

# Pienaarsrivier Filling Station Geotechnical Investigation Report

## Geotechnical Investigation Report Report No: 8536/17071

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TITLE: **Pienaarsrivier Filling Station  
Geotechnical Investigation Report**

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## **EXECUTIVE SUMMARY**

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*ARQ was appointed by Mr Anton van Vuuren on behalf of Accurate Trading 47 (Pty) Ltd (the Client), to conduct a geotechnical investigation for the proposed Pienaarsrivier Filling Station in the Limpopo Province.*

*The investigation made provision for a near surface investigation in the form of excavator test pits.*

*An additional percussion borehole was drilled on site to evaluate the depth of watertable on site.*

*Recommendations are provided in Section 8.*

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**APPENDIX B PERCUSSION BOREHOLE PROFILE**

**APPENDIX C LABORATORY RESULTS**

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## **LIST OF ABBREVIATIONS AND ACRONYMS**

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ARQ	ARQ Consulting Engineers (Pty) Ltd
AASHTO	American Association of State Highway and Transportation Officials
CBR	California Bearing Ratio
COLTO	Committee of Land Transport Officials
D	Disturbed sample
m	metre
MDD/ OMC	Moisture-density relationship
NGL	Natural Ground Level
PI	Plastic Index
SABS	South African Bureau of Standards
SAICE	South African Institution of Civil Engineers
SANAS	South African National Accreditation System
TMH	Technical Methods for Highways
TP	Test pit

## **1. INTRODUCTION**

ARQ was approached by Mr Anton van Vuuren of Accurate Trading 47 (Pty) Ltd, henceforth referred to as the Client, to conduct a geotechnical investigation for the proposed Pienaarsrivier Filling Station in the Limpopo Province.

The site in question comprise ERF 425 (6 895m<sup>2</sup>) and ERF 426 (7 972m<sup>2</sup>) with a combined total coverage of 1.4 hectares to be investigated.

The development will consist of:

- A brick building (Service station and Quick Service Restaurant (QSR)),
- Future building,
- Car Dispensary (5 x dispensaries),
- Truck Dispensary (1 x dispensaries),
- Truck Building,
- Cashier cubicle,
- Tank Farm (4 tanks),
- Parking,
- Truck stop area, and
- Access Roads.

The investigation comprised test pits excavated using an excavator (Komatsu PC220) provided by the Client. These test pits were excavated to a maximum depth of approximately 2.4m (where refusal occurred) and were profiled by Madaleen Booysen of ARQ according to industry standards.

The investigation was aimed at providing information with regard to:

- General geology of site,
- Engineering properties of materials encountered,
- Water table and groundwater seepage,
- Suitability of materials for use as fill and layer works,
- Bearing capacity/ suitability for founding in the in-situ soil/soft rock layers,
- Potential expansiveness/collapsibility of the soils,
- Excavatability of the in-situ material, and
- Founding recommendations.

## **2. THE SITE**

The site is located to the west of the N1 at the town of Pienaarsrivier in the Limpopo Province at the approximate co-ordinates; 25°12'21.28"S 28°18'0.23"E. Refer to Figure 2-1 below for site locality as seen in Google Earth <sup>TM</sup>.

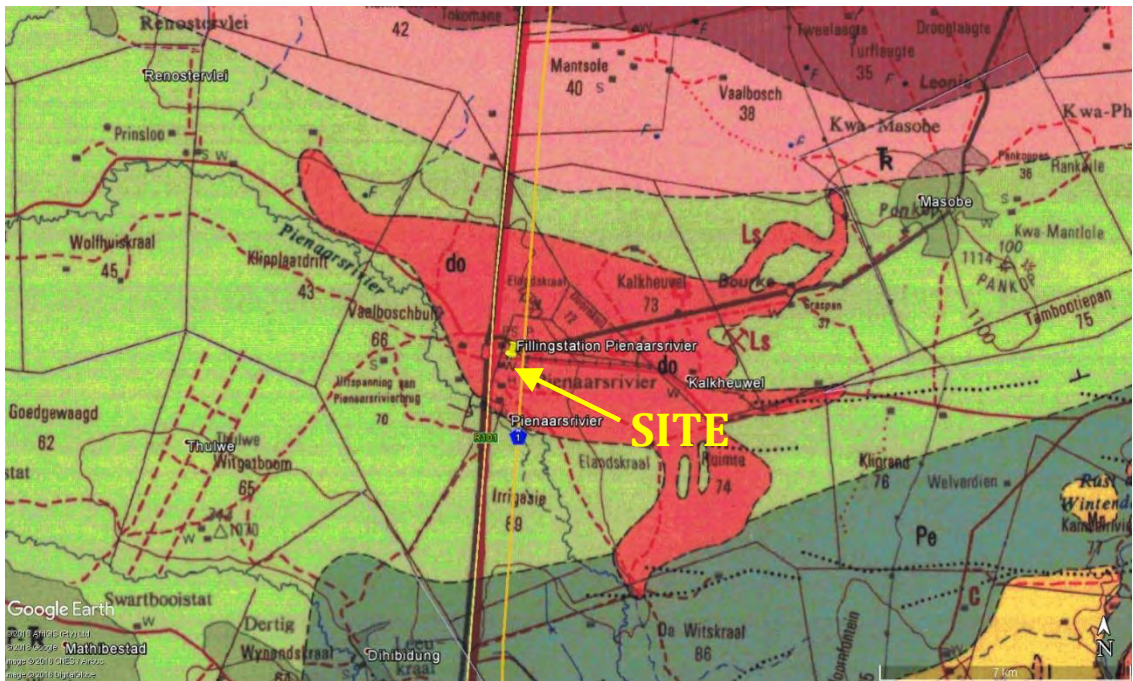




**Figure 2-1: Site locality marked by yellow arrow as seen in Google Earth <sup>TM</sup>.**

### 3. GEOLOGY OF THE AREA

Figure 3-1 below shows the geology of the area overlain in Google Earth™.



**Figure 3-1: Geology overlay as seen in Google Earth.**

The 1:250 000 geological map 2528 PRETORIA shows that the site is underlain by dolerite of the Jurassic Period.

The surrounding area is underlain by multi-coloured siltstone, sandstone, marl, mudstone and shale of the Irrigasie Formation, Karoo Supergroup.



## **4. GENERAL COMMENTS**

The building layout that the Client provided to ARQ could not be overlain accurately prior to the investigation due to the absence of any visible markers. As such a Client representative was present during the fieldwork to ensure correct placing of ARQ's testing positions according to the Client's latest building design.

## **5. METHOD OF INVESTIGATION**

The investigation was carried out in accordance with SAICE's Site Investigation Code of Practice (2010) and comprised test pits only.

One percussion borehole was drilled on site to establish the depth to watertable.

### **5.1. TEST PITS INVESTIGATION**

Sixteen test pits were excavated to determine in-situ soil conditions and suitability of material for founding as well as to be used as fill or layer works. Test pits were positioned on the footprints of the planned structures as indicated by the Client.

The test pits were profiled according to current methods and procedures (Brink and Bruin, 2002). Samples were taken and tested at a SANAS accredited soils laboratory. Positioning of test pits was undertaken on site, and recorded using a hand-held GPS.

### **5.2. PERCUSSION BOREHOLE**

After some concerns were raised that the watertable was not encountered during the excavation of the test pits and additional percussion borehole was drilling on site.

The sole purpose of the borehole was to determine the depth to watertable, as such no samples were logged or evaluated.

## **6. TESTING LOCALITY AND COORDINATES**

Coordinates of the test pits are included in Table 6-1 below.

**Table 6-1: Test pit coordinates.**

Coordinates		
	South	East
TP A	25°12'20.40"S	28°17'57.40"E
TP B	25°12'20.30"S	28°18'00.60"E
TP C	25°12'20.20"S	28°17'59.20"E
TP D	25°12'20.20"S	28°17'59.60"E
TP E	25°12'20.40"S	28°17'55.30"E
TP F	25°12'19.40"S	28°17'58.40"E
TP G	25°12'19.40"S	28°17'58.70"E
TP H	25°12'19.60"S	28°17'59.30"E
TP I	25°12'19.70"S	28°18'00.20"E
TP J	25°12'19.10"S	28°17'56.50"E
TP K	25°12'19.40"S	28°17'56.40"E
TP L	25°12'19.90"S	28°17'56.00"E
TP M	25°12'20.30"S	28°18'00.20"E
TP N	25°12'20.40"S	28°17'58.00"E
TP O	25°12'19.00"S	28°17'59.20"E
TP P	25°12'18.90"S	28°17'54.30"E

**Table 6-2: Borehole coordinate.**

Coordinates		
	South	East
BH01	25°12'20.50"S	28°17'59.30"E

Figure 6-1 overleaf shows positions of test pits in yellow markers and borehole in pink marker, as seen in Google Earth™.



**Figure 6-1: Site layout showing positions of TP A to TP P and BH01.**

## 7. RESULTS OF THE INVESTIGATION

### 7.1. TYPICAL SOIL PROFILE

A summary of the test pit profiles is presented in Table 7-1, whilst comprehensive soil profiles are included in **Appendix A**.

A site-specific geological characterization is provided in the section below. Disturbed samples were collected from six soil layers (in 5 test pits) which are indicated in Table 7-2.

**Table 7-1: Summary of test pits profiles.**

Layer			Refusal/ termination
Test pit	Soft to stiff, sandy clay, Topsoil	Soft to hard rock, sandstone and dolerite	
TP A	0.0-0.6m	0.6-1.5m	Refusal 1.5m
TP B	0.0-0.5m	0.5-2.0m	Refusal 2.0m
TP C	0.0-0.6m	0.6-1.8m	Refusal 1.8m
TP D	0.0-0.6m	0.6-1.4m	Refusal 1.4m
TP E	0.0-1.1m	1.1-2.4m	Refusal 2.4m
TP F	0.0-0.7m	0.7-2.0m	Refusal 2.0m
TP G	0.0-0.5m	0.5-2.1m	Refusal 2.1m
TP H	0.0-0.6m	0.6-1.7m	Refusal 1.7m
TP I	0.0-0.6m	0.6-2.1m	Refusal 2.1m
TP J	0.0-0.8m	0.8-1.8m	Refusal 1.8m
TP K	0.0-0.5m	0.5-1.7m	Refusal 1.7m
TP L	0.0-0.7m	0.7-1.8m	Refusal 1.8m
TP M	0.0-0.5m	0.5-1.9m	Refusal 1.9m
TP N	0.0-0.6m	0.6-2.0m	Refusal 2.0m
TP O	0.0-0.8m	0.8-2.1m	Refusal 2.1m
TP P	0.0-0.45m	0.45-2.4m	Refusal 2.4m

The following tests were conducted on the layers indicated above by the blue shading.

**Table 7-2: Laboratory testing.**

Laboratory test conducted	Colour indication
California Bearing Ratio (CBR), Maximum Dry Density/Optimum Moisture, Foundation Indicators, Moisture content pH and conductivity	

The percussion borehole profile can be viewed in **Appendix B**.

### 7.2. CHARACTERISATION OF GEOLOGICAL HORIZONS

The site-specific geology can be characterised as follows:

#### a) Top soil

- Sandy silty clay - This horizon is generally described as dark brown soft to stiff sandy clay ranging in thicknesses from 0.45-1.1m. Plant roots are expected due to the dense vegetation and as such not specifically mentioned in each profile.

*b) Soft to hard rock altered sandstone and dolerite*

- Altered sandstone and dolerite – Dolerite rock was encountered along with an altered sandstone. The term altered implies some baking of the sandstone was also observed. This may be due to the alteration of the sandstone during the dolerite intrusion. It is believed that the site is located on the gradual contact between the two lithologies and as such a mixture/ combination of the two is present on site with no distinct separation.
- The soft to hard rock was excavated until refusal conditions were encountered by the excavator at a depth between 1.4-2.4m below natural ground level (NGL). The rocks exhibited differential weathering with some staining along joints.

### 7.3. LABORATORY TESTING OF SOIL

Soil samples obtained during investigations were sent to an independent soil laboratory (SGS Matrolab Pretoria) for testing.

A summary of the laboratory test results are provided in Table 7-3 overleaf whilst the comprehensive results are presented in **Appendix C**.

**Table 7-3: Summary of laboratory results.**

Sample No.	TP B	TP E	TP G	TP G	TP J	TP I
Depth (m)	0.5-2.0	1.1-2.4	0.0-0.5	0.5-2.1	0.0-0.8	0.7-1.8
Liquid Limit	53	45	45	50	47	55
Plasticity Index	26	20	22	22	26	24
Plasticity Index of whole sample	8	5	10	4	15	5
Linear shrinkage	11.5	9	10.5	11	13.5	11
Grading modulus	2.01	1.99	1.56	2.28	1.42	2.44
% passing 0.425mm	29	28	51	20	57	19
% passing 0.075mm	19	16	29	12	36	13
Expansiveness rating	Low	Low	Low	Low	Low	Low
AASHTO Classification	A-2-7(1)	A-2-7(0)	A-2-7(2)	A-2-7(0)	A-7-6(4)	A-2-7(0)
pH values	7.9	7.9	7.5	8	7.8	8
Electrical Conductivity (S/m)	0.0862	0.0611	0.0939	0.0523	0.0863	0.0805
Corrosivity	Very corrosive	Very corrosive	Very corrosive	Very corrosive	Very corrosive	Very corrosive
Optimum moisture content (%)	13.5	10.8	15.3	11.4	14.9	9.2
Max Dry Density (kg/m <sup>3</sup> )	1991	2089	1806	2075	1740	2107
CBR @ 100% Mod AASHTO (%)	11	30	7	15	6	30
CBR @ 95% Mod AASHTO (%)	9	17	6	8	4	24
CBR @ 93% Mod AASHTO (%)	8	13	6	7	3	22
Max swell @ 100% Mod AASHTO (%)	0.7	0.1	1.1	0.7	1.6	0.3
Classification (COLTO)	NC	NC	NC	NC	NC	NC

\*NC = Non-Classifiable. All samples were NC due to high a PI.

## 7.4. GEOTECHNICAL EVALUATIONS

Comprehensive geotechnical evaluations are given in the sections below.

It is important to bear in mind that the soil samples collected on site from the layer beneath the top soil, i.e. “soft to hard rock, sandstone and dolerite”, was obtained from the soil fines between the broken pieces of rock and as such is merely an indication of the fines portion of this layer which in actual fact comprise mostly rock fragments. .

### 7.4.1. GRADING ANALYSIS

The grading curve of the material tested can be viewed in Figure 7-1. Specific values can be viewed in the individual laboratory results in **Appendix C**.

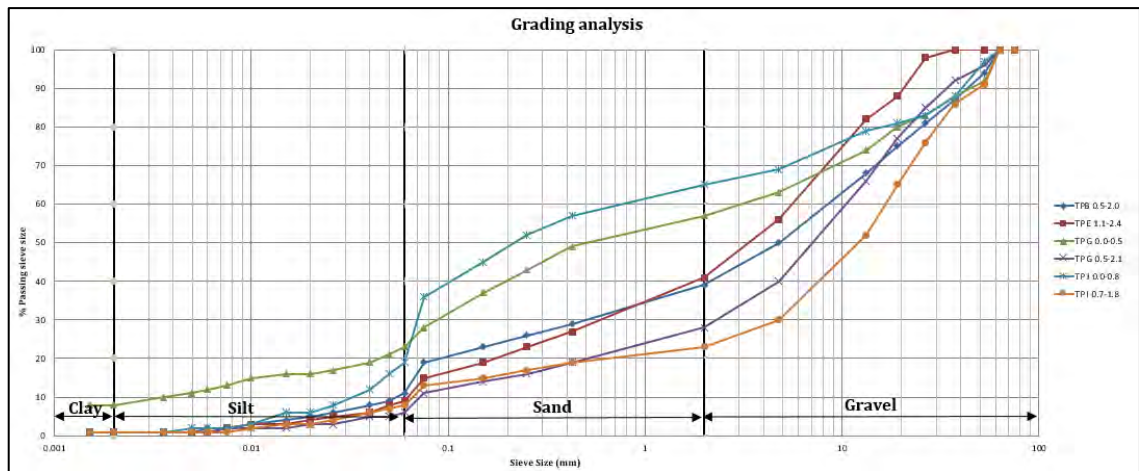


Figure 7-1: Grading curve.

### 7.4.2. EXPANSIVE/ACTIVE SOILS

Although the finer portion ( $<0.425\text{mm}$ ) of the material tested yielded high Plasticity Index (PI) values, the expansiveness rating of the material, which is a function of the PI of the hole samples vs. the clay fraction of the sample, is low. Therefore expansive soils (i.e. heaving or shrinking) is not expected to be problematic on this site.

### 7.4.3. COLLAPSIBLE SOILS

A soil with a collapsible fabric may be defined as a soil which can withstand relatively large imposed stresses with minor settlement at a low in-situ moisture content but will exhibit a decrease in volume (which could be of large magnitude) with no increase in the applied stress if wetting-up occurs.

No collapsible structure was identified within the material and thus collapsible material is not expected to be problematic on this site.

### 7.4.4. PH AND CORROSIVITY

Corrosivity of the material on site was classified as “Very corrosive” with an alkaline pH that ranges from 7.5-8.0 (a pH of 7.0 indicates a completely neutral material) and an electrical conductivity of 0.0523-0.0939 S/m.



#### **7.4.5. MOISTURE CONTENT**

From **Table 7-3** it can be seen that the optimum moisture content of the soils tested ranges from 9.2-15.3%.

The material on site was typically described as slightly moist, and it will likely be necessary to add water during the compaction process to bring the material to optimum moisture content.

#### **7.4.6. COMPACTION AND STRENGTH PROPERTIES**

CBR tests were conducted according to TMH1 (1986) on representative samples which were subsequently classified according to COLTO (1998). A summary of strength and compaction properties of materials sampled are presented in **Table 7-3**.

None of the materials tested are classifiable according to COLTO due to their high PI values ( $>12$  or  $>3 \times GM + 10$ ). Considering the CBR of the material in isolation (i.e. apart from the PI values rendering the material non-classifiable) the strength of the top soil material is similar to that of a G10 or worse and the strength of the soil portion of the rock layer ranges between that of a G7 to a G9.

#### **7.4.7. PERMEABILITY**

The coefficient of permeability depends primarily on the grading and density.

It is possible to estimate the coefficient of permeability for the material at a depth of 0.5-2.4m below NGL by using the empirical method proposed by Hazen. The sieve size allowing 10% of sampled material (by weight) to pass is used as input into Hazen's empirical formulation. The coefficient of permeability was calculated as  $3.6 \times 10^{-5}$  m/s. This value correlates with the typical coefficient of permeability for very fine sands or silts and clay silts (Table 2.1 in Craig's Soil Mechanics, 2004). This is in line with what would be expected.

Therefore, in the absence of permeability specific testing it is proposed that the in-situ permeability of the material surrounding the top of the tank will be approximately  $3.6 \times 10^{-5}$  m/s, and will decrease with depth as more competent rock is encountered.

### **7.5. EXCAVATION CONDITIONS**

Based on SABS 1200, "soft" excavation conditions can be expected up to depths of between 1.4m and 2.4m beneath natural ground level.

Although the depth of the investigation was limited to a maximum depth of 2.4m, it is estimated that "intermediate" excavation conditions can be expected in the sandstone bedrock immediately below the "soft" excavation conditions. It is possible that the sandstone bedrock becomes more competent with depth and that at some level "hard" excavation conditions occur, however due to the limited depth of this investigation no more detail can be provided on this.

#### **7.5.1. GROUNDWATER**

No water table or seepage was encountered in any test pits.

A percussion borehole was drilled on site with the singular purpose of locating the watertable if encountered within 10m below NGL.

The drilling conducted was concluded without additional fluid being added during the drilling process. The watertable encountered during the drilling proses was located at 9m below NGL.

The site was subjected to heavy rains during the day leading up to the drilling and two days thereafter. The amount of rain received during the period of 13 February 2019 to 15 February 2019 can be obtained from the South African Weather Service, at a cost. However as the closest measuring station is some 36km away the relevance of the data cannot be ensured.

The standing watertable was measured 48 hours after the drilling was completed instead of the usual 24 hours as ARQ thought it prudent to evaluate the rise of watertable along with the rain encountered. The watertable measured after 48 hours was at 5.5m below NGL.

## **8. RECOMMENDATIONS**

The recommendations given in this report are based on the near-surface geotechnical investigation conducted on site and a single percussion borehole (watertable depth only).

### **8.1. FOUNDING OF LIGHT STRUCTURES**

The following founding methods are recommended for the light structures:

#### Option 1:

Remove the top soil and found the light structures (single storey buildings) on very soft to soft rock dolerite or sandstone. Strip or pad footings can be used and the foundations should be designed such as not to exceed allowable bearing pressures of 250kPa. Based on the test pits this founding depth will vary between  $\pm 0.5\text{m}$  and  $1.1\text{m}$  below NGL (average depth  $\pm 0.7\text{m}$ ).

#### Option 2:

Remove the top soil until very soft rock or harder dolerite or sandstone is encountered (as per the depths described in Option 1). Then backfill the excavation with G7 quality material or better compacted in maximum 150mm layers to minimum 93% of its Mod AASHTO maximum dry density at 0 to +2% of its optimum moisture content. The light structures can then be founded on strip or pad footings on the G7 material at a minimum depth of 0.5m below ground level. The foundations should be designed such as not to exceed allowable bearing pressures of 150kPa. The plan dimensions of the excavation must be equal to the width of the foundation plus a width equal to the thickness of the G7 backfill. For pad footings both plan dimensions (length and width) of the excavation must be increased by a length equal to the thickness of the G7 backfill layer.

#### Option 3:

If higher allowable bearing pressures are required the top soil and very soft rock must be removed and the structures founded on pad or strip footings on the soft rock (maximum

allowable bearing pressure of 500 kPa) or on medium hard rock or harder (maximum allowable bearing pressures of 1 MPa).

Please note:

All foundations should be inspected by a competent geotechnical engineer/engineering geologist prior to concrete in order to verify that the founding conditions are in agreement with the recommendations given in this report.

## **8.2. ACCESS ROADS AND PARKING**

### **8.2.1. USE OF MATERIAL IN LAYERWORKS**

The topsoil material above the bedrock was found to be non-classifiable (i.e. worse than G10) and is therefore unsuitable for use in layerworks. The two samples tested from this material have a subgrade rating (based on their AASHTO classification) of good and poor respectively. This material's consistency was however often described as "soft" in the test pits and therefore, together with the fact that 1 out of 2 samples have a poor subgrade rating, is considered to be a fair to poor subgrade material. The material may however be used for landscaping or rehabilitation purposes.

The soil material sampled from the rock layer underlying the topsoil was non-classifiable and is therefore unsuitable for use in layerworks. It does however have a good to excellent rating as a subgrade.

As all of the material sampled was non-classifiable and therefore not suitable for use in layerworks it is recommended that the Client import material for use in layerworks from a commercial source.

### **8.2.2. DESIGN OF LAYERWORKS**

Due to the load requirements and vibration impacts of the fuel tankers it is recommended that the Client appoint a specialist Pavement/ Road Engineer to design the layerworks required.

## **8.3. TANK FARM**

### **8.3.1. FOUNDING**

Based on information received from the Client the base of the tank farm will be placed 4.5m below NGL. As the test pits refused above this level it is believed that medium hard rock or harder (allowable bearing capacity of 1MPa) will be present at the proposed tank base level for founding.

The rock strength should be verified by a competent geotechnical engineer/ engineering geologist once the excavation for the tank farm has reached the proposed founding level.

## **8.4. PRECAUTIONARY**

### **8.4.1. CORROSIVE SOILS**

The material on site was evaluated to be "Very Corrosive". It is recommended that the Client take adequate preventative measures (e.g. sufficient cover to steel reinforcement, adequate

concrete mix design) in order to ensure that the material do not corrode the concrete, steel reinforcement, tanks, pipes or any other underground services.

#### **8.4.2. PRESENCE OF MARL**

Although no marl rock was encountered during the investigation, the possible presence of the rock in the surrounding area should not be overlooked.

It is recommended that the Client take precautionary measures during construction and for the lifetime of the development to ensure that any calcite minerals present on site are not dissolved due to improper drainage or maintenance of the development.

#### **8.4.3. DRAINAGE**

It is essential that proper site drainage and plumbing/services precautions be taken to prevent saturation of underlying materials, e.g.. proper down pipes which eject away from the proposed structure must be installed in conjunction with a concrete or a paved apron with a width of at least 1m.

### **9. CONCLUSION**

The investigation undertaken has revealed valuable information relating to the soil and rock profile on site as well as the engineering properties of the materials.

### **10. GENERAL**

The comments and recommendations contained within this report are based on a limited number of tests and observations which ARQ believe are representative. However, conditions at variance with those described in this report should not be overlooked.

### **11. REFERENCES**

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## **APPENDIX A**

### **TEST PIT PROFILES**


















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**Test Pit: TP A**

<div><div>Client: MDV Development</div><div>Project: PienaarsrivierFilling Station - 8536</div><div>Date Profiled: 2019/01/30</div><div>Coordinates: 25°12'20.4 "S, 28°17'57.4 "E</div><div>Elevation: 1045 m</div><div>Profiled By: Madaleen Booysen</div></div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>SOFT TO STIFF, SANDY SILTY CLAY</b> Slightly moist, dark brown, soft to stiff, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6				(0.6 m)	
0.7			X	<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	
0.8			X		
0.9			X		
1.0			X		
1.1			X		
1.2			X		
1.3			X		
1.4			X		
1.5			X		(1.5 m)
1.6				<b>Refused On: Hard rock sandstone and dolerite</b>	
1.7					
1.8					
1.9					
2.0					
2.1					
2.2					
<div><div>Excavation Method: EXCAVATOR</div><div>Unstable Sides: None</div><div>Refusal: 1.5 m on Hard rock sandstone and dolerite</div><div>Water Table: None</div></div>					




**Test Pit: TP B**

<div><div>Client: MDV Development</div><div>Project: PienaarsrivierFilling Station - 8536</div><div>Date Profiled: 2019/01/30</div><div>Coordinates: 25°12'20.3 "S, 28°18'00.6 "E</div><div>Elevation: 1044 m</div><div>Profiled By: Madaleen Booysen</div></div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>SOFT, SANDY SILTY CLAY</b> Slightly moist, dark brown, soft, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6	<div>D</div>			<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	
0.7					
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					
				<b>Refused On: Hard rock sandstone and dolerite</b>	
2.1					
2.2					
<div><div>Excavation Method: EXCAVATOR</div><div>Unstable Sides: None</div><div>Refusal: 2 m on Hard rock sandstone and dolerite</div><div>Water Table: None</div></div>					




**Test Pit: TP C**

<div><div>Client: MDV Development</div><div>Project: PienaarsrivierFilling Station - 8536</div><div>Date Profiled: 2019/01/30</div><div>Coordinates: 25°12'20.2 "S, 28°17'59.2 "E</div><div>Elevation: 1047 m</div><div>Profiled By: Madaleen Booysen</div></div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>SOFT, SANDY SILTY CLAY</b> Slightly moist, dark brown, soft, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6				(0.6 m)	
0.7				<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8				(1.8 m)	
1.9				<b>Refused On: Hard rock sandstone and dolerite</b>	
2.0					
2.1					
2.2					
<div><div>Excavation Method: EXCAVATOR</div><div>Unstable Sides: None</div><div>Refusal: 1.8 m on Hard rock sandstone and dolerite</div><div>Water Table: None</div></div>					

**Test Pit: TP D**


<div><div>Client: MDV Development</div><div>Project: PienaarsrivierFilling Station - 8536</div><div>Date Profiled: 2019/01/30</div><div>Coordinates: 25°12'20.2 "S, 28°17'59.6 "E</div><div>Elevation: 1038 m</div><div>Profiled By: Madaleen Booysen</div></div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>SOFT, SANDY SILTY CLAY</b> Slightly moist, dark brown, soft, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6				(0.6 m)	
0.7				<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.4				(1.4 m)	
<b>Refused On: Hard rock sandstone and dolerite</b>					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					
2.1					
2.2					
<div><div>Excavation Method: EXCAVATOR</div><div>Unstable Sides: None</div><div>Refusal: 1.4 m on Hard rock sandstone and dolerite</div><div>Water Table: None</div></div>					

**Test Pit: TP E**




<div>Client: MDV Development</div> <div>Project: PienaarsrivierFilling Station - 8536</div> <div>Date Profiled: 2019/01/30</div> <div>Coordinates: 25°12'20.4 "S, 28°17'55.3 "E</div> <div>Elevation: 1048 m</div> <div>Profiled By: Madaleen Booysen</div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>SOFT TO STIFF, SANDY SILTY CLAY</b> Slightly moist, dark brown, soft to stiff, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6					
0.7					
0.8					
0.9					
1.0					
1.1				(1.1 m)	
1.2			<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite		
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					
2.1					
2.2					
Refused On: Hard rock sandstone and dolerite					(2.4 m)
<div>Excavation Method: EXCAVATOR</div> <div>Unstable Sides: None</div> <div>Refusal: 2.4 m on Hard rock sandstone and dolerite</div> <div>Water Table: None</div>					






**Test Pit: TP F**

<b>Client:</b> MDV Development <b>Project:</b> Pienaarsrivier Filling Station - 8536 <b>Date Profiled:</b> 2019/01/30 <b>Coordinates:</b> 25°12'19.4 "S, 28°17'58.4 "E <b>Elevation:</b> 1048 m <b>Profiled By:</b> Madaleen Booysen					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>SOFT, SANDY SILTY CLAY</b> Slightly moist, dark brown, soft, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6					
0.7				<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	(0.7 m)
0.8			X		
0.9			X		
1.0			X		
1.1			X		
1.2			X		
1.3			X		
1.4			X		
1.5			X		
1.6			X		
1.7			X		
1.8			X		
1.9			X		
2.0			X		(2 m)
2.0				<b>Refused On: Hard rock sandstone and dolerite</b>	
2.1					
2.2					
<b>Excavation Method:</b> EXCAVATOR <b>Unstable Sides:</b> None <b>Refusal:</b> 2 m on Hard rock sandstone and dolerite <b>Water Table:</b> None					





**Test Pit: TP G**

<b>Client:</b> MDV Development <b>Project:</b> Pienaarsrivier Filling Station - 8536 <b>Date Profiled:</b> 2019/01/30 <b>Coordinates:</b> 25°12'19.4 "S, 28°17'58.7 "E <b>Elevation:</b> 1047 m <b>Profiled By:</b> Madaleen Booysen					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1	D			<b>SOFT, SANDY SILTY CLAY</b> Slightly moist, dark brown, soft, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6	D			<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	(0.5 m)
0.7					
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					
2.1					
2.2				<b>Refused On: Hard rock sandstone and dolerite</b>	(2.1 m)
<b>Excavation Method:</b> EXCAVATOR <b>Unstable Sides:</b> None <b>Refusal:</b> 2.1 m on Hard rock sandstone and dolerite <b>Water Table:</b> None					



**Test Pit: TP H**

<div><div>Client: MDV Development</div><div>Project: PienaarsrivierFilling Station - 8536</div><div>Date Profiled: 2019/01/30</div><div>Coordinates: 25°12'19.6 "S, 28°17'59.3 "E</div><div>Elevation: 1044 m</div><div>Profiled By: Madaleen Booysen</div></div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>STIFF, SANDY SILTY CLAY</b> Slightly moist, dark brown, stiff, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6					
0.6				<b>HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weatheredwith joint staining, fine grained, highly jointed, hard rock, altered sandstone and dolerite	
0.7					
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7				<b>Refused On: Hard rock sandstone and dolerite</b>	
1.8					
1.9					
2.0					
2.1					
2.2					
<div><div>Excavation Method: EXCAVATOR</div><div>Unstable Sides: None</div><div>Refusal: 1.7 m on Hard rock sandstone and dolerite</div><div>Water Table: None</div></div>					

**Test Pit: TP I**



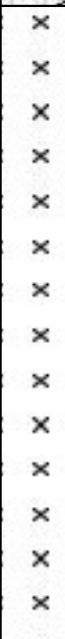
<div>Client: MDV Development</div> <div>Project: PienaarsrivierFilling Station - 8536</div> <div>Date Profiled: 2019/01/30</div> <div>Coordinates: 25°12'19.7 "S, 28°18'00.2 "E</div> <div>Elevation: 1043 m</div> <div>Profiled By: Madaleen Booysen</div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>STIFF, SANDY SILTY CLAY</b> Slightly moist, dark brown, stiff, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6				(0.6 m)	
0.7				<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					
2.1				(2.1 m)	
2.2					
<div>Excavation Method: EXCAVATOR</div> <div>Unstable Sides: None</div> <div>Refusal: 2.1 m on Hard rock sandstone and dolerite</div> <div>Water Table: None</div>					

**Test Pit: TP J**


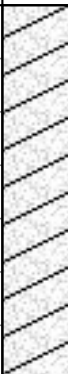
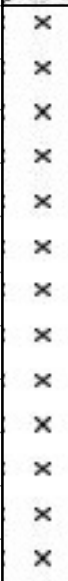
<div><div>Client: MDV Development</div><div>Project: PienaarsrivierFilling Station - 8536</div><div>Date Profiled: 2019/01/30</div><div>Coordinates: 25°12'19.1 "S, 28°17'56.5 "E</div><div>Elevation: 1046 m</div><div>Profiled By: Madaleen Booysen</div></div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1	D			<b>SOFT TO STIFF, SANDY SILTY CLAY</b> Slightly moist, dark brown, soft to stiff, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6					
0.7					
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8			<b>Refused On: Hard rock sandstone and dolerite</b>		(1.8 m)
1.9					
2.0					
2.1					
2.2					
<div><div>Excavation Method: EXCAVATOR</div><div>Unstable Sides: None</div><div>Refusal: 1.8 m on Hard rock sandstone and dolerite</div><div>Water Table: None</div></div>					




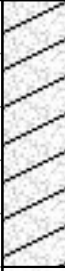
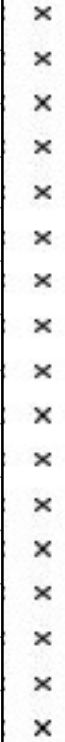
**Test Pit: TP K**

<div>Client: MDV Development</div> <div>Project: PienaarsrivierFilling Station - 8536</div> <div>Date Profiled: 2019/01/30</div> <div>Coordinates: 25°12'19.4 "S, 28°17'56.4 "E</div> <div>Elevation: 1046 m</div> <div>Profiled By: Madaleen Booysen</div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>STIFF, SANDY SILTY CLAY</b> Slightly moist, dark brown, stiff, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6				<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	
0.7					
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					
2.1					
2.2					
<div>Excavation Method: EXCAVATOR</div> <div>Unstable Sides: None</div> <div>Refusal: 1.7 m on Hard rock sandstone and dolerite</div> <div>Water Table: None</div>					



**Test Pit: TP L**

<div><div>Client: MDV Development</div><div>Project: PienaarsrivierFilling Station - 8536</div><div>Date Profiled: 2019/01/30</div><div>Coordinates: 25°12'19.9 "S, 28°17'56.0 "E</div><div>Elevation: 1045 m</div><div>Profiled By: Madaleen Booysen</div></div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>SOFT TO STIFF, SANDY SILTY CLAY</b> Slightly moist, dark brown, soft to stiff, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6					
0.7				(0.7 m)	
0.8				<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					(1.8 m)
1.8				<b>Refused On: Hard rock sandstone and dolerite</b>	
1.9					
2.0					
2.1					
2.2					
<div><div>Excavation Method: EXCAVATOR</div><div>Unstable Sides: None</div><div>Refusal: 1.8 m on Hard rock sandstone and dolerite</div><div>Water Table: None</div></div>					

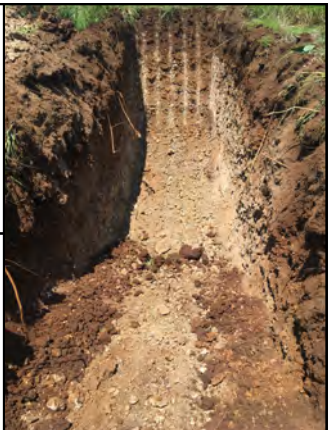
**Test Pit: TP M**

<div>Client: MDV Development</div> <div>Project: PienaarsrivierFilling Station - 8536</div> <div>Date Profiled: 2019/01/30</div> <div>Coordinates: 25°12'20.3 "S, 28°18'00.2 "E</div> <div>Elevation: Not specified</div> <div>Profiled By: Madaleen Booysen</div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>STIFF, SANDY SILTY CLAY</b> Slightly moist, dark brown, stiff, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5				(0.5 m)	
0.6				<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	
0.7					
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9				(1.9 m)	
Refused On: Hard rock sandstone and dolerite					
2.0					
2.1					
2.2					
<div>Excavation Method: EXCAVATOR</div> <div>Unstable Sides: None</div> <div>Refusal: 1.9 m on Hard rock sandstone and dolerite</div> <div>Water Table: None</div>					


**Test Pit: TP N**

<div><div>Client: MDV Development</div><div>Project: PienaarsrivierFilling Station - 8536</div><div>Date Profiled: 2019/01/30</div><div>Coordinates: 25°12'20.4 "S, 28°17'58.0 "E</div><div>Elevation: 1046 m</div><div>Profiled By: Madaleen Booysen</div></div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>SOFT, SANDY SILTY CLAY</b> Slightly moist, dark brown, soft, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6				<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	(0.6 m)
0.7			X		
0.8			X		
0.9			X		
1.0			X		
1.1			X		
1.2			X		
1.3			X		
1.4			X		
1.5			X		
1.6			X		
1.7			X		
1.8			X		
1.9			X		
2.0			X		(2 m)
2.1				<b>Refused On: Hard rock sandstone and dolerite</b>	
2.2					
<div><div>Excavation Method: EXCAVATOR</div><div>Unstable Sides: None</div><div>Refusal: 2 m on Hard rock sandstone and dolerite</div><div>Water Table: None</div></div>					

**Test Pit: TP O**

<div><div>Client: MDV Development</div><div>Project: PienaarsrivierFilling Station - 8536</div><div>Date Profiled: 2019/01/30</div><div>Coordinates: 25°12'19.0 "S, 28°17'59.2 "E</div><div>Elevation: 1045 m</div><div>Profiled By: Madaleen Booysen</div></div>					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>STIFF, SANDY SILTY CLAY</b> Slightly moist, dark brown, stiff, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5					
0.6					
0.7					
0.8					(0.8 m)
0.9			x	<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered with joint staining, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	
1.0			x		
1.1			x		
1.2			x		
1.3			x		
1.4			x		
1.5			x		
1.6			x		
1.7			x		
1.8			x		
1.9			x		
2.0			x		
2.1			x		(2.1 m)
2.2					<b>Refused On: Hard rock sandstone and dolerite</b>
<div><div>Excavation Method: EXCAVATOR</div><div>Unstable Sides: None</div><div>Refusal: 2.1 m on Hard rock sandstone and dolerite</div><div>Water Table: None</div></div>					

**Test Pit: TP P**

<b>Client:</b> MDV Development <b>Project:</b> Pienaarsrivier Filling Station - 8536 <b>Date Profiled:</b> 2019/01/30 <b>Coordinates:</b> 25°12'18.9 "S, 28°17'54.3 "E <b>Elevation:</b> 1048 m <b>Profiled By:</b> Madaleen Booysen					
Depth (m)	Sampling	Ground Water	Symbol	Description	
0.1				<b>VERY SOFT TO SOFT, SANDY SILTY CLAY</b> Slightly moist, dark brown, very soft to soft, sandy silty clay Topsoil	
0.2					
0.3					
0.4					
0.5			X	<b>SOFT ROCK TO HARD ROCK, ALTERED SANDSTONE AND DOLERITE</b> Light brown, slightly weathered to moderately weathered, fine grained, highly jointed, soft rock to hard rock, altered sandstone and dolerite	(0.45 m)
0.6			X		
0.7			X		
0.8			X		
0.9			X		
1.0			X		
1.1			X		
1.2			X		
1.3			X		
1.4			X		
1.5			X		
1.6			X		
1.7			X		
1.8			X		
1.9			X		
2.0			X		
2.1			X		
2.2			X		
				<b>Refused On: Hard rock sandstone and dolerite</b>	(2.4 m)
<b>Excavation Method:</b> EXCAVATOR <b>Unstable Sides:</b> None <b>Refusal:</b> 2.4 m on Hard rock sandstone and dolerite <b>Water Table:</b> None					



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## **APPENDIX B**

### **PERCUSSION BOREHOLE PROFILE**

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## Sheet: 1 of 1

**Driller:** Paulus

[illegible]

**Notes:** Standing watertable was measured 48 hour after drilling at 5.5m. The area experienced heavy rain during the 3 days prior to measurement of watertable.

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## **APPENDIX C**

### **LABORATORY RESULTS**

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SGS MATROLAB (PTY) LTD  
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a SANAS Accredited Testing Laboratory, No. T0025

256 Brander Street, Jan Niemand Park, Pretoria.  
P.O. Box 912387, Silverton, 0127  
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Fax : (012) 800 3043  
Email : bennie.vanniekerk@sgs.com

## TEST RESULTS

ARQ CONSULTING ENGINEERS  
P.O. BOX 76379  
LYNNWOOD RIDGE  
0040  
Attention: Madaleen Booysen

Project : Pienaarsrivier Filling Station

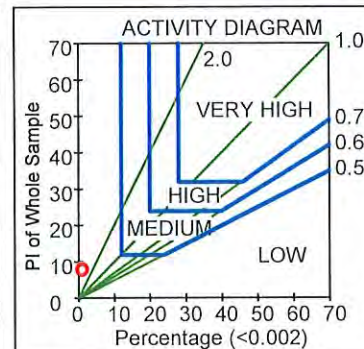
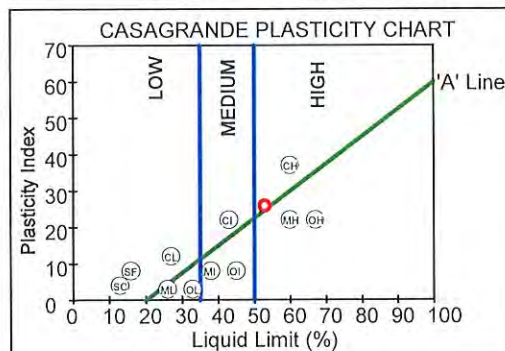
Your Ref : 8536  
Our Ref : PL/26628  
Date Reported : 18.02.2019

## FOUNDATION INDICATOR (ASTM: D422)

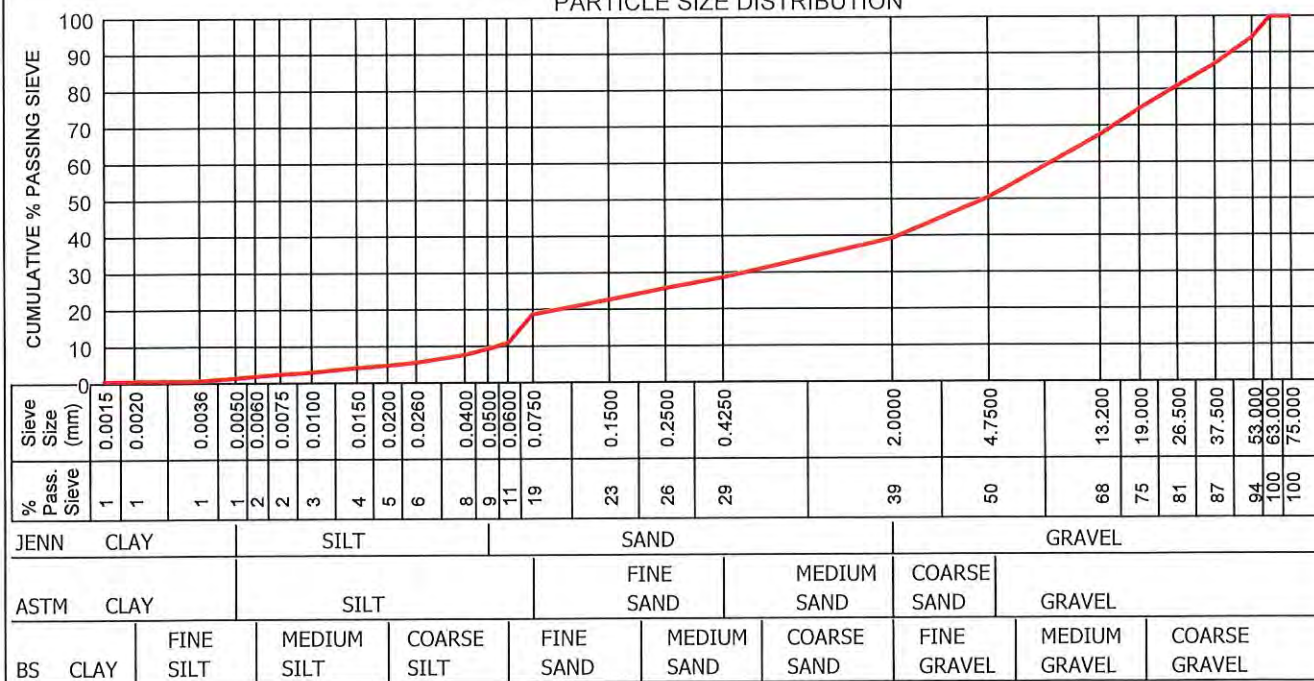
Sample No. : A9/272  
Hole No. : TPB  
Depth : 500-2000  
Liquid Limit (%) : 53  
Plasticity Index : 26  
Linear Shrinkage (%) : 11.5  
PI of Whole Sample : 8  
P.R.A. Classification : A-2-7(1)  
Unified Soil Classification : GC  
Activity : 8.00  
Heave Classification : LOW  
Grading Modulus : 2.13  
Percentage (<0.002) : 1.0  
Moisture Content (%) : 10.4

Material Description : Light brown SILTY SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	1.4	7.9	30.1	60.6	SILTY SAND
Astm	1.4	17.4	31.6	49.6	SILTY SAND
British Standard	0.6	10.4	28.4	60.6	SILTY SAND



## PARTICLE SIZE DISTRIBUTION



Remarks : Sampled by client.

FORM: A6

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Technical Signatory : B. Van Niekerk / A. Verwey / S. Dewnath

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## TEST RESULTS

ARQ CONSULTING ENGINEERS

P.O BOX 76379

LYNNWOOD RIDGE

0040

Attention: Madaleen Booysen

Project : Pienaarsrivier Filling Station

Your Ref : 8536

Our Ref : PL/26628

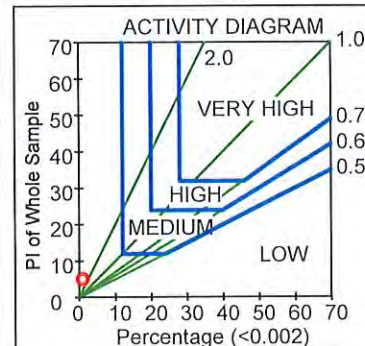
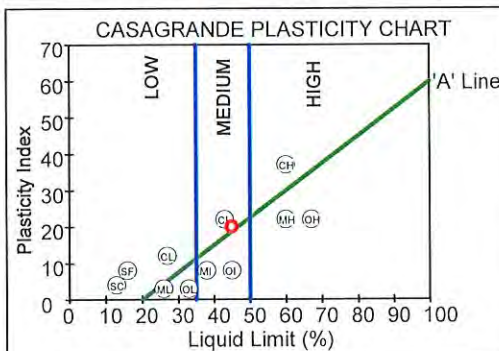
Date Reported : 18.02.2019

## FOUNDATION INDICATOR (ASTM: D422)

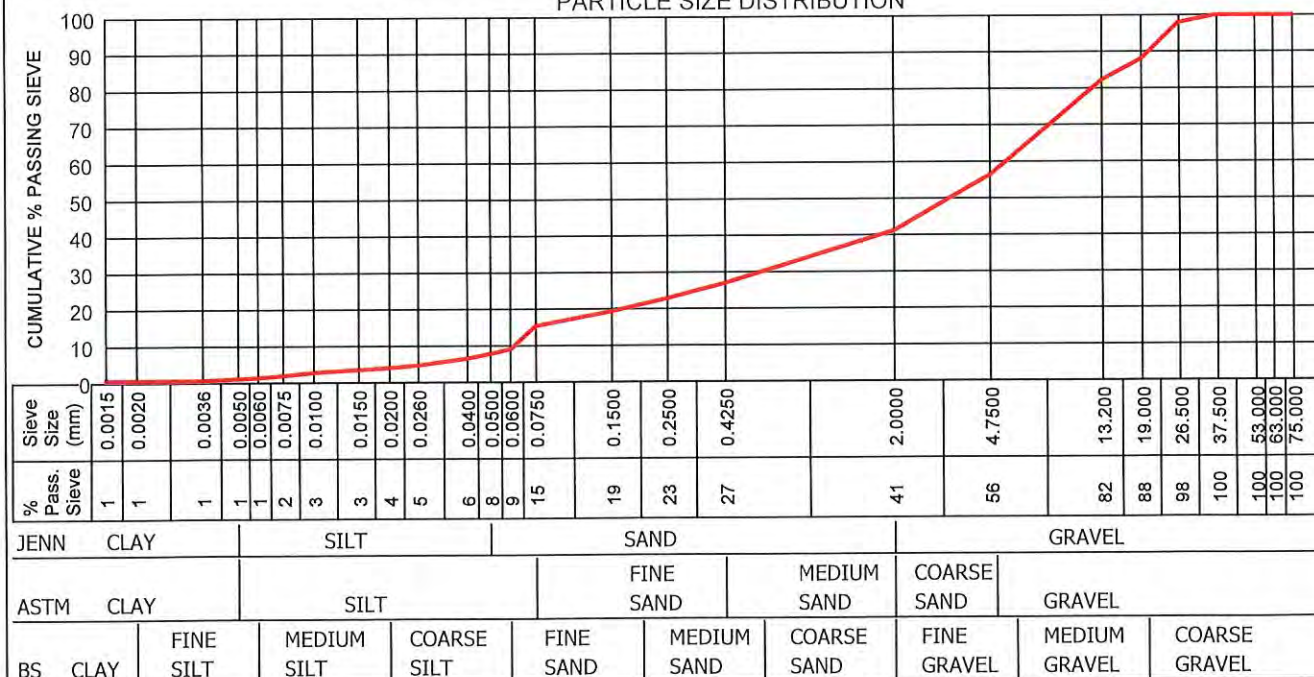
Sample No. : A9/273  
Hole No. : TPE  
Depth : 1100-2400  
Liquid Limit (%) : 45  
Plasticity Index : 20  
Linear Shrinkage (%) : 9.0  
PI of Whole Sample : 5  
P.R.A. Classification : A-2-7(0)  
Unified Soil Classification : SC  
Activity : 5.00  
Heave Classification : LOW  
Grading Modulus : 2.17  
Percentage (<0.002) : 1.0  
Moisture Content (%) : 6.5

Material Description : Light yellow brown SILTY SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	1.0	6.7	33.5	58.8	SAND
Astm	1.0	14.3	41.0	43.7	SILTY SAND
British Standard	0.5	8.5	32.1	58.8	SILTY SAND



## PARTICLE SIZE DISTRIBUTION



Remarks : Sampled by client.

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- CIVIL ENGINEERING SERVICES -  
Reg.No.: 2003/021980/07 - VAT. Reg.No.: 4040210587

a SANAS Accredited Testing Laboratory, No. T0025

256 Brander Street, Jan Niemand Park, Pretoria.  
P.O. Box 912387, Silverton, 0127  
Tel. : (012) 800 1299  
Fax : (012) 800 3043  
Email : bennie.vanniekerk@sgs.com

## TEST RESULTS

ARQ CONSULTING ENGINEERS

P.O BOX 76379

LYNNWOOD RIDGE

0040

Attention: Madaleen Booysen

Project : Pienaarsrivier Filling Station

Your Ref : 8536

Our Ref : PL/26628

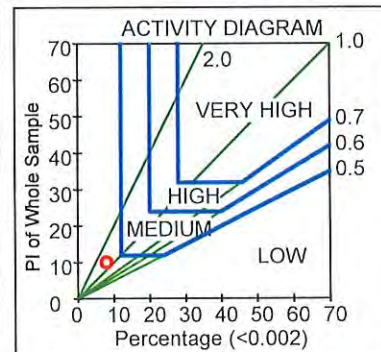
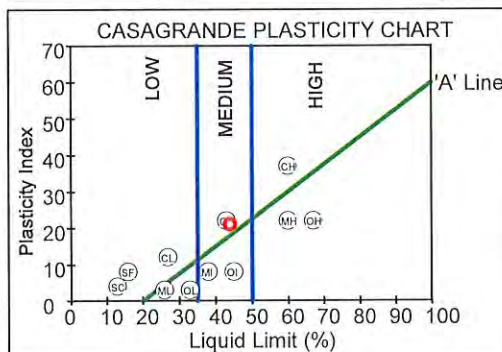
Date Reported : 18.02.2019

## FOUNDATION INDICATOR (ASTM: D422)

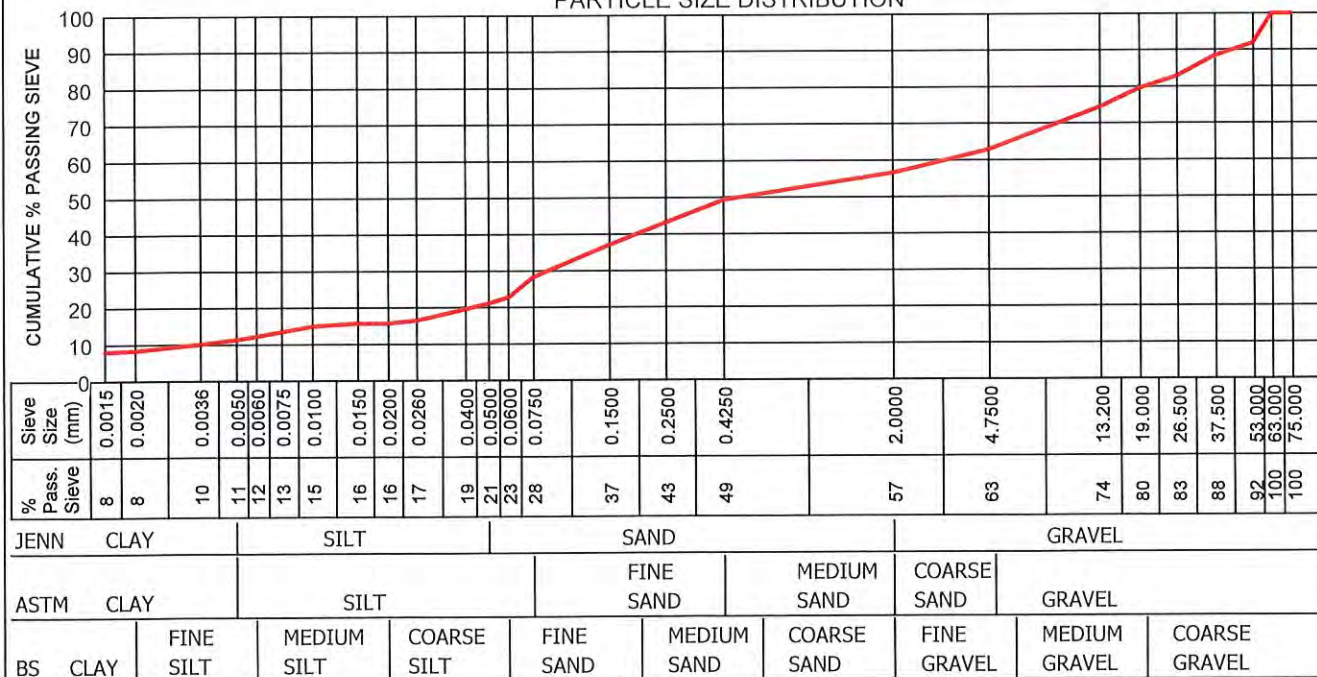
Sample No. : A9/274  
Hole No. : TPG  
Depth : 0-500  
Liquid Limit (%) : 44  
Plasticity Index : 21  
Linear Shrinkage (%) : 10.5  
PI of Whole Sample : 10  
P.R.A. Classification : A-2-7(1)  
Unified Soil Classificati: SC  
Activity : 1.25  
Heave Classification : LOW  
Grading Modulus : 1.66  
Percentage (<0.002) : 8.0  
Moisture Content (%) : 12.0

Material Description : Dark olive SILTY SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	11.3	9.8	35.4	43.5	CLAYEY SAND
Astm	11.3	16.9	34.6	37.2	SILTY SAND
British Standard	8.4	14.4	33.8	43.5	SILTY SAND



## PARTICLE SIZE DISTRIBUTION



Remarks : Sampled by client.

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P.O. Box 912387, Silverton, 0127  
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Fax : (012) 800 3043  
Email : bennie.vanniekerk@sgs.com

## TEST RESULTS

ARQ CONSULTING ENGINEERS  
P.O. BOX 76379  
LYNNWOOD RIDGE  
0040  
Attention: Madaleen Booysen

Project : Pienaarsrivier Filling Station

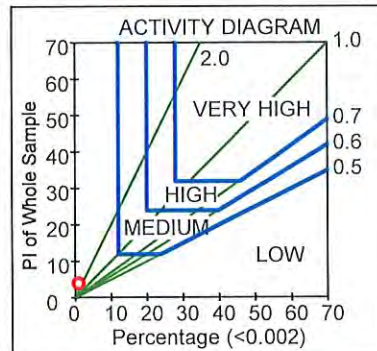
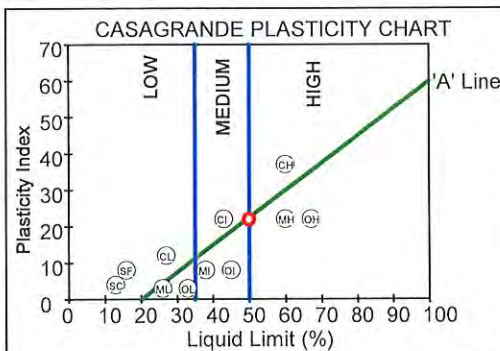
Your Ref : 8536  
Our Ref : PL/26628  
Date Reported : 18.02.2019

## FOUNDATION INDICATOR (ASTM: D422)

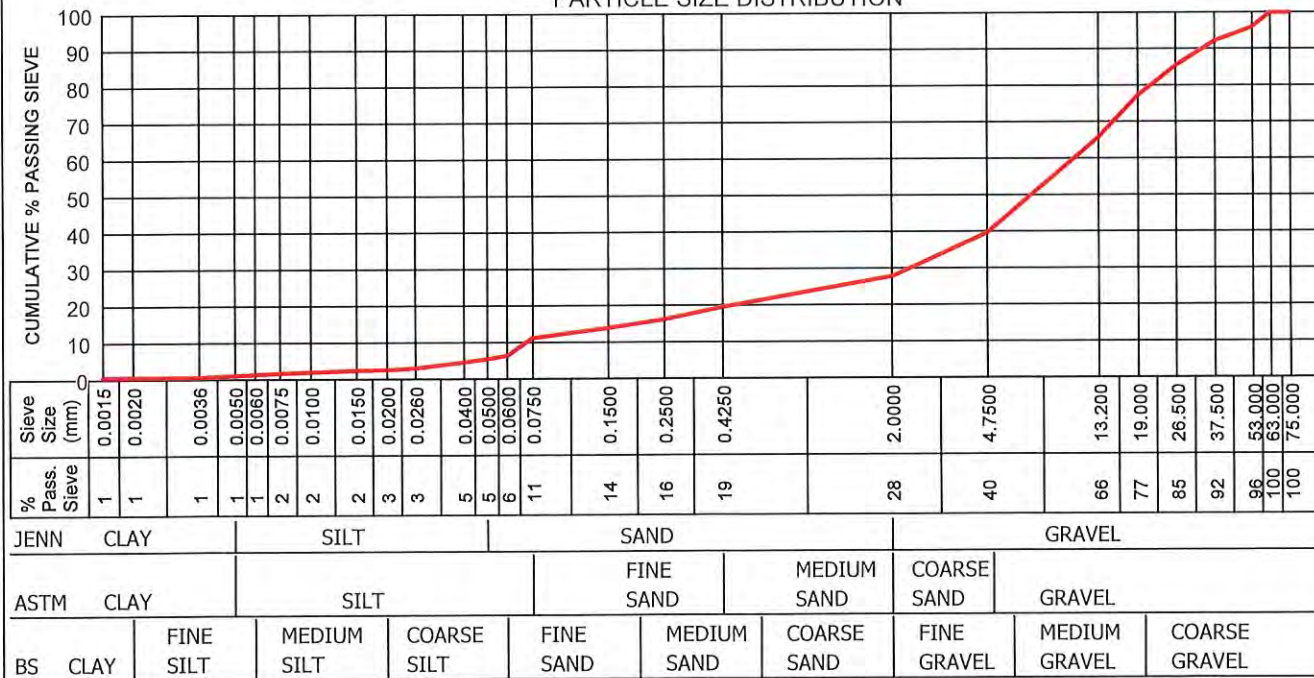
Sample No. : A9/275  
Hole No. : TPG  
Depth : 500-2100  
Liquid Limit (%) : 50  
Plasticity Index : 22  
Linear Shrinkage (%) : 11.0  
PI of Whole Sample : 4  
P.R.A. Classification : A-2-7(0)  
Unified Soil Classificati: GW-GM  
Activity : 4.00  
Heave Classification : LOW  
Grading Modulus : 2.42  
Percentage (<0.002) : 1.0  
Moisture Content (%) : 6.2

Material Description : Light yellow brown SILTY SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	1.0	4.4	22.4	72.2	SAND
Astm	1.0	10.2	28.4	60.5	SILTY SAND
British Standard	0.6	5.8	21.4	72.2	SILTY SAND



## PARTICLE SIZE DISTRIBUTION



Remarks : Sampled by client.

FORM: A6

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P.O Box 912387, Silverton, 0127  
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Fax : (012) 800 3043  
Email : bennie.vanniekerk@sgs.com

## TEST RESULTS

ARQ CONSULTING ENGINEERS  
P.O BOX 76379  
LYNNWOOD RIDGE  
0040  
Attention: Madaleen Booysen

Project : Pienaarsrivier Filling Station

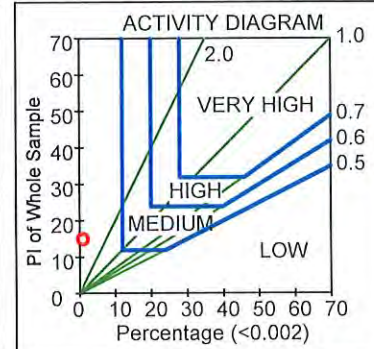
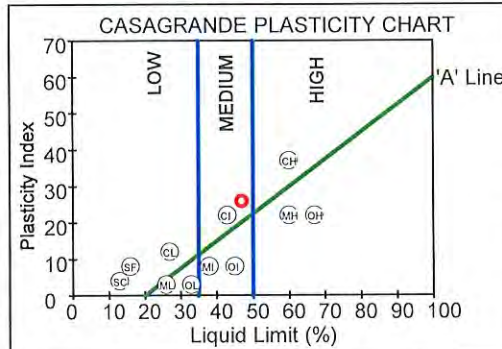
Your Ref : 8536  
Our Ref : PL/26628  
Date Reported : 18.02.2019

## FOUNDATION INDICATOR (ASTM: D422)

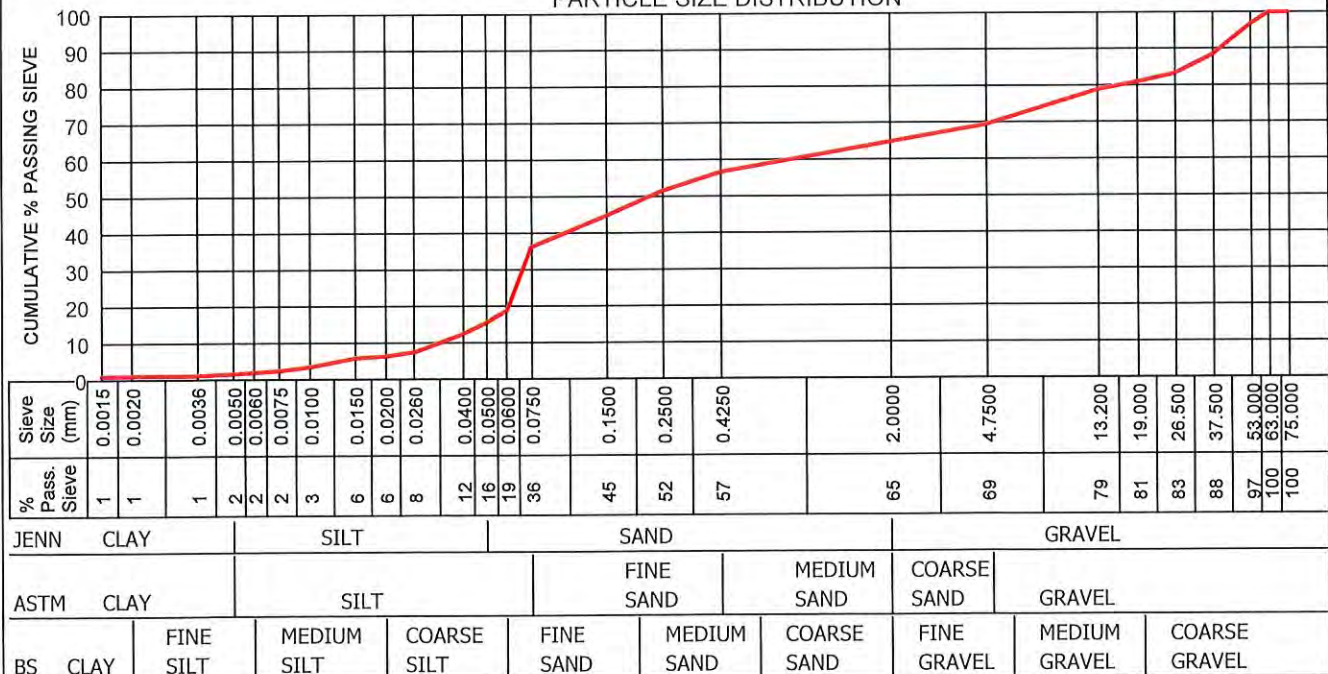
Sample No. : A9/276  
Hole No. : TPJ  
Depth : 0-800  
Liquid Limit (%) : 47  
Plasticity Index : 26  
Linear Shrinkage (%) : 13.5  
PI of Whole Sample : 15  
P.R.A. Classification : A-7-6(4)  
Unified Soil Classificati: SC  
Activity : 15.00  
Heave Classification : LOW  
Grading Modulus : 1.42  
Percentage (<0.002) : 1.0  
Moisture Content (%) : 10.2

Material Description : Dark brown SILTY SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	1.6	14.0	49.2	35.2	SILTY SAND
Astm	1.6	34.6	33.2	30.6	SILTY SAND
British Standard	1.1	17.8	45.9	35.2	SILTY SAND



## PARTICLE SIZE DISTRIBUTION



Remarks : Sampled by client.

FORM: A6

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## TEST RESULTS

ARQ CONSULTING ENGINEERS

P.O BOX 76379

LYNNWOOD RIDGE

0040

Attention: Madaleen Booysen

Project : Pienaarsrivier Filling Station

Your Ref : 8536

Our Ref : PL/26628

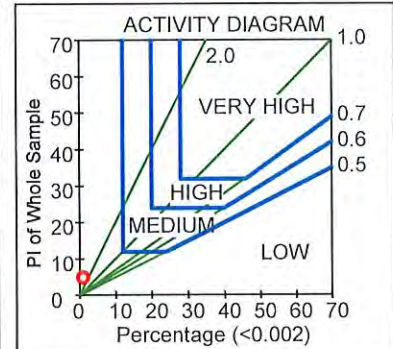
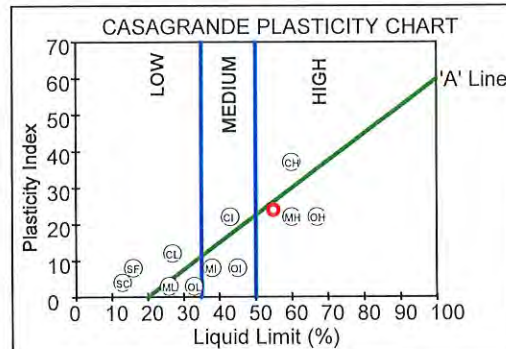
Date Reported : 18.02.2019

## FOUNDATION INDICATOR (ASTM: D422)

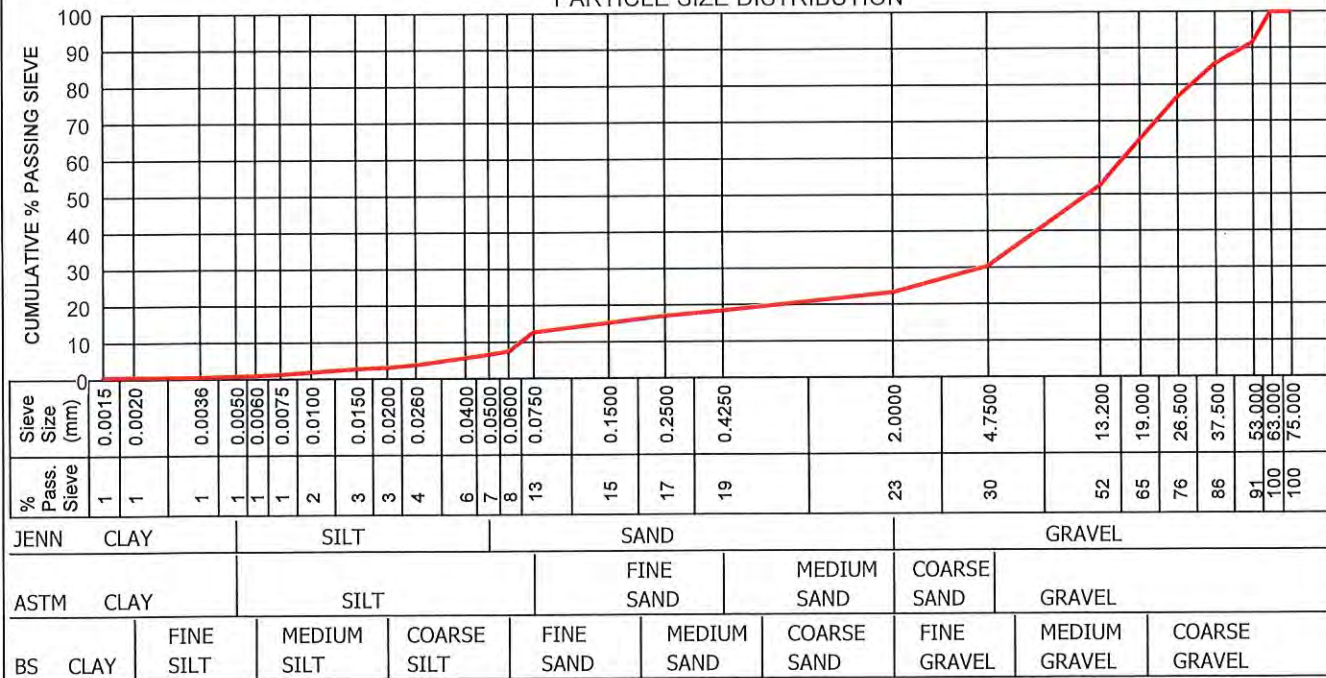
Sample No. : A9/293  
Hole No. : TPI  
Depth : 700-1800  
Liquid Limit (%) : 55  
Plasticity Index : 24  
Linear Shrinkage (%) : 11.0  
PI of Whole Sample : 5  
P.R.A. Classification : A-2-7(0)  
Unified Soil Classification: GM  
Activity : 5.00  
Heave Classification : LOW  
Grading Modulus : 2.45  
Percentage (<0.002) : 1.0  
Moisture Content (%) : 12.5

Material Description : Yellowish brown SILTY SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	0.8	5.8	16.7	76.6	SILTY SAND
Astm	0.8	11.9	17.7	69.6	SILTY SAND
British Standard	0.6	7.0	15.8	76.6	SILTY SAND



## PARTICLE SIZE DISTRIBUTION



Remarks : Sampled by client.

FORM: A6

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P.O. BOX 912387 SILVERTON 0127  
Tel. : 012-800 1299  
Fax. : 012-800 3034  
Email : [lizette.breiting@sgs.com](mailto:lizette.breiting@sgs.com)

## TEST RESULTS

Project: Pienaarsrivier Filling Atation

Your Ref: 8536  
Our Ref: PL/26628  
Date Reported: 18.02.2019

### PROPERTIES OF AGGREGATE AND SAND

[illegible]

Remarks: Sampled by client.
-----------------------------

Test covered, not part of scope of accreditation

for SGS Matrolab (Pty) Ltd. Technical Signatory: B. van Niekerk/L. Breiting

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P.O. BOX 912387 SILVERTON 0127  
Tel. : 012-800 1299  
Fax. : 012-800 3034  
Email : lizette.breiting@sgs.com

## TEST RESULTS

Project: Pienaarsrivier Filling Atation

Your Ref: 8536  
Our Ref: PL/26628a  
Date Reported: 18.02.2019

### PROPERTIES OF AGGREGATE AND SAND

[illegible]

Remarks: Sampled by client.
-----------------------------

Test covered, not part of scope of accreditation

for SGS Matrolab (Pty) Ltd. Technical Signatory: B. van Niekerk/L. Breiting

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**Client** : ARQ CONSULTING ENGINEERS (PTY) LTD  
**Address** : PO BOX 76379  
 : LYNNWOOD RIDGE  
 : 0040

**Client Reference** : PL-26628  
**Order No.** :

**Attention** : Madaleen Booysen  
**Facsimile** :  
**E-mail** :

**Date Received** : 01/02/2019  
**Date Tested** : 31/01/2019 - 18/02/2019  
**Date Reported** : 18/02/2019

**Project** : Pienaarsrivier Filling Station  
**Project No.** : 2019-S-177

**Report Status** : FINAL  
**Page** : 1 of 19

Herewith please find the test report(s) pertaining to the above project. All tests were conducted in accordance with prescribed test method(s). Information herein consists of the following:

Test(s) conducted / Item(s) measured	Qty.	Test Method(s)	Authorized By**	Page(s)
Moisture Density Relationship	6.000	SANS 3001: GR30		2-11
Atterberg Limits <0.425mm	6.000	SANS GR10,GR11,GR12		2-11
Sieve Analysis 0.075mm	6.000	SANS 3001: GR1, GR2		2-11
California Bearing Ratio (CBR)	6.000	SANS 3001: GR40		2-11
Foundation Indicators	6.000	ASTM: D422		12-17
PH & Conductivity	6.000	SANS 5854,6240		18-19

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a SANAS Accredited Testing Laboratory, No. T0025

Tests marked \* "Not SANAS Accredited" in this Report are not included in the  
 SANAS Schedule of Accreditation for the laboratory.

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Results only have bearing on the samples tested.

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4.4.0(SGS)(2016.08.31)

Technical Signatory: B. Van Niekerk / A. Verwey / S. Dewnath

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Client : ARQ CONSULTING ENGINEERS (PTY) LTD  
 Project : Pienaarsrivier Filling Station  
 Project No : 2019-S-177

Date Received : 31/01/2019  
 Date Reported : 18/02/2019  
 Page No. : of

**MATERIALS TEST REPORT**

Laboratory Number	A9/272			
Field Number				
Client Reference	8536			
Depth (m)	500-2000			
Position	TPB			
Coordinates	X Y			
Description	Light brown			
Additional information	Sampled by client.			
Calcrete/Crushed Stabilizing Agent	Natural			

**Sieve Analysis (Wet preparation)****SANS 3001: GR1, GR2**

Percentage Passing	100 mm	100		
	75 mm	100		
	63 mm	100		
	50 mm	94		
	37.5 mm	87		
	28 mm	81		
	20 mm	75		
	14 mm	68		
	5 mm	51		
	2 mm	51		
	0.425 mm	29		
	0.075 mm	19		
Grading Modulus		2.01		

**Soil Mortar Analysis**

Coarse Sand	2.0-0.425	43		
Coarse Fine Sand	0.425-0.250	6		
Medium Fine Sand	0.250-0.150	6		
Fine Fine Sand	0.150-0.075	8		
Silt and Clay	<0.075	37		

**Atterberg Limits****SANS GR10, GR11, GR12**

Liquid Limit	%	53		
Plasticity Index	%	26		
Linear Shrinkage	%	11.5		

**Maximum Dry Density & Optimum Moisture Content****SANS 3001: GR30**

Max. Dry Density	kg/m <sup>3</sup>	1991		
Optimum Moisture	%	13.5		

**CBR SANS 3001: GR40****UCS****ITS**

Test Type	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)
Interpolated Data												
@100%	11.3											
@ 98%	10.4											
@ 97%	9.9											
@ 95%	9.1											
@ 93%	8.4											
@ 90%	7.4											
Value @ Mod. AASHTO effort												
Swell (%) @ Mod. AASHTO effort	0.7											

**Classifications**

HRB	A-2-7(1)			
COLTO	G9			
TRH14				

a SANAS Accredited Testing Laboratory, No. T0025

Client : ARQ CONSULTING ENGINEERS (PTY) LTD  
Project : Pienaarsrivier Filling Station  
Project No. : 2019-S-177

Date Received : 31/01/2019  
Date Reported : 18/02/2019  
Page No. : 4 of 4

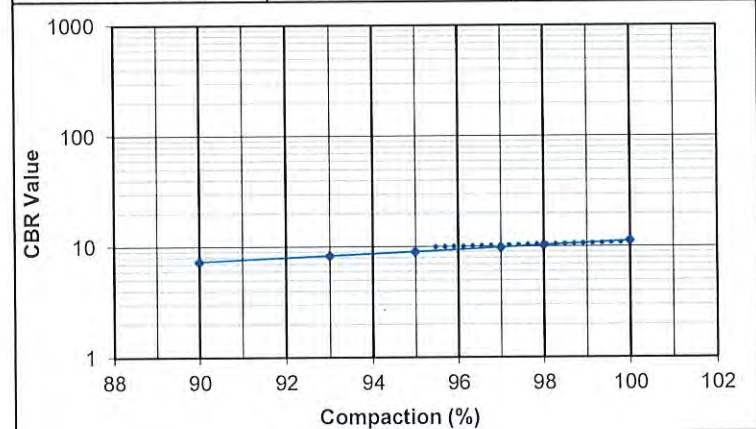
## CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

Laboratory No.	A9/272	
Field Number		
Client Reference	8536	
Depth (m)	500-2000	
Position	TPB	
Coordinates	X Y	
Description	Light brown	
Additional information	Sampled by client.	
Calcrete/Crushed Stabilizing Agent	Natural	

Laboratory No.	A9/272	
Maximum Dry Density & Optimum Moisture Content		SANS 3001: GR30
MDD	kg/m <sup>3</sup>	1991
OMC	%	13.5

### California Bearing Ratio SANS 3001: GR40

Compaction Data			
Moisture	%	14.6	
Dry Density	kg/m <sup>3</sup>	1972 1879 1780	
Compaction	%	100.0 95.3 90.3	
Penetration Data			
CBR at	2.50 mm	11 10 7	
	5.00 mm	12 10 9	
	7.50 mm	12 10 9	
Swell	%	0.7 0.9 1	
Final Moisture (%)			



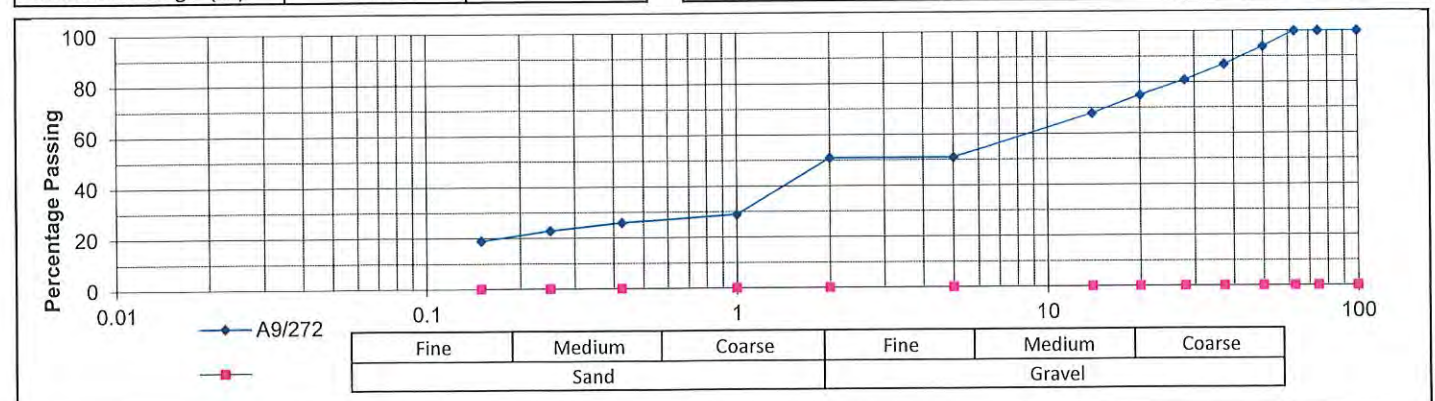
Interpolated CBR Data		
@ 100%	11	
@ 98%	10	
@ 97%	10	
@ 95%	9	
@ 93%	8	
@ 90%	7	
@ SANS3001 Midpoint	10	

Classifications	
HRB (AASHTO)	A-2-7(1)
COLTO	
TRH14	G9

Sieve Analysis (Wet preparation) SANS 3001: GR1, GR2	
Percentage Passing	
100 mm	100
75 mm	100
63 mm	100
50 mm	94
37.5 mm	87
28 mm	81
20 mm	75
14 mm	68
5 mm	51
2 mm	51
0.425 mm	29
0.250 mm	26
0.150 mm	23
0.075 mm	19
Grading Modulus	2.0

Soil Mortar Analysis	
Coarse Sand	43
Coarse Fine Sand	6
Medium Fine Sand	6
Fine Fine Sand	8
Silt and Clay	37

Atterberg Limits SANS GR10, GR11, GR12	
Liquid Limit (%)	53
Plasticity Index (%)	26
Linear Shrinkage (%)	11.5





Client : ARQ CONSULTING ENGINEERS (PTY) LTD  
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## MATERIALS TEST REPORT

Laboratory Number	A9/273			
Field Number				
Client Reference	8536			
Depth (m)	1100-2400			
Position	TPE			
Coordinates	X Y			
Description	Light yellow brown			
Additional information	Sampled by client.			
Calcrete/Crushed Stabilizing Agent	Natural			

### Sieve Analysis (Wet preparation)

SANS 3001: GR1, GR2

Sieve Analysis (Wet Preparation)			Grading Data (mm)		
Percentage Passing	100 mm	100			
	75 mm	100			
	63 mm	100			
	50 mm	100			
	37.5 mm	100			
	28 mm	98			
	20 mm	89			
	14 mm	83			
	5 mm	57			
	2 mm	57			
0.425 mm	28				
0.075 mm	16				
Grading Modulus	1.99				

### Soil Mortar Analysis

Coarse Sand	2.0-0.425	51			
Coarse Fine Sand	0.425-0.250	8			
Medium Fine Sand	0.250-0.150	6			
Fine Fine Sand	0.150-0.075	7			
Silt and Clay	<0.075	28			

### Atterberg Limits

SANS GR10,GR11,GR12

Liquid Limit	%	45			
Plasticity Index	%	20			
Linear Shrinkage	%	9			

### Maximum Dry Density & Optimum Moisture Content

SANS 3001: GR30

Max. Dry Density	kg/m <sup>3</sup>	2089			
Optimum Moisture	%	10.8			

CBR SANS 3001: GR40

UCS

ITS

Test Type	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)
Interpolated Data												
@100%	29.6											
@ 98%	23.4											
@ 97%	20.8											
@ 95%	16.5											
@ 93%	13											
@ 90%	9.2											
Value @ Mod. AASHTO effort												
Swell (%) @ Mod. AASHTO effort	0.1											

### Classifications

HRB	A-2-7(0)			
COLTO	G9			
TRH14				

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## CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

Laboratory No.	A9/273	
Field Number		
Client Reference	8536	
Depth (m)	1100-2400	
Position	TPE	
Coordinates	X Y	
Description	Light yellow brown	
Additional information	Sampled by client.	
Calcrete/Crushed Stabilizing Agent	Natural	

Laboratory No.	A9/273	
Maximum Dry Density & Optimum Moisture Content		SANS 3001: GR30
MDD	kg/m <sup>3</sup>	2089
OMC	%	10.8

### California Bearing Ratio SANS 3001: GR40

Compaction Data				
Moisture	%	10.8		
Dry Density	kg/m <sup>3</sup>	2090	1985	1889
Compaction	%	100.0	95.0	90.4
Penetration Data				
CBR at	2.50 mm	30	16	10
	5.00 mm	27	19	16
	7.50 mm	26	22	15
Swell	%	0.1	0.3	1
Final Moisture (%)				

### Sieve Analysis (Wet preparation) SANS 3001: GR1, GR2

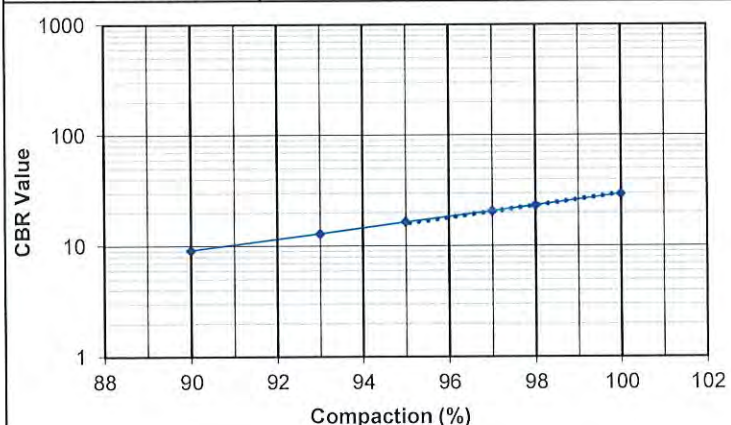
Percentage Passing	100 mm	100
	75 mm	100
	63 mm	100
	50 mm	100
	37.5 mm	100
	28 mm	98
	20 mm	89
	14 mm	83
	5 mm	57
	2 mm	57
	0.425 mm	28
	0.250 mm	24
	0.150 mm	20
	0.075 mm	16
Grading Modulus		2.0

### Soil Mortar Analysis

Coarse Sand	51
Coarse Fine Sand	8
Medium Fine Sand	6
Fine Fine Sand	7
Silt and Clay	28

### Atterberg Limits SANS GR10, GR11, GR12

Liquid Limit (%)	45
Plasticity Index (%)	20
Linear Shrinkage (%)	9.0

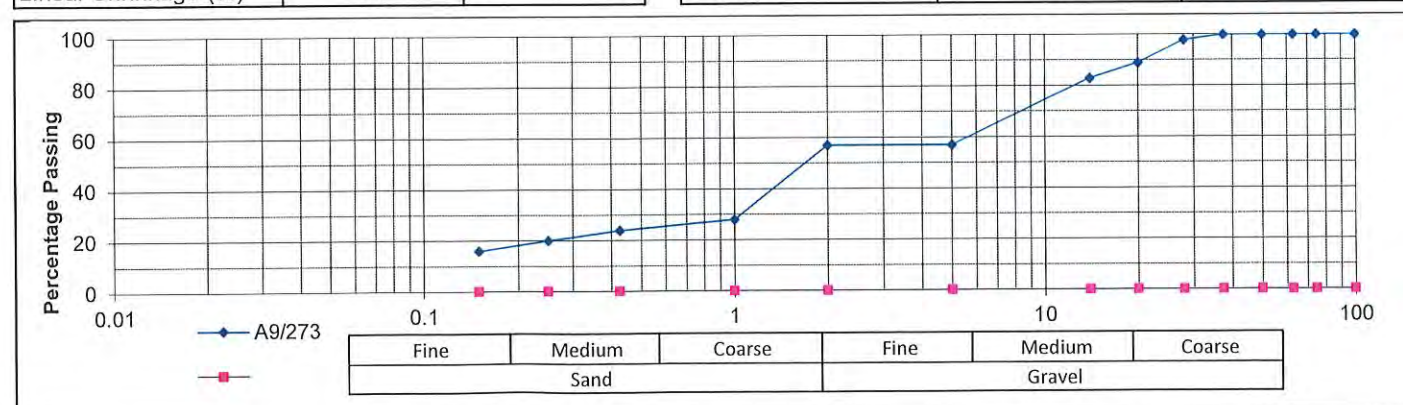


### Interpolated CBR Data

@ 100%	30
@ 98%	23
@ 97%	21
@ 95%	17
@ 93%	13
@ 90%	9
@ SANS3001 Midpoint	22

### Classifications

HRB (AASHTO)	A-2-7(0)
COLTO	
TRH14	G9





Client : ARQ CONSULTING ENGINEERS (PTY) LTD  
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## MATERIALS TEST REPORT

Laboratory Number	A9/274	A9/275		
Field Number				
Client Reference	8536	8536		
Depth (m)	0-500	500-2100		
Position	TPG	TPG		
Coordinates	X			
	Y			
Description	Dark olive	Light yellow brown		
Additional information	Sampled by client.	Sampled by client.		
Calcrete/Crushed				
Stabilizing Agent	Natural	Natural		

### Sieve Analysis (Wet preparation)

SANS 3001: GR1, GR2

Percentage Passing	100 mm	100	100		
	75 mm	100	100		
	63 mm	100	100		
	50 mm	92	96		
	37.5 mm	89	92		
	28 mm	84	85		
	20 mm	81	77		
	14 mm	76	66		
	5 mm	64	40		
	2 mm	64	40		
	0.425 mm	51	20		
	0.075 mm	29	12		
Grading Modulus		1.56	2.28		

### Soil Mortar Analysis

Coarse Sand	2.0-0.425	20	50		
Coarse Fine Sand	0.425-0.250	9	8		
Medium Fine Sand	0.250-0.150	10	6		
Fine Fine Sand	0.150-0.075	14	7		
Silt and Clay	<0.075	46	29		

### Atterberg Limits

SANS GR10, GR11, GR12

Liquid Limit	%	45	50		
Plasticity Index	%	22	22		
Linear Shrinkage	%	10.5	11		

### Maximum Dry Density & Optimum Moisture Content

SANS 3001: GR30

Max. Dry Density	kg/m <sup>3</sup>	1806	2075		
Optimum Moisture	%	15.3	11.4		

CBR SANS 3001: GR40

UCS

ITS

Test Type	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)
Interpolated Data	6.9			15								
@100%	6.5			11.8								
@98%	6.4			10.5								
@97%	6			8.2								
@95%	5.7			6.5								
@93%	5.2			4.5								
@90%												
Value @ Mod. AASHTO effort												
Swell (%) @ Mod. AASHTO effort	1.1			0.7								

### Classifications

HRB	A-2-7(2)	A-2-7(0)		
COLTO				
TRH14	G10	G10		

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## CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

Laboratory No.	A9/274	A9/275
Field Number		
Client Reference	8536	8536
Depth (m)	0-500	500-2100
Position	TPG	TPG
Coordinates	X	
	Y	
Description	Dark olive	Light yellow brown
Additional information	Sampled by client.	Sampled by client.
Calcrete/Crushed Stabilizing Agent	Natural	Natural

Laboratory No.	A9/274	A9/275
Maximum Dry Density & Optimum Moisture Content SANS 3001: GR30		
MDD	kg/m <sup>3</sup>	1806
OMC	%	15.3
		2075
		11.4

### California Bearing Ratio SANS 3001: GR40

Compaction Data						
Moisture	%	15.5			11.2	
Dry Density	kg/m <sup>3</sup>	1865	1718	1641	2080	1975
Compaction	%	100.0	92.1	88.0	100.0	95.0
					90.7	

Penetration Data						
CBR at	2.50 mm	7	6	5	12	11
	5.00 mm	6	5	4	15	14
	7.50 mm	5	5	4	19	18
Swell	%	1.1	1.2	1.5	0.7	0.9
Final Moisture (%)						

### Sieve Analysis (Wet preparation) SANS 3001: GR1, GR2

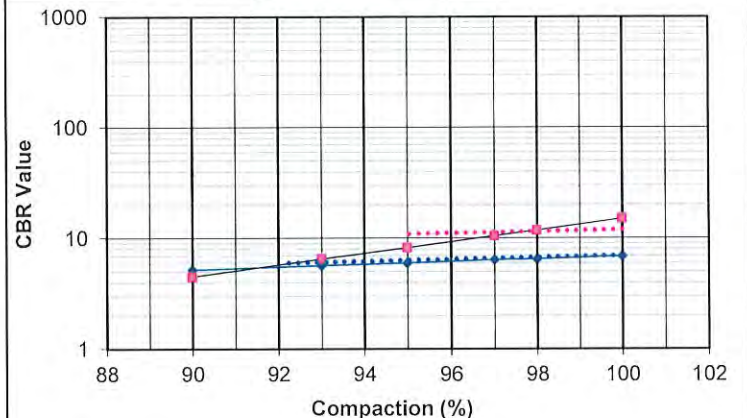
Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	92	96
	37.5 mm	89	92
	28 mm	84	85
	20 mm	81	77
	14 mm	76	66
	5 mm	64	40
	2 mm	64	40
	0.425 mm	51	20
	0.250 mm	45	17
	0.150 mm	39	15
	0.075 mm	29	12
Grading Modulus		1.6	2.3

### Soil Mortar Analysis

Coarse Sand	20	50
Coarse Fine Sand	9	8
Medium Fine Sand	10	6
Fine Fine Sand	14	7
Silt and Clay	46	29

### Atterberg Limits SANS GR10, GR11, GR12

Liquid Limit (%)	45	50
Plasticity Index (%)	22	22
Linear Shrinkage (%)	10.5	11.0

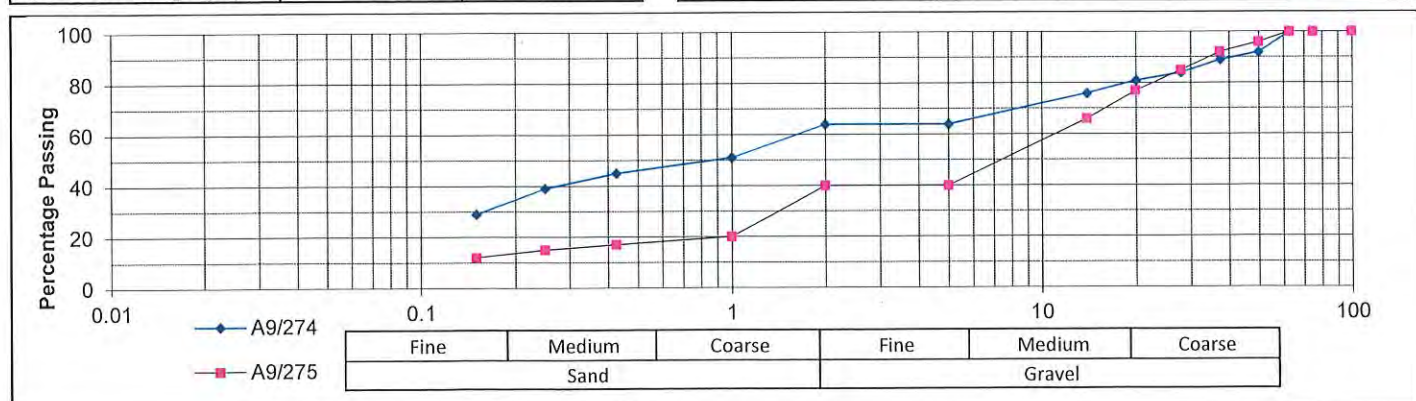


### Interpolated CBR Data

@ 100%	7	15
@ 98%	7	12
@ 97%	6	11
@ 95%	6	8
@ 93%	6	7
@ 90%	5	5
@ SANS3001 Midpoint	6	11

### Classifications

HRB (AASHTO)	A-2-7(2)	A-2-7(0)
COLTO		
TRH14	G10	G10





Client : ARQ CONSULTING ENGINEERS (PTY) LTD  
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**MATERIALS TEST REPORT**

Laboratory Number	A9/276			
Field Number				
Client Reference	8536			
Depth (m)	0-800			
Position	TPJ			
Coordinates	X Y			
Description	Dark brown			
Additional information	Sampled by client.			
Calcrete/Crushed Stabilizing Agent	Natural			

**Sieve Analysis (Wet preparation)****SANS 3001: GR1, GR2**

Percentage Passing	100 mm	100		
	75 mm	100		
	63 mm	100		
	50 mm	97		
	37.5 mm	89		
	28 mm	84		
	20 mm	82		
	14 mm	80		
	5 mm	70		
	2 mm	65		
	0.425 mm	57		
	0.075 mm	36		
Grading Modulus		1.42		

**Soil Mortar Analysis**

Coarse Sand	2.0-0.425	12		
Coarse Fine Sand	0.425-0.250	8		
Medium Fine Sand	0.250-0.150	10		
Fine Fine Sand	0.150-0.075	13		
Silt and Clay	<0.075	56		

**Atterberg Limits****SANS GR10, GR11, GR12**

Liquid Limit	%	47		
Plasticity Index	%	26		
Linear Shrinkage	%	13.5		

**Maximum Dry Density & Optimum Moisture Content****SANS 3001: GR30**

Max. Dry Density	kg/m <sup>3</sup>	1740		
Optimum Moisture	%	14.9		

**CBR SANS 3001: GR40****UCS****ITS**

Test Type			CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)
Interpolated Data	@100%	Mod. AASHTO	5.8											
	@ 98%		4.9											
	@ 97%		4.5											
	@ 95%		3.8											
	@ 93%		3.1											
	@ 90%		2.4											
Value @ Mod. AASHTO effort														
Swell (%) @ Mod. AASHTO effort			1.6											

**Classifications**

HRB	A-7-6(4)			
COLTO				
TRH14				



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## CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

Laboratory No.	A9/276	
Field Number		
Client Reference	8536	
Depth (m)	0.0-0.8	
Position	TPJ	
Coordinates	X Y	
Description	Dark brown	
Additional information	Sampled by client.	
Calcrete/Crushed Stabilizing Agent	Natural	

Laboratory No.	A9/276	
Maximum Dry Density & Optimum Moisture Content		SANS 3001: GR30
MDD	kg/m <sup>3</sup>	1740
OMC	%	14.9

### California Bearing Ratio SANS 3001: GR40

Compaction Data				
Moisture	%	14.8		
Dry Density	kg/m <sup>3</sup>	1745	1607	1521
Compaction	%	100.0	92.1	87.2
Penetration Data				
CBR at	2.50 mm	6	3	2
	5.00 mm	7	3	2
	7.50 mm	6	3	2
Swell	%	1.6	1.9	2
Final Moisture (%)				

### Sieve Analysis (Wet preparation) SANS 3001: GR1, GR2

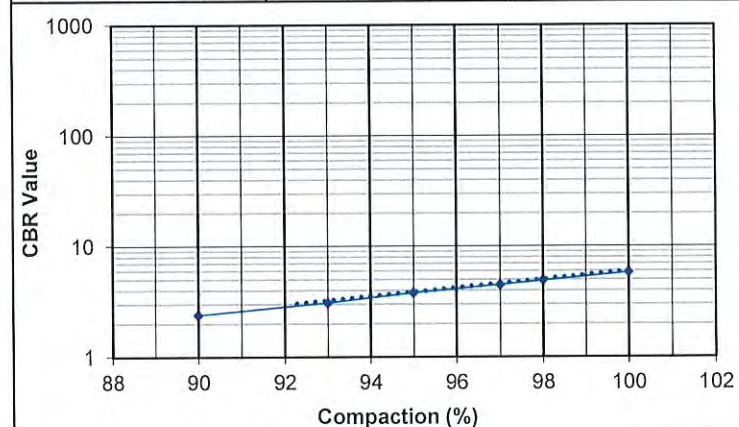
Percentage Passing	100 mm	100
	75 mm	100
	63 mm	100
	50 mm	97
	37.5 mm	89
	28 mm	84
	20 mm	82
	14 mm	80
	5 mm	70
	2 mm	65
	0.425 mm	57
	0.250 mm	52
	0.150 mm	45
	0.075 mm	36
Grading Modulus		1.4

### Soil Mortar Analysis

Coarse Sand	12
Coarse Fine Sand	8
Medium Fine Sand	10
Fine Fine Sand	13
Silt and Clay	56

### Atterberg Limits SANS GR10, GR11, GR12

Liquid Limit (%)	47
Plasticity Index (%)	26
Linear Shrinkage (%)	13.5

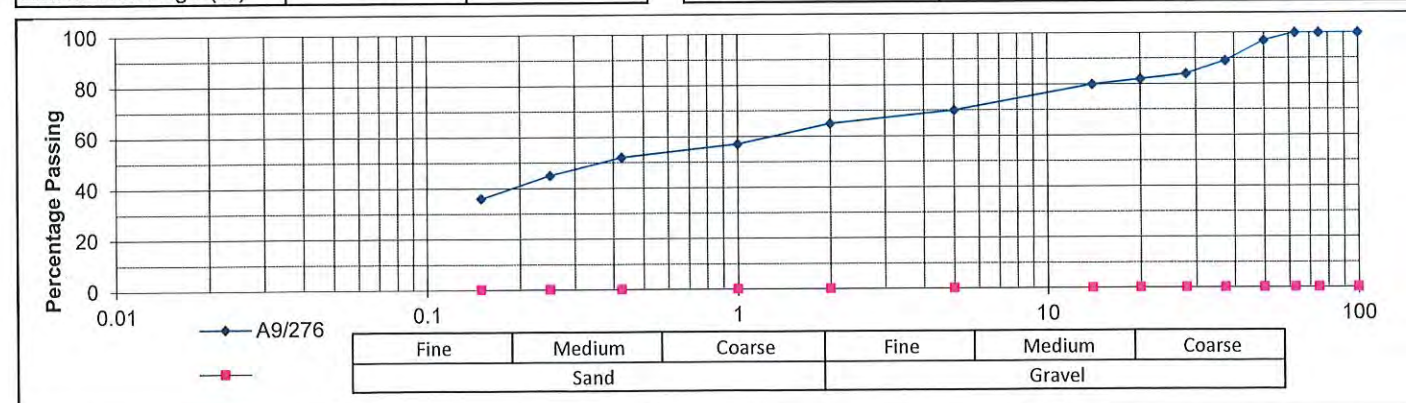


### Interpolated CBR Data

CBR	@ 100%	6
	@ 98%	5
	@ 97%	5
	@ 95%	4
	@ 93%	3
	@ 90%	2
	@ SANS3001 Midpoint	4

### Classifications

HRB (AASHTO)	A-7-6(4)
COLTO	
TRH14	





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## MATERIALS TEST REPORT

Laboratory Number	A9/293			
Field Number				
Client Reference	8536			
Depth (m)	700-1800			
Position	TPI			
Coordinates	X			
	Y			
Description	Yellowish brown			
Additional information	Sampled by client.			
Calcrete/Crushed				
Stabilizing Agent	Natural			

### Sieve Analysis (Wet preparation)

SANS 3001: GR1, GR2

Sieve Analysis (Wet Preparation)		Sieve Analysis (Dry Preparation)	
Percentage Passing	100 mm	100	
	75 mm	100	
	63 mm	100	
	50 mm	92	
	37.5 mm	86	
	28 mm	77	
	20 mm	66	
	14 mm	53	
	5 mm	31	
	2 mm	24	
0.425 mm	19		
0.075 mm	13		
Grading Modulus	2.44		

### Soil Mortar Analysis

Coarse Sand	2.0-0.425	21			
Coarse Fine Sand	0.425-0.250	8			
Medium Fine Sand	0.250-0.150	7			
Fine Fine Sand	0.150-0.075	11			
Silt and Clay	<0.075	53			

### Atterberg Limits

SANS GR10,GR11,GR12

Liquid Limit	%	55			
Plasticity Index	%	24			
Linear Shrinkage	%	11			

### Maximum Dry Density & Optimum Moisture Content

SANS 3001: GR30

Max. Dry Density	kg/m <sup>3</sup>	2107			
Optimum Moisture	%	9.2			

### CBR SANS 3001: GR40

### UCS

### ITS

Test Type	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)	CBR (%)	UCS (kPa)	ITS (kPa)
Interpolated Data												
@100%	30.2											
@ 98%	27.7											
@ 97%	26.5											
@ 95%	24.2											
@ 93%	22.2											
@ 90%	19.4											
Value @ Mod. AASHTO effort												
Swell (%) @ Mod. AASHTO effort	0.3											

### Classifications

HRB	A-2-7(0)			
COLTO				
TRH14	G8			



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## CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

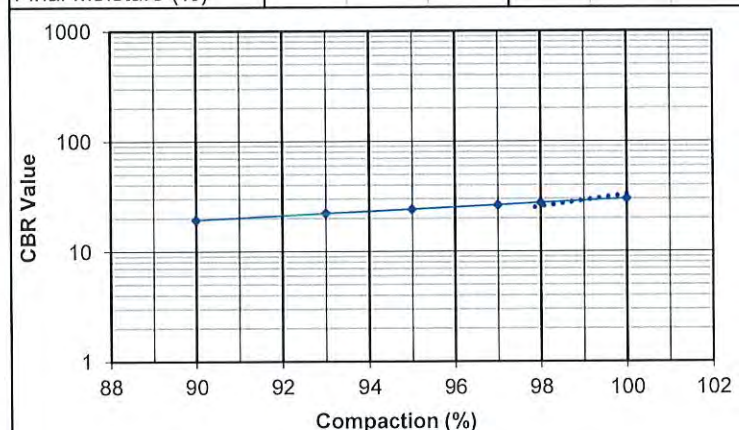
Laboratory No.	A9/293	
Field Number		
Client Reference	8536	
Depth (m)	700-1800	
Position	TPI	
Coordinates	X Y	
Description	Yellowish brown	
Additional information	Sampled by client.	
Calcrete/Crushed		
Stabilizing Agent	Natural	

Laboratory No.	A9/293	
Maximum Dry Density & Optimum Moisture Content		SANS 3001: GR30
MDD	kg/m <sup>3</sup>	2107
OMC	%	9.2

California Bearing Ratio		SANS 3001: GR40
--------------------------	--	-----------------

Compaction Data				
Moisture	%	9.6		
Dry Density	kg/m <sup>3</sup>	2105	2058	1911
Compaction	%	100.0	97.8	90.8

Penetration Data				
CBR at	2.50 mm	33	25	20
	5.00 mm	42	33	22
	7.50 mm	44	36	22
Swell	%	0.3	0.4	0.6
Final Moisture (%)				



Interpolated CBR Data		
CBR	@ 100%	30
	@ 98%	28
	@ 97%	27
	@ 95%	24
	@ 93%	22
	@ 90%	19
	@ SANS3001 Midpoint	29

Classifications	
HRB (AASHTO)	A-2-7(0)
COLTO	
TRH14	G8

### Sieve Analysis (Wet preparation) SANS 3001: GR1, GR2

Percentage Passing	100 mm	100
	75 mm	100
	63 mm	100
	50 mm	92
	37.5 mm	86
	28 mm	77
	20 mm	66
	14 mm	53
	5 mm	31
	2 mm	24
	0.425 mm	19
	0.250 mm	17
	0.150 mm	15
	0.075 mm	13
Grading Modulus		2.4

Soil Mortar Analysis	
Coarse Sand	21
Coarse Fine Sand	8
Medium Fine Sand	7
Fine Fine Sand	11
Silt and Clay	53

Atterberg Limits SANS GR10, GR11, GR12	
Liquid Limit (%)	55
Plasticity Index (%)	24
Linear Shrinkage (%)	11.0

