

**GEOTECHNICAL CONDITIONS ON ERF 131
GROOTDRINK AND PLOT 2627 BOEGOEBERG
SETTLEMENT: A REPORT FOR THE EXPANSION
AND FORMALISATION OF GROOTDRINK
COMMUNITY**

2020/J09/MCP_01



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EXECUTIVE SUMMARY

1 INTRODUCTION

It is envisaged to develop some 36 hectare of land on Erf 131 Grootdrink and Plot 2627 of Boegoeberg settlement as an expansion and formalization of the existing Grootdrink community. For this purpose Cedar Land Geotechnical Consult (Pty) Ltd was appointed as sub consultant to Macroplan to conduct a geotechnical investigation on the property.

2 SITE DESCRIPTION

2.1 Site Location

The village of Grootdrink is located between Upington and Groblershoop in the Northern Cape. It is some 49 km from Groblershoop. The area of investigation consisting of Erf 131 Grootdrink and Plot 2627 Boegoeberg Settlement is located on the perimeter of the village. The size of the property is 36 hectare.

2.2 Topography and Drainage

The land investigated is located between 844,0mamsl and 862,00mamsl. Topographical it can be described as a series of undulating, low rises. On average the slope is virtually due west to east between 1,3% in the north and 2,8% in the south.

Drainage takes place by means of surface sheetwash. The sheetwash is disposed of towards the east according to the slope of the land. The drainage courses are contained in narrow, steeply sloping and well defined gullies.

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.

2.4 Climatic Conditions

The climate can be described as arid. The Thornthwaite moisture index is less than -40 ; and the Weinert N value approximately 35. 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.

2.5 Existing Facilities

Informal housing consisting of galvanized iron structures and some reed structures is present in the northern, western and southern parts of the site, directly adjacent to the existing village. Vacant, undeveloped land extends from the informal housing to the limits of the area of investigation to the north, west and south of Grootdrink.

3 NATURE OF INVESTIGATION

In compliance with the requirements of SANS 634 and GFSH-2 28 test pits were excavated to provide applicable geotechnical information. The test pits were profiled by a professionally registered geotechnical engineer.

Soil testing consisted of conductivity and pH determinations, foundation indicator and CBR testing.

4 CONCLUSIONS

The property is regarded as being of intermediate suitability for residential development. Founding conditions can be defined as R and S. The factors that reduce the suitability of the land for development are :

- The presence of hard rock and very dense hardpan calcrete close to the surface. The presence thereof will result in conditions of hard excavation.
- 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.

4.1 Stratigraphy

Bedrock on site occurs as the lower basalts of the Leerkrans Formation, Wilgenhoutsdrift Group. The lower basalt is described as consisting of greenstone and green-schist. It is extensively sheared and mineralogically altered. The presence of volcanic features such as metabasalt and felsic lava features are recognizable. The basalt is described as dark grey, very closely jointed, very fine grained, very hard rock. Discontinuities in the basalt are open and filled with sand. Green-schist is described as light grey green to dark grey, very closely jointed and very intensely laminated, very fine grained, hard rock. Discontinuities are closed, smooth and clean. The dip of the laminations is variable, but mostly orientated at 90° with the horizontal.

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.

4.2.2 Residual Basalt

Residual basalt underlies the colluvium. It is described as pale light yellow grey, very dense, intact silty sand tending to highly weathered, medium hard rock. Calcification of the residual soil may occur.

4.2.3 Residual Green-schist

Residual green-schist underlies nodular calcrete. It is described as pale light grey green and brown, loose, intact, silty sand and matrix supported gravels of green-schist.

4.2.4 Fill

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 underlies the colluvium. The hardpan calcrete can be described as white, sometimes mottled like grey, very fine grained and very dense.

4.2.5(ii) Nodular Calcrete

Nodular calcrete, including boulder calcrete, underlies the colluvium directly as a pure pedocrete; to a sub-horizon contained within a horizon of residual soil; or as an extensively calcified and nodular horizon. The nodular calcrete can be described as dirty white, rounded fine to medium coarse, gravel to boulder sized concretions contained in a matrix of very fine sand. The consistency varies from dense to very dense.

4.3 Groundwater

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.

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.

4.4 Conditions of Excavation

On average over the entire site refusal of excavation on bedrock or very dense hardpan calcrete was encountered at depths between 100mm minimum and 1400mm maximum, averaging 780mm deep. The implication of this is that should trenches require excavated depths to 1000mm, 22% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 48% of the excavation may be classified as hard.

4.5 Site Class Designation

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

4.5.1 Geotechnical Zone I

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

4.5.2 Geotechnical Zone II

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. 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.

4.5.3 Geotechnical Zone III

The zone is classed as S, meaning that the proposed horizon for founding is slightly compressible and rapid settlement less than 10mm is expected. Slope across the land is between 2% and 6%.

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 medium dense to very dense residual soil or pedocretes.

4.6 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.

4.7 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 in-situ soils are suitable for the construction of in-situ selected layerworks.*
- *Wearing Course for Gravel Roads in Urban Areas: None of the soil materials are 100% suitable for this purpose. The nodular calcrete proved to be better suited than the other soil materials for this purpose and should be reserved for the construction of gravel wearing course for the internal streets.*

4.8 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 corrosive due to the presence of soluble salts contained in the materials.*
- *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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1 INTRODUCTION

It is envisaged to develop some 36 hectare of land on Erf 131 Grootdrink and Plot 2627 of Boegoeberg settlement as an expansion and formalization of the existing Grootdrink 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 property.

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 :

Directors : FJ Breytenbach (Pr Eng) B Eng (Civ) NDT (Geology); M Breytenbach M Sc (Mathematical Statistics)

- *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 Grootdrink is located directly to the west and adjacent to the National Route 10 between Upington and Groblershoop in the Northern Cape. It is some 49 km from Groblershoop. The area of investigation consisting of Erf 131 Grootdrink and Plot 2627 Boegoeberg Settlement is located on the perimeter of the village, on the northern, 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 844,0mamsl and 862,00mamsl. Topographical it can be described as a series of undulating, low rises, usually less than six meters in height. On average the slope is virtually due west to east between 1,3% in the north and 2,8% in the south.

Drainage takes place by means of surface sheetwash. The sheetwash is disposed of towards the east according to the slope of the land. However, the southern part of the land is drained by three non-perennial water courses towards the east. The three courses combine into one. It follows a course through the southern extreme of the existing village. The drainage courses are contained in narrow, steeply sloping and well defined gullies.

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 Thornthwaite 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, western and southern parts of the site, directly adjacent to the existing village. Electricity is provided to three overhead high mast street lighting. A sewer line exists the village to the west, but it is not known whether the system is in operation. Some residents have created small vegetable and flower gardens on the stands.

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 Grootdrink.

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 6 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.



TYPICAL OUTCROPS OF GREENSCHIST -
NOTE LENSES OF QUARTZ (arrowed)



WASTE DUMPS OF CALCRETE, CONCRETE
ROCK AND SANDY MATERIAL



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



CONDITIONS IN GROOTDRINK VILLAGE



CONDITIONS IN GROOTDRINK VILLAGE

PHOTO 1

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 AL are indicated on this figure.

TABLE 1 : SOIL PROFILING PARAMETERS

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

SOIL TYPE

SOIL TYPE	PARTICLE SIZE(mm)
Clay	<0,002
Silt	0,002-0,06
Sand	0,06-2,0
Gravel	2,0-60,0
Cobbles	60,0-200,0
Boulders	>200,0

MOISTURE CONDITION

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

SOIL STRUCTURE

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

ORIGIN

Transported	Alluvium, hillwash, talus etc.
Residual	Weathered from parent rock, eg residual granite
Pedocretes	Femcrete, 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

5.2 Materials Testing

Soil testing was undertaken by Roadlab in Upington. As a matter of quality control duplicate



FIGURE 2 :
SITE PLAN

LEGEND

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

COORDINATES – GROOTDRINK		
System: WGS84 WGT1		
Point	Y	X
A	-072661.276	3160506.661
B	-072638.816	3160592.976
C	-072591.684	3160591.456
D	-072542.838	3160590.193
E	-072487.807	3160589.487
F	-072421.722	3160647.650
G	-072393.549	3161098.995
H	-072678.613	3161312.237
J	-072762.454	3161544.680
K	-073322.201	3161491.265
L	-073320.205	3161474.845
M	-073230.326	3161430.280
N	-073170.268	3161389.457
P	-073146.944	3161464.534
Q	-073108.290	3161452.391
R	-073002.855	3161462.528
S	-072990.036	3161329.193
T	-072962.755	3161316.240
U	-072928.620	3161299.083
V	-072731.828	3161144.887
W	-072720.587	3161083.610
X	-072724.610	3161068.828
Y	-072773.341	3161045.561
Z	-072730.408	3160955.641
AA	-072701.521	3160895.137
AB	-072681.485	3160811.486
AC	-072708.120	3160567.298
AD	-072873.069	3160585.290
AE	-072905.370	3160597.939
AF	-072926.725	3160618.994
AG	-072948.157	3160603.067
AH	-072972.408	3160592.410
AJ	-073431.700	3160644.991
AK	-073437.347	3160591.862
AL	-073441.090	3160516.844



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TAASK: Erf 131 Grootdrink and Plot 2627
JOB NAME: Boegoeborg Settlement
LIGGING: Expansion and Formalisation of
SITE: Grootdrink Community
KLIENT: !Kheis Municipality
TEKENING NO: Figure 2 : Site Plan
DATING: 23 July 2020

Adapted from Project : Grootdrink, Dated June 2020.
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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 retrieve undisturbed samples to determine properties of settlement or collapse fairly accurately.

Soil testing consisted of the following :

- Conductivity and pH determinations on five samples of the in-situ materials to determine the corrosivity thereof.
- Foundation indicator testing on ten 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.

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 metamorphic rocks towards Groblershoop, but it is in fact highly complex and from a stratigraphical viewpoint provides complicated geological sequence. 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 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,

TABLE 2 : SUMMARY OF SOIL TESTING

TEST PIT NO	SAMPLE NO	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	GM	PI	LL	ACTIVITY	pH	CONDUCTIVITY (Sm^{-1})	% < 0,002mm	OMC	MDD	SOIL CLASS		
														COLTO	PRA	UNIFIED
2	U9240	150-800	Green schist	Rock fragments	2,00	7	33	Low	7,72	0,05	0,7				A-2-4(0)	SM
5	U9241	200-900	Nodular calcrete	Sandy gravel	1,90	9	39	Low			1,4	13,8	1796	No Class	A-2-4(0)	SM
8	U9242	0-900	Colluvium	Sandy gravel	2,40	8	37	Low	8,30	0,17	0,4				A-2-4(0)	GW-GM
12	U9243	500-800	Residual basalt	Sandy gravel	2,40	9	45	Low			1,2				A-2-5(0)	GW-GM
14	U9244	100-900	Residual basalt	Gravel	2,70	4	19	Low	7,80	0,10	0,3				A-1-a(0)	GW
17	U9245	0-900	Colluvium	Sandy gravel	2,20	4	19	Low			1,9	4,0	2280	G7	A-1-b(0)	GM-GC
20	U9246	0-600	Nodular calcrete	Sandy gravel	2,10	7	27	Low	7,22	0,09	1,1				A-2-4(0)	GM-GC
23	U9247	200-700	Nodular calcrete	Gravelly sand	1,60	4	19	Low			2,9	11,0	1951	G8	A-2-4(0)	SM-SC
25	U9248	300-500	Green schist	Rock fragments	1,80	7	33	Low	7,75	0,08	2,8				A-2-4(0)	SM
28	U9249	200-900	Nodular calcrete	Sandy gravel	2,20	7	33	Low			0,8				A-2-4(0)	GM

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 Kaaiken 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 Kaaiken 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 Wilgenhoutsdrif Group, on which Grootdrink is located.

The regional geology is indicated on Figure 4 : Regional Geology.

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 the lower basalts of the Leerkrans Formation, Wilgenhoutsdrift Group. The Wilgenhoutsdrift Group is largely a volcanogenic succession. The group lies to

the east of the Brakbosch fault system and has been subjected to intense deformation and shearing. Age dating on acid lavas place the age of the group at 1300m Ma. The lower basalt is described as consisting of greenstone and green-schist. It is extensively sheared and mineralogically altered. The presence of volcanic features such as metabasalt and felsic lava features is recognizable. .

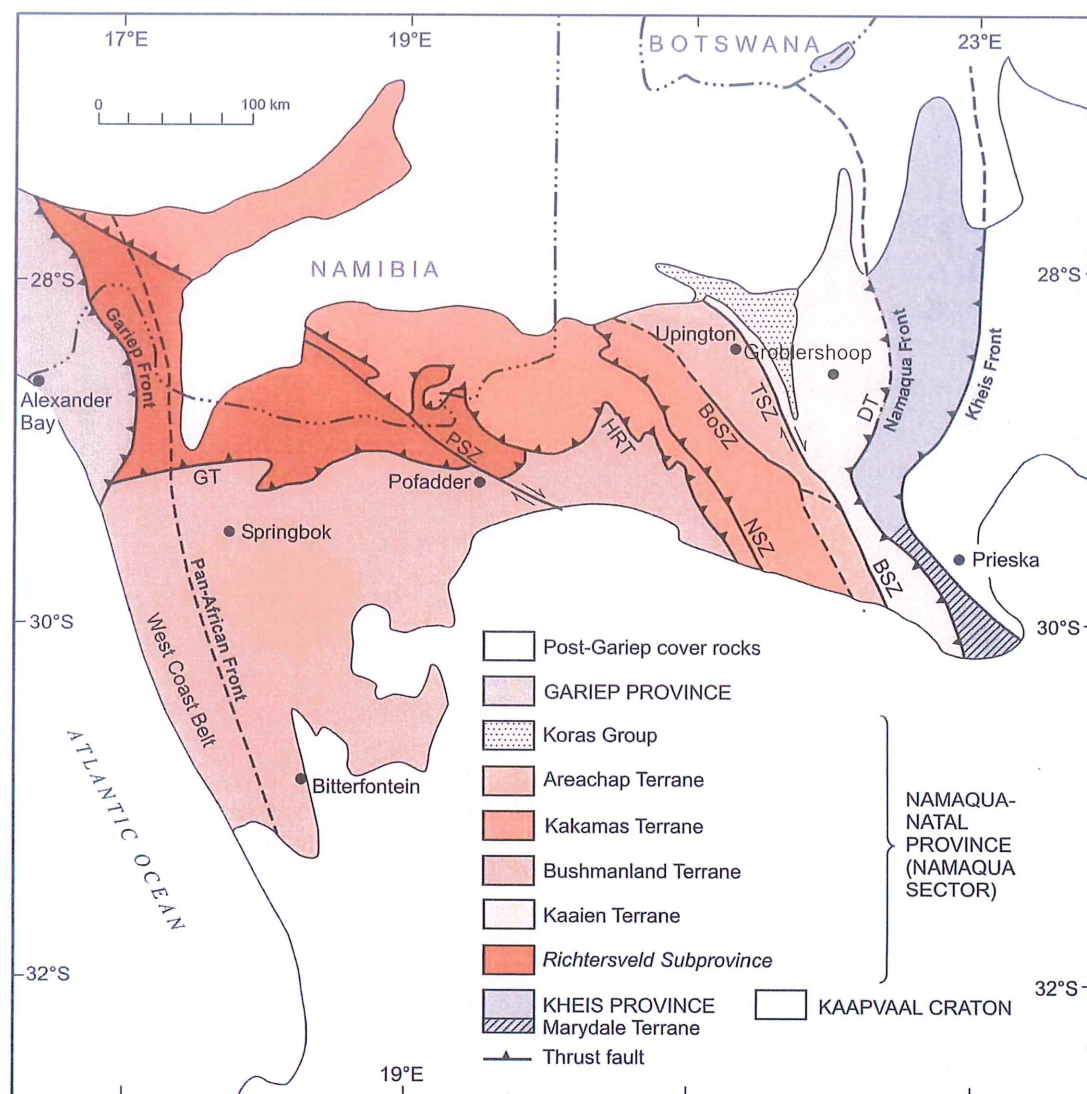
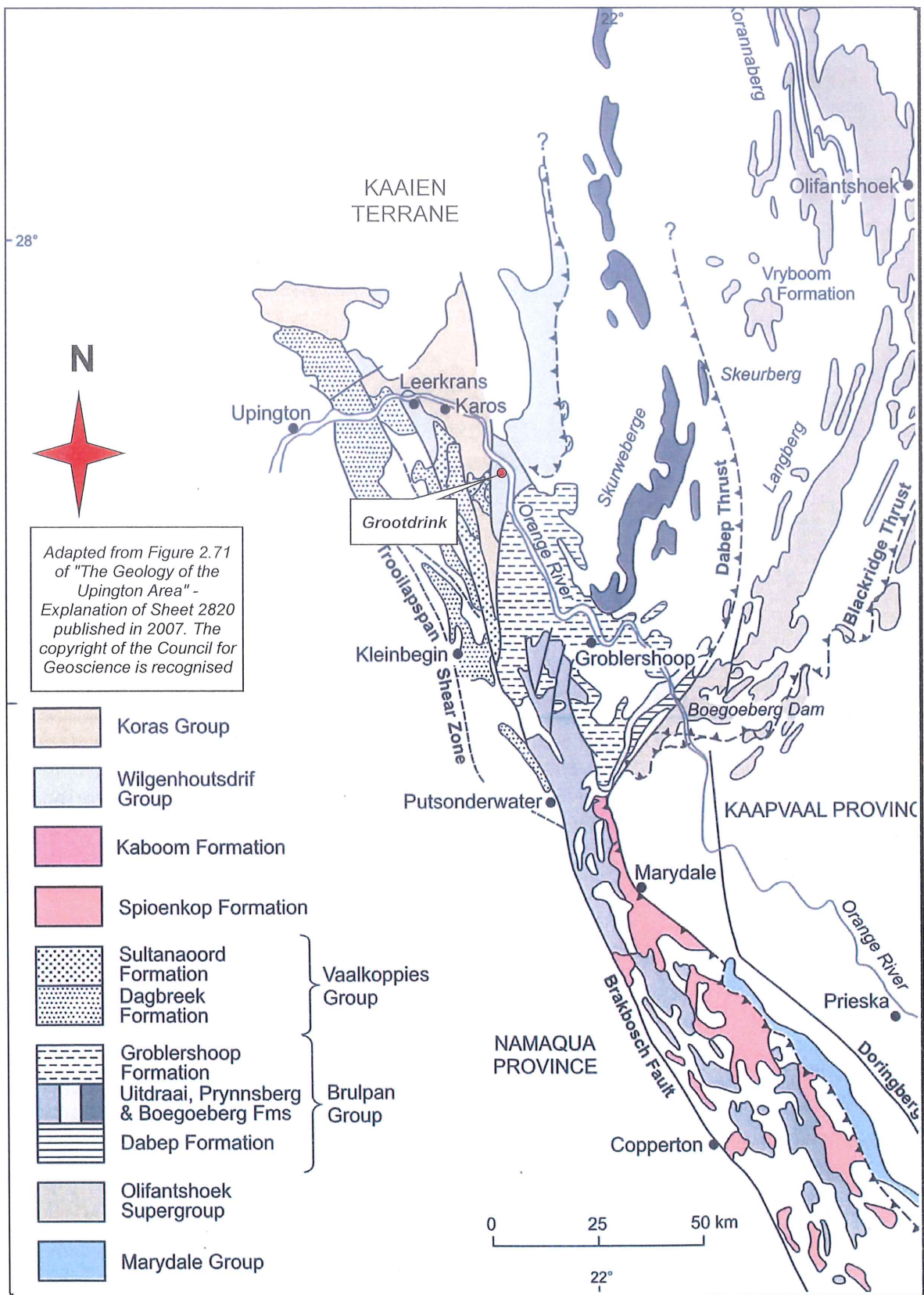


FIGURE 3 : TECTONIC SUBDIVISION OF THE NAMAQUA SECTOR

The basalt is described as dark grey, very closely jointed, very fine grained, very hard rock. Discontinuities in the basalt are open and filled with sand. The presence of basalt was recorded in TP's 1, 8, 12 to 14 and 26. Green-schist was encountered in TP's 2, 10, 20, 22, 23, 25, 27 and 28. It is described as light grey green to dark grey, very closely jointed and very intensely laminated, very fine grained, hard rock. Discontinuities are closed, smooth and clean. The dip of the laminations is variable, but mostly orientated at 90° with the horizontal and striking parallel with the Brakbosch fault zone, that is approximately north-south.



REGIONAL GEOLOGY

FIGURE 4

Adapted from Project : Grootdrink, Dated June 2020.
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is recognised



Lithology	Formation	Group
C	Calcrete	Mokolanen
Gr	Greenschist	Leerkran
B	Basaltic lava	Wilgenhoutsdrif

FIGURE 5 :
SITE GEOLOGY

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


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TAASK: Expansion and Formalisation of
JOB NAME: Grootdrink Community
LIGGING: Erf 131 Grootdrink and Plot 2627
SITE: Boegoeberg Settlement
KLIENT: !Kheis Municipality
TEKENING NO: Figure 5 : Site Geology
DRAUING NO:
DATUM: 27 July 2020
DATE:

6.3 Soil Profile

The soil profile on site is of limited vertical extent. This condition can be attributed to several factors of which the presence of a surface horizon of calcrete is perhaps the most important. It provides a durable capping, protecting bedrock against the processes of weathering, be it due to mechanical or chemical agents. Another contributing factor is the combination of the dry climatic conditions and bedrock with a high quartz content and low basic mineral content. These rock materials are resistant against chemical decomposition in dry conditions and the high quartz content thereof ensure durability in hot and dry conditions. Surface materials that are present therefore consist of materials due to gravitational deposition.

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.

On site colluvium as surface deposit was found in all the test pits except TP's 4, 14, 15, 20, 21, 25, 27 and 28. The horizon of colluvium was between 100mm and 900mm thick in the test pits. 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.

6.3.2 Mokalanen Formation

Calcrete of the Mokalanen Formation, Kalahari Group, is present as an ubiquitous surface duricrust on site. Again there is a difference in opinion between Moen (Reference 14.4 page 147) and Partridge^{Reference 14.5} 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.

Be it as it may, calcrete was encountered as the dominant lithic material on site, in virtually a continuous cover over the green-schist and basalt, with the latter two materials outcropping occasionally only in limited areas of localized extent. The calcrete is present as either dense to very dense nodular calcrete or hardpan calcrete.

6.3.2(i) *Hardpan Calcrete*

Hardpan calcrete was encountered in TP's 4, 7, 11 and 19 only. It underlies the colluvium, occurring from depths between 100mm and 200mm minimum, extending to 200mm to 400mm maximum, at which stage refusal of excavation occurred. Moen reports the calcrete to be up to five meters thick in the area. In TP 4 the hardpan calcrete was encountered as an outcrop and similar conditions were noted elsewhere on site. The hardpan calcrete can be described as white, sometimes mottled like grey, very fine grained and very dense.

6.3.2(ii) *Nodular Calcrete*

Nodular calcrete was, including boulder calcrete encountered in TP's 3, 5, 6, 9, 15, 16, 18, 20, 21 and 23 to 28. It occurs in variable conditions on site : from underlying the colluvium directly as a pure pedocrete ; to a sub-horizon contained within a horizon of residual soil ; or as an extensively calcified and nodular horizon. It was present between 100mm and 700mm deep minimum, but as outcrops in TP's 15, 20, 21, 25, 27 and 28. The horizon of nodular calcrete extended to depths between 300mm to 1300mm maximum, at which stage either refusal of excavation occurred or residual soil materials were encountered. The nodular calcrete can be described as dirty white, rounded fine to medium coarse, gravel to boulder sized concretions contained in a matrix of very fine sand. The consistency varies from dense to very dense.

6.3.3 Residual Basalt

Residual basalt was encountered in TP's 8 and 12 to 14 only, underlying the colluvium at a depth varying between 400mm and 900mm. It is described as pale light yellow grey, very dense, intact silty sand tending to highly weathered, medium hard rock. Calcification of the residual soil may occur. Refusal of excavation occurred at depths between 800mm and 1100mm on medium hard rock, basalt.

6.3.4 Residual Green-schist

Residual green-schist was encountered in TP 20 only underlying nodular calcrete at a depth of 900mm. It is described as pale light grey green and brown, loose, intact, silty sand and matrix supported gravels of green-schist. Refusal of excavation occurred at a depth of 900mm on medium hard rock, green-schist.

6.3.5 Fill

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 southwestern 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 14.6} 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 2ls⁻¹ 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 in the indicated 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. The content of active clay, that is the material smaller than 0,002mm in diameter, was less than 3% for all the samples tested. As per the activity diagrams contained on the report sheets in Addendum B, the activities of all samples plot in the "low" zone. Any future structure will thus not be subject to heave.

TABLE 3 : SUMMARY OF ENGINEERING PROPERTIES

TEST PIT NO	SAMPLE NO	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	SOIL CLASS		COHESION (kNm ⁻²)	FRICTION ANGLE (°) ¹	COMPRESSIBILITY ²	EROSION RESISTANCE ^{2 * 5}	PERMEABILITY ^{2*} k (cms ⁻¹)	SPECIFICATIONS FOR UNPAVED ROADS ^{3*}					SUITABILITY FOR ROAD CONSTRUCTION ⁴	
					PRA	UNIFIED						MAXIMUM SIZE	OVERSIZE INDEX (I _a)	GRADING COEFFICIENT (G _c)	SHRINKAGE PRODUCT (S _p)	CBR @ 95% MOD	CONSTRUCTION ⁴	
																	PAVED	UNPAVED
2	U9240	150-800	Green schist	Rock fragments	A-2-4(0)	SM	20 to 22	32° to 35°	Low	8	(7,5±4,8)X10 ⁻⁶	28,0	0,0	30,6	119,0			Good
5	U9241	200-900	Nodular calcrete	Sandy gravel	A-2-4(0)	SM	20 to 22	32° to 35°	Low	8	(7,5±4,8)X10 ⁻⁶	37,5	3,0	25,6	252,0	6	Not suitable	Good but dusty
8	U9242	0-900	Colluvium	Sandy gravel	A-2-4(0)	GW-GM	<5	30° to 40°	Negligable	1 to 4	(2,7±1,3)X10 ⁻²	37,5	3,0	25,1	80,0			Ravels and corrugates
12	U9243	300-600	Residual basalt	Gravelly sand	A-2-5(0)	GW-GM	<5	30° to 40°	Negligable	1 to 4	(2,7±1,3)X10 ⁻²	37,5	9,0	27,9	143,0			Good
14	U9244	100-900	Residual basalt	Sandy gravel	A-1-a(0)	GW	<5	35° to 40°	Negligable	1	(2,7±1,3)X10 ⁻²	37,5	5,0	11,2	27,0			Ravels and corrugates
17	U9245	0-900	Colluvium	Sandy gravel	A-1-b(0)	GM-GC	<5	28° to 40°	Negligable to very low	Highly variable	>3X10 ⁻⁷	50,0	12,0	15,2	93,0	23	Selected layer	Ravels and corrugates
20	U9246	0-600	Nodular calcrete	Sandy gravel	A-2-4(0)	GM-GC	<5	28° to 40°	Negligable to very low	Highly variable	>3X10 ⁻⁷	37,5	5,0	20,9	132,0			Good
23	U9247	200-700	Nodular calcrete	Sandy gravel	A-2-4(0)	SM-SC	5 to 22	30° to 35°	Low	5 to 8	2,7X10 ⁻⁶ to 5X10 ⁻⁷	63,0	2,0	18,3	156,0	15	Selected layer	Good
25	U9248	300-500	Green schist	Rock fragments	A-2-4(0)	SM	20 to 22	32° to 35°	Low	8	(7,5±4,8)X10 ⁻⁶	37,5	2,0	25,4	157,5			Good
28	U9249	200-900	Nodular calcrete	Sandy gravel	A-2-4(0)	GM	<5	30° to 40°	Negligable	4	>3X10 ⁻⁷	37,5	3,0	23,5	94,5			Good

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.

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 4, 14, 15, 20, 21, 25, 27 and 28. The horizon of colluvium was between 100mm and 900mm thick in the test pits, but generally less than 500mm. 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 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 Soils

Residual basalt was encountered in TP's 8 and 12 to 14 only underlying the colluvium at a depth varying between 400mm and 900mm. Residual green-schist was encountered in TP 20 only underlying nodular calcrete at a depth of 900mm. Both materials consist predominantly of sand with a high gravel content and loose to 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(iii) Pedocretes

Hardpan calcrete was encountered in TP's 4, 7, 11 and 19 only. It underlies the colluvium, occurring from depths between 100mm and 200mm minimum, extending to 200mm to 400mm maximum. Nodular calcrete was, including boulder calcrete, encountered in TP's 3, 5, 6, 9, 15, 16, 18, 20, 21 and 23 to 28. Both materials are of medium dense to 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.

7.1.3 Corrosivity

When discussing soil corrosivity, it is applicable to consider the guidelines as proposed by Evans^{Reference 14.7}. 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 $0,01\text{Sm}^{-1}$, 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 $0,05\text{Sm}^{-1}$, 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 7,2 and 8,3. The soils are thus regarded as not corrosive due to the acidity thereof.
- *Water Soluble Salts Content* : The conductivity of the samples of material tested varied between $0,05\text{Sm}^{-1}$ minimum for the green-schist to $0,17\text{Sm}^{-1}$ maximum for the colluvium. All in-situ materials can therefore be regarded as corrosive due to the salt content thereof.

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 encountered in TP's 3 and 35 in the unlined stormwater course.

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 in-situ materials to be generally of G7 to G8 quality and the nodular calcrete unclassified for purposes of paved road or segmental block road construction. This type of construction is applicable to access roads to townships. The soil materials are therefore suitable only for the construction of in-situ selected layerworks and not for subbase and base course construction.

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 especially the nodular calcrete complies in all aspects to the requirements for a gravel wearing course. In most cases the use of the nodular calcrete will provide a good gravel wearing course. The use of the residual materials and colluvium will result in a wearing course subject to raveling and corrugations. This can be attributed the non-cohesive character of most of the materials. In contradiction to the construction of paved roads, calcrete appears to be the material more suitable for gravel wearing course construction, although experience has taught that if a calcrete with a high plasticity index is used for this purpose, the road surface can become slippery in wet conditions.

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 Brink^{Reference 14.8} for compacted material. This approach is followed as the arenaceous character of the in-situ materials 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* : The colluvium is regarded as very low to negligibly compressible with cohesion (c_0) of less than $5,0\text{kNm}^{-2}$ and the effective stress envelope approximately 28° to 40° .
- *Nodular Calcrete* : The nodular calcrete is regarded as low to negligibly compressible with cohesion (c_0) of zero to 22Nm^{-2} and the effective stress envelope approximately 28° to 40° .
- *Residual Basalt* : The residual basalt is regarded as negligibly compressible with cohesion (c_0) of less than $5,0\text{kNm}^{-2}$ and the effective stress envelope approximately 30° to 40° .
- *Green-schist Fragments* : Samples of fragments of green-schist tested can be regarded as low compressible with cohesion (c_0) of 20Nm^{-2} to 22Nm^{-2} and the effective stress envelope approximately 32° to 35° .

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.

- *Colluvium* : The permeability of the colluvium is highly variable, depending on the content of coarse material. Based on the Unified materials classification the soil permeability coefficient of the samples tested varies between $2,7 \times 10^{-6} \text{cms}^{-1}$ to less permeable than $3,0 \times 10^{-7} \text{cms}^{-1}$.
- *Nodular Calcrete* : The permeability of the calcrete is highly variable depending on the mode of deposition and regarded as pervious to impervious. Based on the Unified materials classification the soil permeability coefficient of the samples tested varies between $2,7 \times 10^{-6} \text{cms}^{-1}$ to less permeable than $3,0 \times 10^{-7} \text{cms}^{-1}$.
- *Residual Basalt* : The residual basalt is regarded as pervious to impervious. Based on the Unified materials classification the soil permeability coefficient of the samples tested varies between $(2,7 \pm 1,3) \times 10^{-6} \text{cms}^{-1}$.
- *Green-schist Fragments* : The samples of green-schist fragments tested are regarded as semi-pervious to impervious. The soil permeability coefficient varies between $(7,5 \pm 4,8) \times 10^{-6} \text{cms}^{-1}$.

7.1.5(iii) Erosion Potential

- *Colluvium* : The classification of the colluvium in terms of erodibility proves to be variable, but showing a tendency to be fairly to good resistant against erosion.
- *Nodular Calcrete* : The classification of the nodular calcrete in terms of erodibility proves to be variable, but showing a tendency to be moderately to poorly resistant against erosion. However, this classification is applicable to fragments of calcrete and the intact calcrete providing a surface cover over the underlying material proved to be very resistant against erosion over a time span of more than a million years, providing a capping protecting the underlying rock against decomposition and soils against erosion.
- *Residual Basalt* : The classification of the residual basalt in terms of erodibility proves to be moderately resistant to highly resistant against erosion.
- *Green-schist Fragments* : The classification of the green-schist fragments shows it to be poorly resistant against erosion. As with the calcrete, this classification is applicable to fragments of green-schist and the intact bedrock appears to be slightly weathered to unweathered, showing no visual conditions on the surfaces of the rock fragments indicating a tendency towards any undue weathering.

7.2 Properties of Bedrock

The TLB used to excavate the test pits did not penetrate bedrock 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 Basalt

Parametric calculations with Roclab software results for slightly weathered, moderately to widely jointed, medium hard rock to hard rock result in the following properties :

- Cohesion : 10,0MPa
- Friction Angle : 35°
- Tensile Strength : 0,08MPa
- Uni-axle Compressive Strength : 5,8MPa
- Young's Modulus : 9778,7 MPa

All which show a very sound rock.

7.2.2 Green-schist

Parametric calculations with Roclab software results for slightly weathered, very closely jointed, very intensely laminated, medium hard rock result in the following properties :

- Cohesion : 3,4MPa
- Friction Angle : 29,0°
- Tensile Strength : 0,07MPa
- Uni-axle Compressive Strength : 2,5MPa
- Young's Modulus : 8082,4MPa

The above calculations are for schists dipping at 90° with the horizontal plane. Should the angle of dip change the tensile strength, UCS and Young's modulus may change accordingly.

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 Soils

Both the residual green-schist and basalt are of loose to very 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 green-schist and basalt 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 and the nodular calcrete can be regarded as soft excavation. The combined thickness of these strata varied between 100mm and 1300mm in the test pits, averaging 730mm prior to encountering conditions of intermediate or hard rock excavation.
- *Intermediate Excavation* : Refusal of excavation with a TLB occurred in most cases once bedrock of very dense, hardpan calcrete or slightly weathered to unweathered rock was encountered. However, the exception was encountered in TP's 1, 2, 10, 13, 14, 20, 22, 23 and 25 to 28 where slightly weathered rock was encountered from depths varying between 100mm to 900mm minimum to 300mm to 1400mm maximum when refusal of excavation occurred. In these test pits medium to slightly weathered rock can be regarded as intermediate excavation. It was possible to penetrate between 200mm and 500mm into weathered rock, both green-schist and basalt, averaging 300mm 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 1400mm, averaging 780mm.

From the above it is clear that the transition of conditions of excavation is very rapid from soft to hard rock excavation with virtually no 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 14.9} a 10% probability exists that an earthquake with Peak Ground Acceleration exceeding of 0,04g may take place once in 50 years in Grootdrink.

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 14.10} . The zonation is indicated on Figure 6 : Site Class Designation.

8.1 Geotechnical Zone I

This zone comprises 40% of the area investigated. It is characterized by the materials profiles of TP's 1 to 7, 22, 24, 25 and 27. It is present in two separate areas on site. It consists of a superficial horizon less than 400mm thick comprising of colluvium and residual soil overlying very dense calcrete. Several outcrops of calcrete occur in the area. Slope across the land is approximately between 2% and 6%. 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 founding conditions are regarded as favourable and 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 falling 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 16% of the area investigated. It is characterized by the materials profiles of TP's 9, 11, 18 and 19. It is present in two separate areas on site. It consists of a superficial horizon less than 400mm thick comprising of colluvium and residual soil overlying very dense calcrete. Several outcrops of calcrete occur in the area. Slope across the land is

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**FIGURE 6 :
SITE CLASS DESIGNATION**

LEGEND

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

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	40,06	R	Negligible	Less than 400mm of colluvium and residual soil 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%	Intermediate
II	15,52	R	Negligible	Less than 400mm of colluvium and residual soil 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
III	44,42	S	0mm to 10mm compression settlement	Superficial surface horizon of colluvial sand overlying medium dense to very dense nodular calcrete and residual soil	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on very dense pedocretes or residual soil. Foundation bearing pressure not to exceed 50kPa. Good site drainage.	Conditions of hard rock excavation. Landslope between 2% and 6%	Intermediate


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TAASK: Expansion and Formalisation of
JOB NAME: Grootdrink Community

LIGGING: Erf 131 Grootdrink and Plot 2627
SITE: Boegoeberg Settlement

KLIJNT: !Kheis Municipality

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

DATUM: 31 August 2020
DATE:

approximately less than 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 founding conditions are regarded as favourable and stable.

8.3 Geotechnical Zone III

This zone comprises 44% of the area investigated. The zone is present in three separate areas on the property. It is characterized by the materials profiles of TP’s 8, 10, 12 to 17, 20, 21, 23, 26 and 28. It consists of a horizon of colluvium approximately 400mm thick overlying medium dense to very dense residual sand and nodular calcrete and at depth bedrock of either green-schist or basalt. Slope across the land is between 2% and 6%. Foundation stresses induced by conventional strip foundations for single and double storey structures will result in limited compression settlement less than 10mm if founded directly on the nodular calcrete or residual soil. As per the materials profile encountered in the test pits the combined thickness of the strata of nodular calcrete and residual soil is sufficient to dissipate the stresses induced by the foundations effectively. The area is thus zoned as “S” and founding conditions are regarded as favourable, stable and compressible to a maximum of 10mm.

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 Uppington or Groblershoop. The recyclable material may be sold. The builders' rubble 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 Grootdrink.

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 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. The slope across the land varies between approximately 2% and 6%. Two founding alternatives can be considered :

9.1.1 Strip Foundations

The preferable founding alternative is foundations of 400mm wide strip footings placed directly on bedrock or very dense calcrete. Should the areas of the proposed dwellings not exceed 200m² foundations for internal non-loadbearing walls may consist of thickened floorslabs. Should this option be adopted the floorslabs shall be reinforced steel mesh.

TABLE 5 : FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES

AREA	AREA OF PROPERTY (%)	GEOTECHNICAL CLASS	ESTIMATED SOIL MOVEMENT (mm)	SOIL PROFILE	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES	ASSOCIATED PROBLEMS	DEVELOPMENT POTENTIAL
I	16	R	Negligible	Less than 400mm of colluvium and residual soil 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%	Intermediate
II	40	R	Negligible	Less than 400mm of colluvium and residual soil 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
III	44	S	0mm to 10mm compression settlement	Superficial surface horizon of colluvial sand overlying medium dense to very dense nodular calcrete and residual soil	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on dense to very dense pedocretes or residual soil Foundation bearing pressure not to exceed 50kPa Good site drainage	Conditions of hard rock excavation Landslope between 2% and 6%	Intermediate

9.1.2 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.

9.2 Geotechnical Zone II

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

The two options can be discussed as follows :

9.2.1 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 200m² 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

This is the preferred method of founding. The solution of slab-on-the-ground foundations may only be used for dwellings less than 200m² 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.

9.3 Geotechnical Zone III

The zone is classed as S, meaning that less than 10mm of compression settlement may occur. Considering the slope across the land of approximately 2% to 6% and the favourable geotechnical site classification as per Section 8 above, two foundation design alternatives are applicable to the zone.

The two options can be discussed as follows :

9.3.1 Strip Foundations

This is the preferred method of founding. Foundations of 400mm wide placed directly on the medium dense to dense nodular calcrete or residual soil may be used. Should the areas of the proposed dwellings not exceed 200m² foundations for internal non-loadbearing walls may consist of thickened floorslabs. Should this option be adopted the floorslabs shall be reinforced steel mesh.

9.3.2 Slab-on-the-ground Foundations

The solution of slab-on-the-ground foundations may only be used for dwellings less than 200m² in area. Edge beams shall be placed directly on the medium dense to dense nodular calcrete or residual soil. 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.

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 these water courses must be taken into account and infrastructure established only in a safe distance from these features.

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

No extraordinary features requiring special precautionary measures to decrease the impact thereof are present on site.

12 CONCLUSIONS

The property is regarded as being of intermediate suitability for residential development. Founding conditions can be defined as R and S. The factors that reduce the suitability of the land for development are :

- The presence of hard rock and very dense hardpan calcrete close to the surface. The presence thereof will result in conditions of hard excavation.
- 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.

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.

12.1 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 Kaaie Terrane and the site is located on the Leerkrans formation of the Wilgenhoutsdrif Group.

Bedrock on site occurs as the lower basalts of the Leerkrans Formation, Wilgenhoutsdrif Group. The lower basalt is described as consisting of greenstone and green-schist. It is extensively sheared and mineralogically altered. The presence of volcanic features such as metabasalt and felsic lava features are recognizable. The basalt is described as dark grey, very closely jointed, very fine grained, very hard rock. Discontinuities in the basalt are open and filled with sand. Green-schist is described as light grey green to dark grey, very closely jointed and very intensely laminated, very fine grained, hard rock. Discontinuities are closed, smooth and clean. The dip of the laminations is variable, but mostly orientated at 90° with the horizontal.

12.2 Soil Profile

12.2.1 Colluvium

Colluvium as surface deposit was between 100mm and 900mm thick in the test pits. 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.

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 slope closure has ceased	Mining within less than 90m to 240m of surface or where total extraction mining has taken place			
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° and 12° 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			

12.2.2 Residual Basalt

Residual basalt underlies the colluvium at a depth varying between 400mm and 900mm. It is described as pale light yellow grey, very dense, intact silty sand tending to highly weathered, medium hard rock. Calcification of the residual soil may occur.

12.2.3 Residual Green-schist

Residual green-schist underlies nodular calcrete at a depth of 900mm. It is described as pale light grey green and brown, loose, intact, silty sand and matrix supported gravels of green-schist.

12.2.4 Fill

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.

12.2.5 Mokalanen Formation

12.2.5(i) Hardpan Calcrete

Hardpan calcrete underlies the colluvium, occurring from depths between 100mm and 200mm minimum, extending to 200mm to 400mm maximum, at which stage refusal of excavation occurred. The hardpan calcrete can be described as white, sometimes mottled like grey, very fine grained and very dense.

12.2.5(ii) Nodular Calcrete

Nodular calcrete, including boulder calcrete, underlies the colluvium directly as a pure pedocrete; to a sub-horizon contained within a horizon of residual soil; or as an extensively calcified and nodular horizon. It was present between 100mm and 700mm deep minimum, but also as outcrops. The nodular calcrete can be described as dirty white, rounded fine to medium coarse, gravel to boulder sized concretions contained in a matrix of very fine sand. The consistency varies from dense to very dense.

12.3 Groundwater

12.3.1 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.

12.3.2 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.

12.4 Conditions of Excavation

On average over the entire site refusal of excavation on bedrock or very dense hardpan calcrete was encountered at depths between 100mm minimum and 1400mm maximum, averaging 780mm deep. The implication of this is that should trenches require excavated depths to 1000mm, 22% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 48% of the excavation may be classified as hard.

Irrespective of which method of excavation is considered, the most important issue is that across the entire site the depth that can be regarded as hard rock excavation is highly variable as follows:

12.4.1 Geotechnical Zones I and II

These zones are classified as R. The average depth to bedrock or very dense pedocrete is 200mm. Refusal of excavation occurred at an average depth of 580mm. The implication of this is that should trenches require excavated depths to 1000mm, 42% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 61% of the excavation may be classified as hard.

12.4.2 Geotechnical Zone III

These zones are classified as S. The average depth to bedrock is 740mm. Refusal of excavation occurred at an average depth of 1015mm. The implication of this is that should trenches require excavated depths to 1000mm, 100% of the excavation may be classified as soft, suitable for TLB excavation. Should the required depth of excavation increase to 1500mm, 32% of the excavation may be classified as hard, requiring drilling and blasting.

12.5 Site Class Designation

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

12.5.1 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 40% 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.

12.5.2 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 16% 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. The more viable foundation alternative therefore remains founding by means of slab-on-the-ground foundations.

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.

12.5.3 Geotechnical Zone III

The zone is classed as S, meaning that the proposed horizon for founding is slightly compressible and rapid settlement less than 10mm is expected. The distribution thereof encompasses 44% of the proposed area for development. Slope across the land is between

2% and 6%. 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 medium dense to very dense residual soil or pedocretes. The more viable foundation alternative is regarded as 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.

12.6 Land Slope

The average slope across the larger part of the land is between 2% and 6%. Only in Geotechnical Zone II is the slope less than 2% that is over 16% 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.

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 in-situ soils are suitable for the construction of in-situ selected layerworks. The sample of calcrete tested failed to achieve a COLTO index. Provisionally it can therefore be considered suitable only as roadbed only.
- *Wearing Course for Gravel Roads in Urban Areas*: None of the soil materials are 100% suitable for this purpose. The nodular calcrete proved to be better suited than the other soil materials for this purpose and should be reserved for the construction of gravel wearing course for the internal streets in Grootdrink. The use of the soil materials will generally result in a road surface subject to raveling and corrugations.

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 corrosive due to the presence of soluble salts contained in the materials.
- *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*: Material for subbase and base construction must be obtained from commercial sources. Depending on the pavement design, G6 or G7 material may have to be imported for the construction of selected layerworks. 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 commercial sources, but excavated calcrete can be stockpiled for this purpose, alternatively and depending on the designs, the calcrete may be ripped, shaped and recompacted as gravel wearing course.

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 of the very dense pedocretes need to be removed. It is recommended that adequate provision be made for hard rock excavation.

13.5 Land Slope

Slope across the 16% 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 84% 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 of intermediate suitability for development.

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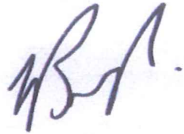
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A handwritten signature in blue ink, appearing to read 'FJ Breytenbach'.

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

31 August 2020

**GEOTECHNICAL CONDITIONS ON ERF 131
GROOTDRINK AND PLOT 2627 BOEGOEBERG
SETTLEMENT: A REPORT FOR THE EXPANSION AND
FORMALISATION OF GROOTDRINK COMMUNITY**

2020/J09/MCP_01

ADDENDUM A: TEST PIT PROFILES

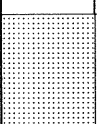
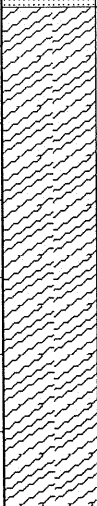







TRIAL HOLE: 1 PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBOEG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'31,7" S 21°45'00,5" E	Cedar Land Geotechnical Consult (Pty) Ltd P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 300 mm on very hard rock, basalt.
0.20		Slightly moist, dark red brown, loose, intact, fine SAND and matrix supported, medium coarse, rounded and subrounded gravels of quartz. Colluvium.				
0.40		Dark grey, very closely jointed, very fine grained, slightly weathered, very hard rock, BASALT. Discontinuities are open, smooth and filled with light red brown, fine sand.				
0.60						
0.80						
1.00						
1.20						

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
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SOIL PROFILE: TEST PIT 1	FIGURE: A1
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TRIAL HOLE: 2 PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBOERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'30,2" S 21°44'54,9" E	Cedar Land Geotechnical Consult (Pty) Ltd P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 800 mm on hard rock, greenschist.
0.20		Slightly moist, dark red brown, loose, intact, fine SAND and matrix supported, medium coarse, rounded and subrounded gravels of quartz and subrounded, white, nodular calcrete concretions. Colluvium.				
0.40		Dark green grey, very intensely laminated, closely jointed, very fine grained, slightly weathered, hard rock, <i>GREENSCHIST</i> . Laminations are closed, smooth and clean. Joints are open, smooth and filled with white powder calcrete.	U9240	0,15-0,8		
0.60						
0.80						 Water encountered  Water level  Bottom of hole  Approximate material change  Disturbed sample  Undisturbed sample
1.00						
1.20						

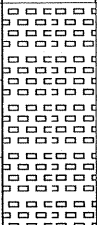
Contractor: ALS Plant Hire
 Date Drilled: 6/7/2020
 Machine: Bell 315SK







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

SOIL PROFILE: TEST PIT 2

FIGURE: A2

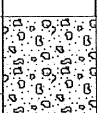
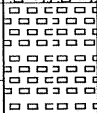

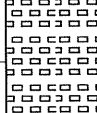






TRIAL HOLE: 4 PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBOEG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'29,4" S 21°44'45,4" E	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 300 mm on very dense, hardpan calcrete.
0.20		White mottled light grey, very dense, hardpan CALCRETE with pockets of dry, light brown, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						
1.00						
1.20						

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

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 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 GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'30,0" S 21°44'39,7" E	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 900 mm on very dense boulder calcrete.
0.20		Abundant, clast supported, medium coarse, rounded, GRAVELS of quartz and nodular calcrete in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				
0.40		Abundant, clast supported, rounded and subrounded, nodules, cobbles and boulders of CALCRETE in a matrix of calcareous and cemented, dry, fine, white sand. Overall consistency is very dense. Pedogenic deposits.				
0.60			U9241	0,2-0,9		
0.80						
1.00						
1.20						 Water encountered  Water level  Bottom of hole  Approximate material change  Disturbed sample  Undisturbed sample

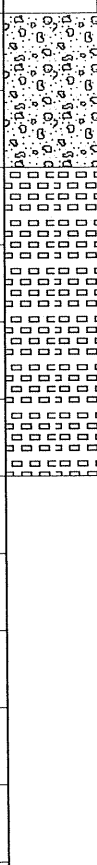
Contractor: ALS Plant Hire
Date Drilled: 6/7/2020
Machine: Bell 315SK

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 GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'29,5" S 21°44'33,8" E	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 600 mm on very dense boulder calcrete.
0.20		Abundant, clast supported, medium coarse, rounded, GRAVELS of quartz and nodular calcrete in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				
0.40		Abundant, clast supported, coarse, rounded and subrounded, nodules of white, hard, boulder CALCRETE and coarse, angular gravels of quartz cemented in a matrix of dirty white, fine, calcareous sand. Overall consistency is very dense. Pedogenic deposits.				
0.60						
0.80						
1.00						
1.20						

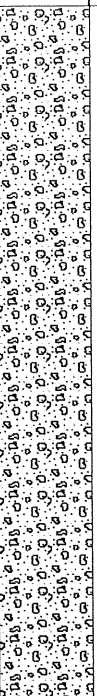

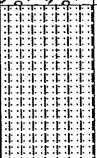






Contractor: ALS Plant Hire Date Drilled: 6/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 6	FIGURE: A6

TRIAL HOLE: 7 PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'32,7" S 21°44'33,0" E	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 400 mm on very dense boulder calcrete.
0.20		Abundant, clast supported, medium coarse, rounded, GRAVELS of quartz and nodular calcrete in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				
0.40		White, very fine grained, very dense, hardpan CALCRETE. Pedogenic deposits.				
0.60						
0.80						
1.00						
1.20						

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 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 GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'32,5" S 21°44'29,1" E	Cedar Land Geotechnical Consult (Pty) Ltd P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 1100 mm on medium hard rock, andesite.
0.20		Abundant, clast supported, medium coarse, subangular and subrounded, GRAVELS of quartz and quartzite in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.				
0.40			U9242	0-0,9		
0.60						<div>  Water encountered  Water level  Bottom of hole  Approximate material change  Disturbed sample  Undisturbed sample </div>
0.80						
1.00		Dry, pale light yellow grey, very dense, intact, silty SAND tending to highly weathered, medium hard rock, basalt. Residual basalt.				
1.20						













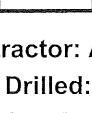
Contractor: ALS Plant Hire Date Drilled: 6/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 8	FIGURE: A8

TRIAL HOLE: 9 PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'36,1" S 21°44'25,2" E	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 700 mm on very dense boulder calcrete.
0.20		Abundant, clast supported, medium coarse, subrounded, GRAVELS of quartz and rounded calcrete nodules in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.				
0.40		Abundant, clast supported, coarse, rounded and subrounded, nodules of white, hard, boulder CALCRETE cemented in a matrix of dirty white, fine, calcareous sand. Overall consistency is very dense. Pedogenic deposits.				
0.60						
0.80						Water encountered Water level Bottom of hole Approximate material change Disturbed sample Undisturbed sample
1.00						
1.20						


Contractor: ALS Plant Hire Date Drilled: 6/7/2020 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 GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT CLIENT: !KHEIS MUNICIPALITY DATE LOGGED: 6/7/2020 LOCATION: 28°33'36,2" S 21°44'31,9" E	Cedar Land Geotechnical Consult (Pty) Ltd P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface Abundant, clast supported, medium coarse, subrounded, GRAVELS of quartz and rounded calcrete nodules in a matrix of dry, light red, fine sand. Overall consistency is medium dense. Colluvium.				NOTES: 1 Refusal of excavation at 900 mm on hard rock, greenschist.
0.20		Slightly moist, light yellow grey, dense, intact, silty SAND and matrix supported, fine, angular gravels of greenschist. Gravels are vertically orientated as platelets. Residual greenschist.				
0.40						
0.60						
0.80		Light grey green, very intensely laminated, closely jointed, very fine grained, highly weathered, soft rock becoming hard rock, GREENSCHIST. Laminations are closed, smooth and clean. Joints are open, smooth and filled with white powder calcrete.				<div>  Water encountered  Water level  Bottom of hole  Approximate material change  Disturbed sample  Undisturbed sample </div>
1.00						
1.20						

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 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 GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'39,2" S 21°44'28,7" E	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface Abundant, clast supported, coarse, angular, <i>COBBLES</i> and coarse <i>GRAVELS</i> of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				NOTES: 1 Instant refusal of excavation at 100 mm on dirty white, very dense, very fine grained, hardpan calcrete.
0.20						
0.40						
0.60						
0.80						
1.00						
1.20						

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 11	FIGURE: A11


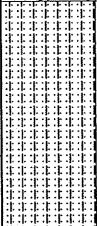
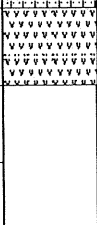
TRIAL HOLE: 12		<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY		
LOGGED BY: FJB		
SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT		
DATE LOGGED: 6/7/2020		
CLIENT: !KHEIS MUNICIPALITY		LOCATION: 28°33'42,2" S 21°44'32,0" E







Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Instant refusal of excavation at 800 mm on very dense sand.
0.20		Abundant, clast supported, coarse, angular, <i>COBBLES</i> and coarse <i>GRAVELS</i> of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				
0.40						
0.60		Slightly moist, pale light yellow green, very dense, calcareous and cemented, <i>silty SAND</i> tending to highly weathered, medium hard rock, basalt. Residual basalt.	U9243	0,5-0,8	●	
0.80						
1.00						
1.20						

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

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 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 GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBOERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: IKHEIS MUNICIPALITY LOCATION: 28°33'42,9" S 21°44'24,9" E	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 700 mm on medium hard rock, basalt.
		Abundant, clast supported, coarse, angular, <i>COBBLES</i> and coarse <i>GRAVELS</i> of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				
0.20						
0.40		Slightly moist, pale light yellow green, very dense, calcareous and cemented, <i>silty SAND</i> tending to highly weathered, medium hard rock, basalt. Residual basalt.				
0.60		Dull green grey, very closely jointed, very fine grained, medium weathered, medium hard rock, <i>BASALT</i> . Discontinuities are > 2 mm, open and filled with white calcareous sand.				
0.80						
1.00						
1.20						

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

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 13	FIGURE: A13

TRIAL HOLE: 14		<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY		
LOGGED BY: FJB		
SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT		
DATE LOGGED: 6/7/2020		
CLIENT: !KHEIS MUNICIPALITY		LOCATION: 28°33'45,9" S 21°44'29,5" E

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 1300 mm on hard rock, basalt.
0.20		<i>FILL:</i> consisting of dry, light brown, loose, fine sand and matrix supported, medium coarse, subrounded, calcrete concretions, gravels of quartz, pieces of plastic, wire, rubber etc. Made ground. Abundant, clast supported, coarse, angular <i>GRAVELS</i> of basalt in a matrix of dry, light grey brown, fine sand. Overall consistency is medium dense. Residual basalt.				
0.40						
0.60			U9244	0,1-0,9		
0.80						<div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> Water encountered Water level Bottom of hole Approximate material change Disturbed sample Undisturbed sample </div>
1.00		Dark green mottled light red, closely jointed, very fine grained, slightly weathered, hard rock, <i>BASALT</i> . Discontinuities are open, smooth and filled with light grey sand.				
1.20						

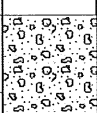
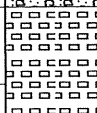
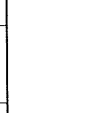






Contractor: ALS Plant Hire Date Drilled: 6/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 14	FIGURE: A14

TRIAL HOLE: 15		<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY		
LOGGED BY: FJB		
SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBOERG SETTLEMENT		
DATE LOGGED: 6/7/2020		
CLIENT: IKHEIS MUNICIPALITY		
LOCATION: 28°33'45,9" S 21°44'33,9" E		

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 1300 mm on very dense nodular calcrete.
0.20						
0.40						
0.60						
0.80						
1.00		White discoloured light blue grey, very fine grained, very dense, fine, rounded, concretions of nodular <i>CALCRETE</i> . Pedogenic deposits.				<div style="border: 1px solid black; padding: 5px; font-size: 0.8em;"> Water encountered Water level Bottom of hole Approximate material change Disturbed sample Undisturbed sample </div>
1.20						









Contractor: ALS Plant Hire Date Drilled: 6/7/2020 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 GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: KAI !GARIB MUNICIPALITY LOCATION: 28°33'48,0" S 21°44'25,5" E	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
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Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 900 mm on very dense nodular calcrete.
0.20		Abundant, clast supported, coarse, angular, <i>COBBLES</i> and coarse <i>GRAVELS</i> of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				
0.40						
0.60		Dirty white, medium coarse, subrounded, nodular CALCRETE concretions in a matrix of dry, white, very dense, cemented, powder calcrete. Pedogenic deposits.				
0.80						
1.00						 Water encountered  Water level  Bottom of hole  Approximate material change  Disturbed sample  Undisturbed sample
1.20						

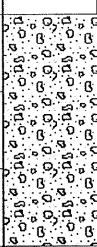
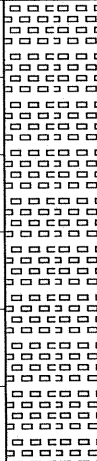






Contractor: ALS Plant Hire Date Drilled: 6/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 16	FIGURE: A16

TRIAL HOLE: 17 PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'51,0" S 21°44'30,4" E	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
--	---

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 900 mm on very dense gravels.
0.20		Abundant, clast supported, subangular and subrounded COBBLES and singular BOULDERS and coarse GRAVELS of quartz and quartzite in a matrix of dry, light red brown, fine sand. Overall consistency is very dense. Colluvium.				
0.40			U9245	0-0,9		
0.60						
0.80						
1.00						 Water encountered  Water level  Bottom of hole  Approximate material change  Disturbed sample  Undisturbed sample
1.20						

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 17	FIGURE: A17

TRIAL HOLE: 18		<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY		
LOGGED BY: FJB		
SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT		
DATE LOGGED: 6/7/2020		
CLIENT: !KHEIS MUNICIPALITY		LOCATION: 28°33'49,7" S 21°44'35,1" E

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 900 mm on very dense nodular calcrete.
0.20		Abundant, clast supported, coarse, angular <i>COBBLES</i> and coarse <i>GRAVELS</i> of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium.				
0.40		Dirty white, medium coarse, subrounded, nodular <i>CALCRETE</i> concretions in a matrix of dry, white, very dense, cemented, powder calcrete. Pedogenic deposits.				
0.60						
0.80						
1.00						
1.20						<div style="font-size: small;">  Water encountered  Water level  Bottom of hole  Approximate material change  Disturbed sample  Undisturbed sample </div>

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 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 GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'50,8" S 21°44'36,3" E	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
--	---

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 200 mm on very dense hardpan calcrete.
0.20		Abundant, clast supported, coarse, angular <i>COBBLES</i> and coarse <i>GRAVELS</i> of quartz in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Colluvium. Dirty white, very fine grained, very dense, hardpan <i>CALCRETE</i> . Pedogenic deposits.				
0.40						
0.60						
0.80						
1.00						
1.20						

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

Contractor: ALS Plant Hire
Date Drilled: 6/7/2020
Machine: Bell 315SK

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

SOIL PROFILE: TEST PIT 19

FIGURE: A19

TRIAL HOLE: 20		<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY		
LOGGED BY: FJB		
SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT		
DATE LOGGED: 6/7/2020		
CLIENT: !KHEIS MUNICIPALITY		
LOCATION: 28°33'54,1" S 21°44'33,5" E		

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 1400 mm on medium hard rock, greenschist.
0.20		Abundant, clast supported, medium coarse, subrounded, concretions of <i>CALCRETE</i> and coarse, angular gravels of quartz in a matrix of fine, white, powdery calcrete. Overall consistency is loose. Pedogenic deposits. Roots are present in the horizon.				
0.40			U9246	0-0,6	●	
0.60		Slightly moist, pale light grey white blotched light green and brown, loose, intact, <i>silty SAND</i> and matrix supported, medium coarse, angular, gravels of greenschist. Residual greenschist.				
0.80						
1.00		Pale light grey, intensely laminated, very closely jointed, very fine grained, slightly weathered, medium hard rock, <i>GREENSCHIST</i> . Laminations are closed, smooth and clean. Joints are open, smooth and stained black. Discontinuities dip at 30° with horizontal.				
1.20						
1.40						
1.40						

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

Contractor: ALS Plant Hire
Date Drilled: 6/7/2020
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 GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'52,9" S 21°44'38,7" E	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
--	---

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 900 mm on very dense hardpan calcrete.
0.20		Abundant, clast supported, coarse, rounded and subrounded, nodular <i>CALCRETE</i> concretions in a matrix of dry, light grey, fine, sand. Overall consistency is medium dense. Pedogenic deposits.				
0.40		Dirty white, very fine grained, very dense, nodular <i>CALCRETE</i> tending to hardpan calcrete. Pedogenic deposits.				
0.60						
0.80						
1.00						
1.20						

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

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 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 GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBOERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°33'59,1" S 21°44'36,8" E	<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
---	---

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 600 mm on hard rock, greenschist.
0.20		Abundant, clast supported, medium coarse, angular GRAVELS of quartz and quartzite in a matrix of dry, light red brown, fine sand. Overall consistency is medium dense. Colluvium.				
0.40		Light grey green, very intensely laminated, very closely jointed, very fine grained, slightly weathered, hard rock, GREENSCHIST. Discontinuities dip at 90° with horizontal.				
0.60						
0.80						
1.00						
1.20						

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

Contractor: ALS Plant Hire
Date Drilled: 6/7/2020
Machine: Bell 315SK

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

SOIL PROFILE: TEST PIT 22

FIGURE: A22

TRIAL HOLE: 23		<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY		
LOGGED BY: FJB		
SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT		
DATE LOGGED: 6/7/2020		
CLIENT: !KHEIS MUNICIPALITY		
LOCATION: 28°34'01,6" S 21°44'38,8" E		

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 1000 mm on hard rock, greenschist.
0.20		Abundant, clast supported, medium coarse, angular <i>GRAVELS</i> of quartz and quartzite in a matrix of dry, light red brown, fine sand. Overall consistency is loose. Colluvium.				
0.40		Abundant, clast supported, medium coarse, rounded, <i>CALCRETE</i> concretions in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Pedogenic deposits.				
0.60						
0.80		Light grey green, very intensely laminated, very closely jointed, very fine grained, slightly weathered, hard rock, <i>GREENSCHIST</i> . Discontinuities dip at 90° with horizontal.	U9247	0,2-0,7	●	
1.00						
1.20						

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

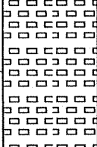
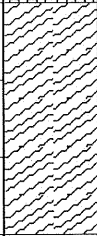

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 23	FIGURE: A23







TRIAL HOLE: 24		<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY		
LOGGED BY: FJB		
SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBOERG SETTLEMENT		
DATE LOGGED: 6/7/2020		
CLIENT: IKHEIS MUNICIPALITY		LOCATION: 28°33'59,0" S 21°44'41,3" E

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 600 mm on very dense hardpan calcrete.
0.20		Abundant, clast supported, medium coarse, angular <i>GRAVELS</i> of quartz and quartzite in a matrix of dry, light red brown, fine sand. Overall consistency is medium dense. Colluvium.				
0.40		Dirty white, very fine grained, very dense, nodular <i>CALCRETE</i> tending to hardpan calcrete. Pedogenic deposits.				
0.60						
0.80						
1.00						
1.20						<div style="font-size: small;"> Water encountered Water level Bottom of hole Approximate material change Disturbed sample Undisturbed sample </div>

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 24	FIGURE: A24

TRIAL HOLE: 25		<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY		
LOGGED BY: FJB		
SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBERG SETTLEMENT		
DATE LOGGED: 6/7/2020		
CLIENT: IKHEIS MUNICIPALITY		
LOCATION: 28°33'56,3" S 21°44'44,0" E		

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 500 mm on hard rock, greenschist.
		Abundant, clast supported, coarse, rounded and subrounded, nodular <i>CALCRETE</i> concretions in a matrix of dry, light grey, fine sand. Overall consistency is medium dense. Pedogenic deposits.				
0.20		Light grey green, intensely laminated, very closely jointed, very fine grained, slightly weathered, hard rock, <i>GREENSCHIST</i> . Discontinuities are closed, smooth and clean. Discontinuities dip at 90° with horizontal.				
						
0.40			U9248	0,2-0,5		
0.60						
0.80						
1.00						
1.20						

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

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 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 GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBOERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°34'01,1" S 21°44'43,8" 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			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 1000 mm on very hard rock, basalt.
		Abundant, clast supported, medium coarse, angular <i>GRAVELS</i> of quartz and quartzite in a matrix of dry, light red brown, fine sand. Overall consistency is medium dense. Colluvium.				
0.20		Abundant, clast supported, medium coarse, rounded, <i>CALCRETE</i> concretions in a matrix of dry, light brown, fine sand. Overall consistency is dense. Pedogenic deposits.				
0.40						
0.60						
0.80		Light grey green, unjointed and massive, very fine grained, medium weathered, very soft rock, <i>BASALT</i> .				
		Light grey green, unjointed and massive, very fine grained, unweathered, very hard rock, <i>BASALT</i> .				
1.00						Water encountered Water level Bottom of hole Approximate material change Disturbed sample Undisturbed sample
1.20						

Contractor: ALS Plant Hire Date Drilled: 6/7/2020 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 GROOTDRINK COMMUNITY LOGGED BY: FJB SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBOERG SETTLEMENT DATE LOGGED: 6/7/2020 CLIENT: !KHEIS MUNICIPALITY LOCATION: 28°34'00,9" S 21°44'48,6" E		<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
---	--	---

Depth (m)	Legend	PROFILE	SAMPLE			Remarks
			Number	Type	Symbol	
0.00		Ground Surface				NOTES: 1 Refusal of excavation at 600 mm on hard rock, greenschist.
0.20		Abundant, clast supported, medium coarse, rounded, <i>CALCRETE</i> concretions in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Pedogenic deposits.				
0.40		Light grey green, intensely laminated, very closely jointed, very fine grained, slightly weathered, hard rock, <i>GREENSCHIST</i> . Discontinuities are closed, smooth and clean. Discontinuities dip at 90° with horizontal.				
0.60						
0.80						
1.00						
1.20						

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

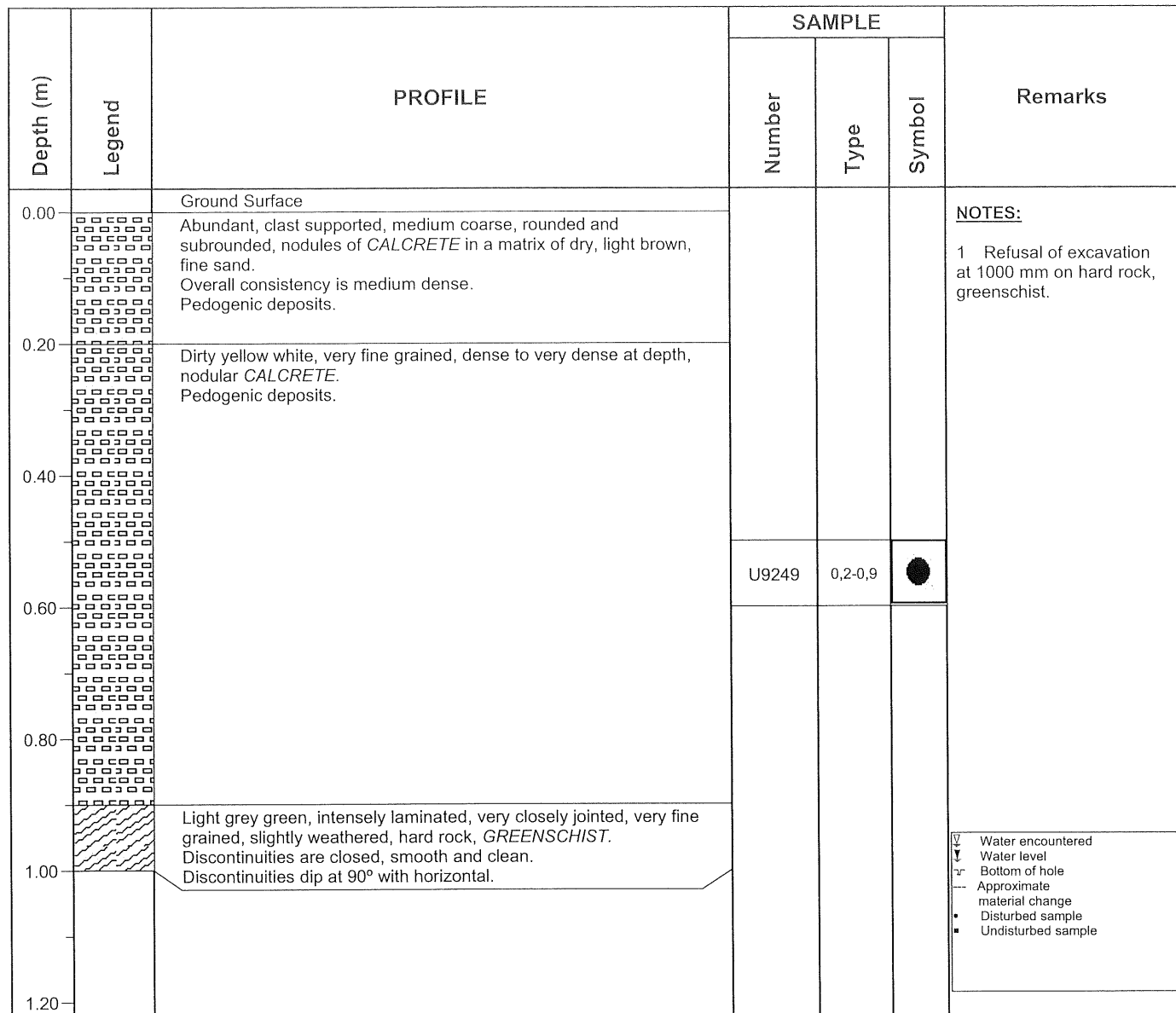
Contractor: ALS Plant Hire
Date Drilled: 6/7/2020
Machine: Bell 315SK

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

SOIL PROFILE: TEST PIT 27

FIGURE: A27

TRIAL HOLE: 28		<i>Cedar Land Geotechnical Consult (Pty) Ltd</i> P O Box 607 Ceres 6835 Cell: 082 570 2767 Email: cedarland.frans@breede.co.za
PROJECT: EXPANSION AND FORMALISATION OF GROOTDRINK COMMUNITY		
LOGGED BY: FJB		
SITE: ERF 131 GROOTDRINK AND PLOT 2627 BOEGOEBOERG SETTLEMENT		
DATE LOGGED: 6/7/2020		
CLIENT: !KHEIS MUNICIPALITY		
LOCATION: 28°33'59,6" S 21°44'55,0" E		



Contractor: ALS Plant Hire Date Drilled: 6/7/2020 Machine: Bell 315SK	Hole Diameter: 600 mm Water Depth: Sheet: 1 of 1
SOIL PROFILE: TEST PIT 28	FIGURE: A28

**GEOTECHNICAL CONDITIONS ON ERF 131
GROOTDRINK AND PLOT 2627 BOEGOEBERG
SETTLEMENT: A REPORT FOR THE EXPANSION AND
FORMALISATION OF GROOTDRINK COMMUNITY**

2020/J09/MCP_01

ADDENDUM B: RESULTS OF MATERIALS TESTING

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
Ceres
6835
Attention : Frans Breytenbach

Date Reported : 2020-08-05

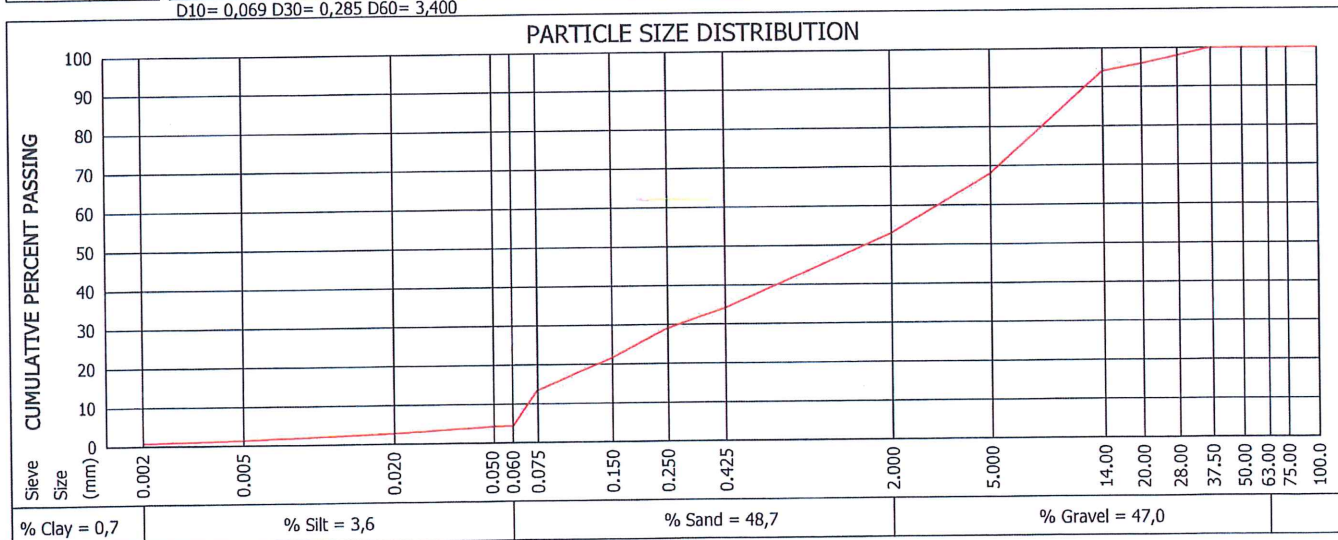
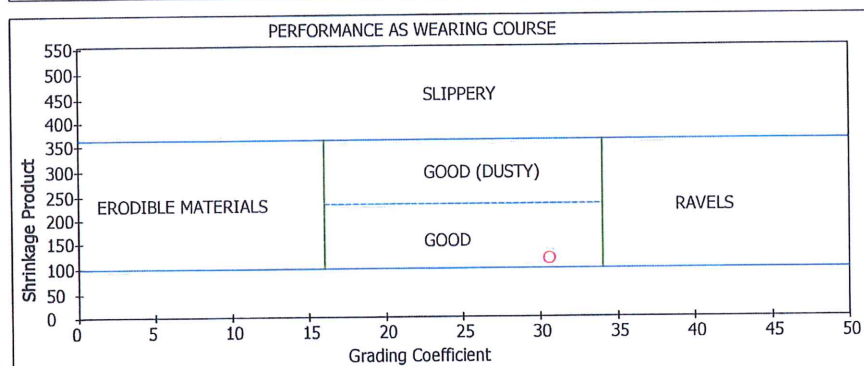
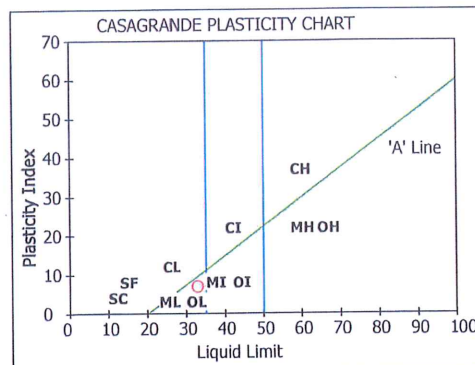
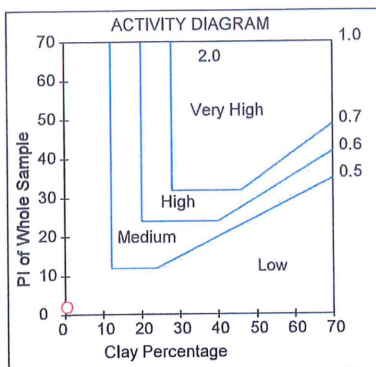
Project : Grootdrink Infrastructure Upgrade

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

Sample No. : U9240
Position : TP 2
Layer Type : 150-800mm
Sample Colour : Light Olive Green Gr
Sample Type : Mix Quartz

Sieve Size(mm)	% Passing	Soil Mortar	2.000 - 0.425	35
100.0	100		0.425 - 0.250	10
75.00	100		0.250 - 0.150	14
63.00	100		0.150 - 0.075	16
50.00	100		< 0.075	25
37.50	100	Effective Size		0,069
28.00	98	Uniformity Coefficient		49,3
20.00	96	Curvature Coefficient		0,3
14.00	94	Oversize Index		0,0
5.000	68	Shrinkage Product		119,0
2.000	53	Grading Coefficient		30,6
0.425	34	Grading Modulus		2,00
0.250	29	Atterberg Limits	Liquid Limit	33
0.150	22		Plasticity Index	7
0.075	13		Linear Shrinkage	3.5
0.060	4,3		PI < 0.075	
0.050	4,1	Unified Soil Classification		SM
0.020	2,7	US Highway Classification		A-2-4(0)
0.005	1,3			
0.002	0,7			

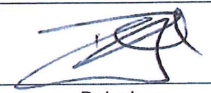
D10= 0,069 D30= 0,285 D60= 3,400



Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.72 [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.
Further use of the above information is not the responsibility or liability of Roadlab.
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Report compiled by : Juraine Okkies

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


D Juckers
Technical Signatory

1... of 16

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
Ceres
6835

Project : Grootdrink Infrastructure Upgrade

Date Reported : 2020-07-20

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.	U9241		
HOLE NO./ Km / CHAINAGE	TP5		
ROAD NO./ NAME Line 1 ROAD NO./ NAME Line 2	S28° 33' 30,0"; E21° 44' 39,7"		
LAYER TESTED/SAMPLED	200-900mm		
SAMPLE DEPTH	200-900mm		
DATE SAMPLED	2020-07-07		
COLOUR OF SAMPLE	Light Brown		
TYPE OF SAMPLE	Mix Calcrete+Quartz		

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	100		
	37.5 mm	97		
	28.0 mm	92		
	20.0 mm	87		
	14.0 mm	83		
	5.0 mm	64		
	2.0 mm	52		
GM %	0.425 mm	42		
	0.075 mm	20		
		1,9		

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	18		
COARSE FINE SAND	0.425 - 0.250	7		
MEDIUM FINE SAND	0.250 - 0.150	15		
FINE FINE SAND	0.150 - 0.075	22		
SILT CLAY	0.075	39		

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

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	39		
	PLASTICITY INDEX	9		
	LINEAR SHRINKAGE	6.0		
CLASSIFICATION	H.R.B.	A-2-4(0)		
	COLTO	-		
	TRH 14	G10		

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

SANS GR30 MAX. DRY DENSITY	OMC %	13,8		
	MDD (kg/m³)	1796		
	COMP MC %	13,7		
SWELL % @	MOD NRB PRO	0,03 0,06 0,13		
	100 %	12		
	98 %	9		
C.B.R. SANS GR40	97 %	8		
	95 %	6		
	93 %	5		
	90 %	3		

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.
Further use of the above information is not the responsibility or liability of Roadlab.
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Report compiled by : Juraine Okkies

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

D Juckers
Technical Signatory

2/16
1 of 1



ROADLAB

Job Request No.: RU3525

Ceder Land Geotechnical Consult (Pty) Ltd

PO Box 607

Ceres

6835

Attention : Frans Breytenbach

Project : Grootdrink Infrastructure Upgrade

Determination Maximum Dry Density & Optimum Moisture Content Test Report

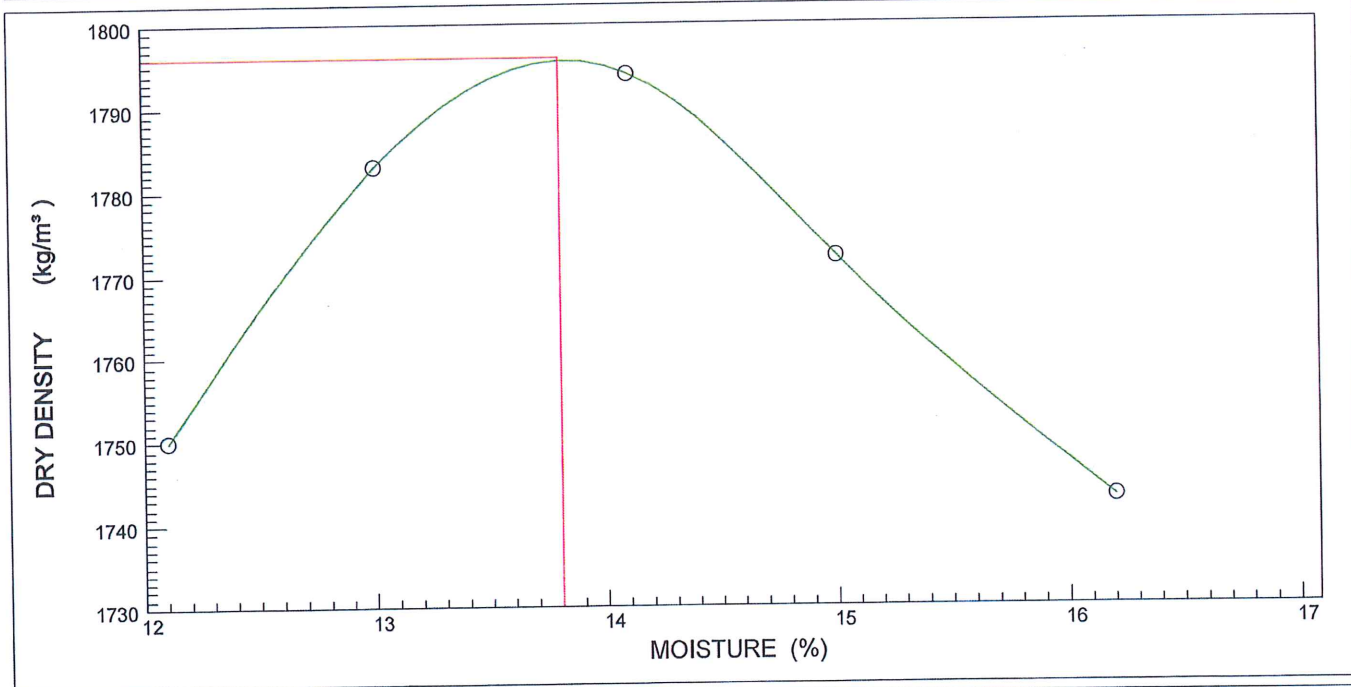
SANS 3001 - GR20/GR30

SAMPLE NO.	U9241
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	100kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	200-900mm
MATERIAL DESCRIPTION	Mix Calcrete + Quartz
HOLE NO./ km / CHAINAGE	TP5
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-07
DATE SAMPLED	2020-07-07
CLIENT MARKING	S28° 33' 30,0"; E21° 44' 39,7"
COLOUR AND TYPE	Light Brown Gravel

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m ³)	1750	1783	1794	1772	1743			
MOISTURE (%)	12,1	13,0	14,1	15,0	16,2			

MAXIMUM DRY DENSITY (kg/m³) : 1796

OPTIMUM MOISTURE CONTENT (%) : 13,8



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

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

Project : Grootdrink Infrastructure Upgrade

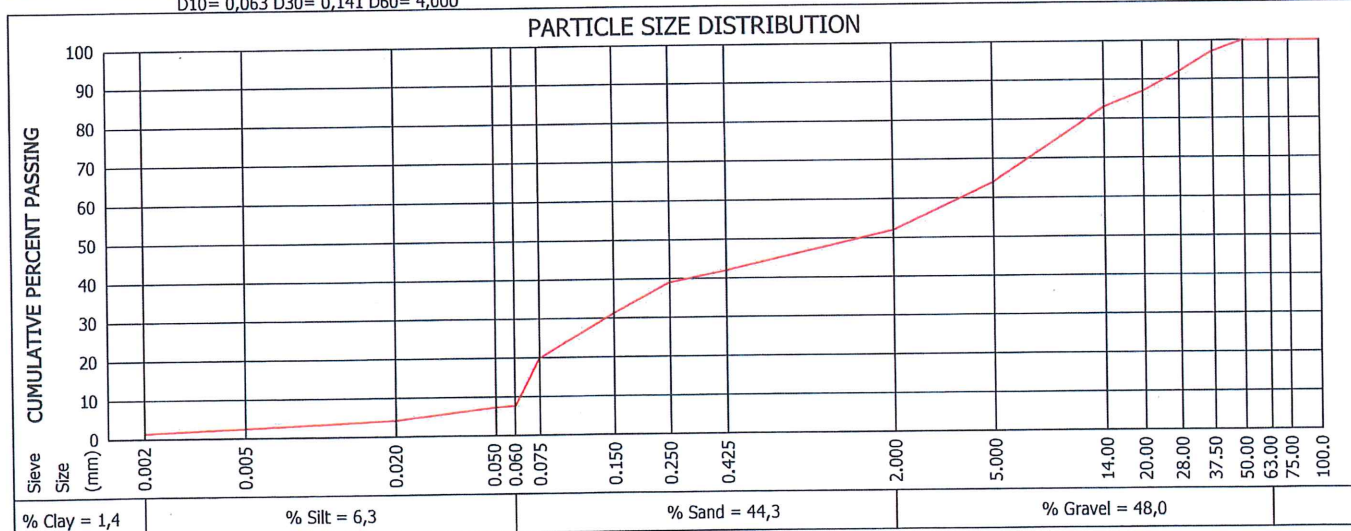
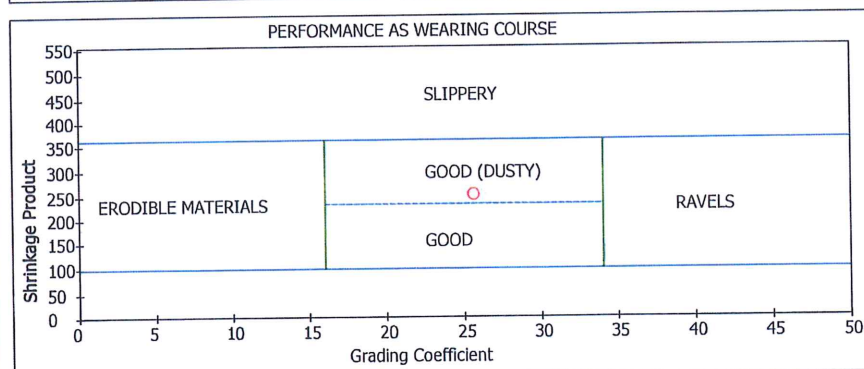
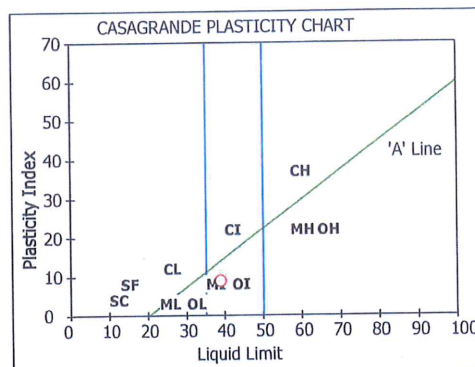
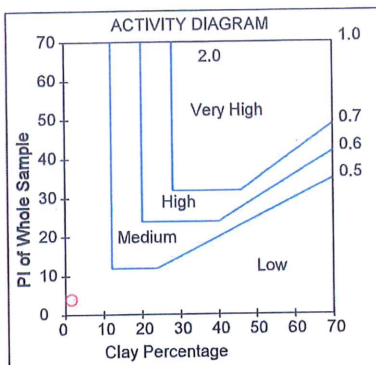
Date Reported : 2020-07-17

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

Sample No. : U9241
Position : TP 5
Layer Type : 200-900mm
Sample Colour : Light Brown Gravel
Sample Type : Mix Calcrete+Quartzs

Sieve Size(mm)	% Passing	Soil Mortar	2.000 - 0.425	18
100.0	100		0.425 - 0.250	7
75.00	100		0.250 - 0.150	15
63.00	100		0.150 - 0.075	22
50.00	100		< 0.075	39
37.50	97	Effective Size		0,063
28.00	92	Uniformity Coefficient		63,5
20.00	87	Curvature Coefficient		0,1
14.00	83	Oversize Index		3,0
5.000	64	Shrinkage Product		252,0
2.000	52	Grading Coefficient		25,6
0.425	42	Grading Modulus		1,90
0.250	39	Atterberg Limits	Liquid Limit	39
0.150	31		Plasticity Index	9
0.075	20		Linear Shrinkage	6.0
0.060	7,7		PI < 0.075	
0.050	7,3	Unified Soil Classification		SM
0.020	4,1	US Highway Classification		A-2-4(0)
0.005	2,4			
0.002	1,4			

D10= 0,063 D30= 0,141 D60= 4,000



Deviation from Test Method :
Remarks and Notes :

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Project : Grootdrink Infrastructure Upgrade

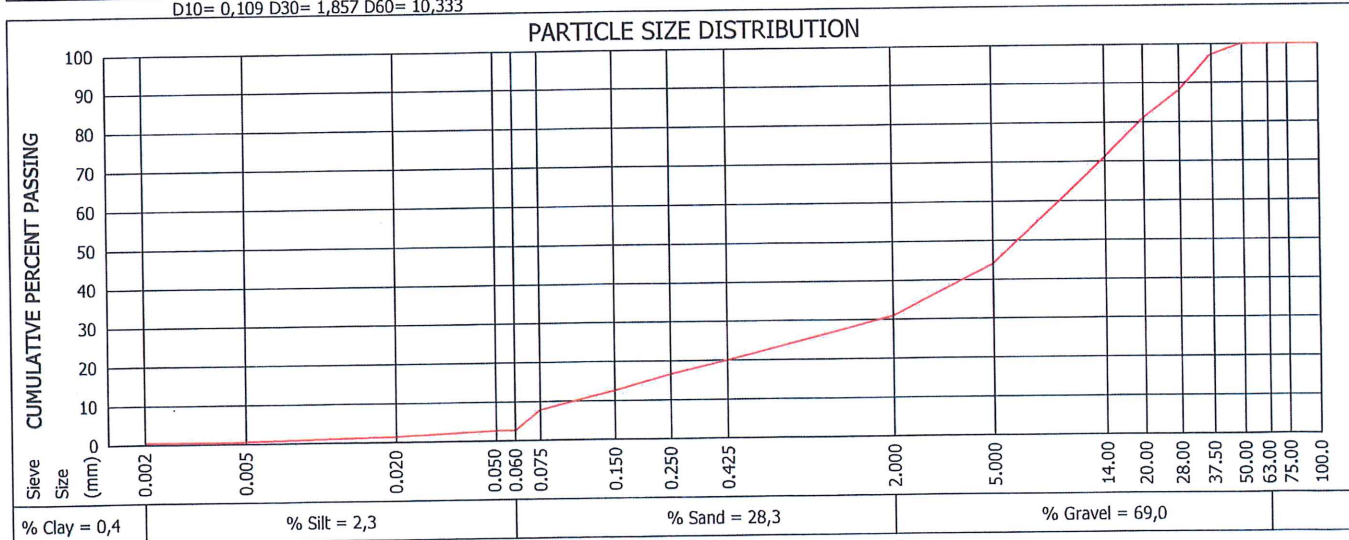
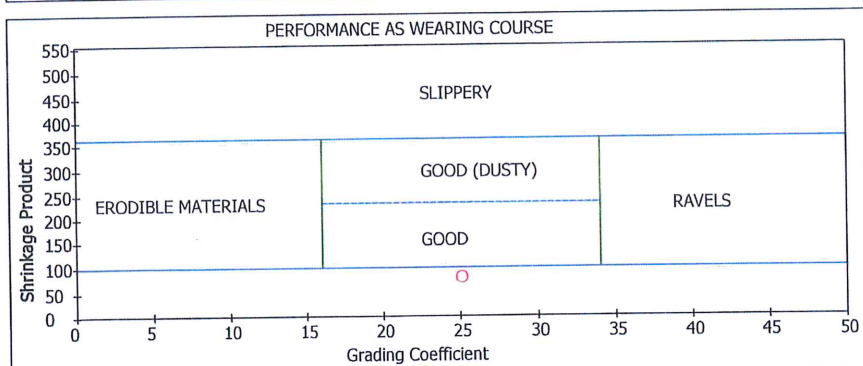
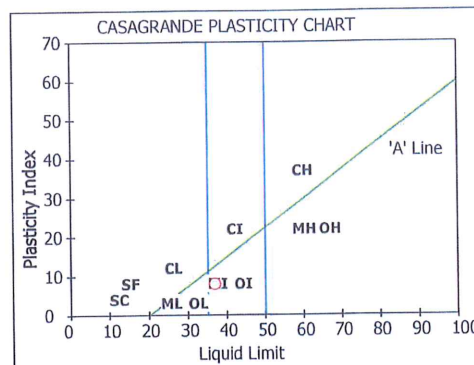
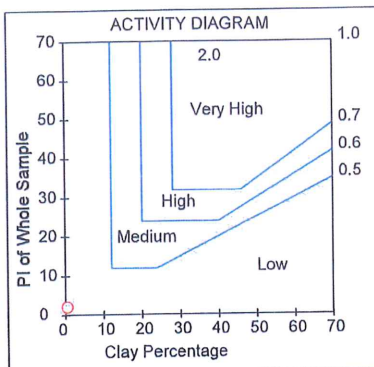
Date Reported : 2020-08-05

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

Sample No. : U9242
Position : TP 8
Layer Type : 0-900mm
Sample Colour : Not Specified
Sample Type : Not Specified

Sieve Size(mm)	% Passing	Soil Mortar	2.000 - 0.425	36
100.0	100		0.425 - 0.250	10
75.00	100		0.250 - 0.150	13
63.00	100		0.150 - 0.075	15
50.00	100		< 0.075	26
37.50	97	Effective Size		0,109
28.00	88	Uniformity Coefficient		94,8
20.00	81	Curvature Coefficient		3,1
14.00	71	Oversize Index		3,0
5.000	44	Shrinkage Product		80,0
2.000	31	Grading Coefficient		25,1
0.425	20	Grading Modulus		2,40
0.250	17	Atterberg Limits	Liquid Limit	37
0.150	13		Plasticity Index	8
0.075	7,8		Linear Shrinkage	4.0
0.060	2,7		PI < 0.075	
0.050	2,6	Unified Soil Classification		GW-GM
0.020	1,4	US Highway Classification		A-2-4(0)
0.005	0,5			
0.002	0,4			


D10= 0,109 D30= 1,857 D60= 10,333



Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 8.30 [SANS 5854] & Conductivity = 0.17 S/m [SANS 6240]

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Date Reported : 2020-07-23

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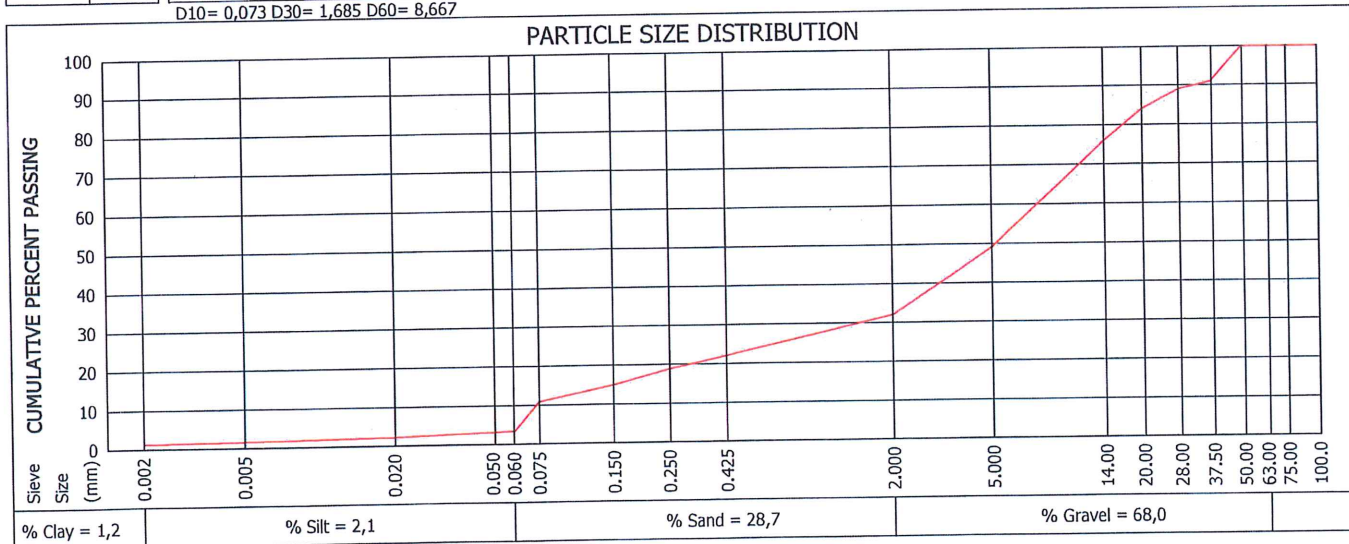
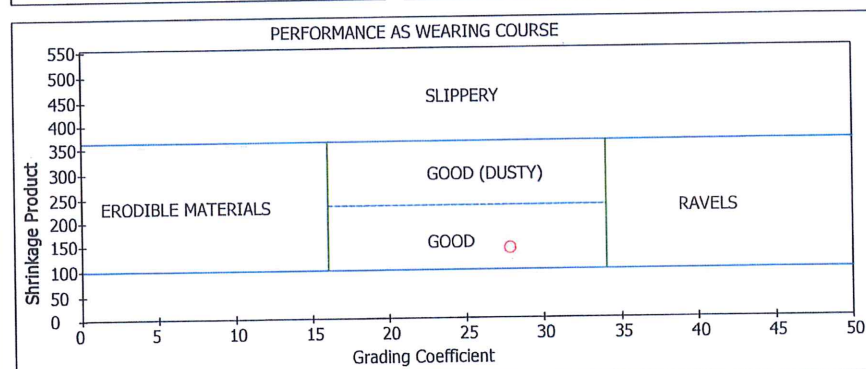
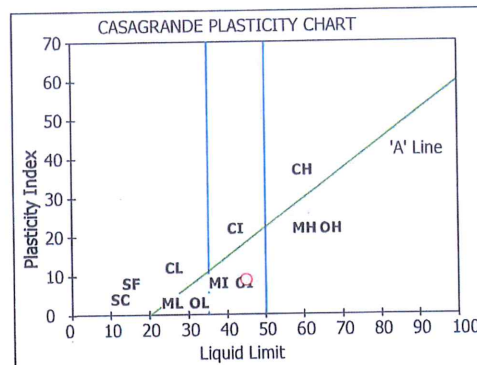
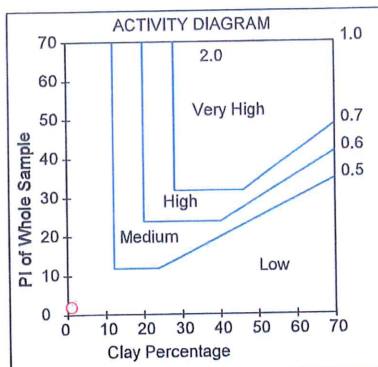
Project : Grootdrink Infrastructure Upgrade

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

Sample No. : U9243
Position : TP 12
Layer Type : 500-800mm
Sample Colour : Dark Brown Gravel
Sample Type : Mix Weathered

Sieve Size(mm)	% Passing	Soil Mortar	2.000 - 0.425	33
100.0	100		0.425 - 0.250	9
75.00	100		0.250 - 0.150	12
63.00	100		0.150 - 0.075	12
50.00	100		< 0.075	34
37.50	91	Effective Size		0,073
28.00	89	Uniformity Coefficient		118,7
20.00	84	Curvature Coefficient		4,5
14.00	76	Oversize Index		9,0
5.000	49	Shrinkage Product		143,0
2.000	32	Grading Coefficient		27,9
0.425	22	Grading Modulus		2,40
0.250	19	Atterberg Limits	Liquid Limit	45
0.150	15		Plasticity Index	9
0.075	11		Linear Shrinkage	6.5
0.060	3,3		PI < 0.075	
0.050	3,1	Unified Soil Classification		GW-GM
0.020	2,1	US Highway Classification		A-2-5(0)
0.005	1,5			
0.002	1,2			

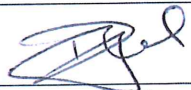
D10= 0,073 D30= 1,685 D60= 8,667



Deviation from Test Method :
Remarks and Notes :

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Date Reported : 2020-08-05

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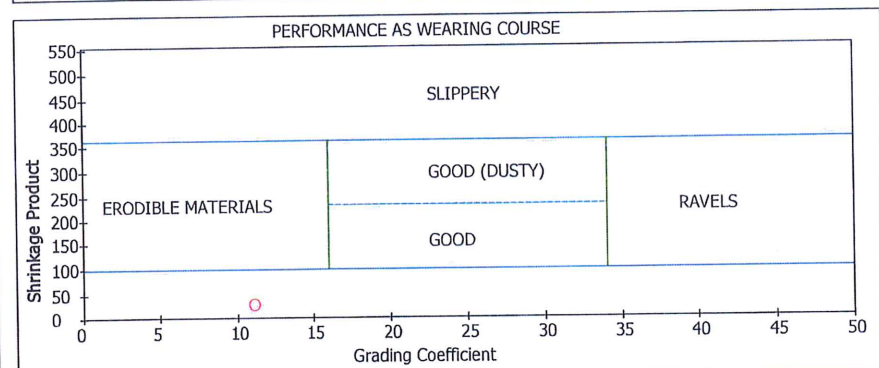
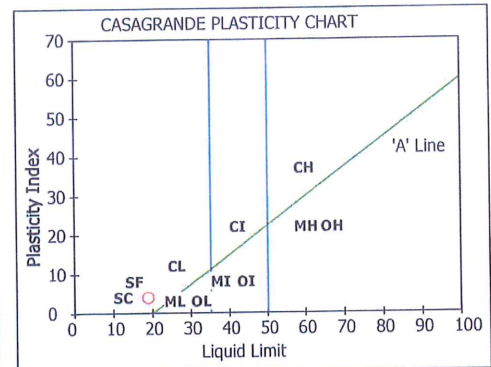
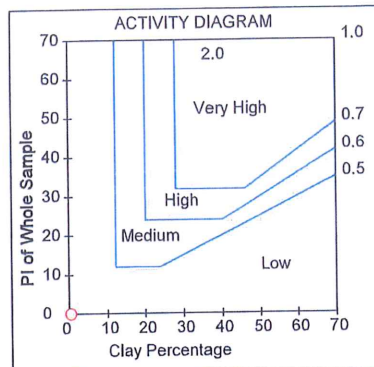
Project : Grootdrink Infrastructure Upgrade

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

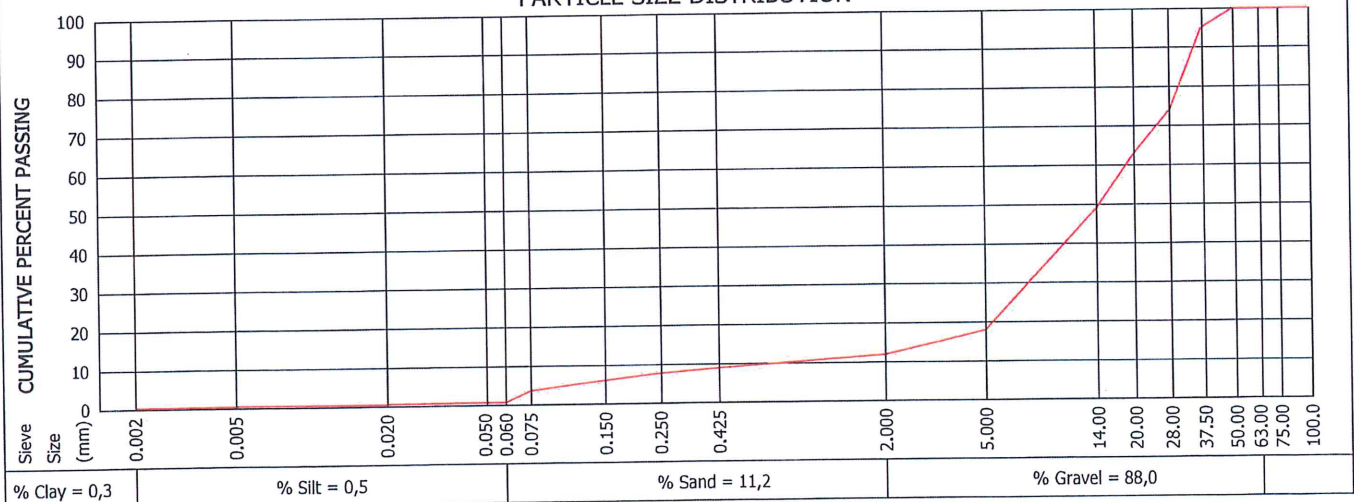
Sample No. : U9244
Position : TP 14
Layer Type : 100 - 900mm
Sample Colour : Light Brown Gravel
Sample Type : Mix Quartzstone

Sieve Size(mm)	% Passing	Soil Mortar	2.000 - 0.425	28
100.0	100		0.425 - 0.250	9
75.00	100		0.250 - 0.150	14
63.00	100		0.150 - 0.075	17
50.00	100		< 0.075	32
37.50	95	Effective Size		0,950
28.00	74	Uniformity Coefficient		19,7
20.00	63	Curvature Coefficient		4,0
14.00	49	Oversize Index		5,0
5.000	18	Shrinkage Product		27,0
2.000	12	Grading Coefficient		11,2
0.425	9,0	Grading Modulus		2,70
0.250	7,8	Atterberg Limits	Liquid Limit	19
0.150	6,1		Plasticity Index	4
0.075	3,6		Linear Shrinkage	3.0
0.060	0,8		PI < 0.075	
0.050	0,8	Unified Soil Classification		GW
0.020	0,5	US Highway Classification		A-1-a(0)
0.005	0,4			
0.002	0,3			

D10= 0,950 D30= 8,484 D60= 18,714



PARTICLE SIZE DISTRIBUTION



Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.80 [SANS 5854] & Conductivity = 0.10 S/m [SANS 6240]

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Project : Grootdrink Infrastructure Upgrade

Attention : Frans Breytenbach

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

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Tel: 011 828 0279 Fax: 011 828 0279
Email: info@roadlab.co.za
Web: www.roadlab.co.za

Date Reported : 2020-07-20

SAMPLE INFORMATION AND PROPERTIES

SAMPLE NO.	U9245		
HOLE NO./ Km / CHAINAGE	TP17		
ROAD NO./ NAME Line 1	S28° 33' 51,0"		
ROAD NO./ NAME Line 2	E21° 44' 30,4"		
LAYER TESTED/SAMPLED	0-900mm		
SAMPLE DEPTH	0-900mm		
DATE SAMPLED	2020-07-07		
COLOUR OF SAMPLE	Reddish Brown		
TYPE OF SAMPLE	Mix Quartzstone		

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

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	100			
	50.0 mm	94			
	37.5 mm	82			
	28.0 mm	72			
	20.0 mm	63			
	14.0 mm	58			
	5.0 mm	40			
	2.0 mm	34			
	0.425 mm	31			
0.075 mm	14				
GM %		2,2	SIEVE ANALYSIS (SANS 3001-GR5:2014)		

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	10		
COARSE FINE SAND	0.425 - 0.250	4		
MEDIUM FINE SAND	0.250 - 0.150	17		
FINE FINE SAND	0.150 - 0.075	28		
SILT CLAY	0.075	41		

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

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	19		
	PLASTICITY INDEX	4		
	LINEAR SHRINKAGE	3.0		
CLASSIFICATION	H.R.B.	A-1-b(0)		
	COLTO	G7		
	TRH 14	G7		

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

CALIFORNIA BEARING RATIO - *(SANS 3001-GR30:2010, SANS 3001-GR40:2010)					
SANS GR30 MAX. DRY DENSITY	OMC %	4,0			
	MDD (kg/m³)	2280			
	COMP MC %	4,1			
SWELL % @	MOD NRB PRO	0,01 0,03 0,06			
	100 %	38			
	98 %	31			
C.B.R. SANS GR40	97 %	28			
	95 %	23			
	93 %	18			
	90 %	13			

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

Deviation from Test Method :

Remarks and Notes :

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Project : Grootdrink Infrastructure Upgrade

Date Reported : 2020-07-17

Determination Maximum Dry Density & Optimum Moisture Content Test Report

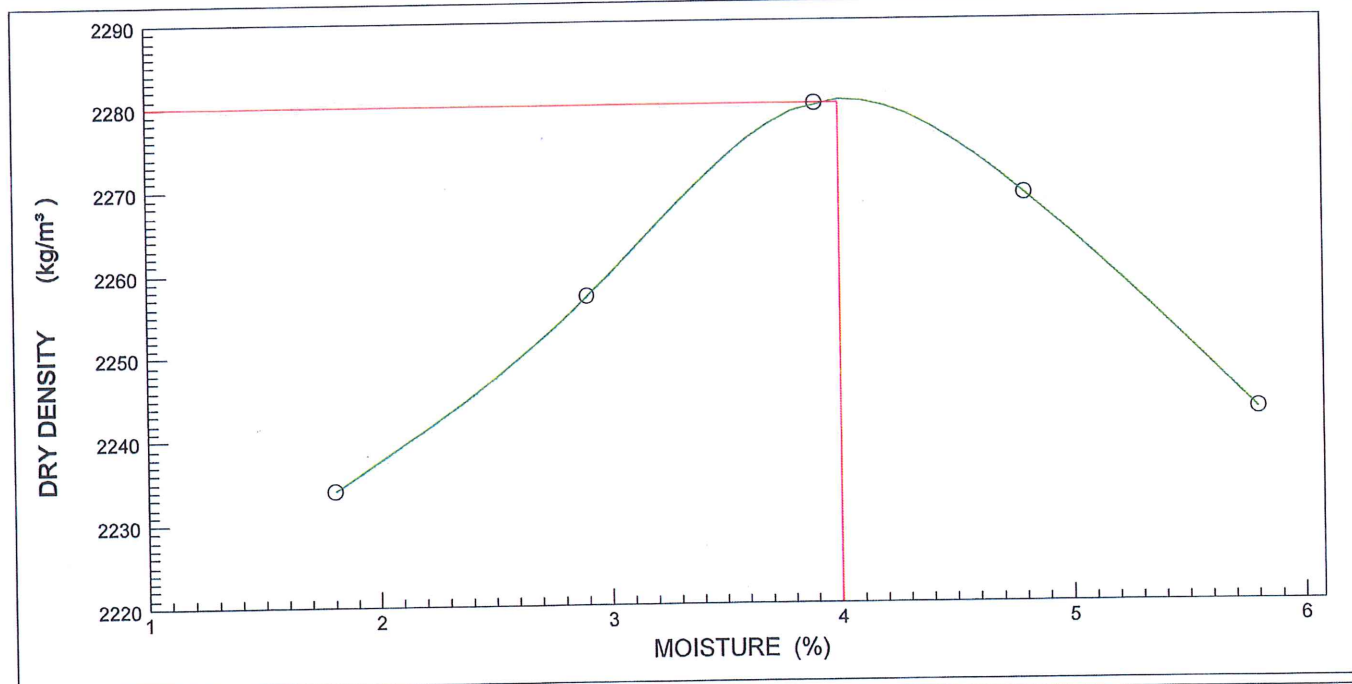
SANS 3001 - GR20/GR30

SAMPLE NO.	U9245
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	99kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	0-900mm
MATERIAL DESCRIPTION	Mix Quartzstone
HOLE NO./ km / CHAINAGE	TP17
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-07
DATE SAMPLED	2020-07-07
CLIENT MARKING	S28° 33' 51,0"; E21° 44' 30,4"
COLOUR AND TYPE	Reddish Brown Gravel

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m ³)	2234	2257	2280	2269	2243			
MOISTURE (%)	1,8	2,9	3,9	4,8	5,8			

MAXIMUM DRY DENSITY (kg/m³) : 2280


OPTIMUM MOISTURE CONTENT (%) : 4,0



Deviation from Test Method :
Remarks and Notes :

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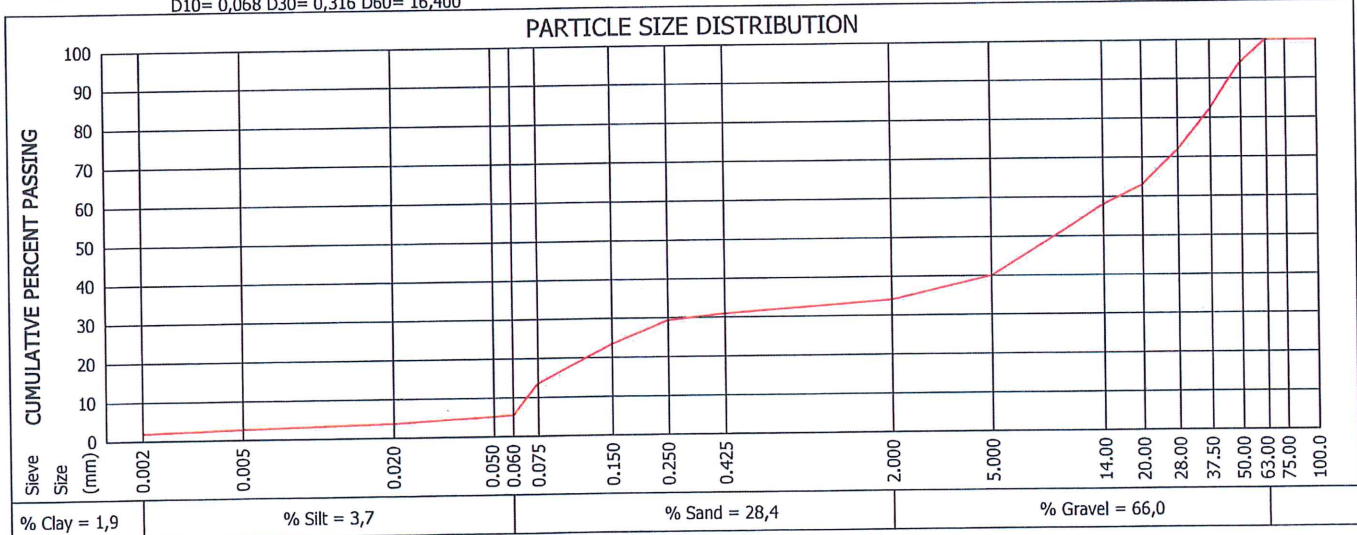
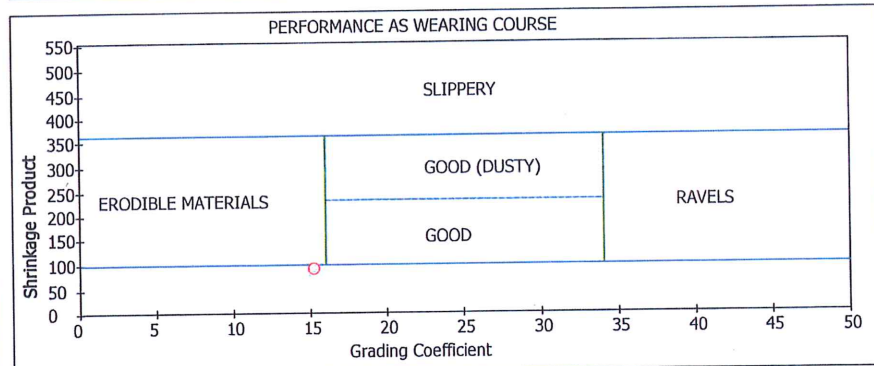
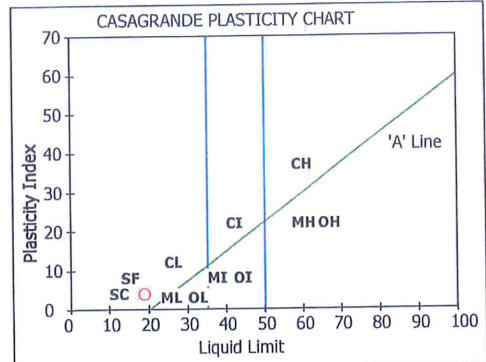
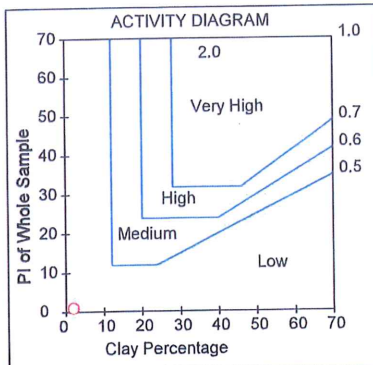
Date Reported : 2020-07-17

Project : Grootdrink Infrastructure Upgrade

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

Sample No. : U9245
Position : TP 17
Layer Type : 0-900mm
Sample Colour : Reddish Brown Gravel
Sample Type : Mix Quartz

Sieve Size(mm)	% Passing	Soil Mortar	2.000 - 0.425	10
100.0	100		0.425 - 0.250	4
75.00	100		0.250 - 0.150	17
63.00	100		0.150 - 0.075	28
50.00	94		< 0.075	41
37.50	82	Effective Size		0,068
28.00	72	Uniformity Coefficient		241,2
20.00	63	Curvature Coefficient		0,1
14.00	58	Oversize Index		12,0
5.000	40	Shrinkage Product		93,0
2.000	34	Grading Coefficient		15,2
0.425	31	Grading Modulus		2,20
0.250	29	Atterberg Limits	Liquid Limit	19
0.150	24		Plasticity Index	4
0.075	14		Linear Shrinkage	3.0
0.060	5,6		PI < 0.075	
0.050	5,2	Unified Soil Classification		GM-GC
0.020	3,7	US Highway Classification		A-1-b(0)
0.005	2,7	D10= 0,068 D30= 0,316 D60= 16,400		
0.002	1,9			



Deviation from Test Method :
Remarks and Notes :

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Project : Grootdrink Infrastructure Upgrade

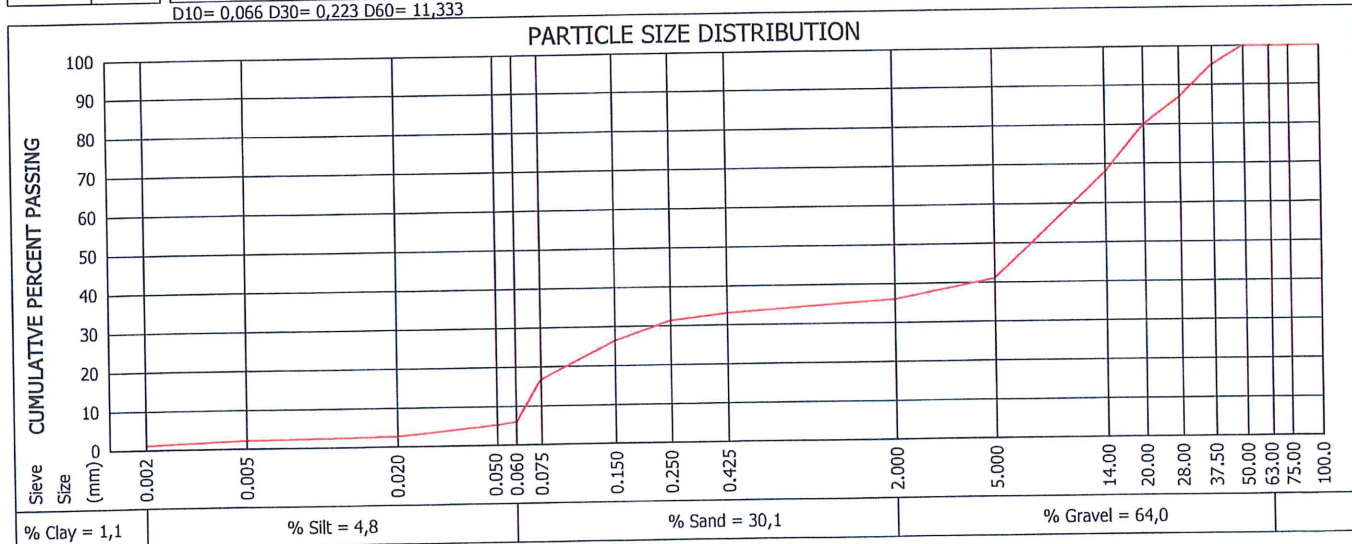
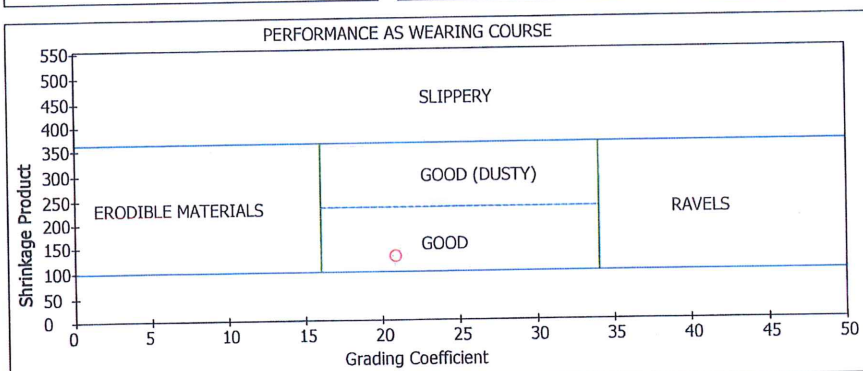
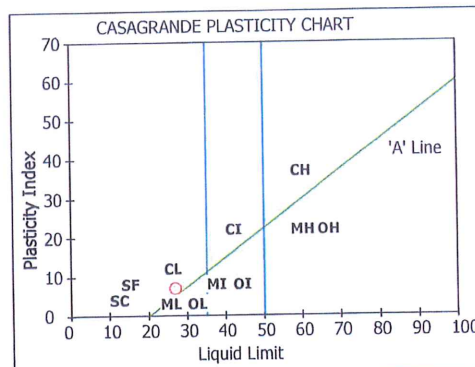
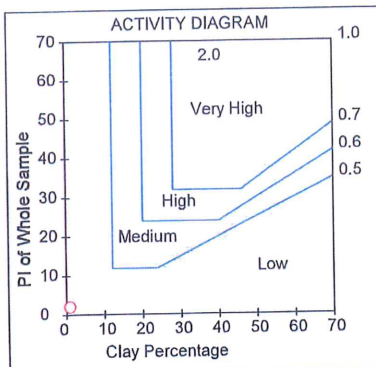
Date Reported : 2020-08-05

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

Sample No. : U9246
Position : TP 20
Layer Type : 0-600mm
Sample Colour : Dark Brown Gravel
Sample Type : Mix Quartz + Calcret

Sieve Size(mm)	% Passing	Soil Mortar	2.000 - 0.425	8
100.0	100		0.425 - 0.250	4
75.00	100		0.250 - 0.150	14
63.00	100		0.150 - 0.075	26
50.00	100		< 0.075	48
37.50	95	Effective Size		0,066
28.00	87	Uniformity Coefficient		171,7
20.00	80	Curvature Coefficient		0,1
14.00	68	Oversize Index		5,0
5.000	41	Shrinkage Product		132,0
2.000	36	Grading Coefficient		20,9
0.425	33	Grading Modulus		2,10
0.250	31	Atterberg Limits	Liquid Limit	27
0.150	26		Plasticity Index	7
0.075	17		Linear Shrinkage	4.0
0.060	5,9		PI < 0.075	
0.050	5,1	Unified Soil Classification		GM-GC
0.020	2,6	US Highway Classification		A-2-4(0)
0.005	2,0			
0.002	1,1			

D10= 0,066 D30= 0,223 D60= 11,333



Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.22 [SANS 5854] & Conductivity = 0.09 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
Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
Ceres
6835

Project : Grootdrink Infrastructure Upgrade

Date Reported : 2020-07-23

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.	U9247		
HOLE NO./ Km / CHAINAGE	TP23		
ROAD NO./ NAME Line 1	S28° 34' 01,6"		
ROAD NO./ NAME Line 2	E21° 44' 38,8"		
LAYER TESTED/SAMPLED	200-700mm		
SAMPLE DEPTH	200-700mm		
DATE SAMPLED	2020-07-07		
COLOUR OF SAMPLE	Brown		
TYPE OF SAMPLE	Mix Calcrete +Quartz		

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

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	93			
	50.0 mm	92			
	37.5 mm	90			
	28.0 mm	88			
	20.0 mm	86			
	14.0 mm	84			
	5.0 mm	73			
	2.0 mm	63			
	0.425 mm	52			
0.075 mm	25				
GM %		1,6	SIEVE ANALYSIS (SANS 3001-GR1:2010)		

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	17	
COARSE FINE SAND	0.425 - 0.250	7	
MEDIUM FINE SAND	0.250 - 0.150	14	
FINE FINE SAND	0.150 - 0.075	23	
SILT CLAY	0.075	40	

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

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	29	
	PLASTICITY INDEX	8	
	LINEAR SHRINKAGE	5.5	
CLASSIFICATION	H.R.B.	A-2-4(0)	
	COLTO	G8	
	TRH 14	G9	

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

SANS GR30 MAX. DRY DENSITY	OMC %	11,0	
	MDD (kg/m³)	1951	
	COMP MC %	11,2	
SWELL % @	MOD NRB PRO	0,04 0,06 0,11	
	100 %	32	
C.B.R. SANS GR40	98 %	24	
	97 %	21	
	95 %	15	
	93 %	11	
	90 %	7	

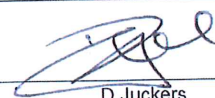
STABILISER IN LAB	Not Applicable		
TEST TYPE	CBR		
SAMPLING METHOD	TMH 5		
WEATHER WHEN SAMPLED	Cold		

Deviation from Test Method :

Remarks and Notes :

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Job Request No.: RU3525
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Email: info@roadlab.co.za
Web: www.roadlab.co.za

Date Reported : 2020-07-17

Project : Grootdrink Infrastructure Upgrade

Determination Maximum Dry Density & Optimum Moisture Content Test Report

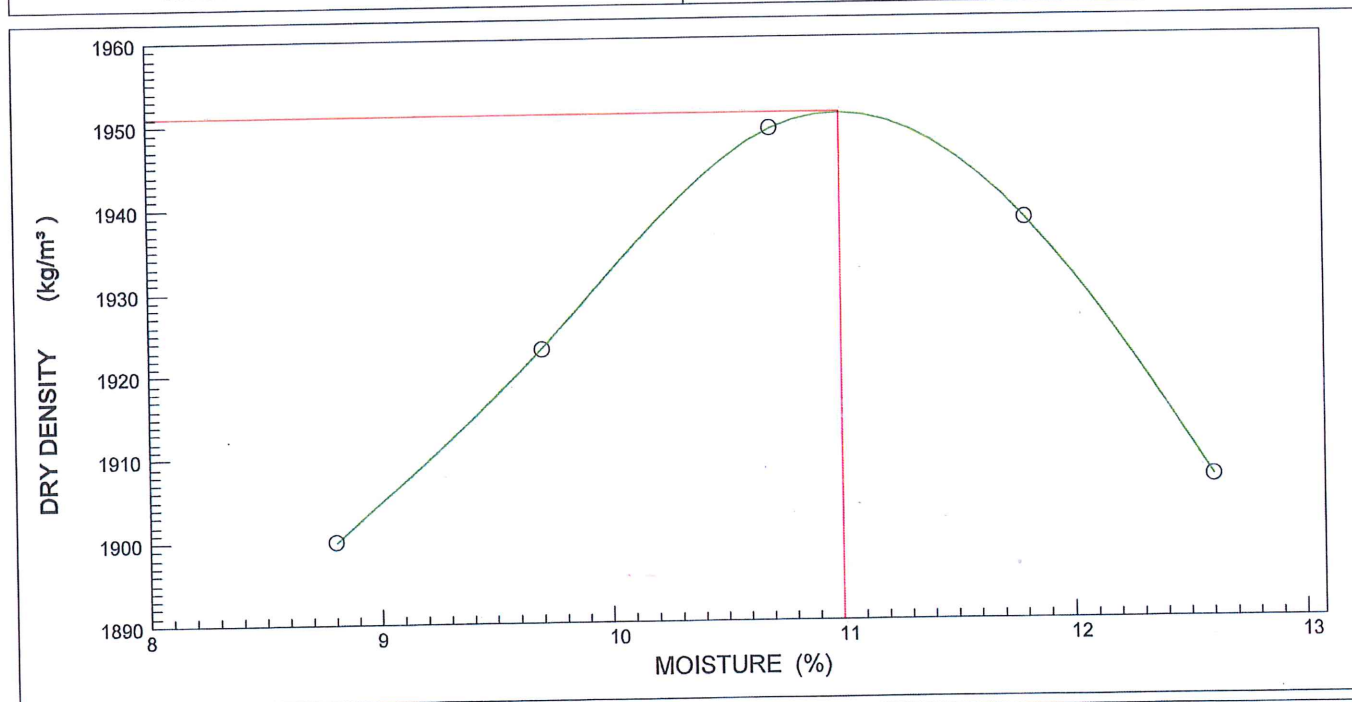
SANS 3001 - GR20/GR30

SAMPLE NO.	U9247
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	90kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	200-700mm
MATERIAL DESCRIPTION	Mix Calcrete + Quartzstone
HOLE NO./ km / CHAINAGE	TP23
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-07
DATE SAMPLED	2020-07-07
CLIENT MARKING	S28° 34' 01,6", E21° 44' 38,8"
COLOUR AND TYPE	Brown Gravel

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m ³)	1900	1923	1949	1938	1907			
MOISTURE (%)	8,8	9,7	10,7	11,8	12,6			

MAXIMUM DRY DENSITY (kg/m³) : 1951


OPTIMUM MOISTURE CONTENT (%) : 11,0



Deviation from Test Method :
Remarks and Notes :

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Attention : Frans Breytenbach

Date Reported : 2020-07-17

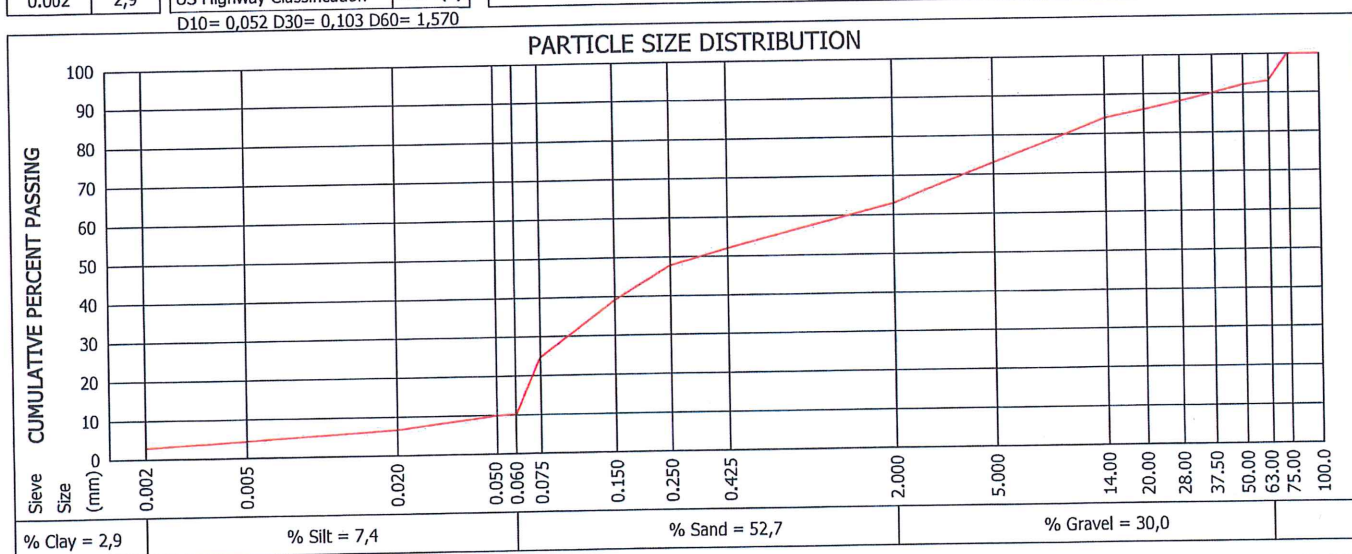
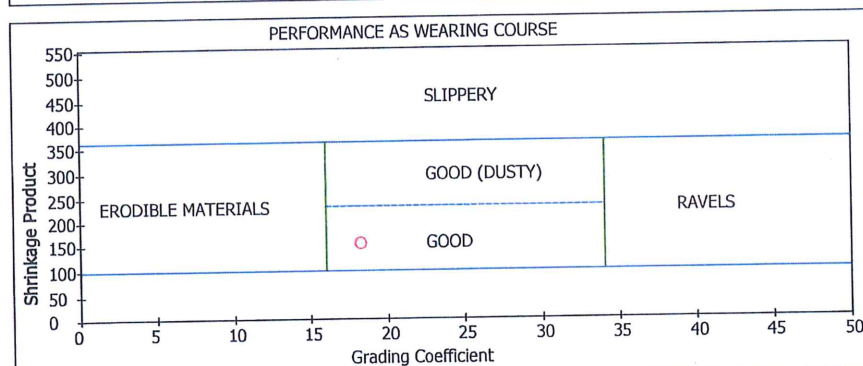
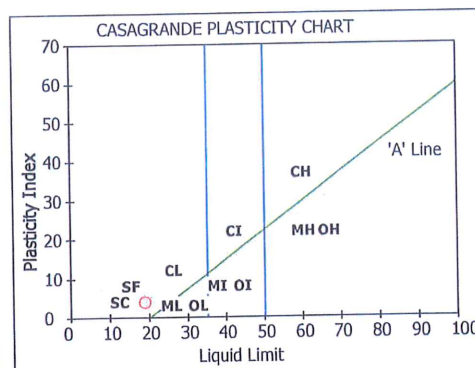
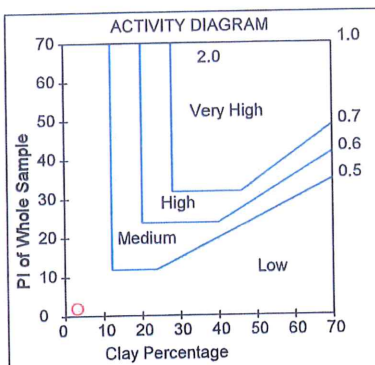
Project : Grootdrink Infrastructure Upgrade

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

Sample No. : U9247
Position : TP 23
Layer Type : 200-700mm
Sample Colour : Brown Gravel
Sample Type : Mix Calcrete+Quartzs

Sieve Size(mm)	% Passing	Soil Mortar	2.000 - 0.425	17
100.0	100		0.425 - 0.250	7
75.00	100		0.250 - 0.150	14
63.00	93		0.150 - 0.075	23
50.00	92		< 0.075	40
37.50	90	Effective Size		0,052
28.00	88	Uniformity Coefficient		30,2
20.00	86	Curvature Coefficient		0,1
14.00	84	Oversize Index		2,0
5.000	73	Shrinkage Product		156,0
2.000	63	Grading Coefficient		18,3
0.425	52	Grading Modulus		1,60
0.250	48	Atterberg Limits	Liquid Limit	19
0.150	39		Plasticity Index	4
0.075	25		Linear Shrinkage	3.0
0.060	10		PI < 0.075	
0.050	9,9	Unified Soil Classification		SM-SC
0.020	6,7	US Highway Classification		A-2-4(0)
0.005	4,3			
0.002	2,9			

D10= 0,052 D30= 0,103 D60= 1,570



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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Job Request No.: RU3525
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Attention : Frans Breytenbach

Project : Grootdrink Infrastructure Upgrade

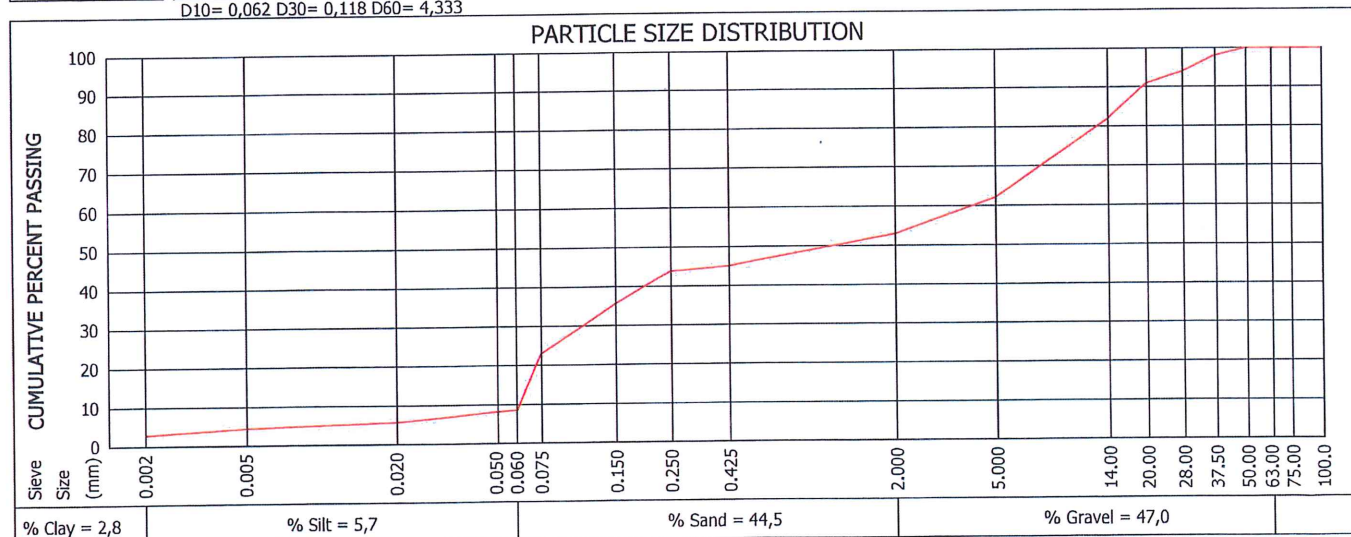
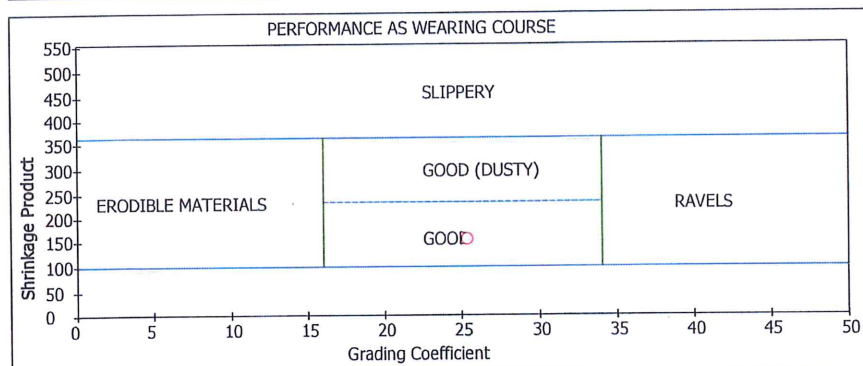
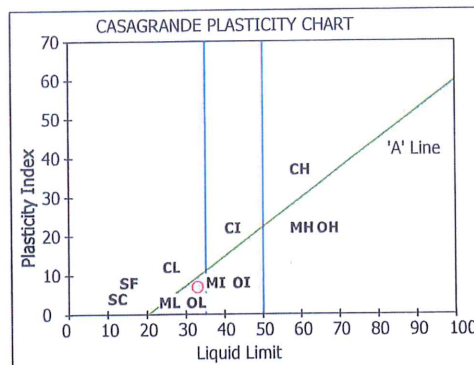
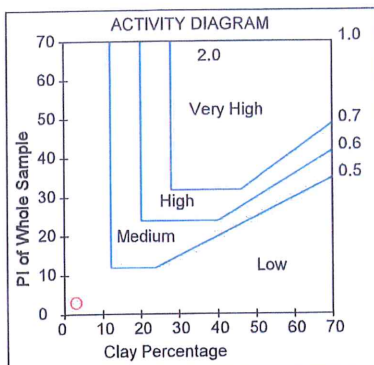
Date Reported : 2020-08-05

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

Sample No. : U9248
Position : TP 25
Layer Type : 200-500mm
Sample Colour : Reddish Brown Gravel
Sample Type : Mix Quartzstone

Sieve Size(mm)	% Passing	Soil Mortar	2.000 - 0.425	14
100.0	100		0.425 - 0.250	3
75.00	100		0.250 - 0.150	16
63.00	100		0.150 - 0.075	24
50.00	100		< 0.075	44
37.50	98	Effective Size		0,062
28.00	94	Uniformity Coefficient		69,9
20.00	91	Curvature Coefficient		0,1
14.00	82	Oversize Index		2,0
5.000	62	Shrinkage Product		157,5
2.000	53	Grading Coefficient		25,4
0.425	45	Grading Modulus		1,80
0.250	44	Atterberg Limits	Liquid Limit	33
0.150	36		Plasticity Index	7
0.075	23		Linear Shrinkage	3.5
0.060	8,5		PI < 0.075	
0.050	8,1	Unified Soil Classification		SM
0.020	5,6	US Highway Classification		A-2-4(0)
0.005	4,3			
0.002	2,8			

D10= 0,062 D30= 0,118 D60= 4,333




Deviation from Test Method :

Remarks and Notes : Chemistry: pH = 7.75 [SANS 5854] & Conductivity = 0.08 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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Attention : Frans Breytenbach

Date Reported : 2020-07-23

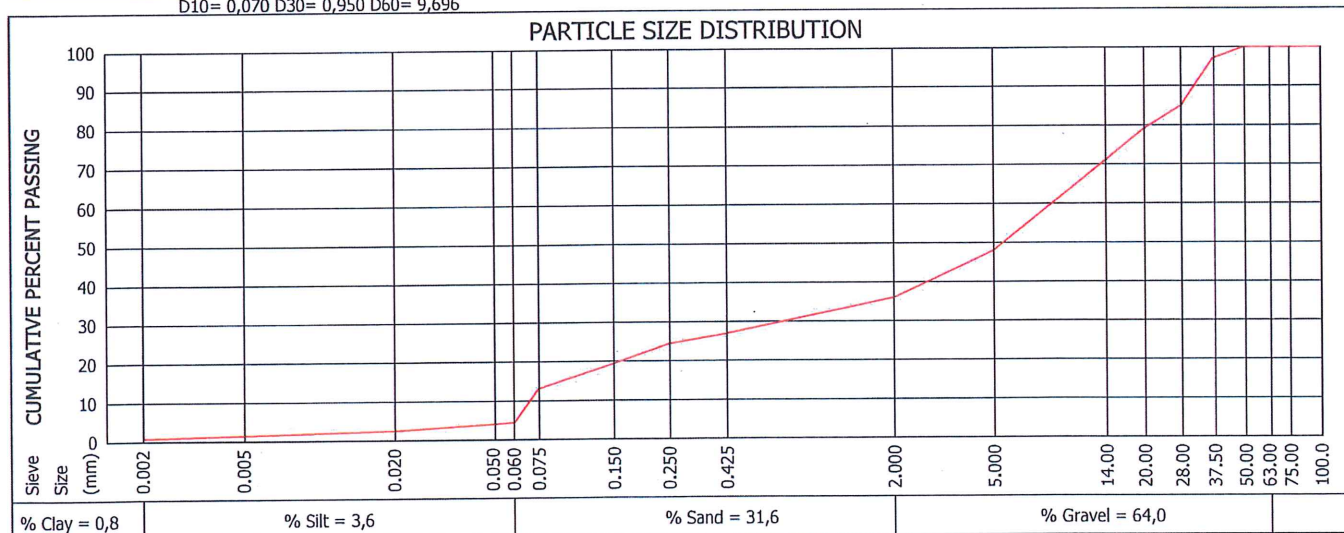
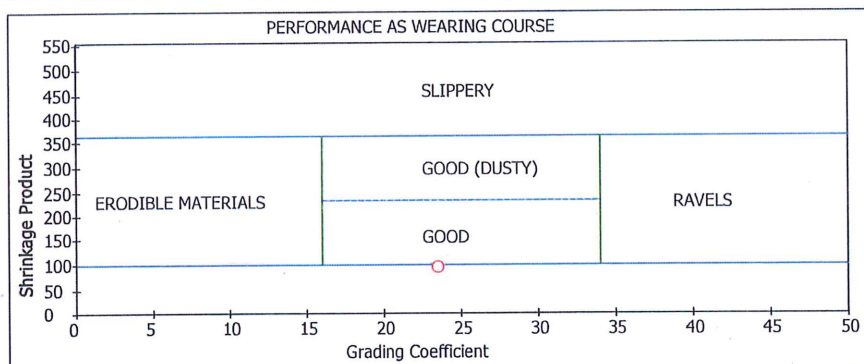
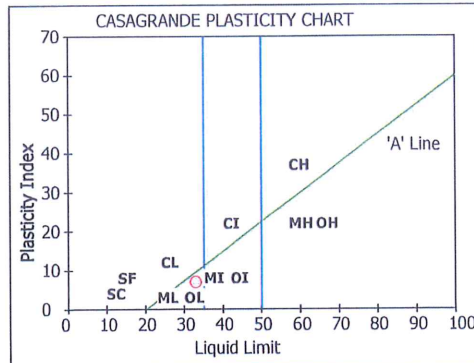
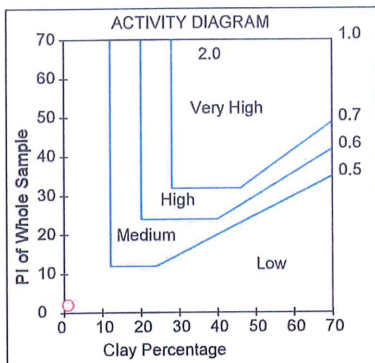
Project : Grootdrink Infrastructure Upgrade

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

Sample No. : U9249
Position : TP 28
Layer Type : 200-900mm
Sample Colour : Light Brown Gravel
Sample Type : Mix Weathered Calcre

Sieve Size(mm)	% Passing	Soil Mortar	2.000 - 0.425	24
100.0	100		0.425 - 0.250	8
75.00	100		0.250 - 0.150	14
63.00	100		0.150 - 0.075	18
50.00	100		< 0.075	36
37.50	97	Effective Size		0,070
28.00	85	Uniformity Coefficient		138,5
20.00	79	Curvature Coefficient		1,3
14.00	71	Oversize Index		3,0
5.000	48	Shrinkage Product		94,5
2.000	36	Grading Coefficient		23,5
0.425	27	Grading Modulus		2,20
0.250	24	Atterberg Limits	Liquid Limit	33
0.150	19		Plasticity Index	7
0.075	13		Linear Shrinkage	3.5
0.060	4,4		PI < 0.075	
0.050	4,0	Unified Soil Classification		GM
0.020	2,4	US Highway Classification		A-2-4(0)
0.005	1,4			
0.002	0,8			

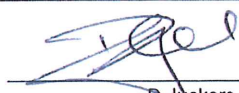
D10= 0,070 D30= 0,950 D60= 9,696



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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