



GEOTECHNICAL

FINAL REPORT

GEOTECHNICAL INVESTIGATION STUDY FOR THE PROPOSED INTERGRATED HUMAN SETTLEMENT ON PORTION 3 OF THE FARM NABOOMSPRUIT 348 KR, MOOKGOPONG, LIMPOPO PROVINCE, SOUTH AFRICA



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DECLARATION

This report has been professionally independently prepared by Ntamu Engineers (Pty) Ltd, which is a South African Professional Consulting firm, with a team of professionals specializing in a number of environmental science and environmental engineering fields.

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A handwritten signature in black ink, appearing to be 'G. M.', is written over a light grey rectangular background.

EXECUTIVE SUMMARY

Ntamu Engineers here in referred as NTE was appointed by Real Development Planning Company to undertake a Phase 1 geotechnical site investigation for the proposed Integrated Human Settlement on Portion 3 Of the Farm Naboomspruit 348 Kr, Mookgopong, Limpopo Province, South Africa.

The site investigation included a review of available data, a subsurface investigation involving a series of test pits and in situ tests, laboratory tests and a report detailing the findings of the investigation. The surface conditions on site were slightly moist at the time of the investigation, and access across the site with equipment was relatively easy.

The site is located in the Southern Hemisphere which is characterised by warm to hot rainy summers and cold dry winters. Mookgopong receives approximately 599 mm of rain annually with most of the rainfall occurring during summer months and the winter months receiving the least rainfall.

According to the Geological Map Sheet 2428 Nylstroom Map at a scale of 1: 250 000, the proposed site is characterised by the Volcanic rocks, sandstone, Basalts of the Letaba formation which forms part of the Karoo Sequence. Furthermore, the site is dominantly underlain by a transported soil horizon confined to the upper portions of the site. Underlying the transported horizon is the ironized ferricrete soil material.

A total of eleven (11) trial pits were advanced to depths ranging between 1 and 1.5 meters below ground level (mbgl) using an TLB. The trial pits data indicates that the site is generally underlain by gravelly sands and silty sands. No groundwater seepage was encountered on all trial pits excavated as part of the investigation. It should also be pointed out that the investigation was carried out during rainy season (January) hence the slightly moist conditions were noted.

A total of fifteen (15) Dynamic Cone Penetrometer (DCP) tests were advanced adjacent to the trial pits to compliment trial pit data. The DCP tests were advanced from surface to depths ranging between 0.42 and 0.78 mbgl. The DCP test results indicate CBR values ranging between 0% and 168%. The derived Estimated Allowable Safe Bearing Pressure (EASBP) ranges between 0 kPa and 2900 kPa indicating a weak to moderate bearing pressure of the underlying soil horizons. It should be noted that the results of DCP testing is affected by the moisture content of the soil profile, as well as any pebbles or cobbles that may be struck during the testing.

A total of four (4) disturbed bulk samples were submitted to an accredited Laboratories and Surveyors for testing. The laboratory testing included grading analysis, Atterberg Limit determinations and Mod/CBR compaction tests. A genuine conclusion and recommendation will be given after receiving of the laboratory analyses.



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The laboratory test results indicate that the site is typically underlain by Clayey sand, sand-clay mixtures classified as SC. The Liquid Limit of the samples ranges between 34% and 38% with the Linear Shrinkage ranging between 6% and 9%. The samples indicate low to medium plasticity Index ranging between 12% and 18%. Furthermore, the laboratory tests indicate that the samples have low to high clay content, with fair to moderate compaction characteristics of the surficial soils with the grading modulus ranging between 0,91 and 2,46. The sample also indicate low to moderate CBR value ranging between 4.2% and 21% at 95% MOD AASHTO.

Thus, the site is **suitable** for Housing Development and can be classified as **2/S1/H**.

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

Ntamu Engineers (NTE) was appointed by Real Development Planning Company to conduct a phase 1 geotechnical investigation assessment for a proposed Integrated Human Settlement on Portion 3 Of the Farm Naboomspruit 348 Kr, Mookgopong, Limpopo Province, South Africa. It is understood that the site measure approximately 10 ha and that the development site has a closed dumping site and also bothered by a railway on the Southern Eastern boundary.

1.2 GENERAL PURPOSE OF THE INVESTIGATION

The general purpose of the investigation includes:

- To describe the location and geology of the proposed site;
- Determine the geological origin of the material on site;
- Investigate and explain the various soil types as well as the predicted foundation circumstances;
- Highlight any problem soils, slope stability or drainage issues;
- Determining the ground water depth level;
- Estimate the bearing capacity, settlement and/or swell potential of the soil;
- Identify and discuss the main on-site geotechnical constraints,
- Recommendation on aspects of the site that can adversely affect the design and cost of the project (Facilitate an adequate and economical design),
- Comment on the founding conditions,
- Provide the geotechnical basis for planning and preliminary design purposes

The general purpose of the investigation was accomplished by:

- Excavation of a total number of eleven (11) trial pits to maximum depth of 1.5 mbgl below ground level and;
- Performing laboratory tests to determine physical or engineering characteristics of the soil on site;
- Performing engineering analysis to develop design guidelines and recommendations.

Subsequent sections of this report contain descriptions of the fieldwork, general subsurface conditions, design recommendations, and construction considerations.

2 METHODOLOGY

2.1 DESKTOP STUDY

Conduct a desktop study for the site to determine the expected geological and geotechnical conditions on site. The desktop study will include the review of the available information from pre-feasibility studies and published maps which include Google Earth Imagery, geological map sheets of the area.

2.2 FIELD INVESTIGATION

The site investigation typically includes subsurface exploration through the excavation of trial pits and DCP testing to obtain information on the physical properties of the surficial soils underlying the site.

Trial test pits – Test pits will be excavated on the footprint of proposed structures using a Tractor Loader Backhoe (TLB) for the purpose of in-situ inspection and profiling purposes, as well as soil sampling for laboratory testing. The soil horizons encountered in each trial pit were described comprehensively applying the MCCSSO technique as advocated by Jennings et al (1973). The acronym – MCCSSO – stands for Moisture, Colour, Consistency, Structure, Texture and Origin. The test pits will be excavated to a maximum depth of about 3m or to practical excavation refusal on shallow bedrock or sidewall collapse. Soil samples will be taken from representative horizon for laboratory testing.

These will be directed by engineering geologist and the pits will generally be backfilled the same day immediately after inspections and sampling are concluded.

Dynamic Cone Penetrometer (DCP) – Dynamic Cone Penetration Tests (DCP) provide an in-situ method to determine the strength of the subsurface and design load of the soil. Once the maximum design load of a soil is known, these results can be used to calculate appropriate footings and foundations for sub/superstructures to be placed on or within the soil. This is achieved by measuring the extent of penetration into the ground of a calibrated tip or cone and weight which is dropped from a standardized height.

2.3 LABORATORY ANALYSES

Representative soil samples will be taken from encountered horizons and submitted to a suitable SANAS accredited soil laboratory for testing in Gauteng Province. The following laboratory tests are proposed, dependent on material, condition and samples collected:

- Foundation indicator tests (Grading, hydrometer and Atterberg Limits);
- Modified AASHTO compaction;
- Soaked California Bearing Ratio (CBR) tests on coarse grained soils;
- Natural Moisture Content

2.4 DELIVERABLES

An interpretive geotechnical report will be compiled to present the information obtained during the site investigation including the prevailing site conditions, local geology and stratigraphy, material classification and characterization, geotechnical design parameters and recommendations for foundation designs and lateral support for basement constructions.

3 SITE DESCRIPTION

3.1 SITE LOCATION

The site is located within Mookgopong, which is approximately 0.66 km south east of Naboomspruit Police Station, Limpopo Province, South Africa. The centre coordinates are approximately - 24.523431°S and 28.716391°E.

The locality map can be viewed in Figure 3-2.

3.2 CLIMATE AND TOPOGRAPHY

The site is located in the Southern Hemisphere which is characterised by warm to hot rainy summers and cold dry winters. Mookgopong receives approximately 599 mm of rain annually with most of the rainfall occurring during summer months and the winter months receiving the least rainfall. The average annual temperatures in Mookgopong are 19.5°C. According to Köppen and Geiger, this climate is classified as BSh. The site lies in an area with a Weinert N value that is less than 5, which indicates that chemical decomposition is the dominant form of weathering.



FIGURE 3-1 MOKGOPONG WEINERT N-VALUES

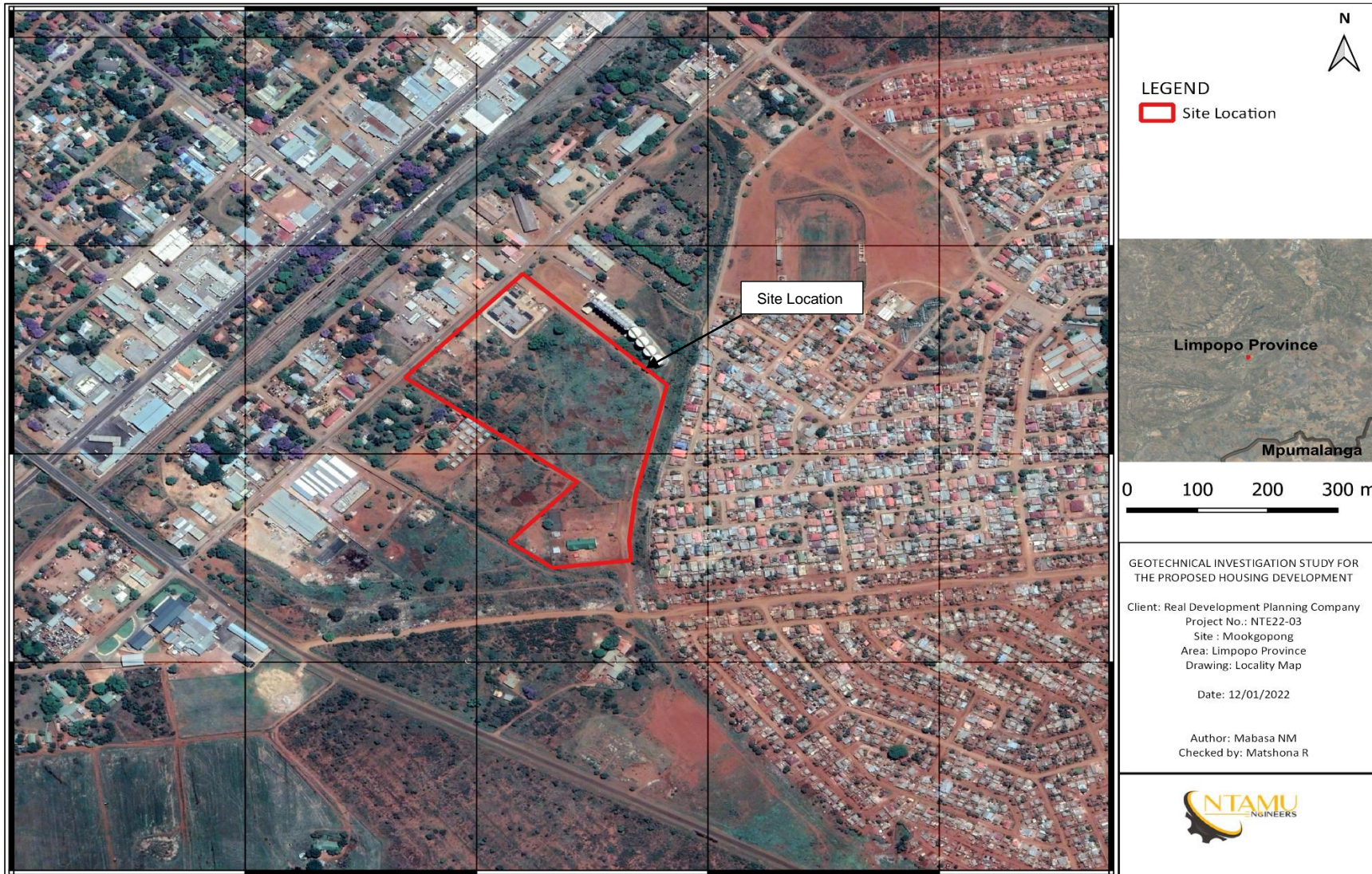


FIGURE 3-2 SITE LOCATION MAP

4 GEOLOGY

4.1 LOCAL GEOLOGY

According to the Geological Map Sheet 2428 Nylstroom Map at a scale of 1: 250 000(Figure 4-1), the proposed site is characterised by the Volcanic rocks, sandstone, Basalts of the Letaba formation which forms part of the Karoo Sequence.

TABLE 4-1 SUMMARY OF GEOLOGY

Map Type	Geological Unit	Formation, group, and supergroup	Symbol
2428 Nylstroom Map	Basalts	Letaba formation, Karoo Sequence	J

4.2 HYDROGEOLOGY

The 1:500 000 Hydrogeological map series of the Republic of South Africa classify the bedrock as fractured, intergranular.

Aeolian and alluvial sands are relatively porous making it easier for infiltration to occur. Contact zones of different geological units, fractures, joints, faults are also preferred groundwater pathways. Other pathways include in-situ features such as permeable pores and cavities within the strata.

Groundwater seepage was not encountered all of the trial pits excavated as part of the investigation. It must be pointed out that this investigation was carried out during rainy season (January); hence slightly moist conditions were noted. During periods of prolonged rainfall, a marked increase in the occurrence and magnitude of groundwater seepage flow can be anticipated. Perched groundwater flows at the soil / rock interface are likely to become more prolific in rainy months.

Depth of groundwater table can be variable, being relatively shallow in low-lying areas and slightly deeper in high lying areas.

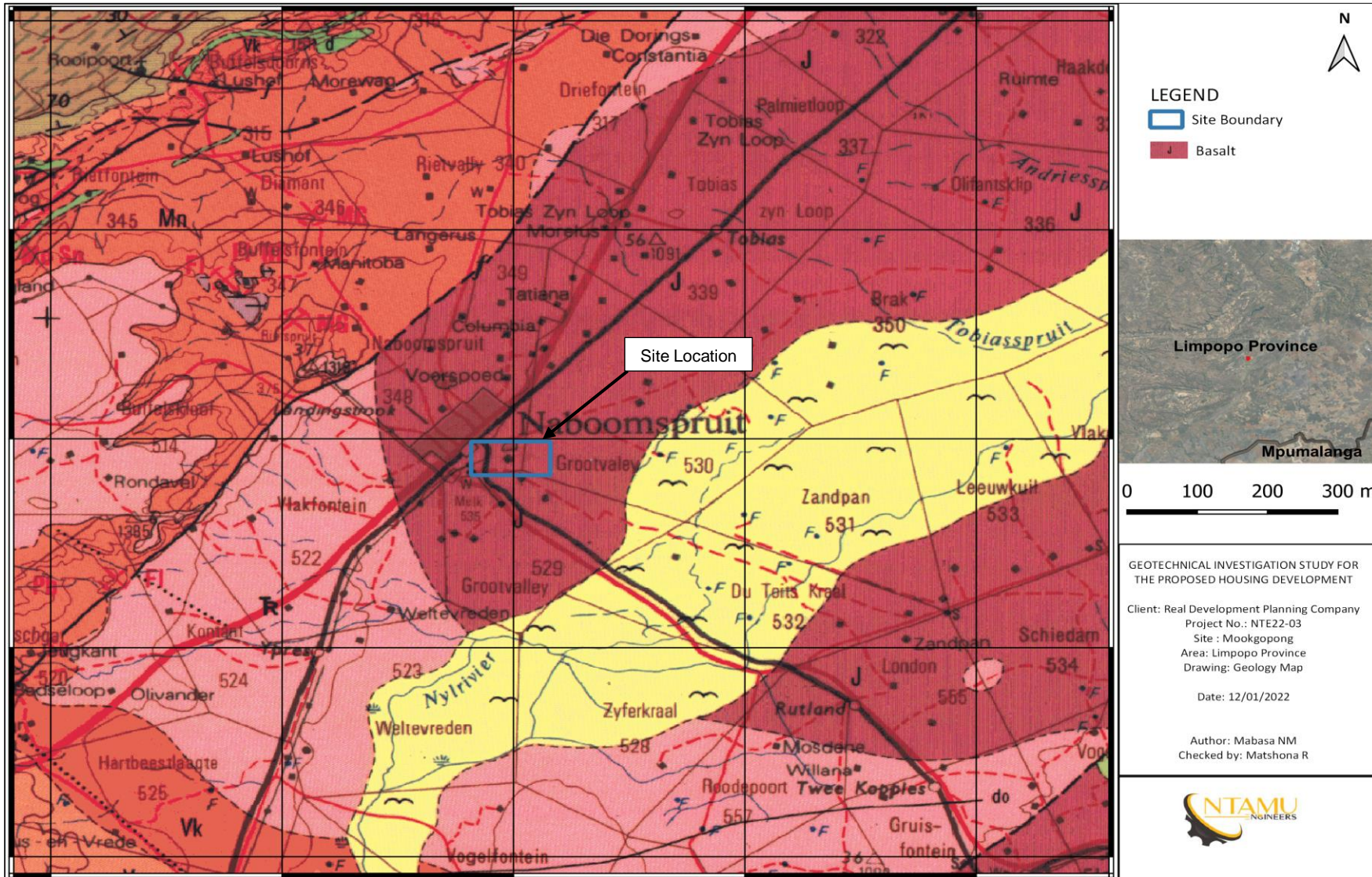


FIGURE 4-1 GEOLOGY MAP

5 FIELD INVESTIGATION RESULTS

5.1 TRIAL PITS

The site investigation was conducted on the 13th of January 2022. A total of eleven (11) trial pits were advanced to depths ranging between 1 and 1.5 meters below ground level (mbgl) using an TLB. A layout with trial pit locations is shown in Figure 5-1 and a photo log of the trial pits is provided in Table 5-3 photo log. Due to erratic GPS satellite signal reception, the coordinates and elevations recorded have an accuracy of only +/- 5 m.

The trial pits excavated across the proposed site revealed that the site can be divided into two separate zones, Zone A and Zone B. The summary of zonation of trial and zonation map can be viewed in Table 5-1 and Figure 5-2.

TABLE 5-1 ZONATION OF TRIAL PITS

Zone A (New Site)	Zone B (Old Dumping Site)
TP 1	TP 5
TP 2	TP 6
TP 3	TP 11
TP 4	
TP 7	
TP 8	
TP 9	
TP 10	

Zone A: New Site

The excavation of the trial pits across zone A site revealed that the site is dominantly underlain by a transported soil horizon confined to the upper portions of the site. Underlying the transported horizon is the ironized ferricrete. The full description of the field logs is presented in Appendix A.

- **Top soil** - The colluvium encountered on site comprises dry to slightly moist, reddish brown, loose to medium dense, intact, silty sand. This material was encountered at depths between 0 to 1.1 mbgl. This horizon was encountered in eight (8) trial pits at TP1, TP2, TP3, TP4, TP7, TP8, TP9 and TP10.
- **Ironized ferricrete** – An ironized ferricrete material underlies the colluvium material. The ferricrete horizon comprises of dry to slightly moist, reddish brown, dense, intact, ironized sandy gravel. The material was encountered at depths between 0.2 to 1.5mbgl. This horizon was encountered in eight (8) trial pits at TP1, TP2, TP3, TP4, TP7, TP8, TP9 and TP10.

Zone B: Old Dumping Site

The excavation of the trial pits across zone B site revealed that the site is dominantly underlain by an uncontrolled fill and transported soil horizon confined to the upper portions of the site. Underlying the transported horizon is the ironized ferricrete. The full description of the field logs is presented in Appendix A.

- **Uncontrolled fill-** The engineering fill encountered on site comprises of slightly moist, brown, loose, intact, silty sand with spotted roots in places, bottles, ash coal pebbles, boulders and bricks. This material was encountered at depths between 0 to 1.4 mbgl. This horizon was found in three (3) trial pits TP5, TP6 and TP11.
- **Top soil** - The colluvium encountered on site comprises dry to slightly moist, reddish brown, loose to medium dense, intact, silty sand. This material was encountered at depths between 0.8 to 0.9 mbgl. This horizon was encountered in one (1) trial pit (TP11).
- **Ironized ferricrete** – An ironized ferricrete material underlies the colluvium material. The ferricrete horizon comprises of dry to slightly moist, reddish brown, dense, intact, ironized sandy gravel, ferricrete nodular. The material was encountered at depths between 0.5 to 1.2mbgl. This horizon was encountered in ten (2) trial pits (TP5 and TP11).

TABLE 5-2 TRIAL PITS SUMMERY

TRIAL PIT NUMBER	END OF HOLE (EOH)	DEPTH(M)	WATER SEEPAGE
TP 1	End of hole due to hard digging	1.5 m	No water seepage
TP 2	End of hole due to hard digging	1.2m	No water seepage
TP 3	End of hole due to hard digging	1 m	No water seepage
TP 4	End of hole due to hard digging	1 m	No water seepage
TP 5	End of hole due to hard digging	1 m	No water seepage
TP 6	End of hole due to hard digging	1.4 m	No water seepage
TP 7	End of hole due to hard digging	1.2 m	No water seepage
TP 8	End of hole due to hard digging	1.2 m	No water seepage
TP 9	End of hole due to hard digging	1.4 m	No water seepage
TP 10	End of hole due to hard digging	1.1 m	No water seepage
TP 11	End of hole due to hard digging	1.2 m	No water seepage



FIGURE 5-1 TRIAL PITS SITE LOCATION

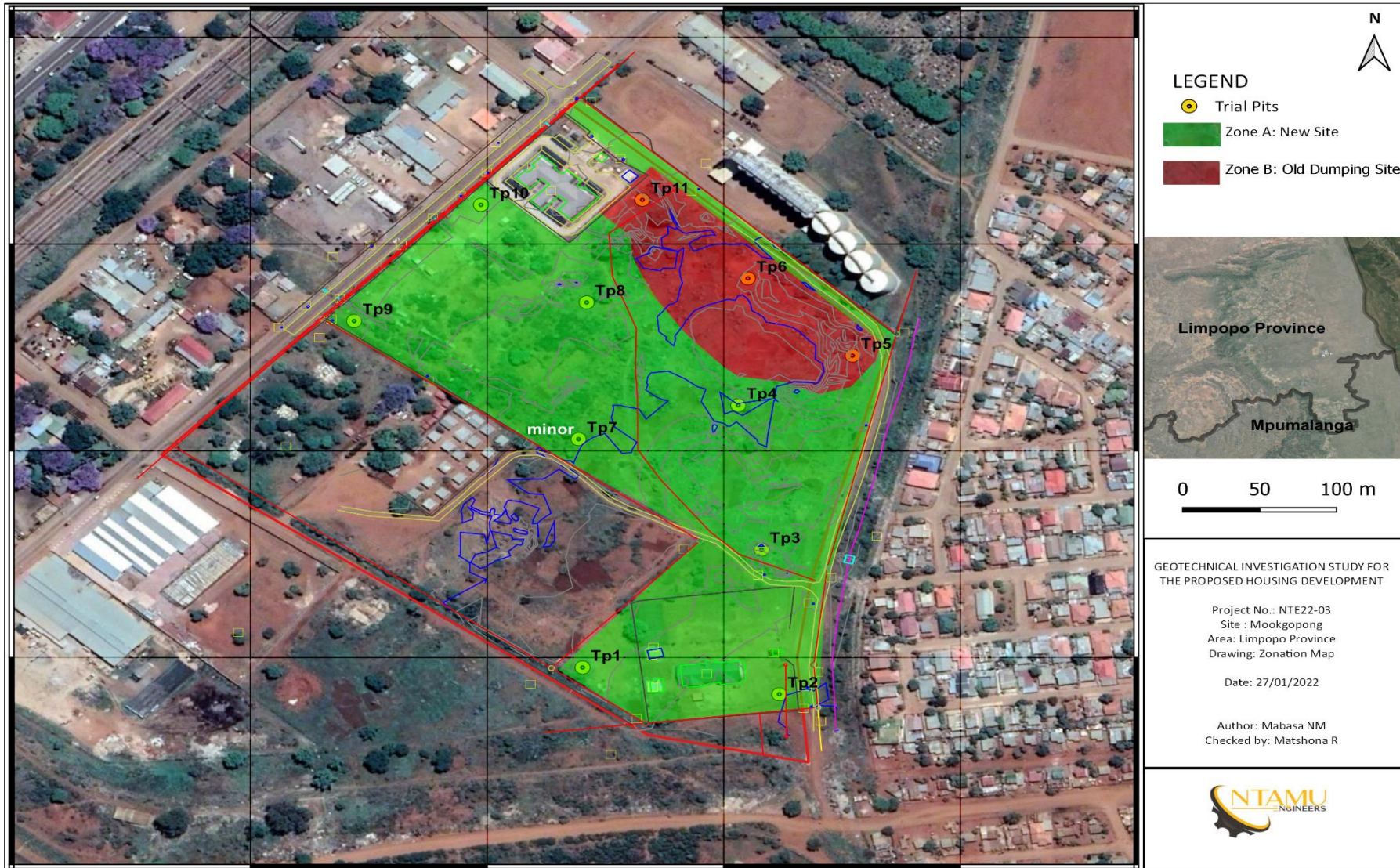






FIGURE 5-2 ZONATION MAP

TABLE 5-3 PHOTO LOG

Photo Logs: Mookgopong Geotechnical Investigation	
	
<p>PLATE 1: Trial pits 10 Soil profiling</p>	<p>PLATE 2: Trial Pit 6 Observed Uncontrolled fill (Old Dumping Site)</p>
	
<p>PLATE 3: Trial pit 1 Soil Profiling</p>	<p>PLATE 4: Trial Pits 10 back filling</p>

5.2 DYNAMIC CONE PENETROMETER TEST

The DCP penetration rates were used for the evaluation of subsoil consistency and the empirical derivation of the estimated allowable safe bearing pressure (EASBP) and in-situ CBR, according to the methods of Terzaghi & Peck, modified by Meyerhof (Craig, 1997) and Draft TMH 6 (1984) respectively. The DCP test results are summarized in Table 5-5 and DCP location can be viewed in Figure 5-3

- A total of fifteen (15) Dynamic Cone Penetrometer (DCP) tests were advanced adjacent to the trial pits to compliment trial pit data. The DCP tests were advanced from surface to depths ranging between 0.42 and 0.78 mbgl.
- The DCP test results indicate CBR values ranging between 0% and 168%.
- The derived Estimated Allowable Safe Bearing Pressure (EASBP) ranges between 0 kPa and 2900 kPa indicating a weak to moderate bearing pressure of the underlying soil horizons.

It should be noted that the results of DCP testing is affected by the moisture content of the soil profile, as well as any pebbles or cobbles that may be struck during the testing. A horizon saturated due to heavy rainfall will provide a lower set of results than a similar test in the dry season. Awkwardly oriented pebbles or cobbles struck may give false high readings. Coordinates and the results of the DCP conducted are shown in Table 5-4

TABLE 5-4 DCP COORDINATES

DYNAMIC CONE PENETRATION	COORDINATES		DYNAMIC CONE PENETRATION	COORDINATES	
	S	E		S	E
DCP 1	-24.525653°	28.715981°	DCP 10	-24.522264°	28.715254°
DCP 2	-24.525828°	28.717073°	DCP11	-24.522225°	28.716292°
DCP 3	-24.524739°	28.716946°	DCP12	-24.523172°	28.716660°
DCP 4	-24.523728°	28.716885°	DCP13	-24.523253°	28.715386°
DCP 5	-24.523324°	28.717586°	DCP14	-24.524300°	28.716774°
DCP 6	-24.522758°	28.716936°	DCP15	-24.525420°	28.716767°
DCP 7	-24.523969°	28.715894°			
DCP 8	-24.522975°	28.715930°			
DCP 9	-24.523101°	28.714488°			

TABLE 5-5 DCP RESULTS

No. Of Blows	DCP1			DCP2			DCP3			DCP4			DCP5			DCP6			DCP7			DCP8			DCP9		
	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	60	18	193	30	42	411	50	22	236	160	5	66	130	7	83	160	5	66	160	5	66	140	6	77	90	11	124
10	70	168	1362	60	42	411	60	168	1362	220	18	193	240	8	100	240	12	141	210	22	236	200	18	193	180	11	124
15	80	168	1362	70	168	1362	70	168	1362	250	42	411	290	22	236	350	8	100	230	70	640	250	22	236	330	6	71
20	90	168	1362	80	168	1362	80	168	1362	300	22	236	350	18	193	490	6	77	280	22	236	280	42	411	460	7	83
25	100	168	1362	100	70	640	90	168	1362	390	11	124	410	18	193	510	70	640	370	11	124	320	29	301	480	70	640
30	160	18	193	110	168	1362	120	42	411	440	22	236	460	22	236	520	168	1362	420	22	236	350	42	411	500	70	640
35	220	18	193	150	29	301	150	42	411	490	22	236	500	29	301	530	168	1362	470	22	236	360	168	1362	520	70	640
40	250	42	411	190	29	301	170	70	640	520	42	411	560	18	193				500	42	411	390	42	411	550	42	411
45	300	22	236	230	29	301	230	18	193	560	29	301	580	70	640				530	42	411	400	168	1362	570	70	640
50	390	11	124	270	29	301	270	29	301	580	70	640	590	168	1362				550	70	640	430	42	411	580	168	1362
55	510	7	91	290	70	640	350	12	141	600	70	640	600	168	1362				570	70	640	450	70	640	590	168	1362
60	610	9	111	320	42	411	360	168	1362	640	29	301	610	168	1362				610	29	301	470	70	640	600	168	1362
65	650	29	301	360	29	301	390	42	411	660	70	640	620	168	1362				630	70	640	500	42	411	610	168	1362
70	670	70	640	410	22	236	400	168	1362	690	42	411							660	42	411	530	42	411			
75	680	168	1362	490	12	141	410	168	1362	700	168	1362							680	70	640	550	70	640			
80	690	168	1362	520	42	411	420	168	1362										710	42	411	580	42	411			
85	700	168	1362	590	14	163																620	29	301			
90	710	168	1362	600	168	1362																650	42	411			
95	720	168	1362	610	168	1362																680	42	411			
	730	168	1362	620	168	1362																690	168	1362			

No. Of Blows	DCP10			DCP11			DCP12			DCP13			DCP14			DCP15		
	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)	Depth (mm)	CBR %	EASBP (kPa)
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	80	12	141	170	5	62	110	8	100	60	18	193	40	29	301	50	22	236
10	90	168	1362	240	14	163	200	11	124	80	70	640	50	168	1362	60	168	1362
15	90	402	2900	330	11	124	270	14	163	100	70	640	60	168	1362	70	168	1362
20	150	20	212	450	7	91	320	22	236	110	168	1362	80	70	640	80	168	1362
25	180	42	411	580	7	83	370	22	236	120	168	1362	100	70	640	90	168	1362
30	240	18	193	650	14	163	400	42	411	180	18	193	110	168	1362	150	18	193
35	330	11	124	660	168	1362	420	70	640	240	18	193	120	168	1362	210	18	193
40	450	7	91	670	168	1362	450	42	411	300	18	193	190	14	163	240	42	411
45	550	9	111				480	42	411	350	22	236	220	42	411	290	22	236
50	590	29	301				680	4	52	400	22	236	270	22	236	380	11	124
55	610	70	640				700	70	640	490	11	124	330	18	193	500	7	91
60	630	70	640				720	70	640	580	11	124	370	29	301	600	9	111
65	640	168	1362				730	168	1362	680	9	111	420	22	236	640	29	301
70	650	168	1362							720	29	301	440	70	640	660	70	640
75	660	168	1362							740	70	640	450	168	1362	670	168	1362
80	670	168	1362							750	168	1362	460	168	1362	680	168	1362
85	680	168	1362							760	168	1362	470	168	1362	690	168	1362
90	690	168	1362							770	168	1362	490	70	640			
95	700	168	1362							780	168	1362						

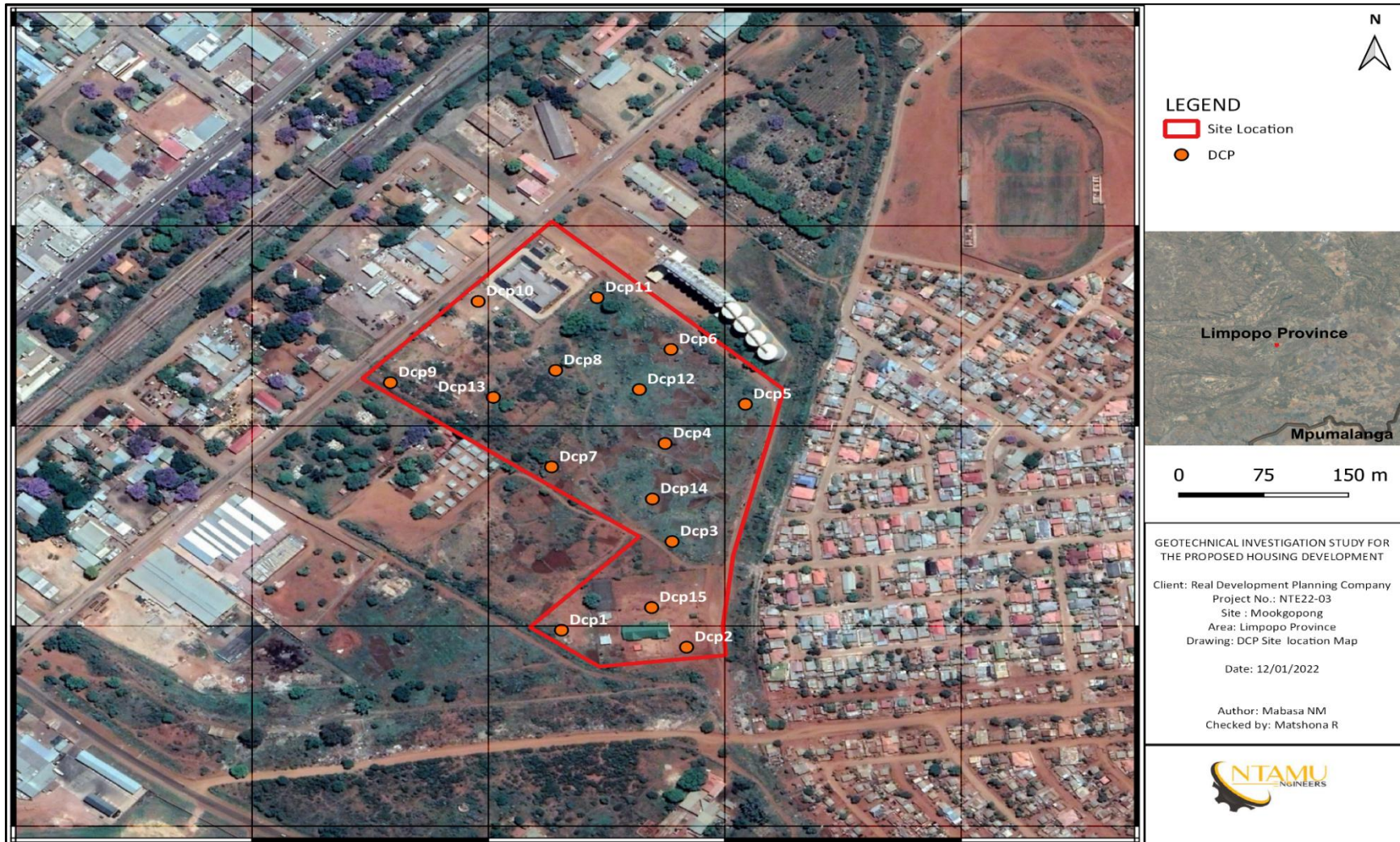






FIGURE 5-3 DCP LOCATION MAP

TABLE 5-6 DCP PHOTO LOG

Photo Logs: Mookgopong Geotechnical Investigation	
	
PLATE 1: Conducting DCP adjacent to TP10	PLATE 2: Conducting DCP adjacent to TP9
	
PLATE 3: boulders and Uncontrolled fill that can affect DCP reading	PLATE 4: Ironized ferricrete nodular

6 LABORATORY RESULTS

Laboratory testing included grading analysis, Atterberg Limit determinations and Mod/CBR compaction tests which are summarized in Figure 6-1. Detailed laboratory test results are presented in Appendix B.

A total of four (4) disturbed bulk samples were submitted for geotechnical laboratory for testing (Tp2, Tp3, Tp7 and Tp9).

- The laboratory test results indicate that the site is typically underlain by Clayey sand, sand-clay mixtures classified as SC.
- The Liquid Limit of the samples ranges between 34% and 38% with the Linear Shrinkage ranging between 6% and 9%. The samples indicate low to medium plasticity Index ranging between 12% and 18%.
- Furthermore, the laboratory tests indicate that the samples have low to high clay content. The moderate clay content and the Plasticity Index indicate that the samples will exhibit low to high potential expansiveness (Van der Merwe, 1964).

Three (3) samples were collected from the test pits excavated and submitted for CBR testing (Tp2, Tp7 and Tp9).

- The samples indicate moderate compaction characteristics of the surficial soils with the grading modulus ranging between 0,91 and 2,46.
- The sample indicate low to moderate CBR value ranging between 4.2% and 21% at 95% MOD AASHTO.
- The laboratory testing shows that the COLTO classification for surficial soils could not be detected according to TRH14 classification.

FIGURE 6-1 SUMMARY OF LABORATORY RESULTS

Sample No.	Lab Ref	Description (m)	Particle Size (%)				Atterberg Limits (%)			GM	Modified ASSHTO		ASSHTO	USCS	Port.Exp	CBR					COLTO Class
			Clay	Silt	Sand	Gravel	LL	LS	PI		MDD (kg/m ³)	OMC (%)	Class	Class		90	93	95	98	100	
TP 2	A22/0178	0.1 – 0.4	24.2	14.4	50.3	11.1	36	8	16	1.32	1968	11.7	A-6(2)	SC	Medium	4.4	6.5	8.8	14	20	-
TP 3	A22/0179	0 – 0.2	7.9	12.3	42.7	37.2	34	6	12	2.06			A-2-6(0)		Low						
TP 7	A22/0180	0.7 – 1.2	32.6	17.7	49.4	0.4	38	9	17	0.91	1726	12.1	A-6(5)	SC	Medium	3.6	3.9	4.2	7.3	11	-
TP 9	A22/0181	0.7 – 1.4	16.4	13.3	47.6	22.6	34	8	18	1.64	2094	9	A-2-6(1)	SC	Low	9.6	15	21	45	73	-

LS = Linear Shrinkage LL = Liquid Limit
State Highways and Transport Officials

PI = Plasticity Index Pot. Exp. = Potential Expansiveness (vd Merwe Classification)
CBR = California Bearing Ratio OMC = Optimum

USCS = Unified Soil Classification System
Moisture content PI = Plasticity Index

AASHTO – American Association for

7 GEOTECHNICAL ASPECTS

It is also the purpose of this investigation to consider various geotechnical factors at the site which may have an influence on the proposed developments and associated infrastructure. The geotechnical factors observed during the field investigation are discussed below.

7.1 WORKABILITY OF SITE MATERIAL

7.1.1 EXCAVATION CHARACTERISTICS

Trial pits were excavated to depths ranging between 0.1 and 1.5 mbgl with all of the test pits terminated due to hard diggings. Excavations for the proposed housing development are expected to utilise soft excavation techniques to remove the thick layer of uncontrolled fill, thin layer of colluvium, intermediate excavation techniques to remove the ferricrete material. It is recommended that all required earthworks be carried out in accordance with guidelines provided by SANS 1200 (latest edition).

7.1.2 PROBLEM SOILS

Problem soils such as dolomite were not encountered during excavation of the trial pits.

7.1.3 SEEPAGE CONDITIONS

No groundwater was not encountered during test pit excavation or profiling. However, a periodical, shallow perched water table, which could cause the flooding of excavations, is expected to be present on the site during and after high rainfall. This is confirmed by the presence of paedogenic material.

7.1.4 SLOPE STABILITY

Layers for material encountered in trial pit TP6 were unstable during excavation and profiling, while stable on all other test pits. Slope instability is anticipated over the TP6 area.

7.1.5 EXISTENCE OF COLLAPSIBLE/COMPRESSIBLE PROFILE

The soils encountered on the site typically comprise clayey sands and silty sand with no visual open-textured structure such as pinholes which indicate collapse potential.

7.1.6 ERODIBILITY OF THE SOIL

During the site investigation, major visible signs of surface soil erosion were identified in the most part of the site, in the form of erosion rills to indicate that the material could be erodible. The site must be shaped to improve stormwater runoff and extensive stormwater management must be considered. **All drainage boundaries near the areas or drainage lines and flood lines must be confirmed by the relevant Competent Person (flood line specialist).**

7.1.7 BEDROCK

No bedrock was encountered within the test excavated. However, a Paedogenic material comprising ironized ferricrete nodular was encountered in ten (10) trial pits (TP1, TP2, TP3, TP4, TP5, TP7, TP8, TP9, TP10 and TP11). The material was encountered at depths between 0.2 to 1.5mbgl.

7.1.8 PAVEMENT LAYERS

The material encountered on site comprises of thin engineering and colluvium layer underlain by Paedogenic material (ironized ferricrete nodular). The gravelly nature of ferricrete nodular material indicates that they may exhibit fair compaction characteristics and therefore may not be suitable for the housing development.

7.1.9 SITE CLASSIFICATION

According to the desktop study, field investigation as well as laboratory testing the following can be concluded: The laboratory tests indicate that material underlying the site are classified as clays and silts which exhibit low to medium potential expansiveness and low to medium plasticity. The development potential has been broadly classified in terms of two Geotechnical Sub-Areas based on field observations/investigation and laboratory soil testing of soil samples, the site can be classified as **2/S1/H** for **Zone A** and **Zone B**

8 CONCLUSION

- A geotechnical investigation was conducted in Mookgopng within Naboomspruit, Limpopo Province, South Africa.
- According to the Geological Map Sheet 2428 Nylstroom Map at a scale of 1: 250 000, the proposed site is characterised by the Volcanic rocks, sandstone, Basalts of the Letaba formation which forms part of the Karoo Sequence.
- The area is not underlain by dolomite; therefore, it is classified as non-dolomitic area.
- A total of eleven (11) trial pits were advanced to depths ranging between 1 and 1.5 meters below ground level (mbgl) using an excavator The trial pits data indicates that the site is generally underlain by silty gravel and sandy gravel.
- The material encountered on site comprises an Uncontrolled fill, colluvium layer underlain by ferricrete nodular.
- A total of fifteen (15) Dynamic Cone Penetrometer (DCP) tests were advanced adjacent to the trial pits to compliment trial pit data. The DCP tests were advanced from surface to depths ranging between 0.42 and 0.78 mbgl. The DCP test results indicate CBR values ranging between 0% and 168%. The derived Estimated Allowable Safe Bearing Pressure (EASBP) ranges between 0 kPa and 2900 kPa indicating a weak to moderate bearing pressure of the underlying soil horizons.

- Groundwater was not encountered during test pit excavation or profiling, however during periods of prolonged rainfall, a marked increase in the occurrence and magnitude of groundwater seepage flow can be anticipated. Perched groundwater flows at the soil / rock interface are likely to become more prolific in rainy months.
- A total of four (4) disturbed bulk samples were submitted to Laboratories for testing.
- The laboratory test results indicate that the site is typically underlain by Clayey sand, sand-clay mixtures classified as SC. The Liquid Limit of the samples ranges between 34% and 38% with the Linear Shrinkage ranging between 6% and 9%. The samples indicate low to medium plasticity Index ranging between 12% and 18%. Furthermore, the laboratory tests indicate that the samples have low to high clay content, with moderate compaction characteristics of the surficial soils with the grading modulus ranging between 0,91 and 2,46. The sample also indicate low to moderate CBR value ranging between 4.2% and 21% at 95% MOD AASHTO.
- Thus, the site is **suitable** for Housing Development and is classified as **2/S1/H**

It is understood that the investigation is for the proposed housing development on portion 3 of the farm Naboomspruit 348 KR in Mookgopong.

8.1 SITE PREPARATIONS, GRADING AND RECOMMENDATIONS

8.1.1 EXCAVABILITY

Soft to hard rock excavation in terms of SABS 1200 is anticipated using light earthmoving equipment due to the nature of the underlying soils.

8.1.2 EARTHWORK CONSTRUCTION

It is recommended that all earthworks be carried out along the guidelines given in SANS 1200 and should be carried out in a manner to promote stable development of the site.

8.1.3 INSTALLATION OF UNDERGROUND SERVICES

Based on engineering properties of material underlying the proposed area; material on-site is classified soft to hard excavation (SANS 1200 D). TLB machines or excavators will be required during excavation for the services.

8.1.4 FOUNDATION RECOMMENDATIONS

It is recommended that the heavy dump proof membrane be placed within the reinforcement on deep strip footing or soil raft foundation.

The foundational recommendations and designs are shown in Table 8-1

TABLE 8-1 FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES FOR SINGLE-STOREY TYPE 1 BUILDINGS FOUNDED ON SOIL HORIZONS SUBJECT TO BOTH CONSOLIDATION AND COLLAPSE SETTLEMENT

NHBRC ZONES	SITE CLASS	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES
<p style="text-align: center;">Zone A Zone B</p>	<p>2/S1/H</p>	<p>Soil Raft</p>	<ul style="list-style-type: none"> • Remove in-situ material from at least 1.5m beyond the perimeter of the structure to a depth of at least 1.0m below natural ground level. Rip and compact 150mm of the bottom in-situ material. Import competent material (at least G6) and compacted to 95% MOD AASHTO MAXIMUM DENSITY in layers not exceeding 150mm.
		<p>Compaction of in-situ soils below individual footings</p>	<ul style="list-style-type: none"> • Remove in-situ material below foundations to a depth and width of 1.5 times the foundation width or to a competent horizon (Basalt bedrock) and replace with material compacted to 93% MOD AASHTO density at -1% to 2% of optimum moisture content. • Normal construction with lightly reinforced strip foundations and light reinforcement in masonry
		<p>Deep Strip Footing</p>	<ul style="list-style-type: none"> • Normal Construction with precautions. Founding on competent horizon (Basalt bedrock) below problematic zone.

9 REFERENCE

The investigation is carried out in accordance with the following guidelines:

- GFSH-2 guidelines published by the Department of Housing (2002),
- Jennings J.E., Brink A.B.A., Williams A.A.B.: "Revised Guide to Soil profiling for Civil Engineering Purposes in Southern Africa" (September 2002).
- South African Bureau of Standards SANS 634. Geotechnical investigations for township development. Pretoria 2012.
- South African Bureau of Standards SANS 1200D. Standardised specification for civil engineering construction Section D: Earthworks. Pretoria 2002 (and amendments).
- Govender, N., 2019. Characterisation of the deep aquifers of South Africa-the bushveld igneous complex, crystalline basement rocks and dolomite formations (Doctoral dissertation, University of the Free State).

APPENDIX A: Soil Logs



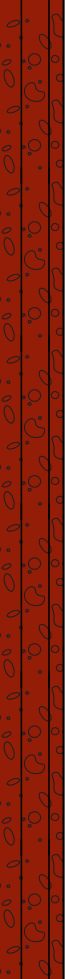
PROJECT NUMBER NTE22-03	DATE 2022/01/16	COORDINATES S-24.525617° E 28.715906°
PROJECT NAME GEOTECHNICAL INVESTIGAT	TOTAL DEPTH 1.5 m	COORD SYS WGS84
CLIENT Real Development Planning Company		COMPLETION 2022/01/16
LOCATION Limpopo		SURFACE ELEVATION 1106 m
SITE Mookgopong		

COMMENTS	LOGGED BY Nduna Mabasa CHECKED BY Matshona R
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Sample Collected	Water Level	Depth (m)	Graphic Log	Soil Description
		0.1	Slightly moist, brown, loose, intact, silty sand with roots in places, colluvium	
		0.2		
		0.3		
		0.4	Slightly moist, reddish brown, medium dense to dense, intact, silty sand, colluvium.	
		0.5		
		0.6		
		0.7		
		0.8		
		0.9		
		1		
		1.1	Slightly moist, reddish brown, dense, intact, sandy gravel, ironized ferricrete material.	
		1.2		
		1.3		
		1.4		
			No Seepage Walls stable Refusal No sample taken	

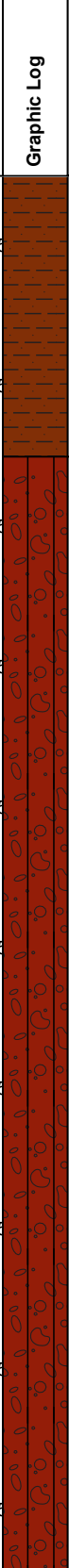
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PROJECT NAME GEOTECHNICAL INVESTIGAT	TOTAL DEPTH 1.2 m	COORD SYS WGS84
CLIENT Real Development Planning Company		COMPLETION 2022/01/16
LOCATION Limpopo		SURFACE ELEVATION 1106 m
SITE Mookgopong		

COMMENTS	LOGGED BY Nduna Mabasa CHECKED BY Matshona R
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Sample Collected	Water Level	Depth (m)	Graphic Log	Soil Description
		0.05		Slightly moist, brown, loose, intact, silty sand with roots in places, colluvium
		0.1		Slightly moist, reddish brown, medium dense to dense, intact, silty sand, colluvium.
		0.15		
		0.2		
		0.25		
		0.3		
		0.35		
		0.4		Slightly moist, reddish brown, dense, intact, sandy gravel, ironized ferricrete material.
		0.45		
		0.5		
		0.55		
		0.6		
		0.65		
		0.7		
		0.75		
		0.8		
		0.85		
		0.9		
		0.95		
		1		
		1.05		
		1.1		
		1.15		
				No Seepage Walls stable CBR taken @ 0.1 - 0.4 m

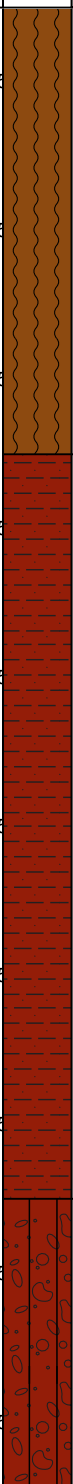
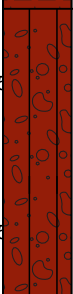
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PROJECT NAME GEOTECHNICAL INVESTIGAT	TOTAL DEPTH 1 m	COORD SYS WGS84
CLIENT Real Development Planning Company		COMPLETION 2022/01/16
LOCATION Limpopo		SURFACE ELEVATION 1113 m
SITE Mookgopong		

COMMENTS	LOGGED BY Nduna Mabasa
	CHECKED BY Matshona R

Sample Collected	Water Level	Depth (m)	Graphic Log	Soil Description
		0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5 0.55 0.6 0.65 0.7 0.75 0.8 0.85 0.9 0.95		<p style="margin-left: 20px;">Slightly moist, brown, loose, intact, silty sand with roots in places, colluvium</p> <hr/> <p style="margin-left: 20px;">Slightly moist, reddish brown, dense, intact, sandy gravel, ironized ferricrete material.</p> <hr/> <p style="margin-left: 20px;">Refusal Walls not stable No seepage No samples taken FI taken @0 - 0.2 m</p>

PROJECT NUMBER NTE22-03	DATE 2022/01/16	COORDINATES S-24.52380° E 28.71620°
PROJECT NAME GEOTECHNICAL INVESTIGAT	TOTAL DEPTH 1 m	COORD SYS WGS84
CLIENT Real Development Planning Company		COMPLETION 2022/01/16
LOCATION Limpopo		SURFACE ELEVATION 1107 m
SITE Mookgopong		

COMMENTS	LOGGED BY Nduna Mabasa CHECKED BY Matshona R
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Sample Collected	Water Level	Depth (m)	Graphic Log	Soil Description
		0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5 0.55 0.6 0.65 0.7 0.75 0.8 0.85 0.9 0.95		<p style="margin-left: 20px;">Slightly moist, brown, loose, intact, silty sand with roots in places, colluvium</p> <hr/> <p style="margin-left: 20px;">Slightly moist, reddish brown, medium dense to dense, intact, silty sand, colluvium.</p> <hr/> <p style="margin-left: 20px;">Slightly moist, reddish brown, dense, intact, sandy gravel, ironized ferricrete material.</p>
		0.95		<p style="margin-left: 20px;">No Seepage Walls stable No Sample taken</p>

PROJECT NUMBER NTE22-03	DATE 2022/01/16	COORDINATES S-24.523327°E 28.717638°
PROJECT NAME GEOTECHNICAL INVESTIGAT	TOTAL DEPTH 1 m	COORD SYS WGS84
CLIENT Real Development Planning Company		COMPLETION 2022/01/16
LOCATION Limpopo		SURFACE ELEVATION 1111 m
SITE Mookgopong		

COMMENTS	LOGGED BY Nduna Mabasa
	CHECKED BY Matshona R

Sample Collected	Water Level	Depth (m)	Graphic Log	Soil Description
		0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5 0.55 0.6 0.65 0.7 0.75 0.8 0.85 0.9 0.95	Slightly moist, brown, loose, intact, silty sand with roots in places, bottles and ash coal, Uncontrolled fill	
			Slightly moist, reddish brown, dense, intact, sandy gravel, ironized ferricrete material.	
			No Seepage Walls stable No Sample taken	



GEOTECHNICAL LOG TP 6

PROJECT NUMBER NTE22-03	DATE 2022/01/16	COORDINATES S-24.522761°E 28.716967°
PROJECT NAME GEOTECHNICAL INVESTIGAT	TOTAL DEPTH 1.4 m	COORD SYS WGS84
CLIENT Real Development Planning Company		COMPLETION 2022/01/16
LOCATION Limpopo		SURFACE ELEVATION 1113 m
SITE Mookgopong		

COMMENTS	LOGGED BY Nduna Mabasa
	CHECKED BY Matshona R

Sample Collected	Water Level	Depth (m)	Graphic Log	Soil Description
		0.1	[Cross-hatched pattern]	Slightly moist, brown, loose, intact, silty sand with roots in places, bottles, refused bags, pebbles and boulders, Uncontrolled fill
		0.2		
		0.3		
		0.4		
		0.5		
		0.6		
		0.7		
		0.8		
		0.9		
		1		
		1.1		
		1.2		
		1.3	[Cross-hatched pattern]	

PROJECT NUMBER NTE22-03	DATE 2022/01/16	COORDINATES S-24.523941° E 28.715880°
PROJECT NAME GEOTECHNICAL INVESTIGAT	TOTAL DEPTH 1.2 m	COORD SYS WGS84
CLIENT Real Development Planning Company		COMPLETION 2022/01/16
LOCATION Limpopo		SURFACE ELEVATION 1106 m
SITE Mookgopong		

COMMENTS	LOGGED BY Nduna Mabasa CHECKED BY Matshona R
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Sample Collected	Water Level	Depth (m)	Graphic Log	Soil Description
		0.05		Slightly moist, brown, loose, intact, silty sand with roots in places, colluvium
		0.1		
		0.15		
		0.2		Slightly moist, reddish brown, medium dense to dense, intact, silty sand, colluvium.
		0.25		
		0.3		
		0.35		
		0.4		
		0.45		
		0.5		
		0.55		
		0.6		
		0.65		
		0.7		Slightly moist, reddish brown, dense, intact, sandy gravel, ironized ferricrete material.
		0.75		
		0.8		
		0.85		
		0.9		
		0.95		No Seepage Walls stable CBR taken @ 0.7 - 1.2 m
		1		
		1.05		
		1.1		
		1.15		



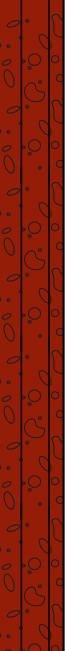
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PROJECT NAME GEOTECHNICAL INVESTIGAT	TOTAL DEPTH 1.2 m	COORD SYS WGS84
CLIENT Real Development Planning Company		COMPLETION 2022/01/16
LOCATION Limpopo		SURFACE ELEVATION 1109 m
SITE Mookgopong		

COMMENTS	LOGGED BY Nduna Mabasa
	CHECKED BY Matshona R

Sample Collected	Water Level	Depth (m)	Graphic Log	Soil Description
		0.05	[Wavy pattern]	Dry, brown, loose, intact, silty sand with roots in places, colluvium
		0.1		
		0.15		
		0.2	[Horizontal line pattern]	Slightly moist, reddish brown, medium dense to dense, intact, silty sand, colluvium.
		0.25		
		0.3		
		0.35		
		0.4		
		0.45		
		0.5		
		0.55		
		0.6		
		0.65		
		0.7	[Circular pattern]	Slightly moist, reddish brown, dense, intact, sandy gravel, ironized ferricrete material.
		0.75		
		0.8		
		0.85		
		0.9		
		0.95	[Circular pattern]	No Seepage Walls stable Refusal No sample taken
		1.0		
		1.05		
		1.1		
		1.15		



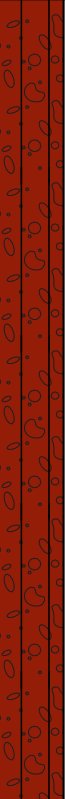
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PROJECT NAME GEOTECHNICAL INVESTIGAT	TOTAL DEPTH 1.4 m	COORD SYS WGS84
CLIENT Real Development Planning Company		COMPLETION 2022/01/16
LOCATION Limpopo		SURFACE ELEVATION 1108 m
SITE Mookgopong		

COMMENTS	LOGGED BY Nduna Mabasa CHECKED BY Matshona R
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Sample Collected	Water Level	Depth (m)	Graphic Log	Soil Description
		0.1		Dry, brown, loose, intact, silty sand with roots in places, colluvium
		0.2		Slightly moist, reddish brown, medium dense to dense, intact, silty sand, colluvium.
		0.3		
		0.4		
		0.5		
		0.6		
		0.7		Slightly moist, reddish brown, dense, intact, sandy gravel, ironized ferricrete material.
		0.8		
		0.9		
		1		
		1.1		
		1.2		
		1.3		No Seepage Walls stable Refusal CBR taken @ 0.7 - 1.4m


PROJECT NUMBER NTE22-03	DATE 2022/01/16	COORDINATES S-24.522221° E 28.715253°
PROJECT NAME GEOTECHNICAL INVESTIGAT	TOTAL DEPTH 1.1 m	COORD SYS WGS84
CLIENT Real Development Planning Company		COMPLETION 2022/01/16
LOCATION Limpopo		SURFACE ELEVATION 1108 m
SITE Mookgopong		

COMMENTS	LOGGED BY Nduna Mabasa CHECKED BY Matshona R
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Sample Collected	Water Level	Depth (m)	Graphic Log	Soil Description
		0.05		Dry, brown, loose, intact, silty sand with roots in places, colluvium
		0.1		
		0.15		
		0.2		Slightly moist, reddish brown, medium dense to dense, intact, silty sand, colluvium.
		0.25		
		0.3		
		0.35		
		0.4		
		0.45		Slightly moist, reddish brown, dense, intact, sandy gravel, ironized ferricrete material.
		0.5		
		0.55		
		0.6		
		0.65		
		0.7		
		0.75		
		0.8		
		0.85	No Seepage Walls stable Refusal No sample taken	
		0.9		
		0.95		
		1		
		1.05		

PROJECT NUMBER NTE22-03	DATE 2022/01/16	COORDINATES S-24.522183° E 28.716289°
PROJECT NAME GEOTECHNICAL INVESTIGAT	TOTAL DEPTH 1.2 m	COORD SYS WGS84
CLIENT Real Development Planning Company		COMPLETION 2022/01/16
LOCATION Limpopo		SURFACE ELEVATION 1111 m
SITE Mookgopong		

COMMENTS	LOGGED BY Nduna Mabasa CHECKED BY Matshona R
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Sample Collected	Water Level	Depth (m)	Graphic Log	Soil Description
		0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4 0.45 0.5 0.55 0.6 0.65 0.7 0.75 0.8 0.85 0.9 0.95 1 1.05 1.1 1.15		<p style="margin: 0;">Slightly moist, brown, loose, intact, silty sand with roots in places, bottles and bricks, Uncontrolled fill</p> <hr/> <p style="margin: 0;">Slightly moist, reddish brown, medium dense to dense, intact, silty sand, colluvium.</p> <hr/> <p style="margin: 0;">Slightly moist, reddish brown, dense, intact, sandy gravel, ironized ferricrete material.</p> <hr/> <p style="margin: 0;">No Seepage Walls stable No Sample taken</p>

Appendix B: Laboratory Results

CLIENT : NTAMU ENGINEERS (PTY)LTD
ADDRESS : MABASA NDUNA
P.O BOX 403,HOUSE 336A
MALAMULELE 0982
ATTENTION : Mr Nduna Mabasa

OUR REF.: PL/48753a

YOUR REF.:

DATE : 24.01.2022

PROJECT : Moogopong Geotech

SGS MATROLAB

a SANAS Accredited Testing Laboratory, No. T0025

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

TEST REPORT / RESULTS

Sample/s: Sampled by : Client
Date Received / Sampled : 13.01.2022
Date Tested : 13-26.01.2022

Sampling method : By Client

Section / Position tested identified by : Client - Refer To Test Results

Number of pages in this Report : 7

General : Samples were delivered to Laboratory by client.

Opinions and interpretations expressed herein are outside the Scope of SANAS Accreditation.
Results only have bearing on the samples tested.
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 a SANAS Accredited Testing Laboratory, No. T0025

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

TEST RESULTS

NTAMU ENGINEERS (PTY)LTD
 MABASA NDUNA
 P.O BOX 403, HOUSE 336A
 MALAMULELE 0982
 Attention: Mr Nduna Mabasa

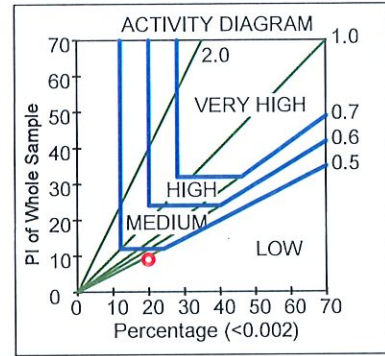
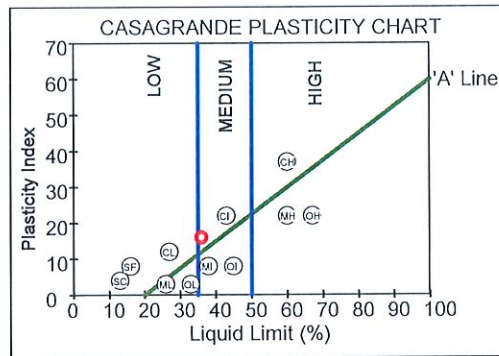
Project : Moogopong Geotech
 Your Ref :
 Our Ref : PL/48753
 Date Reported : 26.01.2022

FOUNDATION INDICATOR (ASTM: D422)

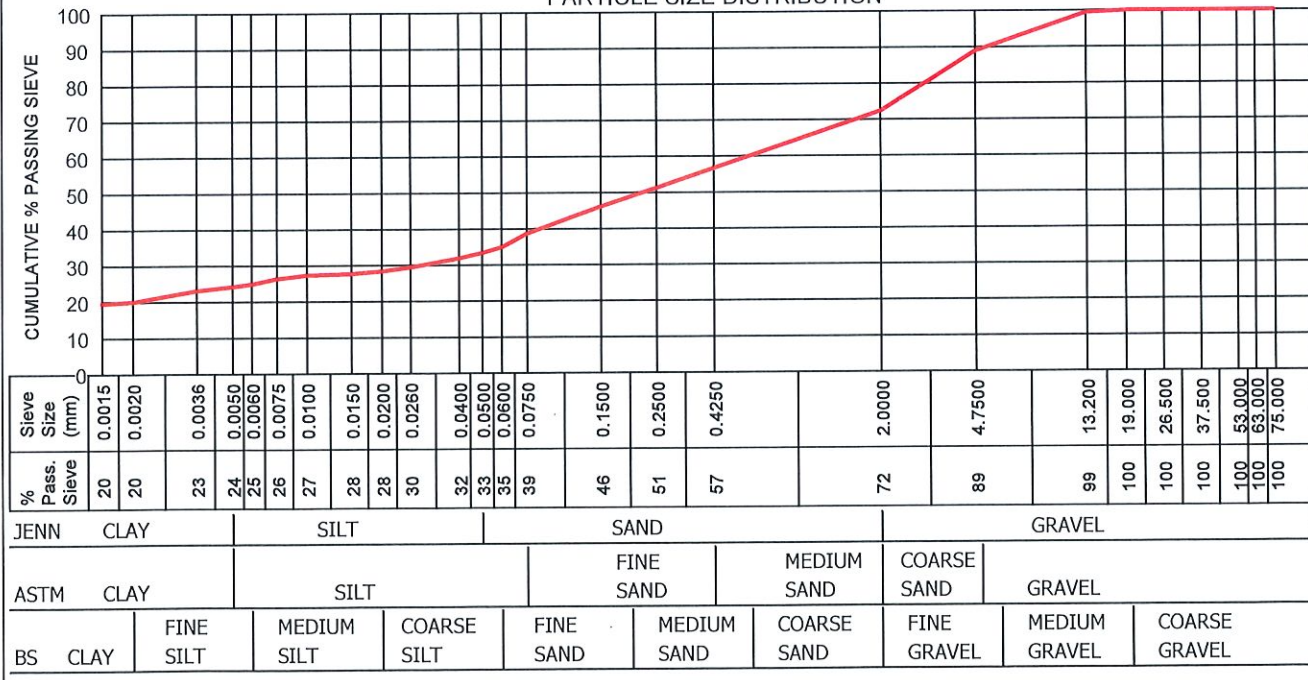
Sample No. : A22/0178
 Hole No. : TP2
 Depth : 100-400
 Liquid Limit (%) : 36
 Plasticity Index : 16
 Linear Shrinkage (%) : 8.0
 PI of Whole Sample : 9
 P.R.A. Classification : A-6(2)
 Unified Soil Classificat: SC
 Activity : 0.45
 Heave Classification : LOW
 Grading Modulus : 1.32
 Percentage (<0.002) : 20.0
 Moisture Content (%) : 12.5

Material Description : Dusky red CLAYEY SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	24.2	9.2	39.1	27.5	SANDY CLAY
Astm	24.2	14.4	50.3	11.1	CLAYEY SAND
British Standard	20.1	14.8	37.5	27.5	CLAYEY SAND



PARTICLE SIZE DISTRIBUTION



Remarks : Sampled by client.

FORM: A6

4.5.0(SGS)(2021.05.05)

Technical Signatory : Martinus Schwartz/Sunil Dewnath

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 P.O Box 912387, Silverton, 0127
 Tel. : (012) 800 1299
 Fax :
 Email : martinus.schwartz@sgs.com

TEST RESULTS

NTAMU ENGINEERS (PTY)LTD
 MABASA NDUNA
 P.O BOX 403,HOUSE 336A
 MALAMULELE 0982
 Attention: Mr Nduna Mabasa

Project : Moogopong Geotech
 Your Ref :
 Our Ref : PL/48753a
 Date Reported : 26.01.2022

SIEVE ANALYSIS, CONSTANTS, CBR(SANS 3001:GR1,GR10,GR12,GR20,GR30,GR40)

SAMPLE NO.	A22/0178				Preparation Method: - Specification COTO:2020
HOLE NO.	TP2				
ROAD NO.					
DEPTH	100-400				
CHAINAGE					
LAYER TYPE					
STABILISED WITH	Natural				
SUPPLIER					
CURING METHOD					
DATE TESTED	13.01.2022				
DESCRIPTION	Dusky red				

SIEVE ANALYSIS (% PASSING)

100.0 mm					
75.00 mm					
63.00 mm					
50.00 mm					
37.50 mm					
28.00 mm					
20.00 mm	100				
14.00 mm	99				
5.000 mm	89				
2.000 mm	72				
0.425 mm	57				
0.075 mm	39				

SOIL MORTAR

COARSE SAND <2.0mm >0.425mm	22				
FINE SAND <0.425mm >0.075mm	25				
MATERIAL <0.075mm	53				

CONSTANTS

GRADING MODULUS	1.32				
PRA CLASSIFICATION	A-6(2)				
COLTO CLASSIFICATION	---				
LIQUID LIMIT (%)	36				
PLASTICITY INDEX (0.425mm)	16				
LINEAR SHRINKAGE (%)	8.0				

MDD

MAXIMUM DRY DENSITY (kg/m ³)	1968				
OPTIMUM MOISTURE CONTENT(%)	11.7				
MOULDING MOISTURE (%)	11.3				

TYPE OF TEST	CBR				
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CBR-UCS @ 100% MDD	20				
CBR-UCS @ 98% MDD	14				
CBR-UCS @ 97% MDD	12				
CBR-UCS @ 95% MDD	8.8				
CBR-UCS @ 93% MDD	6.5				
CBR-UCS @ 90% MDD	4.4				

CBR-UCS @ % MDD derived from calculation.

% SWELL MOULD [A][B][C]	0.90	1.40	1.70										
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Remarks :

FORM: GR40

4.5.0(SGS)(2021.05.05)

Technical Signatory : Martinus Schwartz/Sunil Dewnath

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TEST RESULTS

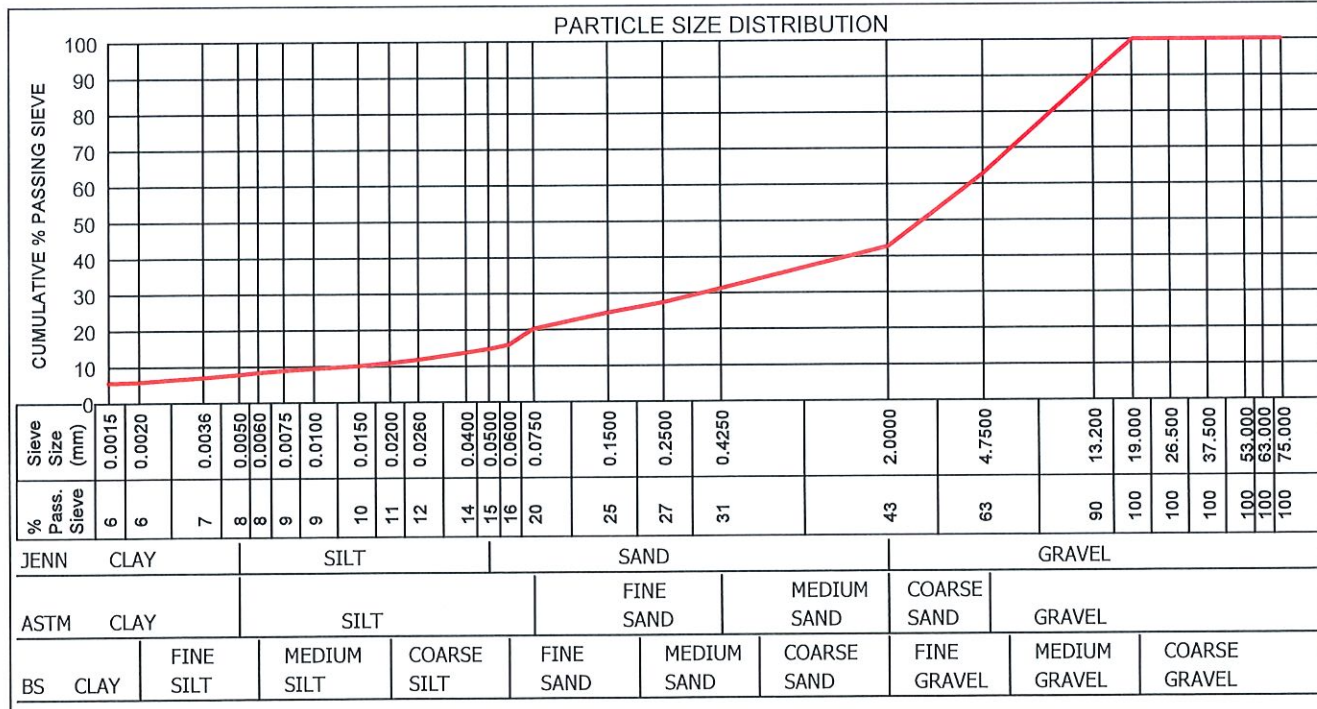
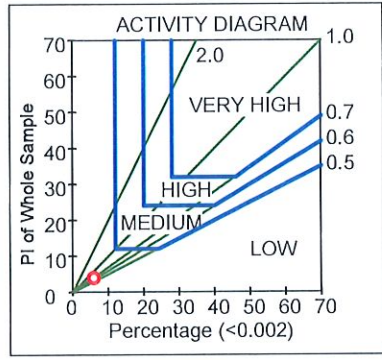
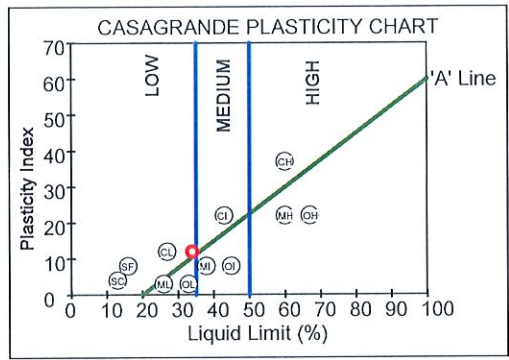
NTAMU ENGINEERS (PTY)LTD
MABASA NDUNA
P.O BOX 403,HOUSE 336A
MALAMULELE 0982
Attention: Mr Nduna Mabasa

Project : Moogopong Geotech
Your Ref :
Our Ref : PL/48753
Date Reported : 26.01.2022

FOUNDATION INDICATOR (ASTM: D422)

Sample No. : A22/0179
Hole No. : TP3
Depth : 0-200
Liquid Limit (%) : 34
Plasticity Index : 12
Linear Shrinkage (%) : 6.0
PI of Whole Sample : 4
P.R.A. Classification : A-2-6(0)
Unified Soil Classificatic: SC
Activity : 0.67
Heave Classification : LOW
Grading Modulus : 2.06
Percentage (<0.002) : 6.0
Moisture Content (%) : 8.7

Material Description : Dusky red SILTY SAND					
	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	7.9	6.9	28.0	57.2	SILTY SAND
Astm	7.9	12.3	42.7	37.2	SILTY SAND
British Standard	5.9	9.9	26.9	57.2	SILTY SAND



Remarks : Sampled by client.

FORM: A6

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Technical Signatory : Martinus Schwartz/Sunil Dewnath

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P.O Box 912387, Silverton, 0127
Tel. : (012) 800 1299
Fax :
Email : martinus.schwartz@sgs.com

TEST RESULTS

NTAMU ENGINEERS (PTY)LTD
MABASA NDUNA
P.O BOX 403,HOUSE 336A
MALAMULELE 0982
Attention: Mr Nduna Mabasa

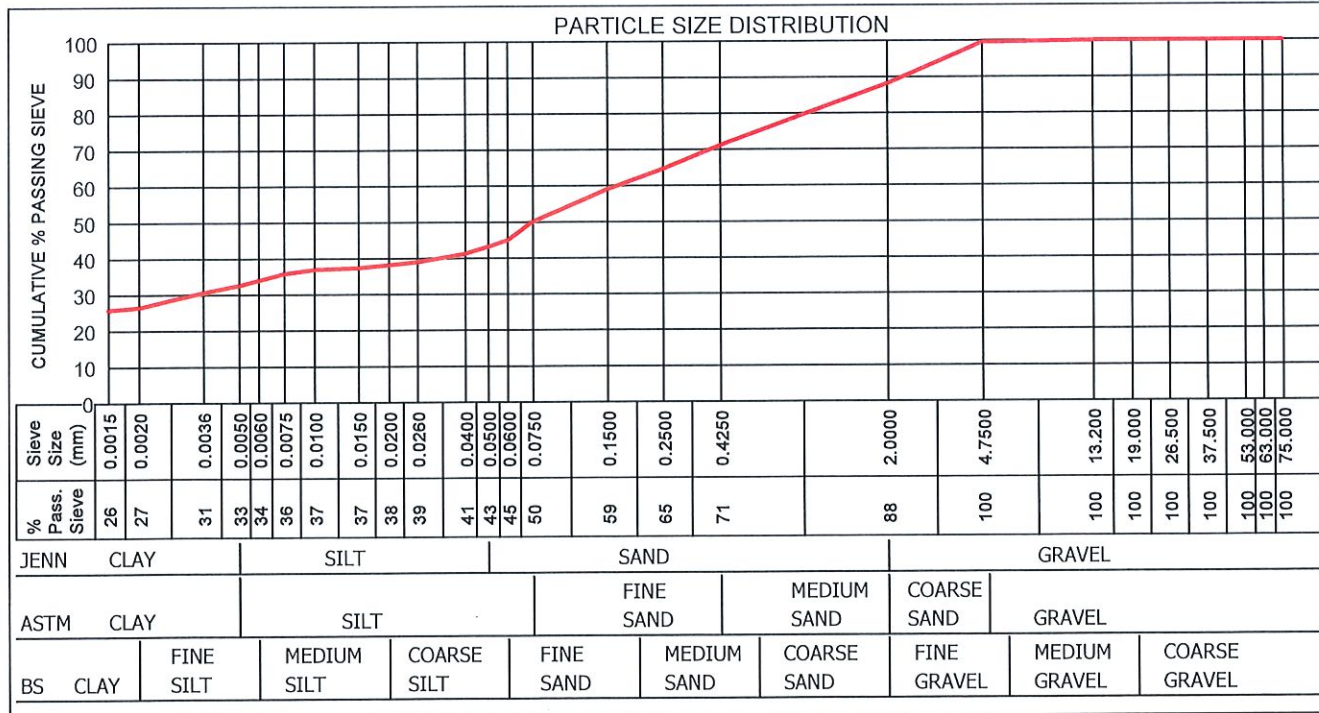
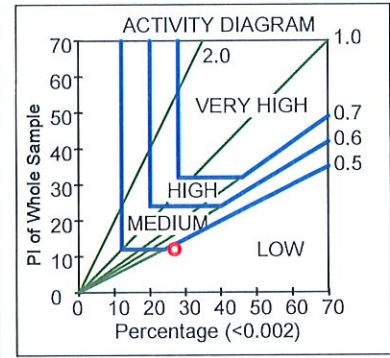
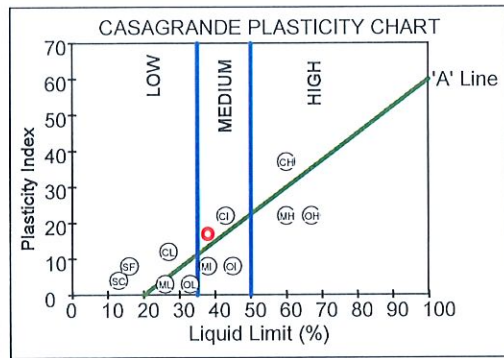
Project : Moogopong Geotech

Your Ref :
Our Ref : PL/48753
Date Reported : 26.01.2022

FOUNDATION INDICATOR (ASTM: D422)

Sample No. : A22/0180
Hole No. : TP7
Depth : 700-1200
Liquid Limit (%) : 38
Plasticity Index : 17
Linear Shrinkage (%) : 9.0
PI of Whole Sample : 12
P.R.A. Classification : A-6(5)
Unified Soil Classificatic: SC
Activity : 0.44
Heave Classification : LOW
Grading Modulus : 0.91
Percentage (<0.002) : 27.0
Moisture Content (%) : 14.8

Material Description : Dark red SANDY CLAY					
	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	32.6	10.6	45.1	11.7	SANDY CLAY
Astm	32.6	17.5	49.4	0.4	SANDY CLAY
British Standard	26.5	18.5	43.2	11.7	SANDY CLAY



Remarks : Sampled by client.

FORM: A6

4.5.0(SGS)(2021.05.05)

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TEST RESULTS

NTAMU ENGINEERS (PTY)LTD
 MABASA NDUNA
 P.O BOX 403, HOUSE 336A
 MALAMULELE 0982
 Attention: Mr Nduna Mabasa

Project : Moogopong Geotech
 Your Ref :
 Our Ref : PL/48753b
 Date Reported : 26.01.2022

SIEVE ANALYSIS, CONSTANTS, CBR(SANS 3001:GR1,GR10,GR12,GR20,GR30,GR40)

SAMPLE NO.	A22/0180				Preparation Method:
HOLE NO.	TP7				
ROAD NO.					
DEPTH	0700-1200				
CHAINAGE					
LAYER TYPE					
STABILISED WITH	Natural				
SUPPLIER					
CURING METHOD					
DATE TESTED	13.01.2022				
DESCRIPTION	Dark red				- Specification COTO:2020

SIEVE ANALYSIS (% PASSING)

100.0 mm					
75.00 mm					
63.00 mm					
50.00 mm					
37.50 mm					
28.00 mm					
20.00 mm					
14.00 mm	100				
5.000 mm	100				
2.000 mm	88				
0.425 mm	71				
0.075 mm	50				

SOIL MORTAR

COARSE SAND <2.0mm >0.425mm	19				
FINE SAND <0.425mm >0.075mm	24				
MATERIAL <0.075mm	57				

CONSTANTS

GRADING MODULUS	0.90				
PRA CLASSIFICATION	A-6(5)				
COLTO CLASSIFICATION	---				
LIQUID LIMIT (%)	38				
PLASTICITY INDEX (0.425mm)	17				
LINEAR SHRINKAGE (%)	9.0				

MDD

MAXIMUM DRY DENSITY (kg/m ³)	1726				
OPTIMUM MOISTURE CONTENT(%)	12.1				
MOULDING MOISTURE (%)	12.2				

TYPE OF TEST	CBR				
--------------	-----	--	--	--	--

CBR-UCS @ 100% MDD	11				
CBR-UCS @ 98% MDD	7.3				
CBR-UCS @ 97% MDD	6.1				
CBR-UCS @ 95% MDD	4.2				
CBR-UCS @ 93% MDD	3.9				
CBR-UCS @ 90% MDD	3.6				

CBR-UCS @ % MDD derived from calculation.

% SWELL MOULD [A][B][C]	1.60	2.41	2.50												
-------------------------	------	------	------	--	--	--	--	--	--	--	--	--	--	--	--

Remarks :

FORM: GR40

4.5.0(SGS)(2021.05.05)

Technical Signatory : Martinus Schwartz/Sunil Dewnath

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 P.O Box 912387, Silverton, 0127
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 Email : martinus.schwartz@sgs.com

TEST RESULTS

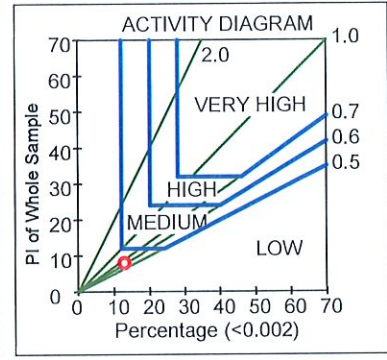
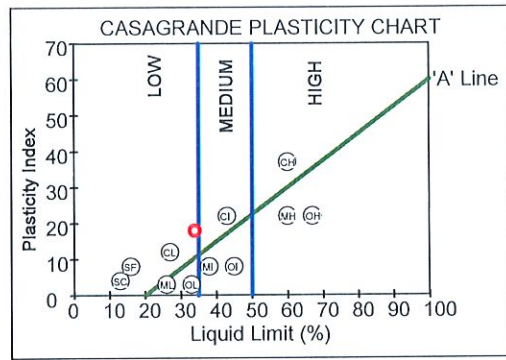
NTAMU ENGINEERS (PTY)LTD
 MABASA NDUNA
 P.O BOX 403,HOUSE 336A
 MALAMULELE 0982
 Attention: Mr Nduna Mabasa

Project : Moogopong Geotech
 Your Ref :
 Our Ref : PL/48753
 Date Reported : 26.01.2022

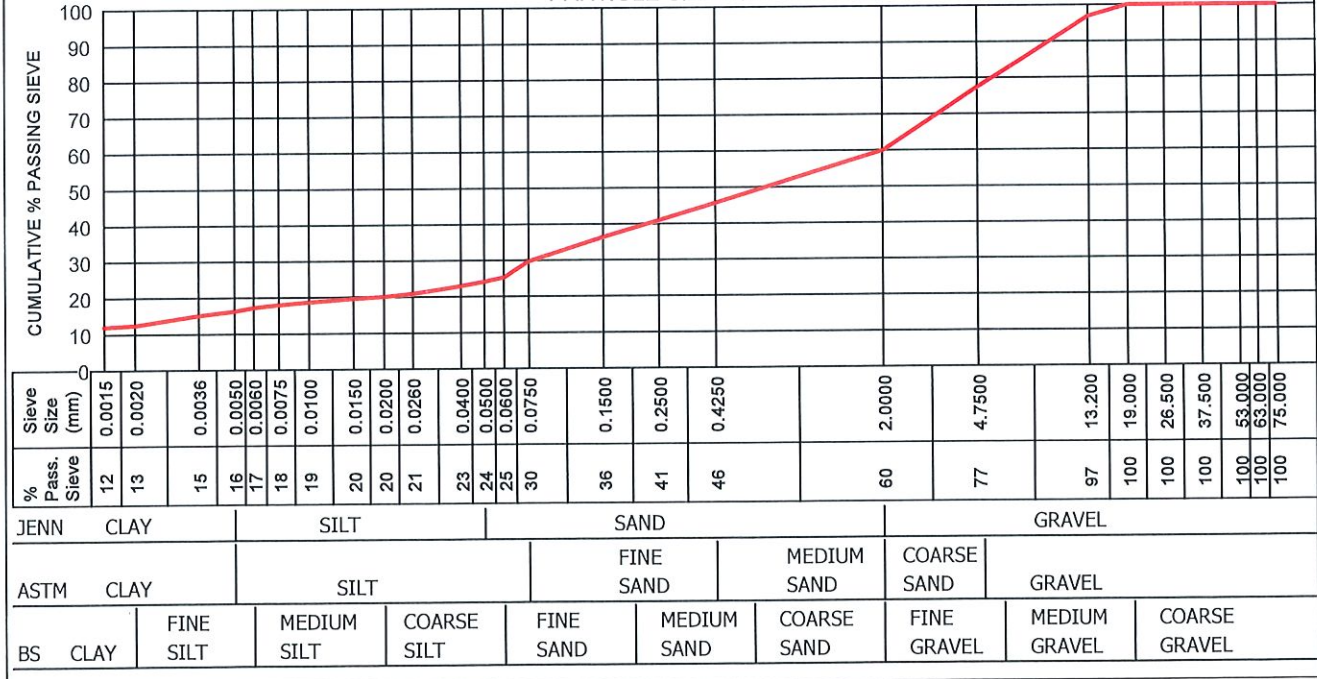
FOUNDATION INDICATOR (ASTM: D422)

Sample No. : A22/0181
 Hole No. : TP9
 Depth : 700-1400
 Liquid Limit (%) : 34
 Plasticity Index : 18
 Linear Shrinkage (%) : 8.0
 PI of Whole Sample : 8
 P.R.A. Classification : A-2-6(1)
 Unified Soil Classificatic: SC
 Activity : 0.62
 Heave Classification : LOW
 Grading Modulus : 1.64
 Percentage (<0.002) : 13.0
 Moisture Content (%) : 6.6

Material Description : Dark red brown CLAYEY SAND					
	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	16.4	7.7	35.9	40.0	CLAYEY SAND
Astm	16.4	13.3	47.6	22.6	CLAYEY SAND
British Standard	12.5	12.8	34.7	40.0	CLAYEY SAND



PARTICLE SIZE DISTRIBUTION



Remarks : Sampled by client.

FORM: A6

4.5.0(SGS)(2021.05.05)

Technical Signatory : Martinus Schwartz/Sunil Dewnath

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256 Brander Street, Jan Niemand Park, Pretoria.
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 Tel. : (012) 800 1299
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 Email : martinus.schwartz@sgs.com

a SANAS Accredited Testing Laboratory, No. T0025

TEST RESULTS

NTAMU ENGINEERS (PTY)LTD
 MABASA NDUNA
 P.O BOX 403,HOUSE 336A
 MALAMULELE 0982
 Attention: Mr Nduna Mabasa

Project : Moogopong Geotech
 Your Ref :
 Our Ref : PL/48753c
 Date Reported : 26.01.2022

SIEVE ANALYSIS, CONSTANTS, CBR(SANS 3001:GR1,GR10,GR12,GR20,GR30,GR40)

SAMPLE NO.	A22/0181				Preparation Method:
HOLE NO.	TP9				
ROAD NO.					
DEPTH	700-1000				
CHAINAGE					
LAYER TYPE					
STABILISED WITH	Natural				
SUPPLIER					
CURING METHOD					
DATE TESTED	13.01.2022				
DESCRIPTION	Dark red brown				- Specification COTO:2020

SIEVE ANALYSIS (% PASSING)

100.0 mm					
75.00 mm					
63.00 mm					
50.00 mm					
37.50 mm					
28.00 mm					
20.00 mm	100				
14.00 mm	97				
5.000 mm	77				
2.000 mm	60				
0.425 mm	46				
0.075 mm	30				

SOIL MORTAR

COARSE SAND <2.0mm >0.425mm	24				
FINE SAND <0.425mm >0.075mm	27				
MATERIAL <0.075mm	49				

CONSTANTS

GRADING MODULUS	1.65				
PRA CLASSIFICATION	A-2-6(1)				
COLTO CLASSIFICATION	---				
LIQUID LIMIT (%)	34				
PLASTICITY INDEX (0.425mm)	18				
LINEAR SHRINKAGE (%)	8.0				

MDD

MAXIMUM DRY DENSITY (kg/m ³)	2094				
OPTIMUM MOISTURE CONTENT(%)	9.0				
MOULDING MOISTURE (%)	9.0				

TYPE OF TEST	CBR				
--------------	-----	--	--	--	--

CBR-UCS @ 100% MDD	73				
CBR-UCS @ 98% MDD	45				
CBR-UCS @ 97% MDD	35				
CBR-UCS @ 95% MDD	21				
CBR-UCS @ 93% MDD	15				
CBR-UCS @ 90% MDD	9.6				

CBR-UCS @ % MDD derived from calculation.

% SWELL MOULD [A][B][C]	0.20	0.40	0.60										
-------------------------	------	------	------	--	--	--	--	--	--	--	--	--	--

Remarks :
 FORM: GR40
 4.5.0(SGS)(2021.05.05)
 Technical Signatory :  Martinus Schwartz/Sunil Dewnath

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