GEOTECHNICAL CONDITIONS ON ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT: A REPORT FOR THE EXPANSION AND FORMALISATION OF THE TOPLINE COMMUNITY

2020/J09/MCP_01

ON BEHALF OF : MACROPLAN

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EXECUTIVE SUMMARY

1 INTRODUCTION

It is envisaged to develop some 36 hectare of land on Erven 1, 16 and 87 Saalskop (Topline) ; and Plot 2777 of Boegoeberg Settlement as an expansion and formalization of the existing Topline community. For this purpose Cedar Land Geotechnical Consult (Pty) Ltd was appointed as sub consultant to Macroplan to conduct a geotechnical investigation on the properties.

2 SITE DESCRIPTION

2.1 Site Location

The village of Topline is located directly to the west and adjacent to the National Route 10 between Upington and Groblershoop in the Northern Cape. It is some 25 km from Groblershoop. The area of investigation consisting of Erven 1, 16 and 87 Saalskop (Topline) ; and Plot 2777 of Boegoeberg is located on the perimeter of the village, on the western and southern sides thereof. The size of the property is 36 hectare.

2.2 Topography and Drainage

The land investigated is located between 864,0mamsl and 851,00mamsl. Topographical it can be divided into three sections. These three sections are bordered by two centrally located non-perennial water courses, joining into one on the eastern perimeter of the area of investigation. The three areas can be described as follows ;

- *Northern Section : This section is located between the northern limit of investigation up to the northern-most gully and initially slopes at 1,0% due south. After a distance of some 230 meters the slope increases to 4,6% terminating at the water course.*
- *Central Section : The central section is present as a ridge striking northwest to southeast between the two water courses. Slope of the central part of the ridge is virtually flat at less than 1%, while the two flanks slope at 4,3% towards the south and northeast.*
- *Southern Section : This section is located from the southern water course, terminating at the southern limit of investigation. The eastern and western limits of this section are characterized by very flat surfaces with slopes less than 1%. The remainder central part of the site is characterised by a low and undulating landscape, generally sloping towards the east at 2%.*

Drainage takes place by means of surface sheetwash. The sheetwash is disposed of in the watercourses as described above. A berm of approximately two meters high is present on the eastern bank of the water course between the existing village and the water course.

2.3 Vegetation and Landscape

The area of investigation is referred to as Bushmanland Arid Grassland. The landscape features are described as consisting of extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses giving this vegetation type the character of semi-desert steppe. In places low shrubs change the vegetation structure. On site it was found that in the areas where natural vegetation is present it consists of a sparse stand of Acacia melliflora, prosopis glandulosa and Boscia albitrunca. Stands of aloe claviflora are present.

2.4 Climatic Conditions

The area is located in a summer-rainfall region with mean annual precipitation between 70mm to 200mm ; mean maximum summer temperature of 38°C and mean minimum winter temperature of -0,6°C. Frost incidence varies between 10 and 35 days per year. The development of whirl winds are common on hot summer days. The Thornthwaithe moisture index is less than -40 ; and the Weinert N value approximately 35.

2.5 Existing Facilities

2.5.1 Informal Housing

Informal housing consisting of galvanized iron structures and some reed structures is present in the northern and southern parts of the site, directly adjacent to the existing village. Electricity is provided to overhead high mast street lighting.

2.5.2 Vacant Land

Vacant, undeveloped land extends from the informal housing to the limits of the area of investigation to the north, west and south of Topline.

3 NATURE OF INVESTIGATION

3.1 Test Pitting

On 7 July 2020 28 test pits were excavated with a Bell 315SK TLB on hire from ALS Plant Rentals. The TLB was equipped with a 600mm wide bucket. All test pits were excavated to refusal. The test pits were profiled by a professionally registered geotechnical engineer.

3.2 Materials Testing

Soil testing was undertaken by Roadlab in Upington. Soil testing consisted of the following :

- Conductivity and pH determinations on seven samples of the in-situ materials to determine the corrosivity thereof.
- Foundation indicator testing on 11 samples of the in-situ materials to determine possible conditions of heave or settlement.
- CBR and road indicator testing on three samples to determine the suitability of the in-situ materials to be utilized as road layerworks.

4 GEOLOGY, SOILS AND GROUNDWATER

4.1 Geology

The area of investigation is located on a subduction zone dating approximately 1000 million years old. The zone is located between the lithology of the Kaapvaal Craton and the Namaqua-Natal mobile belt. The remains of the original geology in the area are referred to as the Kaaien Terrane and the site is located on Kalkwerf granite-gneiss that is intrusive into the Groblershoop Formation of the Brulpan Group.

Bedrock occurs on site as strongly foliated, gneissic rock. In thin section the granite-gneiss can be seen to have suffered extreme deformation, with quartz grains completely recrystallized, showing deformation bands and undulose extinction. The rest of the rock is made up of plagioclase, muscovite, chloritized biotite, occasional garnet, epidote, hornblende and other accessory minerals. Physically the granite-gneiss is described as dirty white mottled light green and pink, massive, micaceous, hard rock, varying to dark grey speckled dull dark red, closely jointed and coarse grained, hard rock.

4.2 Soil Profile

4.2.1 Colluvium

Colluvium consists of pegmatitic gravels, weather resistant scree of quartz and quartzite fragments contained in a sandy matrix. Nodules of calcrete may be contained in the colluvium. The consistency of the colluvium varies between loose and medium dense. The horizon of colluvium was between 100mm and 600mm thick in the test pits.

4.2.2 Made Ground

What appears to be areas levelled and fill material provided for construction of a dam and soccer field

are present on site. The origin of the surface soil is unsure, and it may also originate as debris of the non-perennial stream in which vicinity these test pits are located. This fill is described as light brown, loose, fine sand. The horizon of fill extended to depths varying between 200mm and 700mm in the test pits. However, the soil profile may be of unknown variable composition and depth.

4.2.3 Residual Granite-gneiss

A superficial horizon of residual granite-gneiss is described as abundant clast supported, fine, angular gravels of granite-gneiss in a matrix of light brown, fine sand, with a medium dense consistency.

4.2.4 Waste

Substantial areas of stockpiles of rubble are present in the vacant land. Such rubble consists of items varying from household waste, excavated calcrete to builder's rubble.

4.2.5 Mokalanen Formation

4.2.5(i) Hardpan Calcrete

Hardpan calcrete is present as outcrops or underlies the colluvium, occurring from depths between 100mm and 600mm minimum, extending to 200mm to 800mm maximum, at which stage refusal of excavation occurred. The hardpan calcrete can be described as dirty white, very fine grained and very dense.

4.2.5(ii) Nodular Calcrete

Isolated occurrences of nodular calcrete underlie the colluvium, extending to 600mm and 800mm deep at which depth refusal of excavation occurred. The nodular calcrete can be described as abundant clast supported medium coarse, rounded and subrounded nodules of calcrete in a matrix of very dense, calcareous cemented, fine sand.

4.3 Groundwater

4.3.1 Perched Water

Perched groundwater was not encountered in any of the test pits excavated for this investigation. It is anticipated that perched water will generally not prove problematic on the site.

4.3.2 Permanent Groundwater

The probability for drilling successfully for water in the area is between 40% and 60%, and the probability that such a borehole will yield more than 2l/s is between 10% and 20%. Groundwater is expected to occur at depths less than 15 meters in compact, argillaceous strata.

5 CONDITIONS OF EXCAVATION

On average over the entire site bedrock or refusal of excavation on very dense hardpan calcrete was encountered at depths between 100mm minimum and 1100mm maximum, averaging 520mm deep. The implication of this is that should trenches require excavated depths to 1000mm, 48% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 63% of the excavation may be classified as hard.

6 SITE CLASS DESIGNATION

6.1 Geotechnical Zone I

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. The distribution thereof encompasses 47% of the proposed area for development. Slope across the land is less than 2%. Considering the limited slope and the favourable geotechnical site classification, two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on bedrock or very dense pedocrete.

6.2 Geotechnical Zone II

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. The distribution thereof encompasses 45% of the proposed area for development. Slope across the land is approximately between 2% and 6%. The use of slab-on-the-ground foundations will require additional works in the form of the construction of an engineered fill or cutting to establish a level platform for construction. The more viable foundation alternative therefore remains founding by conventional strip foundations.

6.3 Geotechnical Zone III

This zone comprises 8% of the area investigated. The zone is characterized by surface materials consisting of calcrete that have been partially removed for construction and have been rehabilitated by importing fine, granular materials ; levelled to provide a soccer field and what appears to be a shallow earth dam. Other parts of the area are covered by stockpiles of excavated calcrete and an

unrehabilitated borrow pit is also present. To establish structures in this zone will require rehabilitating the borrow pit, possibly using the available stockpiles of calcrete and levelling out the entire area to provide a reasonably level surface for construction. This will include cut to fill earthworks and compacting the material to a density of at least 93% modified AASHTO. All in all an engineered solution is required to rehabilitate the area to a standard acceptable foe residential development. Such a design will require deviating the water course that drains onto the area. The development potential of the area is regarded as poor and is classified P(Reworked ground) with anticipated settlement consisting of highly variable compression, exceeding 20mm, but highly variable, thus S to S2.

7 SURFACE HYDROLOGY

The average slope across the larger part of the land is less than 2%. In Geotechnical Zone II the slope less between 2% and 6%, that is over 45% of the site. This slope of less than 2% has a detrimental influence on especially the design of a stormwater disposal system depending on gravity to dissipate of the surface water due to downpours. No steep slopes are present on the property.

The non-perennial water courses on site are contained in well-defined, narrow gullies and may be regarded as being of lesser importance, requiring no additional precautionary measures to ensure the safety of the population against flooding. However, a deviated gully drains into the southeastern part of the site into Geotechnical Zone III.

8 MATERIALS UTILIZATION

- *Trench Backfilling : None of the materials are suitable for selected fill or pipe bedding. With exception of the hardpan calcrete all materials can be used for normal backfill.*
- *Layerworks for Paved or Segmental Block Paving : The hardpan calcrete is of G5 and G6 quality and hence suitable for the construction of layerworks up to subbase and base course level for lightly trafficked roads.*
- *Wearing Course for Gravel Roads in Urban Areas : None of the soil materials are 100% suitable for this purpose. The use of these materials will generally result in a road surface subject to raveling and corrugations. However, calcrete is often used for this purpose and is the most suitable material available.*

9 OTHER CONSIDERATIONS

- *Undermining : The area is not subject to undermining.*
- *Seismic Activity : The Peak Ground Acceleration expected in 50 years is 0,04g. A low risk for the development of earth tremors therefore exist.*
- *Soil Corrosivity : The in-situ soils and pedocretes are not corrosive due to acidic properties. All soil materials can be regarded as corrosive due to high soluble salt contents.*

- *Dolomite : The area of investigation is not subject to any restrictions due to the presence of dolomite. Bedrock of dolomite does not occur in the area of investigation.*

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INDEX

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GEOTECHNICAL CONDITIONS ON ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE) ; AND PLOT 2777 BOEGOEBERG SETTLEMENT : A REPORT FOR THE EXPANSION AND FORMALIZATION OF THE TOPLINE COMMUNITY

1 INTRODUCTION

It is envisaged to develop some 36 hectare of land on Erven 1, 16 and 87 Saalskop (Topline) ; and Plot 2777 of Boegoeberg Settlement as an expansion and formalization of the existing Topline community. For this purpose Cedar Land Geotechnical Consult (Pty) Ltd was appointed as sub consultant to Macroplan as per the minutes of the start-up meeting of the project held in the offices of Macroplan on 20 May 2020 to conduct a geotechnical investigation on the properties.

2 TERMS OF REFERENCE

The requirements of the following documents were adhered to in the conduct of the investigation and reporting of the project :

- The document *Geotechnical Site Investigations for Housing Developments (Generic Specification GFSH-2)*, issued by the National Department of Housing in September 2002.
- The document *SANS 634-1 : Geotechnical Investigations for Township Development*, issued by SABS in February 2012.

3 AVAILABLE INFORMATION

The following source of available information recording available data obtained in the larger Upington to Groblershoop area have been consulted for background information :

- *Breytenbach FJ* : Contract NRA N010-110-2012/1F : Geotechnical Investigation for Four Bridge Widenings on the National Route 10 Section 11 between Groblershoop (km 0,0) and Lambrechtsdrift (km 61,1), issued by Soilkraft cc on behalf of Bvi Engineers on 8 March 2012.

4 SITE DESCRIPTION

4.1 Site Location

The village of Topline is located directly to the west and adjacent to the National Route 10 between Upington and Groblershoop in the Northern Cape. It is some 25 km from Groblershoop. The area of investigation consisting of Erven 1, 16 and 87 Saalskop (Topline) ; and Plot 2777 of Boegoeberg is located on the perimeter of the village, on the western and southern sides thereof. The size of the property is 36 hectare.

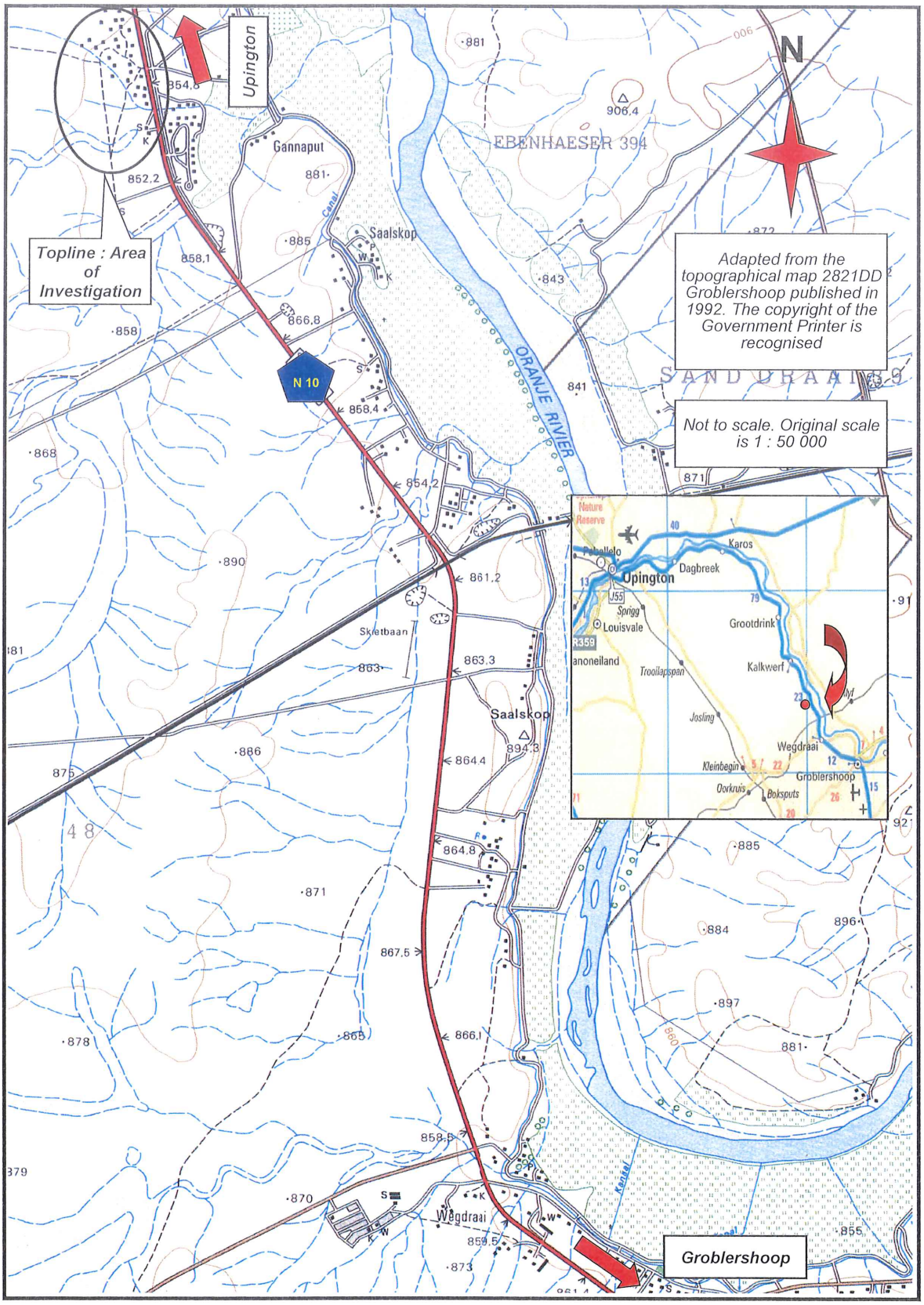
Refer to the attached Figure 1 : Locality Plan.

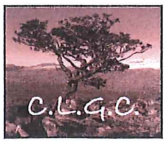
4.2 Topography and Drainage

The land investigated is located between 864,0mamsl and 851,00mamsl. Topographical it can be divided into three sections. These three sections are bordered by two centrally located non-perennial water courses, joining into one on the eastern perimeter of the area of investigation. The three areas can be described as follows ;

- *Northern Section* : This section is located between the northern limit of investigation up to the northern-most gully and initially slopes at 1,0% due south. After a distance of some 230 meters the slope increases to 4,6% terminating at the water course.
- *Central Section* : The central section is present as a ridge striking northwest to southeast between the two water courses. Slope of the central part of the ridge is virtually flat at less than 1%, while the two flanks slope at 4,3% towards the south and northeast.
- *Southern Section* : This section is located from the southern water course, terminating at the southern limit of investigation. The eastern and western limits of this section are characterized by very flat surfaces with slopes less than 1%. The remainder central part of the site is characterised by a low and undulating landscape, generally sloping towards the east at 2%.

Drainage takes place by means of surface sheetwash. The sheetwash is disposed of in the watercourses as described above. The drainage courses are contained in narrow, steeply





LOCALITY PLAN

FIGURE 1

sloping and well defined gullies. A berm of approximately two meters high is present on the eastern bank of the water course between the existing village and the water course.

4.3 Vegetation and Landscape

Based on the work done by Mucina[Reference 14.1] the area of investigation is referred to as Bushmanland Arid Grassland. The landscape features are described as consisting of extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses giving this vegetation type the character of semi-desert steppe. In places low shrubs change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected. On site it was found that in the areas where natural vegetation is present it consists of a sparse stand of Acacia melliflora, prosopis glandulosa and Boscia albitrunca. Stands of aloe claviflora are present, although these plants are removed for herbal medication and extension of urbanization.

4.4 Climatic Conditions

The area is located in a summer-rainfall region with mean annual precipitation between 70mm to 200mm ; mean maximum summer temperature of 38°C and mean minimum winter temperature of -0,6°C. Frost incidence varies between 10 and 35 days per year. The development of whirl winds are common on hot summer days. The Thornthwaithe moisture index is less than -40 ; and the Weinert N value approximately 35. The climate can thus be described as arid. The importance of this is that mechanical breakdown of bedrock will take place rather than chemical decomposition, limiting the formation of secondary minerals such as expansive montmorillonite clay.

4.5 Existing Facilities

Site conditions are illustrated on Photo 1 : Site Conditions. The area can be divided into two zones as follows :

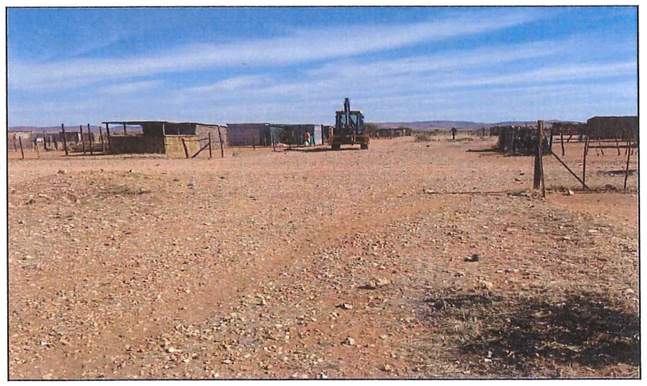
4.5.1 Informal Housing

Informal housing consisting of galvanized iron structures and some reed structures is present in the northern and southern parts of the site, directly adjacent to the existing village. Electricity is provided to overhead high mast street lighting. Some residents have created small vegetable and flower gardens on the stands.

CONDITIONS OF REFUSAL OF EXCAVATION IN HARDPAN CALCRETE

WASTE DUMPS OF CALCRETE, CONCRETE ROCK AND SANDY MATERIAL

SITE CONDITIONS IN OPEN VELD. NOTE COLLUVIAL DEPOSITS OF WHITE QUARTZ GRAVELS



CONDITIONS IN TOPLINE VILLAGE

C.L.G.C.

CONDITIONS IN TOPLINE VILLAGE

PHOTO 1

4.5.2 Vacant Land

Vacant, undeveloped land extends from the informal housing to the limits of the area of investigation to the north, west and south of Topline.

5 NATURE OF INVESTIGATION

5.1 Test Pitting

In compliance with the requirements of SANS 634 and GFSH-2 test pitting was conducted to provide applicable geotechnical information. On 7 July 2020 28 test pits were excavated with a Bell 315SK TLB on hire from ALS Plant Rentals. The TLB was equipped with a 600mm wide bucket. All test pits were excavated to refusal.

The test pits were profiled by a professionally registered geotechnical engineer. For the benefit of the non-geotechnical reader of this document, the guidelines for test pit profiling are summarized in the attached Table 1 : Soil Profiling Parameters. The profiles of the test pits may be found in Addendum A to this report. The positions of the test pits are indicated on the attached Figure 2 : Site Plan. Provisional co-ordinates for property beacons A to AAE are indicated on this figure.

5.2 Materials Testing

Soil testing was undertaken by Roadlab in Upington. As a matter of quality control duplicate samples were sent to the Roadlab branch in Germiston for independent testing to verify the results. Due to general limited vertical extent of the soil profile and coarse nature thereof, it was not feasible to retrieved undisturbed samples to determine properties of settlement or collapse fairly accurately.

Soil testing consisted of the following :

- Conductivity and pH determinations on seven samples of the in-situ materials to determine the corrosivity thereof.
- Foundation indicator testing on 11 samples of the in-situ materials to determine possible conditions of heave or settlement.
- CBR and road indicator testing on three samples to determine the suitability of the in-situ materials to be utilized as road layerworks.

The results of the soil testing may be found in Addendum B. However, for easy reference, these results are summarized in the attached Table 2 : Summary of Soil Testing. The data

sheets contained in Addendum B are copies of the originals, which are available from Roadlab.

TABLE 1 : SOIL PROFILING PARAMETERS

CONSISTENCY : GRANULAR SOILS

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

CONSISTENCY : COHESIVE SOILS

SPT N	SILTS & CLAYS and combinations with SANDS Generally slow draining soils		UCS (kPa)
<2	Very soft	Pick point easlily pushed in 100mm. Easily moulded by fingers.	<50
2-4	Soft	Pick point easlily pushed in 30mm to 40mm. Moulded by fingers with some pressure.	50-125
4-8	Firm	Pick point penetrates to 10mm. Very difficult to mould with fingers.	125-250
8-15	Stiff	Slight indentation by pick point. Cannot be moulded by fingers. Penetrated by thumb nail.	250-500
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 discernable
Moist	Water easily discernable
Very moist	Water can be squeezed out
Wet	Generally below water table

COLOUR

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 colours
Streaked	Randomly orientated streaks of colour
Stained	Local colour variations : Associated with discontinuity surfaces

SOIL STRUCTURE

Intact	No structure present.
Fissured	Presence of discontinuities, possibly cemented.
Slickensided	Very smooth, glossy, often striated discontinuity planes.
Shattered	Presence of open fissures. Soil break into gravel size blocks.
Micro shattered	Small scale shattering, very closely spaced open fissures. Soil breaks into sand size crumbs.
Residual structures	Residual bedding, laminations, foliations etc.

ORIGIN

Transported	Alluvium, hillwash, talus etc.
Residual	Weathered from parent rock, eg 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

6 SITE GEOLOGY AND GEOHYDROLOGY

The geology of the area between Upington and Groblershoop appears to consist of granitoid rock in the north, grading into metamoprphic rocks towards Groblershoop, but it is in fact highly complex and from a stratigraphical viewpoint provides complicated formation. As a background to the site geology an effort is made in this subparagraph to provide a simplified explanation of the regional geology of the area. For this purpose publications by McCarthy[Reference 14.2], Cornell[Reference 14.3] and Moen[Reference 14.4] were consulted. Of these three references, the latter two can be regarded as site specific. However, there is disagreement

FIGURE 2 : SITE PLAN

COORDINATES – TOPLINE System: WGS84 GW21		
Point	Y	X
A	-82029.972	3181804.378
B	-82035.880	3181819.093
C	-82052.895	3181946.112
D	-81912.148	3181964.970
E	-81930.211	3182099.772
F	-81973.873	3182093.921
G	-81975.202	3182103.833
H	-81931.565	3182109.881
J	-81953.201	3182271.347
K	-82073.127	3182360.707
L	-82124.613	3182399.070
M	-82101.936	3182429.507
N	-82094.78	3182430.755
P	-82036.768	3182392.334
Q	-81993.666	3182374.233
R	-81976.557	3182442.970
S	-82003.600	3182454.327
T	-82052.474	3182486.697

COORDINATES – TOPLINE System: WGS84 GW21		
Point	Y	X
U	-82052.537	3182492.311
V	-82008.725	3182522.762
W	-82013.114	3182536.761
X	-82007.605	3182544.413
Y	-82006.558	3182548.761
Z	-82030.526	3182555.104
AA	-82003.586	3182647.246
AB	-82027.582	3182654.261
AC	-82039.715	3182648.398
AD	-82063.910	3182655.472
AE	-82072.890	3182624.758
AF	-82112.324	3182652.126
AG	-82112.999	3182655.514
AH	-82160.087	3182646.137
AJ	-82159.286	3182642.115
AK	-82173.540	3182621.576
AL	-82120.962	3182585.086
AM	-82114.432	3182485.751

COORDINATES – TOPLINE System: WGS84 GW21		
Point	Y	X
AN	-82089.695	3182469.368
AP	-82135.839	3182407.435
AQ	-82332.556	3182554.013
AR	-82349.217	3182543.353
AS	-82371.218	3182533.353
AT	-82367.396	3182512.206
AU	-82376.407	3182507.869
AV	-82382.316	3182529.996
AW	-82387.219	3182548.353
AX	-82393.742	3182599.604
AY	-82302.989	3182617.677
AZ	-82303.599	3182737.497
AAA	-82275.598	3182845.776
AAB	-82080.914	3182898.891
AAC	-81963.653	3182809.382
AAD	-81839.170	3182710.048
AAE	-81580.011	3181893.157

LEGEND

- TP1 — TEST PIT POSITION
- BOSCIA ALBITRUNCA (TO BE CONSERVED)
- RUBBLE
- BORROW PIT

To National Route N10

Adapted from Project : Topline, Dated June 2020.
The Copyright of Lutz & van Zyl Profesional Land Surveyors is recognised

0m 60m 120m 180m 240m 300m

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TAAK: JOB NAME:	Expansion and Formalisation of Topline Community
LIGGING: SITE:	Erven 1, 16 and 87 Saalskop (Topline); and Plot 2777 Boegoeberg Settlement
KLIËNT: CLIENT:	!Kheis Municipality
TEKENING NO: DRAWING NO:	Figure 2 : Site Plan
DATUM: DATE:	8 September 2020

TABLE 2 : SUMMARY OF SOIL TESTING

TEST PIT	SAMPLE NO (CLG)	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	GM	PI	LL	ACTIVITY	pH	CONDUCTIVITY (Sm^{-1})	% < 0,002mm	OMC (%)	MDD (kgm^{-3})	SOIL CLASS		
														COLTO	PRA	UNIFIED
2	U9256	300-600	Hardpan calcrete	Sandy gravel	2,20	4,0	21	Low			1,4	6,8	2,067	G5	A-1-a(0)	GC
5	U9257	100-300	Hardpan calcrete	Sandy gravel	1,90	3,0	19	Low	7,87	0,05	1,3				A-1-a(0)	SC
6	U9258	400-800	Bedrock granite-gneiss	Rock fragments	2,40	8,0	31	Low			0,6				A-2-4(0)	GW-GM
11	U9258	200-500	Hardpan calcrete	Sandy gravel	2,10	4	25	Low	7,82	0,11	0,4				A-1-b(0)	GM-GC
13	U9260	100-800	Hardpan calcrete	Sandy gravel	2,50	5	35	Low			0,4	10,2	1845	G6	A-1-a(0)	GW-GM
18	U9261	300-500	Hardpan calcrete	Sandy gravel	2,00	5	22	Low			2,0				A-1-b(0)	GM-GC
19	U9262	300-600	Bedrock granite-gneiss	Rock fragments	1,90	6	33	Low	7,74	0,15	0,5				A-1-b(0)	SM
20	U9263	100-500	Hardpan calcrete	Sandy gravel	2,00	4	25	Low	7,69	0,06	0,8				A-1-b(0)	GM-GC
24	U9264	0-500	Fill/ Alluvium	Sand & gravel	1,30	4	25	Low	7,85	0,09	1,0				A-2-4(0)	SM-SC
25	U9265	0-700	Fill/ Alluvium	Fine sand	1,00	3	19	Low	7,78	0,06	2,8	8,2	2134	G9	A-2-4(0)	SC
27	U9266	200-700	Nodular calcrete	Sandy gravel	2,40	4	34	Low	7,58	0,06	0,2				A-1-a(0)	GW-GM

between the two sources regarding the stratigraphic classification of the major subdivisions of the Namaqua-Natal province. As the work produced by Cornell is regarded as the reference document, his approach is adopted for this report.

Some concepts must be identified :

- *Craton* : A craton is a block of ancient crust, formed 3000 million years ago and its rocks have essentially remained unchanged. Cratons form the larger parts of the land-building mass.
- *Province* : A tectono-stratigraphic province is defined as a large area of contiguous structural fabric with well-defined boundaries which formed during a particular, geochronologically defined, tectono-metamorphic event. A province is further subdivided in sub-provinces and sub-provinces into terranes.
- *Terrane* : A terrane is a term for a tectonostratigraphic unit, which is a fragment of crustal material formed on, or broken off from, one tectonic plate and accreted or "sutured" to crust lying on another plate. The crustal block or fragment preserves its own distinctive geologic history, which is different from that of the surrounding areas.

6.1 Regional Geology

The geological processes by which the area under consideration was shaped, initiated some 1000 million years ago with the formation of the supercontinent Rodinia. A mountain chain of global extent formed along the boundaries, underlain by metamorphic rocks that have since then been exposed due to erosion. Metamorphic rocks of this age formed across South Africa to the south and west of the Kaapvaal Craton, known as the Namaqua-Natal Province. The Namaqua-Natal Province can be divided into five tectonostratigraphic sub provinces and terranes, based on marked changes in the lithostratigraphy across structural discontinuities. The five domains so recognized are the Richtersveld Sub province, the Bushmanland Terrane, Kakamas Terrane, Areachap Terrane and Kaaien Terrane. The tectonic subdivision as proposed on Figure 2 (Cornell) is reproduced in this document as Figure 3.

The process of landforming can be described as compatible to the modern concept of plate tectonics. In this case the Namaqua plate became buried beneath the Kaapvaal Craton in a subduction zone. Considering the forces involved it can be regarded as a violent process, resulting in the breaking up of the landmass into the five domains as described above, associated with the intrusion of recycled rock material from the subduction zone. What is important for this report is that in the case of the Kaaien terrane, the formation of metaquartzites, deformed early Namaquan volcano-sedimentary rocks and deformed, but thermally metamorphosed bimodal volcanic rocks resulted, amongst others. These rocks are at present referred to as the Brulpan Group. The Brulpan Group was intruded by the Kalkwerf

gneiss, on which Topline is located. The intrusion of the Kalkwerf gneiss into the Kaaien terrane is dated some 950Ma to 1000Ma ago.

The regional geology is indicated on Figure 4 : Regional Geology. The Kalkwerf gneiss is indicated in light brown hatched red and referenced as Mkk on the figure.

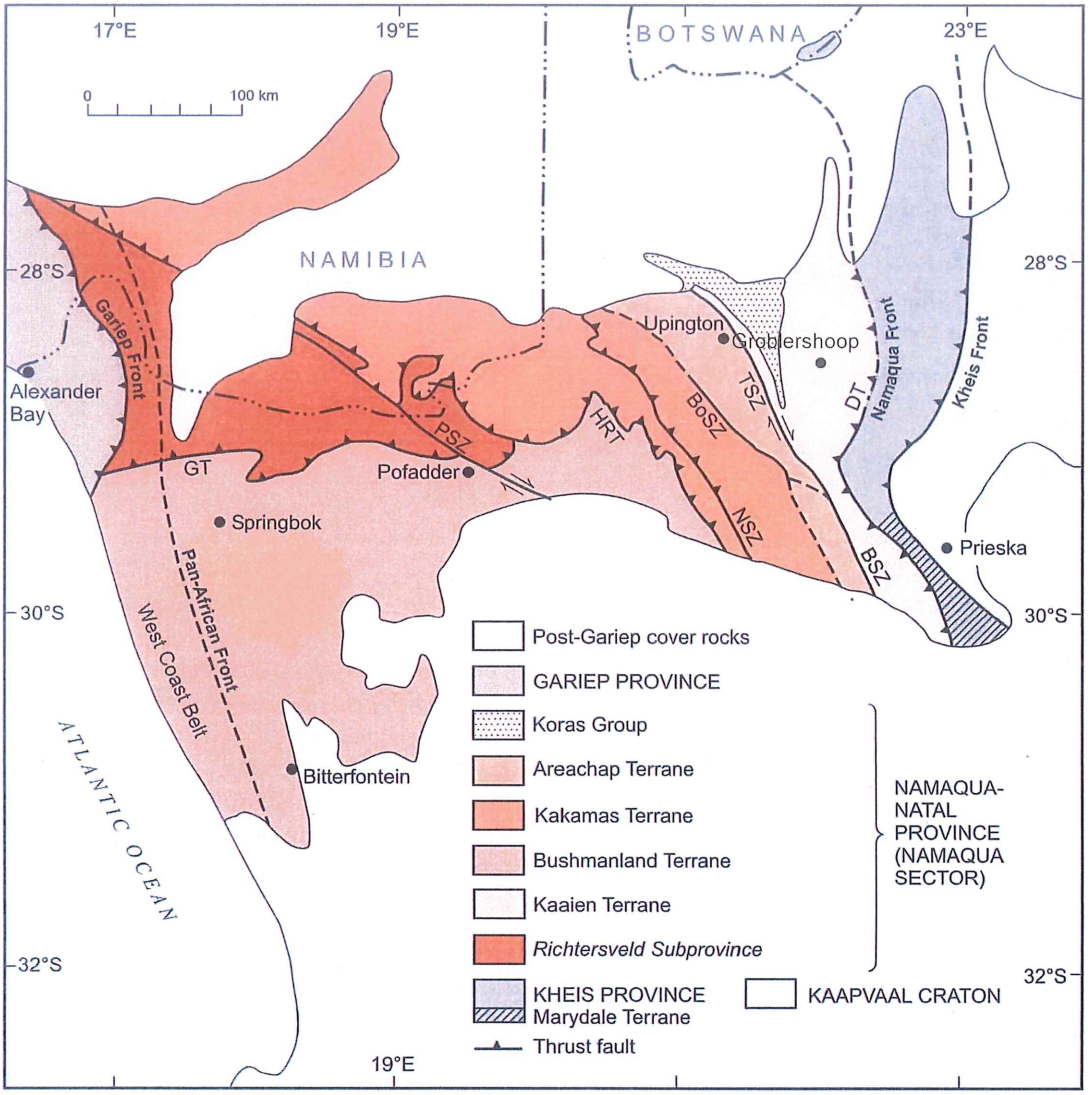
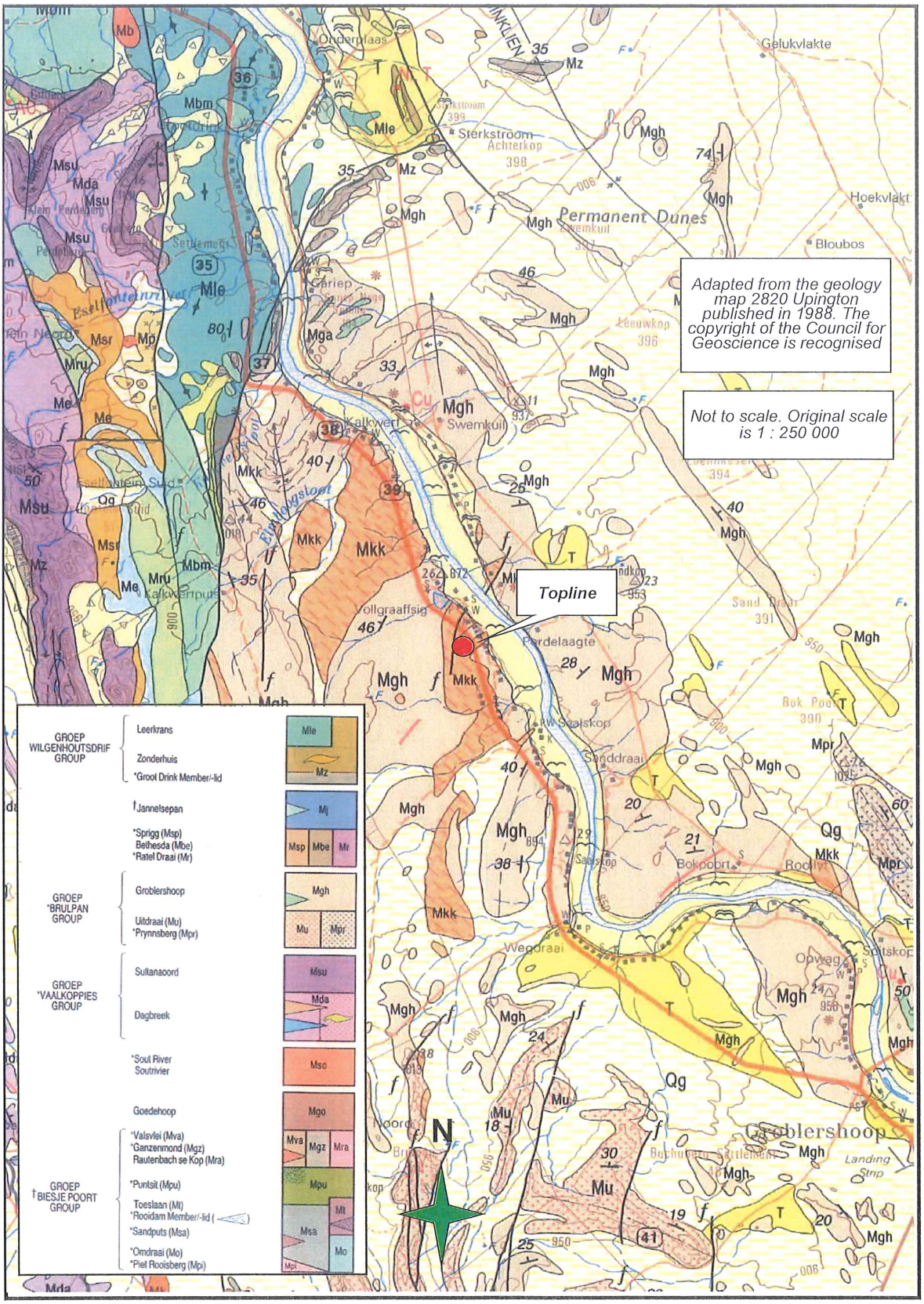


FIGURE 3 : TECTONIC SUBDIVISION OF THE NAMAQUA SECTOR

6.2 Site Geology

The site geology is illustrated on Figure 5. The soil and pedocretes cover all contacts of various rock types, thus hampering field investigations. The inferred material boundaries must be accepted as indicative of the actual conditions only.

Bedrock on site occurs as Kalkwerf granite-gneiss. The Kalkwerf granite-gneiss intruded into the Groblershoop Formation, forming large, deeply weathered and poorly exposed outcrops in



C.L.G.C.

TOPLINE : REGIONAL GEOLOGY

FIGURE 4

Adapted from Project : Topline, Dated June 2020.

0m 60m 120m 180m 240m 300m

FIGURE 5 :
SITE GEOLOGY

LEGEND
- TP1 — TEST PIT POSITION
- BOSCIA ALBITRUNCA (TO BE CONSERVED)
- RUBBLE
- BORROW PIT
- INFERRED MATERIAL BOUNDARY

To National Route N10

Lithology		Formation	Group
C	Calcrete	Mokolanen	Kalahari
G	Kalkwerf granite-gneiss	Groblershoop	Brulpan

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TAAK: JOB NAME: Expansion and Formalisation of Topline Community
LIGGING: SITE: Erven 1, 16 and 87 Saalskop (Topline); and Plot 2777 Boegoeberg Settlement
KLIËNT: CLIENT: !Kheis Municipality
TEKENING NO: DRAWING NO: Figure 5 : Site Geology
DATUM: DATE: 9 September 2020

the Saalskop/Topline area. It is a strongly foliated, gneissic rock with a well-developed augen structure, which has been deformed by subsequent phases of deformation into both tight and open folds, with local development of strong lineation. In thin section the granite can be seen to have suffered extreme deformation, with quartz grains completely recrystallized, showing deformation bands and undulose extinction. The rest of the rock is made up of plagioclase, muscovite, chloritized biotite, occasional garnet, epidote, hornblende and other accessory minerals. On site the granite gneiss was encountered as dirty white mottled light green and pink, massive, micaceous, hard rock, varying to dark grey speckled dull dark red, closely jointed and coarse grained, hard rock.

6.3 Soil Profile

6.3.1 Colluvium

Although the surface soil deposits may easily be regarded as alluvial sands transported by the Orange River, this is not the case. Moen (Reference 14.4 page 149) describes the presence of alluvium and terrace gravels associated with the Orange River as being present on the northeastern banks of the river in the area between Grootdrink and Groblershoop and not on he western bank where T.

On site colluvium as surface deposit was found in all the test pits except TP's 3, 22, 24, 25 and 27. In TP's 1, 2, 4 to 21, 23, 26 and 28 the colluvium consists of pegmatitic gravels, weather resistant scree of quartz and quartzite fragments contained in a sandy matrix. Nodules of calcrete may be contained in the colluvium. The consistency of the colluvium varies between loose and medium dense. The horizon of colluvium was between 100mm and 600mm thick in the test pits.

6.3.2 Made Ground

What appears to be areas levelled and fill material provided for construction of a dam and soccer field was encountered in TP's 22, 24 and 25. The origin of this surface soil is unsure, and it may also originate as debris of the non-perennial stream in which vicinity these test pits are located and can arguably also be regarded as alluvium. It is clear that the course of the stream was deviated for the provision of these facilities. However, the quality of the material differs totally from any other found on site, and it is thus regarded as imported fill. This fill is described as light brown, loose, fine sand. The horizon of fill extended to depths varying between 200mm and 700mm in the test pits.

6.3.3 Residual Granite-gneiss

A superficial horizon of residual granite-gneiss was encountered in TP 25 only. It is described as abundant clast supported, fine, angular gravels of granite-gneiss in a matrix of light brown, fine sand, with a medium dense consistency. The horizon underlies the fill material in the test pit, extending to a depth of 800mm only.

6.3.4 Mokalanen Formation

Calcrete of the Mokalanen Formation, Kalahari Group, is present as an ubiquitous surface duricrust on site. Moen (Reference 14.4 page147) and Partridge[Reference 14.5] disagree regarding the origin of the calcrete. Moen regards the calcrete as being of Tertiary age, but some doubt whether the outcrops are of the same age and in some localities it may still be in the process of forming. Partridge describes the age of the calcrete as straddling the boundary between the Pliocene and Quaternary, making it some 2,6 to 2,8 million years old. It was deposited under arid conditions and possibly reflects a climatic interval of global aridification.

The engineering properties of calcrete may differ widely for samples taken from the same locality. It is therefore important to provide some background in this regard to aid in the understanding of these conditions.

Brink[Reference 14.6] states that during pedocrete development, clay and silt become flocculated and cemented into larger silt to gravel-sized complexes of varying strength and porosity. These particles and aggregations may or may not break down during laboratory testing and under compaction. The mineralogy of the cementing material and of the clay fraction is different from those of normal, temperate zone soils on which current specifications for soil testing and classification is based. Calcrete can therefore be expected to exhibit differences in behaviour from those of traditional soil materials.

Whereas in traditional soil mechanics it is assumed that all the water is outside the particles, calcrete aggregates retain moisture and this affects conventional moisture content and Atterberg limit determinations. Palygorskite which is the dominant clay in calcrete has approximately the same plasticity index as some smectites, which can be regarded as highly expansive. However, the palygorskite has a non-expansive lattice and a hollow, needle-like shape instead of the usual flaky particle shape of most other clays. It has the lowest shrinkage limit and dry density and the highest optimum moisture content and shear strength of all clays.

Be it as it may, calcrete was encountered as the dominant lithic material on site, in virtually a continuous cover over the granite-gneiss. It appears as if outcrops of granite-gneiss are

present in low-lying areas of the site where the cover of duricrust has been eroded away by water. The calcrete is present as either dense to very dense nodular calcrete or hardpan calcrete.

6.3.4(i) Hardpan Calcrete

Hardpan calcrete was encountered in TP's 1 to 5, 8, 11 to 15, 17, 18, 20, 21, 23 and 26. It is present as outcrops or underlies the colluvium, occurring from depths between 100mm and 600mm minimum, extending to 200mm to 800mm maximum, at which stage refusal of excavation occurred. Moen reports the calcrete to be up to five meters thick in the area. In TP 3 the hardpan calcrete was encountered as an outcrop and similar conditions were noted elsewhere on site. The hardpan calcrete can be described as dirty white, very fine grained and very dense.

6.3.4(ii) Nodular Calcrete

Nodular calcrete, including boulder calcrete, was encountered in TP's 16, 17 and 28. It was present at 200mm deep in TP's 16 and 28 underlying the colluvium, extending to 600mm and 800mm deep at which depth refusal of excavation occurred. In TP 27 it was present as an outcrop, extending to 700mm deep, at which stage refusal of excavation occurred. The nodular calcrete can be described as abundant clast supported medium coarse, rounded and subrounded nodules of calcrete in a matrix of very dense, calcareous cemented, fine sand.

6.3.5 Waste

Substantial areas of stockpiles of rubble are present in the vacant land. Such rubble consists of items varying from household waste, excavated calcrete to builder's rubble. The presence of these stockpiles are indicated on Figure 2 : Site Plan.

6.4 Groundwater

6.4.1 Perched Water

Perched groundwater was not encountered in any of the test pits excavated for this investigation. Considering the climate of the area and the nature of in situ materials, it is anticipated that perched water will generally not prove problematic on the site, except in the lesser drainage courses in the southeastern corner of the site after events of inundation. Even if it did occur, the grading of in-situ materials is such that dispersal will take place fairly rapidly. Furthermore, it is expected that perched water and/or surface seepage may occur shortly after precipitation events and in years of excessive rain only.

6.4.2 Permanent Groundwater

Vegter[Reference 14.7] indicates the probability for drilling successfully for water in the area to be between 40% and 60%, and the probability that such a borehole will yield more than 2l/s is between 10% and 20%. Groundwater is expected to occur at depths less than 15 meters in compact, argillaceous strata.

7 GEOTECHNICAL EVALUATION

The engineering properties of the in-situ materials are summarized in Table 3 : Summary of Engineering Properties. The characterizations have been derived based on the Unified materials classifications as reported by literature studies.

7.1 Engineering and Material Characteristics

7.1.1 Properties of Heave

The results of the materials testing as reported in Table 2 indicate the in-situ materials are not expansive. Any future structures will thus not be subject to heave. The content of active clay, that is the material smaller than 0,002mm in diameter, was less than 3% for all the samples tested.

7.1.2 Properties of Settlement

7.1.2(i) Colluvium

On site colluvium as surface deposit was found in all the test pits except TP's 3, 22, 24, 25 and 27. In TP's 1, 2, 4 to 21, 23, 26 and 28 the colluvium consists of pegmatitic gravels, weather resistant scree of quartz and quartzite fragments contained in a sandy matrix. Nodules of calcrete may be contained in the colluvium. The consistency of the colluvium varies between loose and medium dense. The horizon of colluvium was between 100mm and 600mm thick in the test pits. The consistency cannot be described as very loose, and voided soil matrices were not encountered in the colluvial horizons. The properties of the colluvium are thus such that it does not tend to excessive settlement.

7.1.2(ii) Residual Granite-gneiss

A superficial horizon of residual granite-gneiss was encountered in TP 25 only. It is described as abundant clast supported, fine, angular gravels of granite-gneiss in a matrix of light brown, fine sand, with a medium dense consistency. The consistency cannot be described as very

TABLE 3 : SUMMARY OF ENGINEERING PROPERTIES

TEST PIT NO	SAMPLE NO	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	SOIL CLASS PRA	SOIL CLASS UNIFIED	COHESION[1] (kNm^{-2})	FRICTION ANGLE (°)[1]	COMPRESSIBILITY[2]	EROSION RESISTANCE[2+5]	PERMEABILITY[2] k (cms^{-1})	SPECIFICATIONS FOR UNPAVED ROADS[3] MAXIMUM SIZE	OVERSIZE INDEX (I_o)	GRADING COEFFICIENT(G_c)	SHRINKAGE PRODUCT(S_p)	CBR @ 95% MOD	SUITABILITY FOR ROAD CONSTRUCTION[4] PAVED	UNPAVED
2	U9256	300-600	Hardpan calcrete	Sandy gravel	A-1-a(0)	GC	<5	28° to 35°	Very low	3	>3X10^{-7}	63,0	3,0	19,4	58,0	56	Subbase & base	Ravels & corrugates
5	U9257	100-300	Hardpan calcrete	Sandy gravel	A-1-a(0)	SC	5 to 10	30° to 35°	Low	5	(3±2)X10^{-7}	37,5	9,0	16,5	64,5			Ravels & corrugates
6	U9258	400-800	Bedrock granite-gneiss	Rock fragments	A-2-4(0)	GW-GM	<5	30° to 40°	Negligible	1 to 4	(2,7±1,3)X10^{-2}	37,5	2,0	30,0	57,0			Ravels & corrugates
11	U9258	200-500	Hardpan calcrete	Sandy gravel	A-1-b(0)	GM-GC	<5	28° to 40°	Negligible to very low	Highly	>3X10^{-7}	28,0	0,0	23,0	70,0			Ravels & corrugates
13	U9260	100-800	Hardpan calcrete	Sandy gravel	A-1-a(0)	GW-GM	<5	30° to 40°	Negligible	1 to 4	(2,7±1,3)X10^{-2}	75,0	7,0	17,0	27,0	49	Subbase	Ravels & corrugates
18	U9261	300-500	Hardpan calcrete	Sandy gravel	A-1-b(0)	GM-GC	<5	28° to 40°	Negligible to very low	Highly	>3X10^{-7}	37,5	3,0	24,5	126,0			Good
19	U9262	300-600	Bedrock granite-gneiss	Rock fragments	A-1-b(0)	SM	20 to 22	32° to 35°	Low	8	(7,5±4,8)X10^{-6}	28,0	0,0	30,0	93,0			Ravels & corrugates
20	U9263	100-500	Hardpan calcrete	Sandy gravel	A-1-b(0)	GM-GC	<5	28° to 40°	Negligible to very low	Highly	>3X10^{-7}	37,5	11,0	19,4	76,0			Ravels & corrugates
24	U9264	0-500	Fill/ Alluvium	Fine sand	A-2-4(0)	SM-SC	5 to 22	30° to 35°	Low	5 to 8	2,7X10^{-6} to 5X10^{-7}	20,0	0,0	18,7	128,0			Good
25	U9265	0-700	Fill/ Alluvium	Fine sand	A-2-4(0)	SC	5 to 10	30° to 35°	Low	5	(3±2)X10^{-7}	14,0	0,0	7,8	115,5	7	Lower selected	Erodible
27	U9266	200-700	Nodular calcrete	Sandy gravel	A-1-a(0)	GW-GM	<5	30° to 40°	Negligible	1 to 4	(2,7±1,3)X10^{-2}	28,0	0,0	26,2	22,0			Ravels & corrugates

1 Obrzud RF and Truty A : The Hardening Soil Model - A Practical Guidebook, 2018 edition, revised 21 October 2018.

2 Brink ABA et al : Soil Survey for Engineering, published in 1982.

3 The Structural Design, Construction and Maintenance of Unpaved Roads (Draft TRH 20), Committee of State Road Authorities 1990.

4 Structural Design of Flexible Pavements for Interurban and Rural Roads (Draft TRH 4), Committee of State Road Authorities 1996.

5 Erosion resistance : 1 is best 10 is poor.

loose, and voided soil matrices were not encountered in the colluvial horizons. The properties of the residual granite-gneiss are thus such that it does not tend to excessive settlement.

7.1.2(iii) Pedocretes

Hardpan calcrete was encountered in TP's 1 to 5, 8, 11 to 15, 17, 18, 20, 21, 23 and 26. It is present as outcrops or underlies the colluvium, occurring from depths between 100mm and 600mm minimum, extending to 200mm to 800mm maximum, at which stage refusal of excavation occurred. Nodular calcrete, including boulder calcrete, was encountered in TP's 16, 17 and 28. It was present at 200mm deep in TP's 16 and 28 underlying the colluvium, extending to 600mm and 800mm deep at which depth refusal of excavation occurred. In TP 27 it was present as an outcrop, extending to 700mm deep, at which stage refusal of excavation occurred. Both materials are of very dense consistency. The soil matrices are either intact or calcareous cemented. It can thus accommodate stresses imposed by conventional housing structures without undue settlement. Only limited – if any –settlement can thus be expected for structures such as single storey units of masonry construction.

7.1.2(iv) Made Ground

Made ground (fill) was encountered in TP's 22, 24 and 25. The origin of the surface soil is unsure, and it may also originate as debris of the non-perennial stream in which vicinity these test pits are located and can arguably also be regarded as alluvium. However, the quality of the material differs totally from any other found on site, and it is thus regarded as imported fill. This fill is described as light brown, loose, fine sand. The horizon of fill extended to depths varying between 200mm and 700mm in the test pits.

In principle the properties of settlement of the fill encountered in TP's 22, 24 and 25 cannot be regarded as a limiting factor towards residential development as it can be regarded as slightly compressible and the horizon is of limited thickness only, as per the test pits.

7.1.3 Corrosivity

When discussing soil corrosivity, it is applicable to consider the guidelines as proposed by EvansReference [14.8]. The corrosivity of a soil towards buried, exposed, metallic surfaces is dependent 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 tests carried out for the compilation of this report must be considered as indicative of the corrosivity of the soils only. 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 $0,01Sm^{-1}$, corrosiveness is generally not a problem. However, the potential for corrosivity of the soil increases with an increase in conductivity. Should the conductivity of the soil exceed $0,05Sm^{-1}$, 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.

The results of the chemical testing carried out for this report indicate the following :

- *Acidity* : The pH of the samples of material tested varied between 7,58 and 7,87. The soils are thus regarded as not corrosive due to the acidity there of.
- *Water Soluble Salts Content* : The conductivity of the samples of material tested varied between $0,06Sm^{-1}$ for the colluvium and some of the hardpan calcrete samples to $0,15Sm^{-1}$ for the residual granite-gneiss. All soil materials can therefore be regarded as corrosive due to high soluble salt contents.

Other considerations are :

- *Heterogeneity of the Soil* : Conditions of corrosive soils due to a heterogeneous soil profile do not occur on the property.
- *Water Logged Soils* : Conditions of water logged soils were not encountered on site and neither is it expected that such conditions can develop.

7.1.4 Materials Utilisation

7.1.4(i) Backfilling of Service Trenches

The hardpan calcrete is not suitable to be used for any type of backfill due to its tendency to break into boulder and cobble sized fragments on excavation. Such fragments cannot be compacted properly on backfilling.

All other materials, that is the colluvium, nodular calcrete and residual soils can be used for normal backfilling of services trenches. However, due to the coarse granular composition thereof these materials are not suitable for pipe bedding or selected backfill around pipes.

7.1.4(ii) Construction of Paved or Segmental Block Streets

Only provisional indicators for future guidance of development are provided as far as material quality for road construction is concerned, complying with the requirements applicable to the level of investigation.

The results of the compaction testing on soil samples show the hardpan calcrete to be of G5 and G6 quality and the fill material of G9 quality. Based on the results of this limited testing the calcrete is suitable to be used for the construction of base and subbase courses of lightly trafficked paved streets in townships. Similarly the fill material is suitable only to be used for the construction of a road fill or lower selected layer.

7.1.4(iii) Wearing Course for Urban Gravel Roads

The properties to provide guidance for the use of soil materials for the structural design of a wearing course for urban gravel roads are contained in the various sub-columns of the column "Specifications for Unpaved Roads" in Table 3. The various parameters are colour-coded : Green = suitable ; red = unsuitable. The two sub-columns with a light yellow-brown background contain the parameters on which the physical behaviour of the wearing is course is determined.

From the table it is clear that none of the in-situ materials comply in all aspects to the requirements for a gravel wearing course. In most cases the use of these materials will result in a wearing course subject to raveling and corrugations. This can be attributed the non-cohesive character of most of the materials.

7.1.5 Other Considerations

The properties discussed in this subsection of the report were obtained from literature reported values based on studies done by the US Army Corps of Engineers as reported by BrinkReference [14.9] for compacted material. This approach is followed as the arenaceous character of the in-situ materials that did not allow the retrieval of undisturbed sampling. The typical soil properties associated with the Unified classifications of the materials are thus reported.

7.1.5(i) Compressibility

The compressibility of the material can be regarded as a necessary input to pavement design as well as lesser important supporting information for geotechnical classification for site class designation.

- *Colluvium* : Samples for materials testing were not retrieved from the colluvium. However, based on the high gravel content of the colluvium it is regarded as low to fairly compressible only.
- *Fill/Alluvium* : The fill is regarded as potentially only low compressible with cohesion (c_0) of 5 kNm^{-2} to 22kNm^{-2} and the effective stress envelope approximately 30° to 35°.
- *Nodular Calcrete* : The nodular calcrete is regarded as negligibly compressible with cohesion (c_0) less than 5 kNm^{-2} and the effective stress envelope approximately 30° to 40°.
- *Hardpan Calcrete* : The hardpan calcrete is regarded as negligibly compressible with cohesion (c_0) less than 5kNm^{-2} to 10kNm^{-2} and the effective stress envelope approximately 28° to 40°.
- *Residual Granite-gneiss* : The residual granite-gneiss is regarded as negligibly compressible with cohesion (c_0) of less than 5kNm^{-2} to 22Nm^{-2} and the effective stress envelope approximately 30° to 40°.

7.1.5(ii) Permeability

Permeability is an important parameter in the design of surface drainage and seepage drains. As such indicators in this regard are provided.

- *Fill/Alluvium* : The permeability of the fill is regarded as semi-pervious to impervious. The soil permeability coefficient varies between 2,7X$10^{-6}$$cms^{-1}$ to 5,0X$10^{-7}$$cms^{-1}$.
- *Calcrete* : The permeability of the calcrete is highly variable depending on the mode of deposition and regarded as pervious to impervious. The soil permeability coefficient varies between more permeable than 2,7X$10^{-6}$$cms^{-1}$ to 5,0X$10^{-7}$$cms^{-1}$.
- *Residual Granite-gneiss* : The residual granite-gneiss is regarded as pervious to impervious. The soil permeability coefficient varies between (7,5±4,8)X$10^{-6}$$cms^{-1}$.

7.1.5(iii) Erosion Potential

- *Fill/Alluvium* : The fill is regarded as moderately to poorly resistant against erosion. This condition can be attributed to the loose consistency thereof and non-cohesive nature of the material.
- *Calcrete* : Conflicting properties of susceptibility to erosion are recorded for the calcrete, varying from highly erodible to highly resistant against erosion. A holistic approach will be to consider the presence of calcrete as a very dense capping of competent material overlying the residual soils and bedrock. This capping has protected the underlying material successfully for more than one million years against erosion and can still hardly be removed even with mechanical equipment. The calcrete is therefore regarded as erosion resistant.

- *Residual Granite-gneiss* : The residual granite-gneiss is regarded as moderately to highly susceptible to erosion.

7.2 Properties of Bedrock

The TLB used to excavate the test pits did not penetrate bedrock or hardpan calcrete to any significant extent and refusal of excavation occurred within millimeters after encountering bedrock. It is not customary to penetrate bedrock in the case of a geotechnical investigation for purposes of a residential development. Refusal of excavation on hard rock is accepted as suitable. One can thus accept bedrock to be hard tending to very hard once refusal of excavation was encountered.

7.2.1 Granite-gneiss

Parametric calculations with Roclab software results for slightly weathered, closely jointed and laminated, micaceous rich hard rock, granite-gneiss result in the following properties :

- Cohesion : 5,14MPa
- Friction Angle : 33,2°
- Tensile Strength : 0,032MPa
- Uni-axle Compressive Strength : 2,4MPa
- Young's Modulus : 3402,2 MPa

All which show a moderately sound rock.

7.2.2 Calcrete

Although the calcrete fragments tested can be regarded as similar to sandy gravels, hardpan calcrete can also be regarded as resembling massive rock in in-situ conditions. Voided matrices were not encountered in the hardpan calcrete during the investigation. The results of the materials testing on samples of the hardpan calcrete fragments approach that of the nodular calcrete. However, it must be borne in mind that in in-situ conditions the properties of hardpan calcrete approaches that of soft rock rather than a gravelly sand. The grading modulus of the samples of hardpan calcrete fragments tested varied between 1,90 and 2,50 ; plasticity index between three and five ; and clay content less than 2%. The activity of the hardpan calcrete is described as low. The PRA classification of the calcrete is generally A-1-a(0) to A-1-b(0) ; and the Unified classification varying between GC and GM. Based on these properties and material classification the hardpan calcrete is regarded as non-expansive and no consolidation settlement and no collapse settlement can thus be expected for structures such as single storey units of masonry construction.

The test results of the hardpan calcrete reflect the properties of excavated fragments of material and not the intact mass of hardpan calcrete. It is therefore accepted that the properties of the very dense calcrete can be considered as tending towards soft rock to medium hard rock, limestone.

Brink (Reference 14.6) reports an average UCS of 32MPa for intact samples of hardpan calcrete from the Kalahari region. Using this as input to parametric calculations with Roclab software results for very dense calcrete tending to widely jointed, slightly weathered, medium hard rock, limestone result in the following properties :

- Cohesion : 1,08MPa
- Friction Angle : 24°
- Tensile Strength : 0,018MPa
- Uni-axle Compressive Strength : 550kPa
- Young's Modulus : 2340MPa

All which show a sound pedocrete, not compressible, not permeable nor subject to erosion.

7.3 Excavation Classification with Respect to Services

7.3.1 Hand Excavation

7.3.1(i) Colluvium

The colluvium can be considered as suitable to be excavated by swing tools.

7.3.1(ii) Pedogenic Deposits

The nodular and hardpan calcrete are of dense to very dense consistency. Such material cannot be considered as suitable to be manually excavated and may as minimum require the use of a 55kW TLB and eventually the use of an excavator.

7.3.1(iii) Residual Granite-gneiss

Residual granite-gneiss is of medium dense consistency. In a condition of medium dense consistency it will be possible to excavate these materials manually ; in a state of dense consistency it will be possible to excavate it manually with considerable effort ; and if very dense, not at all and may as minimum require the use of a 55kW TLB. It must also be taken in consideration that the very dense pedocretes overlie the residual soils, which will in any case require mechanical equipment for excavation.

7.3.1(iv) Bedrock

Bedrock of granite-gneiss cannot be excavated manually successfully.

7.3.2 Classification of Material for Machine Excavation

In terms of Table 5 of SANS 634 : 2012 the following is applicable :

7.3.2(i) Restricted Excavation

- *Soft Excavation* : All soil strata can be regarded as soft excavation. The combined thickness of these strata varied between 100mm and 800mm in the test pits, averaging 250mm prior to encountering conditions of intermediate or hard rock excavation.
- *Intermediate Excavation* : Refusal of excavation with a TLB occurred in most cases once very dense, hardpan calcrete or slightly weathered to unweathered rock was encountered. It was possible to penetrate between 100mm and 700mm into weathered granite-gneiss and hardpan calcrete, averaging 280mm thick, prior to encountering hard rock excavation.
- *Hard Rock Excavation :* Refusal of excavation occurred on conditions of hard rock excavation in all the test pits at depths varying between 100mm and 1100mm, averaging 520mm.

From the above it is clear that the transition of conditions of excavation is rapid from soft to hard rock excavation with limited intermediate excavation.

7.3.2(ii) Non-restricted Excavation

The classification as per subparagraph 7.3.2(i) : Restricted Excavation as above is also applicable for non-restricted excavation.

7.4 Seismicity

A 10% probability of an event with magnitude less than 100cms^{-2} to take place once in 50 years is regarded as favourable ; and a natural seismic activity with magnitude exceeding 100cms^{-2} is regarded as unfavourable. Based on a report compiled by Kijko[Reference 14.10] a 10% probability exists that an earthquake with Peak Ground Acceleration exceeding of 0,04g may take place once in 50 years in Topline.

The closest source of seismic measurements to Grootdrink under control of the Council for Geoscience is Tontelbos at 31° 10' 12"S and 20' 30' 00"E.

- The annual probability for an earthquake with intensity of 4,5 on the Modified Mercalli Scale to occur in the area is less than $10^{-0,7}$; and with an intensity of 8,5 to occur the probability is $10^{-3.8}$.
- The annual probability for an earthquake with an acceleration of $10^{-1,9}$g to occur in the area is less than $10^{-0,7}$; and with an acceleration of $10^{-0,75}$g to occur in the area is less than $10^{-3,8}$.

To put the above information into perspective, Table 4 : Earthquake and Magnitude and Intensity, is attached to this report.

7.5 Undermining

The area of investigation is not undermined.

7.6 Dolomite Stability

The area of investigation is not subject to dolomite related instabilities.

8 SITE CLASS DESIGNATIONS

Based on the above discussions the property can be divided into three zones as per the guidelines posted by SANS 10400 : Section H[Reference 14.11] . The zonation is indicated on Figure 6 : Site Class Designation.

8.1 Geotechnical Zone I

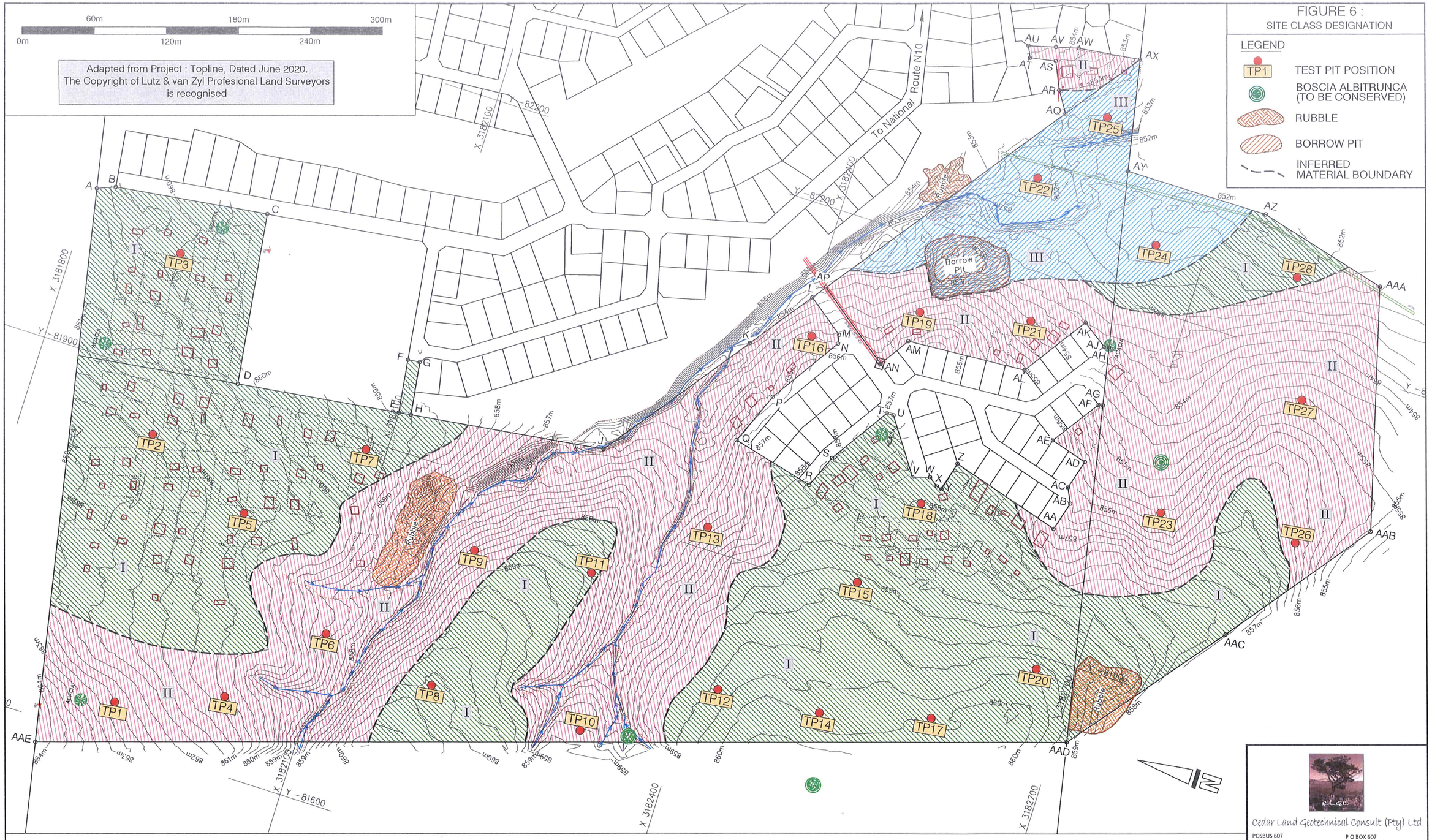
This zone comprises 47% of the area investigated. It is characterized by the materials profiles of TP's 2, 3, 5, 7, 8, 11, 12, 14, 15, 17, 18, 20 and 28. It is present in three separate areas on site. It consists of a superficial horizon less than 400mm thick comprising of colluvium and very dense calcrete. Several outcrops of calcrete occur in the area. Slope across the land is less than approximately 2%. Foundation stresses induced by conventional strip foundations for single and double storey structures will result in almost negligible settlement if founded directly on the slightly weathered and unweathered hard rock to very hard rock, or on the very dense calcrete. The area is thus zoned as "R" and regarded as stable.

TABLE 4 : 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 filling 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	Disasterous	Ground cracks badly ; buildings destroyed ; railway lines bent ; landslides on steep slopes	7.0 to 7.3	400 to 700
XI	Very disasterous	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

8.2 Geotechnical Zone II

This zone comprises 45% of the area investigated. It is characterized by the materials profiles of TP's 1, 4, 6, 9, 10, 13, 16, 19, 21, 23, 26 and 27. It is present in three separate areas on site. It consists of a superficial horizon less than 400mm thick comprising of colluvium,



FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES

AREA	AREA OF PROPERTY (%)	GEOTECHNICAL CLASS	ESTIMATED SOIL MOVEMENT(mm)	SOIL PROFILE	CONSTRUCTION TYPE	FOUNDATION DESIGN	ASSOCIATED PROBLEMS	DEVELOPMENT POTENTIAL
I	47,40	R	Negligible	Less than 400mm of colluvium overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on very dense pedocretes or bedrock	Conditions of hard rock excavation. Landslope less than 2% favours slab-on-the-ground foundations.	Intermediate
II	44,91	R	Negligible	Less than 400mm of colluvium overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on very dense pedocretes or bedrock.	Conditions of hard rock excavation. Landslope between 2% and 6% favours strip footing foundations	Intermediate
III	7,69	P (Reworked ground)	Highly variable (S to S2)	Stockpiles of calcrete and waste cover the area. An obsolete borrow pit is present and areas of reworked soil forming a sportsfield. The natural soil condition consists of colluvium and residual granite-gneiss overlying calcrete and bedrock granite.	If rehabilitated modified normal	Rehabilitate excavations with available stockpiles of calcrete according to an engineered design. Foundations according to professional design. Refer to discussion in Section 8 of report. Alternative : Reserve as public open space	Presence of deviated water course - possible flooding	Poor

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TAAK/JOB NAME: Expansion and Formalisation of Topline Community

LIGGING/SITE: Erven 1, 16 and 87 Saalskop (Topline); and Plot 2777 Boegoeberg Settlement

KLIËNT/CLIENT: !Kheis Municipality

TEKENING NO/DRAWING NO: Figure 6 : Site Class Designation

DATUM/DATE: 8 September 2020

residual soil and very dense calcrete. Several outcrops of calcrete occur in the area. Slope across the land is between 2% and 6% approximately. Foundation stresses induced by conventional strip foundations for single and double storey structures will result in almost negligible settlement if founded directly on the slightly weathered and unweathered hard rock or very dense calcrete. The area is thus zoned as "R" and regarded as stable.

8.3 Geotechnical Zone III

This zone comprises 8% of the area investigated. The zone is present in the south eastern part of the site. Test pits 22, 24 and 25 were excavated in the area, but they do not necessarily represent the natural soil profile thereof, as it is clear that the surface materials consisting of calcrete have been partially removed for construction and have been rehabilitated by importing fine, granular materials ; levelled to provide a soccer field and what appears to be a shallow earth dam. These imported materials are of loose consistency. Other parts of the area are covered by stockpiles of excavated calcrete and an unrehabilitated borrow pit is also present. Access to excavate test pits in these features was not possible.

To establish structures in this zone will require rehabilitating the borrow pit, possibly using the available stockpiles of calcrete and levelling out the entire area to provide a reasonably level surface for construction. This will include cut to fill earthworks and compacting the material to a density of at least 93% modified AASHTO. All in all an engineered solution is required to rehabilitate the area to a standard acceptable foe residential development. Such a design will require deviating the water course that drains onto the area.

The development potential of the area is regarded as poor and is classified P(Reworked ground) with anticipated settlement consisting of highly variable compression, exceeding 20mm, but highly variable, thus S to S2.

8.4 Other Considerations

The contents of this subparagraph 8.4 largely fall outside the scope of a geotechnical investigation. However, it is given in good faith in an effort to find a solution to the presence of waste in the area.

The excavation of a large pit locally to bury and cover the waste is an exercise requiring environmental, geotechnical and groundwater inputs, amongst others. The provision of such a facility may require a considerable period of time, costs and construction to finalise.

Therefore, two options can be considered to deal with this waste :

8.4.1 Disposal at a Waste Site

The waste material can be removed and disposed at a waste site. However, this creates logistical and legal issues. Loading and transporting the waste to either Groblershoop or Upington will be expensive. It is also doubtful whether the waste sites at these two locations will accept the waste and can treat such a volume in a suitable manner.

8.4.2 Recycling

The suitability of the stockpiles of waste for recycling depends on the composition of the waste. Basically three components have been identified visually, namely :

- *Household Waste* : Including putrefied food, nappies, bubble sheet pill containers, clothing etc.
- *Recyclable Waste* : Including plastic beverage bottles, glass, various metals and wood.
- *Construction Waste* : This includes blocks of concrete, bricks and stockpiles of calcrete.

To solve the issue it can be considered to involve the community by separating the waste. As the household waste represents a much smaller volume than the entire bulk of waste, this may potentially be disposed of at either Upington or Groblershoop. The recyclable may be sold. The construction waste can be crushed and used as fill material during construction. Such material may also be used as successfully as a gravel wearing course for streets in Topline.

8.4.3 Presence of Colluvial Quartz Gravels

White, colluvial quartz gravels are widely distributed in the area which is earmarked for residential development. There exists a big demand for such gravels as ornamental features in urban areas, especially for water-wise gardens. The community can benefit from the collecting and marketing these materials through a coordinated effort.

9 FOUNDATION RECOMMENDATIONS AND SOLUTIONS

The foundation design alternatives and ancillary issues as discussed in subparagraphs 9.1 and 9.2 below are summarized in Table 5 : Foundation Design, Building Procedures and Precautionary Measures. In some cases more than one foundation solution is offered in the discussion below. Whichever option is used, the design must adhere strictly on the proposals of SANS 10400H. As geotechnical conditions favour the use of both alternatives, the decision of which option to use must be based on financial and practical considerations. In all cases

TABLE 5 : FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES

AREA	AREA OF PROPERTY (%)	GEOTECH NICAL CLASS	ESTIMATED SOIL MOVEMENT (mm)	SOIL PROFILE	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES	ASSOCIATED PROBLEMS	DEVELOPMENT POTENTIAL
I	47	R	Negligible	Less than 400mm of colluvium overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on very dense pedocretes or bedrock	Conditions of hard rock excavation. Landslope less than 2% favours slab-on-the-ground foundations.	Intermediate
II	45	R	Negligible	Less than 400mm of colluvium overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on very dense pedocretes or bedrock	Conditions of hard rock excavation Landslope between 2% and 6% favours strip footing foundations	Intermediate
III	8	P(Reworked ground)	Highly variable (S to S2)	Stockpiles of calcrete and waste cover the area. An obsolete borrow pit is present and areas of reworked soil forming a sportsfield. The natural soil condition consists of colluvium and residual granite overlying calcrete and bedrock granite.	If rehabilitated modified normal	Rehabilitate excavations with available stockpiles of calcrete according to an engineered design. Foundations according to professional design. Refer to discussion in Section 8 of the report. Alternative : Reserve as public open space	Presence of deviated water course - possible flooding	Poor

service trenches shall not be excavated parallel to buildings within 1500mm of the building perimeter.

9.1 Geotechnical Zone I

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. Considering the limited slope across the land of less than 2% only and the stable geotechnical site classification as per Section 8 above, two foundation design alternatives are applicable to the zone.

9.1.1 Strip Foundations

Foundations of 400mm wide placed directly on the very dense hardpan calcrete may be used. Should the areas of the proposed dwellings not exceed 200m^2 foundations for internal non-loadbearing walls may consist of thickened floorslabs. Should this option be adopted the floorslabs shall be reinforced steel mesh.

9.1.2 Slab-on-the-ground Foundations

This is the preferred method of founding. The solution of slab-on-the-ground foundations may only be used for dwellings less than 200m^2 in area. Edge beams shall be placed directly on the very dense hardpan calcrete.

Foundations for internal non-loadbearing walls shall consist of thickened floorslabs. The foundations shall not contain any changes in surface levels with steps exceeding 400mm and do not support any chimneys or walls which support concrete roofs.

9.2 Geotechnical Zone II

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. The slope across the land varies between approximately 2% and 6%. Two founding alternatives can be considered :

9.2.1 Strip Foundations

The preferable founding alternative is foundations of 400mm wide strip footings placed directly on bedrock. Should the areas of the proposed dwellings not exceed 200m^2 foundations for internal non-loadbearing walls may consist of thickened floorslabs. Should this option be adopted the floorslabs shall be reinforced steel mesh.

9.2.2 Slab-on-the-ground Foundations

Considering the slope across the land of approximately 2% to 6% the use of slab-on-the-ground foundations may require additional works in the form of the construction of an engineered fill or cutting to establish a level platform for construction, but it still remains a viable alternative. This latter option of additional earthworks may be costly and hence is regarded as less attractive than conventional strip footings.

9.3 Geotechnical Zone III

The zone is classed as P(Reworked Ground)/(S-S2). Highly variable geotechnical conditions prevail, varying from stockpiles of calcrete, an old borrow pit to partially rehabilitated land and what appears to be a deviated water course.

Two option for land utilization are available, namely :

9.3.1 Land Rehabilitation

This will include backfilling and compaction of the existing borrow pit, for which the stockpiles of excavated calcrete and builders' rubble may be used. After which the land can be reshaped by a cut-to-fill operation to provide a reasonably level for construction. The course of the gully terminating on site need to be deviated or reinstated to its original position to ensure that the area is not subject to seasonal flooding or inundation. All such works shall be undertaken under supervision of a consulting engineer according to his design. On completion of the works, the elastic properties of the rehabilitated land can be determined by applicable materials testing, such as plate loads, and the foundation design of the structures be done accordingly. This will most probably consist of reinforced strip foundations.

9.3.1 Public Open Space

The recommended alternative is to set the land aside and use it as public open space. However, for good measure the borrow pit may be backfilled with the available stockpiles of calcrete and builders; rubble.

10 DRAINAGE

The water courses on site are contained in narrow and well-defined gullies of such extent that

they do not influence the various geotechnical site class designations. They are therefore not zoned separately. However, the presence of the deviated water course in the eastern part of the site near TP 22 may result in inundation of that area. Surface run-off may also collect in the old borrow-pit.

The slope of less than 2% in certain areas of the land is regarded as marginal and may result in problems with the design of stormwater and sewerage disposal systems depending on dissipation by gravity.

11 SPECIAL PRECAUTIONARY MEASURES

In Geotechnical Zones I and II no extraordinary features requiring special precautionary measures to decrease the impact of development on site are present on site. The decision whether development of Geotechnical Zone III shall proceed should be based on financial constraints and demand for housing.

12 CONCLUSIONS

The property is regarded as being of intermediate suitability for residential development in Geotechnical Zones I and II, with Geotechnical Zone III as poor. Founding conditions can be defined as R in the areas regarded as intermediate.

12.1 Factors Influencing the Development of the Site

12.1.1 Geotechnical Zones I and II

- The presence of hard rock and very dense hardpan calcrete close to the surface. The presence thereof will result in conditions of hard excavation. On the other hand it provides conditions favouring conventional methods of founding.
- The limited slope of less than 2% in Geotechnical Zone II will have a detrimental influence on the design of stormwater disposal systems and sewerage reticulation.
- The presence of waste material need to be addressed.

12.1.2 Geotechnical Zone III

- The presence of hard rock and very dense hardpan calcrete close to the surface. The presence thereof will result in conditions of hard excavation. On the other hand it provides conditions favouring conventional methods of founding.
- The presence of an apparently rerouted gully draining onto the site.

TABLE 6 : INFLUENCE OF CONSTRAINTS PER GEOTECHNICAL ZONING

CONSTRAINT	KEY TO CLASSIFICATION			CLASSIFICATION PER GEOTECHNICAL ZONE		
	MOST FAVOURABLE (1)	INTERMEDIATE (2)	LEAST FAVOURABLE (3)	I	II	III
Collapsible soil	Any collapsible horizon or consecutive horizons totalling a depth of less than 750mm in thickness	Any collapsible horizon or consecutive horizons with a depth of more than 750mm in thickness	A least favourable situation for this constraint does not occur			
Seepage	Permanent or perched water table more than 1,5m below ground surface	Permanent or perched water table less than 1,5m below ground surface	Swamps and marshes			
Active soil	Low soil heave potential anticipated	Moderate soil heave potential anticipated	High soil heave potential anticipated			
Highly compressible soil	Low soil compressibility anticipated	Moderate soil compressibility anticipated	High soil compressibility anticipated			
Erodibility of Soil	Low	Intermediate	High			
Difficulty of excavation to 1,5m depth	Scattered or occasional boulders less than 10% of the total volume	Rock or hardpan pedocretes between 10% and 40% of the total volume	Rock or hardpan pedocretes more than 40% of the total volume			
Undermined ground	Undermining at a depth greater than 240m below surface, except where total extraction mining has not occurred	Old undermined areas to a depth of 90m to 240m below surface where stope closure has ceased	Mining within less than 90m to 240m of surface or where total extraction mining has taken place			Unrehabilitated and partially rehabilitated borrow areas
Dolomite and limestone stability	Possibly stable. Areas of dolomite overlain by Karroo rocks or intruded by sills. Areas of Black Reef rocks. Anticipated Inherent Risk Class 1	Potentially characterised by instability. Anticipated Inherent Risk Classes 2 to 5	Known sinkholes and dolines Anticipated Inherent Risk Classes 6 to 8			
Steep slopes*	Between 2° and 6° in all regions	Slopes between 6° and 18° and less than 2° (Natal and Western Cape) Slopes between 6° and12° and less than 2° (all other regions)	More than 18° (Natal and Western Cape). More than 12° (all other regions)			
Areas of unstable natural slopes*	Low risk	Intermediate risk	High risk (Especially in areas subject to seismic activity)			
Areas subject to seismic activity	10% probability of an event less than $100cms^{-2}$ within 50 years	Mining induced seismic activity more than $100cms^{-2}$	Natural seismic activity more than $100cms^{-2}$			
Areas subject to flooding	A "most favourable" situation for this constraint does not occur	Areas adjacent to a known drainage channel or floodplain with slope less than 1%	Areas with a known drainage channel or floodplain			

- Areas of reworked soils, stockpiles of calcrete and builders' rubble and excavations for materials procurement.
- The presence of waste material need to be addressed.

The conclusions as based on the site conditions are summarized in Table 6 : Influence of Constraints per Geotechnical Zoning. This classification is based on the proposals of the document *Geotechnical Site Investigations for Housing Developments (Generic Specification GFSH-2)*, issued by the National Department of Housing in September 2002.

12.2 Stratigraphy

The available information shows that the area of investigation is located on a subduction zone dating approximately 1000 million years old. The zone is located between the lithology of the Kaapvaal Craton and the Namaqua-Natal mobile belt. The remains of the original geology in the area are referred to as the Kaaien Terrane and the site is located on Kalkwerf granite-gneiss that is intrusive into the Groblershoop Formation of the Brulpan Group.

Bedrock occurs on site as strongly foliated, gneissic rock. In thin section the granite-gneiss can be seen to have suffered extreme deformation, with quartz grains completely recrystallized, showing deformation bands and undulose extinction. The rest of the rock is made up of plagioclase, muscovite, chloritized biotite, occasional garnet, epidote, hornblende and other accessory minerals. Physically the granite-gneiss is described as dirty white mottled light green and pink, massive, micaceous, hard rock, varying to dark grey speckled dull dark red, closely jointed and coarse grained, hard rock.

12.3 Soil Profile

12.3.1 Colluvium

On site the colluvium consists of pegmatitic gravels, weather resistant scree of quartz and quartzite fragments contained in a sandy matrix. Nodules of calcrete may be contained in the colluvium. The consistency of the colluvium varies between loose and medium dense. The horizon of colluvium was between 100mm and 600mm thick in the test pits.

12.3.2 Made Ground

What appears to be areas levelled and fill material provided for construction of a dam and soccer field was encountered in TP's 22, 24 and 25. The origin of the surface soil is unsure, and it may also originate as debris of the non-perennial stream in which vicinity these test pits are located. This fill is described as light brown, loose, fine sand. The horizon of fill extended

to depths varying between 200mm and 700mm in the test pits. However, the soil profile may be of unknown variable composition and depth. Access to the area is limited due to the high level of land disturbance.

12.3.3 Residual Granite-gneiss

A superficial horizon of residual granite-gneiss was encountered in TP 25 only. It is described as abundant clast supported, fine, angular gravels of granite-gneiss in a matrix of light brown, fine sand, with a medium dense consistency.

12.3.4 Waste

Substantial areas of stockpiles of rubble are present in the vacant land. Such rubble consists of items varying from household waste, excavated calcrete to builder's rubble.

12.3.5 Mokalanen Formation

12.3.5(i) Hardpan Calcrete

Hardpan calcrete is present as outcrops or underlies the colluvium, occurring from depths between 100mm and 600mm minimum, extending to 200mm to 800mm maximum, at which stage refusal of excavation occurred. The hardpan calcrete can be described as dirty white, very fine grained and very dense.

12.3.5(ii) Nodular Calcrete

Isolated occurrences of nodular calcrete underlie the colluvium, extending to 600mm and 800mm deep at which depth refusal of excavation occurred. The nodular calcrete can be described as abundant clast supported medium coarse, rounded and subrounded nodules of calcrete in a matrix of very dense, calcareous cemented, fine sand.

12.4 Groundwater

12.4.1 Perched Water

Perched groundwater was not encountered in any of the test pits excavated for this investigation. It is anticipated that perched water will generally not prove problematic on the site.

12.4.2 Permanent Groundwater

The probability for drilling successfully for water in the area is between 40% and 60%, and the probability that such a borehole will yield more than 2l/s is between 10% and 20%. Groundwater is expected to occur at depths less than 15 meters in compact, argillaceous strata.

12.5 Conditions of Excavation

On average over the entire site bedrock or refusal of excavation on very dense hardpan calcrete was encountered at depths between 100mm minimum and 1100mm maximum, averaging 520mm deep. The implication of this is that should trenches require excavated depths to 1000mm, 48% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 63% of the excavation may be classified as hard.

12.6 Site Class Designation

It is concluded that the entire area is regarded as suitable for residential development as follows :

12.6.1 Geotechnical Zone I

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. The distribution thereof encompasses 47% of the proposed area for development. Slope across the land is less than 2%. Considering the limited slope and the favourable geotechnical site classification, two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on bedrock or very dense pedocrete.

Geotechnical conditions related to foundation design can be regarded as favourable, but the conditions of hard rock excavation close to the surface and slope less than 2% detract from the ease suitability of establishing services and overall the development potential is regarded as intermediate only.

12.6.2 Geotechnical Zone II

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. The distribution thereof encompasses 45% of the proposed area for development. Slope across the land is approximately between 2% and 6%.

The use of slab-on-the-ground foundations will require additional works in the form of the construction of an engineered fill or cutting to establish a level platform for construction. The more viable foundation alternative therefore remains founding by conventional strip foundations.

Geotechnical conditions related to foundation design can be regarded as favourable, but the conditions of hard rock excavation close to the surface detracts from the ease suitability of establishing services and overall the development potential is regarded as intermediate only.

12.5.3 Geotechnical Zone III

This zone comprises 8% of the area investigated. The zone is characterized by surface materials consisting of calcrete that have been partially removed for construction and have been rehabilitated by importing fine, granular materials ; levelled to provide a soccer field and what appears to be a shallow earth dam. Other parts of the area are covered by stockpiles of excavated calcrete and an unrehabilitated borrow pit is also present. To establish structures in this zone will require rehabilitating the borrow pit, possibly using the available stockpiles of calcrete and levelling out the entire area to provide a reasonably level surface for construction. This will include cut to fill earthworks and compacting the material to a density of at least 93% modified AASHTO. All in all an engineered solution is required to rehabilitate the area to a standard acceptable foe residential development. Such a design will require deviating the water course that drains onto the area. The development potential of the area is regarded as poor and is classified P(Reworked ground) with anticipated settlement consisting of highly variable compression, exceeding 20mm, but highly variable, thus S to S2.

12.6 Land Slope

The average slope across the larger part of the land is less than 2%. In Geotechnical Zone II the slope less between 2% and 6%, that is over 45% of the site. This slope of less than 2% has a detrimental influence on especially the design of a stormwater disposal system depending on gravity to dissipate of the surface water due to downpours. The land slope also affects the design of the sewerage disposal but to a lesser extent as the gradient of the pipes can be adjusted according to design requirements.

No steep slopes are present on the property.

12.7 Areas Subject to Flooding

The non-perennial water courses on site are contained in well-defined, narrow gullies and

may be regarded as being of lesser importance, requiring no additional precautionary measures to ensure the safety of the population against flooding. However, a deviated gully drains into the southeastern part of the site into Geotechnical Zone III.

12.8 Materials Utilization

- *Trench Backfilling* : None of the materials are suitable for selected fill or pipe bedding. With exception of the hardpan calcrete all materials can be used for normal backfill.
- *Layerworks for Paved or Segmental Block Paving* : The hardpan calcrete is of G5 and G6 quality and hence suitable for the construction of layerworks up to subbase and base course level for lightly trafficked roads.
- *Wearing Course for Gravel Roads in Urban Areas* : None of the soil materials are 100% suitable for this purpose. The use of these materials will generally result in a road surface subject to raveling and corrugations. However, calcrete is often used for this purpose and is the most suitable material available.

12.9 Other Considerations

- *Undermining* : The area is not subject to undermining.
- *Seismic Activity* : The Peak Ground Acceleration expected in 50 years is 0,04g. A low risk for the development of earth tremors therefore exist.
- *Soil Corrosivity* : The in-situ soils and pedocretes are not corrosive due to acidic properties. All soil materials can be regarded as corrosive due to high soluble salt contents.
- *Dolomite* : The area of investigation is not subject to any restrictions due to the presence of dolomite. Bedrock of dolomite does not occur in the area of investigation.

13 RECOMMENDATIONS

13.1 Foundation and Structural Design

Section 9 of this document provides guidelines for foundation and structural design. These guidelines are based strictly on the contents of SANS 10400H and the NHBRC Home Owners Manual published in 2015. It is recommended that development take place strictly according to these guidelines. More than one founding solution is applicable on the site, and the property developer can base his choice on financial constraints.

13.2 Materials Utilization

- *Trench Backfill* : With exception of the hardpan calcrete, the in-situ materials may be used for normal backfill of trenches. The hardpan calcrete shall be spoilt and not used at all for

this purpose. Material for pipe bedding and selected backfill shall be obtained from commercial sources.

- *Layerworks for Paved or Segmental Block Paving* : The hardpan calcrete is of G5 and G6 quality and hence suitable for the construction of layerworks up to subbase and base course level for lightly trafficked roads. It is recommended that a centerline investigation consisting of test pitting and soil sampling be conducted to allow the consulting engineer to produce suitable pavement designs for the project.
- *Wearing Course for Gravel Roads in Urban Areas* : Material for the construction of a gravel wearing course shall be obtained from stockpiled or calcrete from a licensed borrow pit.

13.3 Conditions of Excavation

Although manual excavation is possible through the colluvium, residual soil and to some extent through the calcrete, it is considered as not an economic proposition, mostly due to the consistency and composition of the soil. Excavation through these soils shall require the use of a TLB rated at 55kW minimum, or preferably a 30 ton excavator to remove the very dense pedocretes. It is recommended that adequate provision be made for hard rock excavation.

13.4 Land Slope

Slope across the 47% of the land is less than 2%. This is regarded as being of intermediate suitability for urban development only. This has an influence on especially the stormwater disposal system but to a lesser extent on the waste water design. In theory the slope of 2% to 6% on 53% of the land can be regarded as favourable for urban development, but the combination of the slope and presence of rock outcrops result in conditions less desirable for development.

14 SOURCES OF REFERENCE

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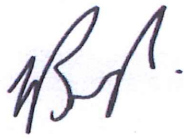

FJ Breytenbach, Pr Eng 8 September 2020
For Cedar Land Geotechnical Consult (Pty) Ltd

GEOTECHNICAL CONDITIONS ON ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT: A REPORT FOR THE EXPANSION AND FORMALISATION OF THE TOPLINE COMMUNITY

2020/J09/MCP_01

ADDENDUM A: TEST PIT PROFILES

TRIAL HOLE: 1

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'03,2" S 21°50'08,7" E*

Cedar Land Geotechnical Consult (Pty) Ltd
P O Box 607
Ceres
6835
Cell: 082 570 2767
Email:
cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Dry, light brown, loose, intact, fine *SAND* and matrix supported, medium coarse, subrounded and subangular gravels of quartz. Colluvium.				1 Refual of excavation at 300 mm on very dense hardpan calcrete.
0.20		Dirty white, very fine grained, very dense, hardpan *CALCRETE*. Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⌐ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 1

FIGURE: A1

TRIAL HOLE: 2

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'02,0" S 21°50'16,8" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Dry, light brown, loose, intact, fine *SAND* and matrix supported, medium coarse, subrounded and subangular gravels of quartz. Colluvium.				1 Refual of excavation at 600 mm on very dense hardpan calcrete.
0.20						
		Dirty white, very fine grained, very dense, hardpan *CALCRETE* with pockets of light red brown, fine sand. Pedogenic deposits.				
0.40			U9256	0,3-0,6	●	
0.60						
0.80						
1.00						

Water encountered
Water level
Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 2

FIGURE: A2

TRIAL HOLE: 3

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'01,2" S 21°50'22,3" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Dirty white, very fine grained, very dense, hardpan *CALCRETE*. Pedogenic deposits.				1 Refual of excavation at 100 mm on very dense hardpan calcrete.
0.20						
0.40						
0.60						
0.80						Water encountered Water level Bottom of hole Approximate material change Disturbed sample Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 3

FIGURE: A3

TRIAL HOLE: 4

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'06,0" S 21°50'09,9" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 700 mm on very dense hardpan calcrete.
0.20						
0.40						
0.60		Dirty white mottled light brown, very fine grained, very dense, hardpan *CALCRETE.* Pedogenic deposits.				
0.80						▽ Water encountered ▼ Water level ⌐ Bottom of hole --- Approximate material change • Disturbed sample ■ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 4

FIGURE: A4

TRIAL HOLE: 5

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'05,0" S 21°50'15,4" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Dry, light brown, loose, intact, fine *SAND* and matrix supported, medium coarse, subrounded and subangular gravels of quartz. Colluvium.				1 Refual of excavation at 300 mm on very dense hardpan calcrete.
		Dirty white, very fine grained, very dense, hardpan *CALCRETE*. Pedogenic deposits.				
0.20			U9257	0,1-0,3	●	
0.40						
0.60						
0.80						
1.00						

▽ Water encountered
▼ Water level
⊥ Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 5

FIGURE: A5

TRIAL HOLE: 6

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'08,1" S 21°50'12,7" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.				NOTES: 1 Refual of excavation at 800 mm on hard rock, granite-gneiss.
0.20						
0.40		Dirty white, very closely jointed, intensely laminated, very fine grained, medium weathered, soft rock becoming hard rock at depth, micaceous and schist-rich *GRANITE-GNEISS* with singular grains of fine gravel sized quartz grains. Joints are closed, smooth and clean.				
0.60			U9258	0,4-0,8	●	
0.80						▽ Water encountered ▼ Water level ⌐ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 6

FIGURE: A6

TRIAL HOLE: 7

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'07,6" S 21°50'18,1" E*

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Email:
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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 400 mm on hard rock, granite-gneiss.
0.20						
		Dirty white mottled light green and pink, massive, micaceous, slightly weathered, hard rock, *GRANITE-GNEISS* with pockets of dirty white mottled light brown, very dense, hardpan calcrete.				
0.40						
0.60						
0.80						Water encountered Water level Bottom of hole Approximate material change Disturbed sample Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 7

FIGURE: A7

TRIAL HOLE: 8

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'11,2" S 21°50'12,2" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 400 mm on very dense hardpan calcrete.
0.20						
		Dirty white mottled light grey, very fine grained, very dense, hardpan *CALCRETE*.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⌐ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 8

FIGURE: A8

TRIAL HOLE: 9

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'11,2" S 21°50'16,5" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 600 mm on hard rock, granite-gneiss.
0.20		Dirty white mottled light green and pink, massive, micaceous, slightly weathered, hard rock, *GRANITE-GNEISS* with pockets of dirty white mottled light brown, very dense, hardpan calcrete.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⌐ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 9

FIGURE: A9

TRIAL HOLE: 10

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'15,4" S 21°50'12,3" E*

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Email:
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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 400 mm on hard rock, granite-gneiss.
0.20						
		Dirty white mottled light green and pink, massive, micaceous, slightly weathered, hard rock, *GRANITE-GNEISS* with pockets of dirty white mottled light brown, very dense, hardpan calcrete.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⌐ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 10

FIGURE: A10

TRIAL HOLE: 11

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'14,4" S 21°50'17,0" E*

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cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 500 mm on very dense hardpan calcrete.
0.20		Dirty white mottled light grey, very fine grained, very dense, hardpan *CALCRETE*. Pedogenic deposits.				
0.40			U9259	0,2-0,5	●	
0.60						
0.80						
1.00						

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 11

FIGURE: A11

TRIAL HOLE: 12

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'18,6" S 21°50'14,8" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 300 mm on very dense hardpan calcrete.
0.20		Dirty white mottled light grey, very fine grained, very dense, hardpan *CALCRETE*. Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⌐ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 12

FIGURE: A12

TRIAL HOLE: 13

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'17,0" S 21°50'19,4" E*

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6835
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Email:
cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 800 mm on very dense hardpan calcrete.
0.20		Dirty white, very fine grained, very dense, hardpan *CALCRETE* tending to boulder calcrete. Calcrete occurs en mass as horizontal lenses < 50 mm thick. Pedogenic deposits.				
0.40			U9260	0,1-0,8	●	
0.60						
0.80						▽ Water encountered ▼ Water level ⌐ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 13

FIGURE: A13

TRIAL HOLE: 14

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'21,4" S 21°50'15,1" E*

Cedar Land Geotechnical Consult (Pty) Ltd
P O Box 607
Ceres
6835
Cell: 082 570 2767
Email:
cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 400 mm on very dense hardpan calcrete.
0.20		Dirty white, very fine grained, very dense, hardpan *CALCRETE*. Pedogenic deposits.				
0.40						
0.60						
0.80						
1.00						

Water encountered
Water level
Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 14

FIGURE: A14

TRIAL HOLE: 15

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'21,3" S 21°50'19,2" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 300 mm on very dense hardpan calcrete.
0.20		Dirty white, very fine grained, very dense, hardpan *CALCRETE* with matrix supported inclusions of dull light grey quartz fragments, 1 cm diameter maximum. Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level Bottom of hole ---- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 15

FIGURE: A15

TRIAL HOLE: 16

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'18,1" S 21°50'25,9" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 600 mm on very dense nodular calcrete.
0.20		Abundant, clast supported, medium coarse, rounded and subrounded, nodules of *CALCRETE* in a matrix of very dense, calcareous and cemented, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⌐ Bottom of hole --- Approximate material change ▪ Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 16

FIGURE: A16

TRIAL HOLE: 17

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'24,3" S 21°50'16,0" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 200 mm on very dense hardpan calcrete.
0.20		Dirty white mottled light grey, very fine grained, very dense, hardpan *CALCRETE*. Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 17

FIGURE: A17

TRIAL HOLE: 18

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'22,3" S 21°50'22,1" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.	U9261	0-0,3	●	1 Refual of excavation at 500 mm on very dense hardpan calcrete.
0.20						
		Dirty white mottled light grey, very fine grained, very dense, voided, hardpan *CALCRETE*. Voids are filled with light red fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⌐ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 18

FIGURE: A18

TRIAL HOLE: 19

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'20,7" S 21°50'27,6" E*

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Ceres
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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES: 1 Refual of excavation at 600 mm on hard rock, granite-gneiss.
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				
0.20						
		Dark grey speckled dull red, closely jointed, coarse grained, slightly weathered, hard rock, *GRANITE-GNEISS*. Joints are closed, smooth and clean.				
0.40			U9262	0,3-0,6	●	
0.60						
0.80						Water encountered; Water level; Bottom of hole; Approximate material change; • Disturbed sample; ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 19

FIGURE: A19

TRIAL HOLE: 20

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'26,6" S 21°50'18,4" E*

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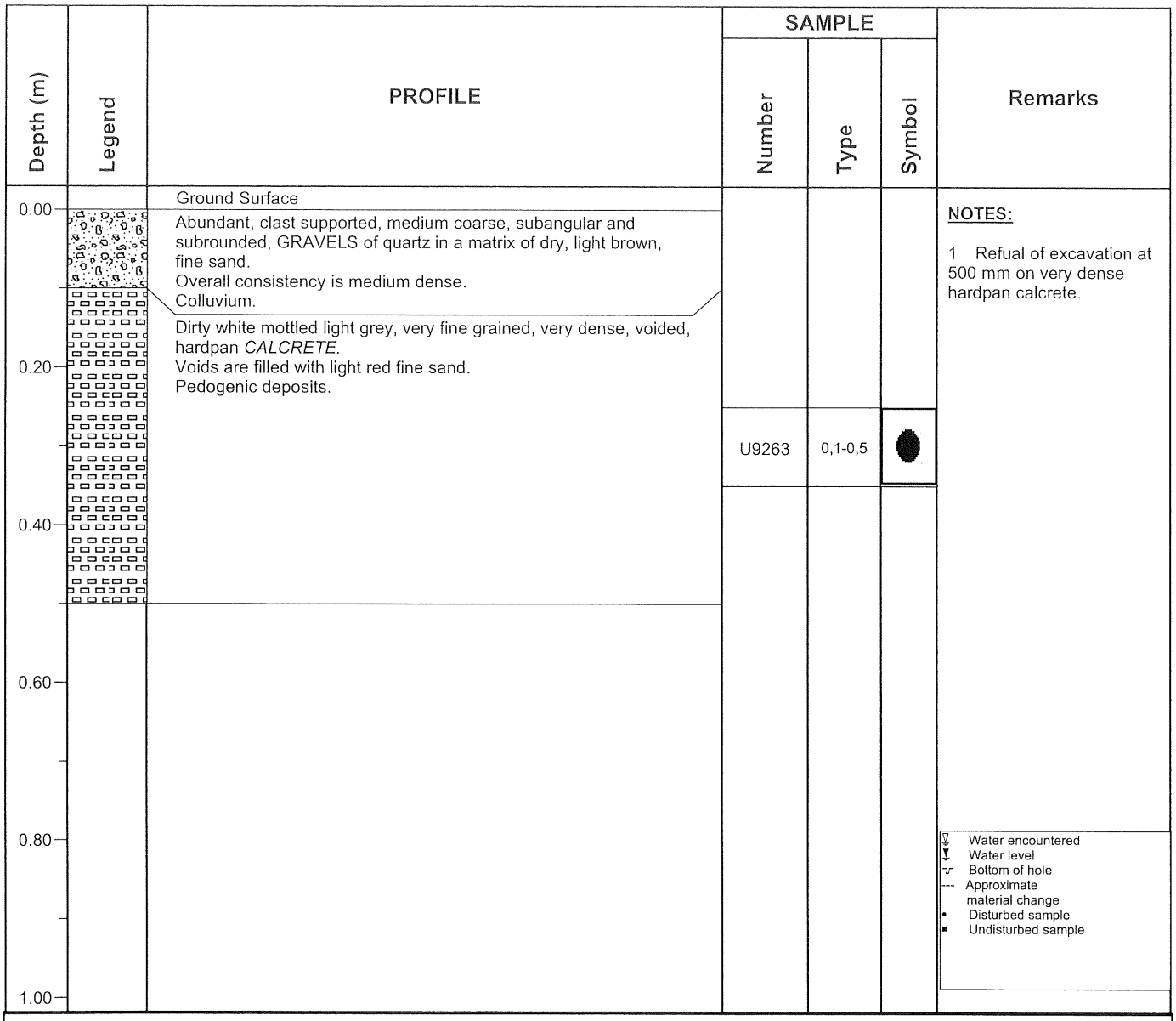

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 20

FIGURE: A20

TRIAL HOLE: 21

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'23,6" S 21°50'28,4" E*

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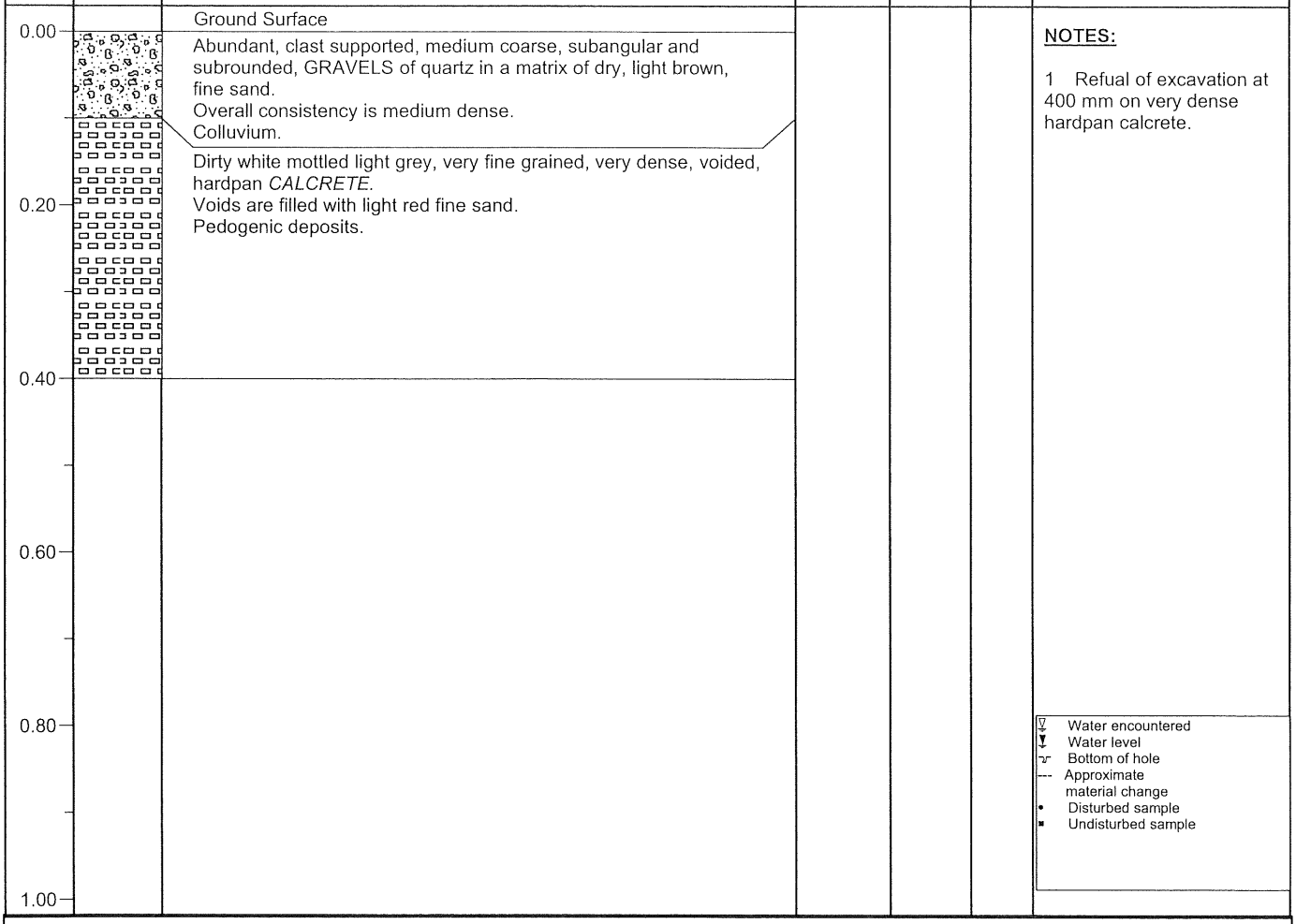

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 21

FIGURE: A21

TRIAL HOLE: 22

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'22,6" S 21°50'32,6" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		FILL: consisting of slightly moist, light brown, loose, intact, fine sand. Made ground.				1 Refual of excavation at 400 mm on hard rock, granite-gneiss.
0.20		Dark grey speckled dull red, closely jointed, coarse grained, slightly weathered, hard rock, *GRANITE-GNEISS.* Joints are closed, smooth and clean.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⊽ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 22

FIGURE: A22

TRIAL HOLE: 23

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'28,5" S 21°50'24,1" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 600 mm on very dense hardpan calcrete.
0.20		Dirty white mottled light grey, very fine grained, very dense, voided, hardpan *CALCRETE*. Voids are filled with light red fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						
1.00						

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 23

FIGURE: A23

TRIAL HOLE: 24

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'26,2" S 21°50'31,8" E*

Cedar Land Geotechnical Consult (Pty) Ltd
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Ceres
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Cell: 082 570 2767
Email:
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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		FILL: consisting of slightly moist, light brown, loose, intact, fine sand. Made ground.				1 Refual of excavation at 900 mm on hard rock, granite-gneiss.
0.20			U9264	0-0,5	●	
0.40						
		Dark grey speckled dull red, closely jointed, coarse grained, slightly weathered, hard rock, *GRANITE-GNEISS.* Joints are closed, smooth and clean.				
0.60						
0.80						
1.00						

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 24

FIGURE: A24

TRIAL HOLE: 25

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'23,9" S 21°50'35,0" E*

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Ceres
6835
Cell: 082 570 2767
Email:
cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		FILL: consisting of slightly moist, light brown, loose, intact, fine sand. Made ground.				1 Refual of excavation at 1100 mm on hard rock, granite-gneiss.
0.20						
			U9265	0-0,7	●	
0.40						
0.60						
0.80		Abundant, clast supported, fine, angular GRAVELS of granite-gneiss in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Residual granite-gneiss.				
		Dark grey speckled dull red, closely jointed, coarse grained, slightly weathered, hard rock, *GRANITE-GNEISS*. Joints are closed, smooth and clean.				
1.00						
1.20						

Water encountered
Water level
Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 25

FIGURE: A25

TRIAL HOLE: 26

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'32,2" S 21°50'24,5" E*

Cedar Land Geotechnical Consult (Pty) Ltd
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Ceres
6835
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Email:
cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 400 mm on very dense hardpan calcrete.
0.20		Dirty white mottled light grey, very fine grained, very dense, voided, hardpan *CALCRETE*. Voids are filled with light red fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						
1.00						

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 26

FIGURE: A26

TRIAL HOLE: 27

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'31,2" S 21°50'28,7" E*

Cedar Land Geotechnical Consult (Pty) Ltd
P O Box 607
Ceres
6835
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Email:
cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, rounded, *CALCRETE* concretions in a matrix of dry, pale light brown, fine calcareous sand. Overall consistency is medium dense. Pedogenic deposits.				1 Refual of excavation at 700 mm on very dense nodular calcrete.
0.20		Abundant, clast supported, medium coarse, rounded and subrounded, nodules of *CALCRETE* in a matrix of very dense, calcareous and cemented, fine sand. Pedogenic deposits.				
0.40			U9266	0,2-0,7	●	
0.60						
0.80						▽ Water encountered ▼ Water level ⌐ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 27

FIGURE: A27

TRIAL HOLE: 28

PROJECT: *EXPANSION AND FORMALISATION OF TOPLINE COMMUNITY*

LOGGED BY: *FJB*

SITE: *ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT*

DATE LOGGED: *7/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°45'30,1" S 21°50'32,2" E*

Cedar Land Geotechnical Consult (Pty) Ltd
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Ceres
6835
Cell: 082 570 2767
Email:
cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				NOTES:
		Abundant, clast supported, medium coarse, subangular and subrounded, *GRAVELS* of quartz in a matrix of dry, light brown fine sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 800 mm on very dense nodular calcrete.
0.20		Abundant, clast supported, medium coarse, rounded and subrounded, nodules of *CALCRETE* in a matrix of very dense, calcareous and cemented, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⌐ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 7/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 28

FIGURE: A28

GEOTECHNICAL CONDITIONS ON ERVEN 1, 16 AND 87 SAALSKOP (TOPLINE); AND PLOT 2777 BOEGOEBERG SETTLEMENT: A REPORT FOR THE EXPANSION AND FORMALISATION OF THE TOPLINE COMMUNITY

2020/J09/MCP_01

ADDENDUM B: RESULTS OF MATERIALS TESTING

ROADLAB

Roadlab Germiston
207 Rietfontein Road Germiston
1401
Tel: 011 828 0279 Fax: 011 828 0279
Email: info@roadlab.co.za
Web: www.roadlab.co.za

Job Request No.: RU3525

Date Reported : 2020-08-05

Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
Ceres
6835

Project : Topline Infrastructure Upgrade

Attention : Frans Breytenbach

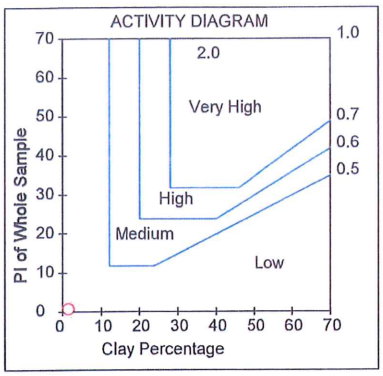
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

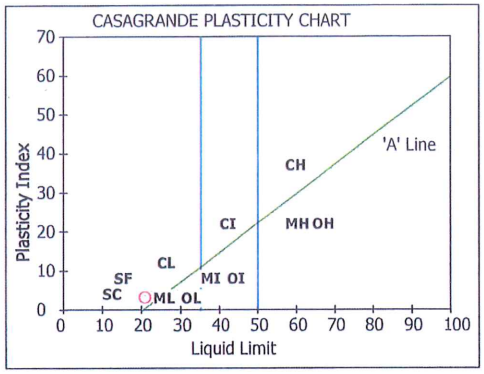
Sample No.	: U9256
Position	: TP 2
Layer Type	: 300-600mm
Sample Colour	: Dark Brown
Sample Type	: Gravel Quartz & Calc

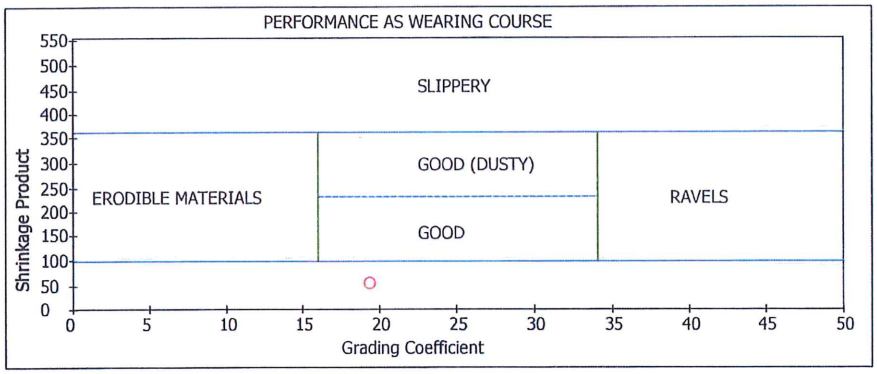
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	94
50.00	93
37.50	90
28.00	80
20.00	68
14.00	61
5.000	43
2.000	35
0.425	29
0.250	26
0.150	21
0.075	14
0.060	4,2
0.050	3,7
0.020	2,2
0.005	2,0
0.002	1,4

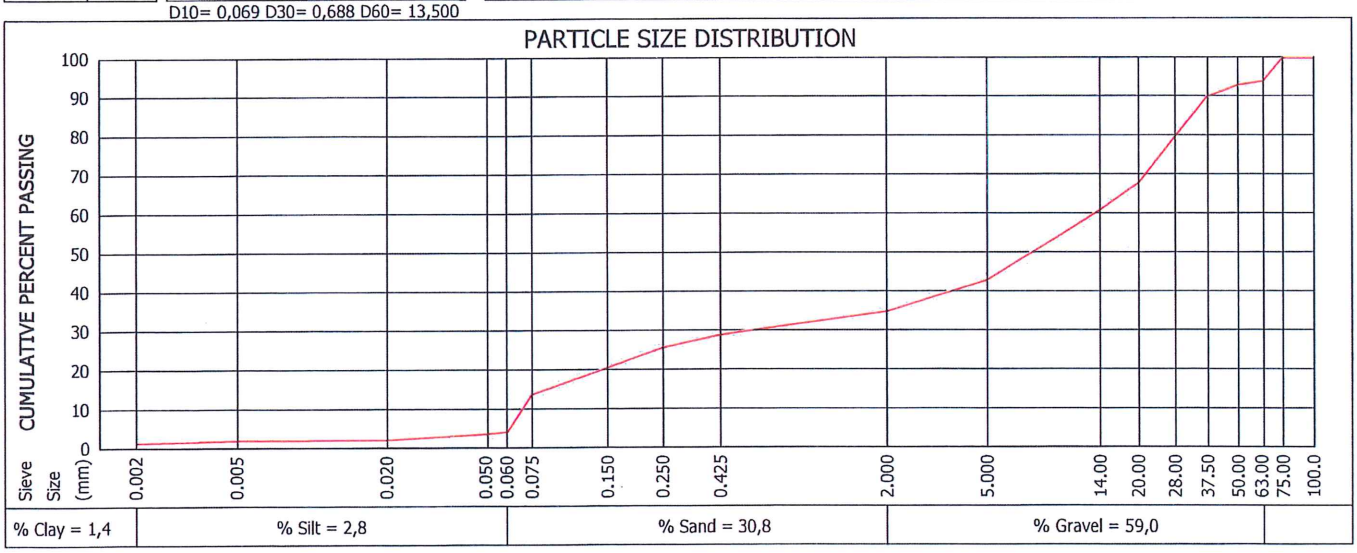
Soil Mortar	2.000 - 0.425	18
	0.425 - 0.250	9
	0.250 - 0.150	15
	0.150 - 0.075	19
	< 0.075	39
Effective Size		0,069
Uniformity Coefficient		195,7
Curvature Coefficient		0,5
Oversize Index		3,0
Shrinkage Product		58,0
Grading Coefficient		19,4
Grading Modulus		2,20
Atterberg Limits	Liquid Limit	21
	Plasticity Index	4.0
	Linear Shrinkage	2.0
	PI < 0.075	
Unified Soil Classification		GC
US Highway Classification		A-1-a(0)

D10= 0,069 D30= 0,688 D60= 13,500









% Clay = 1,4	% Silt = 2,8	% Sand = 30,8	% Gravel = 59,0

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
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Report compiled by : Juraine Okkies

sanas Testing Laboratory
Accreditation No. T0296
Prog.ver 10.7 (2019/11/07)

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Job Request No.: RU3525

Date Reported : 2020-08-04

Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
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Project : Topline Infrastructure Upgrade

Attention : Frans Breytenbach

Determination of the California Bearing Ratio Test Report SANS 3001 - GR1 / GR2 / GR10 / GR20 / GR30 / GR40 / PR5

SAMPLE INFORMATION AND PROPERTIES

SAMPLE NO.		U9256			
HOLE NO./ Km / CHAINAGE		TP2			
ROAD NO./ NAME Line 1 ROAD NO./ NAME Line 2		S28° 45' 02,0" E21° 50' 16,8"			
LAYER TESTED/SAMPLED		300-600mm			
SAMPLE DEPTH		300-600mm			
DATE SAMPLED		2020-07-08			
COLOUR OF SAMPLE		Dark Brown			
TYPE OF SAMPLE		Mix Quartz+Calcrete			

SIEVE ANALYSIS - % PASSING SIEVES *(SANS 3001-GR1:2010, SANS 3001-GR2:2010)

SIEVE ANALYSIS (GR 1) % PASSING	100.0 mm				
	75.0 mm	100			
	63.0 mm	94			
	50.0 mm	93			
	37.5 mm	90			
	28.0 mm	80			
	20.0 mm	68			
	14.0 mm	61			
	5.0 mm	43			
	2.0 mm	35			
	0.425 mm	29			
	0.075 mm	14			
GM %		2,2			

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	18			
COARSE FINE SAND	0.425 - 0.250	9			
MEDIUM FINE SAND	0.250 - 0.150	15			
FINE FINE SAND	0.150 - 0.075	19			
SILT CLAY	0.075	39			

ATTERBERG LIMITS ANALYSIS - *(SANS 3001-GR10:2010)

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	21			
	PLASTICITY INDEX	3.6			
	LINEAR SHRINKAGE	2.0			
CLASSIFICATION	H.R.B.	A-1-a(0)			
	COLTO	G5			
	TRH 14	G5			

CALIFORNIA BEARING RATIO - *(SANS 3001-GR30:2010, SANS 3001-GR40:2010)

SANS GR30 MAX. DRY DENSITY	OMC %	6,8			
	MDD (kg/m³)	2067			
	COMP MC %	6,8			
SWELL % @	MOD | NRB | PRO	0,01 | 0,02 | 0,04			
C.B.R. SANS GR40	100 %	88			
	98 %	73			
	97 %	67			
	95 %	56			
	93 %	46			
	90 %	35			

STABILISER IN LAB	Not Applicable			
TEST TYPE	CBR			
SAMPLING METHOD	TMH 5			
WEATHER WHEN SAMPLED	Cold			

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
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Report compiled by : Juraine Okkies

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Project : Topline Infrastructure Upgrade

Attention : Frans Breytenbach

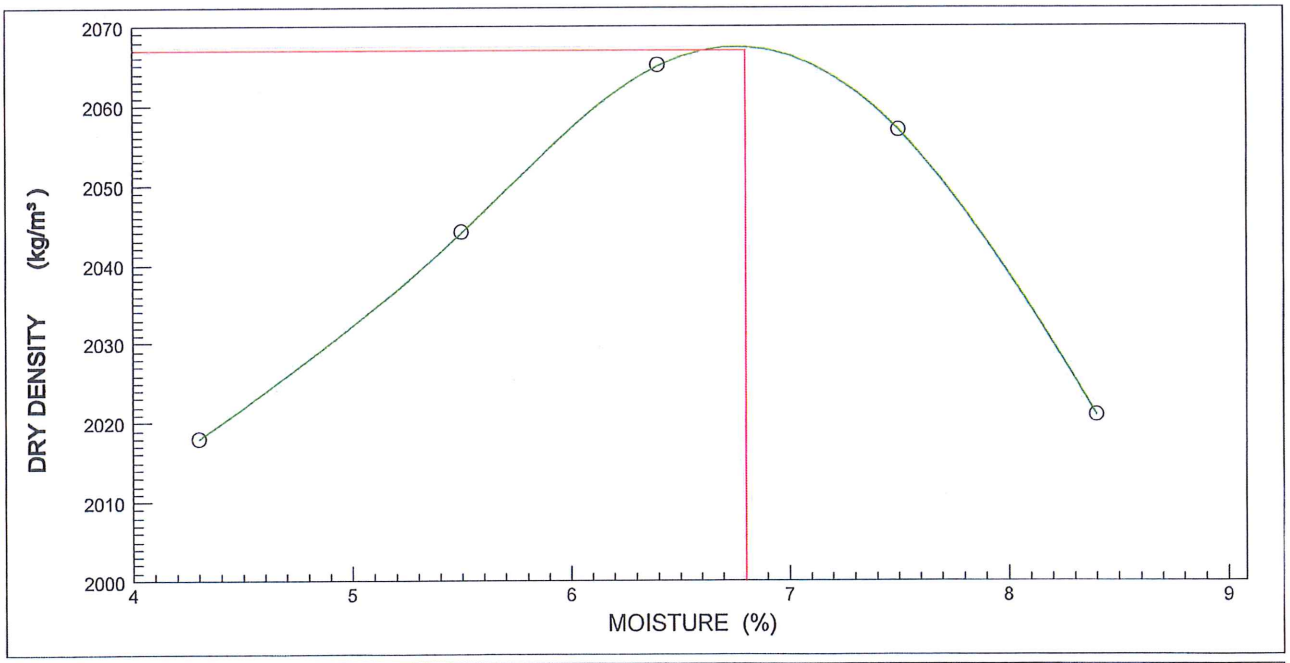
Determination Maximum Dry Density & Optimum Moisture Content Test Report

SANS 3001 - GR20/GR30

SAMPLE NO.	U9256
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	98kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	300-600mm
MATERIAL DESCRIPTION	Mix Calcrete + Quartzstone
HOLE NO./ km / CHAINAGE	TP2
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-09
DATE SAMPLED	2020-07-08
CLIENT MARKING	S28° 45' 02,0"; E21° 50' 16,8"
COLOUR AND TYPE	Dark Brown Gravel

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m³)	2018	2044	2065	2057	2021			
MOISTURE (%)	4,3	5,5	6,4	7,5	8,4			

MAXIMUM DRY DENSITY (kg/m³) : 2067	OPTIMUM MOISTURE CONTENT (%) : 6,8



Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
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Report compiled by : Juraine Okkies

sanas Testing Laboratory
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Date Reported : 2020-08-12

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
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Attention : Frans Breytenbach

Project : Topline Infrastructure Upgrade

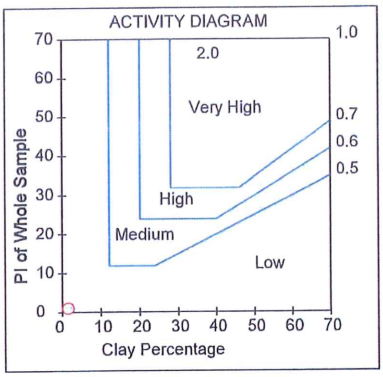
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

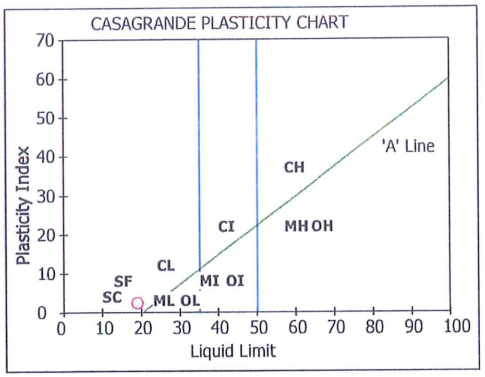
Sample No.	: U9257
Position	: TP 5
Layer Type	: 100-300mm
Sample Colour	: Orange Brown Sand
Sample Type	: Mix Calcrete+Quartzs

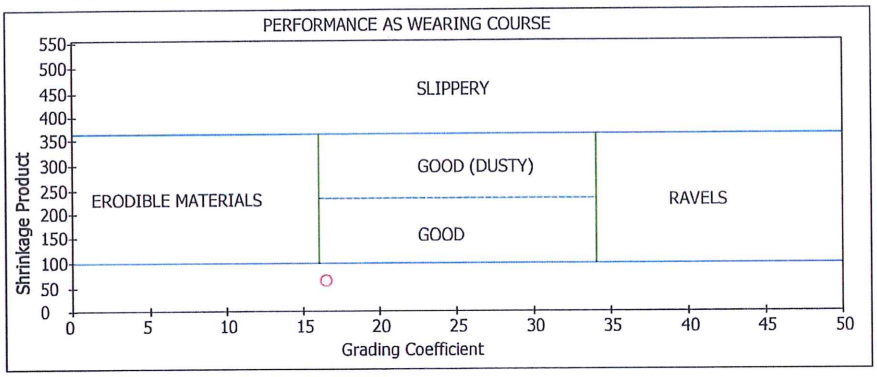
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	91
28.00	80
20.00	74
14.00	67
5.000	55
2.000	50
0.425	43
0.250	38
0.150	30
0.075	20
0.060	6,1
0.050	5,5
0.020	3,3
0.005	2,7
0.002	1,3

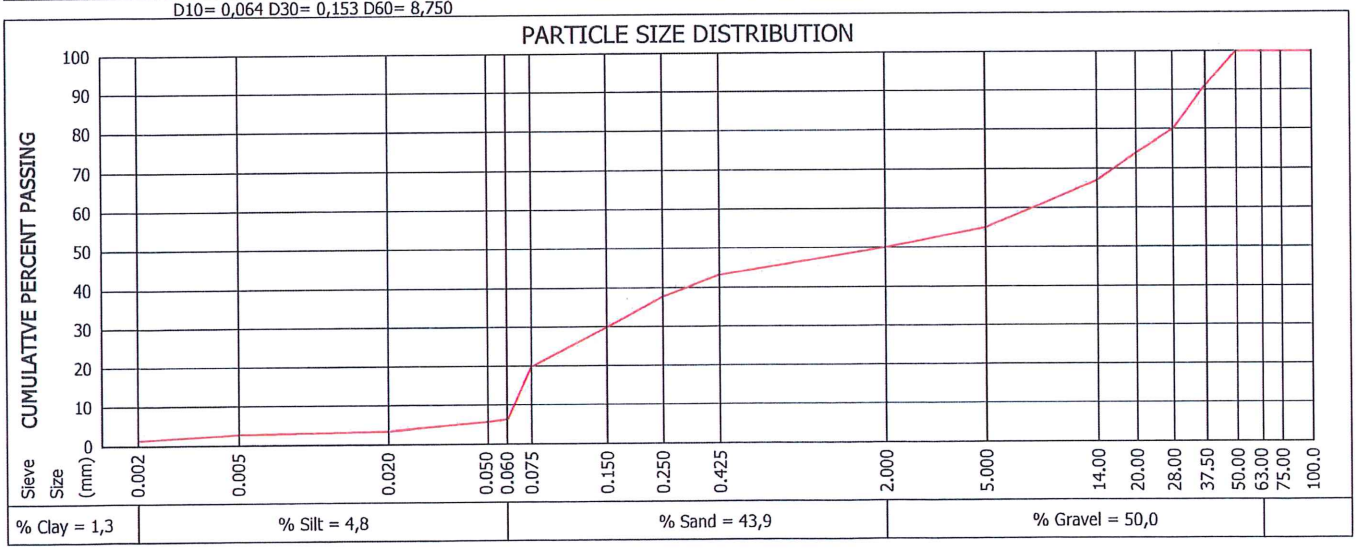
Soil Mortar	2.000 - 0.425	14
	0.425 - 0.250	11
	0.250 - 0.150	16
	0.150 - 0.075	20
	< 0.075	40
Effective Size		0,064
Uniformity Coefficient		136,7
Curvature Coefficient		0,0
Oversize Index		9,0
Shrinkage Product		64,5
Grading Coefficient		16,5
Grading Modulus		1,90
Atterberg Limits	Liquid Limit	19
	Plasticity Index	3,0
	Linear Shrinkage	1,5
	PI < 0.075	
Unified Soil Classification		SC
US Highway Classification		A-1-b(0)

D10= 0,064 D30= 0,153 D60= 8,750









% Clay = 1,3	% Silt = 4,8	% Sand = 43,9	% Gravel = 50,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.87 [SANS 5854] & Conductivity = 0.05 S/m [SANS 6240]

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
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Report compiled by : Juraine Okkies

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Prog.ver 10.7 (2019/11/07)

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PO Box 607
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Attention : Frans Breytenbach

Date Reported : 2020-08-12

Project : Topline Infrastructure Upgrade

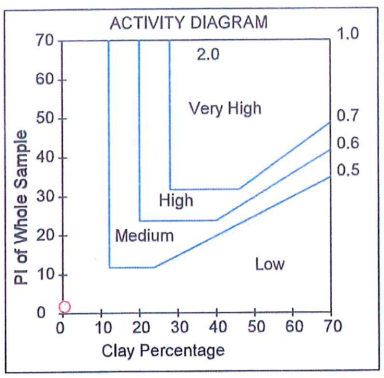
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

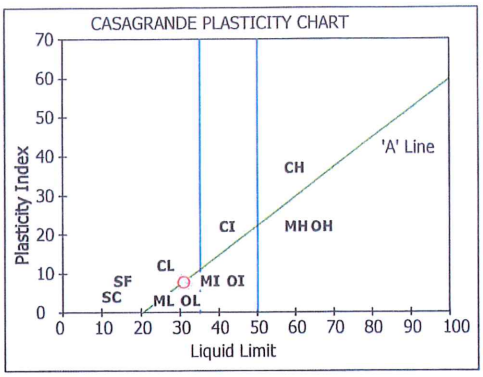
Sample No.	: U9258
Position	: TP 6
Layer Type	: 400-800mm
Sample Colour	: Light Brown Grey Gra
Sample Type	: Weathered Granite

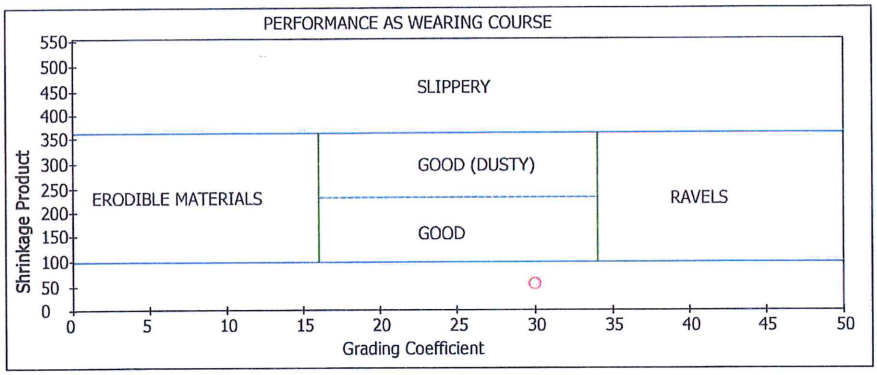
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	98
28.00	96
20.00	85
14.00	78
5.000	50
2.000	36
0.425	19
0.250	15
0.150	11
0.075	7,1
0.060	1,7
0.050	1,6
0.020	1,1
0.005	0,8
0.002	0,6

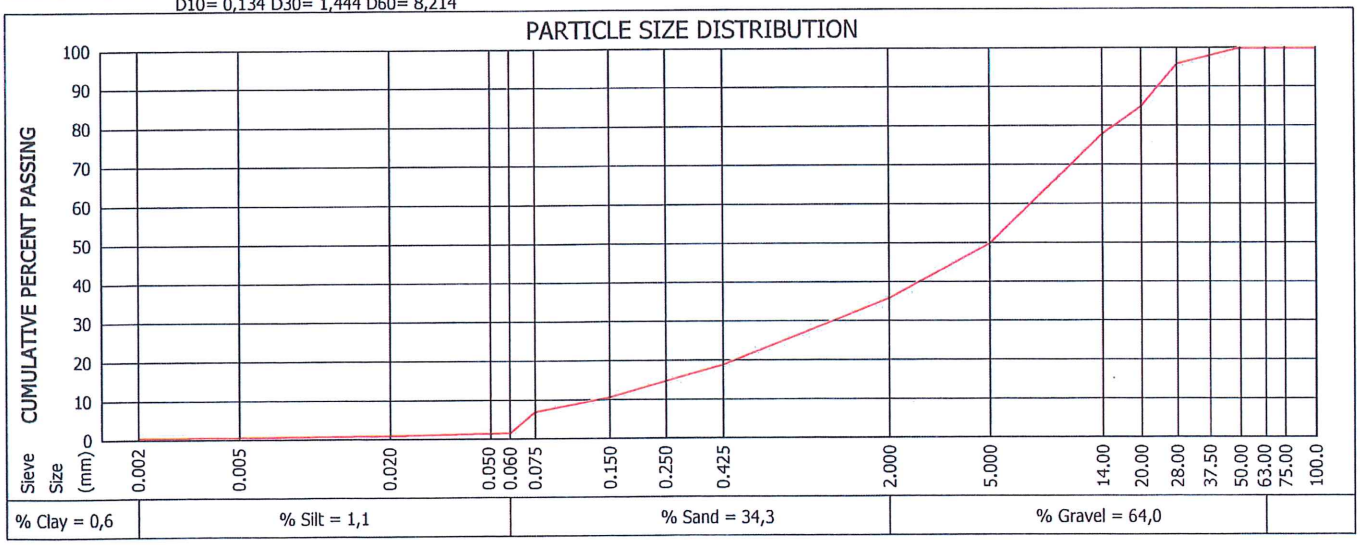
Soil Mortar	2.000 - 0.425	46
	0.425 - 0.250	12
	0.250 - 0.150	12
	0.150 - 0.075	11
	< 0.075	20
Effective Size		0,134
Uniformity Coefficient		61,3
Curvature Coefficient		1,9
Oversize Index		2,0
Shrinkage Product		57,0
Grading Coefficient		30,0
Grading Modulus		2,40
Atterberg Limits	Liquid Limit	31
	Plasticity Index	8
	Linear Shrinkage	3.0
	PI < 0.075	
Unified Soil Classification		GW-GM
US Highway Classification		A-2-4(0)

D10= 0,134 D30= 1,444 D60= 8,214









% Clay = 0,6	% Silt = 1,1	% Sand = 34,3	% Gravel = 64,0

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
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Report compiled by : Juraine Okkies

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Date Reported : 2020-08-21

Job Request No.: RU3525

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Attention : Frans Breytenbach

Project : Topline Infrastructure Upgrade

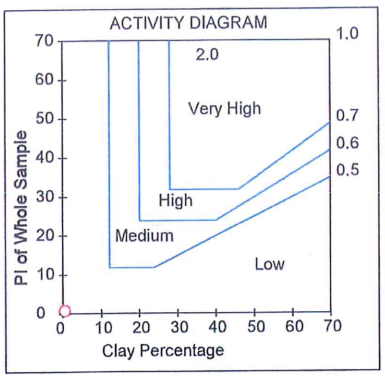
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

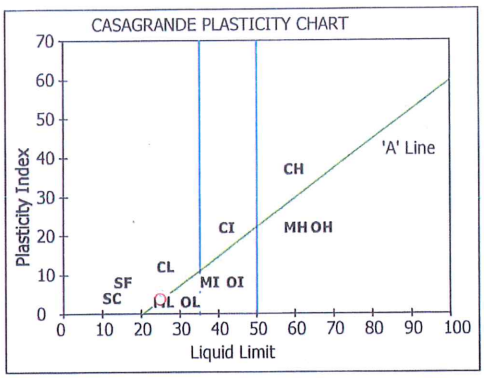
Sample No.	: U9259
Position	: TP 11
Layer Type	: 200-500mm
Sample Colour	: Brown Gravel
Sample Type	: Mix Calcrete+Quartzs

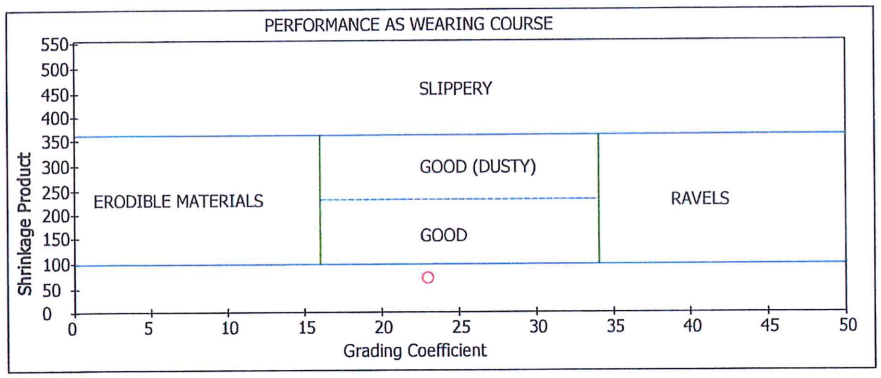
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	100
28.00	89
20.00	79
14.00	67
5.000	48
2.000	41
0.425	35
0.250	32
0.150	25
0.075	16
0.060	5,0
0.050	4,2
0.020	1,8
0.005	1,3
0.002	0,4

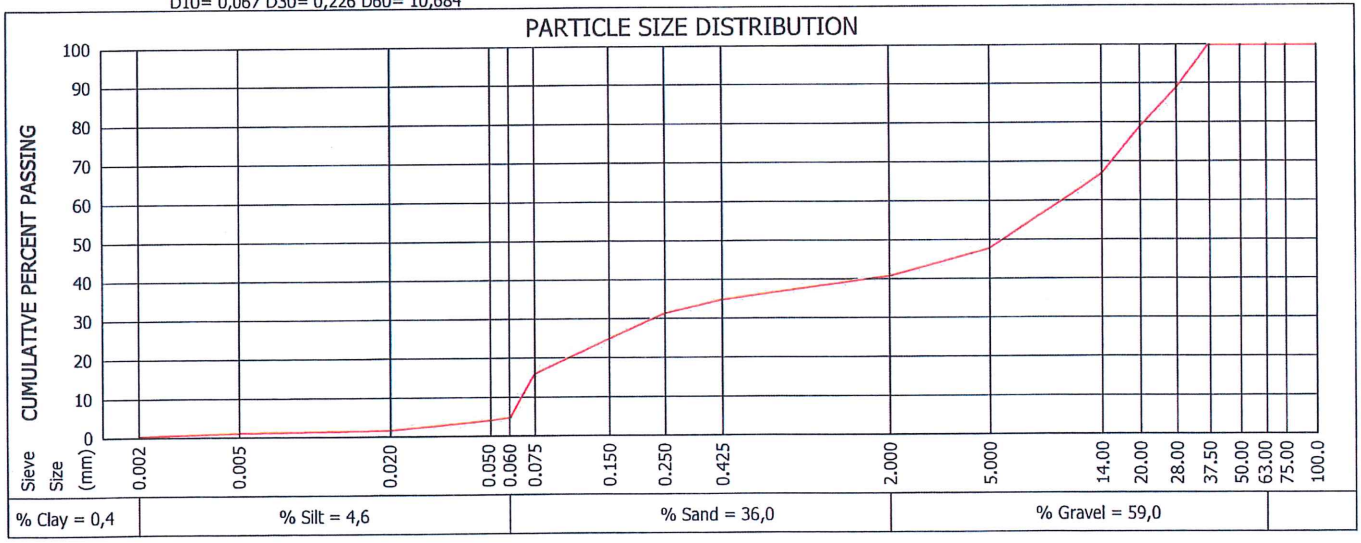
Soil Mortar	2.000 - 0.425	15
	0.425 - 0.250	9
	0.250 - 0.150	15
	0.150 - 0.075	22
	< 0.075	39
Effective Size		0,067
Uniformity Coefficient		159,5
Curvature Coefficient		0,1
Oversize Index		0,0
Shrinkage Product		70,0
Grading Coefficient		23,0
Grading Modulus		2,10
Atterberg Limits	Liquid Limit	25
	Plasticity Index	4
	Linear Shrinkage	2,0
	PI < 0.075	
Unified Soil Classification		GM-GC
US Highway Classification		A-1-b(0)

D10= 0,067 D30= 0,226 D60= 10,684









% Clay = 0,4	% Silt = 4,6	% Sand = 36,0	% Gravel = 59,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.82 [SANS 5854] & Conductivity = 0.11 S/m [SANS 6240]

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
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Report compiled by : Juraine Okkies

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Date Reported : 2020-07-17

Job Request No.: RU3525
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Attention : Frans Breytenbach

Project : Topline Infrastructure Upgrade

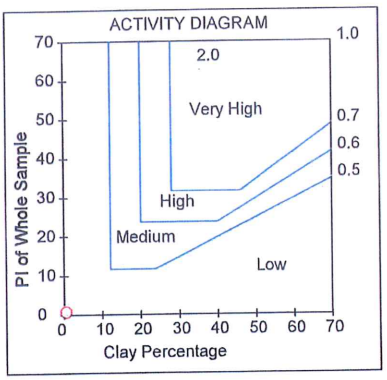
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

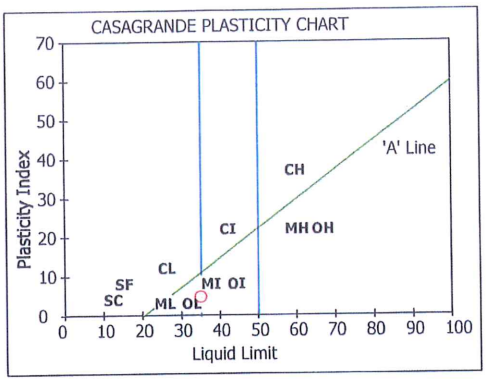
Sample No.	: U9260
Position	: TP 13
Layer Type	: 100-800mm
Sample Colour	: Light Brown Gravel
Sample Type	: Weathered Cal+OCC Qu

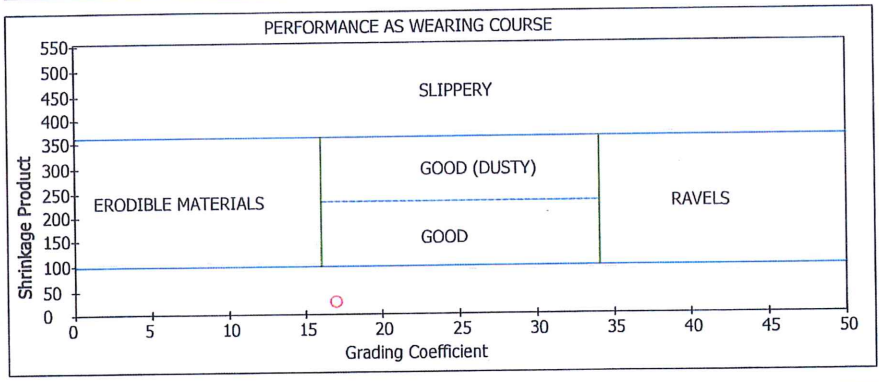
Sieve Size(mm)	% Passing
100.0	100
75.00	94
63.00	94
50.00	92
37.50	85
28.00	73
20.00	65
14.00	57
5.000	37
2.000	27
0.425	18
0.250	16
0.150	12
0.075	6,1
0.060	1,9
0.050	1,6
0.020	1,1
0.005	0,7
0.002	0,4

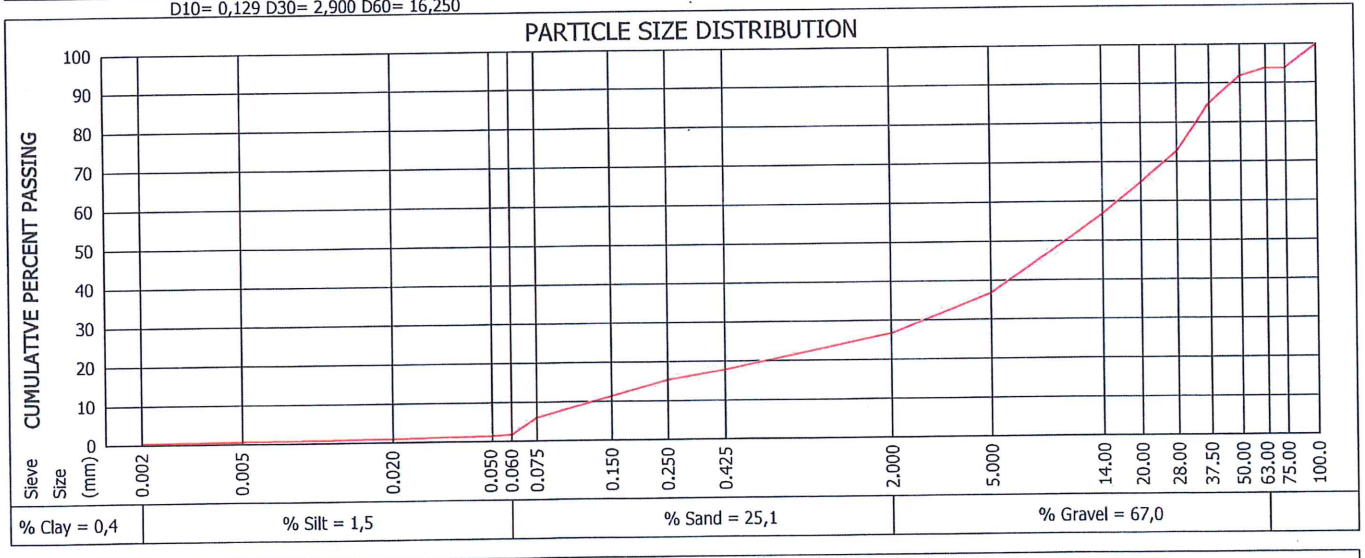
Soil Mortar	2.000 - 0.425	32
	0.425 - 0.250	11
	0.250 - 0.150	15
	0.150 - 0.075	20
	< 0.075	22
Effective Size		0,129
Uniformity Coefficient		126,0
Curvature Coefficient		4,0
Oversize Index		7,0
Shrinkage Product		27,0
Grading Coefficient		17,0
Grading Modulus		2,50
Atterberg Limits	Liquid Limit	35
	Plasticity Index	5
	Linear Shrinkage	1,5
	PI < 0.075	
Unified Soil Classification		GW-GM
US Highway Classification		A-1-a(0)

D10= 0,129 D30= 2,900 D60= 16,250









% Clay = 0,4	% Silt = 1,5	% Sand = 25,1	% Gravel = 67,0

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
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Job Request No.: RU3525

Date Reported : 2020-07-24

Ceder Land Geotechnical Consult (Pty) Ltd
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Project : Topline Infrastructure Upgrade

Attention : Frans Breytenbach

Determination of the California Bearing Ratio Test Report SANS 3001 - GR1 / GR2 / GR10 / GR20 / GR30 / GR40 / PR5

SAMPLE INFORMATION AND PROPERTIES

SAMPLE NO.	U9260			
HOLE NO./ Km / CHAINAGE	TP13			
ROAD NO./ NAME Line 1 ROAD NO./ NAME Line 2	S28° 45' 17,0"; E21° 50' 19,4"			
LAYER TESTED/SAMPLED	100-800mm			
SAMPLE DEPTH	100-800mm			
DATE SAMPLED	2020-07-08			
COLOUR OF SAMPLE	Light Brown			
TYPE OF SAMPLE	Mix Ironst+Calcrete			

SIEVE ANALYSIS - % PASSING SIEVES *(SANS 3001-GR1:2010, SANS 3001-GR2:2010)

SIEVE ANALYSIS (GR 1) % PASSING	100.0 mm	100			
	75.0 mm	94			
	63.0 mm	94			
	50.0 mm	92			
	37.5 mm	85			
	28.0 mm	73			
	20.0 mm	65			
	14.0 mm	57			
	5.0 mm	37			
	2.0 mm	27			
	0.425 mm	18			
	0.075 mm	6			
GM %		2,5			

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	32			
COARSE FINE SAND	0.425 - 0.250	11			
MEDIUM FINE SAND	0.250 - 0.150	15			
FINE FINE SAND	0.150 - 0.075	20			
SILT CLAY	0.075	22			

ATTERBERG LIMITS ANALYSIS - *(SANS 3001-GR10:2010)

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	35			
	PLASTICITY INDEX	5			
	LINEAR SHRINKAGE	1.5			
CLASSIFICATION	H.R.B.	A-1-a(0)			
	COLTO	G6			
	TRH 14	G6			

CALIFORNIA BEARING RATIO - *(SANS 3001-GR30:2010, SANS 3001-GR40:2010)

SANS GR30 MAX. DRY DENSITY	OMC %	10,2			
	MDD (kg/m³)	1845			
SWELL % @	COMP MC %	10,4			
	MOD | NRB | PRO	0,01 | 0,03 | 0,06			
C.B.R. SANS GR40	100 %	103			
	98 %	77			
	97 %	66			
	95 %	49			
	93 %	37			
	90 %	24			

STABILISER IN LAB	Not Applicable			
TEST TYPE	CBR			
SAMPLING METHOD	TMH 5			
WEATHER WHEN SAMPLED	Cold			

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
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Report compiled by : Juraine Okkies

sanas Testing Laboratory
Accreditation No. T0296
Prog.ver 10.7 (2019/11/07)

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Date Reported : 2020-07-17

Job Request No.: RU3525
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Attention : Frans Breytenbach

Project : Topline Infrastructure Upgrade

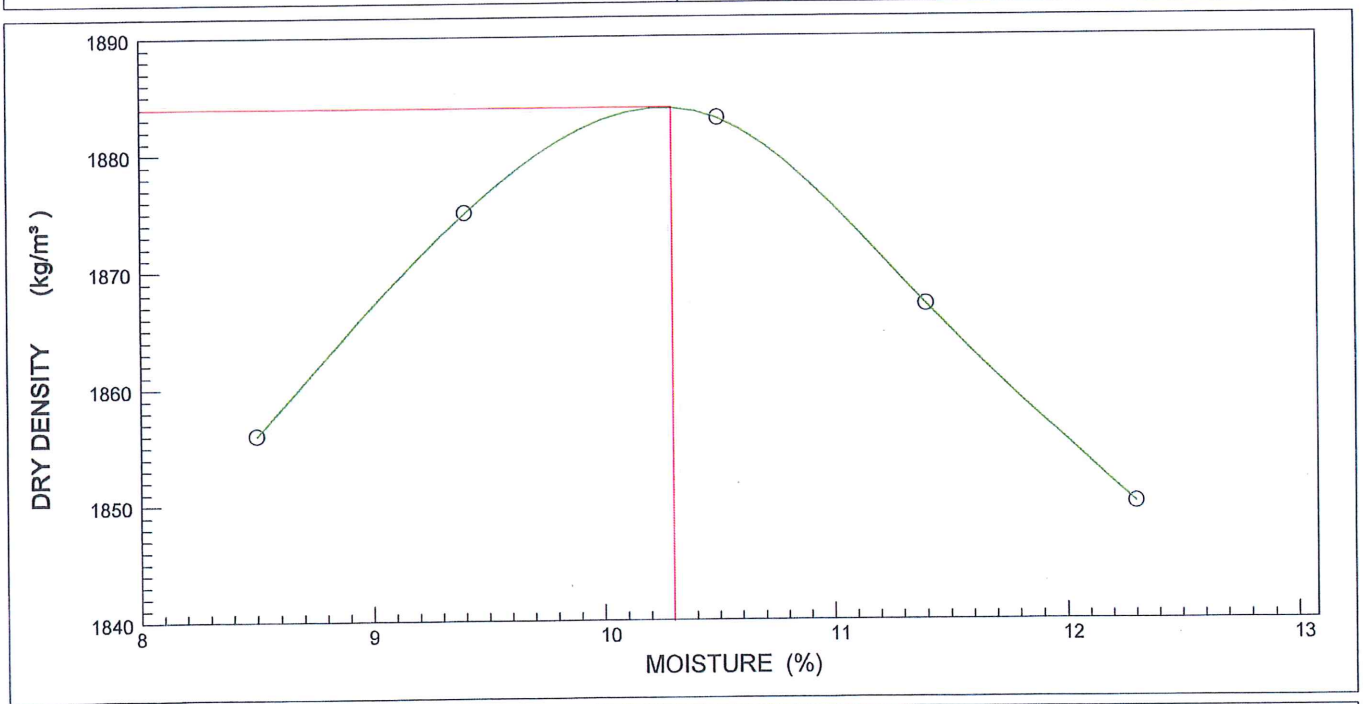
Determination Maximum Dry Density & Optimum Moisture Content Test Report

SANS 3001 - GR20/GR30

SAMPLE NO.	U9260
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	97kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	100-800mm
MATERIAL DESCRIPTION	Mix Weathered Calcrete + OCC Quartz
HOLE NO./ km / CHAINAGE	TP13
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-09
DATE SAMPLED	2020-07-08
CLIENT MARKING	S28° 45' 17,0"; E21° 50' 19,4"
COLOUR AND TYPE	Light Brown Gravel

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m³)	1856	1875	1883	1867	1850			
MOISTURE (%)	8,5	9,4	10,5	11,4	12,3			

MAXIMUM DRY DENSITY (kg/m³) : 1884	OPTIMUM MOISTURE CONTENT (%) : 10,3



Deviation from Test Method :
Remarks and Notes :

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Job Request No.: RU3525

Date Reported : 2020-08-12

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Attention : Frans Breytenbach

Project : Topline Infrastructure Upgrade

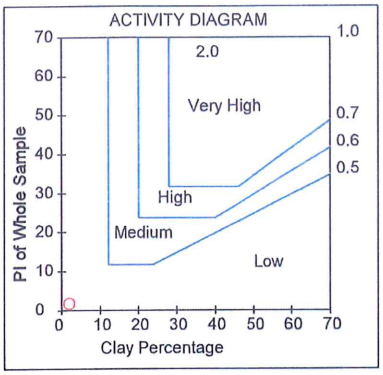
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

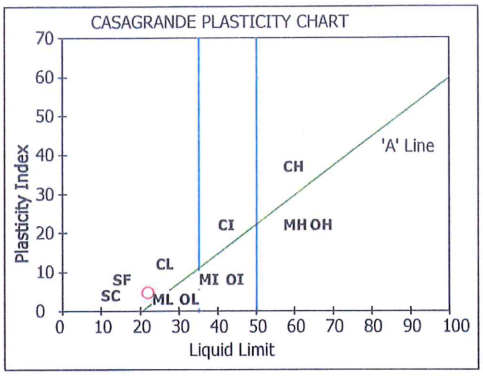
Sample No.	: U9261
Position	: TP 18
Layer Type	: 0-300mm
Sample Colour	: OrangeBrown Gravel
Sample Type	: Mix Quartzstone

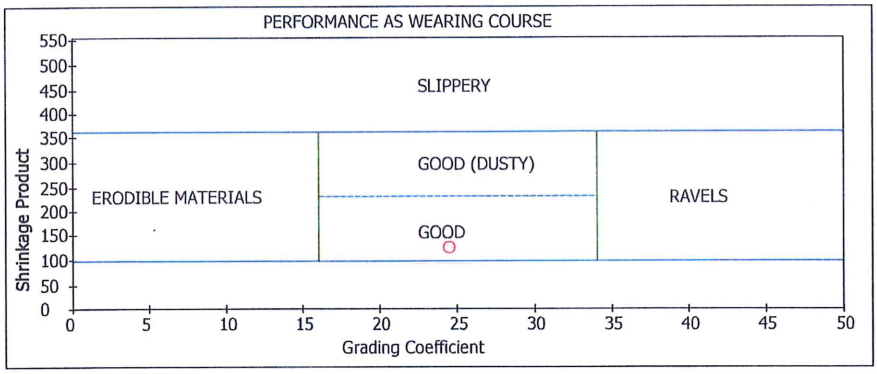
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	97
28.00	91
20.00	84
14.00	78
5.000	49
2.000	41
0.425	36
0.250	32
0.150	27
0.075	19
0.060	6,4
0.050	5,9
0.020	4,2
0.005	2,8
0.002	2,0

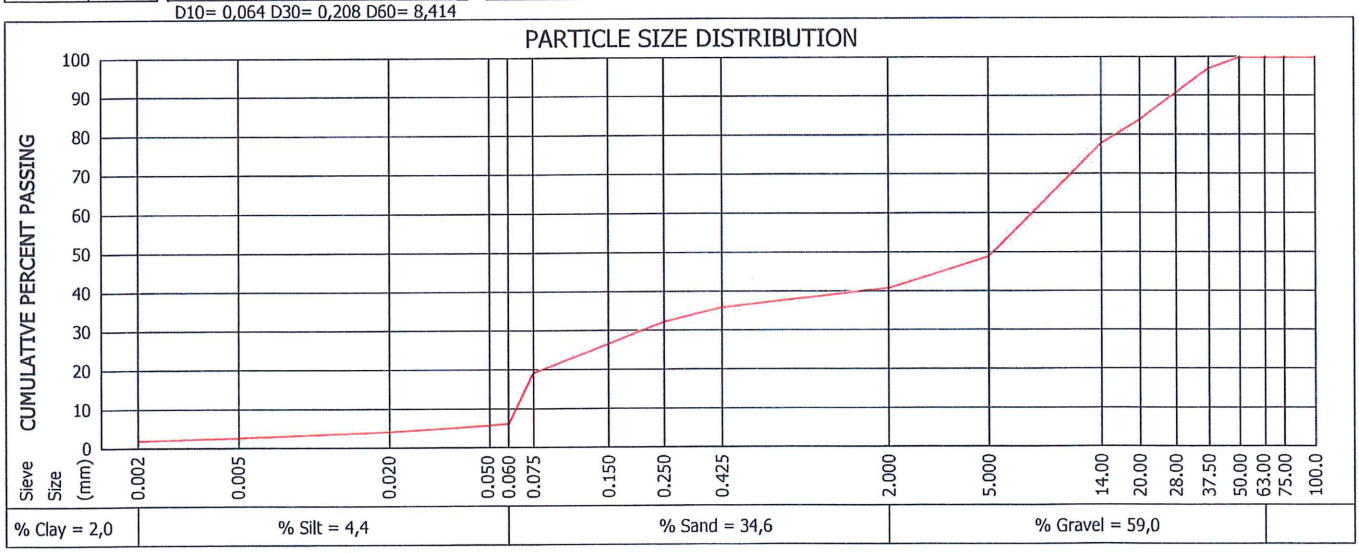
Soil Mortar	2.000 - 0.425	13
	0.425 - 0.250	9
	0.250 - 0.150	13
	0.150 - 0.075	19
	< 0.075	46
Effective Size		0,064
Uniformity Coefficient		131,5
Curvature Coefficient		0,1
Oversize Index		3,0
Shrinkage Product		126,0
Grading Coefficient		24,5
Grading Modulus		2,00
Atterberg Limits	Liquid Limit	22
	Plasticity Index	5
	Linear Shrinkage	3.5
	PI < 0.075	
Unified Soil Classification		GM-GC
US Highway Classification		A-1-b(0)

D10= 0,064 D30= 0,208 D60= 8,414









% Clay = 2,0	% Silt = 4,4	% Sand = 34,6	% Gravel = 59,0

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
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sanas Testing Laboratory
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Date Reported : 2020-08-06

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Attention : Frans Breytenbach

Project : Topline Infrastructure Upgrade

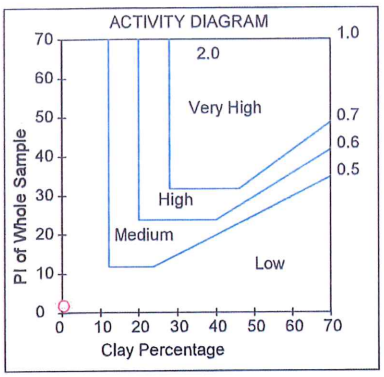
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

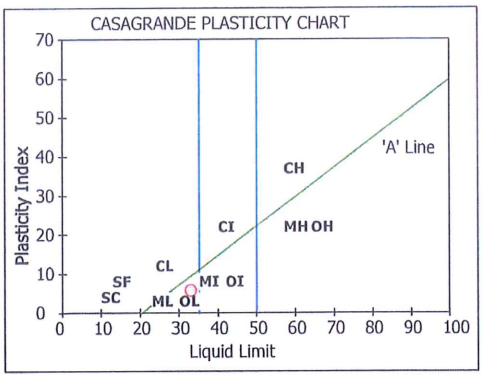
Sample No.	: U9262
Position	: TP 19
Layer Type	: 300-600mm
Sample Colour	: Light Brown Gravel
Sample Type	: Mix Weathered Quartz

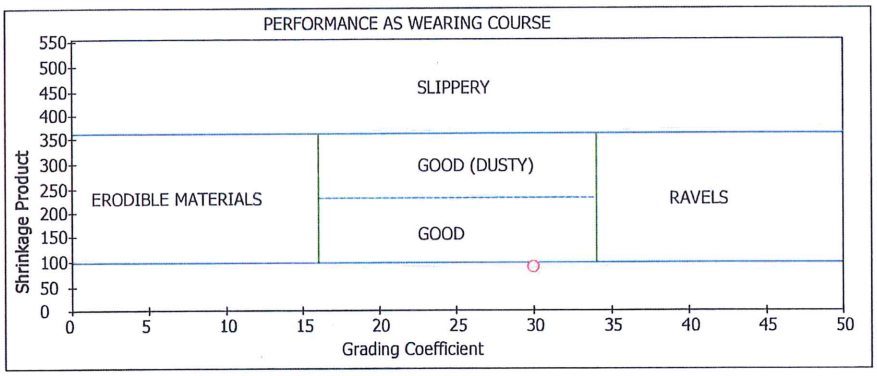
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	100
28.00	95
20.00	90
14.00	84
5.000	60
2.000	45
0.425	31
0.250	27
0.150	20
0.075	13
0.060	3,7
0.050	3,3
0.020	2,1
0.005	1,4
0.002	0,5

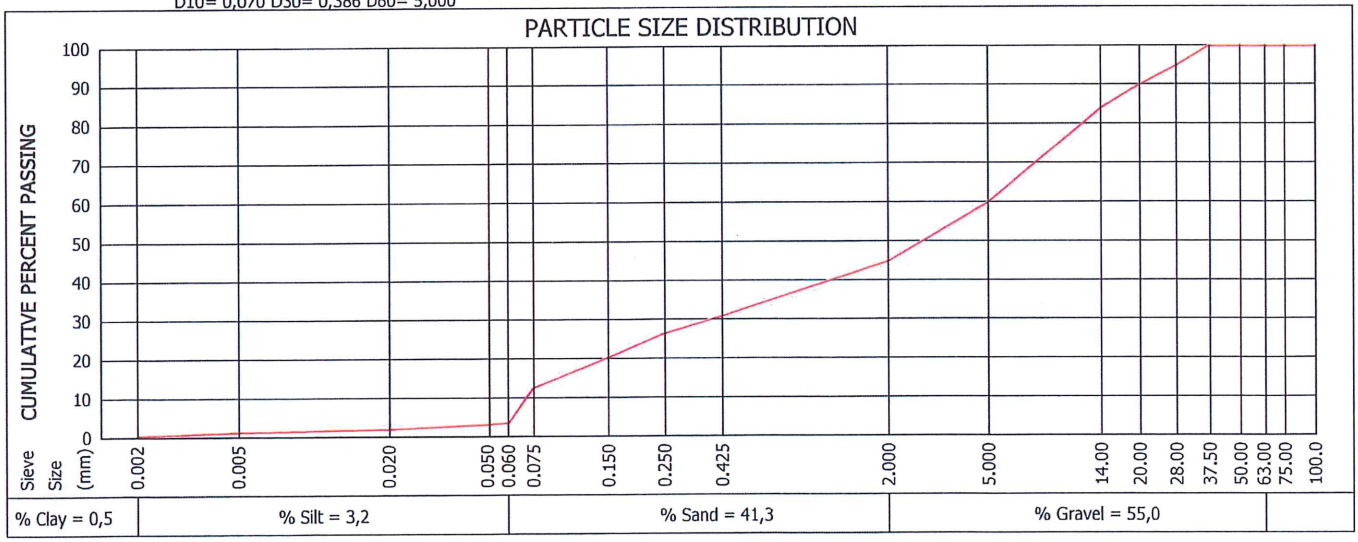
Soil Mortar	2.000 - 0.425	32
	0.425 - 0.250	10
	0.250 - 0.150	14
	0.150 - 0.075	16
	< 0.075	29
Effective Size		0,070
Uniformity Coefficient		71,4
Curvature Coefficient		0,4
Oversize Index		0,0
Shrinkage Product		93,0
Grading Coefficient		30,0
Grading Modulus		2,10
Atterberg Limits	Liquid Limit	33
	Plasticity Index	6
	Linear Shrinkage	3,0
	PI < 0.075	
Unified Soil Classification		SM
US Highway Classification		A-1-b(0)

D10= 0,070 D30= 0,386 D60= 5,000









% Clay = 0,5	% Silt = 3,2	% Sand = 41,3	% Gravel = 55,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.74 [SANS 5854] & Conductivity = 0.15 S/m [SANS 6240]

Report compiled by : Juraine Okkies

sanas Testing Laboratory
Accreditation No. T0296
Prog.ver 10.7 (2019/11/07)

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Date Reported : 2020-08-12

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
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Attention : Frans Breytenbach

Project : Topline Infrastructure Upgrade

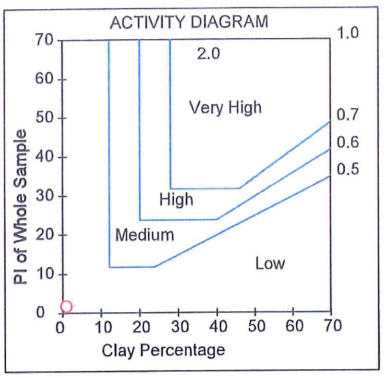
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

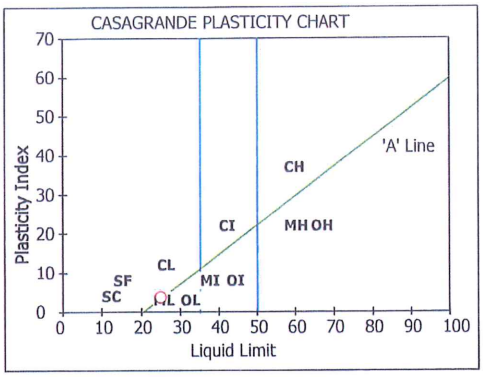
Sample No.	: U9263
Position	: TP 20
Layer Type	: 100-500mm
Sample Colour	: Dark Brown Gravel
Sample Type	: Mix Calcrete+Quartz

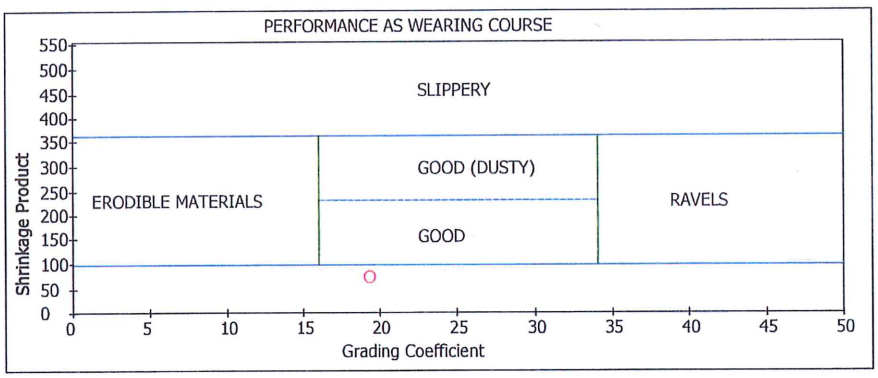
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	89
28.00	84
20.00	73
14.00	62
5.000	45
2.000	41
0.425	38
0.250	34
0.150	27
0.075	17
0.060	5,2
0.050	4,8
0.020	3,1
0.005	1,9
0.002	0,8

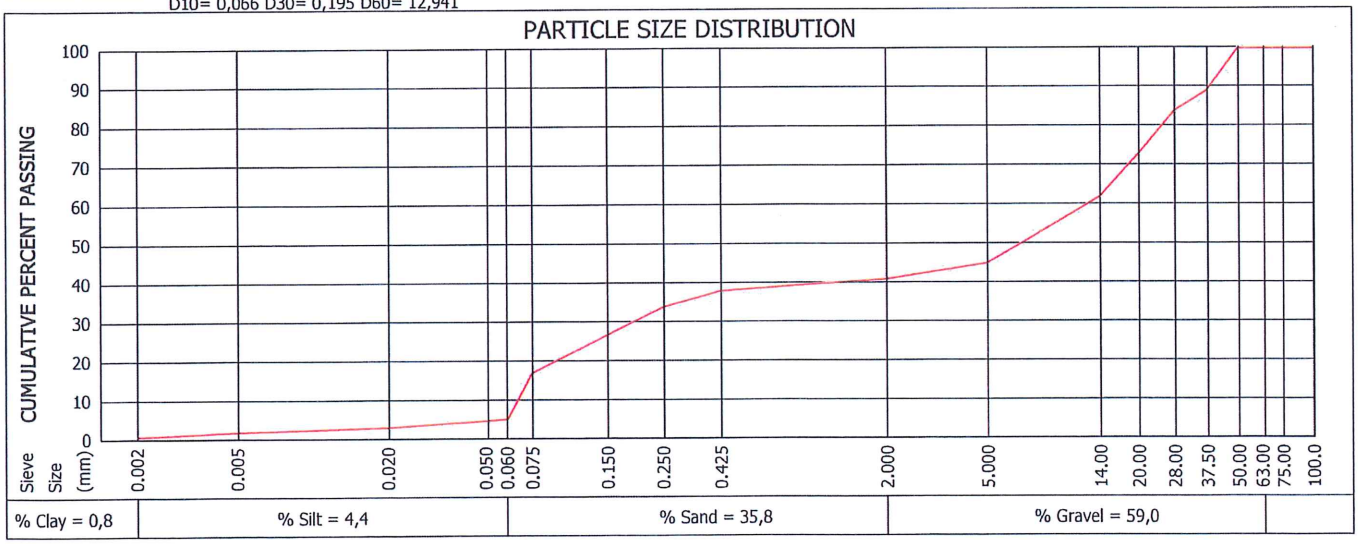
Soil Mortar	2.000 - 0.425	9
	0.425 - 0.250	9
	0.250 - 0.150	17
	0.150 - 0.075	24
	< 0.075	41
Effective Size		0,066
Uniformity Coefficient		196,1
Curvature Coefficient		0,0
Oversize Index		11,0
Shrinkage Product		76,0
Grading Coefficient		19,4
Grading Modulus		2,00
Atterberg Limits	Liquid Limit	25
	Plasticity Index	4
	Linear Shrinkage	2,0
	PI < 0.075	
Unified Soil Classification		GM-GC
US Highway Classification		A-1-b(0)

D10= 0,066 D30= 0,195 D60= 12,941









% Clay = 0,8	% Silt = 4,4	% Sand = 35,8	% Gravel = 59,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.69 [SANS 5854] & Conductivity = 0.06 S/m [SANS 6240]

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Accreditation No. T0296
Prog.ver 10.7 (2019/11/07)

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Job Request No.: RU3525

Date Reported : 2020-08-21

Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
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6835

Project : Topline Infrastructure Upgrade

Attention : Frans Breytenbach

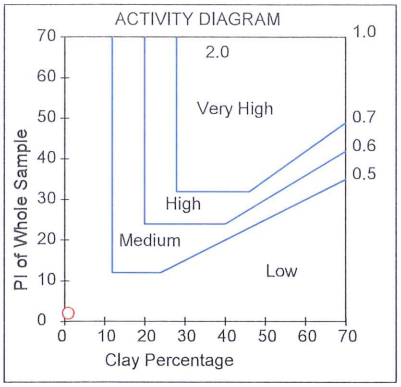
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

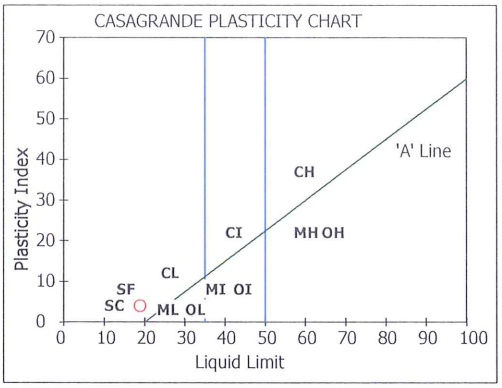
Sample No.	: U9264
Position	: TP 24
Layer Type	: 0-500mm
Sample Colour	: Reddish Brown Gravel
Sample Type	: Mix Quartziticstone

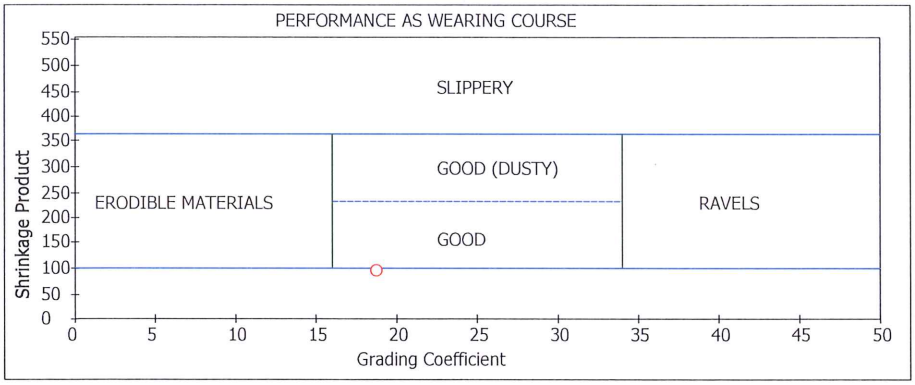
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	100
28.00	100
20.00	99
14.00	95
5.000	85
2.000	78
0.425	64
0.250	57
0.150	45
0.075	29
0.060	7,4
0.050	6,7
0.020	3,7
0.005	2,4
0.002	1,0

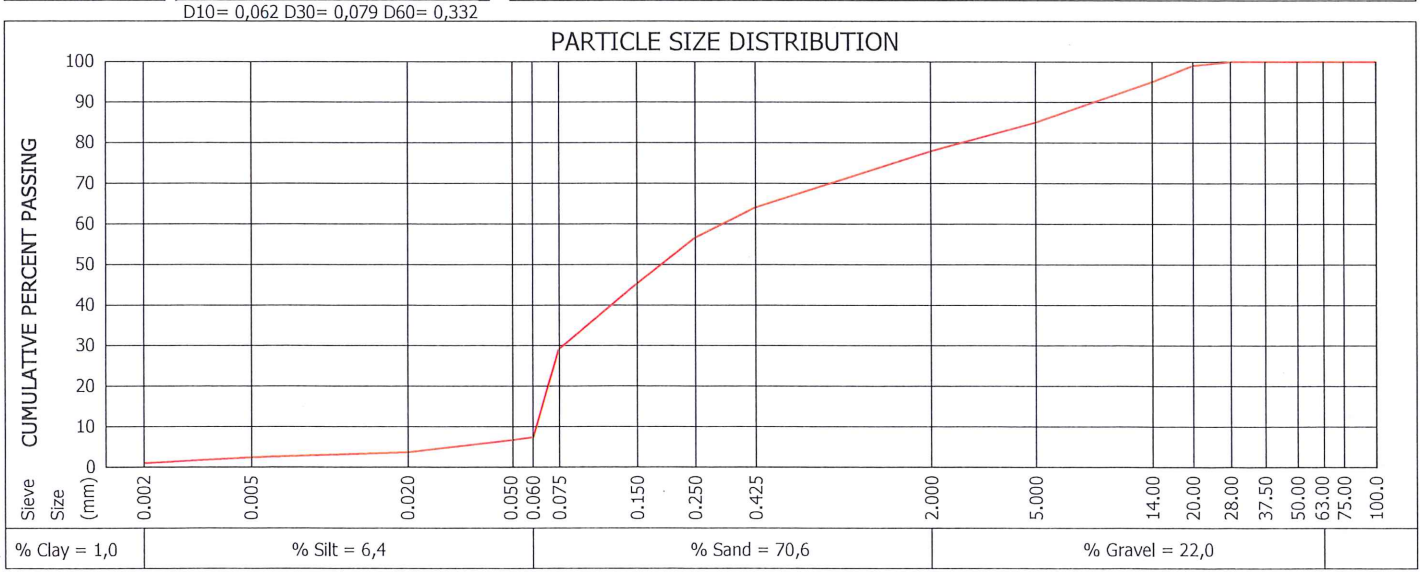
Soil Mortar	2.000 - 0.425	18
	0.425 - 0.250	9
	0.250 - 0.150	15
	0.150 - 0.075	21
	< 0.075	37
Effective Size		0,062
Uniformity Coefficient		5,4
Curvature Coefficient		0,3
Oversize Index		0,0
Shrinkage Product		96,0
Grading Coefficient		18,7
Grading Modulus		1,30
Atterberg Limits	Liquid Limit	19
	Plasticity Index	4.0
	Linear Shrinkage	1.5
	PI < 0.075	
Unified Soil Classification		SC
US Highway Classification		A-2-4(0)

D10= 0,062 D30= 0,079 D60= 0,332









% Clay = 1,0	% Silt = 6,4	% Sand = 70,6	% Gravel = 22,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.85 [SANS 5854] & Conductivity = 0.09 S/m [SANS 6240]

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Date Reported : 2020-07-17

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
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Attention : Frans Breytenbach

Project : Topline Infrastructure Upgrade

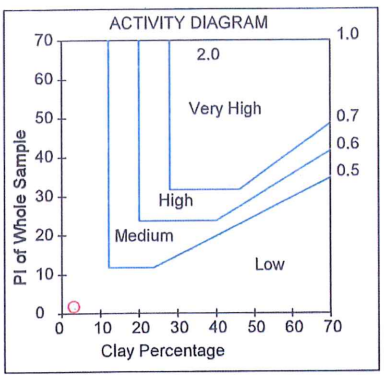
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

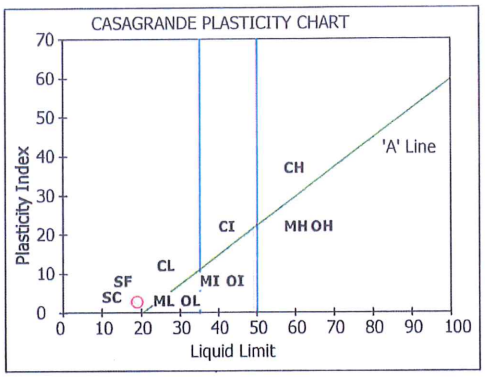
Sample No.	: U9265
Position	: TP 25
Layer Type	: 0-700mm
Sample Colour	: Dark Brown
Sample Type	: Mix Quartzstone

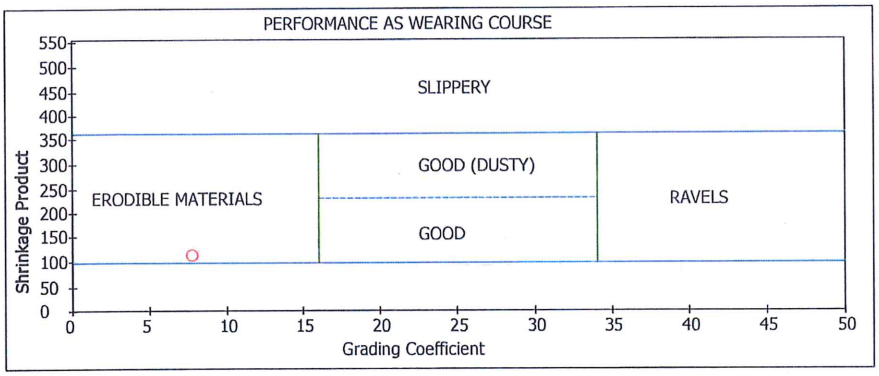
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	100
28.00	100
20.00	100
14.00	99
5.000	97
2.000	92
0.425	77
0.250	66
0.150	52
0.075	33
0.060	12
0.050	11
0.020	7,7
0.005	4,5
0.002	2,8

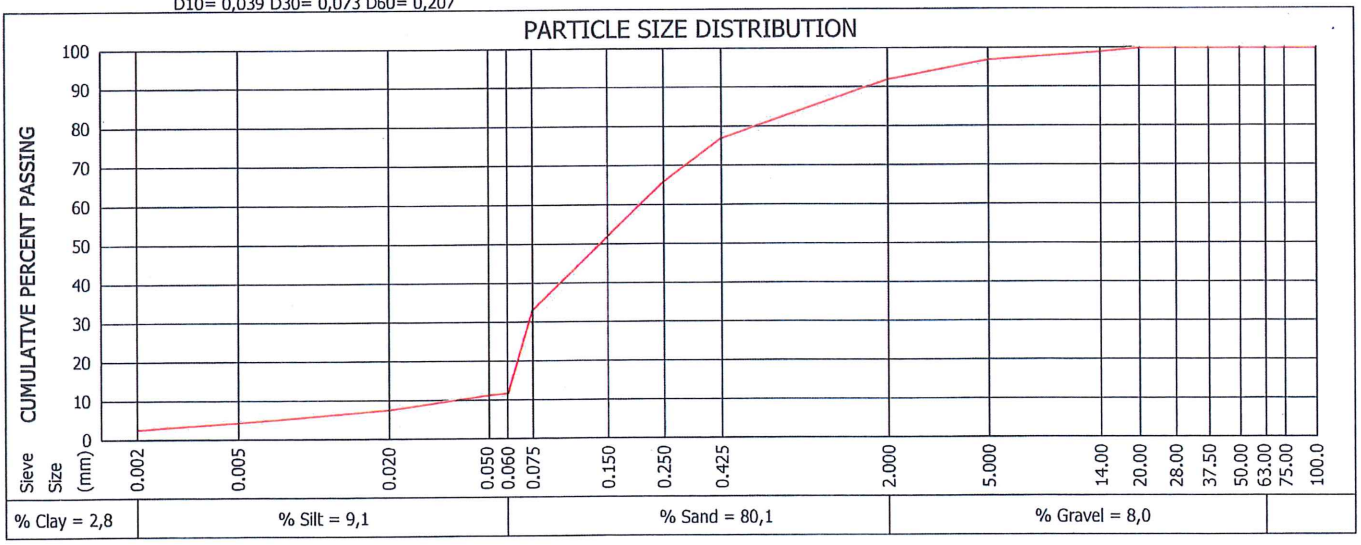
Soil Mortar	2.000 - 0.425	16
	0.425 - 0.250	12
	0.250 - 0.150	15
	0.150 - 0.075	21
	< 0.075	36
Effective Size		0,039
Uniformity Coefficient		5,3
Curvature Coefficient		0,7
Oversize Index		0,0
Shrinkage Product		115,5
Grading Coefficient		7,8
Grading Modulus		1,00
Atterberg Limits	Liquid Limit	19
	Plasticity Index	3.0
	Linear Shrinkage	1.5
	PI < 0.075	
Unified Soil Classification		SC
US Highway Classification		A-2-4(0)

D10= 0,039 D30= 0,073 D60= 0,207









% Clay = 2,8	% Silt = 9,1	% Sand = 80,1	% Gravel = 8,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.78 [SANS 5854] & Conductivity = 0.06 S/m [SANS 6240]

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
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Job Request No.: RU3525

Date Reported : 2020-07-24

Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
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6835

Project : Topline Infrastructure Upgrade

Attention : Frans Breytenbach

Determination of the California Bearing Ratio Test Report SANS 3001 - GR1 / GR2 / GR10 / GR20 / GR30 / GR40 / PR5

SAMPLE INFORMATION AND PROPERTIES

SAMPLE NO.		U9265			
HOLE NO./ Km / CHAINAGE		TP25			
ROAD NO./ NAME Line 1 ROAD NO./ NAME Line 2		S28° 45' 23,9" E21° 50' 35,0"			
LAYER TESTED/SAMPLED		0-700mm			
SAMPLE DEPTH		0-700mm			
DATE SAMPLED		2020-07-08			
COLOUR OF SAMPLE		Light Brown			
TYPE OF SAMPLE		Mix Quartz Sand			

SIEVE ANALYSIS - % PASSING SIEVES *(SANS 3001-GR1:2010, SANS 3001-GR2:2010)

SIEVE ANALYSIS (GR 1) % PASSING	100.0 mm				
	75.0 mm				
	63.0 mm				
	50.0 mm				
	37.5 mm				
	28.0 mm				
	20.0 mm	100			
	14.0 mm	99			
	5.0 mm	97			
	2.0 mm	92			
	0.425 mm	77			
	0.075 mm	33			
GM %		1,0			

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	16			
COARSE FINE SAND	0.425 - 0.250	12			
MEDIUM FINE SAND	0.250 - 0.150	15			
FINE FINE SAND	0.150 - 0.075	21			
SILT CLAY	0.075	36			

ATTERBERG LIMITS ANALYSIS - *(SANS 3001-GR10:2010)

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	19			
	PLASTICITY INDEX	3.3			
	LINEAR SHRINKAGE	1.5			
CLASSIFICATION	H.R.B.	A-2-4(0)			
	COLTO	G9			
	TRH 14	G10			

CALIFORNIA BEARING RATIO - *(SANS 3001-GR30:2010, SANS 3001-GR40:2010)

SANS GR30 MAX. DRY DENSITY	OMC %	8,2			
	MDD (kg/m³)	2134			
	COMP MC %	8,4			
SWELL % @	MOD | NRB | PRO	0,01 | 0,02 | 0,04			
C.B.R. SANS GR40	100 %	9			
	98 %	8			
	97 %	8			
	95 %	7			
	93 %	7			
	90 %	6			

STABILISER IN LAB	Not Applicable			
TEST TYPE	CBR			
SAMPLING METHOD	TMH 5			
WEATHER WHEN SAMPLED	Cold			

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
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Report compiled by : Juraine Okkies

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Job Request No.: RU3525

Date Reported : 2020-07-23

Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
Ceres
6835

Project : Topline Infrastructure Upgrade

Attention : Frans Breytenbach

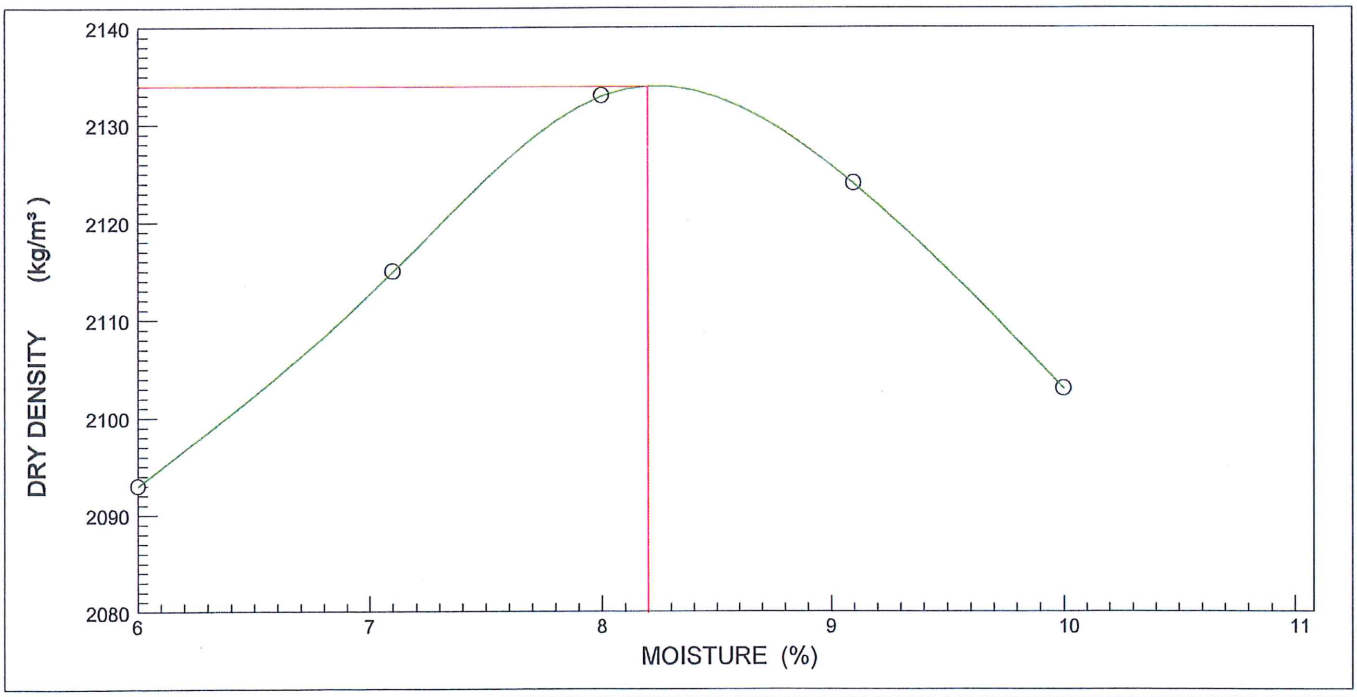
Determination Maximum Dry Density & Optimum Moisture Content Test Report

SANS 3001 - GR20/GR30

SAMPLE NO.	U9265
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	91kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	0-700mm
MATERIAL DESCRIPTION	Mix Quartz
HOLE NO./ km / CHAINAGE	TP25
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-09
DATE SAMPLED	2020-07-08
CLIENT MARKING	S28° 45' 23,9"; E21° 50' 35,0"
COLOUR AND TYPE	Light Brown S.Sand

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m³)	2093	2115	2133	2124	2103			
MOISTURE (%)	6,0	7,1	8,0	9,1	10,0			

MAXIMUM DRY DENSITY (kg/m³) : 2134	OPTIMUM MOISTURE CONTENT (%) : 8,2



Deviation from Test Method :
Remarks and Notes :

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Date Reported : 2020-08-06

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Attention : Frans Breytenbach

Project : Topline Infrastructure Upgrade

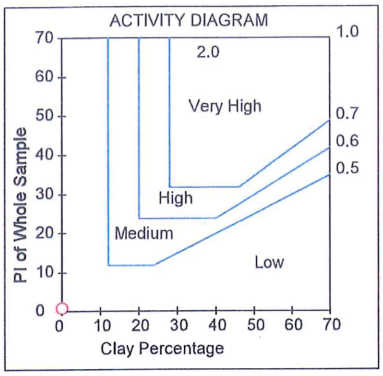
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

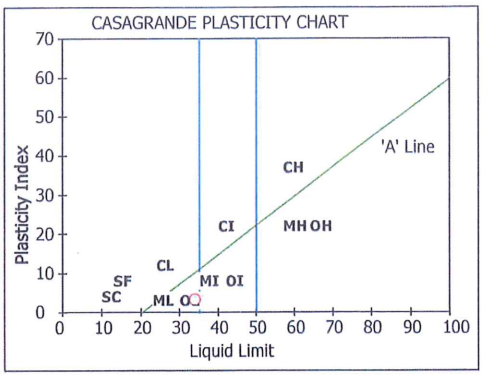
Sample No.	: U9266
Position	: TP 27
Layer Type	: 200-700mm
Sample Colour	: Light Brown Gravel
Sample Type	: Mix Weathered Quartz

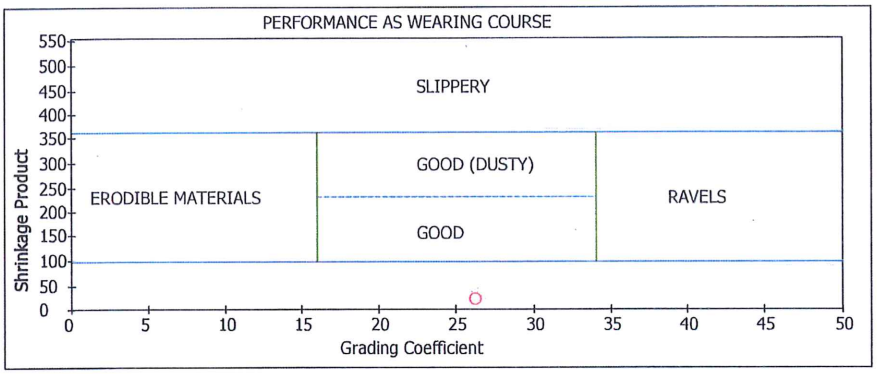
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	100
28.00	93
20.00	83
14.00	72
5.000	43
2.000	32
0.425	22
0.250	20
0.150	15
0.075	8,9
0.060	2,8
0.050	2,4
0.020	1,3
0.005	0,7
0.002	0,2

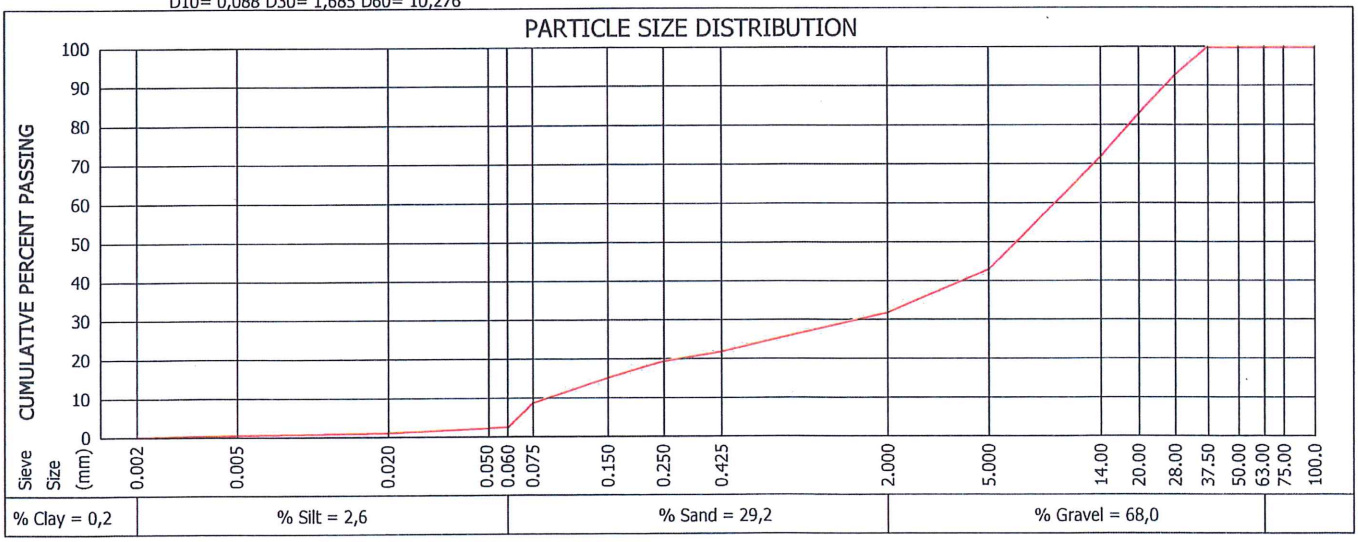
Soil Mortar	2.000 - 0.425	29
	0.425 - 0.250	9
	0.250 - 0.150	14
	0.150 - 0.075	20
	< 0.075	29
Effective Size		0,088
Uniformity Coefficient		116,8
Curvature Coefficient		3,1
Oversize Index		0,0
Shrinkage Product		22,0
Grading Coefficient		26,2
Grading Modulus		2,40
Atterberg Limits	Liquid Limit	34
	Plasticity Index	4.0
	Linear Shrinkage	1.0
	PI < 0.075	
Unified Soil Classification		GW-GM
US Highway Classification		A-1-a(0)

D10= 0,088 D30= 1,685 D60= 10,276









% Clay = 0,2	% Silt = 2,6	% Sand = 29,2	% Gravel = 68,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.58 [SANS 5854] & Conductivity = 0.06 S/m [SANS 6240]

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