with **grazing land capability** consisting of shallow brownish yellow, apedal, loamy sand soils and shallow rocky/stony soils. These soils are dominated by Clovelly, Glencoe and Mispah soil forms, symbolized as soil types Cv4, Cv5, Gc2 and Ms/R.

Approximately 3.95% (13.79 ha) of the proposed Development Area was classed as **wetland** consisting of grey, imperfectly to poorly drained sandy soils. These soils are dominated Wasbank, Cartref and Fernwood soil forms, symbolized as soil types Wa, Cf and Fw-D. The large section of soil type Fw-D is excavated to some extent or mechanically disturbed by previous sand mining activities.

Approximately 14.98% (52.19 ha) of the proposed Development Area consists of areas classed as **wilderness land**. Unit Wb1 consists of a previously excavated site which appears to be rehabilitated to some extent. Unit Exc1 consists of a site where soil are currently excavated but are also backfilled simultaneously at some sections. Unit Exc2 consists of an excavated site where sand is currently mined.

Soils and land capability (Soil Study Area)

Approximately 24.53% (124.4 ha) of the Soil Study Area is dominated by soils with **arable land capability**, consisting of red and brownish yellow, apedal, loamy sand to sandy loam soils. These arable soils are dominated by Hutton, Glencoe and Clovelly soil forms, symbolized as soil types Hu1, Hu2, Hu3, Gc1, Cv1, Cv2 and Cv3.

Approximately 50.89% (258.06 ha) of the Soil Study Area is dominated by soils with **grazing land capability** consisting of shallow brownish yellow, apedal, loamy sand soils and shallow rocky/stony soils. These soils are dominated by Clovelly, Glencoe and Mispah soil forms, symbolized as soil types Cv4, Cv5, Gc2 and Ms/R.

Approximately 13.52% (68.56 ha) of the Soil Study Area was classed as **wetland** consisting of grey, imperfectly to poorly drained sandy soils. These soils are dominated Wasbank, Cartref, Fernwood and Kroonstad soil forms, symbolized as soil types Wa, Cf, Fw, Fw-D and Kd.

Approximately 11.08% (56.17 ha) of the Soil Study Area consists of areas classed as **wilderness land**. Unit Wb1 consists of a previously excavated site which appears to be rehabilitated to some extent. Unit Exc1 consists of a site where soil are currently excavated but are also backfilled simultaneously at some sections. Unit Exc2 consists

of excavated sites where sand is currently mined as well as a former road quarry.

Pre-mining land use (proposed Development area)

The majority (80.19%) of the proposed Development Area is utilized for grazing purposes from time to time. A further 12.22% of an area that was previously mined/excavated is grazed simultaneously although the carrying capacity is probably very low. This translates to 92.4% of the Development Area which are currently utilized for grazing purposes.

The other disturbed areas which has no grazing capacity consists of the current sand mining pit (1.37%), a former sand mining pit (0.01%) and the current quarry and landfill area (4.58%) which translates to a total of 5.96%

The remainder (1.64%) of the proposed Development Area is occupied by very small uses such as a dam, gravel road, tar road, cemetery and soccer field.

Pre-mining land use (Soil Study Area)

The majority (83.55%) of the Soil Study Area is utilized for grazing purposes from time to time. A further 10.18% of an area that was previously mined/excavated is grazed simultaneously although the carrying capacity is probably very low. This translates to 93.73% of the Soil Study Area which are currently utilized for grazing purposes.

The other disturbed areas which has no grazing capacity consists of the current sand mining pit (0.94%), a former sand mining pit (0.34%) and the current quarry and landfill area (3.15%) which translates to a total of 4.43%

The remainder (1.84%) of the Soil Study Area is occupied by very small uses such as a dam, gravel road, tar road, cemetery and soccer field.

8. RECOMMENDATIONS

- The wetland soils (soil type Fw-D) within the northern part of the Development Area as shown in Figure 4c is the biggest concern. Some erven are located in saturated areas not suitable for residential development. The layout plan should probably be adapted. Rehab Green cc is willing to attend a site visit together with a wetland specialist to clarify the wetland issue.

REFERENCES

Chamber of Mines of South Africa, Coaltech Research Association, 2007. Guidelines for the rehabilitation of mined land. Johannesburg.

Department of Environmental Affairs and Tourism, 1998. Environmental impact management. Implementation of sections 21, 22 and 26 of the Environmental Conservation Act, 1989, Pretoria: Government Printer (1998).

Department of Water Affairs and Forestry, 2003. A practical field procedure for the identification and delineation of wetlands and riparian areas, DWAF, Pretoria.

Die Misstof vereniging van Suid Afrika, 1986. Bemestings handleiding, tweede hersiene uitgawe 1986, Pretoria.

Non-Affiliated Soil Analysis Working Committee, 1991. Methods of soil analysis. SSSSA, Pretoria.

Soil Classification Working Group, 1991. Soil classification. A taxonomic system for South Africa. Institute for Soil, Climate and Water, Pretoria.

Van der Watt, H.v.H and Van Rooyen T. H, 1990. A glossary of soil science, Pretoria: Soil Science Society of South Africa (1990).

APPENDIX A

SOIL CLASSIFICATION SYSTEM

The classification system categorizes soil types in an upper soil Form level which is subdivided into a number of lower Family levels. Each soil Form (higher level) is defined by a unique vertical sequence of soil horizons with specific defined properties. The soil Families (lower level) are a subdivision of the soil Form (higher level), differentiated on the basis of specific characteristics such as leaching status, calcareousness, structure types and sizes etc.

In this way, standardised soil identification and communication is allowed by use of soil Form names and family numbers or names e.g. Hutton 2100 or Hutton Hayfield. The soil Form and soil Family together are referred to as soil types.

The soil Forms are indicated by the name and the Family by its appropriate number e.g. Hutton 2100. The soil Form and Family are then symbolized e.g. Hu and referred to as soil type Hu. The soil Form and Family are often further categorized based on effective soil depth, terrain unit and slope and a numerical number is added to the symbol e.g. Hu1. For example, where the Hutton 2100 soil Form and Family occurs at an effective depth of 900-1200 mm, it is symbolized and referred to as soil type Hu1, and where this soil Form and Family occurs at an effective depth of 600-900 mm it is symbolized and referred to as soil type Hu2.

APPENDIX B

SOIL PROPERTIES AND CHARACTERISTICS

Various terms in the soil legend are used to describe a series of soil properties and characteristics such as the dominant soil Form and Family, effective soil depth, internal drainage, and clay content per soil horizon and texture class.

1. Effective soil depth

Effective soil depth can be considered as the depth freely permeable to plant roots and water. Effective soil depth categories used in the soil legend are as follows:

Very shallow	< 300mm
Shallow	300-600 mm
Moderately deep	600-900 mm
Deep	900-1500 mm
Very deep	> 1500 mm

2. Internal drainage

Internal drainage is the flow of water (annual precipitation) through the soil profile. Soils with the ability to drain annual precipitation through the profile without waterlogged periods within certain parts of the profile are called **well-drained** soils. Soils which lack this ability will display properties indicating temporary to permanent water logged conditions in parts of the soil profile in the form of mottling, leaching or gleying.

Moderately well-drained soils mostly display impeded internal drainage in the lower profile e.g. soft plinthic horizons, which is the result of periodically fluctuating water tables which are characterized by mottling and accumulation of iron and manganese oxides.

Imperfectly drained soils mostly display impeded internal drainage in the upper and lower parts of the profile e.g. E and plinthic horizons, which is the result of periodic lateral flow of water in the profile and fluctuating water tables. Such soils are characterized by grey, leached, sandy horizons and mottled plinthic horizons.

Poorly drained soils mostly display impeded internal drainage in the upper and lower parts of the soil profile e.g. E, plinthic and G-horizons and are the result of long term to permanent wetness in the soil profile, which is characterized by grey, leached, sandy horizons, mottled plinthic horizons and gleyed clay horizons.

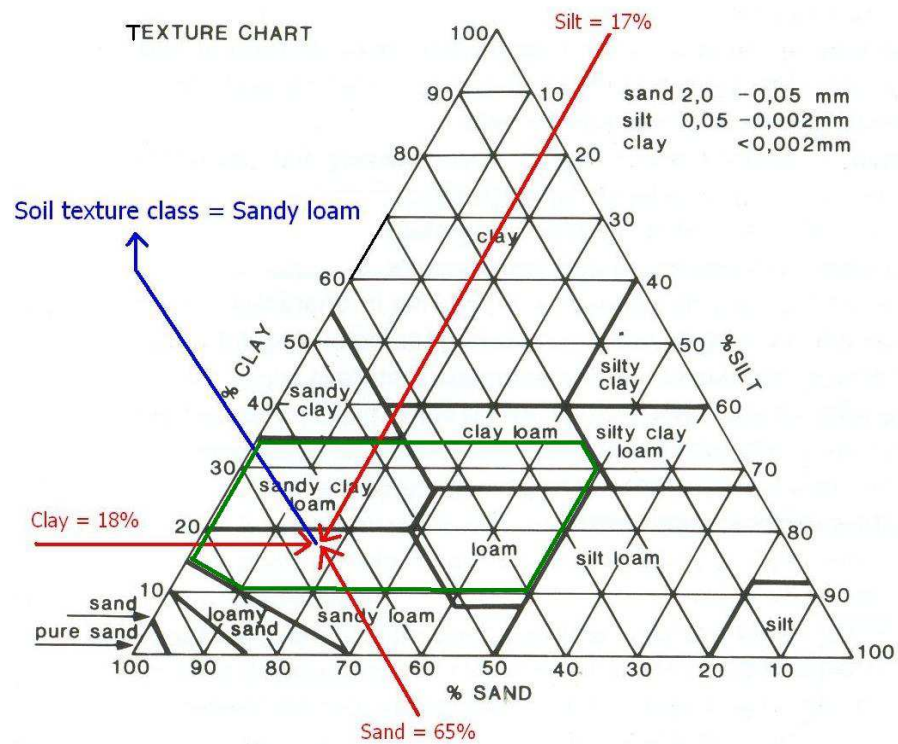
3. Texture class

Soil texture refers to the relative proportions of the various particle size separates in the soil. Particle sizes are defined in the following **fractions**.

Sand – (2.0 – 0.05 mm)
 Silt – (0.05 – 0.002 mm)
 Clay – (< 0.002 mm)

The relative proportions of these 3 fractions (as illustrated by the red arrows in Figure B1) determines 1 of 12 soil texture classes e.g. sandy loam, loam, sandy clay loam etc. The different texture class zones are demarcated by the thick black lines in the diagram. The green zone can be used as a guideline for moderate to high agricultural potential, but needs to be evaluated together with other soil properties.

Figure B1: Soil texture chart



APPENDIX C WETLAND DELINEATION

1. Legal framework

In order to determine the existence and extent of a wetland in the proposed mining area the legal framework on what classifies as a wetland should be applied. The National Water Act, 1998 (Act 36 of 1998), (NWA), includes a wetland in the definition of a watercourse. A watercourse is:

- *“a river or spring;*
- *a natural channel in which water flows regularly or intermittently;*
- *a wetland, lake or dam into which, or from which, water flows, and*
- *any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse.”*

A wetland is then further defined by the NWA as *“land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”*.

Based on the above definition, the Department of Water Affairs and Forestry (DWAf), now the Department of Water Affairs (DWA), published a set of guidelines describing field indicators and methods for determining whether an area is a wetland or riparian area, and for finding its boundaries (DWAf, 2005). These guidelines state that wetlands must have one or more of the following attributes:

- *Wetland (Hydromorphic) soils* that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of *water loving plants (hydrophytes)*; and
- A *high water table* that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.

Based on the NWA definition of a wetland, four indicators were identified within the DWAf (2005) guidelines to assist in identifying wetland areas:

- *Terrain Unit Indicator.* The topography of the area is usually used to determine where in the landscape the wetland is likely to occur.
- *Soil Form Indicator.* Certain soil forms, as defined by the Soil Classification Working Group (1991), are associated with prolonged and frequent saturation.
- *Soil Wetness Indicator.* The soil wetness indicator identifies the morphological “signatures” developed in the soil profile as a result of prolonged and frequent saturation.
- *Vegetation Indicator.* The vegetation indicator identifies hydrophilic vegetation associated with frequently saturated soils.

2. Processes in wetland soils and associated properties

The following processes normally take place under anaerobic/saturated or so-called wetland conditions:

- Mottling (localized colouring and alterations due to continued exposure to wetness);
- Concretions (accumulation and cohesion of minerals into hard fragments).
- Leaching (removal of soluble constituents by percolating water);
- Gleying (reduction of ferric oxides under anaerobic conditions resulting in grey, low chroma soil colours); and
- Illuviation of colloidal matter from one horizon to another, resulting in the development of grey sandy E-horizons and grey clay G-horizons.

These processes usually result in soil properties which provide undisputable evidence of temporary to permanent wetness such as:

Dark grey coloured A-horizons

The A-horizon is the upper 200-300 mm of the soil profile and is usually defined by a slightly darker colour due to a greater or lesser amount of humified organic matter. The dark grey A-horizon is common to almost all the soils found in permanent and seasonal zones. The dark grey colour usually appears only in the moist state and rapidly fades in to a plain grey colour when it dries out. The dark appearance is due to higher organic carbon content which builds up under the long term moist conditions in a wetland system. The carbon and also fine organic matter loses its dark colour in the dry state and the grey colour of the soil particles becomes prominent. The grey soil colour is the result of the removal of soluble constituents (iron oxides, silicate clay) by percolating water. The dark grey A-horizon is common in permanent, seasonal and temporary wetland zones.

Grey to pale grey E-horizons

The E-horizon underlies the A-horizon, having a lower content of colloidal matter (clay, sesquioxides, organic matter) usually reflected by a pale colour and a relative accumulation of quartz and/or other resistant minerals of sand or silt sizes. The E-horizon develops under high lateral flow (permanent or periodic) of water in the soil profile, which removes some colloidal matter to the lower soil profile and some further down the wetland system. The E-horizon is thus the flow path for shallow groundwater in the wetland zone. The grey and pale grey E-horizon is common in permanent and seasonal wetland zones and less common in temporary zones.

Yellowish grey E-horizons

The colour of the E-horizon reflects the intensity of removal of colloidal matter from the horizon. This results in the phenomenon that some E-horizons have a yellowish colour in the moist state but become grey in the dry state. The yellowish colour in the moist state is due to an incomplete covering of the mineral soil particle by ferric oxides and indicates a less leached state and less anaerobic (saturated conditions) conditions. The yellowish E-horizons are therefore strongly related to temporary wetland zones and occur less in seasonal or permanent wetland zones.

Plinthic horizons

Plinthic horizons are characterised by localization and accumulation of iron and manganese oxides under conditions of a fluctuating water table, resulting in distinct reddish brown, yellowish brown and/or black mottles, with or without hardening to form sesquioxide concretions. Plinthic horizons are the result of fluctuating water tables which implies wetter and dryer phases and are therefore found commonly in seasonal

and temporary wetland zones and less in permanent wetland zones.

G-horizons

Gleying is the process of reduction of ferric oxides and hydrated oxides under anaerobic conditions, resulting in grey, low chroma matrix colours. This usually goes along with clay illuviation from the upper horizon which results in a grey clay horizon and is called a G-horizon. G-horizons are commonly found in permanent wetland zones, occasionally in seasonal zones and rarely in temporary wetland zones.

APPENDIX D COORDINATES OF SOIL SAMPLING POINTS

Table D1: Coordinates of soil sampling points

Coordinates of Soil Sampling Points				
Soil sampling point	Projected Coordinate System Ellipsoid: WGS 1984 Coordinate system: LO29 Datum: Hartbeesthoek 1994		Geographic Coordinate System Ellipsoid: WGS 1984 Datum: Hartbeesthoek 1994	
	Y (m)	X (m)	X/Lat (dd)	Y/Long (dd)
E26	-2856545.000	22064.000	-25.816692	29.220040
F20	-2856395.000	21164.000	-25.815352	29.211062
G25	-2856245.000	21914.000	-25.813987	29.218539
H18	-2856095.000	20864.000	-25.812648	29.208065
K16	-2855645.000	20564.000	-25.808590	29.205067
M10	-2855345.000	19664.000	-25.805895	29.196087
R13	-2854595.000	20114.000	-25.799119	29.200563

APPENDIX E ENVIRONMENTAL IMPACT ASSESSMENT

Table E1: Environmental Impact Assessment

			Rating										Residual impacts after mitigation				
													Rating				
No	Environmental component	Potential Impact	Status	Magnitude	Extent	Duration	Probability	Significance	Reversibility	Irreplaceable loss of resource	Potential of impacts to be mitigated	Proposed mitigation measures	Magnitude	Extent	Duration	Probability	Significance
1. CONSTRUCTION PHASE																	
1.1 Construction of residential units, shopping complexes, industrial complexes, stores, vehicle parking areas, roads etc.																	
	Soil	The construction of structures that cover the soil surface by means of concrete, tar or paving. 1. Compaction of the soil surface for building foundations, parking areas etc will alter the soil's physical properties negatively. 2. Covering the soil surface with concrete, tar or paving will cause productive functioning of the soil to cease completely.	-	10	1	5	5	80	1	1	1	Contain construction footprint as far as possible. Prevent removal of the natural vegetation cover where possible.	10	1	5	5	80
	Land capability	The current arable, grazing or wilderness land capability will cease completely until the structures is removed.	-	10	1	5	5	80	1	1	1	All mitigation measures applied on soils will mitigate land capability as far as possible	10	1	5	5	80
	Land use	The current land uses such as grazing will cease completely until the structures is removed.	-	10	1	5	5	80	1	1	1	All mitigation measures applied on soils will mitigate land uses as far as possible	10	1	5	5	80
1.2 Possible contamination of soil by spillages of fuel or oil by mechanical equipment																	
	Soil	Possible contamination of soils by spillages of fuel or oil by mechanical equipment. Soil physical and chemical properties will be adversely affected.	-	8	1	1	4	40	1	1	1	All accidental fuel and oil spillages will be cleaned up immediately. Contaminated soil will be disposed at a suitable disposal facility. All mechanical equipment will be serviced at an approved facility.	4	1	1	4	24

	Land capability	Soil physical and chemical properties will be adversely affected and will cause some reduction in land capability.	-	8	1	1	4	40	1	1	1	All mitigation measures applied on soils will mitigate land capability as far as possible	4	1	1	4	24
	Land use	Soil physical and chemical properties will be adversely affected and will cause some reduction in land use.	-	8	1	1	4	40	1	1	1	All mitigation measures applied on soils will mitigate land uses as far as possible	4	1	1	4	24
1.3 Possible soil erosion at exposed building footprints due to higher runoff																	
	Soil	Possible soil erosion at exposed construction sites where the current natural vegetation were removed.	-	6	1	1	4	32	1	2	2	Implement runoff control measures and structures during the first stages of construction as far as possible. Contain construction footprint as far as possible. Prevent removal of the natural vegetation cover where possible.	4	1	1	4	24
	Land capability	Soil erosion will adversely affect land capability.	-	6	1	1	4	32	1	2	2	All mitigation measures applied on soils will mitigate land capability as far as possible	4	1	1	4	24
	Land use	Soil erosion will adversely affect land uses.	-	6	1	1	4	32	1	2	2	All mitigation measures applied on soils will mitigate land uses as far as possible	4	1	1	4	24
2. Operational Phase																	
2.1 Use and maintenance of residential units, shopping complexes, industrial complexes, stores, vehicle parking areas, roads etc.																	
	Soil	All impacts on soils during the construction phase will remain during the operational phase. The productive functioning of soil at areas covered by concrete, tar or paving will remain ceased	-	10	1	5	5	80	1	1	1	Evaluation of the runoff control system and structures. Rectification where structures are inadequate. Frequent maintenance where necessary and prompt repair after damages caused by any nature.	10	1	5	5	80
	Land capability	The pre-construction land capability at areas covered by concrete, tar or paving will remain ceased.	-	10	1	5	5	80	1	1	1	All mitigation measures applied on soils will mitigate land capability as far as possible	10	1	5	5	80
	Land use	The pre-construction land uses at areas	-	10	1	5	5	80	1	1	1	All mitigation measures	10	1	5	5	80

[illegible]