P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

GEOTECHNICAL INVESTIGATION REPORT FOR PROPOSED RESIDENTIAL HOUSES, MATWABENG, FREE STATE PROVINCE.

FINAL REPORT

Prepared by

Phezulu Geotechnical Civils

Prepared for

Servinet Consulting Engineers

Date

January 2021

Project Ref

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Prepared by	**Phezulu Geotechnical Civils**		
Revised and approved by	**G. Ndlela** *On Behalf of:* ***Phezulu Geotechnical Civils***	Pr. Sci. Nat., MSAIEG - Reg. No. 400162/11	
Under the directive of	**Mr. X.R Nhlabathi**	Technical Director	

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1. INTRODUCTION

This report presents the results and findings of a geotechnical investigation conducted for the proposed construction **of Residential houses at Matwabeng.** The investigation was authorized by **Servinet Consulting Engineers** through approval of a quotation that was prepared by **Phezulu Geotechnical Civils.**

2. SCOPE OF THE WORK

The investigation was carried out in accordance with the GFSH-2 guidelines published by the Department of Housing (2002), The application of the national building regulations (SANS 10400-H) and SANS 634 (Geotechnical investigation for Housing developments) guidelines.

The objectives of the geotechnical investigation included but not limited to:

- Describing the location, topography, and geology of the proposed site,
- Evaluate the geological and geotechnical conditions of the soils underlying the site,
- Establish the soil profiles across the site and expected founding conditions,
- Evaluate their engineering properties and suitability for the proposed development,
- Highlighting any problem soils, slope stability or drainage issues,
- Assess the groundwater conditions, including surface run off possibilities, seepage, ponding, and note the occurrence of any perched or permanent water tables.
- Evaluate the workability of the site materials regarding their excitability and compatibility,
- Determining the suitability of the site for the proposed development and make recommendations for the design earthwork, foundations, and engineering services.

3. NATURE OF THE INVESTIGATION

The geotechnical site investigation involved excavating a total of Ten (10) trial pits with a TLB to maximum of 3m or refusal, soil profiling, soil sampling for laboratory tests and conducting dynamic probe light **(DPL)** test.

Soil samples were collected for the following laboratory tests:

- Foundation indicator test (Grading, Atterberg limits and potential expansiveness),
- MOD/CBR/ Indicator tests (Determine the suitability for possible road pavements material use),
- Chemical Test (PH and Conductivity)

4. AVAILABLE INFORMATION

The following maps and/or plans were available for reference purposes and are reproduced in this report:

- Google Earth® imagery maps,
- 1:250 000 Geological maps of the area: **2826 Winburg**
- Topographical sheet, raster image 2826/2827.
- Generic Specification GFSH-2, National Department of Housing Specification: Geotechnical site investigations for housing development, September 2002
- NHBRC Home Building Manual, Part 1 and 2, dated March 2015
- South African National Standards: Geotechnical investigations for township development (SANS 634:2012)

5. GENERAL DESCRIPTION OF SITE

5.1. Site location and size

The study area for this investigation is located at **Matwabeng**, Setsoto Local Municipality, Thabo Mofutsanyane District Municipality, Free State, South Africa. Matwabeng is located approximately 75km south west of Bethlehem CBD (via N5 Road) and 130km north of Maseru Bridge boarder post. The area is located at the following absolute coordinates: Latitude **28°20'39.71"S** and Longitude **27°38'16.85"E**.

The total area of the stand boundary is **14.5 ha**

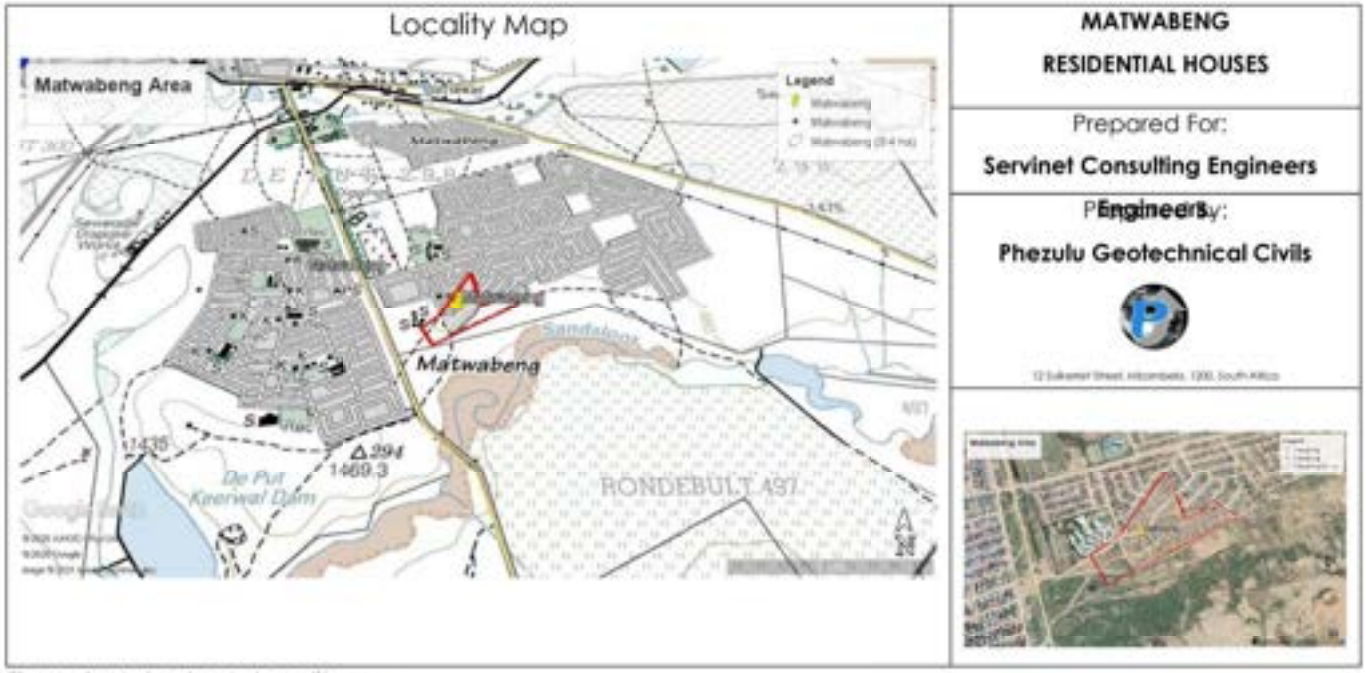

Figure 1: Matwabeng Locality Map

5.2 Existing facilities

According to Google Earth Map(last update 2019), the site was entirely occupied by shacks though out however during the site investigation (carried out January 2021), it was found that most shacks were demolished with only few remnants identified. Some portion of this site is used as a dump site.

Figure 2: Site during investigation

6.1 5.3 Climate and weathering

The climate of this area was extracted from the document titled "Integrated ***Environmental Management Plan: Setsoso Local Municipality (2019/2020***)". According ti the above mentioned document, municipality falls within the summer rainfall area, of which differs with the season of the year. Rainfall is recorded where highest rainfall occurs in the summer season and least amount of rain winter period. Rainfall averages between 600 mm and 750 mm . Matwabeng like the other eastern parts of the Free State province has a climate characterized by warm to hot summers and cold winters.

The area generally has a low average temperature; therefore, the design of buildings needs to carefully consider insulation, orientation, materials and environmentally sensitive designs linked to thermal considerations. The highest temperatures are experienced between November and February when an average temperature of up to 29C have been recorded. Then the coldest average daily temperature is experienced in June and July when average minimum temperatures are below 0C.

The climatic regime plays a fundamental role in the development of a soil profile. Weinert (1980) demonstrated that mechanical disintegration is the predominant mode of rock weathering in areas where the climatic "N-value" is greater than 5, while chemical decomposition predominates where the N-value is less than 5. Weinert's climatic N-value for the project area is between 2-5 which indicates the predominantly chemical decomposition of the underlying rock has taken place as shown in Figure 3 – Macro-climatic region of South Africa. However, this does not rule out the occurrence of mechanical weathering of rock.

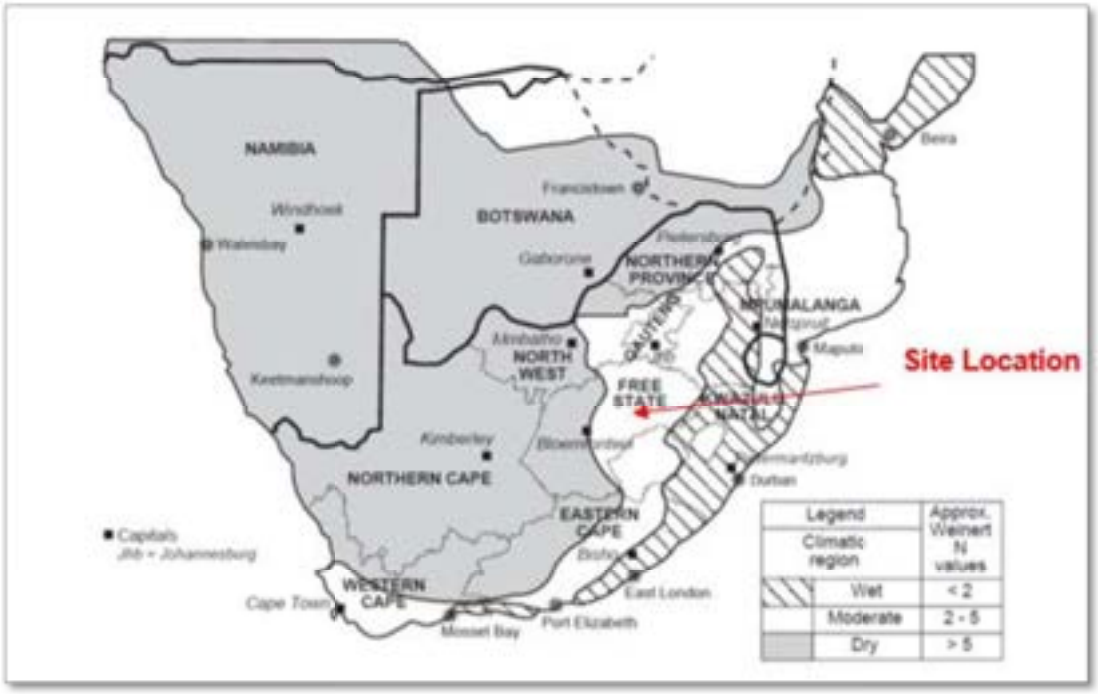

Figure 3: Macro-climatic regions of Southern Africa (source: adapted from Weinert, 1980)

5.4Topography

The area drains towards the south into the Sandsloot River (approximately 240m from site boundary. (see Figure 1: Locality map)

5.5 Site geology

According to the published 1:250 000 **2826 Winburg** geological map and the 1:2000000 of **South Africa Geological Map**. The area falls under Adelaide subgroup of the Beauford the Karoo Supergroup. Adelaide subgroup comprises of rocks such as exceptionally fine to coarse grained buff white and white sandstone, blue grey shales and subordinates' conglomerates. The most predominate rocks on site were the weathered sandstones.

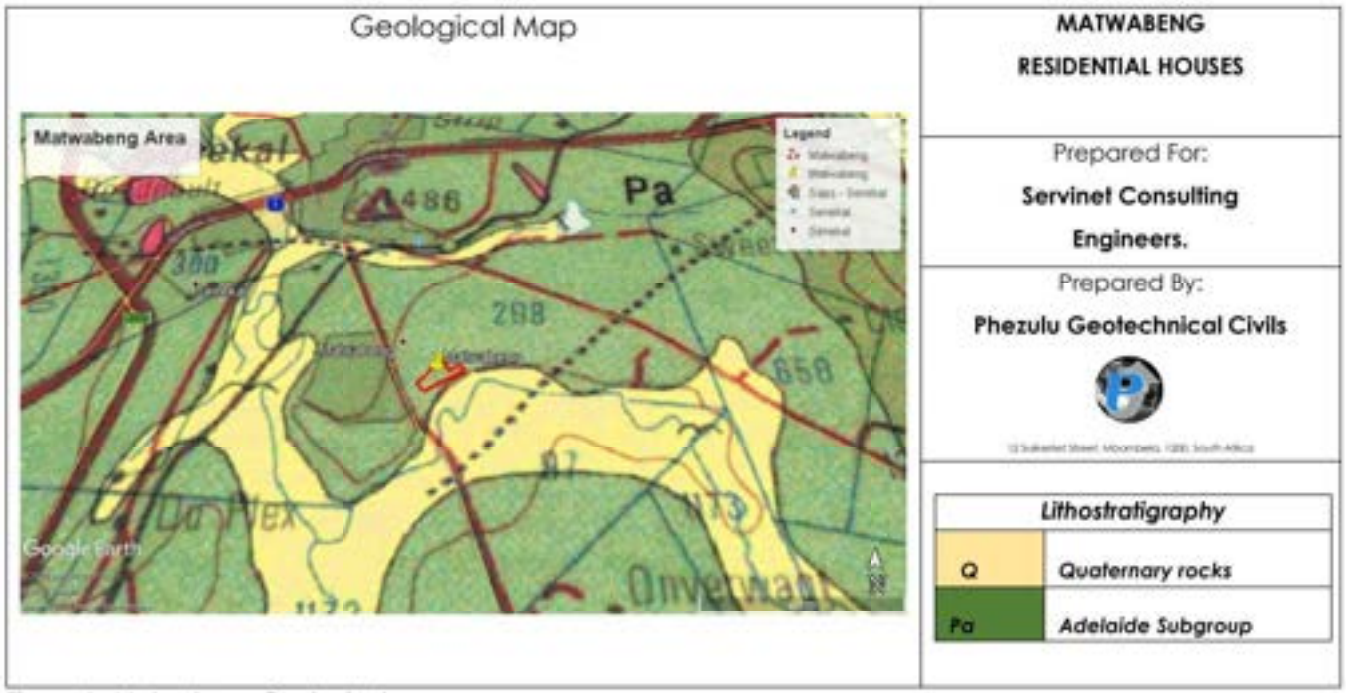

Figure 4 : Matwabeng Geological map

6 INVESTIGATION RESULTS

6.1 Excavation of test pits

The subsurface investigation comprised of the excavation of 10 test pits. The number of test pits excavated is set in accordance with SANS 634:2011 (Geotechnical investigation for township development) and GFSH-2 (Generic specification,2002) standards. All trial pits coordinates were recorded using a handheld GPS, the position of test pits was placed randomly with respect to site layout and in such a manner that covers the whole site. The trial pits were excavated to the depth of refusal of the TLB **(BELL 315SJ TURBO 4X4)** or refusal on a bedrock.

Each trial pit was profiled and photographed by field engineering Geologist in accordance with the current MCCSSO standard procedures proposed by Brink and Bruin (2002). All the test pits are then backfilled and lightly compacted after completion of fieldwork.

Figure 5: Test Pits Positions

6.1.1 Generalized soil profiles.

Descriptions of the various soil strata as encountered in the test pits are summarized below and detailed soil profiles and photos are given in appendix B.

6.1.1.1 Hill wash

The project area is covered by a thick layer of transported material, deemed to represent hill wash. This material is generally described as slightly moist to moist, loose/dense clayey sand with an intact structure. This layer overlies the residual horizon across the site. It extends from the surface to the maximum depth of 0.60 m.

6.1.1.2 Residual

Residual soils developed from the highly in-situ weathering of bedrock were encountered underlying bedrock at depths up to 2.10m. These soils comprised of moist, light brown to yellow, dense to very dense, intact, clayey sand/sand materials.

6.1.1.3 Bedrocks

Weathered Adelaide shales and sandstones were encountered in various test pits throughout the site.

Figure 6 : Typical soils profiles

6.1.2 Groundwater occurrence

No groundwater was encountered on site(however the ground was moist in certain areas).

6.2 DPL

A total of 9 DPL tests were carried out, one next to each inspection pit position after excavation and sampling was conducted. The DPL tests were carried out to assess the bearing capacity of the insitu material.

The results as shown on the DPL results attached on appendix 3 indicate that the in-situ material has stiff to hard materials with ±150kPa up to a maximum depth of 2.1m below the existing ground level with hard (bearing capacity of more than 150kPa) on materials only existing after 2.1m up to the maximum refusal depth of 3.0m below the existing ground level. Detailed test results is attached on appendix C.

6.3 Percolation Test

Long-term sustainable infiltration rates may be affected by several factors including the movement of the water into the soil (permeability). For residential development, an onsite storm water infiltration is normally utilized. This normally includes diversion of the storm water into a system that will allow infiltration into the ground. For the purpose of this project, on-site percolation test was conducted with respect to the site boundaries to deduce the onsite percolation rate.

Note that no factor of safety is applied to the calculated value. The actual percolation rate may be significantly different based on the actual soil exposures.

Two site permeability tests were conducted, and the results are summarized below:

Table 1: Percolation test

Hole no.	Percolation Time(min)	Interval time in min	Percolation Depth(cm)	Percolation rate(min/cm)
Test 1	0	0	130	0.000
	5	5	100	0.0500
	10	5	85	0.0588
	15	5	75	0.0667
	20	5	70	0.0714
	25	5	60	0.0833
	30	5	57	0.0877
	35	5	50	0.1000
	40	5	47	0.1064
	45	5	40	0.1250
	50	5	40	0.1250
	55	5	37	0.1351
	60	5	35	0.1429
Test 2	0	0	140	0.0000
	5	5	130	0.0385
	10	5	120	0.0417
	15	5	110	0.0455
	20	5	110	0.0455
	35	15	90	0.1667
	50	15	80	0.1875
	65	15	70	0.2142
	95	30	60	0.5000
	125	30	50	0.6000
Result of the Test				Pass
Average application rate				**40-52L/m²**

1	2
Percolation time determined in accordance with percolation test min	**Rate of application of effluent to subsoil infiltration areas** (L/m^2 of french drain sides)
0 to 3	108 max.
3 to 5	108 to 100
6 to 10	99 to 80
11 to 15	79 to 65
16 to 20	64 to 53
21 to 26	52 to 40
27 to 30	39 to 33
Over 30	Not permitted
NOTE Intermediate values may be obtained by interpolation.	

Figure 7:Rate of effluent

6.4 LABORATORY TEST RESULTS

The Geotechnical site investigations for housing development (GFSH-2) guideline was consulted, due to the uniformity of the material onsite a total of 17 disturbed sample were taken, according to the limited variability of the geotechnical character and the landforms and simplicity of the site. Different tests were performed to determine the geo-mechanical and chemical properties of typical soil horizons encountered on site.

Foundation indicator tests comprising of a particle size distribution analysis (sieve and hydrometer grading) and Atterberg Limits tests to establish the soil type, potential heave and gives an indication of suitability of the material for use in pavement layers and as engineered fills.

CBR, Modified AASHTO, Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) tests and chemical tests (Ph and Conductivity) were carried out according to standard procedures prescribed for this type of work.

A summary of the results is presented in Tables below and detailed results are included on Appendix D of this report. These tests permit a basic classification of the soils and group them according to typical engineering properties and evaluation of their suitability for use as construction materials.

6.4.1 Grading, Atterberg limits and potential expansiveness

Table 2: Foundation indicators summary

Hole No	Sample depth(m)	Sample number	GM	Atterberg limits			Unified soil classification	US Highway (General subgrade rating)
				LL (%)	PI (%)	LS (%)	USC	
TP1	0.00-0.60	21314/1	0.67	40	25	12.3	SC	A-6
TP1	0.60-1.40	21314/2	0.89	33	18	8.1	SC	A-2-6 (Excellent to good)
TP2	0.00-0.45	21314/3	1.23	38	24	11.2	SC	A-2-6(Excellent to good)
TP2	0.45-1.20	21314/4	1.84	21	5	1.5	SM/SC	A-2-6(Excellent to good)
TP3	0.00-0.50	21314/5	0.52	46	26	12.4	CL	A-7-6
TP3	0.50-1.60	21314/6	1.29	21	5	1.6	SM/SC	A-2-4(Excellent to good)
TP4	0.00-0.30	21314/7	0.58	34	20	10.1	SC	A-6
TP4	0.30-1.00	21314/8	1.67	33	18	8.1	SC	A-2-6(Excellent to good)
TP5	0.00-0.40	21314/9	0.74	34	20	10.1	SC	A-2-6(Excellent to good)
TP5	0.40-0.60	21314/10	1.00	37	23	11.2	SC	A-2-6(Excellent to good)
TP6	0.00-0.40	21314/11	0.69	24	9	3.6	SC	A-4
TP6	0.40-0.95	21314/12	1.98	32	16	7.9	SW/SC	A-2-6(Excellent to good)
TP7	0.40-0.70	21314/13	1.33	20	5	1.7	SM/SC	A-2-4(Excellent to good)
TP8	0.00-0.40	21314/14	0.69	32	17	8	SC	A-6
TP8	0.40-1.00	21314/15	1.71	21	6	1.7	SM/SC	A-2-4(Excellent to good)
TP9	0.00-1.00	21314/16	0.67	21	6	1.9	SM/SC	A-4
TP9	1.00-2.10	21314/17	0.78	28	14	1.9	SC	A-6

Where:

GM = Grading modulus

LL = Liquid Limit

PI = Plasticity Index

LS = Linear Shrinkage

USC=Unified soil classification

The laboratory test shows that the material according to unified soil classification comprises of:

- **SC:** Clayey sands, sand-clay mixtures.
- **SM/SC:** Clayey/Silty Sands
- **CL-** Inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays

The laboratory results show that the site is highly dominated by ***SC*** materials which according to USC are clayey sands and sand-clay mixtures as well as silty sands and inorganic clays in places. The material has a grading modulus ranging from **0.52%** to **1.98%** and linear shrinkage of **1.5%** to **12.3%.** The soil is dominantly characterized by low to high plastic behavior with Liquid limit ranging from **20% to 40%;** therefore, the site has relatively low heave potential. The most dominant general rating for residual material uses as a subgrade is ***fair to poor***, therefore cannot be used as a subgrade.

Table 3 : Soil classification related to plasticity index, (Van Der Merwe, 1964)

Ip (%)	Soil description
0	Non plastic
1-5	Slightly plastic
5-10	Low plastic
10-20	Medium plastic
20-40	Highly plastic
>40	Very highly plastic

Table 4 : Activity based classification of clays (Van Der Merwe, 1964)

Activity	Classification
<0.75	Inactive
0.75-1.25	Normal
>1.25	Active

6.4.2 Moisture/Density and CBR

Table 5: II. Moisture/Density and CBR

Hole no.		TP1	TP2	TP3	TP3	TP4	TP6	TP7	TP8	TP9	TP9
Sample depth (m)		0.60-1.40	0.45-1.20	0.00-0.50	0.50-1.60	0.30-1.00	0.40-0.95	0.40-0.70	0.40-1.00	0.00-1.00	1.00-2.10
OMC (%)		12.2	13.4	17.9	14.9	12.1	13.5	12.6	13.5	13.1	11.3
MDD (kg/m3)		1932	1859	1594	1832	1856	1922	1836	1922	1855	1924
Swell at Mod AASHTO %		0.65	0.06	3.79	0.72	0.09	0.13	0.08	0.08	0.30	0.60
CBR at various densities	**90%**	2	6	1	2	4	5	4	8	4	2
	93%	3	9	1	3	6	7	5	10	5	3
	95%	3	11	1	4	8	9	6	13	5	4
	97%	4	14	2	6	11	11	9	18	6	4
	98%	5	15	2	6	13	13	11	20	7	5
	100%	7	18	2	8	20	17	17	27	8	6
TRH14 Class/COLTO Classification		G9	G9	<G9	<G9	<G9	G9	G9	G8	<G9	<G9

Where:

CBR- Californian bearing ratio

OMC- optimum moisture content

MDD- maximum dry density

The material has maximum dry density values of **1594kg/m³** to **1932kg/m³**, optimum moisture content values of **11.3%-17.9%.** The material from **tested pits** is classified, according to the TRH 14/COLTO guidelines, as a **G9** and **<G9 Material.**

6.4.3 PH and Conductivity

The in-situ material was collected and submitted to the laboratory for chemistry test (Ph and conductivity). Soil electrical conductivity (EC) is a measure of the number of salts in soil (salinity of soil) or ability of the soil to conduct an electrical current and **pH** is a scale of acidity from 0 to 14. It tells how acidic or alkaline a substance is. More acidic solutions have lower **pH**. More alkaline solutions have higher **Ph**.

Several environmental factors influence buried metals. These factors are:

- Electrical conductivity of the soil
- ***Chemical properties of the soil***
- Ability of the soil to support sulphide reducing bacteria
- Heterogeneity of the soil (long-line currents)
- Bacteria attack

Corrosion decreases the electrical conductivity of the material and the pH level. Therefore, conductivity of soil has a profound influence on the rate of corrosion of buried metallic objects. Based on the significance of soil resistivity on corrosivity, Duligal (1996) provides the following table for evaluation of the conductivity of soil:

Table 6: Guideline Values of Interpretation of Soil Conductivity (Duligal, 1996)

pH	Conductivity (S/m)	Potential corrosiveness
7-8	<0.1	Non-corrosive
5-6 or 9-10	0.1-0.5	Mildly corrosive
3-4 or 11-12	0.5-1.0	Corrosive
<3 or >12	>1	Highly corrosive

The table below shows the summarized pH and conductivity results.

Table 7: pH and conductivity results

Hole no.	Sample Depth	pH	EC (µS/cm)	TEMPERATURE (°C)
TP2	0.50-1.60	8.2	52	24.4
TP9	0.00-1.00	7.5	65	24.5

From the lab results the pH of the material onsite is **between 7 and 8** with conductivity f 52-65µ**S/cm(<0.1S/m)** therefore the material **non-corrosive.**

7 GEOTECHNICAL SITE CLASSIFICATION

The impact of the geotechnical constraints on subsidy housing development may be evaluated according to Table below, which is a summary of the general geotechnical constraints relevant to housing developments. (Partridge, Wood and Brink, 1993), the Class column indicates the severity of the specific constrains for the site.

Table 8: Geotechnical classification for urban Development (after partridge, Wood and Brink)

Constraint		Most favorable (1)	Intermediate (2)	Least favorable (3)
A	**collapsible**	Surface collapsible horizon <750 mm thick	Collapsible horizon >750 mm thick	
B	**seepage**	Water table permanently deeper than 1.5 m below surface	Permanent or seasonal water table within 1.5 m of surface	Swamp and marshes
C	**active**	<2.5 mm differential movement expected	2.5-15 mm differential movement	>15 mm differential movement expected
D	**High compressible soils**	<2.5 mm differential movement expected	2.5 - 15 mm differential movement	>15 mm differential movement expected
E	**Erodibility of soils**	Low	Moderately dispersive	Highly dispersive soil
F	**Difficulty of excavation to 1.5m depth**	<10% rock or hardpan pedocretes	10-50% rock or hardpan pedocretes	>50% rock or hardpan pedocretes
G	**Undermined ground**	where depth to undermining is >100m in reasonably competent rock	Old undermined areas where stope closure has ceased	Where the depth to undermining is <100m
H	**Stability: (Dolomite and limestone)**		Possibly unstable	Probably unstable
I	**Steep slopes**	Slope <6%	Slope 6-15%	Slope >15%
J	**Area of unstable natural slopes**	Low risk	Intermediate risk	High risk
K	**Area subject to seismic activity**	100-year max probability of <5 Mod Mercalli intensity	100-year max probability of 5-8 Mod Mercalli intensity	100-year maximum probability of >8 Mod Mercalli intensity
L	**Rea subject to flooding**		Areas above 1:50 year flood line but with slope <1%	Areas below 1:50 year flood line

7.1 Collapsible soils

Collapsible soils consist of loose, dry, low-density materials that collapse and compact under the addition of water or excessive loading specifically in areas of young alluvial fans, debris flow sediments, and loess (wind-blown sediment) deposits. Collapsible soils are those that appear to be strong and stable in their natural (dry) state, but which rapidly consolidate under saturation, generating large and often unexpected settlements.

Soil collapse occurs when the land surface is saturated at depths greater than those reached by typical rain events. This saturation eliminates the clay bonds holding the soil grains together (SWARTZ, 1985).

The residual material onsite is moist, dense, intact, clayey sand/clayey silts, and its thickness varies throughout the site. Material on site is not likely collapsible because of its nature and consistency. The site is classified as **1A.**

7.2 Shallow Seepage/Groundwater levels

No ground water or seepage was encountered onsite. The site is classified as **1B.**

7.3 Active Soils

The potential expansiveness of a soil depends upon its clay content, the type of clay mineral, its chemical composition and mechanical character. A material is potentially expansive and active if it exhibits the following properties (Kantey and Brink, 1952):

- clay content greater than 12 %,
- plasticity index of more than 12,
- liquid limit of more than 30 %, and
- linear shrinkage of more than 8 %.

According to the laboratory results the material on site exhibits the following properties:

- Clay content is **12.5-46.6%,**
- Plasticity index is **5-26%,**
- Liquid limit is **20-46%,** and
- Linear shrinkage of more than **1.5-12.5%.**

Based on the above laboratory properties of the material on site comprises of plasticity index, Linear shrinkage, clay content and liquid limit extremely greater than that thresholds values, the material is **active**. Therefore, site is classified as **2C.**

7.4 Highly Compressible Soil

According to Swartz, 1985, Compressibility is the degree to which a soil mass decreases in volume when supporting a load. Compressibility is lowest in coarse-grained soils where particles are in contact with each other. It increases as the proportion of small particles increases and becomes highest in fine-grained soils which contain organic matter. The following are some examples of compressibility for various soils:

Gravels and sands are practically incompressible. If a moist mass of these materials is subjected to compression, there is no significant change in their volume.

Clays and slits are compressible. If a moist mass of clay is subjected to compression, moisture and air may be expelled, resulting in volume reduction which is not immediately recovered when the load is removed.

Fine-grained soils which contain at least 50 percent of silt + clay may be listed in three classes of compressibility based on their liquid limit. They are as follows:

- Low compressibility: LL smaller than 30.
- Medium compressibility: LL from 30 to 50.
- High compressibility: LL greater than 50.

According to the laboratory results the material on site exhibits the following properties:

Due to the consistency of the material and the laboratory result, the material is high plasticity behavior with **20 and 46%** liquid limit, if a moist mass of this material is subjected to compression, there will be a slight significant change in the volume, the material has **medium compressibility**. The site is classified as **2D.**

7.5 Erodibility of soil

The material on site **(sand-clays)** are generally prone to erosion by wind and water, however no evidence of erosion features such as galleys, dongas or erosion channels was observed on the site.

The overall slope of the land is too gentle to create high velocity run-off, although some galleys were observed outside investigation boundary the site is classified as **1E**.

Figure 8: Gullies object adjacent to site boundary

7.6 Difficult of excavation

The excitability characteristics were estimated from the performance of the TLB used for the Investigation. The site is classified as being soft to intermediate to hard excavations (Classification of material for machine excavation SANS 1200 D) with maximum depth of **0.60-2.10m.** This site is classified as **1F**.

Table 9: Classification of material for machine excavation (SANS 1200 D)

Classification	Descriptions
Soft excavation	Material that can be efficiently removed or loaded, without prior ripping, by means of a bulldozer, tractor-scraper, track type front-end loader or back-acting excavator without the use of pneumatic tools such as paving breakers
Intermediate excavation	Material that can be efficiently ripped by a bulldozer fitted with a single tine ripper or with a back-acting excavator of flywheel power exceeding 0,10 kW per mm of tined-bucket width or the use of pneumatic tools before removal by equipment equivalent to that specified above.
Hard rock excavation	Excavation in material that cannot, before removal, be efficiently ripped by a bulldozer. This is material that cannot be efficiently removed without blasting or without wedging and splitting.
Boulder excavation (Class A)	Excavation in material containing more than 40 % by volume boulders of size in the range of 0,03-20m3, in a matrix of soft material or smaller boulders.
Boulder excavation (Class B)	Excavation in material containing 40 % or less by volume boulders of size in the range of 0,03-20m3, in a matrix of soft material or smaller boulders and which require individual drilling and blasting in order to be loaded by a track type front-end loader or back-acting excavator

7.7 Undermined ground

There are no other closed or working shafts or other signs of mining activity within a radius of 1km of the site, therefore site is classified as **1G.**

7.8 Stability: Dolomite and Limestone.

No indication of the presence of soluble rock formations was found during the desk study and field investigation, based on the geology of an area the area is sitting on the Adelaide subgroup. The area is non-dolomitic. The site is classified as **1H.**

7.9 Steep Slopes

Slope is a measure of change in elevation. On a topographic map the amount of elevation change is related to the number of contour lines. The elevation of site ranges from 1459**m-1468m**. The map below shows that the site is relatively moderate slope with maximum slope of **6.6% and 2.5% Average slope.** Although the slope is strongly dipping outside, The area falls under the most favorable class, the site is classified as **1I.**

Figure 9: Topographic Map

7.10 Area of unstable natural slopes

Steeper slopes have greater risks for instability. The natural tendency of steep slopes is to move some of its materials downwards until the natural angle of repose is found. Any form of slope modification will eventually impact the stability of a slope. No evidence of unstable natural slope was observed on site during site investigation. The site is classified as **1J.**

7.11 Seismic Activity

According to Kijko et. al (2003), the peak ground acceleration for the area is less than 0,04 m/s2, with a 10% probability of being exceeded in a 50-year period. The seismic activity in the area is therefore low. The site is classified as **1K.**

7.12 Areas subject to flooding (1:50 and 1:100 Year Flood Lines)

A 1:50 year flood line implies that an area below that line has a high probability of being flooded at least once in every fifty-year period. Similar contextual definition applies for the 1:100-year flood line. Proper flood line should be available from the Local Municipality Town Planning Department **1L.**

8 TERRAIN MAPPING UNITS AND SITE CLASSIFICATION

8.1 Terrain mapping units (GFSH-2)

Based on the discussions and conclusions provided in **section 7** above, the site is classified as **2CD.**

8.2 NHBRC site classification

The residential site class designation according to NHBRC is marked with class symbols within the areas designated. The site designation classes are set out in Table below. The site class designations are: **R/H-H1.**

Table 10: Residential Class Designations" after Watermeyer and Tromp (1992) and the Joint Structural Division of the SAICE as prescribed by the NHBRC.

Geotechnical Characteristics				
TYPICAL FOUNDING MATERIAL	**CHARACTER OF FOUNDING MATERIAL**	**EXPECTED RANGE OF TOTAL SOIL MOVEMENTS (mm)**	**ASSUMED DIFFERENTIAL MOVEMENT (% OF TOTAL)**	**SITE CLASS**
Rocks excluding Mudrocks which exhibits swelling	Stable	-	-	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	*50%* 50%	H H1

9. FINAL DEVELOPMENT RECOMMENDATIONS

Based on desktop study and field work, the material is *soil activity and compressibility*. During field observation it was noted that the site is a likely to be deemed a wetland, therefore the site should be developed with ***caution prior to advices/authorization*** from ***professional registered Environmentalist.***

Figure 10: Site images

9.1 Excitability

The site was classified as soft intermediate excavation as it was medium to excavated with a TLB (SANS 1200) up to **2.10m,** however hard excavations should be expected in certain areas from 0.60m. Excavator with a hydraulic hammer during earthwork may be required on the hard rock. ***It is the contractor's responsibility to provide safe working conditions within excavations.***

9.2 Use of materials

The material on site is classified according to TRH14 classification as G9 which is a weaker selected subgrade according to table below. It is highly advised to **not** to use site material as subgrade however, the material should be aided/and or replaced with ***G6 and G7 material.***

Table 11: Shear Properties of Granular Materials (Theyse et al, 1996)

Material	Moisture state	Cohesion C [kPa]	Internal Friction [°]
High density crushed stone **G1**	Dry Wet	65 45	55 55
Moderate density crushed stone **G2**	Dry Wet	55 40	52 52
Crushed stone and soil binder **G3**	Dry Wet	50 35	50 50
Base quality gravel **G4**	Dry Wet	45 35	48 48
Subbase quality gravel **G5**	Moderate Wet	40 30	43 43
Low quality subbase gravel **G6**	Moderate Wet	30 25	40 40
Good Selected subgrade **G7**	Dry Wet	25 20	35 35
Moderate selected subgrade **G8**	Dry Wet	30 20	30 30
Weaker selected subgrade **G9**	Dry Wet	30 20	28 28
Soil fill **G10**	Dry Wet	35 20	25 25

9.3 Drainage

9.3.1 Surface drainage

Surface drainage of building platforms should be designed to direct water away from fill edges, to prevent overtopping of the fill crest and erosion of fill embankment slopes. Surface water on these platforms should be directed to, and collected in, open lined drains or piped to the natural drainage line.

It is important that grassing or protection of fill embankments be carried out as soon as possible after construction, to minimize ponding of the water on the cut platforms to reduce slope instability and piping erosion.

Run-off from building roofs should be piped from gutters, through downpipes, and discharged into the storm water reticulation system. In addition, a suitable concrete apron should be provided at least **1.5 m** wide and shaped away from the edge of the structure to ensure effective run-off.

9.3.2 Subsurface drainage

It is strongly recommended that the subsoil drains be designed according to the specific filter criteria of the in-situ soils to prevent piping of the material and subsequent rapid erosion.

9.4 Site clearance

All vegetation should be cleared from the areas over which structures are to be built. Any removal of surface topsoil will probably bring any groundwater seepage closer to the surface and this should be borne in mind and made clear to the contractor.

Earthworks should commence shortly after vegetation clearing to prevent erosion runoff along the steeply sloping south slope.

8.3 Percolation

The general feasibility of an on-site sanitation system a septic tank soak-away disposal method, has been evaluated in terms of the requirements laid down by SANS 10400-P: Drainage.

Several criteria are used to assess whether septic tank soak-away systems are feasible.

These are the following: -

- Suitability of the subsoils/existing geotechnical conditions for disposal of wastewater and sewage effluent by subsoil percolation,
- Occurrence of groundwater,
- Availability of sufficient area that may be allocated for evapotranspiration purposes, and
- Sufficient soil cover.

Results of the percolation tests conducted at the site suggest that the underlying soils are sufficiently permeable to sustain on site sanitation. The site is suitable for the disposal of effluent via a septic tank and soakaway system provided enough evapotranspiration area is available. The soak-away system must be constructed on areas where effluent will not flow out due to the steepness of the ground, generally slopes less than 10°.

In addition, the trenches should ideally run parallel to the contours. Thus, wastewater should be disposed off via this system. Although there is a river nearby, the site distance to the river falls within the accepted category(more than 30m from site)

9.5 Founding of the structure

Table 12 : Foundation design, building procedures and precautionary measures for single-story residential buildings (SAICE, 1995)

SITE CLASS DESIGNATIONS	TYPICAL FOUNDING MATERIAL	CHARACTER OF FOUNDING MATERIAL	SINGLE/DOUBLE STOREY MANSORY HOUSE CONSTRUCTION
R	Rocks	Stable	-
H-H1	Fine grained soils with moderate to extremely high plasticity (Clays, silty clays, clayey silts and sandy clays)	Expansive soils	Normal, Modified and soil raft

9.5.1 Site Class: H1/H2

The above given foundation is deemed suitable for H-H1 material, however the ***most*** suitable foundation for this area would be raft foundations**. Raft foundations** are the types of foundation which are spread across the entire area of the building to support heavy structural loads from columns and walls.

9 CONCLUSSIONS

Based on the profiles of 10 test pits excavated within the area proposed for the proposed construction of Matwabeng residential houses, evaluation of geotechnical constraints together DPL results and laboratory, the following can be concluded:

- This geotechnical report contains the findings and development recommendations for the construction of the proposed **Housing project at Matwabeng, Free State**
- ***Seventeen (17)*** disturbed samples were taken from the trial pits for laboratory analysis. The disturbed samples were sent for amongst other tests: particle size distribution, hydrometer analysis, and Atterberg limits determination and CBR and MOD ASSHTO, pH and EC.
- The site is underlain by topsoil underlain by residual soils underlain by Adelaide Subgroup sandstones and shales.
- Intermediate excavation in terms of SABS 1200D is generally anticipated from surface to depths in excess maximum of approximate **0.60-2.10 m** below ground level.
- NHBRC Site Classification ***R/H-H1/2CD.***
- Due to the predominantly moist moisture condition declaring the site a *wetland*, and consistency and type of the material onsite (including laboratory results) it is advised that the most appropriate foundation *is* ***raft foundation***.
- It is contractor's responsibility to watch out for pipelines during construction.
- One of the more important factors in the promotion of a stable site is the control and removal of surface water from the property. It is important that the design of the storm water management system, allow for the drainage of accumulated surface water from the platform and into the municipal storm water system or natural drainage lines.
- In general, It is considered that the conditions prevailing on site during the site investigation are such that the majority of the site is considered suitable for the development, ***provided that the recommendations outlined in this report are adhered to.***

- Finally, it must be understood that the ground conditions described in this report refer specifically to those encountered at the inspection positions on site. It is therefore possible that conditions at variance with those discussed above may be encountered on site.
- In this regard, it is important that an engineering geologist or geotechnical engineer carry out periodic inspections of the site during construction to ensure that any variation in the anticipated ground conditions can be assessed, and revised recommendations made to avoid unnecessary delays and expense.
- In general, It is considered that the conditions prevailing on site during the site investigation are such that the majority of the site is considered suitable for the development, provided that the recommendations outlined in this report are adhered to.

10 REFERENCES

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- SANS10400-H Foundations
- SANS 10400-P drainage

20-341 List of Appendices

A-maps

B-Profiles

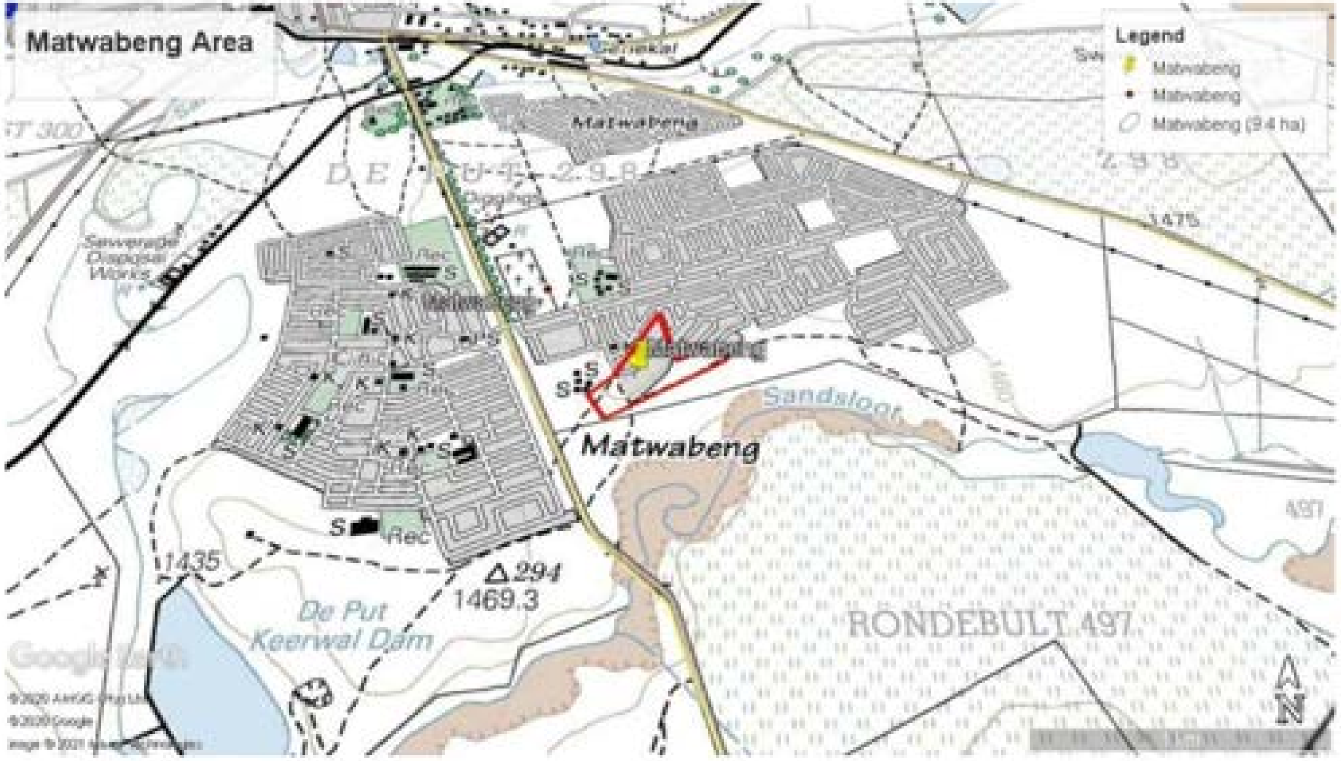
C-DPL

D-Laboratory Results

E- Percolation Test

A-MAPS

Locality Map



MATWABENG

RESIDENTIAL HOUSES

Prepared For:

Servinet Consulting Engineers.

Prepared By:

Phezulu Geotechnical Civils

12 Sukeriet Street, Mbombela, 1200, South Africa

Geological Map

MATWABENG

RESIDENTIAL HOUSES

Prepared For:

Servinet Consulting Engineers.

Prepared By:

Phezulu Geotechnical Civils

12 Sukerriet Street, Mbombela, 1200, South Africa

Lithostratigraphy	
Q	*Quaternary rocks*
Pa	*Adelaide Subgroup*

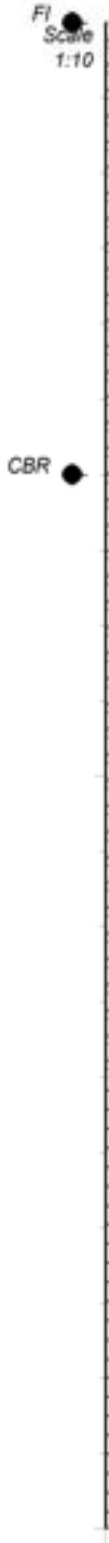

Matwabeng
Test Pits Location
Legend
Matwabeng
Matwabeng (9.4 ha)
TP1
TP10
TP2
TP3
TP4
TP5
TP6
TP7
TP8
TP9
TP1
TP2
TP3
TP4
Matwabeng
TP5
TP6
TP7
TP8
TP9
TP10
Google Earth
200 m
N

B-PROFILES

dotPLOT Servinet Consulting Engineers.

HOLE No: **TP-01**
Sheet 1 of 1

JOB NUMBER: 21-341



0.00 Moist, Brown, dense intact, clayey SAND:
HILL WASH.

0.60 Moist, Brown to Yellow, dense intact, clayey SAND:
RESIDUAL.

1.40 Grey green, fine grained, weathered, soft to medium hard SHALE.
ADELAIDE SUBGROUP.

2.00

NOTES

1) EOH @ 2.00m on weathered Shale
2) No Groundwater or water seepage was encountered.
3) Disturbed sample FI at 0.00-0.60m.
4) Disturbed sample CBR & FI at 0.60-1.40m.
5) Coordinates measured with handled Garmin GPS.
6) Stable sidewalls.

CONTRACTOR : Phezulu Geotechnical Civils
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DRILLED BY :
PROFILED BY : Phezulu Geotechnical Civils
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DIAM :
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DATE : 29/01/2021 08:51
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ELEVATION : 1484.19m
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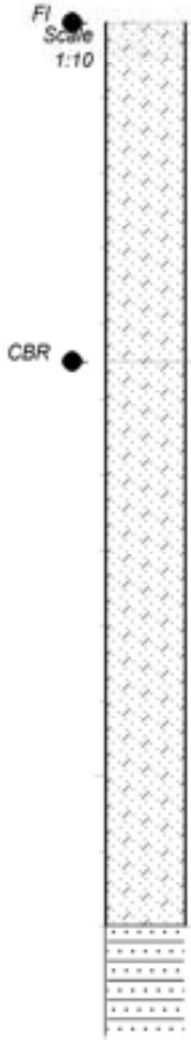
Y-COORD : 27° 38'31.52"E

HOLE No: **TP-01**

dotPLOT Servinet Consulting Engineers.

HOLE No: **TP-02**
Sheet 1 of 1

JOB NUMBER: 21-341



0.00 Moist, Brown, dense intact, clayey SAND:
HILL WASH.

0.45 Moist, Brown to Yellow, dense intact, clayey SAND:
RESIDUAL.

1.20 Light brown to yellow, fine grained, weathered, soft to medium hard SANDSTONE.
ADELAIDE SUBGROUP.

NOTES

1) EOH @ 1.20 on weathered sandstone.
2) No Groundwater or water seepage was encountered.
3) Disturbed sample FI at 0.00-0.45m.
4) Disturbed sample CBR & FI at 0.45-1.20m.
5) Coordinates measured with handled Garmin GPS.
6) Stable sidewalls.

CONTRACTOR : Phezulu Geotechnical Civils
MACHINE : BELL 315 SJ TURBO 4X4
DRILLED BY :
PROFILED BY : Phezulu Geotechnical Civils

TYPE SET BY :
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DIAM :
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DATE : 19/01/2021

DATE : 29/01/2021 08:51
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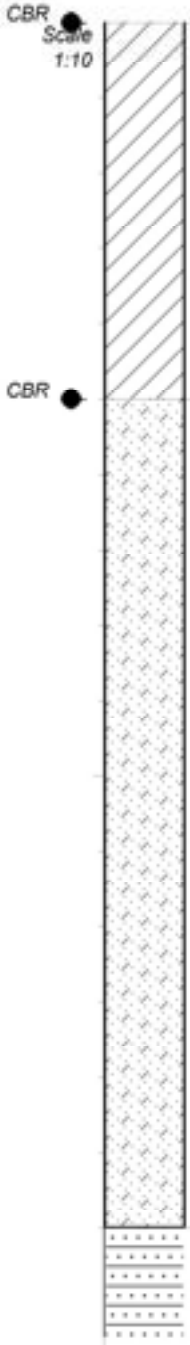
Y-COORD : 27° 38'23.93"E

HOLE No: **TP-02**

dotPLOT Servinet Consulting Engineers.

HOLE No: **TP-03**
Sheet 1 of 1

JOB NUMBER: 21-341



0.00 Moist, Dark Brown to Black, dense intact, CLAY:
HILL WASH.

0.50 Moist, Brown to Yellow, dense intact, clayey SAND:
RESIDUAL.

1.60 Light brown to yellow, fine grained, weathered, soft to medium hard SANDSTONE.
ADELAIDE SUBGROUP.

NOTES

1) EOH @ 1.60m on weathered sandstone.
2) No Groundwater or water seepage was encountered.
3) Disturbed sample CBR & FI at 0.00-0.50m.
4) Disturbed sample CBR, FI pH & EC at 0.50-1.60m.
5) Coordinates measured with handled Garmin GPS.
6) Stable sidewalls.

CONTRACTOR : Phezulu Geotechnical Civils
MACHINE : BELL 315 SJ TURBO 4X4
DRILLED BY :
PROFILED BY : Phezulu Geotechnical Civils

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DATE : 19/01/2021

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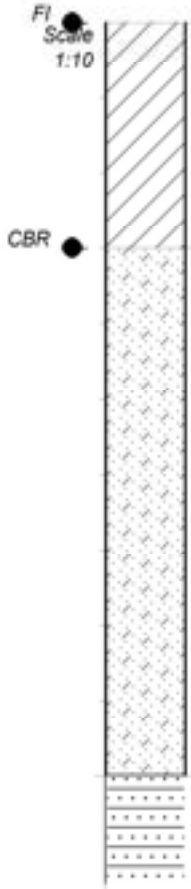
Y-COORD : 27° 38'21.64"E

HOLE No: **TP-03**

dotPLOT Servinet Consulting Engineers.

HOLE No: **TP-04**
Sheet 1 of 1

JOB NUMBER: 21-341



0.00 Slighly Moist, Brown, loose intact, CLAY:
HILL WASH.

0.30 Moist, Brown to Yellow, dense to very dense shattered, clayey SAND:
RESIDUAL.

1.00 Light brown to yellow, fine grained, weathered, soft to medium hard SANDSTONE.
ADELAIDE SUBGROUP.

NOTES

1) EOH @ 1.00m on weathered sandstone.
2) No Groundwater or water seepage was encountered.
3) Disturbed sample FI at 0.00-0.30m.
4) Disturbed sample CBR & FI at 0.30-1.00m.
5) Coordinates measured with handled Garmin GPS.
6) Stable sidewalls.

CONTRACTOR : Phezulu Geotechnical Civils
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DRILLED BY :
PROFILED BY : Phezulu Geotechnical Civils

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DIAM :
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Y-COORD : 27° 38'16.11"E

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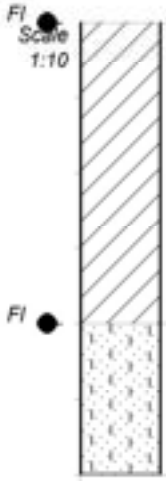
dotPLOT Servinet Consulting Engineers.

HOLE No: **TP-05**
Sheet 1 of 1

JOB NUMBER: 21-341



0.00 Moist, Dark Brown to Black, loose intact, CLAY:
HILL WASH.

0.40 Moist, Grey, dense to very dense intact, silty SAND:
RESIDUAL.

0.60

NOTES

1) EOH @ 0.60m.
2) No Groundwater or water seepage was encountered.
3) Disturbed sample FI at 0.00-0.40m.
4) Disturbed sample FI at 0.40-0.60m.
5) Coordinates measured with handled Garmin GPS.
6) Stable sidewalls.

CONTRACTOR : Phezulu Geotechnical Civils
MACHINE : BELL 315 SJ TURBO 4X4
DRILLED BY :
PROFILED BY : Phezulu Geotechnical Civils

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DIAM :
DATE :
DATE : 19/01/2021

DATE : 29/01/2021 08:51
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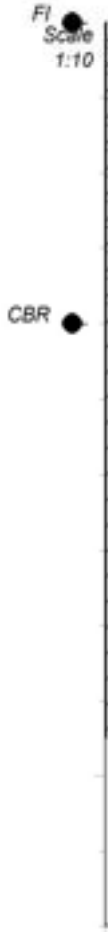
Y-COORD : 27° 38'10.18"E

HOLE No: **TP-05**

dotPLOT Servinet Consulting Engineers.

HOLE No: **TP-06**
Sheet 1 of 1

JOB NUMBER: 21-341



0.00 Moist, Brown, loose intact, clayey SAND:
HILL WASH.

0.40 Moist, Grey, medium dense shattered, clayey GRAVEL:
RESIDUAL.

0.95 **BEDROCK.**

1.20

NOTES

1) EOH @ 1.20m.
2) No Groundwater or water seepage was encountered.
3) Disturbed sample FI at 0.00-0.40m.
4) Disturbed sample CBR & FI at 0.40-0.95m.
5) Coordinates measured with handled Garmin GPS.
6) Stable sidewalls.

CONTRACTOR : Phezulu Geotechnical Civils
MACHINE : BELL 315 SJ TURBO 4X4
DRILLED BY :
PROFILED BY : Phezulu Geotechnical Civils

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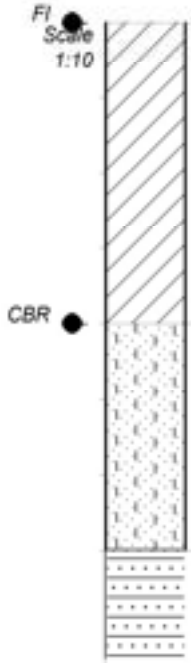
Y-COORD : 27° 38'16.38"E

HOLE No: **TP-06**

dotPLOT Servinet Consulting Engineers.

HOLE No: **TP-07**
Sheet 1 of 1

JOB NUMBER: 21-341



0.00 Moist, Brown, medium dense intact, CLAY:
HILL WASH.

0.40 Moist, Brown to Yellow, medium dense intact silty SAND:
RESIDUAL.

0.70 Light brown to yellow, fine grained, weathered, soft to medium hard SANDSTONE.
ADELAIDE SUBGROUP.

NOTES

1) EOH @ 0.70m on weathered sandstone.
2) No Groundwater or water seepage was encountered.
3) Disturbed sample FI at 0.00-0.40m.
4) Disturbed sample CBR & FI at 0.40-0.70m.
5) Coordinates measured with handled Garmin GPS.
6) Stable sidewalls.

CONTRACTOR : Phezulu Geotechnical Civils
MACHINE : BELL 315 SJ TURBO 4X4
DRILLED BY :
PROFILED BY : Phezulu Geotechnical Civils

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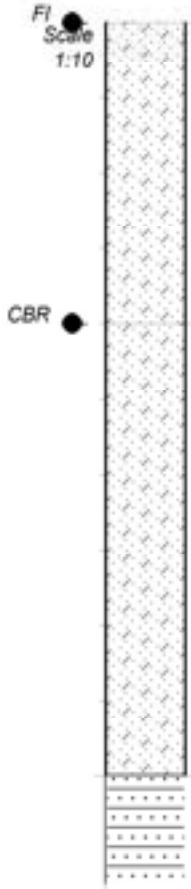
Y-COORD : 27° 38'16.26"E

HOLE No: **TP-07**

dotPLOT Servinet Consulting Engineers.

HOLE No: **TP-08**
Sheet 1 of 1

JOB NUMBER: 21-341



0.00 Slightly Moist, Brown, medium dense intact, clayey SAND:
HILL WASH.

0.40 Moist, Grey, dense to vey dense intact, clayey SAND:
RESIDUAL.

1.00 Light brown to yellow, fine grained, weathered, soft to medium hard SANDSTONE.
ADELAIDE SUBGROUP.

NOTES

1) EOH @ 1.00m on weathered sandstone.
2) No Groundwater or water seepage was encountered.
3) Disturbed sample FI at 0.00-0.40m.
4) Disturbed sample CBR & FI at 0.40-1.00m.
5) Coordinates measured with handled Garmin GPS.
6) Stable sidewalls.

CONTRACTOR : Phezulu Geotechnical Civils
MACHINE : BELL 315 SJ TURBO 4X4
DRILLED BY :
PROFILED BY : Phezulu Geotechnical Civils

TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 19/01/2021

DATE : 29/01/2021 08:51
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ELEVATION : 1488.99m
X-COORD : -28° 20'45.25"S
Y-COORD : 27° 38'16.49"E

HOLE No: **TP-08**

dotPLOT Servinet Consulting Engineers.

HOLE No: **TP-09**
Sheet 1 of 1

JOB NUMBER: 21-341

0.00

Slightly Moist, Dark Brown, loose intact, CLAY:
HILL WASH.

1.00

Moist, Yellow, dense intact, clayey SAND:
RESIDUAL.

2.10

Light brown to yellow, fine grained, weathered, soft to medium hard SANDSTONE.
ADELAIDE SUBGROUP.

NOTES

1) EOH @ 2.10m on weathered sandstone.
2) No Groundwater or water seepage was encountered.
3) Disturbed sample CBR, FI, pH & EC at 0.00-1.00m.
4) Disturbed sample CBR & FI at 1.00-2.10m.
5) Coordinates measured with handled Garmin GPS.
6) Stable sidewalls.

CONTRACTOR : Phezulu Geotechnical Civils
MACHINE : BELL 315 SJ TURBO 4X4
DRILLED BY :
PROFILED BY : Phezulu Geotechnical Civils

INCLINATION : Vertical
DIAM :
DATE :
DATE : 19/01/2021

ELEVATION : 1480.39m
X-COORD : -28° 20'41.91"S
Y-COORD : 27° 38'26.15"E

HOLE No: **TP-09**

TYPE SET BY :
SETUP FILE : STANDARD.SET

DATE : 29/01/2021 08:51
TEXT : ..WABENGHOUSINGPROJECT.txt

dot PLOT Servinet Consulting Engineers.

HOLE No: **TP-10**
Sheet 1 of 1

JOB NUMBER: 21-341

Scale 1:10

0.00 Slightly Moist, Brown, loose intact, CLAY:
HILL WASH.

0.40

NOTES

1) EOH @ 0.40m.
2) Not sampled
3) Coordinates measured with handled Garmin GPS.
4) Stable sidewalls.

CONTRACTOR : Phezulu Geotechnical Civils
MACHINE : BELL 315 SJ TURBO 4X4
DRILLED BY :
PROFILED BY : Phezulu Geotechnical Civils

TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 19/01/2021

DATE : 29/01/2021 08:51
TEXT : ..WABENGHOUSINGPROJECT.txt

ELEVATION : 1490.82m
X-COORD : -28° 20'32.41"S
Y-COORD : 27° 38'21.34"E

HOLE No: **TP-10**

dot PLOT Servinet Consulting Engineers.

LEGEND
Sheet 1 of 1

JOB NUMBER: 21-341

	GRAVEL	{SA02}
	SAND	{SA04}
	SILTY	{SA07}
	CLAY	{SA08}
	CLAYEY	{SA09}
	SANDSTONE	{SA11}
	SHALE	{SA12}
Name ●	DISTURBED SAMPLE	{SA38}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 29/01/2021 08:51
TEXT : ..WABENGHOUSINGPROJECT.txt

ELEVATION :
X-COORD :
Y-COORD :

LEGEND
SUMMARY OF SYMBOLS

P.O Box 1796
12 Sulkeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 6298
Reg. No. 2011/005646/23
Vat no. 4610267686

Geotechnical Site Investigation For Matwabeng residential houses. Free State, South Africa

SOIL PROFILES PHOTOS

TP-01

TP-02

TP-03

TP-04

TP-05

TP-06

TP-07


Matuwatang
Housing Project
21-341
TP7


Matuwatang
Housing Project
21-341
TP7

TP-08

TP-09

TP-10

C-DPL RESULTS

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client: **Servinet Consulting Engineers.** Date : 19-01-2021

Contract: **Matwabeng Housing Project, Free State**

Description: **DPL was done from existing ground level**

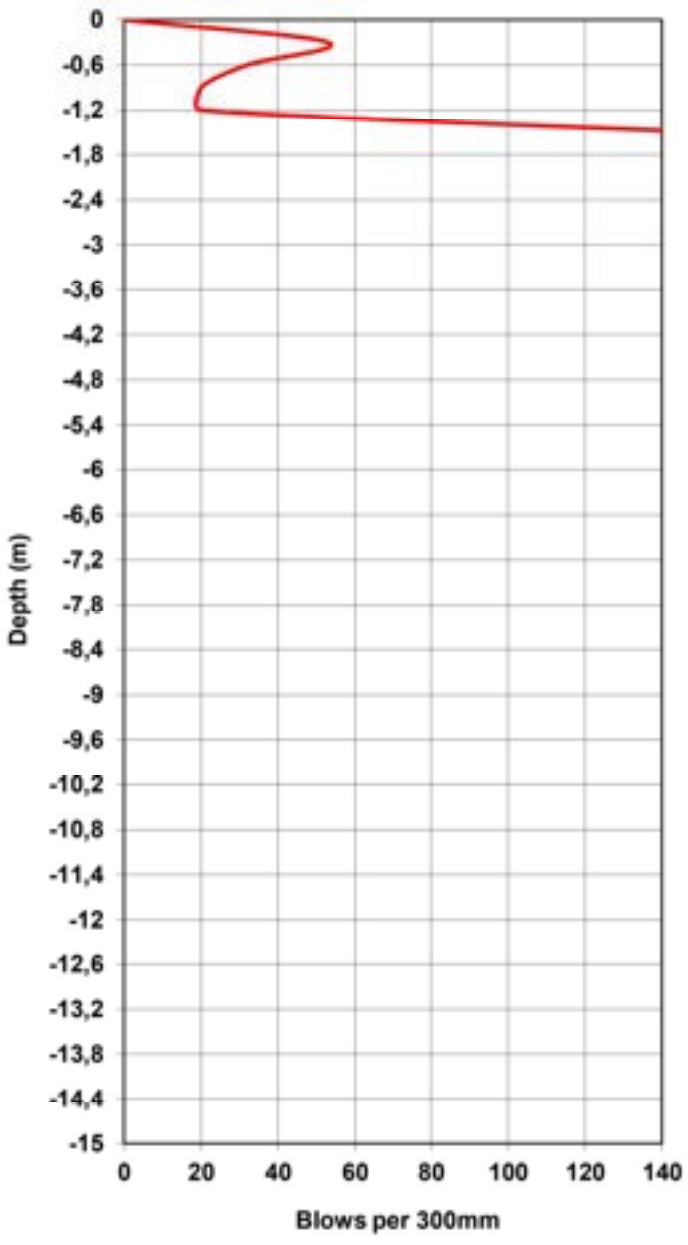
DPL No. : 1 @ TP 1

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth metres	Blows per 300mm	Inferred Consistency	Insitu Shear Strength
0			
0,3	53	Very Stiff	225 kPa
0,6	32	Stiff	140 kPa
0,9	20	Stiff	90 kPa
1,2	20	Stiff	90 kPa
1,5	150	Hard	>300 kPa
	END		

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings



Notes

Refusal at 1,5 m after 150 attempts

Plotted as Cohesive material

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

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e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client: **Servinet Consulting Engineers.** Date : 19-01-2021

Contract: **Matwabeng Housing Project, Free State**

Description: **DPL was done from existing ground level**

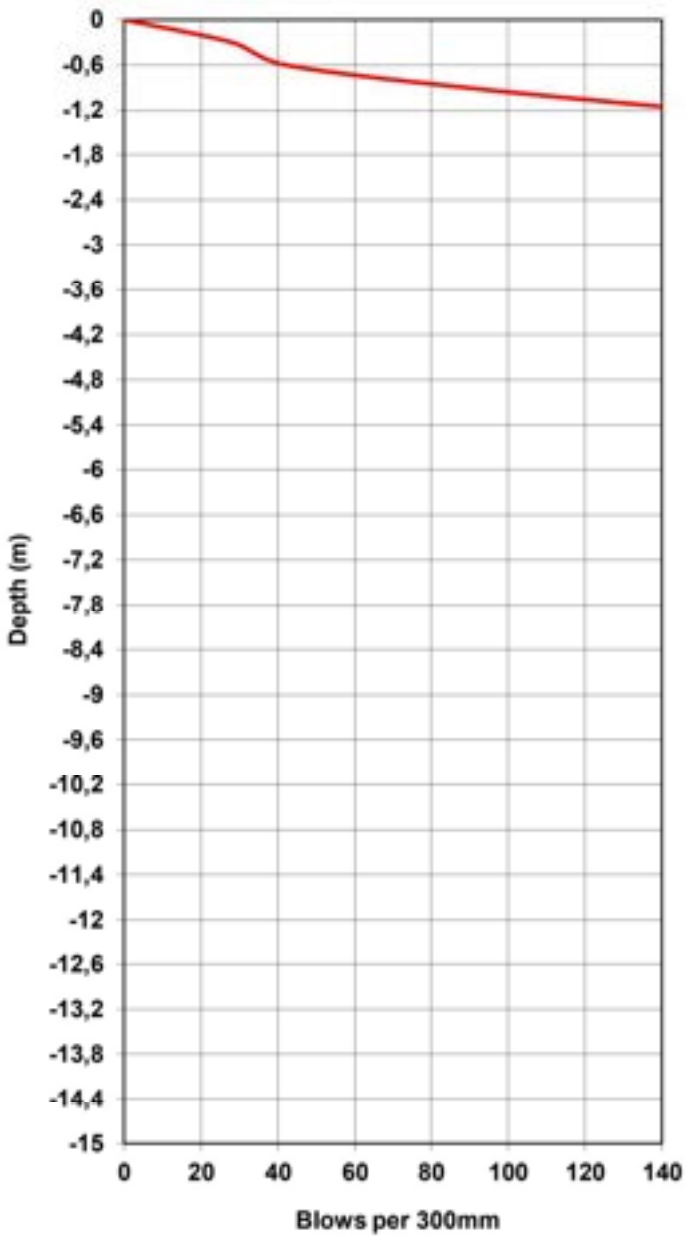
DPL No. : 2 @ TP 2

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth metres	Blows per 300mm	Inferred Consistency	Insitu Shear Strength
0			
0,3	28	Stiff	125 kPa
0,6	42	Very Stiff	180 kPa
0,9	89	Hard	>300 kPa
1,2	150	Hard	>300 kPa
	END		

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings



Notes

Refusal at 1,2 m after 150 attempts

Plotted as Cohesive material

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

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e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
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Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client: **Servinet Consulting Engineers.** Date : 19-01-2021

Contract: **Matwabeng Housing Project, Free State**

Description: **DPL was done from existing ground level**

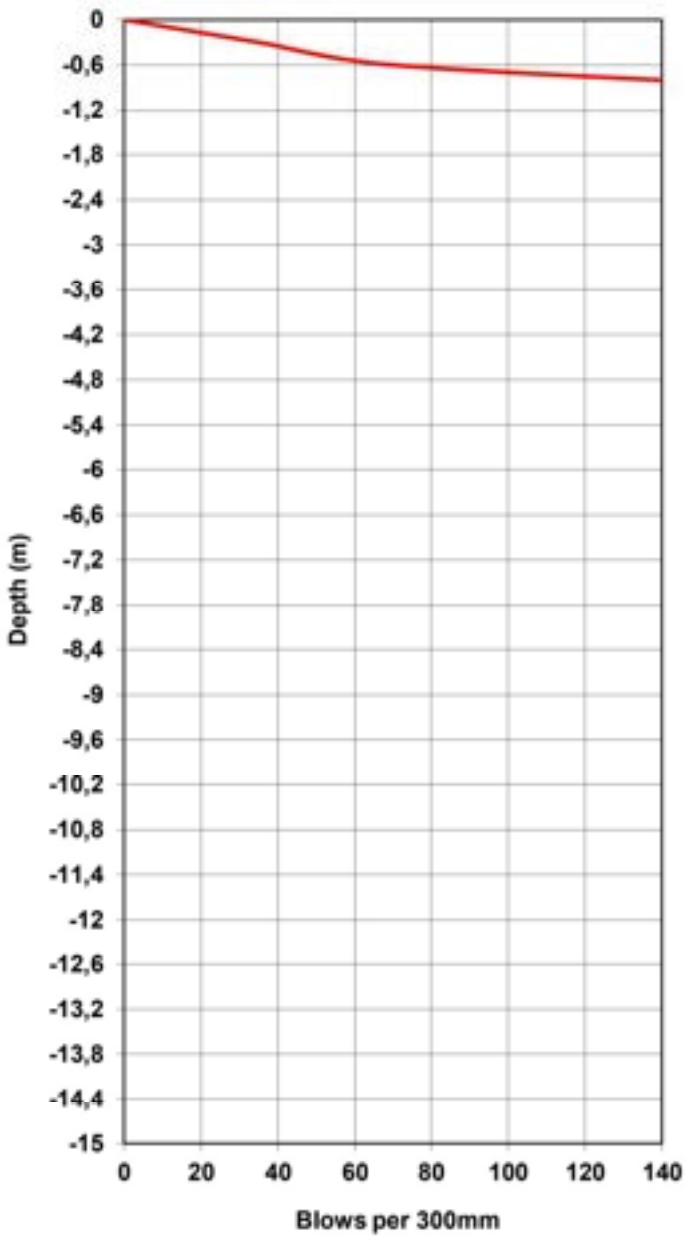
DPL No. : 3 @ TP 3

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth metres	Blows per 300mm	Inferred Consistency	Insitu Shear Strength
0			
0,3	35	Very Stiff	155 kPa
0,6	70	Very Stiff	300 kPa
0,9	180	Hard	>300 kPa
	END		

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings



Notes

Refusal at 0,9 m after 150 attempts

Plotted as Cohesive material

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

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e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
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Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client: **Servinet Consulting** Date : 19-01-2021

Contract: **Matwabeng housing project**

Description: **DPL was done from existing ground level**

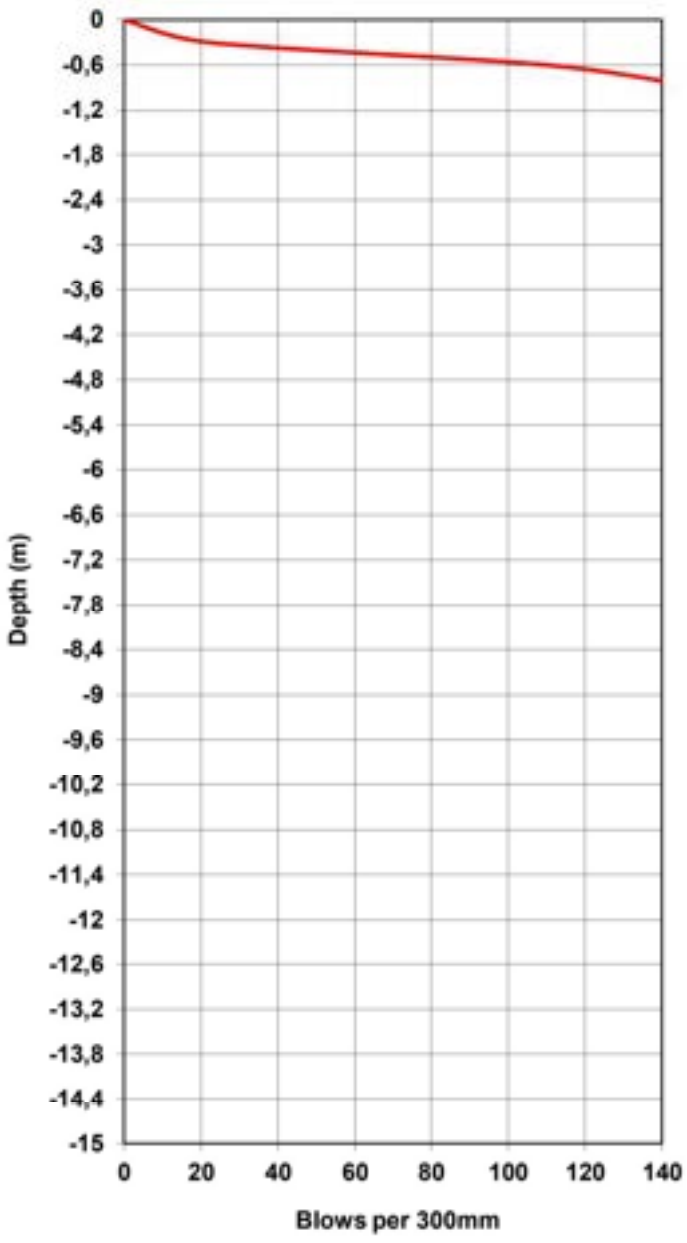
DPL No. : 4 @ TP 4

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth metres	Blows per 300mm	Inferred Consistency	Insitu Shear Strength
0			
0,3	22	Stiff	100 kPa
0,6	110	Hard	>300 kPa
0,9	150	Hard	>300 kPa
	END		

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings



Notes

Refusal at 0,9 m after 150 attempts

Plotted as Cohesive material

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client: **Servinet Consulting Engineers** Date : 19-01-2021

Contract: **Matwabeng Housing Project, Free State**

Description: **DPL was done from existing ground level**

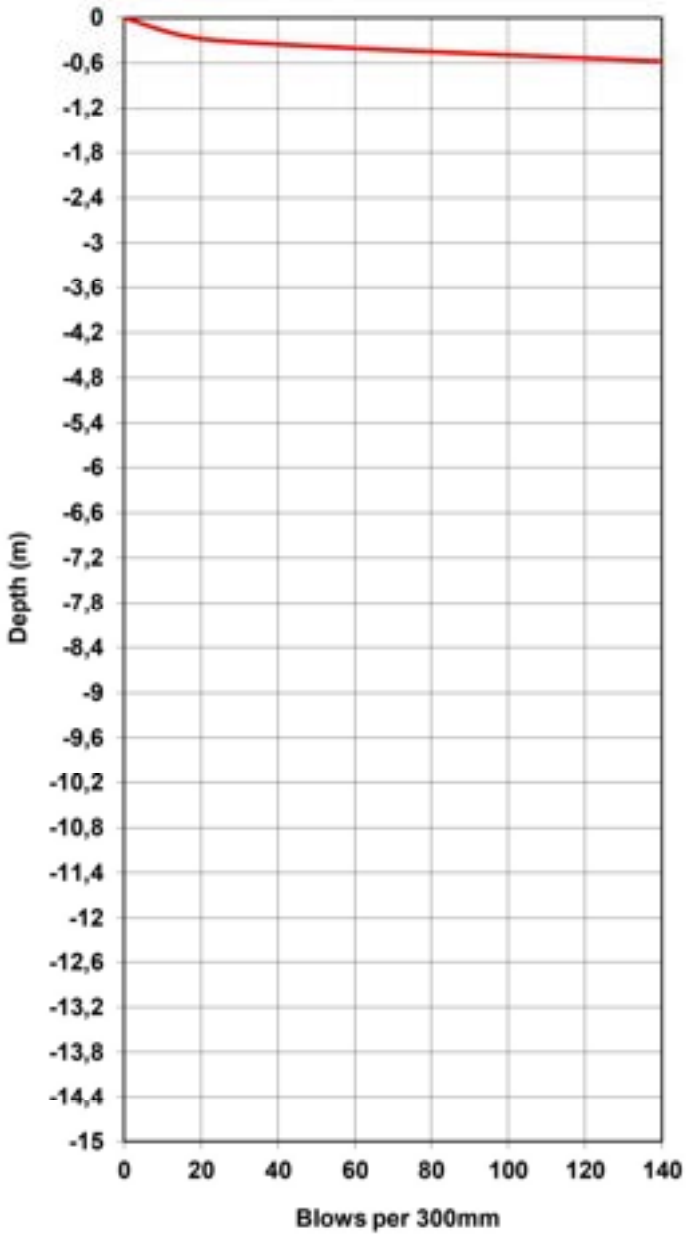
DPL No. : 5 @ TP 5

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth metres	Blows per 300mm	Inferred Consistency	Insitu Shear Strength
0			
0,3	24	Stiff	105 kPa
0,6	150	Hard	>300 kPa
	END		

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings



Notes

Refusal at 0,6 m after 150 attempts

Plotted as Cohesive material

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client: **Servinet Consulting Engineer** Date : 19-01-2021

Contract: **Matwabeng Housing Project, Free State**

Description: **DPL was done from existing ground level**

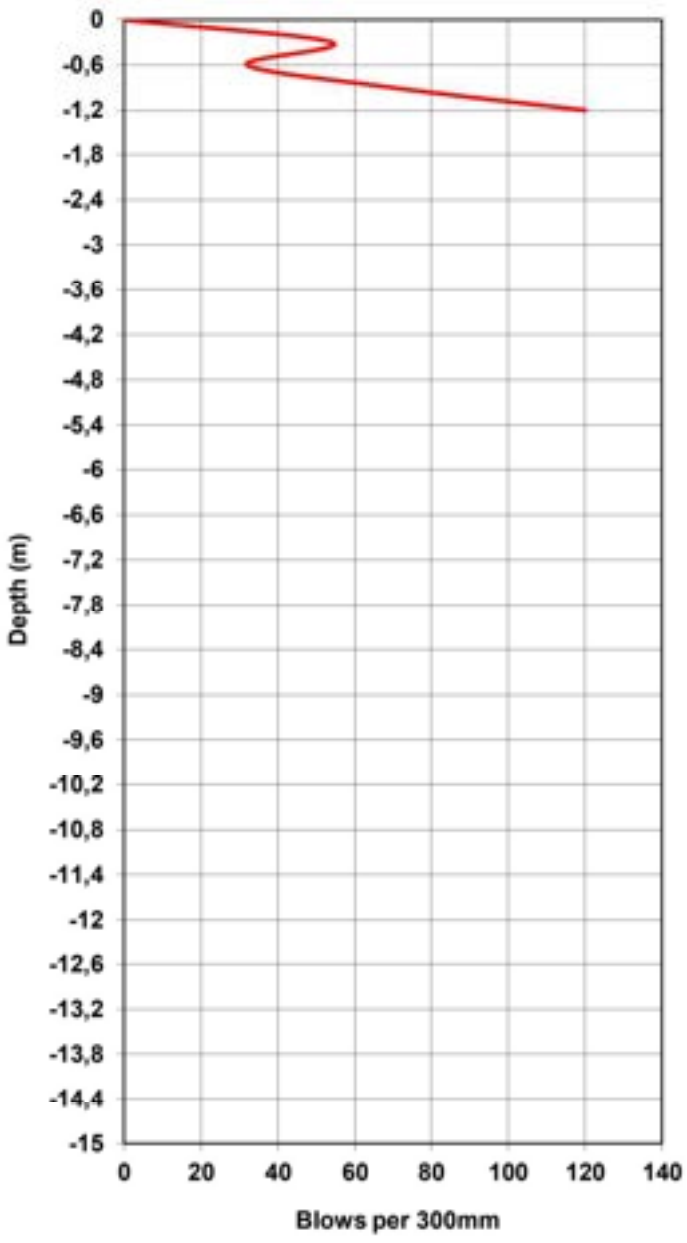
DPL No. : 6 @ TP 6

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth metres	Blows per 300mm	Inferred Consistency	Insitu Shear Strength
0			
0,3	54	Very Stiff	230 kPa
0,6	32	Stiff	140 kPa
0,9	70	Very Stiff	300 kPa
1,2	120	Hard	>300 kPa
	END		

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings



Notes

Refusal at 1,2 m after 150 attempts

Plotted as Cohesive material

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

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e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client: **Servinet Consulting Engineers** Date : 19-01-2021

Contract: **Matwabeng Housing Project, Free State**

Description: **DPL was done from existing ground level**

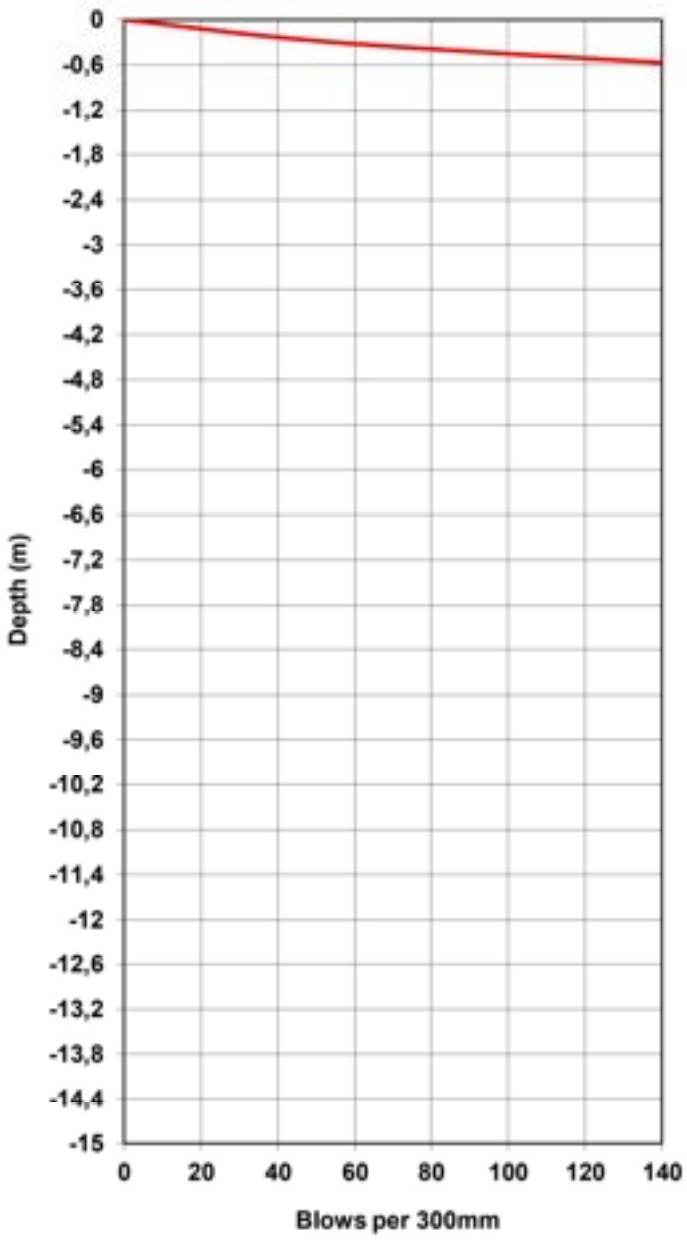
DPL No. : 7 @ TP 7

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth metres	Blows per 300mm	Inferred Consistency	Insitu Shear Strength
0			
0,3	55	Very Stiff	235 kPa
0,6	150	Hard	>300 kPa
	END		

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings



Notes

Refusal at 0,6 m after 150 attempts

Plotted as Cohesive material

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client: **Servinet Consulting Engineers** Date : 19-01-2021

Contract: **Matwabeng Housing Project, Free State**

Description: **DPL was done from existing ground level**

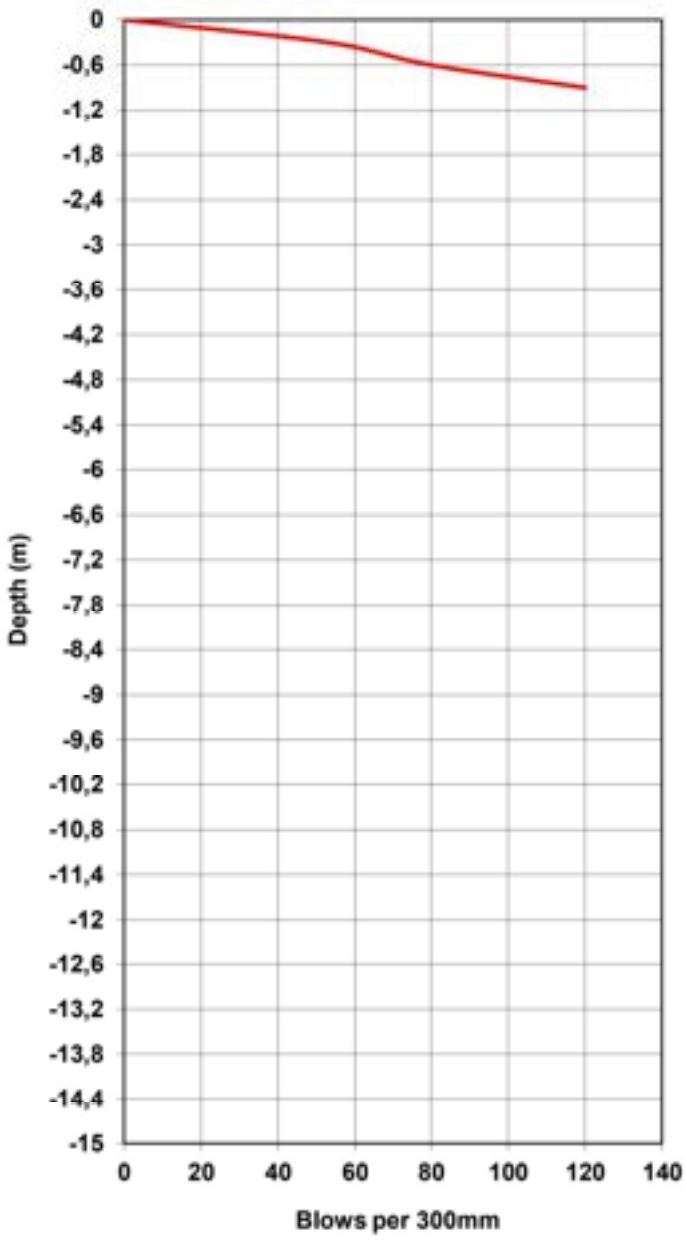
DPL No. : 8 @ TP 8

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth metres	Blows per 300mm	Inferred Consistency	Insitu Shear Strength
0			
0,3	53	Very Stiff	225 kPa
0,6	80	Hard	>300 kPa
0,9	120	Hard	>300 kPa
	END		

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings



Notes

Refusal at 0,9 m after 150 attempts

Plotted as Cohesive material

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client: **Servinet Consulting Engineers** Date : 19-01-2021

Contract: **Matwabeng Housing Project, Free State**

Description: **DPL was done from existing ground level**

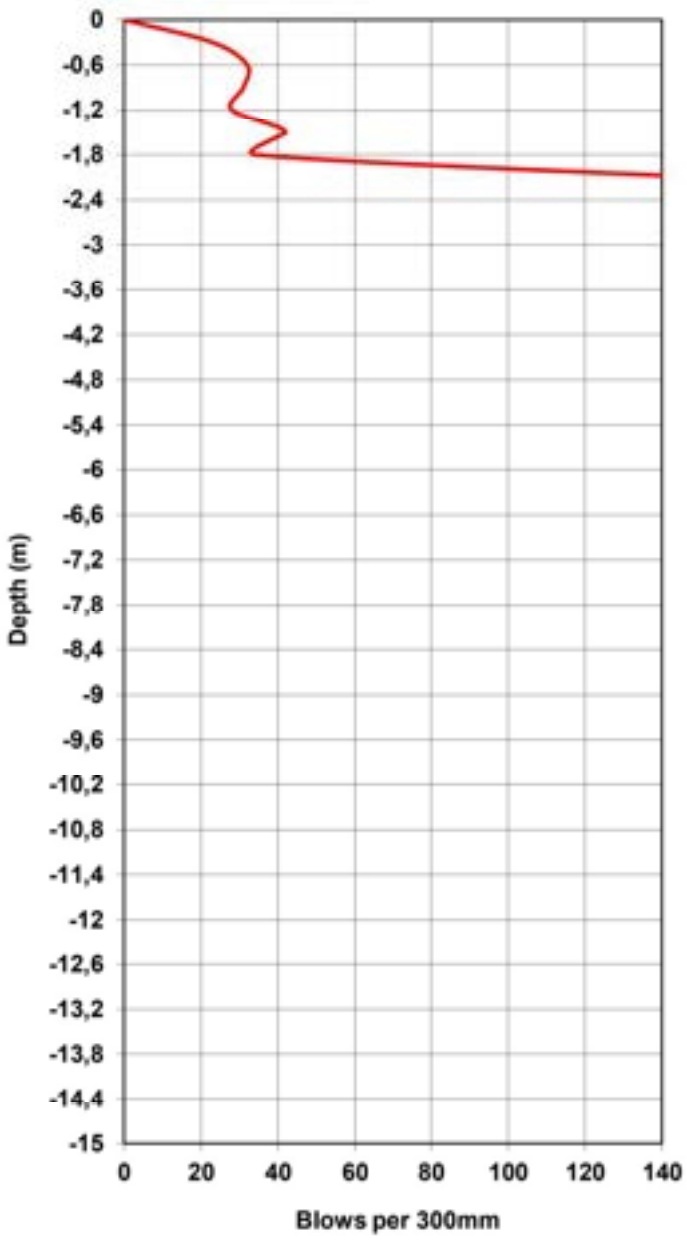
DPL No. : 9 @ TP 9

Light Dynamic Penetrometer Probe

THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth metres	Blows per 300mm	Inferred Consistency	Insitu Shear Strength
0			
0,3	23	Stiff	105 kPa
0,6	32	Stiff	140 kPa
0,9	31	Stiff	135 kPa
1,2	28	Stiff	125 kPa
1,5	42	Very Stiff	180 kPa
1,8	34	Stiff	150 kPa
2,1	150	Hard	>300 kPa
	END		

Hammer: 10kg falling 550mm
Cone: 25mm diameter with 60 degree apex angel
Rods: 16mm diameter, 22mm diameter couplings



Notes

Refusal at 2,1 m after 150 attempts

Plotted as Cohesive material

D-LABORATORY RESULTS

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

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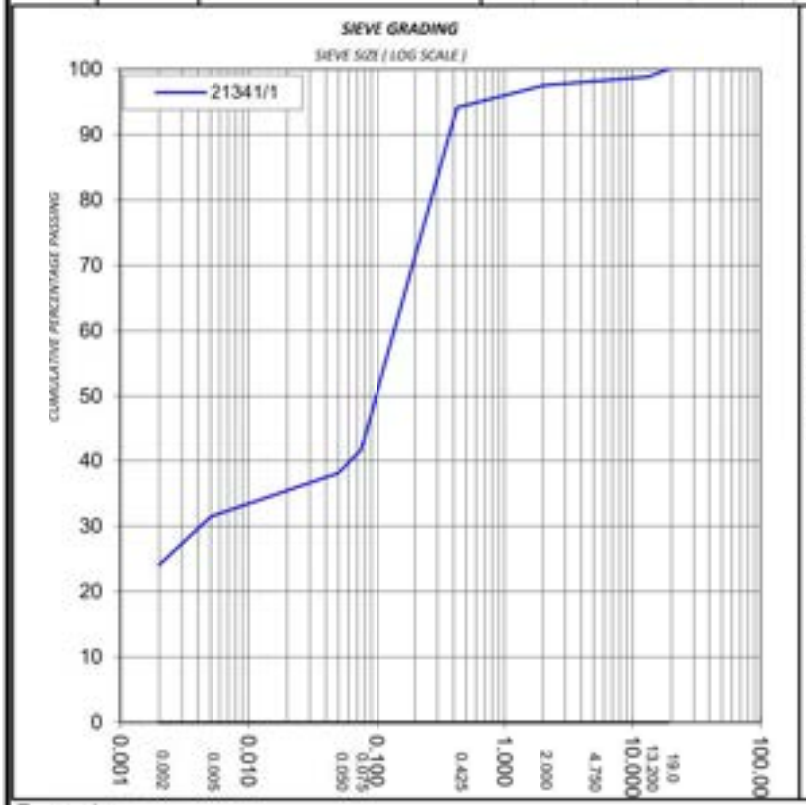
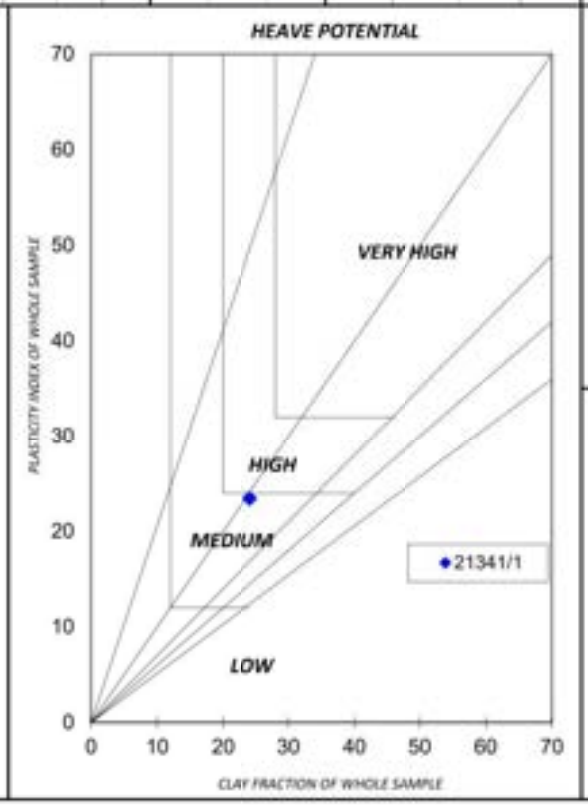
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

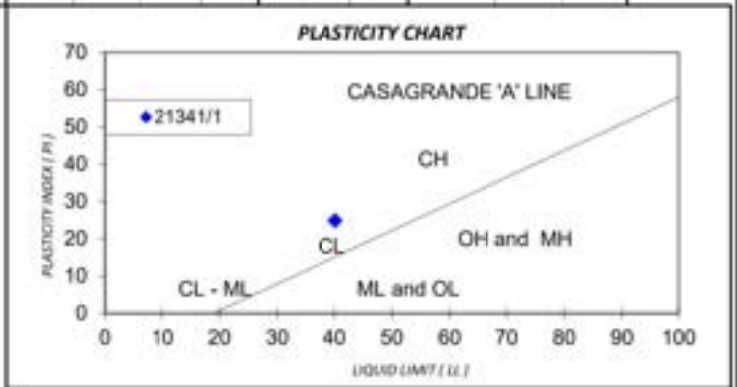
Contract : **Geotechnical Investigation for Matwabeng Residential Houses** | Client : **Servinet Consulting Engineers** | **Date : 19-Jan-21**

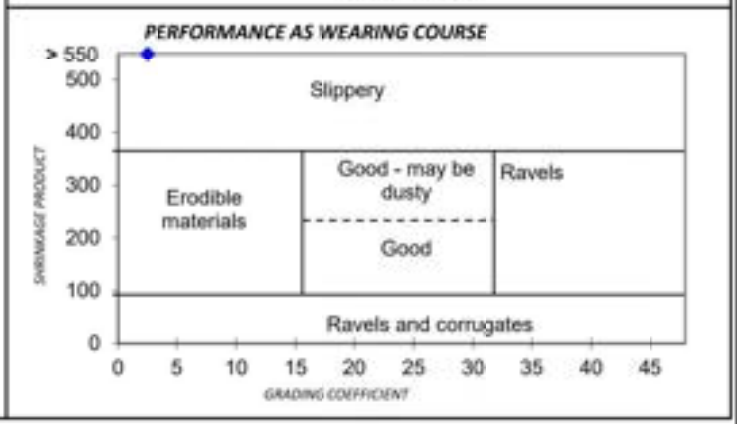
Description : **Material sampled from TP 1 @ 0-0.6 m below Existing Ground Level**

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US Highway	Group Index
0-0.6	21341/1	drk Yellow Clayey sand				100	99	98	97	94	42	38.1	31.4	24.1	3.5	57.4	6.9	32.2	<0.002	137.4	0.1	0.67	40	25	12.3	SC	-	A-6	5









Remarks:

THIS MATERIAL IS NOT SUITABLE FOR WEARING COARSE AS THE SHRINKAGE PRODUCT IS GREATER THAN 550

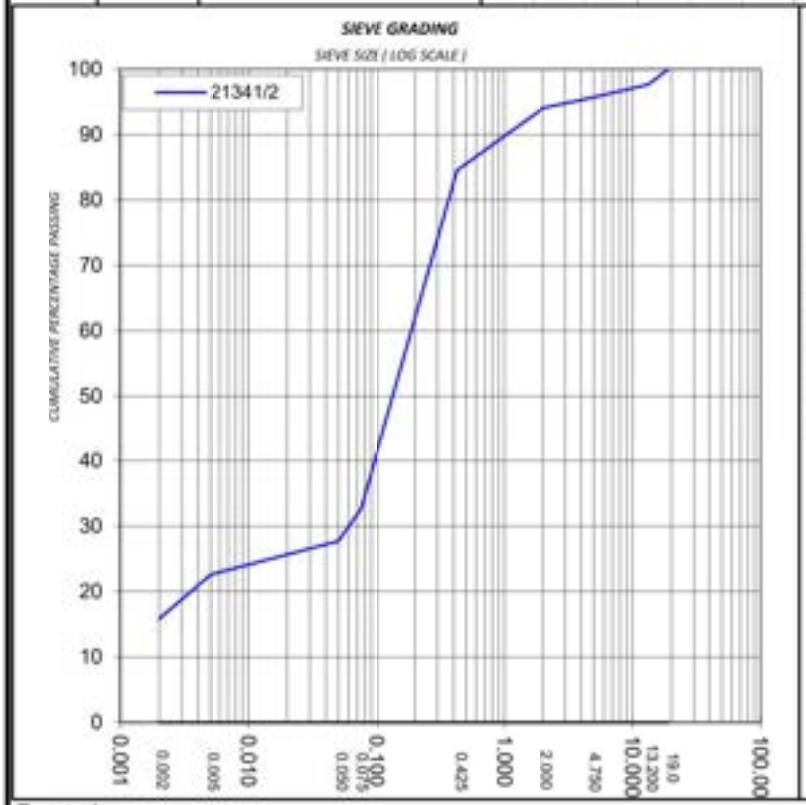
P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

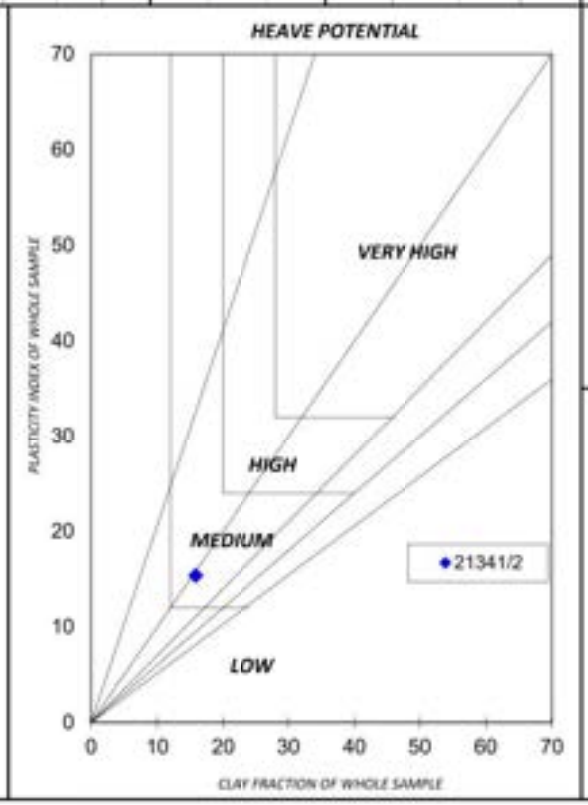
Phezulu Geotechnical Civils

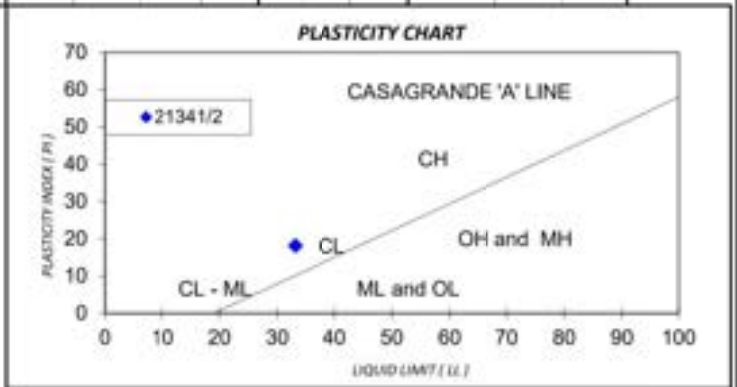
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

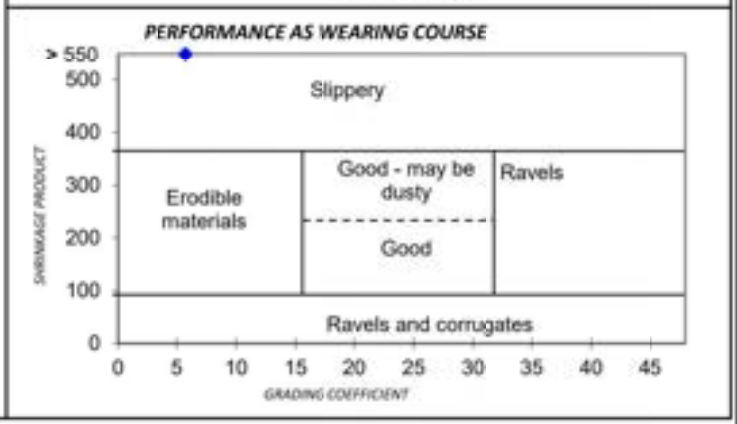
Contract :	**Geotechnical Investigation for Matwabeng Residential Houses**	Client :	**Servinet Consulting Engineers**	**Date : 19-Jan-21**	
Description :	**Material sampled from TP 1 @ 0.6-1.4 m below Existing Ground Level**				

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US.Highway	Group Index
0.6-1.4	21341/2	ll Yellow Clayey sand				100	98	96	94	85	33	27.7	22.6	15.8	10.1	60.5	5.5	24.0	<0.002	187.1	19.5	0.89	33	18	8.1	SC	<G9	A-2-6	1









Remarks:

THIS MATERIAL IS NOT SUITABLE FOR WEARING COARSE AS THE SHRINKAGE PRODUCT IS GREATER THAN 550

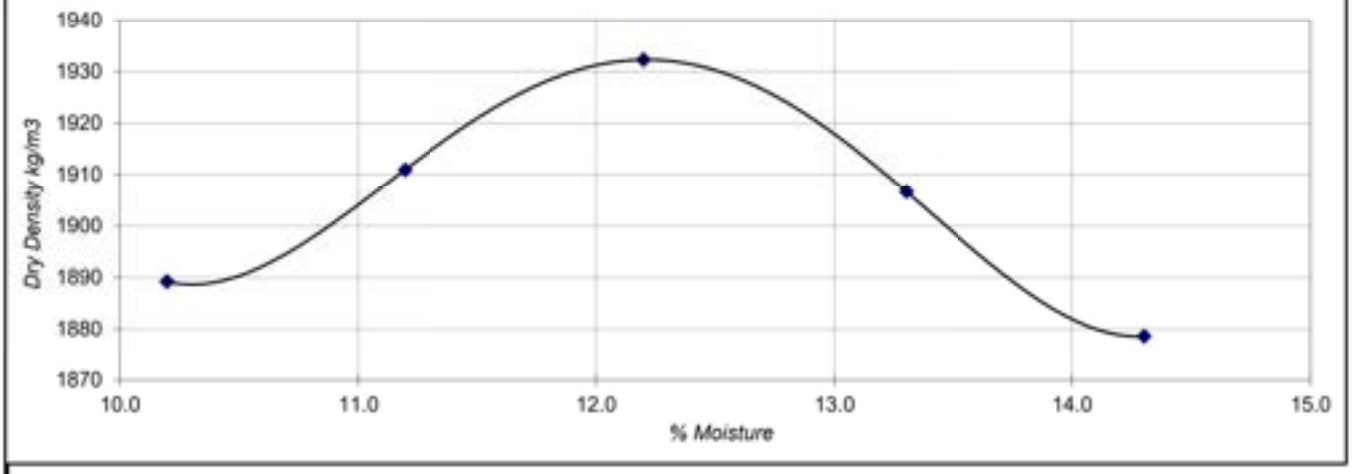
P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

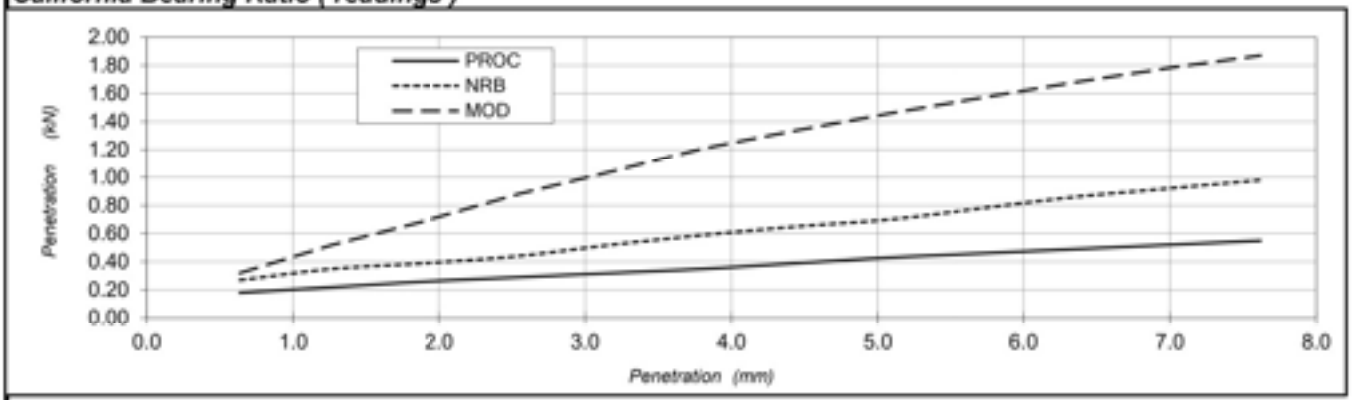
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client:	***Servinet Consulting Engineers***	*Date:*	**19-Jan-21**
Contract :	***Geotechnical Investigation for Matwabeng Residential Houses***	*Sample no:*	***21341/2***
Description:	***Material sampled from TP 1 @ 0.6-1.4 m below Existing Ground Level***		

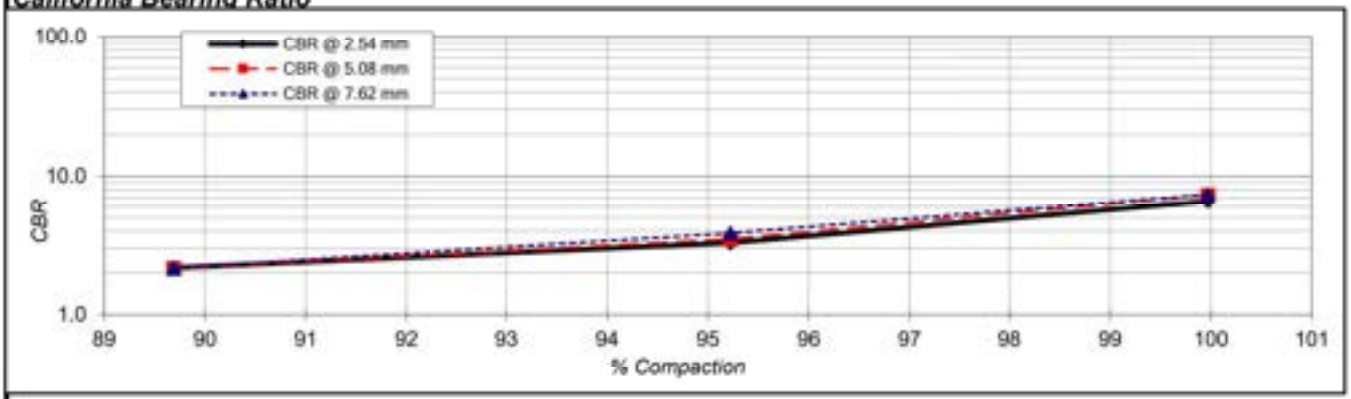
Maximum dry density =	**1932 kg/m³**
Optimum moisture content =	**12.2 %**



California Bearing Ratio (readings)



California Bearing Ratio



% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	**7**	**5**	**4**	**3**	**3**	**2**
CBR of 20.016 kN	7	5	5	3	3	2
CBR of 25.354 kN	7	6	5	4	3	2

% Swell

	Mod	*N.R.B.*	*Proc.*
Swell /	1.00	1.00	1.00
Reading	1.83	2.20	2.65
% Swell	**0.65**	**0.94**	**1.30**

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Tel : 013 004 0119
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Reg. No. 2011/005646/23
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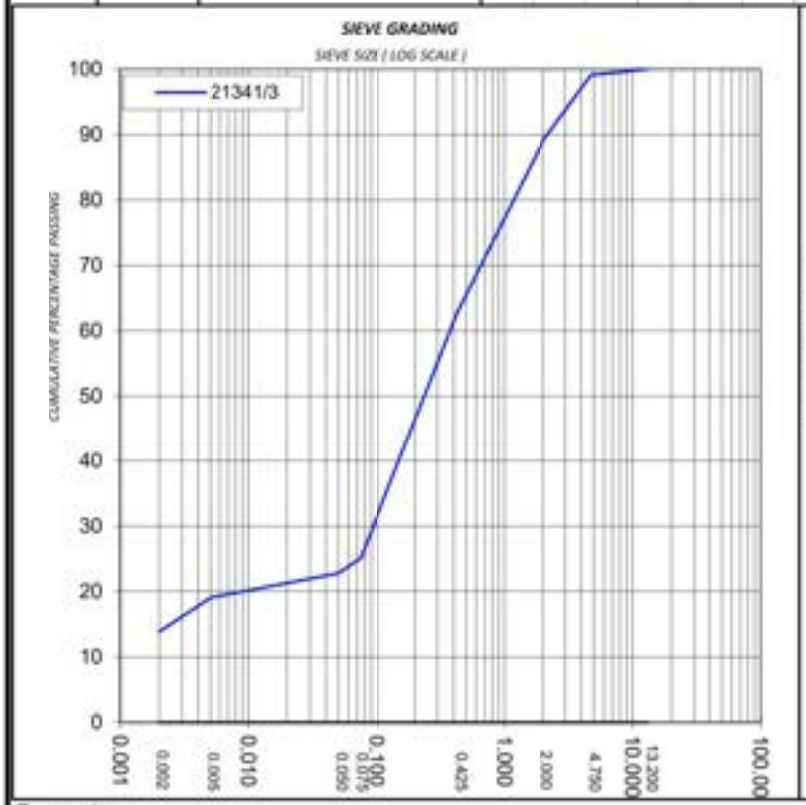
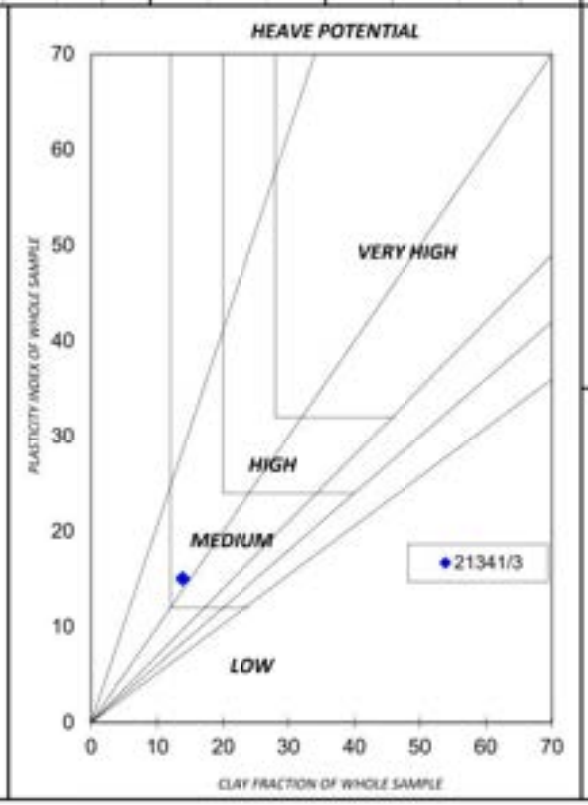
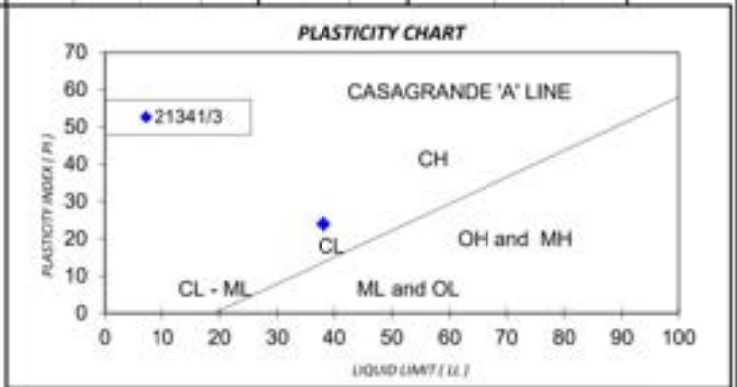
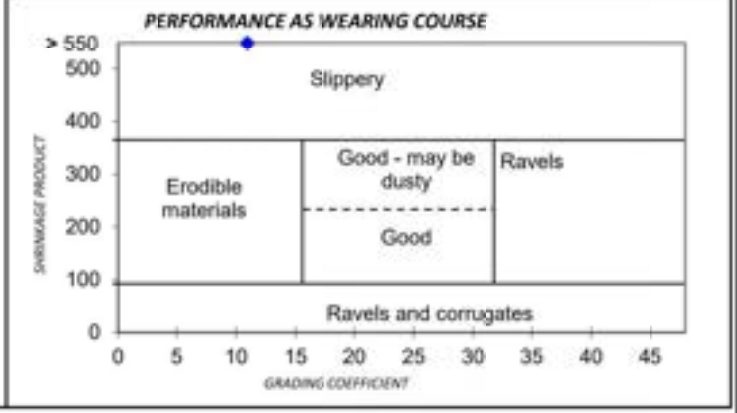
Contract :	**Geotechnical Investigation for Matwabeng Residential Houses**	Client : **Servinet Consulting Engineers**	**Date : 19-Jan-21**
Description :	**Material sampled from TP 2 @ 0-0.45 m below Existing Ground Level**		

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US.Highway	Group Index
0-0.45	21341/3	drk Yellow Clayey sand					100	99	89	63	25	22.8	19.1	13.9	29.5	44.9	4.2	21.4	<0.002	374.6	23.5	1.23	38	24	11.2	SC	-	A-2-6	1









Remarks:

THIS MATERIAL IS NOT SUITABLE FOR WEARING COARSE AS THE SHRINKAGE PRODUCT IS GREATER THAN 550

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12 Suikeriet Street
Central Park
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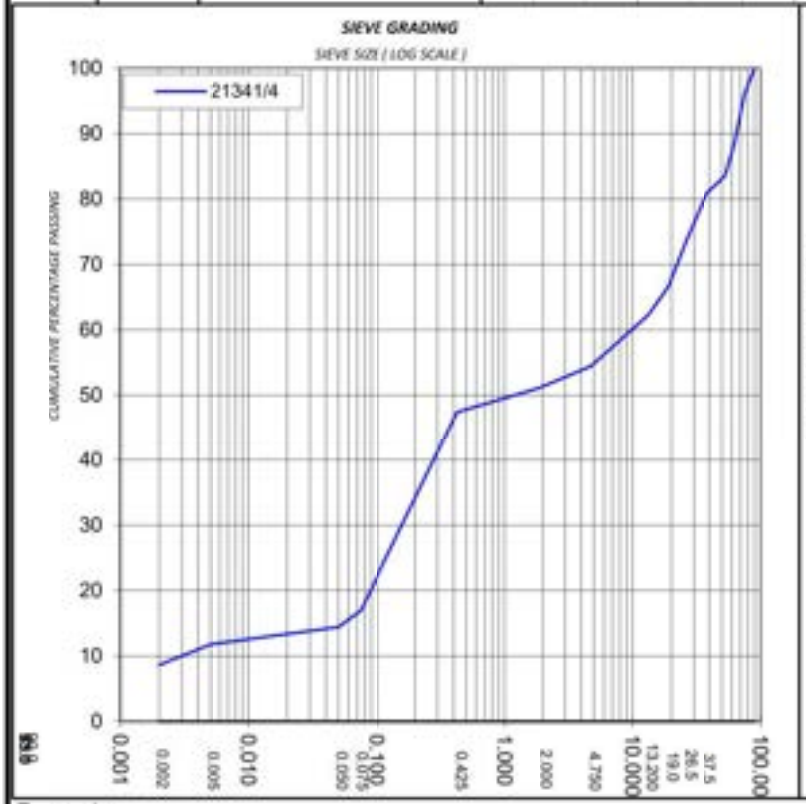
Nelspruit
1200
NLA Member No. 241

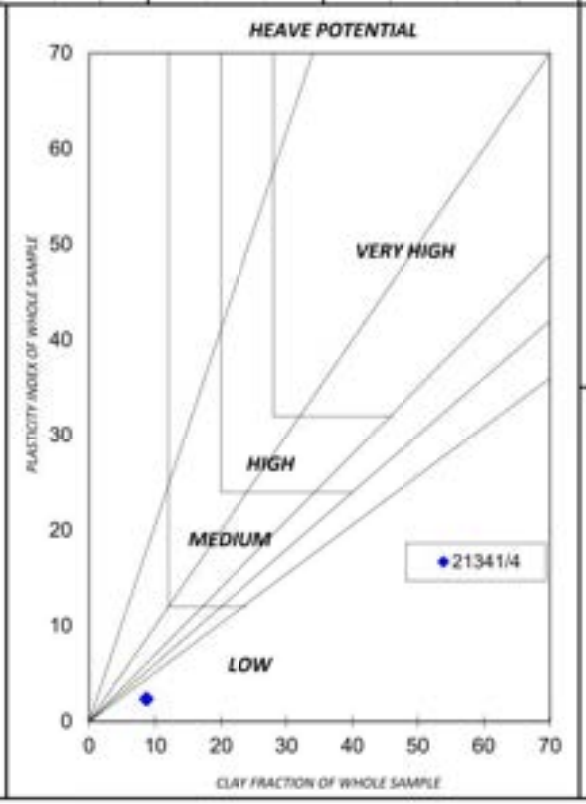
Phezulu Geotechnical Civils

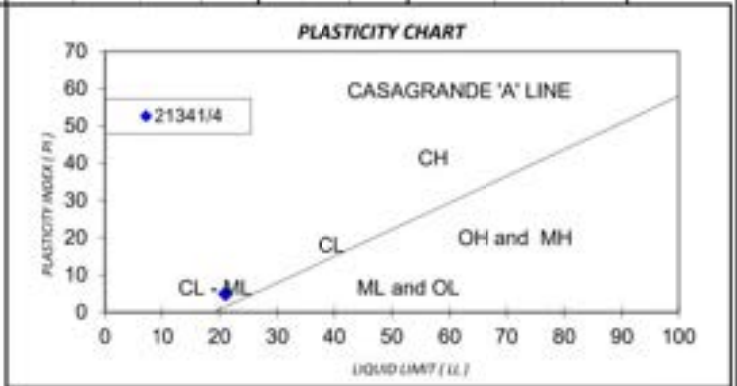
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

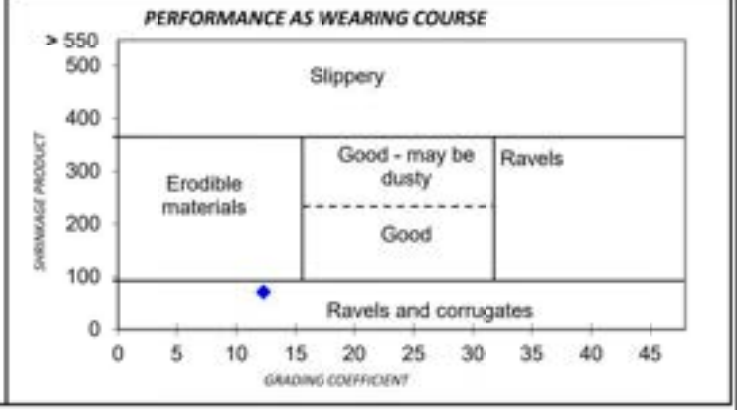
Contract :	Geotechnical Investigation for Matwabeng Residential Houses	Client : Servinet Consulting Engineers	Date : 19-Jan-21
Description :	Material sampled from TP 2 @ 0.45-1.2 m below Existing Ground Level		

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US Highway	Group Index
0.45-1.2	21341/4	drk Yel. Orange Silty/Clayey sand	84	81	74	67	62	54	51	47	17	14.4	11.8	8.6	7.7	64.2	5.2	23.0	0.003	3308.8	0.9	1.84	21	5	1.5	sm/sc	G9	A-1-b	0









Remarks:

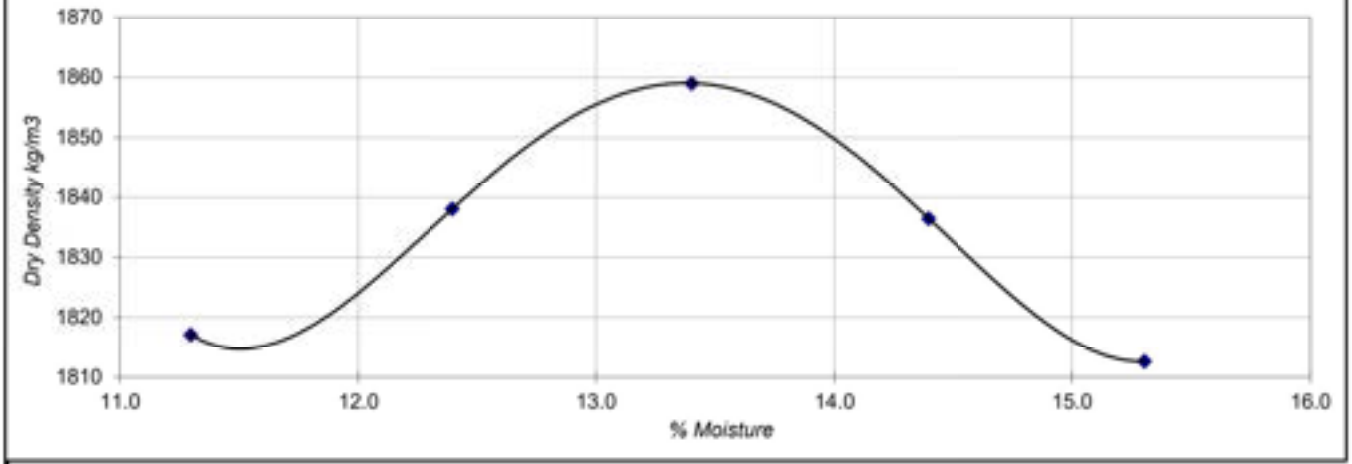
P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

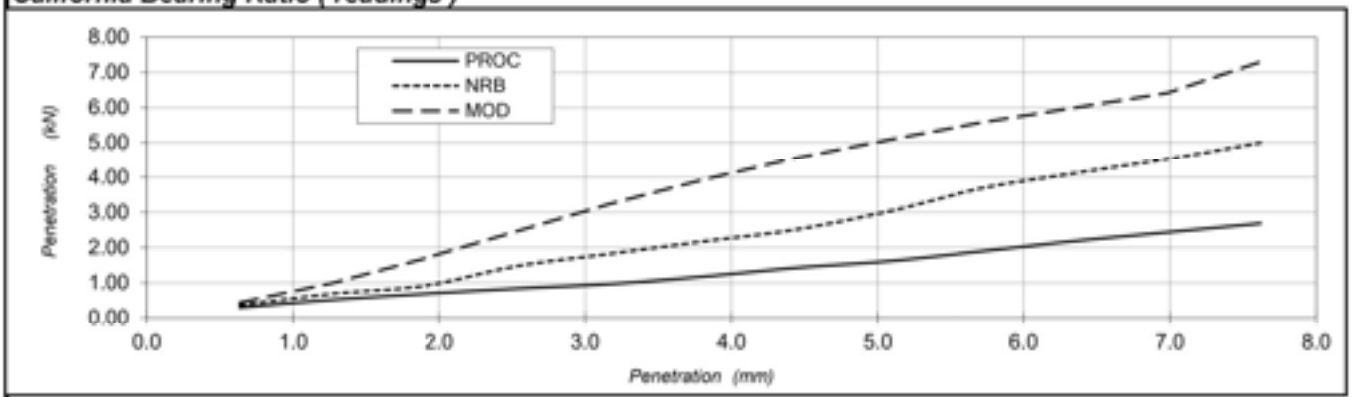
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client:	***Servinet Consulting Engineers***	*Date:*	**19-Jan-21**
Contract :	***Geotechnical Investigation for Matwabeng Residential Houses***	*Sample no:*	***21341/4***
Description:	***Material sampled from TP 2 @ 0.45-1.2 m below Existing Ground Level***		

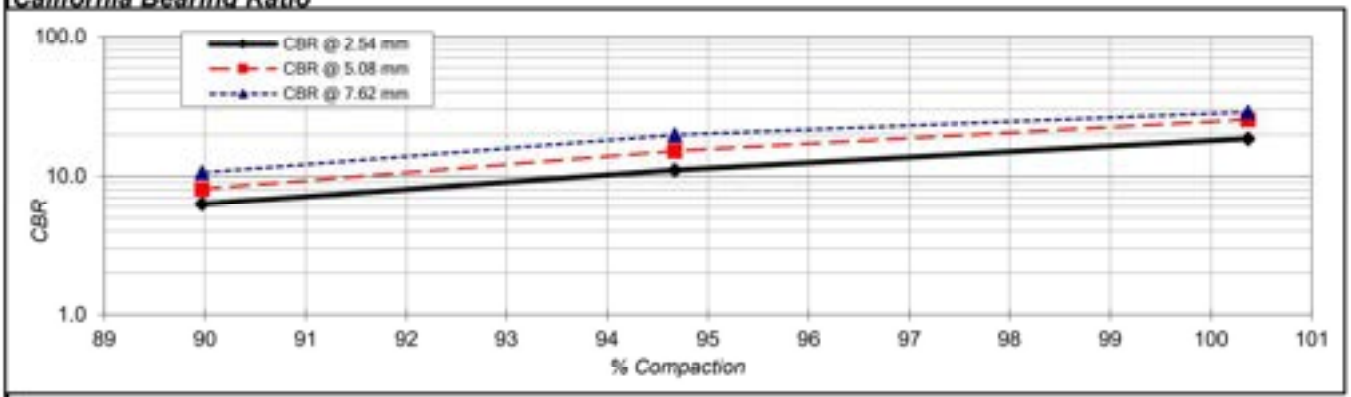
Maximum dry density =	**1859 kg/m³**
Optimum moisture content =	**13.4 %**



California Bearing Ratio (readings)



California Bearing Ratio



% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	**18**	**15**	**14**	**11**	**9**	**6**
CBR of 20.016 kN	25	21	19	16	12	8
CBR of 25.354 kN	28	25	23	20	16	11

% Swell

	Mod	*N.R.B.*	*Proc.*
Swell /	1.00	1.00	1.00
Reading	1.07	1.14	1.27
% Swell	**0.06**	**0.11**	**0.21**

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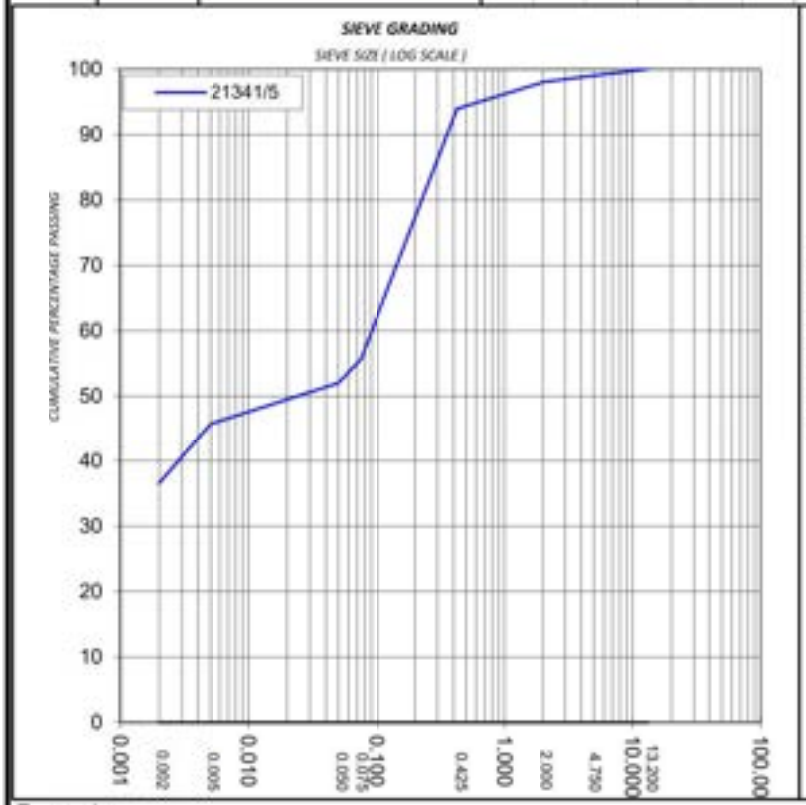
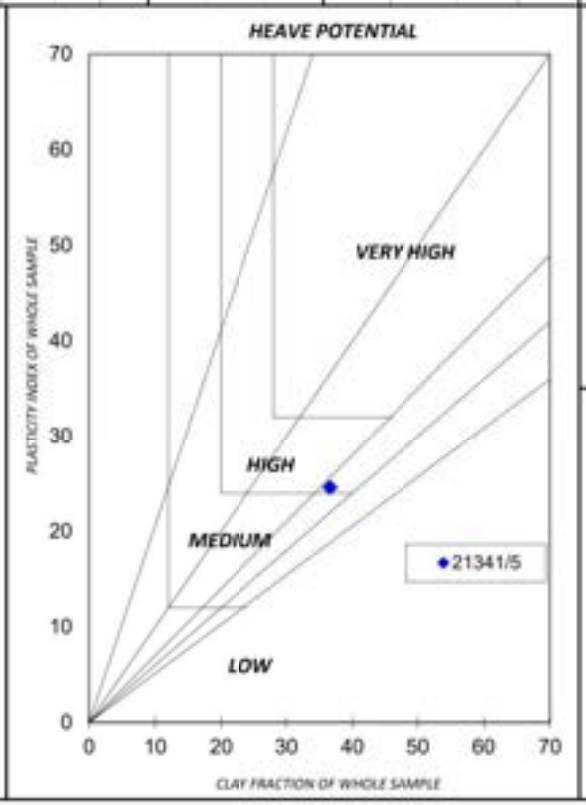
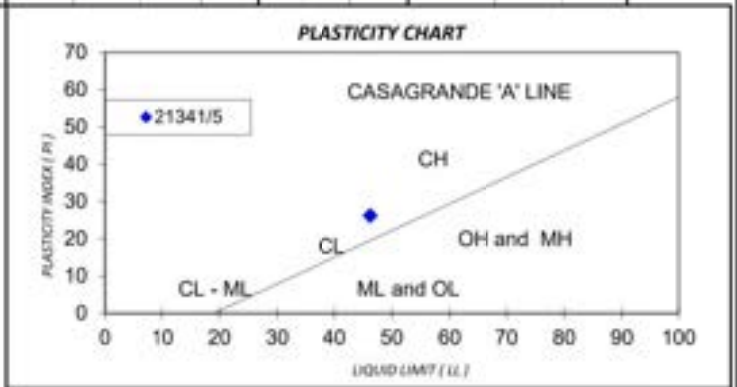
Contract : **Geotechnical Investigation For Matwabeng Residential Houses** | Client : **Servinet Consulting Engineers** | **Date : 19-Jan-21**

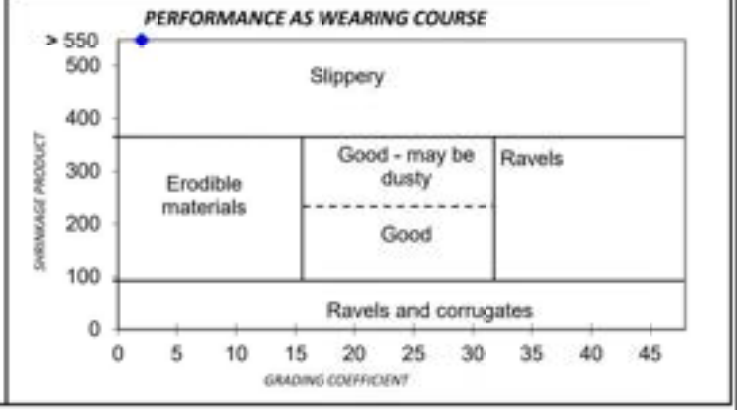
Description : **Material sampled from TP 3 @ 0-0.50 m below Existing Ground Level**

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing												Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US.Highway	Group Index
0-0.50	21341/5	drk Yellow Inorganic clay					100	99	98	94	56	52.1	45.7	36.6	4.2	42.7	6.5	46.6	<0.002	91.2	1.1	0.52	46	26	12.4	CL	<G9	A-7-6	11









Remarks:

THIS MATERIAL IS NOT SUITABLE FOR WEARING COARSE AS THE SHRINKAGE PRODUCT IS GREATER THAN 550

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
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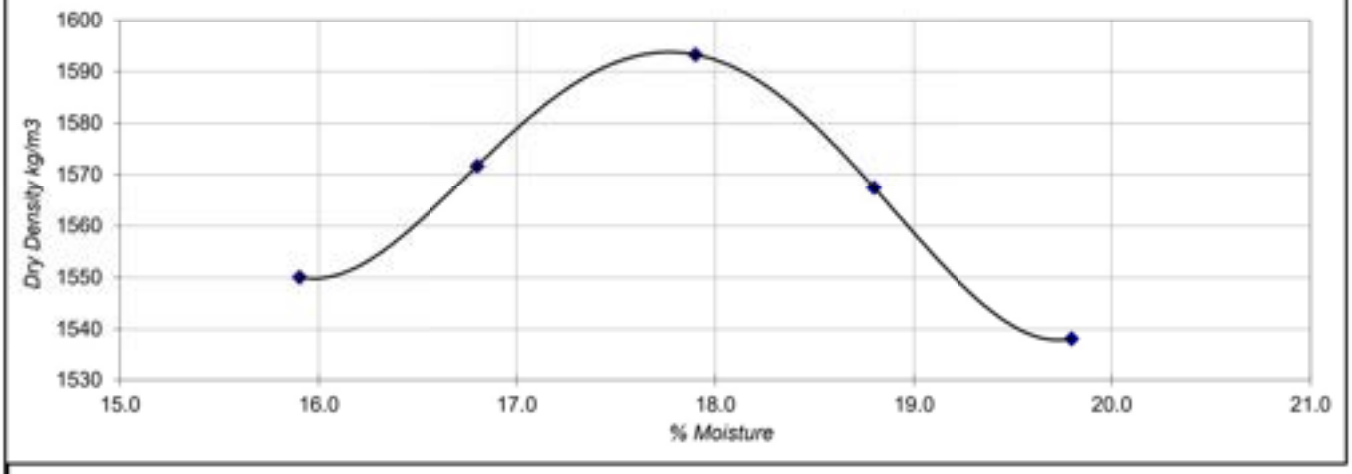
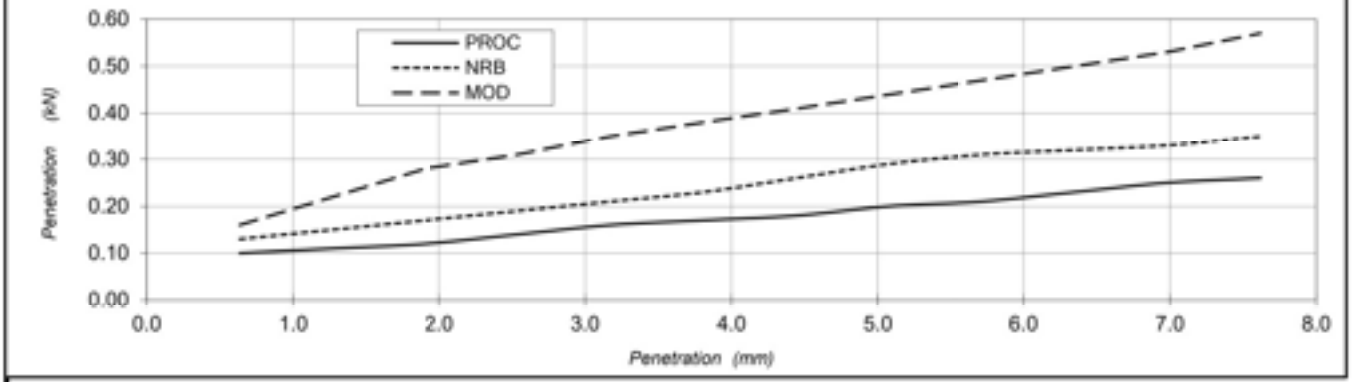
Client:	***Servinet Consulting Engineers***	*Date:*	**19-Jan-21**
Contract :	***Geotechnical Investigation For Matwabeng Residential Houses***	*Sample no:*	***21341/5***
Description:	***Material sampled from TP 3 @ 0-0.50 m below Existing Ground Level***		

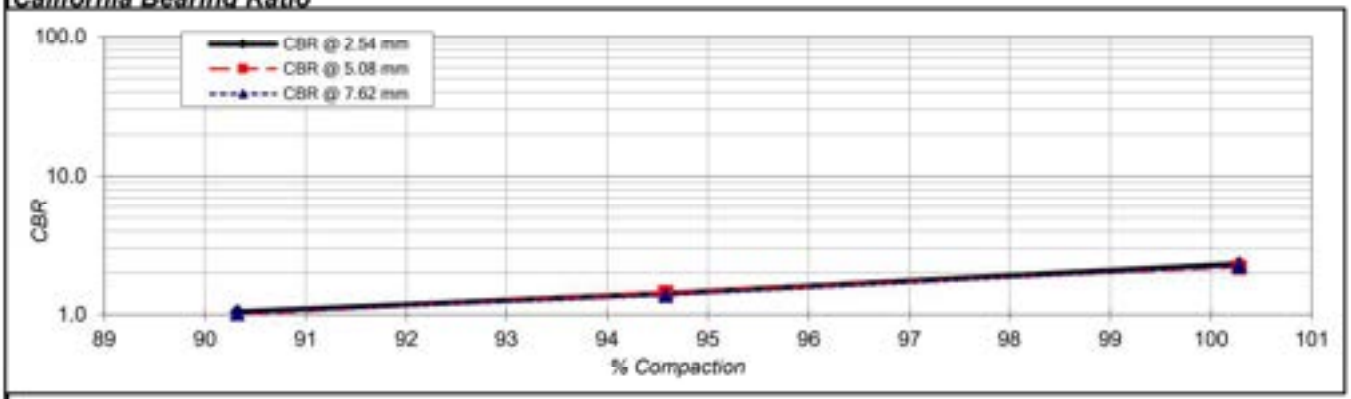
Maximum dry density =	**1594 kg/m³**
Optimum moisture content =	**17.9 %**



California Bearing Ratio (readings)



California Bearing Ratio



% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	**2**	**2**	**2**	**1**	**1**	**1**
CBR of 20.016 kN	2	2	2	1	1	1
CBR of 25.354 kN	2	2	2	1	1	1

% Swell

	Mod	*N.R.B.*	*Proc.*
Swell /	1.00	1.00	1.00
Reading	5.80	7.30	9.48
% Swell	**3.78**	**4.96**	**6.68**

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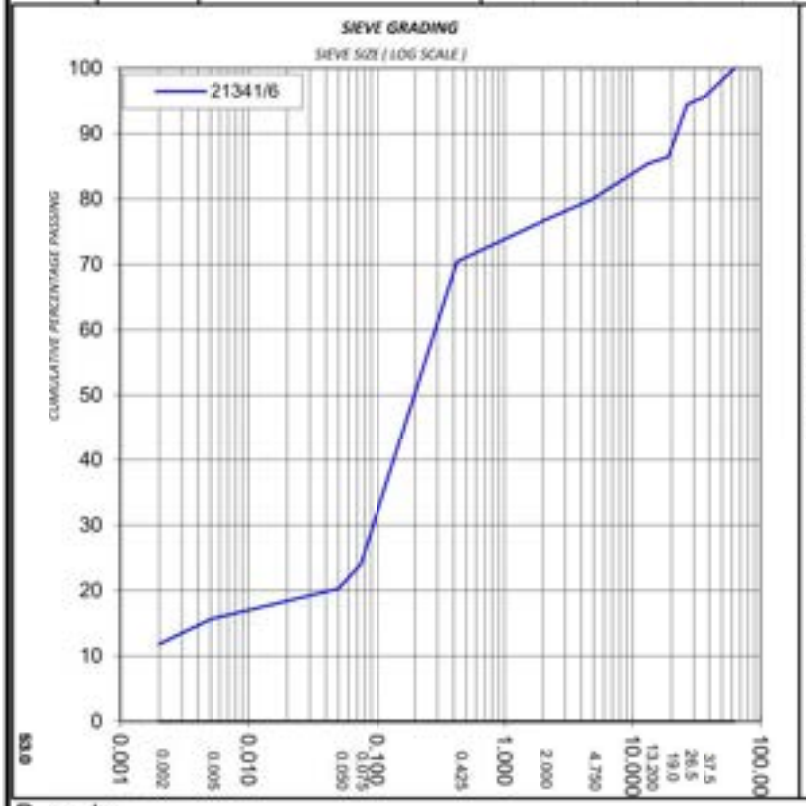
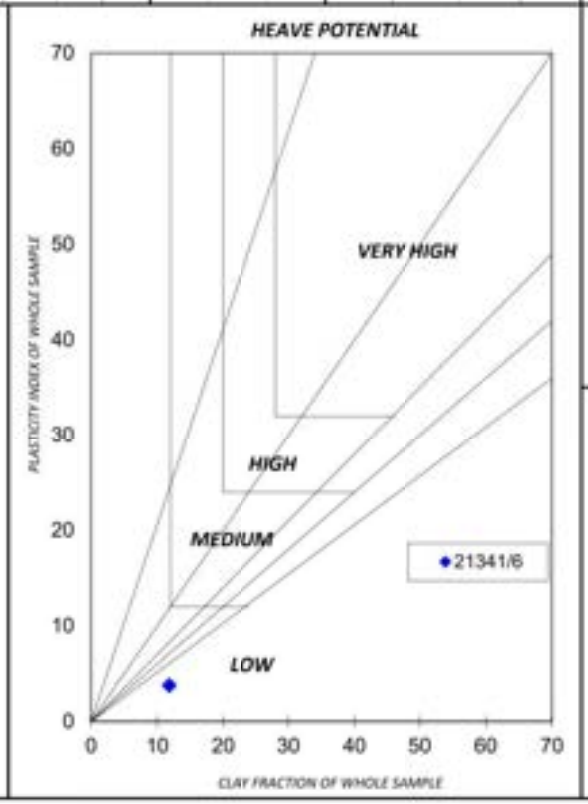
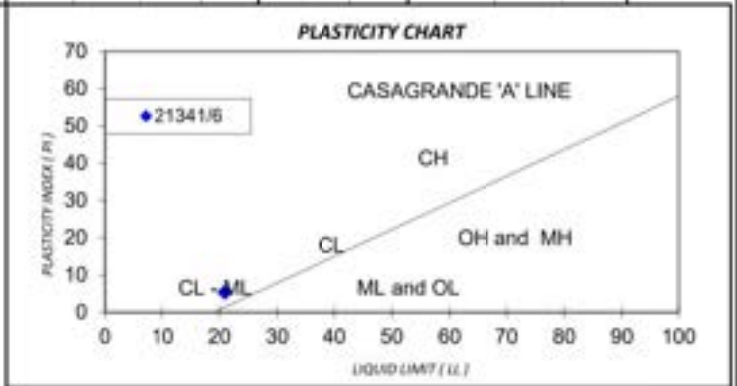
Contract : **Geotechnical Investigation For Matwabeng Residential Houses** | Client : **Servinet Consulting Engineers** | **Date : 19-Jan-21**

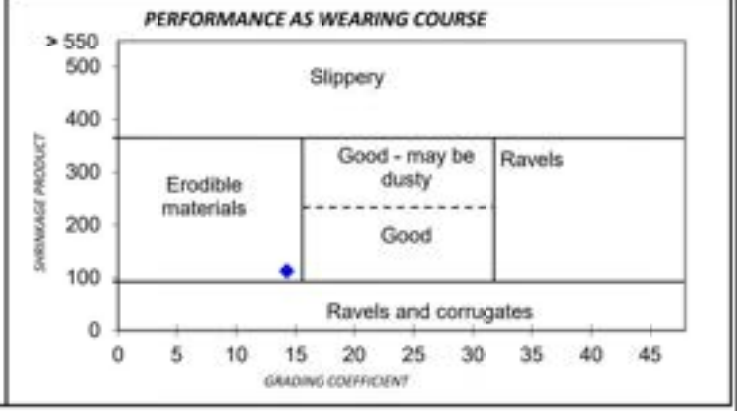
Description : **Material sampled from TP 3 @ 0.50-1.6 m below Existing Ground Level**

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US.Highway	Group Index
0.50-1.6	21341/6	drk Yellow Silty/Clayey sand	99	96	94	86	85	80	77	70	24	20.3	15.6	11.8	8.1	65.4	6.1	20.4	<0.002	287.6	30.4	1.29	21	5	1.6	sm/sc	<G9	A-2-4	0









Remarks:

P.O Box 1766
12 Suikeriet Street
Central Park
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Nelspruit
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e-mail : xolani@phezulugc.co.za
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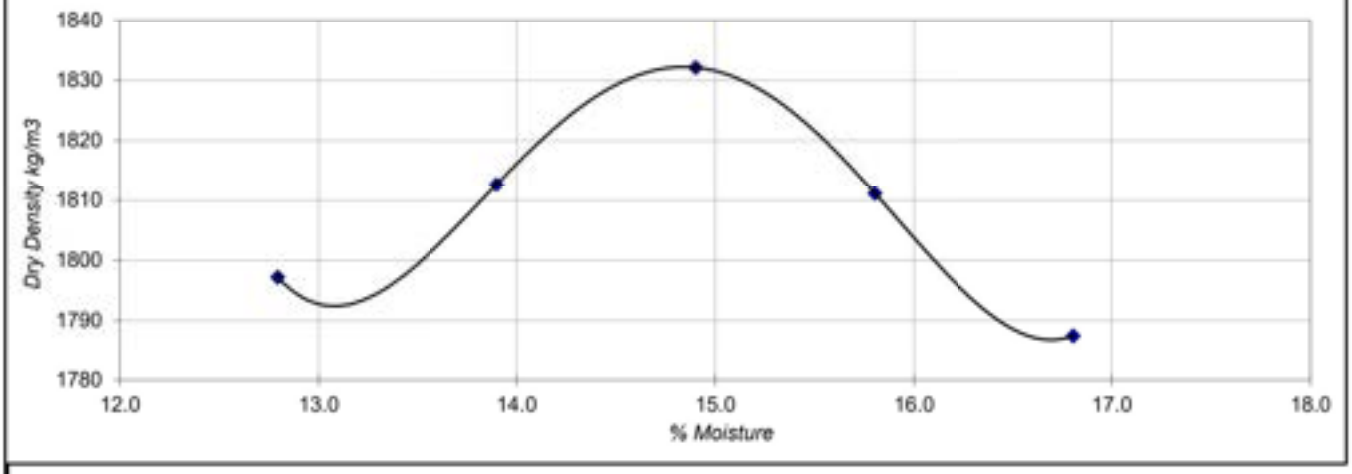
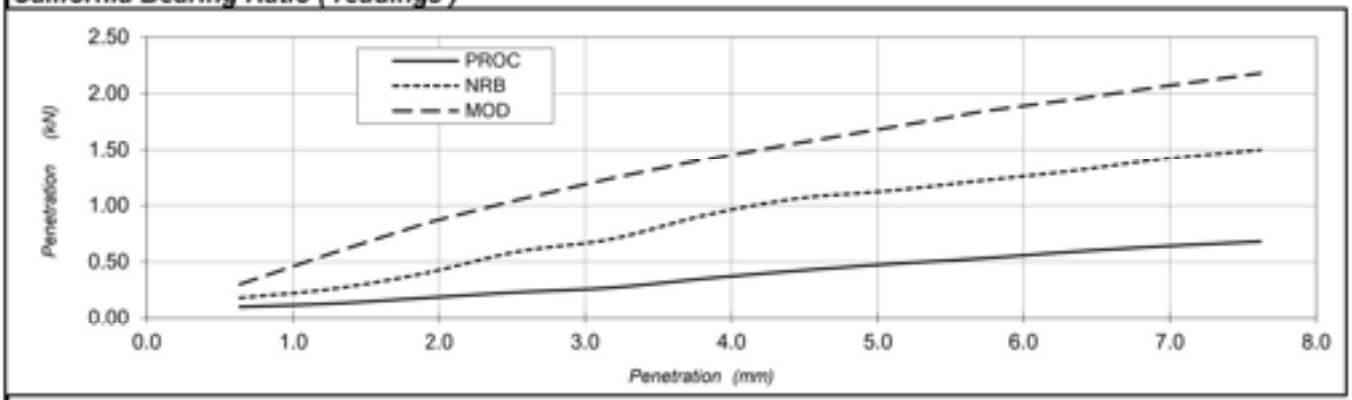
Client:	***Servinet Consulting Engineers***	*Date:*	**19-Jan-21**
Contract :	***Geotechnical Investigation For Matwabeng Residential Houses***	*Sample no:*	***21341/6***
Description:	***Material sampled from TP 3 @ 0.50-1.6 m below Existing Ground Level***		

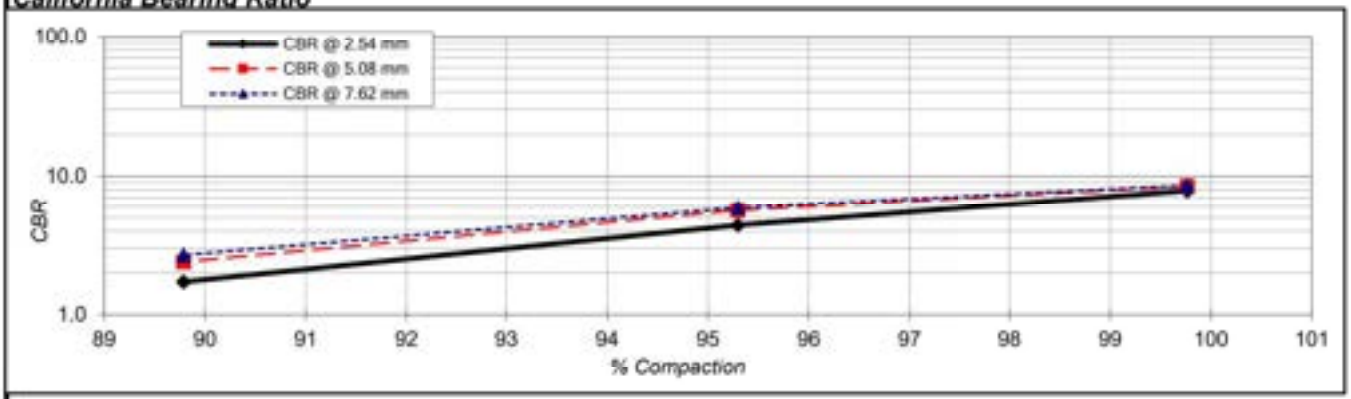
Maximum dry density =	**1832 kg/m³**
Optimum moisture content =	**14.9 %**



California Bearing Ratio (readings)



California Bearing Ratio



% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	**8**	**6**	**6**	**4**	**3**	**2**
CBR of 20.016 kN	9	7	7	5	4	2
CBR of 25.354 kN	9	7	7	6	4	3

% Swell

	Mod	*N.R.B.*	*Proc.*
Swell /	1.00	1.00	1.00
Reading	1.92	2.49	3.20
% Swell	**0.72**	**1.17**	**1.73**

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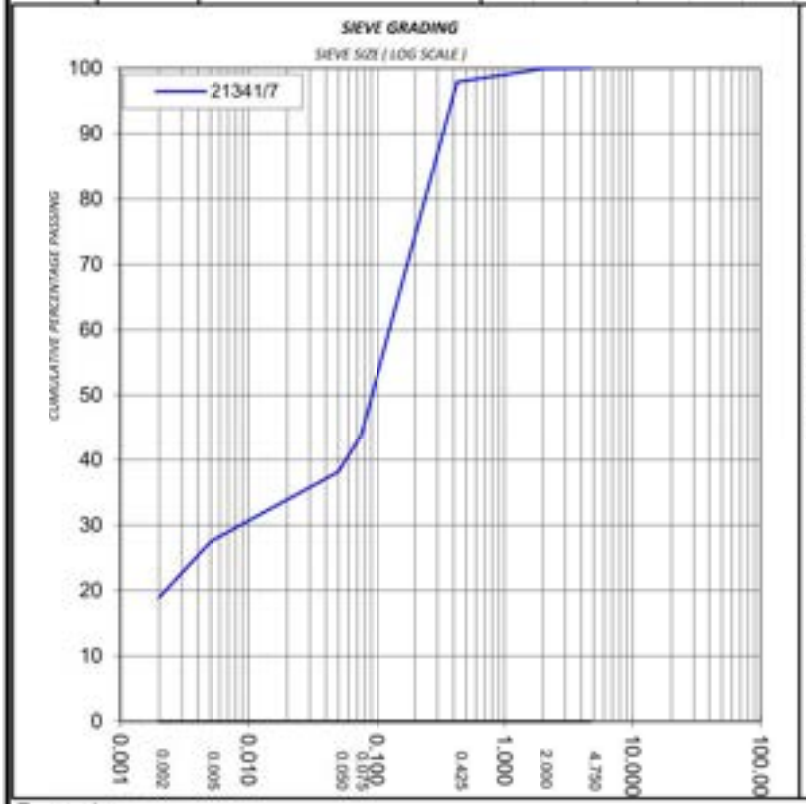
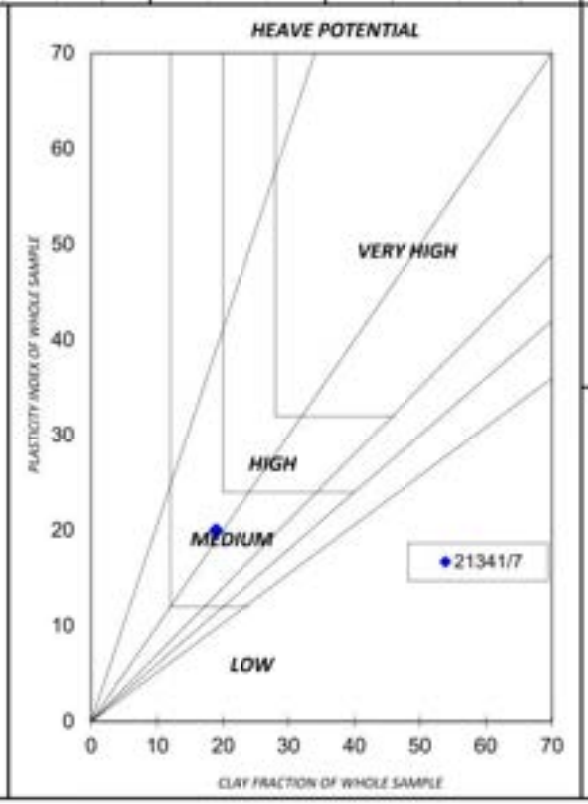
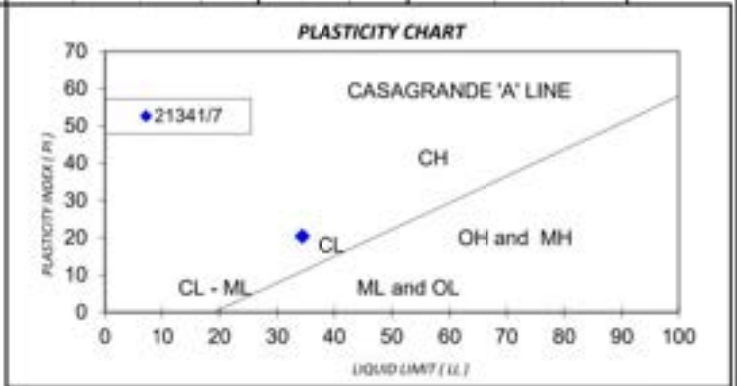
Contract : **Geotechnical Investigation For Matwabeng Residential Houses** | Client : **Servinet Consulting Engineers** | **Date : 19-Jan-21**

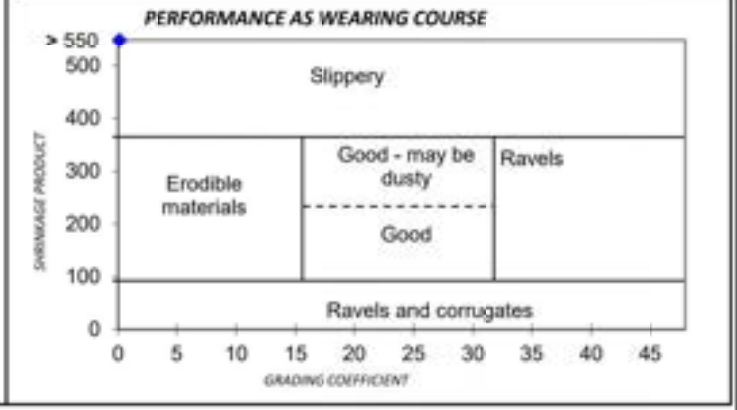
Description : **Material sampled from TP 4 @ 0-0.30 m below Existing Ground Level**

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US Highway	Group Index
0-0.30	21341/7	drk Yellow Clayey sand						100	100	98	44	38.2	27.4	18.9	2.0	59.8	10.7	27.5	<0.002	126.2	0.6	0.58	34	20	10.1	SC	-	A-6	5









Remarks:

THIS MATERIAL IS NOT SUITABLE FOR WEARING COARSE AS THE SHRINKAGE PRODUCT IS GREATER THAN 550

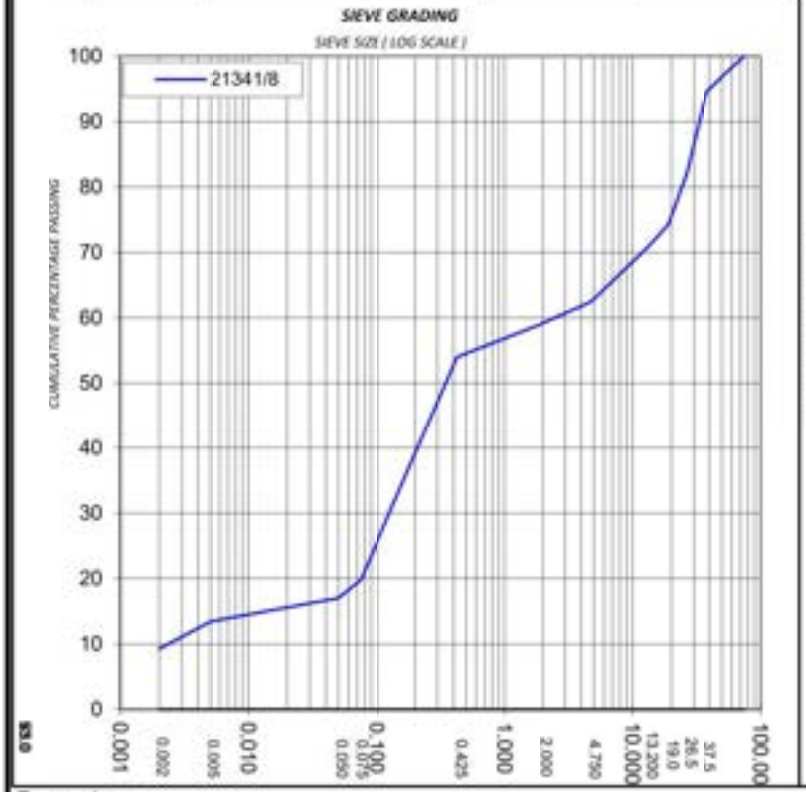
P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

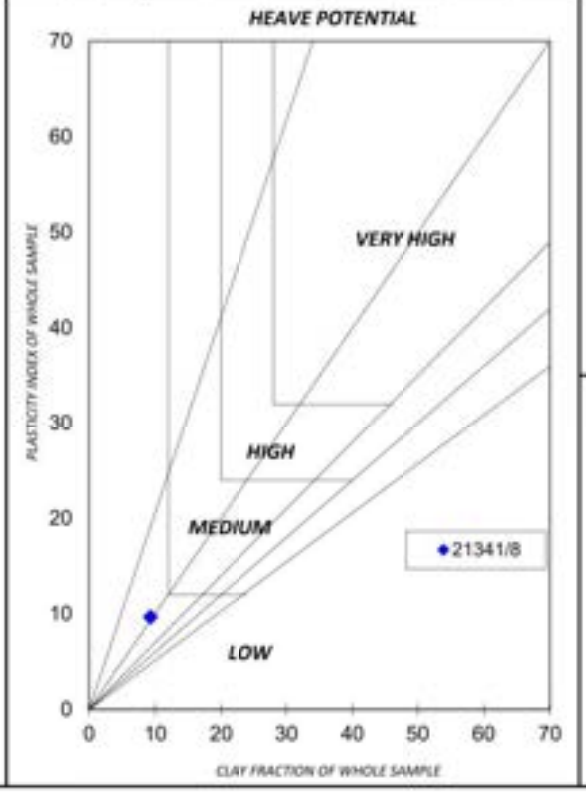
Phezulu Geotechnical Civils

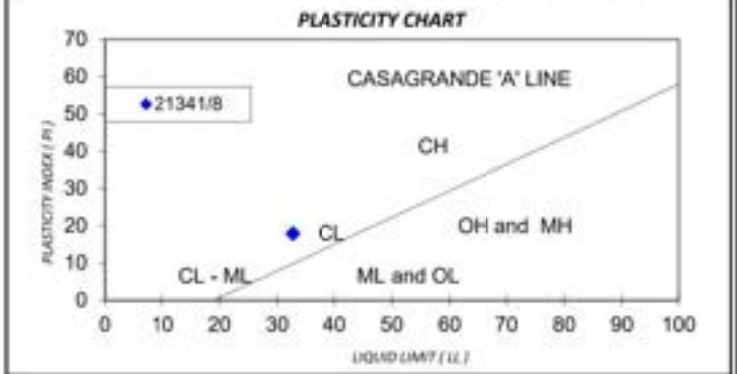
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

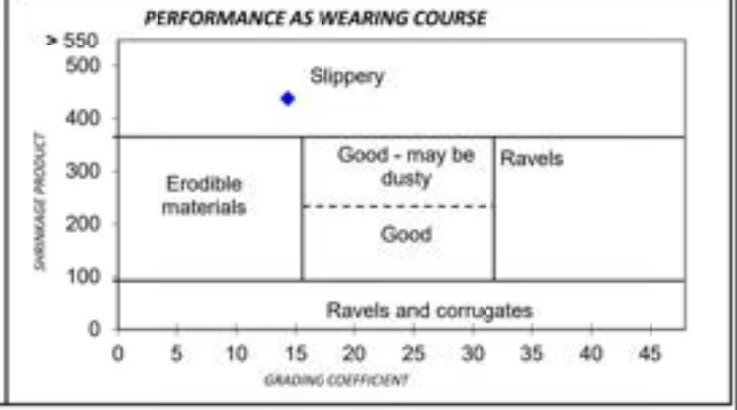
Contract :	Geotechnical Investigation For Matwabeng Residential Houses	Client : Servinet Consulting Engineers	Date : 19-Jan-21
Description :	Material sampled from TP 8 @ 0.30-1.0 m below Existing Ground Level		

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US.Highway	Group Index
0.30-1.0	21341/8	drk Yellow Clayey sand	97	94	82	74	71	62	59	54	20	17.1	13.4	9.3	8.7	62.5	6.1	22.7	0.002	1056.5	2.7	1.67	33	18	8.1	SC	<G9	A-2-6	0









Remarks:

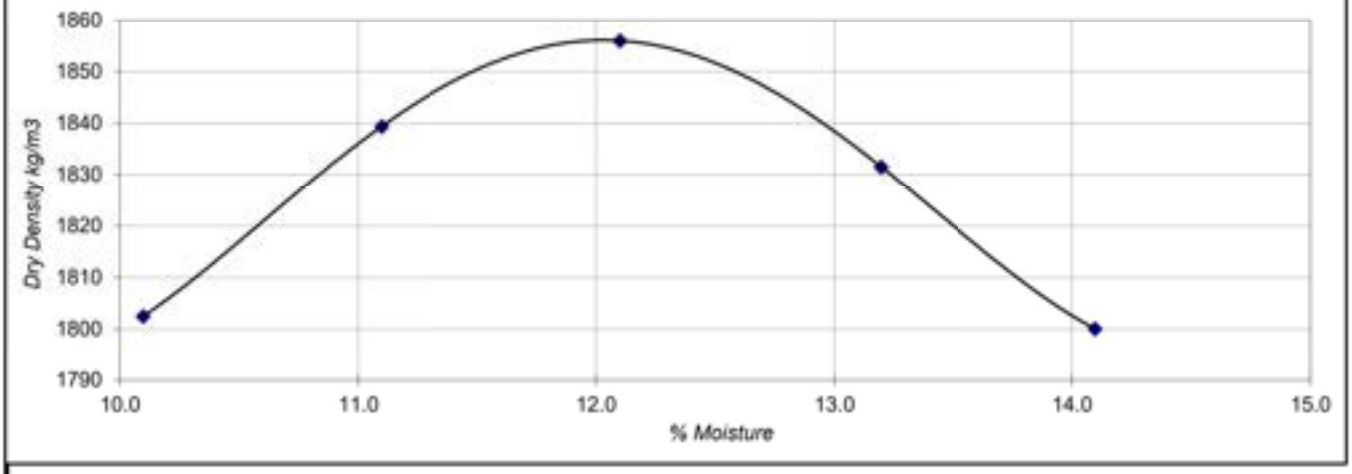
P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

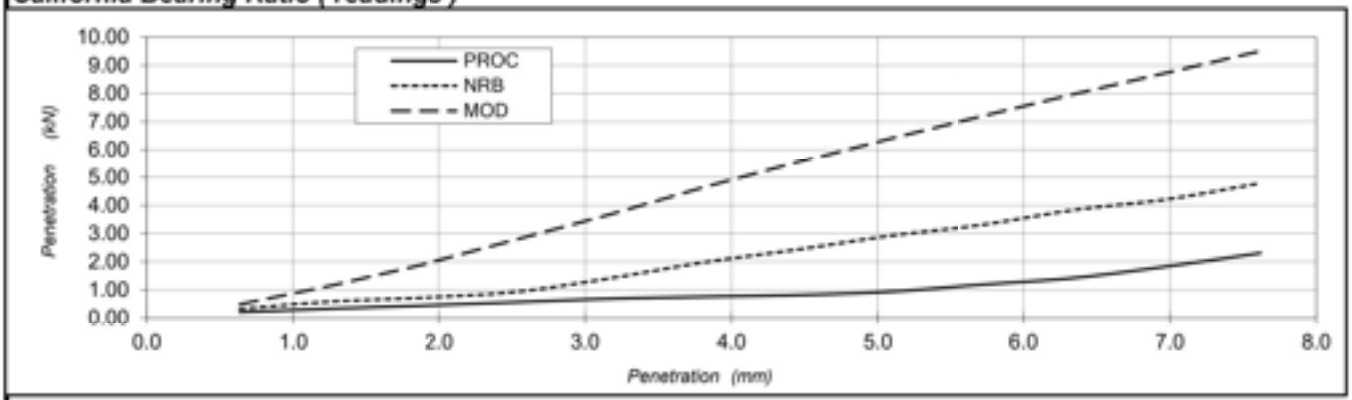
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client:	***Servinet Consulting Engineers***	*Date:*	**19-Jan-21**
Contract :	***Geotechnical Investigation For Matwabeng Residential Houses***	*Sample no:*	***21341/8***
Description:	***Material sampled from TP 8 @ 0.30-1.0 m below Existing Ground Level***		

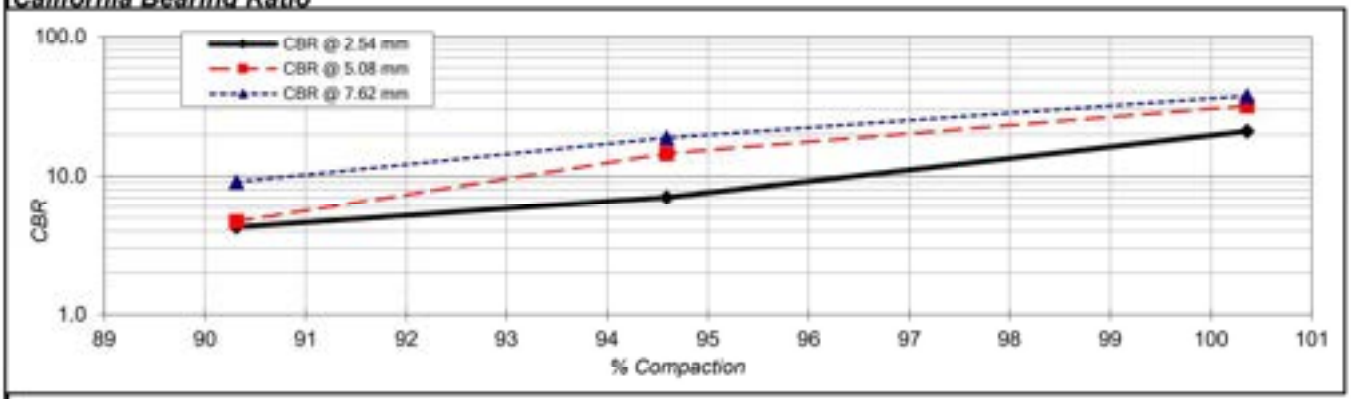
Maximum dry density =	**1856 kg/m³**
Optimum moisture content =	**12.1 %**



California Bearing Ratio (readings)



California Bearing Ratio



% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	**20**	**13**	**11**	**8**	**6**	**4**
CBR of 20.016 kN	30	23	20	15	10	4
CBR of 25.354 kN	36	28	25	20	14	9

% Swell

	Mod	*N.R.B.*	*Proc.*
Swell /	1.00	1.00	1.00
Reading	1.12	1.20	1.39
% Swell	**0.09**	**0.16**	**0.31**

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Domain www.phezulugc.co.za
Tel : 013 004 0119
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Fax : 086 543 8298
Reg. No. 2011/005646/23
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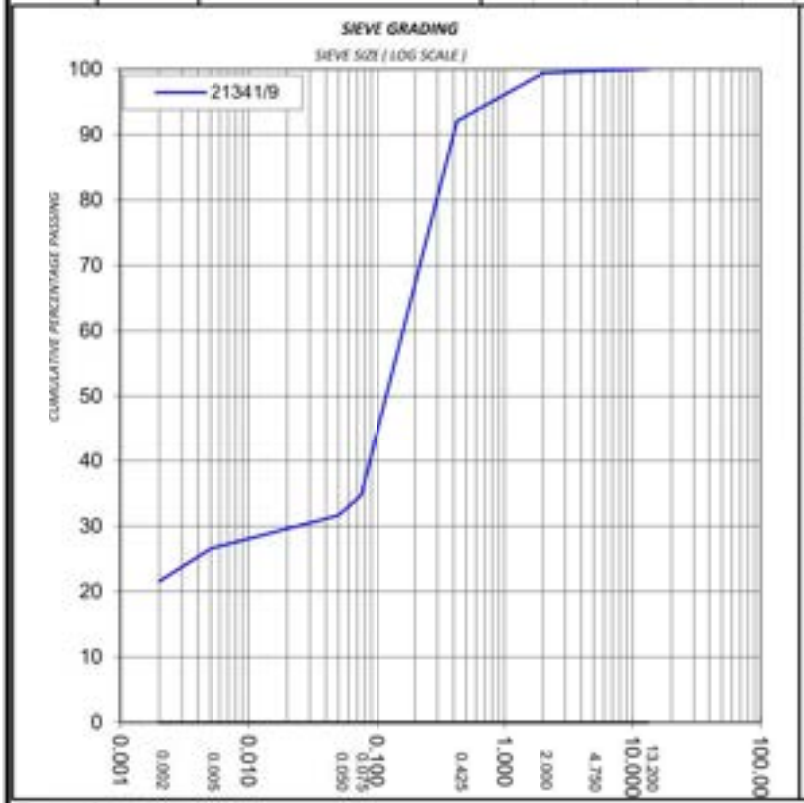
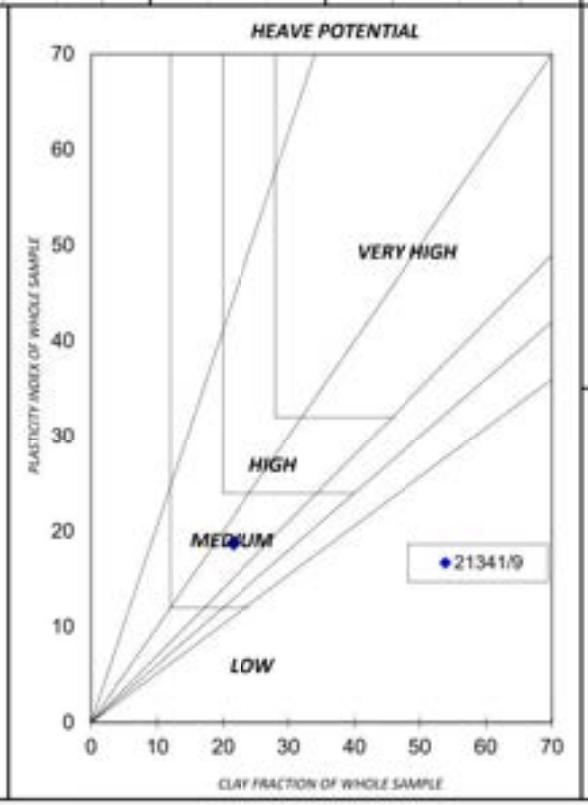
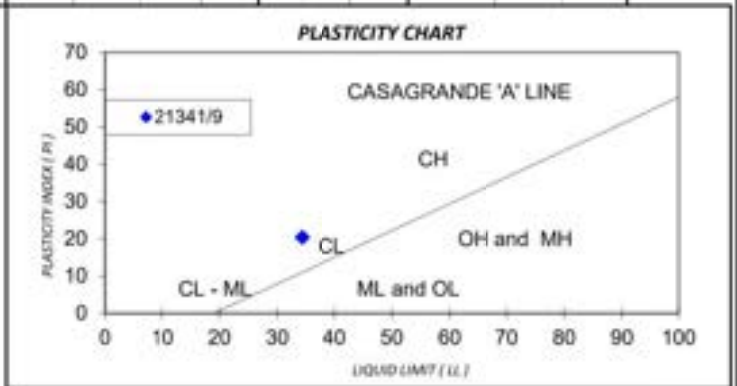
Contract : **Geotechnical Investigation For Matwabeng Residential Houses** | Client : **Servinet Consulting Engineers** | **Date : 19-Jan-21**

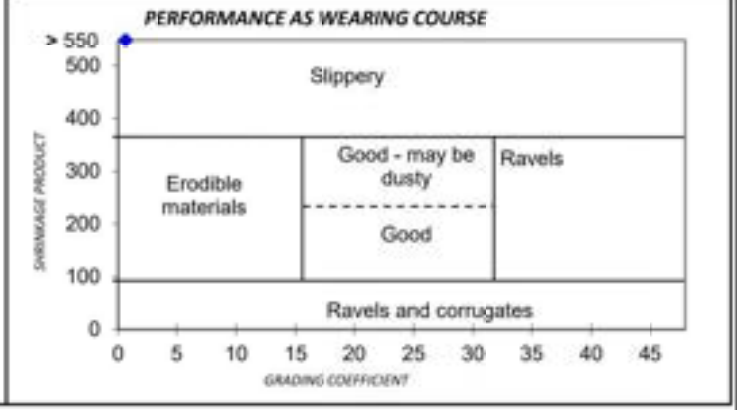
Description : **Material sampled from TP 5 @ 0-0.40 m below Existing Ground Level**

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing												Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US.Highway	Group Index
0-0.40	21341/9	tl Grey Clayey sand					100	100	99	92	35	31.6	26.5	21.6	7.4	60.8	5.1	26.7	<0.002	161.2	3.5	0.74	34	20	10.1	SC	-	A-2-6	2









Remarks:

THIS MATERIAL IS NOT SUITABLE FOR WEARING COARSE AS THE SHRINKAGE PRODUCT IS GREATER THAN 550

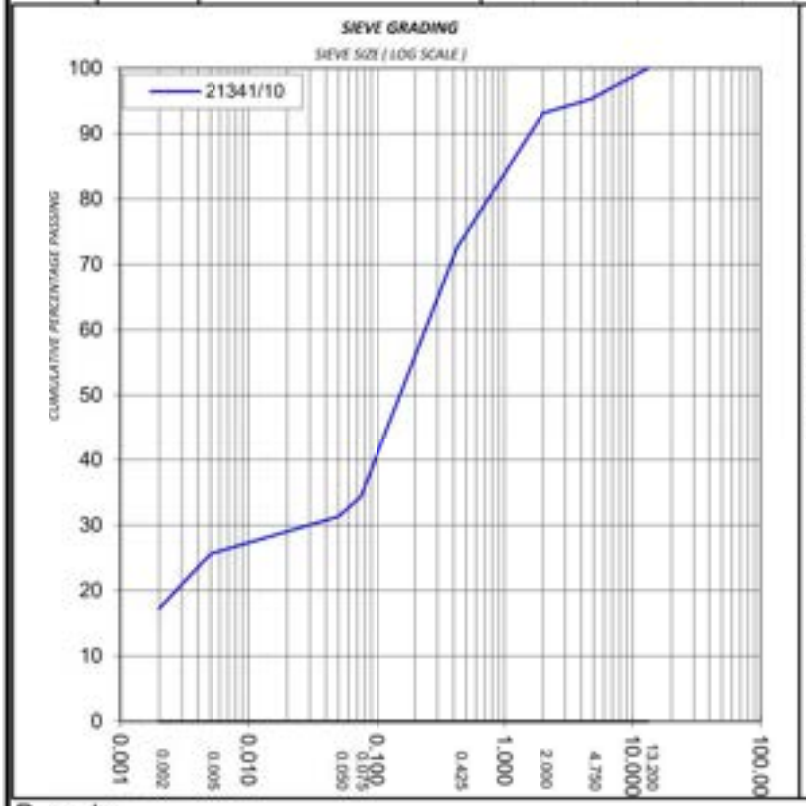
P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

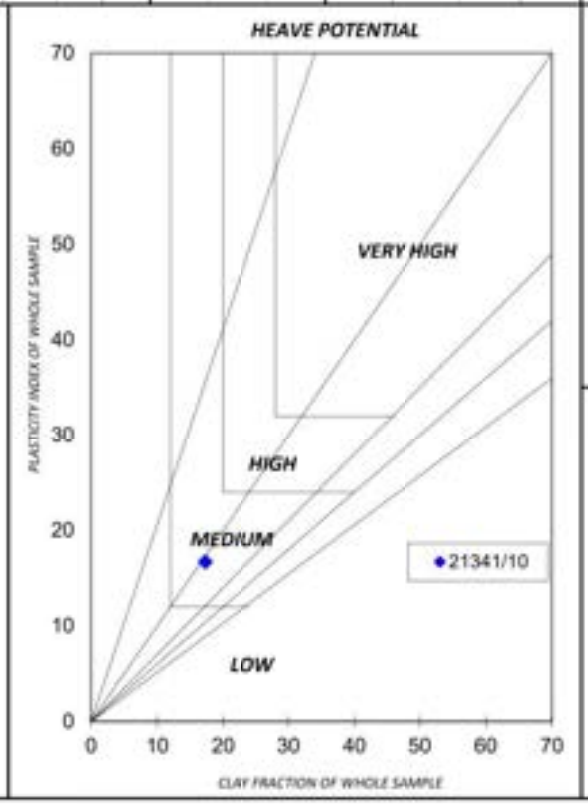
Phezulu Geotechnical Civils

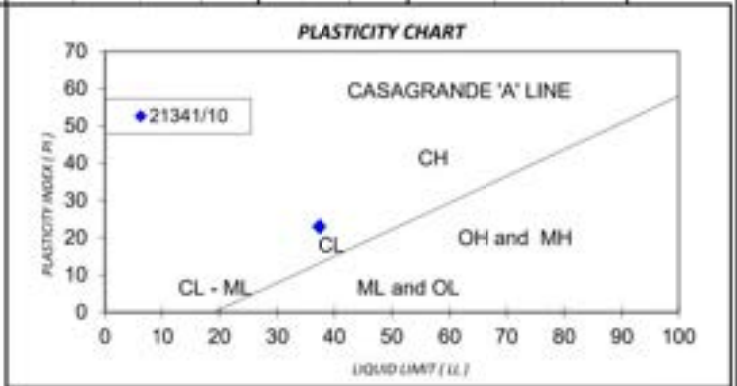
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

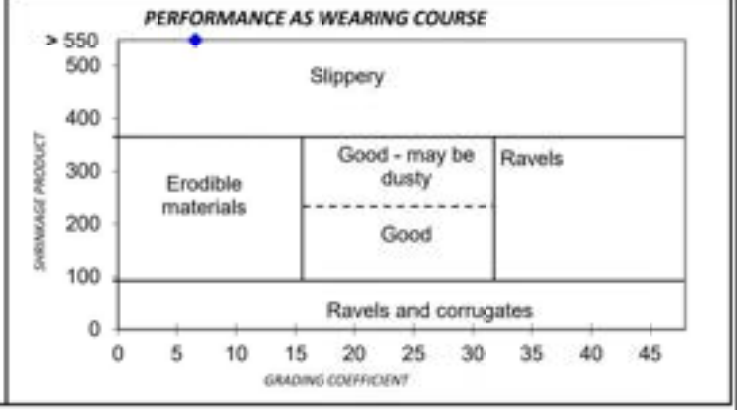
Contract :	**Geotechnical Investigation For Matwabeng Residential Houses**	Client :	**Servinet Consulting Engineers**	**Date : 19-Jan-21**	
Description :	**Material sampled from TP 5 @ 0.40-0.60 m below Existing Ground Level**				

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US.Highway	Group Index
0.40-0.60	21341/10	lt Grey Clayey sand					100	95	93	73	34	31.3	25.6	17.2	22.1	44.3	6.1	27.5	<0.002	240.0	3.7	1.00	37	23	11.2	SC	-	A-2-6	3









Remarks:

THIS MATERIAL IS NOT SUITABLE FOR WEARING COARSE AS THE SHRINKAGE PRODUCT IS GREATER THAN 550

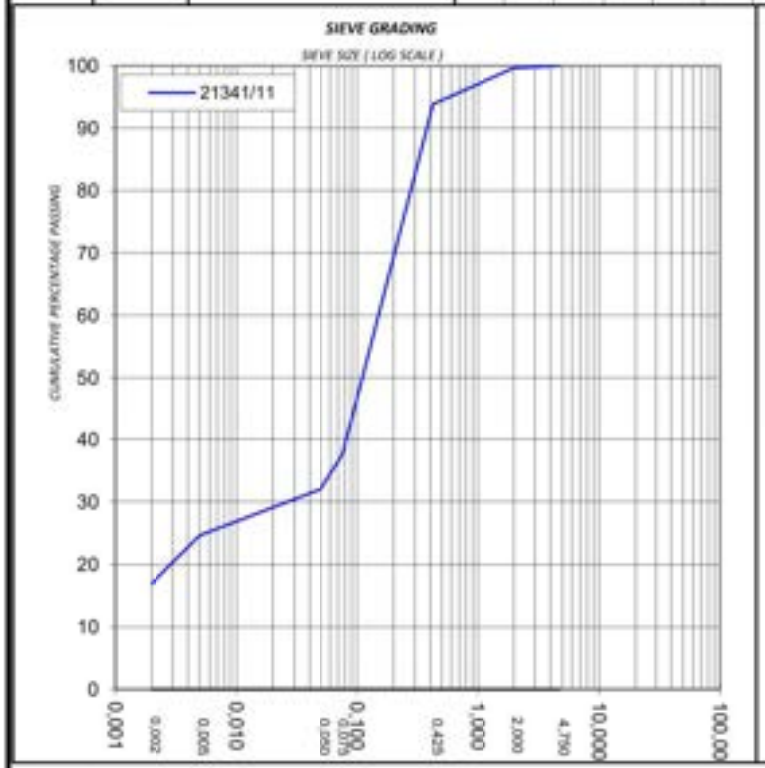
P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

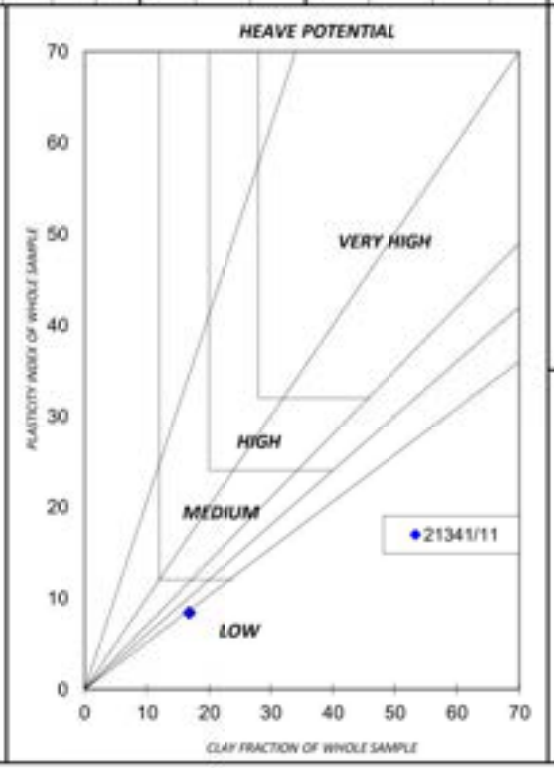
Phezulu Geotechnical Civils

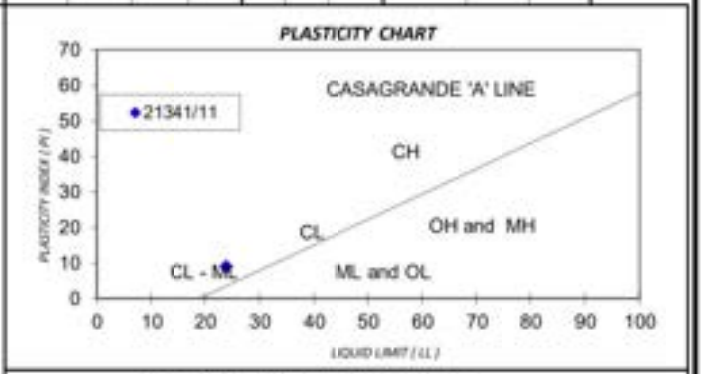
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

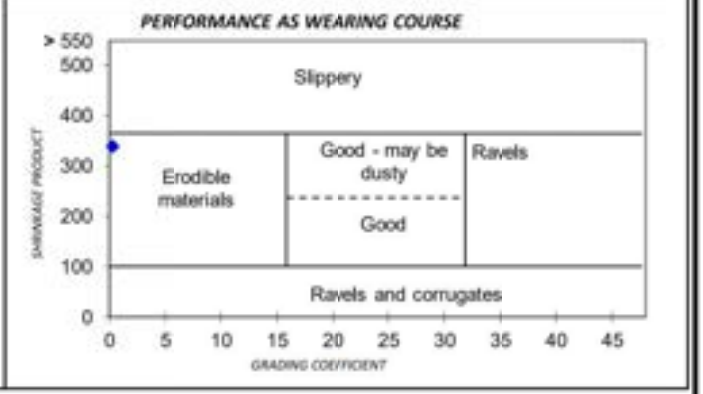
Contract :	Geotechnical Investigation For Matwabeng Residential Houses	Client :	Servinet Consulting Engineers	Date :	19-Jan-21
Description :	Material sampled from TP 6 @ 0-0.40 m below Existing Ground Level				

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425 >0,05mm	Silt <0,05 >0,005mm	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US Highway	Group Index
0-0.40	21341/11	drk Yellow Clayey sand						100	100	94	38	32,1	24,6	16,9	5,9	61,9	7,5	24,7	<0.002	149,9	4,5	0,69	24	9	3,6	SC	-	A-4	1









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12 Suikeriet Street
Central Park
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Nelspruit
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e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
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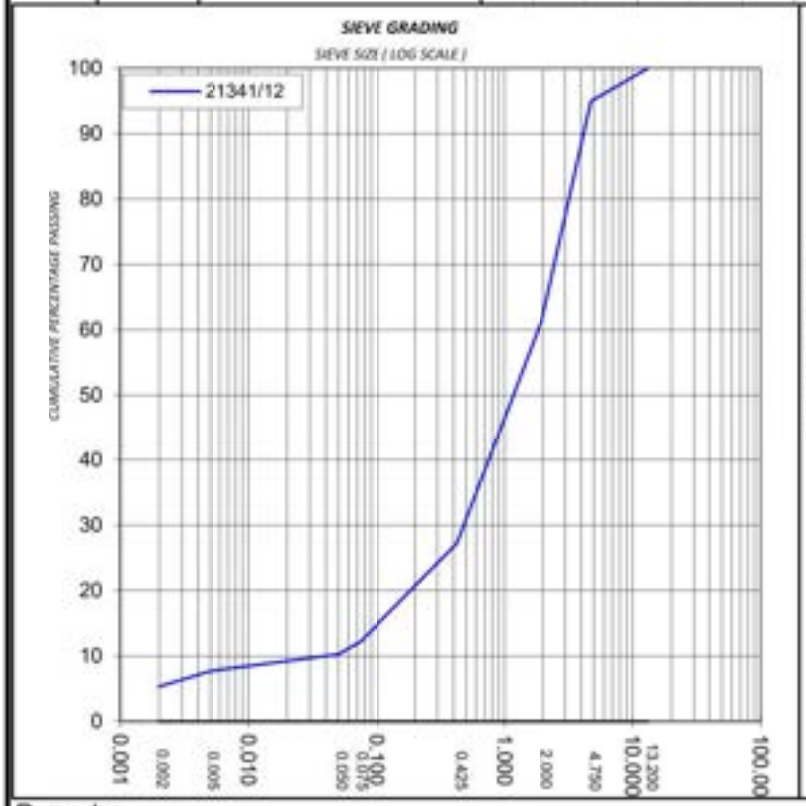
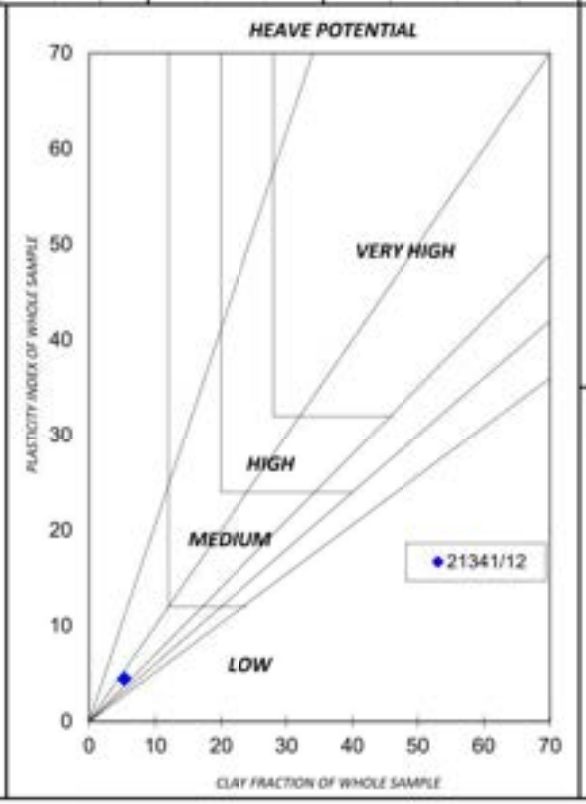
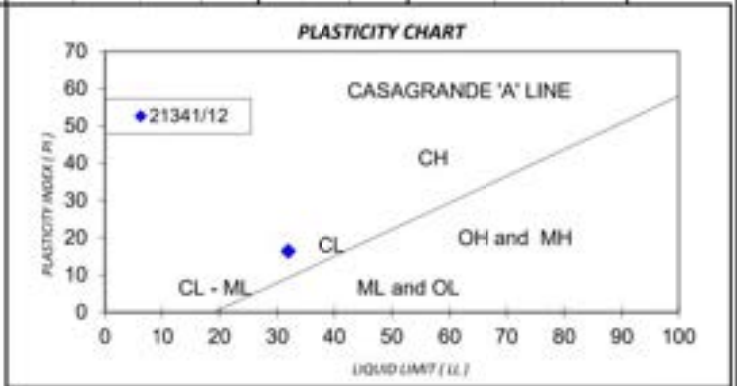
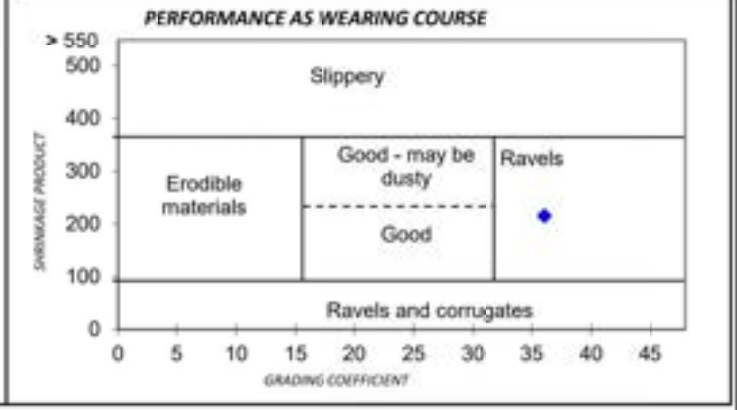
Contract :	**Geotechnical Investigation For Matwabeng Residential Houses**	Client :	**Servinet Consulting Engineers**	**Date : 19-Jan-21**	
Description :	**Material sampled from TP 6 @ 0.40-0.95 m below Existing Ground Level**				

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US.Highway	Group Index
0.40-0.95	21341/12	drk Yellow Well graded clayey sand					100	95	62	27	12	10.3	7.7	5.3	56.0	27.4	4.1	12.5	0.039	47.1	3.3	1.98	32	16	7.9	sw/sc	G9	A-2-6	0









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P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
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Phezulu Geotechnical Civils

e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
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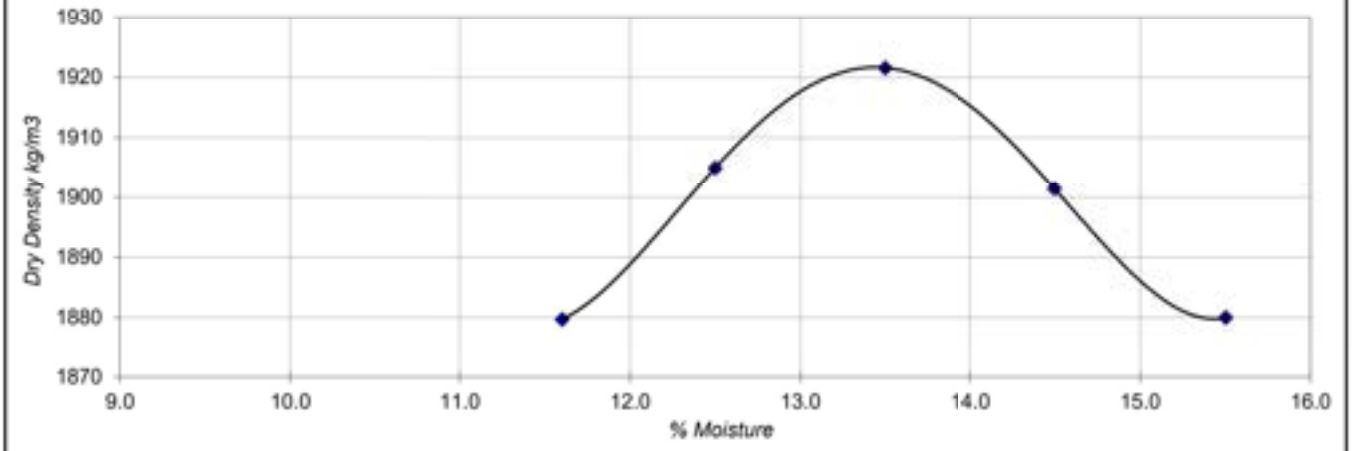
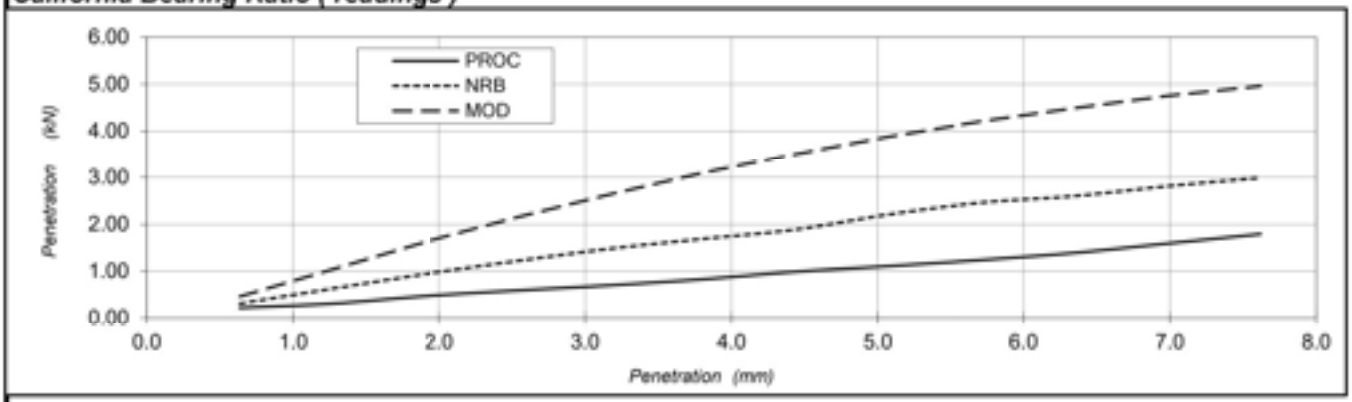
Client:	***Servinet Consulting Engineers***	*Date:*	**19-Jan-21**
Contract :	***Geotechnical Investigation For Matwabeng Residential Houses***	*Sample no:*	***21341/12***
Description:	***Material sampled from TP 6 @ 0.40-0.95 m below Existing Ground Level***		

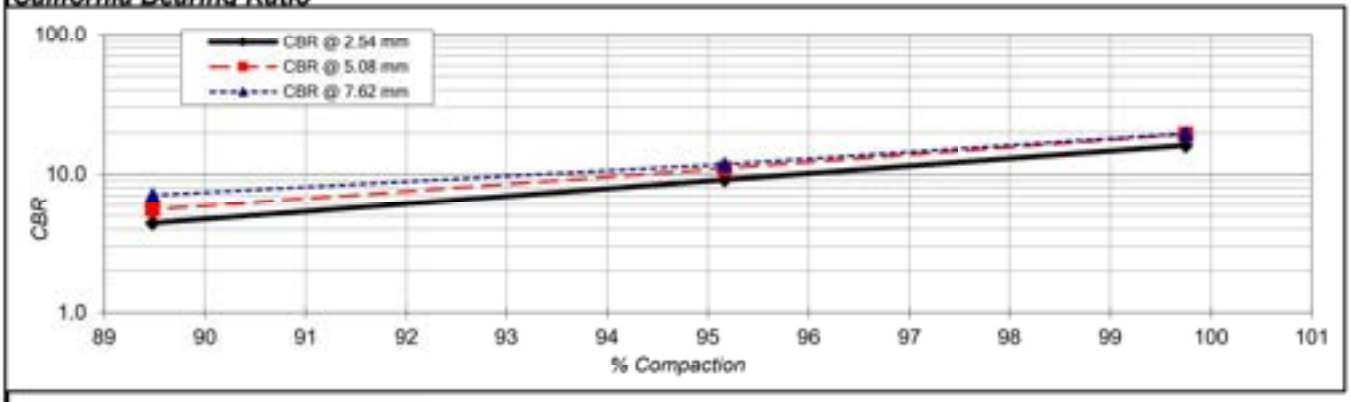
Maximum dry density =	**1922 kg/m³**
Optimum moisture content =	**13.5 %**



California Bearing Ratio (readings)



California Bearing Ratio



% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	**17**	**13**	**11**	**9**	**7**	**5**
CBR of 20.016 kN	20	16	14	11	8	6
CBR of 25.354 kN	20	16	14	12	10	7

% Swell

	Mod	*N.R.B.*	*Proc.*
Swell /	1.00	1.00	1.00
Reading	1.16	1.39	1.72
% Swell	**0.13**	**0.31**	**0.57**

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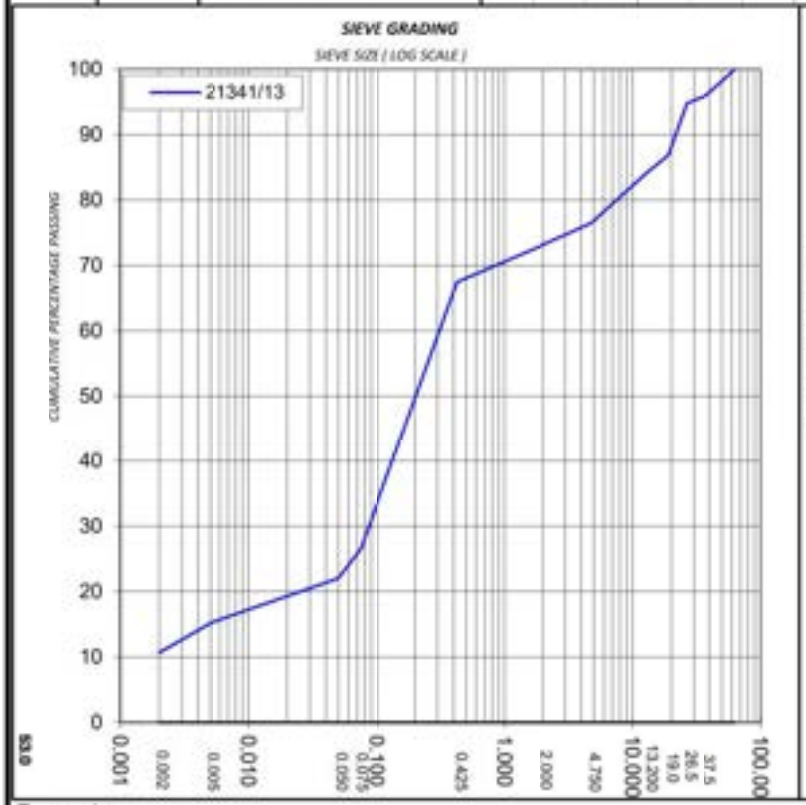
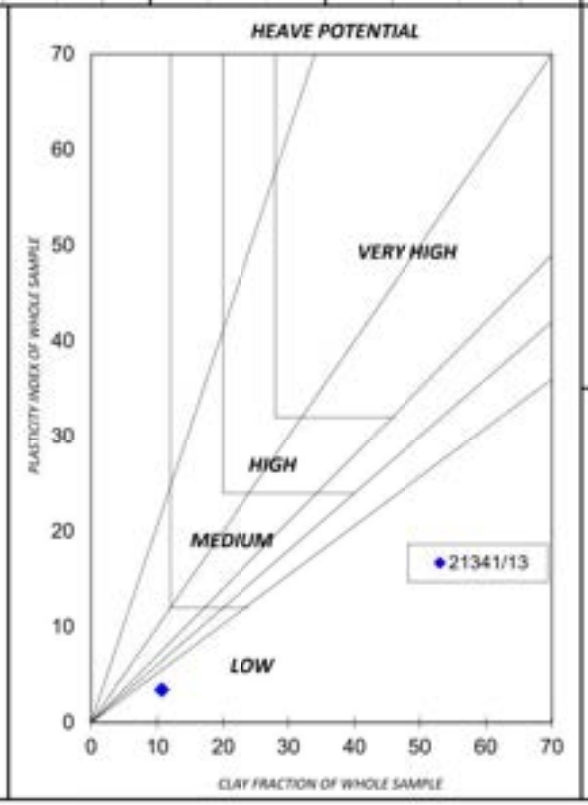
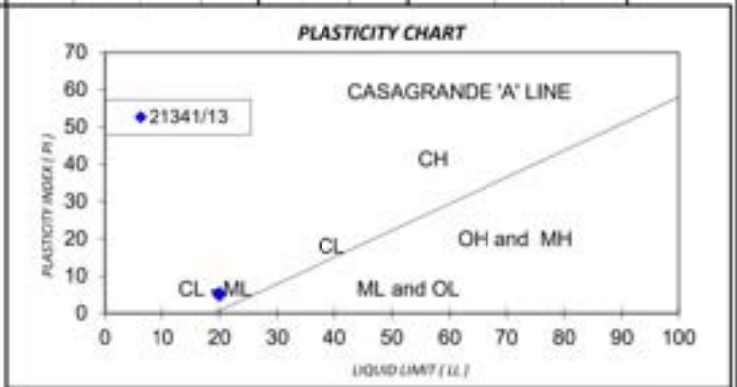
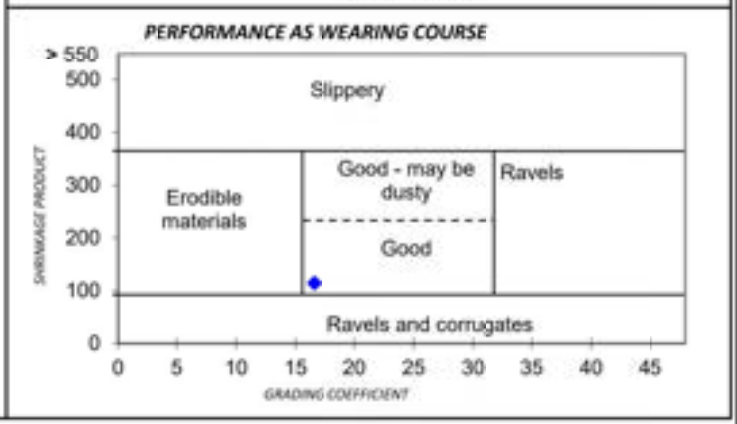
Contract :	Geotechnical Investigation For Matwabeng Residential Houses	Client :	Servinet Consulting Engineers	Date :	19-Jan-21
Description :	Material sampled from TP 7 @ 0.40-0.70 m below Existing Ground Level				

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US.Highway	Group Index
0.40-0.70	21341/13	drk Yel. Orange Silty/Clayey sand	99	96	95	87	84	76	73	67	27	22.0	15.2	10.7	7.8	62.1	9.3	20.8	<0.002	309.8	24.3	1.33	20	5	1.7	sm/sc	<G9	A-2-4	0









Remarks:

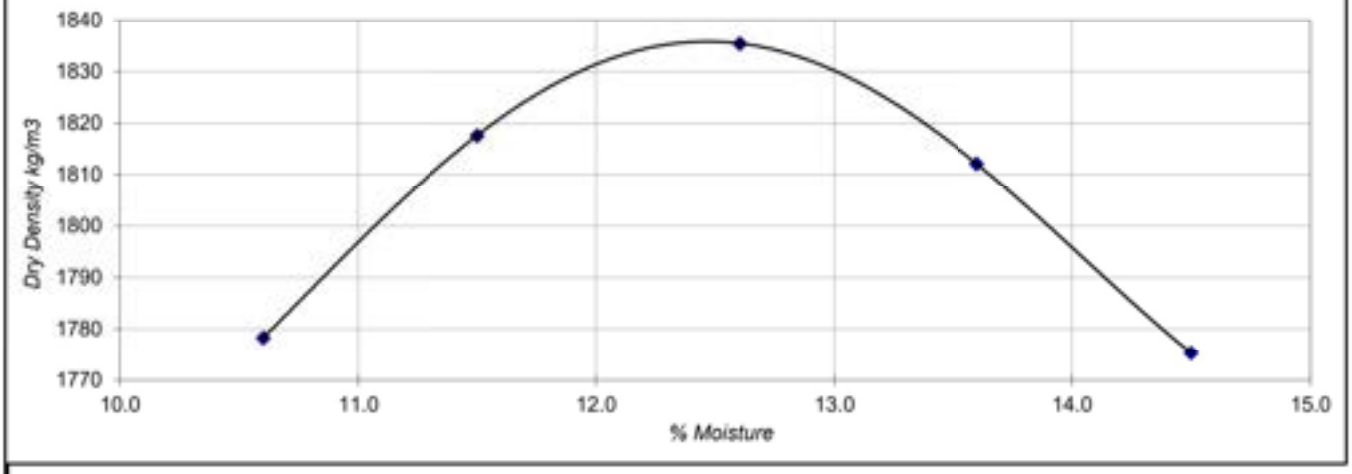
P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

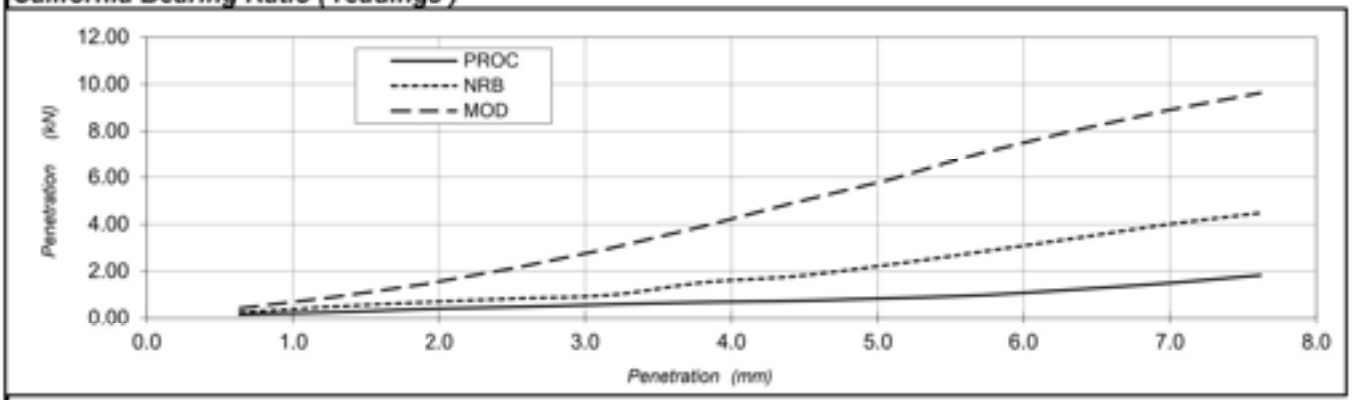
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client:	***Servinet Consulting Engineers***	*Date:*	**19-Jan-21**
Contract :	***Geotechnical Investigation For Matwabeng Residential Houses***	*Sample no:*	***21341/13***
Description:	***Material sampled from TP 7 @ 0.40-0.70 m below Existing Ground Level***		

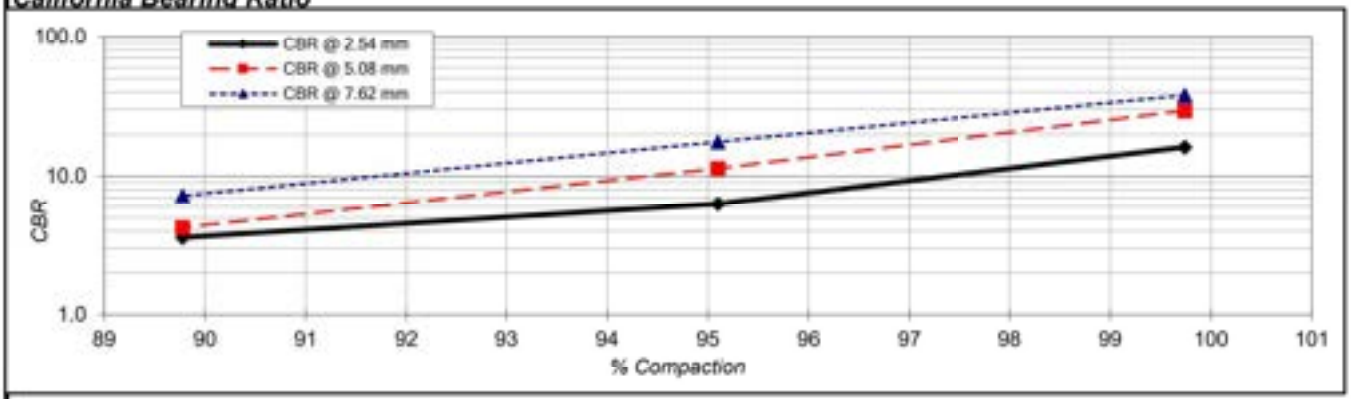
Maximum dry density =	**1836 kg/m³**
Optimum moisture content =	**12.6 %**



California Bearing Ratio (readings)



California Bearing Ratio



% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	**17**	**11**	**9**	**6**	**5**	**4**
CBR of 20.016 kN	31	21	17	11	8	4
CBR of 25.354 kN	40	29	24	17	12	7

% Swell

	Mod	*N.R.B.*	*Proc.*
Swell /	1.00	1.00	1.00
Reading	1.10	1.25	1.49
% Swell	**0.08**	**0.20**	**0.39**

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

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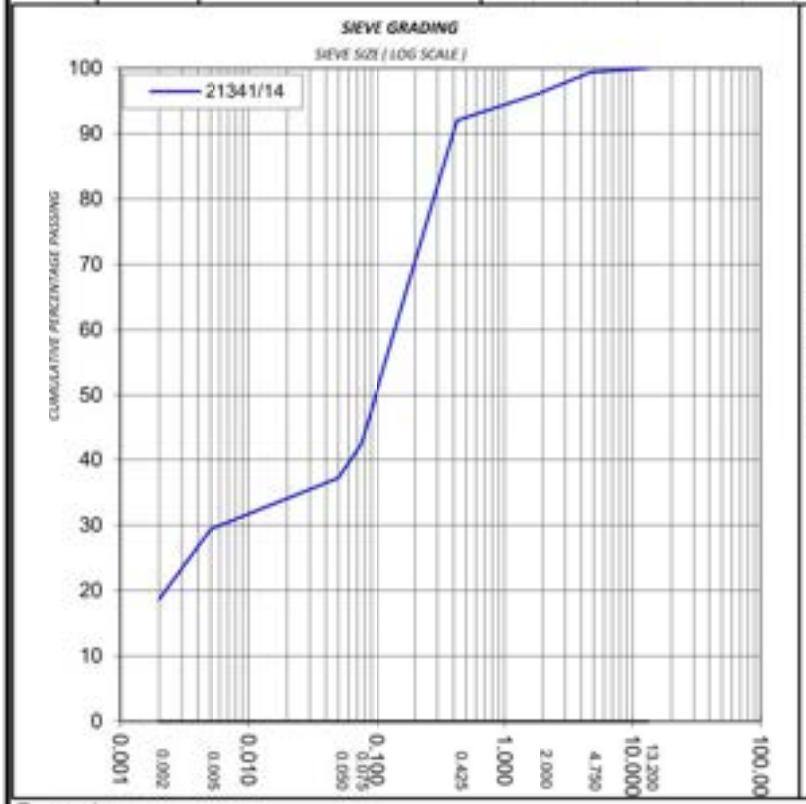
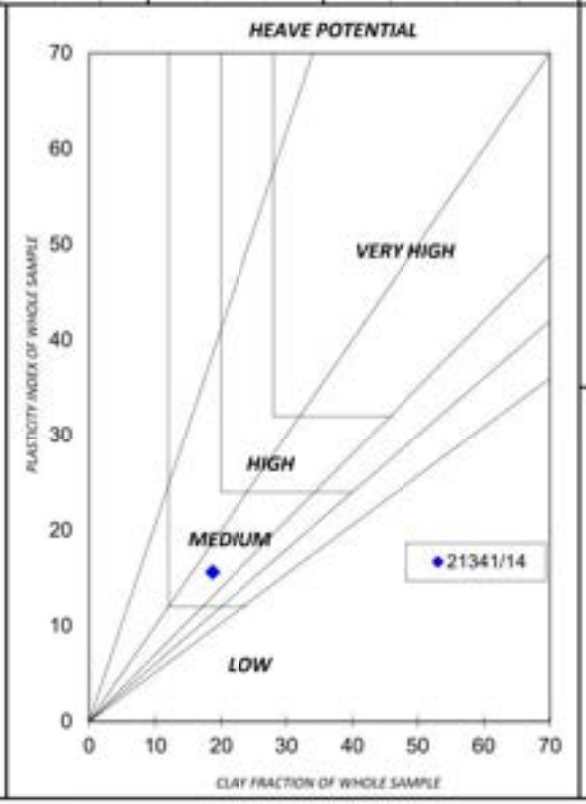
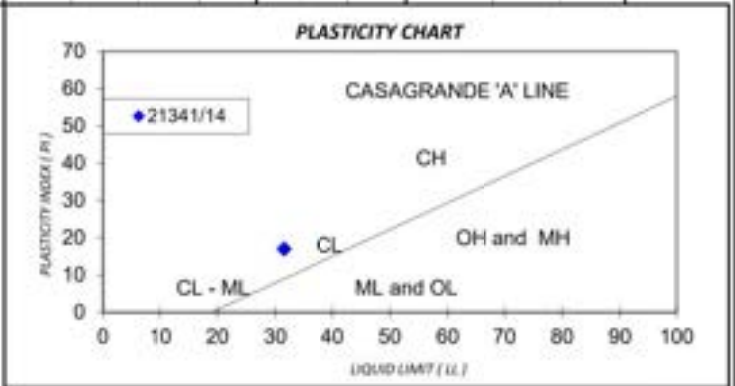
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

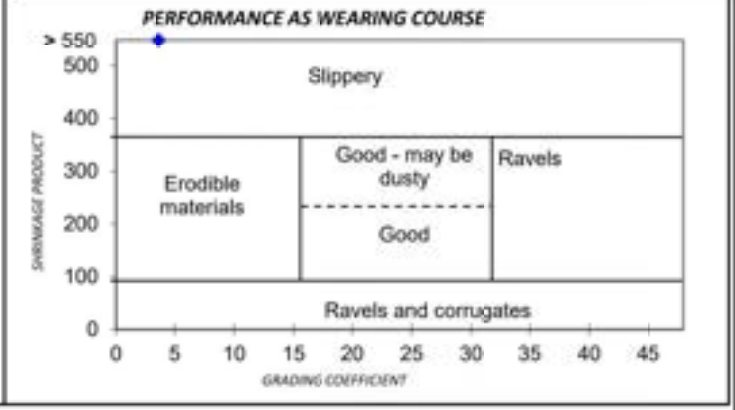
Contract :	**Geotechnical Investigation For Matwabeng Residential Houses**	Client : **Servinet Consulting Engineers**	**Date : 19-Jan-21**
Description :	**Material sampled from TP 8 @ 0-0.40 m below Existing Ground Level**		

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US Highway	Group Index
0-0.40	21341/14	drk Yellow Clayey sand					100	99	96	92	42	37.2	29.4	18.7	4.5	56.9	8.2	30.5	<0.002	139.0	0.3	0.69	32	17	8.0	SC	-	A-6	3









Remarks:

THIS MATERIAL IS NOT SUITABLE FOR WEARING COARSE AS THE SHRINKAGE PRODUCT IS GREATER THAN 550

P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

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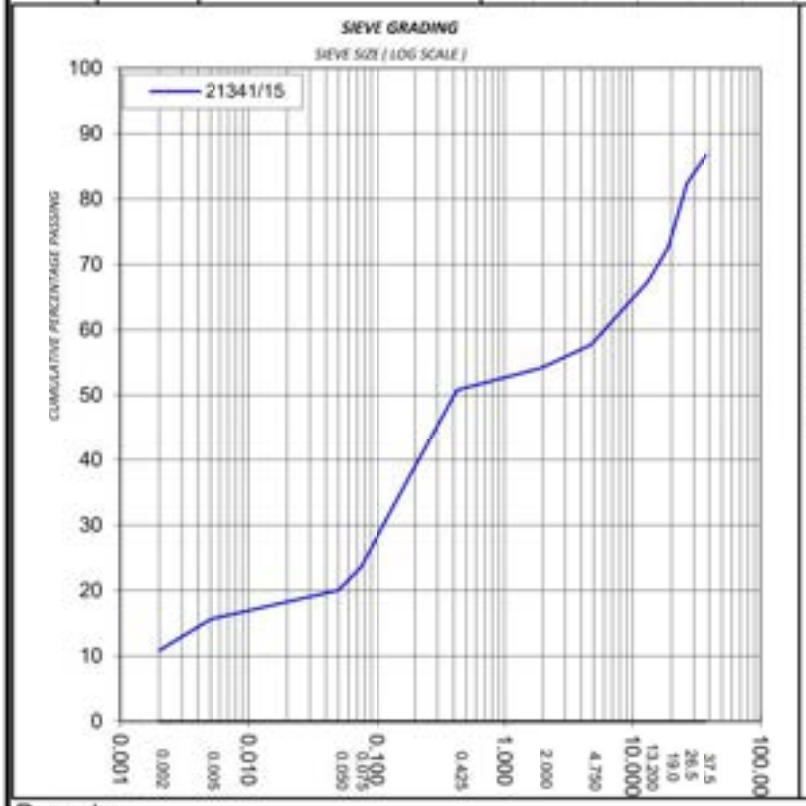
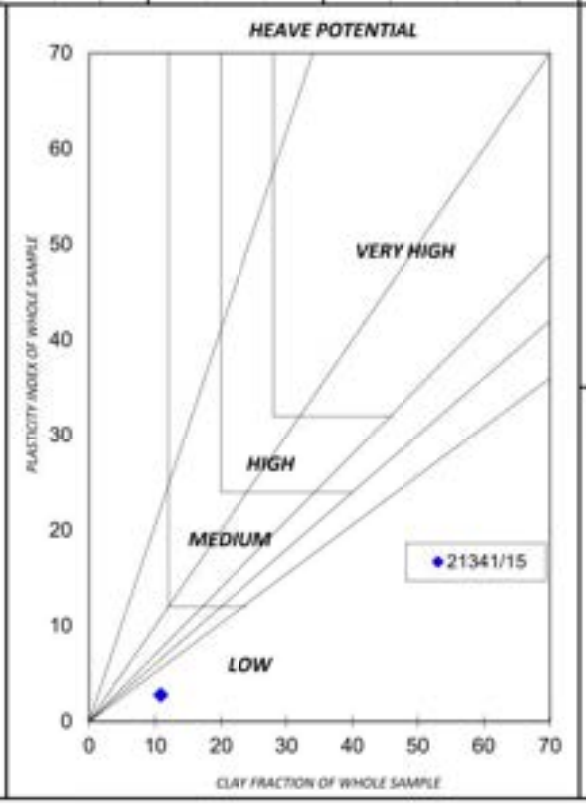
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

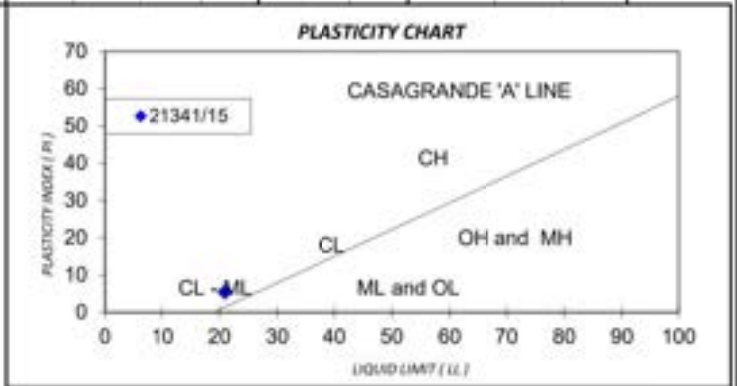
Contract : **Geotechnical Investigation For Matwabeng Residential Houses** | Client : **Servinet Consulting Engineers** | **Date : 19-Jan-21**

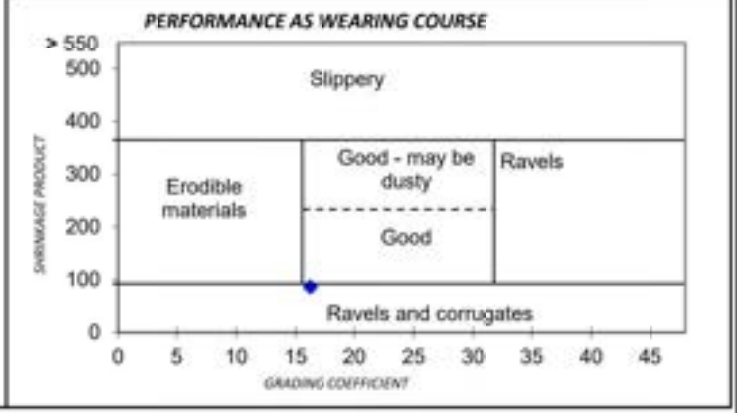
Description : **Material sampled from TP 8 @ 0.4-1.0 m below Existing Ground Level**

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing											Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US.Highway	Group Index
0.4-1.0	21341/15	drk Yel. Orange Silty/Clayey sand		87	82	73	67	58	54	51	24	20.1	15.6	10.8	6.3	56.7	8.2	28.8	<0.002	6044.8	2.1	1.71	21	6	1.7	sm/sc	G8	A-2-4	0









Remarks:

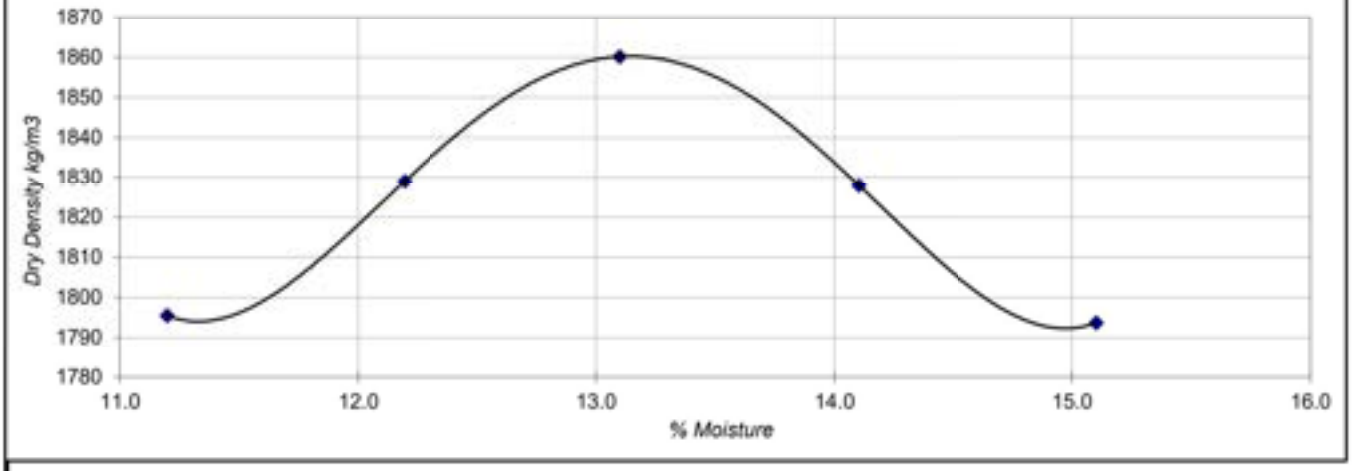
P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

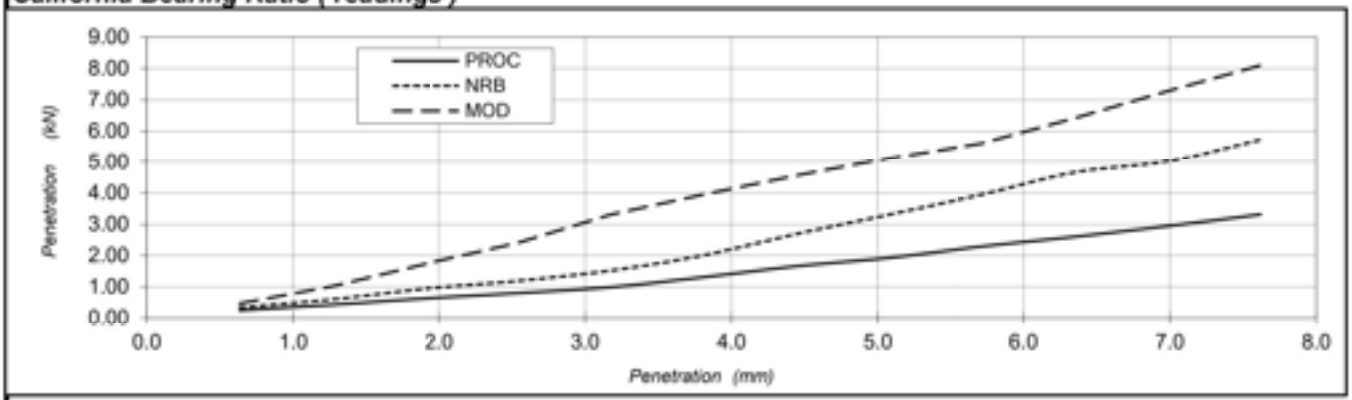
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client:	***Servinet Consulting Engineers***	*Date:*	**19-Jan-21**
Contract :	***Geotechnical Investigation For Matwabeng Residential Houses***	*Sample no:*	***21341/15***
Description:	***Material sampled from TP 8 @ 0.4-1.0 m below Existing Ground Level***		

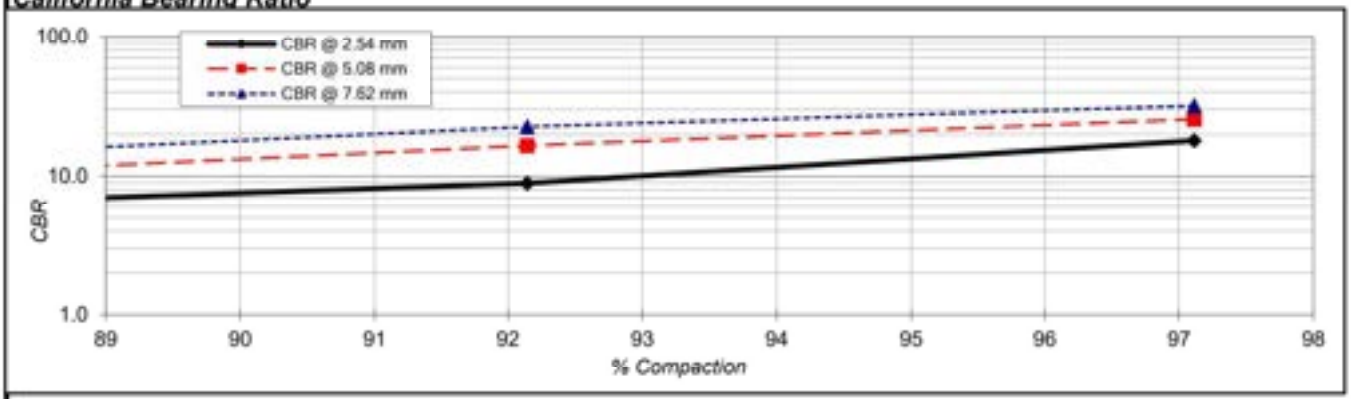
Maximum dry density =	**1922 kg/m³**
Optimum moisture content =	**13.5 %**



California Bearing Ratio (readings)



California Bearing Ratio



% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	**27**	**20**	**18**	**13**	**10**	**8**
CBR of 20.016 kN	33	28	25	21	18	13
CBR of 25.354 kN	39	34	32	28	25	18

% Swell

	Mod	*N.R.B.*	*Proc.*
Swell /	1.00	1.00	1.00
Reading	1.10	1.16	1.23
% Swell	**0.08**	**0.13**	**0.18**

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Nelspruit
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Cell : 071 897 3005
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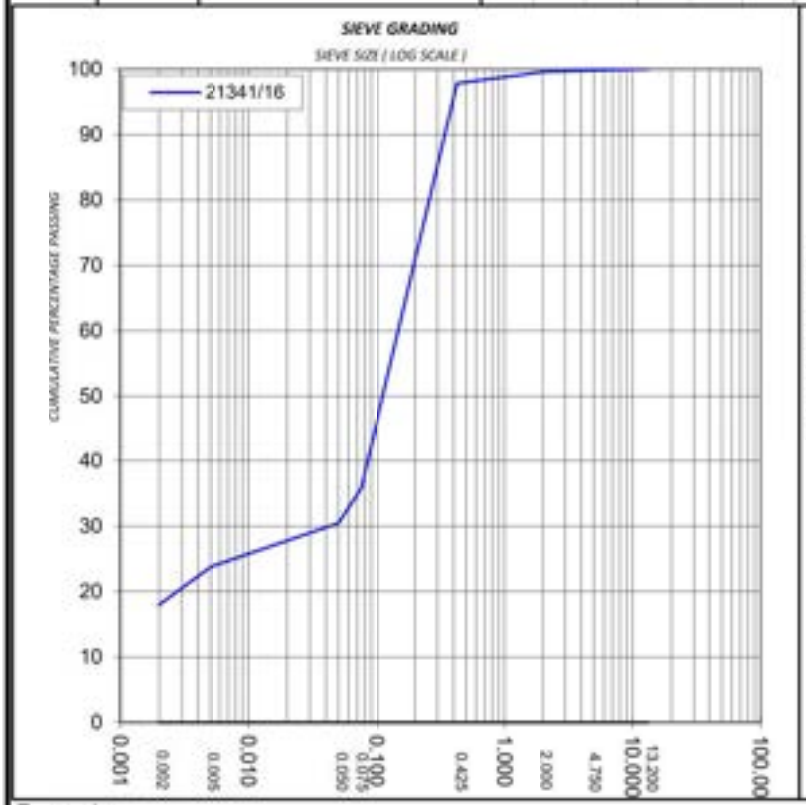
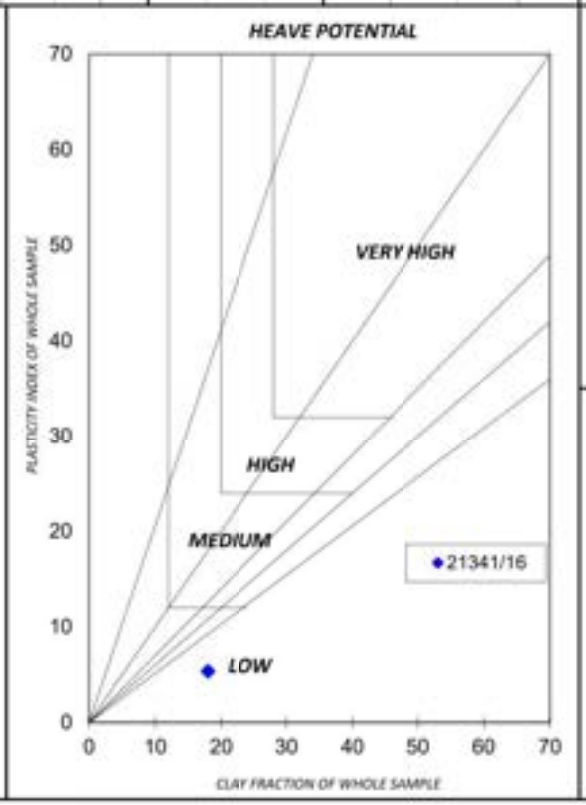
Reg. No. 2011/005646/23
Vat no. 4610267686

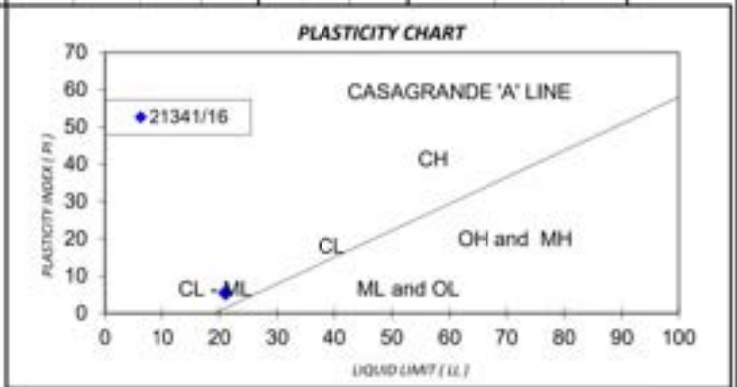
Contract : **Geotechnical Investigation For Matwabeng Residential Houses** | Client : **Servinet Consulting Engineers** | **Date : 19-Jan-21**

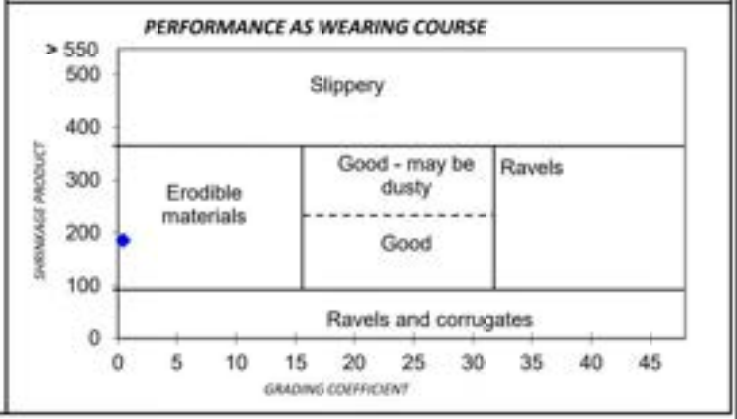
Description : **Material sampled from TP 9 @ 1-1.0 m below Existing Ground Level**

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing												Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US.Highway	Group Index
1-1.0	21341/16	drk Yellow Silty/Clayey sand					100	100	100	98	36	30.5	23.8	18.0	1.8	67.6	6.7	23.9	<0.002	147.8	12.4	0.67	21	6	1.9	sm/sc	<G9	A-4	0









Remarks:

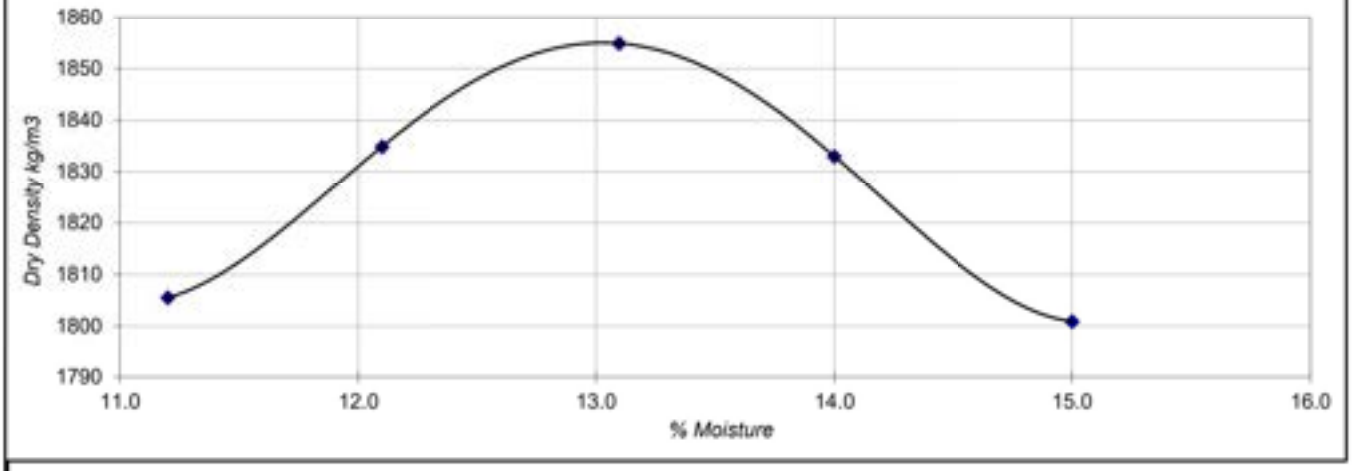
P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

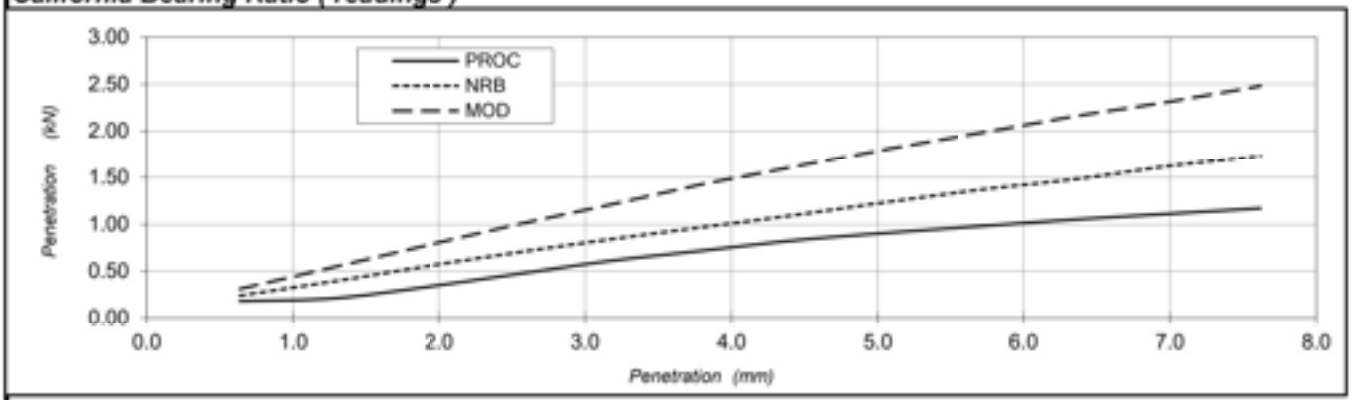
e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

Client:	***Servinet Consulting Engineers***	*Date:*	**19-Jan-21**
Contract :	***Geotechnical Investigation For Matwabeng Residential Houses***	*Sample no:*	***21341/16***
Description:	***Material sampled from TP 9 @ 1-1.0 m below Existing Ground Level***		

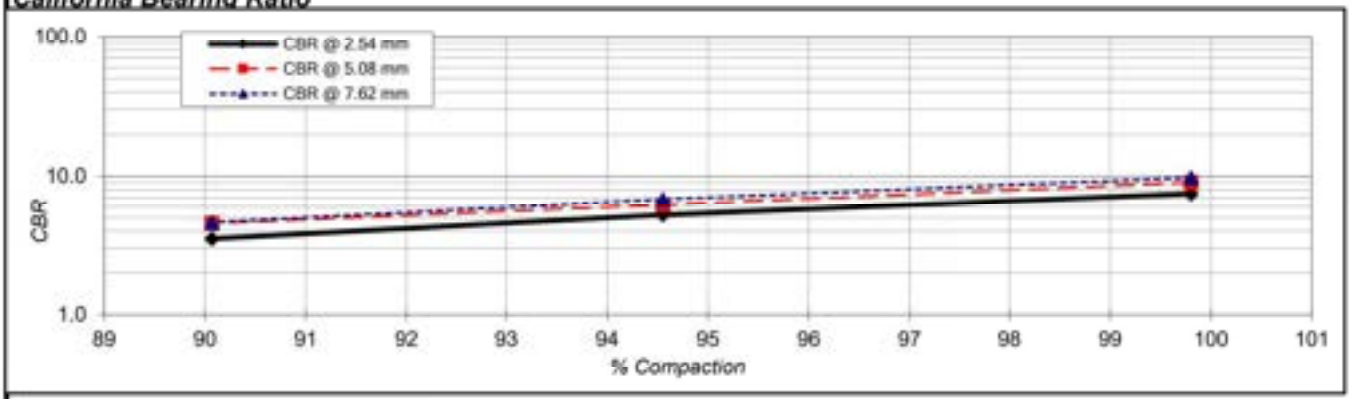
Maximum dry density =	**1855 kg/m³**
Optimum moisture content =	**13.1 %**



California Bearing Ratio (readings)



California Bearing Ratio



% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	**8**	**7**	**6**	**5**	**5**	**4**
CBR of 20.016 kN	9	8	7	6	6	5
CBR of 25.354 kN	10	9	8	7	6	5

% Swell

	Mod	*N.R.B.*	*Proc.*
Swell /	1.00	1.00	1.00
Reading	1.39	1.89	2.60
% Swell	**0.31**	**0.70**	**1.26**

P.O Box 1766
12 Suikeriet Street
Central Park
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Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

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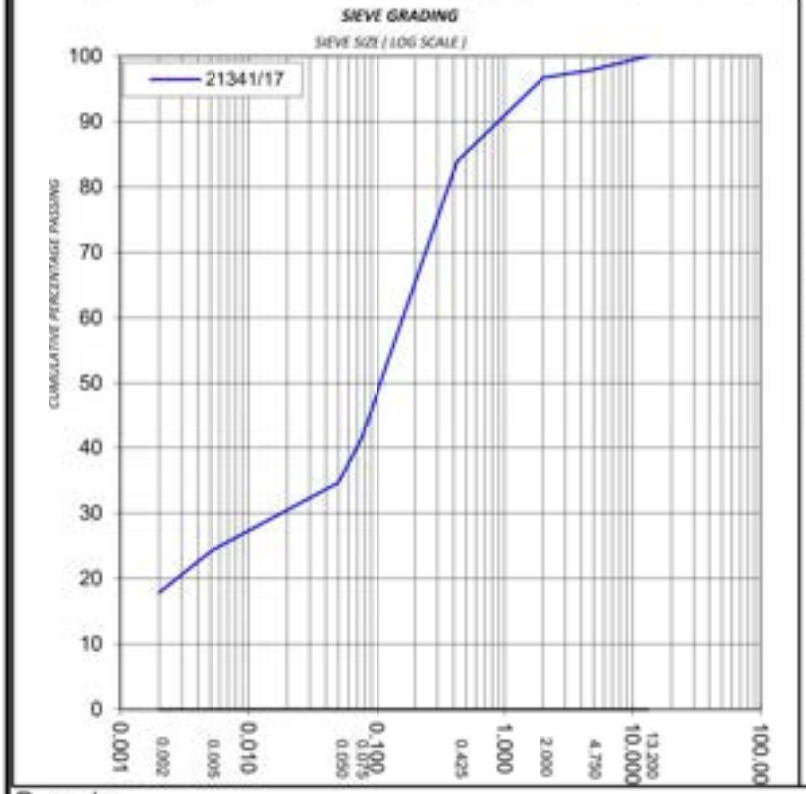
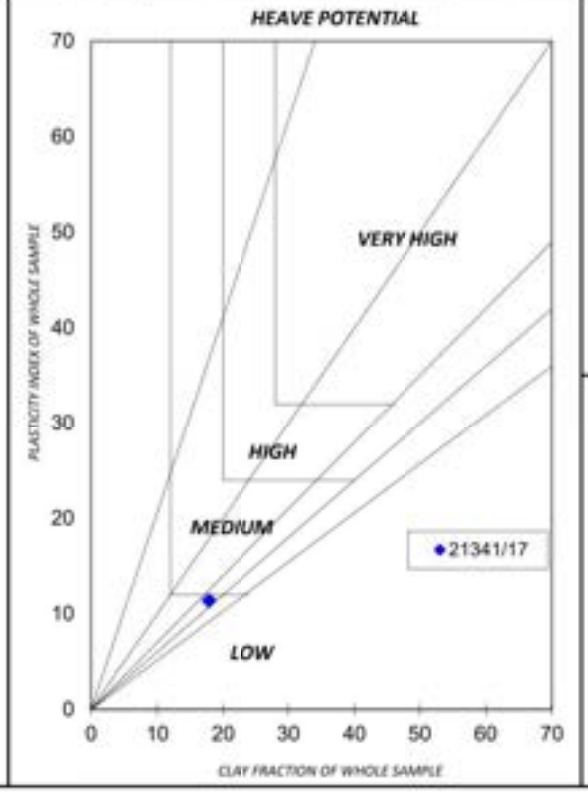
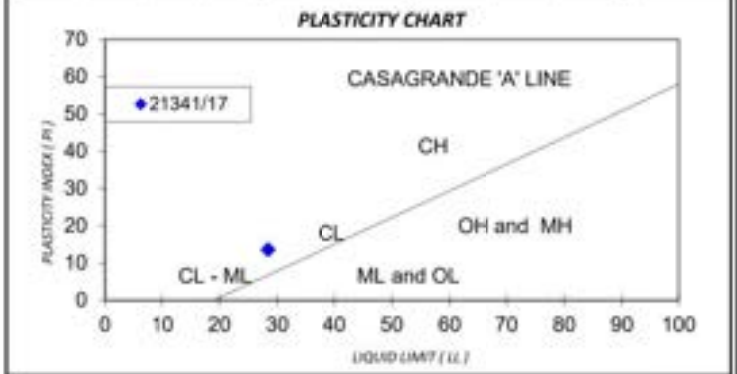
Contract : **Geotechnical Investigation For Matwabeng Residential Houses** | Client : **Servinet Consulting Engineers** | **Date : 19-Jan-21**

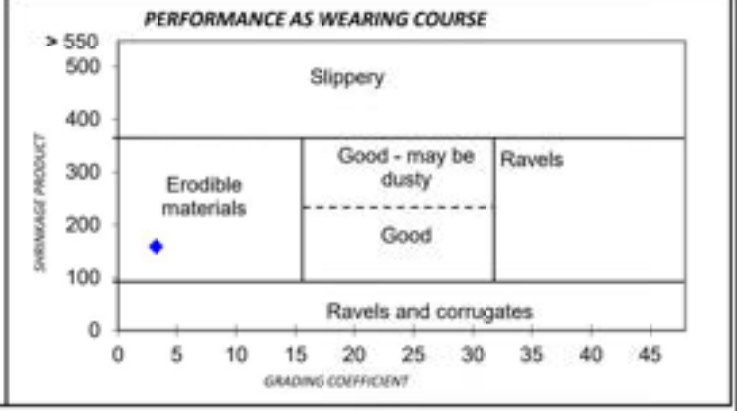
Description : **Material sampled from TP 9 @ 1-2.1 m below Existing Ground Level**

Depth (m)	Sample No.	Description (Unified Soil Classification)	Sieve analysis Cumulative percentage passing												Soil Mortar Analysis % of mat. <2,00 mm				Effective size	Uniformity - coef.	Curvature coef.	Grading modulus	Atterberg Limits			Classifications			
			53,0 mm	37,5 mm	26,5 mm	19,0 mm	13,2 mm	4,75 mm	2,00 mm	0,425 mm	0,075 mm	0,05 mm	0,005 mm	0,002 mm	Coarse - sand <2,0 >0,425mm	Fine - sand <0,425	Silt <0,05	Clay <0,005 mm					Liquid Limit	Plasticity Index	Linear Shrinkage	Unified Soil	COLTO	US.Highway	Group Index
1-2.1	21341/17	lt Yellow Clayey sand					100	98	97	84	41	34.7	24.1	17.9	13.3	50.8	10.9	25.0	<0.002	160.9	2.0	0.78	28	14	1.9	SC	<G9	A-6	2









Remarks:

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Nelspruit
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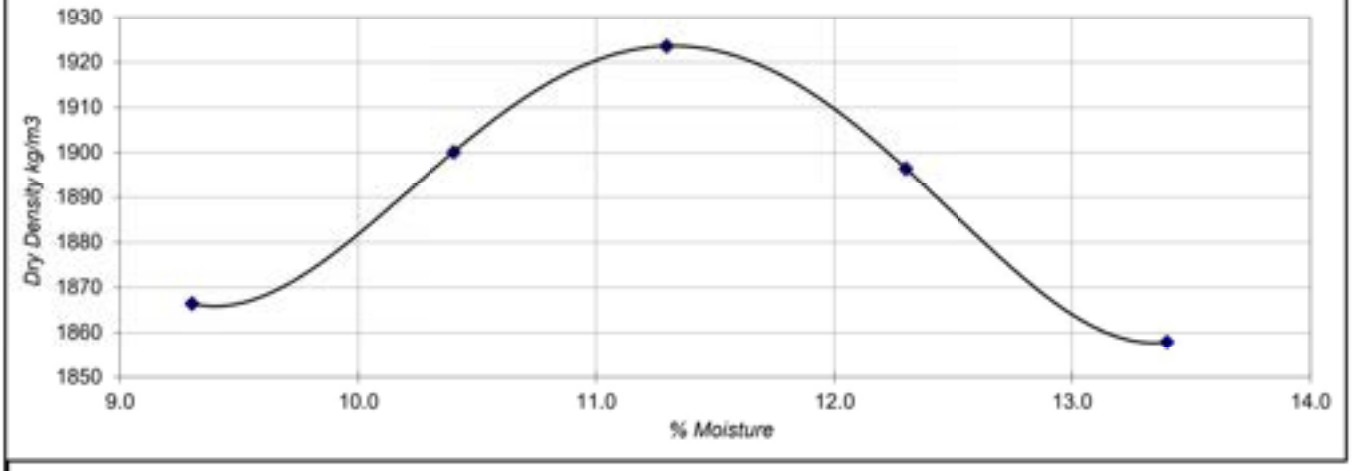
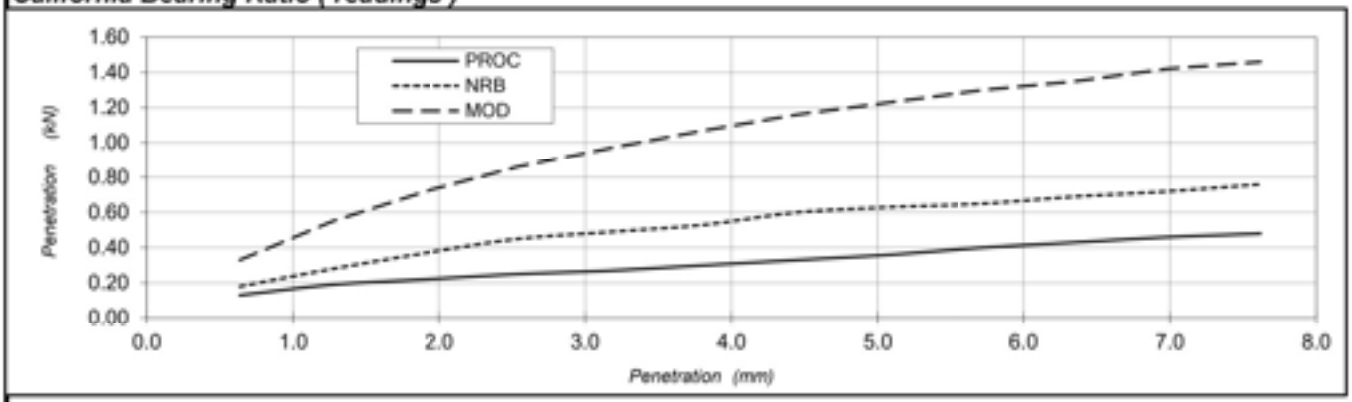
Client:	***Servinet Consulting Engineers***	*Date:*	**19-Jan-21**
Contract :	***Geotechnical Investigation For Matwabeng Residential Houses***	*Sample no:*	***21341/17***
Description:	***Material sampled from TP 9 @ 1-2.1 m below Existing Ground Level***		

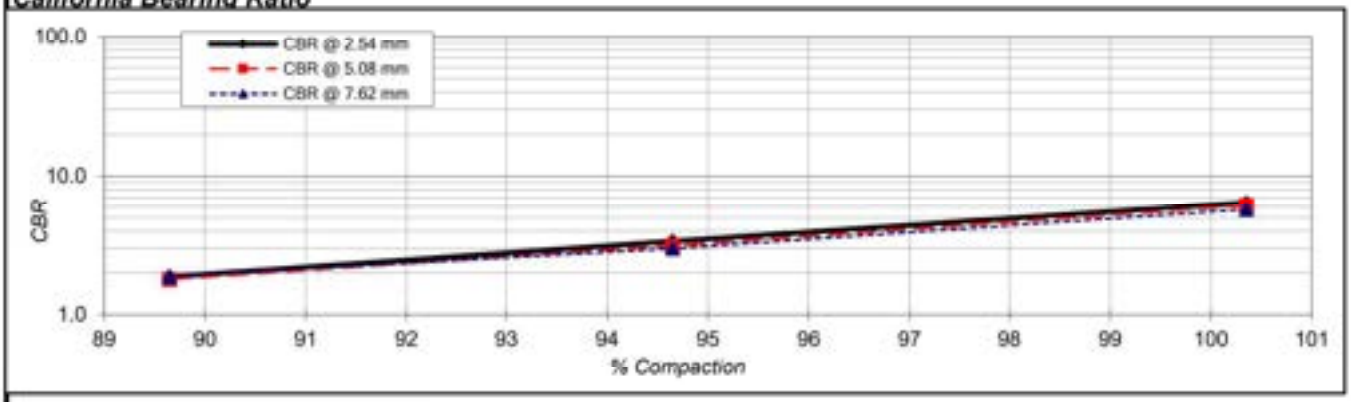
Maximum dry density =	**1924 kg/m³**
Optimum moisture content =	**11.3 %**



California Bearing Ratio (readings)



California Bearing Ratio



% Compaction	100	98	97	95	93	90
CBR of 13.344 kN	**6**	**5**	**4**	**4**	**3**	**2**
CBR of 20.016 kN	6	5	4	3	3	2
CBR of 25.354 kN	6	4	4	3	3	2

% Swell

	Mod	*N.R.B.*	*Proc.*
Swell /	1.00	1.00	1.00
Reading	1.76	2.53	3.82
% Swell	**0.60**	**1.20**	**2.22**

No 52 Bester street, Nelspruit 1200
P O Box 2814 Nelspruit 1200
Tel: 013 753 2370, Fax: 013 753 2911, Cell 073 761 0626
Email: madoada@msmabuya.co.za, www.msmabuya.co.za
Reg: 2007/034872/07, Vat: 4920255686
Coordinates: S25°20'23.4"E031°00'31.3"

MS MABUYA
CIVIL LABORATORY

PH & ELECTRICAL CONDUCTIVITY

BY TEST METHOD: TMH1 A20 & A21T

CLIENT: Phezulu Geotechnical Civils
ADDRESS: 12 Suikkerriet Street, Central Park
Nelspruit
1200
PROJECT: Matwabeng Housing
Tel / Email: xolaninhlabathi@gmail.com
ATTENTION: Mr. Xolani Nhlabathi

DATE RECIEVED: 22 Jan 2021
DATE TESTED: 22 Jan 2021
DATE REPORTED: 25 Jan 2021
JOB NUMBER: MSJ2824-21
REPORT NO: MSJ2824-21(i)

Specimen Particulars			Ph : Method A20		CONDUCTIVITY : METHOD A21T	
Lab Sample Number	Position	Depth (m)	PH	Temperatue	Conductivity (µS/cm)	Temperature
MS0128-21	TP 03	0.0 1.0	8.2	24.4	52	24.4
MS0129-21	TP 09	0.5 - 1.6	7.5	24.5	64	24.5

Signature:

L. Makeke
Technical Signatory

21-341 Matwabeng Residential Housing

E-PERCOLATION TEST

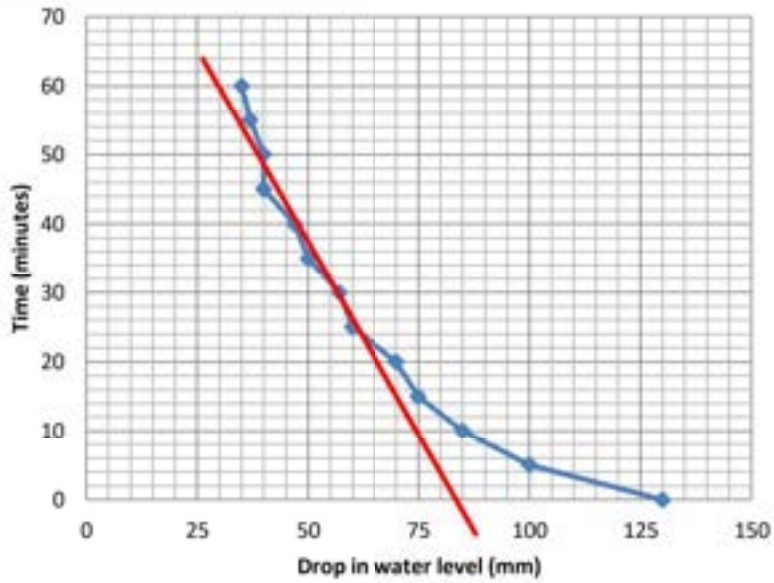
P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

PERCOLATION TEST

Time (Minutes)	Test Hole No. 1 - Drop Height (mm)
0	130
5	100
10	85
15	75
20	70
25	60
30	57
35	50
40	47
45	40
50	40
55	37
60	35
65	
Rate : Application :	40-52



Comments: .....

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Technical Signatory : _____

Mr. X.R Nhlabathi

Technical Signatory

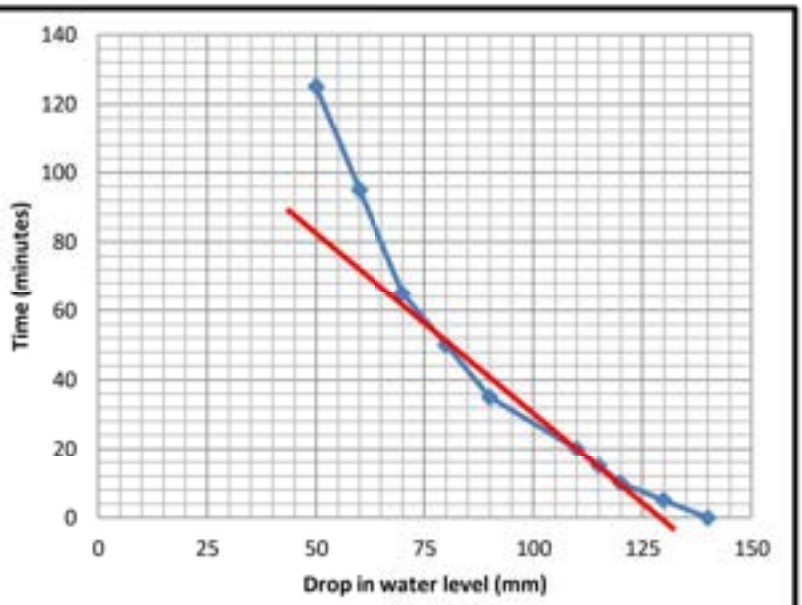
P.O Box 1766
12 Suikeriet Street
Central Park
Unit 57.1
Nelspruit
1200
NLA Member No. 241

Phezulu Geotechnical Civils

e-mail : xolani@phezulugc.co.za
Domain www.phezulugc.co.za
Tel : 013 004 0119
Cell : 071 897 3005
Fax : 086 543 8298
Reg. No. 2011/005646/23
Vat no. 4610267686

PERCOLATION TEST

Time (Minutes)	Test Hole No. 2 - Drop Height (mm)
0	140
5	130
10	120
15	115
20	110
35	90
50	80
65	70
95	60
125	50
Rate : Application :	40-52



Comments: .....

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Technical Signatory : _____

Mr. X.R Nhlabathi

Technical Signatory