iX ENGINEERS (Pty)Ltd

REPORT ON THE GEOTECHNICAL / FOUNDING CONDITION FOR THE UPGRADE of CARNARVON WASTEWATER TREATMENT WORKS - P08403:OXIDATION PONDS

GEOTECHNICAL INVESTIGATION

REFERENCE:SLN1028 **Document No.: 2025/K250/Doc.** **JULY 2025**

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File Reference : SLN1028
Your Reference : CARNARVON WASTEWATER - OXIDATION PONDS
Date : JULY 2025

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GEOTECHNICAL INVESTIGATION

CONTENTS

TABLES

FIGURES

APPENDICES

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EXECUTIVE SUMMARY

- A soils investigation was conducted on the 18th of June 2025 for the Upgrade of Carnarvon Wastewater Treatment Works - Northern Cape Province, as per instruction received from the client: iX Engineers (PTY) LTD (Kimberley).
- The approximate size of the investigated site is ±6.7ha.
- Six (6) test pits were excavated at the location specified by the client and is indicated on the Layout Plan (Appendix F). Ten (10) Foundation Indicator samples, seven (7) Maximum Dry Density (MDD) samples and seven (7) California Bearing Ratio (CBR) samples.
- The geology of the investigated site consists of the underlying Carnarvon formation and overlain by Alluvium and transported materials. The sedimentary rock included in the Carnarvon formation consists of Grey to blue-grey mudstone, siltstone and sandstone. To the north of the site an intrusive dolerite sill.
- Carnarvon is in the semi-arid climatic region with Weinert's N – value of between 4 and 5.
- Ground-water seepage was not encountered during the investigation in the excavated test pits.
- Determining a flood line is not part of the scope for this report and therefore, no flood line of any kind was determined. Provision should be made for subsoil drainage structures or surface drainage where applicable.
- Typical materials that were found on site are : SM: Silty SAND, Silty SAND with gravel; SW-SM: Well graded SAND with silt and gravel; GW-GM: Well graded GRAVEL with silt and sand: GP-GM: Poorly graded GRAVEL with silt and sand.
- Refusal layer / Bedrock was encountered during the investigation in Test Pit 1 to Test Pit 6 at an average depth of 1.120m ranging from 0.300m to 2.200m for the investigated area.
- The materials which occur on site consists of a Low (<7.5mm) potential expansiveness according to Van der Merwe's Method (1964) that can be expected in the area investigated.
- The materials encountered on site includes G6, G7, G8 and G9, according to the COLTO classification system, for all materials tested on site. The materials with G6 Classification are suitable for Subbase, Selected layer and Fill. The materials with G7, G8 and G9 Classification are suitable for Selected layer and Fill. Materials to be used in backfilling and layer works must be stockpiled and tested to confirm material quality.
- The soil profiles have a Moderately Corrosive to Corrosive nature therefore caution should be exercised when selecting materials used for the installation of services and other facilities.

- Sidewall collapse of the test pits during the investigation was only observed in the top layer of dry materials at an average depth of 0.300m. No Sidewall collapse was observed in the materials below 0.300m.

  Excavation in the area of the proposed site should generally be feasible with large (Excavator) equipment, with Medium Dense materials and Hard Sandstone occurring on site. The restricted excavation class for the investigated area, to an average depth of 1.120m, is Soft Excavation, according to the SANS 634:2012 Edition 1.

- Test Pit 1 and Test Pit 2:

  A competent horizon was encountered at an average depth of 1.450m ranging from 1.200m to 1.700m consisting of Silty SAND with gravel. The presumptive values of allowable bearing pressures for spread foundations as determined according to *NAVFAC for Silty SAND with gravel is 200kPa to 400kPa.

- Test Pit 3, Test Pit 4, Test Pit 5 and Test Pit 6:

  A competent horizon was encountered at refusal depth during the investigation at an average depth of 0.623m ranging from 0.300m to 1.400m consisting of Hard Sandstone. The presumptive values of allowable bearing pressures for spread foundations as determined according to *NAVFAC for the Hard Sandstone encountered at an average depth of 0.623m is 1500kPa to 2500kPa.

REPORT

1. INTRODUCTION

1.1 Terms of reference

iX Engineers (PTY) LTD (Kimberley) appointed Simlab (Pty) Limited - Geotechnical Services (Kimberley) to conduct a soils investigation and compile a soils report for the Upgrade of Carnarvon Wastewater Treatment Works - Northern Cape Province. The scope of the investigation was to investigate the proposed area by excavating six (6) 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 and services.
- Determine the characteristics of the *in situ* soils / materials for the use of back filling materials.

This report contains the results and findings of the soils investigation conducted by Simlab (Simlab (Pty) Limited - Geotechnical Services (Kimberley). The investigation includes six (6) test pits and laboratory testing of the *in situ* soils / materials.

Recommendations are made with regard to founding conditions for the proposed establishment for buildings 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 2.4 km from the Carnarvon Town Centre in a northeastern direction. The centre co-ordinate of the investigated area is 23 Y0082064 X3426803. See Figure 1, Locality Plan and Layout Plan in Appendices A & F for more detail.

Figure 1 – Site Location (Google Earth)

1.3 Area

The size of the investigated area is approximately ±6.7ha.

1.4 Available Information

At the time of the investigation the following were available:

- 1 : 50 000 Topocadastral map (3022 Britstown)
- 1 : 250 000 Geological map (3022 Britstown)
- Google Photo of the area / site

2. INFORMATION USED IN THE STUDY

- ABA Brink & RMH Bruin (2002), Guidelines for Soil and Rock Logging in South Africa. South Africa: Association of Engineering Geologists - South Africa Section.
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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

iX Engineers (PTY) LTD (Kimberley).

3.2 Client Contact Details

Table 1: Client Contact Details

Street Address
10 Olive Road Montrio Corporate Park **KIMBERLEY** 8301
Cell: 072 323 5059
tanryn@ixengineers.co.za

3.3 Project Name

Report on the Geotechnical / Founding Conditions for the Upgrade of Carnarvon Wastewater Treatment Works – Northern Cape Province.

3.4 Testing Laboratory

Simlab (Pty) Limited – Geotechnical Services (Kimberley)

3.5 Laboratory Contact Details

Table 2: Laboratory Contact Details

Postal Address	Street Address
PO Box 1231 **KIMBERLEY** 8300	3 Roper Street Kimberley North **KIMBERLEY** 8301
Tel : 053 – 832 2472 / 5	
www.simlab.co.za ; simkby@simlab.co.za	

3.6 Sample Details

Sampled by:	Mr. D Motswana (Materials Tester)
Date Sampled:	18th of June 2025
Date Tested:	23rd of June 2024 – 2nd of July 2025
Report Date:	8th of August 2025

3.7 Sampling and Testing

Sampling was conducted according to TMH5: 1981, Method MA2 and the specifications of the client. Test Pits were excavated by means of a TLB (CASE). Samples were tested according to the SANS 3001 as well as TMH1: 1986, specifications.

- SANS 3001 – GR1: 2013 – Wet preparation and particle size analysis.
- SANS 3001 – GR10: 2013 – 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: 2015 – Determination of the maximum dry density and optimum moisture content.
- SANS 3001 – GR40: 2013 – 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 (1964).
- Estimated Bearing Ratio of the Materials – Dr. B van Wyk's method.

3.8 Positions Sampled

Simlab (Pty) Limited – Geotechnical Services (Kimberley) sampled and tested at the location specified by the iX Engineers (Kimberley) and is indicated on the Layout Plan / Site Zoning Plan (Appendix F).

4. TOPOGRAPHY

The proposed site is located near Carnarvon. The site is on a portion of a clear field with short indigenous grasses covering the site and structures with treatment ponds. The site has no visually observable slope.

5. GEOLOGY

The geology of the investigated site consists of the underlying Carnarvon formation and overlain by Alluvium and transported materials. The sedimentary rock included in the Carnarvon formation consists of Grey to blue-grey mudstone, siltstone and sandstone. To the north of the site an intrusive dolerite sill. Table 3 summarise the Geology encountered in the investigated area.

Table 3: Geology Formation

Symbol	Typical Materials / Rock Type	Super Group	Group	Sub - Group	Formation
Jd	Intrusive Dolerite	-			
Pc	Grey to blue-grey mudstone, siltstone and sandstone	Karoo	Ecca	-	Carnarvon
	Alluvium	-			

Figure 3 is an extract of the 3022 Britstown Geology map.

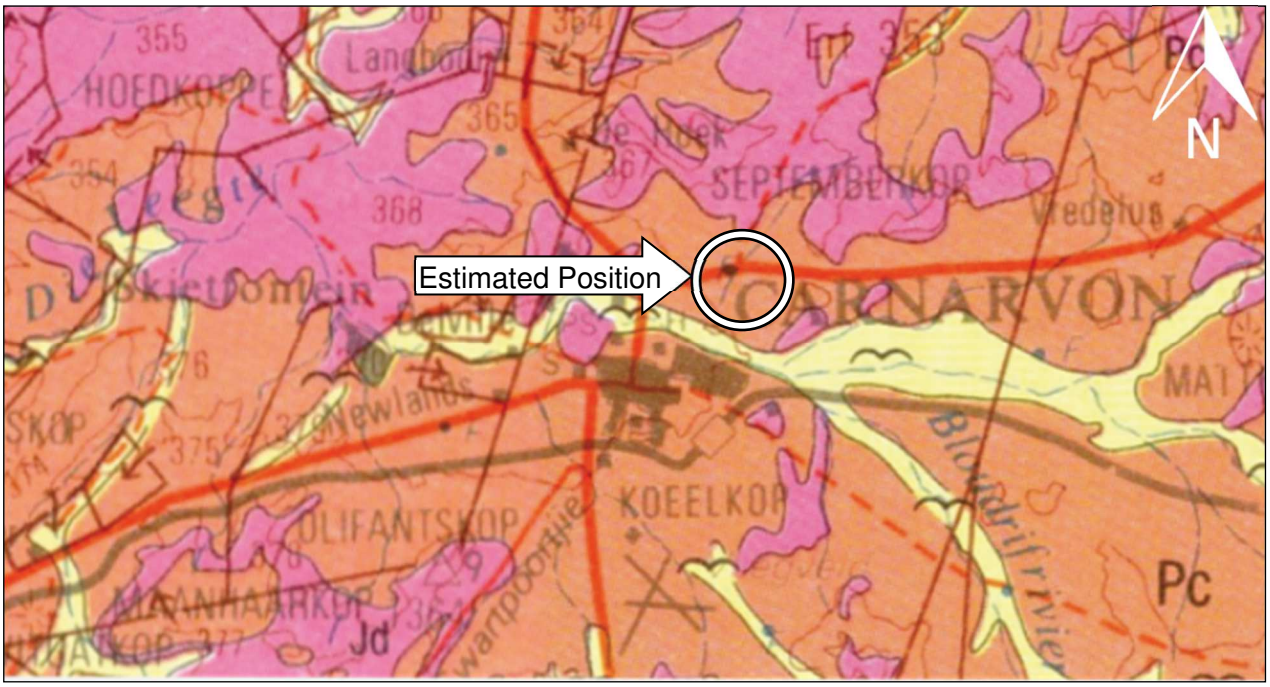


Figure 3 – Detail Geological Map (Department of Mines) Geological Detail Scale 1 : 250 000

6. CLIMATE

The Carnarvon area is a semi-arid region with primarily summer rainfall. The rainfall is between 100mm and 250mm per year according to Vegetation of Southern Africa - By R M Cowling, D M Richardson and S M Pierce.

Carnarvon normally receives about 202mm of rain per year, with most rainfall occurring mainly during summer. Carnarvon receives the lowest rainfall (4.6mm) in August and the highest (33.6mm) in January.

The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Carnarvon ranges from 17°C in June to 34°C in January. The region is the coldest during July when the mercury drops to 6°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 Carnarvon.

Table 4: Average Rainfall, Average Minimum and Maximum Temperature

Month	Average Rainfall (mm)	Average Minimum Temperature (°C)	Average Maximum Temperature (°C)
January	33.6	21	34
February	31.4	21	33
March	29.7	19	31
April	22.7	15	25
May	12.8	11	22
June	11.6	7	17
July	7.2	6	17
August	4.6	7	20
September	4.8	11	24
October	7.9	14	28
November	8.1	17	30
December	27.4	19	32

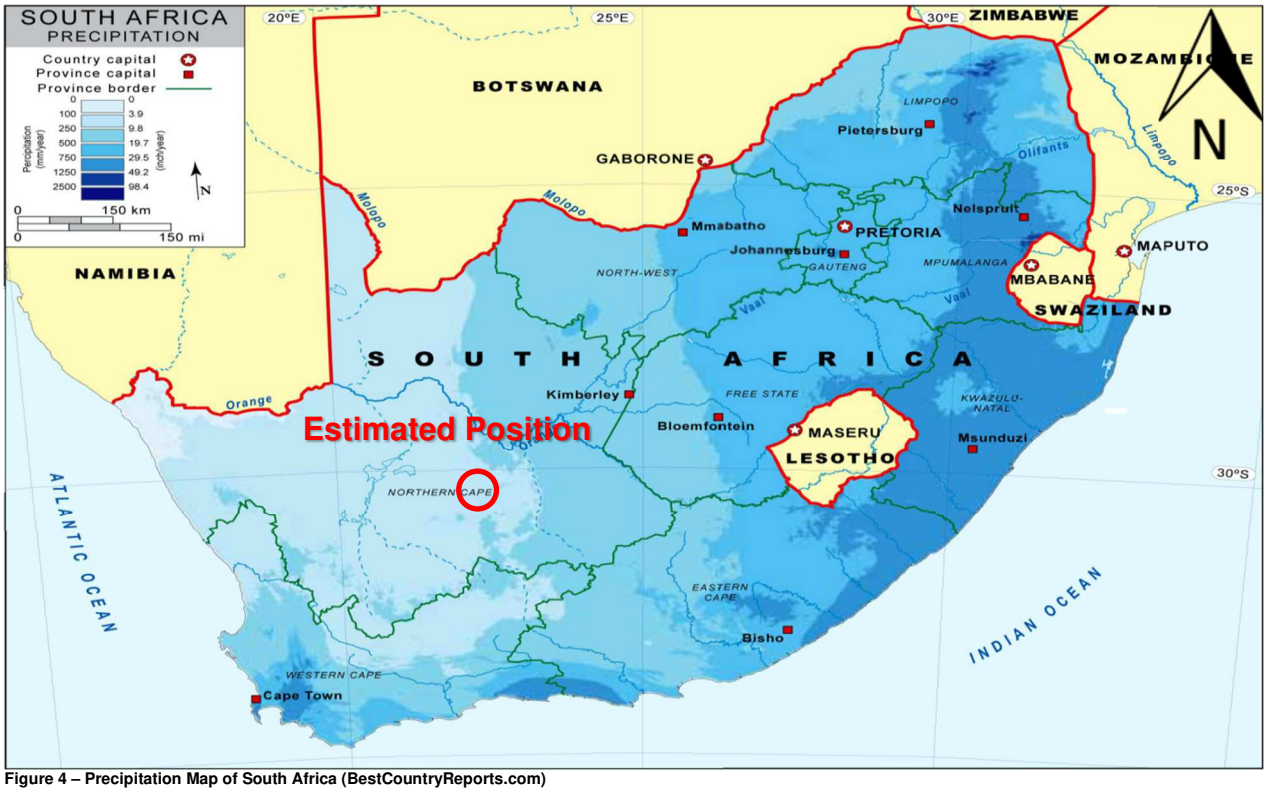


Figure 4 – Precipitation Map of South Africa (BestCountryReports.com)

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

Colour on Figure 4	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

Carnarvon is in the semi-arid climatic region with Weinert's N – value of between 4 and 5. (Adapted from Weinert, 1980). Refer to Figure 4 and Table 5.

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. D Motswana (Materials Tester) conducted the investigation on the 18th of June 2025. The test pits were excavated with a TLB (CASE) and profiled according to the methods stipulated by Williams, Jennings & Brink, 1973. The test pit profiles, laboratory test results and field test results are provided in Appendices B, C, & D.

Six (6) test pits were excavated at positions indicated on the Location Plan and Layout Plan (Appendices A & F). Ten (10) Foundation Indicator samples, seven (7) Maximum Dry Density (MDD) samples and seven (7) California Bearing Ratio (CBR) samples were obtained from site to determine the Engineering Properties of the materials. The properties of the materials were tested at Simlab (Pty) Limited – Geotechnical Services (Kimberley). Please visit the Simlab website for more information. www.simlab.co.za

The purpose of testing the Foundation Indicators was to determine the basic physical characteristics of these disturbed samples, comprising of the determination of Atterberg Limits and the Particle Size Distribution, including the determination of the percentage clay fraction. This information will be used to determine the potential expansiveness of the different materials.

The Foundation Indicators were tested according to the SANS 3001 Method GR1, GR10 and GR20 and TMH1; 1986 Method A6. The potential expansiveness of the materials was determined according to Van der Merwe's Method (1964).

Maximum Dry Density (MDD) and California Bearing Ratio (CBR) 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 backfilling works. The classification of the materials tested, was done according to COLTO.

Test Pits and Dynamic Cone Penetrometer (DCP's) Tests Co-ordinates are given in Table 6.

Table 6: Test Pit and Dynamic Cone Penetrometer (DCP's) Tests Co-ordinates

Position Name	Co-ordinates
Test Pit 1	23 Y0082068 X3426684
Test Pit 2	23 Y0082035 X3426689
Test Pit 3	23 Y0082007 X3426929
Test Pit 4	23 Y0082151 X3426951
Test Pit 5	23 Y0082147 X3426964
Test Pit 6	23 Y0082105 X3426961

Co-ordinate system – WGS 84

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

Table 7: Depth of Test Pit

Test Pit No.	Depth of Test Pit (m)	Depth to Refusal Layer (m)	Materials Description at Bottom of Test Pit	Groundwater Seepage
Test Pit 1	2.030	2.030	Refusal - Hard Sandstone.	Not Encountered
Test Pit 2	2.200	2.200	Refusal - Hard Sandstone.	Not Encountered
Test Pit 3	1.400	1.400	Refusal - Hard Sandstone.	Not Encountered
Test Pit 4	0.230	0.230	Refusal - Hard Sandstone.	Not Encountered
Test Pit 5	0.560	0.560	Refusal - Hard Sandstone.	Not Encountered
Test Pit 6	0.300	0.300	Refusal - Hard Sandstone.	Not Encountered

Refusal layer / Bedrock of shale was encountered during the investigation in all six test pits. The average depth of the test pits is 1.120m ranging from 0.230m to 2.200m.

Excavation in the area of the proposed site should generally be feasible with large (Excavator) equipment, with Medium Dense materials and Hard Sandstone occurring on site. The restricted excavation class for the investigated area, to an average depth of 1.120m, is Soft Excavation, according to the SANS 634:2012 Edition 1.

The materials found at the bottom of the test pits are typically classified as Hard Excavation. Hard Excavation Materials cannot be removed without blasting or wedging and splitting according to SANS 634:2012 Edition 1 which is summarised in Table 8.

Table 8: Classification of Materials for Machine Excavation (SANS 634:2012 Edition 1)

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

Ground-water seepage was not encountered at the time of the investigation in any of the test holes. A shallow water-table can be expected from time to time during the rainy season. Considering the natural environment and climate, one can expect that the ground-water seepage may theoretically occur above the investigated average test pit depth of 1.120m.

If shallow seepage through the soil is to occur, an estimated permeability has been calculated for each soil horizon tested. The Estimated permeability of the in-situ materials is determined by Hazen's Formula (1911) and presented in Table 9.

Table 9: *In Situ* Materials Permeability

Test Pit No.	Layer Thickness (mm)	USC	Permeability (Hazen's Formula (1911)) (cm/s)
Test Pit 1	0 – 1700 1700 – 2030	SM SM	4.410×10^{-6} / 6.615×10^{-6} 2.250×10^{-4} / 3.375×10^{-4}
Test Pit 2	0 – 1200 1200 – 2200	SM SM	3.610×10^{-6} / 5.415×10^{-6} 3.600×10^{-5} / 5.400×10^{-5}
Test Pit 3	0 – 570 570 – 1400	SM SW-SM	8.100×10^{-7} / 1.215×10^{-6} 7.290×10^{-4} / 1.094×10^{-3}
Test Pit 4	0 – 230	GW-GM	1.988×10^{-2} / 2.982×10^{-2}
Test Pit 5	0 – 240 240 – 560	SM GP-GM	1.600×10^{-5} / 2.400×10^{-5} 8.281×10^{-3} / 1.242×10^{-2}
Test Pit 6	0 – 300	GP-GM	7.912×10^{-3} / 1.188×10^{-2}

8. TEST RESULTS

The Foundation Indicators were tested according to the SANS 3001 Method GR1, GR10, GR20 and TMH1, method A6. Maximum Dry Density (MDD) and California Bearing Ratio (CBR) 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 backfilling and / or layer works. The classification of the materials tested, was done according to COLTO and the Unified Soil Classification (USC).

The test results are summarised in Tables 10 to 23. Refer to Appendix B for complete test results. Refer to Appendix A for the *in situ* material profiles.

Table 10: 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 – 1700 1700 – 2030	SM SM	13 5	9 9	64 54	14 32	1.26 1.74
Test Pit 2	0 – 1200 1200 – 2200	SM SM	16 6	8 13	65 66	11 15	1.16 1.32
Test Pit 3	0 – 570 570 – 1400	SM SW-SM	21 5	18 7	53 49	8 39	0.90 1.89
Test Pit 4	0 – 230	GW-GM	1	5	26	68	2.45
Test Pit 5	0 – 240 240 – 560	SM GP-GM	8 4	12 4	69 31	11 61	1.21 2.27
Test Pit 6	0 – 300	GP-GM	2	7	21	70	2.42

Note: USC – Unified Soil Classification

Table 11 below discusses the Plastic Index, Linear Shrinkage and % Clay Fraction Fraction of each investigated test pit, respectively.

Table 11: 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 – 1700 1700 – 2030	SM SM	2 3	1.0 1.5	13 5
Test Pit 2	0 – 1200 1200 – 2200	SM SM	3 2	1.5 1.0	16 6
Test Pit 3	0 – 570 570 – 1400	SM SW-SM	3 4	1.5 2.0	21 5
Test Pit 4	0 – 230	GW-GM	4	2.0	1
Test Pit 5	0 – 240 240 – 560	SM GP-GM	2 3	1.0 1.5	8 4
Test Pit 6	0 – 300	GP-GM	5	2.5	2

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

The materials description is done according to the Unified Soil Classification Criteria (USC). See the descriptions of the classification abbreviations below:

- SM: Silty SAND, Silty SAND with gravel.
- SW-SM: Well graded SAND with silt and gravel.
- GW-GM: Well graded GRAVEL with silt and sand.
- GP-GM: Poorly graded GRAVEL with silt and sand.

The compacted strength of the *in situ* materials as determined by Maximum Dry Density (MDD) and California Bearing Ratio (CBR) values are summarised in Table 12 below.

Table 12: *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 – 1700 1700 – 2030	SM SM	2062 / 7.7 1910 / 11.2	21 48	11 24	11 24	*G9 *G7
Test Pit 2	1200 – 2200	SM	1890 / 9.9	19	11	9	*G9
Test Pit 3	570 – 1400	SW-SM	1950 / 10.9	39	25	21	*G6
Test Pit 4	0 – 230	GW-GM	1943 / 10.8	38	25	21	*G6
Test Pit 5	240 – 560	GP-GM	2009 / 8.6	40	25	20	*G6
Test Pit 6	0 – 300	GP-GM	2088 / 8.6	28	16	13	*G8

USC – Unified Soil Classification

The potential expansiveness of the materials was determined according to Van der Merwe's Method (1964). The evaluation of the Swelling Potential of Materials is summarised in Table 13.

Table 13: Potential Expansiveness

Test Pit No.	**Layer Thickness** (mm)	**Unified Soil Classification** (USC)	**Potential Expansiveness** (mm) *Van Der Merwe
Test Pit 1	0 – 1700 1700 – 2030	SM SM	Low Low **Total: Low**
Test Pit 2	0 – 1200 1200 – 2200	SM SM	Low Low **Total: Low**
Test Pit 3	0 – 570 570 – 1400	SM SW-SM	Low Low **Total: Low**
Test Pit 4	0 - 230	GW-GM	Low **Total: Low**
Test Pit 5	0 – 240 240 – 560	SM GP-GM	Low Low **Total: Low**
Test Pit 6	0 - 300	GP-GM	Low **Total: Low**

Note: Potential Expansiveness / can be higher than summarised

The soil layers in the profiles can be assessed for collapsibility based on the percentage <0.002mm fraction. The potential for the collapsibility of soils at this site is assessed by the criteria proposed by three investigators namely: Handy (1973), Clevenger (1958) and Priklonski (1952).

The following criteria by Handy (1973) (Table 14) can be followed to assess the collapsibility.

Table 14: 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 with regards to collapsibility is based on Handy's criteria and summarised in Table 15.

Table 15: 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 Test Pit Depth** (%)
Test Pit 1	0 – 1700 1700 – 2030	SM SM	13 5	High probability of collapse High probability of collapse	9
Test Pit 2	0 – 1200 1200 – 2200	SM SM	16 6	High probability of collapse High probability of collapse	11
Test Pit 3	0 – 570 570 – 1400	SM SW-SM	21 5	High probability of collapse High probability of collapse	13
Test Pit 4	0 - 230	GW-GM	1	High probability of collapse	1
Test Pit 5	0 – 240 240 – 560	SM GP-GM	8 4	High probability of collapse High probability of collapse	6
Test Pit 6	0 - 300	GP-GM	2	High probability of collapse	2

Note: USC : Unified Soil Classification

The assessment of the profiles for the test pits with regards to settlement probability is based on Clevenger (1958) criteria and summarised in Table 16. The criteria of Clevenger consist of the following:

- If the dry unit weight is less than 12.6kN/m^3 - the settlement will be large and
- If the dry unit weight is greater than 14.1kN/m^3 - the settlement will be small.

Table 16: 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 – 1700 1700 – 2030	SM SM	18.2 16.9	Settlement will be small Settlement will be small
Test Pit 2	1200 – 2200	SM	16.7	Settlement will be small
Test Pit 3	570 – 1400	SW-SM	17.2	Settlement will be small
Test Pit 4	0 - 230	GW-GM	17.2	Settlement will be small
Test Pit 5	240 – 560	GP-GM	17.7	Settlement will be small
Test Pit 6	0 - 300	GP-GM	18.4	Settlement will be small

The assessment of the profiles for the test pits with collapsible probability is based on Priklonski (1952) criteria and summarised in Table 17. 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 17: 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 – 1700 1700 – 2030	SM SM	-8.4 -6.9	Highly collapsible soils Highly collapsible soils
Test Pit 2	0 – 1200 1200 – 2200	SM SM	-7.0 -10.0	Highly collapsible soils Highly collapsible soils
Test Pit 3	0 – 570 570 – 1400	SM SW-SM	-6.6 -3.8	Highly collapsible soils Highly collapsible soils
Test Pit 4	0 – 230	GW-GM	-5.7	Highly collapsible soils
Test Pit 5	0 – 240 240 – 560	SM GP-GM	-8.5 -7.6	Highly collapsible soils Highly collapsible soils
Test Pit 6	0 – 300	GP-GM	-4.5	Highly collapsible soils

The Handy model indicates the materials have a “High probability of collapse” probability. The Priklonski model indicate that the materials at this site are Highly collapsible soils. According to Clevenger’s model the settlement due to collapse will be small.

Table 18 below discusses the different materials and their soil properties of each investigated test pit, respectively.

Table 18: Materials Discussion

Test Pit No.	Description	Classification Details (Max – Min Values)	Classification and recommended usage
Test Pit 1	Silty SAND. Silty SAND with gravel.	MDD: 2062 – 1910 OMC: 11.2 – 7.7 LL: 24 – 22 PI: 3 – 2 LS: 1.5 – 1.0 GM: 1.74 – 1.26 CBR @ 100%: 48 – 21 CBR @ 95%: 24 – 11 CBR @ 93%: 18 – 9	COTO: G7/G9: Materials are suitable for selected layers and subgrade. AASHTO: A-1-b / A-3a: Excellent to good rating for subgrade material.
Test Pit 2	Silty SAND. Silty SAND with gravel.	MDD: 1890 OMC: 9.9 LL: 29 – 25 PI: 3 – 2 LS: 1.5 – 1.0 GM: 1.32 – 1.16 CBR @ 100%: 19 CBR @ 95%: 11 CBR @ 93%: 9	COTO: G9: Materials are suitable for selected layers and subgrade. AASHTO: A-3a: Excellent to good rating for subgrade material.
Test Pit 3	Silty SAND. Well graded SAND with silt and gravel.	MDD: 1950 OMC: 10.9 LL: 27 – 26 PI: 4 – 3 LS: 2.0 – 1.5 GM: 1.89 – 0.90 CBR @ 100%: 39 CBR @ 95%: 25 CBR @ 93%: 21	COTO: G6: Materials are suitable for Subbase and selected layers. AASHTO: A-1-b: Excellent to good rating for subgrade material. A-4a: Fair to poor rating for subgrade material.
Test Pit 4	Well graded GRAVEL with silt and sand.	MDD: 1950 OMC: 10.9 LL: 28 PI: 4 LS: 2.0 GM: 2.45 CBR @ 100%: 38 CBR @ 95%: 25 CBR @ 93%: 21	COTO: G6: Materials are suitable for Subbase and selected layers. AASHTO: A-1-a: Excellent to good rating for subgrade material.
Test Pit 5	Silty SAND Poorly graded GRAVEL with sand.	MDD: 2009 OMC: 8.6 LL: 28 – 22 PI: 3 – 2 LS: 2.5 – 1.2 GM: 2.27 – 1.21 CBR @ 100%: 40 CBR @ 95%: 25 CBR @ 93%: 20	COTO: G6: Materials are suitable for Subbase and selected layers. AASHTO: A-1-b / A-3a: Excellent to good rating for subgrade material.
Test Pit 6	Poorly graded GRAVEL with sand.	MDD: 2088 OMC: 8.6 LL: 29 PI: 5 LS: 2.5 GM: 2.42 CBR @ 100%: 28 CBR @ 95%: 16 CBR @ 93%: 13	COTO: G8: Materials are suitable for selected layers and subgrade. AASHTO: A-1-a: Excellent to good rating for subgrade material.

Note: SP – Slightly Plastic, NP – Non-Plastic.

Materials for trench back filling were evaluated according to SANS 1200 – LB, Selected Fill Material. The requirements are:

- Plasticity Index of less than 6.
- Free from vegetation.
- No lumps or stones exceeding a diameter of 30mm.

The materials encountered on site are evaluated and presented in Table 19.

Table 19: Suitability for Selected Fill

Test Hole No.	Layer Thickness (mm)	Plasticity Index	Vegetation	Lumps or Stones >30mm	Suitable for Selected Fill
Test Pit 1	0 – 1700 1700 – 2030	2 3	Present Not Present	Present Present	Not Suitable Not Suitable
Test Pit 2	0 – 1200 1200 – 2200	3 2	Present Not Present	Not Present Not Present	Not Suitable Suitable
Test Pit 3	0 – 570 570 – 1400	3 4	Present Not Present	Present Not Present	Not Suitable Suitable
Test Pit 4	0 – 230	4	Present	Present	Not Suitable
Test Pit 5	0 – 240 240 – 560	2 3	Present Not Present	Not Present Present	Not Suitable Not Suitable
Test Pit 6	0 – 300	5	Present	Present	Not Suitable

Presumptive Values of Allowable Bearing Pressures for Spread Foundations as determined according to *NAVFAC using the Unified Soil Classification (USC) Criteria is summarised in Table 20 below.

Table 20: Allowable Bearing Ratio according to NAVFAC

Test Pit No.	Layer Thickness (mm)	Unified Soil Classification (USC)	Consistency	Allowable Bearing Ratio Range (kPa)
Test Pit 1	0 – 1700 1700 – 2030 2030+	SM SM Hard Sandstone	Medium dense Medium dense Hard	200 – 400 200 – 400 1500 – 2500
Test Pit 2	0 – 1200 1200 – 2200 2200+	SM SM Hard Sandstone	Medium dense Medium dense Hard	200 – 400 200 – 400 1500 – 2500
Test Pit 3	0 – 570 570 – 1400 1400+	SM SW-SM Hard Sandstone	Medium dense Medium dense Hard	200 – 400 400 – 700 1500 – 2500
Test Pit 4	0 – 230 230+	GW-GM Hard Sandstone	Medium dense Hard	800 – 1200 1500 – 2500
Test Pit 5	0 – 240 240 – 560 560+	SM GP-GM Hard Sandstone	Medium dense Medium dense Hard	200 – 400 800 – 1200 1500 – 2500
Test Pit 6	0 – 300 300+	GP-GM Hard Sandstone	Medium dense Hard	800 – 1200 1500 – 2500

Dynamic Cone Penetrometer (DCP's) Tests were conducted adjacent the investigated test pits at natural ground level (NGL) in order to determine the Estimated Bearing Ratio of the unconsolidated materials according to *Dr. B van Wyk's method. The field test results are included in Appendix C. The Estimated Bearing Ratio is summarised in Table 21 below.

Table 21: Estimated Bearing Ratio

Test Pit No.	Layer Thickness (mm)	Estimated Bearing Ratio (kPa)
Test Pit 1 (From Surface)	0 – 310 310 – 655 655 – 1030 1030 – 1481 1481 – 1882	152 140 121 124 115
Test Pit 2 (From Surface)	0 – 155 155 – 564 546 – 739 739 – 1092 1092 – 1455 1455 – 1912	192 133 139 126 113 114
Test Pit 3 (From Surface)	0 – 298 298 – 652 652 – 1187	157 138 114
Test Pit 4 (From Surface)	0 – 176	200
Test Pit 5 (From Surface)	0 – 98 98 – 491	200 175
Test Pit 6 (From Surface)	0 – 266	191

The Estimated Bearing Ratio in Table 21 is an indication of the properties of the materials at the time of the investigation. The Dynamic Cone Penetrometer (DCP's) Tests values should only be used for comparative purposes and not as a standard since Dynamic Cone Penetrometer (DCP's) Tests values will vary with variations in moisture content. Therefore, a wet profile will have a lower Estimated Bearing Ratio value than a dry profile.

The results of Conductivity tests (TMH1: 1986, method A21), pH-Value (TMH1: 1986, method A20) and Corrosiveness are summarised in Table 22.The following criteria in Table 23 can be used to assess the corrosiveness of the materials found on site.

Table 22: pH-Value, Conductivity of Materials on Site

Test Pit No.	Layer Thickness (mm)	USC	pH-Value	Conductivity (Sm^{-1})	Corrosiveness
Test Pit 1	0 – 1700 1700 – 2030	SM SM	8.31 8.38	0.0605 0.0656	Moderately Corrosive Moderately Corrosive
Test Pit 2	0 – 1200 1200 – 2200	SM SM	7.99 8.08	0.0807 0.0504	Moderately Corrosive Moderately Corrosive
Test Pit 3	0 – 570 570 – 1400	SM SW-SM	7.92 7.98	0.1110 0.1110	Corrosive Corrosive

Test Pit No.	Layer Thickness (mm)	USC	pH-Value	Conductivity (Sm^{-1})	Corrosiveness
Test Pit 4	0 – 230	GW-GM	8.20	0.1614	Corrosive
Test Pit 5	0 – 240 240 – 560	SM GP-GM	8.16 8.15	0.0757 0.0908	Moderately Corrosive Moderately Corrosive
Test Pit 6	0 – 300	GP-GM	8.12	0.0605	Moderately Corrosive

Note: USC – Unified Soil Classification

Table 23: 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 soil profiles have a Moderately Corrosive to Corrosive nature therefore caution should be exercised when selecting materials used for the installation of services and other facilities.

9. RECOMMENDATIONS

9.1 Structures and Layer Works

The materials which occur on site consists of Low (<7.5mm) potential expansiveness according to Van der Merwe's Method (1964).

The potential settlement and collapsibility were not determined during the investigation. A site classification of C indicates the presence of Compressible and Potentially Collapsible Soils (Site Class C) which needs to be taken into consideration for the design of other structures.

Test Pit 1 and Test Pit 2:

A competent horizon was encountered at an average depth of 1.450m ranging from 1.200m to 1.700m consisting of Silty SAND with gravel. The presumptive values of allowable bearing pressures for spread foundations as determined according to *NAVFAC for Silty SAND with gravel is 200kPa to 400kPa. Remove insitu material below foundations to a depth and width of 1.5 times the foundation width and replace with material compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content. Normal construction with lightly reinforced strip foundation and light reinforcement in masonry.

Test Pit 3, Test Pit 4, Test Pit 5 and Test Pit 6:

A competent horizon was encountered at refusal depth during the investigation at an average depth of 0.623m ranging from 0.300m to 1.400m consisting of Hard Sandstone. The presumptive values of allowable bearing pressures for spread foundations as determined according to *NAVFAC for the Hard Sandstone encountered at an average depth of 0.623m is 1500kPa to 2500kPa. Normal construction with drainage precautions

The materials encountered on site includes G6, G7, G8 and G9, according to the COLTO classification system, for all materials tested on site. The materials with G6 Classification are suitable for Subbase, Selected layer and Fill. The materials with G7, G8 and G9 Classification are suitable for Selected layer and Fill. Materials to be used in backfilling and layer works must be stockpiled and tested to confirm material quality.

Provision should be made for subsoil drainage structures or surface drainage where applicable.

9.2 Trench Excavations / Excavatablity

Sidewall collapse of the test pits during the investigation was only observed in the top layer of dry materials at an average depth of 0.300m. No Sidewall collapse was observed in the materials below 0.300m.

Excavation in the area of the proposed site should generally be feasible with large (Excavator) equipment, with Medium Dense materials and Hard Sandstone occurring on site. The restricted excavation class for the investigated area, to an average depth of 1.120m, is Soft Excavation, according to the SANS 634:2012 Edition 1.

9.3 Potential Groundwater Seepage

Ground-water seepage was not encountered at the time of the investigation in any of the test pits. A shallow water-table can be expected from time to time during the rainy season. Considering the natural environment and climate, one can expect that the ground-water seepage may theoretically occur above the investigated average test pit depth of 1.120m.

9.4 Slope Stability

The site has no visually observable slope. This slope in the immediate area of the investigated site is not steep enough to be unstable and estimated to be less than 2º.

9.5 Soil Conditions

The soil conditions described in this report refer specifically to those encountered in the Test Pits and Dynamic Cone Penetrometer (DCP) Tests executed on site. It is therefore quite possible that conditions may differ with those discussed above can be encountered elsewhere. It is therefore important that Simlab (Pty) Limited carry out periodic inspections of the earthworks and open foundation excavations. Any change from the anticipated soil conditions could then be taken into account to avoid unnecessary expense. In this regard, it is important that the construction phase of the project be treated as an augmentation of the geotechnical investigation.

J.P. DU PLESSIS (Laboratory Manager)

BJ VAN VUUREN (Technologist / CEO)
(N Dip Eng.: Civil (General), B Tech Eng.: Geotechnical, BSc (Hons) Eng.: Transportation Planning)
(Technical Signatory)

PW VAN HEERDEN (Technologist)
(B Tech Eng.: Transportation)

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

APPENDIX A
LOCATION PLAN

Simlab (EDMS) BEPERK GEOTEGNIESE DIENSTE
(PTY) LIMITED GEOTECHNICAL SERVICES
REG. No. 1987/004282/07 NLA No. 2012/187
1231, KIMBERLEY, 8300, SOUTH AFRICA. 3 Roper Street, KIMBERLEY, 8301
+27 (0) 53 832 2472 / 831 7560, +27 (0) 53 832 2472, simkby@simlab.co.za

LOCATION PLAN

APPENDIX B

*IN SITU MATERIAL PROFILES

(Test Pits & Materials Photos)

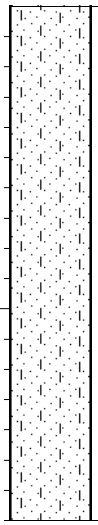
Simlab
(PTY) LIMITED - GEOTECHNICAL SERVICES

iX ENGINEERS (Pty)Ltd.
REPORT ON THE GEOTECHNICAL / FOUNDING CONDITION FOR THE UPGRADE OF CARNARVON WASTEWATER TREATMENT WORKS
P08403:OXIDATION PONDS.

HOLE No: Test Pit 1
Sheet 1 of 1

JOB NUMBER: 2025/K250/Doc.

Scale 1:25



0.00 Dry dark reddish brown medium dense silty SAND.

025/1075

1.70 Slightly moist light red brown medium dense silty SAND with sandstone gravel.

025/1076

2.03 2.030+ Refusal - Hard Sandstone.

NOTES

1) Disturbed sample 025/1075 taken at 0.850m.
2) Disturbed sample 025/1076 taken at 1.865m.
3) No groundwater seepage encountered in test pit.
4) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : TLB
DRILLED BY : Mr. D Motswana
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : 18/06/2025
DATE : 29/07/2025

ELEVATION : -
X-COORD : X3426684
Y-COORD : 23 Y0082068

HOLE No: Test Pit 1

TYPE SET BY : Mr. PW van Heerden
SETUP FILE : STANDARD.SET

DATE : 31/07/2025 15:34
TEXT : ..ort\InSituProfile110.txt

Simlab
(PTY) LIMITED - GEOTECHNICAL SERVICES

iX ENGINEERS (Pty)Ltd.
REPORT ON THE GEOTECHNICAL / FOUNDING CONDITION FOR THE UPGRADE OF CARNARVON WASTEWATER TREATMENT WORKS
P08403:OXIDATION PONDS.

HOLE No: Test Pit 2
Sheet 1 of 1

JOB NUMBER: 2025/K250/Doc.

Scale 1:25

025/1077	0.00	Dry dark reddish brown medium dense silty SAND.
	1.20	Dry light brown medium dense silty SAND with sandstone gravel.
025/1078		
	2.20	2.200+ Refusal - Hard Sandstone.

NOTES

1) Disturbed sample 025/1077 taken at 0.600m.
2) Disturbed sample 025/1078 taken at 1.700m.
3) No groundwater seepage encountered in test pit.
4) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : TLB
DRILLED BY : Mr. D Motswana
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : 18/06/2025
DATE : 29/07/2025

ELEVATION : -
X-COORD : X3426689
Y-COORD : 23 Y0082035

HOLE No: Test Pit 2

TYPE SET BY : Mr. PW van Heerden
SETUP FILE : STANDARD.SET

DATE : 31/07/2025 15:34
TEXT : ..ort\InSituProfile110.txt

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REPORT ON THE GEOTECHNICAL / FOUNDING CONDITION FOR THE UPGRADE OF CARNARVON WASTEWATER TREATMENT WORKS
P08403:OXIDATION PONDS.

HOLE No: Test Pit 3
Sheet 1 of 1

JOB NUMBER: 2025/K250/Doc.

Scale 1:25

025/1079	0.00	Dry dark reddish brown medium dense silty SAND.
	0.57	Slightly moist light reddish brown medium dense well -graded SAND with silt and sandstone gravel.
025/1080		
	1.40	1.400+ Refusal - Hard Sandstone.

NOTES

1) Disturbed sample 025/1079 taken at 0.285m.
2) Disturbed sample 025/1080 taken at 0.985m.
3) No groundwater seepage encountered in test pit.
4) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : TLB
DRILLED BY : Mr. D Motswana
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : 18/06/2025
DATE : 29/07/2025

ELEVATION : -
X-COORD : X3426929
Y-COORD : 23 Y0082007

HOLE No: Test Pit 3

TYPE SET BY : Mr. PW van Heerden
SETUP FILE : STANDARD.SET

DATE : 31/07/2025 15:34
TEXT : ..ort\InSituProfile110.txt

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REPORT ON THE GEOTECHNICAL / FOUNDING CONDITION FOR THE UPGRADE OF CARNARVON WASTEWATER TREATMENT WORKS
P08403:OXIDATION PONDS.

HOLE No: Test Pit 4
Sheet 1 of 1

JOB NUMBER: 2025/K250/Doc.

025/1081	Scale 1:25	0.00	Dry light olive medium densewell-graded sandstone gravel with silt and SAND.
		0.23	0.230+ Refusal - Hard Sandstone.

NOTES

1) Disturbed sample 025/1081 taken at 0.115m.
2) No groundwater seepage encountered in test pit.
3) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : TLB
DRILLED BY : Mr. D Motswana
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : 18/06/2025
DATE : 29/07/2025

ELEVATION : -
X-COORD : X3426951
Y-COORD : 23 Y0082151

HOLE No: Test Pit 4

TYPE SET BY : Mr. PW van Heerden
SETUP FILE : STANDARD.SET

DATE : 31/07/2025 15:34
TEXT : ..ort\InSituProfile110.txt

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REPORT ON THE GEOTECHNICAL / FOUNDING CONDITION FOR THE UPGRADE OF CARNARVON WASTEWATER TREATMENT WORKS
P08403:OXIDATION PONDS.

HOLE No: Test Pit 5
Sheet 1 of 1

JOB NUMBER: 2025/K250/Doc.

Scale 1:25

025/1082	0.00	Dry dark red medium dense silty SAND.
	0.24	
025/1083		Dry light reddish brown medium dense poorly graded sandstone gravel with silt and SAND.
	0.56	
		0.560+ Refusal - Hard Sandstone.

NOTES

1) Disturbed sample 025/1082 taken at 0.120m.
2) Disturbed sample 025/1083 taken at 0.400m.
3) No groundwater seepage encountered in test pit.
4) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : TLB
DRILLED BY : Mr. D Motswana
PROFILED BY : SIMLAB (PTY) LIMITED

INCLINATION : VERTICAL
DIAM : 600mm
DATE : 18/06/2025
DATE : 29/07/2025

ELEVATION : -
X-COORD : X3426964
Y-COORD : 23 Y0082147

HOLE No: Test Pit 5

TYPE SET BY : Mr. PW van Heerden
SETUP FILE : STANDARD.SET

DATE : 31/07/2025 15:34
TEXT : ..ort\InSituProfile110.txt

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REPORT ON THE GEOTECHNICAL / FOUNDING CONDITION FOR THE UPGRADE OF CARNARVON WASTEWATER TREATMENT WORKS
P08403:OXIDATION PONDS.

HOLE No: Test Pit 6
Sheet 1 of 1

JOB NUMBER: 2025/K250/Doc.

Scale
025/1084 1:25

0.00 Dry light reddish brown medium dense poorly graded sandstone gravel with silt and SAND.

0.30 0.300+ Refusal - Hard Sandstone.

NOTES

1) Disturbed sample 025/1084 taken at 0.150m.
2) No groundwater seepage encountered in test pit.
3) SOUTH AFRICAN - WGS84 CO-ORDINATE SYSTEM USED.

CONTRACTOR : SIMLAB (PTY) LIMITED
MACHINE : TLB
DRILLED BY : Mr. D Motswana
PROFILED BY : SIMLAB (PTY) LIMITED

TYPE SET BY : Mr. PW van Heerden
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : 600mm
DATE : 18/06/2025
DATE : 29/07/2025

DATE : 31/07/2025 15:34
TEXT : ..ort\InSituProfile110.txt

ELEVATION : -
X-COORD : X3426961
Y-COORD : 23 Y0082105

HOLE No: Test Pit 6

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(PTY) LIMITED - GEOTECHNICAL SERVICES

iX ENGINEERS (Pty)Ltd.
REPORT ON THE GEOTECHNICAL / FOUNDING CONDITION FOR THE UPGRADE OF CARNARVON WASTEWATER TREATMENT WORKS
P08403:OXIDATION PONDS.

LEGEND
Sheet 1 of 1

JOB NUMBER: 2025/K250/Doc.

	GRAVEL	{SA02}
	SAND	{SA04}
	SILT	{SA06}
	SILTY	{SA07}
	SANDSTONE	{SA11}
Name	DISTURBED SAMPLE	{SA38}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : Mr. PW van Heerden
SETUP FILE : STANDARD.SET

DATE : 31/07/2025 15:34
TEXT : ..ort\InSituProfile110.txt

LEGEND
SUMMARY OF SYMBOLS

APPENDIX C

LABORATORY TEST RESULTS

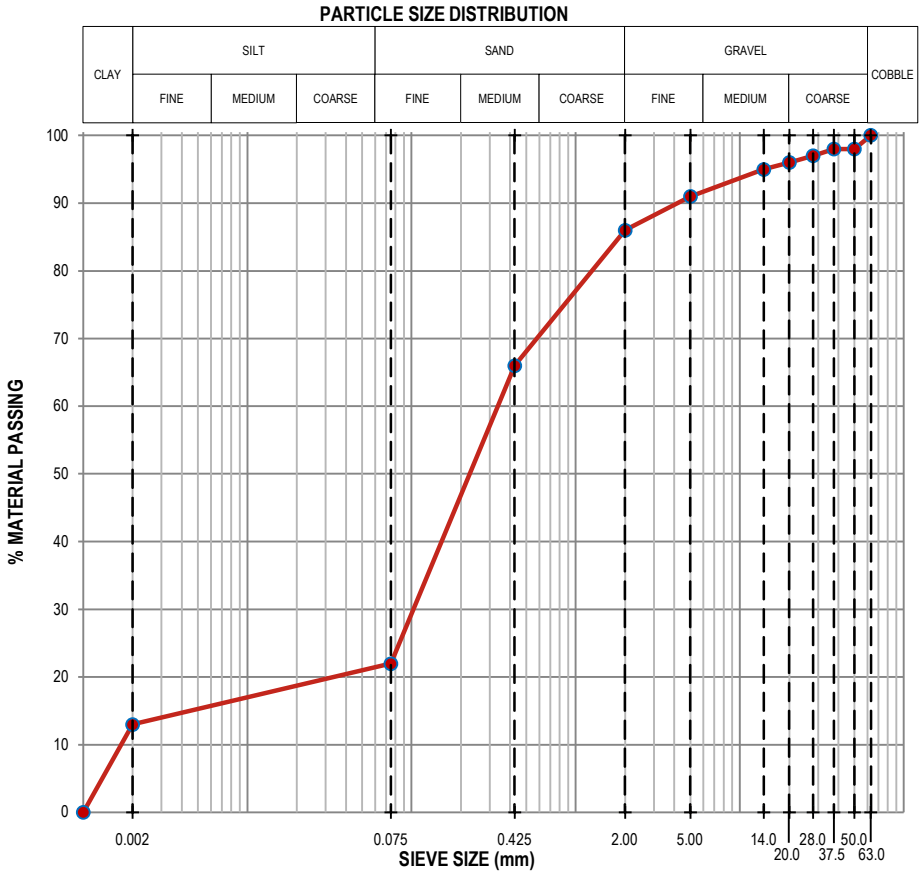
(Material Classification)

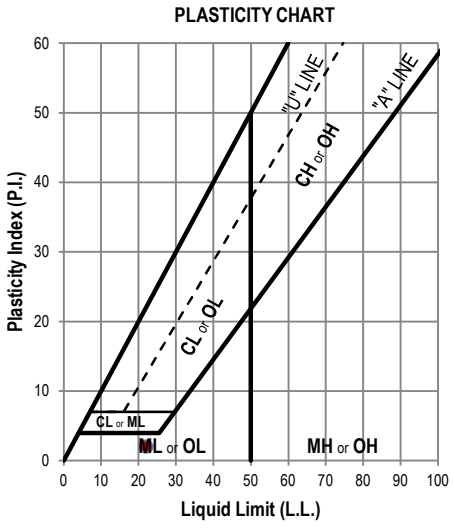
Simlab (EDMS) BEPERK GEOTEGNIESE DIENSTE
(PTY) LIMITED GEOTECHNICAL SERVICES
REG. No. 1987/004282/07 NLA No. 2012/187
1231, KIMBERLEY, 8300, SOUTH AFRICA. 3 Roper Street, KIMBERLEY, 8301
☎ +27 (0) 53 832 2472 / 831 7560, +27 (0) 53 832 2472, simkby@simlab.co.za

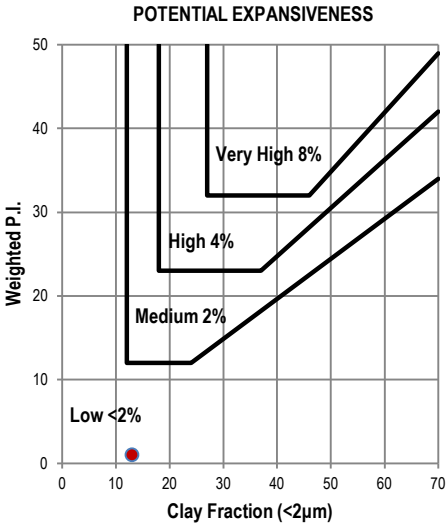
MATERIAL CLASSIFICATION TEST RESULTS

TEST PIT / HOLE No.:	TP1	MATERIAL DEPTH (mm) :	0 - 1700	SAMPLE No / LABORATORY No.:	025/1075
MATERIAL DESCRIPTION :	Dry dark reddish brown medium dense silty SAND.				

IN SITU MOISTURE CONTENT (GR20) (%)			3.3
SIEVE ANALYSIS SANS 3001 - GR1 : 2013	SIEVE SIZE		% PASSING
		63.0 mm	100
		50.0 mm	98
		37.5 mm	98
		28.0 mm	97
		20.0 mm	96
		14.0 mm	95
		5.00 mm	91
		2.00 mm	86
		0.425 mm	66
		0.075 mm	22
*TMH1: METHOD A6		0.002 mm	13
*SANS 3001 PR5: 2011	GRADING MODULUS (GM)		1.26
	SOIL MORTAR	COARSE SAND	23
		FINE SAND (Course)	12
		FINE SAND (Medium)	12
		FINE SAND (Fine)	27
		SILT AND CLAY (<0.075mm)	25
ATTERBERG LIMITS MATERIAL PASSING 0.425mm SANS 3001 - GR10: 2011		L.L. (%)	22
		P.I. (%)	2
		L.S. (%)	1.0
* MEASURES OF GRADATIONS	C_U (ASTM D2487)		188.5
	C_C (ASTM D2487)		14.1
	% Clay (>0.002mm)		13
	% Silt (0.075 - 0.002mm)		9
	% Sand (0.075 - 2.0mm)		64
	% Gravel (>2.0mm)		14
CBR DETERMINATION SANS 3001 - GR 40: 2013	MAX. DRY DENSITY (kg/m³)		2062
	OPTIMUM MOISTURE (%)		7.7
	SWELL (%)		0.0
	CBR @ 100%		21
	CBR @ 98%		16
	CBR @ 95%		11
	CBR @ 93%		9
	CBR @ 90%		6
PROCTOR MAX. DRY DENSITY (kg/m³)			1856
*COMPACTIBILITY (Ratio) (SABS 1200 LB)			0.25
*CONDUCTIVITY (Sm⁻¹) (TMH1: Method A20)			0.0605
*pH VALUE (TMH1: Method A21)			8.31
*POTENTIAL EXPANSIVENESS			Low - 0.0mm
*AASHTO SOIL CLASSIFICATION			A-3a (0)
*UNIFIED SOIL CLASSIFICATION			SM
*COLTO CLASSIFICATION			G9







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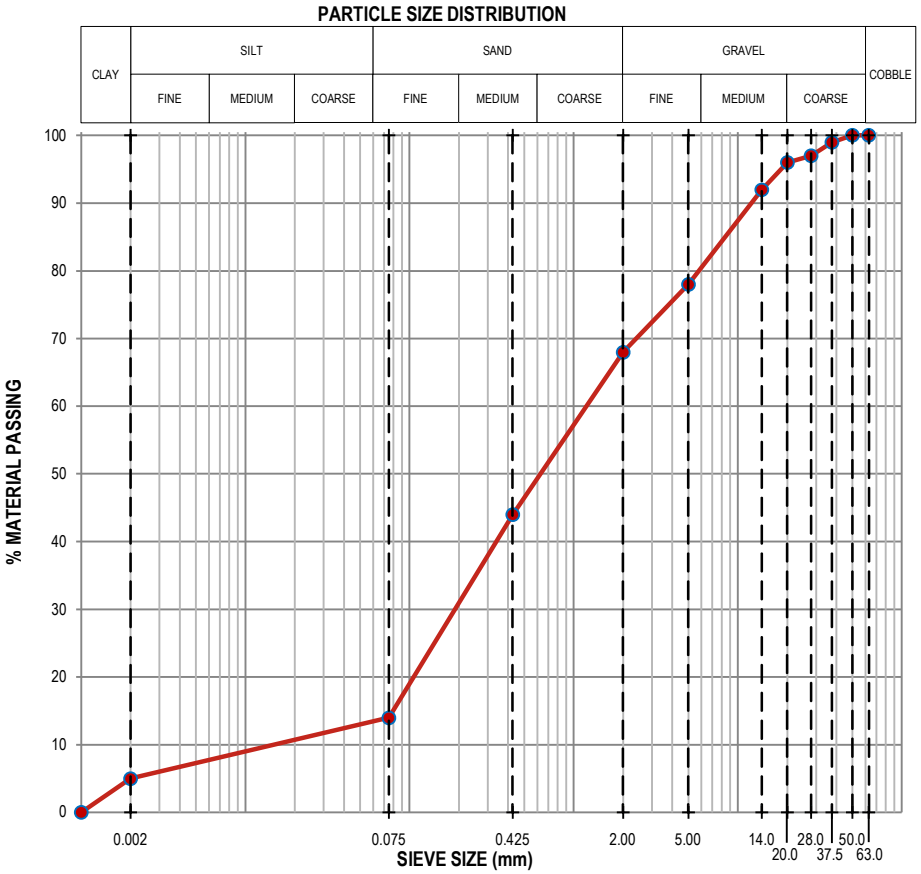
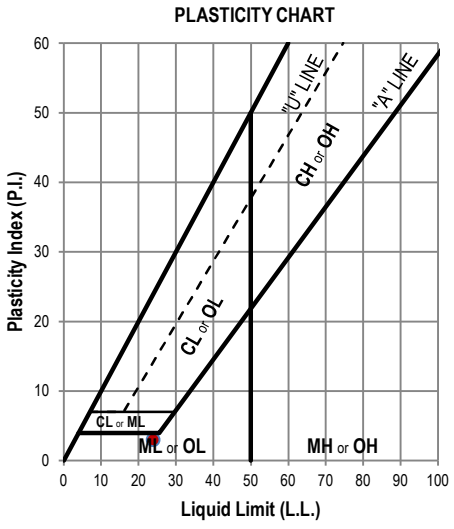
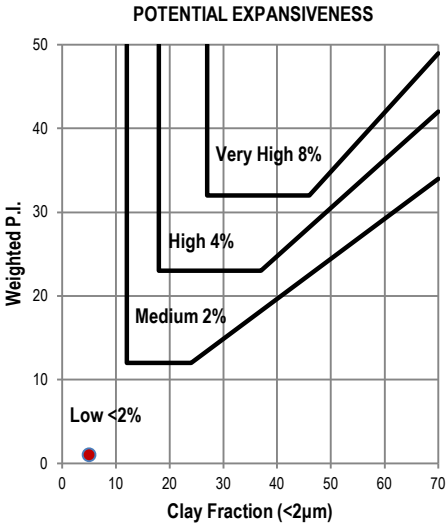
MATERIAL CLASSIFICATION TEST RESULTS

TEST PIT / HOLE No.:	TP1	MATERIAL DEPTH (mm) :	1700 - 2030	SAMPLE No / LABORATORY No.:	025/1076
MATERIAL DESCRIPTION :	Slightly moist light red brown medium dense silty SAND with sandstone gravel.				

IN SITU MOISTURE CONTENT (GR20) (%)		8.2
SIEVE ANALYSIS SANS 3001 - GR1 : 2013	SIEVE SIZE	% PASSING
	63.0 mm	100
	50.0 mm	100
	37.5 mm	99
	28.0 mm	97
	20.0 mm	96
	14.0 mm	92
	5.00 mm	78
	2.00 mm	68
	0.425 mm	44
	0.075 mm	14
*TMH1: METHOD A6	0.002 mm	5
*SANS 3001 PR5: 2011	GRADING MODULUS (GM)	1.74
SOIL MORTAR	COARSE SAND	34
	FINE SAND (Course)	15
	FINE SAND (Medium)	11
	FINE SAND (Fine)	19
	SILT AND CLAY (<0.075mm)	21
ATTERBERG LIMITS MATERIAL PASSING 0.425mm SANS 3001 - GR10: 2011	L.L. (%)	24
	P.I. (%)	3
	L.S. (%)	1.5
* MEASURES OF GRADATIONS	C_U (ASTM D2487)	98.3
	C_C (ASTM D2487)	1.6
	% Clay (>0.002mm)	5
	% Silt (0.075 - 0.002mm)	9
	% Sand (0.075 - 2.0mm)	54
	% Gravel (>2.0mm)	32
CBR DETERMINATION SANS 3001 - GR 40: 2013	MAX. DRY DENSITY (kg/m³)	1910
	OPTIMUM MOISTURE (%)	11.2
	SWELL (%)	0.0
	CBR @ 100%	48
	CBR @ 98%	36
	CBR @ 95%	24
	CBR @ 93%	18
	CBR @ 90%	12
PROCTOR MAX. DRY DENSITY (kg/m³)		1719
*COMPACTIBILITY (Ratio) (SABS 1200 LB)		0.24
*CONDUCTIVITY (Sm⁻¹) (TMH1: Method A20)		0.0656
*pH VALUE (TMH1: Method A21)		8.38
*POTENTIAL EXPANSIVENESS		Low - 0.0mm
*AASHTO SOIL CLASSIFICATION		A-1-b (0)
*UNIFIED SOIL CLASSIFICATION		SM
*COLTO CLASSIFICATION		G7







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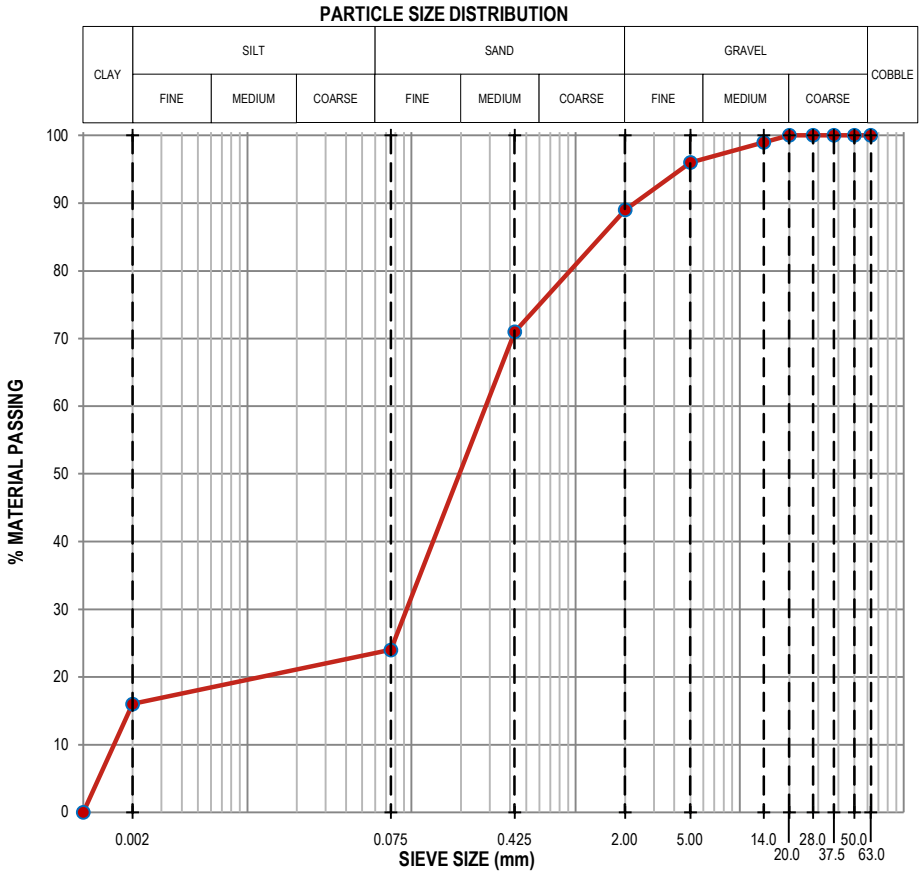
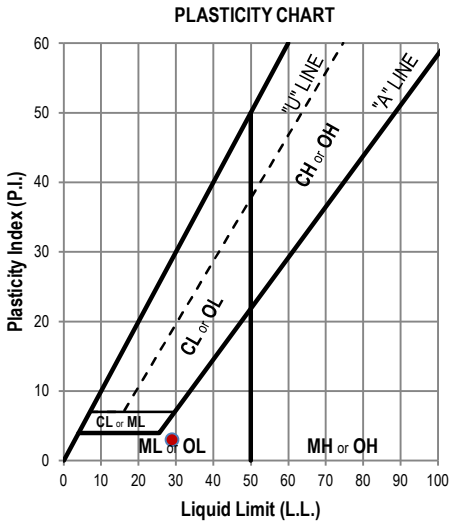
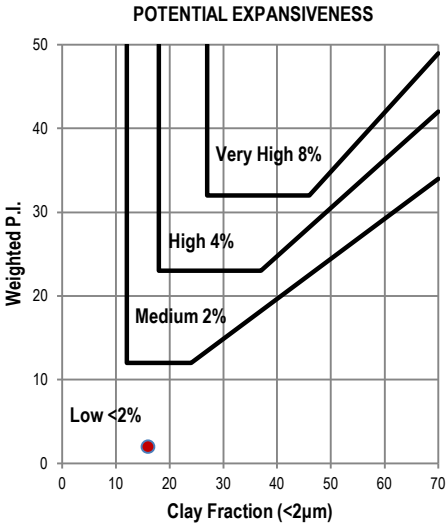
MATERIAL CLASSIFICATION TEST RESULTS

TEST PIT / HOLE No.:	TP2	MATERIAL DEPTH (mm) :	0 - 1200	SAMPLE No / LABORATORY No.:	025/1077
MATERIAL DESCRIPTION :	Dry dark reddish brown medium dense silty SAND.				

IN SITU MOISTURE CONTENT (GR20) (%)		4.9
SIEVE ANALYSIS SANS 3001 - GR1 : 2013	SIEVE SIZE	% PASSING
	63.0 mm	100
	50.0 mm	100
	37.5 mm	100
	28.0 mm	100
	20.0 mm	100
	14.0 mm	99
	5.00 mm	96
	2.00 mm	89
	0.425 mm	71
	0.075 mm	24
*TMH1: METHOD A6	0.002 mm	16
*SANS 3001 PR5: 2011	GRADING MODULUS (GM)	1.16
SOIL MORTAR	COARSE SAND	21
	FINE SAND (Course)	10
	FINE SAND (Medium)	13
	FINE SAND (Fine)	29
	SILT AND CLAY (<0.075mm)	27
ATTERBERG LIMITS MATERIAL PASSING 0.425mm SANS 3001 - GR10: 2011	L.L. (%)	29
	P.I. (%)	3
	L.S. (%)	1.5
* MEASURES OF GRADATIONS	C_U (ASTM D2487)	171.5
	C_C (ASTM D2487)	12.9
	% Clay (>0.002mm)	16
	% Silt (0.075 - 0.002mm)	8
	% Sand (0.075 - 2.0mm)	65
	% Gravel (>2.0mm)	11
CBR DETERMINATION SANS 3001 - GR 40: 2013	MAX. DRY DENSITY (kg/m³)	-
	OPTIMUM MOISTURE (%)	-
	SWELL (%)	-
	CBR @ 100%	-
	CBR @ 98%	-
	CBR @ 95%	-
	CBR @ 93%	-
	CBR @ 90%	-
PROCTOR MAX. DRY DENSITY (kg/m³)		
*COMPACTIBILITY (Ratio) (SABS 1200 LB)		-
*CONDUCTIVITY (Sm⁻¹) (TMH1: Method A20)		0.0807
*pH VALUE (TMH1: Method A21)		7.99
*POTENTIAL EXPANSIVENESS		Low - 0.0mm
*AASHTO SOIL CLASSIFICATION		A-3a (0)
*UNIFIED SOIL CLASSIFICATION		SM
*COLTO CLASSIFICATION		-







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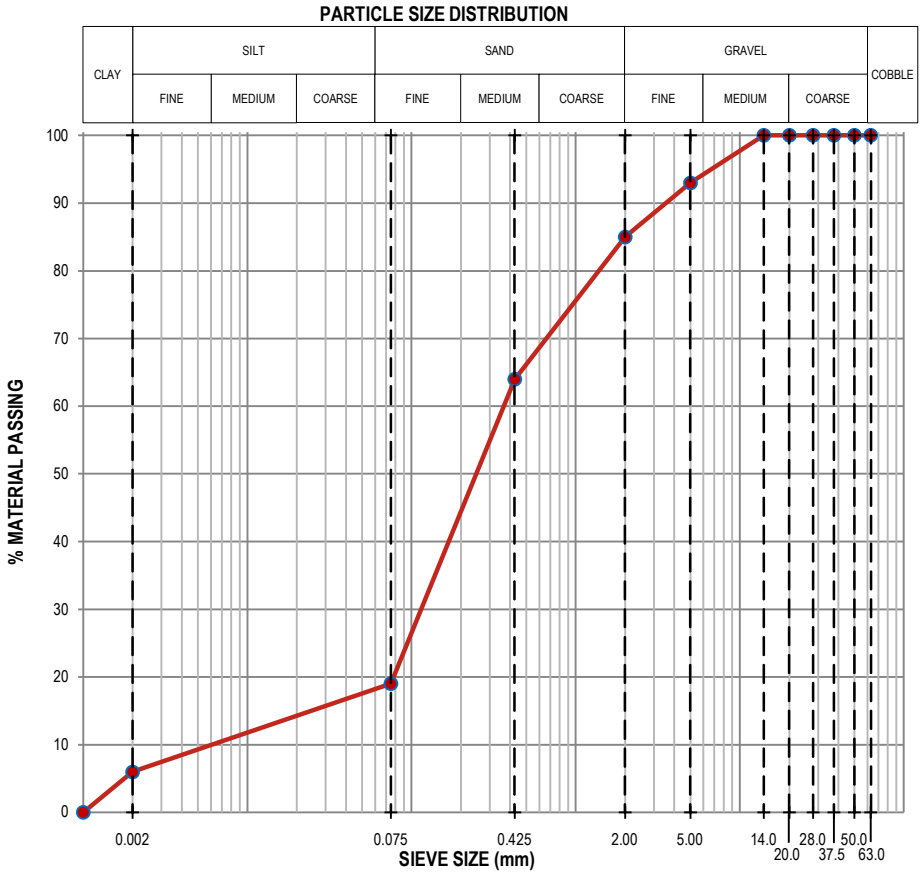
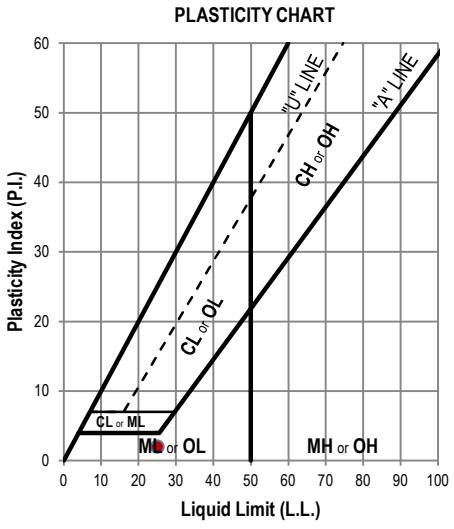
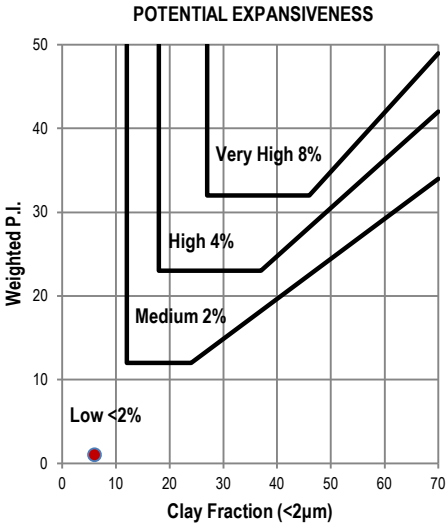
MATERIAL CLASSIFICATION TEST RESULTS

TEST PIT / HOLE No.:	TP2	MATERIAL DEPTH (mm) :	1200 - 2200	SAMPLE No / LABORATORY No.:	025/1078
MATERIAL DESCRIPTION :	Dry light brown medium dense silty SAND with sandstone gravel.				

IN SITU MOISTURE CONTENT (GR20) (%)		3.1
SIEVE ANALYSIS SANS 3001 - GR1 : 2013	SIEVE SIZE	% PASSING
	63.0 mm	100
	50.0 mm	100
	37.5 mm	100
	28.0 mm	100
	20.0 mm	100
	14.0 mm	100
	5.00 mm	93
	2.00 mm	85
	0.425 mm	64
	0.075 mm	19
*TMH1: METHOD A6	0.002 mm	6
*SANS 3001 PR5: 2011	GRADING MODULUS (GM)	1.32
SOIL MORTAR	COARSE SAND	25
	FINE SAND (Course)	13
	FINE SAND (Medium)	13
	FINE SAND (Fine)	27
	SILT AND CLAY (<0.075mm)	22
ATTERBERG LIMITS MATERIAL PASSING 0.425mm SANS 3001 - GR10: 2011	L.L. (%)	25
	P.I. (%)	2
	L.S. (%)	1.0
* MEASURES OF GRADATIONS	C_U (ASTM D2487)	65.7
	C_C (ASTM D2487)	5.6
	% Clay (>0.002mm)	6
	% Silt (0.075 - 0.002mm)	13
	% Sand (0.075 - 2.0mm)	66
	% Gravel (>2.0mm)	15
CBR DETERMINATION SANS 3001 - GR 40: 2013	MAX. DRY DENSITY (kg/m³)	1890
	OPTIMUM MOISTURE (%)	9.9
	SWELL (%)	0.0
	CBR @ 100%	19
	CBR @ 98%	16
	CBR @ 95%	11
	CBR @ 93%	9
	CBR @ 90%	7
PROCTOR MAX. DRY DENSITY (kg/m³)		1701
*COMPACTIBILITY (Ratio) (SABS 1200 LB)		0.21
*CONDUCTIVITY (Sm⁻¹) (TMH1: Method A20)		0.0540
*pH VALUE (TMH1: Method A21)		8.08
*POTENTIAL EXPANSIVENESS		Low - 0.0mm
*AASHTO SOIL CLASSIFICATION		A-3a (0)
*UNIFIED SOIL CLASSIFICATION		SM
*COLTO CLASSIFICATION		G9







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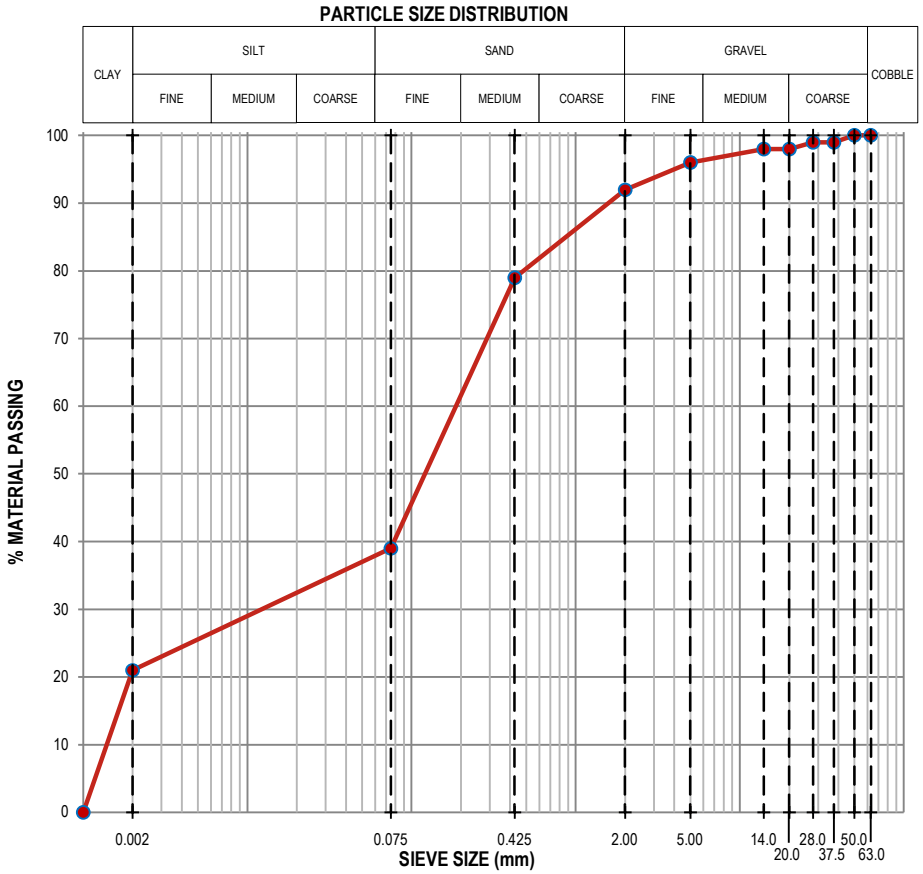
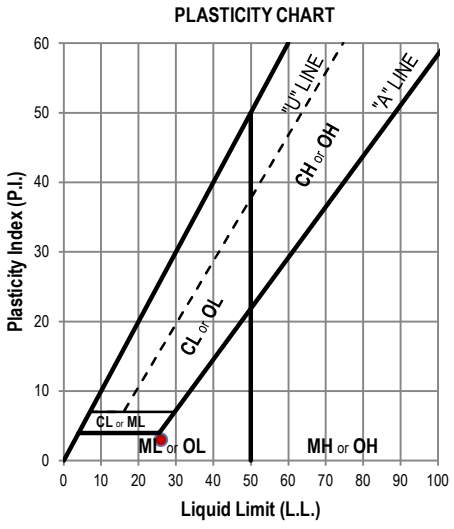
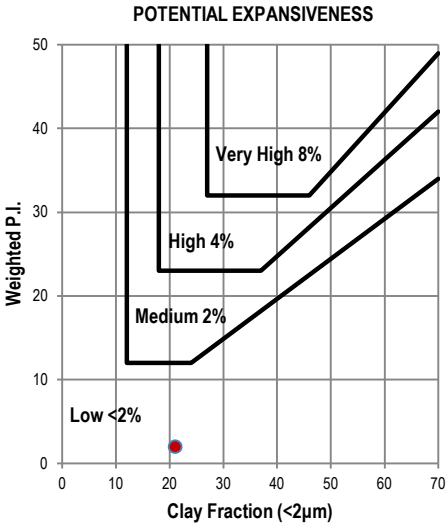
MATERIAL CLASSIFICATION TEST RESULTS

TEST PIT / HOLE No.:	TP3	MATERIAL DEPTH (mm) :	0 - 570	SAMPLE No / LABORATORY No.:	025/1079
MATERIAL DESCRIPTION :	Dry dark reddish brown medium dense silty SAND.				

IN SITU MOISTURE CONTENT (GR20) (%)			3.3
SIEVE ANALYSIS SANS 3001 - GR1 : 2013	SIEVE SIZE		% PASSING
		63.0 mm	100
		50.0 mm	100
		37.5 mm	99
		28.0 mm	99
		20.0 mm	98
		14.0 mm	98
		5.00 mm	96
		2.00 mm	92
		0.425 mm	79
		0.075 mm	39
*TMH1: METHOD A6		0.002 mm	21
*SANS 3001 PR5: 2011 SOIL MORTAR	GRADING MODULUS (GM)		0.90
	COARSE SAND		14
	FINE SAND (Course)		9
	FINE SAND (Medium)		11
	FINE SAND (Fine)		23
	SILT AND CLAY (<0.075mm)		43
ATTERBERG LIMITS MATERIAL PASSING 0.425mm SANS 3001 - GR10: 2011	L.L. (%)		26
	P.I. (%)		3
	L.S. (%)		1.5
* MEASURES OF GRADATIONS	C_U (ASTM D2487)		259.0
	C_C (ASTM D2487)		0.6
	% Clay (>0.002mm)		21
	% Silt (0.075 - 0.002mm)		18
	% Sand (0.075 - 2.0mm)		53
	% Gravel (>2.0mm)		8
CBR DETERMINATION SANS 3001 - GR 40: 2013	MAX. DRY DENSITY (kg/m³)		-
	OPTIMUM MOISTURE (%)		-
	SWELL (%)		-
	CBR @ 100%		-
	CBR @ 98%		-
	CBR @ 95%		-
	CBR @ 93%		-
	CBR @ 90%		-
PROCTOR MAX. DRY DENSITY (kg/m³)			
*COMPACTIBILITY (Ratio) (SABS 1200 LB)			-
*CONDUCTIVITY (Sm⁻¹) (TMH1: Method A20)			0.1110
*pH VALUE (TMH1: Method A21)			7.92
*POTENTIAL EXPANSIVENESS			Low - 0.0mm
*AASHTO SOIL CLASSIFICATION			A-4a (0)
*UNIFIED SOIL CLASSIFICATION			SM
*COLTO CLASSIFICATION			-







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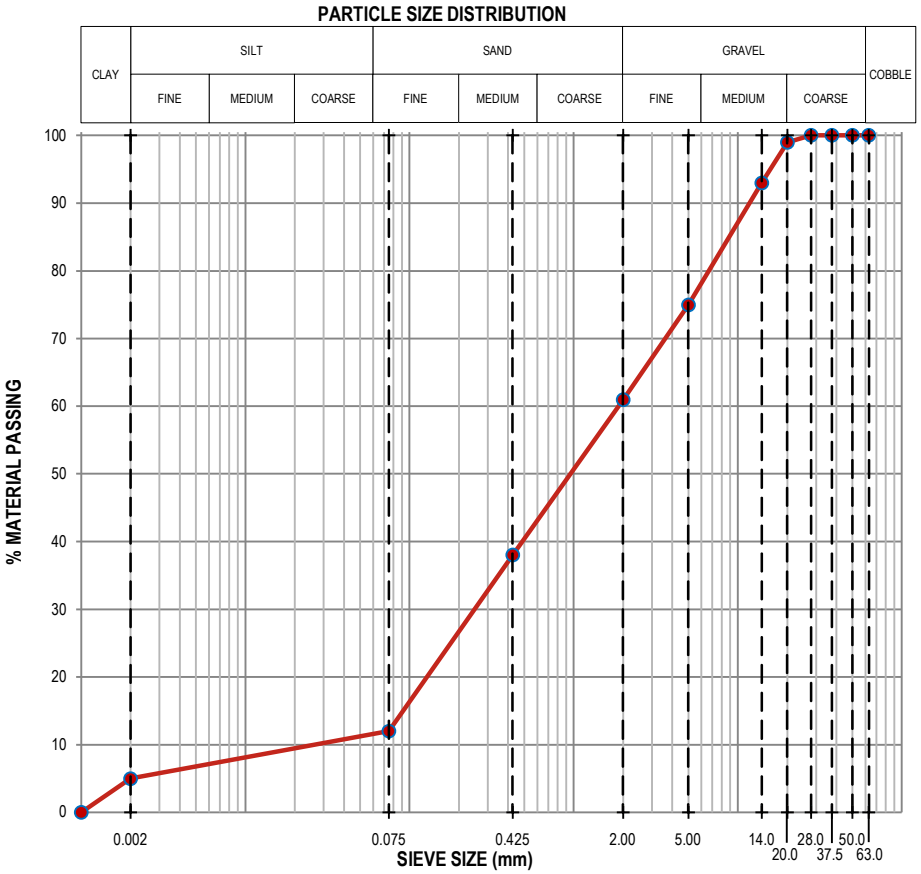
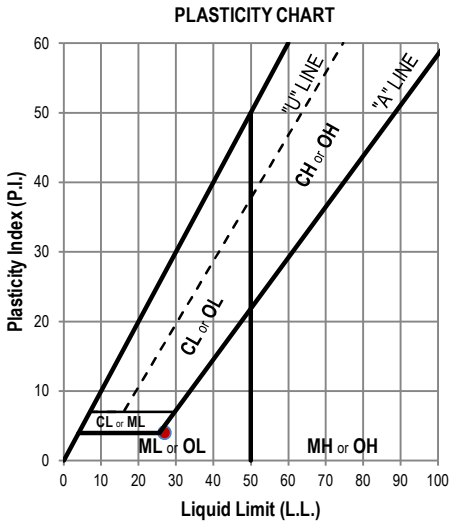
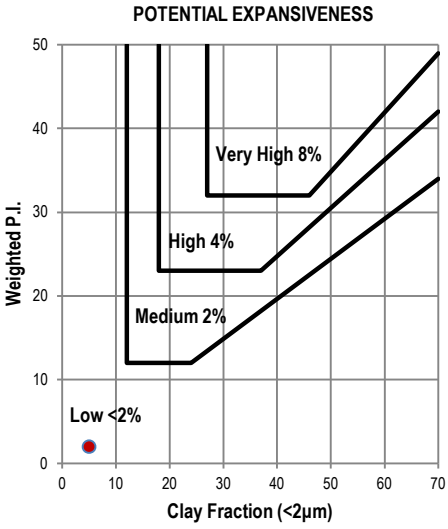
MATERIAL CLASSIFICATION TEST RESULTS

TEST PIT / HOLE No.:	TP3	MATERIAL DEPTH (mm) :	570 - 1400	SAMPLE No / LABORATORY No.:	025/1080
MATERIAL DESCRIPTION :	Slightly moist light reddish brown medium dense well -graded SAND with silt and sandstone gravel.				

IN SITU MOISTURE CONTENT (GR20) (%)			8.0
SIEVE ANALYSIS SANS 3001 - GR1 : 2013	SIEVE SIZE		% PASSING
	63.0 mm		100
	50.0 mm		100
	37.5 mm		100
	28.0 mm		100
	20.0 mm		99
	14.0 mm		93
	5.00 mm		75
	2.00 mm		61
	0.425 mm		38
	0.075 mm		12
*TMH1: METHOD A6	0.002 mm		5
*SANS 3001 PR5: 2011	GRADING MODULUS (GM)		1.89
SOIL MORTAR	COARSE SAND		38
	FINE SAND (Course)		13
	FINE SAND (Medium)		10
	FINE SAND (Fine)		19
	SILT AND CLAY (<0.075mm)		20
ATTERBERG LIMITS MATERIAL PASSING 0.425mm SANS 3001 - GR10: 2011	L.L. (%)		27
	P.I. (%)		4
	L.S. (%)		2.0
* MEASURES OF GRADATIONS	C_U (ASTM D2487)		71.6
	C_C (ASTM D2487)		1.2
	% Clay (>0.002mm)		5
	% Silt (0.075 - 0.002mm)		7
	% Sand (0.075 - 2.0mm)		49
	% Gravel (>2.0mm)		39
CBR DETERMINATION SANS 3001 - GR 40: 2013	MAX. DRY DENSITY (kg/m³)		1950
	OPTIMUM MOISTURE (%)		10.9
	SWELL (%)		0.0
	CBR @ 100%		39
	CBR @ 98%		32
	CBR @ 95%		25
	CBR @ 93%		21
	CBR @ 90%		16
PROCTOR MAX. DRY DENSITY (kg/m³)			1755
*COMPACTIBILITY (Ratio) (SABS 1200 LB)			0.22
*CONDUCTIVITY (Sm⁻¹) (TMH1: Method A20)			0.1110
*pH VALUE (TMH1: Method A21)			7.98
*POTENTIAL EXPANSIVENESS			Low - 0.0mm
*AASHTO SOIL CLASSIFICATION			A-1-b (0)
*UNIFIED SOIL CLASSIFICATION			SW-SM
*COLTO CLASSIFICATION			G6







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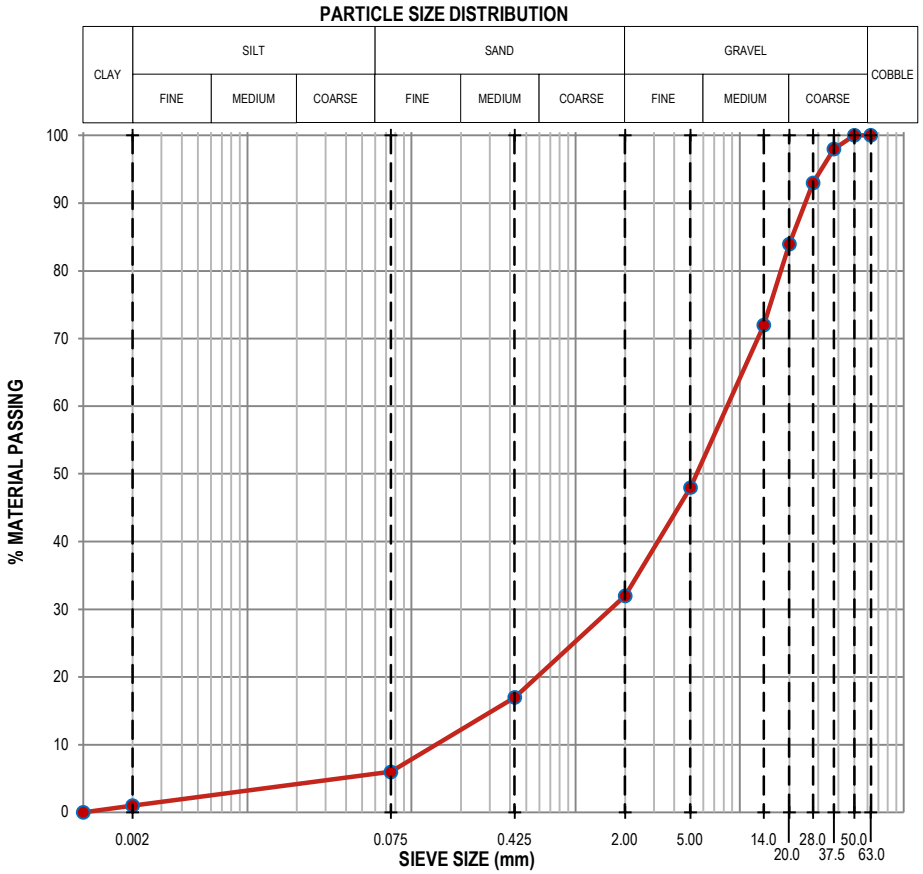
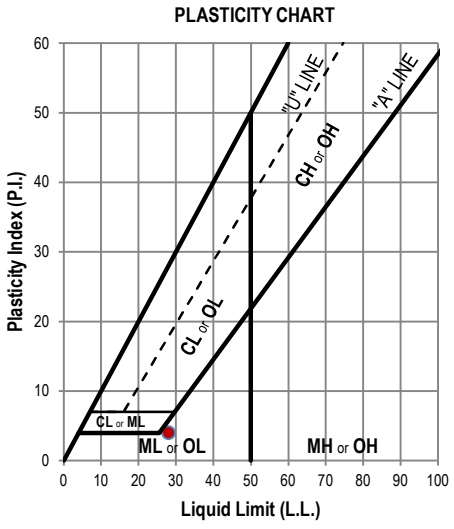
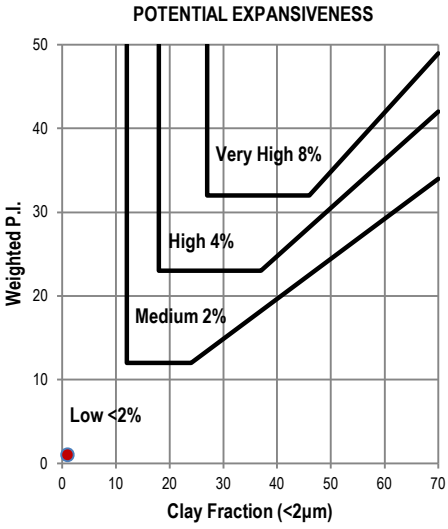
MATERIAL CLASSIFICATION TEST RESULTS

TEST PIT / HOLE No.:	TP4	MATERIAL DEPTH (mm) :	0 - 230	SAMPLE No / LABORATORY No.:	025/1081
MATERIAL DESCRIPTION :	Dry light olive medium densewell-graded sandstone gravel with silt and SAND.				

IN SITU MOISTURE CONTENT (GR20) (%)		1.3
SIEVE ANALYSIS SANS 3001 - GR1 : 2013	SIEVE SIZE	% PASSING
	63.0 mm	100
	50.0 mm	100
	37.5 mm	98
	28.0 mm	93
	20.0 mm	84
	14.0 mm	72
	5.00 mm	48
	2.00 mm	32
	0.425 mm	17
	0.075 mm	6
*TMH1: METHOD A6	0.002 mm	1
*SANS 3001 PR5: 2011	GRADING MODULUS (GM)	2.45
SOIL MORTAR	COARSE SAND	47
	FINE SAND (Course)	10
	FINE SAND (Medium)	10
	FINE SAND (Fine)	15
	SILT AND CLAY (<0.075mm)	17
ATTERBERG LIMITS MATERIAL PASSING 0.425mm SANS 3001 - GR10: 2011	L.L. (%)	28
	P.I. (%)	4
	L.S. (%)	2.0
* MEASURES OF GRADATIONS	C_U (ASTM D2487)	67.4
	C_C (ASTM D2487)	2.0
	% Clay (>0.002mm)	1
	% Silt (0.075 - 0.002mm)	5
	% Sand (0.075 - 2.0mm)	26
	% Gravel (>2.0mm)	68
CBR DETERMINATION SANS 3001 - GR 40: 2013	MAX. DRY DENSITY (kg/m³)	1950
	OPTIMUM MOISTURE (%)	10.9
	SWELL (%)	0.0
	CBR @ 100%	38
	CBR @ 98%	32
	CBR @ 95%	25
	CBR @ 93%	21
	CBR @ 90%	16
PROCTOR MAX. DRY DENSITY (kg/m³)		1755
*COMPACTIBILITY (Ratio) (SABS 1200 LB)		0.25
*CONDUCTIVITY (Sm⁻¹) (TMH1: Method A20)		0.1614
*pH VALUE (TMH1: Method A21)		8.20
*POTENTIAL EXPANSIVENESS		Low - 0.0mm
*AASHTO SOIL CLASSIFICATION		A-1-a (0)
*UNIFIED SOIL CLASSIFICATION		GW-GM
*COLTO CLASSIFICATION		G6







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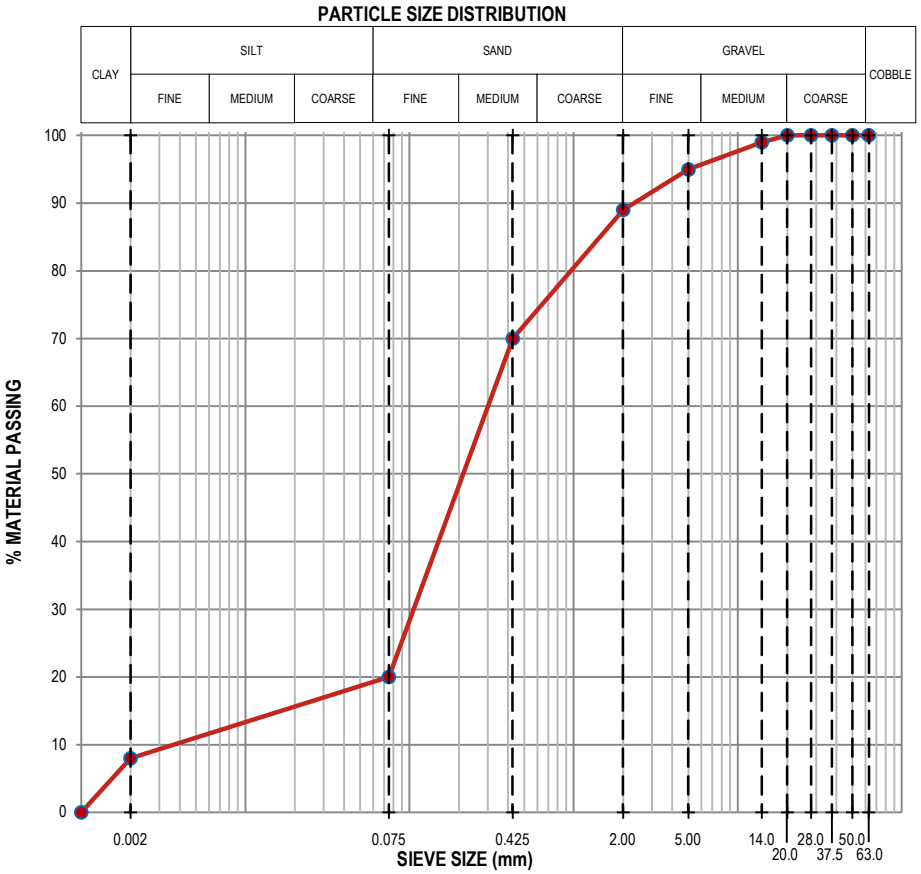
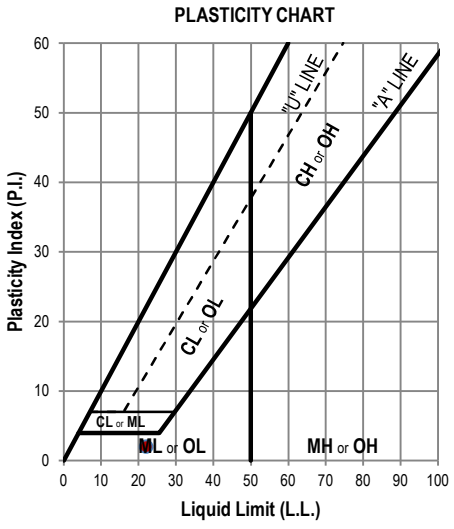
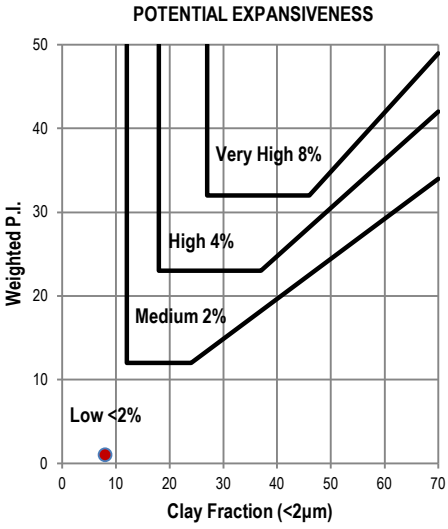
MATERIAL CLASSIFICATION TEST RESULTS

TEST PIT / HOLE No.:	TP5	MATERIAL DEPTH (mm) :	0 - 240	SAMPLE No / LABORATORY No.:	025/1082
MATERIAL DESCRIPTION :	Dry dark red medium dense silty SAND.				

IN SITU MOISTURE CONTENT (GR20) (%)		3.0
SIEVE ANALYSIS SANS 3001 - GR1 : 2013	SIEVE SIZE	% PASSING
	63.0 mm	100
	50.0 mm	100
	37.5 mm	100
	28.0 mm	100
	20.0 mm	100
	14.0 mm	99
	5.00 mm	95
	2.00 mm	89
	0.425 mm	70
	0.075 mm	20
*TMH1: METHOD A6	0.002 mm	8
*SANS 3001 PR5: 2011	GRADING MODULUS (GM)	1.21
SOIL MORTAR	COARSE SAND	21
	FINE SAND (Course)	12
	FINE SAND (Medium)	19
	FINE SAND (Fine)	26
	SILT AND CLAY (<0.075mm)	22
ATTERBERG LIMITS MATERIAL PASSING 0.425mm SANS 3001 - GR10: 2011	L.L. (%)	22
	P.I. (%)	2
	L.S. (%)	1.0
* MEASURES OF GRADATIONS	C_U (ASTM D2487)	88.8
	C_C (ASTM D2487)	7.9
	% Clay (>0.002mm)	8
	% Silt (0.075 - 0.002mm)	12
	% Sand (0.075 - 2.0mm)	69
	% Gravel (>2.0mm)	11
CBR DETERMINATION SANS 3001 - GR 40: 2013	MAX. DRY DENSITY (kg/m³)	-
	OPTIMUM MOISTURE (%)	-
	SWELL (%)	-
	CBR @ 100%	-
	CBR @ 98%	-
	CBR @ 95%	-
	CBR @ 93%	-
	CBR @ 90%	-
PROCTOR MAX. DRY DENSITY (kg/m³)		
*COMPACTIBILITY (Ratio) (SABS 1200 LB)		-
*CONDUCTIVITY (Sm⁻¹) (TMH1: Method A20)		0.0757
*pH VALUE (TMH1: Method A21)		8.16
*POTENTIAL EXPANSIVENESS		Low - 0.0mm
*AASHTO SOIL CLASSIFICATION		A-3a (0)
*UNIFIED SOIL CLASSIFICATION		SM
*COLTO CLASSIFICATION		-







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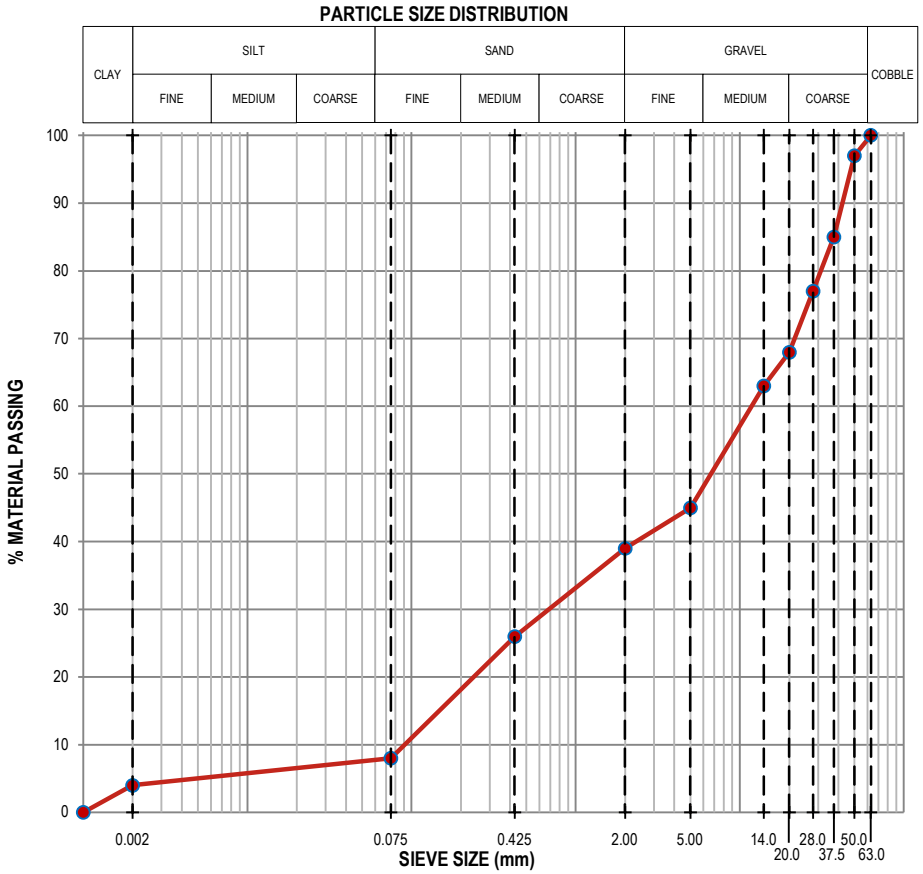
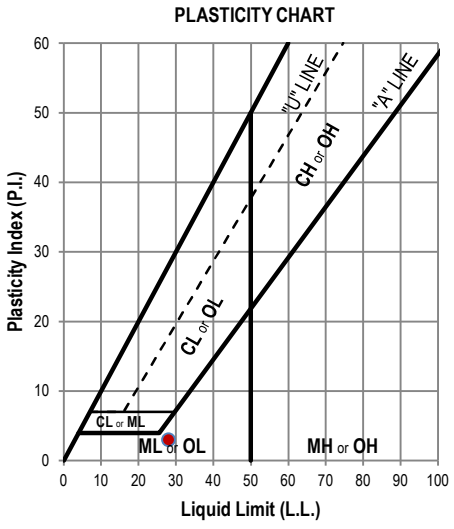
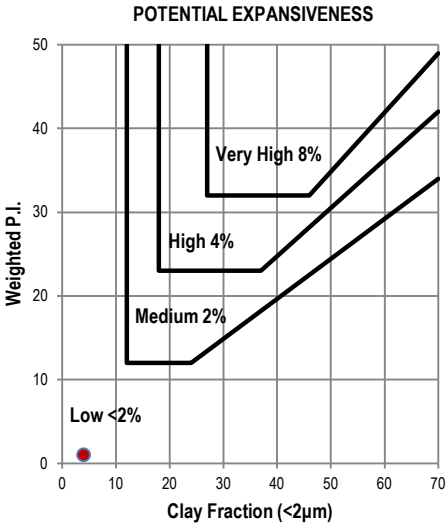
MATERIAL CLASSIFICATION TEST RESULTS

TEST PIT / HOLE No.:	TP5	MATERIAL DEPTH (mm) :	240 - 560	SAMPLE No / LABORATORY No.:	025/1083
MATERIAL DESCRIPTION :	Dry light reddish brown medium dense poorly graded sandstone gravel with silt and SAND.				

IN SITU MOISTURE CONTENT (GR20) (%)			2.3
SIEVE ANALYSIS SANS 3001 - GR1 : 2013	SIEVE SIZE		% PASSING
		63.0 mm	100
		50.0 mm	97
		37.5 mm	85
		28.0 mm	77
		20.0 mm	68
		14.0 mm	63
		5.00 mm	45
		2.00 mm	39
		0.425 mm	26
		0.075 mm	8
*TMH1: METHOD A6		0.002 mm	4
*SANS 3001 PR5: 2011	GRADING MODULUS (GM)		2.27
	SOIL MORTAR	COARSE SAND	33
		FINE SAND (Course)	11
		FINE SAND (Medium)	12
		FINE SAND (Fine)	24
		SILT AND CLAY (<0.075mm)	20
ATTERBERG LIMITS MATERIAL PASSING 0.425mm SANS 3001 - GR10: 2011		L.L. (%)	28
		P.I. (%)	3
		L.S. (%)	1.5
* MEASURES OF GRADATIONS	C_U (ASTM D2487)		137.4
	C_C (ASTM D2487)		0.4
	% Clay (>0.002mm)		4
	% Silt (0.075 - 0.002mm)		4
	% Sand (0.075 - 2.0mm)		31
	% Gravel (>2.0mm)		61
CBR DETERMINATION SANS 3001 - GR 40: 2013	MAX. DRY DENSITY (kg/m³)		2009
	OPTIMUM MOISTURE (%)		8.6
	SWELL (%)		0.0
	CBR @ 100%		40
	CBR @ 98%		33
	CBR @ 95%		25
	CBR @ 93%		20
	CBR @ 90%		15
PROCTOR MAX. DRY DENSITY (kg/m³)			1808
*COMPACTIBILITY (Ratio) (SABS 1200 LB)			0.28
*CONDUCTIVITY (Sm⁻¹) (TMH1: Method A20)			0.0908
*pH VALUE (TMH1: Method A21)			8.15
*POTENTIAL EXPANSIVENESS			Low - 0.0mm
*AASHTO SOIL CLASSIFICATION			A-1-a (0)
*UNIFIED SOIL CLASSIFICATION			GP-GM
*COLTO CLASSIFICATION			G6







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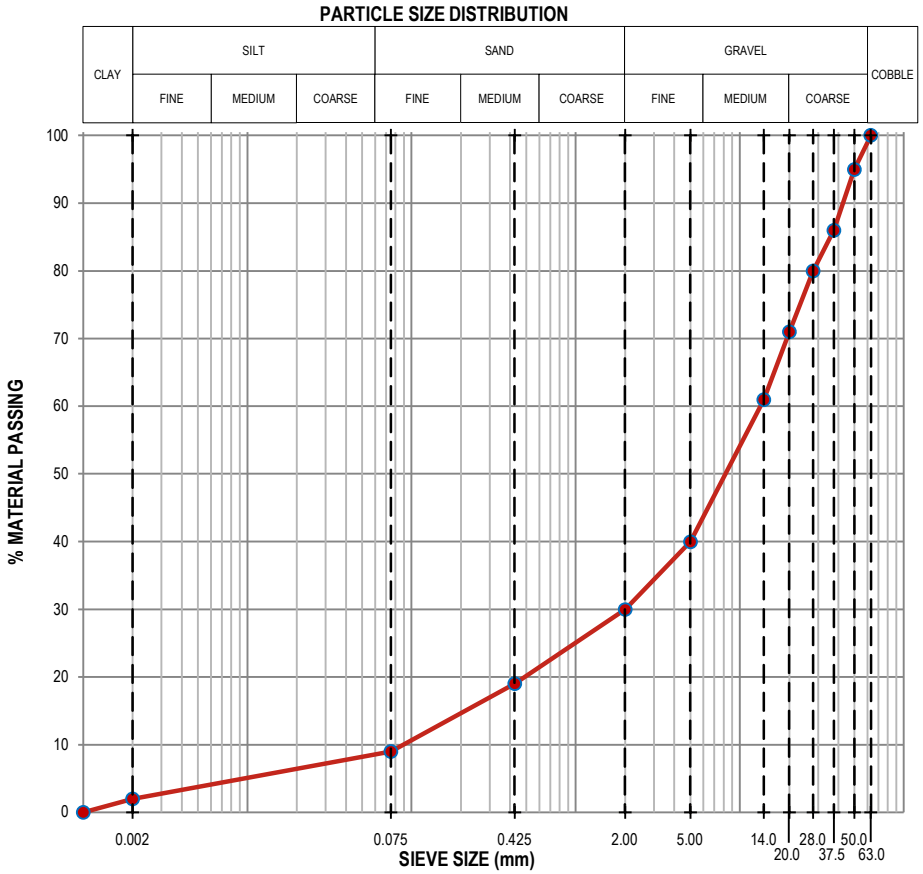
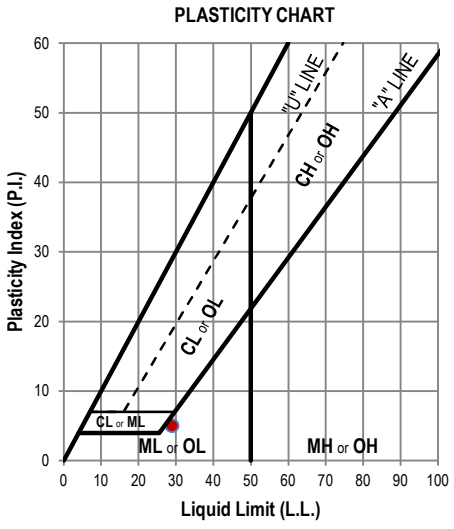
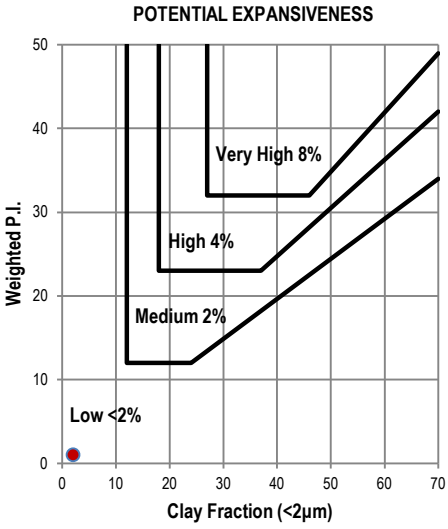
MATERIAL CLASSIFICATION TEST RESULTS

TEST PIT / HOLE No.:	TP6	MATERIAL DEPTH (mm) :	0 - 300	SAMPLE No / LABORATORY No.:	025/1084
MATERIAL DESCRIPTION :	Dry light reddish brown medium dense poorly graded sandstone gravel with silt and SAND.				

IN SITU MOISTURE CONTENT (GR20) (%)		1.4
SIEVE ANALYSIS SANS 3001 - GR1 : 2013	SIEVE SIZE	% PASSING
	63.0 mm	100
	50.0 mm	95
	37.5 mm	86
	28.0 mm	80
	20.0 mm	71
	14.0 mm	61
	5.00 mm	40
	2.00 mm	30
	0.425 mm	19
	0.075 mm	9
*TMH1: METHOD A6	0.002 mm	2
*SANS 3001 PR5: 2011	GRADING MODULUS (GM)	2.42
SOIL MORTAR	COARSE SAND	37
	FINE SAND (Course)	10
	FINE SAND (Medium)	8
	FINE SAND (Fine)	14
	SILT AND CLAY (<0.075mm)	31
ATTERBERG LIMITS MATERIAL PASSING 0.425mm SANS 3001 - GR10: 2011	L.L. (%)	29
	P.I. (%)	5
	L.S. (%)	2.5
* MEASURES OF GRADATIONS	C_U (ASTM D2487)	152.5
	C_C (ASTM D2487)	3.3
	% Clay (>0.002mm)	2
	% Silt (0.075 - 0.002mm)	7
	% Sand (0.075 - 2.0mm)	21
	% Gravel (>2.0mm)	70
CBR DETERMINATION SANS 3001 - GR 40: 2013	MAX. DRY DENSITY (kg/m³)	2088
	OPTIMUM MOISTURE (%)	8.6
	SWELL (%)	0.0
	CBR @ 100%	28
	CBR @ 98%	22
	CBR @ 95%	16
	CBR @ 93%	13
	CBR @ 90%	9
PROCTOR MAX. DRY DENSITY (kg/m³)		1879
*COMPACTIBILITY (Ratio) (SABS 1200 LB)		0.28
*CONDUCTIVITY (Sm⁻¹) (TMH1: Method A20)		0.0605
*pH VALUE (TMH1: Method A21)		8.12
*POTENTIAL EXPANSIVENESS		Low - 0.0mm
*AASHTO SOIL CLASSIFICATION		A-1-a (0)
*UNIFIED SOIL CLASSIFICATION		GP-GM
*COLTO CLASSIFICATION		G8







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APPENDIX D

*DYNAMIC CONE PENETROMETER (DCP'S) TESTS

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DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 1 **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	15	0	-	-	-	-	-
5	40	25	25	5,0	Very Dense	174	57
10	73	58	33	6,6	Dense	144	39
15	111	96	38	7,6	Dense	129	33
20	138	123	27	5,4	Dense	165	52
25	167	152	29	5,8	Dense	157	47
30	193	178	26	5,2	Dense	169	54
35	221	206	28	5,6	Dense	161	49
40	252	237	31	6,2	Dense	150	43
45	285	270	33	6,6	Dense	144	39
50	325	310	40	8,0	Dense	124	31
55	355	340	30	6,0	Dense	154	45
60	381	366	26	5,2	Dense	169	54
65	410	395	29	5,8	Dense	157	47
70	442	427	32	6,4	Dense	147	41
75	475	460	33	6,6	Dense	144	39
80	515	500	40	8,0	Dense	124	31
85	557	542	42	8,4	Dense	119	29
90	597	582	40	8,0	Dense	124	31
95	635	620	38	7,6	Dense	129	33
100	670	655	35	7,0	Dense	137	36
105	714	699	44	8,8	Dense	115	27
110	760	745	46	9,2	Dense	111	25
115	794	779	34	6,8	Dense	140	38
120	826	811	32	6,4	Dense	147	41
125	866	851	40	8,0	Dense	124	31
130	914	899	48	9,6	Dense	107	24
135	958	943	44	8,8	Dense	115	27
140	997	982	39	7,8	Dense	126	32
145	1045	1030	48	9,6	Dense	107	24
150	1075	1060	30	6,0	Dense	154	45
155	1112	1097	37	7,4	Dense	132	34
160	1153	1138	41	8,2	Dense	122	30
165	1191	1176	38	7,6	Dense	129	33
170	1233	1218	42	8,4	Dense	119	29
175	1265	1250	32	6,4	Dense	147	41
180	1304	1289	39	7,8	Dense	126	32
185	1350	1335	46	9,2	Dense	111	25
190	1390	1375	40	8,0	Dense	124	31
195	1440	1425	50	10,0	Dense	104	23
200	1496	1481	56	11,2	Dense	95	20
205	1542	1527	46	9,2	Dense	111	25
210	1588	1573	46	9,2	Dense	111	25
215	1632	1617	44	8,8	Dense	115	27
220	1669	1654	37	7,4	Dense	132	34
225	1719	1704	50	10,0	Dense	104	23
230	1774	1759	55	11,0	Dense	97	20
235	1815	1800	41	8,2	Dense	122	30
240	1861	1846	46	9,2	Dense	111	25
245	1897	1882	36	7,2	Dense	134	35
250	1897	1882	0	0,0	Very Dense	> 200	> 110

** According to Dr B van Wyk's Method

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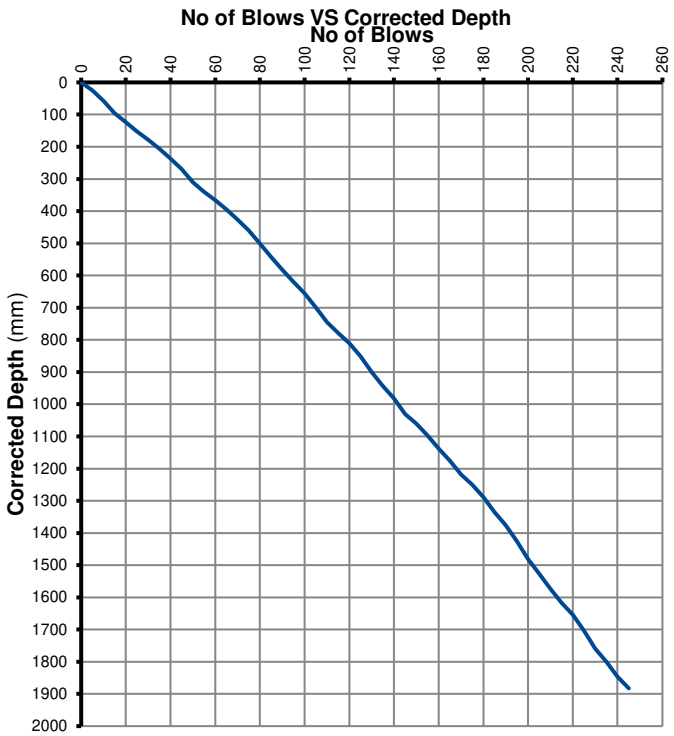
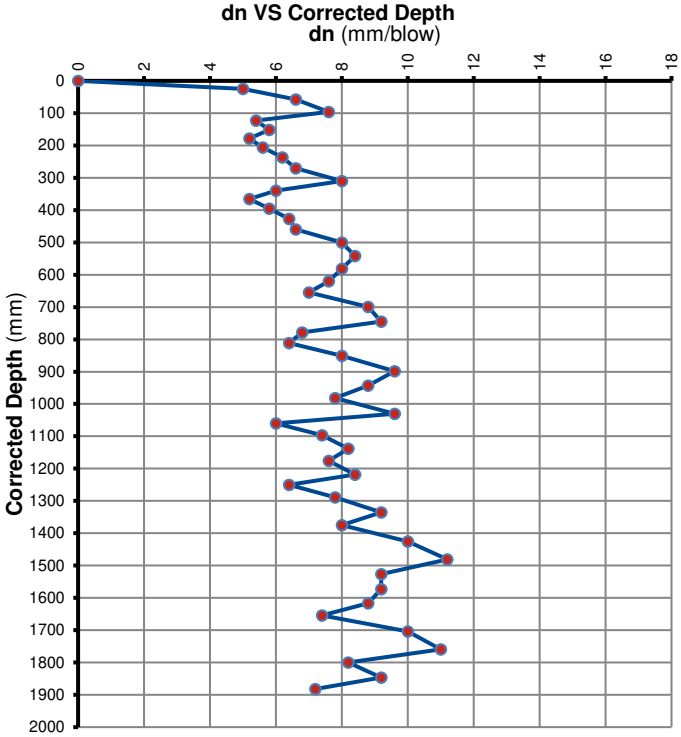
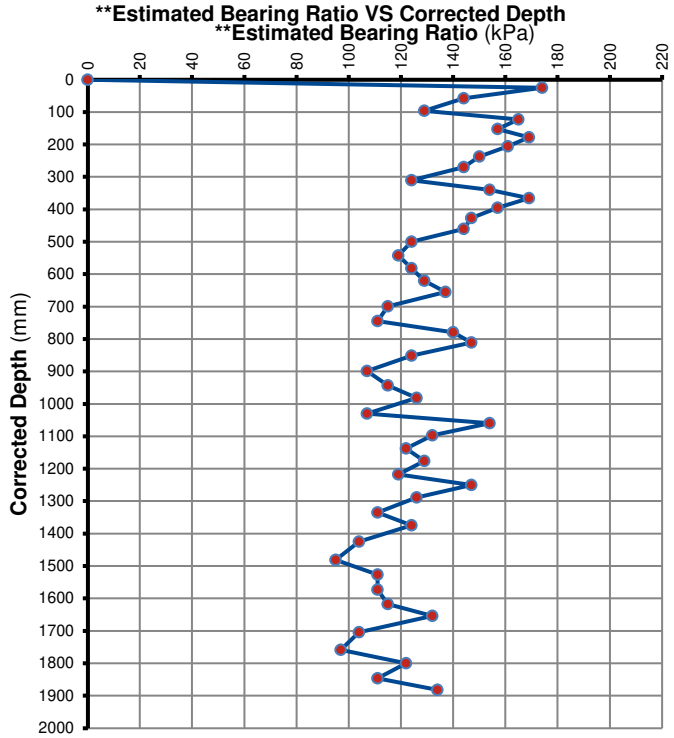
DYNAMIC CONE PENETROMETER (DCP) TEST

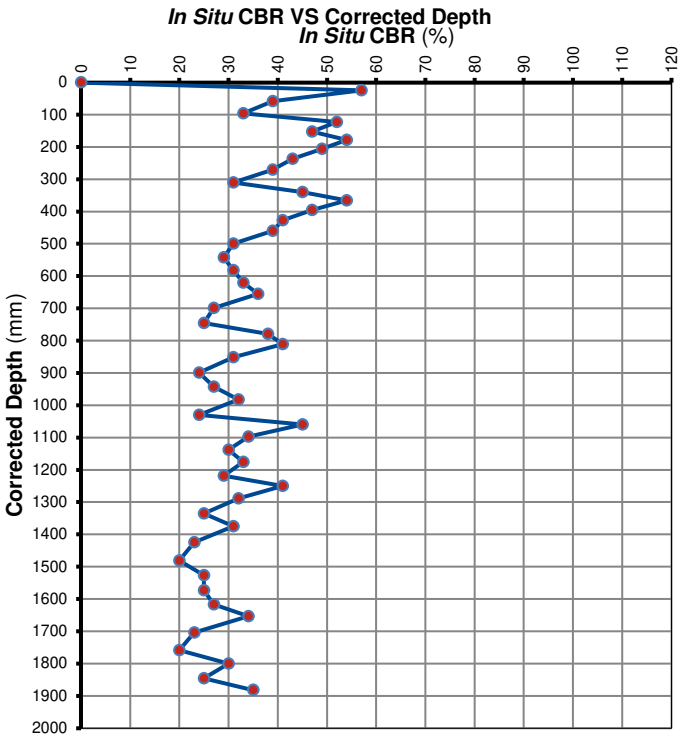
POSITION: Test Pit 1 **DEPTH BELOW NGL:** 0.000m

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









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DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 2 **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	20	0	-	-	-	-	-
5	35	15	15	3,0	Very Dense	> 200	> 110
10	54	34	19	3,8	Very Dense	> 200	82
15	67	47	13	2,6	Very Dense	> 200	> 110
20	84	64	17	3,4	Very Dense	> 200	95
25	102	82	18	3,6	Very Dense	> 200	88
30	125	105	23	4,6	Very Dense	183	64
35	153	133	28	5,6	Dense	161	49
40	175	155	22	4,4	Very Dense	188	68
45	202	182	27	5,4	Dense	165	52
50	238	218	36	7,2	Dense	134	35
55	269	249	31	6,2	Dense	150	43
60	306	286	37	7,4	Dense	132	34
65	339	319	33	6,6	Dense	144	39
70	379	359	40	8,0	Dense	124	31
75	424	404	45	9,0	Dense	113	26
80	472	452	48	9,6	Dense	107	24
85	518	498	46	9,2	Dense	111	25
90	554	534	36	7,2	Dense	134	35
95	584	564	30	6,0	Dense	154	45
100	621	601	37	7,4	Dense	132	34
105	661	641	40	8,0	Dense	124	31
110	702	682	41	8,2	Dense	122	30
115	731	711	29	5,8	Dense	157	47
120	759	739	28	5,6	Dense	161	49
125	792	772	33	6,6	Dense	144	39
130	829	809	37	7,4	Dense	132	34
135	865	845	36	7,2	Dense	134	35
140	904	884	39	7,8	Dense	126	32
145	944	924	40	8,0	Dense	124	31
150	987	967	43	8,6	Dense	117	28
155	1033	1013	46	9,2	Dense	111	25
160	1073	1053	40	8,0	Dense	124	31
165	1112	1092	39	7,8	Dense	126	32
170	1163	1143	51	10,2	Dense	102	22
175	1211	1191	48	9,6	Dense	107	24
180	1258	1238	47	9,4	Dense	109	25
185	1308	1288	50	10,0	Dense	104	23
190	1347	1327	39	7,8	Dense	126	32
195	1393	1373	46	9,2	Dense	111	25
200	1438	1418	45	9,0	Dense	113	26
205	1475	1455	37	7,4	Dense	132	34
210	1515	1495	40	8,0	Dense	124	31
215	1557	1537	42	8,4	Dense	119	29
220	1607	1587	50	10,0	Dense	104	23
225	1665	1645	58	11,6	Dense	93	19
230	1724	1704	59	11,8	Dense	92	18
235	1779	1759	55	11,0	Dense	97	20
240	1836	1816	57	11,4	Dense	94	19
245	1881	1861	45	9,0	Dense	113	26
250	1932	1912	51	10,2	Dense	102	22
255	1932	1912	0	0,0	Very Dense	> 200	> 110

** According to Dr B van Wyk's Method

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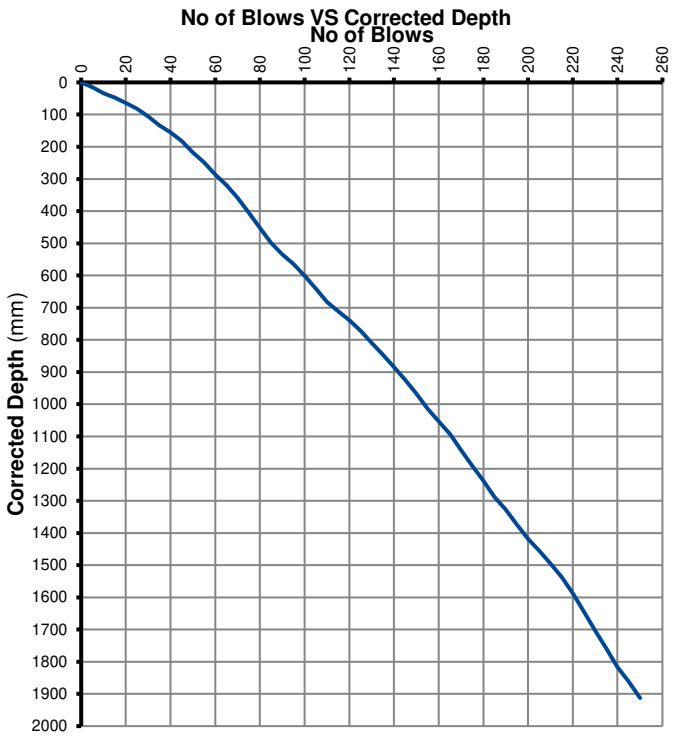
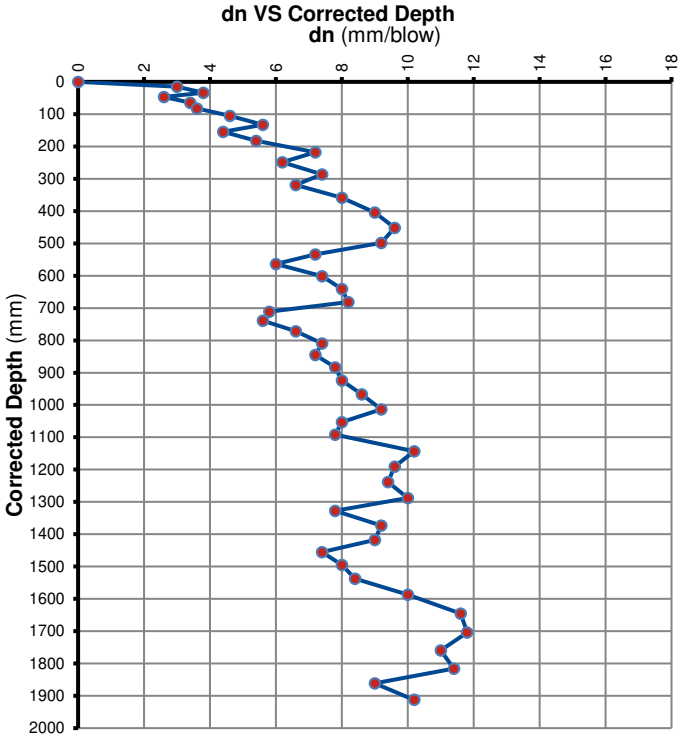
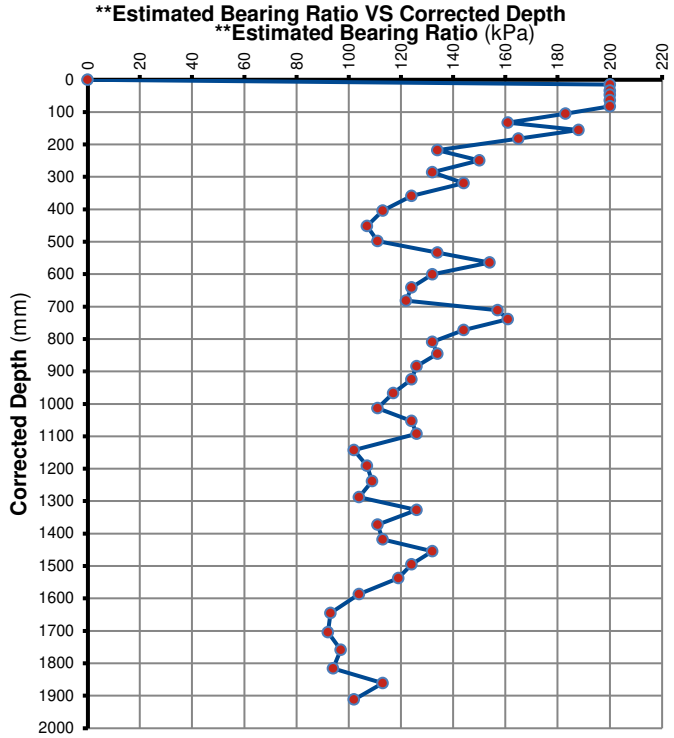
DYNAMIC CONE PENETROMETER (DCP) TEST

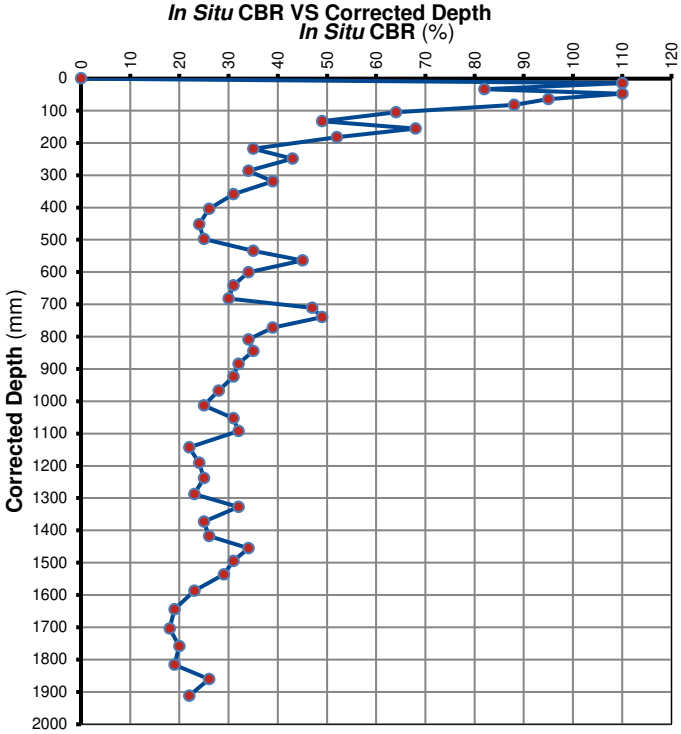
POSITION: Test Pit 2 **DEPTH BELOW NGL:** 0.000m

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









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DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 3 **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	30	0	-	-	-	-	-
5	53	23	23	4,6	Very Dense	183	64
10	88	58	35	7,0	Dense	137	36
15	125	95	37	7,4	Dense	132	34
20	147	117	22	4,4	Very Dense	188	68
25	177	147	30	6,0	Dense	154	45
30	210	180	33	6,6	Dense	144	39
35	243	213	33	6,6	Dense	144	39
40	268	238	25	5,0	Very Dense	174	57
45	294	264	26	5,2	Dense	169	54
50	328	298	34	6,8	Dense	140	38
55	357	327	29	5,8	Dense	157	47
60	386	356	29	5,8	Dense	157	47
65	416	386	30	6,0	Dense	154	45
70	451	421	35	7,0	Dense	137	36
75	488	458	37	7,4	Dense	132	34
80	519	489	31	6,2	Dense	150	43
85	559	529	40	8,0	Dense	124	31
90	602	572	43	8,6	Dense	117	28
95	646	616	44	8,8	Dense	115	27
100	682	652	36	7,2	Dense	134	35
105	722	692	40	8,0	Dense	124	31
110	765	735	43	8,6	Dense	117	28
115	813	783	48	9,6	Dense	107	24
120	859	829	46	9,2	Dense	111	25
125	906	876	47	9,4	Dense	109	25
130	954	924	48	9,6	Dense	107	24
135	1000	970	46	9,2	Dense	111	25
140	1043	1013	43	8,6	Dense	117	28
145	1092	1062	49	9,8	Dense	106	23
150	1133	1103	41	8,2	Dense	122	30
155	1172	1142	39	7,8	Dense	126	32
160	1217	1187	45	9,0	Dense	113	26
165	1217 Refusal	1187	0	0,0	Very Dense	> 200	> 110

** According to Dr B van Wyk's Method

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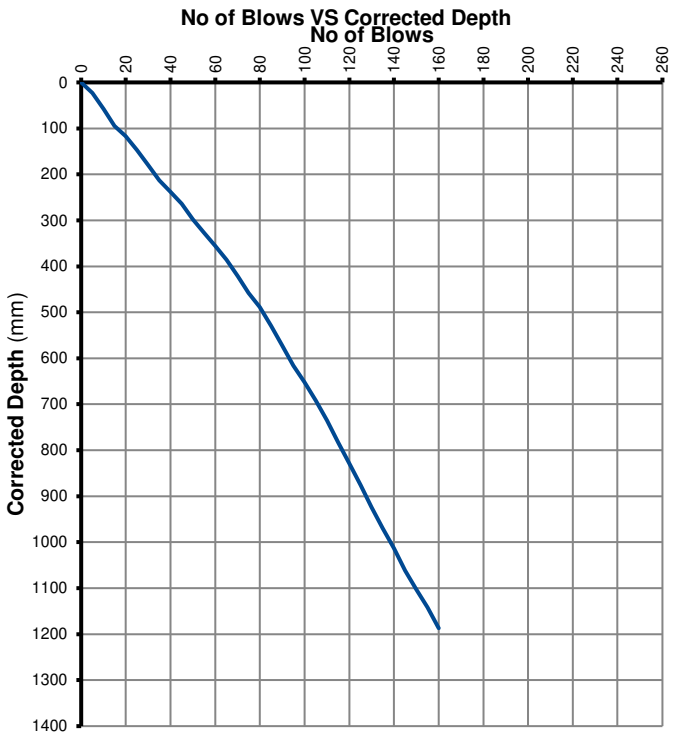
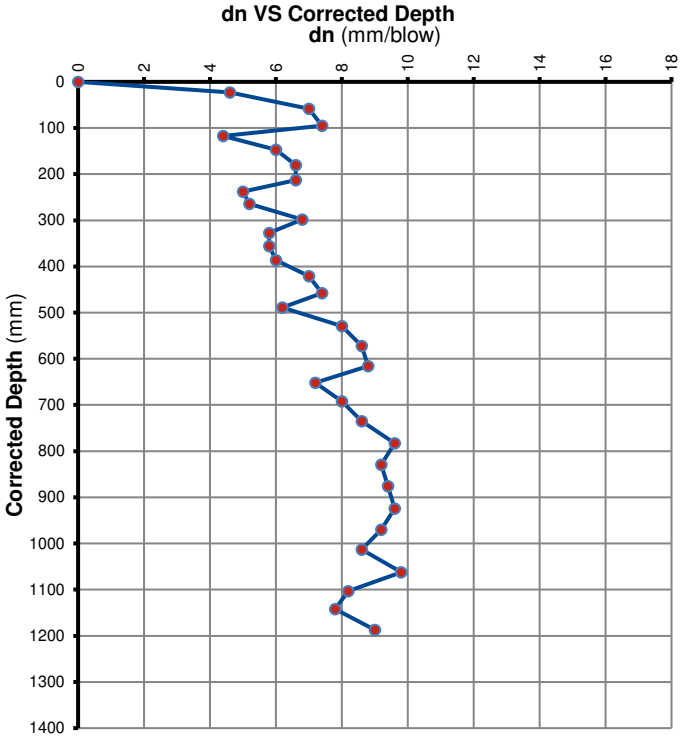
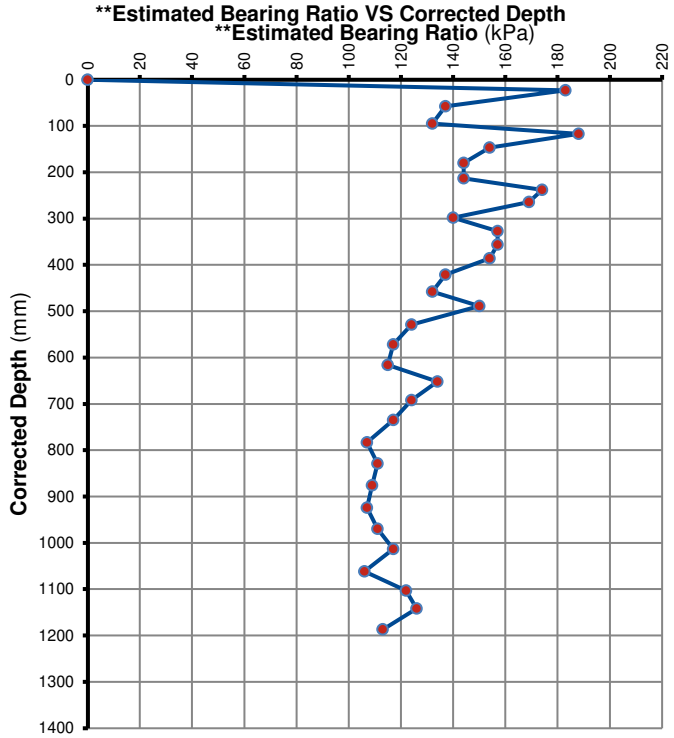
DYNAMIC CONE PENETROMETER (DCP) TEST

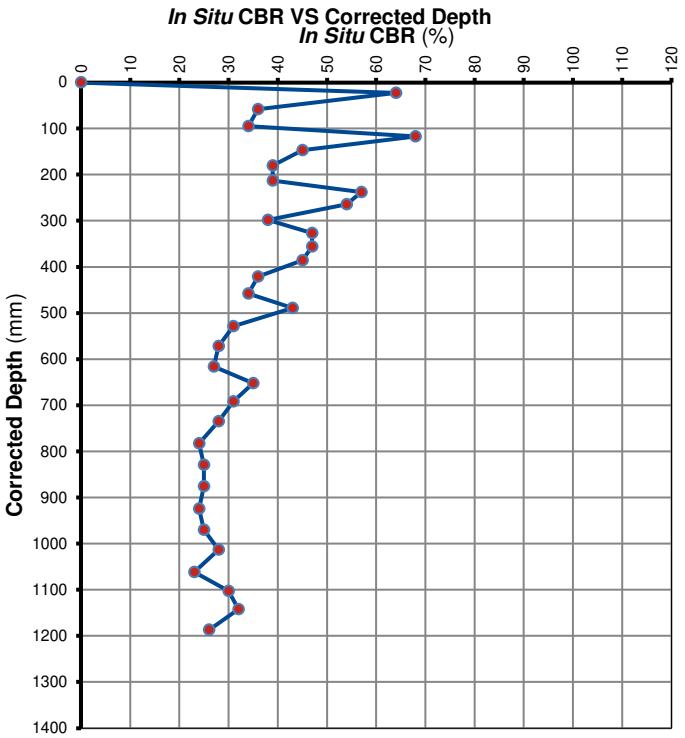
POSITION: Test Pit 3 **DEPTH BELOW NGL:** 0.000m

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









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DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 4 **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	11	0	-	-	-	-	-
5	24	13	13	2,6	Very Dense	> 200	> 110
10	43	32	19	3,8	Very Dense	> 200	82
15	53	42	10	2,0	Very Dense	> 200	> 110
20	65	54	12	2,4	Very Dense	> 200	> 110
25	85	74	20	4,0	Very Dense	200	77
30	105	94	20	4,0	Very Dense	200	77
35	125	114	20	4,0	Very Dense	200	77
40	140	129	15	3,0	Very Dense	> 200	> 110
45	155	144	15	3,0	Very Dense	> 200	> 110
50	169	158	14	2,8	Very Dense	> 200	> 110
55	182	171	13	2,6	Very Dense	> 200	> 110
60	187	176	5	1,0	Very Dense	> 200	> 110
65	187	176	0	0,0	Very Dense	> 200	> 110

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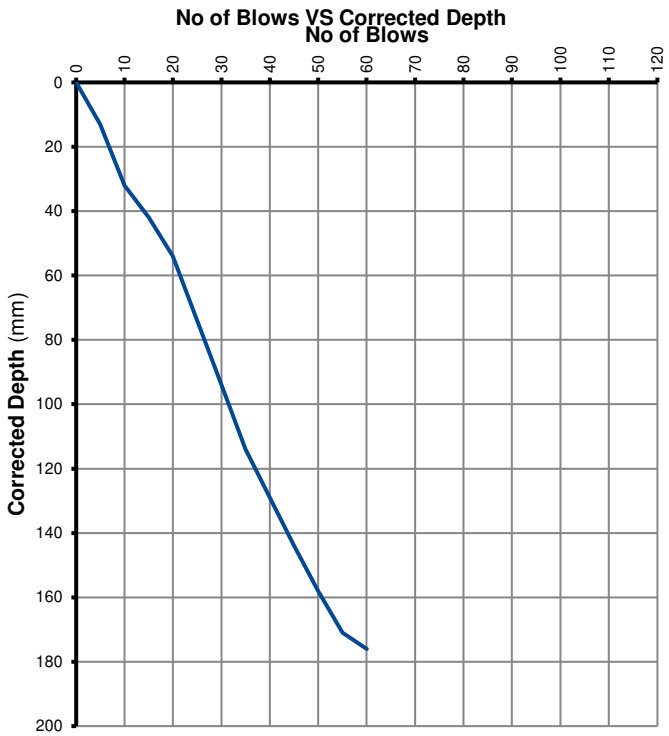
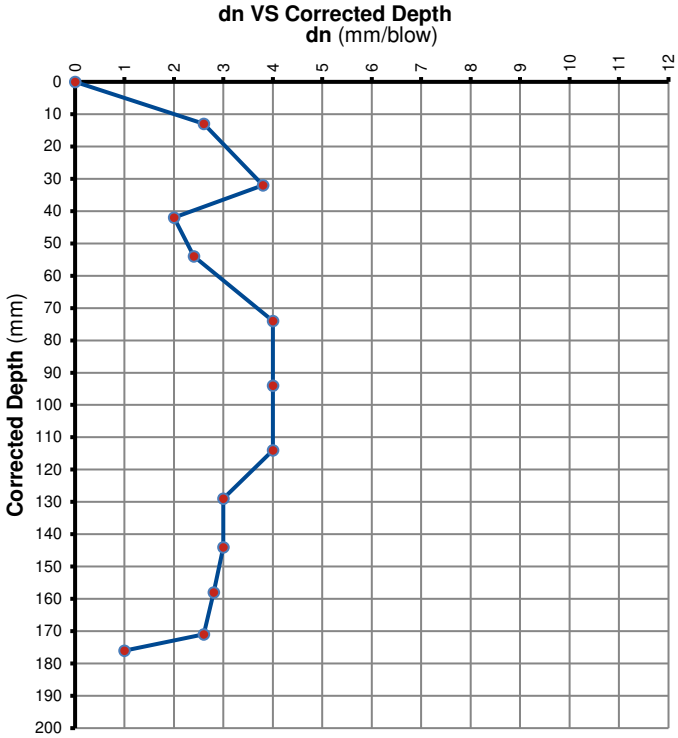
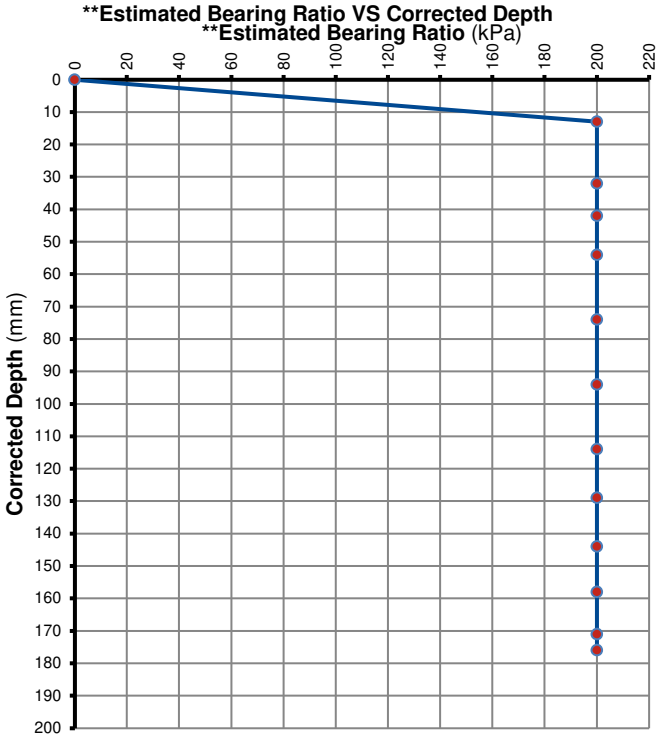
DYNAMIC CONE PENETROMETER (DCP) TEST

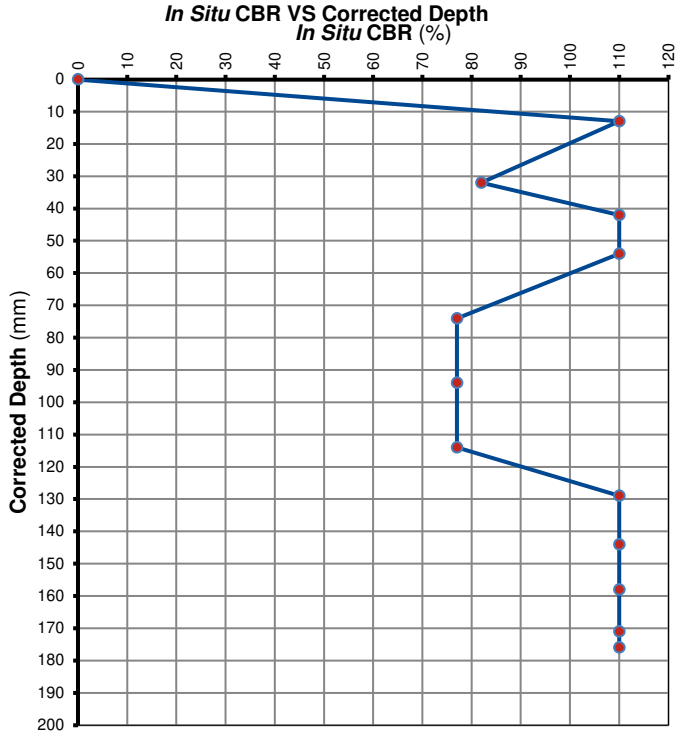
POSITION: Test Pit 4 **DEPTH BELOW NGL:** 0.000m

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









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DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 5 **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	22	0	-	-	-	-	-
5	35	13	13	2,6	Very Dense	> 200	> 110
10	51	29	16	3,2	Very Dense	> 200	103
15	69	47	18	3,6	Very Dense	> 200	88
20	88	66	19	3,8	Very Dense	> 200	82
25	100	78	12	2,4	Very Dense	> 200	> 110
30	120	98	20	4,0	Very Dense	200	77
35	144	122	24	4,8	Very Dense	178	60
40	165	143	21	4,2	Very Dense	193	72
45	187	165	22	4,4	Very Dense	188	68
50	213	191	26	5,2	Dense	169	54
55	241	219	28	5,6	Dense	161	49
60	265	243	24	4,8	Very Dense	178	60
65	293	271	28	5,6	Dense	161	49
70	324	302	31	6,2	Dense	150	43
75	348	326	24	4,8	Very Dense	178	60
80	384	362	36	7,2	Dense	134	35
85	415	393	31	6,2	Dense	150	43
90	437	415	22	4,4	Very Dense	188	68
95	466	444	29	5,8	Dense	157	47
100	492	470	26	5,2	Dense	169	54
105	501	479	9	1,8	Very Dense	> 200	> 110
110	512	490	11	2,2	Very Dense	> 200	> 110
115	513	491	1	0,2	Very Dense	> 200	> 110
120	513	491	0	0,0	Very Dense	> 200	> 110

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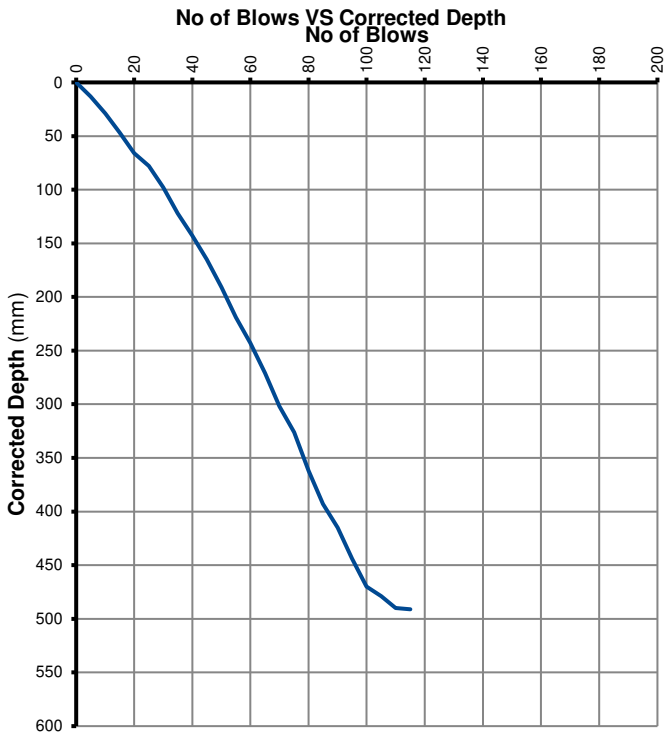
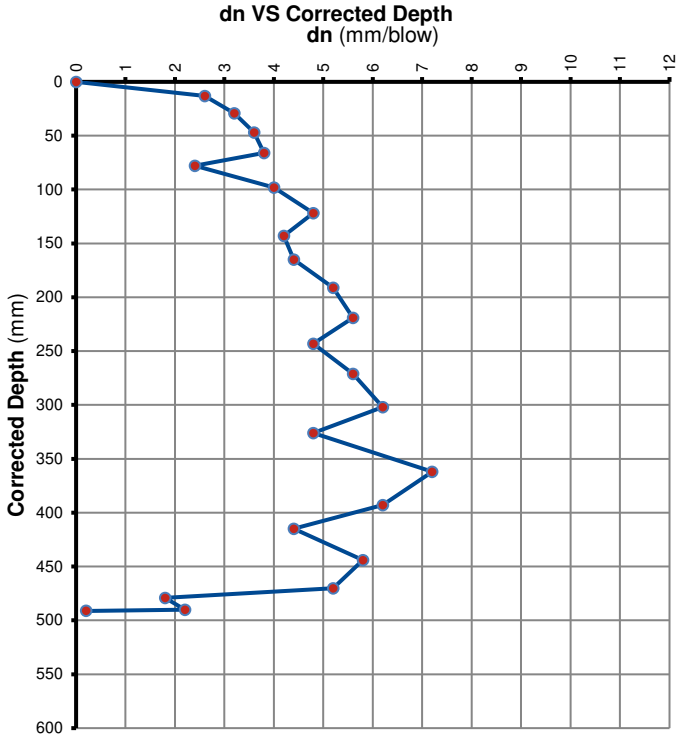
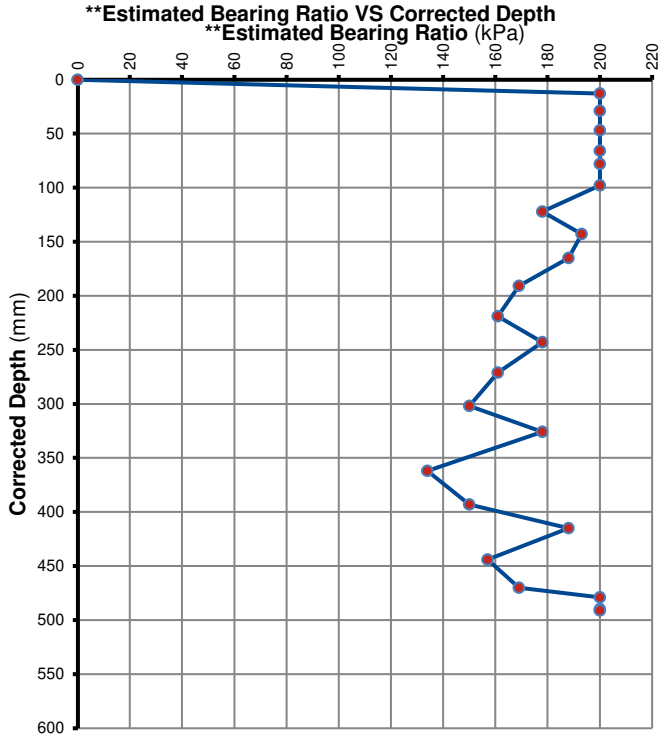
DYNAMIC CONE PENETROMETER (DCP) TEST

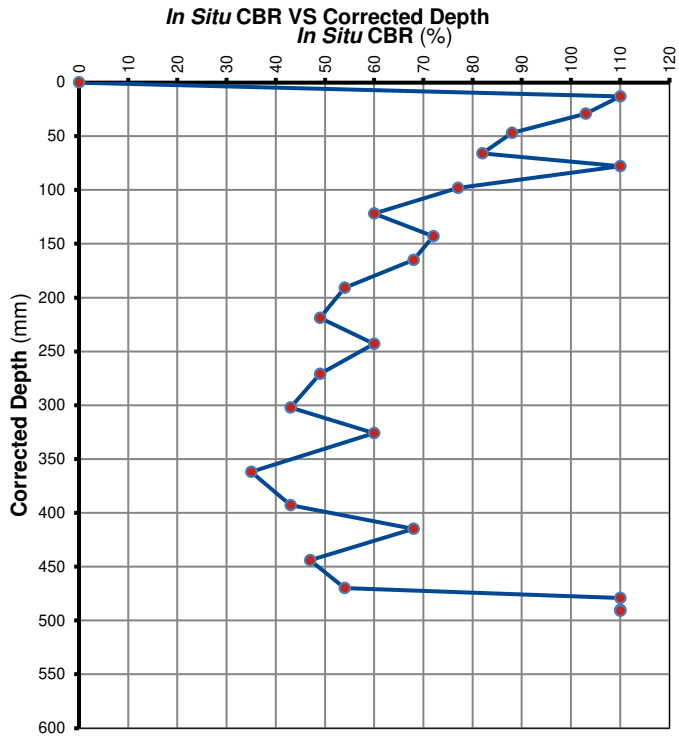
POSITION: Test Pit 5 **DEPTH BELOW NGL:** 0.000m

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









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DYNAMIC CONE PENETROMETER (DCP) TEST

POSITION: Test Pit 6 **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	11	0	-	-	-	-	-
5	26	15	15	3,0	Very Dense	> 200	> 110
10	39	28	13	2,6	Very Dense	> 200	> 110
15	57	46	18	3,6	Very Dense	> 200	88
20	73	62	16	3,2	Very Dense	> 200	103
25	93	82	20	4,0	Very Dense	200	77
30	112	101	19	3,8	Very Dense	> 200	82
35	132	121	20	4,0	Very Dense	200	77
40	157	146	25	5,0	Very Dense	174	57
45	177	166	20	4,0	Very Dense	200	77
50	198	187	21	4,2	Very Dense	193	72
55	226	215	28	5,6	Dense	161	49
60	247	236	21	4,2	Very Dense	193	72
65	277	266	30	6,0	Dense	154	45
70	277	266	0	0,0	Very Dense	> 200	> 110

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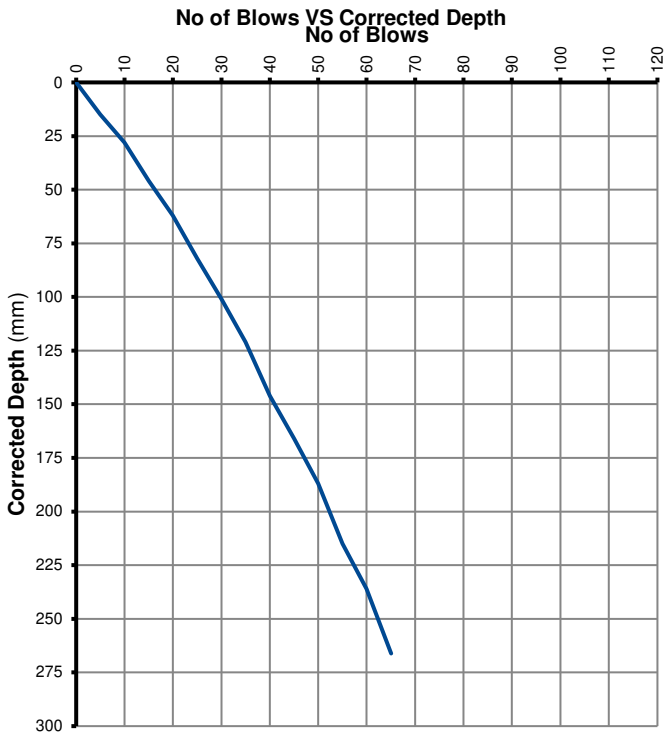
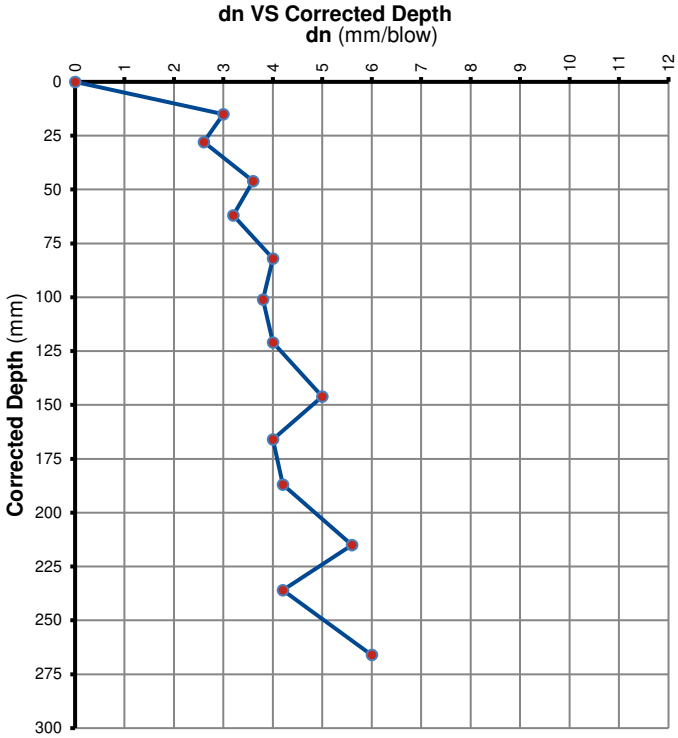
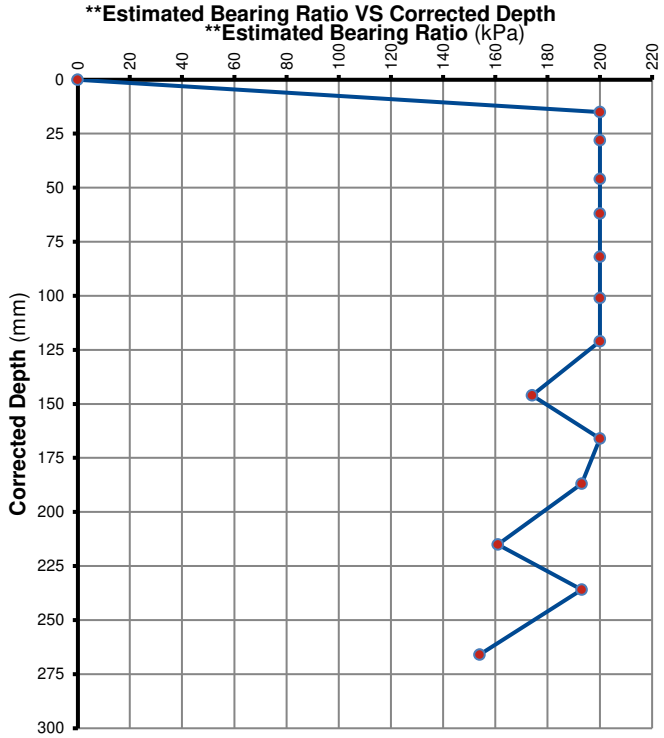
DYNAMIC CONE PENETROMETER (DCP) TEST

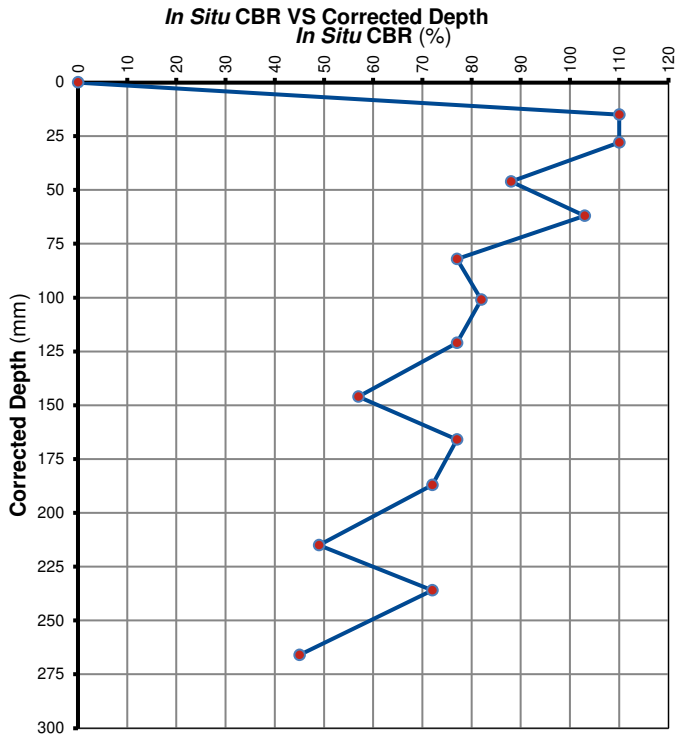
POSITION: Test Pit 6 **DEPTH BELOW NGL:** 0.000m

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









** According to Dr B van Wyk's Method

APPENDIX E
SITE PHOTOS

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SITE PHOTOS

Test Pit 1

Test Pit 2

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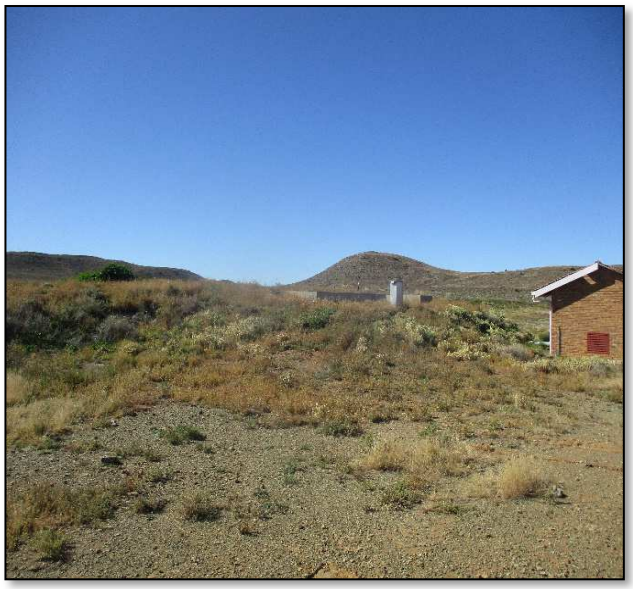
SITE PHOTOS

Test Pit 3



Test Pit 4

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SITE PHOTOS

Test Pit 5

Test Pit 6

APPENDIX F
SITE AND TEST PIT PHOTO'S

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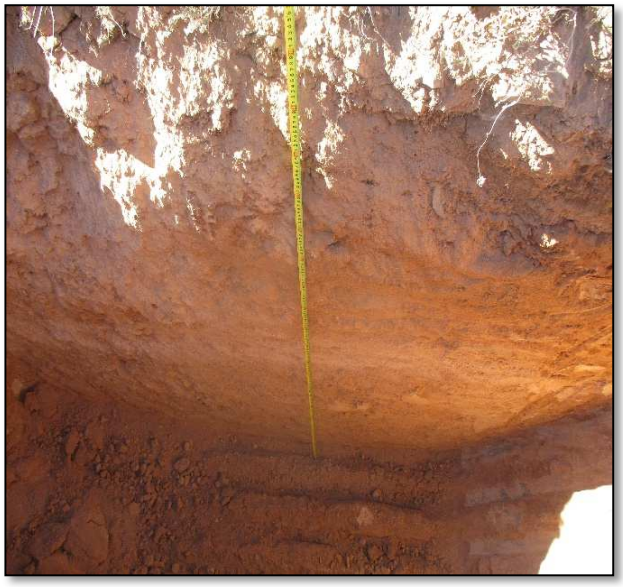
SITE AND TEST PIT PHOTOS

Test Pit 1



Test Pit 2

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SITE AND TEST PIT PHOTOS

Test Pit 3

Test Pit 4

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SITE AND TEST PIT PHOTOS

Test Pit 5

Test Pit 6

APPENDIX G
LAYOUT PLAN

Simlab (EDMS) BEPERK GEOTEGNIESE DIENSTE
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LAYOUT PLAN

COORDINATES

Test Pit 1 23 Y0082068 X3426684
Test Pit 2 23 Y0082035 X3426689
Test Pit 3 23 Y0082007 X3426929
Test Pit 4 23 Y0082151 X3426951
Test Pit 5 23 Y0082147 X3426964
Test Pit 6 23 Y0082105 X3426961

APPENDIX H
GEOLOGICAL PLAN

Simlab (EDMS) BEPERK GEOTEGNIESE DIENSTE
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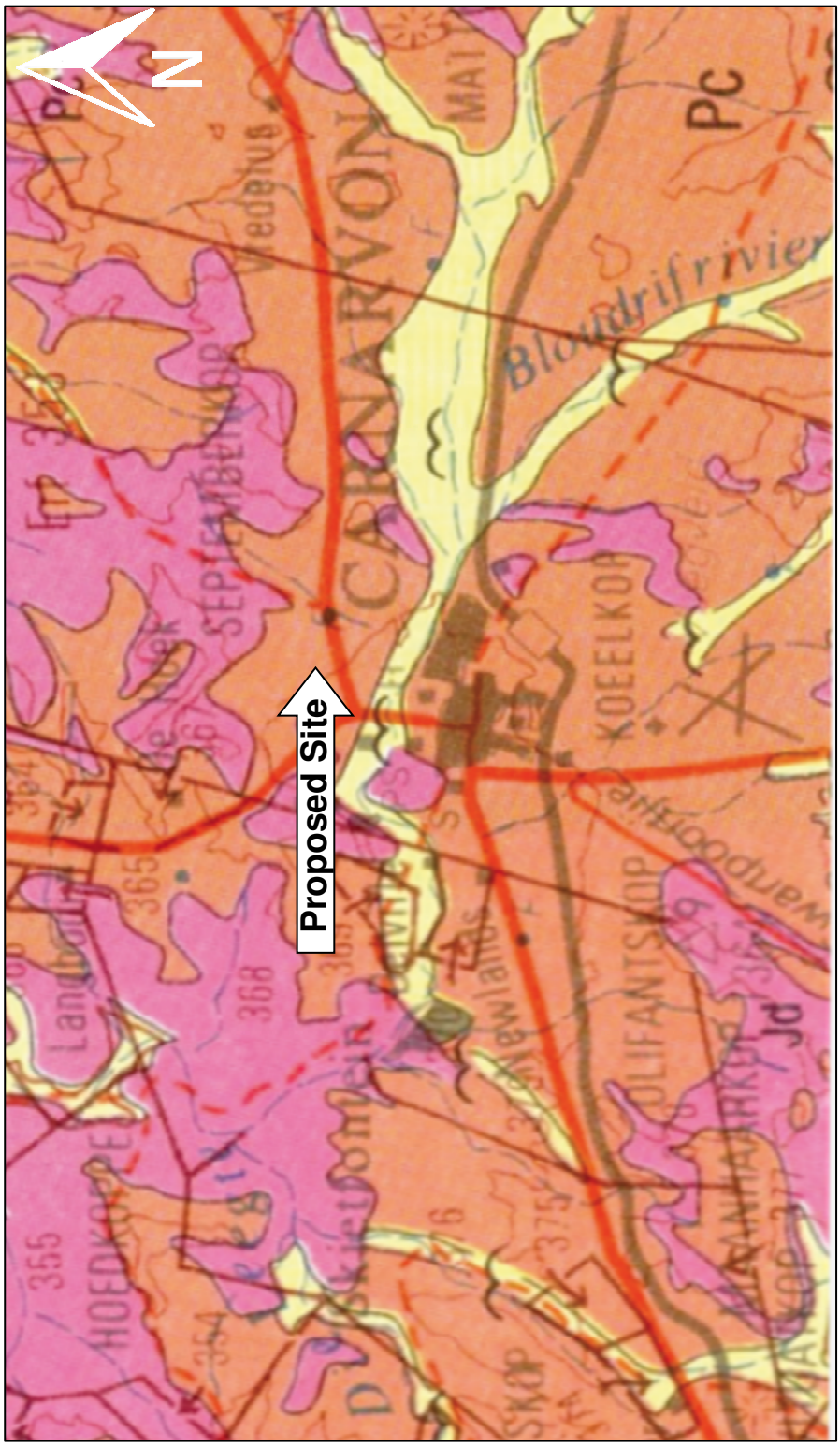
GEOLOGICAL PLAN



Alluvium

Pc - Grey to blue-grey mudstone, siltstone and sandstone

Jd - Intrusive Dolerite

Scale of Detail - 1 : 250 000