Annexure J

Geotechnical Investigation

JOINT EFFORT TRUST
(Bloemfontein)

GEOTECHNICAL REPORT FOR THE PROPOSED NEW TOWN ESTABLISHMENT AT FARM KLOOF 2921, BLOEMFONTEIN, FREE STATE.

GEOTECHNICAL INVESTIGATION

REFERENCE: SL / 2769 **Document No.: 2016/393/Doc.** **SEPTEMBER 2016**

REG. No. 1987/004282/07 NLA No. 2012/187

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Enquiries : BLOEMFONTEIN
File Reference : SL / 2769
Your Reference : New Town Establishment at De Kloof 2921, Bloemfontein - 37ha.

Document Number : 2016/393/Doc.
Date : SEPTEMBER 2016

JOINT EFFORT TRUST
(Bloemfontein)

GEOTECHNICAL REPORT FOR THE PROPOSED NEW TOWN ESTABLISHMENT AT FARM KLOOF 2921, BLOEMFONTEIN, FREE STATE.

GEOTECHNICAL INVESTIGATION

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DISCLAIMER

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EXECUTIVE SUMMARY

- A geotechnical investigation was conducted on 13th July 2016 for the Proposed New Town Establishment at Farm De Kloof 2921, Bloemfontein, Free State Province as per instruction received from the client; JOINT EFFORT TRUST (Bloemfontein).
- The approximate size of the investigated site is 37.0ha.
- The sampling of the materials was done in accordance to the TMH 5:1981 and as specified by the client. Nineteen (19) test pits were excavated using a TLB (KOMATSU WB93R). Sixteen (16) foundation indicator samples along with twelve (12) Maximum Dry Density (MOD AASHTO) and California Bearing Ratio (CBR) were sampled on site to determine the Engineering properties of the materials.
- The geology of the Bloemfontein area is underlain by the Lower Stage of the Beaufort Group which is part of the Karoo Super Group. The sedimentary rocks that are present in this group consist of fine-grained grey sandstone and coarse arkose alternating with green and maroon-coloured mudstone beds. The typical materials / rock type found in the area of Bloemfontein are Mudstone and Dolerite as per Table 3 and Figure 2.
- Bloemfontein is in the semi-arid to sub-tropical climatic region with Weinert's N – value of between 2 and 4, where chemical decomposition is the predominant rock weathering mode.
- No ground-water seepage was encountered at the time of the investigation.
- Determining a flood line is not part of this report scope and thus, no flood line of any kind was determined. Provision should be made for drainage structures underground or at the surface where applicable.
- The materials occurring on site has a Mildly Corrosive, Moderately Corrosive to Corrosive nature. Full chemical testing for the presence of sulphates and chlorides has not been conducted.
- Typical materials that were found on site are: SW-SC – Well-graded sand with silty clay and weathered dolerite gravel, SM – Silty sand with weathered dolerite gravel, CL – Sandy lean clay, SC – Clayey sand with weathered dolerite gravel, SW – Well-graded sand with weathered dolerite gravel, GP-GC – Poorly graded weathered dolerite gravel with clay and sand and SC-SM – Silty clayey sand with weathered dolerite gravel. Refusal layers / Bedrock were encountered during the investigation in some of the test pits.
- The excavation class (excavatability) for the investigated area is Soft to an average depth of 0.763m. The materials on site could be efficiently removed with a TLB (4x4) to a depth of 0.763m. Surface rock were encountered.
- The Plasticity Index (PI) of the materials ranges from Non Plastic (NP) to 24%, the Linear Shrinkage (LS) ranges from 0.0% to 12.1% and the percentage of Clay Fraction in the soils sample (<0.002mm) ranges from 0% to 28%.
- In general, the materials which occur on site are low to medium potentially expansive according to Van Der Merwe's method with high probability of collapsing nature according to Handy (1973) and Priklonski (1952) criteria therefore the materials on site are in general classified as H2.
- The general materials on site have COLTO classification between G6 and No Classification.
- The general foundation is considered to be: Strip footings or Slab-on-the-ground foundation.

REPORT

1. INTRODUCTION

1.1 Terms of reference

JOINT EFFORT TRUST (Bloemfontein) appointed Simlab (Pty) Limited - Geotechnical Services (Bloemfontein) to conduct a geotechnical investigation and write a geotechnical report for the Proposed New Town Establishment at Farm De Kloof 2921, Bloemfontein, Free State Province.

The scope of the investigation was to investigate the proposed area by excavating nineteen (19) test pits covering the area of the proposed development.

The purpose of the investigation was to determine the feasibility of the area for the proposed development as well as the founding conditions for these structures and to gain the following information:

- Determine the geological and geotechnical characteristics of the *in situ* soils / materials underlying the site.
- Determine the excavatability of the *in situ* soils / materials on site.
- Identify geotechnical constraints for the establishment of structures, services and roads.
- Determine the characteristics of the *in situ* soils / materials for the use in filling and the construction of roads.

This report contains the results and findings of the geotechnical investigation done by Simlab (Pty) Limited - Geotechnical Services (Bloemfontein) for Proposed New Town Establishment at Farm Kloof 2921, Bloemfontein, Free State Province. The investigation included nineteen (19) test pits and laboratory testing results of the *in situ* soils / materials.

Recommendations are made with regard to founding conditions for the proposed establishment for buildings, roads and other structures. Recommendations are based on the information gathered at the time of the investigation.

1.2 Location

The proposed site is located approximately 8.0km from the Bloemfontein City Centre in a northern direction. The proposed site is located in Kenneth Kaunda Road (Eeufees Road) towards the N1,

Bloemfontein. Entrance to the site can be gained via Kenneth Kaunda Road (Eeufees Road) on the left in the direction of the N1. The proposed site is situated on a farm with the centre co-ordinate of the investigated area as 27 Y0075318 X3215810. See Location Plan and Layout Plan in Appendices A & H for more detail.

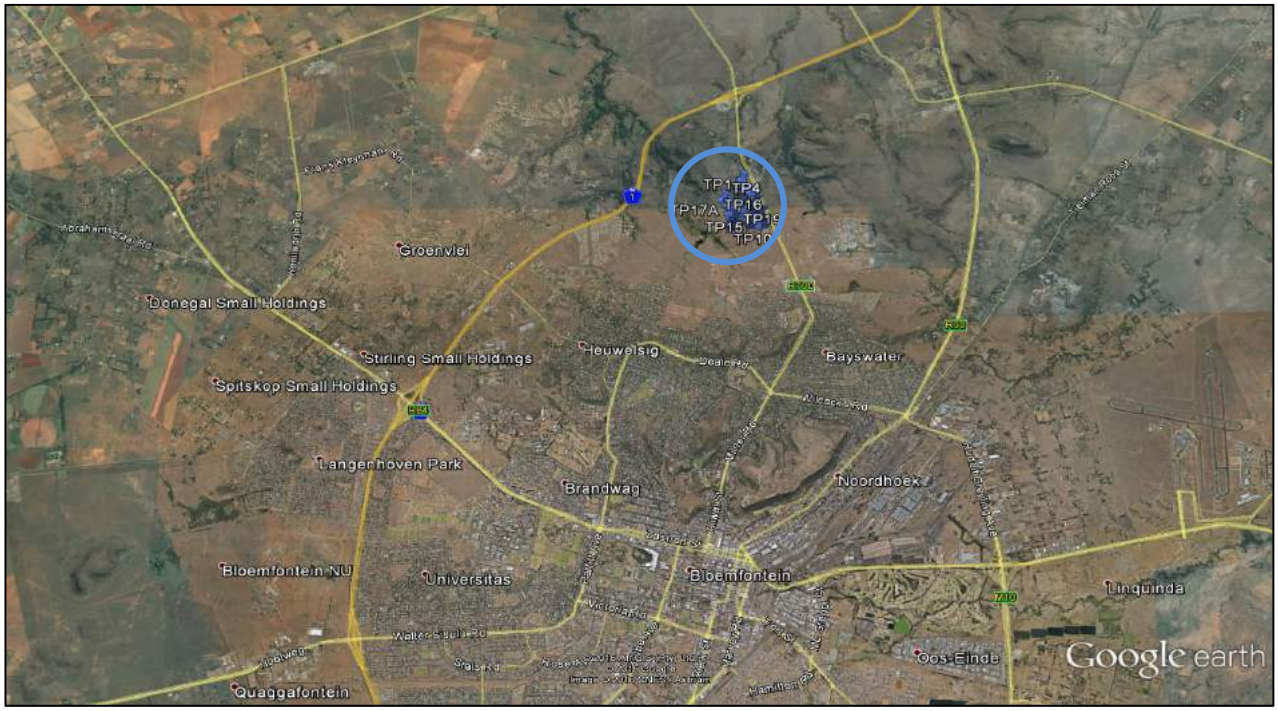

Figure 1 – Site Location (Google Earth)

1.3 Area

The size of the investigated area is 37.0ha.

1.4 Available Information

At the time of the investigation the following were available:

- 1 : 50 000 Topocadastral map (2926, Bloemfontein)
- 1 : 250 000 Geological map (2926, Bloemfontein)
- Google Photo of the area / site
- Drawing indicating site boundry

2. INFORMATION USED IN THE STUDY

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- Software: Google Earth® 6.2.2. 6613, Google Inc. 2013, Map Source® 6.16.3, Garmin™, 2010 and dotPLOT® 2.4.0, Software Africa©, 2010.

3. PROJECT DETAIL

3.1 Client

JOINT EFFORT TRUST (Bloemfontein)

3.2 Client Representative

Mr. Hennie Lambrechts

3.3 Client Contact Details

Table 1: Client Contact Details

Postal Address	Street Address
PO Box 363 **BLOEMFONTEIN** 9300	162 Nelson Mandela Drive **BLOEMFONTEIN** 9301
Tel : 051 430 1551	
admin@hlarchitects.co.za	

3.4 Project Name

Geotechnical Report on the Geotechnical / Foundation Conditions for the Proposed New Town Establishment at Farm De Kloof 2921, Bloemfontein, Free State Province.

3.5 Testing Laboratory

Simlab (Pty) Limited – Geotechnical Services (Bloemfontein)

3.6 Laboratory Contact Details

Table 2: Laboratory Contact Details

Postal Address	Street Address
PO Box 6249 **BLOEMFONTEIN**	Cnr Lunn Road & Grey Street Hilton

Postal Address	Street Address
9300	**BLOEMFONTEIN** 9301
Tel : 051 – 447 0224 / 5	Fax : 051 – 448 8329
www.simlab.co.za ; simbfn@simlab.co.za	

3.7 Sample Details

Sampled by:	Mr FJ Coetser (Technical Assistant)
	Mr WT Hitge (Technologist)
Date Sampled:	13th July 2016
Date Tested:	18th July 2016 – 29th August 2016
Report Date:	16th September 2016

3.8 Sampling and Testing

Sampled according to the TMH5: 1981, method MA2 and specifications of the client. Sampling was done by means of a TLB (KOMATSU WB93R). Tested according to the SANS 3001 as well as TMH1: 1986, specifications. The test methods used include SANAS accredited methods:

- * SANS 3001 – GR1: 2011 – Wet preparation and particle size analysis.
- * SANS 3001 – GR10: 2011 – Determination of the one-point liquid limit, plastic limit, plasticity index and linear shrinkage.
- SANS 3001 – GR20: 2010 – Determination of the moisture content by oven-drying.
- * SANS 3001 – GR30: 2010 – Determination of the maximum dry density and optimum moisture content.
- * SANS 3001 – GR40: 2010 – Determination of the California Bearing Ratio.
- * SANS 3001 – PR5: 2011 – Computation of soil-mortar percentages and grading modulus.
- * SABS 0120: Part 3 – The extent to which a particular material will compact.
- * TMH1: 1986, A6 – The determination of the grain size distribution in soils by means of a hydrometer. (Particle Size Distribution of Samples)
- * TMH1: 1986, A20 – The electrometric determination of the pH-value of a soil suspension.
- * TMH1: 1986, A21T – Tentative method for the determination of the conductivity of a saturated soil paste and water.
- * TMH6: 1984, ST6 - Dynamic Cone Penetrometer (DCP) Test
- * COLTO Classification of Materials properties.
- * Potential Expansiveness of the Materials – Van Der Merwe's method.
- * Estimated Bearing Ratio of the Materials – Dr. B van Wyk's method.

- * Classification of Site – NHBRC Home Building Manual, Part1, Section2, Table: Residential Site Class Designations.

Tests marked - * / “Not SANAS Accredited” in this report are not in the SANAS Schedule of Accreditation for this laboratory” Opinions and interpretations expressed in the report are outside the scope of SANAS Accreditation of Simlab (Pty) Limited – Geotechnical Services.

3.9 Positions Sampled

Simlab (Pty) Limited – Geotechnical Services (Bloemfontein) sampled and tested at positions shown on the Layout Plan (Appendix H).

4. TOPOGRAPHY

The proposed site is situated on an area with relatively flat plains, hills and valleys with slopes. A house is situated in the centre of the site with large trees surrounding it. Some fences are found on site that divided the farm into sections where the previous owner housed some livestock. Typical grasses are found on site, with a few trees and rock outcrops.

5. GEOLOGY

The geology of the Bloemfontein area is underlain by the Lower Stage of the Beaufort Group which is part of the Karoo Super Group. The sedimentary rocks that are present in this group consist of fine-grained grey sandstone and coarse arkose alternating with green and maroon-coloured mudstone beds. The typical materials / rock type found in the area of Bloemfontein are Dolerite, (K_3l) Sandstone / Shale / Mudstone and, (K_2u) Mudstone / Shale. Table 3 summarise the Geology found in the area of Bloemfontein.

Table 3: Geology Formation

Symbol	Typical Materials / Rock Type	Super Group	Group	Sub - Group	Formation
	Dolerite	Intrusive Rock			
K_3l	Sandstone / Shale / Mudstone	Karoo	Beaufort	Lower	-
K_2u	Mudstone / Shale	Karoo	Ecca	Upper	-

Figure 2 is an extract of the 2926, Bloemfontein Geology map.

Figure 2 – Detail Geological Map (Department of Mines) Geological Detail Scale 1 : 250 000

6. CLIMATE

The Bloemfontein area is a moderate region with primarily summer rainfall. The rainfall is between 250mm and 500mm per year according to Vegetation of Southern Africa - By R M Cowling, D M Richardson and S M Pierce.

Bloemfontein normally receives about 407mm of rain per year, with most rainfall occurring mainly during summer. Bloemfontein receives the lowest rainfall (2mm) in June and the highest (68mm) in January.

The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Bloemfontein ranges from 16°C in June to 29.2°C in January. The region is the coldest during July when the mercury drops to 0°C on average during the night. (SA Explorer ©, 2013)

Table 4 is a summary of the average rainfall along with the average minimum and maximum temperatures for Bloemfontein.

Table 4: Average Rainfall, Average Minimum and Maximum Temperature

Month	Average Rainfall (mm)	Average Minimum Temperature (°C)	Average Maximum Temperature (°C)
January	68	14	29
February	67	14	28
March	68	12	26

Month	Average Rainfall (mm)	Average Minimum Temperature (°C)	Average Maximum Temperature (°C)
April	37	8	23
May	12	3	19
June	2	0	16
July	2	0	16
August	4	2	19
September	9	6	22
October	35	9	25
November	51	11	27
December	52	13	29

Figure 3 – Precipitation Map of South Africa (BestCountryReports.com)

Table 5: South African Rainfall and Comparison of Two Climatic Indices

Colour on Figure 3	Description	Weinert N-Value	Thornthwaite Moisture Index (I_m)	Typical Mean Annual Rainfall (mm)
	Arid	> 5	< - 40	< 250
	Semi-arid	4 to 5	- 20 to - 40	250 to 500
	Semi-arid to sub-tropical	2 to 4	- 20 to + 20	500 to 1000
	Humid tropical	< 2	+ 20 to + 100	> 1000

Bloemfontein is in the semi-arid to sub-tropical climatic region with Weinert's N – value of between 2 and 4. (Adapted from Weinert, 1980).

A climatic N-value of > 5 is associated with arid regions, where mechanical disintegration is the predominant rock weathering mode. A climatic N-value of < 5 is associated with the humid warm areas and a surplus of water, where chemical decomposition is the predominant rock weathering mode.

Environmental factors determine the mode of weathering and climate is the most important. Weathering products of rock depend mainly on the rock forming minerals (parent materials), the climatic conditions under which they had formed and the time of exposure to weathering processes. Climate does not only determine the mode of weathering which is likely to take place, but also the rate of weathering. The effect of climate on the weathering process (i.e. soils formation) is determined by the climatic N-value defined by Weinert.

7. SITE INVESTIGATION

Mr FJ Coetser (Technical Assistant) accompanied by Mr WT Hitge (Technologist) did the investigation on the 13th of July 2016. Test pits were excavated with a TLB (KOMATSU WB93R) and profiled according to the methods stipulated in the Williams, Jennings & Brink, 1973. The profiles, laboratory test results and field test results are given in Appendices B, C, D & E.

Nineteen (19) test pits were excavated at positions indicated on the Location Plan and Layout Plan. (Appendices A & H). Sixteen (16) foundation indicator samples along with twelve (12) Maximum Dry Density (MOD AASHTO) and California Bearing Ratio (CBR) samples were sampled on site.

The material properties were tested at Simlab (Pty) Limited – Geotechnical Services (Bloemfontein) a SANAS Accredited Testing Laboratory – T0455. Please visit the Simlab or SANAS website for more information regarding SANAS Accreditation. www.simlab.co.za or www.sanas.co.za

The purpose for testing the foundation indicators was to determine the basic physical characteristics of these disturbed samples, comprising the determination of Atterberg Limits and the Grain Size Distribution, including the Clay Fraction. This information will be used to determine the potential expansiveness of the materials.

The foundation indicators were tested according to the SANS 3001, Method GR1, GR10 and GR20. The potential expansiveness of the materials was determined according to Van der Merwe's method.

The Maximum Dry Density and California Bearing Ratio were tested according to the SANS 3001, Method GR30 and GR40. These tests were conducted to determine the quality of the materials and to determine if the materials can be used for backfill and / or layer works. The classification of the materials tested, was done according to SANS 3001, Method GR1, GR10, GR30 and GR40.

Test Pit Co-ordinates are given in Table 6.

Table 6: Test Pits Co-ordinates

Test Pit No.	Co-ordinates
Test Pit 1	27 Y0075375 X3215424
Test Pit 2	27 Y0075459 X3215534
Test Pit 3	27 Y0075399 X3215648
Test Pit 4	27 Y0075242 X3215663
Test Pit 5	27 Y0075318 X3215810
Test Pit 6	27 Y0075171 X3215866
Test Pit 7	27 Y0075201 X3216056
Test Pit 8	27 Y0075084 X3216073
Test Pit 9	27 Y0075034 X3216253
Test Pit 10	27 Y0075132 X3216285
Test Pit 11	27 Y0075232 X3216177
Test Pit 12	27 Y0075266 X3216278
Test Pit 13	27 Y0075445 X3216340
Test Pit 14	27 Y0075598 X3216301
Test Pit 15	27 Y0075603 X3216066
Test Pit 16	27 Y0075690 X3215805
Test Pit 17	27 Y0075611 X3215914
Test Pit 18	27 Y0075510 X3216181
Test Pit 19	27 Y0075377 X3216081

Co-ordinate system – WGS 84

The depth of the test pits and type of bedrock encountered in the investigation are summarised in Table 7.

Table 7: Depth of Test Pits

Test Pit No.	Depth of Test Pit (mm)	Depth to Refusal Layer (mm)	Materials Description at Bottom of Test Pit
Test Pit 1	0 – 750	750	Hard Rock, Dolerite

Test Pit No.	Depth of Test Pit (mm)	Depth to Refusal Layer (mm)	Materials Description at Bottom of Test Pit
Test Pit 2	0 – 3000	3000	Clayey Sand with weathered dolerite gravel
Test Pit 3	0 – 3000	3000	Silty sand
Test Pit 4	Surface	Surface	Hard Rock, Dolerite
Test Pit 5	Surface	Surface	Hard Rock, Dolerite
Test Pit 6	0 – 450	450	Hard Rock, Dolerite
Test Pit 7	0 – 400	400	Hard Rock, Dolerite
Test Pit 8	0 – 800	800	Hard Rock, Dolerite
Test Pit 9	0 – 1400	1400	Hard Rock, Dolerite
Test Pit 10	0 – 900	900	Hard Rock, Dolerite
Test Pit 11	0 – 400	400	Hard Rock, Dolerite
Test Pit 12	0 – 400	400	Hard Rock, Dolerite
Test Pit 13	Surface	Surface	Hard Rock, Dolerite
Test Pit 14	Surface	Surface	Hard Rock, Dolerite
Test Pit 15	Surface	Surface	Hard Rock, Dolerite
Test Pit 16	Surface	Surface	Hard Rock, Dolerite
Test Pit 17	0 – 3000	3000	Silty sand with weathered dolerite
Test Pit 18	0 – 400	400	Hard Rock, Dolerite
Test Pit 19	Surface	Surface	Hard Rock, Dolerite

Refusal layers / bedrock were encountered during the investigation in some of the test pits. No refusal layer / bedrock were encounter in test pits 2, 3 and 17. The bedrock depth range from 0.400m to 1.400m from the surface with an average depth of 0.763m. Figure 4 shows the contours of the refusal depths encountered during the investigation. Due to the wide spread of these test pits, Figure 4 is only for illustration purposes and either shallower or deeper bedrock may be found in the investigated area.

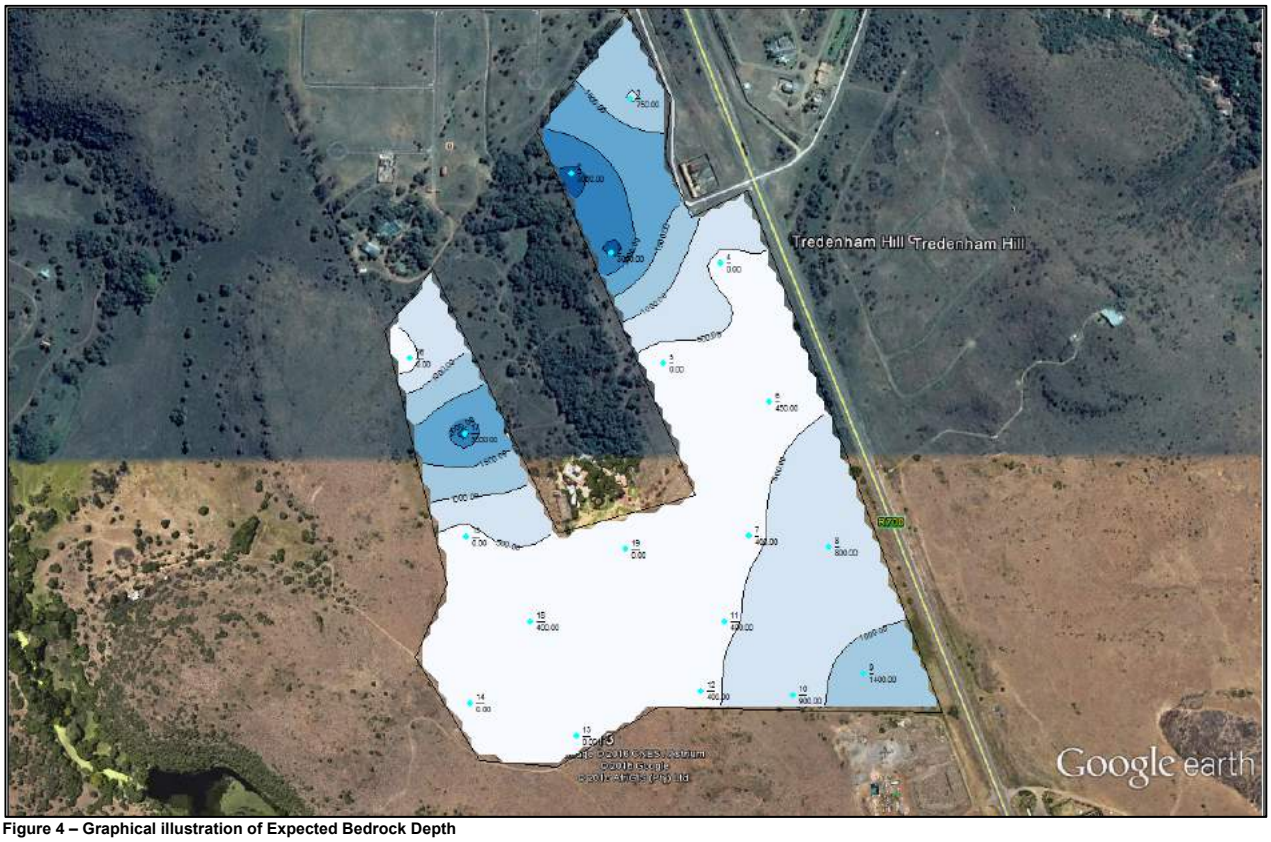


Figure 4 – Graphical illustration of Expected Bedrock Depth

Table 8: Expected Bedrock Depth Contour Lines

Colour on Figure 4	Lower Limit of Bedrock Depth	Upper Limit of Bedrock Depth
	0.000m	0.500m
	0.500m	1.000m
	1.000m	1.500m
	1.500m	2.000m
	2.000m	2.500m
	2.500m	3.000m

8. TEST RESULTS

The profiles, laboratory test results and field test results are given in Appendices B, C, D & E. The potential expansiveness of the materials was determined according to *Van Der Merwe's method. The evaluation of the Swelling Potential of Materials is summarised in Table 9.

Table 9: Potential Expansiveness

Test Pit No.	Layer Thickness (mm)	Unified Soil Classification (USC)	Potential Expansiveness (mm) *Van Der Merwe
Test Pit 1	0 – 450 450 – 750	SW-SC SM	Low Low **Total : Low**

Test Pit No.	Layer Thickness (mm)	Unified Soil Classification (USC)	Potential Expansiveness (mm) *Van Der Merwe
Test Pit 2	0 – 1100 1100 – 3000	CL SC	Medium / 18.7mm Low **Total : Medium / 18.7mm**
Test Pit 3	550 – 1300 1300 – 3000	SC SM	Low Low **Total : Low**
Test Pit 6	120 – 450	SW	Low **Total : Low**
Test Pit 7	0 – 400	GP-GC	Low **Total : Low**
Test Pit 8	0 – 600 600 – 800	CL SC-SM	Medium / 11.1mm Low **Total : Medium / 11.1mm**
Test Pit 9	0 – 1400	CL	Medium / 22.6mm **Total : Medium / 22.6mm**
Test Pit 12	0 – 400	GP-GC	Low **Total : Low**
Test Pit 17	0 – 600 600 – 2300 2300 – 3000	CL CL CL	Medium / 11.1mm Low Medium / 5.4mm **Total : Medium / 16.5mm**
Test Pit 18	0 – 400	SM	Low **Total : Low**

Potential expansive material were encountered during the investigation in test pits 2, 8, 9 and 17. The potential expansiveness ranges from 11.1mm to 22.6mm with an average of 17.2mm with a Medium classification. The potential expansiveness of the site are Low in areas and Medium in other areas. The determination of the expansiveness classification of the site was done using the results from the test pits and Van Der Merwe's method.

The investigated area materials profile is summarised in Table 10.

Table 10: Materials Profile Summary

Materials Layer	Average Starting Depth (mm)	Average Layer Bottom (mm)	Average Layer Thickness (mm)
First Layer	Surface	573	573
Second Layer	573	1357	785
Third Layer	1357	3000	2215

Materials Layer	Average Starting Depth (mm)	Average Layer Bottom (mm)	Average Layer Thickness (mm)
Refusal Layer	763	-	-

The various materials that are encountered in the test pit profiles are summarised in Table 11.

Table 11: Summary of Materials encountered in Test Pit Profiles

Materials Description	First Layer Depth range (mm)	Second Layer Depth range (mm)	Third Layer Depth range (mm)
SW-SC	0 – 450	-	-
SM	0 – 400	450 – 750	1300 – 3000
CL	0 – 1100 0 – 600 0 – 1400 0 – 600	600 – 2300	2300 – 3000
SC	-	1100 – 3000 550 – 1300	-
SW	-	120 – 450	-
GP-GC	0 – 400 0 – 400	-	-
SC-SM	-	600 – 800	-

The materials description is done according to the Unified Soil Classification Criteria (USC) Refers to the following for description:

- SW-SC – Well-graded sand with silty clay and weathered dolerite gravel.
- SM – Silty sand with weathered dolerite gravel.
- CL – Sandy lean clay.
- SC – Clayey sand with weathered dolerite gravel.
- SW – Well-graded sand with weathered dolerite gravel.
- GP-GC – Poorly graded weathered dolerite gravel with clay and sand.
- SC-SM – Silty clayey sand with weathered dolerite gravel.

Dolerite Bedrock were encountered during the investigation on the surface and in the test pits.

Dynamic Cone Penetrometer (DCP's) tests were done adjacent to test pits from the surface in order to estimate the bearing ratio of the unconsolidated materials according to *Dr. B van Wyk's method. The field test results are given in Appendix E. The Estimated Bearing Ratio is summarised in Table 12.

Table 12: Estimated Bearing Ratio

Test Pit No.	Layer Thickness (mm)	Estimated Bearing Ratio (kPa)
Test Pit 1 (From Surface)	0 – 435	71
	435 – 589	196
	589 – 621	177
Test Pit 2 (From Surface)	0 – 353	58
	353 – 645	136
	645 – 920	174
	920 – 1095	189
	1095 – 1175	166
	1175 – 1333	186
	1333 – 1537	163
	1537 – 1780	153
Test Pit 3 (From Surface)	0 – 366	42
	366 – 574	65
	574 – 827	136
	827 – 935	188
	935 – 1078	161
	1078 – 1794	136
Test Pit 8 (From Surface)	0 – 382	41
	382 – 502	100
	502 – 551	200
Test Pit 9 (From Surface)	0 – 430	63
	430 – 1160	129
	1160 – 1739	200
Test Pit 10 (From Surface)	0 – 656	38
	656 – 881	107
	881 – 929	200
Test Pit 17 (From Surface)	0 – 142	116
	142 – 974	139
	974 – 1150	186
	1150 – 1335	168
	1335 – 1542	170
	1542 – 1643	194
	1643 – 1775	145

The estimated bearing ratio in Table 12 was at the time of the investigation. The Dynamic Cone Penetrometer (DCP) test values should only be used for comparative purposes and not as a standard since dynamic penetration will vary with variations in moisture content. Therefore a wet profile will have lower bearing ratio values than a dry profile.

Estimated Bearing Ratio of the materials as determined according to *NAVFAC using the Unified Soil Classification Criteria (USC) is summarised in Table 13.

Table 13: Estimated Bearing Ratio according to NAVFAC

Test Pit No.	Layer Thickness (mm)	Unified Soil Classification (USC)	Consistency	Estimated Bearing Ratio (kPa)
Test Pit 1	0 – 450 450 – 750	SW-SC SM	Loose Medium Dense	100 – 200 200 – 400
Test Pit 2	0 – 1100 1100 – 3000	CL SC	Firm Medium Dense	50 – 100 200 – 300
Test Pit 3	550 – 1300 1300 – 3000	SC SM	Medium Dense Medium Dense	200 – 300 200 – 400
Test Pit 6	120 – 450	SW	Medium Dense	200 – 400
Test Pit 7	0 – 400	GP-GC	Medium Dense	500 – 700
Test Pit 8	0 – 600 600 – 800	CL SC-SM	Firm Medium Dense	50 – 100 200 – 400
Test Pit 9	0 – 1400	CL	Firm	50 – 100
Test Pit 12	0 – 400	GP-GC	Medium Dense	500 – 700
Test Pit 17	0 – 600 600 – 2300 2300 – 3000	CL CL CL	Firm Firm Firm	50 – 100 50 – 100 50 – 100
Test Pit 18	0 – 400	SM	Medium Dense	200 – 400

Estimated Bearing Ratio of the materials as determined according to *Dr. B van Wyk's method and according to *NAVFAC using the Unified Soil Classification (USC) Criteria are estimates. The consistency description is done visually during the excavation of the test pits. Plate Bearing Tests can be conducted for the actual Bearing Ratio.

The criteria used to classify the Residential Site Class Designations is summarised in Table 14 (NHBRC Home Building Manual, Part1, Section2, Table: Residential Site Class Designations).

Table 14: NHBRC Home Building Manual, Part1, Section2, Table: Residential Site Class Designations

Typical Founding Material	Character of Founding Material	Expected Range of Total Soil Movements (mm)	Assumed Differential Movement (% of Total)	Site Class
Rock (excluding mud rocks which may exhibit swelling to some depth)	Stable	Negligible	-	R
Fine grained soils with moderate to very high plasticity (clays, silty clays, clayey silts and sandy clays)	Expansive Soils	<7.5 7.5 – 15 15 – 30 >30	50% 50% 50% 50%	H H1 H2 H3
Silty sands, sands, sandy and gravely soils	Compressible And Potentially Collapsible Soils	<5 5 – 10 >10	75% 75% 75%	C C1 C2
Fine grained soils (clayey silts and clayey sands of low plasticity), sands, sandy and gravely soils	Compressible	<10 10 – 20 >20	50% 50% 50%	S S1 S2

Typical Founding Material	Character of Founding Material	Expected Range of Total Soil Movements (mm)	Assumed Differential Movement (% of Total)	Site Class
Contaminated soils, Controlled fill, Dolomitic areas, Landslip, Landfill, Marshy areas Mine waste fill, mining subsidence Reclaimed areas, Uncontrolled fill, Very soft silts / silty clays	Variable	Variable		P

With reference to the results of the investigation and the assessment for potential collapsible materials with the available information and test results, the site class is given as H/H1/H2/C/S/R in the area investigated. The investigated site has been conservatively classified as a H2. Classification of the test pits according to the test results and investigation is summarised in Table 15.

Table 15: Classification of Test Pits

Test Pit No.	Depth of Test Pit (mm)	Unified Soil Classification (USC)	Potential Heave (mm)	Classification (NHBRC)
Test Pit 1	0 – 450 450 – 750	SW-SC SM	Low Low	**H** **C**
		Average	**Low**	**H**
Test Pit 2	0 – 1100 1100 – 3000	CL SC	Medium / 18.7mm Low	**H2** **S**
		Average	**Medium / 18.7mm**	**H2**
Test Pit 3	550 – 1300 1300 – 3000	SC SM	Low Low	**S** **C**
		Average	**Low**	**C**
Test Pit 4	Surface	Hard Rock, Dolerite		**R**
Test Pit 5	Surface	Hard Rock, Dolerite		**R**
Test Pit 6	120 – 450	SW	Low	**C**
		Average	**Low**	**C**
Test Pit 7	0 – 400	GP-GC	Low	**S**
		Average	**Low**	**S**
Test Pit 8	0 – 600 600 – 800	CL SC-SM	Medium / 11.1mm Low	**H1** **S**
		Average	**Medium / 11.1mm**	**H1**
Test Pit 9	0 – 1400	CL	Medium / 22.6mm	**H2**
		Average	**Medium / 22.6mm**	**H2**
Test Pit 11	0 – 400	Hard Rock, Dolerite		**R**
Test Pit 12	0 – 400	GP-GC	Low	**S**
		Average	**Low**	**S**

Test Pit No.	Depth of Test Pit (mm)	Unified Soil Classification (USC)	Potential Heave (mm)	Classification (NHBRC)
Test Pit 13	Surface	Hard Rock, Dolerite		**R**
Test Pit 14	Surface	Hard Rock, Dolerite		**R**
Test Pit 15	Surface	Hard Rock, Dolerite		**R**
Test Pit 16	Surface	Hard Rock, Dolerite		**R**
Test Pit 17	0 – 600 600 – 2300 2300 – 3000	CL CL CL	Medium / 11.1mm Low Medium / 5.4mm	**H1** **H** **H**
		Average	**Medium / 16.5mm**	**H2**
Test Pit 18	0 – 400	SM	Low	**C**
		Average	**Low**	**C**
Test Pit 19	Surface	Hard Rock, Dolerite		**R**

Classification H/C/S is for fine grained soils with an estimated total heave of less than 7.5mm or Estimated Total Settlement less than 10.0mm, Classification H1 is for fine grained soils with an estimated total heave between 7.5mm and 15.0mm, Classification H2 is for fine grained soils with an estimated total heave of between 15.0mm and 30.0mm. Figure 5 shows the site zoning plan, for more detail see Appendix H.

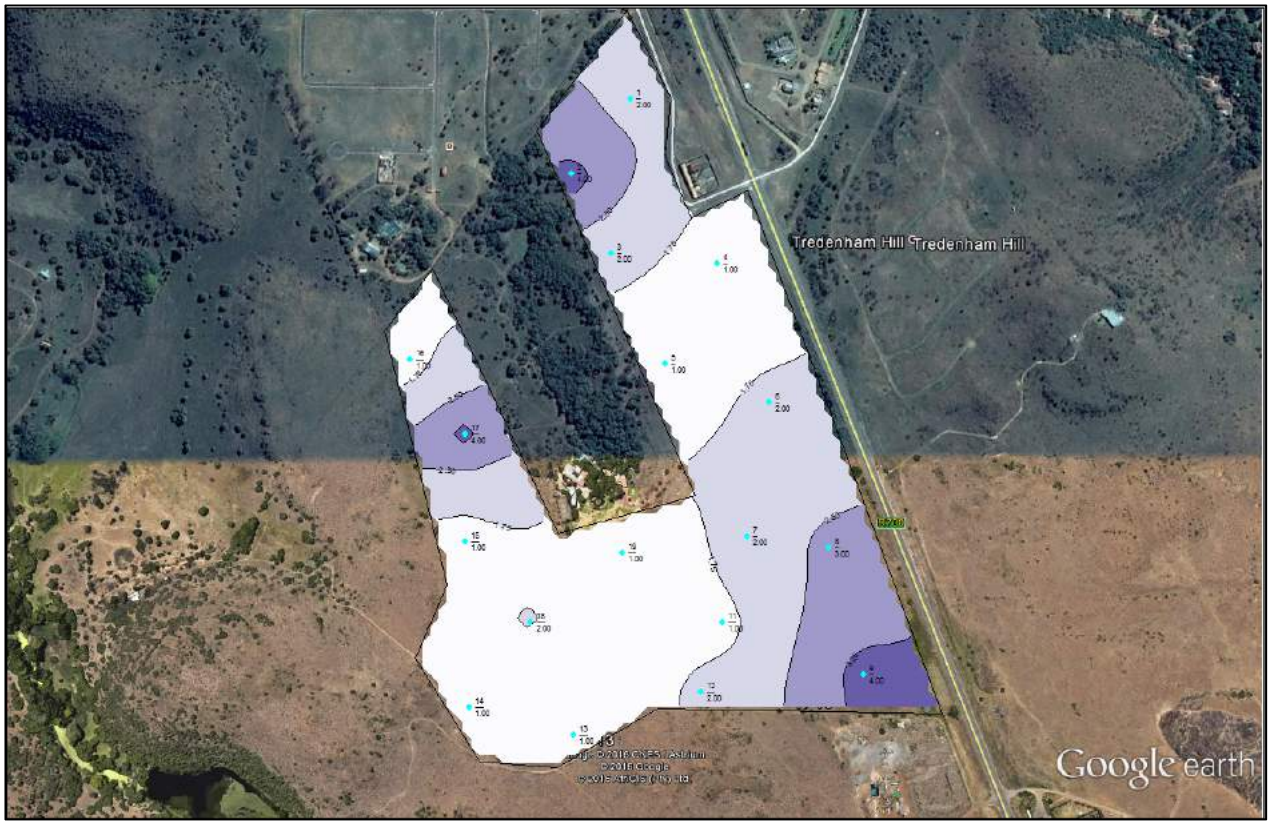


Figure 5 – Site Classification (Site Zoning)

Table 16: Site Zoning (Classification) Colour Description

Colour on Figure 5	Classification (NHBRC)	Lower Limit of Total Movement	Upper Limit of Total Movement
Zone 1	R	-	-
Zone 2	H / C / S	0.0mm	7.5mm / 10.0mm
Zone 3	H1	7.5mm	15.0mm
Zone 4	H2	15.0mm	30.0mm

Site Classification

Zone 1 – R, Bedrock

Zone 2 – H/C/S, Estimated Total Heave less than 7.5mm / Estimated Total Settlement less than 10.0mm.

Zone 3 – H1, Estimated Total Heave between 7.5mm and 15.0mm.

Zone 4 – H2, Estimated Total Heave between 15.0mm and 30.0mm.

H / S - Differential settlements equals 50% of the total settlement. C - Differential settlements equals 75% of the total settlement. (Reference: Home Building Manual, Part1, Section2, Table 5: Residential site class designations). For a detailed description of the site class designations refer to Table 17.

Table 17: Residential Site Class Designations

Site Class	Estimated Total Movement (mm)	Construction Type	Foundation Design and Building Procedures
R / H / C / S	< 7.5mm / < 10.0mm	Normal	• Normal construction (strip footings or slab-on-the-ground) foundation. • Site drainage and service/plumbing precautions recommended.
H1	7.5 - 15mm	Modified Normal Soil Raft	• Lightly reinforced strip footings. • Articulation joints at all internal/external doors and openings. • Light reinforcement in masonry. • Site drainage and plumbing/service precautions. • Remove all or necessary parts of expansive horizon to 1.0m beyond the perimeter of the building and replace with inert backfill compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content. • Normal construction with lightly reinforced strip footings and light reinforcement in masonry if residual movements are <7.5mm, or construction type appropriate to residual movements. • Site drainage and plumbing/service precautions.
H2	15 - 30mm	Stiffened or cellular raft Piled construction Split construction Soil raft	• Stiffened or cellular raft of articulated lightly reinforced masonry. • Site drainage and plumbing/service precautions. • Piled foundations with suspended floor slabs with or without ground beams. • Site drainage and plumbing/service precautions. • Combination of reinforced masonry and full movement joints. • Suspended floors or fabric reinforced ground slabs acting independently from the building. • Site drainage and plumbing/service precautions. • As for H1.

9. GEOTECHNICAL EVALUATION

9.1 Potentially Collapsible Soils

Collapsible soils can be defined as soils with a high void ratio and with a low density that when subjected to a combination of direct actions (loads) and an increase in soils moisture content, experiences sudden or rapid settlements. With reference to the soil profiles in Appendix B and laboratory test results in Appendix C, the typical materials that could be found on site are: SW-SC – Well-graded sand with silty clay and weathered dolerite gravel, SM – Silty sand with weathered dolerite gravel, CL – Sandy lean clay, SC – Clayey sand with weathered dolerite gravel, SW – Well-graded sand with weathered dolerite gravel, GP-GC – Poorly graded weathered dolerite gravel with clay and sand and SC-SM – Silty clayey sand with weathered dolerite gravel.

The soil layers in the profiles can be assessed for collapsibility based on the percentage <0.002mm fraction. The potential for collapsibility of the soils encountered at this site is assessed by criteria proposed by three investigators.

The following criteria by Handy (1973) (Table 18) can be followed to assess the collapsibility.

Table 18: Criteria by Handy (1973)

% Clay (<0.002mm)	Collapsibility (Probability)
≤16%	High probability of collapse
17-24%	Probability of collapse
25-32%	Less than 50% probability of collapse
>32%	Usually safe from collapse

The assessment of the profiles for all the test pits is based on Handy's criteria and summarised in Table 19.

Table 19: Site Materials Collapsibility (Probability) (Criteria by Handy (1973))

Test Pit No.	Layer Thickness (mm)	USC	% Clay (<0.002mm)	Collapsibility (Probability)	Estimated Percentage of Clay in Total Depth of Test Pit
Test Pit 1	0 – 450 450 – 750	SW-SC SM	2 4	High probability of collapse High probability of collapse	3
Test Pit 2	0 – 1100 1100 – 3000	CL SC	23 12	Probability of collapse High probability of collapse	16
Test Pit 3	550 – 1300 1300 – 3000	SC SM	8 8	High probability of collapse High probability of collapse	*11

Test Pit No.	Layer Thickness (mm)	USC	% Clay (<0.002mm)	Collapsibility (Probability)	Estimated Percentage of Clay in Total Depth of Test Pit
Test Pit 6	120 – 450	SW	0	High probability of collapse	*1
Test Pit 8	0 – 600 600 – 800	CL SC-SM	20 8	Probability of collapse High probability of collapse	17
Test Pit 9	0 – 1400	CL	28	Less than 50% probability of collapse	28
Test Pit 12	0 – 400	GP-GC	1	High probability of collapse	1
Test Pit 17	0 – 600 600 – 2300 2300 – 3000	CL CL CL	18 12 30	Probability of collapse High probability of collapse Less than 50% probability of collapse	17
Test Pit 18	0 – 400	SM	2	Probability of collapse	2

Note: * Predicted Clay Content, USC - Unified Soil Classification

The percentage Clay (<0.002mm) distribution over the investigated area, can be seen in Figure 6. Figure 6 shows the percentage Clay (<0.002mm) of the expected (estimated) clay based on the results of the test pits tested. Due to the wide spread of these test pits, Figure 6 is only for illustration purposes.

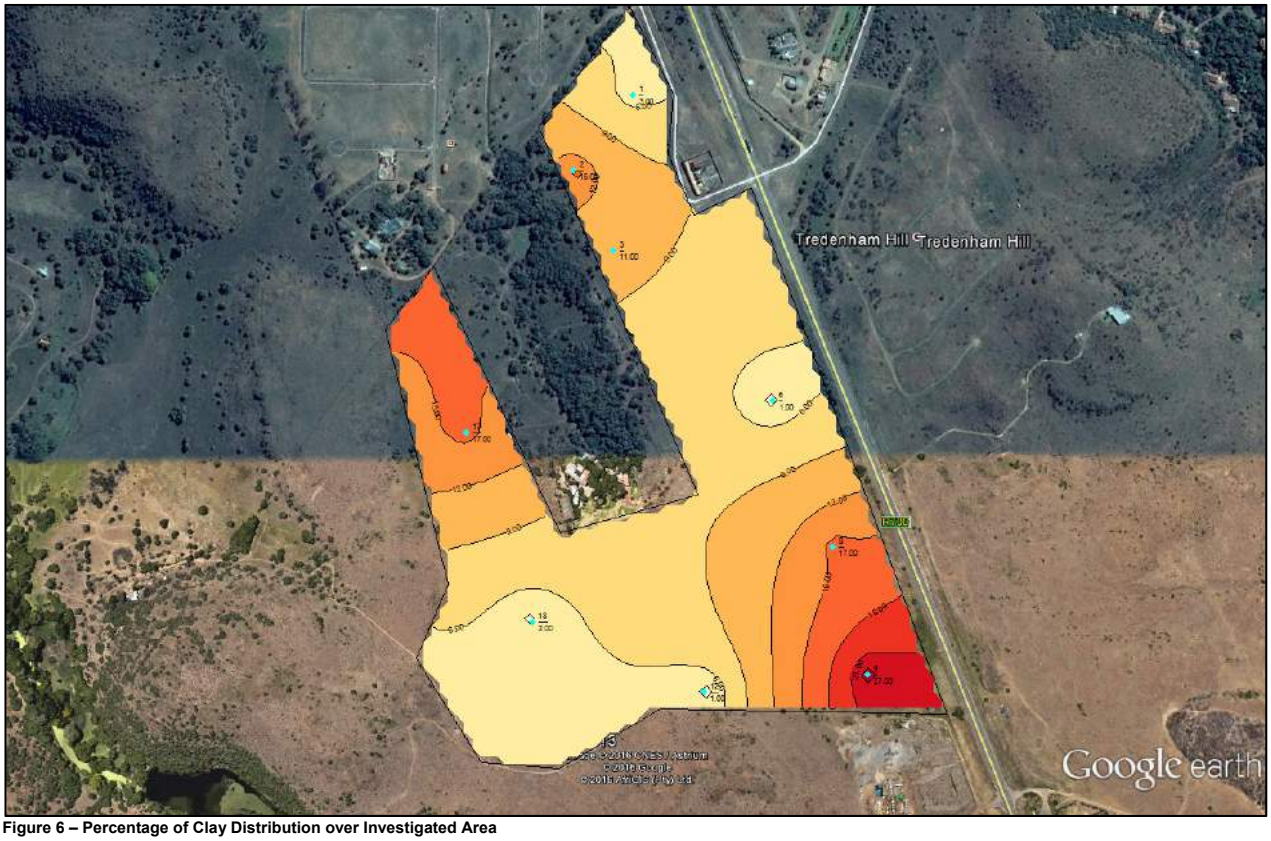


Figure 6 – Percentage of Clay Distribution over Investigated Area

Table 20: Graphical Illustration of Clay Distribution over Investigated Area Colours

Colour on Figure 6	Lower Limit of % Clay in Test Pit	Upper Limit of % Clay in Test Pit
	0	3
	3	6
	6	9
	9	12
	12	15
	15	18
	18	21
	21	24
	24	27

The assessment of the profiles for all the test pits is based on Clevenger (1958) criteria and summarised in Table 21. The criteria of Clevenger consist of the following, if dry unit weight is less than 12.6kN/m^3, settlement will be large; if dry unit weight is greater than 14.1kN/m^3, settlement will be small.

Table 21: Site Materials Settlement (Probability) (Criteria by Clevenger (1958))

Test Pit No.	Layer Thickness (mm)	Unified Soil Classification (USC)	Weight (kN/m^3)	Settlement (Probability)
Test Pit 1	0 – 450	SW-SC	19.5	Settlement will be small
	450 – 750	SM	20.6	Settlement will be small
Test Pit 2	0 – 1100	CL	14.7	Settlement will be small
	1100 – 3000	SC	18.3	Settlement will be small
Test Pit 3	1300 – 3000	SM	15.7	Settlement will be small
Test Pit 6	120 – 450	SW	20.3	Settlement will be small
Test Pit 7	0 – 400	GP-GC	19.0	Settlement will be small
Test Pit 9	0 – 1400	CL	14.9	Settlement will be small
Test Pit 17	0 – 600	CL	15.5	Settlement will be small
	600 – 2300	CL	16.3	Settlement will be small
	2300 – 3000	CL	16.3	Settlement will be small
Test Pit 18	0 – 400	SM	19.5	Settlement will be small

The assessment of the profiles for all the test pits is based on Priklonski (1952) criteria and summarised in Table 22. The criteria of Priklonski consist of the following, KD = (natural moisture content – plastic limit) / (plasticity index), KD < 0.0 : highly collapsible soils, KD > 0.5 : non collapsible soils, KD > 1.0 : swelling soils.

Table 22: Site Materials Collapsibility (Probability) (Criteria by Priklonski (1952))

Test Pit No.	Layer Thickness (mm)	Unified Soil Classification (USC)	K_D	Collapsibility (Probability)
Test Pit 1	0 – 450	SW-SC	-4.4	Highly collapsible soils
	450 – 750	SM	0.0	Highly collapsible soils
Test Pit 2	0 – 1100	CL	-0.7	Highly collapsible soils
	1100 – 3000	SC	-1.4	Highly collapsible soils
Test Pit 3	550 – 1300	SC	-0.8	Highly collapsible soils
	1300 – 3000	SM	-1.4	Highly collapsible soils
Test Pit 6	120 – 450	SW	0.0	Highly collapsible soils
Test Pit 7	0 – 400	GP-GC	-2.0	Highly collapsible soils
Test Pit 8	0 – 600	CL	-1.0	Highly collapsible soils
	600 – 800	SC-SM	-3.1	Highly collapsible soils
Test Pit 9	0 – 1400	CL	-0.7	Highly collapsible soils
Test Pit 12	0 – 400	GP-GC	-2.3	Highly collapsible soils
Test Pit 17	0 – 600	CL	-0.9	Highly collapsible soils
	600 – 2300	CL	-1.0	Highly collapsible soils
	2300 – 3000	CL	-0.5	Highly collapsible soils
Test Pit 18	0 – 400	SM	0.0	Highly collapsible soils

Although Handy and Priklonski models show that the materials at this site are most probably highly collapsible, the actual settlement due to collapse may not be that large according to Clevengers model.

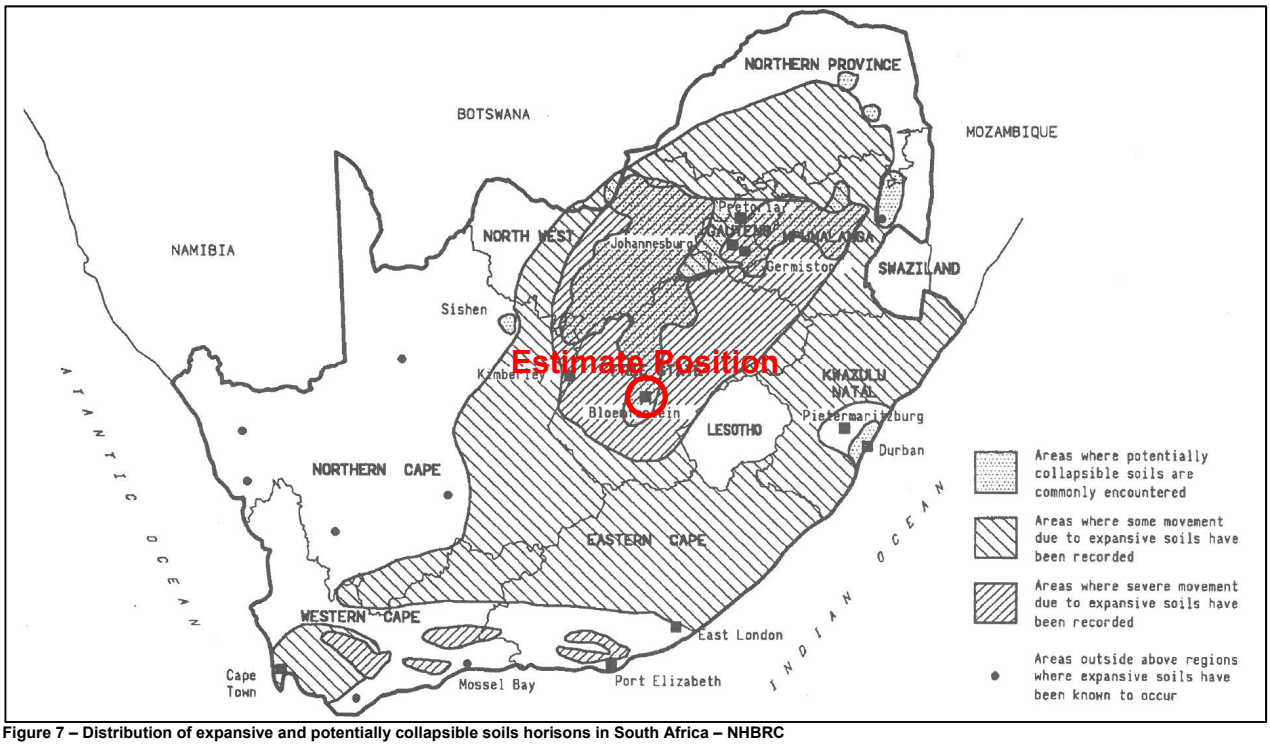


Figure 7 – Distribution of expansive and potentially collapsible soils horisons in South Africa – NHBRC

In the Bloemfontein area potentially collapsible soils are commonly encountered. (Reference: Home Building Manual, Part1, Section2, Figure S1, Distribution of expansive and potentially collapsible soil horisons in South Africa)

9.2 Potentially Expansive Soils

Expansive soils are defined as fine-grained soils, the clay mineralogy of which is such that it changes in volume to varying degrees in response to change in moisture content. This is the soils increases (heaves or swells) upon wetting up and decreases in volume (shrinks) upon drying out. A summary of the potential expansiveness calculated according to Van Der Merwe's method is summarised in Table 9.

Low to medium potentially expansive soils were encountered during the investigation in the area investigated and is confirmed by the laboratory results in Appendix C. The Plasticity Index (PI) of the materials ranges from Non Plastic (NP) to 24%, the Linear Shrinkage (LS) ranges from 0.0% to 12.1% and the percentage of Clay Fraction in the soils sample (<0.002mm) ranges from 0% to 28% as summarised in Table 23.

Table 23: Summary of Plastic Index, Linear Shrinkage and % Clay Fraction

Test Pit No.	Layer Thickness (mm)	Unified Soil Classification (USC)	Plastic Index (PI)	Linear Shrinkage (LS)	% Clay Fraction (<0.002mm)
Test Pit 1	0 – 450 450 – 750	SW-SC SM	4 SP	2.0 1.3	2 4
Test Pit 2	0 – 1100 1100 – 3000	CL SC	18 12	9.2 6.4	23 12
Test Pit 3	550 – 1300 1300 – 3000	SC SM	16 14	8.0 6.8	8 8
Test Pit 6	120 – 450	SW	NP	0.0	0
Test Pit 7	0 – 400	GP-GC	7	2.7	2
Test Pit 8	0 – 600 600 – 800	CL SC-SM	13 4	6.7 2.3	20 8
Test Pit 9	0 – 1400	CL	24	12.1	28
Test Pit 12	0 – 400	GP-GC	8	3.7	1
Test Pit 17	0 – 600 600 – 2300 2300 – 3000	CL CL CL	16 12 18	7.5 5.5 8.7	18 11 6
Test Pit 18	0 – 400	SM	SP	1.6	2

Note: * SP – Slightly Plastic, NP – Non Plastic

The particle size distribution of the materials found on site is summarised in Table 24. The particle size distribution shows the clay (<0.002mm), silt (0.002mm – 0.075mm), sand (0.075mm – 2.000mm) and gravel (>2.000mm) content of the materials.

Table 24: Particle Size Distribution of Samples

Test Pit No.	Layer Thickness (mm)	USC	Clay (< 0.002mm)	Silt (> 0.002 - 0.075mm)	Sand (> 0.075 - 2.000mm)	Gravel (> 2.000mm)	Grading Modulus (GM)
Test Pit 1	0 – 450	SW-SC	2	9	37	52	2.16
	450 – 750	SM	4	10	36	50	2.09
Test Pit 2	0 – 1100	CL	23	37	39	1	0.51
	1100 – 3000	SC	12	22	51	15	1.20
Test Pit 3	550 – 1300	SC	8	39	48	5	0.77
	1300 – 3000	SM	8	34	49	9	0.83
Test Pit 6	120 – 450	SW	0	3	23	74	2.60
Test Pit 7	0 – 400	GP-GC	2	8	30	60	2.23
Test Pit 8	0 – 600	CL	20	32	46	2	0.58
	600 – 800	SC-SM	8	29	34	29	1.33
Test Pit 9	0 – 1400	CL	28	24	42	6	0.69
Test Pit 12	0 – 400	GP-GC	1	4	14	77	2.64
Test Pit 17	0 – 600	CL	18	40	39	3	0.53
	600 – 2300	CL	11	43	44	1	0.58
	2300 – 3000	CL	6	38	31	1	0.40
Test Pit 18	0 – 400	SM	2	17	54	27	1.55

USC - Unified Soil Classification

9.3 Potentially Compressible Soils

Compressible soils can be defined as materials that, when subjected to direct actions (loads), undergoes a gradual settlement as volume changes occur. Given ideal conditions such as saturated moisture content and applied load, the materials will be compressible to a certain degree. In general potentially compressible soils were encountered during the investigation. The compactability of materials found on site are summarised in Table 25.

Table 25: *In Situ* Materials Compactability

Test Pit No.	Layer Thickness (mm)	Unified Soil Classification (USC)	Compactability (Ratio)	Compactability (%)
Test Pit 1	0 – 450	SW-SC	0.57	56.7%
	450 – 750	SM	0.57	56.7%
Test Pit 3	1300 – 3000	SM	0.45	44.9%
Test Pit 6	120 – 450	SW	0.59	59.8%

Test Pit No.	Layer Thickness (mm)	Unified Soil Classification (USC)	Compactability (Ratio)	Compactability (%)
Test Pit 7	0 – 400	GP-GC	0.78	78.4%
Test Pit 17	0 – 600	CL	0.61	60.6%
	600 – 2300	CL	0.72	72.4%
	2300 – 3000	CL	0.57	56.7%

The compacted strength of the *in situ* materials as measured by California Bearing Ratio (CBR) value are summarised in Table 26.

Table 26: *In Situ* Materials Compacted Strength (CBR Values)

Test Pit No.	Layer Thickness (mm)	USC	MDD (kg/m^3) / OMC (%)	California Bearing Ratio (CBR Values)			Classification of the Materials (COLTO)
				100%	95%	93%	
Test Pit 1	0 – 450	SW-SC	2225 / 8.3	57	38	29	G6
	450 – 750	SM	2338 / 7.6	98	44	4	G6
Test Pit 2	0 – 1100	CL	1670 / 13.9	67	4	1	No Classification
	1100 – 3000	SC	2071 / 8.1	12	8	7	No Classification
Test Pit 3	1300 – 3000	SM	1777 / 17.7	9	7	7	No Classification
Test Pit 6	120 – 450	SW	2303 / 4.6	49	40	37	G6
Test Pit 7	0 – 400	GP-GC	2155 / 7.8	81	27	17	No Classification
Test Pit 9	0 – 1400	CL	1683 / 16.8	3	3	3	No Classification
Test Pit 17	0 – 600	CL	1760 / 9.5	4	4	4	No Classification
	600 – 2300	CL	1844 / 11.5	7	5	4	No Classification
	2300 – 3000	CL	1841 / 7.8	4	4	4	No Classification
Test Pit 18	0 – 400	SM	2207 / 9.5	62	42	36	G6

Note: * MDD – Maximum Dry Density, OMC – Optimum Moisture Content, USC - Unified Soil Classification

9.4 Shallow Seepage / Ground-Water Level / Area Subject to Flooding

No ground-water seepage was encountered at the time of the investigation. A shallow water-table can be expected from time to time in the rainy season.

The natural slope of the investigated area may not be steep enough to drain away the rainwater. Care must be taken to cannel rain water away from structure. Some of the rainwater may collect and form ponds until it has seeped into the *in situ* materials. These ponds may subject the area to surface flooding during abnormal rainfall. Therefore the surface drainage of the site should be improved.

Determining a flood line is not part of this report scope and thus, no flood line of any kind was determined. Provision should be made for drainage structures underground or at the surface where applicable.

9.5 Slope Stability (Steep Slopes & Unstable Natural Slopes)

Mildly steep slopes were found with no unstable natural slopes found on the proposed site. The investigated area is situated on flat planes with hills and valleys.

9.6 Erodibility of the Soils Profile

Due to the nature of the materials, erodibility is a concern. The materials have the potential to be erodible. This can occur during high rainfall. The materials have the possibility to be washed away during heavy rainstorms.

9.7 Excavatibility

Excavation average depth in the area investigated 0.763m with the deepest test pit 3.000m deep and the shallowest 0.400m with same places with surface rock. Excavation in the area of the proposed site should generally be feasible with normal TLB (4x4, 8Ton) to large (Excavator) equipment, although shallow bedrock or boulders may occur. According to the SANS 634:2012 Edition 1, the restricted excavation class for the investigated area to an average depth of 0.763m is Soft Rock.

The materials found at the bottom of the test pits are classified as Hard Rock, Dolerite. It might be possible do dig deeper than 0.763m with a 20ton tracked excavator, however the hard rock may become denser the deeper you dig into it, thus becoming Very Hard Rock that may require blasting or wedging according to SANS 634:2012 Edition 1. This will have an effect on the excavation of deep trenches for the installation of services as well as shallow trenches for foundations where shallow rock is expected.

Table 27: Classification of Materials for Machine Excavation (SANS 634:2012 Edition 1)

Excavation	Classification	Description
Restricted	Soft Rock	Materials can be efficiently removed by back-acting excavator (TLB) with flywheel power >0.10 kW for every tined bucket width
	Intermediate Rock	Materials can be removed by excavator with flywheel power >0.10 kW for every tined bucket width or with the use of pneumatic tools
	Hard Rock	Materials that cannot be removed without blasting or wedging and splitting

9.8 Relationship between pH-Value, Conductivity and Corrosiveness of Soils

The following criteria in Table 28 and Table 29 can be used to assess the corrosiveness of the materials found on site.

Table 28: Range of Corrosiveness

Lower Limit (Sm^{-1})	Upper Limit (Sm^{-1})	Corrosiveness
> 0.2000	-	Very Corrosive
0.1000	0.2000	Corrosive
0.0500	0.1000	Moderately Corrosive
0.0100	0.0500	Mildly Corrosive
-	< 0.0100	Progressively Less (Decreasingly) Corrosive

The results of Conductivity (TMH1: 1986, method A21), pH-Value (TMH1: 1986, method A20), Corrosiveness are summarised in Table 29.

Table 29: pH-Value, Conductivity of Materials on Site

Test Pit No.	Layer Thickness (mm)	USC	pH-Value	Conductivity (Sm^{-1})	Corrosiveness
Test Pit 1	0 – 450	SW-SC	6.53	0.0205	Mildly Corrosive
	450 – 750	SM	6.99	0.0112	Mildly Corrosive
Test Pit 2	0 – 1100	CL	7.24	0.1167	Corrosive
	1100 – 3000	SC	8.00	0.0654	Moderately Corrosive
Test Pit 3	550 – 1300	SC	8.06	0.0747	Moderately Corrosive
	1300 – 3000	SM	7.66	0.1587	Corrosive
Test Pit 6	120 – 450	SW	8.21	0.0112	Mildly Corrosive
Test Pit 7	0 – 400	GP-GC	8.37	0.1400	Corrosive
Test Pit 8	0 – 600	CL	8.40	0.1587	Corrosive
	600 – 800	SC-SM	8.57	0.0252	Mildly Corrosive
Test Pit 9	0 – 1400	CL	8.23	0.1961	Corrosive
Test Pit 12	0 – 400	GP-GC	8.41	0.0294	Mildly Corrosive
Test Pit 17	0 – 600	CL	7.73	0.1120	Corrosive
	600 – 2300	CL	7.71	0.0700	Moderately Corrosive
	2300 – 3000	CL	7.65	0.1400	Corrosive
Test Pit 18	0 – 400	SM	8.21	0.0257	Mildly Corrosive

Note : USC : Unified Soil Classification

The soil profiles have a Mildly Corrosive, Moderately Corrosive to Corrosive nature, therefore caution should be exercised when selecting materials used for the installation of services and other facilities.

9.9 Seismic Evaluation

The following table can be used to assess the Peak Ground Acceleration (PGA) in correlation to the Mercalli scale.

Table 30: Peak Ground Acceleration (PGA) in correlation to Mercalli scale

Peak Ground Acceleration (g)	**Peak Ground Velocity** (cm/s)	**Perceived Shaking**	**Potential Damage**
< 0.0017	< 0.1	Not felt	None
0.0017 – 0.014	0.1 – 1.1	Weak	None
0.014 – 0.039	1.1 – 3.4	Light	None
0.039 – 0.092	3.4 – 8.1	Moderate	Very light
0.092 – 0.180	8.1 – 16	Strong	Light
0.180 – 0.340	16 – 31	Very Strong	Moderate
0.340 – 0.650	31 – 60	Severe	Moderate to heavy
0.650 – 1.240	60 – 116	Violent	Heavy
> 1.240	> 116	Extreme	Very heavy

According to the data received from Council of Geoscience (2003), the expected gravity acceleration with 10% probability of exceedance in 50 years, is between 0.125g and 0.150g for the area investigated (SANS 1016-4: 2010 Ed1, Figure C.1). According to the Mercalli scale, the perceived shaking will be “Moderate” to “Strong” and the potential damage being “Light”.

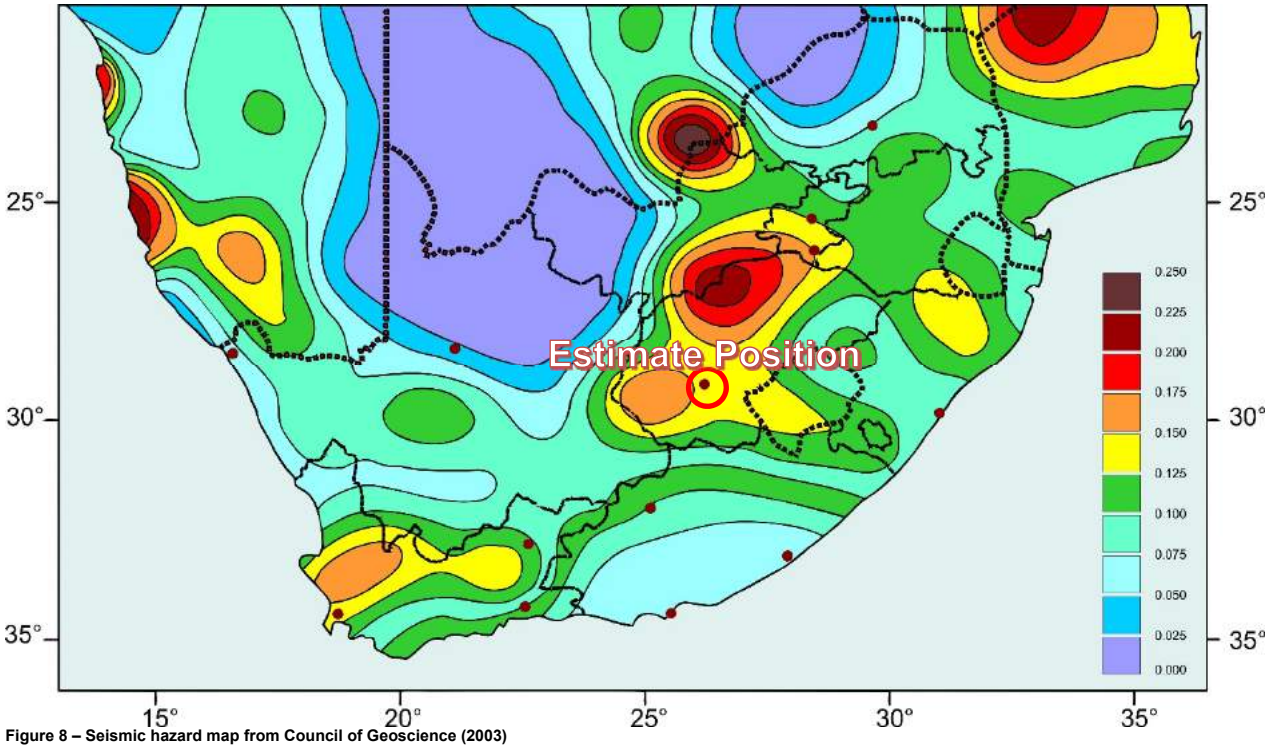


Figure 8 – Seismic hazard map from Council of Geoscience (2003)

9.10 Other Considerations

The following items are applicable to the area investigated:

- Undermined Ground – The area investigated has not been subjected to mining activity.
- Dolomite and Limestone Stability – According to NHBRC, Part 1, Section 2 (Figure S2), the area investigated is not part of the distribution of major dolomitic groups.
- Cemetery Sites – No indication of any graves were visible during the investigation.
- Historic Monuments – No indication of any historic monuments were visible during the investigation.

10. SITE CLASSIFICATION

For urban planning purposes the site is classified according to the classification system described in the * NHBRC's Home Building Manual, Part 1 & 2 using Van Der Merwe's method and based on the SANS 634 : 2012 Ed1, Table 1 – Geotechnical constraints in urban development.

10.1 Classification of Site and Soils Conditions

Site classification is based on the assumption that the site will mainly be utilised for single storey masonry structures. Based on the laboratory test results and observations the general soils conditions can be classified according to Table 31.

Table 31: Geotechnical constraints in urban development (SANS 634 : 2012 Ed1, Table 1)

Constraint		Descriptor			Class
Letter	**Description**	**1** (most favourable)	**2** (intermediate)	**3** (least favourable)	
A	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	1
B	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	1
C	Active soil	Low soil-heave potential anticipated	Moderate soil-heave potential anticipated	High soil-heave potential anticipated	1
D	Highly compressible soil	Low soil compressibility anticipated	Moderate soil compressibility anticipated	High soil compressibility anticipated	2
E	Erodibility of soil	Low	Intermediate	High	1
F	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 volume	2
G	Undermined ground	Undermining at a depth greater than 200m below surface (except where total extraction mining has not occurred)	Old undermined areas to a depth of 200m below surface where stope closure has ceased	Mining within less than 200m of surface or where total extraction mining has taken place	1
H	Stability (dolomite land)	Possibly stable. Areas of dolomite overlain by Karoo rocks or intruded by sills. Areas of Back Reef rocks. Anticipated inherent hazard class 1 (see SANS 1936-2)	Potentially characterized by instability. Anticipated inherent hazard classes 2 to 5 (see SANS 1936-2)	Known sinkholes and dolines. Anticipated inherent hazard classes 2 to 5 (see SANS 1936-2)	1
I	Steep slopes	Between 2° and 6°	Slope between 2° and 12° or less than 2°	More than 12°	1
J	Areas of unstable natural slopes	Low risk	Intermediate risk	High risk (especially in areas subject to seismic activity)	1
K	Areas subject to seismic activity	10% probability of an event less than 100 cm/s^2 within 50 years	Mining-induced seismic activity more than 100 cm/s^2	Natural seismic activity more than 100 cm/s^2	1
L	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 within a known drainage channel or floodplain	1

Site Class Designation according to Table 31 is H-H2/C/S/R/2D/2F. Classification 2D is for Moderate soil compressibility anticipated and 2F Rock or hardpan pedocretes between 10% and 40% of the total volume.

a) Recommended Foundation Option for Site Class R – Zone 1

- Normal construction (strip footings or slab-on-the-ground) foundation. Site drainage and service/plumbing precautions recommended.

b) Recommended Foundation Option for Site Class H/C/S – Zone 2

- Normal construction (strip footings or slab-on-the-ground) foundation. Site drainage and service/plumbing precautions recommended.

c) Recommended Foundation Option for Site Class H1 – Zone 3

- Modified Normal construction (strip footings or slab-on-the-ground) foundation or Soil Raft. Site drainage and service/plumbing precautions recommended.

d) Recommended Foundation Option for Site Class H2– Zone 4

- Stiffened or cellular raft foundation (Stiffened or cellular raft of articulated lightly reinforced masonry) or Soil Raft. Site drainage and service/plumbing precautions recommended.

Slope Stability

No unstable slope was noticed in the area.

11. RECOMMENDATIONS

11.1 In general, the materials which occur on site are low to medium potentially expansive according to Van Der Merwe's method with high probability of collapsing nature according to Handy (1973) and Priklonski (1952) criteria therefore the materials on site are in general classified as H2 (NHBRC, Part1, Section2, Table 1 : Residential site class designations). If possible, expansive materials must be avoided or pre-collapse before construction of the foundations.

11.2 The general foundation is considered to be Strip footings or Slab-on-the-ground. Site drainage and plumbing / service precautions.

It will be advisable to remove all the overburden materials ranging from 0.400m to 1.400m with an average depth of 0.763m in the specific locations of strip footings and construct it directly on top of the bedrock found on site if possible.

If the materials are not removed it is recommended the materials below footings to be compacted. Remove in situ materials below foundations to an average depth of approximately 450-600mm and width of 1.5 times the foundation depth and width or to a competent horison and replace with materials (G6/G7) compacted to 93% Mod AASHTO density at -1% to +2% of OMC. The G7 materials found in situ can be used for the trench back filling.

It is recommended that the subgrade beneath surface beds of surface slabs be ripped to a minimum depth of 150mm and compacted to 93% Mod AASHTO density.

In the area of H2 classification, Stiffened or cellular raft - Stiffened with articulated lightly reinforced masonry must be considered. Site drainage and plumbing / service precautions recommended.

Note: The final decision on the type of foundation used for the applicable structure should be made and designed by a Structural Engineer.

11.3 It is recommended that the site drainage be improved for surface flooding. Drainage canals must be constructed to channel the water from structures after construction.

11.4 The general materials on site have COLTO classification between G6 and No Classification.

The materials with a G6 Classification can be improved by modification: By mixing the *in situ* materials with G5 materials (Weathered Dolerite) or crushed stone (Dolerite). After modification of the materials it can be stabilised with lime or cement to improve the materials further.

The materials with No Classification cannot be used in backfill and/or road construction.

11.5 Conditions can vary on site. Recommendations should be re-evaluated if this becomes apparent during the excavation.

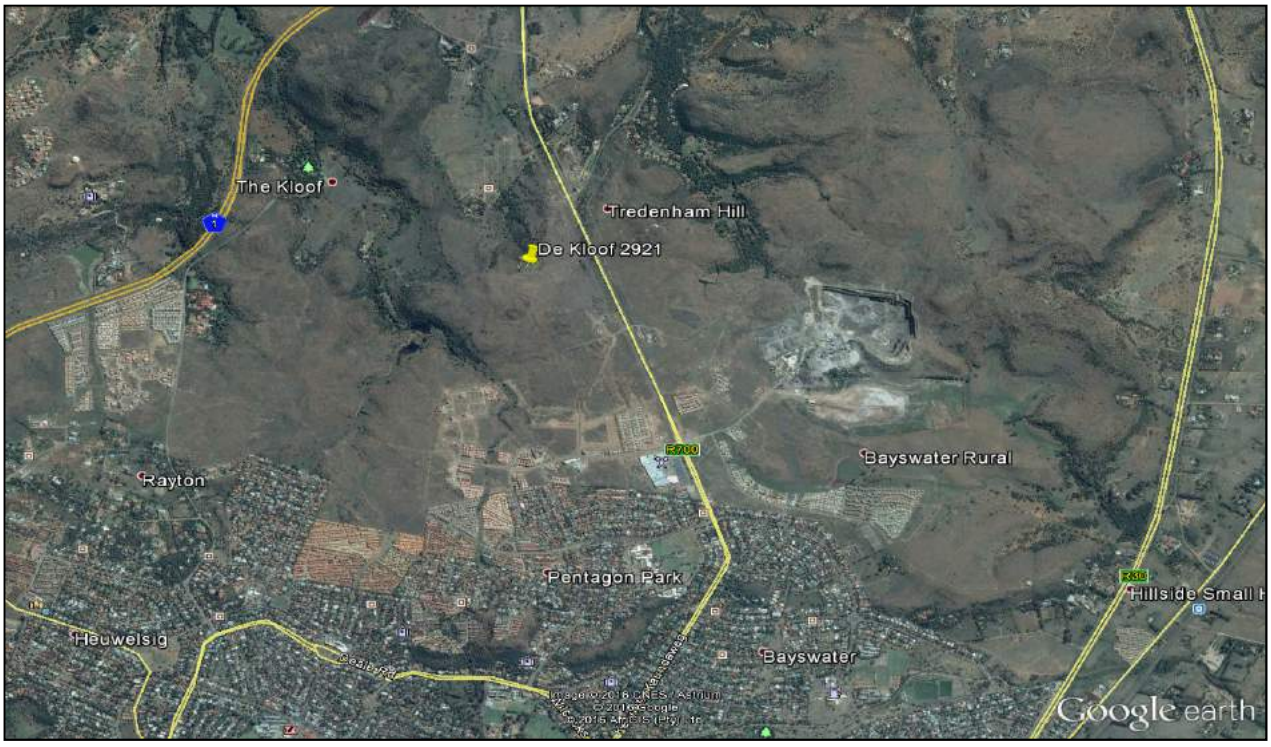
BJ VAN VUUREN (Technologist / CEO)
(ND Civil-General, B-Tech – Geotechnical, BSc Hons – Transport)
(Technical Signatory)

For: **SIMLAB (PTY) LIMITED – GEOTECHNICAL SERVICES**

APPENDIX A
LOCATION PLAN

Simlab (EDMS) BEPERK GEOTEGNIESE DIENSTE (PTY) LIMITED GEOTECHNICAL SERVICES
sanas Testing Laboratory T0455
REG. No. 1987/004282/07 NLA No. 2012/187
6249, BLOEMFONTEIN, 9300, SOUTH AFRICA. Cnr. Lunn Road & Grey Street, Hilton, BLOEMFONTEIN, 9301
☎ +27 (0) 51 447 0224/5, +27 (0) 82 821 9435, +27 (0) 51 448 8329, simbfn@simlab.co.za

LOCATION PLAN



Simlab (EDMS) BEPERK (PTY) LIMITED GEOTECHNICAL SERVICES
GEOTEGNIESE DIENSTE
sanas Testing Laboratory T0455
REG. No. 1987/004282/07 NLA No. 2012/187
6249, BLOEMFONTEIN, 9300, SOUTH AFRICA. Cnr. Lunn Road & Grey Street, Hilton, BLOEMFONTEIN, 9301
☎ +27 (0) 51 447 0224/5, +27 (0) 82 821 9435, +27 (0) 51 448 8329, simbfn@simlab.co.za

LOCATION PLAN

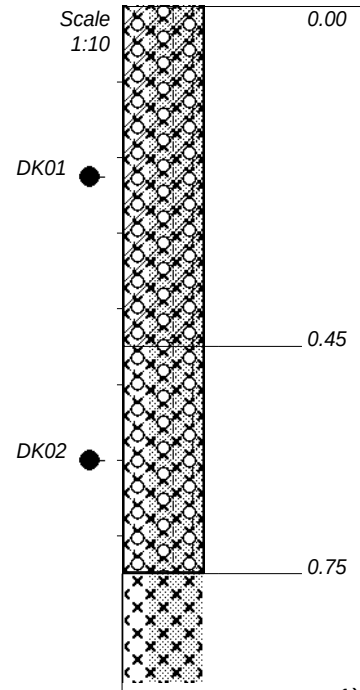
APPENDIX B
IN SITU MATERIALS PROFILES

(PTY) LIMITED - GEOTECHNICAL SERVICES

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 1
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.



0.00 Dry dark red brown loose well-graded sand with silty clay and weathered dolerite gravel.

0.45 Slightly moist yellow orange medium dense silty sand with weathered dolerite gravel.

0.75 0.750+ Refusal - Hard Rock, Dolerite.

NOTES

1) Disturbed sample DK01 taken at 0.225m.
2) Disturbed sample DK02 taken at 0.600m.
3) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3215424
Y-COORD : 27 Y0075375

HOLE No: Test Pit 1

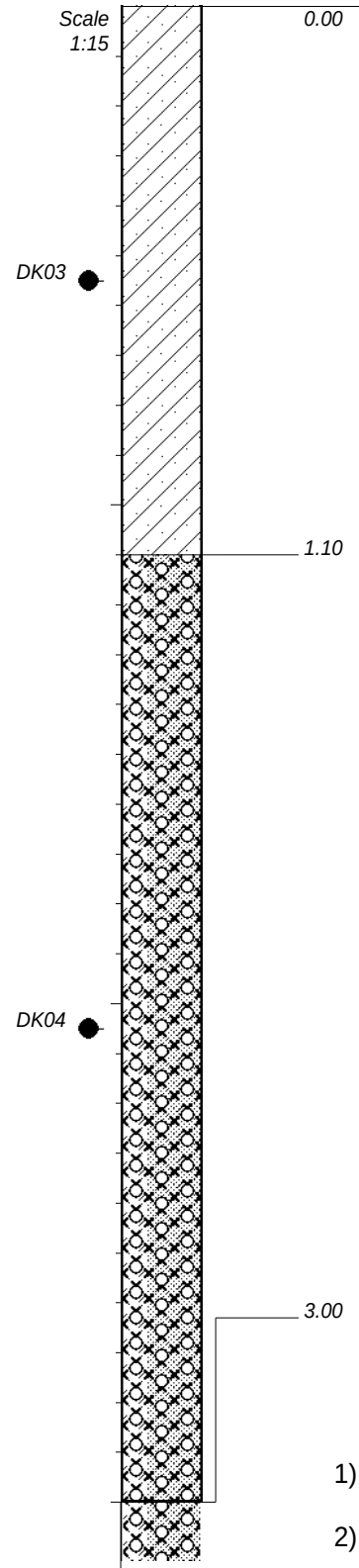
TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 2
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.



0.00 Slightly moist dark brown firm sandy lean clay.

1.10 Slightly moist light orange medium dense clayey sand with weathered dolerite gravel.

3.00 3.000+ Slightly moist light orange medium dense clayey sand with weathered dolerite gravel.

NOTES

1) Disturbed sample DK03 taken at 0.550m.
2) Disturbed sample DK04 taken at 2.050m.
3) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3215534
Y-COORD : 27 Y0075459

HOLE No: Test Pit 2

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

DATE : 13/09/2016 15:42
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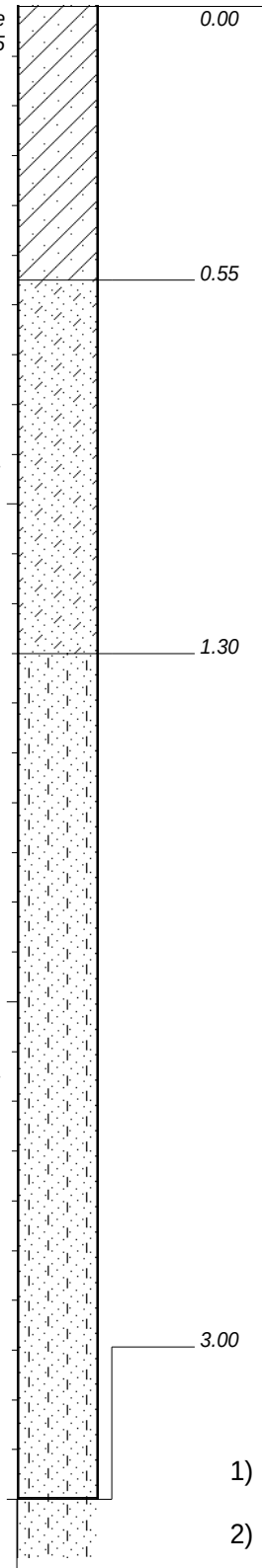
JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 3
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:15



0.00 Slightly moist dark brown firm sandy lean clay.

0.55 Slightly moist light brown orange medium dense clayey sand.

1.30 Slightly moist light yellow orange medium dense silty sand.

3.00 3.000+ Slightly moist light yellow orange medium dense silty sand.

NOTES

1) Disturbed sample DK05 taken at 0.925m.
2) Disturbed sample DK06 taken at 2.150m.
3) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3215648
Y-COORD : 27 Y0075399

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

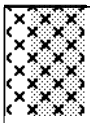
HOLE No: Test Pit 3

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 4
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:10



0.00

0.00

Surface Rock - Hard Rock, Dolerite.

0.001+ Surface Rock - Hard Rock, Dolerite.

NOTES

1) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

ELEVATION : -
X-COORD : X3215663
Y-COORD : 27 Y0075242

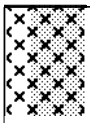
HOLE No: Test Pit 4

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 5
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:10



0.00

0.00

Surface Rock - Hard Rock, Dolerite.

0.001+ Surface Rock - Hard Rock, Dolerite.

NOTES

1) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

ELEVATION : -
X-COORD : X3215810
Y-COORD : 27 Y0075318

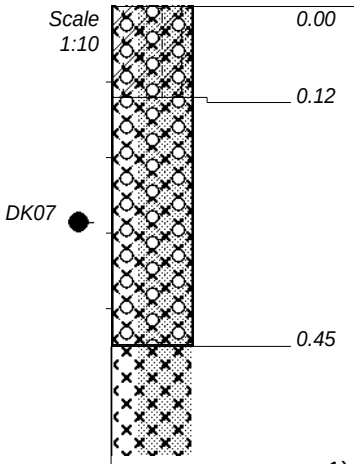
HOLE No: Test Pit 5

(PTY) LIMITED - GEOTECHNICAL SERVICES

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 6
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.



Dry dark red brown loose well-graded sand with silty clay and weathered dolerite gravel.

Dry light brown yellow medium dense well-graded sand with weathered dolerite gravel.

0.450+ Refusal - Hard Rock, Dolerite.

NOTES

1) Disturbed sample DK07 taken at 0.285m.

2) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

ELEVATION : -
X-COORD : X3215866
Y-COORD : 27 Y0075171

HOLE No: Test Pit 6

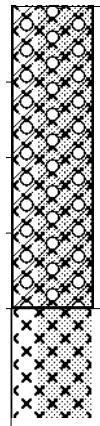
(PTY) LIMITED - GEOTECHNICAL SERVICES

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 7
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:10



0.00 Slightly moist red brown medium dense poorly graded weathered dolerite gravel with clay and sand.

0.40 0.400+ Refusal - Hard Rock, Dolerite.

NOTES

1) Disturbed sample DK08 taken at 0.200m.

2) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3216056
Y-COORD : 27 Y0075201

HOLE No: Test Pit 7

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

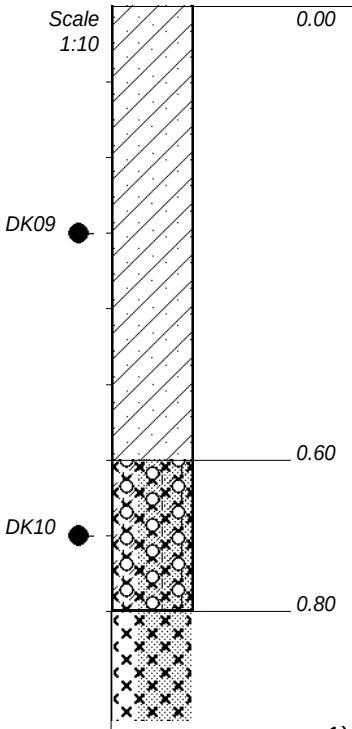
DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

(PTY) LIMITED - GEOTECHNICAL SERVICES

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 8
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.



0.00 Slightly moist dark red brown firm sandy lean clay.

0.60 Slightly moist light yellow grey medium dense silty, clayey sand with weathered dolerite gravel.

0.80 0.800+ Refusal - Hard Rock, Dolerite.

NOTES

1) Disturbed sample DK09 taken at 0.300m.
2) Disturbed sample DK10 taken at 0.700m.
3) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3216073
Y-COORD : 27 Y0075084

HOLE No: Test Pit 8

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

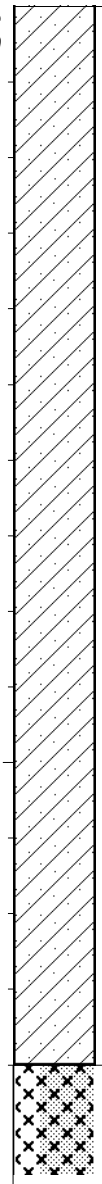
(PTY) LIMITED - GEOTECHNICAL SERVICES

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 9
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:10



0.00 Slightly moist dark brown black firm sandy lean clay.

1.40 1.400+ Refusal - Hard Rock, Dolerite.

NOTES

1) Disturbed sample DK11 taken at 0.700m.

2) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3216253
Y-COORD : 27 Y0075034

HOLE No: Test Pit 9

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

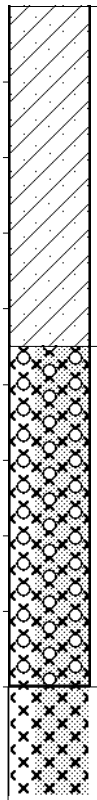
(PTY) LIMITED - GEOTECHNICAL SERVICES

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 10
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:10



0.00 Slightly moist dark brown black firm sandy lean clay.

0.45 Slightly moist light yellow brown grey medium dense weathered dolerite gravel.

0.90 0.900+ Refusal - Hard Rock, Dolerite.

NOTES

1) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3216285
Y-COORD : 27 Y0075132

HOLE No: Test Pit 10

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

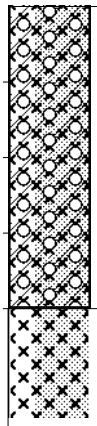
(PTY) LIMITED - GEOTECHNICAL SERVICES

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 11
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:10



0.00 Slightly moist red brown yellow medium dense sandy clay with weathered dolerite gravel.

0.40 0.400+ Refusal - Hard Rock, Dolerite.

NOTES

1) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3216177
Y-COORD : 27 Y0075232

HOLE No: Test Pit 11

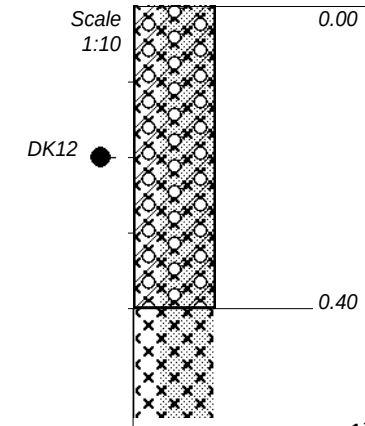
TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 12
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.



0.00 Slightly moist red brown yellow medium dense poorly graded weathered dolerite gravel with clay.

0.40 0.400+ Refusal - Hard Rock, Dolerite.

NOTES

1) Disturbed sample DK12 taken at 0.200m.

2) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3216278
Y-COORD : 27 Y0075266

HOLE No: Test Pit 12

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

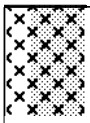
DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 13
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:10



0.00 — Surface Rock - Hard Rock, Dolerite.

0.00 — 0.001+ Surface Rock - Hard Rock, Dolerite.

NOTES

1) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3216340
Y-COORD : 27 Y0075445

HOLE No: Test Pit 13

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

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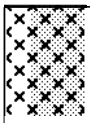
JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 14
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:10



0.00

0.00

Surface Rock - Hard Rock, Dolerite.

0.001+ Surface Rock - Hard Rock, Dolerite.

NOTES

1) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

ELEVATION : -
X-COORD : X3216301
Y-COORD : 27 Y0075598

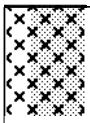
HOLE No: Test Pit 14

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 15
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:10



0.00 Surface Rock - Hard Rock, Dolerite.

0.00 0.001+ Surface Rock - Hard Rock, Dolerite.

NOTES

1) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3216066
Y-COORD : 27 Y0075603

HOLE No: Test Pit 15

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

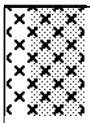
DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 16
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:10



0.00 Surface Rock - Hard Rock, Dolerite.

0.00 0.001+ Surface Rock - Hard Rock, Dolerite.

NOTES

1) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3215805
Y-COORD : 27 Y0075690

HOLE No: Test Pit 16

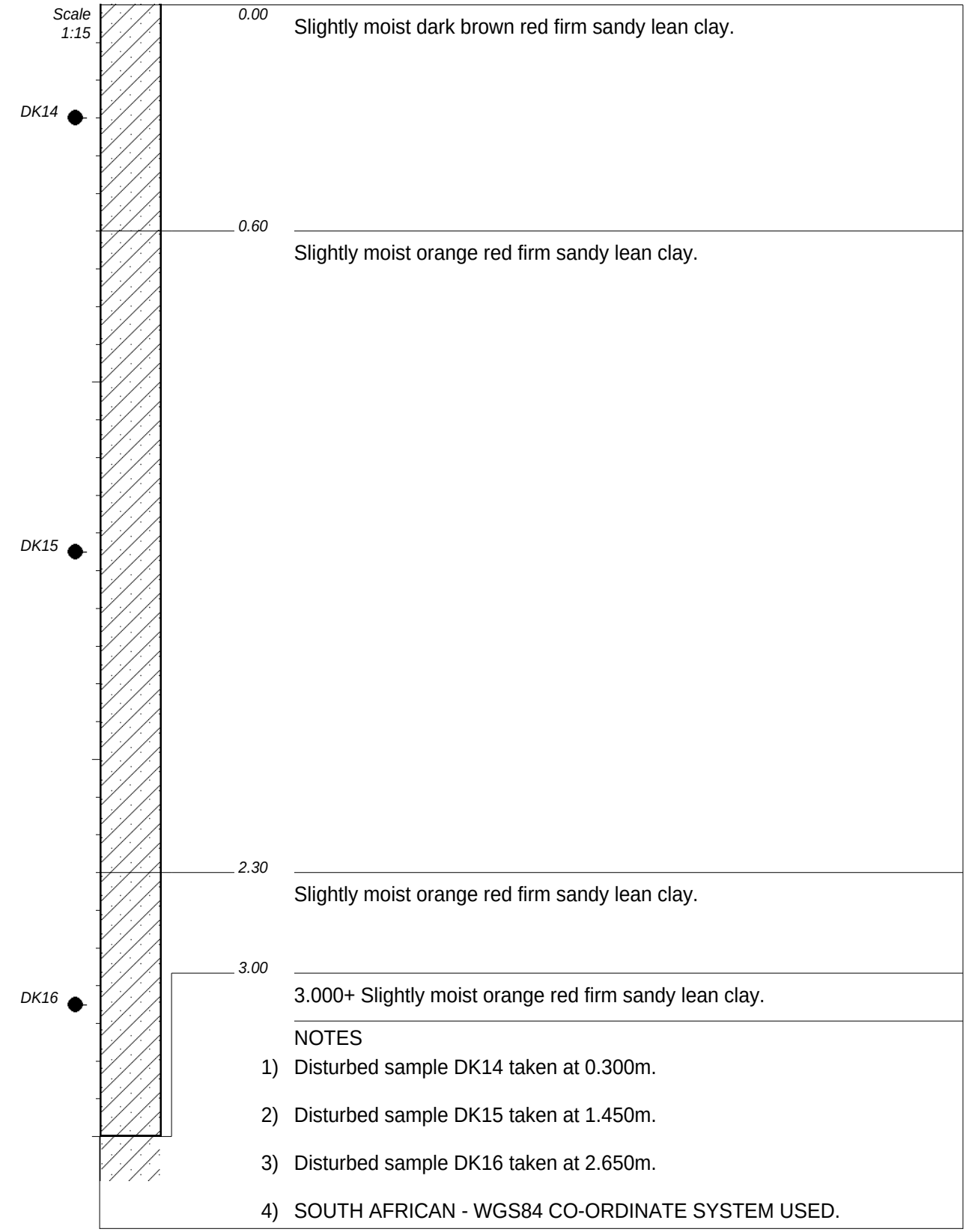
TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 17
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.



0.00 Slightly moist dark brown red firm sandy lean clay.

0.60 Slightly moist orange red firm sandy lean clay.

2.30 Slightly moist orange red firm sandy lean clay.

3.00 3.000+ Slightly moist orange red firm sandy lean clay.

NOTES

1) Disturbed sample DK14 taken at 0.300m.
2) Disturbed sample DK15 taken at 1.450m.
3) Disturbed sample DK16 taken at 2.650m.
4) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3215914
Y-COORD : 27 Y0075611

HOLE No: Test Pit 17

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

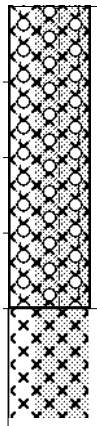
DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 18
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:10



0.00 Dry light brown yellow medium dense silty sand with weathered dolerite gravel.

0.40 0.400+ Refusal - Hard Rock, Dolerite.

NOTES

1) Disturbed sample DK13 taken at 0.200m.

2) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3216181
Y-COORD : 27 Y0075510

HOLE No: Test Pit 18

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

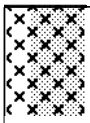
DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

HOLE No: Test Pit 19
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

Scale 1:10



0.00 — Surface Rock - Hard Rock, Dolerite.

0.00 — 0.001+ Surface Rock - Hard Rock, Dolerite.

NOTES

1) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : KOMATAU (WB 93R)
DRILLED BY : FJ Coetser
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : -
DATE : 13/09/2016

ELEVATION : -
X-COORD : X3216081
Y-COORD : 27 Y0075377

HOLE No: Test Pit 19

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

(PTY) LIMITED - GEOTECHNICAL SERVICES

JOINT EFFORT TRUST (Bloemfontein)
Geotechnical Investigation at Farm:
De Kloof 2921, Bloemfontein.

LEGEND
Sheet 1 of 1

JOB NUMBER: 2016/393/Doc.

	GRAVEL	{SA02}
	SAND	{SA04}
	SANDY	{SA05}
	SILTY	{SA07}
	CLAY	{SA08}
	CLAYEY	{SA09}
	DOLERITE	{SA18}{SA42}
Name ●	DISTURBED SAMPLE	{SA38}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : BM DU PREEZ
SETUP FILE : STANDARD.SET

DATE : 13/09/2016 15:42
TEXT : ..esktop\InSituProfile.txt

LEGEND
SUMMARY OF SYMBOLS

APPENDIX C
LABORATORY TEST RESULTS

Simlab (EDMS) BEPERK GEOTEGNIESE DIENSTE (PTY) LIMITED GEOTECHNICAL SERVICES
REG. No. 1987/004282/07 NLA No. 2012/187
6249, BLOEMFONTEIN, 9300, SOUTH AFRICA. Cnr. Lunn Road & Grey Street, Hilton, BLOEMFONTEIN, 9301
☎ +27 (0) 51 447 0224/5, +27 (0) 82 821 9435, +27 (0) 51 448 8329, simbfn@simlab.co.za
sanas Testing Laboratory T0455

MATERIAL ANALYSIS

HOLE No. / KM		**Test Pit 1**				**Test Pit 2**
MATERIAL DEPTH (mm)		0 - 450	450 - 750		+750	0 - 1100
SAMPLE / LAB. No.		**DK01 / 016/2743**	**DK02 / 016/2744**		**N/S**	**DK03 / 016/2745**
MATERIAL DESCRIPTION		Dry dark red brown loose well-graded sand with silty clay and weathered dolerite gravel.	Slightly moist yellow orange medium dense silty sand with weathered dolerite gravel.		Hard Rock, Dolerite (Refusal)	Slightly moist dark brown firm sandy lean clay.
*** IN SITU FIELD MOISTURE (%)**		2.5	4.4			8.2
*** UNIFIED SOIL CLASSIFICATION**		**SW-SC**	**SM**			**CL**
TRH14 / * COLTO CLASSIFICATION		**G6**	**G6**			**No Classification**
DETERMINATION OF THE MOISTURE CONTENT BY OVEN-DRYING (SANS 3001-GR20:2010); * WET PREPARATION AND PARTICLE SIZE ANALYSIS (SANS 3001-GR:2011); * COMPUTATION OF SOIL-MORTAR PERCENTAGES & GRADING MODULUS (SANS 3001-PR5:2011)						
SIEVE ANALYSIS	**63.0 mm**					
	50.0 mm	100	100			
	37.5 mm	99	99			
	28.0 mm	94	96			
	20.0 mm	91	88			
	14.0 mm	88	86			
	5.00 mm	75	72			100
	2.00 mm	48	50			99
	0.425 mm	26	27			90
	0.075 mm	11	14			60
	*** 0.002 mm**	2	4			23
SOIL MORTAR	**COARSE SAND**	46	46			9
	FINE SAND	9 / 8 / 14	6 / 8 / 11			5 / 9 / 17
	MATERIAL<0.075 mm	23	29			61
GRADING MODULUS (GM)		2.16	2.09			0.51
*** DETERMINATION OF THE ONE-POINT LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LINEAR SHRINKAGE (SANS 3001-GR10:2011); *DETERMINATION OF THE pH VALUE OF A SOIL SUSPENSION (TMH1:1986, Method A20); * TENTATIVE METHOD FOR THE DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF A SATURATED SOIL PASTE AND WATER (TMH1:1986, Method A21T)**						
ATTERBERG LIMITS PASSING SIEVE 0.425mm	**L.L (%)**	24	-			38
	P.I. / L.S. (%)	4 / 2.0	SP / 1.3			18 / 9.2
POTENTIAL EXPANSIVENESS (mm)		Low	Low			Medium / 18.7mm
pH VALUE / CONDUCTIVITY (Sm^{-1})		6.53 / 0.0205	6.99 / 0.0112			7.24 / 0.1167
*** DETERMINATION OF THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT (SANS 30010GR30:2010; * DETERMINATION OF THE CALIFORNIA BEARING RATIO (SANS 3001-GR40:2010); * THE EXTENT TO WHICH A PARTICULAR MATERIAL WILL COMPACT (SABS 0120, Part 3)**						
CBR / UCS / ITS DETERMINATION	**MOD AASHTO**	**MAX DRY DENSITY (kg/m^3)**	2225	2338		1670
		OPT MOISTURE (%)	8.3	7.6		13.9
		COMP MOISTURE (%)	8.3	7.7		13.9
		DRY DENSITY (kg/m^3)	2210	2338		1670
		CBR (%)	65	98		67
		COMPACTABILITY (Ratio / %)	0.57 / 56.7%	0.57 / 56.7%		
		PERMEABILITY ($cm.s^{-1}$)				
		SWELL (%)	0.1	0.1		1.1
	NRB	**DRY DENSITY (kg/m^3)**	2072	2219		1605
		CBR (%)	29	44		7
	PROCTOR	**MAX DRY DENSITY (kg/m^3)**	1983	2131		1548
		OPT MOISTURE (%)	-	-		-
		CBR (%)	17	23		1
	CBR	**100%**	74	98		67
		98%	57	71		21
		95%	38	44		4
		93%	29	32		1
		90%	19	20		0

Simlab (EDMS) BEPERK GEOTEGNIESE DIENSTE (PTY) LIMITED GEOTECHNICAL SERVICES
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MATERIAL ANALYSIS

HOLE No. / KM			**Test Pit 2**		**Test Pit 3**	
MATERIAL DEPTH (mm)			1100 - 3000	+3000	0 - 550	550 - 1300
SAMPLE / LAB. No.			**DK04 / 016/2746**	**N/S**	**N/S**	**DK05 / 016/2747**
MATERIAL DESCRIPTION			Slightly moist light orange medium dense clayey sand with weathered dolerite gravel.	Slightly moist light orange medium dense clayey sand with weathered dolerite gravel.	Slightly moist dark brown firm sandy lean clay.	Slightly moist light brown orange medium dense clayey sand.
*** IN SITU FIELD MOISTURE (%)**			4.8			6.7
*** UNIFIED SOIL CLASSIFICATION**			**SC**			**SC**
TRH14 / * COLTO CLASSIFICATION			**No Classification**			
DETERMINATION OF THE MOISTURE CONTENT BY OVEN-DRYING (SANS 3001-GR20:2010); * WET PREPARATION AND PARTICLE SIZE ANALYSIS (SANS 3001-GR:2011); * COMPUTATION OF SOIL-MORTAR PERCENTAGES & GRADING MODULUS (SANS 3001-PR5:2011)						
SIEVE ANALYSIS	**63.0 mm**					
	50.0 mm					
	37.5 mm					
	28.0 mm					
	20.0 mm					
	14.0 mm		100			
	5.00 mm		97			100
	2.00 mm		85			95
	0.425 mm		61			81
	0.075 mm		34			47
	*** 0.002 mm**		12			8
SOIL MORTAR	**COARSE SAND**		28			15
	FINE SAND		7 / 8 / 17			6 / 8 / 21
	MATERIAL<0.075 mm		40			50
GRADING MODULUS (GM)			1.20			0.77
*** DETERMINATION OF THE ONE-POINT LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LINEAR SHRINKAGE (SANS 3001-GR10:2011); *DETERMINATION OF THE pH VALUE OF A SOIL SUSPENSION (TMH1:1986, Method A20); * TENTATIVE METHOD FOR THE DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF A SATURATED SOIL PASTE AND WATER (TMH1:1986, Method A21T)**						
ATTERBERG LIMITS PASSING SIEVE 0.425mm	**L.L (%)**		33			35
	P.I. / L.S. (%)		12 / 6.4			16 / 8.0
POTENTIAL EXPANSIVENESS (mm)			Low			Low
pH VALUE / CONDUCTIVITY (Sm^{-1})			8.00 / 0.0654			8.06 / 0.0747
*** DETERMINATION OF THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT (SANS 30010GR30:2010; * DETERMINATION OF THE CALIFORNIA BEARING RATIO (SANS 3001-GR40:2010); * THE EXTENT TO WHICH A PARTICULAR MATERIAL WILL COMPACT (SABS 0120, Part 3)**						
CBR / UCS / ITS DETERMINATION	**MOD AASHTO**	**MAX DRY DENSITY (kg/m^3)**	2071			
		OPT MOISTURE (%)	8.1			
		COMP MOISTURE (%)	8.1			
		DRY DENSITY (kg/m^3)	2071			
		CBR (%)	12			
		COMPACTABILITY (Ratio / %)				
		PERMEABILITY ($cm.s^{-1}$)				
		SWELL (%)	1.9			
	NRB	**DRY DENSITY (kg/m^3)**	1921			
		CBR (%)	7			
	PROCTOR	**MAX DRY DENSITY (kg/m^3)**	1847			
		OPT MOISTURE (%)	-			
		CBR (%)	5			
	CBR	**100%**	12			
		98%	10			
		95%	8			
		93%	7			
		90%	5			

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MATERIAL ANALYSIS

HOLE No. / KM		**Test Pit 3**		**Test Pit 4**	**Test Pit 5**
MATERIAL DEPTH (mm)		1300 - 3000	+3000	Surface	Surface
SAMPLE / LAB. No.		**DK06 / 016/2748**	**N/S**	**N/S**	**N/S**
MATERIAL DESCRIPTION		Slightly moist light yellow orange medium dense silty sand.	Slightly moist light yellow orange medium dense silty sand.	Hard Rock, Dolerite (Surface Rock)	Hard Rock, Dolerite (Surface Rock)
*** IN SITU FIELD MOISTURE (%)**		6.8			
*** UNIFIED SOIL CLASSIFICATION**		**SM**			
TRH14 / * COLTO CLASSIFICATION		**No Classification**			
DETERMINATION OF THE MOISTURE CONTENT BY OVEN-DRYING (SANS 3001-GR20:2010); * WET PREPARATION AND PARTICLE SIZE ANALYSIS (SANS 3001-GR:2011); * COMPUTATION OF SOIL-MORTAR PERCENTAGES & GRADING MODULUS (SANS 3001-PR5:2011)					
SIEVE ANALYSIS	**63.0 mm**				
	50.0 mm				
	37.5 mm				
	28.0 mm				
	20.0 mm	100			
	14.0 mm	99			
	5.00 mm	97			
	2.00 mm	91			
	0.425 mm	84			
	0.075 mm	42			
	*** 0.002 mm**	8			
SOIL MORTAR	**COARSE SAND**	8			
	FINE SAND	11 / 15 / 20			
	MATERIAL<0.075 mm	46			
GRADING MODULUS (GM)		0.83			
*** DETERMINATION OF THE ONE-POINT LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LINEAR SHRINKAGE (SANS 3001-GR10:2011); *DETERMINATION OF THE pH VALUE OF A SOIL SUSPENSION (TMH1:1986, Method A20); * TENTATIVE METHOD FOR THE DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF A SATURATED SOIL PASTE AND WATER (TMH1:1986, Method A21T)**					
ATTERBERG LIMITS PASSING SIEVE 0.425mm	**L.L (%)**	40			
	P.I. / L.S. (%)	14 / 6.8			
POTENTIAL EXPANSIVENESS (mm)		Low			
pH VALUE / CONDUCTIVITY (Sm^{-1})		7.66 / 0.1587			
*** DETERMINATION OF THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT (SANS 30010GR30:2010; * DETERMINATION OF THE CALIFORNIA BEARING RATIO (SANS 3001-GR40:2010); * THE EXTENT TO WHICH A PARTICULAR MATERIAL WILL COMPACT (SABS 0120, Part 3)**					
CBR / UCS / ITS DETERMINATION	**MOD AASHTO**	**MAX DRY DENSITY (kg/m^3)**	1777		
		OPT MOISTURE (%)	17.7		
		COMP MOISTURE (%)	17.8		
		DRY DENSITY (kg/m^3)	1777		
		CBR (%)	9		
		COMPACTABILITY (Ratio / %)	0.45 / 44.9%		
		PERMEABILITY ($cm.s^{-1}$)			
		SWELL (%)	2.9		
	NRB	**DRY DENSITY (kg/m^3)**	1668		
		CBR (%)	7		
	PROCTOR	**MAX DRY DENSITY (kg/m^3)**	1558		
		OPT MOISTURE (%)	-		
		CBR (%)	5		
	CBR	**100%**	9		
		98%	8		
		95%	7		
		93%	7		
		90%	6		

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MATERIAL ANALYSIS

HOLE No. / KM		**Test Pit 6**			**Test Pit 7**
MATERIAL DEPTH (mm)		0 - 120	120 - 450	+450	0 - 400
SAMPLE / LAB. No.		**N/S**	**DK07 / 016/2749**	**N/S**	**DK08 / 016/2750**
MATERIAL DESCRIPTION		Dry dark red brown loose well-graded sand with silty clay and weathered dolerite gravel.	Dry light brown yellow medium dense well-graded sand with weathered dolerite gravel.	Hard Rock, Dolerite (Refusal)	Slightly moist red brown medium dense poorly graded weathered dolerite gravel with clay and sand.
*** IN SITU FIELD MOISTURE (%)**			1.6		4.1
*** UNIFIED SOIL CLASSIFICATION**			**SW**		**GP-GC**
TRH14 / * COLTO CLASSIFICATION			**G6**		**No Classification**
DETERMINATION OF THE MOISTURE CONTENT BY OVEN-DRYING (SANS 3001-GR20:2010); * WET PREPARATION AND PARTICLE SIZE ANALYSIS (SANS 3001-GR:2011); * COMPUTATION OF SOIL-MORTAR PERCENTAGES & GRADING MODULUS (SANS 3001-PR5:2011)					
SIEVE ANALYSIS	**63.0 mm**				100
	50.0 mm		100		94
	37.5 mm		97		76
	28.0 mm		97		67
	20.0 mm		96		61
	14.0 mm		92		57
	5.00 mm		58		48
	2.00 mm		26		40
	0.425 mm		10		28
	0.075 mm		3		10
	*** 0.002 mm**		0		2
SOIL MORTAR	**COARSE SAND**		63		29
	FINE SAND		9 / 7 / 10		15 / 15 / 16
	MATERIAL<0.075 mm		12		25
GRADING MODULUS (GM)			2.60		2.23
*** DETERMINATION OF THE ONE-POINT LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LINEAR SHRINKAGE (SANS 3001-GR10:2011); *DETERMINATION OF THE pH VALUE OF A SOIL SUSPENSION (TMH1:1986, Method A20); * TENTATIVE METHOD FOR THE DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF A SATURATED SOIL PASTE AND WATER (TMH1:1986, Method A21T)**					
ATTERBERG LIMITS PASSING SIEVE 0.425mm	**L.L (%)**		-		25
	P.I. / L.S. (%)		NP / 0.0		7 / 2.7
POTENTIAL EXPANSIVENESS (mm)			Low		Low
pH VALUE / CONDUCTIVITY (Sm^{-1})			8.21 / 0.0112		8.37 / 0.1400
*** DETERMINATION OF THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT (SANS 30010GR30:2010; * DETERMINATION OF THE CALIFORNIA BEARING RATIO (SANS 3001-GR40:2010); * THE EXTENT TO WHICH A PARTICULAR MATERIAL WILL COMPACT (SABS 0120, Part 3)**					
CBR / UCS / ITS DETERMINATION	**MOD AASHTO**	**MAX DRY DENSITY (kg/m^3)**		2303		2155
		OPT MOISTURE (%)		4.6		7.8
		COMP MOISTURE (%)		4.6		7.8
		DRY DENSITY (kg/m^3)		2291		2155
		CBR (%)		49		81
		COMPACTABILITY (Ratio / %)		0.59 / 59.8%		0.78 / 78.4%
		PERMEABILITY ($cm.s^{-1}$)				
		SWELL (%)		0.0		0.1
	NRB	**DRY DENSITY (kg/m^3)**		2164		2042
		CBR (%)		38		27
	PROCTOR	**MAX DRY DENSITY (kg/m^3)**		2074		1948
		OPT MOISTURE (%)		-		-
		CBR (%)		32		9
	CBR	**100%**		49		81
		98%		45		52
		95%		40		27
		93%		37		17
		90%		32		9

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MATERIAL ANALYSIS

HOLE No. / KM			**Test Pit 7**	**Test Pit 8**		
MATERIAL DEPTH (mm)			+400	0 - 600	600 - 800	+800
SAMPLE / LAB. No.			**N/S**	**DK09 / 016/2751**	**DK10 / 016/2752**	**N/S**
MATERIAL DESCRIPTION			Hard Rock, Dolerite (Refusal)	Slightly moist dark red brown firm sandy lean clay.	Slightly moist light yellow grey medium dense silty, clayey sand with weathered dolerite gravel.	Hard Rock, Dolerite (Refusal)
*** IN SITU FIELD MOISTURE (%)**				8.5	6.7	
*** UNIFIED SOIL CLASSIFICATION**				**CL**	**SC-SM**	
TRH14 / * COLTO CLASSIFICATION						
DETERMINATION OF THE MOISTURE CONTENT BY OVEN-DRYING (SANS 3001-GR20:2010); * WET PREPARATION AND PARTICLE SIZE ANALYSIS (SANS 3001-GR:2011); * COMPUTATION OF SOIL-MORTAR PERCENTAGES & GRADING MODULUS (SANS 3001-PR5:2011)						
SIEVE ANALYSIS	**63.0 mm**					
	50.0 mm					
	37.5 mm					
	28.0 mm					
	20.0 mm				100	
	14.0 mm				97	
	5.00 mm			100	87	
	2.00 mm			98	71	
	0.425 mm			92	60	
	0.075 mm			52	37	
	*** 0.002 mm**			20	8	
SOIL MORTAR	**COARSE SAND**			7	16	
	FINE SAND			5 / 10 / 25	3 / 5 / 24	
	MATERIAL<0.075 mm			53	52	
GRADING MODULUS (GM)				0.58	1.33	
*** DETERMINATION OF THE ONE-POINT LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LINEAR SHRINKAGE (SANS 3001-GR10:2011); *DETERMINATION OF THE pH VALUE OF A SOIL SUSPENSION (TMH1:1986, Method A20); * TENTATIVE METHOD FOR THE DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF A SATURATED SOIL PASTE AND WATER (TMH1:1986, Method A21T)**						
ATTERBERG LIMITS PASSING SIEVE 0.425mm	**L.L (%)**			35	23	
	P.I. / L.S. (%)			13 / 6.7	4 / 2.3	
POTENTIAL EXPANSIVENESS (mm)				Medium / 11.1mm	Low	
pH VALUE / CONDUCTIVITY (Sm^{-1})				8.40 / 0.1587	8.57 / 0.0252	
*** DETERMINATION OF THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT (SANS 30010GR30:2010; * DETERMINATION OF THE CALIFORNIA BEARING RATIO (SANS 3001-GR40:2010); * THE EXTENT TO WHICH A PARTICULAR MATERIAL WILL COMPACT (SABS 0120, Part 3)**						
CBR / UCS / ITS DETERMINATION	**MOD AASHTO**	**MAX DRY DENSITY (kg/m^3)**				
		OPT MOISTURE (%)				
		COMP MOISTURE (%)				
		DRY DENSITY (kg/m^3)				
		CBR (%)				
		COMPACTABILITY (Ratio / %)				
		PERMEABILITY ($cm.s^{-1}$)				
		SWELL (%)				
	NRB	**DRY DENSITY (kg/m^3)**				
		CBR (%)				
	PROCTOR	**MAX DRY DENSITY (kg/m^3)**				
		OPT MOISTURE (%)				
		CBR (%)				
	CBR	**100%**				
		98%				
		95%				
		93%				
		90%				

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MATERIAL ANALYSIS

HOLE No. / KM			**Test Pit 9**		**Test Pit 10**	
MATERIAL DEPTH (mm)			0 - 1400	+1400	0 - 450	450 - 900
SAMPLE / LAB. No.			**DK11 / 016/2753**	**N/S**	**N/S**	**N/S**
MATERIAL DESCRIPTION			Slightly moist dark brown black firm sandy lean clay.	Hard Rock, Dolerite (Refusal)	Slightly moist dark brown black firm sandy lean clay.	Slightly moist light yellow brown grey medium dense weathered dolerite gravel.
*** IN SITU FIELD MOISTURE (%)**			5.9			
*** UNIFIED SOIL CLASSIFICATION**			**CL**			
TRH14 / * COLTO CLASSIFICATION			**No Classification**			
DETERMINATION OF THE MOISTURE CONTENT BY OVEN-DRYING (SANS 3001-GR20:2010); * WET PREPARATION AND PARTICLE SIZE ANALYSIS (SANS 3001-GR:2011); * COMPUTATION OF SOIL-MORTAR PERCENTAGES & GRADING MODULUS (SANS 3001-PR5:2011)						
SIEVE ANALYSIS	**63.0 mm**					
	50.0 mm					
	37.5 mm					
	28.0 mm					
	20.0 mm					
	14.0 mm					
	5.00 mm		100			
	2.00 mm		94			
	0.425 mm		86			
	0.075 mm		52			
	*** 0.002 mm**		28			
SOIL MORTAR	**COARSE SAND**		9			
	FINE SAND		3 / 4 / 29			
	MATERIAL<0.075 mm		55			
GRADING MODULUS (GM)			0.69			
*** DETERMINATION OF THE ONE-POINT LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LINEAR SHRINKAGE (SANS 3001-GR10:2011); *DETERMINATION OF THE pH VALUE OF A SOIL SUSPENSION (TMH1:1986, Method A20); * TENTATIVE METHOD FOR THE DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF A SATURATED SOIL PASTE AND WATER (TMH1:1986, Method A21T)**						
ATTERBERG LIMITS PASSING SIEVE 0.425mm	**L.L (%)**		47			
	P.I. / L.S. (%)		24 / 12.1			
POTENTIAL EXPANSIVENESS (mm)			Medium / 22.6mm			
pH VALUE / CONDUCTIVITY (Sm^{-1})			8.23 / 0.1961			
*** DETERMINATION OF THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT (SANS 30010GR30:2010; * DETERMINATION OF THE CALIFORNIA BEARING RATIO (SANS 3001-GR40:2010); * THE EXTENT TO WHICH A PARTICULAR MATERIAL WILL COMPACT (SABS 0120, Part 3)**						
CBR / UCS / ITS DETERMINATION	**MOD AASHTO**	**MAX DRY DENSITY (kg/m^3)**	1683			
		OPT MOISTURE (%)	16.8			
		COMP MOISTURE (%)	16.7			
		DRY DENSITY (kg/m^3)	1683			
		CBR (%)	3			
		COMPACTABILITY (Ratio / %)				
		PERMEABILITY ($cm.s^{-1}$)				
		SWELL (%)	8.5			
	NRB	**DRY DENSITY (kg/m^3)**	1582			
		CBR (%)	3			
	PROCTOR	**MAX DRY DENSITY (kg/m^3)**	1453			
		OPT MOISTURE (%)	-			
		CBR (%)	3			
	CBR	**100%**	3			
		98%	3			
		95%	3			
		93%	3			
		90%	3			

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MATERIAL ANALYSIS

HOLE No. / KM		Test Pit 10	Test Pit 11		Test Pit 12
MATERIAL DEPTH (mm)		+900	0 - 400	+400	0 - 400
SAMPLE / LAB. No.		N/S	N/S	N/S	DK12 / 016/2754
MATERIAL DESCRIPTION		Hard Rock, Dolerite (Refusal)	Slightly moist red brown yellow medium dense sandy clay with weathered dolerite gravel.	Hard Rock, Dolerite (Refusal)	Slightly moist red brown yellow medium dense poorly graded weathered dolerite gravel with clay.
* IN SITU FIELD MOISTURE (%)					2.3
* UNIFIED SOIL CLASSIFICATION					GP-GC
TRH14 / * COLTO CLASSIFICATION					
DETERMINATION OF THE MOISTURE CONTENT BY OVEN-DRYING (SANS 3001-GR20:2010); * WET PREPARATION AND PARTICLE SIZE ANALYSIS (SANS 3001-GR:2011); * COMPUTATION OF SOIL-MORTAR PERCENTAGES & GRADING MODULUS (SANS 3001-PR5:2011)					
SIEVE ANALYSIS	63.0 mm				96
	50.0 mm				89
	37.5 mm				77
	28.0 mm				68
	20.0 mm				60
	14.0 mm				53
	5.00 mm				33
	2.00 mm				19
	0.425 mm				12
	0.075 mm				5
	* 0.002 mm				1
SOIL MORTAR	COARSE SAND				37
	FINE SAND				8 / 10 / 19
	MATERIAL<0.075 mm				25
GRADING MODULUS (GM)					2.64
* DETERMINATION OF THE ONE-POINT LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LINEAR SHRINKAGE (SANS 3001-GR10:2011); *DETERMINATION OF THE pH VALUE OF A SOIL SUSPENSION (TMH1:1986, Method A20); * TENTATIVE METHOD FOR THE DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF A SATURATED SOIL PASTE AND WATER (TMH1:1986, Method A21T)					
ATTERBERG LIMITS PASSING SIEVE 0.425mm	L.L (%)				29
	P.I. / L.S. (%)				8 / 3.7
POTENTIAL EXPANSIVENESS (mm)					Low
pH VALUE / CONDUCTIVITY (Sm^{-1})					8.41 / 0.0294
* DETERMINATION OF THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT (SANS 30010GR30:2010; * DETERMINATION OF THE CALIFORNIA BEARING RATIO (SANS 3001-GR40:2010); * THE EXTENT TO WHICH A PARTICULAR MATERIAL WILL COMPACT (SABS 0120, Part 3)					
CBR / UCS / ITS DETERMINATION	MOD AASHTO: MAX DRY DENSITY (kg/m^3)				
	MOD AASHTO: OPT MOISTURE (%)				
	MOD AASHTO: COMP MOISTURE (%)				
	MOD AASHTO: DRY DENSITY (kg/m^3)				
	MOD AASHTO: CBR (%)				
	MOD AASHTO: COMPACTABILITY (Ratio / %)				
	MOD AASHTO: PERMEABILITY ($cm.s^{-1}$)				
	MOD AASHTO: SWELL (%)				
	NRB: DRY DENSITY (kg/m^3)				
	NRB: CBR (%)				
	PROCTOR: MAX DRY DENSITY (kg/m^3)				
	PROCTOR: OPT MOISTURE (%)				
	PROCTOR: CBR (%)				
	CBR: 100%				
	CBR: 98%				
	CBR: 95%				
	CBR: 93%				
	CBR: 90%				

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MATERIAL ANALYSIS

HOLE No. / KM		Test Pit 12	Test Pit 13	Test Pit 14	Test Pit 15
MATERIAL DEPTH (mm)		+400	Surface	Surface	Surface
SAMPLE / LAB. No.		N/S	N/S	N/S	N/S
MATERIAL DESCRIPTION * IN SITU FIELD MOISTURE (%)		Hard Rock, Dolerite (Refusal)	Hard Rock, Dolerite (Surface Rock)	Hard Rock, Dolerite (Surface Rock)	Hard Rock, Dolerite (Surface Rock)
* UNIFIED SOIL CLASSIFICATION					
TRH14 / * COLTO CLASSIFICATION					
DETERMINATION OF THE MOISTURE CONTENT BY OVEN-DRYING (SANS 3001-GR20:2010); * WET PREPARATION AND PARTICLE SIZE ANALYSIS (SANS 3001-GR:2011); * COMPUTATION OF SOIL-MORTAR PERCENTAGES & GRADING MODULUS (SANS 3001-PR5:2011)					
SIEVE ANALYSIS	63.0 mm				
	50.0 mm				
	37.5 mm				
	28.0 mm				
	20.0 mm				
	14.0 mm				
	5.00 mm				
	2.00 mm				
	0.425 mm				
	0.075 mm				
	* 0.002 mm				
SOIL MORTAR	COARSE SAND				
	FINE SAND				
	MATERIAL<0.075 mm				
GRADING MODULUS (GM)					
* DETERMINATION OF THE ONE-POINT LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LINEAR SHRINKAGE (SANS 3001-GR10:2011); *DETERMINATION OF THE pH VALUE OF A SOIL SUSPENSION (TMH1:1986, Method A20); * TENTATIVE METHOD FOR THE DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF A SATURATED SOIL PASTE AND WATER (TMH1:1986, Method A21T)					
ATTERBERG LIMITS PASSING SIEVE 0.425mm	L.L (%)				
	P.I. / L.S. (%)				
POTENTIAL EXPANSIVENESS (mm)					
pH VALUE / CONDUCTIVITY (Sm^{-1})					
* DETERMINATION OF THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT (SANS 30010GR30:2010; * DETERMINATION OF THE CALIFORNIA BEARING RATIO (SANS 3001-GR40:2010); * THE EXTENT TO WHICH A PARTICULAR MATERIAL WILL COMPACT (SABS 0120, Part 3)					
CBR / UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m^3)				
		OPT MOISTURE (%)				
		COMP MOISTURE (%)				
		DRY DENSITY (kg/m^3)				
		CBR (%)				
		COMPACTABILITY (Ratio / %)				
		PERMEABILITY ($cm.s^{-1}$)				
		SWELL (%)				
	NRB	DRY DENSITY (kg/m^3)				
		CBR (%)				
	PROCTOR	MAX DRY DENSITY (kg/m^3)				
		OPT MOISTURE (%)				
		CBR (%)				
	CBR	100%				
		98%				
		95%				
		93%				
		90%				

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MATERIAL ANALYSIS

HOLE No. / KM			**Test Pit 16**	**Test Pit 17**		
MATERIAL DEPTH (mm)			Surface	0 - 600	600 - 2300	2300 - 3000
SAMPLE / LAB. No.			**N/S**	**DK14 / 016/2756**	**DK15 / 016/2757**	**DK16 / 016/2758**
MATERIAL DESCRIPTION			Hard Rock, Dolerite (Surface Rock)	Slightly moist dark brown red firm sandy lean clay.	Slightly moist orange red firm sandy lean clay.	Slightly moist orange red firm sandy lean clay.
*** IN SITU FIELD MOISTURE (%)**				6.0	6.9	12.8
*** UNIFIED SOIL CLASSIFICATION**				**CL**	**CL**	**CL**
TRH14 / * COLTO CLASSIFICATION				**No Classification**	**No Classification**	**No Classification**
DETERMINATION OF THE MOISTURE CONTENT BY OVEN-DRYING (SANS 3001-GR20:2010); * WET PREPARATION AND PARTICLE SIZE ANALYSIS (SANS 3001-GR:2011); * COMPUTATION OF SOIL-MORTAR PERCENTAGES & GRADING MODULUS (SANS 3001-PR5:2011)						
SIEVE ANALYSIS	**63.0 mm**					
	50.0 mm					
	37.5 mm					
	28.0 mm					
	20.0 mm					
	14.0 mm					
	5.00 mm			100	100	100
	2.00 mm			97	99	99
	0.425 mm			92	88	93
	0.075 mm			58	55	68
	*** 0.002 mm**			18	12	30
SOIL MORTAR	**COARSE SAND**			6	11	6
	FINE SAND			3 / 4 / 28	6 / 8 / 20	4 / 6 / 15
	MATERIAL<0.075 mm			59	56	69
GRADING MODULUS (GM)				0.53	0.58	0.40
*** DETERMINATION OF THE ONE-POINT LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LINEAR SHRINKAGE (SANS 3001-GR10:2011); *DETERMINATION OF THE pH VALUE OF A SOIL SUSPENSION (TMH1:1986, Method A20); * TENTATIVE METHOD FOR THE DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF A SATURATED SOIL PASTE AND WATER (TMH1:1986, Method A21T)**						
ATTERBERG LIMITS PASSING SIEVE 0.425mm	**L.L (%)**			37	33	39
	P.I. / L.S. (%)			16 / 7.5	12 / 5.5	18 / 8.7
POTENTIAL EXPANSIVENESS (mm)				Medium / 11.1mm	Low	Medium / 5.4mm
pH VALUE / CONDUCTIVITY (Sm^{-1})				7.73 / 0.1120	7.71 / 0.0700	7.65 / 0.1400
*** DETERMINATION OF THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT (SANS 30010GR30:2010; * DETERMINATION OF THE CALIFORNIA BEARING RATIO (SANS 3001-GR40:2010); * THE EXTENT TO WHICH A PARTICULAR MATERIAL WILL COMPACT (SABS 0120, Part 3)**						
CBR / UCS / ITS DETERMINATION	**MOD AASHTO**	**MAX DRY DENSITY (kg/m^3)**		1760	1844	1841
		OPT MOISTURE (%)		9.5	11.5	7.8
		COMP MOISTURE (%)		9.5	11.6	7.8
		DRY DENSITY (kg/m^3)		1760	1844	1841
		CBR (%)		4	7	4
		COMPACTABILITY (Ratio / %)		0.61 / 60.6%	0.72 / 72.4%	0.57 / 56.7%
		PERMEABILITY ($cm.s^{-1}$)				
		SWELL (%)		3.9	2.5	6.6
	NRB	**DRY DENSITY (kg/m^3)**		1660	1842	1702
		CBR (%)		4	5	4
	PROCTOR	**MAX DRY DENSITY (kg/m^3)**		1569	1706	1610
		OPT MOISTURE (%)		-	-	-
		CBR (%)		4	3	3
	CBR	**100%**		4	7	4
		98%		4	6	4
		95%		4	5	4
		93%		4	5	4
		90%		4	4	3

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MATERIAL ANALYSIS

HOLE No. / KM		**Test Pit 17**	**Test Pit 18**		**Test Pit 19**
MATERIAL DEPTH (mm)		+3000	0 - 400	+400	Surface
SAMPLE / LAB. No.		**N/S**	**DK13 / 016/2755**	**N/S**	**N/S**
MATERIAL DESCRIPTION		Slightly moist orange red firm sandy lean clay.	Dry light brown yellow medium dense silty sand with weathered dolerite gravel.	Hard Rock, Dolerite (Refusal)	Hard Rock, Dolerite (Surface)
*** IN SITU FIELD MOISTURE (%)**			3.8		
*** UNIFIED SOIL CLASSIFICATION**			**SM**		
TRH14 / * COLTO CLASSIFICATION			**G6**		
DETERMINATION OF THE MOISTURE CONTENT BY OVEN-DRYING (SANS 3001-GR20:2010); * WET PREPARATION AND PARTICLE SIZE ANALYSIS (SANS 3001-GR:2011); * COMPUTATION OF SOIL-MORTAR PERCENTAGES & GRADING MODULUS (SANS 3001-PR5:2011)					
SIEVE ANALYSIS	**63.0 mm**		100		
	50.0 mm		94		
	37.5 mm		90		
	28.0 mm		88		
	20.0 mm		86		
	14.0 mm		85		
	5.00 mm		80		
	2.00 mm		73		
	0.425 mm		53		
	0.075 mm		19		
	*** 0.002 mm**		2		
SOIL MORTAR	**COARSE SAND**		28		
	FINE SAND		12 / 12 / 22		
	MATERIAL<0.075 mm		26		
GRADING MODULUS (GM)			1.55		
*** DETERMINATION OF THE ONE-POINT LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LINEAR SHRINKAGE (SANS 3001-GR10:2011); *DETERMINATION OF THE pH VALUE OF A SOIL SUSPENSION (TMH1:1986, Method A20); * TENTATIVE METHOD FOR THE DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF A SATURATED SOIL PASTE AND WATER (TMH1:1986, Method A21T)**					
ATTERBERG LIMITS PASSING SIEVE 0.425mm	**L.L (%)**		-		
	P.I. / L.S. (%)		SP / 1.6		
POTENTIAL EXPANSIVENESS (mm)			Low		
pH VALUE / CONDUCTIVITY (Sm^{-1})			8.21 / 0.0257		
*** DETERMINATION OF THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT (SANS 30010GR30:2010; * DETERMINATION OF THE CALIFORNIA BEARING RATIO (SANS 3001-GR40:2010); * THE EXTENT TO WHICH A PARTICULAR MATERIAL WILL COMPACT (SABS 0120, Part 3)**					
CBR / UCS / ITS DETERMINATION	**MOD AASHTO**	**MAX DRY DENSITY (kg/m^3)**		2207	
		OPT MOISTURE (%)		9.5	
		COMP MOISTURE (%)		9.5	
		DRY DENSITY (kg/m^3)		2207	
		CBR (%)		62	
		COMPACTABILITY (Ratio / %)			
		PERMEABILITY ($cm.s^{-1}$)			
		SWELL (%)		0.0	
	NRB	**DRY DENSITY (kg/m^3)**		2100	
		CBR (%)		42	
	PROCTOR	**MAX DRY DENSITY (kg/m^3)**		2014	
		OPT MOISTURE (%)		-	
		CBR (%)		31	
	CBR	**100%**		62	
		98%		53	
		95%		42	
		93%		36	
		90%		29	

APPENDIX D
PARTICLE SIZE DISTRIBUTION

Geotechnical Investigation at Farm De Kloof 2921, Bloemfontein

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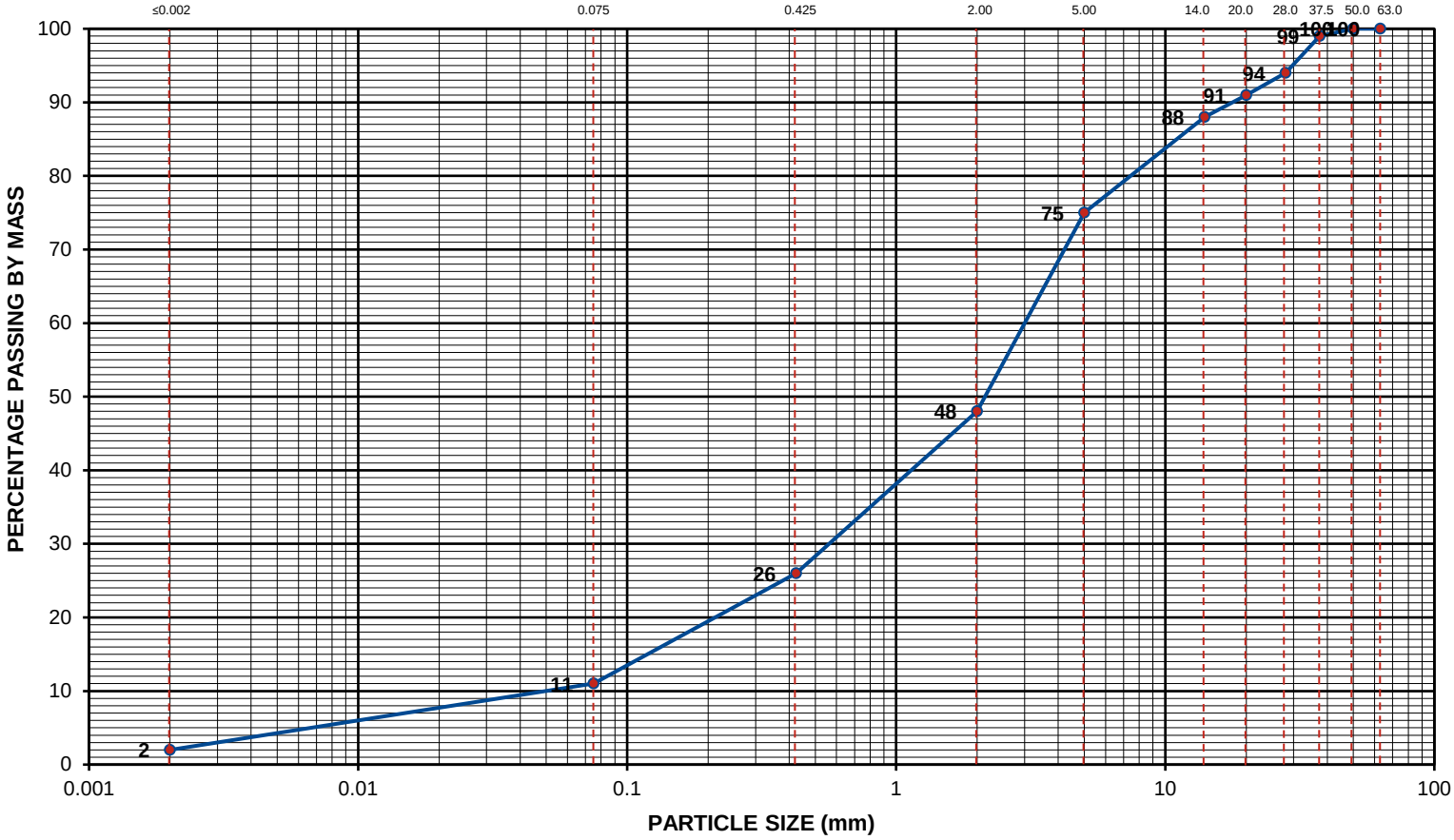

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
2%	9%			37%			52%			-

***PARTICLE SIZE DISTRIBUTION**

HOLE No. : Test Pit 1	**DEPTH :** 0-450mm	**SAMPLE No. :** DK01 / 016/2743
MATERIAL DESCRIPTION : (SW-SC) Dry dark red brown loose well-graded sand with silty clay and weathered dolerite gravel.		
ATTERBERG LIMITS : 24 / 4 / 2.0 (GM: 2.16)	**POTENTIAL EXPANSIVENESS :** Low	**PAGE No. :** 1 of 16

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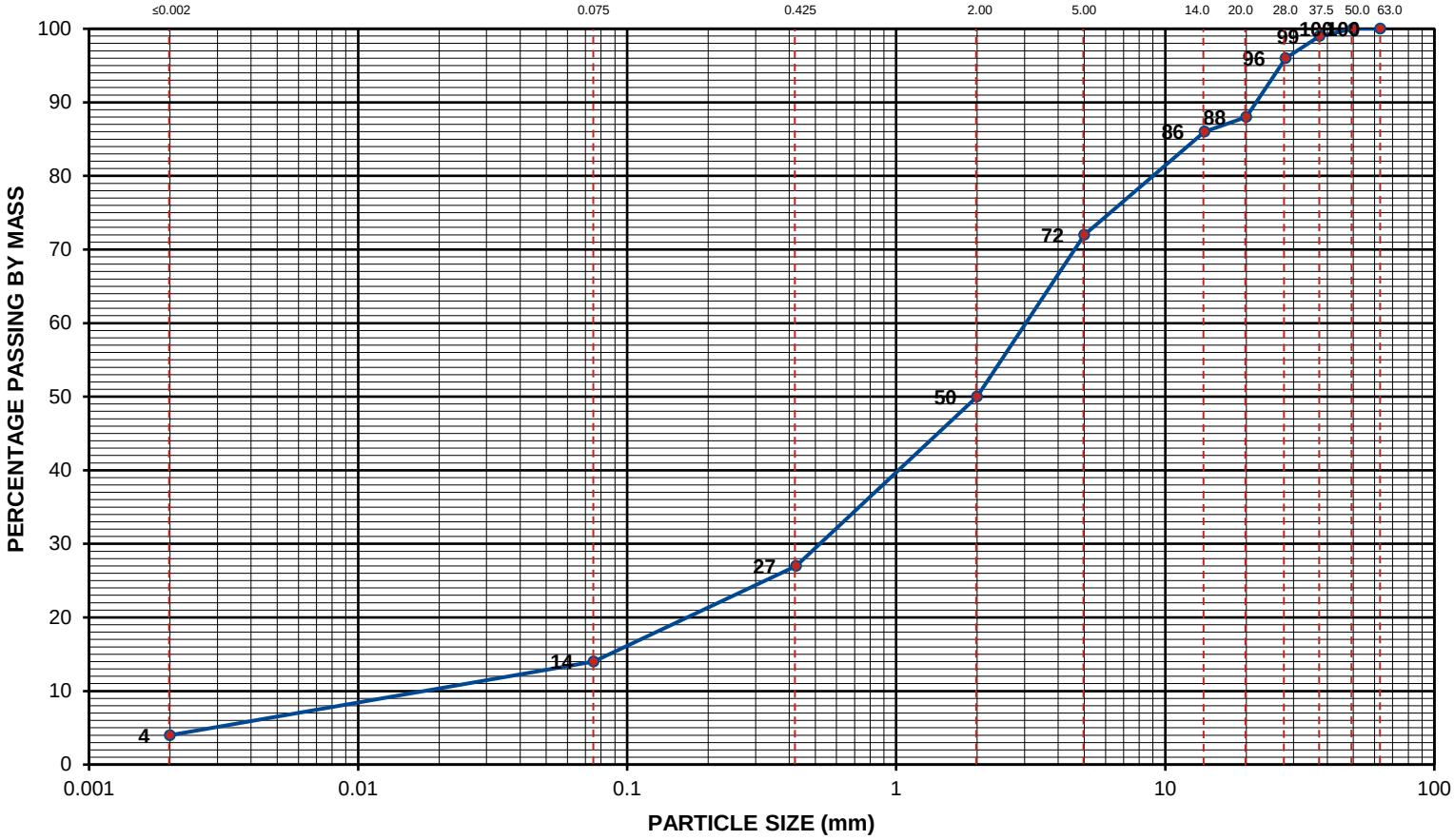

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
4%	10%			36%			50%			-

***PARTICLE SIZE DISTRIBUTION**

HOLE No. : Test Pit 1 | **DEPTH :** 450-750mm | **SAMPLE No. :** DK02 / 016/2744

MATERIAL DESCRIPTION : (SM) Slightly moist yellow orange medium dense silty sand with weathered dolerite gravel.

ATTERBERG LIMITS : - / SP / 1.3 (GM: 2.09) | **POTENTIAL EXPANSIVENESS :** Low | **PAGE No. :** 2 of 16

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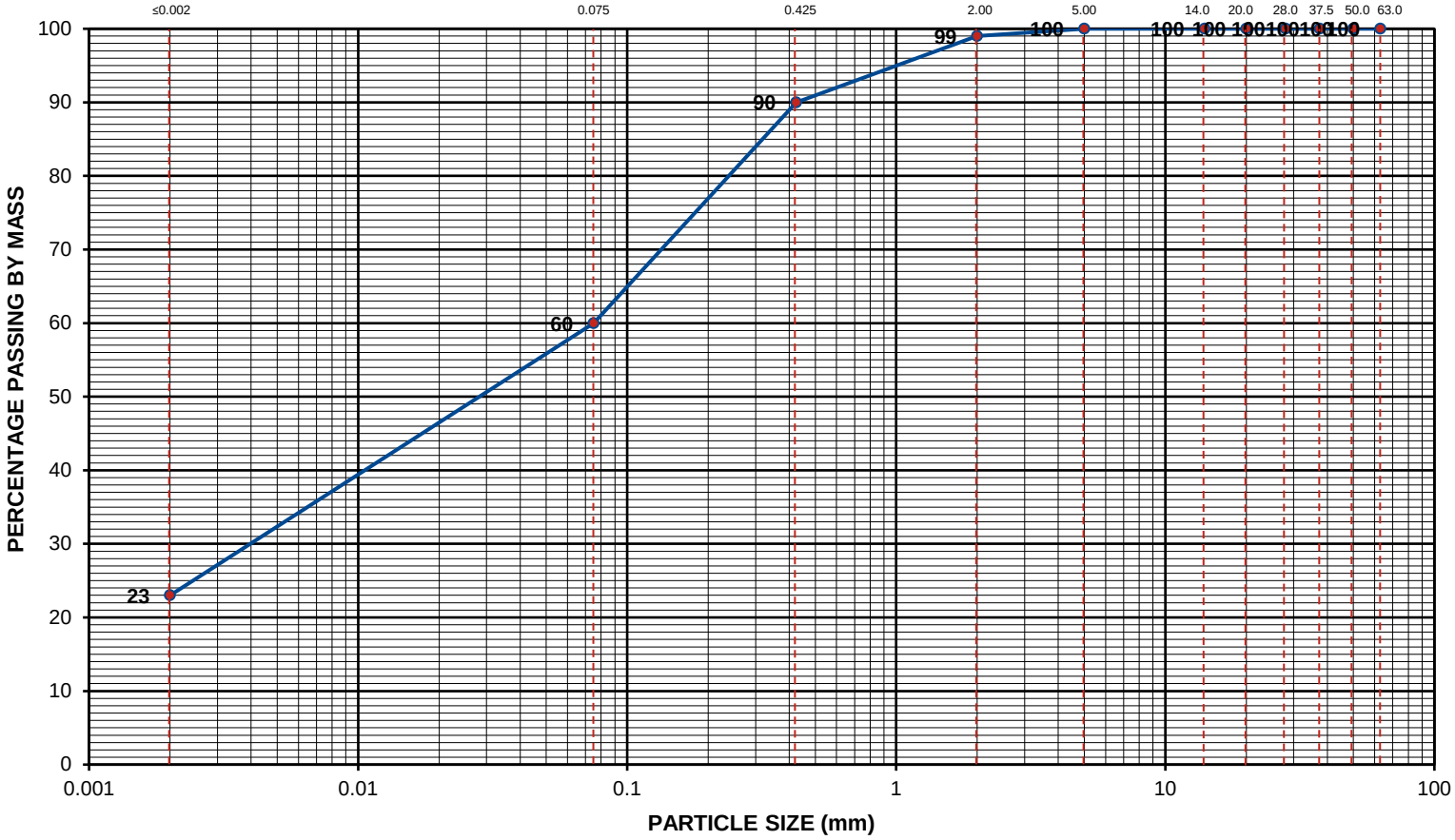

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
23%	37%			39%			1%			-

HOLE No. : Test Pit 2	**DEPTH :** 0-1100mm	**SAMPLE No. :** DK03 / 016/2745
MATERIAL DESCRIPTION : (CL) Slightly moist dark brown firm sandy lean clay.		
ATTERBERG LIMITS : 38 / 18 / 9.2 (GM: 0.51)	**POTENTIAL EXPANSIVENESS :** Medium - 18.7mm	**PAGE No. :** 3 of 16

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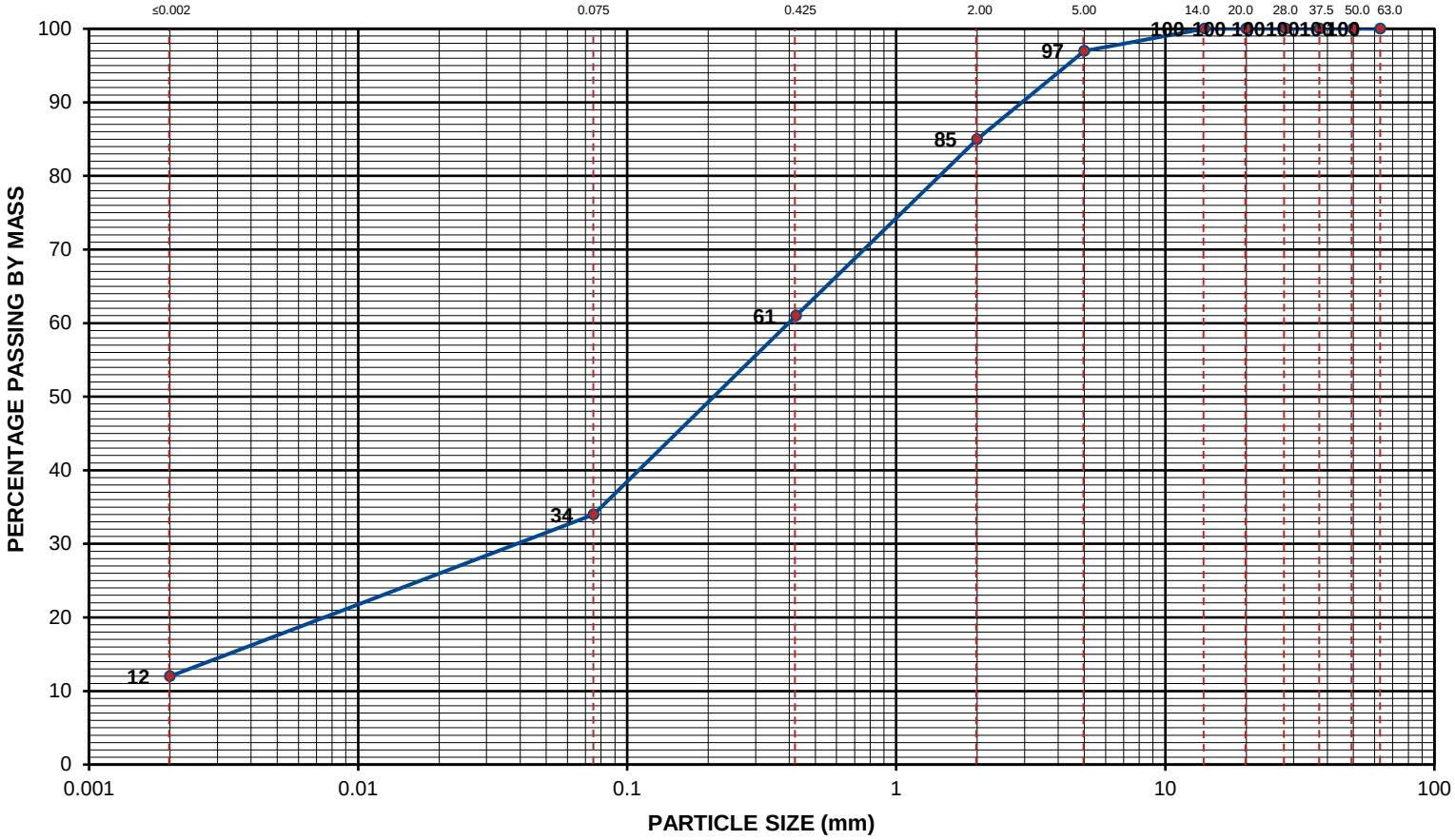

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
12%	22%			51%			15%			-

HOLE No. : Test Pit 2	**DEPTH :** 1100-3000mm	**SAMPLE No. :** DK04 / 016/2746
MATERIAL DESCRIPTION : (SC) Slightly moist light orange medium dense clayey sand with weathered dolerite gravel.		
ATTERBERG LIMITS : 33 / 12 / 6.4 (GM: 1.20)	**POTENTIAL EXPANSIVENESS :** Low	**PAGE No. :** 4 of 16

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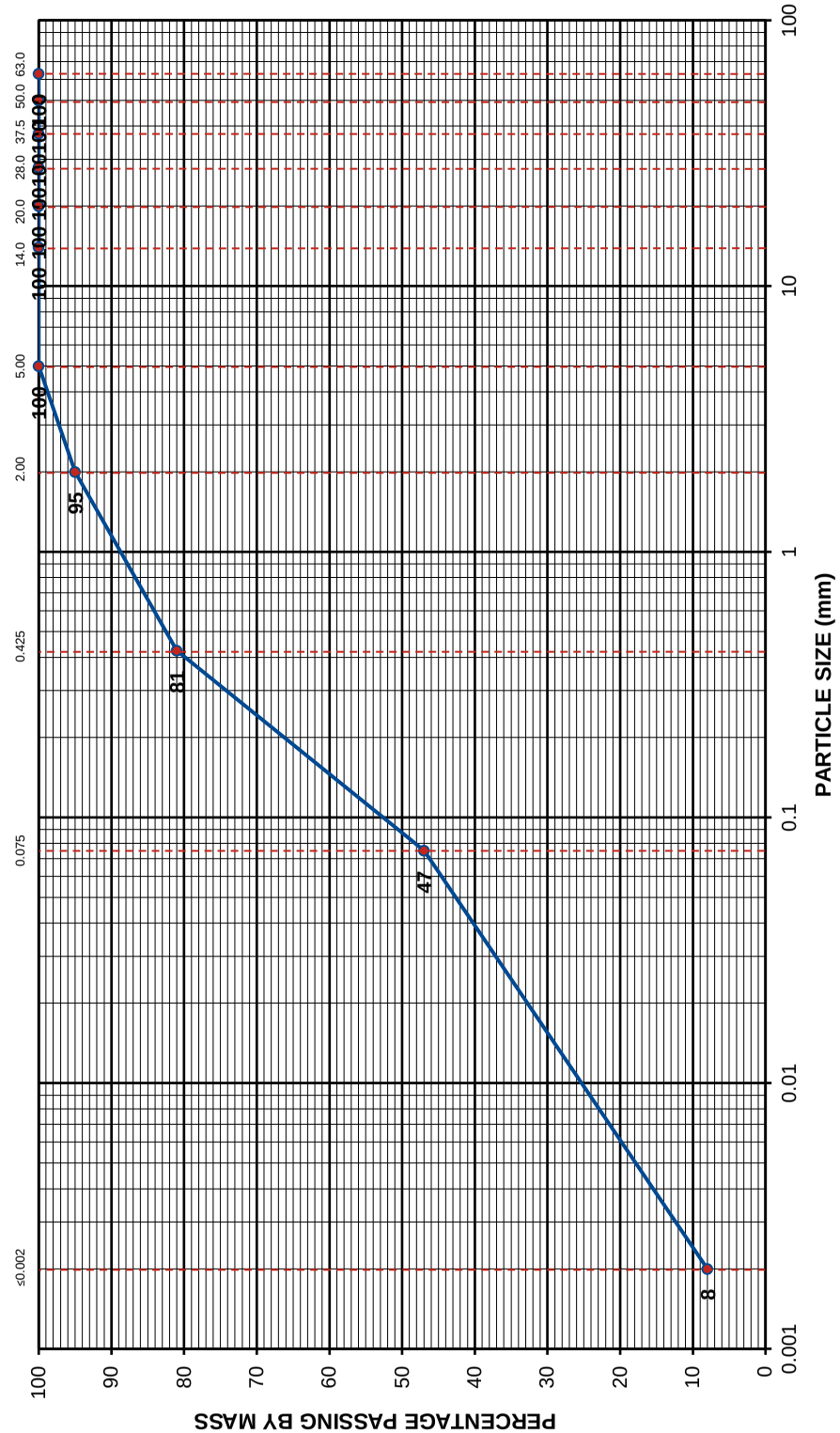

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLE
8%	SILT 39%			SAND 48%			GRAVEL 5%			-

HOLE No. : Test Pit 3 **DEPTH :** 550-1300mm **SAMPLE No. :** DK05 / 016/2747

MATERIAL DESCRIPTION : (SC) Slightly moist light brown orange medium dense clayey sand.

ATTERBERG LIMITS : 35 / 16 / 8.0 (GM: 0.77) **POTENTIAL EXPANSIVENESS :** Low **PAGE No. :** 5 of 16

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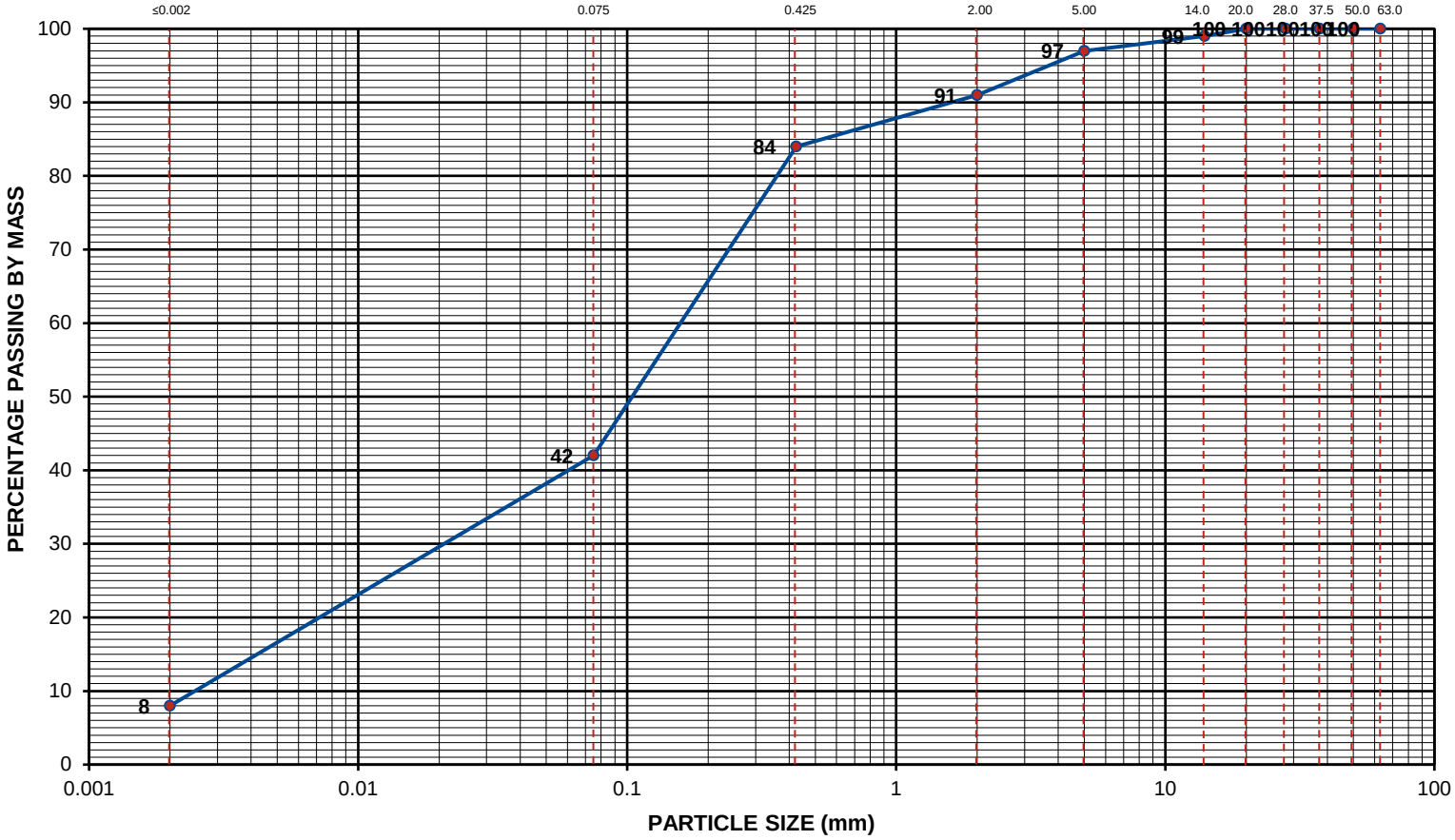

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
8%	34%			49%			9%			-

HOLE No. : Test Pit 3	**DEPTH :** 1300-3000mm	**SAMPLE No. :** DK06 / 016/2748
MATERIAL DESCRIPTION : (SM) Slightly moist light yellow orange medium dense silty sand.		
ATTERBERG LIMITS : 40 / 14 / 6.8 (GM: 0.83)	**POTENTIAL EXPANSIVENESS :** Low	**PAGE No. :** 6 of 16

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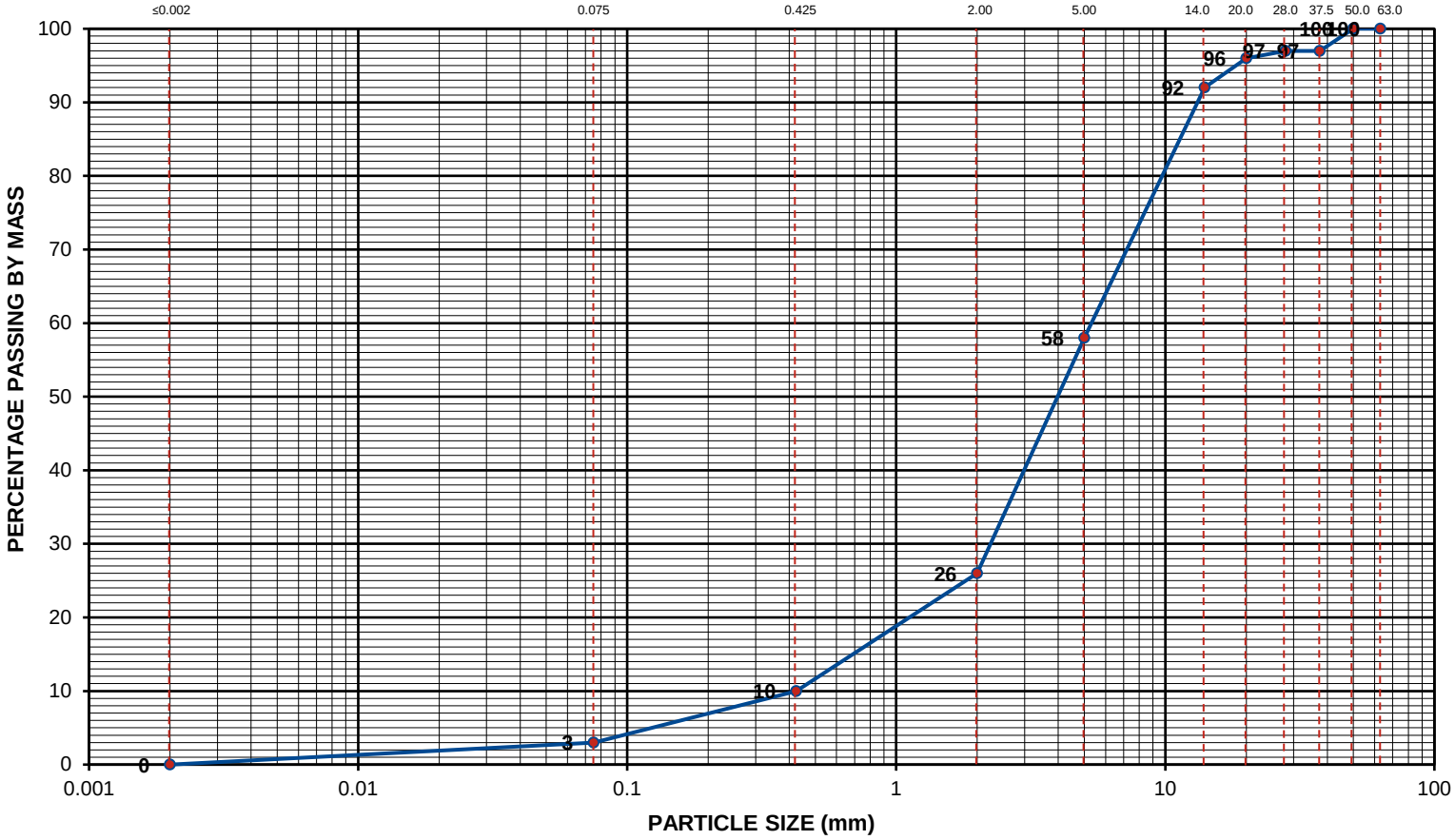

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
0%	3%			23%			74%			-

HOLE No. : Test Pit 6	**DEPTH :** 120-450mm	**SAMPLE No. :** DK07 / 016/2749
MATERIAL DESCRIPTION : (SW) Dry light brown yellow medium dense well-graded sand with weathered dolerite gravel.		
ATTERBERG LIMITS : - / NP / 0.0 (GM: 2.60)	**POTENTIAL EXPANSIVENESS :** Low	**PAGE No. :** 7 of 16

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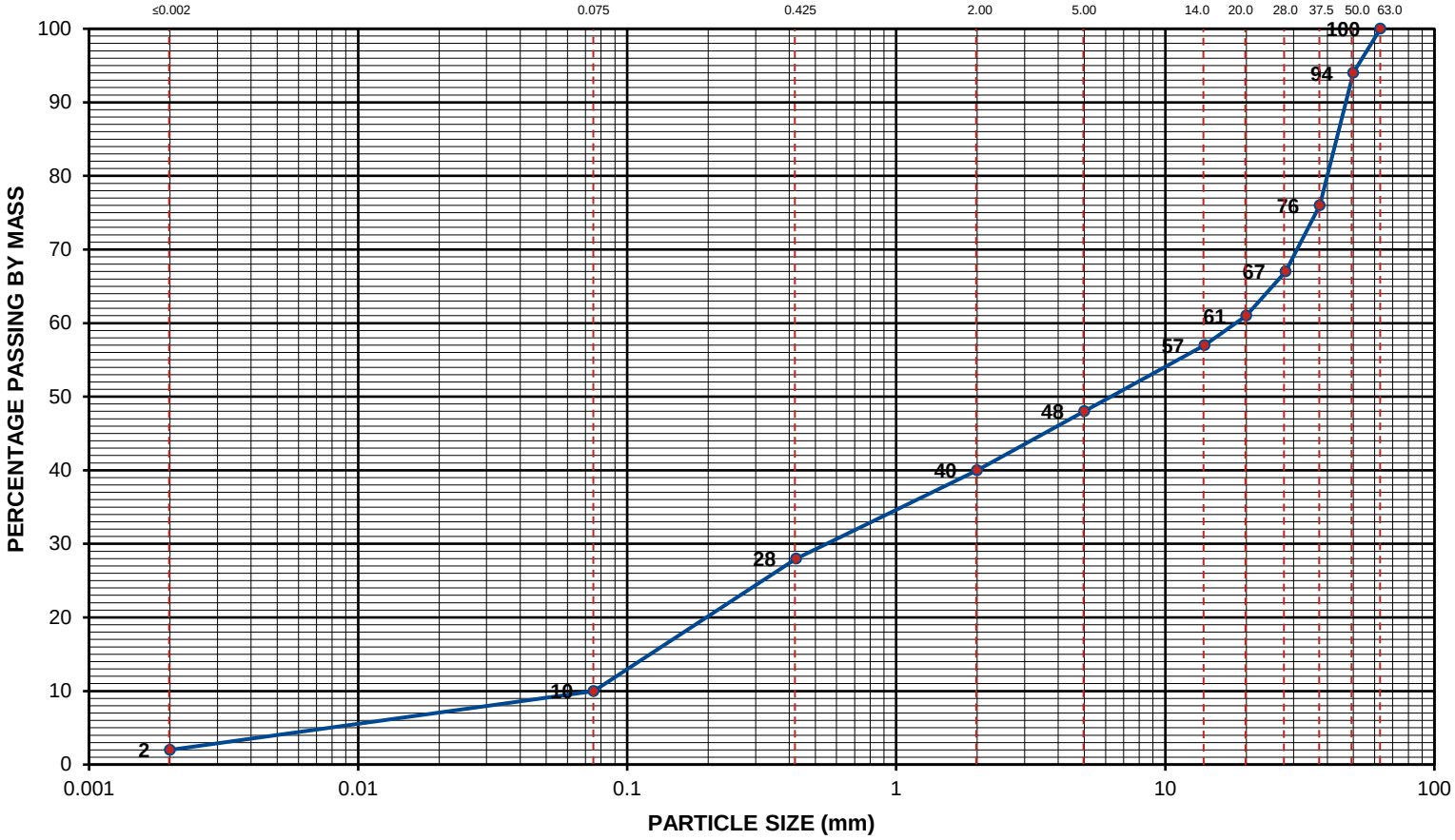

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
2%	8%			30%			60%			-

HOLE No. : Test Pit 7	**DEPTH :** 0-400mm	**SAMPLE No. :** DK08 / 016/2750
MATERIAL DESCRIPTION : (GP-GC) Slightly moist red brown medium dense poorly graded weathered dolerite gravel with clay and san		
ATTERBERG LIMITS : 25 / 7 / 2.7 (GM: 2.23)	**POTENTIAL EXPANSIVENESS :** Low	**PAGE No. :** 8 of 16

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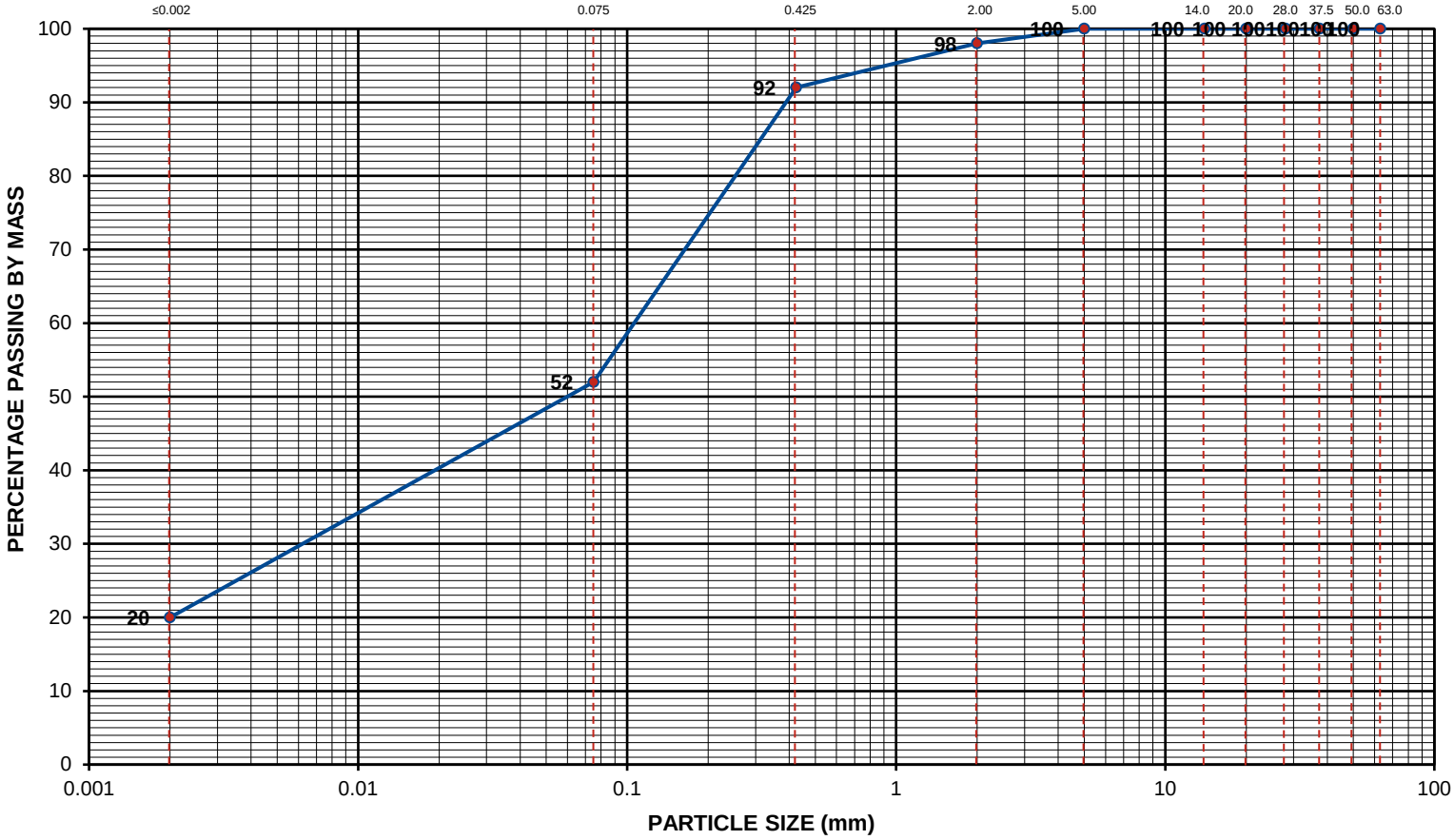

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
20%	32%			46%			2%			-

***PARTICLE SIZE DISTRIBUTION**

HOLE No. : Test Pit 8	**DEPTH :** 0-600mm	**SAMPLE No. :** DK09 / 016/2751
MATERIAL DESCRIPTION : (CL) Slightly moist dark red brown firm sandy lean clay.		
ATTERBERG LIMITS : 35 / 13 / 6.7 (GM: 0.58)	**POTENTIAL EXPANSIVENESS :** Medium - 11.1mm	**PAGE No. :** 9 of 16

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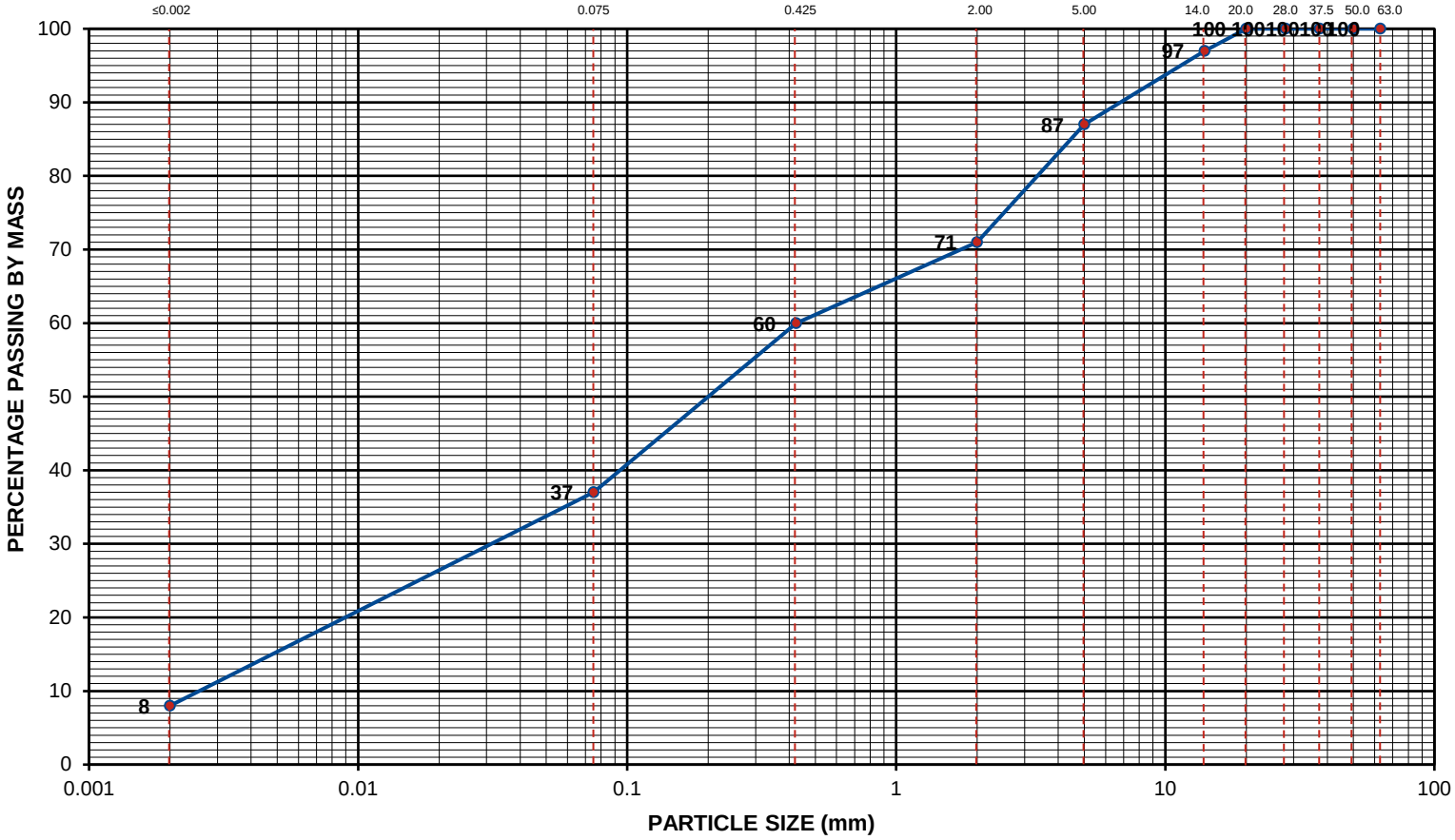

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
8%	29%			34%			29%			-

HOLE No. : Test Pit 8	**DEPTH :** 600-800mm	**SAMPLE No. :** DK10 / 016/2752
MATERIAL DESCRIPTION : (SC-SM) Slightly moist light yellow grey medium dense silty, clayey sand with weathered dolerite gravel.		
ATTERBERG LIMITS : 23 / 4 / 2.3 (GM: 1.33)	**POTENTIAL EXPANSIVENESS :** Low	**PAGE No. :** 10 of 16

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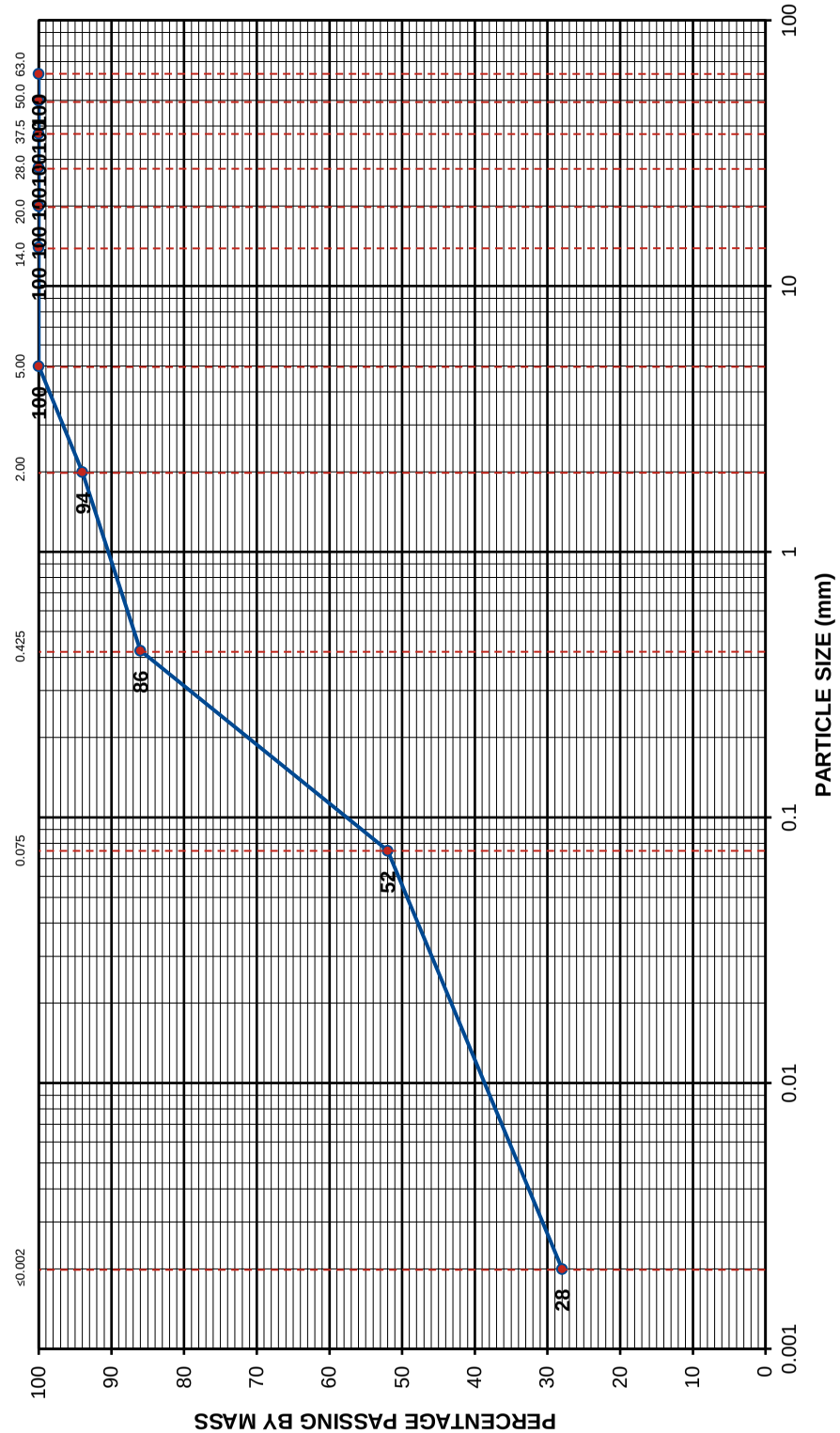

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLE
28%	SILT 24%			SAND 42%			GRAVEL 6%			-

HOLE No. : Test Pit 9 **DEPTH :** 0-1400mm **SAMPLE No. :** DK11 / 016/2753

MATERIAL DESCRIPTION : (CL) Slightly moist dark brown black firm sandy lean clay.

ATTERBERG LIMITS : 47 / 24 / 12.1 (GM: 0.69) **POTENTIAL EXPANSIVENESS :** Medium - 22.6mm **PAGE No. :** 11 of 16

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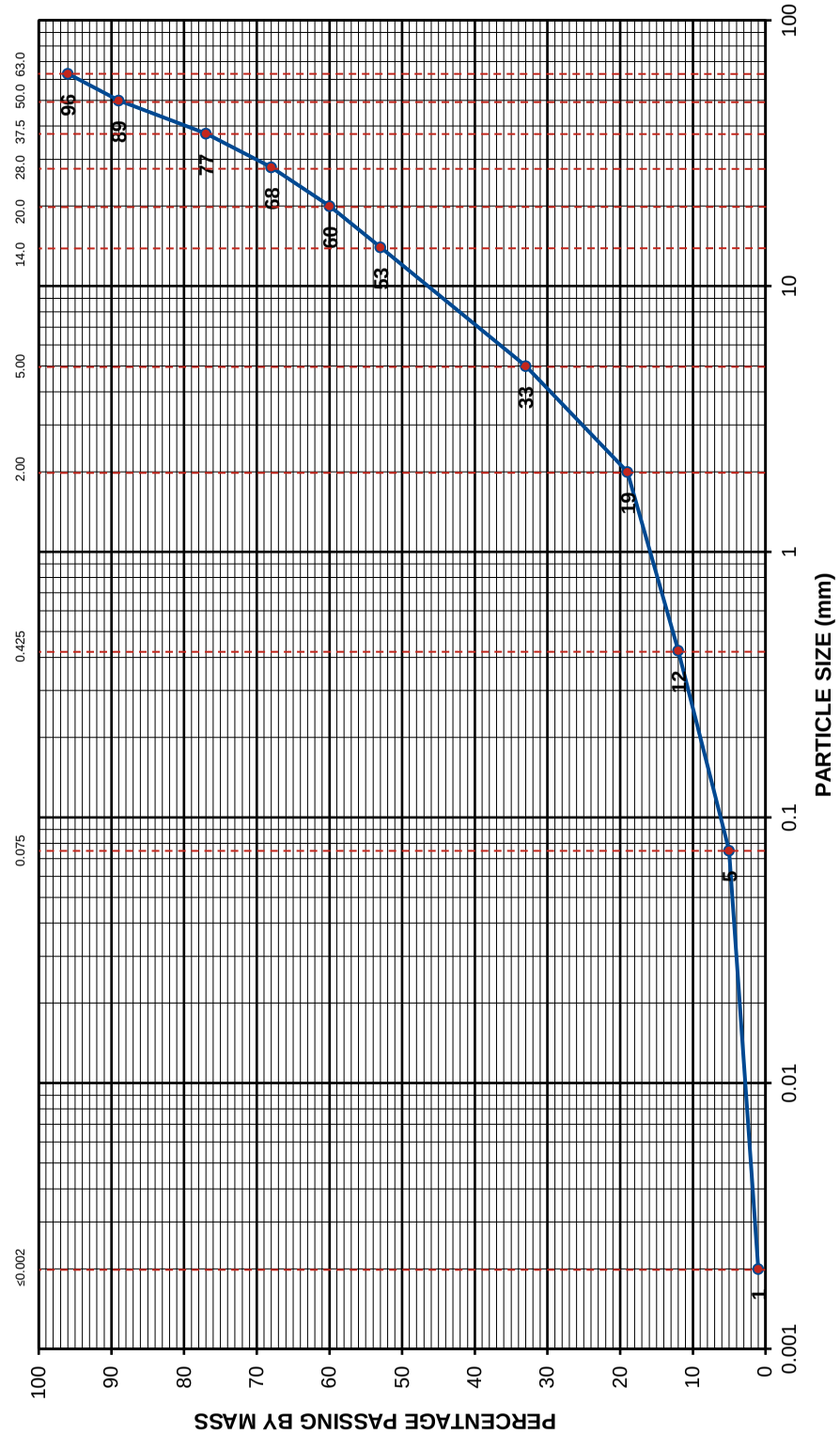

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLE
1%	SILT 4%			SAND 14%			GRAVEL 77%			4%

HOLE No. : Test Pit 12 **DEPTH :** 0-400mm **SAMPLE No. :** DK12 / 016/2754

MATERIAL DESCRIPTION : (GP-GC) Slightly moist red brown yellow medium dense poorly graded weathered dolerite gravel with clay.

ATTERBERG LIMITS : 29 / 8 / 3.7 (GM: 2.64) **POTENTIAL EXPANSIVENESS :** Low **PAGE No. :** 12 of 16

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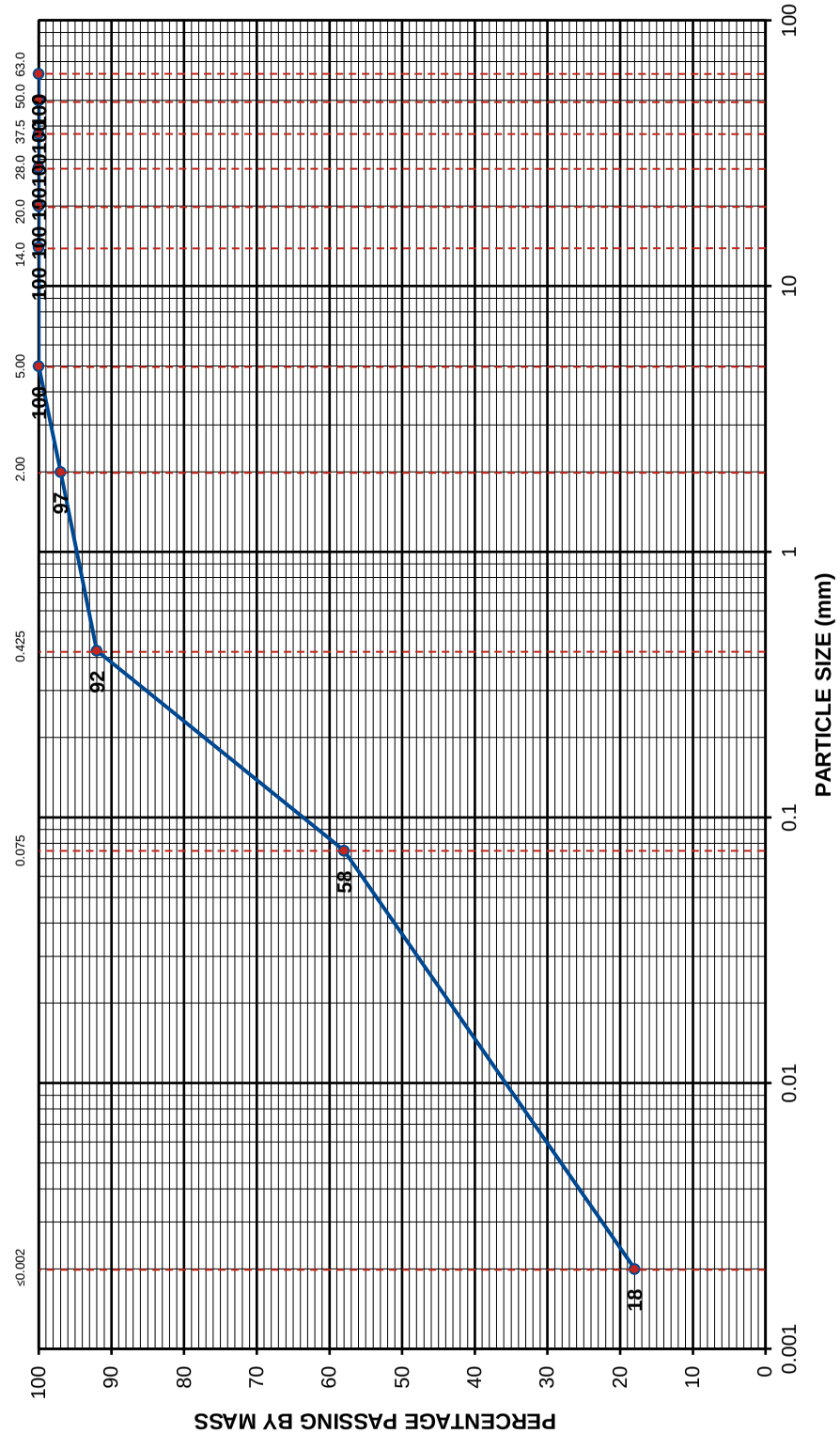
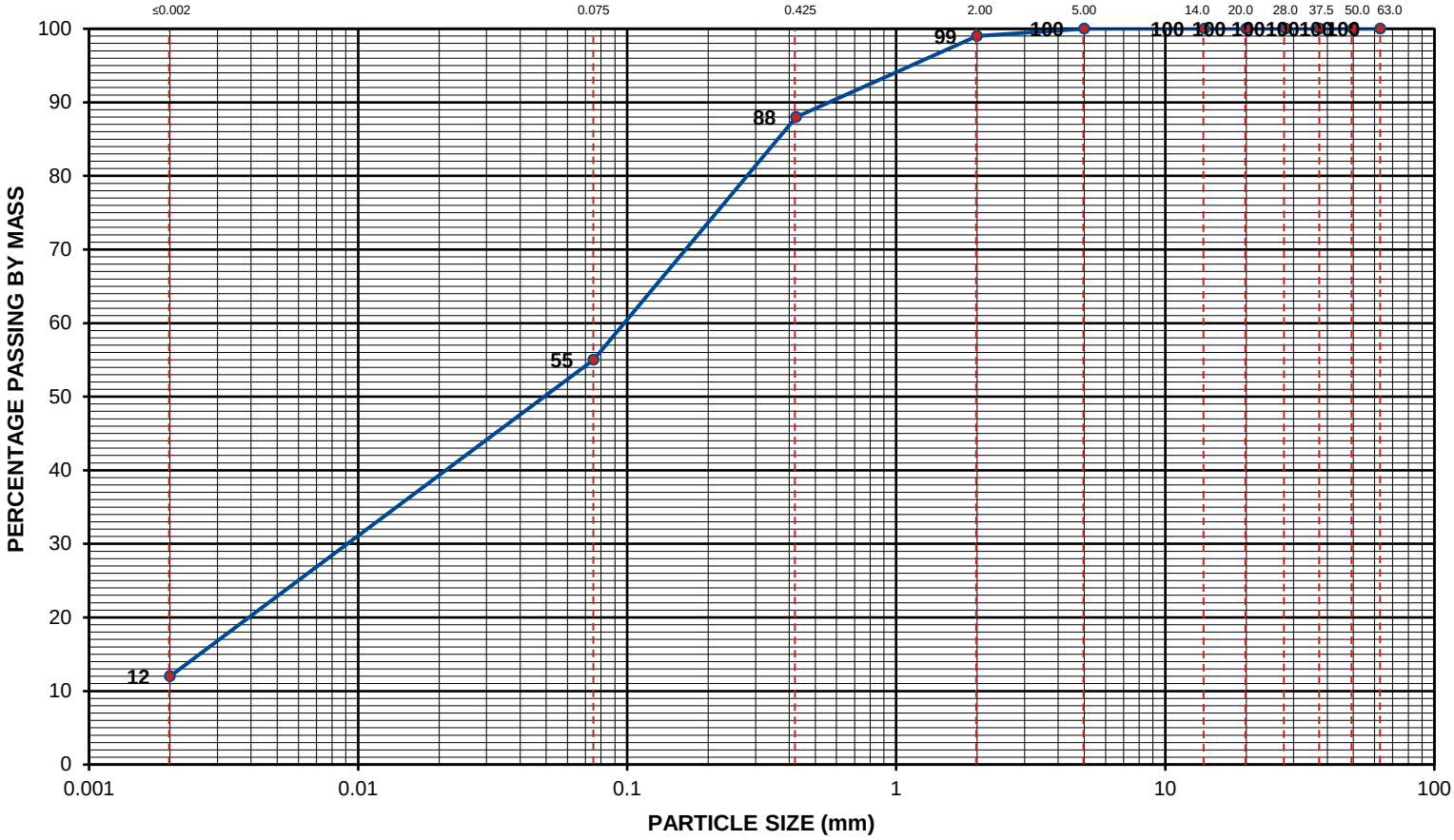


(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
18%	40%			39%			3%			-

HOLE No. : Test Pit 17 **DEPTH :** 0-600mm **SAMPLE No. :** DK14 / 016/2756

MATERIAL DESCRIPTION : (CL) Slightly moist dark brown red firm sandy lean clay.

ATTERBERG LIMITS : 37 / 16 / 7.5 (GM: 0.53) **POTENTIAL EXPANSIVENESS :** Medium - 11.1mm **PAGE No. :** 13 of 16



*PARTICLE SIZE DISTRIBUTION

(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
12%	43%			44%			1%			-

HOLE No. : Test Pit 17	**DEPTH :** 600-2300mm	**SAMPLE No. :** DK15 / 016/2757
MATERIAL DESCRIPTION : (CL) Slightly moist orange red firm sandy lean clay.		
ATTERBERG LIMITS : 33 / 12 / 5.5 (GM: 0.58)	**POTENTIAL EXPANSIVENESS :** Low	**PAGE No. :** 14 of 16

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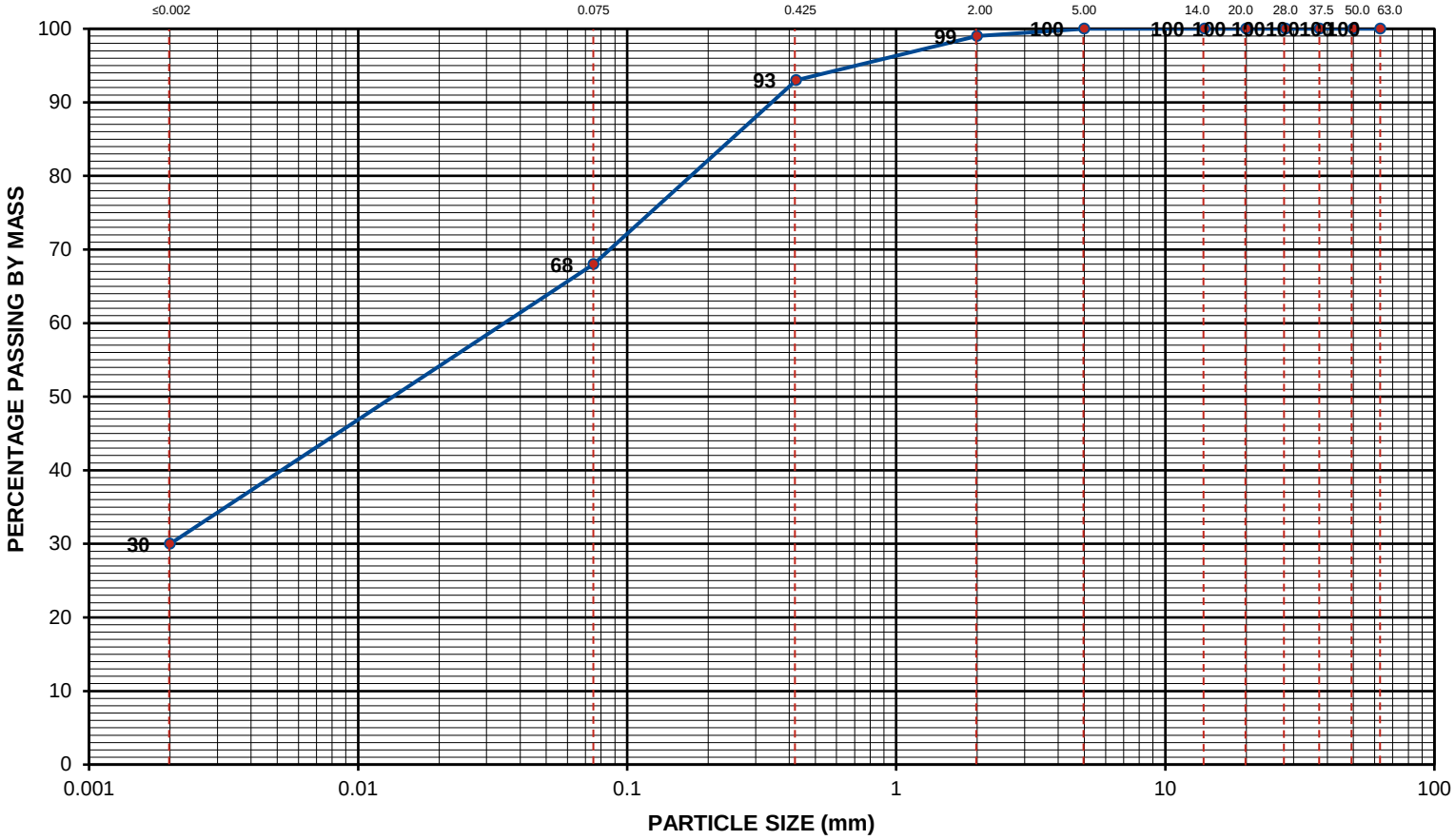
*PARTICLE SIZE DISTRIBUTION

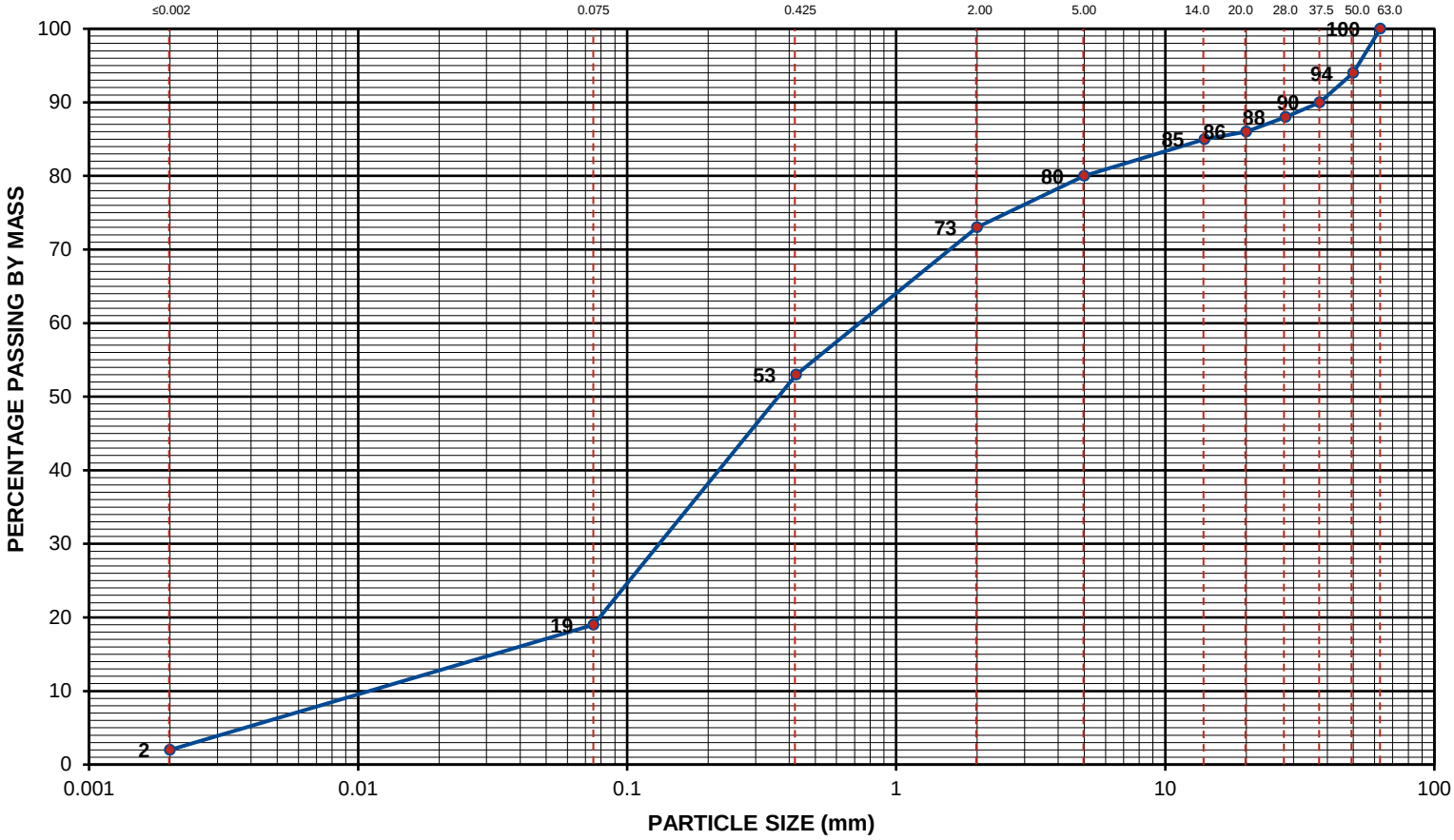


(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
30%	38%			31%			1%			-

HOLE No. : Test Pit 17	**DEPTH :** 2300-3000mm	**SAMPLE No. :** DK16 / 016/2757
MATERIAL DESCRIPTION : (CL) Slightly moist orange red firm sandy lean clay.		
ATTERBERG LIMITS : 39 / 18 / 8.7 (GM: 0.40)	**POTENTIAL EXPANSIVENESS :** Medium - 5.4mm	**PAGE No. :** 15 of 16

Geotechnical Investigation at Farm De Kloof 2921, Bloemfontein

Document No. : 2016/393/Doc.



(≤0.002)	(0.002 - 0.006)	(0.006 - 0.020)	(0.020 - 0.060)	(0.060 - 0.200)	(0.200 - 0.600)	(0.600 - 2.000)	(2.0 - 6.0)	(6.0 - 20.0)	(20.0 - 60.0)	(60.0 - 200.0)
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
CLAY	**SILT**			**SAND**			**GRAVEL**			**COBBLE**
2%	17%			54%			27%			-

***PARTICLE SIZE DISTRIBUTION**

HOLE No. : Test Pit 18	**DEPTH :** 0-400mm	**SAMPLE No. :** DK13 / 016/2755
MATERIAL DESCRIPTION : (SM) Dry light brown yellow medium dense silty sand with weathered dolerite gravel.		
ATTERBERG LIMITS : - / SP / 1.6 (GM: 1.55)	**POTENTIAL EXPANSIVENESS :** Low	**PAGE No. :** 16 of 16

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APPENDIX E
DYNAMIC CONE PENETROMETER (DCP's) TEST

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*DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 01 **DEPTH BELOW NGL:** 0.000m

***DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)**

No of Blows	Depth (mm)	Corrected Depth (mm)	Penetration Tempo	dn (mm/blow)	Consistency	**Estimated Bearing Ratio (kPa)	*In Situ* CBR
0	130	0	-	-	-	-	-
5	285	155	155	31.0	Loose	44	5
10	386	256	101	20.2	Medium Dense	64	9
15	435	305	49	9.8	Dense	106	23
20	456	326	21	4.2	Very Dense	193	72
25	470	340	14	2.8	Very Dense	> 200	> 110
30	481	351	11	2.2	Very Dense	> 200	> 110
35	490	360	9	1.8	Very Dense	> 200	> 110
40	494	364	4	0.8	Very Dense	> 200	> 110
45	506	376	12	2.4	Very Dense	> 200	> 110
50	515	385	9	1.8	Very Dense	> 200	> 110
55	526	396	11	2.2	Very Dense	> 200	> 110
60	542	412	16	3.2	Very Dense	> 200	103
65	565	435	23	4.6	Very Dense	183	64
70	589	459	24	4.8	Very Dense	178	60
75	619	489	30	6.0	Dense	154	45
80	621	491	2	0.4	Very Dense	> 200	> 110

** According to Dr B van Wyk's Method

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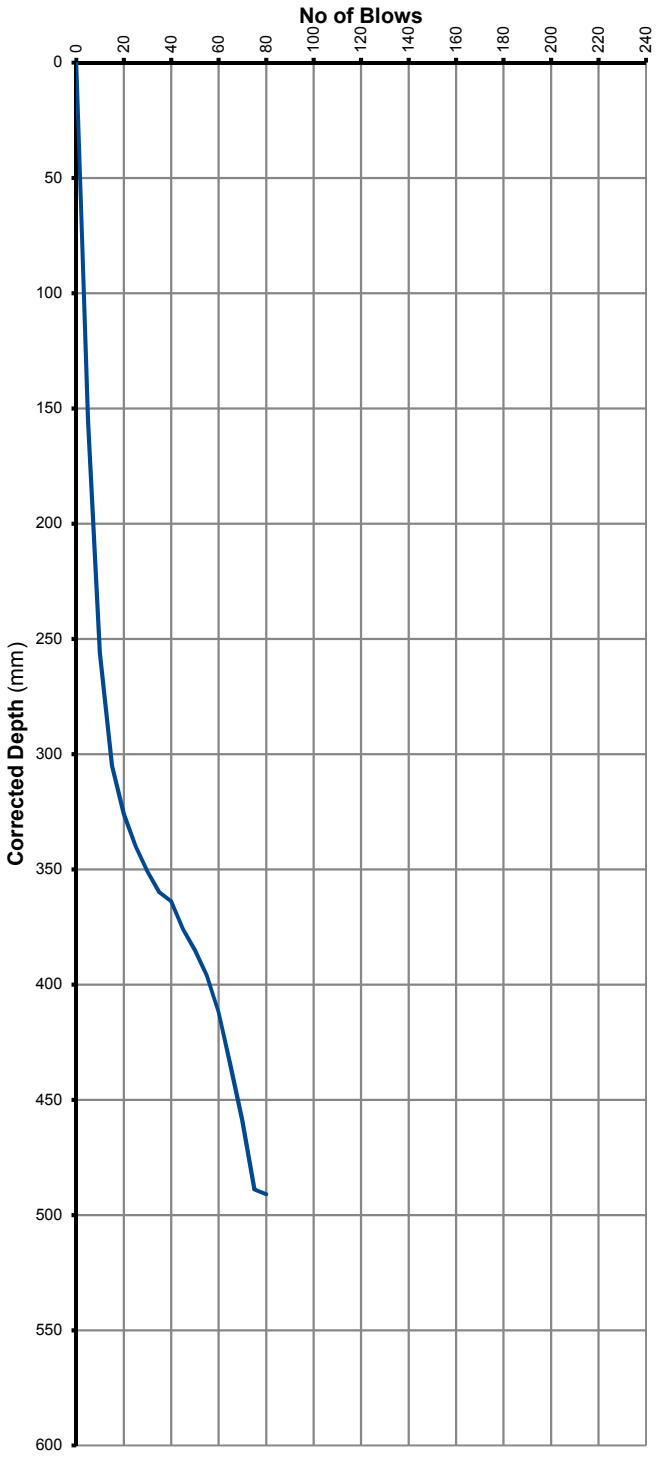
*DYNAMIC CONE PENETROMETER (DCP) TEST

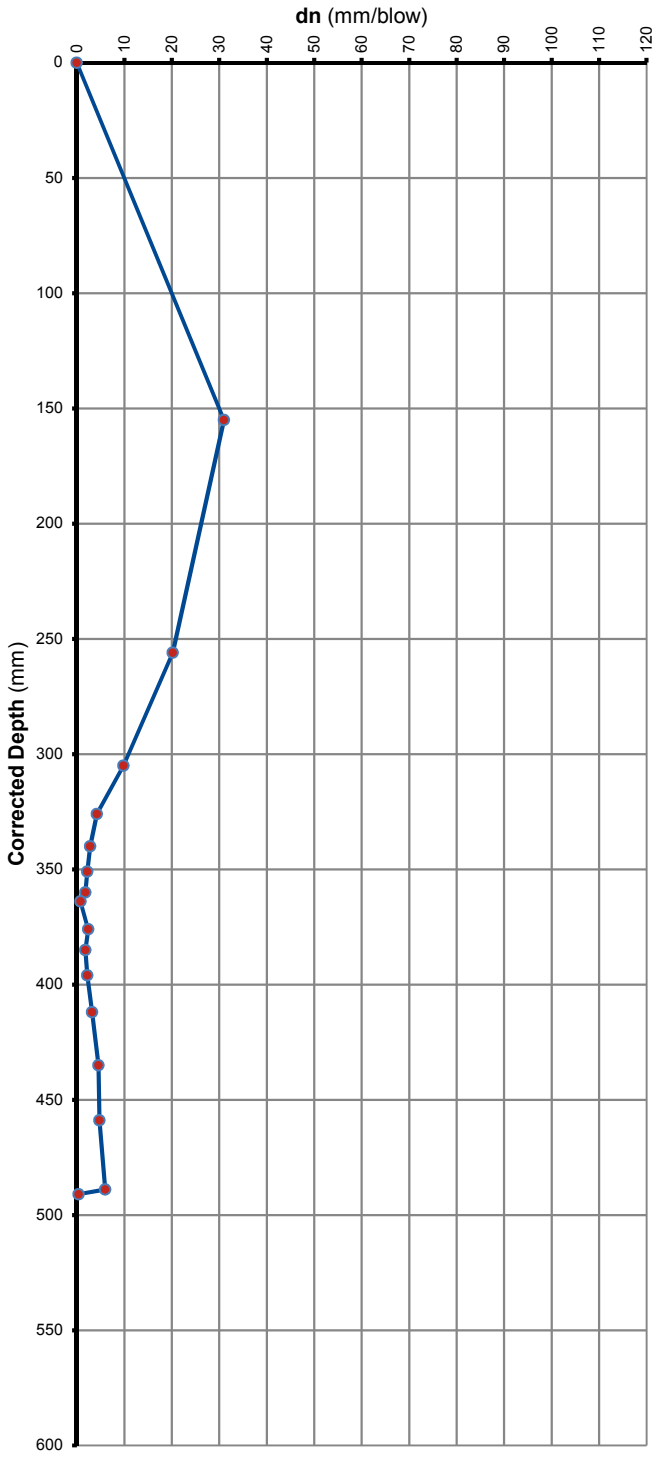
POSITION: Test Pit 01 **DEPTH BELOW NGL:** 0.000m

***DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)**

No of Blows VS Corrected Depth



dn VS Corrected Depth



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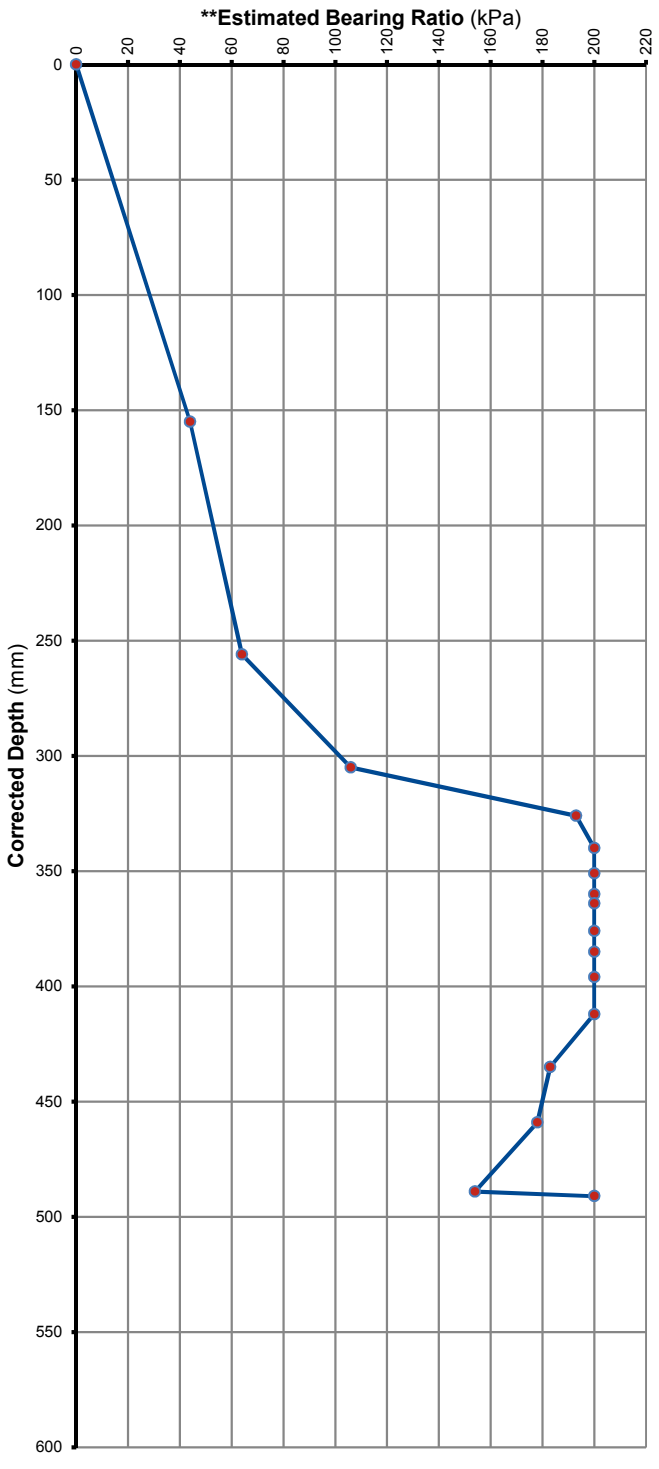
*DYNAMIC CONE PENETROMETER (DCP) TEST

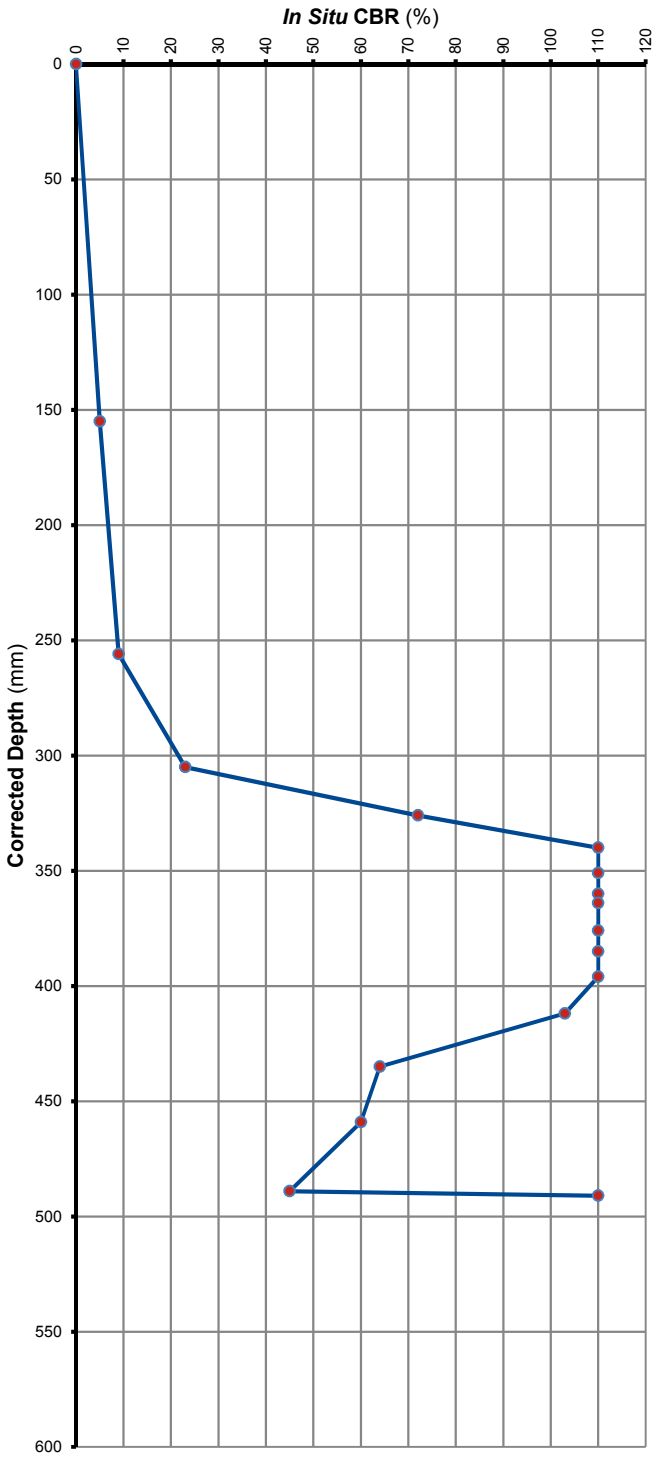
POSITION: Test Pit 01 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

**Estimated Bearing Ratio VS Corrected Depth



In Situ CBR VS Corrected Depth



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*DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 02 **DEPTH BELOW NGL:** 0.000m

***DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)**

No of Blows	Depth (mm)	Corrected Depth (mm)	Penetration Tempo	dn (mm/blow)	Consistency	**Estimated Bearing Ratio (kPa)	*In Situ* CBR
0	120	0	-	-	-	-	-
5	268	148	148	29.6	Medium Dense	46	5
10	389	269	121	24.2	Medium Dense	55	7
15	473	353	84	16.8	Medium Dense	72	11
20	526	406	53	10.6	Dense	99	21
25	568	448	42	8.4	Dense	119	29
30	603	483	35	7.0	Dense	137	36
35	636	516	33	6.6	Dense	144	39
40	669	549	33	6.6	Dense	144	39
45	705	585	36	7.2	Dense	134	35
50	735	615	30	6.0	Dense	154	45
55	765	645	30	6.0	Dense	154	45
60	790	670	25	5.0	Very Dense	174	57
65	816	696	26	5.2	Dense	169	54
70	842	722	26	5.2	Dense	169	54
75	866	746	24	4.8	Very Dense	178	60
80	889	769	23	4.6	Very Dense	183	64
85	916	796	27	5.4	Dense	165	52
90	941	821	25	5.0	Very Dense	174	57
95	965	845	24	4.8	Very Dense	178	60
100	992	872	27	5.4	Dense	165	52
105	1013	893	21	4.2	Very Dense	193	72
110	1040	920	27	5.4	Dense	165	52
115	1062	942	22	4.4	Very Dense	188	68
120	1083	963	21	4.2	Very Dense	193	72
125	1104	984	21	4.2	Very Dense	193	72
130	1126	1006	22	4.4	Very Dense	188	68
135	1146	1026	20	4.0	Very Dense	200	77
140	1167	1047	21	4.2	Very Dense	193	72
145	1191	1071	24	4.8	Very Dense	178	60
150	1215	1095	24	4.8	Very Dense	178	60
155	1245	1125	30	6.0	Dense	154	45
160	1270	1150	25	5.0	Very Dense	174	57
165	1296	1176	26	5.2	Dense	169	54
170	1321	1201	25	5.0	Very Dense	174	57
175	1345	1225	24	4.8	Very Dense	178	60
180	1368	1248	23	4.6	Very Dense	183	64
185	1389	1269	21	4.2	Very Dense	193	72
190	1411	1291	22	4.4	Very Dense	188	68
195	1434	1314	23	4.6	Very Dense	183	64
200	1453	1333	19	3.8	Very Dense	> 200	82
205	1487	1367	34	6.8	Dense	140	38
210	1508	1388	21	4.2	Very Dense	193	72
215	1559	1439	51	10.2	Dense	102	22
220	1583	1463	24	4.8	Very Dense	178	60
225	1607	1487	24	4.8	Very Dense	178	60
230	1633	1513	26	5.2	Dense	169	54
235	1657	1537	24	4.8	Very Dense	178	60
240	1687	1567	30	6.0	Dense	154	45
245	1718	1598	31	6.2	Dense	150	43
250	1748	1628	30	6.0	Dense	154	45

** According to Dr B van Wyk's Method

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*DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 02 **DEPTH BELOW NGL:** 0.000m

***DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)**

No of Blows	Depth (mm)	Corrected Depth (mm)	Penetration Tempo	dn (mm/blow)	Consistency	**Estimated Bearing Ratio (kPa)	*In Situ* CBR
255	1780	1660	32	6.4	Dense	147	41
260	1813	1693	33	6.6	Dense	144	39
265	1840	1720	27	5.4	Dense	165	52
270	1870	1750	30	6.0	Dense	154	45
275	1900	1780	30	6.0	Dense	154	45

** According to Dr B van Wyk's Method

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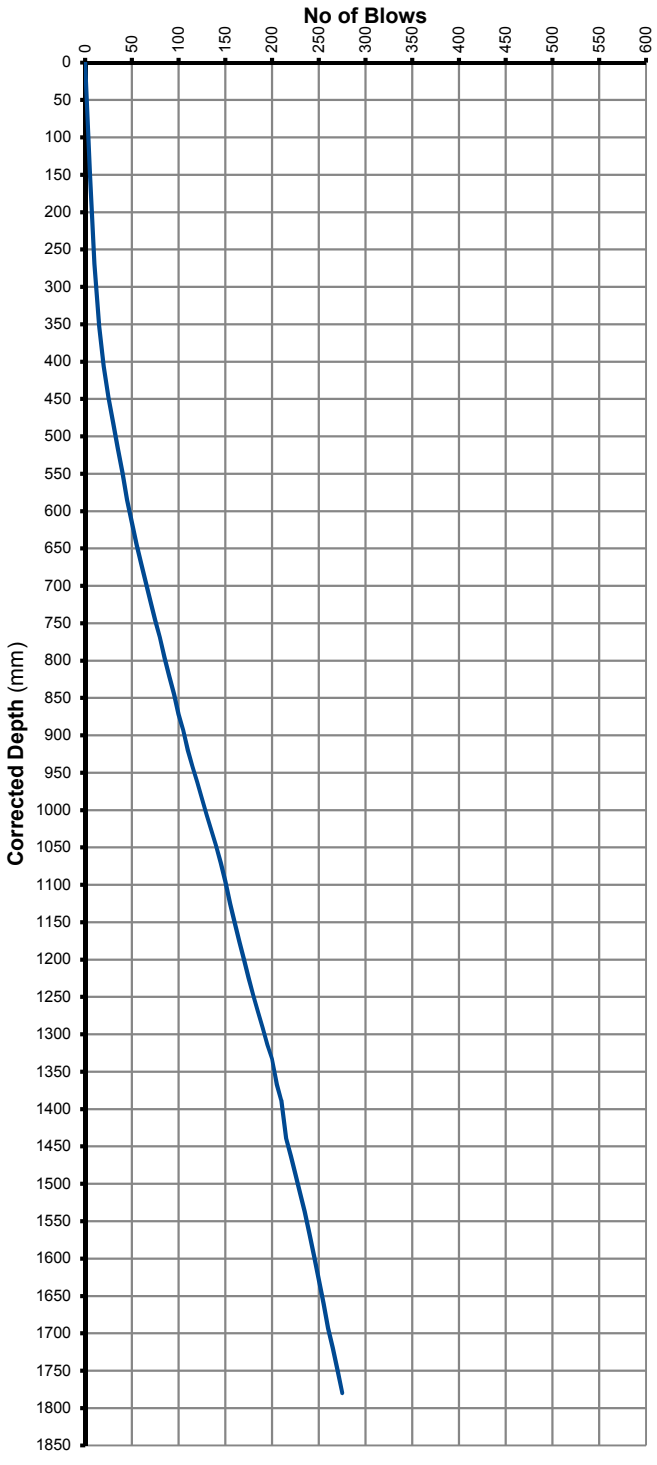
*DYNAMIC CONE PENETROMETER (DCP) TEST

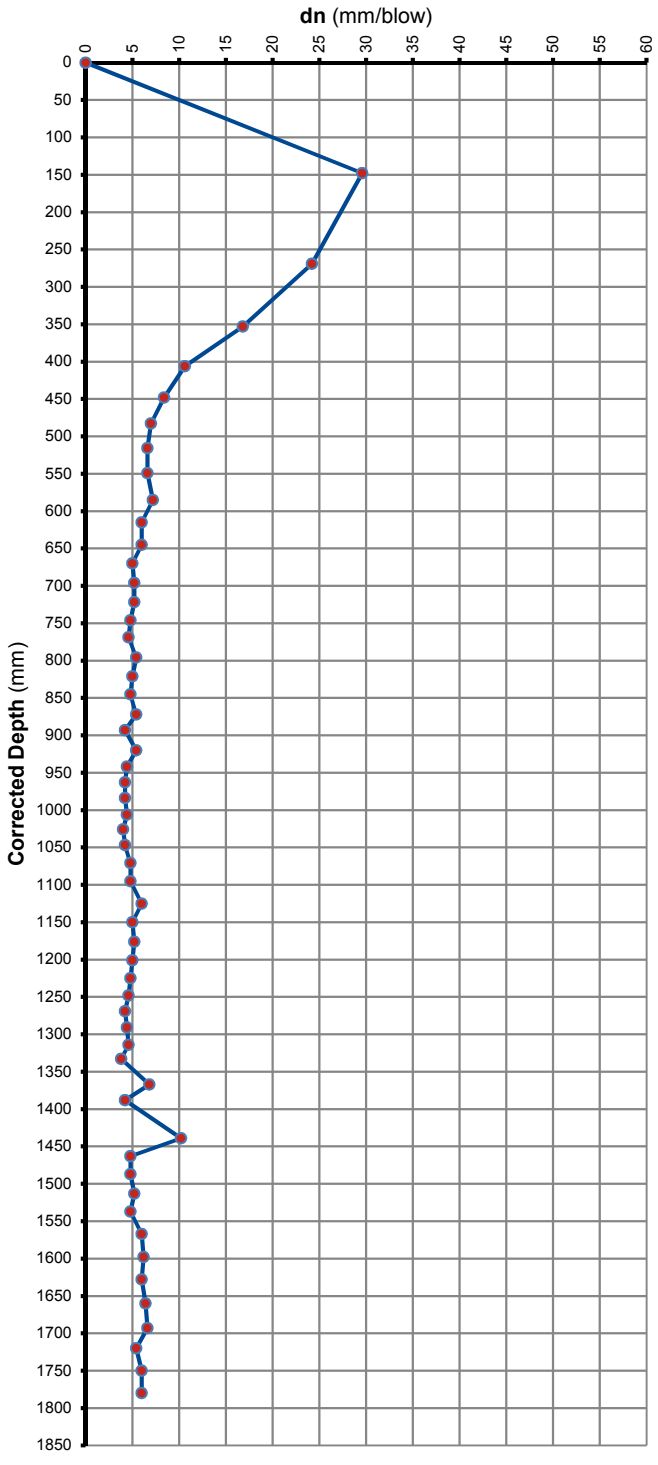
POSITION: Test Pit 02 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

No of Blows VS Corrected Depth



dn VS Corrected Depth



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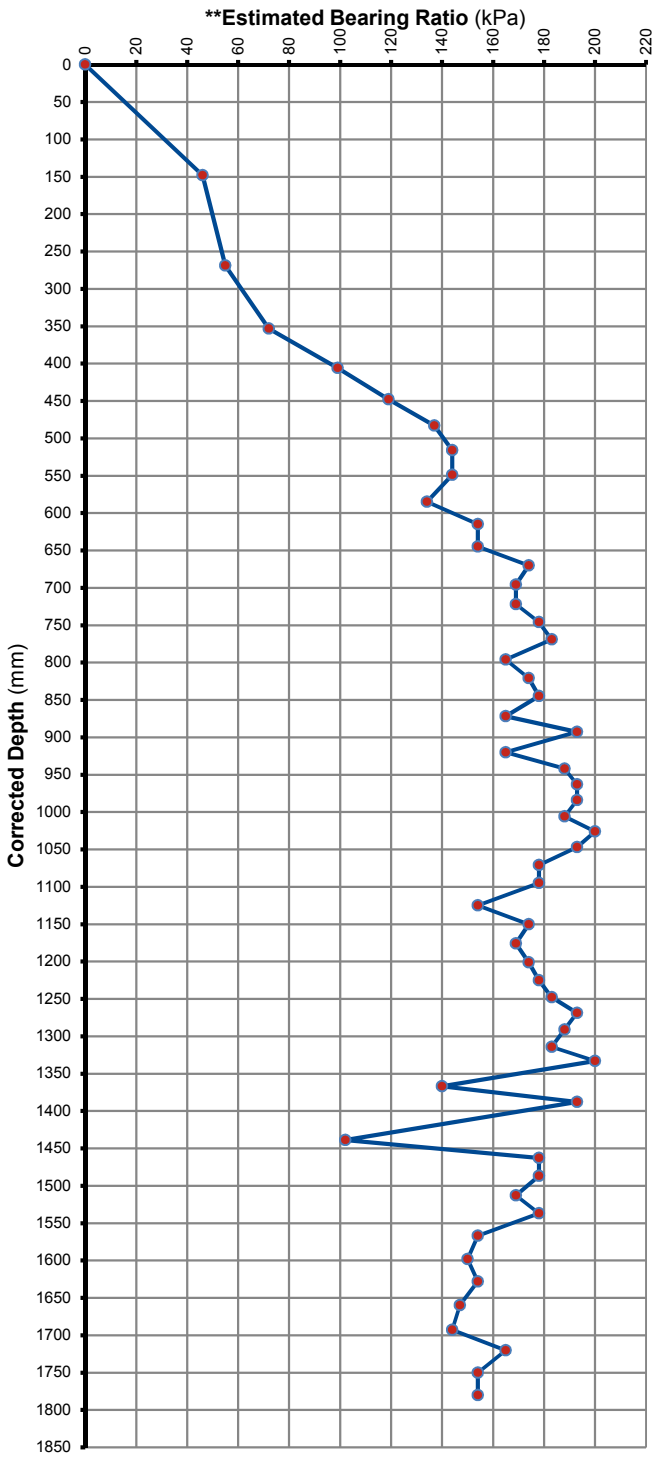
*DYNAMIC CONE PENETROMETER (DCP) TEST

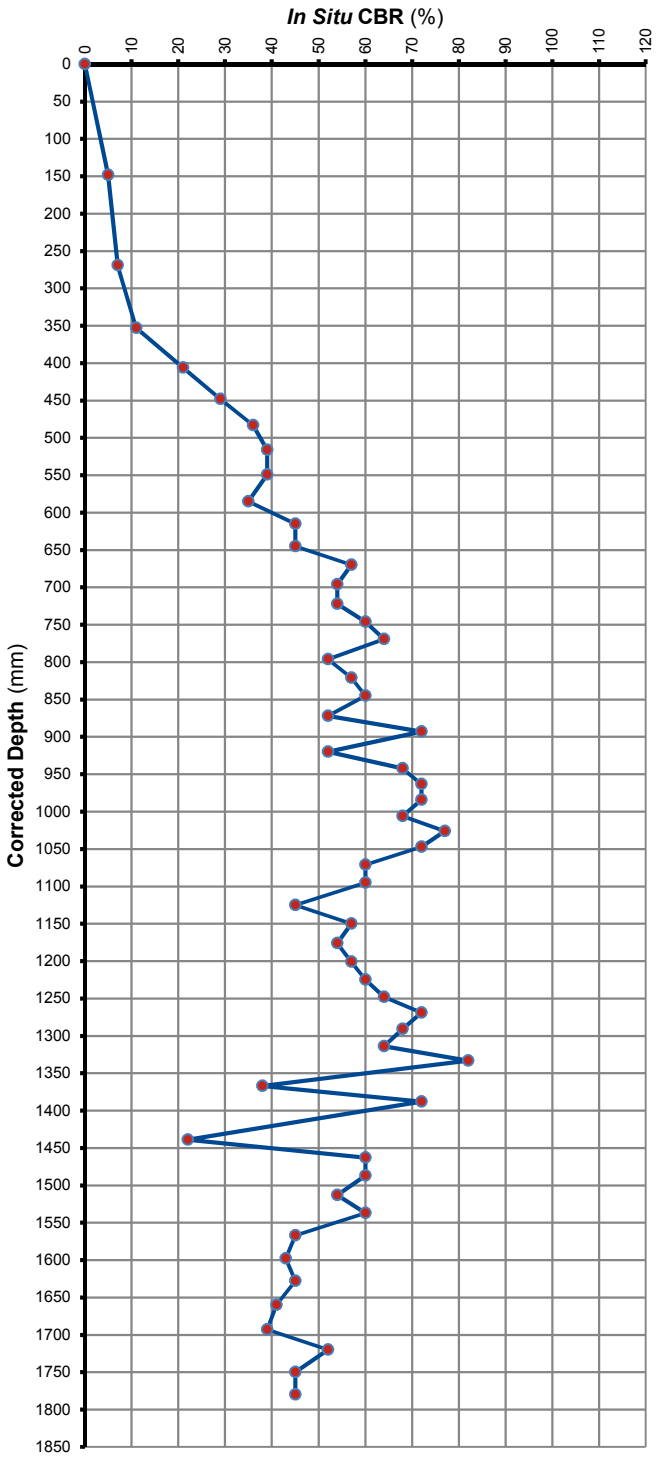
POSITION: Test Pit 02 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

**Estimated Bearing Ratio VS Corrected Depth



In Situ CBR VS Corrected Depth



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*DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 03 **DEPTH BELOW NGL:** 0.000m

***DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)**

No of Blows	Depth (mm)	Corrected Depth (mm)	Penetration Tempo	dn (mm/blow)	Consistency	**Estimated Bearing Ratio (kPa)	*In Situ* CBR
0	130	0	-	-	-	-	-
5	320	190	190	38.0	Loose	41	4
10	496	366	176	35.2	Loose	42	4
15	635	505	139	27.8	Medium Dense	48	6
20	704	574	69	13.8	Medium Dense	82	15
25	749	619	45	9.0	Dense	113	26
30	788	658	39	7.8	Dense	126	32
35	827	697	39	7.8	Dense	126	32
40	866	736	39	7.8	Dense	126	32
45	900	770	34	6.8	Dense	140	38
50	931	801	31	6.2	Dense	150	43
55	957	827	26	5.2	Dense	169	54
60	979	849	22	4.4	Very Dense	188	68
65	998	868	19	3.8	Very Dense	> 200	82
70	1016	886	18	3.6	Very Dense	> 200	88
75	1040	910	24	4.8	Very Dense	178	60
80	1065	935	25	5.0	Very Dense	174	57
85	1092	962	27	5.4	Dense	165	52
90	1109	979	17	3.4	Very Dense	> 200	95
95	1152	1022	43	8.6	Dense	117	28
100	1183	1053	31	6.2	Dense	150	43
105	1208	1078	25	5.0	Very Dense	174	57
110	1244	1114	36	7.2	Dense	134	35
115	1278	1148	34	6.8	Dense	140	38
120	1313	1183	35	7.0	Dense	137	36
125	1355	1225	42	8.4	Dense	119	29
130	1394	1264	39	7.8	Dense	126	32
135	1430	1300	36	7.2	Dense	134	35
140	1468	1338	38	7.6	Dense	129	33
145	1503	1373	35	7.0	Dense	137	36
150	1537	1407	34	6.8	Dense	140	38
155	1571	1441	34	6.8	Dense	140	38
160	1604	1474	33	6.6	Dense	144	39
165	1634	1504	30	6.0	Dense	154	45
170	1667	1537	33	6.6	Dense	144	39
175	1699	1569	32	6.4	Dense	147	41
180	1731	1601	32	6.4	Dense	147	41
185	1770	1640	39	7.8	Dense	126	32
190	1810	1680	40	8.0	Dense	124	31
195	1854	1724	44	8.8	Dense	115	27
200	1886	1756	32	6.4	Dense	147	41
205	1924	1794	38	7.6	Dense	129	33

** According to Dr B van Wyk's Method

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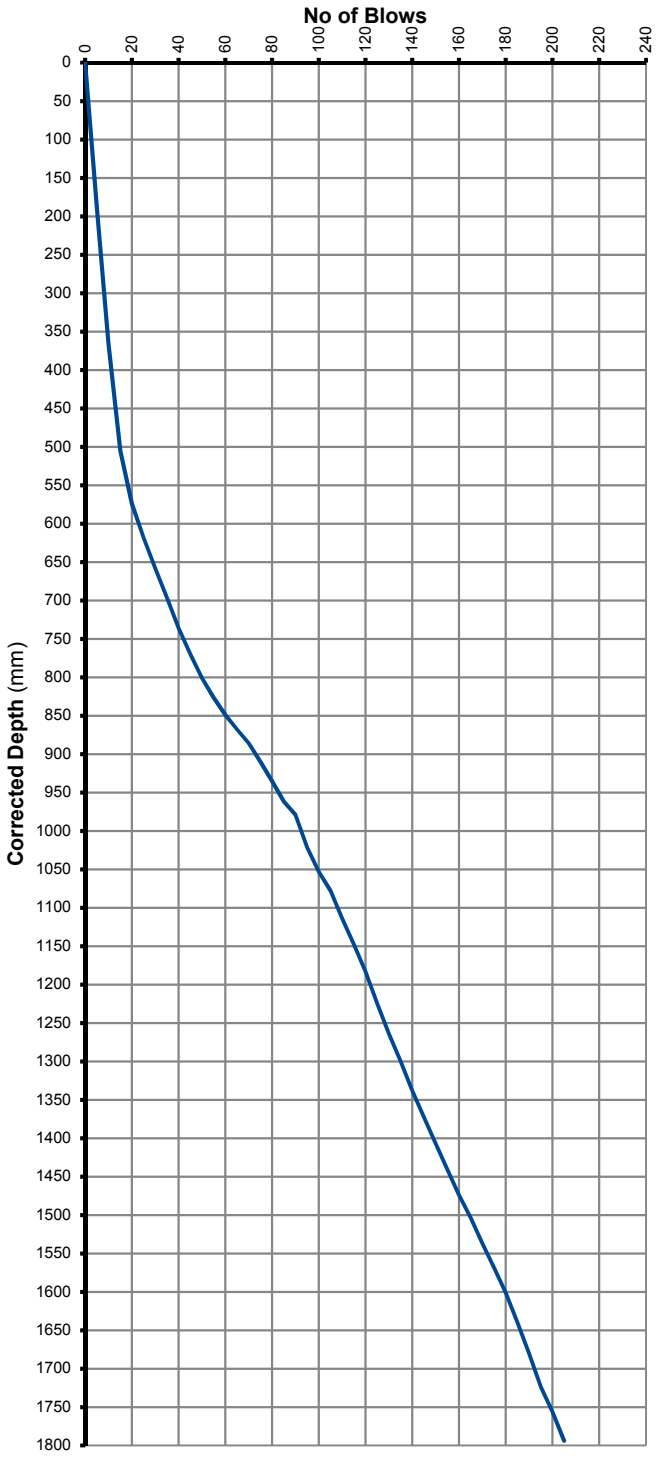
*DYNAMIC CONE PENETROMETER (DCP) TEST

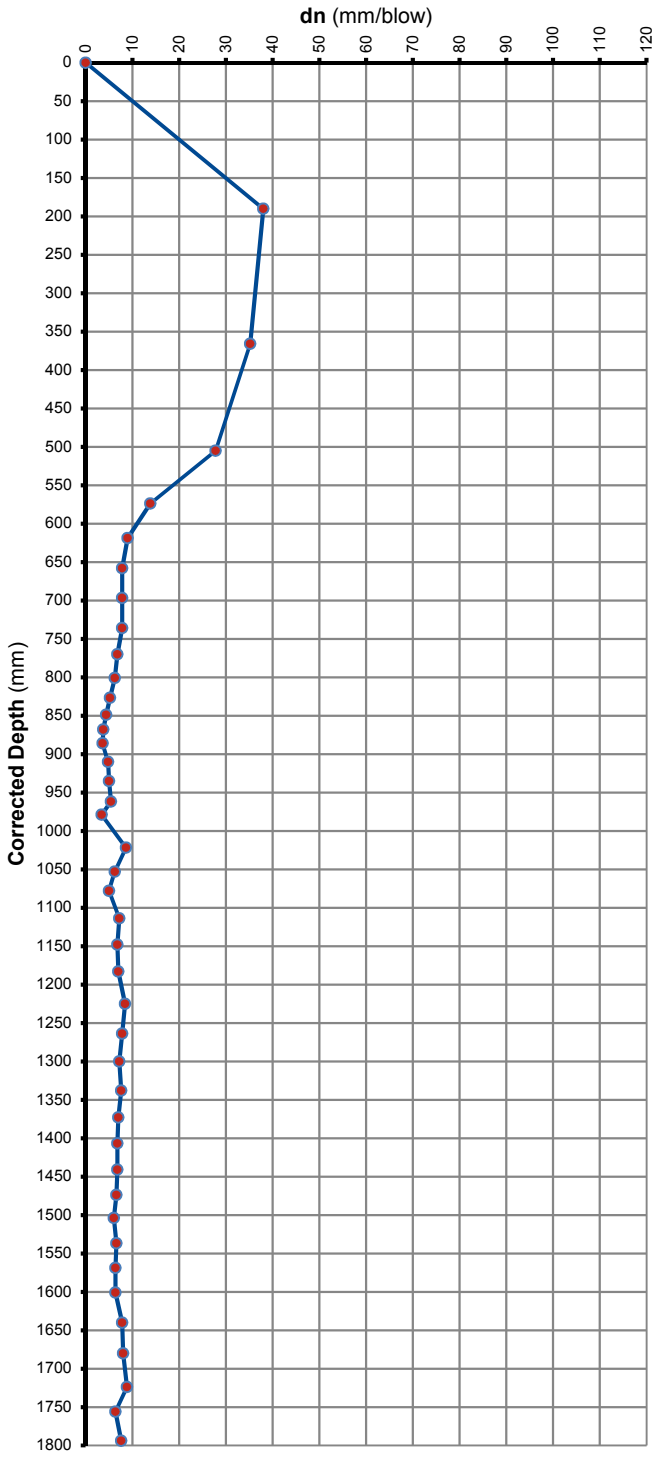
POSITION: Test Pit 03 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

No of Blows VS Corrected Depth



dn VS Corrected Depth



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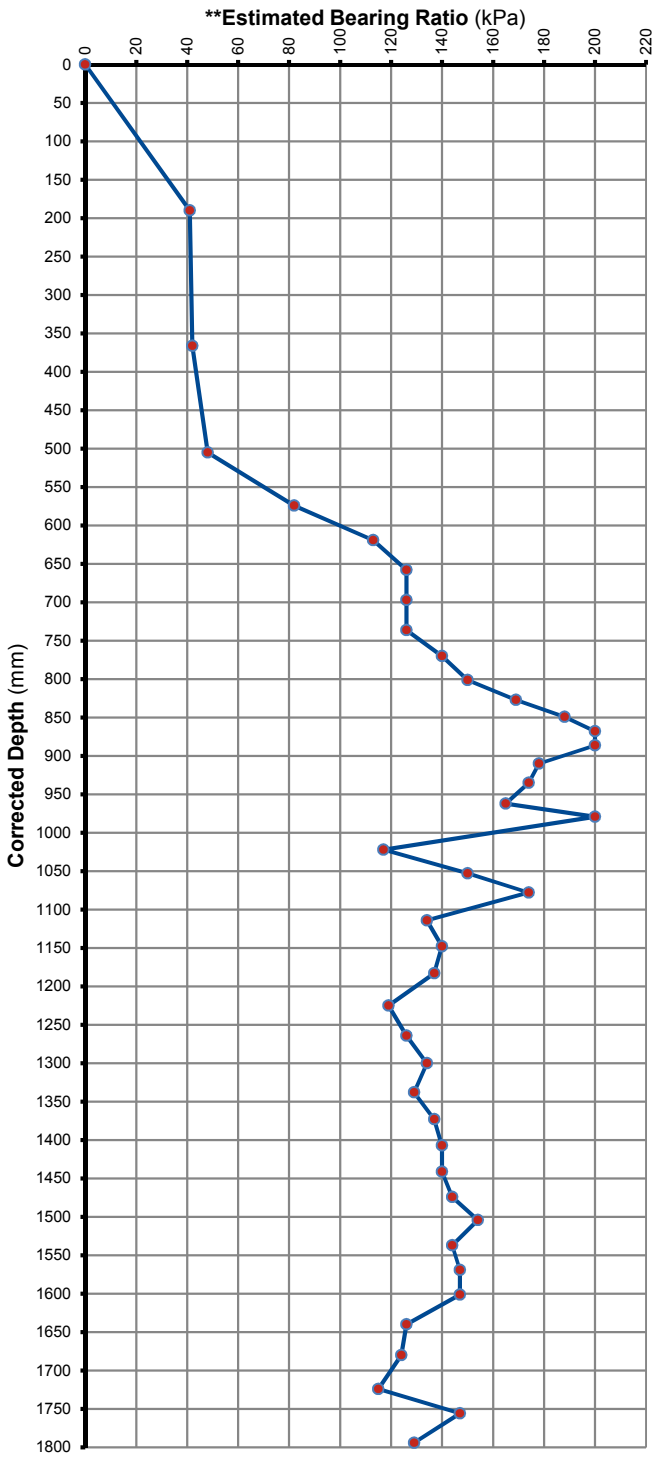
*DYNAMIC CONE PENETROMETER (DCP) TEST

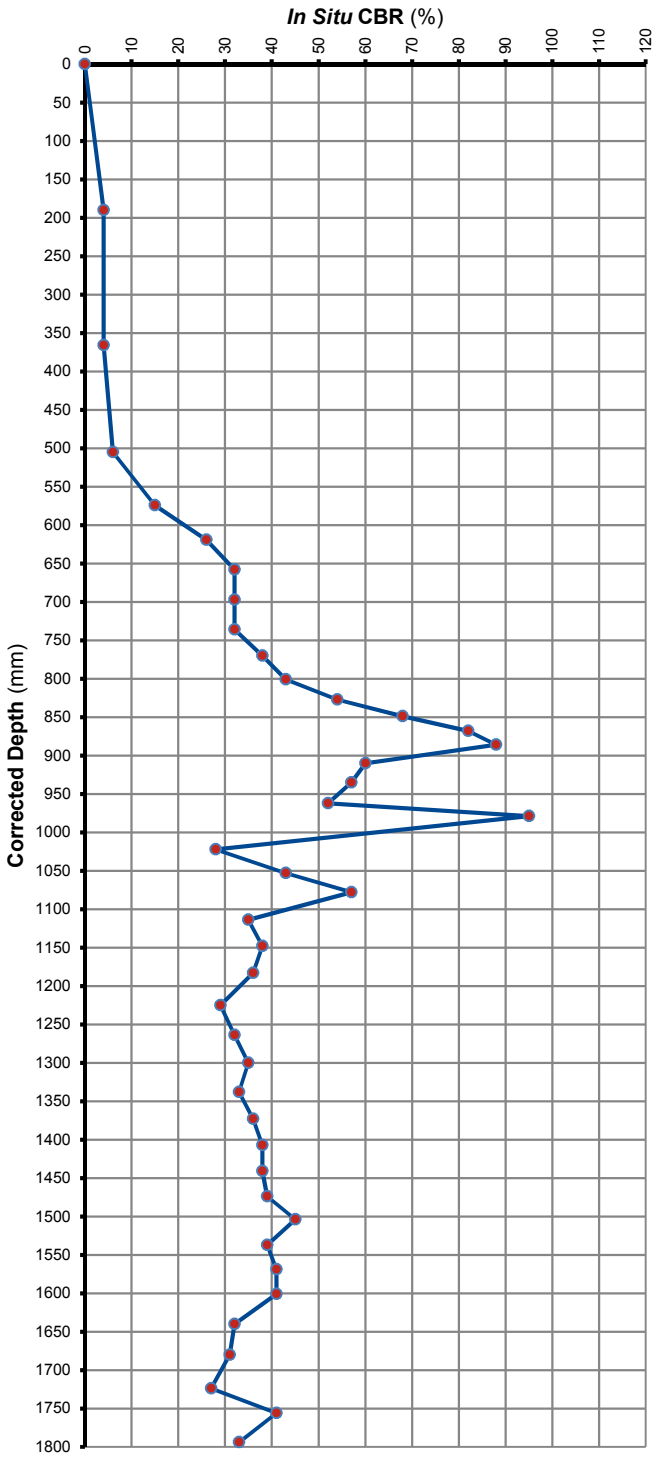
POSITION: Test Pit 03 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

****Estimated Bearing Ratio VS Corrected Depth**



***In Situ* CBR VS Corrected Depth**



** According to Dr B van Wyk's Method

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*DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 08 **DEPTH BELOW NGL:** 0.000m

***DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)**

No of Blows	Depth (mm)	Corrected Depth (mm)	Penetration Tempo	dn (mm/blow)	Consistency	**Estimated Bearing Ratio (kPa)	*In Situ* CBR
0	125	0	-	-	-	-	-
5	287	162	162	32.4	Loose	43	5
10	507	382	220	44.0	Loose	39	3
15	588	463	81	16.2	Medium Dense	74	12
20	627	502	39	7.8	Dense	126	32
25	635	510	8	1.6	Very Dense	> 200	> 110
30	642	517	7	1.4	Very Dense	> 200	> 110
35	645	520	3	0.6	Very Dense	> 200	> 110
40	654	529	9	1.8	Very Dense	> 200	> 110
45	659	534	5	1.0	Very Dense	> 200	> 110
50	664	539	5	1.0	Very Dense	> 200	> 110
55	667	542	3	0.6	Very Dense	> 200	> 110
60	672	547	5	1.0	Very Dense	> 200	> 110
65	676	551	4	0.8	Very Dense	> 200	> 110

** According to Dr B van Wyk's Method

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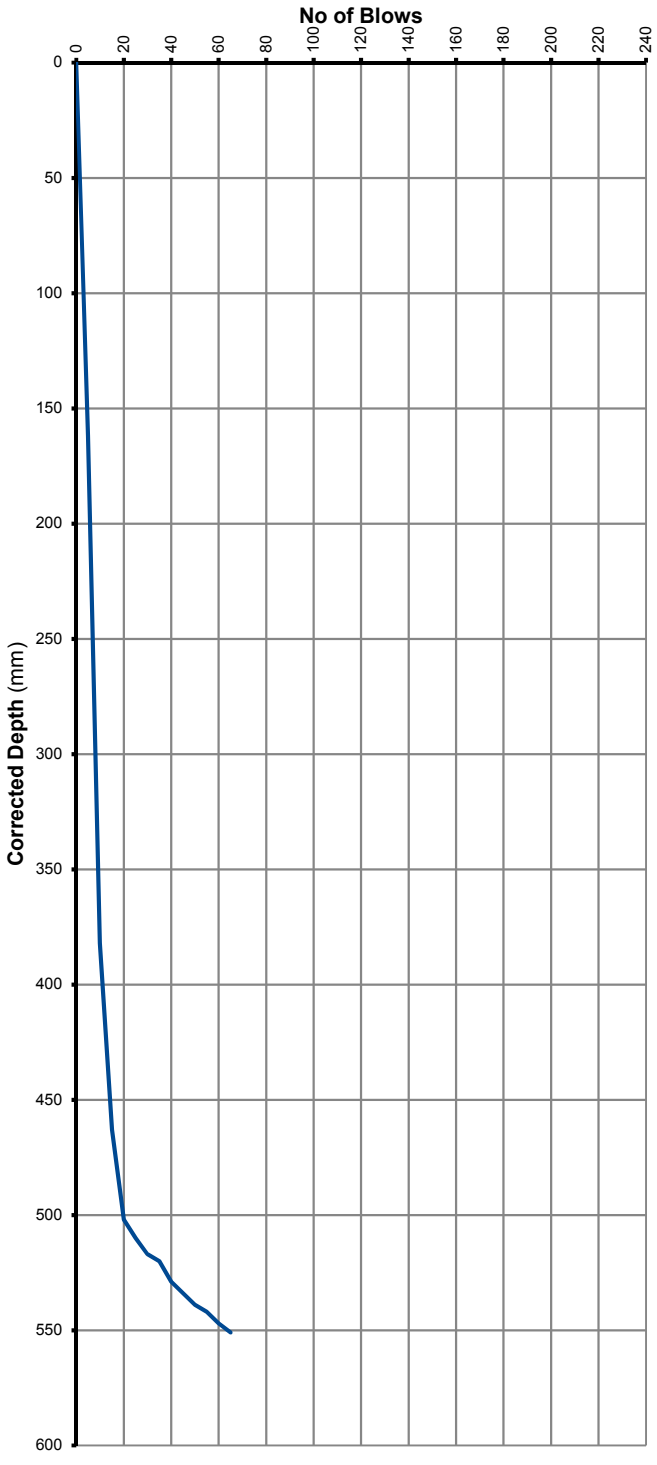
*DYNAMIC CONE PENETROMETER (DCP) TEST

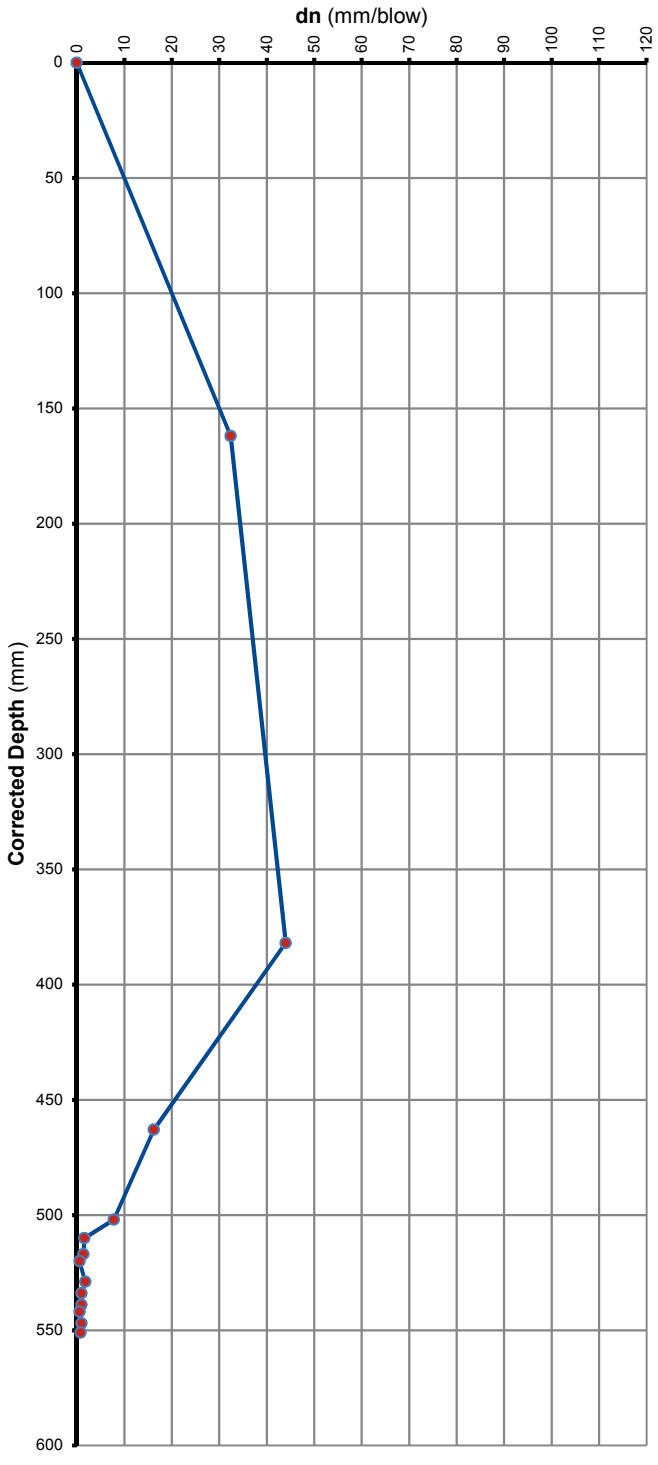
POSITION: Test Pit 08 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

No of Blows VS Corrected Depth



dn VS Corrected Depth



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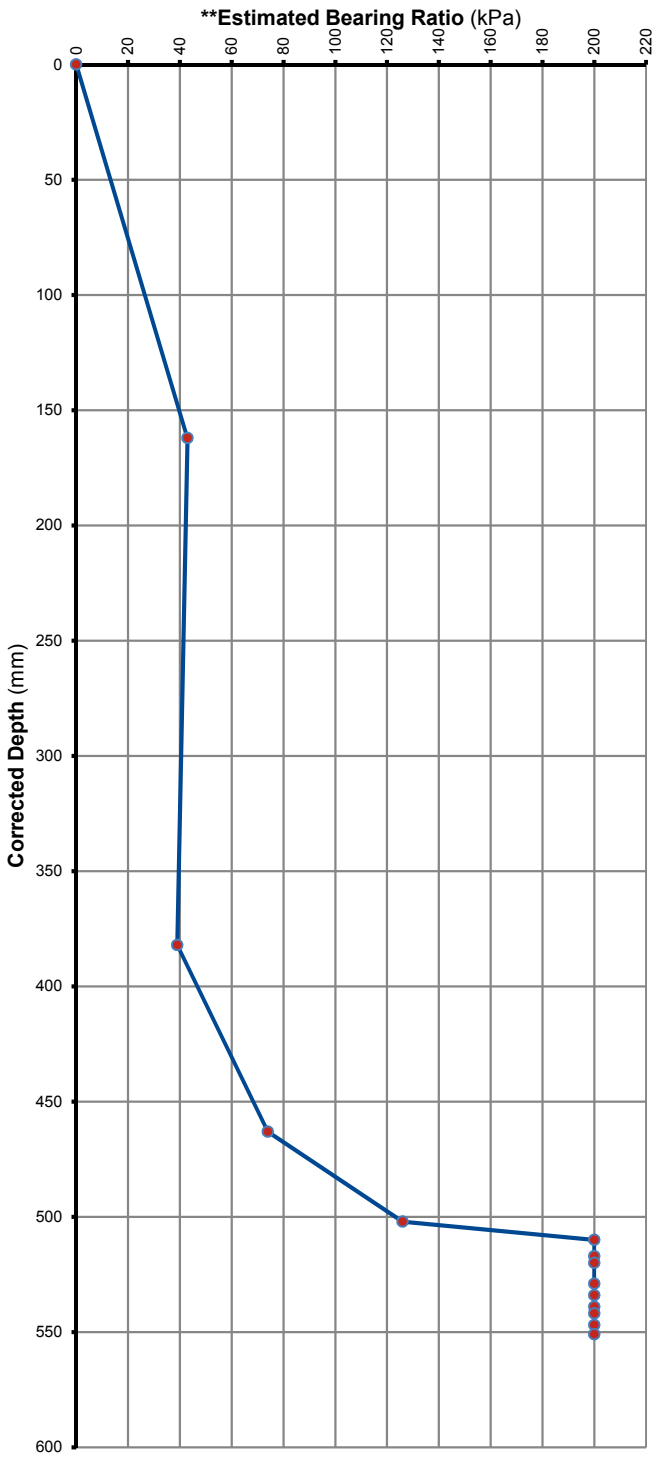
*DYNAMIC CONE PENETROMETER (DCP) TEST

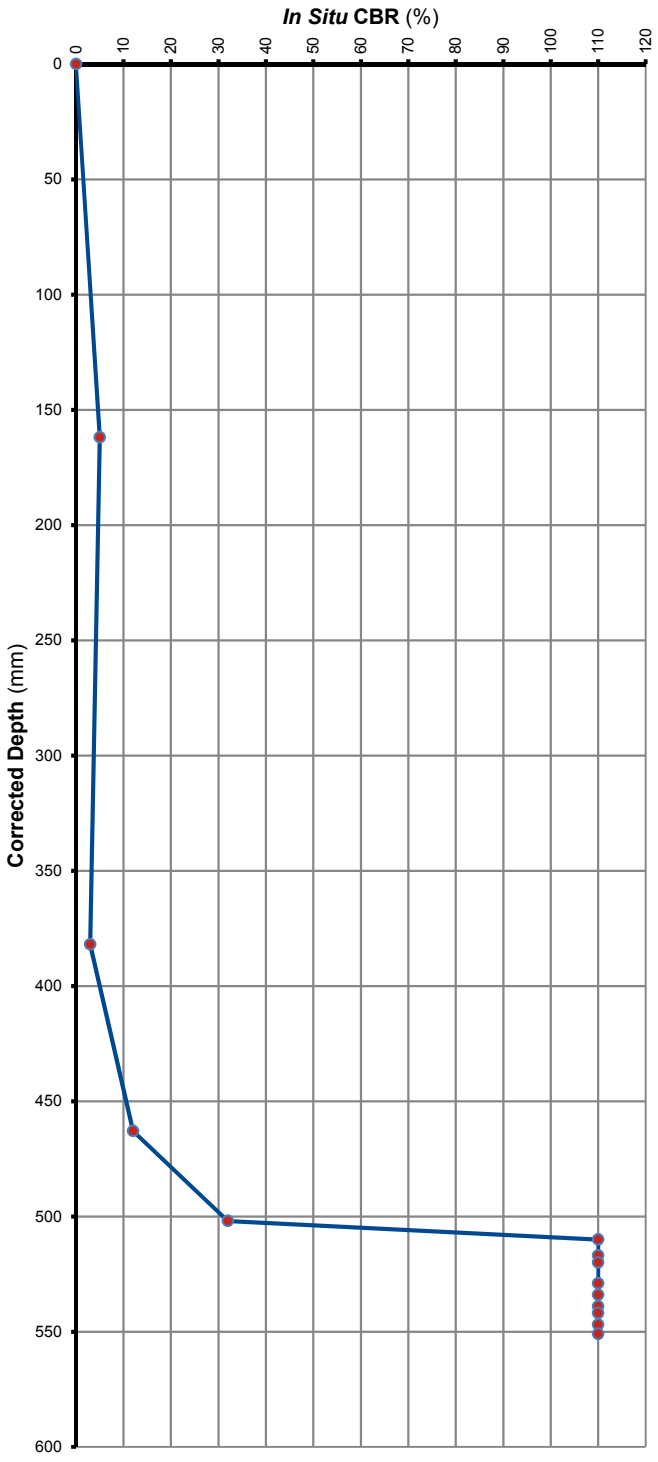
POSITION: Test Pit 08 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

**Estimated Bearing Ratio VS Corrected Depth



In Situ CBR VS Corrected Depth



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*DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 09 **DEPTH BELOW NGL:** 0.000m

***DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)**

No of Blows	Depth (mm)	Corrected Depth (mm)	Penetration Tempo	dn (mm/blow)	Consistency	**Estimated Bearing Ratio (kPa)	*In Situ* CBR
0	120	0	-	-	-	-	-
5	247	127	127	25.4	Medium Dense	53	7
10	384	264	137	27.4	Medium Dense	49	6
15	484	364	100	20.0	Medium Dense	64	9
20	550	430	66	13.2	Medium Dense	85	16
25	601	481	51	10.2	Dense	102	22
30	644	524	43	8.6	Dense	117	28
35	684	564	40	8.0	Dense	124	31
40	725	605	41	8.2	Dense	122	30
45	757	637	32	6.4	Dense	147	41
50	793	673	36	7.2	Dense	134	35
55	834	714	41	8.2	Dense	122	30
60	876	756	42	8.4	Dense	119	29
65	915	795	39	7.8	Dense	126	32
70	953	833	38	7.6	Dense	129	33
75	989	869	36	7.2	Dense	134	35
80	1023	903	34	6.8	Dense	140	38
85	1060	940	37	7.4	Dense	132	34
90	1102	982	42	8.4	Dense	119	29
95	1143	1023	41	8.2	Dense	122	30
100	1181	1061	38	7.6	Dense	129	33
105	1218	1098	37	7.4	Dense	132	34
110	1254	1134	36	7.2	Dense	134	35
115	1280	1160	26	5.2	Dense	169	54
120	1299	1179	19	3.8	Very Dense	> 200	82
125	1316	1196	17	3.4	Very Dense	> 200	95
130	1334	1214	18	3.6	Very Dense	> 200	88
135	1353	1233	19	3.8	Very Dense	> 200	82
140	1372	1252	19	3.8	Very Dense	> 200	82
145	1390	1270	18	3.6	Very Dense	> 200	88
150	1408	1288	18	3.6	Very Dense	> 200	88
155	1416	1296	8	1.6	Very Dense	> 200	> 110
160	1423	1303	7	1.4	Very Dense	> 200	> 110
165	1430	1310	7	1.4	Very Dense	> 200	> 110
170	1435	1315	5	1.0	Very Dense	> 200	> 110
175	1445	1325	10	2.0	Very Dense	> 200	> 110
180	1452	1332	7	1.4	Very Dense	> 200	> 110
185	1456	1336	4	0.8	Very Dense	> 200	> 110
190	1465	1345	9	1.8	Very Dense	> 200	> 110
195	1478	1358	13	2.6	Very Dense	> 200	> 110
200	1486	1366	8	1.6	Very Dense	> 200	> 110
205	1500	1380	14	2.8	Very Dense	> 200	> 110
210	1515	1395	15	3.0	Very Dense	> 200	> 110
215	1530	1410	15	3.0	Very Dense	> 200	> 110
220	1543	1423	13	2.6	Very Dense	> 200	> 110
225	1550	1430	7	1.4	Very Dense	> 200	> 110
230	1558	1438	8	1.6	Very Dense	> 200	> 110
235	1564	1444	6	1.2	Very Dense	> 200	> 110
240	1578	1458	14	2.8	Very Dense	> 200	> 110
245	1582	1462	4	0.8	Very Dense	> 200	> 110
250	1586	1466	4	0.8	Very Dense	> 200	> 110

** According to Dr B van Wyk's Method

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*DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 09 **DEPTH BELOW NGL:** 0.000m

***DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)**

No of Blows	Depth (mm)	Corrected Depth (mm)	Penetration Tempo	dn (mm/blow)	Consistency	**Estimated Bearing Ratio (kPa)	*In Situ* CBR
255	1592	1472	6	1.2	Very Dense	> 200	> 110
260	1597	1477	5	1.0	Very Dense	> 200	> 110
265	1606	1486	9	1.8	Very Dense	> 200	> 110
270	1617	1497	11	2.2	Very Dense	> 200	> 110
275	1627	1507	10	2.0	Very Dense	> 200	> 110
280	1638	1518	11	2.2	Very Dense	> 200	> 110
285	1647	1527	9	1.8	Very Dense	> 200	> 110
290	1657	1537	10	2.0	Very Dense	> 200	> 110
295	1667	1547	10	2.0	Very Dense	> 200	> 110
300	1674	1554	7	1.4	Very Dense	> 200	> 110
305	1683	1563	9	1.8	Very Dense	> 200	> 110
310	1692	1572	9	1.8	Very Dense	> 200	> 110
315	1698	1578	6	1.2	Very Dense	> 200	> 110
320	1711	1591	13	2.6	Very Dense	> 200	> 110
325	1720	1600	9	1.8	Very Dense	> 200	> 110
330	1732	1612	12	2.4	Very Dense	> 200	> 110
335	1743	1623	11	2.2	Very Dense	> 200	> 110
340	1750	1630	7	1.4	Very Dense	> 200	> 110
345	1764	1644	14	2.8	Very Dense	> 200	> 110
350	1775	1655	11	2.2	Very Dense	> 200	> 110
355	1784	1664	9	1.8	Very Dense	> 200	> 110
360	1795	1675	11	2.2	Very Dense	> 200	> 110
365	1804	1684	9	1.8	Very Dense	> 200	> 110
370	1817	1697	13	2.6	Very Dense	> 200	> 110
375	1827	1707	10	2.0	Very Dense	> 200	> 110
380	1834	1714	7	1.4	Very Dense	> 200	> 110
385	1845	1725	11	2.2	Very Dense	> 200	> 110
390	1854	1734	9	1.8	Very Dense	> 200	> 110
395	1859	1739	5	1.0	Very Dense	> 200	> 110

** According to Dr B van Wyk's Method

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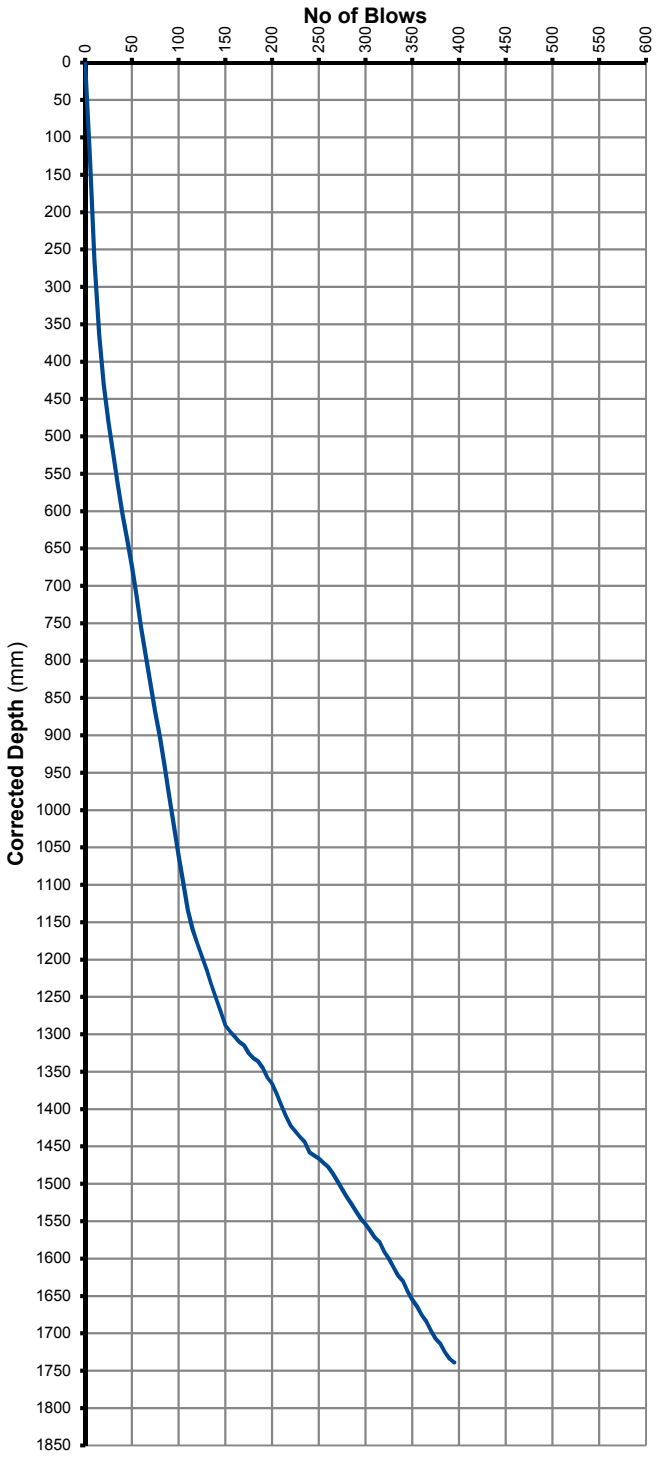
*DYNAMIC CONE PENETROMETER (DCP) TEST

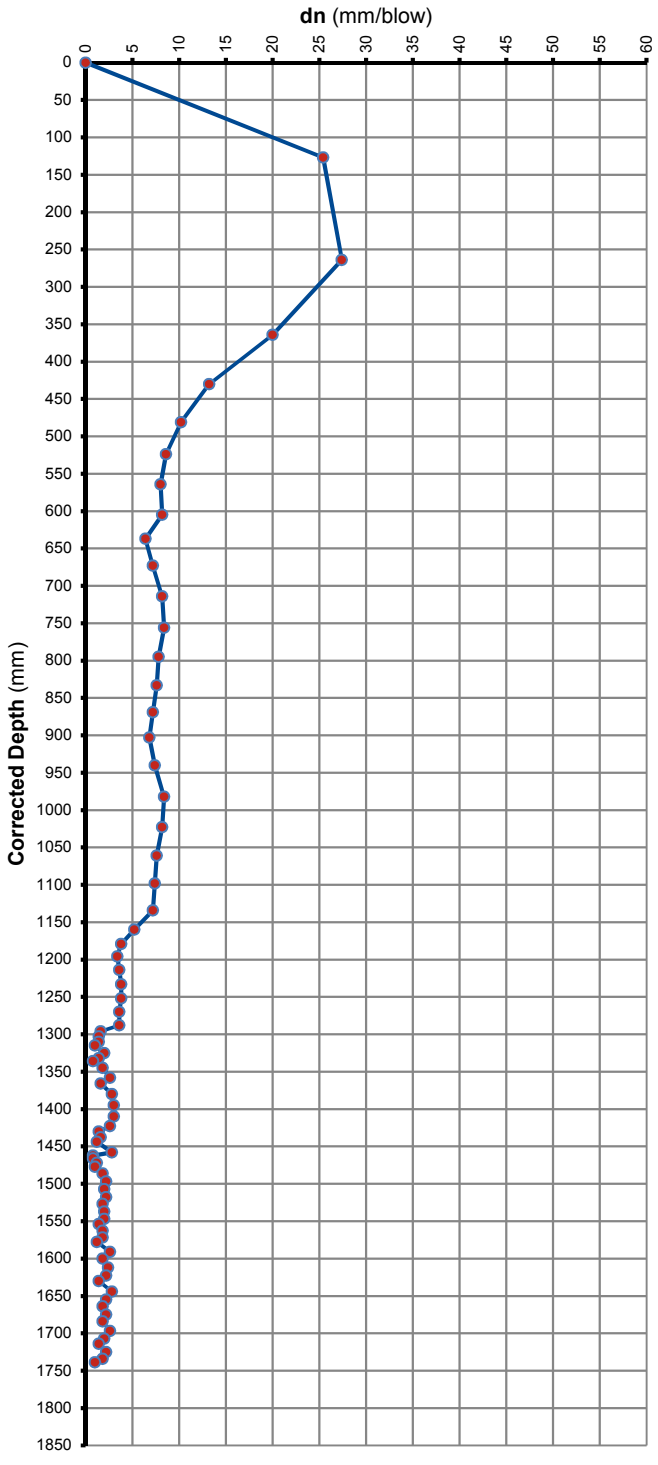
POSITION: Test Pit 09 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

No of Blows VS Corrected Depth



dn VS Corrected Depth



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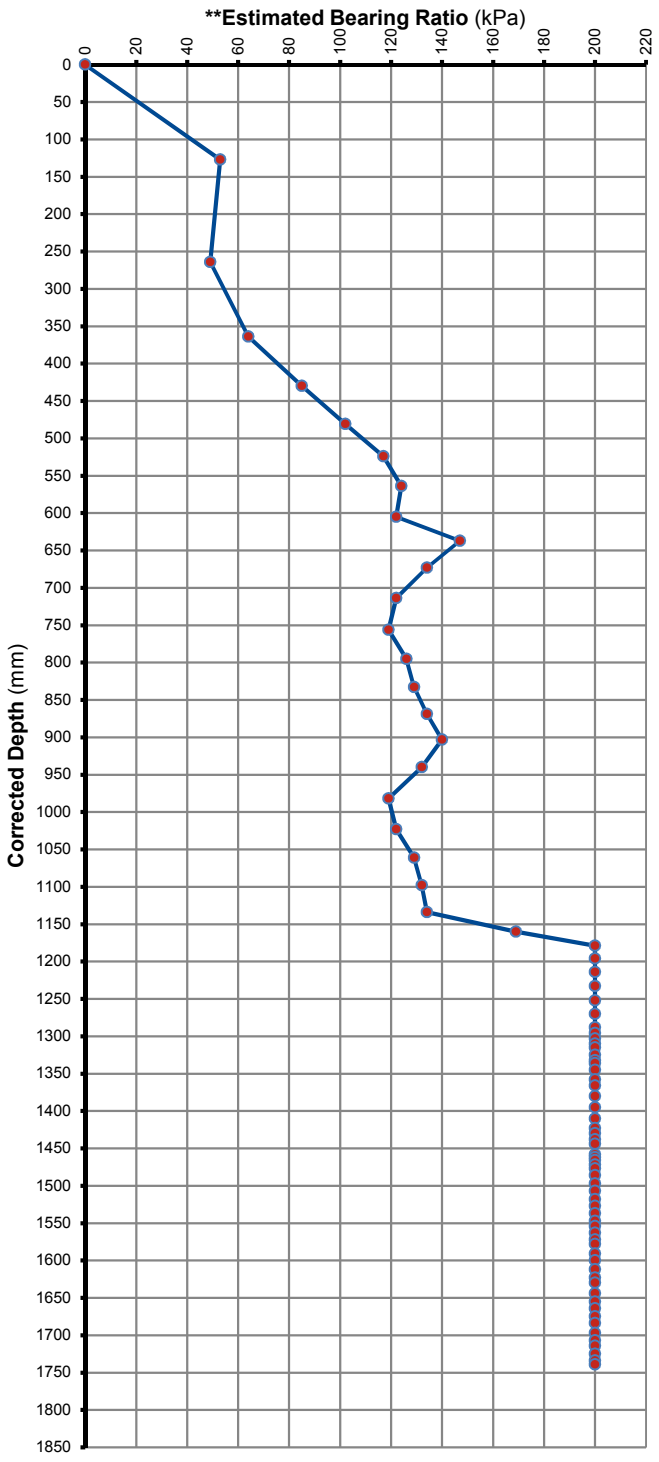
*DYNAMIC CONE PENETROMETER (DCP) TEST

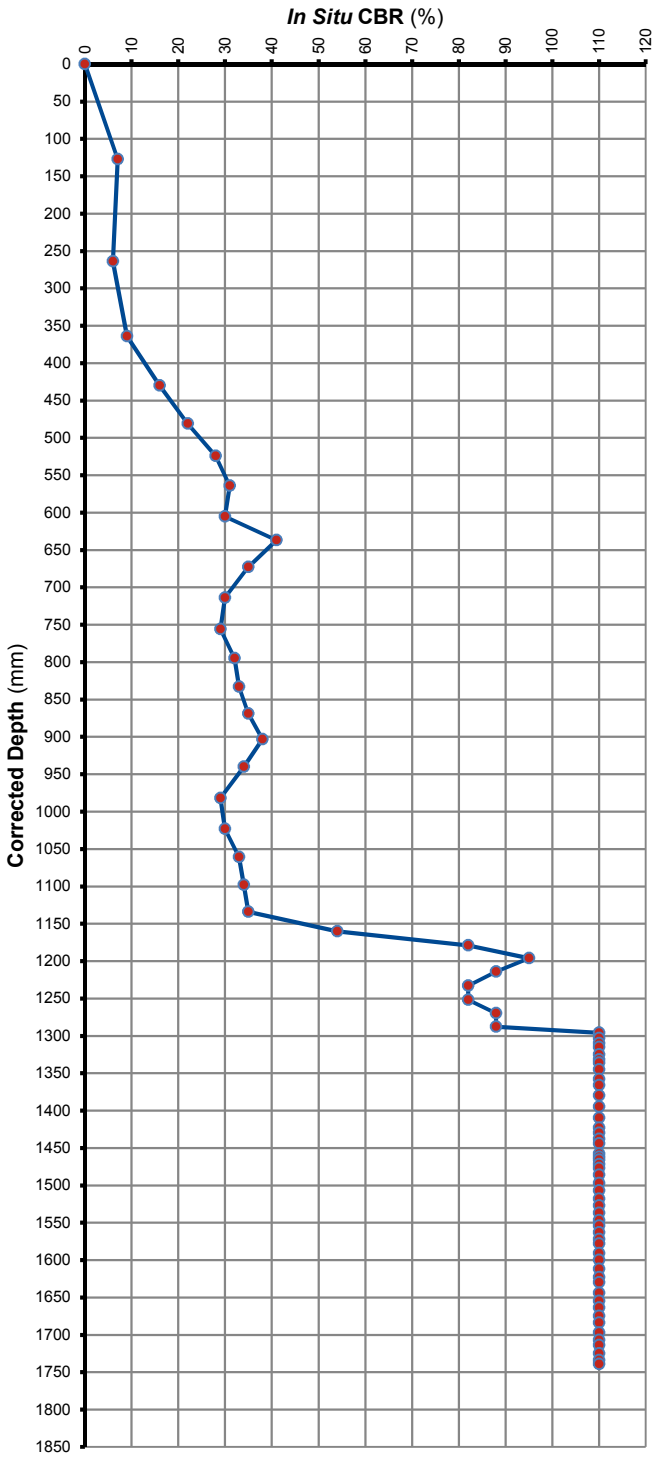
POSITION: Test Pit 09 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

**Estimated Bearing Ratio VS Corrected Depth



In Situ CBR VS Corrected Depth



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*DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 10 **DEPTH BELOW NGL:** 0.000m

***DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)**

No of Blows	Depth (mm)	Corrected Depth (mm)	Penetration Tempo	dn (mm/blow)	Consistency	**Estimated Bearing Ratio (kPa)	*In Situ* CBR
0	125	0	-	-	-	-	-
5	350	225	225	45.0	Loose	38	3
10	588	463	238	47.6	Loose	34	3
15	781	656	193	38.6	Loose	41	4
20	875	750	94	18.8	Medium Dense	67	10
25	928	803	53	10.6	Dense	99	21
30	976	851	48	9.6	Dense	107	24
35	1006	881	30	6.0	Dense	154	45
40	1023	898	17	3.4	Very Dense	> 200	95
45	1034	909	11	2.2	Very Dense	> 200	> 110
50	1039	914	5	1.0	Very Dense	> 200	> 110
55	1042	917	3	0.6	Very Dense	> 200	> 110
60	1049	924	7	1.4	Very Dense	> 200	> 110
65	1054	929	5	1.0	Very Dense	> 200	> 110

** According to Dr B van Wyk's Method

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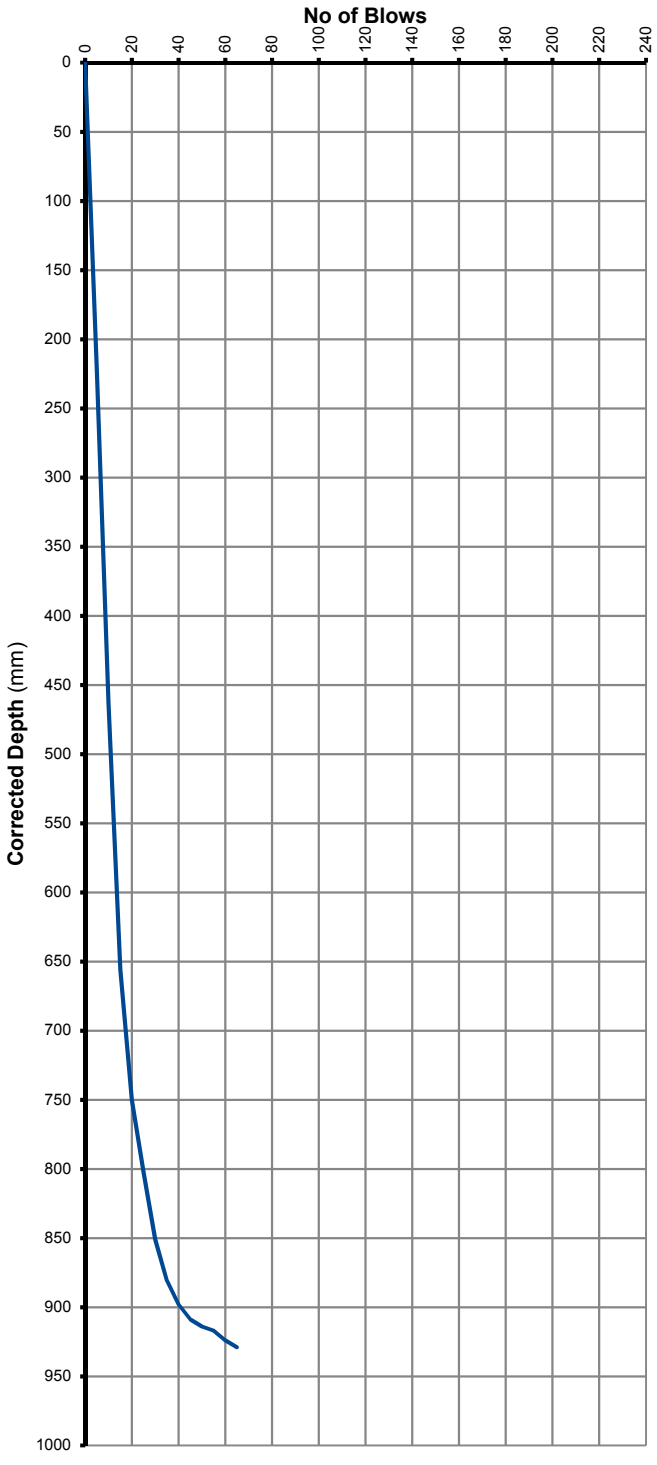
*DYNAMIC CONE PENETROMETER (DCP) TEST

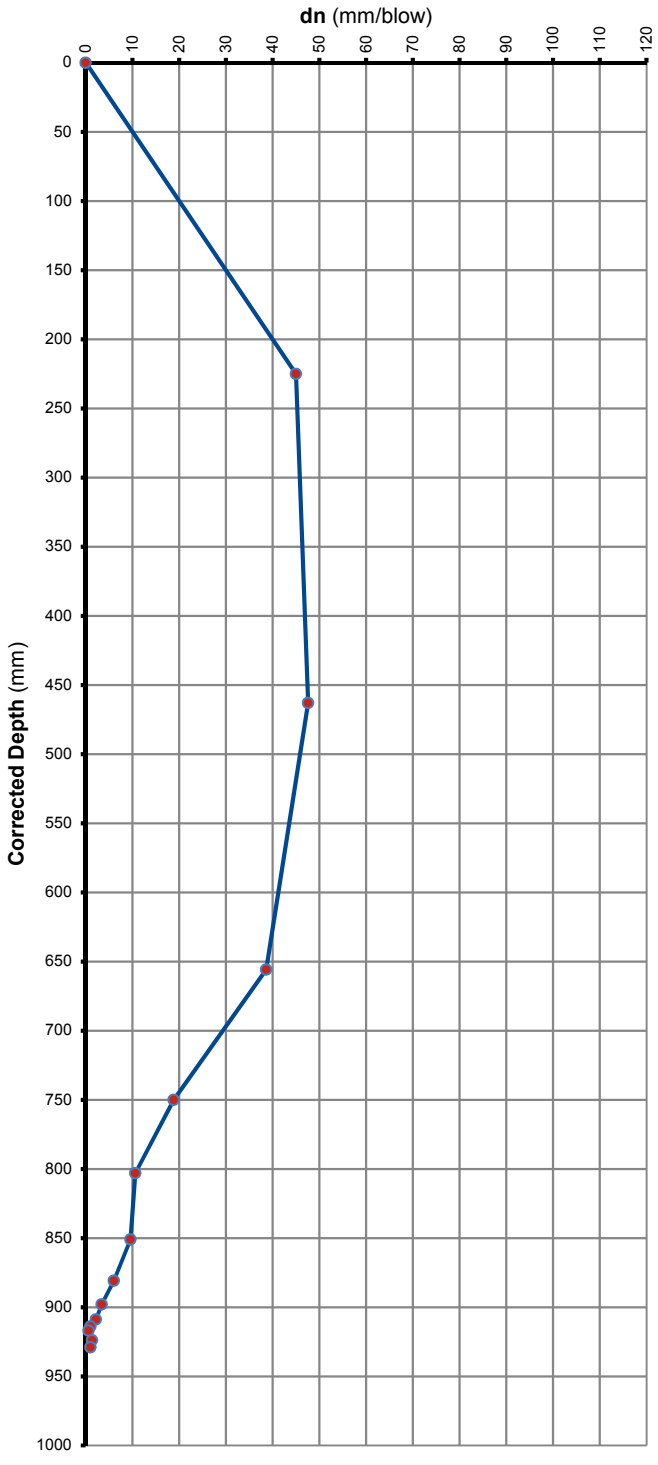
POSITION: Test Pit 10 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

No of Blows VS Corrected Depth



dn VS Corrected Depth



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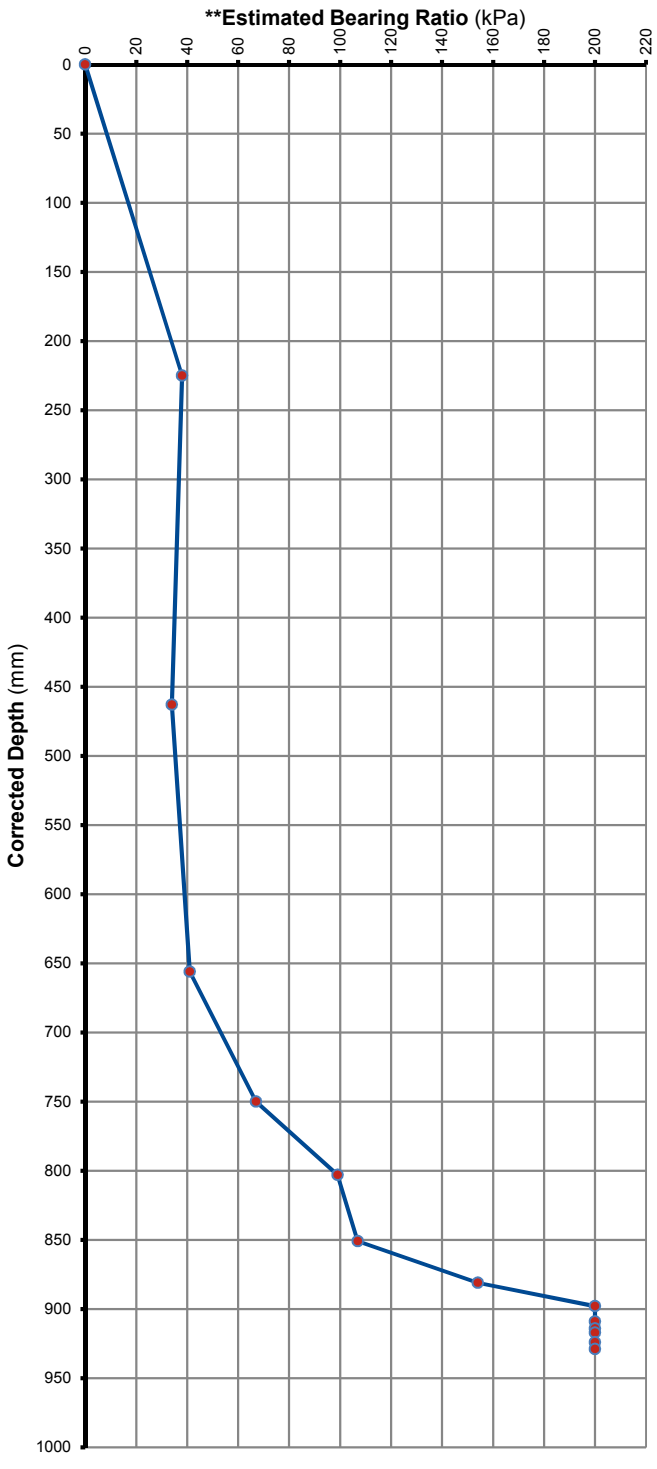
*DYNAMIC CONE PENETROMETER (DCP) TEST

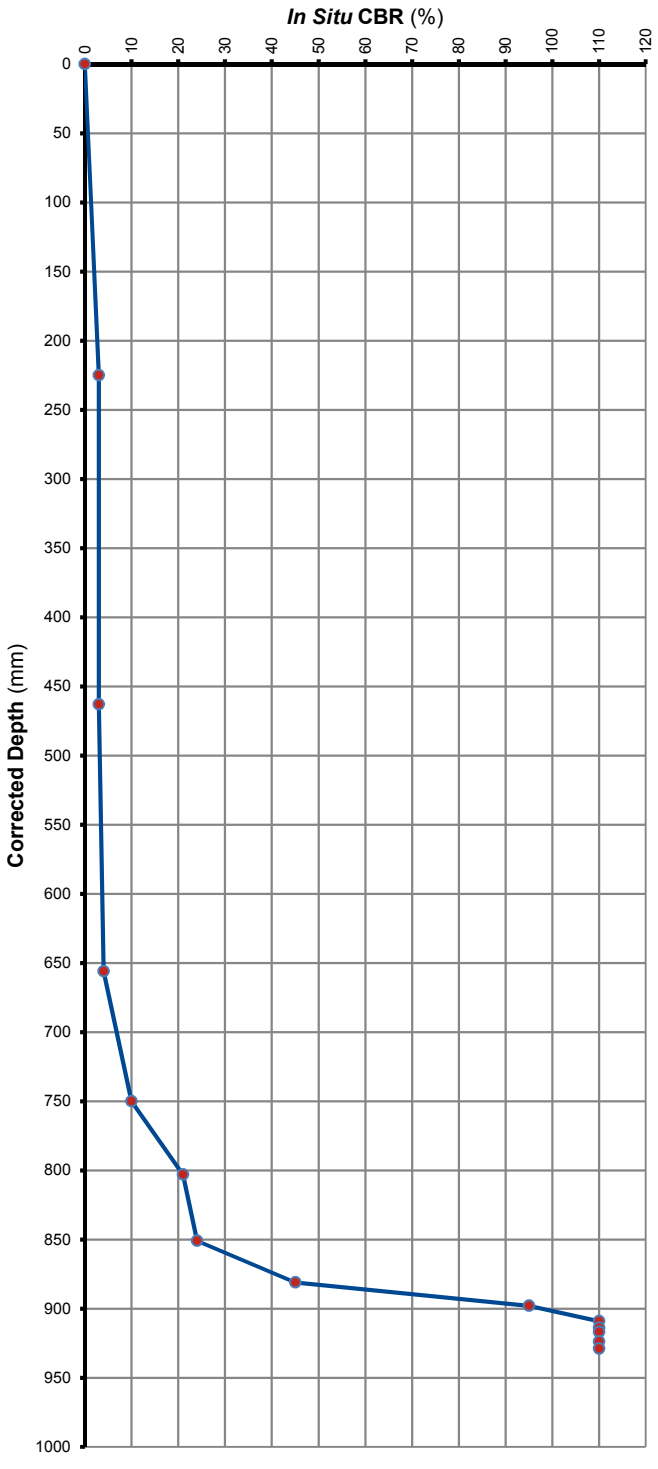
POSITION: Test Pit 10 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

**Estimated Bearing Ratio VS Corrected Depth



In Situ CBR VS Corrected Depth



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*DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 17 **DEPTH BELOW NGL:** 0.000m

***DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)**

No of Blows	Depth (mm)	Corrected Depth (mm)	Penetration Tempo	dn (mm/blow)	Consistency	**Estimated Bearing Ratio (kPa)	*In Situ* CBR
0	130	0	-	-	-	-	-
5	247	117	117	23.4	Medium Dense	57	7
10	272	142	25	5.0	Very Dense	174	57
15	465	335	193	38.6	Loose	41	4
20	527	397	62	12.4	Dense	89	17
25	570	440	43	8.6	Dense	117	28
30	609	479	39	7.8	Dense	126	32
35	643	513	34	6.8	Dense	140	38
40	671	541	28	5.6	Dense	161	49
45	699	569	28	5.6	Dense	161	49
50	727	597	28	5.6	Dense	161	49
55	756	626	29	5.8	Dense	157	47
60	784	654	28	5.6	Dense	161	49
65	816	686	32	6.4	Dense	147	41
70	850	720	34	6.8	Dense	140	38
75	888	758	38	7.6	Dense	129	33
80	923	793	35	7.0	Dense	137	36
85	957	827	34	6.8	Dense	140	38
90	990	860	33	6.6	Dense	144	39
95	1019	889	29	5.8	Dense	157	47
100	1050	920	31	6.2	Dense	150	43
105	1078	948	28	5.6	Dense	161	49
110	1104	974	26	5.2	Dense	169	54
115	1120	990	16	3.2	Very Dense	> 200	103
120	1145	1015	25	5.0	Very Dense	174	57
125	1167	1037	22	4.4	Very Dense	188	68
130	1190	1060	23	4.6	Very Dense	183	64
135	1214	1084	24	4.8	Very Dense	178	60
140	1235	1105	21	4.2	Very Dense	193	72
145	1257	1127	22	4.4	Very Dense	188	68
150	1280	1150	23	4.6	Very Dense	183	64
155	1306	1176	26	5.2	Dense	169	54
160	1330	1200	24	4.8	Very Dense	178	60
165	1355	1225	25	5.0	Very Dense	174	57
170	1381	1251	26	5.2	Dense	169	54
175	1408	1278	27	5.4	Dense	165	52
180	1436	1306	28	5.6	Dense	161	49
185	1465	1335	29	5.8	Dense	157	47
190	1490	1360	25	5.0	Very Dense	174	57
195	1515	1385	25	5.0	Very Dense	174	57
200	1539	1409	24	4.8	Very Dense	178	60
205	1566	1436	27	5.4	Dense	165	52
210	1595	1465	29	5.8	Dense	157	47
215	1624	1494	29	5.8	Dense	157	47
220	1642	1512	18	3.6	Very Dense	> 200	88
225	1672	1542	30	6.0	Dense	154	45
230	1694	1564	22	4.4	Very Dense	188	68
235	1713	1583	19	3.8	Very Dense	> 200	82
240	1730	1600	17	3.4	Very Dense	> 200	95
245	1750	1620	20	4.0	Very Dense	200	77
250	1773	1643	23	4.6	Very Dense	183	64

** According to Dr B van Wyk's Method

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sanas Testing Laboratory T0455

*DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 17 **DEPTH BELOW NGL:** 0.000m

***DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)**

No of Blows	Depth (mm)	Corrected Depth (mm)	Penetration Tempo	dn (mm/blow)	Consistency	**Estimated Bearing Ratio (kPa)	*In Situ* CBR
255	1800	1670	27	5.4	Dense	165	52
260	1830	1700	30	6.0	Dense	154	45
265	1865	1735	35	7.0	Dense	137	36
270	1905	1775	40	8.0	Dense	124	31

** According to Dr B van Wyk's Method

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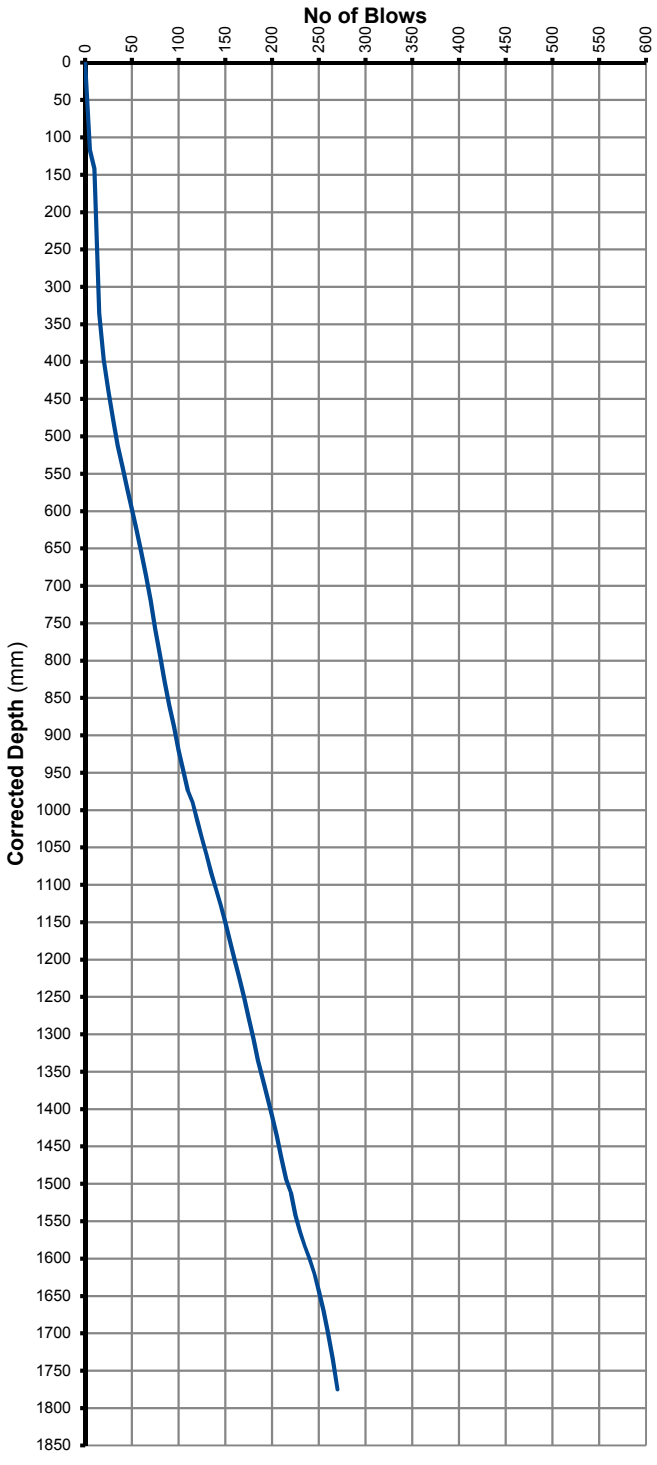
T0455

*DYNAMIC CONE PENETROMETER (DCP) TEST

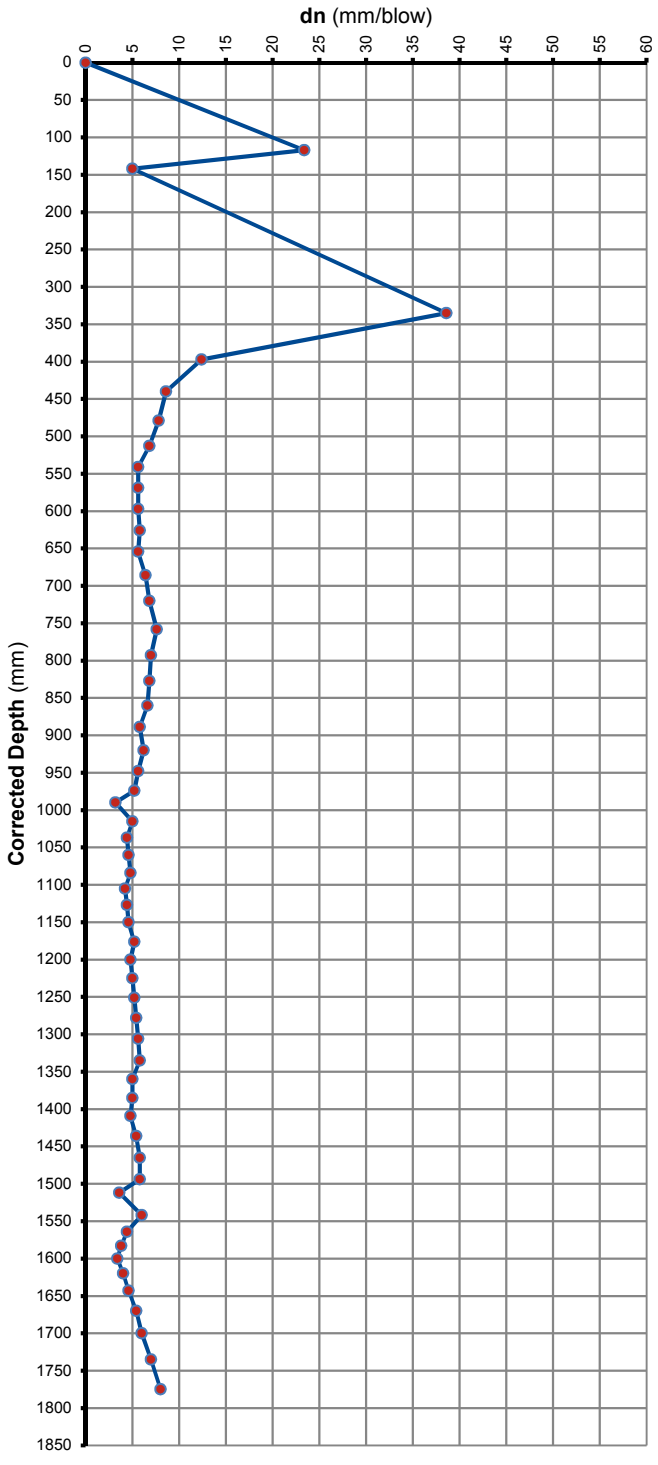
POSITION: Test Pit 17 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

No of Blows VS Corrected Depth



dn VS Corrected Depth



** According to Dr B van Wyk's Method

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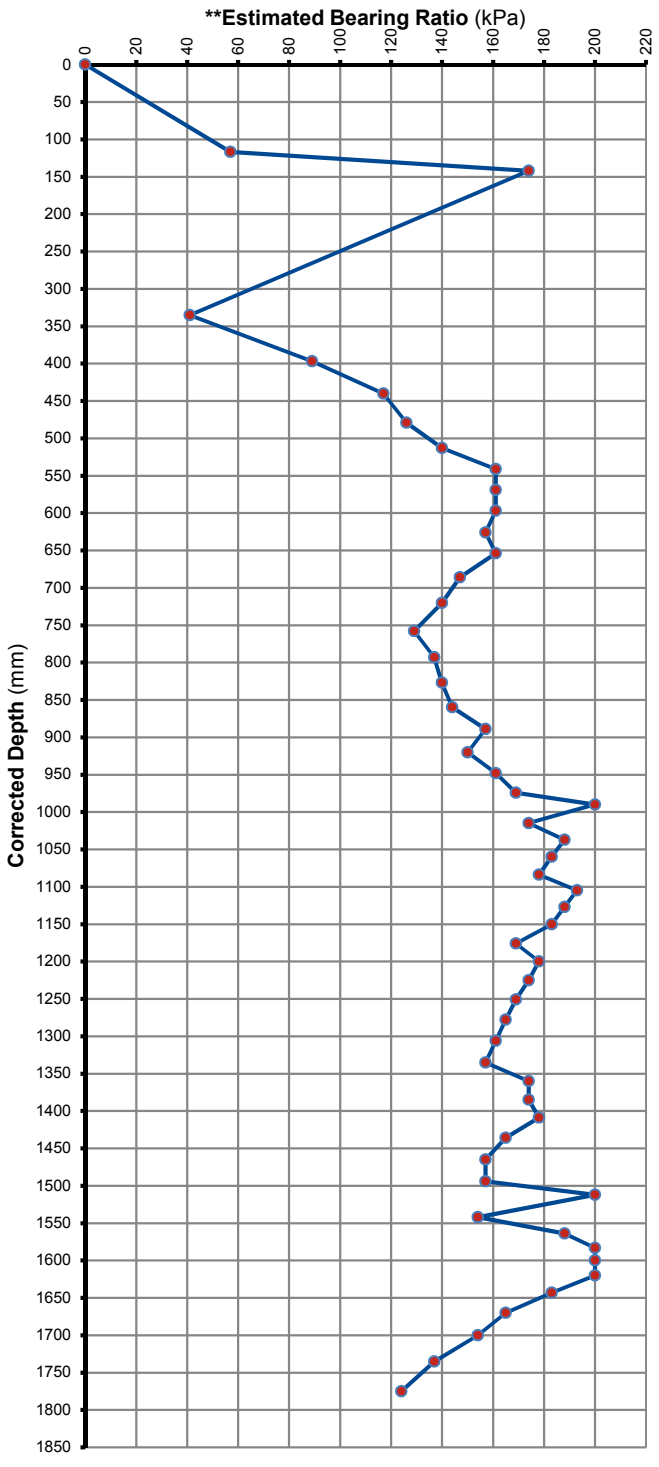
*DYNAMIC CONE PENETROMETER (DCP) TEST

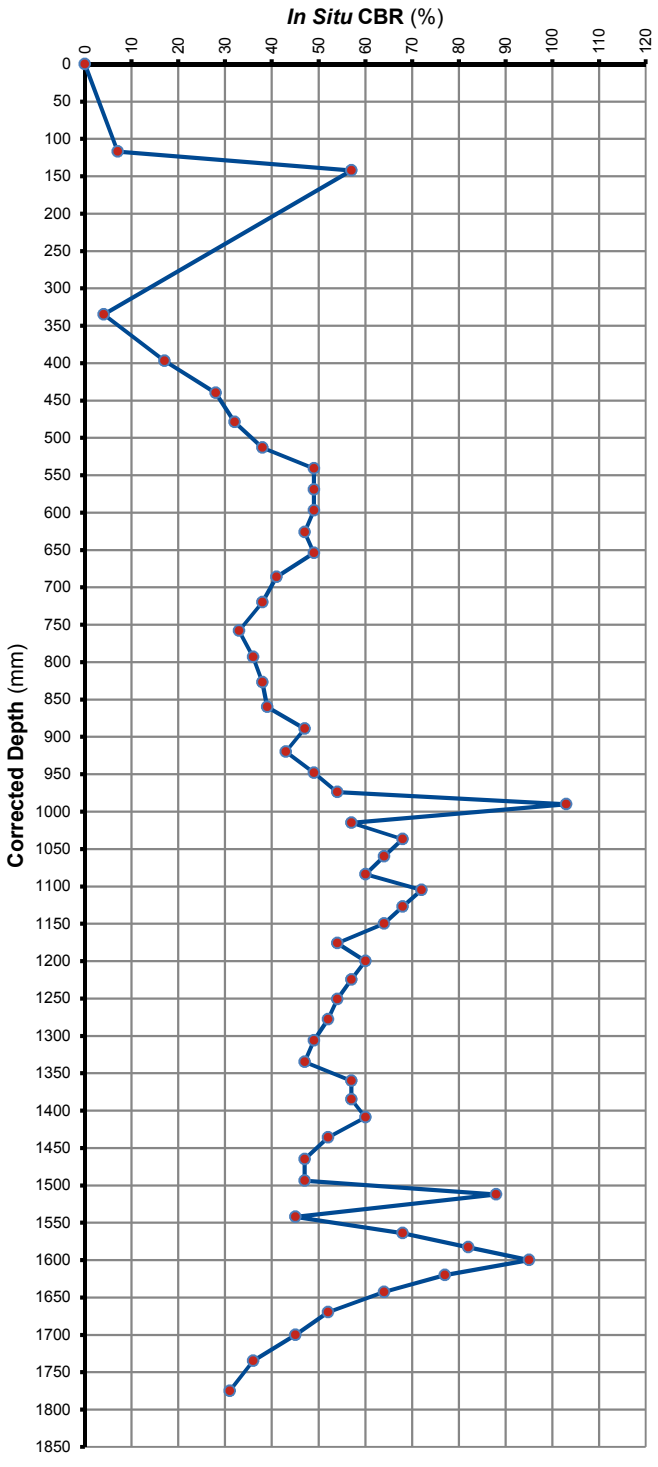
POSITION: Test Pit 17 **DEPTH BELOW NGL:** 0.000m

*DYNAMIC CONE PENETROMETER TEST RESULT SUMMARY (TMH 6: 1984, METHOD ST6)

**Estimated Bearing Ratio VS Corrected Depth



In Situ CBR VS Corrected Depth



** According to Dr B van Wyk's Method

APPENDIX F
TEST PIT PHOTOS

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TEST PIT PHOTOS

TEST PIT 01

TEST PIT 02

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TEST PIT PHOTOS

TEST PIT 03

TEST PIT 04

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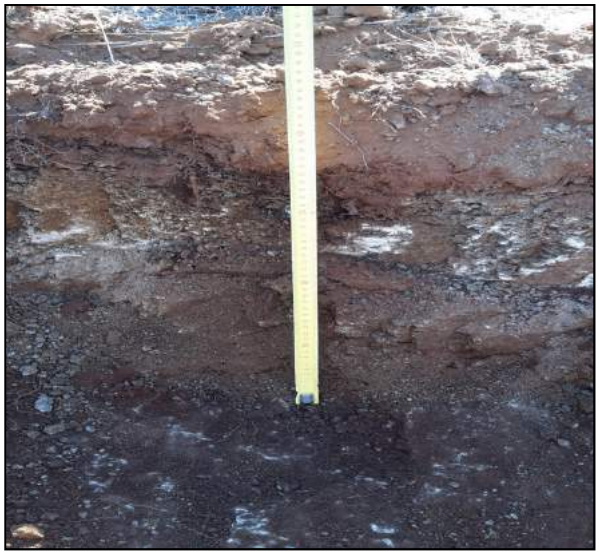
TEST PIT PHOTOS

TEST PIT 05



TEST PIT 06

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TEST PIT PHOTOS

TEST PIT 07

TEST PIT 08

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TEST PIT PHOTOS

TEST PIT 09

TEST PIT 10

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TEST PIT PHOTOS

TEST PIT 11

TEST PIT 12

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TEST PIT PHOTOS

TEST PIT 13

TEST PIT 14

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TEST PIT PHOTOS

TEST PIT 15

TEST PIT 16

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TEST PIT PHOTOS

TEST PIT 17

TEST PIT 18

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TEST PIT PHOTOS

TEST PIT 19

APPENDIX G
SITE PHOTOS

Simlab (EDMS) BEPERK GEOTEGNIESE DIENSTE
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SITE PHOTOS

TEST PIT 01

TEST PIT 02

6249, BLOEMFONTEIN, 9300, SOUTH AFRICA. Cnr. Lunn Road & Grey Street, Hilton, BLOEMFONTEIN, 9301
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SITE PHOTOS

TEST PIT 03

TEST PIT 04

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SITE PHOTOS

TEST PIT 05

TEST PIT 06

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SITE PHOTOS

TEST PIT 07

TEST PIT 08

6249, BLOEMFONTEIN, 9300, SOUTH AFRICA. Cnr. Lunn Road & Grey Street, Hilton, BLOEMFONTEIN, 9301
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SITE PHOTOS

TEST PIT 09

TEST PIT 10

6249, BLOEMFONTEIN, 9300, SOUTH AFRICA. Cnr. Lunn Road & Grey Street, Hilton, BLOEMFONTEIN, 9301
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SITE PHOTOS

TEST PIT 11

TEST PIT 12

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SITE PHOTOS

TEST PIT 13

TEST PIT 14

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SITE PHOTOS

TEST PIT 15

TEST PIT 16

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SITE PHOTOS

TEST PIT 17

TEST PIT 18

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SITE PHOTOS

TEST PIT 19

APPENDIX H
LAYOUT PLAN

Simlab (EDMS) BEPERK GEOTEGNIESE DIENSTE (PTY) LIMITED GEOTECHNICAL SERVICES
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LAYOUT PLAN

Test Pit 1 : 27 Y0075375 X3215424
Test Pit 2 : 27 Y0075459 X3215534
Test Pit 3 : 27 Y0075399 X3215648
Test Pit 4 : 27 Y0075242 X3215663
Test Pit 5 : 27 Y0075318 X3215810
Test Pit 6 : 27 Y0075171 X3215866
Test Pit 7 : 27 Y0075201 X3216056
Test Pit 8 : 27 Y0075084 X3216073
Test Pit 9 : 27 Y0075034 X3216253
Test Pit 10 : 27 Y0075132 X3216285
Test Pit 11 : 27 Y0075232 X3216177
Test Pit 12 : 27 Y0075266 X3216278
Test Pit 13 : 27 Y0075445 X3216340
Test Pit 14 : 27 Y0075598 X3216301
Test Pit 15 : 27 Y0075603 X3216066
Test Pit 16 : 27 Y0075690 X3215805
Test Pit 17 : 27 Y0075611 X3215914
Test Pit 18 : 27 Y0075510 X3216181
Test Pit 19 : 27 Y0075377 X3216081

Simlab (EDMS) BEPERK GEOTEGNIESE DIENSTE
(PTY) LIMITED GEOTECHNICAL SERVICES
sanas Testing Laboratory T0455
REG. No. 1987/004282/07 NLA No. 2012/187
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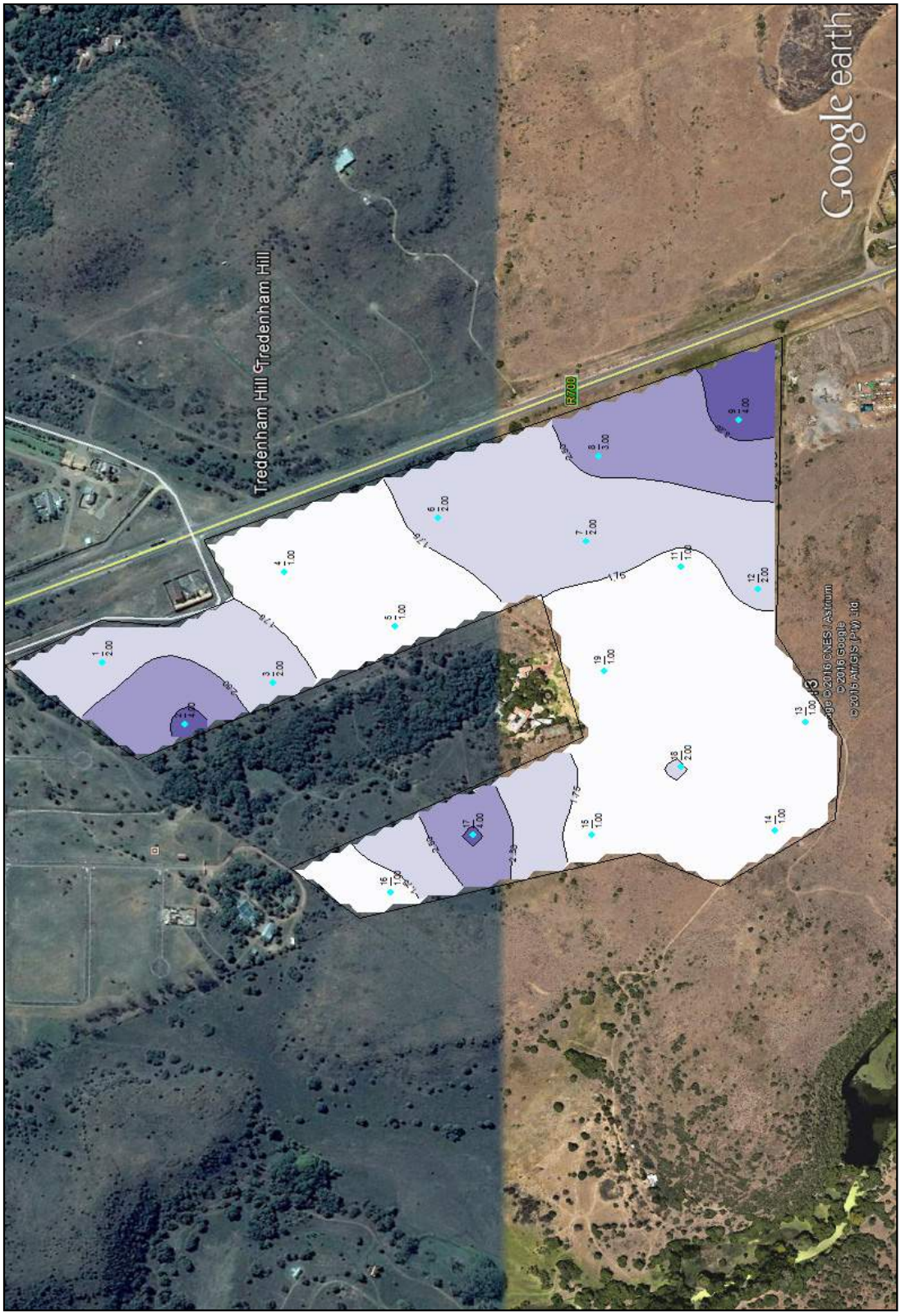
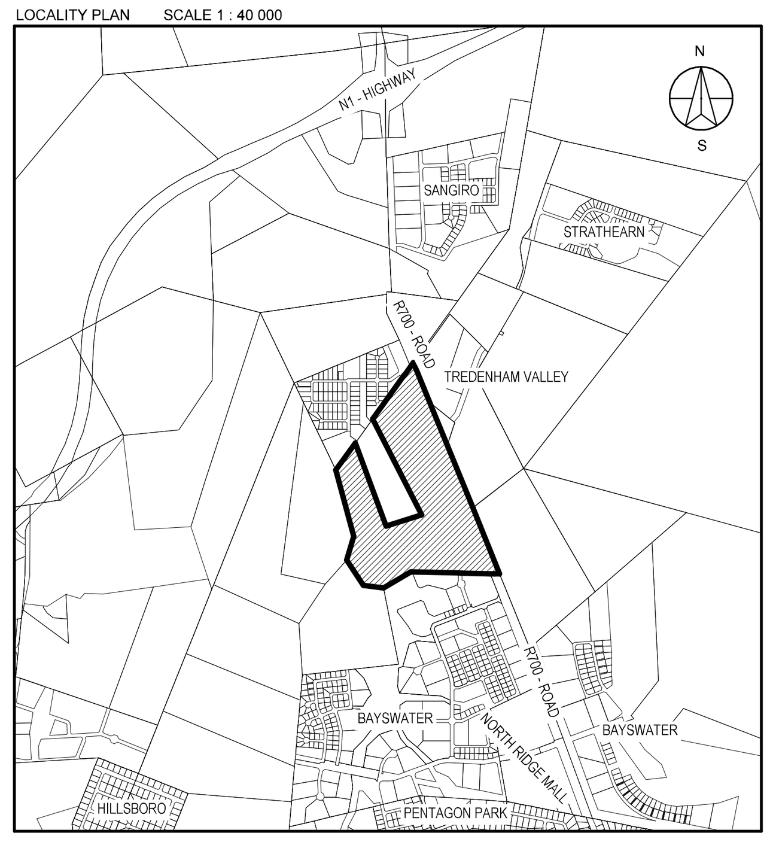
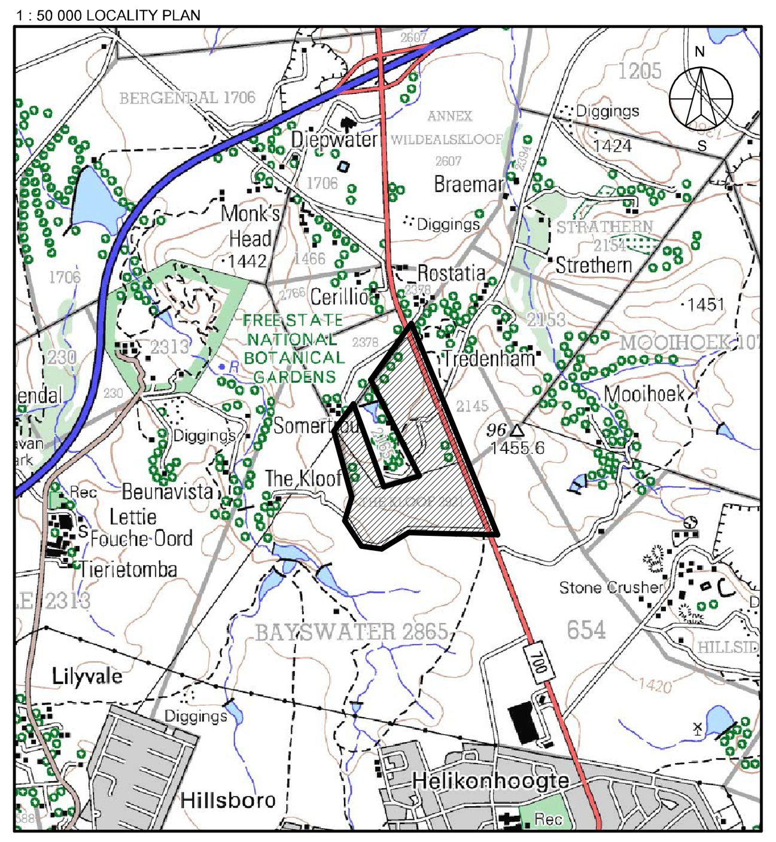
LAYOUT PLAN







Coordinate Table - OUTSIDE FIGURE		
ID	Y	X
A	75734.07	3215787.50
B	75630.94	3215644.21
C	75474.08	3216071.12
D	75287.79	3216012.59
E	75539.38	3215517.01
F	75324.49	3215218.81
G	75144.95	3215656.25
H	74868.88	3216336.18
J	75339.38	3216325.18
K	75482.32	3216410.55
L	75589.34	3216396.57
M	75677.08	3216261.90
N	75639.89	3216136.86

Coordinate Table - P.O.S.		
ID	Y	X
a1	75695.54	3215761.36
a2	75670.83	3215727.02
a3	75576.09	3215984.85
a4	75514.14	3215962.09
a5	75504.65	3215987.93
a6	75610.51	3216026.83
a7	75588.85	3216107.19
a8	75601.30	3216110.96
a9	75597.88	3216123.66
a10	75565.56	3216243.60
a11	75557.91	3216254.24
a12	75547.93	3216260.87
a13	75535.16	3216263.80
a14	75444.76	3216251.56
a15	75356.86	3216264.75
a16	75357.55	3216294.74
a17	75489.93	3216373.80
a18	75568.55	3216363.53
a19	75663.81	3216217.31
a20	75269.10	3216250.80
a21	75200.48	3216222.82
a22	75192.74	3216245.99
a23	75197.53	3216252.47
a24	75185.66	3216216.78
a25	75114.36	3216187.70
a26	75094.14	3216248.30
a27	75098.92	3216254.78
a28	75166.57	3216253.19
a29	75175.78	3216246.39
a30	75344.38	3215761.93
a31	75281.52	3215730.02
a32	75272.63	3215733.33
a33	75258.12	3215768.91
a34	75243.49	3215837.00
a35	75354.04	3215882.08
a36	75392.41	3215806.50
a37	75404.46	3215506.40
a38	75393.40	3215533.41
a39	75403.74	3215600.73
a40	75401.60	3215613.90
a41	75379.91	3215656.61
a42	75320.98	3215626.69
a43	75332.55	3215598.92
a44	75314.54	3215510.55
a45	75319.01	3215463.10
a46	75356.62	3215371.25
a47	75365.75	3215367.43
a48	75384.41	3215375.07
a49	75429.68	3215428.42
a50	75431.56	3215440.23
a51	75384.85	3215302.32
a52	75368.37	3215342.57
a53	75372.19	3215351.70
a54	75394.69	3215360.91
a55	75453.13	3215429.78
a56	75410.14	3215534.76
a57	75420.32	3215603.43
a58	75419.35	3215609.34
a59	75477.52	3215638.87

TOWN PLANNERS:

N. DEVENISH - Pr. PLN A/1133/1999
MAKECHA DEV. ASS. CC TRADING AS MDA

GEOTECHNICAL REPORT:

A REPORT WAS CONDUCTED BY AURECON SOUTH AFRICA (PTY) LTD THAT ACCOMPANY THIS LAYOUT PLAN AS PART OF THE TOWN ESTABLISHMENT MEMORANDUM.

J.H.W. VERMAAK (Pr Tech Eng) Ninham Shand
AURECON SOUTH AFRICA (PTY) LTD

CONTOURS:

THE CONTOURS ON THIS PLAN HAVE BEEN SURVEYED BY CONVENTIONAL METHODS AND ADHERE TO REQUIREMENTS AS STIPULATED IN THE TOWNSHIPS ORDINANCE, 1969 (No. 9 OF 1969)

J. NORTJÉ (PLS 1065)
DE WAAL EN NORTJE LAND SURVEYORS

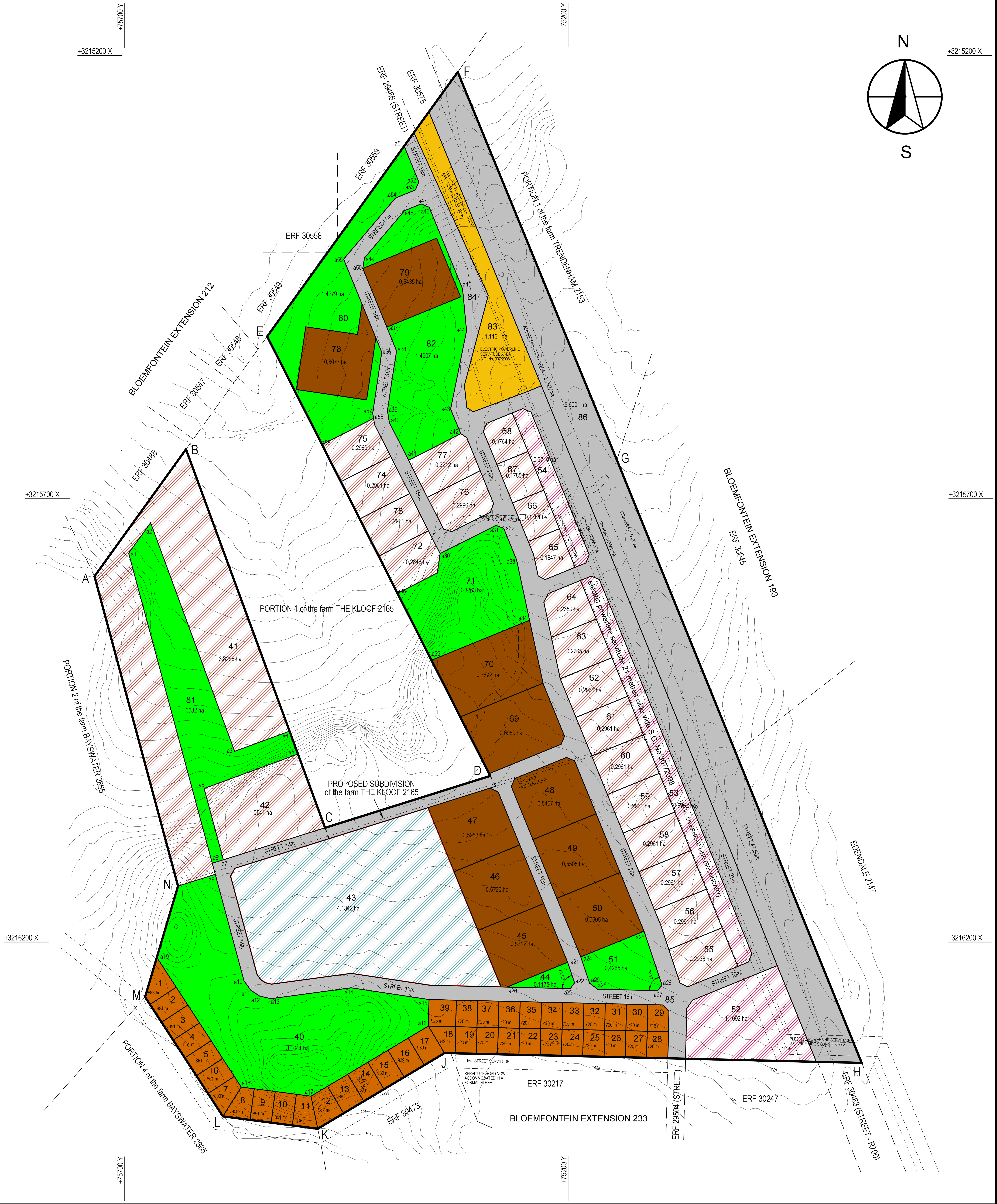
FLOODLINES:

IT IS HEREBY CERTIFIED THAT THE 1 : 100 YEAR AND 1 : 50 YEAR FLOODLINES HAVE BEEN DETERMINED BY AURECON SOUTH AFRICA (PTY) LTD THAT ACCOMPANY THIS LAYOUT PLAN AS PART OF THE TOWN ESTABLISHMENT MEMORANDUM

J.H.W. VERMAAK (Pr Tech Eng) Ninham Shand
AURECON SOUTH AFRICA (PTY) LTD

TRAFFIC IMPACT:

M.J. MARAIS (Pr Eng) 920023
M.J. MARAIS



LEGEND:

HATCH	ZONING	ERF NUMBERS	NO. OF ERVEN	AREA HA	%
	SINGLE RESIDENTIAL 2	1 - 39	39	3,0107	6.10
	GENERAL RESIDENTIAL 2	45 - 50, 69 - 70, 78 - 79	10	4,8696	9.86
	GENERAL RESIDENTIAL 3	41 - 42, 55 - 68, 72 - 77	22	10,2152	20.69
	MEDICAL USE ZONE	43	1	4,1342	8.37
	SERVICE INDUSTRY 1	52 - 54, 82	4	2,4164	4.89
	PUBLIC OPEN SPACE	40, 44, 51, 71, 80, 81	6	9,5250	19.29
	MUNICIPAL PURPOSES	83	1	1,1131	2.25
	STREET	84 - 86	3	14,0810	28.52
TOTAL			85	49,3652	100

NOTES:

1. THE FIGURE A,B,C,D,E,F,G,H,J,K,L,M,N,A REPRESENTS PROPOSED TOWNSHIP ESTABLISHMENT ON THE FARM THE KLOOF 2921 AND PROPOSED SUBDIVISION OF THE FARM THE KLOOF 2165, DISTRICT BLOEMFONTEIN, AREA = 49,1106 HA.
2. ALL SPLAYS ARE 7 X 7 METER UNLESS INDICATED OTHERWISE.
3. ALL MEASUREMENTS ARE APPROXIMATE AND ARE SUBJECT TO FINAL SURVEYING.
4. ERF NUMBERS ALLOCATED ARE TEMPORARY.
5. THE RULING SINGLE RESIDENTIAL ERF SIZE IS 850m².
6. THE SMALLEST SINGLE RESIDENTIAL ERF SIZE IS 642m².
7. STREET WIDTH IS 16m AND 25m AS INDICATED.
8. STREET LENGTH 3,5km.
9. MINIMUM STREET GRADIENT: 1:100
10. MAXIMUM STREET GRADIENT: 1:3.7
11. 1,0m COUNTOUR INTERVALS
12. TH1 TEST HOLE.

DRAWN	C.J.	DRAWING CHECKED	N.D.
DESIGNED	N.D.	DESIGN CHECKED	N.D.

CLIENT:

-

mda
Town & Regional Planners, Environmental & Development Consultants
PO Box 100982
Brandhof 9324
Tel: +27(51) 447-1583
Fax: +2786 693 1792
9 Barnes Street
Westdene
BLOEMFONTEIN
E-mail: admin@mdagroup.co.za

LOCAL AUTHORITY:

MANGAUNG METRO MUNICIPALITY

PROJECT:

PROPOSED TOWNSHIP ESTABLISHMENT ON THE FARM THE KLOOF 2921 AND PROPOSED SUBDIVISION OF THE FARM THE KLOOF 2165, BLOEMFONTEIN

PLAN TYPE:

PROPOSED LAYOUT PLAN

SCALE: 1 : 2 500

DATE: 07/07/2015

PROJECT NO.

424500BHT MD51

APPENDIX J
GEOLOGICAL MAP

Simlab (EDMS) BEPERK GEOTEGNIESE DIENSTE (PTY) LIMITED GEOTECHNICAL SERVICES
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GEOLOGICAL MAP