

**A PHASE ONE GEOTECHNICAL INVESTIGATION REPORT ON PORTION 8
OF THE FARM BOSCHOEK 103 JQ FOR A PROPOSED RESIDENTIAL
TOWNSHIP ESTABLISHMENT**

Report Number: 2020/J014/NDC



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1 INTRODUCTION

1.1 Appointment

It has been proposed to establish a new township on portion 8 of the farm Boschoek 103 JQ. To this end Soilkraft cc was appointed by Mr Samuel Chauke on behalf of Nkanivo Development Consultants to undertake a phase one geotechnical investigation of the property, as described by the SANS 634^{Reference 9.1} specification. The purpose of the investigation was to:

- identify possible relevant geotechnical constraints
- propose certain recommendations regarding the founding of structures
- identify other factors possibly influencing the future development of the area

1.2 Scope of Investigation and Investigation Constraints

The phase one geotechnical investigation is not considered a detailed or purpose-specific investigation for individual structures or purposes, but provides general site information suitable for township establishment or rezoning purposes.

2 AVAILABLE INFORMATION

The following sources of information were consulted:

- 1 : 50 000 topographical map: 2527CA Rustenburg (West), published in 2000
- 1 : 250 000 scale geological map, 2526 Rustenburg, published in 1981
- Geotechnical investigations conducted in the vicinity of the study area

3 SITE DESCRIPTION

3.1 Site Location

The study area is situated on portion 8 of the farm Boschoek 103 JQ, approximately 25km due north west of Rustenburg and 5km due south south east of Ledig. The property measured some 34.3ha in size, of which approximately 15ha was considered for development. The remaining parts of the property were very steep and mountainous, making it unsuitable for development. Site access was gained from an existing unpaved road exiting the provincial road R565 in a south westerly direction. From here the site itself was accessed using internal unpaved tracks and gravel paths.

The site is bordered to the north east by the road reserve of road R565, while all other boundaries are shared with holdings or farmland.

Refer to the attached Figure 1 : Locality Plan.

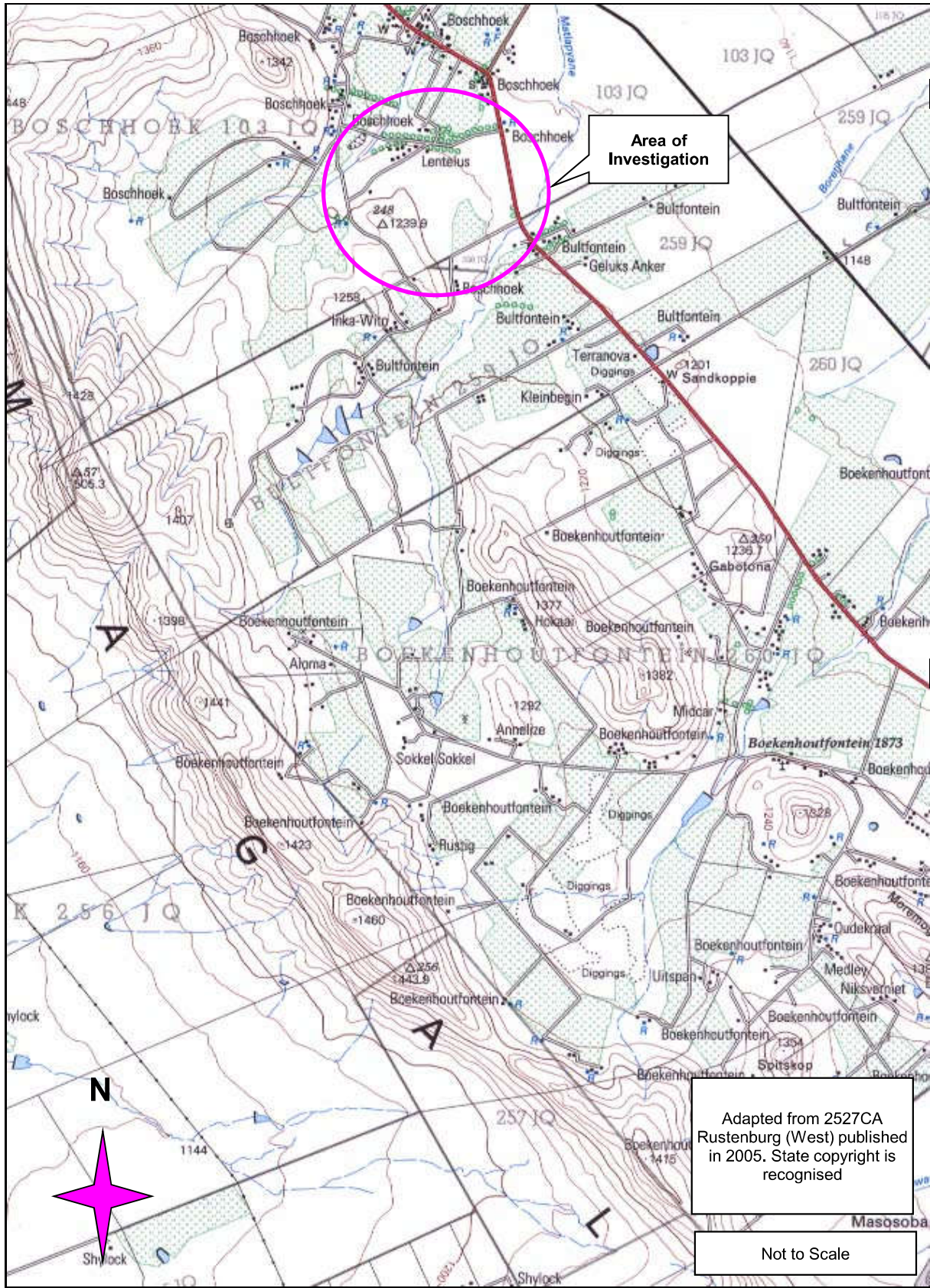
3.2 Topography and Drainage

A topographical survey plan of the study area provided by the project team revealed that site is relatively flat in the northern parts and becomes increasingly steep towards the south west. Elevations in the area earmarked for development increased from 1164m to 1224m above mean sea level. However, the area further south west become excessively steep and saw elevations between 1224m and 1342m above mean sea level (based on cartographic sources).

Drainage takes place by means of sheet wash and infiltration. No streams or drainage features are indicated on this site on regional maps. Taking into account the steep gradient found on parts of the study area, it is likely that significant surface runoff can be generated as overland flow during intense or prolonged precipitation events.

3.3 Vegetation

According to Mucina and Rutherford ^{Reference 9.2}, the study area is associated with vegetation of the Gold Reef Mountain Bushveld. The vegetation typically consists of dense, woody (e.g. *Acacia*) vegetation, while herbaceous layers are dominated by grass. The vegetation is described as “least threatened” and erosion susceptibility is expected to be low.



LOCALITY PLAN

FIGURE 1

3.4 Climate and Weather Conditions

The site is located in an area with an approximate Weinert N-value between 2.4 and 4.6 and a Thornthwaite Moisture Index between 0 and -20. Climatically the area may thus be described sub-humid. The importance of this is that climatic conditions are conducive to chemical weathering of bedrock in preference to mechanical breakdown thereof. As a result, expansive clays may form where suitable parent materials are present. That being stated, mechanical weathering cannot be discounted, particularly if brittle materials such as sandstone or shale are present.

4 EXISTING FACILITIES

At the time of the investigation, the study area was partially occupied by ongoing settlement. Stands were actively being allocated, cleared and used to settle upon. In addition, the northernmost portion of the site was in use as a commercial facility for concrete and brick production and sales. Elevated water storage tanks and communal taps were installed on the site to supply water to local residents, and an overhead electrical powerline crossed the site. No other services were noted on the site.

A number of small, abandoned and largely demolished buildings were found near the southern corner of the site. These appeared to consist of abandoned farm houses. In addition, stockpiles of what appeared to be waste material and a defunct crushing and loading plant were found in the north western corner of the site.

Photo 1 : Site Conditions conveys the site conditions encountered during the investigation.

5 SITE INVESTIGATION

5.1 Trial Holes

For the purposes of the investigation a total of 16 trial holes were excavated on 20 October 2020. The trial holes were excavated using a Cat 426F2 backhoe, supplied by DEW Plant Hire in Rustenburg. The machine was found to be in a good, working condition. Trial holes were distributed across the property in such a fashion as to obtain a representative impression of the entire area.

The trial holes were inspected, profiled and sampled by a professional engineering geologist according to the guidelines of SAICE and SAIEG^{Reference 9.3}. For the benefit of the non-geotechnical reader, these guidelines are summarised in the attached Table 1 : Soil Profiling Parameters. The profiles of trial holes may be found in Appendix A to this report. The profile descriptions reflect the impressions created by the pedological conditions and may vary from the results of the soil test.

Figure 2 illustrates the distribution of trial holes.



SITE CONDITIONS

PHOTO 1

TABLE 1: SOIL PROFILING PARAMETERS

CONSISTENCY : GRANULAR SOILS

CONSISTENCY : COHESIVE SOILS

SPT N	GRAVELS & SANDS Generally free draining soils		DRY DENSITY (kg/m ³)	SPT N	SILTS & CLAYS and combinations with SANDS. Generally slow draining soils		UCS (kPa)
<4	Very loose	Crumbles very easily when scraped with geological pick.	<1450	<2	Very soft	Pick point easily pushed in 100mm. Easily moulded by fingers.	<50
4-10	Loose	Small resistance to penetration by sharp pick point.	1450-1600	2-4	Soft	Pick point easily pushed in 30mm to 40mm. Moulded by fingers with some pressure.	50-125
10-30	Medium dense	Considerable resistance to penetration by sharp pick point.	1600-1750	4-8	Firm	Pick point penetrates to 10mm. Very difficult to mould with fingers.	125-250
30-50	Dense	Very high resistance to penetration by sharp pick point. Requires many blows by pick point for excavation.	1750-1925	8-15	Stiff	Slight indentation by pick point. Cannot be moulded by fingers. Penetrated by thumb nail.	250-500
>50	Very dense	High resistance to repeated blows of geological pick. Requires power tools for excavation.	>1925	15-30	Very stiff	Slight indentation by blow of pick point. Requires power tools for excavation.	500-1000

SOIL TYPE

SOIL TYPE	PARTICLE SIZE (mm)
Clay	<0.002
Silt	0.002-0.06
Sand	0.06-2.0
Gravel	2.0-60.0
Cobbles	60.0-200.0
Boulders	>200.0

MOISTURE CONDITION

Dry	No water detectable
Slightly moist	Water just discernible
Moist	Water easily discernible
Very moist	Water can be squeezed out
Wet	Generally below water table

SOIL STRUCTURE

COLOUR		SOIL STRUCTURE	
Speckled	Very small patches of colour <2mm	Intact	No structure present.
Mottled	Irregular patches of colour 2-6mm	Fissured	Presence of discontinuities, possibly cemented.
Blotched	Large irregular patches 6-20mm	Slickensided	Very smooth, glossy, often striated discontinuity planes.
Banded	Approximately parallel bands of varying colours	Shattered	Presence of open fissures. Soil break into gravel size blocks.
Streaked	Randomly orientated streaks of colour	Micro shattered	Small scale shattering, very closely spaced open fissures. Soil breaks into sand size crumbs.
Stained	Local colour variations : Associated with discontinuity surfaces	Residual structures	Residual bedding, laminations, foliations etc.

ORIGIN

Transported	Alluvium, hill wash, talus etc.
Residual	Weathered from parent rock e.g. residual granite
Pedocretes	Ferricrete, silcrete, calcrete etc.

DEGREE OF CEMENTATION OF PEDOCRETES

TERM	DESCRIPTION	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 between strong fingers. Some material can be crumbled by strong pressure between thumb and hard surface. Under light hammer blows disintegrate to a friable state.	0.5-2.0
Cemented	Material crumbles under firm blows of sharp pick point. Grains can be dislodged with some difficulty by a knife blade.	2.0-5.0
Strongly cemented	Firm blows of sharp pick point on hand-held specimen show 1-3mm indentations. Grains cannot be dislodged by knife blade.	5.0-10.0
Very strongly cemented	Hand-held specimen can be broken by single firm blow of hammer head. Similar appearance to concrete.	10.0-25.0

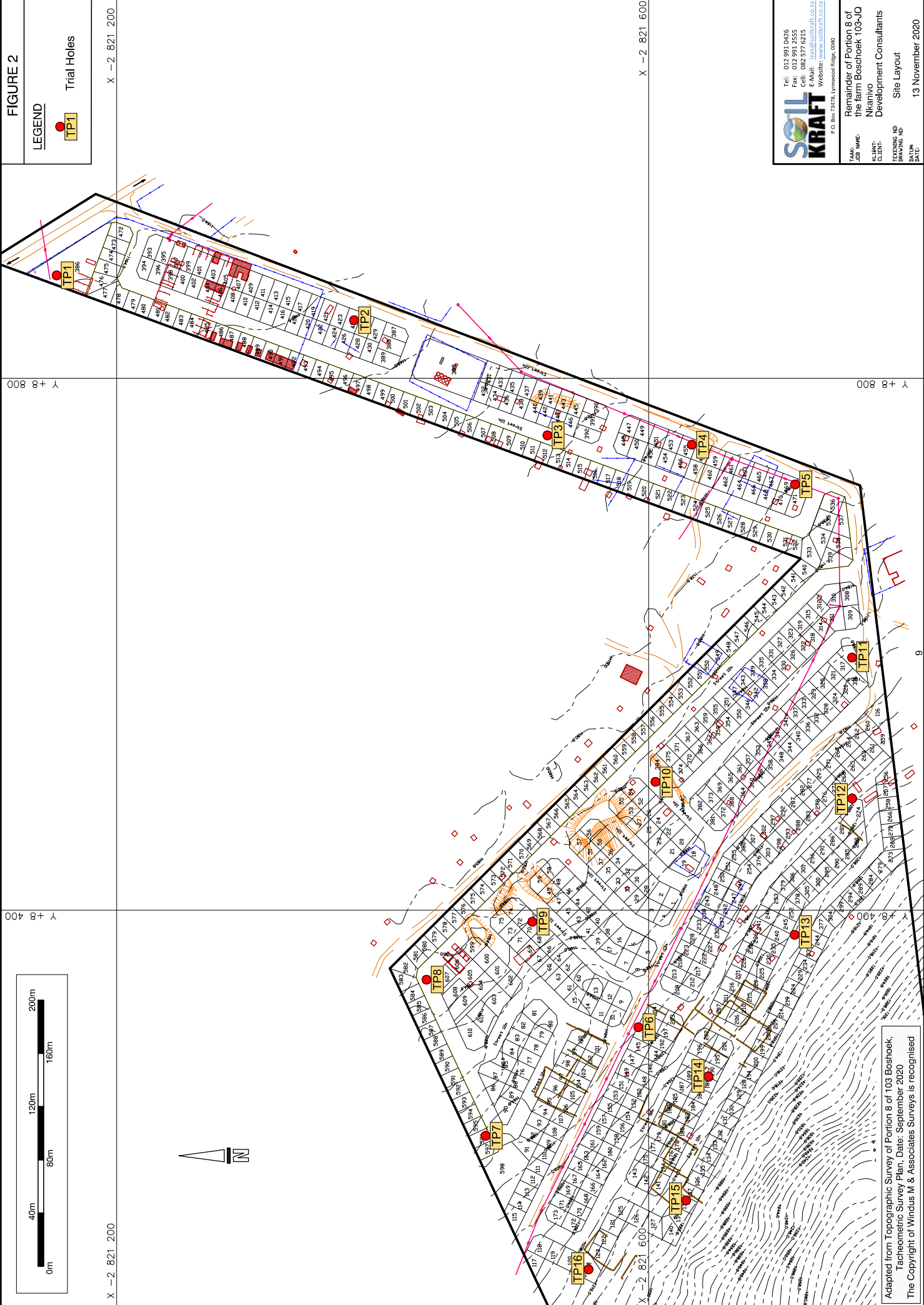


FIGURE 2

LEGEND
TP1 Trial Holes

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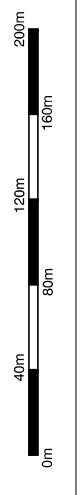
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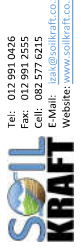
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Remainder of Portion 8 of
 the farm Boshoek 109-JQ
 Nkanvno
 Development Consultants
 Site Layout
 13 November 2020

DRAW NAME:
 CLIENT:
 DRAWING NO:
 DATE:

Adapted from Topographic Survey of Portion 8 of 103 Boshoek,
 Tacheometric Survey Plan, Date: September 2020
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5.2 Materials Tests

Material tests were performed by the commercial geotechnical laboratory facility of Specialised Testing Laboratory (STL) in Pretoria. STL is a SANAS accredited laboratory. Material tests included the following:

- *Foundation Indicators:* Foundation indicator tests were performed to establish the general geotechnical properties of in situ materials including grading, hydrometer analysis and Atterberg Limits.
- *Soil Chemistry:* Soil chemistry was assessed by means of soil paste pH and conductivity analyses. The soil chemistry was analysed to determine whether the materials are corrosive and would affect metal objects installed below surface level (e.g. utilities, services, etc.).
- *Settlement Tests:* Undisturbed block samples were collected from selected materials and used for consolidation tests. These tests are used to assess the materials' susceptibility to settlement.

The test results of disturbed soil tests are summarised in Table 2, while the complete material test results are included in Appendix B.

6 DISCUSSION

6.1 Geology

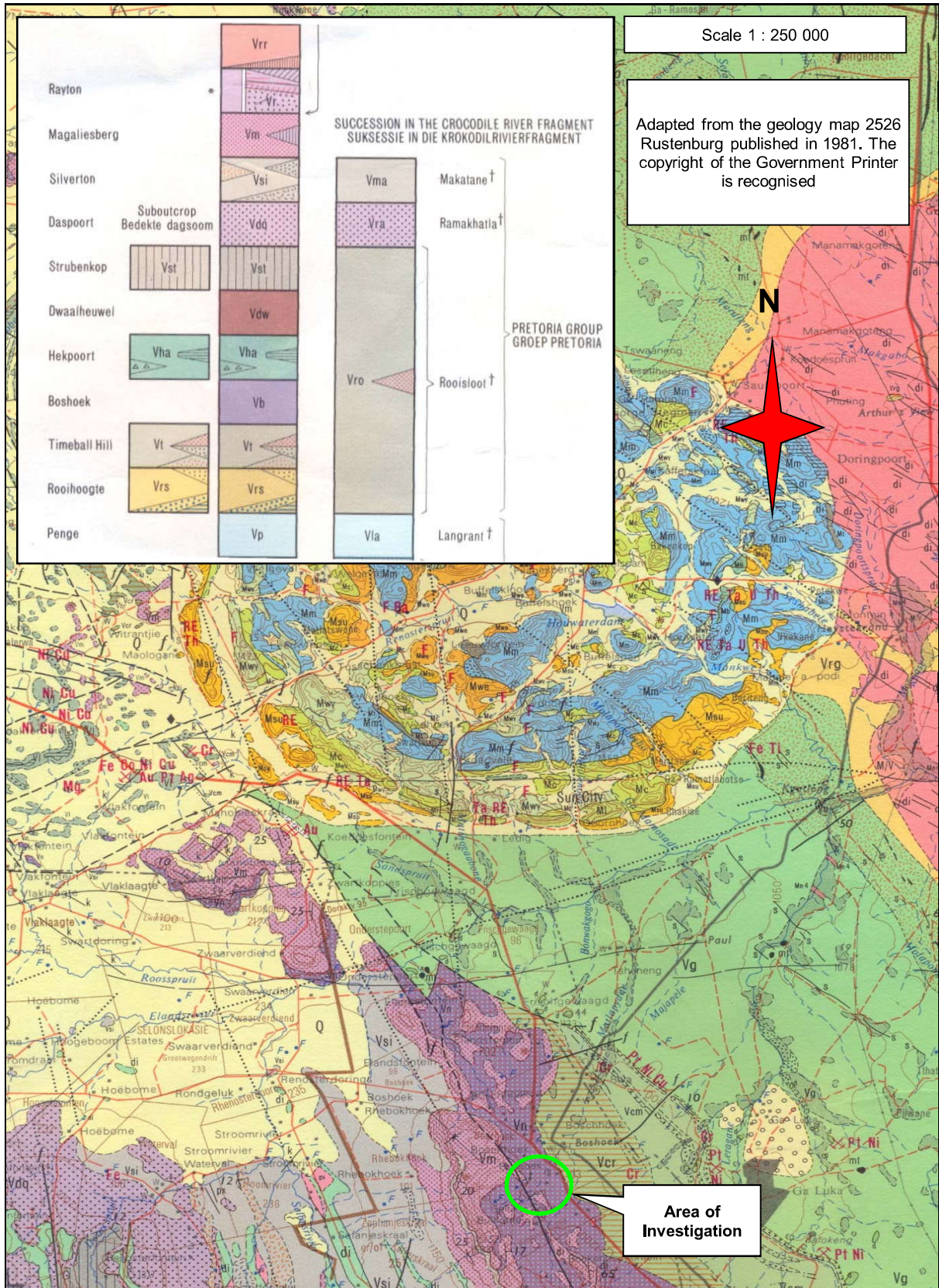
The regional geological map indicates that the site is underlain by complex geology. According to the map, the north eastern side of the study area is underlain by the Kolobeng Norite of the Rustenburg Layered Suite (Bushveld Igneous Complex). Bedrock materials typically include norite, diabase and hybrid rocks. However, the south western side of the study area is underlain by the Magaliesberg Formation of the Pretoria Group (Transvaal Supergroup), which typically includes quartzite and minor hornfels bedrock. Of importance, the regional map indicates that a fault line between the two geological units spans the site and is orientated north north west to south south east.

None of the trial holes excavated on site contained unweathered bedrock material. However, the steep and mountainous area south west of the proposed development area hosted extensive quartzite bedrock outcrop. As such, the Magaliesberg Formation is confirmed on the site. While some residual soils on the northern parts of the site seem compliant with residual norite, the exact geological origin cannot be confirmed in the absence of bedrock material.

Figure 3 : Regional Geology Map allows an overview of the geology of the area.

TABLE 2 : SUMMARY OF SOIL TESTS

TRIAL HOLE NO	SAMPLE NO	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	GM	PI	LL	% CLAY CONTENT	ACTIVITY CLASS	pH	CONDUCTIVITY (S/m)	SOIL CLASS	
												PRA	UNIFIED
1	SKT-102-877	0 - 900	Colluvium 1	Sand	1.05	8	19	16	Low	4.8	0.024	A-2-4	SC
2	SKT-102-879	700 - 2500	Ferruginised colluvium	Clayey sand	0.96	15	29	24	Low			A-6	SC
4	SKT-102-881	300 - 1400	Colluvium 1	Sand	1.05	3	17	5	Low			A-2-4	SM
7	SKT-102-882	400 - 2200	Scree deposit	Sandy gravel	2.20	14	30	7	Low	5.0	0.016	A-2-6	GC
12	SKT-102-883	300 - 1400	Colluvium 2	Sandy gravel	2.37	12	27	7	Low			A-2-6	SC
14	SKT-102-884	1000 - 1400	Residual quartzite	Sandy gravel	2.14	16	40	7	Low	4.7	0.022	A-2-6	SC
16	SKT-102-885	400 - 2500	Scree deposit	Sandy gravel	2.11	17	39	9	Low			A-2-6	SC



REGIONAL GEOLOGY

FIGURE 3

6.2 Soil Profiles

Prior to discussing the geotechnical zoning of the land, it is important to distinguish between the different materials present on site. Due to the geology and topography of the site, physical properties, as well as vertical and lateral distribution of the materials were notable variable. Nevertheless, the materials encountered can be summarised as follows:

- *Fill Materials:* Fill materials were erratically distributed across the site as surficial pockets which are of minor significance. However, in the vicinity of trial holes 8, 9 and 10, extensive fill material was encountered, mostly in the form of stockpiled waste or earth. The stockpiled materials appeared to resemble some waste or leftover material sourced from mining operations, or even possibly metal processing waste or slag. The fill materials were not sampled as the composition was variable and it was clearly not suitable for construction or founding.
- *Colluvium 1:* The first discernible colluvial horizon identified consisted of sandy material with light grey, grey brown or dark grey brown colour. The horizon mostly had a loose or very loose consistency and was intact. Vertical thicknesses of this horizon were variable and ranged from 200mm to 2400mm, while occasionally also containing surficial pockets of rubble. Material test results suggest that the material has a low expansive potential, with active clay content between 5% and 16% and associated plasticity indices between 3% and 8%. The material had a grading modulus of 1.05 on both occasions tested, while a PRA classification of A-2-4 was also awarded to both samples. In addition, consolidation samples were extracted from this horizon and results for one of the samples revealed that the material is very highly susceptible to compression. The second sample, taken from trial hole 1, was far less susceptible to settlement and was scrutinised further. In hindsight it was noted that the sample may have been compacted to some extent by vehicular traffic in the past. Consequently, the results of this sample are treated with caution.
- *Colluvium 2:* The second discernible colluvial horizon could arguably constitute a poorly developed pebble marker horizon. Nevertheless, the sandy gravel horizon had distinctive red colour derivatives with occasional black discolourations. The horizon mostly had a medium dense or dense consistency and an intact structure. Test results reported a low affinity to heave, with active clay content and a plasticity index of 7% and 12%, respectively. The sample had a grading modulus of 2.37 and was awarded a PRA classification of A-2-6, though it should be taken into account that some oversized particles forming part of the horizon (i.e. cobbles) were deliberately excluded during sampling.
- *Ferruginised Colluvium:* Ferruginised colluvium was found in trial holes 1 and 2, where it consisted of light grey blotched orange clayey sand with a loose to medium dense consistency and an intact structure. Despite the material's active clay content (i.e. 24%), it had a plasticity index of only 15% and was classified as a low expansive potential material. A grading modulus of 0.96 was calculated and a PRA classification of A-6 was awarded.
- *Scree Deposits:* The most dominant material encountered in soil profiles on this site consisted of scree deposits originating from the adjacent quartzite ridge. For the most part the scree consisted of sandy gravel and quartzite cobbles. The horizon matrix typically had brown red colour, a

medium dense or dense consistency and an intact structure. Oversized gravel and cobble fragments were excluded during sampling and the subsequent results confirmed a low affinity to heave. The sample contained active clay content between 7% and 9%, with plasticity indices between 14% and 17%. In addition, the selectively sampled material had grading moduli between 2.11 and 2.20, and a PRA classification of A-2-6 was awarded to all samples tested.

- *Residual Quartzite*: The material identified as residual quartzite appeared to have been modified to some extent and could correspond closely with the indicated fault line on site. Nevertheless, the horizon was generally described as grey white mottled dark red (or dark red mottled white) sandy gravel with a very dense consistency and intact structure. As with other materials, the residual quartzite has a low affinity to heave with active clay content and a plasticity index of 7% and 16%, respectively. The material had a grading modulus of 2.14 and was awarded a PRA classification of A-2-6.

6.3 Groundwater

- *Perched Water*: No seepage or perched water was encountered in any of the trial holes during the site investigation. However, based on physical observations, it is expected that seepage water may occur in profiles on the northern side of the site, particularly in the vicinity of trial holes 1 and 2. These conditions are expected to be strongly seasonal and will most likely occur between the middle and end of the rainy season.
- *Permanent Water*: Vegter^{Reference 9.4} indicates the probability of drilling successfully for water in the area to be between 20% and 30% and if water is encountered, the probability is between 40% and 60% that the yield of such a borehole will exceed 2l/s.

6.4 Geotechnical Zoning

When discussing the geotechnical conditions of the area, it is important to keep the following issues in mind:

- *Properties of Heave*: Material test results suggest that none of the soils tested are particularly expansive. As such, conditions of soil heave are not expected to prove problematic.
- *Properties of Settlement*: Consolidation test results suggest that colluvial soils are very susceptible to compression, even at loads as low as 50kPa. The total settlement that may occur depends on the vertical thickness of the material underlying future foundations and hence settlement was estimated for each trial hole soil profile.
- *Steep Slopes*: Despite the fact that problematically steep slopes were excluded from the proposed development area, the south western part of the proposed development area is still characterised by steep slopes which become progressively steeper further west.
- *Excavations*: The area surrounding trial hole 8 appeared to form part of a fairly deep excavation, as illustrated in Photo 2. This area appears to have been excavated decades ago and was presumably used to procure gravel, following which it was left unrehabilitated.



DEEP EXCAVATION

PHOTO 2

- *Fill Materials*: Heaps or stockpiles of fill material occurred between trial holes 8 and 10, as shown in Photo 3. These fill materials consisted of stockpiled earth (close to trial hole 10), as well as what appeared to be waste materials from a mining or metal production plant.

The geotechnical classification of the property is in accordance with the guidelines of the NHBRC^{Reference 9.5}. Within the limitations of the scope of the investigation and based on the principles as explained above, the site can be divided into the following zones:

- **Zone 1: S₂**: The first zone includes the northern-most corridor of the site where soil profiles consist of substantial colluvial deposits, which are susceptible to consolidation settlement. Total soil settlement is expected to exceed 20mm.
- **Zone 2: S**: This zone abruptly borders zone 1 and combined settlement of less than 10mm is expected to occur. The soil profiles generally consist of colluvial soils which may overlie a poorly developed pebble marker horizon.
- **Zone 3: S/P_{slope}**: This zone includes the majority of the southern and south western parts of the study area. The soil profiles in this zone are characterised by substantial scree deposits which are often quite coarse. Limited soil settlement (i.e. less than 10mm) is expected; however, this zone is characterised by steep slopes which become increasingly steep towards the south west. The gradients are considered to be of “intermediate” favourability in this zone, with peripheral parts of the zone tending to “least favourable”.
- **Zone 4: P_{Fill}**: Zone 4 includes the area where fill materials have been stockpiled. As this area is covered, it is not known what the underlying soil profile consists of, though it is likely that the underlying profile is similar to that of Zone 2. In its present state, however, this zone is not suitable for development. It is possible that this site may be rendered suitable for development at a later stage, provided all fill materials are removed and limited supplementary geotechnical work is undertaken to ensure that the underlying soil profiles (and geotechnical conditions) comply with those of the surrounding area.
- **Zone 5: P_{Excavations}**: This final zone is not considered suitable for development. The zone includes an area which has historically been excavated fairly deeply (estimated up to four metres deep) and has been left in an unrehabilitated state.

Figure 4 illustrates the geotechnical zoning derived from the trial hole investigation and material test results.

6.5 Conditions of Excavation

As far as conditions of excavation are concerned, the following applies to the study area, as deduced from trial hole excavation using a backhoe (TLB):



FILL MATERIAL

PHOTO 3

FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES

AREA	GEOTECHNICAL CLASS	% OF TOTAL AREA	ESTIMATED SOIL MOVEMENT	SOIL PROFILE	DEVELOPMENT POTENTIAL	CONSTRUCTION TYPE	FOUNDATION DESIGN	ASSOCIATED PROBLEMS
1	S2	25,50%	Combined soil settlement exceeding 20mm	Thick colluvial deposits	Intermediate	Modified	Reinforced concrete raft OR Soil replacement raft	Corrosive soils Seasonal seepage water
2	S	30,25%	Combined soil settlement up to 10mm	Colluvial soils overlying pebble marker and/or scree deposits	Intermediate	Normal	Normal strip footings	Corrosive soils
3	S/F _{slope}	33,82%	Combined soil settlement of less than 10mm	Colluvial cover overlying scree deposits and/or residual quartzite	Intermediate	Modified	Soil replacement raft	Steep slopes Coarse scree Corrosive soils Difficult excavation
4	P _{Fill}	8,93%	N/A	Stockpiles of fill	Not Suitable	N/A	N/A	Problematic fill stockpiles Requires rehabilitation
5	P _{Excavations}	1,49%	N/A	N/A	Not Suitable	N/A	N/A	Deep excavations

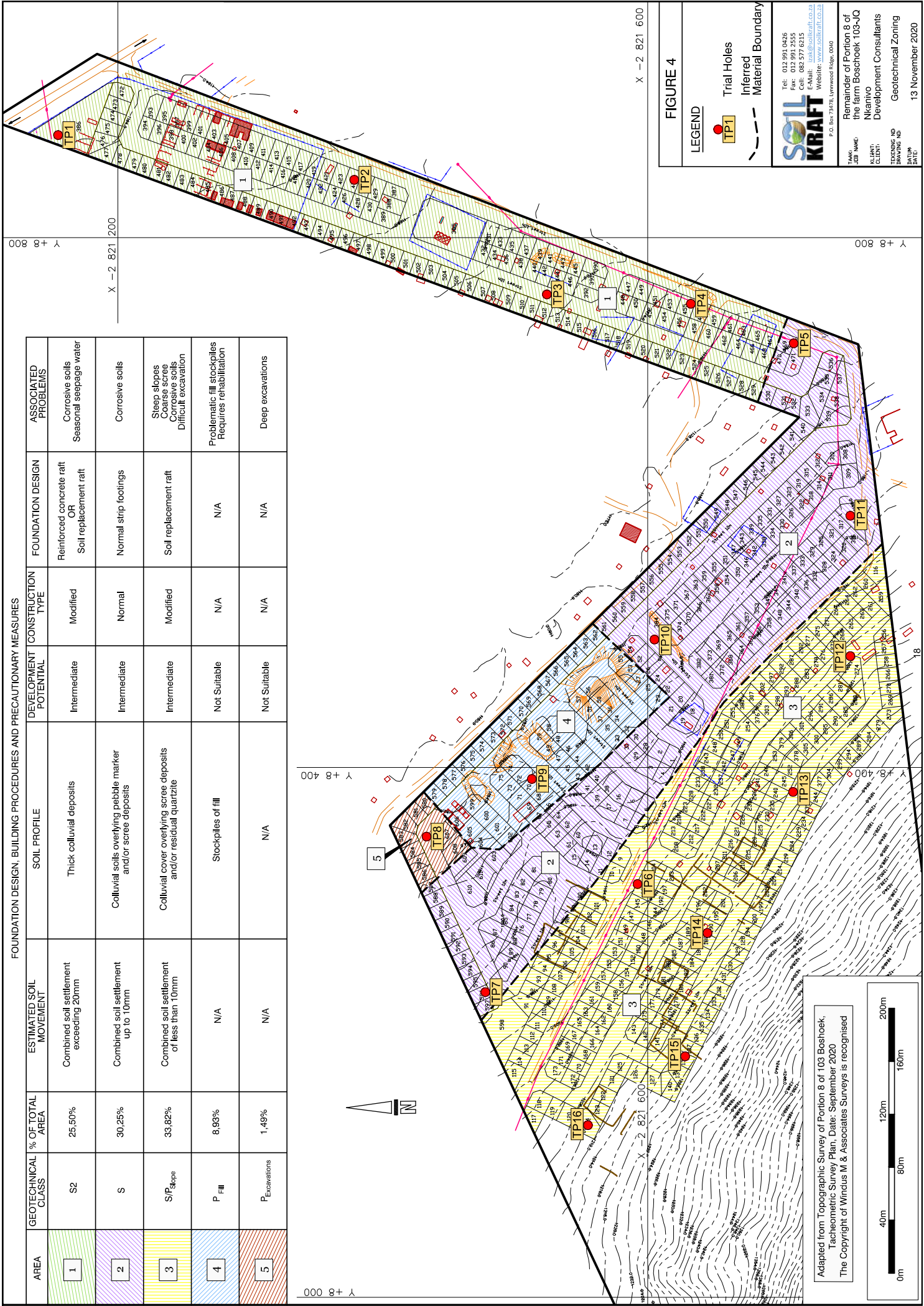


FIGURE 4

LEGEND

- Trial Holes
- Inferred Material Boundary

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Remainder of Portion 8 of the farm Boschhoek 103-JQ

CLIENT: Nkanvvo Development Consultants
 DRAWING NO: Geotechnical Zoning
 DATE: 13 November 2020

- *Fill Materials:* The fill materials are considered excavatable by backhoe or similar mechanical means. The volume of fill in geotechnical zone 4 is substantial, though, and would require earthmoving equipment to be relocated or loaded effectively.
- *Colluvium 1:* The first colluvial material can be considered soft soil excavation and offered little resistance to excavation using a backhoe.
- *Colluvium 2:* The second colluvial horizon required notable effort to excavate due to its medium dense or dense consistency. Intermediate soil excavation must be anticipated.
- *Ferruginised Colluvium:* The ferruginised colluvial materials also made for conditions of soft soil excavation. The material was easily excavatable using a backhoe but may suffer instability associated with expected seasonal groundwater influx.
- *Scree Deposits:* The scree deposits generally made for difficult soil excavation due to the material's dense or very dense consistency, and its composition. Excavation by backhoe was impeded by the inclusion of cobbles in this horizon, which could in places be considered similar to boulder class excavation. The scree deposits induced gradual refusal of excavation (using a backhoe) on at least one occasion.
- *Residual Quartzite:* The residual quartzite horizon had a very dense consistency and made for conditions of difficult soil excavation. The horizon induced gradual refusal of excavation on all occasions it was encountered.
- *Bedrock:* No bedrock was encountered in any of the trial holes. Bedrock found on the adjacent ridge is expected to constitute hard or very hard rock material.
- *Seepage:* Groundwater seepage is expected to occur in geotechnical zone 1 and may necessitate for deep excavations to be pumped dry in summer (i.e. rainy season).
- *General:* Proven depths of excavation by backhoe ranged from 1300mm to 2500mm, with 9 of the 16 trial holes reaching or exceeding a depth of 2000mm. In addition, gradual refusal of excavation by backhoe was recorded in 7 of the 16 trial holes.
- *Trial Holes:* Cognisance must be taken of the location of trial holes as backfilled test positions will not comply with the remainder of the soil profiles on site and are disturbed.

6.6 Seismicity

Kijko^{Reference 9.6} indicates that the annual probability of an earthquake with intensity of 4.2 on the Modified Mercalli Scale to occur in the area is less than 10^0 . The probability of an earthquake with an intensity of 7.1 to occur is 10^{-3} . A 10% probability exists that an earthquake with Peak Ground Acceleration between 0.14g and 0.18g may take place once in 50 years. Seismic events in this region are generally associated with mining activity.

To put the above information into perspective, Table 3 : Earthquake and Magnitude and Intensity, is attached to this report.

TABLE 3 : EARTHQUAKE MAGNITUDE AND INTENSITY

MODIFIED MERCALLI INTENSITY SCALE	INTENSITY	DESCRIPTION	RICHTER SCALE MAGNITUDE	RADIUS OF PERCEPTIBILITY (km)
I	Instrumental	Detected only by seismography		
II	Feeble	Noted only by sensitive people	3.5 to 4.2	3 to 24
III	Slight	Like the vibrations due to a passing lorry. Felt by people at rest, especially on upper floors		
IV	Moderate	Felt by people while walking. Rocking of loose objects, including vehicles	4.3 to 4.8	24 to 48
V	Rather strong	Felt generally ; most sleepers are awakened and bells ring		
VI	Strong	Trees sway and suspended objects swing ; damage by overturning and flinging of loose objects	4.9 to 5.4	48 to 112
VII	Very strong	General public alarm ; walls crack ; plaster falls	5.5 to 6.1	110 to 200
VIII	Destructive	Car drivers seriously disturbed; masonry fissured ; buildings damaged	6.2 to 6.9	200 to 400
IX	Ruinous	Houses collapse ; pipes break		
X	Disastrous	Ground cracks badly ; buildings destroyed ; railway lines bent ; landslides on steep slopes	7.0 to 7.3	400 to 700
XI	Very disastrous	Few buildings remain standing; bridges destroyed ; all services out of action ; great landslides and floods	7.4 to 8.1	400 to 700
XII	Catastrophic	Total destruction ; objects thrown into the air; ground rises and falls in waves	>8.1	400 to 700

6.7 Soil Corrossivity

When discussing soil corrossivity, it is applicable to consider the guidelines as proposed by Evans^{Reference 9.7}. The corrossivity of a soil towards buried, exposed, metallic surfaces depends on the following properties of the soil:

- Electrical conductivity.
- Chemical properties of the soil.
- Ability of the soil to support sulphate reducing bacteria.
- Heterogeneity of the soil.

The pH of a soil gives an indication of potential acid related problems. Should the soil pH be less than 6.0, corrosion may take place and should the pH be less than 4.50, the problem of corrosion may be serious. If the conductivity of the soil is less than 0.1mS/cm, corrossivity is generally not a problem. However, the corrosion potential of the soil increases with an increase in conductivity. Should the conductivity of the soil exceed 0.5mS/cm, the soil can be regarded as very corrosive. Should exposed metal pipes pass from argillaceous soils to arenaceous soils or vice versa, electrochemical cells are set up due to the different rates of oxygen diffusion of the soils. Sulphate reducing bacteria is usually present under anaerobic conditions, that is, typically saturated or waterlogged clays.

Soil chemistry tests were performed on materials considered most likely to host services and utilities in future. Results revealed the following:

- *Colluvium*: A sample taken from the colluvium 1 horizon had a soil pH of 4.8 and a soil paste conductivity of 0.024S/m. As such, the material is considered slightly corrosive on account of conductivity, but corrosive to very corrosive on account of acidity.
- *Scree Deposits*: The matrix material of the scree deposits was sampled for analyses. The results reported a pH of 5.0 and a soil paste conductivity of 0.016S/m. As a result, the material is considered slightly corrosive on account of conductivity and mildly corrosive on account of its acidity.
- *Residual Quartzite*: The residual quartzite is considered corrosive to very corrosive on account of acidity (i.e. pH of 4.7), and slightly corrosive on account of its conductivity (i.e. 0.022S/m).
- *Seasonally Seepage Water*: The expected conditions of seasonal seepage water in geotechnical zone 1 are likely to exacerbate corrosion by processes of oxidation (i.e. rusting).

Taking all of the above into consideration, precautionary measures will be required to counter the effects of corrosive soils on this site.

6.8 Other Considerations

- *Historic Monuments*: There are no historic monuments on the site; however, a number of abandoned and partially demolished buildings were found.
- *Undermining*: No evidence of undermining was observed on site; however, this remains to be verified. Cognisance must be taken of the large excavation area at trial hole 8, where it appears gravel materials were procured in past decades.
- *Cemetery Sites*: No graves were observed during the investigation. Considering the proposals of Fischer^{Reference 9.8} the property is not suitable for cemetery site development.
- *Termite Nesting*: Termite nests were encountered at multiple locations on the site.
- *Dolomite*: The site is not located on dolomitic land.

7 CONCLUSIONS

Based on the outcome of the phase one geotechnical investigation, the following factors must be considered:

- *Geology*: The property apparently straddles a fault line which forms a geological boundary between the Magaliesberg Formation (Pretoria Group, Transvaal Supergroup) and the Kolobeng Norite (Rustenburg Layered Suite, Bushveld Igneous Complex). Only bedrock of the Magaliesberg Formation quartzite was found in outcrop along the steep, mountainous ridge.
- *Soil Profiles*: The profiles on the site are highly variable due to the geological and topographical nature of the study area. In general, the north eastern parts of the site are characterised by thick colluvial deposits, while the southern and south western parts are dominated by scree deposits.
- *Groundwater*: Seasonal seepage water is expected to occur in soil profiles in the northern parts of the study area, in geotechnical zone 1.
- *Founding Conditions*: The site was divided into five geotechnical zones namely **S2**, **S**, **S/P**_{Slope}, **P**_{Fill} and **P**_{Excavations}. Very steep and mountainous areas south west of the proposed township area were excluded from development.
- *Conditions of Excavation*: Apart from some colluvial materials which made for soft excavation, the majority of soil materials encountered made for intermediate or hard/difficult soil excavation. Scree deposits, in particular, presented a major impediment to excavation due to the inclusion of quartzite cobbles.
- *Corrossivity*: Tests revealed that in situ materials are corrosive to very corrosive, mostly on account of soil acidity.
- *Cemetery Sites*: No graves were observed on site.
- *Historic Monuments*: There are no historic monuments on the site.
- *Undermining*: As far as could be determined, the area is not subject to undermining, though this must be verified. An area was identified where a substantial volume of gravel had been procured in past decades.

- *Seismicity*: A 10% probability exists that an earthquake with Peak Ground Acceleration of 0.14g to 0.18g may take place once in 50 years. Seismic events in this region are generally associated with mining activity.
- *Termite Nesting*: A number of termite nests were noted on the surface of the study area.
- *Dolomite*: The site is not dolomitic.

8 RECOMMENDATIONS

8.1 Preliminary Proposals for Founding and Construction

The recommendations provided below are based on guidelines for single storey masonry structures and are provided as a general indication, as per SANS 634. These recommendations should not be considered as design-specific recommendations for individual structures.

8.1.1 Geotechnical Zone 1: **S2**

Construction in this zone must anticipate expected soil settlement in excess of 20mm. The following options are recommended for construction:

- **Reinforced Raft**: Structures may be founded by means of reinforced rafts capable of accommodating combined settlement exceeding 20mm at a suitable safety factor. The raft should not exert more than 50kPa foundation pressure. The superstructure must contain lightly reinforced masonry and articulation joints must be installed at all doors and opening, while floor slabs must be fabric reinforced.
- **Soil Replacement Raft**: Alternatively, structures may founded by means of a soil replacement raft. In this case materials must be excavated to at least 1.5 times the widest foundation and 1.0m beyond the proposed building footprint, before being replaced with inert material of at least G7 quality in 150mm layers which are compacted to 93% Mod AASHTO density at moisture contents between -1% and +2% of optimum moisture content. Founding may then be done by means of lightly reinforced strip footings, with foundation loads limited to 50kPa. Masonry must be lightly reinforced.

In addition to the above, it is expected that seasonal groundwater seepage may occur. During years of high rainfall, such seepage may affect founding depths and as a result, provision should be made in this regard.

8.1.2 Geotechnical Zone 2: **S**

Provided soil profiles underlying individual structures do not contain excessively coarse fragments (i.e. cobbles) in the scree deposits, founding in this zone may be done by means of conventional strip footings and normally constructed superstructure.

8.1.3 Geotechnical Zone 3: *S/P_{Slope}*

Founding in this zone is out of the ordinary. While limited soil movement is expected, which would generally result in conventional foundation construction, the nature of the scree deposits in this zone is very coarse. As a result, it is anticipated that normal strip footings would not be a suitable method of founding.

Instead, it is recommended that structures be founded by means of a soil replacement raft. In this case, the coarse scree materials must be excavated to at least 1.5 times the widest foundation and 1.0m beyond the proposed building footprint, before being replaced with inert material of at least G7 quality in 150mm layers which are compacted to 93% Mod AASHTO density at moisture contents between -1% and +2% of optimum moisture content. Founding may then be done by means of lightly reinforced strip footings, with foundation loads limited to 50kPa. Masonry must be lightly reinforced.

8.1.4 Geotechnical Zone 4: *P_{Fill}*

This zone, in its current state, is not suitable for development or construction as it hosts large stockpiles of loose-lying fill. It is recommended that the stockpiles and all fill materials immediately surrounding this zone be cleared entirely, following which limited supplementary geotechnical work (i.e. trial holes) must be undertaken to determine what in situ geotechnical conditions are and whether these comply with adjacent geotechnical zones.

8.1.5 Geotechnical Zone 5: *P_{Excavations}*

This zone is not considered suitable for development due to the prevailing, large excavation depression present. Considering the cost and effort that would be required to rehabilitate this zone in order to render it suitable for development, it is unlikely to be financially feasible. It is recommended instead, that this site be considered an open green or public open space.

8.1.6 General Measures

It is critical that site drainage and storm water be planned carefully to ensure efficient drainage in lower-lying parts of the site, while also preventing erosion induced by rapid runoff in the steep parts of the site. It is further recommended that geotechnical zone 5 be considered carefully, as far as drainage is concerned, as the large depression is likely to fill with excess surface runoff water during intense or prolonged precipitation events and may potentially pose a safety hazard.

8.2 Conditions of Excavation

Considering the parameters of "Conditions of Excavation" as per SABS 1200, one must allow for the following prevailing site conditions:

- *Fill Materials*: Fill materials are considered soft, easy excavation, though earthmoving equipment may be required to remove the large volume of material which was stockpiled.
- *Colluvium 1*: The first colluvial horizon can be considered soft soil excavation. Excavation by hand will be feasible, provided groundwater influx does not occur.
- *Colluvium 2*: The second colluvial horizon should best be excavated by mechanical means (i.e. machine) due to the material's consistency.
- *Ferruginised Colluvium*: This material can be excavated by hand or machine; however, considering the anticipated groundwater influx in this horizon, machine excavation is recommended to limit safety concerns.
- *Scree Deposits*: Machine excavation will be essential to remove the scree deposits. The use of a backhoe was only marginally successful and hence, larger excavations equipment (e.g. excavator) is recommended. Provision should also be made to remove substantial volumes of cobbles, similar to boulder class excavation.
- *Residual Quartzite*: Machine excavation is recommended to remove residual quartzite. A backhoe was only partially successful in excavating this material and hence the use of an excavator may be more efficient.
- *Bedrock*: No bedrock was encountered in any of the trial holes. However, quartzite outcrop dominated the adjacent, mountainous ridge. It is expected that the quartzite will constitute hard or very hard rock material.
- *Seepage*: It is anticipated that seasonal groundwater influx will occur in geotechnical zone 1. Provisions must therefore be made to pump dry excavations made in this zone.
- *General*: Proven depths of excavation by backhoe ranged from 1300mm to 2500mm.
- *Trial Holes*: Cognisance must be taken of the location of trial holes as backfilled test positions will not comply with the remainder of the soil profiles on site and are disturbed.
- *Excavation Stability*: Care must be taken when working near or in open excavations. In addition, the steep gradient in parts of this site may adversely affect excavation stability and particular care would need to be taken in this regard. The safety of all persons working in or near open excavations must be ensured.

8.3 Corrossivity

Precautionary measures must be put in place to protect metallic services and utilities installed below ground from corrosive soils. The use of non-metallic (e.g. PVC) materials may be considered, or alternatively a protective coating can be applied to metal objects.

8.4 Further Work

Taking into account the findings of this investigation, limited additional work is recommended as outlined below:

- While no evidence of undermining was found on the site, it is recommended the absence of any underground mining work be confirmed.
- Additional consideration or work may be needed for geotechnical zones 4 and 5, as outlined in sections 8.1.4 and 8.1.5.

Finally, it is advised that particular care must be taken during the phase 2 geotechnical investigation of each individual stand. Due to the highly variable nature of the soil profiles on this site, it is expected that the geotechnical boundaries may not be as simple as derived from the phase one investigation. Therefore, vigilance will be required during the phase 2 investigation to delineate the geotechnical zones accurately.

9 SOURCES OF REFERENCE

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9.3 SAICE: South African Institution of Civil Engineers, Geotechnical Division (1990): *Geoterminology Workshop – Guidelines for Soil and Rock Logging*, published jointly by Association of Engineering Geologists (South Africa Section), South African Institution of Civil Engineers (Geotechnical Division) and South African Institute of Engineering Geologists, Rivonia

9.4 Vegter, J.R. (1995): *An Explanation of a Set of National Ground Water Maps*, published by the Water Research Commission, Pretoria

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9.6 Kijko A., Graham, G., Bejaichund, D.L., Roblin, D.L. and Brandt, M.B.C. (2003): *Probabilistic Peak Ground Acceleration and Spectral Seismic Hazard Maps for South Africa*, Report 2003-0053, Council for Geoscience.

9.7 Evans, U.R. (1971): *The Corrosion and Oxidation of Metals*, published by Edward Arnold.

9.8 Fischer, G.J. (date unknown): *The Selection of Cemetery Sites in South Africa*, published by the Council of Geoscience.

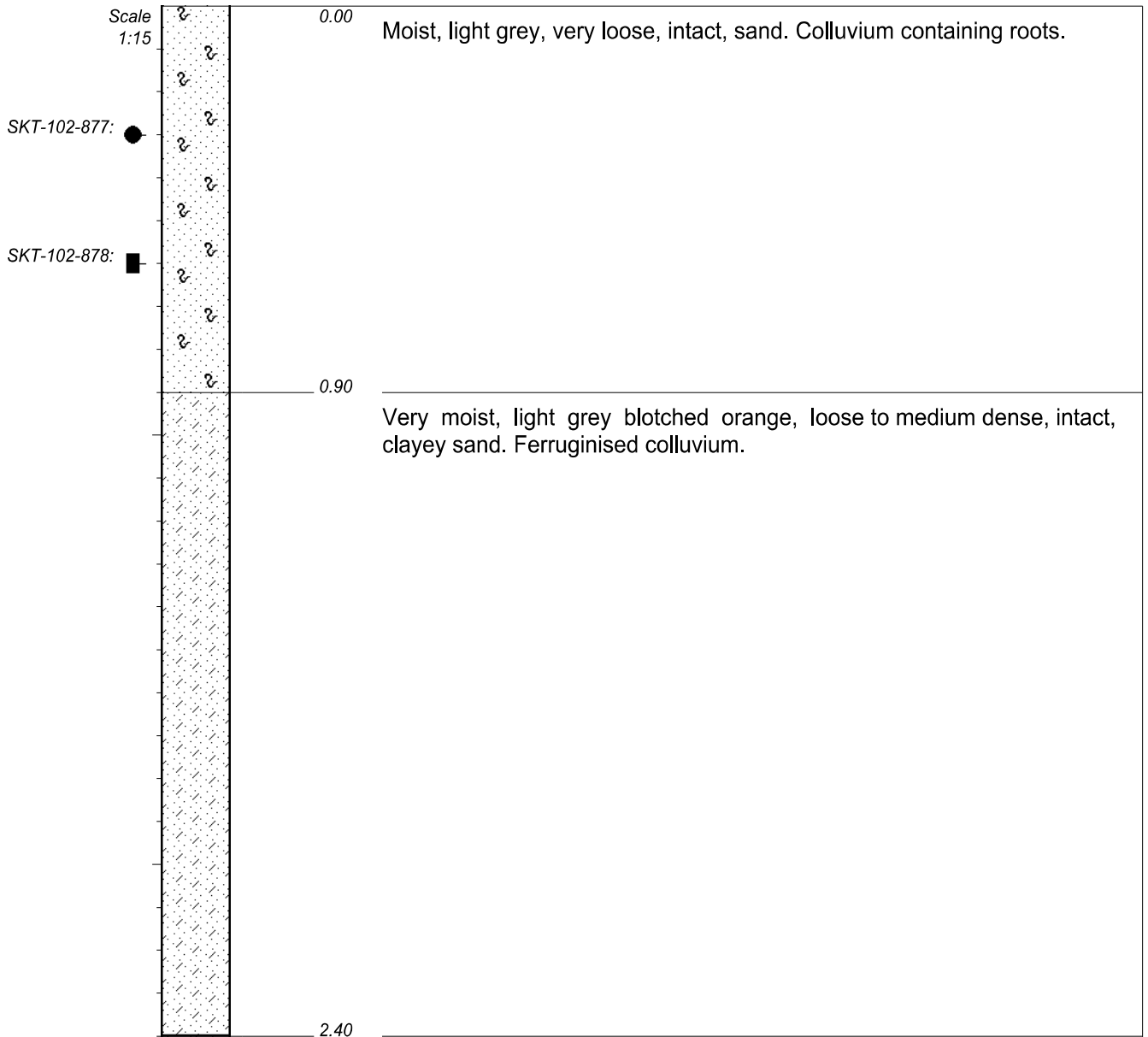
A handwritten signature in black ink, appearing to read 'IJ Breytenbach', with a stylized, cursive script.

IJ Breytenbach (Pr. Sci. Nat.)

12 November 2020

For Soilkraft cc

APPENDIX A: TRIAL HOLE LOG SHEETS



NOTES

- 1) No refusal of excavation.
- 2) No seepage.
- 3) Seasonal seepage expected in soil profile.
- 4) Disturbed Sample SKT-102-877: 0.30m.
- 5) Undisturbed Sample SKT-102-878: 0.60m.

CONTRACTOR : DEW Plant Hire
 MACHINE : Cat 426F2
 DRILLED BY : Thomas
 PROFILED BY : Izak Breytenbach

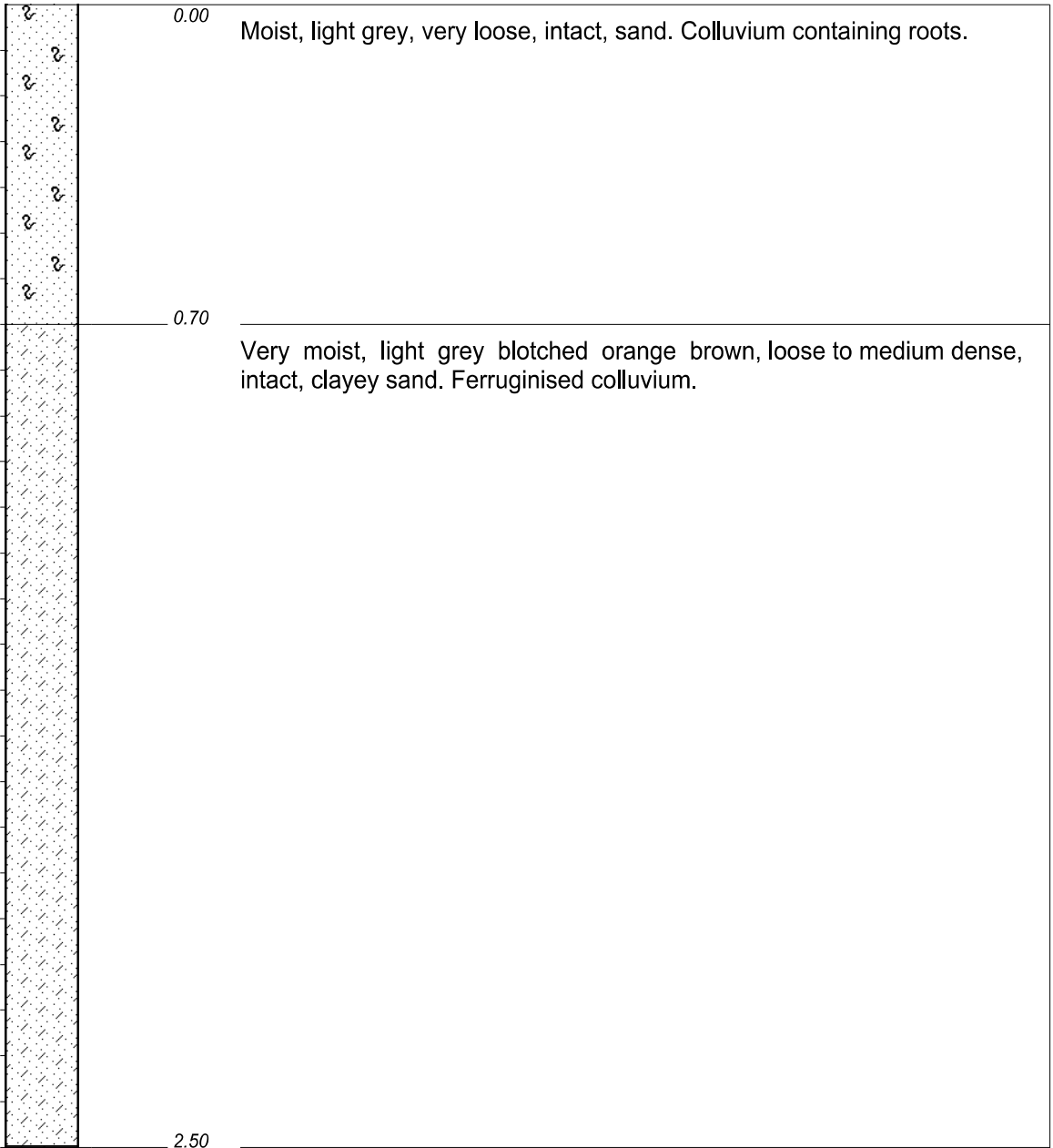
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 DATE : 09/11/2020 16:51
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ELEVATION :
 X-COORD : 25° 29 50.6S
 Y-COORD : 27° 05 18.0E

HOLE No: 1
 Geotechnical Investigation



Scale
1:15



NOTES

- 1) No refusal of excavation.
- 2) No seepage.
- 3) Seasonal seepage expected in soil profile.
- 4) Disturbed Sample SKT-102-879: 1.60m.

CONTRACTOR : DEW Plant Hire
 MACHINE : Cat 426F2
 DRILLED BY : Thomas
 PROFILED BY : Izak Breytenbach

INCLINATION :
 DIAM : 700mm
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 DATE : 20/10/2020
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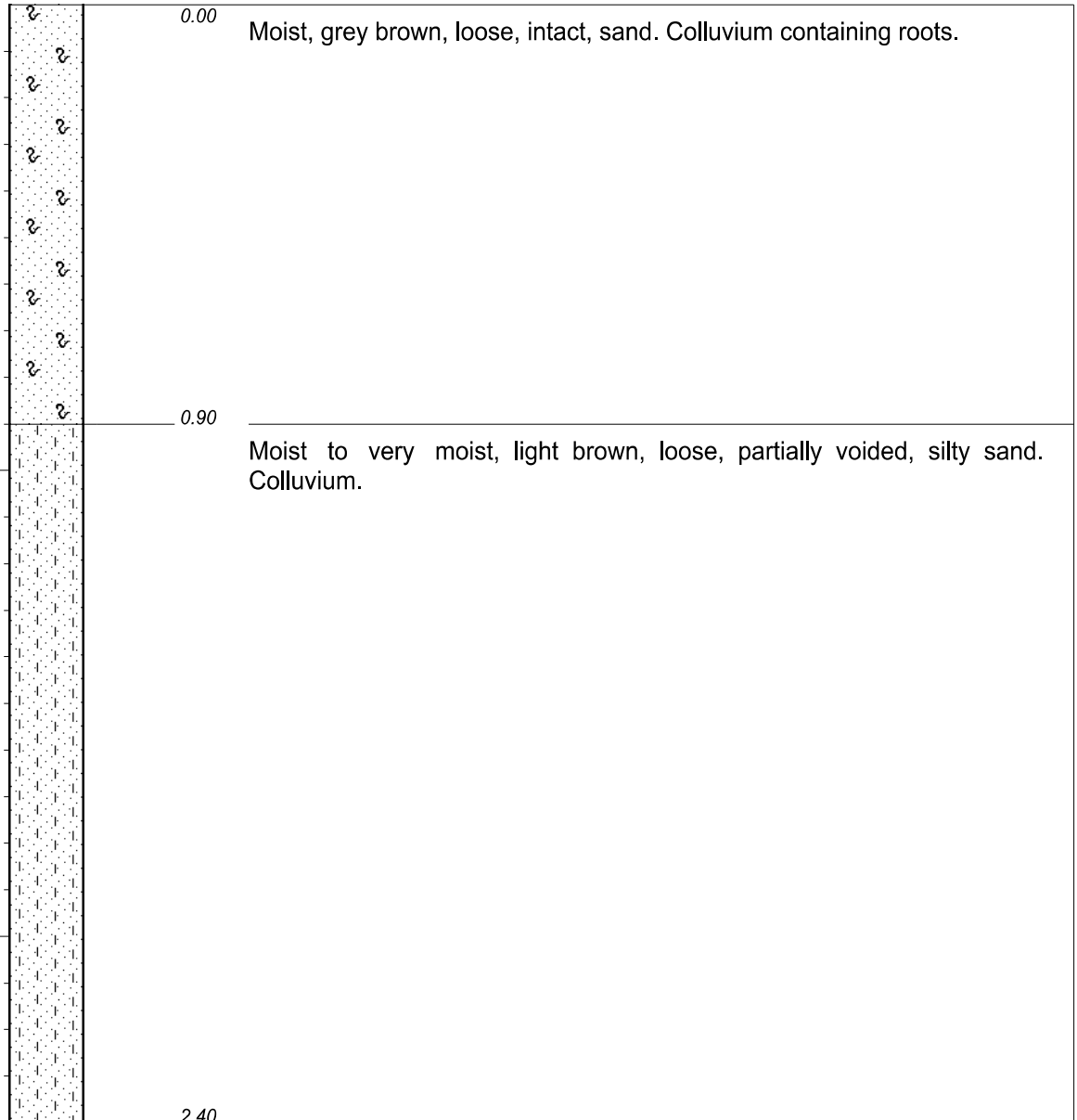
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 X-COORD : 25° 29 57.8S
 Y-COORD : 27° 05 16.7E

TYPE SET BY : Izak Breytenbach
 SETUP FILE : STANDARD.SET

HOLE No: 2
 Geotechnical Investigation



Scale
1:15



NOTES

- 1) No refusal of excavation.
- 2) No seepage.

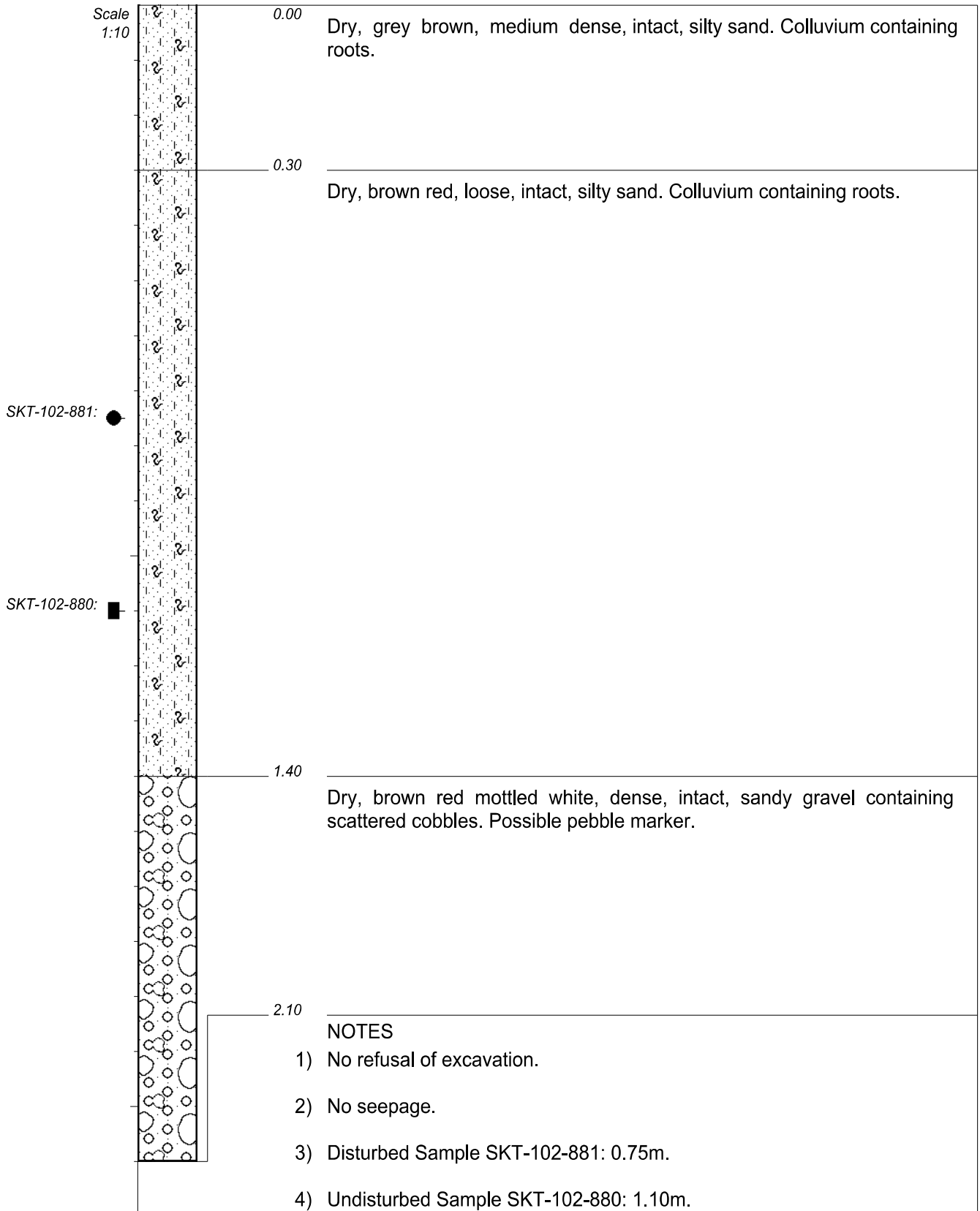
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 MACHINE : Cat 426F2
 DRILLED BY : Thomas
 PROFILED BY : Izak Breytenbach

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 DATE : 20/10/2020
 DATE : 09/11/2020 16:51
 TEXT : ..\Boschoek\TPProfiles.txt

ELEVATION :
 X-COORD : 25° 30 02.6S
 Y-COORD : 27° 05 13.6E

HOLE No: 3
 Geotechnical Investigation

Scale
1:10



CONTRACTOR : DEW Plant Hire
MACHINE : Cat 426F2
DRILLED BY : Thomas
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 20/10/2020
DATE : 09/11/2020 16:51
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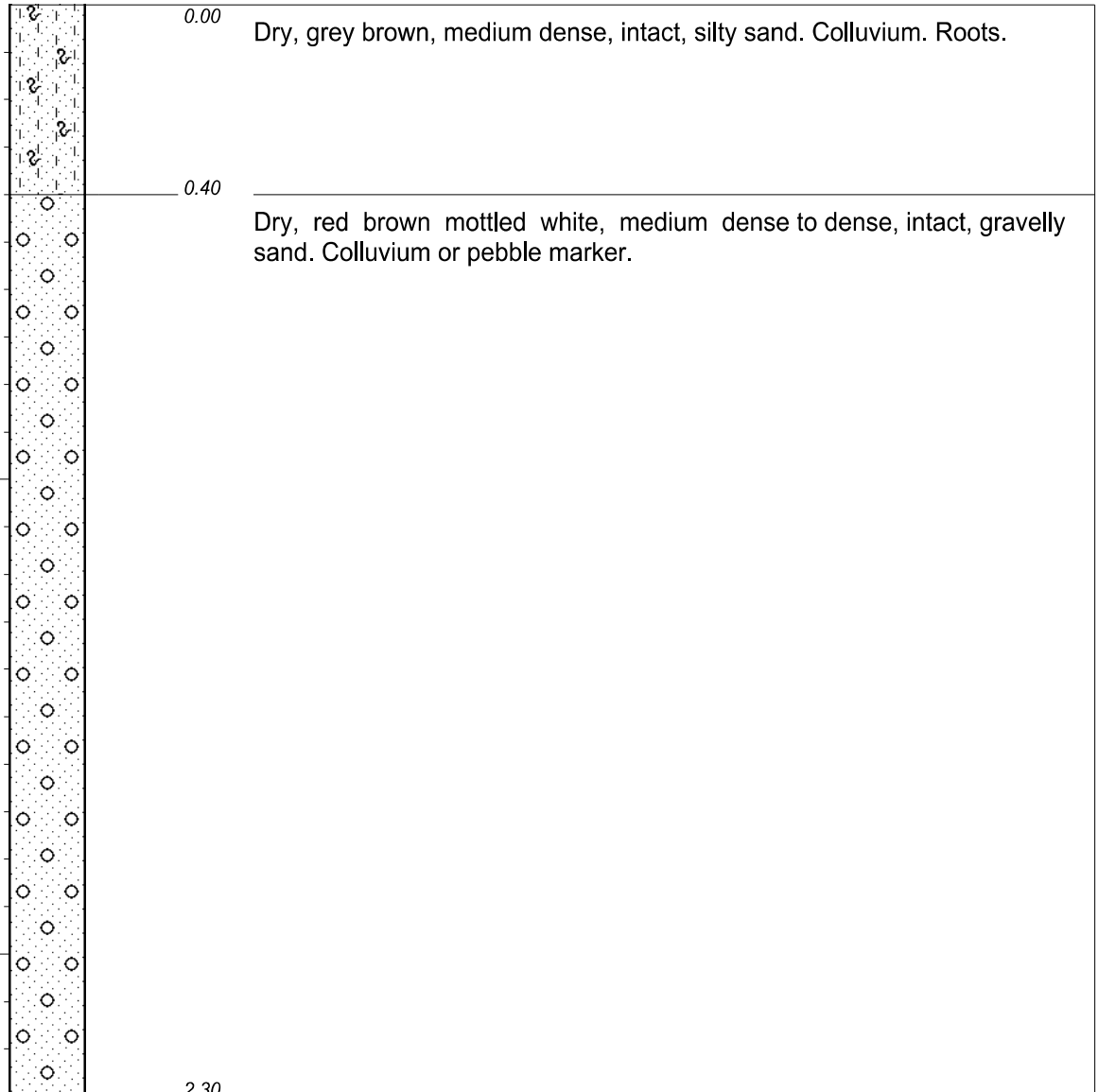
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Y-COORD : 27° 05 13.3E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

HOLE No: 4
Geotechnical Investigation



Scale
1:15



NOTES

- 1) No refusal of excavation.
- 2) No seepage.

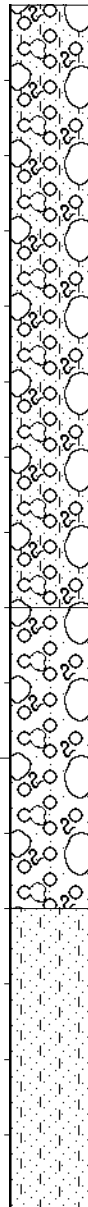
CONTRACTOR : DEW Plant Hire
 MACHINE : Cat 426F2
 DRILLED BY : Thomas
 PROFILED BY : Izak Breytenbach

INCLINATION :
 DIAM : 700mm
 DATE :
 DATE : 20/10/2020
 DATE : 09/11/2020 16:51
 TEXT : ..\Boschoek\TPProfiles.txt

ELEVATION :
 X-COORD : 25° 30 08.6S
 Y-COORD : 27° 05 12.3E

HOLE No: 5
 Geotechnical Investigation

Scale
1:10



0.00

Slightly moist, dark grey brown, loose, intact, silty sand containing scattered gravel and cobbles. Colluvium containing roots and pockets of surface fill, including ash and plastic.

0.80

Dry, brown red, medium dense, intact, sandy gravel containing very abundant cobbles. Scree deposit. Roots.

1.20

Dry, grey white mottled dark red, very dense, intact, silty sand. Residual quartzite.

1.60

NOTES

- 1) Gradual refusal of excavation.
- 2) No seepage.

CONTRACTOR : DEW Plant Hire
MACHINE : Cat 426F2
DRILLED BY : Thomas
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

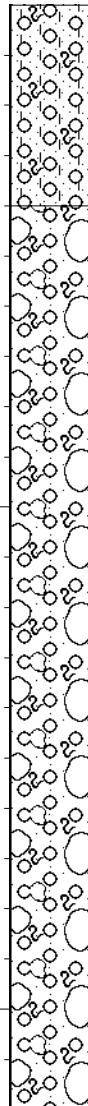
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DIAM : 700mm
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DATE : 20/10/2020

DATE : 09/11/2020 16:51
TEXT : ..\Boschoek\TPProfiles.txt

ELEVATION :
X-COORD : 25° 30 04.8S
Y-COORD : 27° 04 57.6E

HOLE No: 6
Geotechnical Investigation

Scale
1:15



0.00

Slightly moist, dark grey brown, loose, intact, silty sand containing scattered gravel fragments. Colluvium containing roots.

0.40

Dry, brown red, medium dense, intact, sandy gravel containing very abundant cobbles. Scree deposit. Roots.

SKT-102-882: ●

2.20

NOTES

- 1) No refusal of excavation.
- 2) No seepage.
- 3) Disturbed Sample SKT-102-882: 1.30m.

CONTRACTOR : DEW Plant Hire
MACHINE : Cat 426F2
DRILLED BY : Thomas
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 20/10/2020
DATE : 09/11/2020 16:51
TEXT : ..\Boschoek\TPProfiles.txt

ELEVATION :
X-COORD : 25° 30 01.1S
Y-COORD : 27° 04 54.7E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

HOLE No: 7
Geotechnical Investigation



Scale
1:10

0.00
0.00

No trial hole excavated. Area is enclosed by large, deep excavation.

CONTRACTOR : DEW Plant Hire
MACHINE : Cat 426F2
DRILLED BY : Thomas
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 20/10/2020
DATE : 09/11/2020 16:51
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ELEVATION :
X-COORD : 25° 29 59.6S
Y-COORD : 27° 04 58.9E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

HOLE No: 8
Geotechnical Investigation

Scale
1:10



0.00

Dry, dark grey, medium dense, gravelly silty sand containing chromium waste. Fill materials.

0.50

Dry, brown red mottled black, medium dense to dense, intact, clast-supported sandy gravel with scattered cobbles. Colluvium containing roots.

1.30

NOTES

- 1) No refusal of excavation.
- 2) No seepage.
- 3) Hole stopped due to cables in soil profile.

CONTRACTOR : DEW Plant Hire
MACHINE : Cat 426F2
DRILLED BY : Thomas
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 20/10/2020
DATE : 09/11/2020 16:51
TEXT : ..\Boschoek\TPProfiles.txt

ELEVATION :
X-COORD : 25° 30 02.2S
Y-COORD : 27° 05 00.5E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

HOLE No: 9
Geotechnical Investigation



Scale
1:15



0.00

Dry, green grey, medium dense, sand containing what appears to be chromium waste. Fill material.

0.30

Dry, brown red mottled black, medium dense to dense, intact, clast-supported sandy gravel with scattered cobbles. Colluvium containing roots.

2.30

NOTES

- 1) No refusal of excavation.
- 2) No seepage.

CONTRACTOR : DEW Plant Hire
MACHINE : Cat 426F2
DRILLED BY : Thomas
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

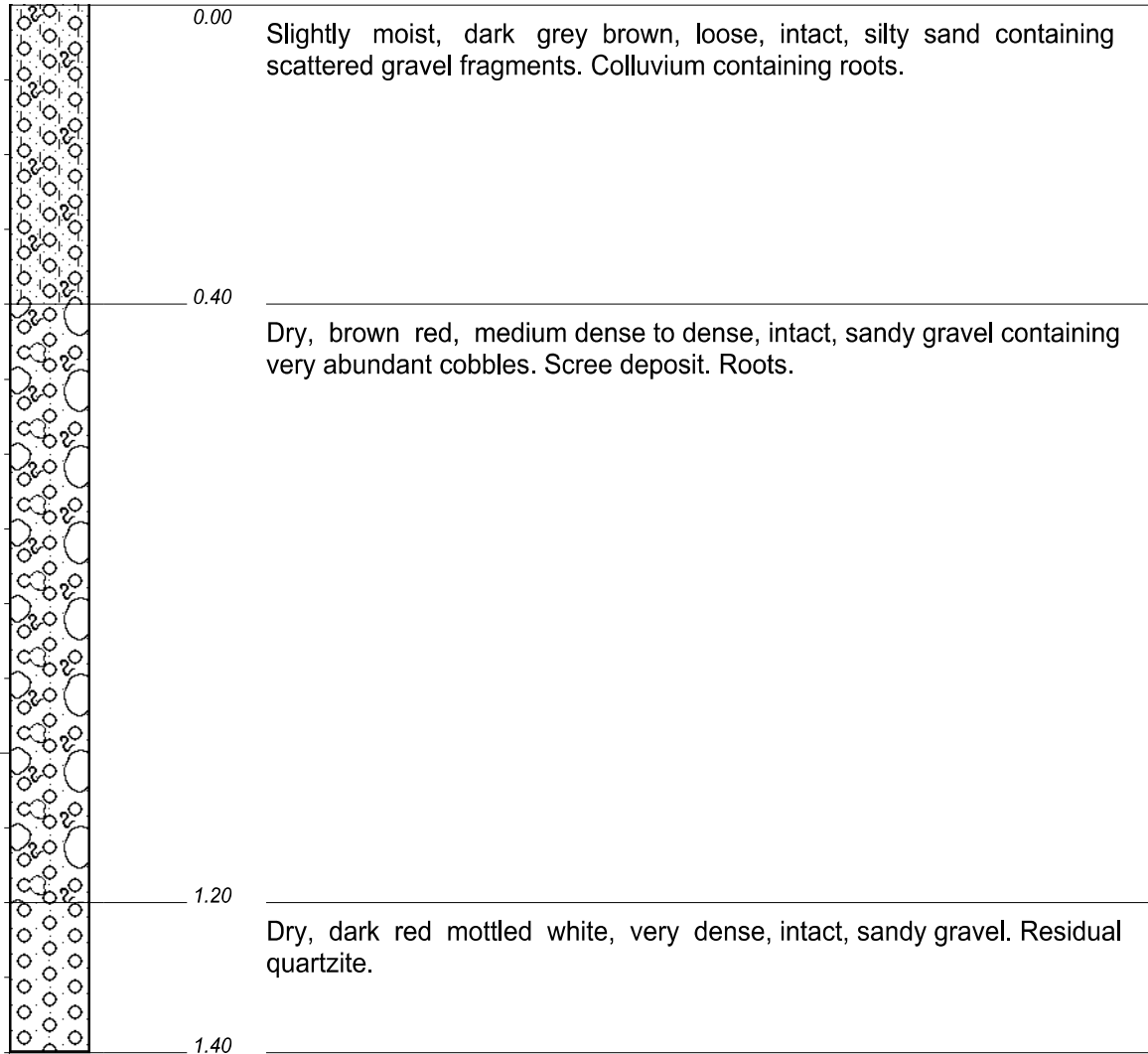
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TEXT : ..\Boschoek\TPProfiles.txt

ELEVATION :
X-COORD : 25° 30 05.2S
Y-COORD : 27° 05 04.2E



Scale
1:10



NOTES

- 1) Gradual refusal of excavation.
- 2) No seepage.

CONTRACTOR : DEW Plant Hire
MACHINE : Cat 426F2
DRILLED BY : Thomas
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 20/10/2020
DATE : 09/11/2020 16:51
TEXT : ..\Boschoek\TPProfiles.txt

ELEVATION :
X-COORD : 25° 30 10.0S
Y-COORD : 27° 05 07.6E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

Scale
1:10



0.00 Slightly moist, dark grey brown, loose, intact, silty sand containing scattered gravel fragments. Colluvium containing roots.

0.30 Dry, brown red mottled black, medium dense to dense, intact, clast-supported sandy gravel with scattered cobbles. Colluvium containing roots.

SKT-102-883: ●

1.40 Dry, dark red mottled white, very dense, intact, sandy gravel. Residual quartzite.

1.90
NOTES
1) Gradual refusal of excavation.
2) No seepage.
3) Erratic bedrock outcrop in vicinity.
4) Disturbed Sample SKT-102-883: 0.85m.

CONTRACTOR : DEW Plant Hire
MACHINE : Cat 426F2
DRILLED BY : Thomas
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 20/10/2020
DATE : 09/11/2020 16:51
TEXT : ..\Boschoek\TPProfiles.txt

ELEVATION :
X-COORD : 25° 30 10.0S
Y-COORD : 27° 05 03.8E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET



Scale
1:10



0.00

Slightly moist, dark grey brown, loose, intact, silty sand containing scattered gravel and cobbles. Colluvium containing roots and pockets of surface fill, including ash and plastic. Roots.

0.20

Dry, brown red, dense, intact, sandy gravel containing very abundant cobbles. Scree deposit. Roots.

1.00

Dry, dark red mottled white, very dense, intact, sandy gravel. Residual quartzite.

1.30

NOTES

- 1) Gradual refusal of excavation.
- 2) No seepage.
- 3) Termite nesting.

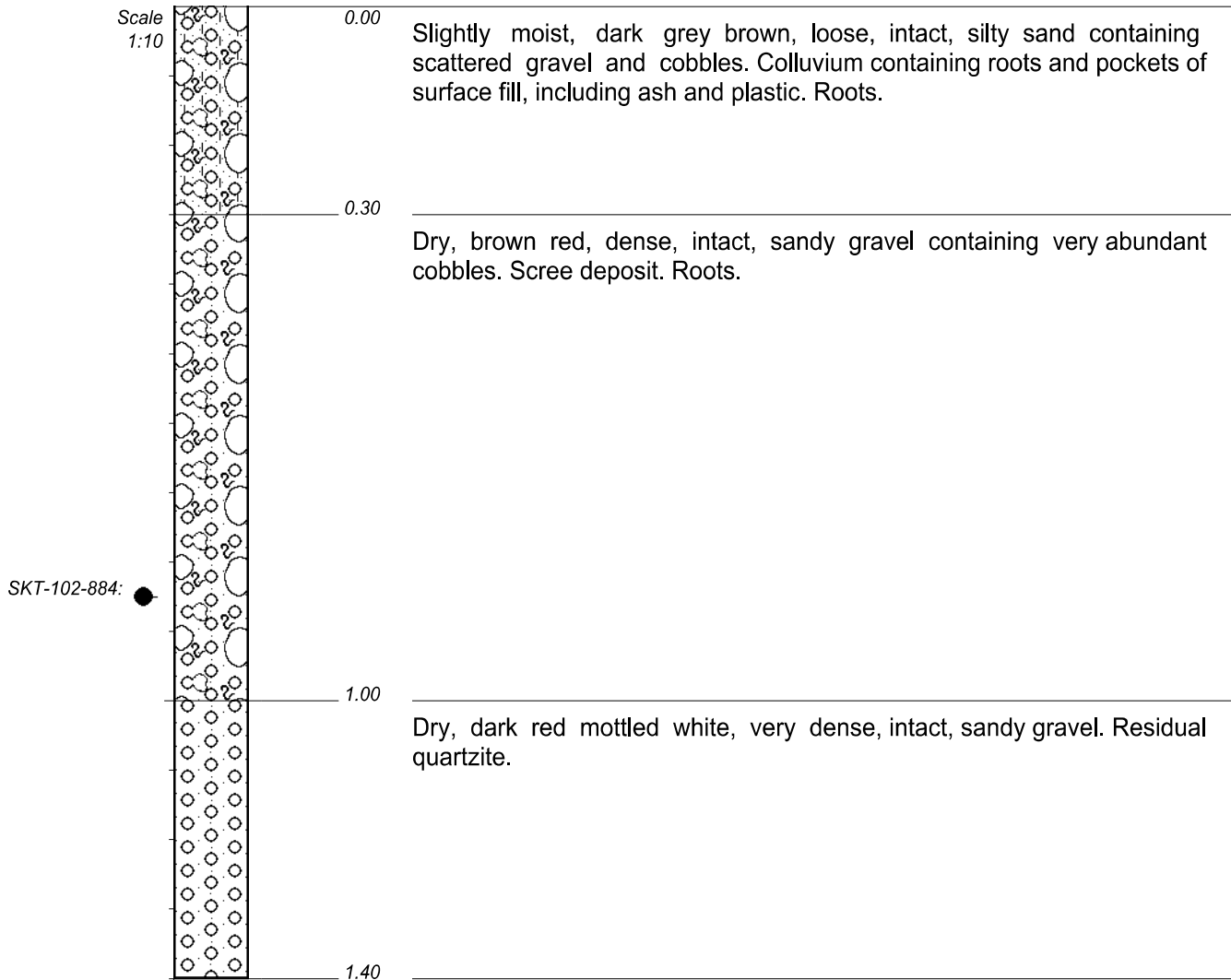
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MACHINE : Cat 426F2
DRILLED BY : Thomas
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 700mm
DATE :
DATE : 20/10/2020

DATE : 09/11/2020 16:51
TEXT : ..\Boschoek\TPProfiles.txt

ELEVATION :
X-COORD : 25° 30 08.6S
Y-COORD : 27° 05 00.1E



- NOTES**
- 1) Gradual refusal of excavation.
 - 2) No seepage.
 - 3) Disturbed Sample SKT-102-884: 0.85m.

CONTRACTOR : DEW Plant Hire
 MACHINE : Cat 426F2
 DRILLED BY : Thomas
 PROFILED BY : Izak Breytenbach
 TYPE SET BY : Izak Breytenbach
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM : 700mm
 DATE :
 DATE : 20/10/2020
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 TEXT : ..\Boschoek\TPProfiles.txt

ELEVATION :
 X-COORD : 25° 30 06.5S
 Y-COORD : 27° 04 56.3E

Scale
1:10



0.00 Slightly moist, dark grey brown, loose, intact, silty sand containing scattered gravel and cobbles. Colluvium containing roots.

0.40 Dry, brown red, medium dense, intact, sandy gravel containing very abundant cobbles. Scree deposit. Roots.

1.20 Dry, grey white mottled dark red, very dense, intact, silty sand. Residual quartzite.

SKT-102-882: ●

2.00

NOTES

- 1) Gradual refusal of excavation.
- 2) No seepage.
- 3) Disturbed Sample SKT-102-882: 1.30m.

CONTRACTOR : DEW Plant Hire
MACHINE : Cat 426F2
DRILLED BY : Thomas
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 20/10/2020
DATE : 09/11/2020 16:51
TEXT : ..\Boschoek\TPProfiles.txt

ELEVATION :
X-COORD : 25° 30 06.0S
Y-COORD : 27° 04 53.0E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

Scale
1:15



0.00

Slightly moist, dark grey brown, loose, intact, silty sand containing scattered gravel fragments. Colluvium containing roots.

0.40

Dry, brown red mottled white, dense, intact, sandy gravel containing scattered cobbles. Scree deposit containing roots.

2.50

SKT-102-885: ●

- NOTES**
- 1) Gradual refusal of excavation.
 - 2) No seepage.
 - 3) Disturbed Sample SKT-102-885: 1.45m.

CONTRACTOR : DEW Plant Hire
MACHINE : Cat 426F2
DRILLED BY : Thomas
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 700mm
DATE :
DATE : 20/10/2020
DATE : 09/11/2020 16:51
TEXT : ..\Boschoek\TPProfiles.txt

ELEVATION :
X-COORD : 25° 30 03.6S
Y-COORD : 27° 04 51.1E



	GRAVEL	{SA02}
	GRAVELLY	{SA03}
	SAND	{SA04}
	SANDY	{SA05}
	SILTY	{SA07}
	CLAYEY	{SA09}
	FILL	{SA32}
	UNDISTURBED SAMPLE	{SA37}
	DISTURBED SAMPLE	{SA38}
	ROOTS	{SA40}
	COBBLES	{SA58}

Name ■

Name ●

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 09/11/2020 16:51
TEXT : ..\Boschoek\TPProfiles.txt

LEGEND
SUMMARY OF SYMBOLS

APPENDIX B: MATERIAL TEST RESULTS



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 Gerrie | 082 309 4448 | gerrie@stlab.co.za
 www.stlab.co.za

Quality | Excellence | On Time

Client Name: Soilkraft
Project Name: Boschoek
Job Number: SKT-102
Date: 2020-11-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR							Sheet Reference: R-STL-011 Rev02	
Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification				
Sample	TH 1	TH 2	TH 4	Sample	TH 1	TH 2	TH 4	
Depth (mm)	0 - 900	700 - 2500	300 - 1400	Depth (mm)	0 - 900	700 - 2500	300 - 1400	
Lab No	SKT-102-877	SKT-102-879	SKT-102-881	Lab No	SKT-102-877	SKT-102-879	SKT-102-881	
53.0	100	100	100	Liquid Limit (%)	19	29	17	
37.5	100	100	100	Plastic Limit (%)	11	14	14	
26.5	100	100	100	Plasticity Index (%)	8	15	3	
19.0	100	100	100	Linear Shrinkage (%)	3.5	7.0	1.0	
13.2	100	100	100	PI of whole sample	5	10	2	
9.5	98	100	100					
6.7	96	99	100	% Gravel	7	6	3	
4.75	95	99	99	% Sand	61	57	82	
2.00	93	94	97	% Silt	16	13	10	
1.00	84	84	92	% Clay	16	24	5	
0.425	67	68	75	Activity	0.5	0.6	0.6	
0.250	57	57	51					
0.150	46	50	34	% Soil Mortar	93	94	97	
0.075	35	42	23					
0.060	32	37	15	Grading Modulus	1.05	0.96	1.05	
0.050	29	36	14	Moisture Content (%)	N / T	N / T	N / T	
0.035	25	33	11	Relative Density (SG)*	2.65	2.65	2.65	
0.020	21	30	9					
0.006	18	26	7	Unified (ASTM D2487)	SC	SC	SM	
0.002	16	24	5	AASHTO (M145-91)	A - 2 - 4	A - 6	A - 2 - 4	
Remarks: *: Assumed								
N / T: Not Tested								
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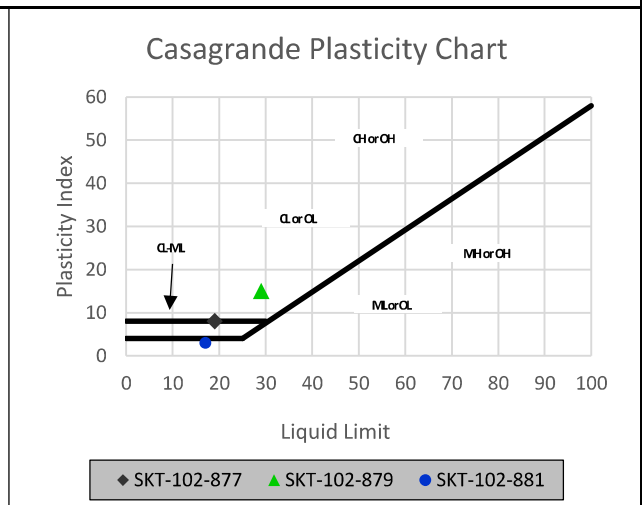
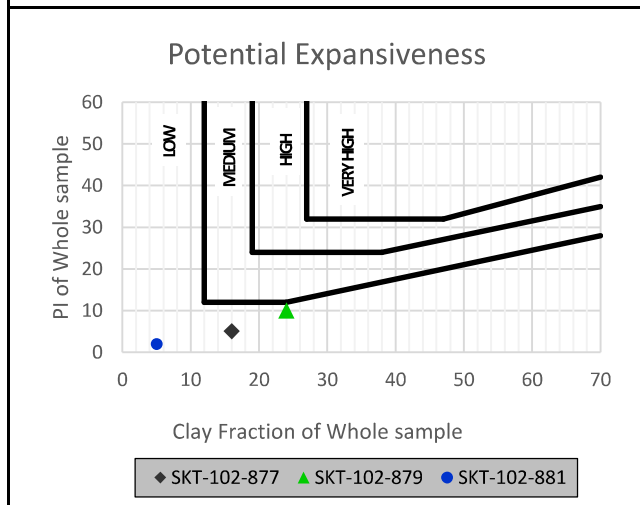
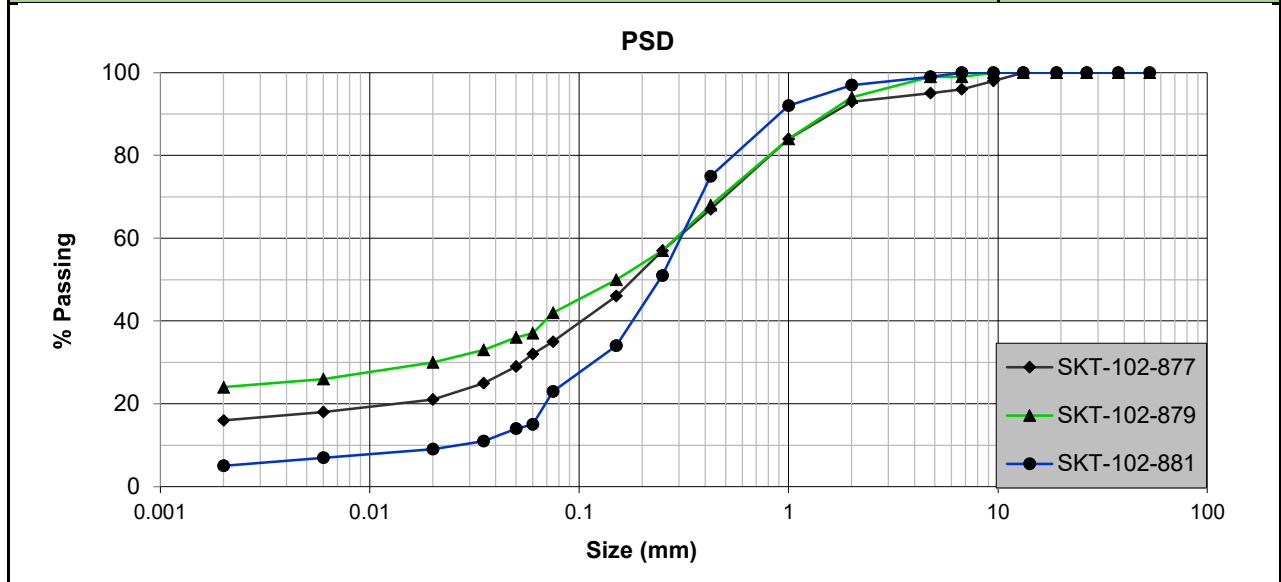


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Client Name: Soilkraft
Project Name: Boschoek
Job Number: SKT-102
Date: 2020-11-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR **Sheet Reference:**
R-STL-011 Rev02



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Client Name: Soilkraft
Project Name: Boschoek
Job Number: SKT-102
Date: 2020-11-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR							Sheet Reference: R-STL-011 Rev02	
Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification				
Sample	TH 7	TH 12	TH 14	Sample	TH 7	TH 12	TH 14	
Depth (mm)	400 - 2200	300 - 1400	300 - 1400	Depth (mm)	400 - 2200	300 - 1400	300 - 1400	
Lab No	SKT-102-882	SKT-102-883	SKT-102-884	Lab No	SKT-102-882	SKT-102-883	SKT-102-884	
53.0	100	100	100	Liquid Limit (%)	30	27	40	
37.5	95	100	92	Plastic Limit (%)	16	15	24	
26.5	89	99	86	Plasticity Index (%)	14	12	16	
19.0	79	94	80	Linear Shrinkage (%)	7.0	6.0	8.5	
13.2	74	92	76	PI of whole sample	3	2	4	
9.5	69	89	72					
6.7	63	81	66	% Gravel	60	69	59	
4.75	57	66	60	% Sand	27	19	29	
2.00	40	31	41	% Silt	6	5	5	
1.00	30	24	34	% Clay	7	7	7	
0.425	24	19	28	Activity	2.0	1.7	2.3	
0.250	21	17	24					
0.150	19	15	21	% Soil Mortar	40	31	41	
0.075	16	13	17					
0.060	13	12	12	Grading Modulus	2.20	2.37	2.14	
0.050	12	11	11	Moisture Content (%)	N / T	N / T	N / T	
0.035	11	10	10	Relative Density (SG)*	2.65	2.65	2.65	
0.020	9	9	9					
0.006	8	7	7	Unified (ASTM D2487)	GC	SC	SC	
0.002	7	7	7	AASHTO (M145-91)	A - 2 - 6	A - 2 - 6	A - 2 - 6	

Remarks: *: Assumed
 N / T: Not Tested

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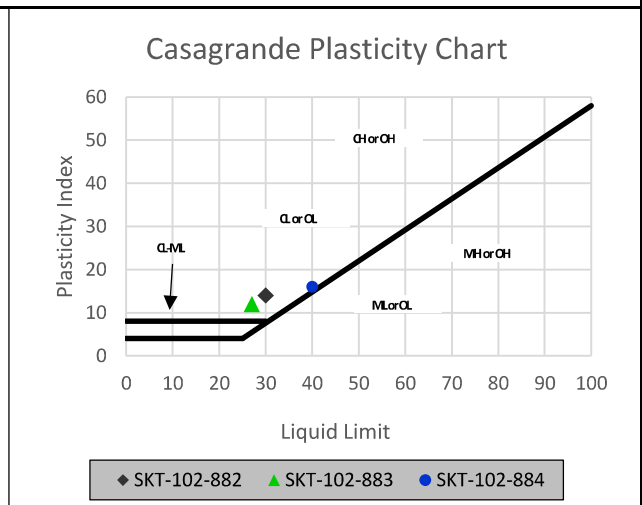
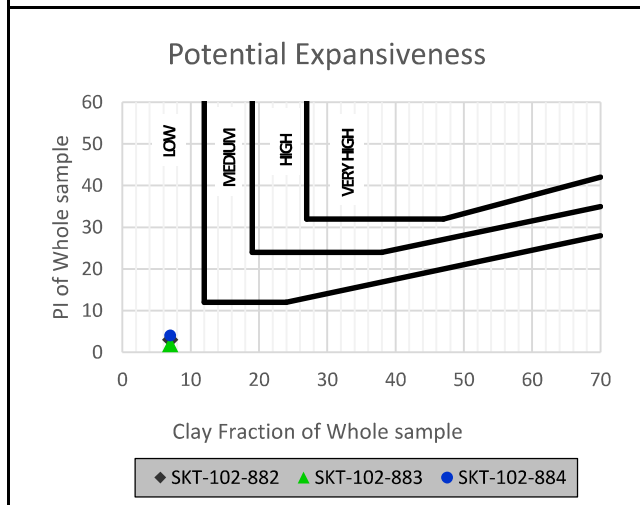
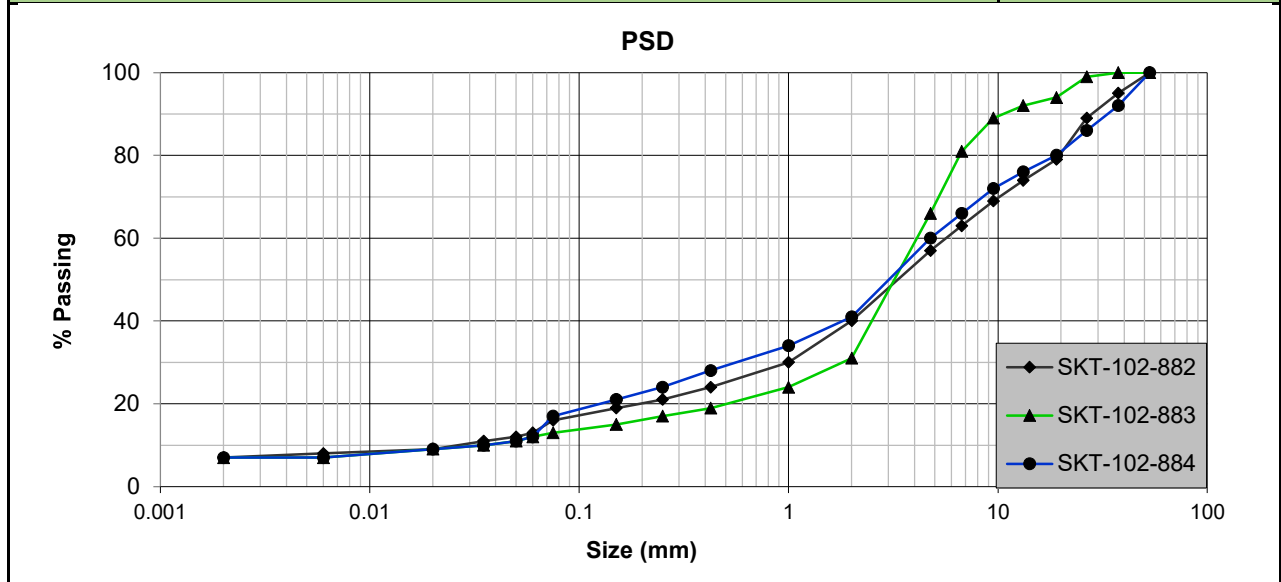


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Client Name: Soilkraft
Project Name: Boschoek
Job Number: SKT-102
Date: 2020-11-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR **Sheet Reference:**
R-STL-011 Rev02



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Client Name: Soilkraft
Project Name: Boschoek
Job Number: SKT-102
Date: 2020-11-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR						Sheet Reference: R-STL-011 Rev02	
Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TH 16			Sample	TH 16		
Depth (mm)	400 - 2500			Depth (mm)	400 - 2500		
Lab No	SKT-102-885			Lab No	SKT-102-885		
53.0	100			Liquid Limit (%)	39		
37.5	100			Plastic Limit (%)	22		
26.5	100			Plasticity Index (%)	17		
19.0	100			Linear Shrinkage (%)	9.0		
13.2	92			PI of whole sample	5		
9.5	86						
6.7	76			% Gravel	58		
4.75	66			% Sand	28		
2.00	42			% Silt	5		
1.00	34			% Clay	9		
0.425	28			Activity	1.9		
0.250	24						
0.150	23			% Soil Mortar	42		
0.075	19						
0.060	14			Grading Modulus	2.11		
0.050	13			Moisture Content (%)	N / T		
0.035	11			Relative Density (SG)*	2.65		
0.020	10						
0.006	10			Unified (ASTM D2487)	SC		
0.002	9			AASHTO (M145-91)	A - 2 - 6		
Remarks: * : Assumed							
N / T: Not Tested							
<small>Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.</small>							

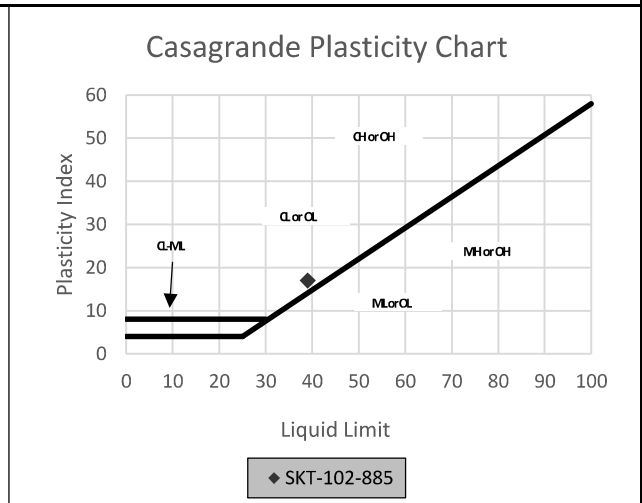
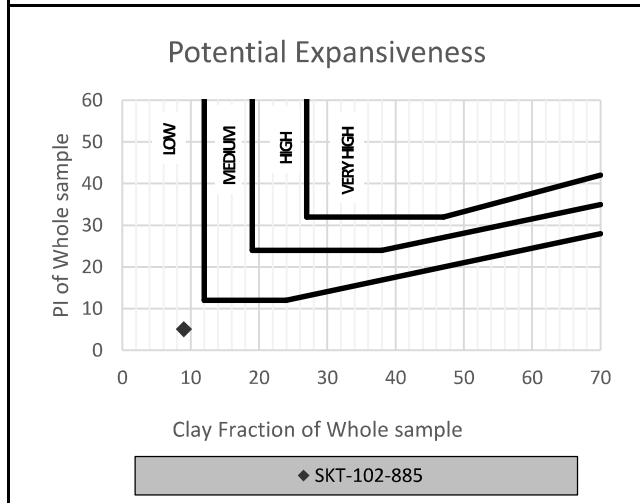
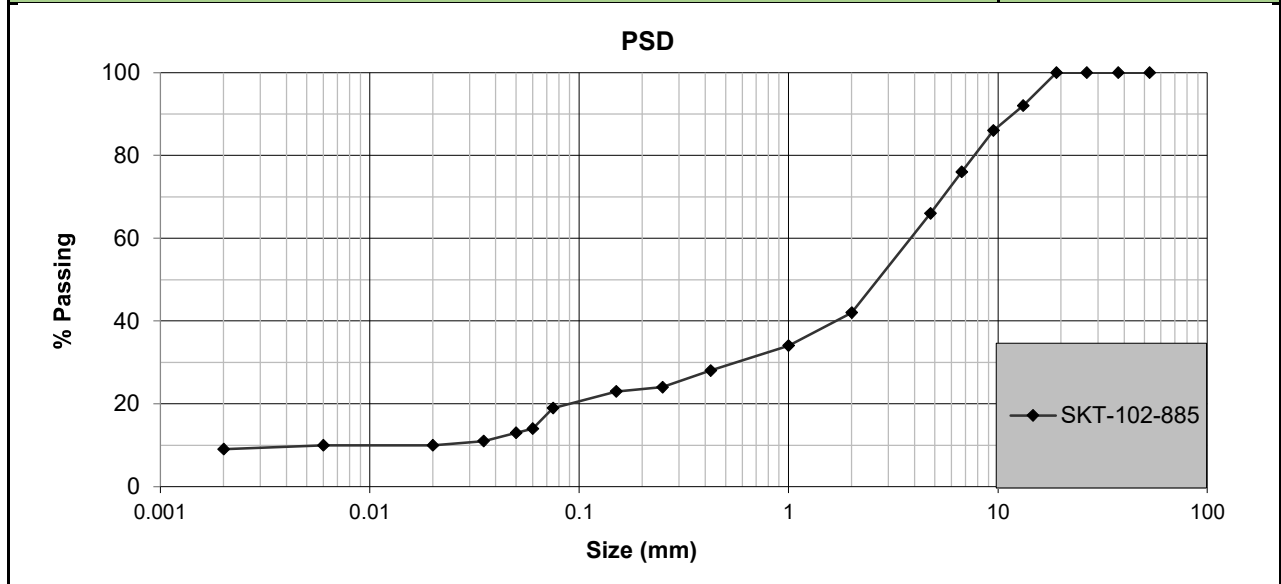


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Client Name: Soilkraft
Project Name: Boschoek
Job Number: SKT-102
Date: 2020-11-09
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR **Sheet Reference:**
R-STL-011 Rev02



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Client Name: Soilkraft
Project Name: Boschoek
Sample: TH 1
Depth: (mm) 0 - 900

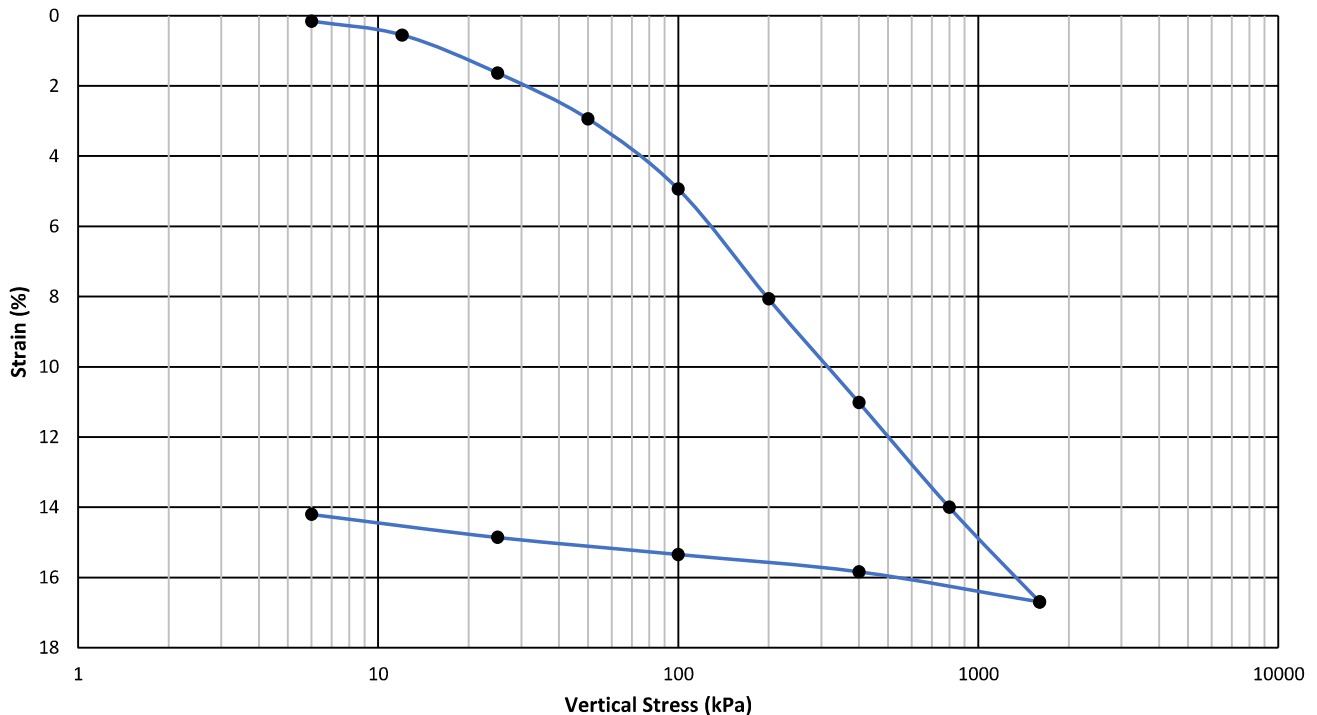
Job Number: SKT-102
Lab Number: SKT-102-878
Method: BS 1377 Part 5
Date: 09/11/2020

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	11.4	
	Final	%	11.9	
Dry Density		kg/m ³	1719	
Void Ratio		-	0.534	
Degree of Saturation		%	56.4	
Relative Density (SG)		-	2.637	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	12	12	12	12	12	12	12	12	12	3	3	3	3
Height after increment	mm	25.36	25.26	24.99	24.65	24.15	23.35	22.60	21.84	21.16	21.38	21.50	21.63	21.79
Total Strain	%	0.16	0.55	1.63	2.94	4.94	8.07	11.02	14.00	16.70	15.84	15.35	14.86	14.21
Void Ratio	-	0.531	0.525	0.509	0.489	0.458	0.410	0.365	0.319	0.278	0.291	0.298	0.306	0.316
Mv (1/Mpa)	-	-	0.660	0.838	0.532	0.412	0.329	0.161	0.084	0.039	0.009	0.020	0.077	0.404

Strain vs Log Stress



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Client Name: Soilkraft
Project Name: Boschoek
Sample: TH 1
Depth: (mm) 0 - 900

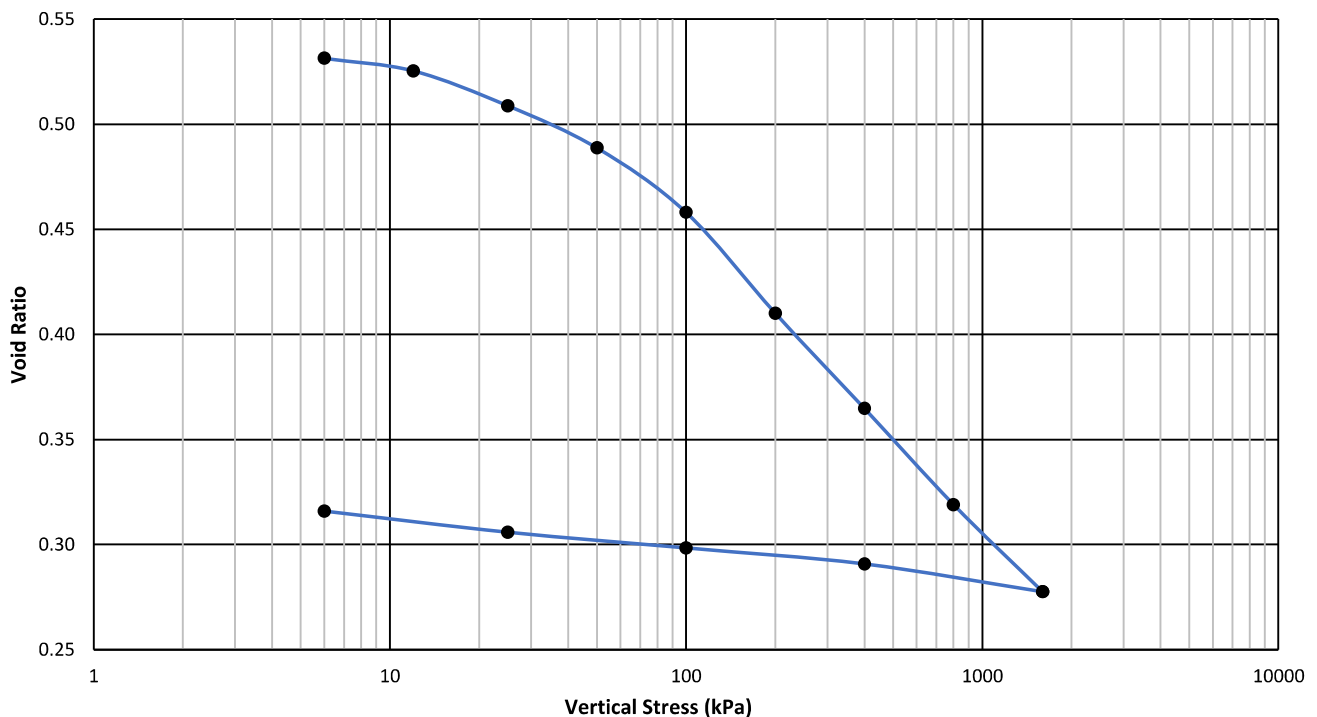
Job Number: SKT-102
Lab Number: SKT-102-878
Method: BS 1377 Part 5
Date: 09/11/2020

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	11.4	
	Final	%	11.9	
Dry Density		kg/m ³	1719	
Void Ratio		-	0.534	
Degree of Saturation		%	56.4	
Relative Density (SG)		-	2.637	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	12	12	12	12	12	12	12	12	12	3	3	3	3
Height after increment	mm	25.36	25.26	24.99	24.65	24.15	23.35	22.60	21.84	21.16	21.38	21.50	21.63	21.79
Total Strain	%	0.16	0.55	1.63	2.94	4.94	8.07	11.02	14.00	16.70	15.84	15.35	14.86	14.21
Void Ratio	-	0.531	0.525	0.509	0.489	0.458	0.410	0.365	0.319	0.278	0.291	0.298	0.306	0.316
Mv (1/Mpa)	-	-	0.660	0.838	0.532	0.412	0.329	0.161	0.084	0.039	0.009	0.020	0.077	0.404

Void Ratio vs Log Stress





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Client Name: Soilkraft
Project Name: Boschoek
Sample: TH 4
Depth: (mm) 300 - 1400

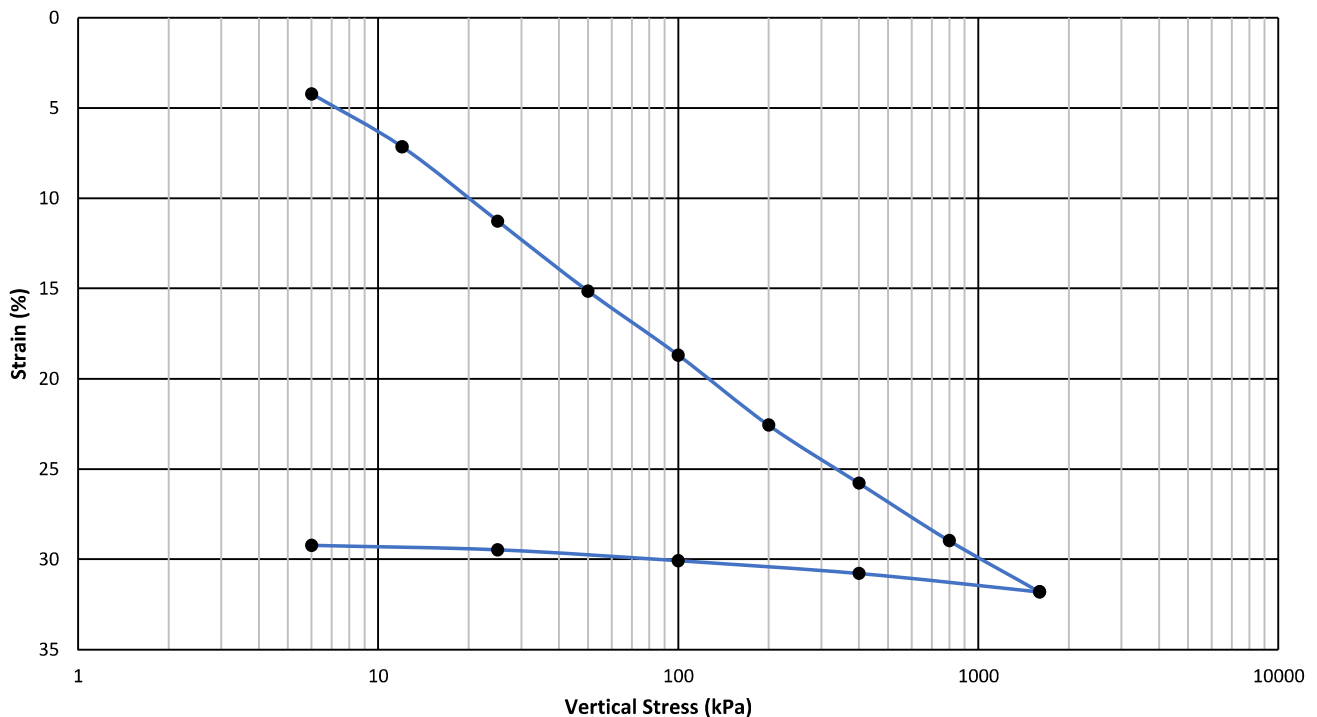
Job Number: SKT-102
Lab Number: SKT-102-880
Method: BS 1377 Part 5
Date: 09/11/2020

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	5.1	
	Final	%	12.0	
Dry Density		kg/m ³	1364	
Void Ratio		-	0.930	
Degree of Saturation		%	14.4	
Relative Density (SG)		-	2.632	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	12	12	12	12	12	12	12	12	12	3	3	3	3
Height after increment	mm	24.33	23.58	22.54	21.56	20.65	19.67	18.85	18.04	17.32	17.58	17.76	17.91	17.98
Total Strain	%	4.22	7.15	11.27	15.14	18.69	22.57	25.78	28.97	31.81	30.78	30.08	29.48	29.22
Void Ratio	-	0.849	0.792	0.712	0.638	0.569	0.494	0.432	0.371	0.316	0.336	0.349	0.361	0.366
Mv (1/Mpa)	-	-	5.102	3.413	1.744	0.837	0.477	0.208	0.107	0.050	0.013	0.034	0.116	0.192

Strain vs Log Stress



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Client Name: Soilkraft
Project Name: Boschoek
Sample: TH 4
Depth: (mm) 300 - 1400

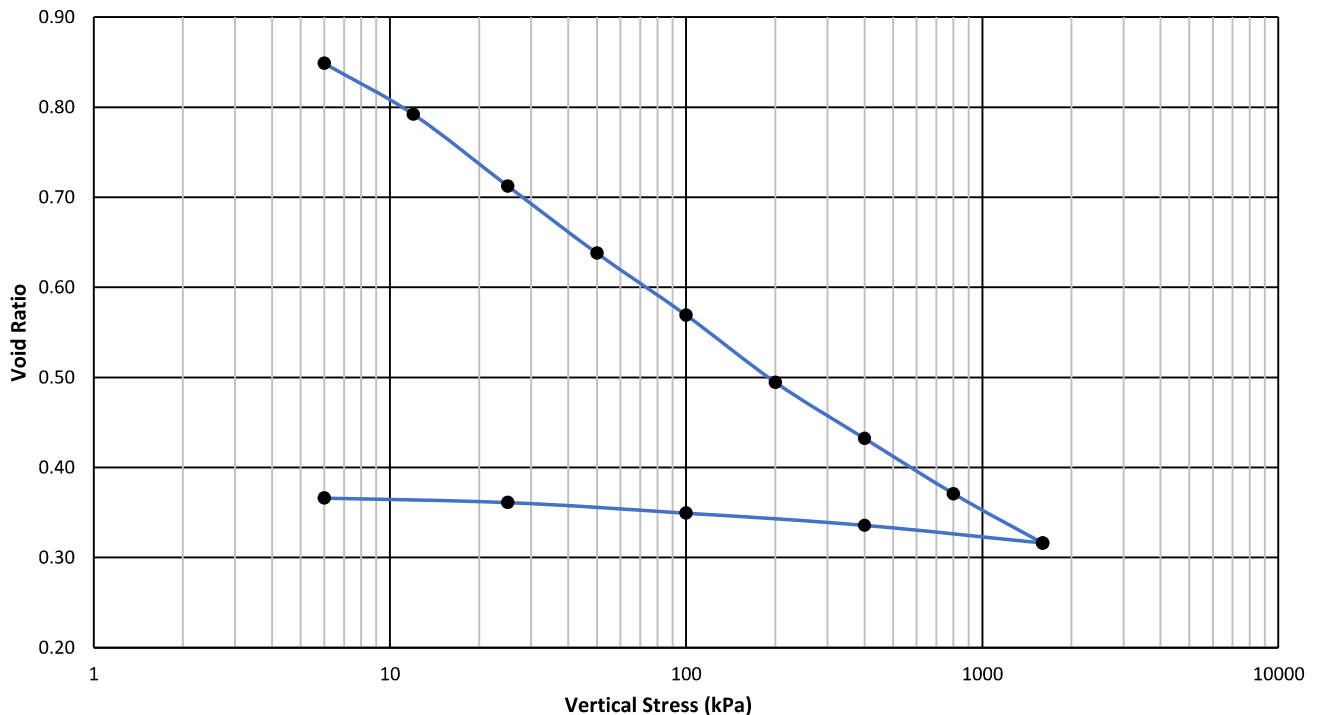
Job Number: SKT-102
Lab Number: SKT-102-880
Method: BS 1377 Part 5
Date: 09/11/2020

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	5.1	
	Final	%	12.0	
Dry Density		kg/m ³	1364	
Void Ratio		-	0.930	
Degree of Saturation		%	14.4	
Relative Density (SG)		-	2.632	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	12	12	12	12	12	12	12	12	12	3	3	3	3
Height after increment	mm	24.33	23.58	22.54	21.56	20.65	19.67	18.85	18.04	17.32	17.58	17.76	17.91	17.98
Total Strain	%	4.22	7.15	11.27	15.14	18.69	22.57	25.78	28.97	31.81	30.78	30.08	29.48	29.22
Void Ratio	-	0.849	0.792	0.712	0.638	0.569	0.494	0.432	0.371	0.316	0.336	0.349	0.361	0.366
Mv (1/Mpa)	-	-	5.102	3.413	1.744	0.837	0.477	0.208	0.107	0.050	0.013	0.034	0.116	0.192

Void Ratio vs Log Stress



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Client Name: Soilkraft
Project Name: Boschoek
Job Number: SKT-102
Date: 09-Nov-20
Method: SANS 3001 GR1, GR3 GR10, GR12 GR20, GR30, GR31, GR40, GR50, GR53, GR54 & BS 1377 (where applicable)

SUMMARY OF TEST DATA

Grading & Hydrometer Analysis (% Passing)

Sample	TH 1	TH 2	TH 4	TH 7	TH 12	TH 14	TH 16
Depth (mm)	0 - 900	700 - 2500	300 - 1400	400 - 2200	300 - 1400	300 - 1400	400 - 2500
Lab No	SKT-102-877	SKT-102-879	SKT-102-881	SKT-102-882	SKT-102-883	SKT-102-884	SKT-102-885
53.0	100	100	100	100	100	100	100
37.5	100	100	100	95	100	92	100
26.5	100	100	100	89	99	86	100
19.0	100	100	100	79	94	80	100
13.2	100	100	100	74	92	76	92
9.5	98	100	100	69	89	72	86
6.7	96	99	100	63	81	66	76
4.75	95	99	99	57	66	60	66
2.00	93	94	97	40	31	41	42
1.00	84	84	92	30	24	34	34
0.425	67	68	75	24	19	28	28
0.250	57	57	51	21	17	24	24
0.150	46	50	34	19	15	21	23
0.075	35	42	23	16	13	17	19
0.060	32	37	15	13	12	12	14
0.050	29	36	14	12	11	11	13
0.035	25	33	11	11	10	10	11
0.020	21	30	9	9	9	9	10
0.006	18	26	7	8	7	7	10
0.002	16	24	5	7	7	7	9
GM	1.05	0.96	1.05	2.20	2.37	2.14	2.11

Atterberg Limits

LL (%)	19	29	17	30	27	40	39
PI (%)	8	15	3	14	12	16	17
LS (%)	3.5	7.0	1.0	7.0	6.0	8.5	9.0

pH & Conductivity

pH	4.8			5.0		4.7	
EC (S/m)	0.024			0.016		0.022	

MDD / OMC

MDD (kg/m ³)							
OMC (%)							

CBR

100%							
98%							
97%							
95%							
93%							
90%							
Swell (%)							

UCS (MPa)

100%							
97%							
90%							

COLTO Classification

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Remarks: _____

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.