REPORT ON ENGINEERING GEOLOGICAL INVESTIGATIONS UNDERTAKEN FOR THE PROPOSED NKAMBENI CEMETERY NEAR HAZYVIEW IN MPUMALANGA

Undertaken for the Messrs Umsebe Development Planners

April 2013
GEO3•1048

TABLE OF CONTENTS

1. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the investigation, together with the interpretation of aerial photographs, the site has been divided into three zones (**Figure 1**, **Appendix A**). The zones delineated contain similar soil profiles and development constraints, which are summarized in **Table 1**.

The proposed cemetery site, which was selected by others, has a number of flaws. These include, permeable soils coupled with a shallow, non-perennial perched, groundwater table, the sites' proximity to the adjacent drainage lines and the potential for grave instability near surface. Notwithstanding these constraints, and taking cognisance that they are characteristic of the area, we are of the opinion that the current site can be pursued for a cemetery, providing the following mitigating measures are implemented:

- A buffer at least 100m wide must be included around the perimeter of the site - extending up-slope from the centre of the adjacent streams; deep-rooted, indigenous, hydrophilic vegetation/trees should be planted in this buffer to reduce the amount of percolating groundwater entering the adjacent streams.
- The non- or slightly cohesive surficial regolith is susceptible to erosion. As such, it is recommended that a phased approach be undertaken to clearing and grubbing the site for use, i.e., areas up to 1-hectare only, should be cleared and grubbed for use as necessary.

Table 1: Summary of Engineering Geological conditions affecting the selection of Cemeteries - Proposed Nkambeni Cemetery near Hazyview

Zone	Abbreviated soil profile	Overall consistency to 1.8m	Required means of excavation to 1.8m		Permeability of the regolith at internment depth - based on soil classification and/or in situ tests			Distance to domestic water source		Distance to drainage feature		Average gradient		Estimated Buffer Zone		Grave Stability	Overall Suitability*
			Excavation method	Cemetery suitability*	Soil classification	Estimated permeability [cm/s]	Cemetery suitability*	Distance [m]	Cemetery suitability*	Distance [m]	Cemetery suitability*	Slope [°]	Cemetery suitability*	Depth [m]	Cemetery suitability*		
I	mostly thin transported soils / reworked residua grading into more competent residua	loose - medium dense	pick and shovel	ideal	*SC* and *SM*	$5x10^{-4}$	too permeable	>1000	suitable	<100	not suitable	mostly <6°	ideal	<2	not suitable	potentially problematic near surface	suitable with mitigating measures
I		dense grading into very dense	backhoe											<1	not suitable	stable	
II	as above with slightly thicker transported soils	medium dense	pick and shovel	ideal				>1000		0	not suitable			<1	not suitable	potentially problematic	not suitable

Criteria used to assess cemetery suitability[3]						
Very loose-loose/very soft-soft: spade; medium dense/ firm: pick and shovel; very dense/ very stiff: backhoe; rock: jack-hammer and blasting.	Upper permeability limit ~ $5x10^{-5}$ cm/s (In arid areas or areas where water resources are situated at greater distance from the cemetery the limit may be increased to 1 x 10^{-4}cm/s). To ensure normal decomposition, the minimum permeability should be 1 x 10^{-7}cm/s.	permeability	distance**	permeability	distance**	Slopes between 2° and 6° are ideal. Slopes <2° results in areas of impeded drainage, while slopes >6° may result in surface erosion.	The basal buffer zone - between the deepest grave and the water table (perched or permanent) should be at least 2.5m.	Consistencies of very loose/ very soft: not recommended; loose/soft: not suitable; medium dense /firm and better: ideal.
		$1x10^{-4}$cm/s	465m	$1x10^{-4}$cm/s	415m			
		$5x10^{-5}$cm/s	308m	$5x10^{-5}$cm/s	258m			
		$1x10^{-5}$cm/s	182m	$1x10^{-5}$cm/s	132m			
		$5x10^{-6}$cm/s	166m	$5x10^{-6}$cm/s	116m			
		$1x10^{-6}$cm/s	153m	$1x10^{-6}$cm/s	103m			
		$5x10^{-7}$cm/s	152m	$5x10^{-7}$cm/s	102m			
		$1x10^{-7}$cm/s	150m	$1x10^{-7}$cm/s	100m			

Notes: / = overlying; * = Cemetery suitability applies only to those areas above the 1:100 year floodline, areas below it must be excluded; ** - deemed safe.

2. INTRODUCTION

2.1. Terms of reference

In terms of an appointment from Mr T Masuku of Messrs Umsebe Development Planners, Geo3cc has undertaken an engineering geological investigation for a proposed cemetery in Nkambeni. Our appointment follows the submission of a proposal and costing dated 7 December 2012 (Our reference GQ/1351/a/hjs).

Within the scope of the investigation, the following objectives were defined:

- determine the excavatability and suitability of the regolith for a cemetery
- assess the basic soil properties of the in situ soils through laboratory testing
- provide a preliminary hydro-geological assessment for the site
- assess the overall suitability of the site for a cemetery

2.2. Site description

The proposed cemetery is situated on Portion A (Portion of Portion 148 of the farm Kaap Block Section F), colloquially known as Sand River, approximately 7-kilometres south-southeast of Hazyview in Mpumalanga (**Figure 2**). The site, with an aerial extent of approximately 40-hectares and occupying a spur sloping to the south, east and north, comprises virgin ground with grass veld, scattered trees and areas of dense scrub.

2.3. Reference sources

The following published maps and aerial photographs were consulted during the investigation:

- 1:250,000 scale Geological Series Map, Barberton 2530
- 1:50,000 scale Topographical Series Map, Kiepersol 2531AA
- Aerial photographs:
  - 0233 and 0232, strip 4, job 987, scale 1:30,000 (three times enlargements), date 1996
  - 1161-1165, strip 54, 1140-1144, strip 55, job 56, date 1944
- Layout plan with boundaries and contours provided by Messrs Umsebe Development Planners has been used in the compilation of **Figure 1**

3. SITE INVESTIGATIONS

3.1. Interpretation of aerial photographs

To facilitate the mapping of soil units on-site, and identify structural geological features traversing or near the site, aerial photographs at scales of approximate 1:10,000 and 1:30,000 were examined stereoscopically. The results from the analysis are summarized in **Figures 1** and **2** (**Appendix A**), which delineates the soil units and information gleaned from our hydro-geological assessment, respectively.

3.2. Fieldwork

The fieldwork phases of the investigation were undertaken in January and February 2013. Seventeen pits, sited to straddle the site, were excavated to refusal or the depth capabilities of a Volvo BL71 backhoe. The pits were profiled according to standard procedures[6] and the result soil logs are included in **Appendix B**.

3.3. Sampling and laboratory testing

During inspection of the *in situ* soils, ten indicator samples were recovered from the sidewalls of the test pits. These samples were submitted to the laboratories of Messrs Engeolab in Rocky Drift for testing according to our instructions.

All samples were subjected to foundation indicator tests, which were used to classify the soils. The test results, in the format they were received from the laboratory, are included in **Appendix C**, while an evaluation of the results is undertaken in **Section 4**.

3.4. Permeability tests

To provide an assessment of the permeability of the regolith, two permeameter tests were undertaken at approximately 1m below natural ground level, next to pits with soil profiles deemed to be representative of the site, i.e., representative of the soils at internment depth. These results are included in **Appendix D**.

3.5. Hydro-census

To obtain an indication of the groundwater users around the site, for an evaluation of the effect the cemetery may have on their water, and to provide an assessment of the groundwater development potential of the area, a hydro-census has been conducted in a 1-kilometre radius of the site. The census has mostly relied on groundwater databases, since residents' in the area are provided with bulk water, and those questioned, were not aware

of additional boreholes. The salient information from the databases are included in **Appendix E**.

4. GEOTECHNICAL ASSESSMENT

4.1. Geology and Subsoils

The results from the fieldwork phase of the investigation reveal the site is underlain by granite bedrock, albeit below a mantle of thin transported soils and residua. In terms of the published 1:250,000 scale geological series map of the area, Barberton 2530, the granite is grey to white in colour, coarse-grained and biotite-rich, and belongs to the Nelspruit Suite of Basement Granitic Rocks (Zn). The geology map also indicates the presence of a diabase sill, extending around the western and southern sides of the site and a shear zone some six kilometres to the east. The near horizontal sill intrusion is situated up-slope of the site and will not influence the hydro-geological or geotechnical characteristics of the site. Similarly, the shear zone is well beyond the influence of the site, i.e., beyond the Mbabala River that constitutes an area of recharge.

A generalized soil profile for the site, i.e. prevalent in Zone I (**Figure 1**), comprises:

a surficial topsoil horizon approximately 0.3m thick
and comprising brown,
loose, open textured, mostly silty SAND
with numerous roots
overlying,
isolated occurrences of thin hillwash
comprising reddish brown, loose or firm,
open textured, silty or clayey SAND with fine roots
overlying,
sporadic pebble marker gravel horizons of abundant
gravels in a matrix of silty or clayey SAND with an overall
consistency of medium dense,
overlying,
some 0.3 to 1.7m of reworked residual granite comprising mostly
reddish brown, medium dense, pinholed, silty SAND with
scattered to numerous gravels
grading with depth into,
mostly greater than 1m of residual granite comprising yellow-brown
speckled buff, medium dense or dense, intact, silty SAND with scattered
to numerous predominantly fine gravels

Below approximately 2m the consistency of the residuum
generally improves to dense throughout.

Zone I' (**Figure 1**) comprises those areas of the site where more competent regolith is prevalent at shallower depth than in Zone I, with the potential for sporadic sub-outcropping and outcropping granite; very dense residua is generally encountered within 2m of natural ground level.

Zone II (**Figure 1**) comprises those areas with thicker transported soils, prevalent in the poorly defined drainage lines.

4.2. Laboratory Results

The results from foundation indicator tests undertaken on samples recovered from the sidewalls of the pits are summarized in **Table 2**, with interpolated soil parameters, based on our experience and/or available literature, included in **Table 3**. These results indicate that the surficial hillwash present sporadically, classifies as *SC* in terms of the Unified Soil Classification (USC). The underlying reworked residual granite typically also classifies as *SC* (USC) and A.2.4 (0) in terms of the PRA classification. With depth, the reworked residua becomes less clayey, grading into residua that classifies as *SM* (USC) and A.1.a (0) (PRA). The plasticity indices and linear shrinkages of the residua tends to decrease with depth, i.e. become less plastic, while the grading modulus/"gravelliness" increases.

4.3. Permeability

The results from *in situ* permeability tests undertaken in the residua with consistencies of medium dense and dense, are of the order of $5x10^{-4}$cm/s (**Appendix D**). These results are, in general, more permeable than the interpolated permeability for the regolith (**Table 3**). The permeabilities are greater than the minimum recommended permeability of $1x10^{-7}$cm/s[2], but more permeable than the maximum recommended permeability[3] of $5x10^{-5}$cm/s.

The permeability of the regolith affects the safe distance[3] that cemeteries should be sited from domestic water sources and drainage features. Based on the recorded permeabilities, the outer boundary of the site should be at least 465m from a domestic water source and at least 415m from a drainage feature[3] (**Table 1**).

4.4. Expansive Soils

Plotting the Plasticity Index (whole sample) against the clay percentage on a standard Activity diagram for each sample tested, reveals that the regolith - transported and residual soils - classify as *low*, i.e. not expansive soils are envisaged on the site.

4.5. Excavatability

With reference to **Figure 1**, pits in Zone I, were typically excavated to approximately 3.0m without refusal of the backhoe, although competent residual granite was often encountered towards the base of the pits. Pits excavated in Zone I' on-the-other-hand, were typically only

Table 2: Laboratory determined soil properties from indicator tests

Test Pit No.	Soil Origin	Horizon Depth [m] From	Horizon Depth [m] To	Sample Depth [m]	Soil Constituents [%] clay [<0,002mm]	silt [0,002-0,06mm]	sand [0,06-2,0mm]	gravel [2,0-60mm]	Atterberg Limits LL	PI	PI*	GM	LS [%]	Activity 0,4 = kaolinite; 0,9 = illite; 1,5-6,0 = montmorillonite		Classification UNIFIED	Classification PRA
TP 1	hillwash	0.30	2.50	0.30 - 2.50	13	17	60	10	42	17	8	1.29	8.4	0.6	LOW	CL	A.2.7 (1)
TP 2	r/r granite	0.80	1.07	0.80 - 1.07	4	10	61	25	28	6	2	1.75	6.0	0.5	LOW	SM/SC	A.1.b (0)
TP 2	r/r granite	0.30	1.00	0.30 - 1.00	3	13	51	33	28	7	2	1.83	3.4	0.7	LOW	SM/SC	A.2.4 (0)
TP 9	r/r granite	0.70	1.00	0.70 - 1.00	4	12	55	29	29	8	3	1.78	4.0	0.8	LOW	SC	A.2.4 (0)
TP 11	r/r granite	0.45	1.75	0.45 - 1.75	6	12	37	45	25	9	3	1.94	4.7	0.5	LOW	SC	A.2.4 (0)
TP 14	r/r granite	0.50	2.20	0.50 - 2.20	3	9	40	48	24	8	2	2.12	3.4	0.7	LOW	SC	A.2.4 (0)
TP 2	r/ granite	1.00	1.60	1.00 - 1.60	4	7	73	16	33	13	3	1.81	6.7	0.8	LOW	CL	A.2.6 (0)
TP 4	r/ granite	0.70	2.00	0.70 - 2.00	3	5	39	53	32	8	2	2.21	3.7	0.7	LOW	SW	A.2.4 (0)
TP 11	r/ granite	1.70	3.00	1.70 - 3.00	4	6	26	64	33	6	1	2.32	2.7	0.3	LOW	SM	A.1.a (0)
TP 16	r/ granite	1.10	2.00	1.10 - 2.00	1	3	34	62	32	4	1	2.41	2.0	1.0	LOW	SW	A.1.a (0)

Notes: PI = plasticity index (*) = on whole sample; LL = liquid limit; LS = linear shrinkage; GM = grading modulus; nt = not tested; r/r = reworked residual; r/ = residual.

Table 3: Interpolated soil parameters from available literature/experience-to be confirmed through appropriate laboratory tests before being used

Test Pit No.		Soil Origin	Horizon Depth [m]		Basic		Geotechnical							Road		
					Relative Density	PI	k			C	Kenny (1959) Ø effective	Ø	Cc (Skempton - Terzaghi & Peck)	TRH 14	CBR @ MOD AASHTO	
			From	To			k [cm/s]	[after Hazen] [cm/s]	Classification						90 - 93%	100%
TP	1	hillwash	0.30	2.50	0.50	17	7.23E-005	1.00E-006	low	82	32	27	0.224 - 0.288	G7	16	61
TP	2	r/r granite	0.80	1.07	0.25	12	5.89E-002	8.41E-004	medium	9	39	26	0.126 - 0.162	G6	39	139
TP	2	r/r granite	0.30	1.00	0.25	7	9.41E-002	4.41E-004	medium	9	38	27	0.126 - 0.162	G6	39	139
TP	9	r/r granite	0.70	1.00	0.75	8	5.70E-003	4.41E-004	medium	32	37	46	0.133 - 0.171	G6	36	121
TP	11	r/r granite	0.45	1.75	0.50	9	4.17E-002	1.00E-004	medium	22	36	41	0.105 - 0.135	G6	38	121
TP	14	r/r granite	0.50	2.20	0.50	7	2.72E-001	1.44E-003	high	18	37	45	0.098 - 0.126	G5	45	139
TP	2	r/ granite	1.00	1.60	0.50	13	6.34E-003	2.03E-003	medium	37	34	38	0.161 - 0.207	G6	28	121
TP	4	r/ granite	0.70	2.00	0.50	7	6.67E-001	7.74E-003	high	17	37	47	0.154 - 0.198	G5	48	139
TP	11	r/ granite	1.70	3.00	0.50	5	3.07E+000	3.14E-003	high	13	39	49	0.161 - 0.207	G5	58	159
TP	16	r/ granite	1.10	2.00	0.25	4	4.80E+001	5.57E-002	high	5	43	36	0.154 - 0.198	G5	69	159

Notes: PI = plasticity index; k = permeability; C = cohesion; phi = internal angle of friction; Cc = coefficient of consolidation.

excavated to 2m or shallower, before the backhoe encountered refusal; sporadic sub-outcropping granite was also encountered in these areas.

Thus, in Zone I, the consistency of the regolith over the depth of interest, i.e. 1.8m, is generally loose to medium dense, although dense locally, and it is envisaged that graves in these areas can readily be excavated by hand. In Zone I' occupying the convex side slopes, with more competent residua present at shallower depth, a backhoe will mostly be required to excavate to the required depth of approximate 1.8m.

4.6. Groundwater

Pits throughout the site mostly encountered groundwater seepage near the interface between the unconsolidated regolith comprising hillwash and reworked residual granite, and the more competent residual granite and/or weathered bedrock. The seepage represents a perched, groundwater table, consistent with our experience in the Lowveld, and formed as a result of infiltrating surface water, perching on top of the more competent and less permeable residua. Overall therefore, the site is susceptible to the development of a perched, groundwater table after periods of prolonged precipitation, i.e. non-perennial. The minimum recommended buffer of at least 2m below internment depth, for the promotion of anaerobic conditions, is therefore not achieved. Of note also, is that the poorly defined drainage depression near Pits 1 and 6, extending to the southeast and east respectively, are susceptible to increased percolating ground- and surface water. Notwithstanding the above comments, locating an area nearby with unconsolidated regolith deeper than 4m, will prove difficult.

4.7. Topography

The recommended gradient for cemeteries is 2° to 6°[3]. Sites with slopes steeper than 6° are susceptible to erosion, while slopes shallower that 2° are susceptible to the ponding of surface water and development of areas with impeded drainage. The overall gradient of the proposed site is mostly less than 6°, although with sporadic slopes as steep as 8°; these steeper slopes, coupled with the non- or slightly cohesive surficial regolith, will make these localized areas more susceptible to erosion once denuded of vegetation.

4.8. Stability of sidewalls

The consistency of the regolith to 1.0m is often loose, suggesting that grave sidewall instability could also pose a problem.

5. HYDRO-GEOLOGICAL ASSESSMENT

5.1. Interpretation of aerial photographs

The topography of the site and environs is characterized by the African erosion surface[5], albeit dissected. As such, bedrock is usually present below a mantle of residua and/or transported soils. However, in the dissected areas characteristic of the proposed cemetery, areas of thick unconsolidated regolith are unlikely.

Stereoscopic interpretation of aerial photographs at a scale of 1:30 000 did not reveal any lineaments, which may provide preferential secondary aquifers in the granite, traversing the site (**Figure 2**). The diabase sill, indicated on the published geological series map and extending around the western and southern boundary of the site, is interpolated to be near horizontal. Furthermore, this diabase sill is present above the site and as such, will not influence the hydro-geology of the site.

5.2. Groundwater potential

Groundwater occurrences in the granites are generally associated with secondary aquifers confined to fractures, zones of deeper weathering and contact zones with intrusive dykes - see comments in Section 5.1 above. Typically, these aquifers are characterised by low yielding[7] boreholes. In terms of Vegter's Hydro-geological Maps[8], the probability of drilling a successful borehole (~0,1 l/s) in the granites is less than 40%, while the probability of drilling a successful borehole with a yield of greater than 2l/s is 10 to 20%. The overall groundwater potential of the site, based on Vegter's Maps[8], is therefore *poor*.

Interrogation of the National Groundwater Archive (NGA) yielded seven boreholes in a 5-kilometre radius of the site. However, none of these holes falls within the required 1-kilometre radius of the site to warrant further investigation. Discussions with hydro-geological consultants working in the area, yielded a single borehole near the site. However, this borehole (MB-01248, **Appendix D**), was drilled above the site with a reported yield of only 0.1l/s. Discussion with residents in the area, revealed they rely on bulk water to the area; no-one that we spoke to knew of additional boreholes in the area. The hydro-census therefore identified a single, low-yielding, borehole near the site - MB-01248 (**Figure 2**).

Taking cognisance of the information gleaned from the hydro-census, bedrock geology and the interpretation of aerial photographs, the overall groundwater development potential of the area is deemed to be *poor*.

6. REPORT PROVISIONS

While every effort was made during the fieldwork to identify the different soil and rock horizons and determine their distribution, guaranteeing that isolated zones of either poorer soils or hard rock excavation has not been identified is impossible under the constraints of an investigation of this nature. The investigation has therefore sought to highlight hydro- and engineering geological constraints affecting the use of the site as a cemetery, and to provide early warning to municipal engineers and environmentalists.

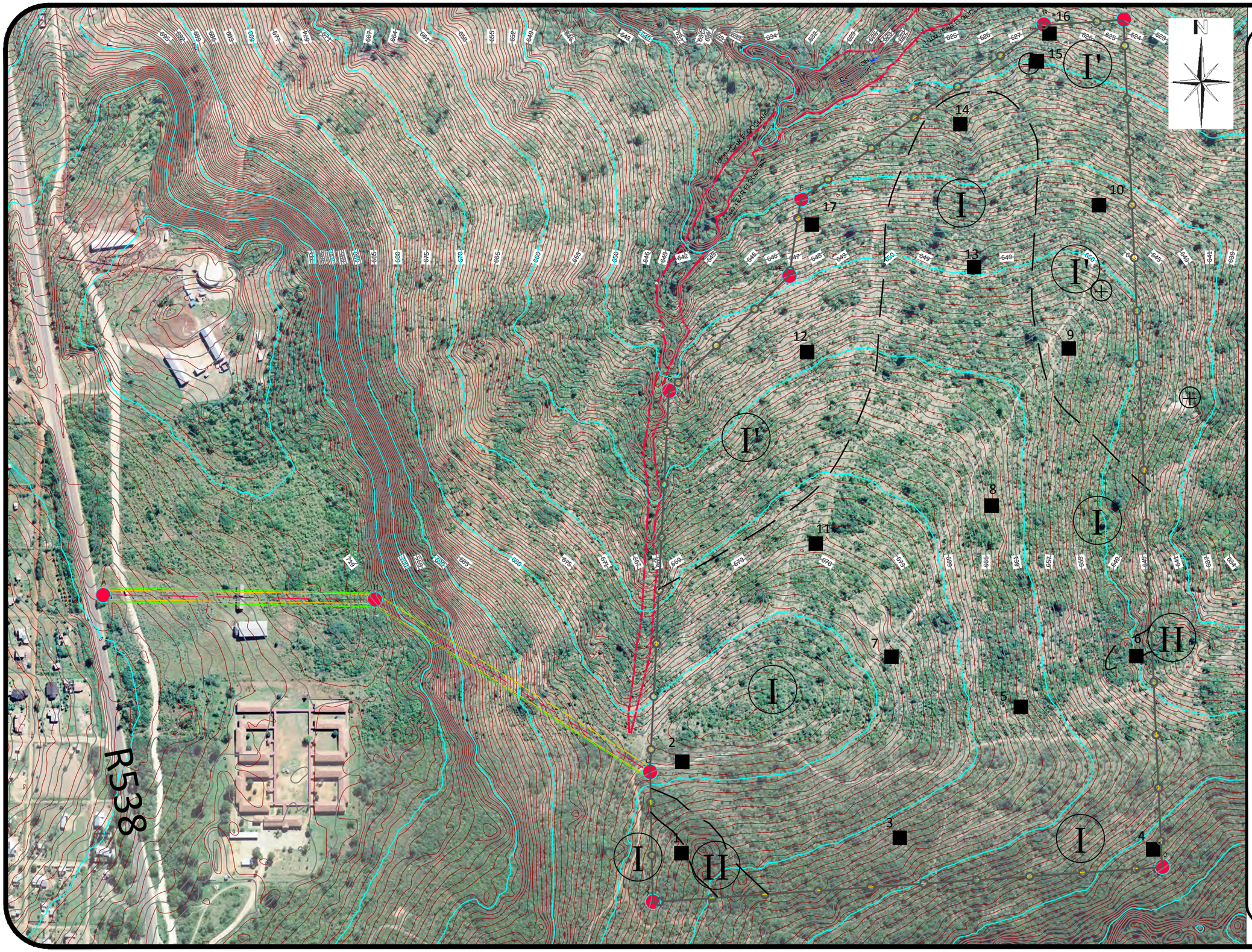
We trust that the above observations suffice in your requirements of us in this project, and will make ourselves available to discuss our findings should there be any queries.

HJ Schurink, Pr.Sci.Nat., GDE.
for Geo3cc

7. REFERENCES

1. **Amoozegar, A.** (1997). *Comparison of Saturated Hydraulic Conductivity and Percolation Rate: Implications for Designing Septic Systems*. ASTM International.
2. **Brink, A.B.A.** *Engineering Geology of Southern Africa.* Volume 1-The first 2 000 million years of geological time, Building Publication, Pretoria, 1979, 319pp.
3. **Fisher, G.J.** *The selection of Cemetery Sites in South Africa*. Fourth Symposium on Terrain Evaluation and Data Storage. August 1994.
5. **Partridge, T.C. and Maud, R.** *Map showing the principal cyclic land surfaces of Southern Africa at 1:2500000*. South African Journal of Geology, 1987, 90(2).
6. **South African Institute for Engineering Geologists-Association of Engineering Geologists-South African Institute of Civil Engineers (Geotechnical Division)**. (1990). *Guidelines for soil and rock logging - Geotechnology Workshop.*
7. **South African Department of Water Affairs and Forestry**. (Second edition 1998). *Minimum requirements for water monitoring at waste management facilities - Waste Management Series*. CPT Book Printers, Cape.
8. **Vegter, J.R.** *Groundwater Resources of South Africa - An Explanation of a set of National Groundwater Maps*. Prepared for the Water Research Commission. August 1995.

APPENDIX A
FIGURES 1 AND 2



General Notes

LEGEND

2 Pit position and number

Cemetery boundary

Geotechnical /soil boundary

I Zone designation

Sporadic granite (+) and diabase (v) outcrops noted during the fieldwork

1:100 Year floodline

Notes:

1) Pit positions have not been surveyed.
2) Soil boundaries to be confirmed in the field.
3) Endecon Ubuntu provided the 1:100 year floodline - areas below this are not to be developed.
4) Basemap provided by Messrs Umsebe Development Planners.

No.	Revision/Issue	Date

Firm Name and Address

GEO3 cc

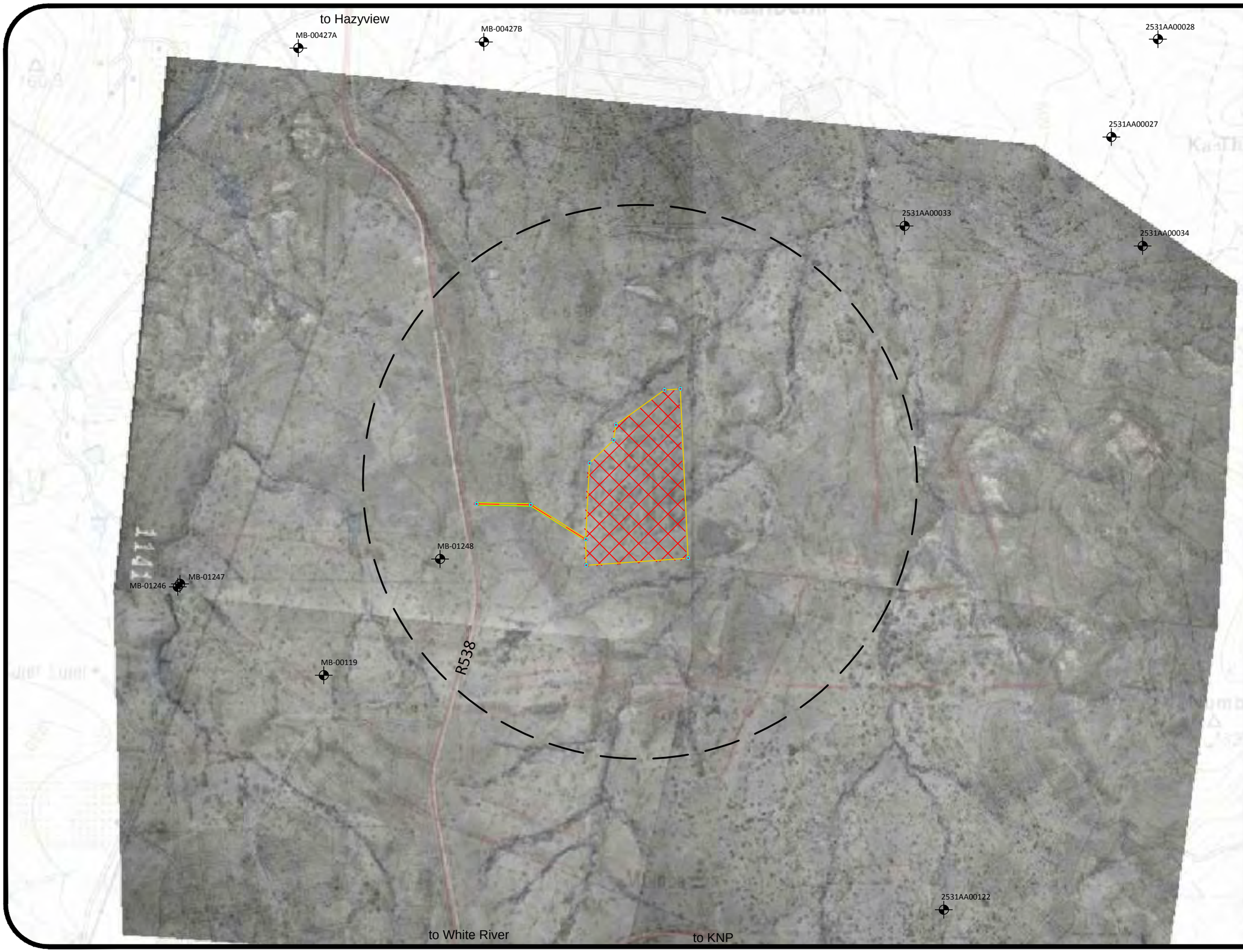
PO Box 6559, Nelspruit, 1200
Tel: 013 758 1226; Fax: 013 758 1786
e-mail: admin@geo3.co.za

Project Name and Address

PROPOSED NKAMBENI CEMETERY NEAR HAZYVIEW IN MPUMALANGA

Umsebe Development Planners

Project: 1046	Sheet: FIGURE 1
Date: March 2013	
Scale: 1:4 000 (A3)	



General Notes

LEGEND

Proposed cemetery

2531 Borehole position and number

1500m Radius around the centre of the proposed cemetery site

Airphoto lineaments

Notes:

1) Borehole positions have not been surveyed.
2) Basemap comprise mosaic of aerial photographs from Job 56 (Surveyor General) and 1:50,000 scale Toptographical Series Map 2531 AA.

No.	Revision/Issue	Date

Firm Name and Address
GEO3 cc
PO Box 6559, Nelspruit, 1200
Tel: 013 758 1226; Fax: 013 758 1786
e-mail: admin@geo3.co.za

Project Name and Address
PROPOSED NKAMBENI CEMETERY NEAR HAZYVIEW IN MPUMALANGA

Umsebe Development Planners

Project	Sheet
1046	FIGURE 2
Date: March 2013	
Scale: 1:20,000 (A3)	

APPENDIX B
SOIL PROFILES

SOIL DESCRIPTIVE TERMS

Descriptive Order - **1**. Moisture. **2**. Colour. **3**. Consistency. **4**. Soil Structure. **5**. Soil Type. **6**. Origin

1. MOISTURE CONDITION - assessment of insitu conditions.	
Dry	No water detectable; sample cannot be moulded.
Slightly Moist	Water just discernable; sample can be moulded.
Moist	Water easily discernable.
Very Moist	Water can be squeezed out.
Wet	Generally below the water table.

2. COLOUR - described in profile, at natural moisture content unless otherwise specified.	
Speckled	Very small patches of colour < 2mm
Mottled	Irregular patches of colour 2 - 6mm
Blotched	Large irregular patches 6-20mm
Banded	Approximately parallel bands of varying colour
Streaked	Randomly orientated streaks of colour
Stained	Local colour variations; associated with discontinuity surfaces

3(a) CONSISTENCY: GRANULAR SOILS - measure of the hardness or denseness of a soil

SPT "N"	GRAVELS & clean SANDS Generally free draining soils		Typical Dry Density(kg/m^3)
< 4	Very Loose	Crumbles very easily when scraped with geological pick.	< 1450
4 - 10	Loose	Small resistance to penetration by sharp geological pick.	1451 - 1600
>10 - 30	Medium dense	Considerable resistance to penetration by sharp end of geological point.	1601 - 1750
>30 - 50	Dense	Very high resistance to penetration by sharp end of geological pick; requires many blows of pick for excavation.	1751 - 1925
> 50	Very Dense	High resistance to repeated blows of geological pick; requires power tools for excavation.	> 1925

3(b) CONSISTENCY: COHESIVE SOILS - measure of the hardness or denseness of a soil

SPT "N"	SILTS and CLAYS and combinations thereof with SANDS. Generally slow draining soils (φ = 0 material).		UCS (kPa)
<2	Very soft	Pick point can easily be pushed in to shaft of handle; easily moulded by fingers.	< 50
2 - 4	Soft	Pick point can easily be pushed in 30 - 40 mm; moulded by fingers with some pressure; easily penetrated by thumb.	50 - 125
5 - 8	Firm	Pick point penetrates up to 10mm; very difficult to mould with fingers; indented by thumb with effort; can just be penetrated with an ordinary hand spade.	126 - 250
9 - 15	Stiff	Slight indentation produced by pushing pick point into soil; cannot be moulded by fingers; penetrated by thumb nail; requires hand pick for excavation.	251 - 500
16 - 20	Very Stiff	Slight indentation produced by blow of pick point; requires power tools for excavation; indented by thumb nail with difficulty.	501 -1000

4. **SOIL STRUCTURE** - presence or absence of fissures or other planes of weakness.	
Intact	Structureless, no discontinuities identified.
Fissured	Soil contains discontinuities which may be open or closed, stained or unstained and of variable origin.
Slickensided	Contains highly polished shear surfaces, glossy and often striated.
Shattered	Very closely to extremely closely spaced continuities resulting in gravel size soil fragments which are usually stiff to very stiff and difficult to break down.
Micro-shattered	As above, but sand-sized fragments.
Controlled / uncontrolled	Descriptive term for fill material; relates to whether the material has been engineered, i.e. controlled, or not, i.e. uncontrolled.
Open textured	Contains small voids between individual grains-visible to the naked eye. Alt pinholed.
Stratified	Parallel bedding planes. Laminated if layers are less than 20mm thick.
Varved	Alternating silty and clayey layers.
Foliated	Residual metamorphic texture.

5. SOIL TYPE - soil texture described on the basis of the grain size of particles.

SOIL TYPE	PARTICLE SIZE [mm]	REMARKS
CLAY	< 0.002	Feels sticky; soils hands; shiny when wet.
SILT	0.002 - 0.06	Dilatant; dusts off once dry; chalky feel on teeth.
SAND fine medium coarse	0.06 -0.2 0.2 - 0.6 0.6 - 2.0	Gritty on teeth. Visible to naked eye. Visible to naked eye.
GRAVEL fine medium coarse	2 - 6 6 - 20 20 - 60	Observed with the naked eye. **Matrix-supported** - clasts supported by matrix **Clast-supported** - clasts touching (matrix may or may not be present).
COBBLES	60 - 200	
BOULDERS	>200	

Fine grained soils: slightly <5%; clayey/silty 5-15%; very silty/clayey 15-35%.
Gravels / cobbles and boulders: occasional <5%, scattered 5-20%, numerous 20-45%; abundant >45%.

6. ORIGIN - origination of particular soil horizon.	
Transported	Alluvium, hillwash, talus, colluvium etc.
Residual	Weathered from parent rock.
Pedocretes	Ferricrete, calcrete, laterite, silcrete, dorbank etc.

DEGREE OF CEMENTATION OF PEDOCRETES		UCS (MPa)
Very weakly cemented	Some material can be crumbled between finger and thumb; disintegrates under knife blade to a friable state.	0.1 - 0.5
Weakly cemented	Cannot be crumbled with fingers; some material can be crumbled by strong pressure between thumb and hard surface; under light hammer blows disintegrates to a friable state.	0.5 - 2.0
Cemented	Material crumbles under firm blows of sharp pick point; grains can be dislodges with some difficulty by a knife blade.	2 - 5
Strongly cemented	Firm blows of sharp pick point on hand held specimen show 1 - 3 mm indentations; grains cannot be dislodged by knife blade.	5 - 10
Hardpan	Hand held specimen can be broken by single firm blow of hammer head; similar appearance to concrete.	10 - 25

Reference: *Guide to soil profiling for Civil Engineering Purposes* - Geoterminology Workshop (1990) SAIEG - AEG - SAICE (Geotechnical Division).

ROCK DESCRIPTIVE TERMS

Description for rocks masses: A - description of rock B - description of discontinueties C - description of fracture filling

A. ROCK DESCRIPTION	Descriptive Order for rock description: **1**. Colour **2**. Weathering **3**. Texture **4**. Fracture and microtexture **5**.Rock hardness **6**. Rock type.
1. Colour	Described wet.

2. Weathering

Degree of Weathering	Extent of Discolouration	Fracture Condition	Surface Characteristics	Original Fabric	Grain Boundary Condition
Unweathered	No visible alteration.	Closed or stained	Unchanged	Preserved	Tight
Slightly weathered	Fractures stained or discoloured < 20% of fracture spacing on both sides of fracture.	Discoloured, may contain thin filling	Partial discolouration. Often unweathered rock colour.	Preserved	Tight
Moderately weathered	Staining or discolouration extends >20% of fracture spacing on both sides of fracture.	Discoloured, may contain thick filling.	Partial to complete discolouration. Not friable except poorly cemented rocks.	Preserved	Partial opening
Highly weathered	Extends throughout the rock.	------	Friable and usually pitted	Mainly preserved	Partial separated.
Completely weathered	Totally discoloured.	------	Resembles a soil	Partially preserved	Complete separation of grains.

3. Texture / **4. Microstructure and fracture spacing**

Classification	Size	Recognition	Separation	Spacing (foliation, cleavage, bedding, etc.)	Spacing (fractures, joints, etc.)	Fracture spacings/metre
Very fine grained	< 0,2	Individual grains cannot be seen with a hand lens.	< 6	very intensely	Very highly	> 50
Fine grained	0,2 - 0,6	Just visible as individual grains under hand lens	6 - 20	intensely		
Medium grained	0,6 - 2,0	Grains clearly visible under hand lens, just visible to the naked eye.	20 - 60	very thinly	Highly	5 - 50
Coarse grained	2 - 6	Grains clearly visible to the naked eye.	60 - 200	thinly		
Very coarse grained	> 6	Grains measurable	200 - 600	medium	Moderately	~1 - 5
			600 - 2 000	thickly	Slightly	~ 1
			> 2 000	very thickly	Very Slightly	< 1

5. Rock Hardness

Hardness	Description	UCS (MPa)	Hardness	Description	UCS (MPa)
Very soft rock	Material crumbles under firm blow with geological pick point; can be peeled with a knife; too hard to cut undisturbed sample by hand.	1 - 3	Hard rock	Breaks with difficulty, rings when struck. Point load or laboratory test results necessary to distinguish between categories.	25 - 70
Soft rock	Can just be scraped and peeled with a knife; 1-3mm indents with firm blow of geological pick.	3 - 10	Very hard rock		70 - 200
Medium hard rock	Firm blows of pick head will break hand held specimen. Cannot be scraped or peeled with a knife.	10 - 25	Extremely hard rock		> 200

6. Rock Type	According to accepted lithographic terminology.
B. DISCONTINUITY SURFACE DESCRIPTION:	Descriptive Order for joint description: **1**.Type **2**. Separation **3**.Fill material **4**. Roughness **5**. Orientation
1. Type	Bedding planes, flow banding, foliation, joints, shears, faults, fractures.

2. Seperation / **3. Fracture filling** / **4. Roughness of discountinuity planes**

Description	Separation	Description	Definition	Classification	Description
Closed	0	Clean	No fracture filling material	Smooth	Appears smooth and is essentially smooth to the touch. May be slickensided.
Very narrow	0 - 0,6	Stained	Colouration of rock only. No recognisable filling.	Slightly rough	Aspiraties on the fracture surface are visible and can be distinctly felt.
Narrow	0,6 - 2,0	Filled	Recognisable filling material.	Medium rough	Asperities are clearly visible and fracture surface feels abrasive.
Wide	2,0 - 6,0			Rough	Large angular asperities can be seen. Some ridge and high side angle steps are evident.
Very wide	6,0 - 20			Very rough	Near vertical steps and ridges occur on the fracture surface.

5. Discontinuity orientation	Discontinuity inclinations (i.e. of joints, bedding, faults,etc.) are measured with respect to the horizontal i.e. a vertical joint dips at 90° in orientated core the fracture inclinations are w.r.t. the core axis.
C. FRACTURE FILLING DESCRIPTION	Fracture filling should be described in terms of the MCCSSO Soil Classification

Note: All dimensions in mm unless otherwise stated. REFERENCE: **South African Institute of Engineering Geologists**, 1990. *Guidelines for soil and rock logging - Geotechnology Workshop*.

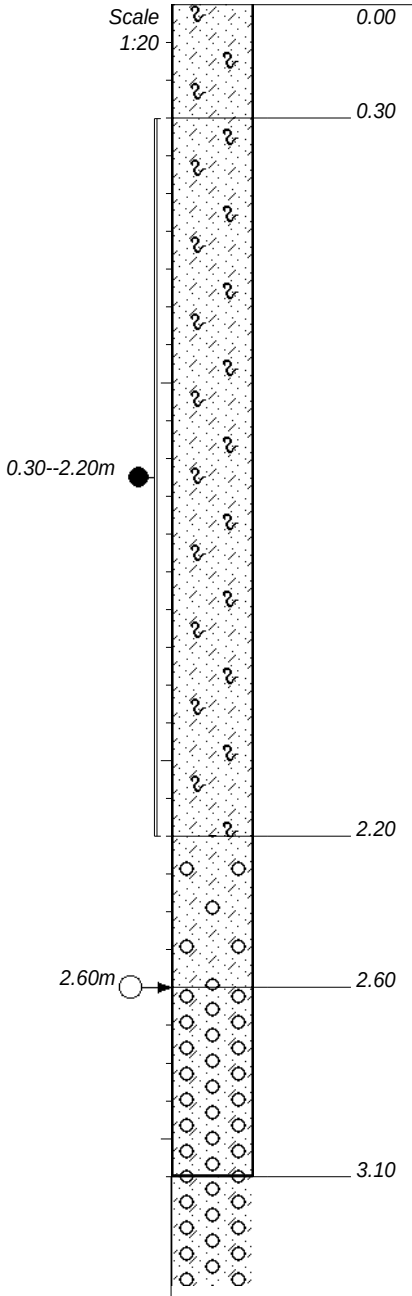
GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP01
Sheet 1 of 1

JOB NUMBER: 1046



Moist, dark reddish brown (in profile dark reddish brown), **soft**, open textured, clayey SAND; numerous roots; topsoil.

Moist, reddish brown (in profile reddish brown), **firm**, open textured, clayey SAND; roots; hillwash.

(LL = 42, PI = 14, LS = 8.4%, GM = 1.29; **SC**, **A.2.7(1)**; activity = low).

Wet, reddish brown (in profile reddish brown), **firm**, pinholed, clayey SAND with scattered predominantly fine gravels; reworked residual granite.

Wet, reddish brown (in profile reddish brown speckled buff), **medium dense**, intact, clayey SAND with numerous predominantly fine GRAVELS; residual granite.

NOTES

1) Pit excavated without refusal.

2) Slow groundwater seepage at 2.60m.

3) Indicator sample taken at 0.30--2.20m.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 778 326
COORD-E/y : -014 421 (31)

HOLE No: TP01

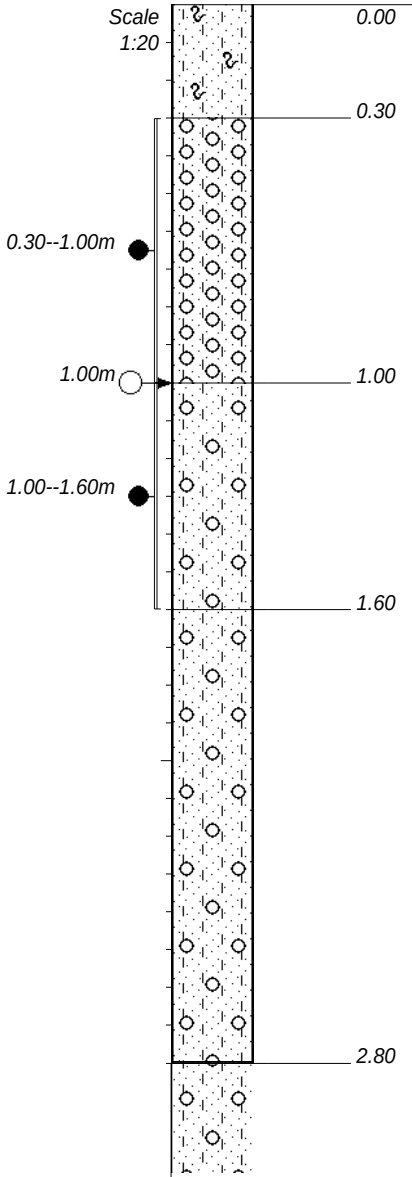
GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP02
Sheet 1 of 1

JOB NUMBER: 1046



0.00 – 0.30: Moist, brown (in profile light brown), **loose**, open textured, silty SAND; roots; topsoil.

0.30 – 1.00: Moist - wet, pale brown (in profile brown mottled yellow-brown speckled buff locally), **loose**, pinholed, slightly clayey silty SAND with numerous predominantly fine GRAVELS; reworked residual granite.

(LL = 28, PI = 7, LS = 3.4%, GM = 1.83; **SM/SC**, **A.2.4(0)**; activity = low; permeability = 6.57x10-4cm/s).

1.00 – 1.60: Wet, yellow-brown (in profile yellow-brown speckled white), **medium dense - dense**, intact, silty SAND with scattered predominantly fine gravels and thin clay lenses (weathered joints); residual granite.

(LL = 33, PI = 13, LS = 6.7%, GM = 2.11; **SC**, **A.2.6(0)**; activity = low).

Below ±1.60m becomes **dense**.

NOTES

1) Pit excavated without refusal.

2) Slow groundwater seepage at 1.00m.

3) Indicator samples taken at 0.30--1.00m and 1.00--1.60m.

4) In situ permeability test undertaken at 0.80--1.07m.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 778 227
COORD-E/y : -014 423 (31)

HOLE No: TP02

GEO3 CC
PO Box 6559
Helspruit
1300
Tel: (013) 758 1226

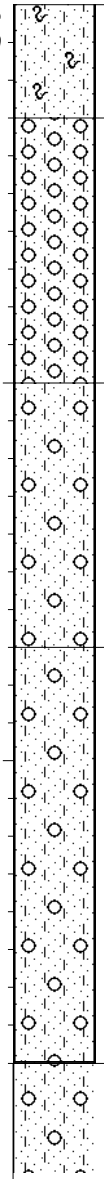
Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY
NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP03
Sheet 1 of 1

JOB NUMBER: 1046

Scale 1:20



0.00 Moist, brown (in profile light brown), **loose**, open textured, silty SAND; roots; topsoil.

0.30 Moist, reddish brown (in profile reddish brown speckled buff locally), **loose**, pinholed, slightly clayey silty SAND with numerous predominantly fine GRAVELS; reworked residual granite.

1.00 Slightly moist, reddish brown (in profile reddish brown speckled buff), **medium dense - dense**, intact, silty SAND with scattered predominantly fine gravels; residual granite.

1.70 As above but **dense** with **very dense** lenses.

2.80

NOTES

1) Pit excavated without refusal.

2) No groundwater seepage encountered.

3) No samples taken.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 778 309
COORD-E/y : -014 658 (31)

HOLE No: TP03

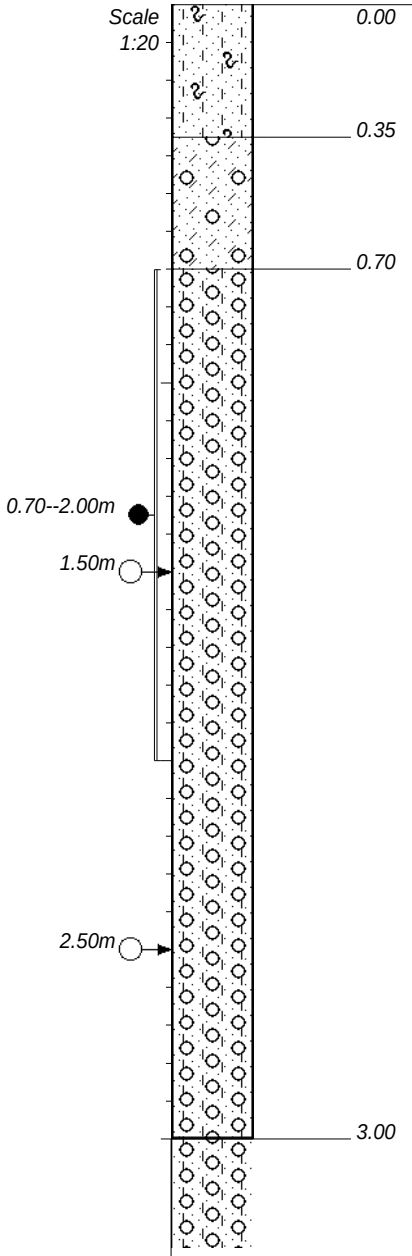
GEO3 CC
PO Box 6559
Helspruit
1300
Tel: (013) 758 1226

Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY
NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP04
Sheet 1 of 1

JOB NUMBER: 1046



Moist, brown (in profile brown), **very loose**, open textured, organic-rich slightly clayey silty SAND; numerous roots; topsoil.

Moist, reddish brown (in profile reddish brown speckled buff locally), **firm**, pinholed, clayey SAND with scattered predominantly fine gravels; reworked residual granite.

Slightly moist, yellow-brown (in profile yellow-brown speckled buff and black), **medium dense - dense**, intact, micaceous silty SAND with scattered predominantly fine gravels; residual granite.

(LL = 32, PI = 8, LS = 3.7%, GM = 2.21; **A.2.4(0)**, **SW**; activity = low).

Becomes progressively more competent with depth.

NOTES

1) Pit excavated without refusal, but slow excavation on **very dense** residuum ?

2) Very slow groundwater seepage from 1.50m and stronger seepage from 2.50m (l/s).

3) Indicator sample taken at 0.70--2.00m.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 778 323
COORD-E/y : -014 931

HOLE No: TP04

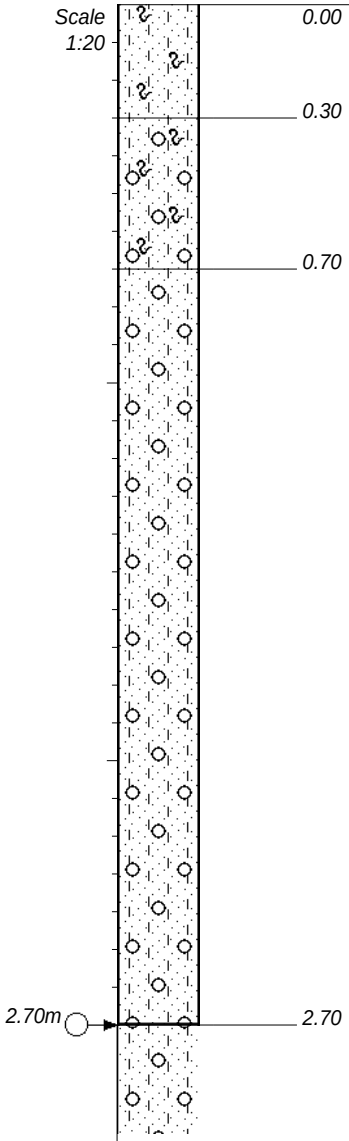
GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY
NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP05
Sheet 1 of 1

JOB NUMBER: 1046



0.00 – 0.30: Moist, brown (in profile brown), **very loose**, open textured, silty SAND; numerous fine roots; topsoil.

0.30 – 0.70: Moist, reddish brown (in profile reddish brown speckled buff locally), **loose**, pinholed, silty SAND with scattered predominantly fine gravels; fine roots; reworked residual granite.

0.70 – 2.70: Slightly moist, yellow-brown (in profile yellowish / reddish brown speckled buff), **dense**, intact/jointed, silty SAND with scattered predominantly fine gravels; residual granite.

NOTES

1) Pit excavated without refusal, but slow excavation.

2) Slow groundwater seepage through the base of the pit.

3) No samples taken.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 778 168
COORD-E/y : -014 791 (31)

HOLE No: TP05

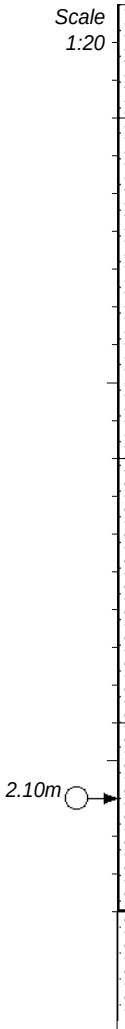
GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP06
Sheet 1 of 1

JOB NUMBER: 1046



0.00

Moist, brown (in profile brown), **very loose**, open textured, organic-rich silty SAND; numerous roots; topsoil.

0.30

Moist - wet, reddish brown (in profile reddish brown), **very loose**, open textured, silty SAND; numerous roots; hillwash.

1.20

Wet, reddish brown (in profile reddish brown speckled black), **loose - medium dense**, intact, silty SAND with numerous predominantly fine GRAVELS; reworked residual granite.

1.90

Moist, yellow-brown (in profile yellow-brown speckled buff), **dense**, intact, silty SAND with scattered - numerous fine GRAVELS; residual granite.

2.40

NOTES

1) Pit excavated without refusal.

2) Moderate groundwater seepage (≤1l/s) at 2.10m.

3) No samples taken.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.

TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23 January 2013

DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 778 112
COORD-E/y : -014 914 (31)

HOLE No: TP06

GEO3 CC
PO Box 6559
Helspruit
1300
Tel: (013) 758 1226

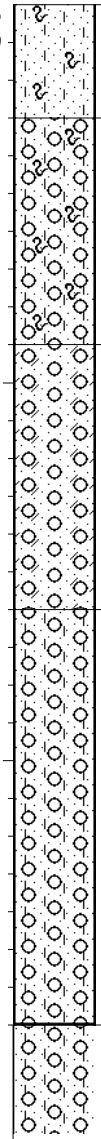
Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY
NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP07
Sheet 1 of 1

JOB NUMBER: 1046

Scale 1:20



0.00 Moist, brown (in profile brown), **very loose**, open textured, silty SAND; numerous fine roots; topsoil.

0.30 Moist - wet, brown (in profile brown), **loose**, pinholed, silty SAND with numerous predominantly fine GRAVELS; fine roots; reworked residual granite.

0.90 Moist, yellow-brown (in profile yellow-brown speckled buff), **firm**, pinholed, clayey SAND with scattered - numerous predominantly fine GRAVELS; reworked residual granite.

1.60 Slightly moist, yellow-brown (in profile yellow-brown speckled buff), **dense**, intact, silty SAND with scattered - numerous predominantly fine GRAVELS; residual granite.

2.70

NOTES

1) Pit excavated without refusal, but slow excavation.

2) No groundwater seepage encountered.

3) No samples taken.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 778 114
COORD-E/y : -014 649 (31)

HOLE No: TP07

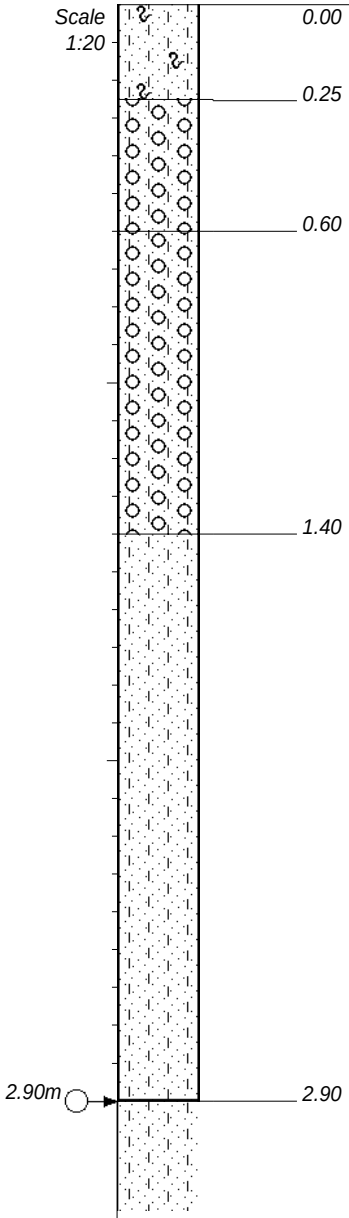
GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY
NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP08
Sheet 1 of 1

JOB NUMBER: 1046



Moist, brown (in profile brown), **very loose**, open textured, silty SAND; numerous fine roots; topsoil.

Abundant angular, coarse, medium and fine GRAVELS, densely packed/jointed with a silty SAND matrix/infilling, overall consistency **medium dense**; residual pegmatite vein.

Moist, reddish brown (in profile brown mottled/speckled reddish brown), **medium dense**, pinholed, silty SAND with numerous predominantly medium and fine GRAVELS; reworked residual granite.

Moist, orange-brown (in profile orange-brown speckled buff), **medium dense - dense**, intact, silty SAND with occasional fine gravels; residual granite.

NOTES

1) Pit excavated without refusal.

2) Very slow groundwater seepage through the base of the pit.

3) No samples taken.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 777 949
COORD-E/y : -014 757 (31)

HOLE No: TP08

GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

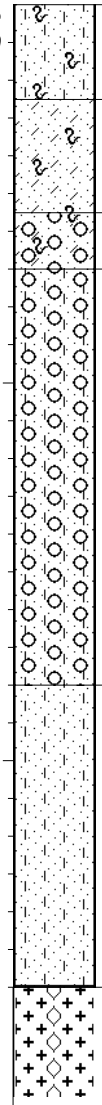
Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP09
Sheet 1 of 1

JOB NUMBER: 1046

Scale 1:20



0.00	Moist, brown (in profile brown), **very loose**, open textured, organic-rich silty SAND; numerous fine roots; topsoil.
0.25	Moist, reddish brown (in profile reddish brown), **loose**, open textured, clayey SAND; roots; hillwash.
0.55	Abundant coarse, medium and fine, sub-rounded, weathered granite and vein quartz GRAVELS, densely packed in a pinholed matrix as above; overall consistency **medium dense**; pebble marker.
0.70	Moist, reddish brown (in profile reddish brown), **medium dense**, pinholed, slightly clayey silty SAND with numerous predominantly fine GRAVELS; reworked residual granite. //(Permeability = 5.53x10-4cm/s)
1.80	Slightly moist, brown (in profile reddish brown speckled black and buff), **medium dense**, intact, micaceous silty SAND with occasional fine gravels; residual granite.
2.60	White speckled black, highly weathered, medium grained, **very soft rock**; GRANITE.

NOTES

1) Pit excavated to refusal.

2) No groundwater seepage encountered.

3) No samples taken.

4) In situ permeability test undertaken at 0.70--1.00m.

5) Additional pit for permeability test.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 777 780
COORD-E/y : -014 844 (31)

HOLE No: TP09

GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

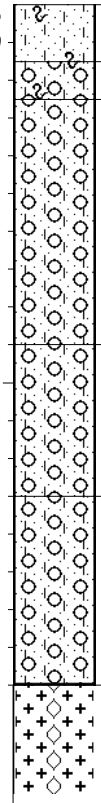
Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP10
Sheet 1 of 1

JOB NUMBER: 1046

Scale 1:20



0.00	Moist, brown (in profile brown), **very loose**, open textured, silty SAND; fine roots; topsoil.
0.15	Scattered coarse, medium and fine gravels in a matrix as above suggests the pebble marker.
0.25	Moist, reddish brown (in profile reddish brown speckled buff), **medium dense**, pinholed locally, silty SAND with numerous weathered, coarse, medium and fine GRAVELS; partially reworked residual granite.
0.90	Abundant coarse, medium and fine pegmatite GRAVELS, densely packed in a matrix as above; overall consistency **dense**, residual pegmatite vein.
1.30	Moist, yellow-brown (in profile yellow-brown speckled white), **very dense**, intact, silty SAND with numerous predominantly medium and fine GRAVELS; residual granite.
1.80	Yellow-brown speckled white, highly weathered, medium to coarse-grained, **very soft rock**; GRANITE.

NOTES

1) Pit excavated to refusal.

2) No groundwater seepage encountered.

3) No samples taken.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 777 624
COORD-E/y : -014 874 (31)

HOLE No: TP10

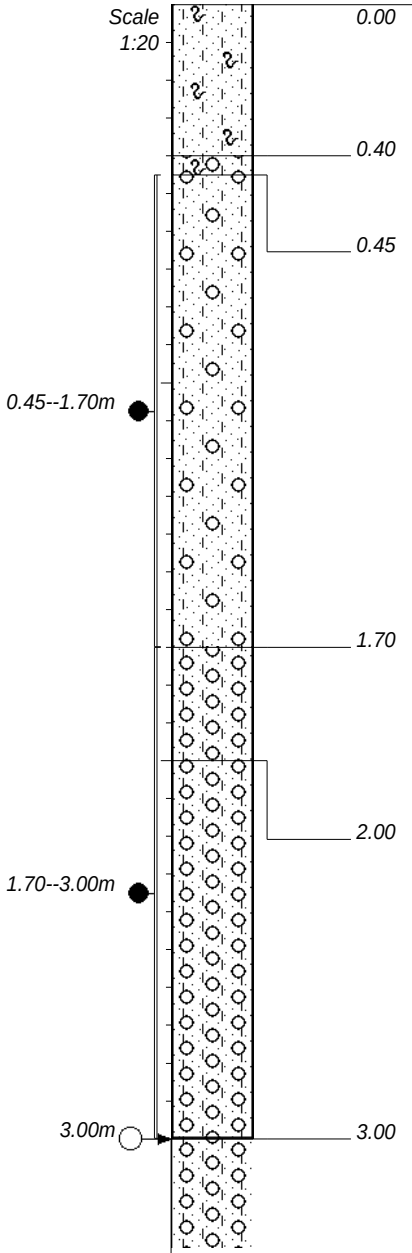
GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY
NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP11
Sheet 1 of 1

JOB NUMBER: 1046



0.00 – 0.40: Moist, brown (in profile brown), **loose**, open textured, silty SAND; numerous roots; topsoil.

0.40 – 0.45: Occasional coarse gravels in a matrix as above suggests the pebble marker.

0.45 – 1.70: Moist, reddish brown (in profile reddish brown mottled/speckled buff locally), **medium dense**, pinholed, slightly clayey silty SAND with scattered - numerous predominantly fine gravels; reworked residual granite.

(LL = 25, PI = 9, LS = 4.7%, GM = 1.95; **SC**, **A.2.4(0)**; activity = low).

1.70 – 3.00: Moist, yellow-brown (in profile yellow-brown speckled buff), **medium dense**, intact, silty SAND with numerous predominantly fine GRAVELS; residual granite.

(LL = 33, PI = 6, LS = 2.7%, GM = 2.32; **SM**, **A.1.a (0)**; activity = low).

Below ±2.00m becomes **dense**.

NOTES

1) Pit excavated without refusal.

2) Slow groundwater seepage through the base of the pit.

3) Indicator samples taken at 0.45--1.70m and 1.70--3.00m.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 24 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 777 991
COORD-E/y : -014 567 (31)

HOLE No: TP11

GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

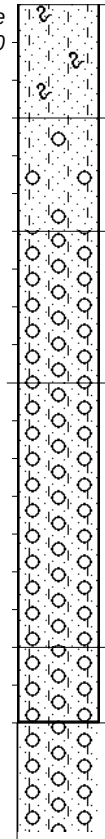
Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY
NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP12
Sheet 1 of 1

JOB NUMBER: 1046

Scale 1:20



0.00	Moist, brown (in profile brown), **loose**, open textured, silty SAND; numerous roots; topsoil.
0.30	Moist, reddish brown (in profile reddish brown mottled/speckled buff locally), **medium dense**, pinholed, slightly clayey silty SAND with scattered - numerous predominantly fine gravels; reworked residual granite.
0.60	Moist, yellow-brown (in profile yellow-brown speckled buff), **medium dense**, intact, silty SAND with numerous predominantly fine GRAVELS; residual granite.
1.00	Below ±1.00m becomes **dense**.
1.70	Below ±1.70m becomes **very dense**.
1.90	

NOTES

1) Pit excavated to near refusal.

2) No groundwater seepage encountered.

3) No samples taken.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 24 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 777 783
COORD-E/y : -014 559 (31)

HOLE No: TP12

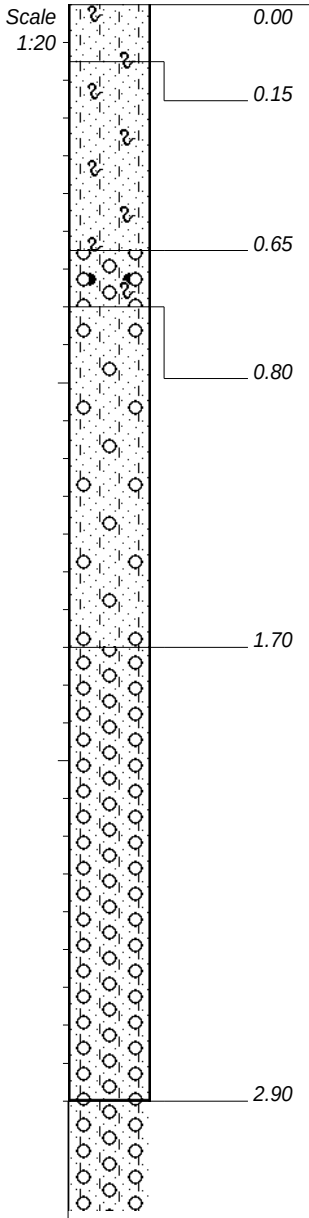
GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY
NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP13
Sheet 1 of 1

JOB NUMBER: 1046



0.00 – 0.15: Moist, brown (in profile brown), **loose**, open textured, silty SAND; numerous roots; topsoil.

0.15 – 0.65: Moist, reddish brown (in profile reddish brown), **loose**, open textured, silty SAND; fine roots; hillwash.

0.65 – 0.80: Abundant predominantly medium and fine, vein quartz GRAVELS and ferricrete concretions, densely packed in a matrix as above; overall consistency **medium dense**; fine roots; pebble marker.

0.80 – 1.70: Moist, reddish brown (in profile reddish brown mottled/speckled buff locally), **medium dense**, pinholed, slightly clayey silty SAND with scattered - numerous predominantly fine gravels; reworked residual granite.

1.70 – 2.90: Moist, yellow-brown (in profile yellow-brown speckled buff), **dense**, intact, silty SAND with numerous predominantly fine GRAVELS; residual granite.

NOTES

1) Pit excavated without refusal.

2) No groundwater seepage encountered.

3) No samples taken.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 24 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 777 693
COORD-E/y : -014 740 (31)

HOLE No: TP13

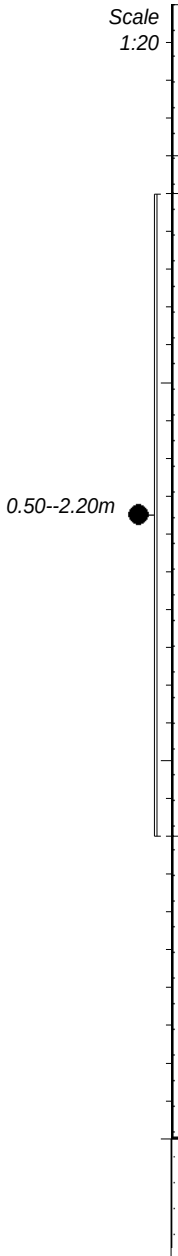
GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP14
Sheet 1 of 1

JOB NUMBER: 1046



0.00 – 0.40: Moist, reddish brown (in profile reddish brown), **very loose**, open textured, silty SAND; numerous roots; topsoil.

0.40 – 0.50: Scattered weathered granite gravels in a matrix as above suggests the pebble marker.

0.50 – 2.20: Moist, reddish brown (in profile reddish brown mottled/speckled buff locally), **medium dense**, pinholed, slightly clayey silty SAND with scattered - numerous predominantly fine gravels; reworked residual granite.

(LL = 24, PI = 8, LS = 3.4%, GM = 2.12; **SC**, **A.2.4(0)**; activity = low).

0.50--2.20m

2.20 – 3.00: Moist, yellow-brown (in profile yellow-brown speckled buff), **medium dense**, intact, silty SAND with numerous predominantly fine GRAVELS; residual granite.

NOTES

1) Pit excavated without refusal.

2) No groundwater seepage encountered.

3) Indicator samples taken at 0.50--2.20m.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 24 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 777 536
COORD-E/y : -014 726 (31)

HOLE No: TP14

GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

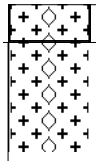
Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP15
Sheet 1 of 1

JOB NUMBER: 1046

Scale 1:20



0.00

0.10

Yellow and reddish brown speckled buff, highly weathered, coarse-grained, **very soft rock**; GRANITE.

NOTES

1) Profile recorded on sub-outcropping weathered granite.

2) No evidence of groundwater seepage.

3) No samples taken.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 24 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 777 469
COORD-E/y : -014 808 (31)

HOLE No: TP15

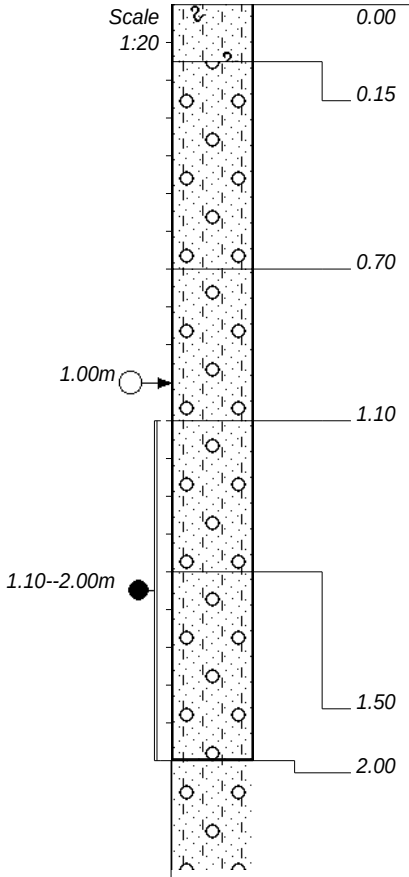
GEO3 CC
PO Box 6559
Helspruit
1300
Tel: (013) 758 1226

Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY
NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP16
Sheet 1 of 1

JOB NUMBER: 1046



Moist, brown (in profile brown), **loose**, open textured, organic-rich silty SAND; numerous fine roots; topsoil.

Moist, reddish brown (in profile reddish brown mottled/speckled buff locally), **loose**, pinholed, slightly clayey silty SAND with scattered - numerous predominantly fine gravels; reworked residual granite.

Below ±0.70m becomes wet.

Slightly moist, yellow-brown (in profile yellow-brown speckled black and buff), **dense**, intact, micaceous silty SAND with scattered predominantly fine gravels; residual granite.

(LL = 32, PI = 4, LS = 2.0%, GM = 2.42; **SW**, **A.1.a(0)**; activity = low).

Becomes progressively more competent with depth.

As above but **very dense** below ±1.50m.

NOTES

1) Pit excavated to near refusal.

2) Slow groundwater seepage at 1.00m.

3) Indicated sample taken at 1.10--2.00m.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 24 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 777 438
COORD-E/y : -014 823 (31)

HOLE No: TP16

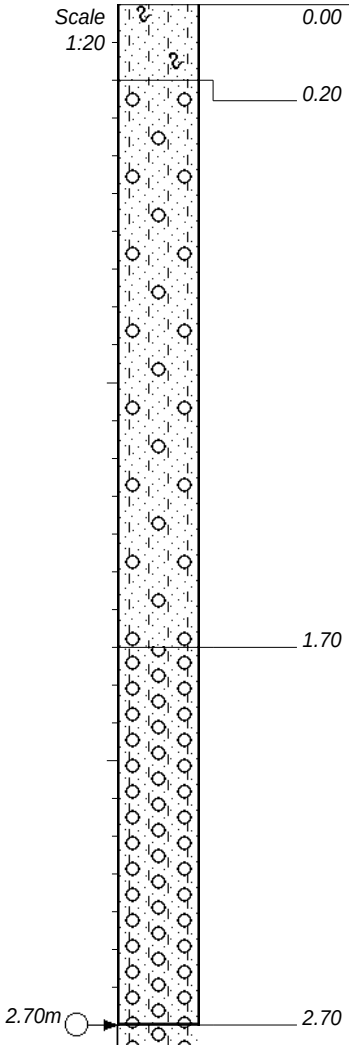
GEO3 CC
PO Box 6559
Nelspruit
1200
Tel: (013) 758 1226

Umsebe Development Planners

PROPOSED NKAMBENI CEMETERY
NEAR HAZYVIEW IN MPUMALANGA

HOLE No: TP17
Sheet 1 of 1

JOB NUMBER: 1046



Moist, brown (in profile brown), **loose**, open textured, silty SAND; numerous roots; topsoil.

Moist, reddish brown (in profile reddish brown mottled/speckled buff locally), **loose**, pinholed, slightly clayey silty SAND with scattered - numerous predominantly fine gravels; reworked residual granite.

Moist, yellow-brown (in profile yellow-brown speckled buff), **medium dense- dense**, jointed, silty SAND with numerous predominantly fine GRAVELS; residual granite.

Becomes slightly more competent with depth.

NOTES

1) Pit excavated without refusal.

2) Slow groundwater seepage through the base of the pit.

3) No samples taken.

CONTRACTOR :
MACHINE : Volvo BL71
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 24 January 2013
DATE : 31/03/2013 08:42
TEXT : ..ts\1046\1046testpits.txt

ELEVATION :
COORD-S/x : 2 777 646
COORD-E/y : -014 566 (31)

HOLE No: TP17

APPENDIX C
LABORATORY TEST RESULTS

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	GEO 3 CC	**PROJECT :**	#1046		
Position :	TP 1	**Depth [m] :**	0.300-2.200	**Source :**	INSITU

Date	**Job No.**	1556
25-Jan-13	**Sample No.**	13/0112

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	100	100	100	90	49	41	36	32	31	29	24	18	17	13	13

ATTERBERG LIMITS

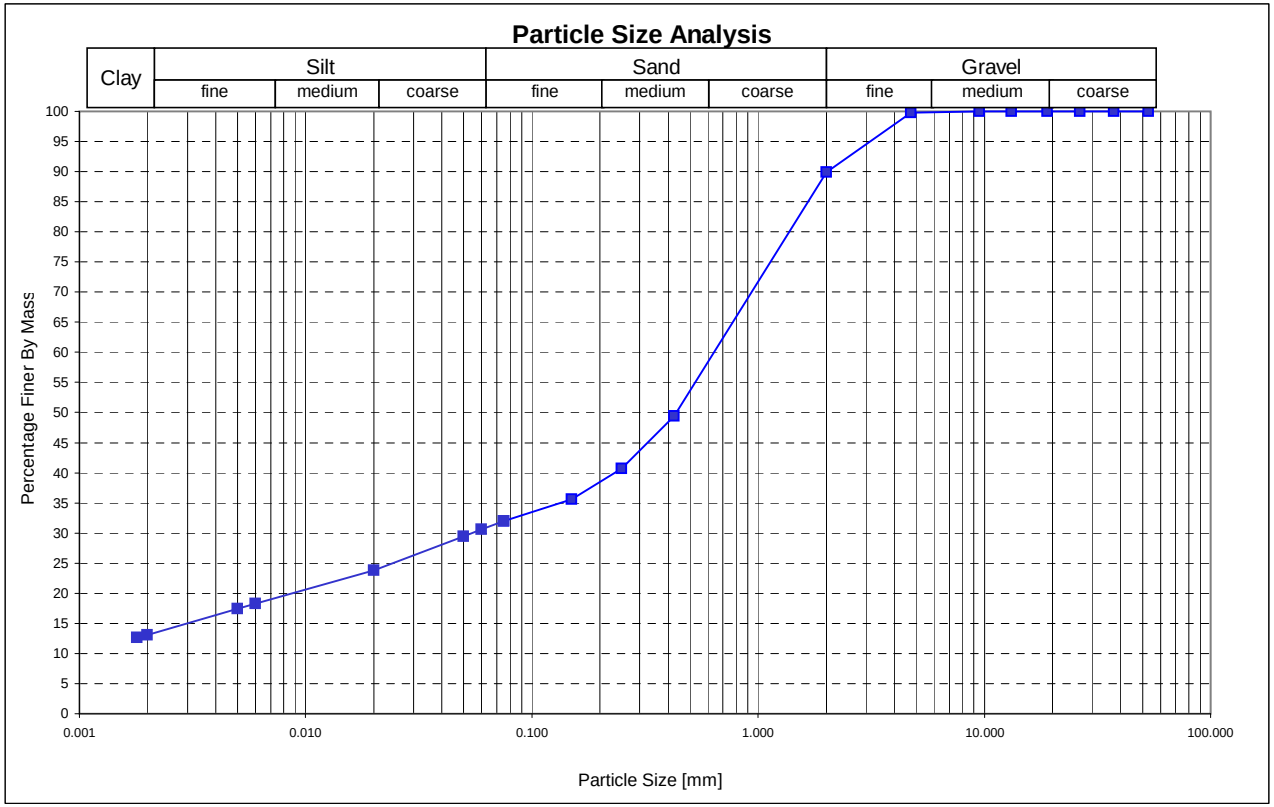
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
42	17	9	8.4	1.29

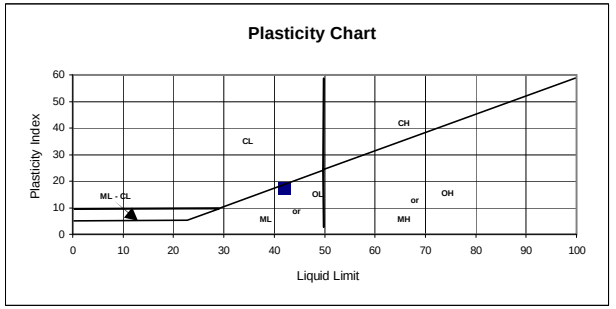
CLASSIFICATION

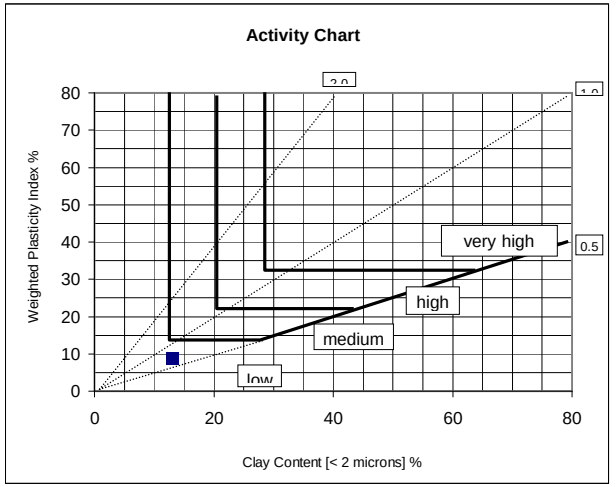
UNIFIED	PRA	TRH
SC	A.2.7 (1)	

Soil constituents % :	**Clay :**	13	**Silt :**	17	**Sand :**	59	**Gravel :**	10	**Fines :**	49	**Soil description :** Pale Red Soil

D_{10} :		**D_{30} :**	0.054	**D_{60} :**	0.638	**Uniformity coefficient :**		**Curvature coefficient :**		Active program :	YES







REMARKS: **none**

CHECKED BY : G van Gelder

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	GEO 3 CC	**PROJECT :**	#1046		
Position :	TP 2	**Depth [m] :**	0.300-1.000	**Source :**	INSITU

Date	**Job No.**	1556
25-Jan-13	**Sample No.**	13/0113

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	100	98	87	54	23	18	16	12	11	10	8	5	5	4	4

ATTERBERG LIMITS

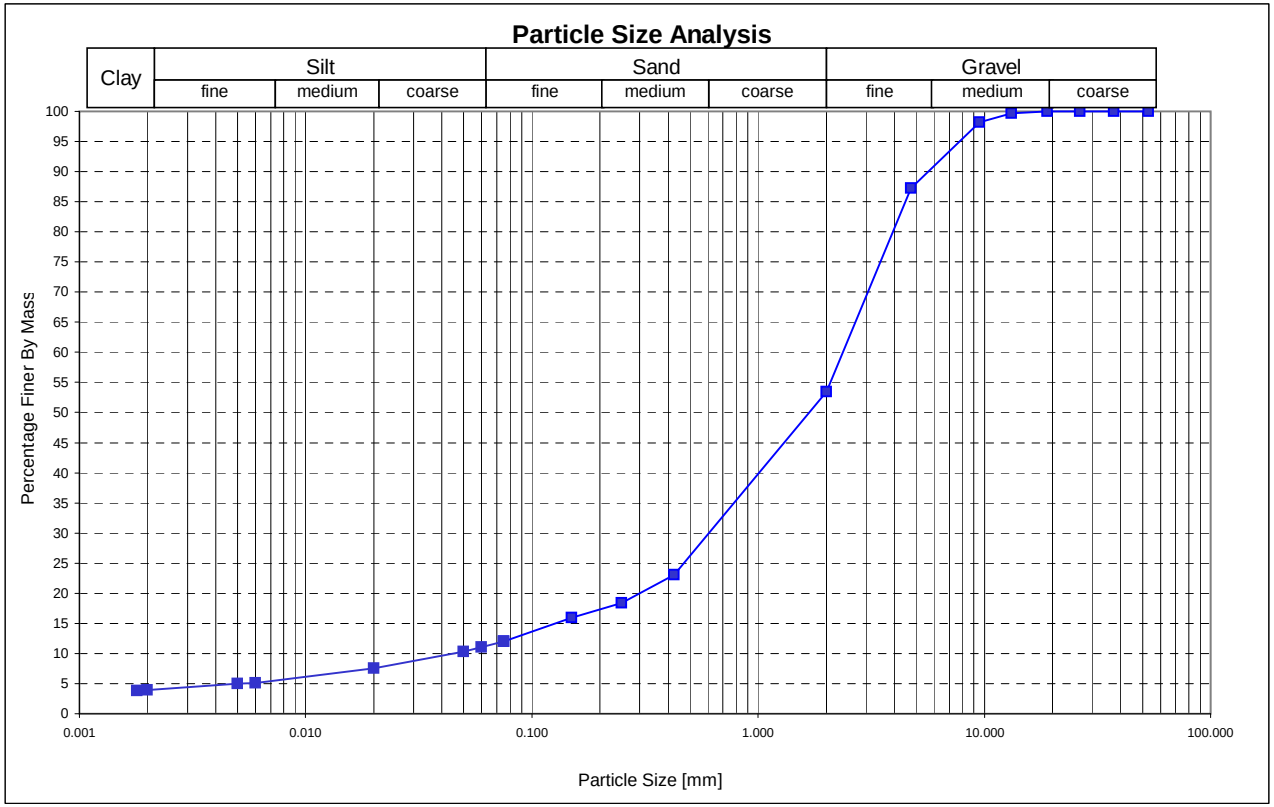
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
33	13	3	6.7	2.11

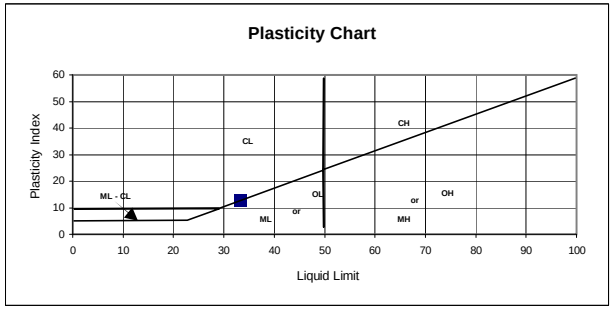
CLASSIFICATION

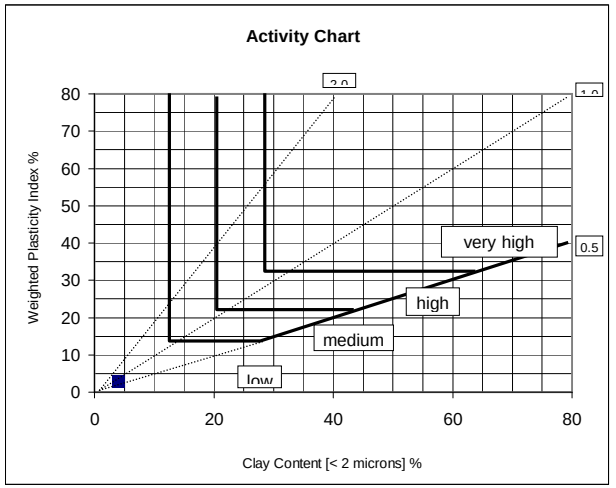
UNIFIED	PRA	TRH
SC	A.2.6 (0)	

Soil constituents % :	**Clay :**	4	**Silt :**	7	**Sand :**	42	**Gravel :**	46	**Fines :**	23	**Soil description :** Light Brown Soil

D_{10} :	0.045	**D_{30} :**	0.606	**D_{60} :**	2.362	**Uniformity coefficient :**	52	**Curvature coefficient :**	3	Active program :	YES







REMARKS: **none**

CHECKED BY : G van Gelder

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	GEO 3 CC	**PROJECT :**	#1046		
Position :	TP 2	**Depth [m] :**	0.800-1.070	**Source :**	INSITU

Date	**Job No.**	1556
21-Feb-13	**Sample No.**	13/0452

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	100	100	95	75	34	26	21	16	14	13	8	6	6	4	4

ATTERBERG LIMITS

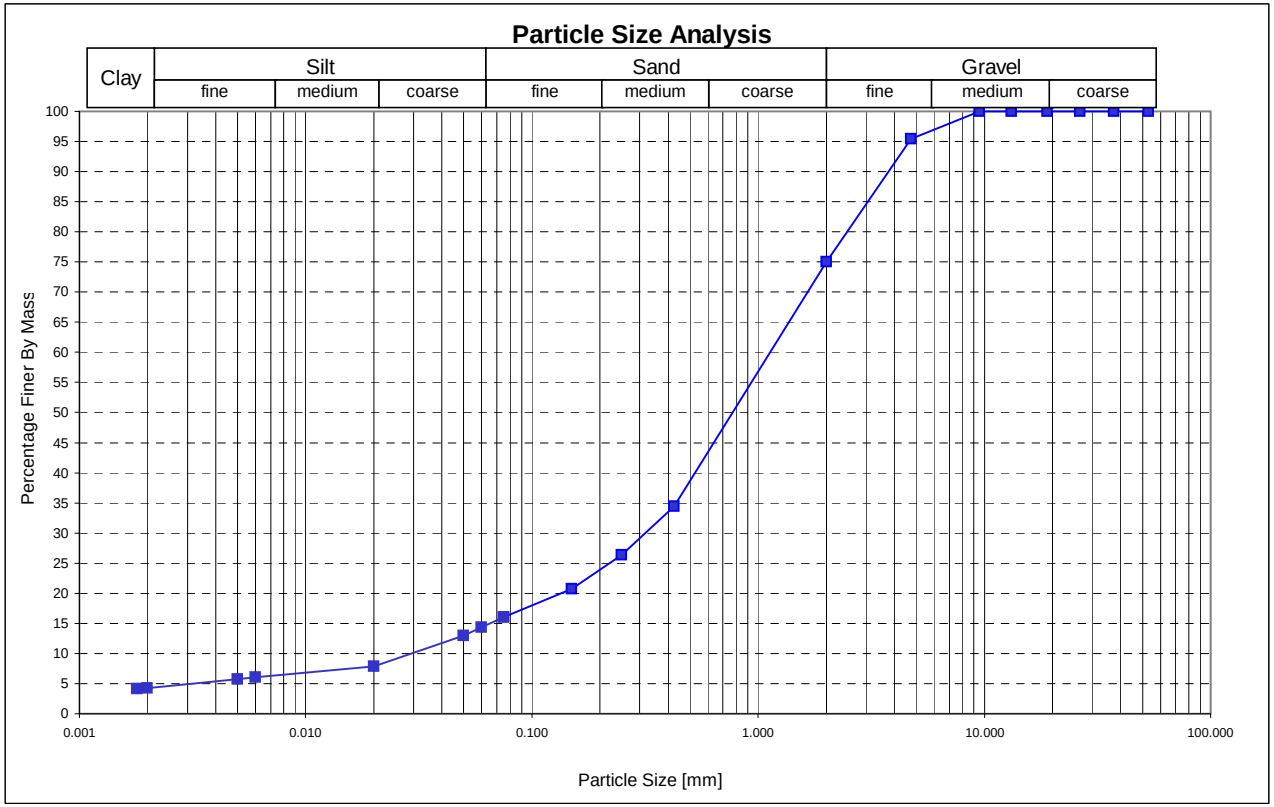
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
28	6	2	3.0	1.75

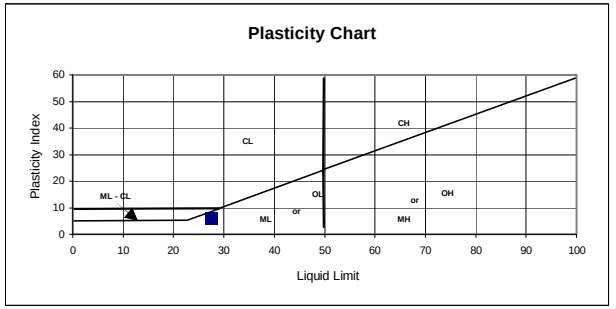
CLASSIFICATION

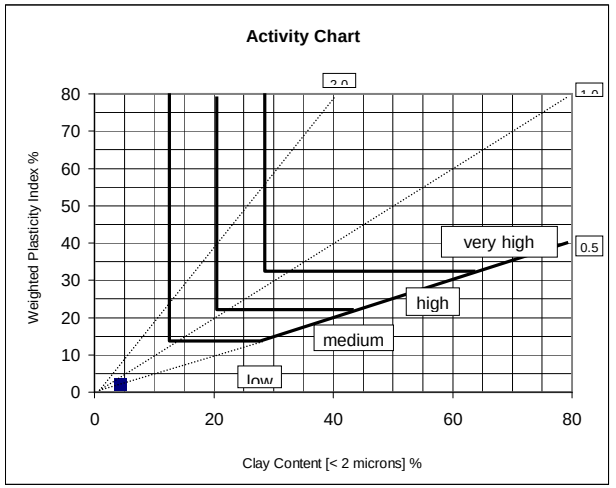
UNIFIED	PRA	TRH
SM/SC	A.1.b (0)	

Soil constituents % :	**Clay :**	4	**Silt :**	10	**Sand :**	61	**Gravel :**	25	**Fines :**	34	**Soil description :**	Light Brown Soil

D_{10} :	0.029	**D_{30} :**	0.318	**D_{60} :**	1.128	**Uniformity coefficient :**	39	**Curvature coefficient :**	3	Active program :	YES







REMARKS: **none**

CHECKED BY : G van Gelder

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	GEO 3 CC	**PROJECT :**	#1046	**Date**	**Job No.** 1556
Position :	TP 2	**Depth [m] :** 1.000-1.600	**Source :** INSITU	25-Jan-13	**Sample No.** 13/0114

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	99	99	94	67	32	27	24	18	16	15	10	6	5	3	3

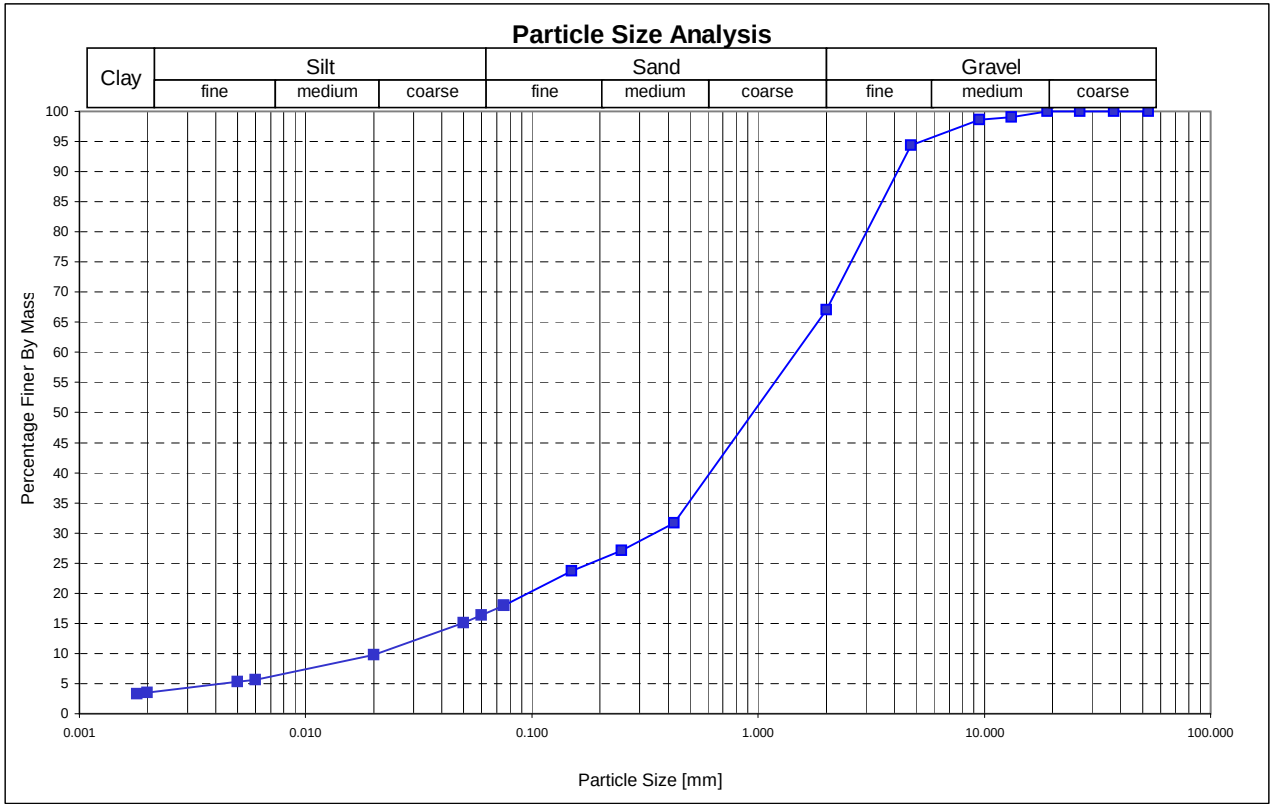
ATTERBERG LIMITS

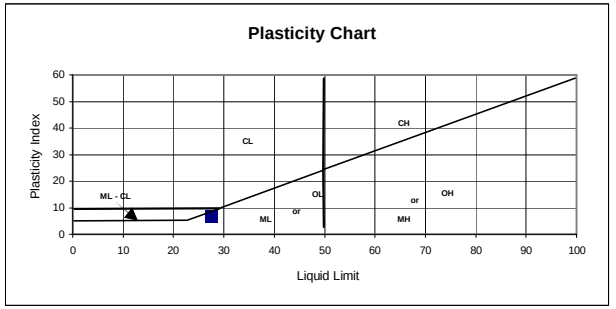
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
28	7	2	3.4	1.83

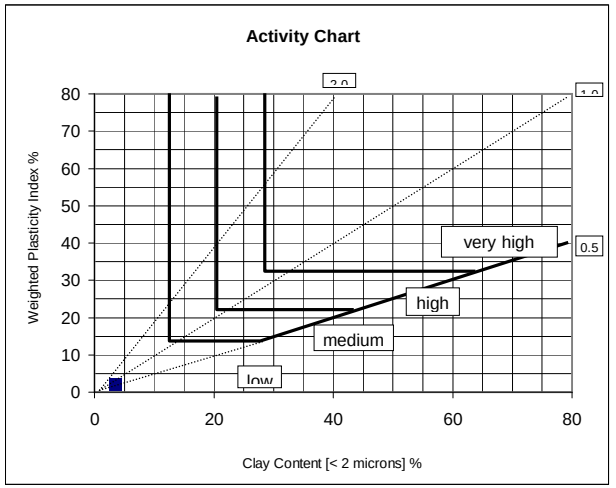
CLASSIFICATION

UNIFIED	PRA	TRH
SM/SC	A.2.4 (0)	

Soil constituents % :	**Clay :** 3	**Silt :** 13	**Sand :** 51	**Gravel :** 33	**Fines :** 32	**Soil description :** Light Brown Soil
D_{10} : 0.021	**D_{30} :** 0.351	**D_{60} :** 1.470	**Uniformity coefficient :** 71	**Curvature coefficient :** 4	Active program : YES	







REMARKS: **none**

CHECKED BY : G van Gelder

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	GEO 3 CC	**PROJECT :**	#1046	**Date**	**Job No.** 1556
Position :	TP 4	**Depth [m] :** 0.700-2.000	**Source :** INSITU	25-Jan-13	**Sample No.** 13/0115

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	100	98	78	47	23	17	13	9	8	7	6	4	4	3	3

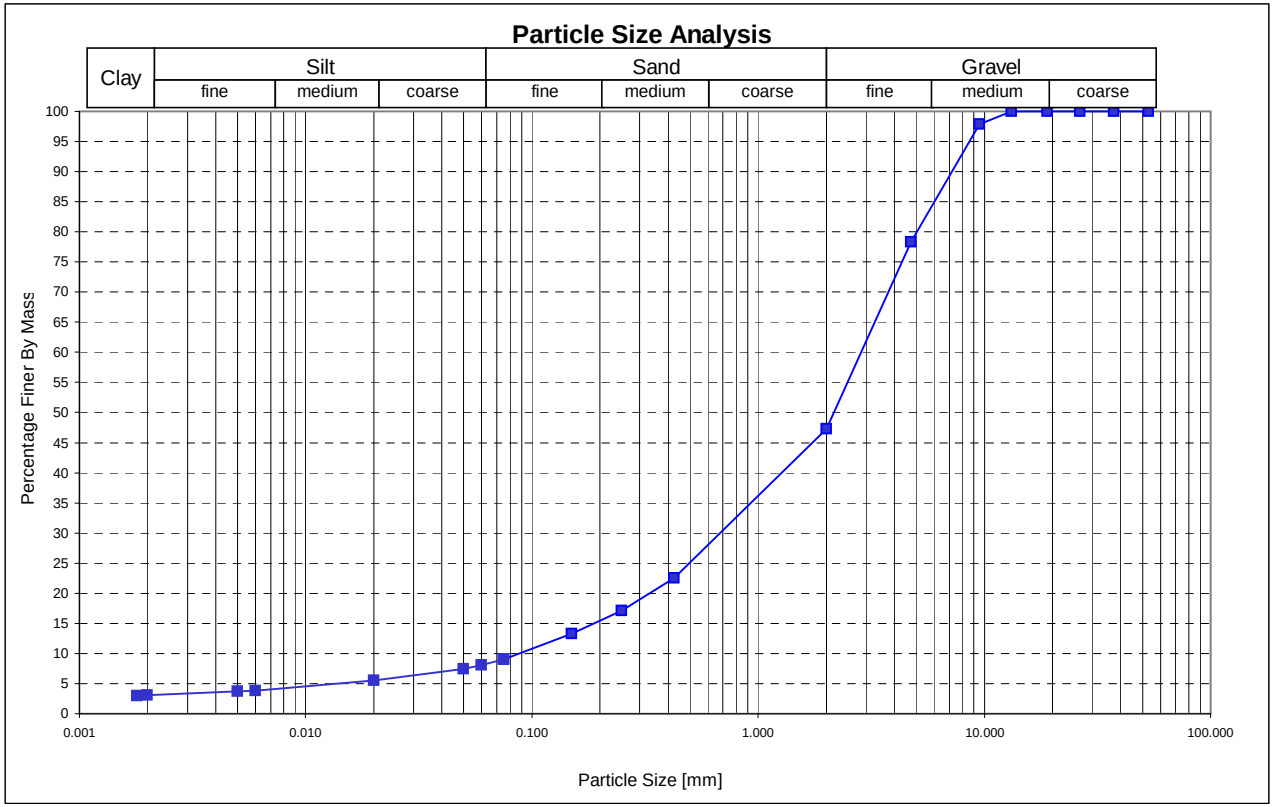
ATTERBERG LIMITS

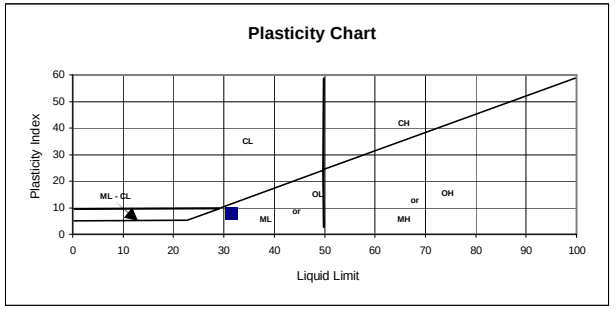
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
32	8	2	3.7	2.21

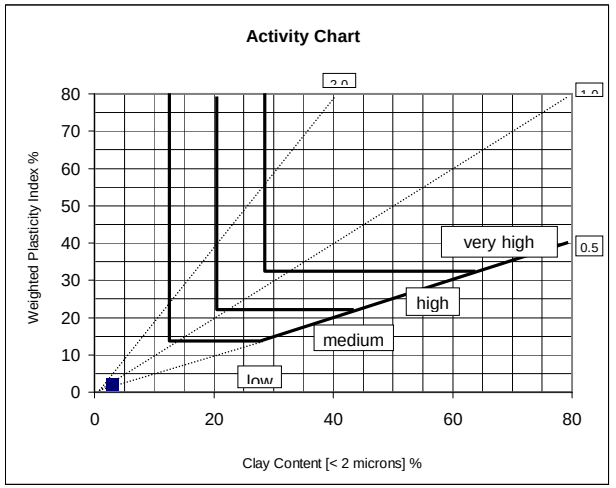
CLASSIFICATION

UNIFIED	PRA	TRH
SW	A.2.4 (0)	

Soil constituents % :	**Clay :** 3	**Silt :** 5	**Sand :** 39	**Gravel :** 53	**Fines :** 23	**Soil description :** Dark Brown Soil
D_{10} : 0.088	**D_{30} :** 0.679	**D_{60} :** 2.850	**Uniformity coefficient :** 32	**Curvature coefficient :** 2	Active program : YES	







REMARKS: **none**

CHECKED BY : G van Gelder

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	GEO 3 CC	**PROJECT :**	#1046		
Position :	TP 9	**Depth [m] :**	0.700-1.000	**Source :**	INSITU

Date	**Job No.**	1556
21-Feb-13	**Sample No.**	13/0453

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	100	100	95	71	34	29	24	17	16	15	10	6	6	4	4

ATTERBERG LIMITS

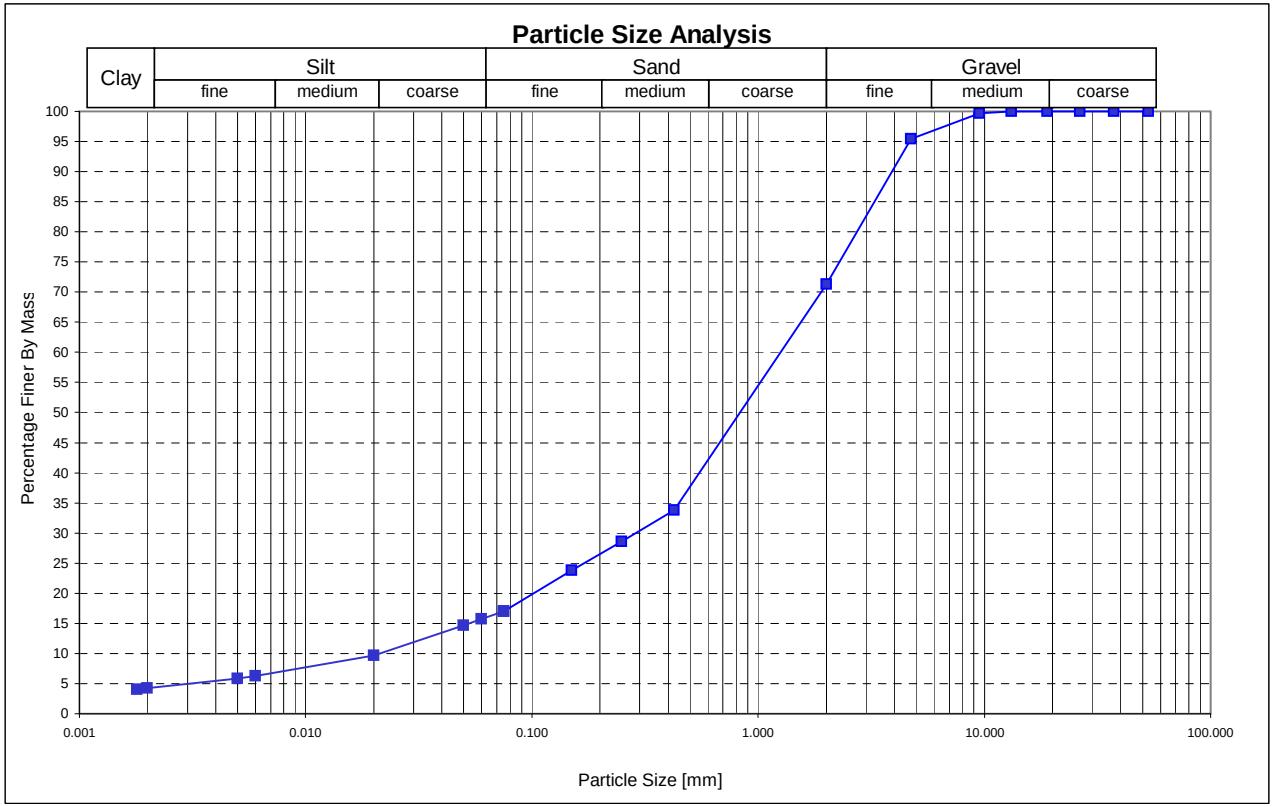
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
29	8	3	4.0	1.78

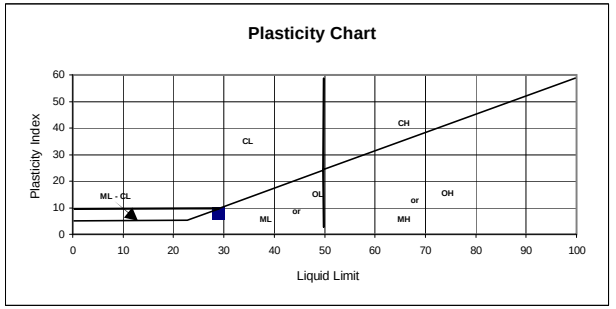
CLASSIFICATION

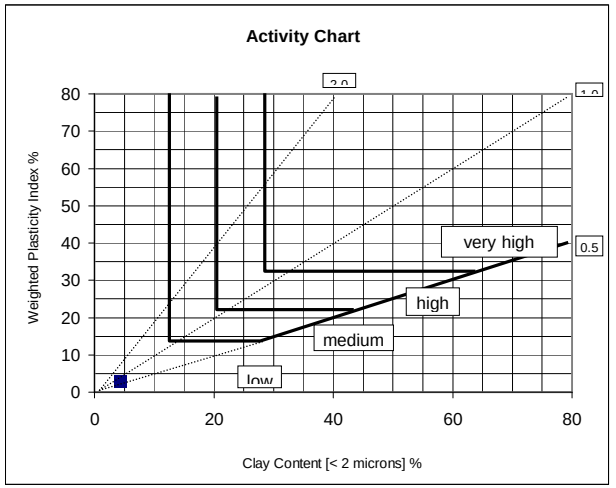
UNIFIED	PRA	TRH
SC	A.2.4 (0)	

Soil constituents % :	**Clay :**	4	**Silt :**	11	**Sand :**	56	**Gravel :**	29	**Fines :**	34	**Soil description :** Light Reddish Brown Soil

D_{10} :	0.021	**D_{30} :**	0.288	**D_{60} :**	1.253	**Uniformity coefficient :**	59	**Curvature coefficient :**	3	Active program :	YES







REMARKS: **none**

CHECKED BY : G van Gelder

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	GEO 3 CC	**PROJECT :**	#1046	**Date**	**Job No.** 1556
Position :	TP 11	**Depth [m] :** 0.450-1.700	**Source :** INSITU	28-Jan-13	**Sample No.** 13/0157

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	99	98	91	55	31	27	24	20	18	17	12	9	8	6	6

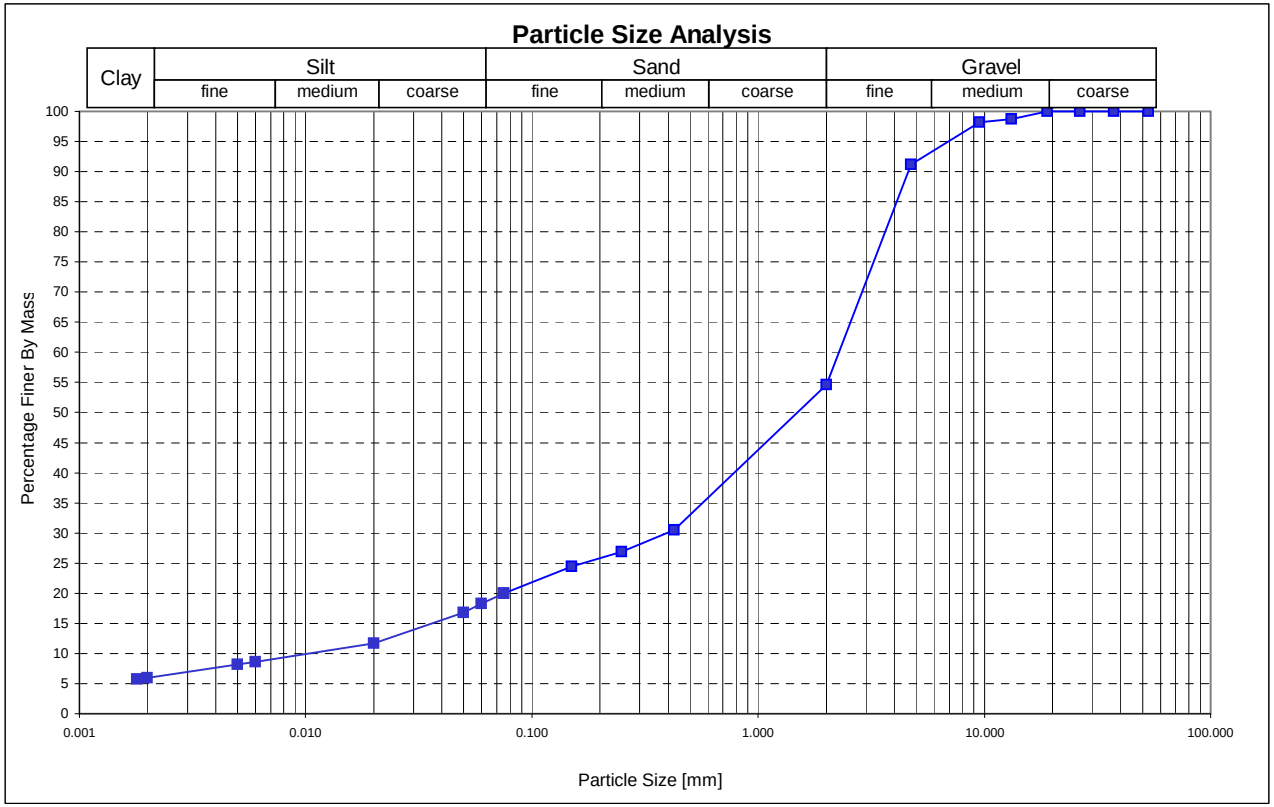
ATTERBERG LIMITS

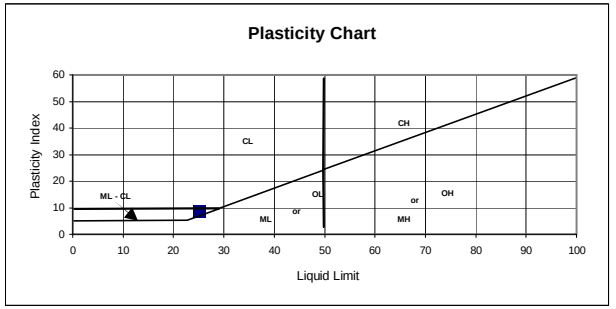
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
25	9	3	4.7	1.95

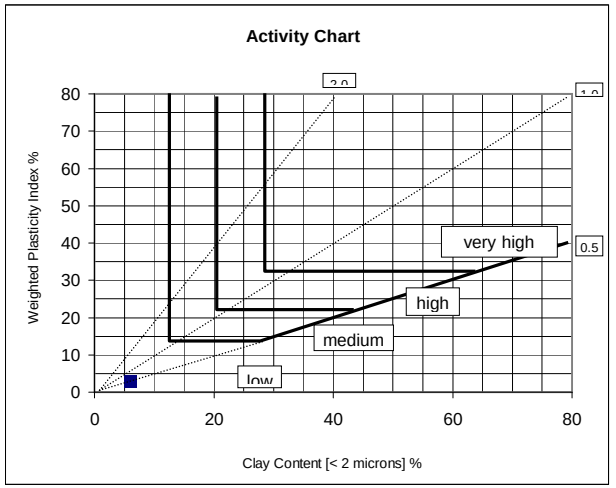
CLASSIFICATION

UNIFIED	PRA	TRH
SC	A.2.4 (0)	

Soil constituents % :	**Clay :** 6	**Silt :** 12	**Sand :** 36	**Gravel :** 45	**Fines :** 31	**Soil description :** Light Reddish Brown Soil
D_{10} : 0.010	**D_{30} :** 0.393	**D_{60} :** 2.272	**Uniformity coefficient :** 218	**Curvature coefficient :** 7	Active program : YES	







REMARKS: **none**

CHECKED BY : G van Gelder

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	GEO 3 CC	**PROJECT :**	#1046		
Position :	TP 11	**Depth [m] :**	1.700-3.000	**Source :**	INSITU

Date	**Job No.**	1556
28-Jan-13	**Sample No.**	13/0158

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	100	99	78	36	21	16	13	11	10	10	7	6	5	4	4

ATTERBERG LIMITS

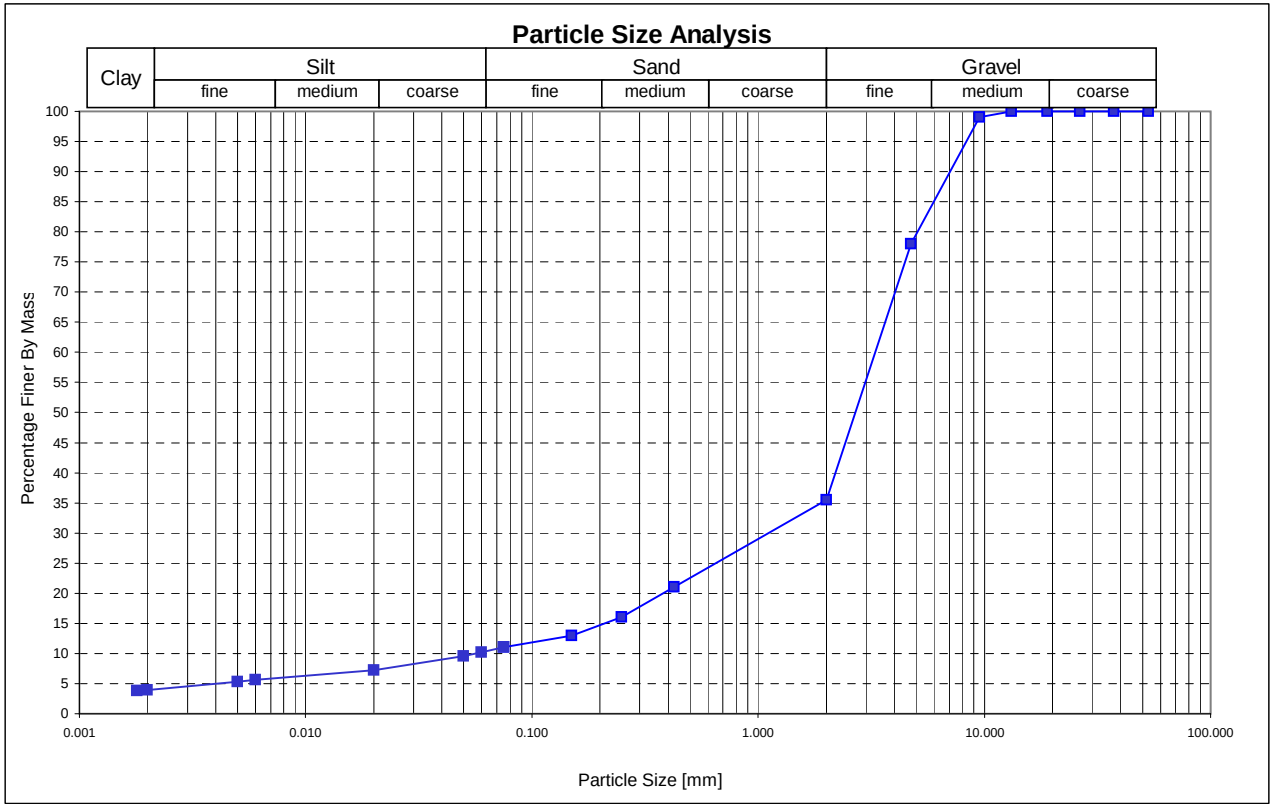
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
33	6		2.7	2.32

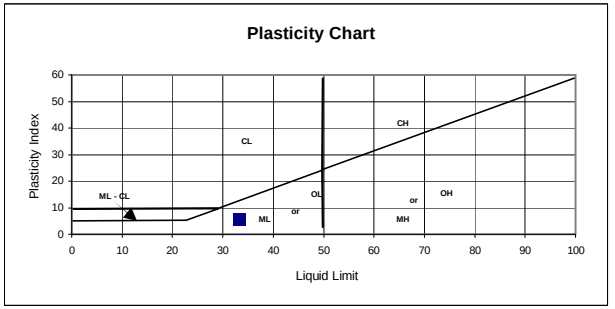
CLASSIFICATION

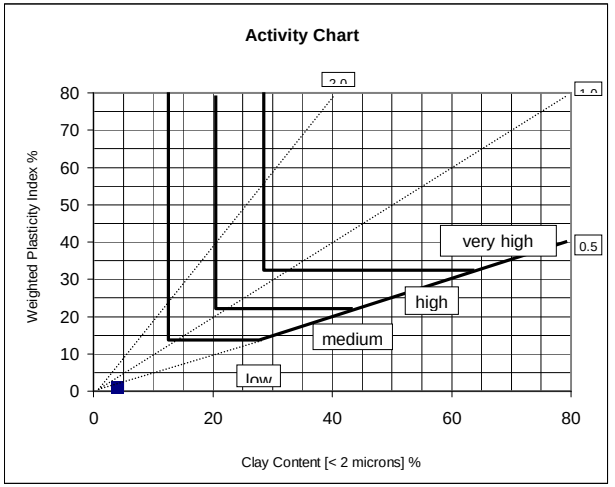
UNIFIED	PRA	TRH
SM	A.1.a (0)	

Soil constituents % :	**Clay :**	4	**Silt :**	6	**Sand :**	25	**Gravel :**	64	**Fines :**	21	**Soil description :**	Light Brown Soil

D_{10} :	0.056	**D_{30} :**	1.109	**D_{60} :**	3.291	**Uniformity coefficient :**	59	**Curvature coefficient :**	7	Active program :	YES







REMARKS: **none**

CHECKED BY : G van Gelder

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	GEO 3 CC	**PROJECT :**	#1046		
Position :	TP 14	**Depth [m] :**	0.500-2.200	**Source :**	INSITU

Date	**Job No.**	1556
28-Jan-13	**Sample No.**	13/0159

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	100	98	86	52	23	19	16	13	12	11	8	5	5	3	3

ATTERBERG LIMITS

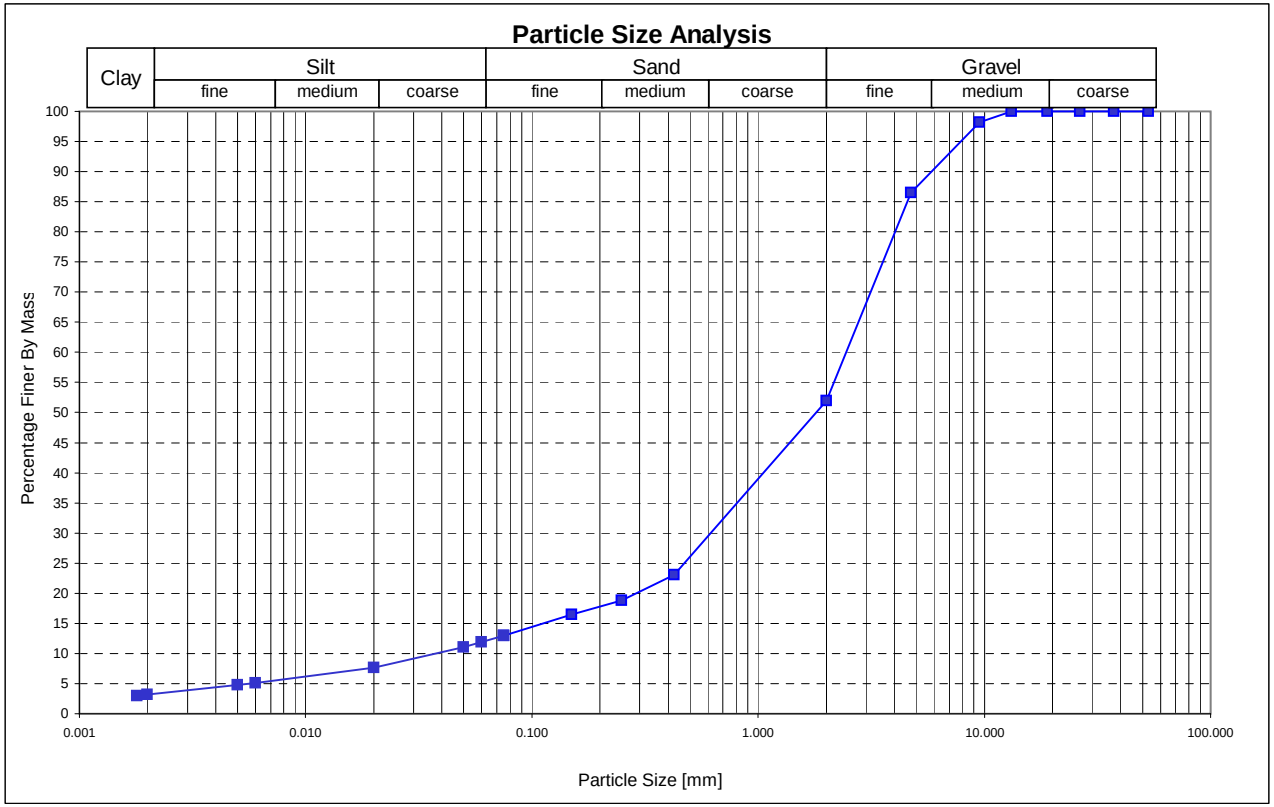
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
24	8	2	3.4	2.12

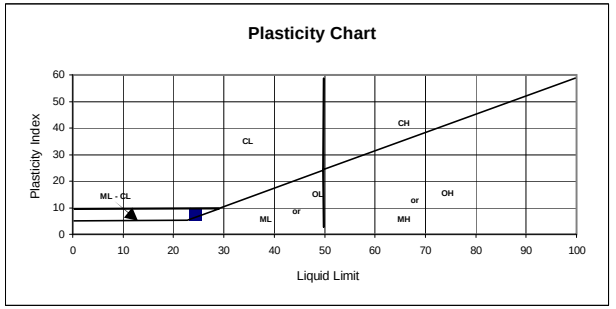
CLASSIFICATION

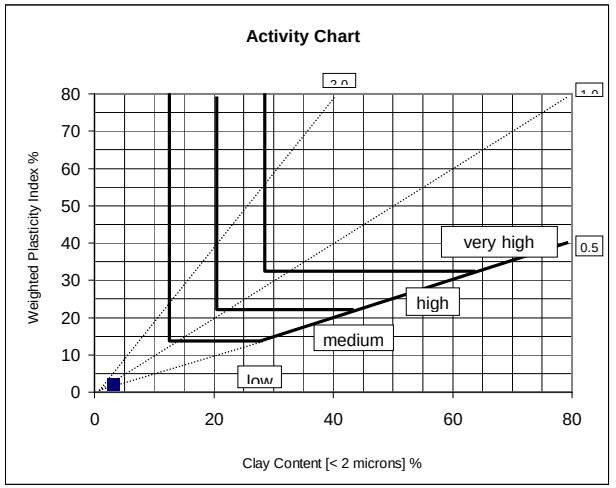
UNIFIED	PRA	TRH
SC	A.2.4 (0)	

Soil constituents % :	**Clay :**	3	**Silt :**	9	**Sand :**	40	**Gravel :**	48	**Fines :**	23	**Soil description :** Light Reddish Brown Soil

D_{10} :	0.038	**D_{30} :**	0.617	**D_{60} :**	2.448	**Uniformity coefficient :**	65	**Curvature coefficient :**	4	Active program :	YES







REMARKS: **none**

CHECKED BY : G van Gelder

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	GEO 3 CC	**PROJECT :**	#1046		
Position :	TP 16	**Depth [m] :**	1.100-2.000	**Source :**	INSITU

Date	**Job No.**	1556
28-Jan-13	**Sample No.**	13/0160

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	100	99	76	38	16	10	8	5	4	3	2	1	1	1	1

ATTERBERG LIMITS

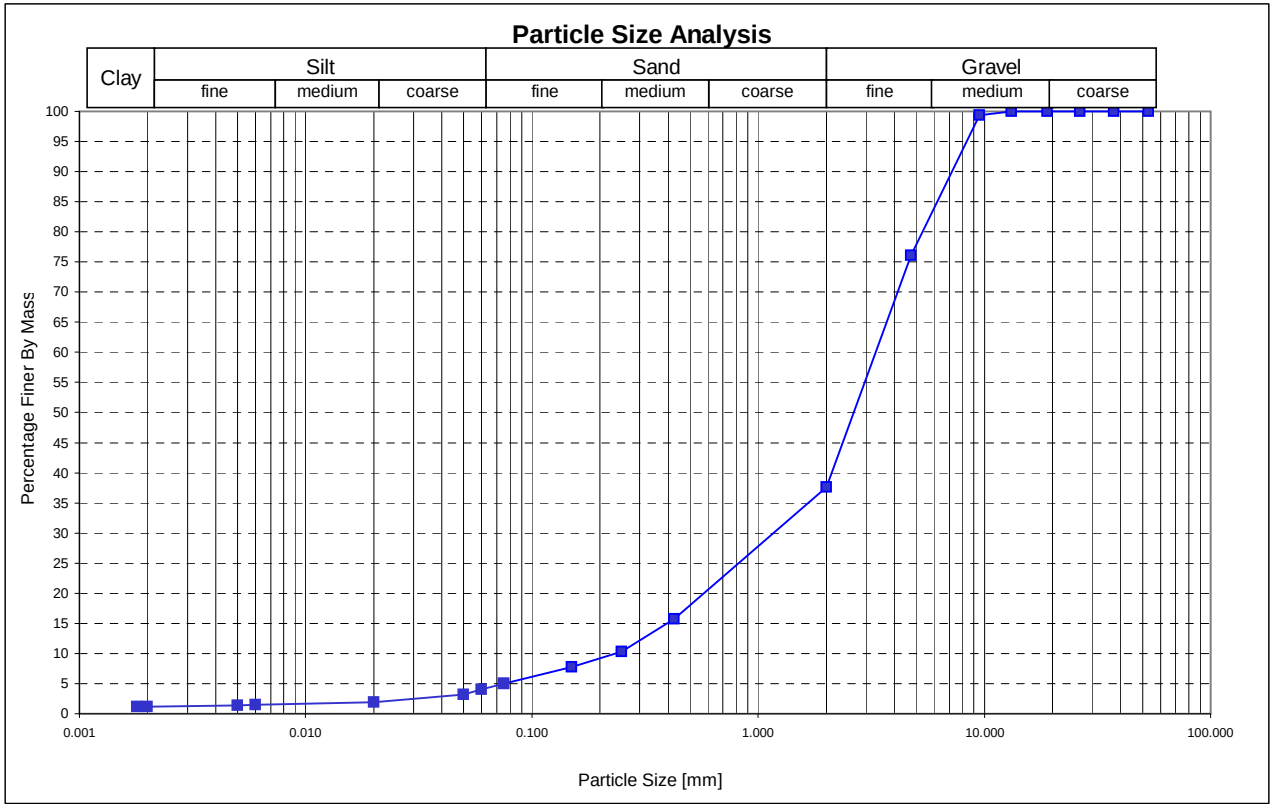
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
32	4		2.0	2.42

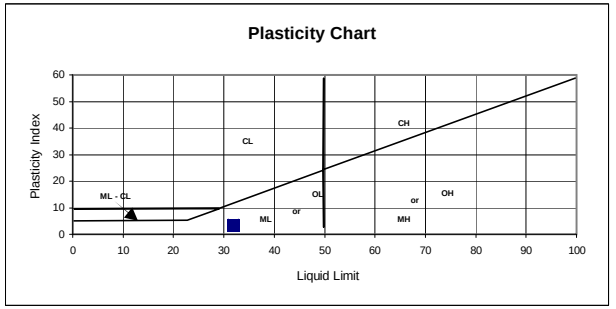
CLASSIFICATION

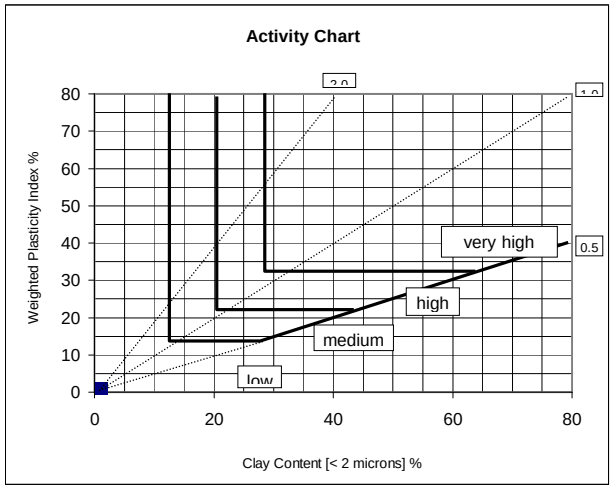
UNIFIED	PRA	TRH
SW	A.1.a (0)	

Soil constituents % :	**Clay :**	1	**Silt :**	3	**Sand :**	34	**Gravel :**	62	**Fines :**	16	**Soil description :** Dark Brown Soil

D_{10} :	0.236	**D_{30} :**	1.166	**D_{60} :**	3.306	**Uniformity coefficient :**	14	**Curvature coefficient :**	2	Active program :	YES







REMARKS: **none**

CHECKED BY : G van Gelder

APPENDIX D
PERMEAMETER TEST RESULTS

GUELPH PERMEAMETER DATA SHEET

JOB NO.: 1046

CLIENT: Umsebe Development Planners **SITE:** Nkambeni Cemetery **POSITION:** TP 02

Coordinates X / Y :

STANDARDIZED PROCEDURE FOR PERMEAMETER READINGS AND CALCULATIONS

Date: 12-Feb-13 Investigator: hjs Depth below g.l. [cm]: Depth of well [cm]:

Combined reservoirs - X = 35.22 cm^2 Reservoir Remarks :

Inner reservoir only - Y = 2.16 cm^2 1 used

1st Set of Readings with height of water in well (H1) set at 5cm

Reading #	Time [min]	Time Interval [min]	Water level in Reservoir [cm]	Water level change [cm]	Rate of water level change [cm/min]
1			21.20		
2	15.0	15.0	21.90	0.70	0.047
3	20.0	5.0	22.50	0.60	0.120
4	25.0	5.0	23.20	0.70	0.140
5	30.0	5.0	24.10	0.90	0.180
6	40.0	10.0	26.00	1.90	0.190
7	50.0	10.0	28.00	2.00	0.200
8	55.0	5.0	28.80	0.80	0.160

2nd Set of Readings with height of water in well (H2) set at 10cm

Reading #	Time [min]	Time Interval [min]	Water level in Reservoir [cm]	Water level change [cm]	Rate of water level change [cm/min]
1			35.90		
2	1.0	1.0	41.20	5.30	5.300
3	2.0	1.0	46.20	5.00	5.000
4	3.0	1.0	50.10	3.90	3.900
5	5.0	2.0	59.50	9.40	4.700
6	7.0	2.0	68.90	9.40	4.700
7	8.0	1.0	73.60	4.70	4.700

R, the steady state rate of flow, is achieved when R is the same in three consecutive time intervals.

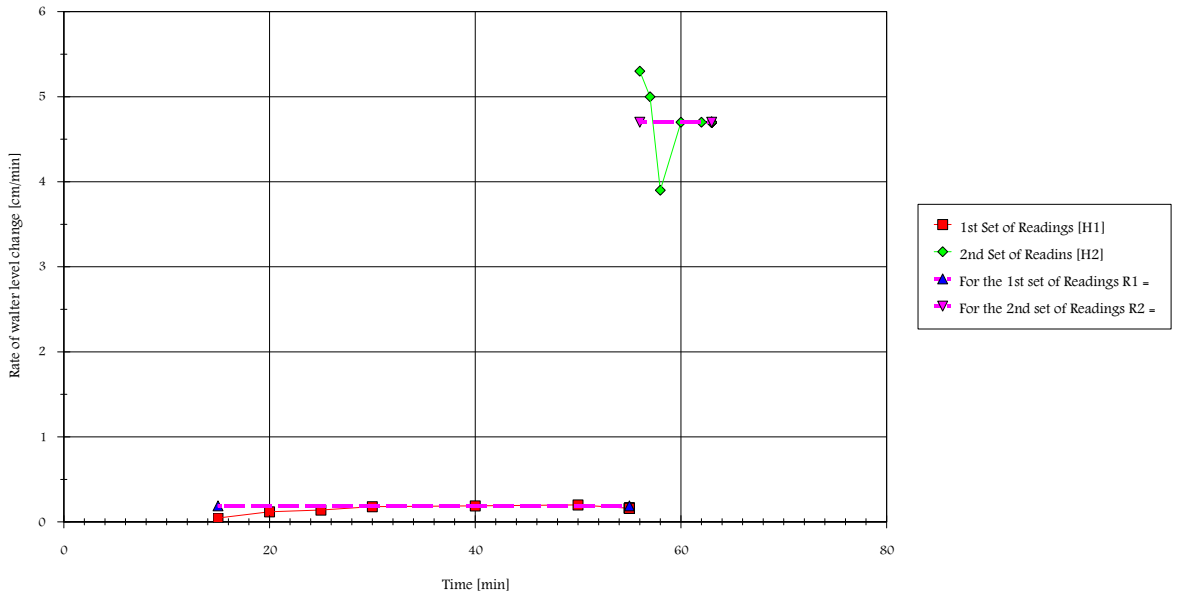
v1.1b

For the 1st set of Readings R1 = 0.190 / 60 = 3.17E-003 cm / sec

For the 2nd set of Readings R2 = 4.700 / 60 = 7.83E-002 cm / sec

Field saturated hydraulic conductivity	0.0041	2.16	7.83E-002	-	0.0054	2.16	3.17E-003	=	6.57E-004	cm / sec
Matrix flux potential	0.0572	2.16	3.17E-003	-	0.0237	2.16	7.83E-002	=	-3.62E-003	cm^2/sec

Alpha parameter: 6.57E-004 / -3.62E-003 = -1.81E-001 cm^-1



GUELPH PERMEAMETER DATA SHEET

JOB NO.: 1046

CLIENT: Umsebe Development Planners **SITE:** Nkambeni Cemetery **POSITION:** TP 09

Coordinates X / Y :

STANDARDIZED PROCEDURE FOR PERMEAMETER READINGS AND CALCULATIONS

Date: 12-Feb-13 Investigator: hjs Depth below g.l. [cm]: 70 Depth of well [cm]: 30

Combined reservoirs - X = 35.22 cm^2 Reservoir Remarks :

Inner reservoir only - Y = 2.16 cm^2 1 used

1st Set of Readings with height of water in well (H1) set at 5cm

Reading #	Time [min]	Time Interval [min]	Water level in Reservoir [cm]	Water level change [cm]	Rate of water level change [cm/min]
1			2.00		
2	1.0	1.0	3.00	1.00	1.000
3	2.0	1.0	8.00	5.00	5.000
4	3.0	1.0	12.50	4.50	4.500
5	4.0	1.0	13.60	1.10	1.100
6	5.0	1.0	18.70	5.10	5.100
7	6.0	1.0	21.80	3.10	3.100
8	7.0	1.0	24.80	3.00	3.000
9	8.0	1.0	27.80	3.00	3.000
10	9.0	1.0	30.80	3.00	3.000

2nd Set of Readings with height of water in well (H2) set at 10cm

Reading #	Time [min]	Time Interval [min]	Water level in Reservoir [cm]	Water level change [cm]	Rate of water level change [cm/min]
1			18.70		
2	1.0	1.0	25.90	7.20	7.200
3	2.0	1.0	33.90	8.00	8.000
4	3.0	1.0	41.60	7.70	7.700
5	4.0	1.0	49.30	7.70	7.700
6	5.0	1.0	56.60	7.30	7.300
7	6.0	1.0	64.10	7.50	7.500
8	7.0	1.0	72.00	7.90	7.900

R, the steady state rate of flow, is achieved when R is the same in three consecutive time intervals.

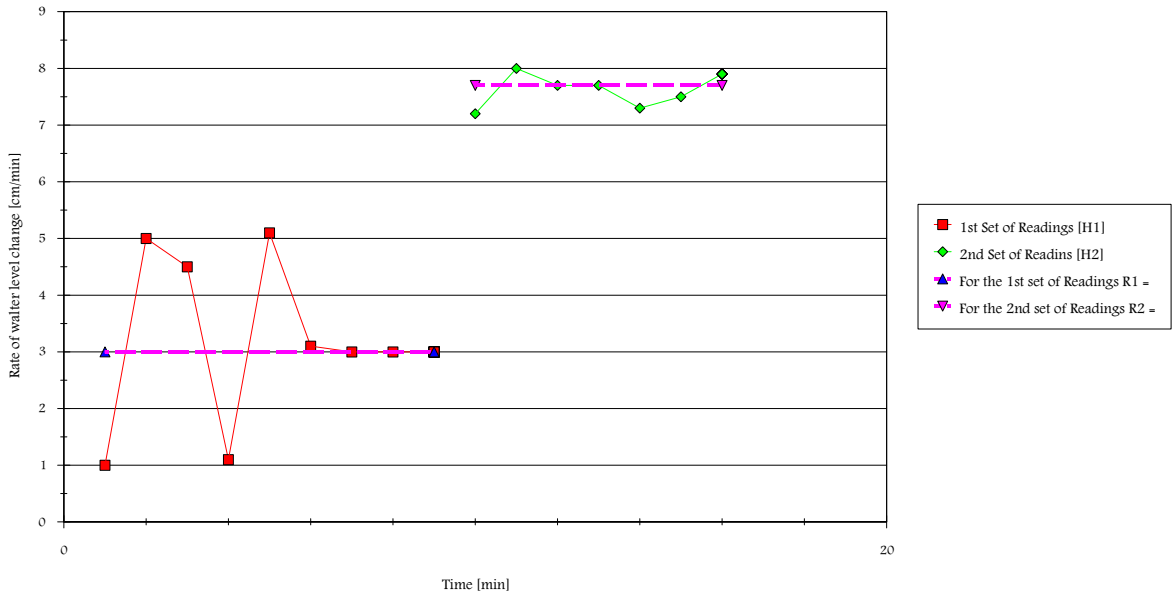
v1.1b

For the 1st set of Readings R1 = 3.000 / 60 = 5.00E-002 cm / sec

For the 2nd set of Readings R2 = 7.700 / 60 = 1.28E-001 cm / sec

Field saturated hydraulic conductivity	0.0041	2.16	1.28E-001	-	0.0054	2.16	5.00E-002	=	5.53E-004	cm / sec
Matrix flux potential	0.0572	2.16	5.00E-002	-	0.0237	2.16	1.28E-001	=	-3.92E-004	cm^2/sec

Alpha parameter: 5.53E-004 / -3.92E-004 = -1.41E+000 cm^-1



APPENDIX E
INFORMATION ON BOREHOLES

USER DEFINED REPORT

Date compiled: 2013/01/24

NR_ON_MAP	Y_COORD	X_COORD	ALTITUDE	BH_DIAM	COLLAR_HI	DEPTH	SITE_STATU	USE_APPLIC	DATE_INSTL	TYPE_INSTL	DEPTH_INTK	DISCH_RATE	DUTY_CYCL	WATER_QU
MB-00431A	-14572.92453	2774425	570.000	165.000		62.000	D	DA						
MB-00431B	-14519.70342	2774400	570.000	165.000		50.000	D	DA						
MB-00427A	-12845.48663	2775596	595.000	165.000		67.000	D	DA						
MB-00427B	-12842.71627	2775562	590.000	165.000		54.000	D	DA						
MB-00638	-13100.65406	2773209	570.000	170.000		47.200	G	DA	19000101	S		0.00000	0.00000	CLASS 2
MB-01036	-12868.34204	2782009	768.000	170.000	0.480	80.110	U	DA	19000101	N	42.000	0.400	18.000	CLASS 1
MB-01245	-12331.37633	2781491	722.000	170.000	0.750	59.070	U	DA	20100118	N	30.000	0.500	18.000	CLASS 0
MB-01246	-12197.93341	2778491	680.000	170.000	0.100	35.460	U	DA	19000101	N	30.000	2.500	24.000	CLASS1
MB-01247	-12213.07675	2778474	680.000	165.000	0.400	28.600	U	DA	19000101	N	24.000	2.000	24.000	CLASS 0
MB-01248	-13606.04159	2778340	720.000	170.000	0.190	59.410	U	DA	19000101	N	40.000	0.100	12.000	CLASS 0

GeositeInfo_DataOwner	GeositeInfo_Identifier	ositeInfo_GeositeTy	GeositeInfo_Latitude	GeositeInfo_Longitude	GeositeInfo_CoordinateMetho	_ElevationC	o_DateWhenStatusWa	Blowing_yield [l/s]	water_level [m]
Geo, Water Affairs - Pretoria	2531AA00027	Borehole	-25.09036	31.17065	Estimated 1:50 000 map	100	01/03/1960	1.0	
Geo, Water Affairs - Pretoria	2531AA00028	Borehole	-25.08564	31.17315	Estimated 1:50 000 map	100	25/02/1960	0.3	
Geo, Water Affairs - Pretoria	2531AA00033	Borehole	-25.09036	31.17066	Estimated 1:50 000 map	100	24/02/1960	0.4	
Geo, Water Affairs - Pretoria	2531AA00034	Borehole	-25.09564	31.17231	Estimated 1:50 000 map	100	19/12/1960	0.3	
Geo, Water Affairs - Pretoria	2531AA00119	Borehole	-25.11644	31.12871	Estimated 1:50 000 map	10	08/07/1994	no info	
Geo, Water Affairs - Pretoria	2531AA00121	Borehole	-25.14144	31.12481	Estimated 1:50 000 map	10	08/07/1994	no info	
Geo, Water Affairs - Pretoria	2531AA00122	Borehole	-25.12786	31.16175	Estimated 1:50 000 map	10	08/07/1994	no info	
Geo, Water Affairs - Pretoria	2531AA00123	Borehole	-25.13424	31.16092	Estimated 1:50 000 map	10	08/07/1994	no info	
Geo, Water Affairs - Pretoria	2531AA00125	Borehole	-25.13734	31.14121	Estimated 1:50 000 map	10	08/07/1994	no info	
Geo, Water Affairs - Pretoria	2531AA00149	Borehole	-25.14481	31.12631	Estimated 1:50 000 map	100		1.3	9.0
Geo, Water Affairs - Pretoria	2531AA00150	Borehole	-25.14481	31.12631	Estimated 1:50 000 map	100		0.0	
Geo, Water Affairs - Pretoria	2531AA00151	Borehole	-25.14481	31.12631	Estimated 1:50 000 map	100		0.1	20.0
Geo, Water Affairs - Pretoria	2531AA00152	Borehole	-25.14481	31.12631	Estimated 1:50 000 map	100		0.0	