

GEOTECHNICAL INVESTIGATION FOR THE PROPOSED
FERROCHROME/FERROALLOYS SMELTER PLANT (125Ktpa –
1Mtpa) WITHIN THE MUSINA-MAKHADO SPECIAL ECONOMIC
ZONE (MMSEZ), MUSINA-MAKHADO LOCAL MUNICIPALITIES,
LOCATED IN MUSINA ON FARM DREYER 526 MS AND VAN DER
BIJL 528 MS WITHIN THE JURISDICTION OF MUSINA LOCAL
MUNICIPALITY, VHEMBE DISTRICT, LIMPOPO PROVINCE.

JUNE 2025



GEO EQUILIBRIA



Balancing the Earth.

© COPYRIGHT 2025 GEO EQUILIBRIA (PTY) LTD

PREPARED BY:	PREPARED FOR:
Geo Equilibria Office No. 03 2010 Centre Stand No. D18 Thohoyandou 0950 073 908 5240 info@geoequilibria.co.za	Gudani Environmental Consulting 37 VOORTREKKER ST Pietersburg 0699 015 291 3620 www.gudaniconsulting.co.za



Geo Equilibria Document Control			Report No.:	25-T-06
Report Title	GEOTECHNICAL INVESTIGATION FOR THE PROPOSED FERROCHROME/FERROALLOYS SMELTER PLANT (125Ktpa – 1Mtpa) WITHIN THE MUSINA-MAKHADO SPECIAL ECONOMIC ZONE (MMSEZ), MUSINA-MAKHADO LOCAL MUNICIPALITIES, LOCATED IN MUSINA ON FARM DREYER 526 MS AND VAN DER BIJL 528 MS WITHIN THE JURISDICTION OF MUSINA LOCAL MUNICIPALITY, VHEMBE DISTRICT, LIMPOPO PROVINCE			
Authors	Name	Title	Date	Signature
Compiled by	Mushiana K.R.	Geologist	12 June 2025	
Compiled by	Tshivhase K.D	Geologist	12 June 2025	

Approved by:

Mushiana Khwathisani Brian (Pr.Sci Nat) (BSc Hons Geology)

Registration No: 137295

13 June 2025



LIST OF ABBREVIATIONS

ABBREVIATION	DESCRIPTION
SAICEs	South African Institute of Civil Engineers
EASBPs	Estimated Allowable Safe Bearing Pressures
Mm	Millimeters
NHBRC	National Home Builders Registration Council
CBR	California Bearing Ratio
KPa	Kilopascal
DCP	Dynamic Cone Penetrometer
MDD	Maximum Dry Density (kg/m ³)
MADD	Modified AASHTO Dry Density
OMC	Optimum moisture Content (%)
PI	Plasticity Index
LL	Liquid Limit
LS	Linear Shrinkage
UCS	Unconfined Compressive Strength (MPa)



EXECUTIVE SUMMARY

This geotechnical report contains the findings and development recommendations for the proposed ferrochrome plant and water treatment plant, industrial (ferrochrome reserved) area, and ferrochrome plant area at Musina on farm Dreyer 526 MS and Van Der Bijl 528 MS within the jurisdiction of Musina Local Municipality, of Vhembe district in Limpopo Province.

The co-ordinates that can be used to locate the sites are:

Ferrochrome plant and water treatment plant: 22° 37' 36" S, 29° 52' 32" E

Industrial (ferrochrome reserved) area: 22° 38' 21" S, 29° 52' 27" E

Ferrochrome plant area: 22° 38' 3" S, 29° 53' 8" E

This geotechnical investigation aimed to identify potential hazards for the development, determine the ground conditions at the site to provide the recommendations for safe and appropriate design. The major geological formation underlain the area is Gumbu Group, Alluvium, Malala Drift Group and Undifferentiated Karoo Supergroup.

Five disturbed samples were taken from the test pit excavations for laboratory analysis of Foundation Indicators and California Bearing Ratio. The laboratory test results are included in Appendix B. The main geotechnical constraints to the development will be Compressible and Potentially Collapsible soils.

In terms of SABS 1200D, intermediate excavation conditions are anticipated from the surface to depths of about 1.6 m. It was noted that excavation was possible with a TLB to that extent, Excavability problems are foreseen from below 1.6 m as there was refusal encountered. Refusal was encountered throughout the site. Based on the material characteristics and the typical soil profiles, the site falls under two geotechnical zone that classifies for Residential Site Class Designations according to NHBRC GFSH-2 document as C1. The characteristic of founding materials are compressible and potentially collapsible soils. The options for suitable foundations are normal, modified normal, deep strip foundations, compaction of in-situ soils below individual footings, and soil raft.



It is considered that the conditions prevailing on site are such that the site is considered suitable for the proposed development, provided the recommendations outlined here are adhered to. Please note that this executive summary does not fully relate to our findings and opinions. Those findings and opinions are only presented through our full report.



TABLE OF CONTENTS

EXECUTIVE SUMMARY	iv
1. INTRODUCTION	1
1.1. PROJECT DESCRIPTION.....	1
2. OBJECTIVES.....	4
3. SITE DESCRIPTION	4
3.1. LOCALITY	4
3.2. SITE DESCRIPTION.....	5
3.2.1. TOPOGRAPHY	5
3.2.2 LANDUSE, INFRASTRUCTURE AND SOIL COVER.....	5
3.3.3. CLIMATE.....	5
3.3.4. DRAINAGE	6
4. METHOD OF INVESTIGATION	8
4.1. DESKTOP STUDY.....	8
4.2. GEOTECHNICAL INVESTIGATION	8
4.3. LABORATORY TESTING.....	9
5. GEOLOGY	11
5.1. ALLUVIUM, COLLUVIUM.....	11
5.2. GUMBU GROUP	11
5.3. UNDIFFERENTIATED KAROO SUPERGROUP	12
6. SOIL PROFILE	14
6.1 TOP COLLUVIUM WITH ABUNDANT ROOTLETS, SILTY SAND MATERIAL ..	14
6.2 SILTY/ SAND GRAVEL WITH BOULDERS, COLLUVIUM.....	14
6.3 SILTY/ SAND GRAVEL WITH BOULDERS OF RESIDUAL ROCK	14
EFFECTS ON THE PROPOSED SITE.....	16
6.4. GROUNDWATER	16
7. GEOTECHNICAL EVALUATION	17
7.1. LABORATORY TEST RESULTS	17
7.1.1. FOUNDATION INDICATORS	17



7.1.2.	GRADING, ATTERBERG LIMITS AND POTENTIAL EXPANSIVENESS	18
7.1.3.	MOISTURE/DENSITY RELATIONSHIP AND CBR	18
7.1.4.	HEAVE/SWELL	18
7.2.	BEARING CAPACITY	21
7.3.	EXCAVABILITY AND SIDEWALL STABILITY	21
7.4.	SLOPE STABILITY AND TOPOGRAPHY	21
7.5.	EROSION.....	22
7.6.	DRAINAGE	22
7.7.	SITE STABILITY	23
7.8.	SITE CLASSIFICATION AND FOUNDATION RECOMMENDATIONS.....	24
7.8.1.	ZONE 1 (NHBRC SITE CLASS DESIGNATION: C1)	24
7.9.	SPECIAL PRECAUTIONARY MEASURES	24
8.	CONCLUSIONS.....	26
	REFERENCES	27
	LIMITATIONS.....	28
	APPENDICES	29
	APPENDIX A: TEST PIT PROFILES	30
	APPENDIX B: LABORATORY TEST RESULTS	43
	APPENDIX: C SOIL BEARING CAPACITY CHART	53
	APPENDIX D: TEST PITS PICTURES	54



LIST OF FIGURES

Figure 1: Locality Map.....	7
Figure 2 : Test Pit Positions	10
Figure 3: Regional Geological Map.....	13
Figure 4 : Geotechnical Zonation Map.....	25

LIST OF TABLES

Table 1: Summary of Test Pit Profile Logs.	15
Table 2 : Summary of Laboratory Results	19
Table 3: Summary of Compaction Characteristics and CBR Results.	20
Table 4: Urban Development Zone Descriptions.	23



1. INTRODUCTION

Geo Equilibria (Pty) Ltd was appointed by Gudani consulting Pty Ltd on behalf of Kinetic Development Group and Alloy Metallurgical Base (Pty) Ltd in March 2025 to conduct a geotechnical investigation for the proposed ferroalloys/ferrochrome smelter plant that will be within the existing and approved Musina-Makhado Special Economic Zone (MMSEZ) ferrochrome plant and water treatment plant, industrial (ferrochrome reserved) area, and ferrochrome plant area at Musina on farm Dreyer 526 MS and Van Der Bijl 528 MS within Musina local municipality, of Vhembe district in Limpopo Province.

The investigation was carried out in accordance with the requirements of the National Department of Housing Generic Specification GFSH-2 (2002). This report presents the findings of the geotechnical investigation and provides recommendations for the appropriate foundation design and precautionary measures to mitigate the identified risks.

Kinetic Development Group Limited (KDGL) proposes to establish the industrial and metallurgical activities in the mentioned farms below within the approved Musina-Makhado Special Economic Zone (MMSEZ) area, Musina and Makhado Local Municipalities, Vhembe District, Limpopo.

1.1. PROJECT DESCRIPTION

Kinetic Development Group Limited (KDG) intends to develop and establish a ferrochrome and ferroalloys smelter plant within the approved MMSEZ area. The scale of the project is planned to have an annual output of 125 000 to 1 000 000 tons, and 2 x 33,000 kVA electric furnaces and their supporting facilities are built. The design shall include general, electric furnace smelting system, raw material system, pellet and roasting process, general transportation, power supply and distribution and electrical facilities (including 132kV transformer station), water supply and drainage system (water, turbidity circulating water system), including ventilation, dust removal, thermal and gas facilities, computer, telecommunications, mechanical repair, inspection, construction, structure, energy analysis and evaluation, environmental protection, occupational safety and health and fire



protection, labour and training, project investment estimates, technical economy and evaluation.

Main facilities within the Project scope include:

High-carbon ferrochrome production workshop; Chromium furnace baking workshop (reserved); Raw materials, batching and feeding system; Charcoal dry; Furnace gas purification and dust removal system; Dust removal system in the production area; Compressed air preparation; 132KV (power supply) substation and the capacitor compensation device; Power supply and distribution, electrical control, automation

instruments, telecommunications facilities; Whole-plant control system; Industrial TV monitoring system; Machine repair shop; Electrode shell production workshop; Water source connected to the production plant purification water supply system;

Net ring water system; Turbring water system; Production and living water supply and drainage system; Whole-plant fire protection system; Ventilation and air-conditioning system; General map of transport and roads, walls, gates; Factory area office building; Laboratory room; Raw material storage yard, spare parts warehouse, finished product warehouse; Raw materials into the factory, finished products factory loadometer duty room; Fire protection, safety, environmental protection and other basic facilities and Slag disposal pit.

The following associated infrastructure is also envisaged:

- Access roads;
- Diesel storage tanks;
- Pipelines to Pollution Control Dams (PCDs);
- Berms to separate dirty/clean water;
- Temporary overburden stockpiles;
- Waste rock dumps;
- Topsoil storage dumps;
- Offices



The scale of the project is planned to the annual output of 125 000 to 1 000 000 tons, and 2 x 33,000 kVA semi-closed high carbon electric furnaces and their supporting facilities are built. The design shall include general, electric furnace smelting system, raw material system, pellet and roasting process, general transportation, power supply and distribution and electrical facilities (including 132kV transformer station), water supply and drainage system (water, turbidity circulating water system), including ventilation, dust removal, thermal and gas facilities, computer, telecommunications, mechanical repair, inspection, construction, structure, energy analysis and evaluation, environmental protection, occupational safety and health and fire protection, labour and training, project investment estimates, technical economy and evaluation.

Main facilities within the Project scope include:

- High-carbon ferrochrome production workshop
- Chromium furnace baking workshop (reserved)
- Raw materials, batching and feeding system
- Charcoal dry
- Furnace gas purification and dust removal system
- Dust removal system in the production area
- Compressed air preparation
- 132KV (power supply) substation and the capacitor compensation device
- Power supply and distribution, electrical control, automation
- instruments, telecommunications facilities
- Whole-plant control system
- Industrial TV monitoring system
- machine repair shop
- Electrode shell production workshop
- Water source is connected to the production plant purification
- water supply system
- Net ring water system
- Turbring water system



2. OBJECTIVES

The primary objective of the geotechnical investigation was to gather information on subsurface conditions at the site. The objectives can be stated as:

- Provide a description of the location geology of the proposed site;
- Define the ground conditions and classify the conditions through detailed soil profile descriptions and groundwater occurrences within the zone of influence of foundations;
- Identify potential geotechnical hazards;
- Comment upon any geotechnical constraints that may impact upon the design and construction of the proposed development (Dolomite area, etc.); and
- Provide the geotechnical basis for safe and appropriate land use planning, infrastructure, and housing unit design as well as formulation of precautionary measures and risk management procedures.

3. SITE DESCRIPTION

3.1. LOCALITY

The development sites (here after referred to as “the site”) is in Farm Dreyer 526 MS and Van Der Bijl 528 MS outside the Musina town. The sites are situated approximately 11.96 km East of Sand River, 67.78 km southeast of Mapungubwe National Park, and the site is bound to N1(west) and R525(north and south) and, respectively. The sites covers an area of approximately 400.64 ha and can be accessed via N1 and R525 road **Figure 1** show the site locality map. The central co-ordinates that can be used to locate the sites are:

Ferrochrome plant and water treatment plant: 22° 37' 36" S, 29° 52' 32" E

Industrial (ferrochrome reserved) area: 22° 38' 21" S, 29° 52' 27" E

Ferrochrome plant area: 22° 38' 3" S, 29° 53' 8" E



3.2. SITE DESCRIPTION

3.2.1. TOPOGRAPHY

Ferrochrome plant and water treatment plant: The peak on-site topographical elevation point recorded was 689 mamsl (meters above mean sea level) and the lowest point at 675 mamsl, with an elevation loss of 14 m over a lateral distance of ~680.35 m. The gradient of the site is 2.05%. The topography of the area is generally a gentle terrain. The topography on the site dips southeast.

Industrial (ferrochrome reserved) area: The peak on-site topographical elevation point recorded was 690 mamsl (meters above mean sea level) and the lowest point at 676 mamsl, with an elevation loss of 14 m over a lateral distance of ~1769.93 m. The gradient of the site is 0.79%. The topography of the area is generally a gentle terrain. The topography on the site dips northeast.

Ferrochrome plant area: The peak on-site topographical elevation point recorded was 684 mamsl (meters above mean sea level) and the lowest point at 673 mamsl, with an elevation loss of 11 m over a lateral distance of ~860.97 m. The gradient of the site is 1.27%. The topography of the area is generally a flat terrain. The topography on the site dips southeast.

3.2.2 LANDUSE, INFRASTRUCTURE AND SOIL COVER

The surface conditions were generally dry at the time of the investigation. Infrastructures encountered were herds of livestock, houses for farmers. Adjacent to the site there was N1 road on east and R525 road on north of the site, Baobab tollgate and Caltex garage at the intersection of N1 and R525.

3.3.3. CLIMATE

The climate at the site is characterized by local steppe climate. This location is classified as BSh by Köppen and Geiger. The mean temperature prevailing in is recorded as 22.9 °C, according to statistical data. Approximately 372 mm of rainfall occurs on a yearly basis.



The driest month is August, with approximately 2 mm of rain. The greatest amount of precipitation occurs in January, with an average of 82 mm. The temperatures are highest on average in December, at around 26.3 °C. The coldest month of the year is July with an average of around 17.1 °C.

3.3.4. DRAINAGE

The proposed site is in Limpopo Catchment Management Area, in Quaternary Catchment A71K. The Sand River is the significant water surface resources at which it bound the site on the north. This river flows from the northern side of the Soutpansberg mountains eastwards for about 200km before it joins the Limpopo River at the South Africa near the border of Zimbabwe. The streams are considered perennial.

The sites are drained by means by means of run-off, with storm water collection generally towards the northeastwards of the sites.



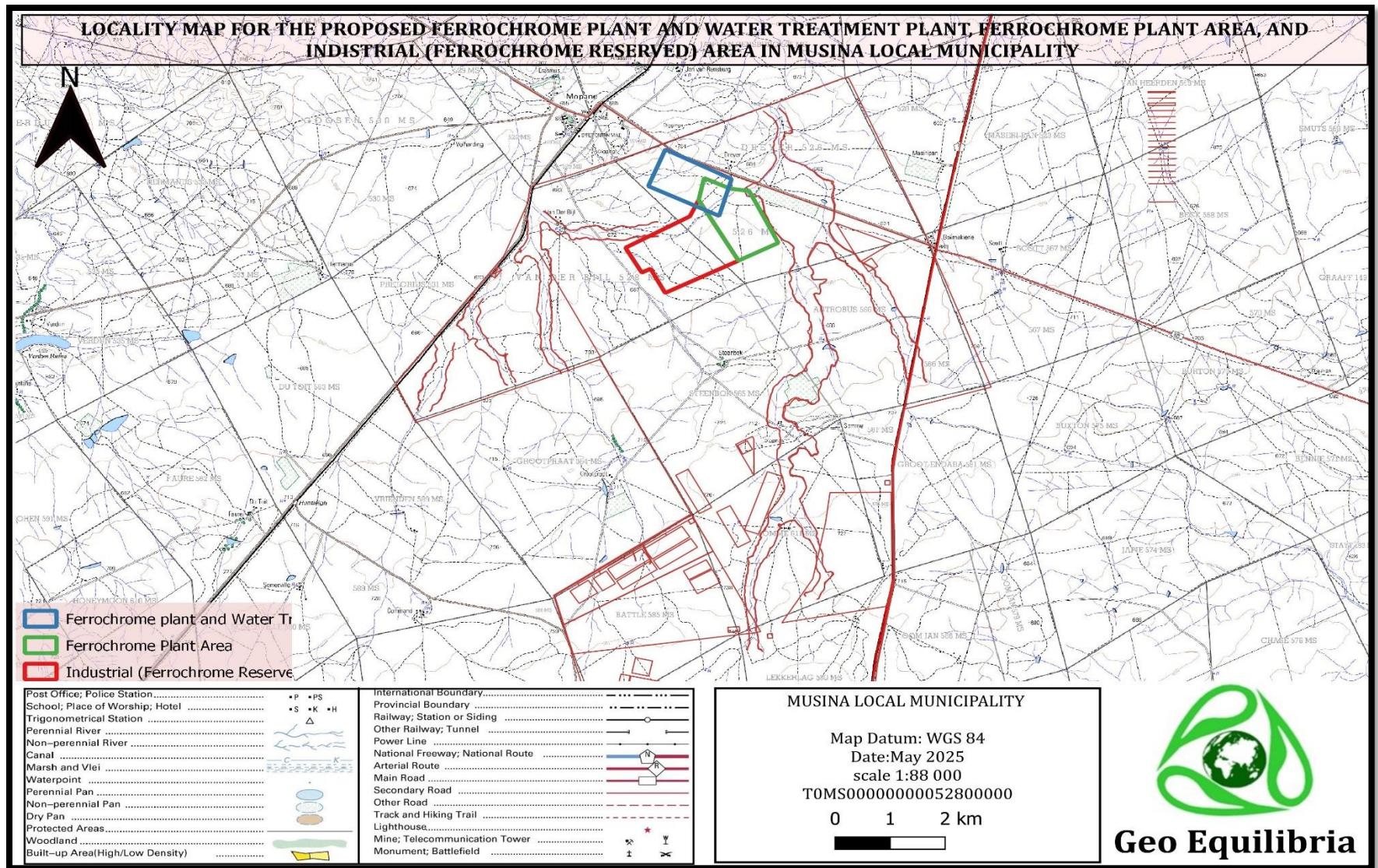


Figure 1: Locality Map.



4. METHOD OF INVESTIGATION

4.1. DESKTOP STUDY

Desk study included a study of published geological and topographic maps, aerial photographs, ortho-photographs, geo-hydrological maps, or any other relevant data from previous work on and around the site. The purpose of the desk study was to:

- Provide background information and technical guidance as well as to refine the scope of work for the follow-up geotechnical assessment; and
- Identify potential geotechnical significant features such as tension cracks, slope failures and bulging of faces to be confirmed during site walkover.

4.2. GEOTECHNICAL INVESTIGATION

A geotechnical investigation was conducted, during which geotechnical significant features across the site such as potential seepage zones, tension cracks and bulging of faces were recorded. This phase of investigation relied on intrusive investigation methods such as test pitting, in-situ testing to collect and provide interpretive information to make recommendations regarding foundation and structural design.

The geotechnical investigation was carried out on the 28th of March 2025, which involved the excavation of 32 test pits (TP1 to TP25) using a TLB from the ground surface to maximum depths of around 1.6 m below ground level or machine refusal.

The test pits were positioned on various sections of the area under investigation considering the anticipated ground conditions, existing land use and the proposed development. The test pits positions were recorded in the field using a handheld Global Positioning System (GPS) with an accuracy of 3 m, and their coordinates appear on the soil profile log that is included in **Appendix A** of this report. The test pits were profiled by a geologist according to standard practice to define ground conditions and groundwater occurrences within the zone of



influence of foundation work. **Figure 2** shows the position of the test pits and geotechnical zonation of the site.

4.3. LABORATORY TESTING

Laboratory testing forms an essential part of geotechnical investigation. Representative disturbed samples were randomly retrieved from soil horizons for examination, identification, and laboratory testing. The laboratory test results are discussed in **Section 7** of this report. All test pits were backfilled with the in-situ material immediately after profiling.



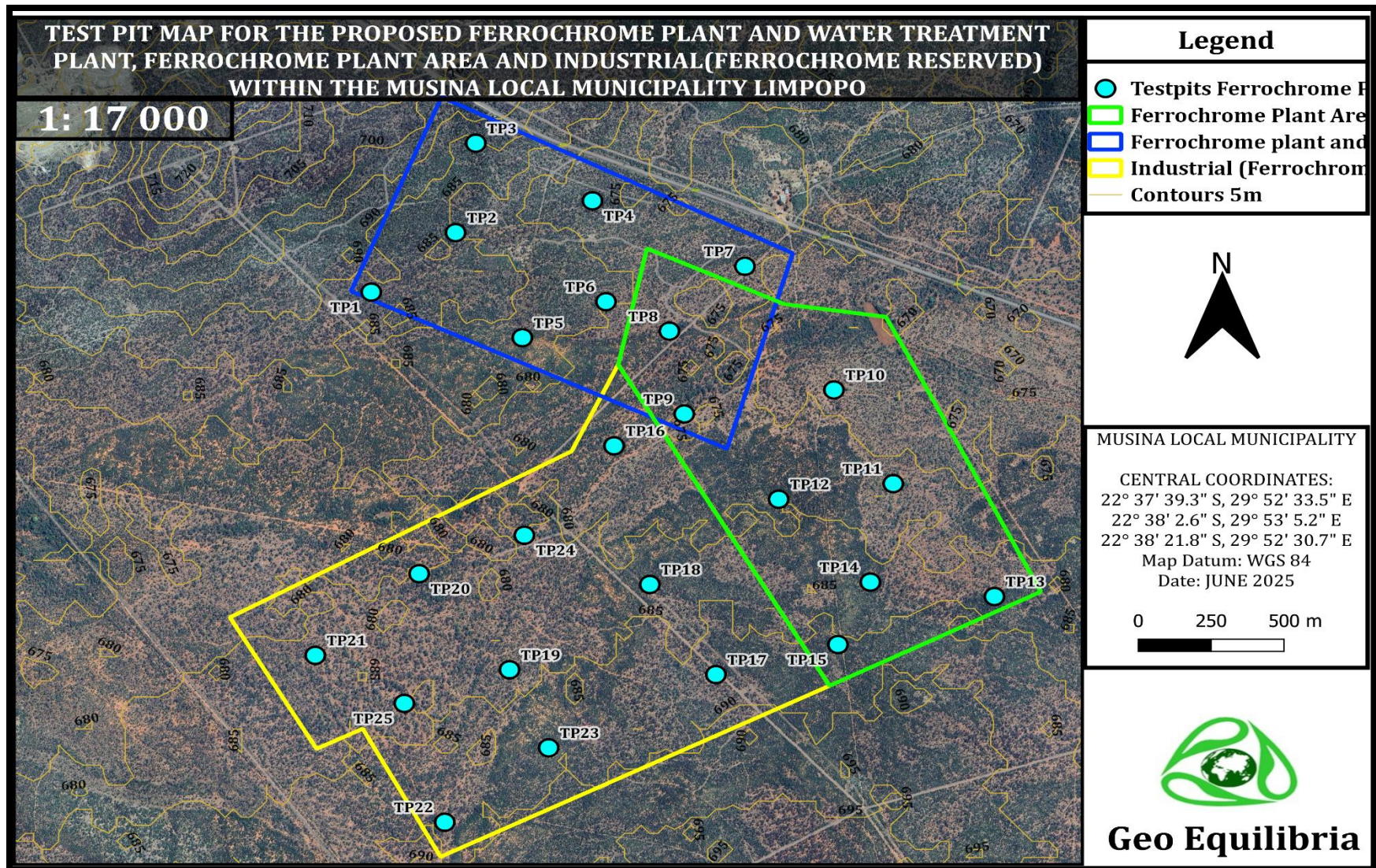


Figure 2 : Test Pit Positions



5. GEOLOGY

The study area is predominantly characterized by lithologies of Alluvium colluvium, Malala Drift Group, Gumbu Group and Undifferentiated Karoo Supergroup.

5.1. ALLUVIUM, COLLUVIUM

Alluvium is material deposited by rivers. It is usually most extensively developed in the lower part of the course of a river, forming floodplains and deltas, but may be deposited at any point where the river overflows its banks or where the velocity of a river is checked. Alluvium consists of silt, sand, clay, and gravel and often contains a good deal of organic matter. It, therefore, yields very fertile soils. In some regions, alluvial deposits contain gold, platinum, or gemstones, and tin ore (cassiterite).

Colluvium (transported soil) occurs at shallow depths across the site and comprises abundant gravel and cobbles in a silty sand matrix (Kipaji, 2023). Quartzite rock is highly resistant to weathering and produces shallow soil profiles from weathering with bedrock occurring at shallow depths. The weathering product of quartzite is generally a gravelly sand that increases in gravel content towards bedrock.

5.2. GUMBU GROUP

The Gumbu Group is of Beit-Bridge complex, of the Central Zone domain of Limpopo Belt (Bamford, 2021). It mainly comprises of metapelite, minor leucogneiss, calc-silicate rocks and marbles. The marbles range from medium to coarse grained rocks with variety of colors like white, grey, and attractive pink. The combined varieties include amphibole, sphene, microcline, scapolite, and quartz. The slight developments of calc-silicate are medium grained, greenish grey and well-banded.

Marble together with associated calc-silicate rocks constitutes of bulk of the group, apparently at the top of the Biet Bridge Complex. Minor intercalations include amphibolite, metaquartzite and garnetiferous leucocratic gneiss. The rocks of the Gumbu Group usually form positive topographic features, often covered by surface limestone.



5.3. UNDIFFERENTIATED KAROO SUPERGROUP

Undifferentiated Karoo Subgroup generally refers to rocks within the Karoo Supergroup in South Africa cannot be definitively assigned to a specific, recognized formation or group. The lithology found within the undifferentiated karoo are shale, mudstone, siltstone, basalt and minor tuff.

This site does not reflect any risk for the formation of the sinkholes or subsidence caused by the presence of the soluble rocks (dolomite or limestone), and no evidence of mining activity beneath the study area has been revealed. The lithologies present in the study area are illustrated in **Figure 3** below



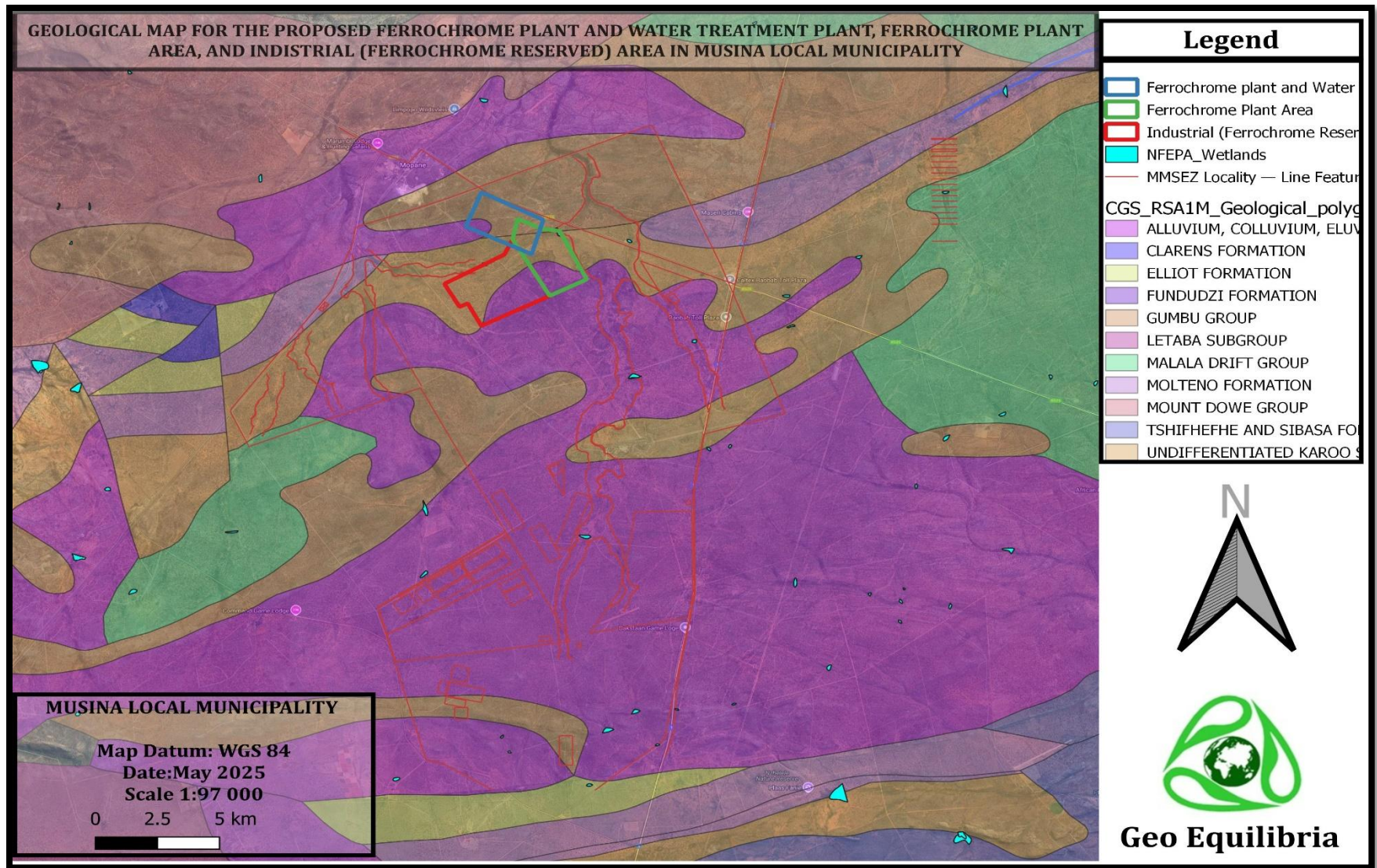


Figure 3: Regional Geological Map.



6. SOIL PROFILE

A brief description of the various soil horizons encountered during these investigations is given below with a summary in **Table 1**. Detailed test pits profiles are given in **Appendix A** of this report. The method involved in the soil profile is regarded as the MCCSSO which is the Moisture, Colour, Consistency, Structure, Soil Type and the Origin of the soil.

6.1 TOP COLLUVIUM WITH ABUNDANT ROOTLETS, SILTY SAND MATERIAL

A relatively thin layer that described as dry, brown, slightly medium dense to dense, the soil structures encountered was fissured and intact. The soil type was sand silty and silty gravel with a small amount of boulders, colluvium and hill-washed soil with abundant rootlets.

This layer ranged in depths between 0.0 m to 0.4 m as encountered in all this test pits excavated.

6.2 SILTY/ SAND GRAVEL WITH BOULDERS, COLLUVIUM

A relatively thin layer that was dark brown to orange brown, dense, silty/clayey gravel soil with boulders that was dry. The origin of the soil was colluvium. Some other part of the site was micro-shattered and others were intact.

This layer ranged in depths between 0.1 m to 0.9 m as encountered in all this test pits excavated.

6.3 SILTY/ SAND GRAVEL WITH BOULDERS OF RESIDUAL ROCK

With accordance to the MCCSSO, this layer described as dry to slightly moist, the soil colour range between dark yellowish orange, dusty red, and dark olive, dense to very dense, poorly graded silty gravel and clayey sand micro-shattered intact residual soils with boulders of parent rock.



This layer ranged in depths between 0.1 m to 1.6 m as encountered in all this test pits excavated.

Table 1: Summary of Test Pit Profile Logs.

TEST PIT NO.	TOTAL DEPTH (M)	THICKNESS OF LAYERS (M)			GROUND WATER SEEPAGE (M)	ZONE
		TRANSPORT ED SOILS	FILL	RESIDUAL SOILS /BEDROCK		
TP1	1.5	0 – 0.6	0.6 – 1.1	1.1 – 1.5	--	1
TP2	0.9	0 – 0.3	0.3 – 0.6	0.6 – 0.9	--	1
TP3	1.0	0 – 0.3	0.3 – 0.6	0.6 – 1.0	--	1
TP4	1.0	0 – 0.2	0.2 – 0.6	0.6 – 1.0	--	1
TP5	1.0	0 – 0.3	0.3 – 0.7	0.7 – 1.0	--	1
TP6	1.0	0 – 0.2	0.2 – 0.6	0.6 – 1.0	--	1
TP7	1.0	0 – 0.3	0.3 – 0.6	0.6 – 1.0	--	1
TP8	1.0	0 – 0.3	0.3 – 0.6	0.6 – 1.0	--	1
TP9	1.1	0 – 0.3	0.3 – 0.7	0.7 – 1.1	--	1
TP10	1.2	0 – 0.4	0.4 – 0.8	0.8 – 1.2	--	1
TP11	1.2	0 – 0.3	0.3 – 0.8	0.8 – 1.2	--	1
TP12	1.6	0 – 0.5	0.5 – 1.0	1.0 – 1.6	--	1
TP13	1.5	0 – 0.6	0.6 – 1.1	1.1 – 1.5	--	1
TP14	1.5	0 – 0.5	0.5 – 1.1	1.1 – 1.5	--	1
TP15	1.5	0 – 0.4	0.4 – 1.0	1.0 – 1.5	--	1
TP16	0.9	0 – 0.3	0.3 – 0.6	0.6 – 0.9	--	1
TP17	1.6	0 – 0.5	0.5 – 1.0	1.0 – 1.6	--	1
TP18	1.6	0 – 0.5	0.5 – 1.0	1.0 – 1.6	--	1



TP19	0.9	0 – 0.3	0.3 – 0.6	0.6 – 0.9	--	1
TP20	1.1	0 – 0.3	0.3 – 0.7	0.7 – 1.1	--	1
TP21	1.2	0 – 0.4	0.4 – 0.9	0.9 – 1.2	--	1
TP22	1.1	0 – 0.3	0.3 – 0.7	0.7 – 1.1	--	1
TP23	1.5	0 – 0.5	0.5 – 1.0	1.0 – 1.5	--	1
TP24	1.0	0 – 0.4	0.4 – 0.7	0.7 – 1.0	--	1
TP25	1.0	0 – 0.3	0.3 – 0.6	0.6 – 1.0	--	1

The soil profile composition and thickness were found to be highly consistent throughout the test pits.

EFFECTS ON THE PROPOSED SITE

Areas with shallow rock will generally be more favorable in terms of founding stability and areas with thicker soil cover will generally experience more soil movement, this is not expected. Soil consistency generally improves with depth and compressibility will decrease as depth increases; this will have a positive effect on foundations. Improvement of foundations and road subgrade will not be necessary.

6.4. GROUNDWATER

No groundwater seepage was observed in any of the pits excavated during the geotechnical investigation. The test pits were excavated in a dry season. The potential for perched water table conditions to develop, particularly after heavy or prolonged periods of precipitation must also not be discounted.



7. GEOTECHNICAL EVALUATION

7.1. LABORATORY TEST RESULTS

Laboratory tests were scheduled to confirm the on-site investigation, provide a more accurate classification, and to establish engineering parameters for the soils. A total of five (5) disturbed soil samples recovered from the test pits were subjected to laboratory testing (as per SANS 3001 test methods).

Testing was undertaken by a SANAS accredited material laboratory *Tzaneen Lab* in Tzaneen, Limpopo Province. The following tests were scheduled:

- Sieve analysis of soil sample to 0.075 mm,
- Atterberg Limits (Liquid Limit, Plastic Limit and Linear Shrinkage),
- Foundation indicators, and
- CBR (California Bearing Ratio).

Table 2 shows a summary of the Laboratory test results; detailed test results of the soil samples are included as **Appendix B** of this report. Detailed analysis has been carried out to facilitate appropriate design for earthworks and layer-works suitability, as well as foundation characteristics. The various tests and pertinent information from these tests are highlighted below.

7.1.1. FOUNDATION INDICATORS

The foundation indicator test results indicate that the silty coarse sandy soil on site has a high fine sand content of average 35%, followed by coarse sand averaging at 33.6%, and 25.2% of silty and 6.2% of clay; with a corresponding Grading Modulus averaging at 2.18 which is indicative of coarse-grained material, and the Potential for Expansiveness is very low according to Van Der Merwe's Activity Chart.

Fine grained soils (clays/silts) drain slowly and can be challenging to work with and compact in wet conditions. Clay soils may be also active, requiring improvement of foundations to stabilize heave. Sandy topsoil material with low fines content (less than 20 % passing the



0.075 mm sieve) can be useful as a source of designated fill material, at the preference of the engineer on site. Coarse grained soils (sand/gravel) drain faster and are not challenging working with and compact in wet conditions.

7.1.2. GRADING, ATTERBERG LIMITS AND POTENTIAL EXPANSIVENESS

Soil samples were taken from the test pits and subjected to full grading and Atterberg limit tests (Foundation Indicator Test) to characterize the soils and estimate potential expansivity. The results are shown in **Table 3** below.

The soils on the site are compressible and are potentially collapsible. There is insignificant variation in soil type having silty/sand gravel. There is insignificant clay content, therefore no major precautions to be adopted in the design of foundations catering for variation in the heave and settlement potential.

7.1.3. MOISTURE/DENSITY RELATIONSHIP AND CBR

Samples of near surface soils were collected for CBR, Mod. AASHTO density and Road Indicator tests to determine the subgrade quality and the suitability of the material as a potential natural construction material. The test results are provided in **Table 3**. The tests indicate that the near-surface soils are typically G6, G7 & G8 quality due to the natural gravel and natural sandy soil respectively.

Road subgrade will not require improvement in the form of an imported selected subgrade layer SSG because the site is comprised of G6, G7 and G8 quality. No road layer works will have to be imported as there are good quality near-surface soils on the surface.

7.1.4. HEAVE/SWELL

Laboratory test results indicate very low potential for expansion in samples taken from two layers. The maximum plasticity index (PI) ranges from 6% to 10% whereas test pit 15 results show no plasticity index. Furthermore, the thickness of the potentially expansive horizons (i.e., the clay contents) is very low.



Table 2 : Summary of Laboratory Results

TEST POSITION	MATERIAL DESCRIPTION	ATTERBERG LIMITS			GRADING				GM	PERFORMANCE AS WEARING COURSE	CLASSIFICATION		EXPANSIVENESS
		LL	PI	LS	CLAY	SILT	FINE SAND	COARSE SAND			AASHTO	UNIFIED	
TP10	Dark Brown Silty Clayey Gravel	21	7	3.24	7	26	39	28	2.22	REVEALS AND CORRUGATES	A-2-4 (0)	GM-GC	LOW
TP15	Dusty Red poorly graded Silty Gravel	-	SP	1.33	7	16	40	37	2.32	RAVELS AND CORRUGATES	A-1-a (0)	GP-GM	LOW
TP18	Dark Yellowish Orange Clayey Sand	31	10	5.21	5	37	24	34	2.14	GOOD	A-2-6 (0)	SC	LOW
TP26	Dark Olive poorly-graded Silty Gravel	32	8	4.06	24	25	41	30	2.26	GOOD	A-2-4 (0)	GP-GM	LOW



Table 3: Summary of Compaction Characteristics and CBR Results.

TP ID.	DEPTH (M)	DESCRIPTION	GM	OMC (%)	MDD (KG/M3)	CBR AT MOD. AASHTO COMPACTION EFFORT						SWELL @ 100% COMPACTION
						90%	93%	95%	97%	98%	100%	
TP10 S2	0.15-0.6	Dark Brown Silty/Clayey Gravel	2.22	6.5	2196	9	12	15	19	21	26	0.03
TP15 S3	0.7-0.9	Dusty Red poorly-graded Silty Gravel	2.32	4.3	2200	24	37	49	65	75	100	0.02
TP18 S3	1.4-1.6	Dark Yellowish Orange Clayey Sand	2.14	10.6	1973	15	22	29	37	42	54	0.08
TP26 S3	0.9-1.4	Dark Olive poorly-graded Sivel	2.26	12.1	1915	12	17	23	30	34	44	0.09

*ABBREVIATION			
MDD	Maximum Dry Density (kg/m3)	GM	Grading Modulus
UCS	Unconfined Compressive Strength (MPa)	PE	Potential Expansiveness
OMC	Optimum moisture Content (%)	SC	Clayey silty sand with gravel
PI	Plasticity Index	SM	Silty sand with gravel
LL	Liquid Limit	NP	Non-Plastic
LS	Linear Shrinkage	CBR	California Bearing Ratio
UCS	Unconfined Compressive Strength (MPa)	PE	Potential Expansiveness



7.2. BEARING CAPACITY

The grading modulus of the samples (TP1 to TP32) were between 2.14 and 2.26. The soil is subsequently classified as <G6, G7 and G8 quality material according to TRH14. Laboratory tests showed that fill material had a dry density ranging between 1915 to 2236 Kg/m³.

The site is comprised of two kinds of soils the sandy silty clay and silty sandy gravel. According to the Soil bearing capacity chart by Anderson (2013), the soils were classified according to the types of soils and the bearing capacity. The allowance bearing capacity exhibited on the firm sandy gravel was said to be able to hold 3.0 s/f tons, PSF 6000 (827 KPA) and PSI 42 (288 kPa) whereas the silty gravel soils could exhibit 2.25 s/f tons, 4500 PSF (216 KPA) and 31 PSI (213 kPa).

Based on the results of the field and laboratory testing, the silty gravel and sandy gravel fill material on site has been allocated an allowable bearing capacity of 288 kPa and 213 kPa.

7.3. EXCAVABILITY AND SIDEWALL STABILITY

Excavability is defined as the ease with which the ground can be dug. This is important for developments as increased costs are associated with installing services or foundations in areas where difficulty is experienced with excavation. In terms of SABS 1200D, intermediate excavation conditions are anticipated from the surface to depths of about 1.6 m and hard excavation below this depth. It was noted that excavation was possible with a TLB to that extent, Excavability problems are foreseen from below 1.6m as there was refusal encountered. Refusal was encountered throughout the site, therefore, excavation to be done by a TLB up to 1.6 m below ground level. Test pits sidewalls were found to be stable throughout the site.

7.4. SLOPE STABILITY AND TOPOGRAPHY

This refers to an area comprising unstable geological materials that can move either gradually (creep) or suddenly as a slump or slide. The risk of movement is determined by



factors such as the nature of the slope, gradient, role of water, type and nature of vegetation covered, seismicity and impact of human activities.

The probability of landslides and mudslides occurring at this area are rare. This is primarily due to the low climatic conditions and composition of residual and transported materials in this area. The proposed site to be developed is located on nearly level terrain which drains northwards of the site. The slope gradient is considered suitable due to the nearly level gradient.

7.5. EROSION

The erosion of soils is a function of the resistance of slope materials to entrainment and transport, and the potential of slope processes that promotes erosion. The resistance of soils to erosion is also related to the mechanical strength, cohesion, and particle size of the material. The site should be covered with growing grass to act as an excellent way to control erosion. The natural slope gradients area, dipping northeast and southeast.

7.6. DRAINAGE

Adequate drainage is an important factor in the promotion of a stable site. Drainage should be such that any rainfall is diverted to the nearest storm water drainage system. Both surface and subsurface drainage should be constructed such that no water ingress into the subsurface soils in and around the foundation base is possible.

The general soil profile has a low permeability, and the site has a gentle topography and therefore a high percentage of rainfall will end up as run-off. Effective storm water systems will be required to accommodate minor flood events (flood events recurring every 1 to 5 years). Drainage will be required at the north end boundary of the site.

It is recommended that the installation of underground services and surface drainage is undertaken in accordance with SANS 1200 LF-1983 or COLTO 2000 specifications.



7.7. SITE STABILITY

The site does not classify as dolomite land and no instability caused by dolomite will therefore occur. The impact of the geotechnical constraints on development may be evaluated according to **Table 5** below, which is a summary of the general geotechnical constraints relevant to developments (Partridge, Wood, and Brink, 1993).

Table 4: Urban Development Zone Descriptions.

	CONSTRAINT	CLASS 1 (Most favourable)	CLASS 2 (Intermediate)	CLASS 3 (Least favourable)
A	Collapsible Soil	<i>Surface collapsible horizon <750 mm thick</i>	Collapsible horizon >750 mm thick	---
B	Seepage	<i>Water table permanently deeper than 1.5 m below surface</i>	Permanent or seasonal water table within 1.5 m of surface	Swamp and marshes
C	Active Soil	<i><2.5 mm differential movement expected</i>	2.5-15 mm differential movement	<i>>15 mm differential movement expected</i>
D	Highly Compressible Soil	<2.5 mm differential movement expected	<i>2.5 - 15 mm differential movement</i>	>15 mm differential movement expected
E	Erodible Soil	Low	<i>Moderately dispersive soils, fissured clay, thick colluvium,</i>	Highly dispersive soil, fissured clay, thick colluvium
F	Difficulty Of Excavation To 1.5 m Depth	<10% rock or hardpan pedocretes	<i>10-50% rock or hardpan pedocretes</i>	>50% rock or hardpan pedocretes
G	Undermined Ground	<i>where depth to undermining is >100m in reasonably competent rock</i>	Old, undermined areas where stope closure has ceased	Where the depth to undermining is <100m
H	Instability In Areas Of Soluble Rock	<i>Stable</i>	Possibly unstable	Probably unstable
I	Steep Slopes	<i>Slope <6%</i>	Slope 6-15%	Slope >15%
J	Areas Of Unstable Natural Slopes	<i>Low risk</i>	Intermediate risk	High risk
K	Areas Subject To Seismic Activity	<i>100-year max probability of <5 Mod Mercalli intensity</i>	100-year max probability of 5-8 Mod Mercalli intensity	100-year maximum probability of >8 Mod Mercalli intensity



L	Areas Subject To Flooding	---	Areas above 1:50 year flood line but with slope <1%	<i>Areas below 1:50 year flood line</i>
---	---------------------------	-----	---	---

7.8. SITE CLASSIFICATION AND FOUNDATION RECOMMENDATIONS

The proposed residential site requires the construction of sound foundations to limit settlements. Based on the material characteristics and the typical soil profiles, the site falls under two geotechnical zone that classifies for Residential Site Class Designations according to NHBRC GFHS-2 document as C1. The results of this classification are dealt with in the subsequent paragraphs. **Figure 4** Shows the Geotechnical Zonation map.

The structural engineer should determine the best economical foundation preference for the proposed development based on the type of development based on the different available construction methods.

7.8.1. ZONE 1 (NHBRC SITE CLASS DESIGNATION: C1)

The following foundation options as defined by the GFHS-2 are recommended for masonry house structures to be erected at Zone 1:

- Modified Normal
- Compaction of in-situ soils below individual footings
- Deep Strip foundations; and
- Soil raft.

7.9. SPECIAL PRECAUTIONARY MEASURES

There is no special geotechnical engineering measures envisaged for this site.



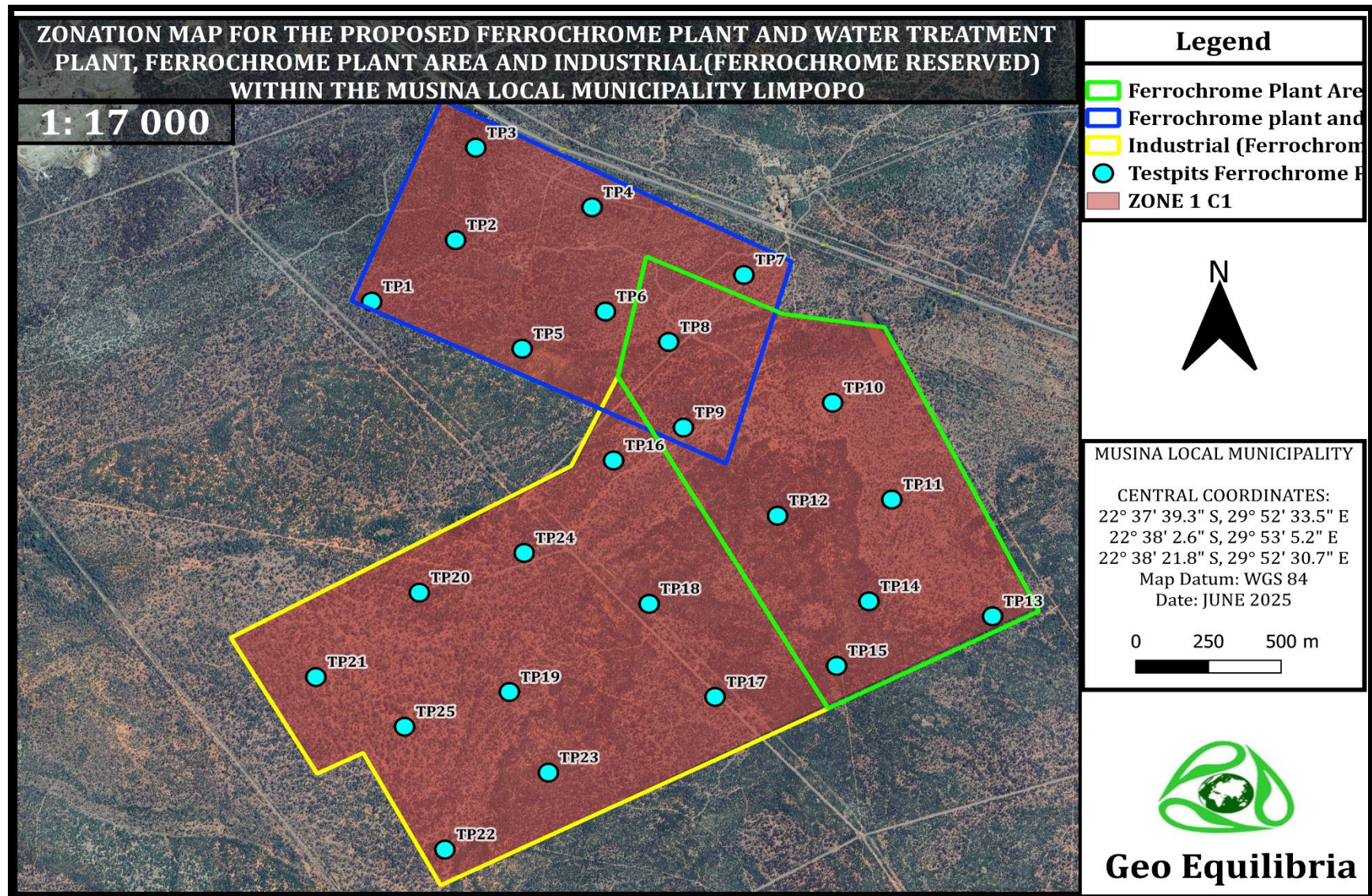


Figure 4 : Geotechnical Zonation Map.



8. CONCLUSIONS

Geo Equilibria (Pty) Ltd was appointed by Gudani consulting Pty Ltd on behalf of Kinetic Development Group and Alloy Metallurgical Base (Pty) Ltd in March 2025 to conduct a geotechnical investigation for the proposed ferroalloys/ferrochrome smelter plant that will be within the existing and approved Musina-Makhado Special Economic Zone (MMSEZ) ferrochrome plant and water treatment plant, industrial (ferrochrome reserved) area, and ferrochrome plant area at Musina on farm Dreyer 526 MS and Van Der Bijl 528 MS within Musina local municipality, of Vhembe district in Limpopo Province.

This geotechnical investigation aimed to identify potential hazards for the development, determine the ground conditions at the site to provide the recommendations for safe and appropriate design. The major geological formation underlain the area is Alluvium colluvium, Undifferentiated Karoo Supergroup and Gumbu Group.

In terms of SABS 1200D, intermediate excavation conditions are anticipated from the surface to depths of about 1.6m. It was noted that excavation was possible with a TLB to that extent, Excavability problems are foreseen from below 1.6 m as there was refusal encountered. Based on the material characteristics and the typical soil profiles, the site falls under two geotechnical zone that classifies for Residential Site Class Designations according to NHBRC GFSH-2 document as C1. The characteristic of founding materials is Compressible and Potentially Collapsible soils.

It is recommended that the structural engineer determine the best economical foundation preference for the proposed development based on the type of development based on the different available construction methods. Conditions prevailing at the site suggest that no problems are foreseen for the development of the proposed structures, provided the recommendations outlined in the report are adhered to.

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 elsewhere on the property. In terms of the geotechnical information gained from the investigation, the site is suitable for the proposed development.



REFERENCES

1. Brink, A.B.A. (1979). Engineering Geology of Southern Africa, Volume 1. Building Publications, and Pretoria.
2. COLTO. (1998). Standard Specification for Road and Bridge Works for State Road Authorities.
3. Generic Specification GFSH-2 (September 2002) of the National Department of Housing.
4. Jennings, J.E., Brink, A.B.A. and Williams, A.A.B. (1973). Revised Guide to Soil Profiling for Civil Engineering Purposes in Southern Africa. Transactions of the South African Institution of Civil Engineers, Vol. 15.
5. Robb, L. J., Brandl, G., Anhaeusser, C. R. and Poujol, M. (2006). Archaean Granitoid Intrusions. In: Johnson, M. R., Annhaeusser, C. R. and Thomas, R. J. (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg/ Council for Geoscience, Pretoria:57-94.
6. SANS 1200 LF-1983.
7. The South African Institute of Engineering Geologists (1996). Guidelines for Soil and Rock Logging.
8. Weinert, H. (1965). A climatic index of weathering. Geotechniques, Vol. 24, No. 4, pp. 475-488.



LIMITATIONS

Geo-Equilibria's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Reports are a geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore consider the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

The assessment and interpretation of the geotechnical information and the design of structures and services and the management of risk is the responsibility of the appointed Engineer.

The recommendations contained herein are not intended to dictate construction methods or sequences. They are furnished to help designers identify potential construction problems related to foundation and earth plans and specifications. Recommendations may also be useful to personnel who observe construction activity.

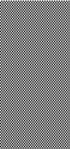
Potential contractors for the project must evaluate potential construction problems based on their review of the contract documents, their own knowledge of and experience in the local area, and based on similar projects in other localities, considering their own proposed methods and procedures.

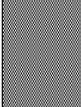


APPENDICES



APPENDIX A: TEST PIT PROFILES

PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 1	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 37' 41.6" S, 29° 52' 9.6" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Reddish brown, silty clay, intact, loose, colluvium soils with grass rootlets				NOTES:
0.2						No water table was encountered
0.3						
0.4						
0.5						
0.6						
0.7		Orange brown slightly moist, loose, intact, colluvium sandy gravelly soil				Refusal on material
0.8						
0.9						
1						
1.1		Orange yellow, slightly moist, micro-shattered, sandy gravel, medium dense to dense, residual soil				
1.2						
1.3						
1.4						
1.5		REFUSAL				

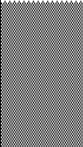
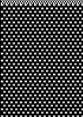
PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 2	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 37' 34.2" S, 29° 52' 19.7" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Dry brown, silty gravel with boulders, intact, dense, colluvium soil with grass rootlets				NOTES:
0.2						No water table was encountered
0.3						
0.4		Dry, very dense, brown silty gravel with boulders, intact, residual soil				Refusal on material
0.5						
0.6						
0.7		Dry, very dense, dark brown, silty sandy with pebbles and boulders, intact, residual soil				
0.8						
0.9						
		REFUSAL				



PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 3	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 37' 23.0" S, 29° 52' 22.1" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
  	0.1		Dry brown, silty gravel with boulders, intact, dense, colluvium soil with grass rootlets			NOTES:
	0.2					No water table was encountered
	0.3		Dry, very dense, brown silty gravel with boulders, intact, residual soil			
	0.4					
	0.5		Dry, very dense, dark brown, silty sandy with pebbles and boulders, intact, residual soil			
	0.6					
	0.7					
	0.8					
	0.9					
	1					
		REFUSAL				

PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 4	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 37' 30.2" S, 29° 52' 36.2" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Dry brown, silty gravel with boulders, intact, dense, colluvium soil with grass rootlets				NOTES:
0.2						
0.3		Dry, very dense, brown silty gravel with boulders, intact, residual soil				No water table was encountered
0.4						
0.5						
0.6						
0.7		Dry, very dense, dark brown, silty sandy with pebbles and boulders, intact, residual soil				Refusal on material
0.8						
0.9						
1						
		REFUSAL				



PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 5	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 37' 47.3" S, 29° 52' 27.7" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Dry brown, silty gravel with boulders, intact, dense, colluvium soil with grass rootlets				NOTES:
0.2						
0.3						
0.4		Dry, very dense, brown silty gravel with boulders, intact, residual soil				No water table was encountered
0.5						
0.6						
0.7						
0.8		Dry, very dense, dark brown, silty sandy with pebbles and boulders, intact, residual soil				
0.9						
1						
		REFUSAL				

PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 6	DATE	28-Mar-25	
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria	
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 37' 42.8" S, 29° 52' 37.8" E			
CONSULTANT:	Geo Equilibria		MACHINE:	TLB			
Depth (m)	Legend	SOIL PROFILE				Sample	
	0.1	Dry brown, silty gravel with boulders, intact, dense, colluvium soil with grass rootlets				NOTES:	
	0.2						
	0.3						
	0.4	Dry, very dense, brown silty gravel with boulders, intact, residual soil				No water table was encountered	
	0.5						
	0.6						
	0.7						
	0.8	Dry, very dense, dark brown, silty sandy with pebbles and boulders, intact, residual soil				Refusal on material	
	0.9						
	1						
		REFUSAL					

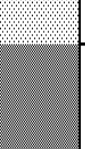
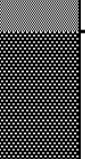


PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 7	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 37' 38.4" S, 29° 52' 54.5" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Dry brown, silty gravel with boulders, intact, dense, colluvium soil with grass rootlets				NOTES:
0.2						
0.3						
0.4		Dry, very dense, brown silty gravel with boulders, intact, residual soil				No water table was encountered
0.5						
0.6						
0.7		Dry, very dense, dark brown, silty sandy with pebbles and boulders, intact, residual soil				Refusal on material
0.8						
0.9						
1		REFUSAL				

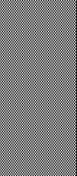
PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 8	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 37' 46.4" S, 29° 52' 45.4" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Dry brown, silty gravel with boulders, intact, dense, colluvium soil with grass rootlets				NOTES:
0.2						
0.3						
0.4		Dry, very dense, brown silty gravel with boulders, intact, residual soil				No water table was encountered
0.5						
0.6						
0.7		Dry, very dense, dark brown, silty sandy with pebbles and boulders, intact, residual soil				Refusal on material
0.8						
0.9						
1		REFUSAL				



PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 9	DATE	28-Mar-25	
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria	
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 37' 56.8" S, 29° 52' 47.2" E			
CONSULTANT:	Geo Equilibria		MACHINE:	TLB			
Depth (m)	Legend	SOIL PROFILE				Sample	
✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	0.1		Brown, silty gravel, intact, dense, dry, colluvium soil				NOTES:
	0.2						
	0.3						
	0.4		Dark brown silty clayey gravel with pebbles, dry, intact, dense. Residual soils.				No water table was encountered
	0.5						
	0.6						
	0.7						Refusal on material
	0.8		Dry, Dark brown silty sand with quartzite rounded pebbles, intact, with quartz dense. Residual Rock.				
	0.9						
	1						
	1.1						
			REFUSAL				

PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 10	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 37' 53.8" S, 29° 53' 5.2" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Brown, silty gravel, intact, dense, dry , colluvium soil				NOTES:
0.2						
0.3						
0.4		Dark brown silty clayey gravel with pebbles, dry, intact, dense. Residual soils.				No water table was encountered
0.5						
0.6						
0.7						
0.8		Dry, Dark brown silty sand with quartzite rounded pebbles, intact, with quartz dense. Residual Rock.				Refusal on material
0.9						
1						
1.1						
1.2		REFUSAL				



PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 11	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 38' 5.4" S, 29° 53' 12.3" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Brown, silty gravel, intact, dense, dry , colluvium soil				NOTES:
0.2						
0.3						
0.4		Dark brown silty clayey gravel with pebbles, dry, intact, dense. Residual soils.				No water table was encountered
0.5						
0.6						
0.7						
0.8						
0.9		Dry, Dark brown silty sand with quartzite rounded pebbles, intact, with quartz dense. Residual Rock.				Refusal on material
1						
1.1						
1.2						
		REFUSAL				

PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 12	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 38' 7.4" S, 29° 52' 58.5" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Reddish brown, silty clay, intact, loose, colluvium soils with grass rootlets				NOTES:
0.2						
0.3						
0.4						
0.5						No water table was encountered
0.6		Orange brown slightly moist, loose, intact, colluvium sandy gravelly soil				
0.7						
0.8						
0.9						Refusal on material
1						
1.1		Orange yellow, slightly moist, micro-shattered, sandy gravel, medium dense to dense, residual soil				
1.2						
1.3						
1.4						
1.5						
1.6						
		REFUSAL				

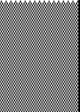


PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 13	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 38' 19.5" S, 29° 53' 24.5" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Reddish brown, silty clay, intact, loose, colluvium soil with grass rootlets				NOTES:
0.2						
0.3						
0.4						
0.5						No water table was encountered
0.6		Orange brown slightly moist, loose, intact, colluvium sandy gravelly soil				
0.7						
0.8						Refusal on material
0.9						
1.0						
1.1		Orange yellow, slightly moist, micro-shattered, sandy gravel, medium dense to dense, residual soil				
1.2						
1.3						
1.4						
1.5						
		REFUSAL				

PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 14	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 38' 17.7" S, 29° 53' 9.5" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Reddish brown, silty clay, intact, loose, colluvium soils with grass rootlets				NOTES:
0.2						
0.3						
0.4						
0.5						No water table was encountered
0.6		Orange brown slightly moist, loose, intact, colluvium sandy gravelly soil				
0.7						
0.8						Refusal on material
0.9						
1						
1.1		Orange yellow, slightly moist, micro-shattered, sandy gravel, medium dense to dense, residual soil				
1.2						
1.3						
1.4						
1.5						
		REFUSAL				

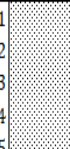
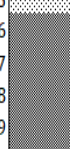
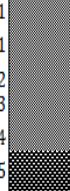


PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 15	DATE	28-Mar-25	
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria	
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 38' 25.5" S, 29° 53' 5.7" E			
CONSULTANT:	Geo Equilibria		MACHINE:	TLB			
Depth (m)	Legend	SOIL PROFILE				Sample	
✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	0.1		Reddish brown, silty clay, intact, loose, colluvium soils with grass rootlets				NOTES:
	0.2						No water table was encountered
	0.3						
	0.4						
	0.5		Orange brown slightly moist, loose, intact, colluvium sandy gravelly soil				
	0.6						
	0.7						
	0.8						Refusal on material
	0.9						
	1		Orange yellow, slightly moist, micro-shattered, sandy gravel, medium dense to dense, residual soil				
	1.1						
	1.2						
	1.3						
	1.4						
	1.5						
		REFUSAL					

PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 16	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 38' 25.5" S, 29° 53' 5.7" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Brown, silty gravel, intact, dense, dry , colluvium soil				NOTES:
0.2						
0.3						
0.4		Dark brown silty clayey gravel with pebbles, dry, intact, dense. Residual soils.				No water table was encountered
0.5						
0.6						
0.7		Dry, Dark brown silty sand with quartzite rounded pebbles, intact, with quartz dense. Residual Rock.				Refusal on material
0.8						
0.9						
		REFUSAL				

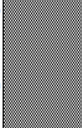
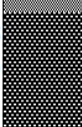


PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 17	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 38' 29.2" S, 29° 52' 51.0" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Reddish brown, silty clay, intact, loose, colluvium soils with grass rootlets				NOTES:
0.2						
0.3						
0.4						
0.5						
0.6		Orange brown slightly moist, loose, intact, colluvium sandy gravelly soil				No water table was encountered
0.7						
0.8						
0.9						
1.0						Refusal on material
1.1		Orange yellow, slightly moist, micro-shattered, sandy gravel, medium dense to dense, residual soil				
1.2						
1.3						
1.4						
1.5						
1.6						

PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 18	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 38' 18.0" S, 29° 52' 43.0" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Reddish brown, silty clay, intact, loose, colluvium soils with grass rootlets				NOTES:
0.2						
0.3						
0.4						
0.5						
0.6		Orange brown slightly moist, loose, intact, colluvium sandy gravelly soil				No water table was encountered
0.7						
0.8						
0.9						
1.0						
1.1		Orange yellow, slightly moist, micro-shattered, sandy gravel, medium dense to dense, residual soil				
1.2						
1.3						
1.4						
1.5						
1.6		REFUSAL				



PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)	TEST PIT	TP 19	DATE	28-Mar-25
SITE:	Musina Local Municipality	LOGGED BY:	Mufamadi M		Geo Equilibria
CLIENT:	Gudani Environmental Consulting	COORDINATES:	22° 38' 28.6" S, 29° 52' 26.2" E		
CONSULTANT:	Geo Equilibria	MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE			Sample
0.1		Brown, silty gravel, intact, dense, dry , colluvium soil			NOTES:
0.2					
0.3					
0.4		Dark brown silty clayey gravel with pebbles, dry, intact, dense. Residual soils.			No water table was encountered
0.5					
0.6					
0.7		Dry, Dark brown silty sand with quartzite rounded pebbles, intact, with quartz dense. Residual Rock.			Refusal on material
0.8					
0.9					
		REFUSAL			

PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)	TEST PIT	TP 20	DATE	28-Mar-25
SITE:	Musina Local Municipality	LOGGED BY:	Mufamadi M	Geo Equilibria	
CLIENT:	Gudani Environmental Consulting	COORDINATES:	22° 38' 16.7" S, 29° 52' 15.3"		
CONSULTANT:	Geo Equilibria	MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE			Sample
0.1		Brown, silty gravel, intact, dense, dry , colluvium soil			NOTES:
0.2					
0.3					
0.4		Dark brown silty clayey gravel with pebbles, dry, intact, dense. Residual soils.			No water table was encountered
0.5					
0.6					
0.7		Dry, Dark brown silty sand with quartzite rounded pebbles, intact, with quartz dense. Residual Rock.			Refusal on material
0.8					
0.9					
1		REFUSAL			
1.1					

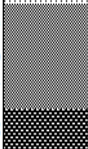


PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 21	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 38' 26.8" S, 29° 52' 2.8" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Brown, silty gravel, intact, dense, dry , colluvium soil				NOTES:
0.2						
0.3						
0.4						
0.5		Dark brown silty clayey gravel with pebbles, dry, intact, dense. Residual soils.				No water table was encountered
0.6						
0.7						
0.8						
0.9		Dry, Dark brown silty sand with quartzite rounded pebbles, intact, with quartz dense. Residual Rock.				Refusal on material
1.0						
1.1						
1.2						
		REFUSAL				

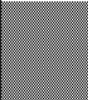
PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)	TEST PIT	TP 22	DATE	28-Mar-25
SITE:	Musina Local Municipality	LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting	COORDINATES:	22° 38' 47.6" S, 29° 52' 18.4" E		
CONSULTANT:	Geo Equilibria	MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE			Sample
0.1		Brown, silty gravel, intact, dense, dry , colluvium soil			NOTES:
0.2					No water table was encountered
0.3					
0.4		Dark brown silty clayey gravel with pebbles, dry, intact, dense. Residual soils.			Refusal on material
0.5					
0.6					
0.7					
0.8		Dry, Dark brown silty sand with quartzite rounded pebbles, intact, with quartz dense. Residual Rock.			
0.9					
1.0					
1.1					
		REFUSAL			



PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 23	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 38' 38.4" S, 29° 52' 30.9" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Reddish brown, silty clay, intact, loose, colluvium soils with grass rootlets				NOTES:
0.2						
0.3						
0.4						
0.5						
0.6		Orange brown slightly moist, loose, intact, colluvium sandy gravelly soil				No water table was encountered
0.7						
0.8						
0.9						
1.0						
1.1		Orange yellow, slightly moist, micro-shattered, sandy gravel, medium dense to dense, residual soil				Refusal on material
1.2						
1.3						
1.4						
1.5						
		REFUSAL				

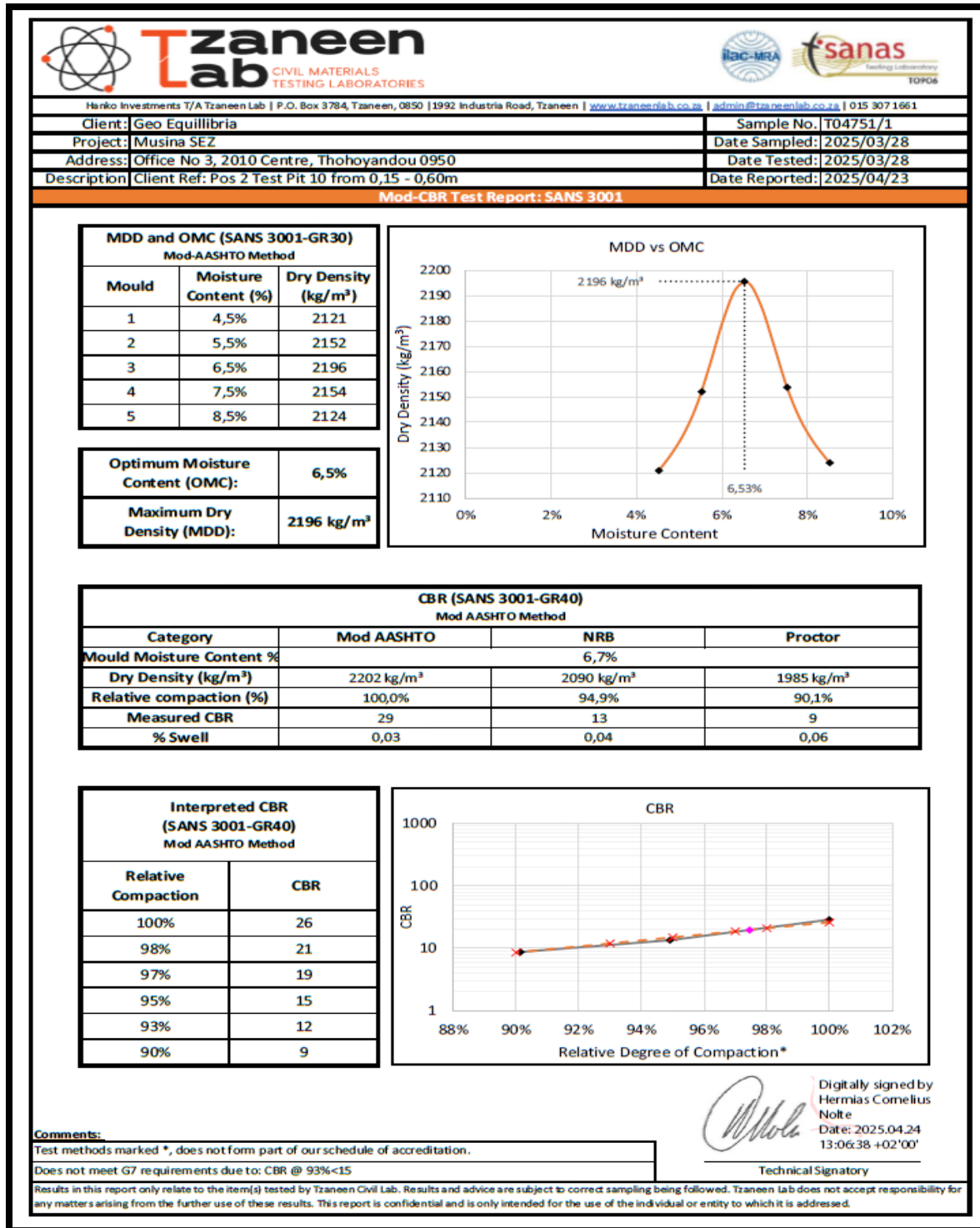
PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 24	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria 
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 38' 11.9" S, 29° 52' 28.0" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Brown, silty gravel, intact, dense, dry, colluvium soil				NOTES:
0.2						
0.3						
0.4						
0.5						
0.6		Dark brown silty clayey gravel with pebbles, dry, intact, dense. Residual soils.				No water table was encountered
0.7						
0.8						
0.9						
1						
		Dry, Dark brown silty sand with quartzite rounded pebbles, intact, with quartz dense. Residual Rock.				Refusal on material
		REFUSAL				



PROJECT:	Ferrochrome Plant Area and Water treatment plant, Industrial (Ferrochrome Reserved)		TEST PIT	TP 25	DATE	28-Mar-25
SITE:	Musina Local Municipality		LOGGED BY:	Mufamadi M		Geo Equilibria
CLIENT:	Gudani Environmental Consulting		COORDINATES:	22° 38' 32.8" S, 29° 52' 13.5" E		
CONSULTANT:	Geo Equilibria		MACHINE:	TLB		
Depth (m)	Legend	SOIL PROFILE				Sample
0.1		Brown, silty gravel, intact, dense, dry, colluvium soil				NOTES:
0.2						
0.3						
0.4		Dark brown silty clayey gravel with pebbles, dry, intact, dense. Residual soils.				No water table was encountered
0.5						
0.6						
0.7		Dry, Dark brown silty sand with quartzite rounded pebbles, intact, with quartz dense. Residual Rock.				Refusal on material
0.8						
0.9						
1.0						
		REFUSAL				



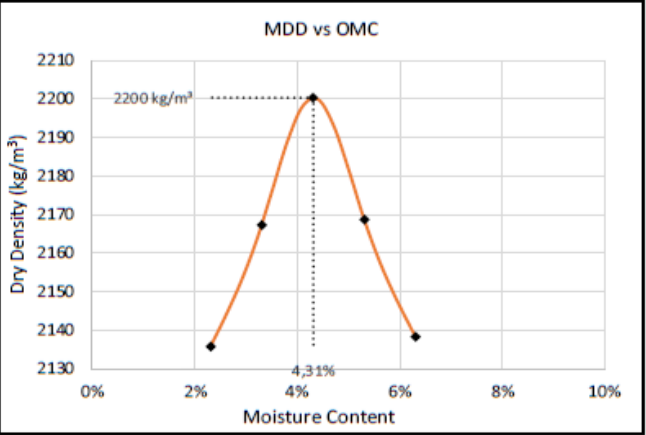
APPENDIX B: LABORATORY TEST RESULTS



 Tzaneen Lab CIVIL MATERIALS TESTING LABORATORIES		 
Hanco Investments T/A Tzaneen Lab P.O. Box 3784, Tzaneen, 0850 1992 Industria Road, Tzaneen www.tzaneenlab.co.za admin@tzaneenlab.co.za 015 307 1661		
Client: Geo Equilibria	Sample No.: T04751/2	
Project: Musina SEZ	Date Sampled: 2025/03/28	
Address: Office No 3, 2010 Centre, Thohoyandou 0950	Date Tested: 2025/03/28	
Description: Client Ref: Pos 3 Test Pit 15 from 0,7 - 0,9m	Date Reported: 2025/04/23	
Mod-CBR Test Report: SANS 3001		

MDD and OMC (SANS 3001-GR30) Mod-AASHTO Method		
Mould	Moisture Content (%)	Dry Density (kg/m³)
1	2,3%	2136
2	3,3%	2167
3	4,3%	2200
4	5,3%	2169
5	6,3%	2138

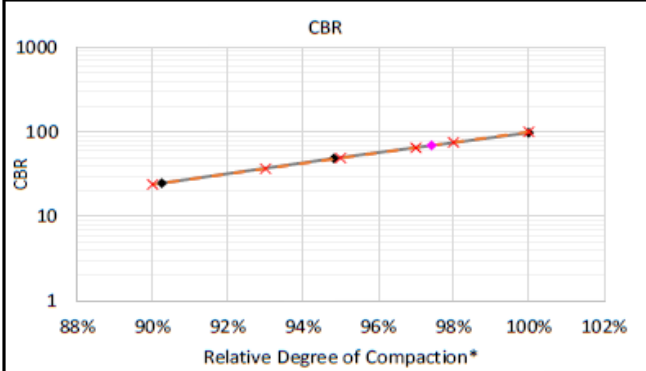
Optimum Moisture Content (OMC):	4,3%
Maximum Dry Density (MDD):	2200 kg/m³



MDD vs OMC

CBR (SANS 3001-GR40) Mod AASHTO Method			
Category	Mod AASHTO	NRB	Proctor
Mould Moisture Content %		4,3%	
Dry Density (kg/m³)	2208 kg/m³	2094 kg/m³	1992 kg/m³
Relative compaction (%)	100,0%	94,8%	90,2%
Measured CBR	98	49	25
% Swell	0,02	0,03	0,04

Interpreted CBR (SANS 3001-GR40) Mod AASHTO Method	
Relative Compaction	CBR
100%	100
98%	75
97%	65
95%	49
93%	37
90%	24



CBR

Comments:

Test methods marked *, does not form part of our schedule of accreditation.

Does not meet GS requirements due to: Max Particle Size>63mm

Results in this report only relate to the item(s) tested by Tzaneen Civil Lab. Results and advice are subject to correct sampling being followed. Tzaneen Lab does not accept responsibility for any matters arising from the further use of these results. This report is confidential and is only intended for the use of the individual or entity to which it is addressed.



Digitally signed by Hermias Cornelius Nolte
Date: 2025.04.24 13:04:36 +02'00'

Technical Signatory

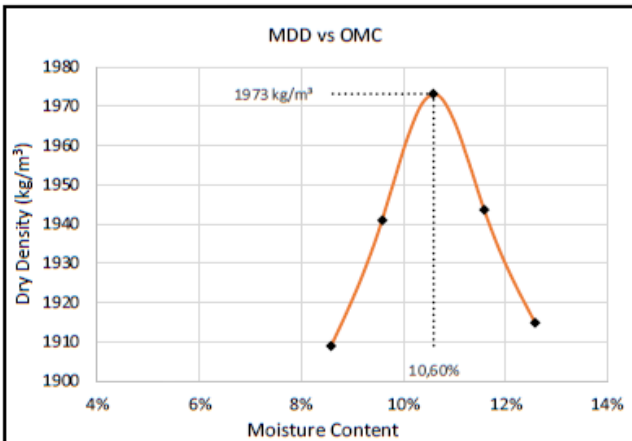




Hanko Investments T/A Tzaneen Lab P.O. Box 3784, Tzaneen, 0850 1992 Industria Road, Tzaneen www.tzaneenlab.co.za admin@tzaneenlab.co.za 015 307 1661			
Client:	Geo Equilibria	Sample No.	T04751/3
Project:	Musina SEZ	Date Sampled:	2025/03/28
Address:	Office No 3, 2010 Centre, Thohoyandou 0950	Date Tested:	2025/03/28
Description:	Client Ref: Pos 3 Test Pit 18 from 1,4 - 1,6m	Date Reported:	2025/04/23
Mod-CBR Test Report: SANS 3001			

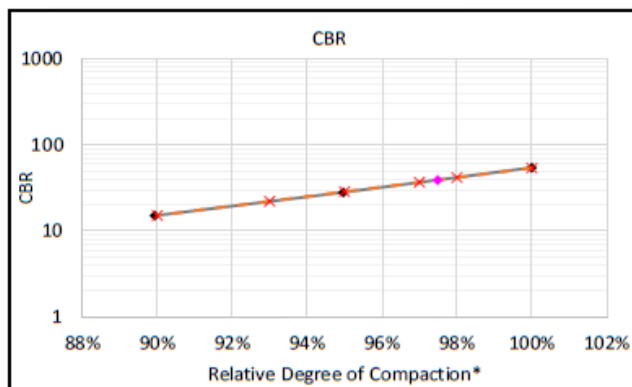
MDD and OMC (SANS 3001-GR30) Mod-AASHTO Method		
Mould	Moisture Content (%)	Dry Density (kg/m³)
1	8,6%	1909
2	9,6%	1941
3	10,6%	1973
4	11,6%	1944
5	12,6%	1915

Optimum Moisture Content (OMC):	10,6%
Maximum Dry Density (MDD):	1973 kg/m³



CBR (SANS 3001-GR40) Mod AASHTO Method			
Category	Mod AASHTO	NRB	Proctor
Mould Moisture Content %		10,6%	
Dry Density (kg/m³)	1974 kg/m³	1875 kg/m³	1775 kg/m³
Relative compaction (%)	100,0%	95,0%	89,9%
Measured CBR	55	28	15
% Swell	0,08	0,13	0,17

Interpreted CBR (SANS 3001-GR40) Mod AASHTO Method	
Relative Compaction	CBR
100%	54
98%	42
97%	37
95%	29
93%	22
90%	15

**Comments:**

Test methods marked *, does not form part of our schedule of accreditation.

Does not meet G6 requirements due to: LS>5

Results in this report only relate to the item(s) tested by Tzaneen Civil Lab. Results and advice are subject to correct sampling being followed. Tzaneen Lab does not accept responsibility for any matters arising from the further use of these results. This report is confidential and is only intended for the use of the individual or entity to which it is addressed.

Digitally signed
by Hemias
Cornelius Nolte
Date: 2025.04.24
13:03:38 +02'00'

Technical Signatory





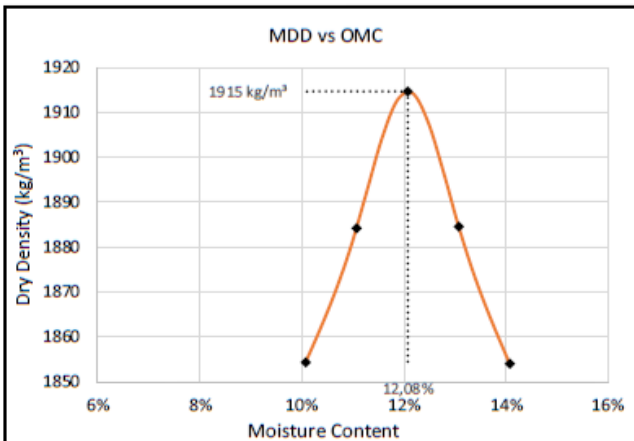
Hanko Investments T/A Tzaneen Lab | P.O. Box 3784, Tzaneen, 0850 | 1992 Industria Road, Tzaneen | www.tzaneenlab.co.za | admin@tzaneenlab.co.za | 015 307 1661

Client: Geo Equilibria	Sample No.: T04751/4
Project: Musina SEZ	Date Sampled: 2025/03/28
Address: Office No 3, 2010 Centre, Thohoyandou 0950	Date Tested: 2025/03/28
Description: Client Ref: Po S3 - Test Pit 26 from 0,9 - 1,4m	Date Reported: 2025/04/23

Mod-CBR Test Report: SANS 3001

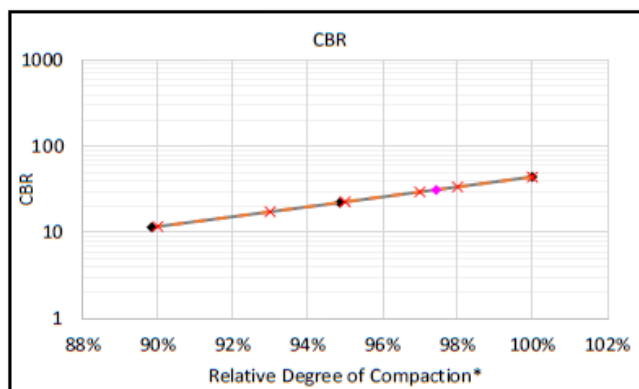
MDD and OMC (SANS 3001-GR30) Mod-AASHTO Method		
Mould	Moisture Content (%)	Dry Density (kg/m³)
1	10,1%	1854
2	11,1%	1884
3	12,1%	1915
4	13,1%	1885
5	14,1%	1854

Optimum Moisture Content (OMC):	12,1%
Maximum Dry Density (MDD):	1915 kg/m³



CBR (SANS 3001-GR40) Mod AASHTO Method			
Category	Mod AASHTO	NRB	Proctor
Mould Moisture Content %		12,1%	
Dry Density (kg/m³)	1916 kg/m³	1818 kg/m³	1721 kg/m³
Relative compaction (%)	100,0%	94,9%	89,8%
Measured CBR	44	22	11
% Swell	0,09	0,14	0,17

Interpreted CBR (SANS 3001-GR40) Mod AASHTO Method	
Relative Compaction	CBR
100%	44
98%	34
97%	30
95%	23
93%	17
90%	12



Comments:

Test methods marked *, does not form part of our schedule of accreditation.

Does not meet G6 requirements due to: CBR @ 95% < 25

Results in this report only relate to the item(s) tested by Tzaneen Civil Lab. Results and advice are subject to correct sampling being followed. Tzaneen Lab does not accept responsibility for any matters arising from the further use of these results. This report is confidential and is only intended for the use of the individual or entity to which it is addressed.

Digitally signed by
Hermias Cornelius
Nolte
Date: 2025.04.24
13:03:14 +02'00'

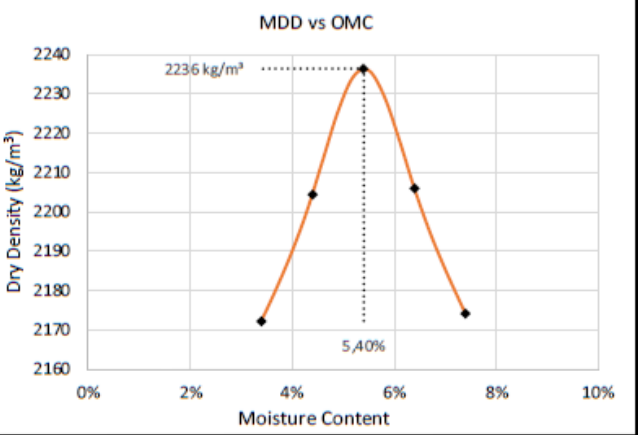
Technical Signatory



 Tzaneen Lab CIVIL MATERIALS TESTING LABORATORIES		 	
Hanco Investments T/A Tzaneen Lab P.O. Box 3784, Tzaneen, 0850 1992 Industria Road, Tzaneen www.tzaneenlab.co.za admin@tzaneenlab.co.za 015 307 1661			
Client: Geo Equilibria		Sample No.: T04751/5	
Project: Musina SEZ		Date Sampled: 2025/03/28	
Address: Office No 3, 2010 Centre, Thohoyandou 0950		Date Tested: 2025/03/28	
Description: Client Ref: Pos S8 - Test Pit 35 from 0,5 - 1,0m		Date Reported: 2025/04/23	
Mod-CBR Test Report: SANS 3001			

MDD and OMC (SANS 3001-GR30) Mod-AASHTO Method		
Mould	Moisture Content (%)	Dry Density (kg/m³)
1	3,4%	2172
2	4,4%	2204
3	5,4%	2236
4	6,4%	2206
5	7,4%	2174

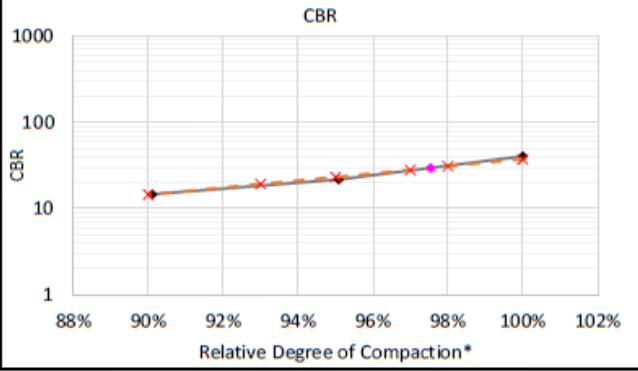
Optimum Moisture Content (OMC):	5,4%
Maximum Dry Density (MDD):	2236 kg/m³



MDD vs OMC

CBR (SANS 3001-GR40) Mod AASHTO Method			
Category	Mod AASHTO	NRB	Proctor
Mould Moisture Content %		5,4%	
Dry Density (kg/m³)	2242 kg/m³	2132 kg/m³	2020 kg/m³
Relative compaction (%)	100,0%	95,1%	90,1%
Measured CBR	40	22	15
% Swell	0,04	0,06	0,07

Interpreted CBR (SANS 3001-GR40) Mod AASHTO Method	
Relative Compaction	CBR
100%	37
98%	31
97%	28
95%	23
93%	19
90%	15



CBR

Comments:

Test methods marked *, does not form part of our schedule of accreditation.

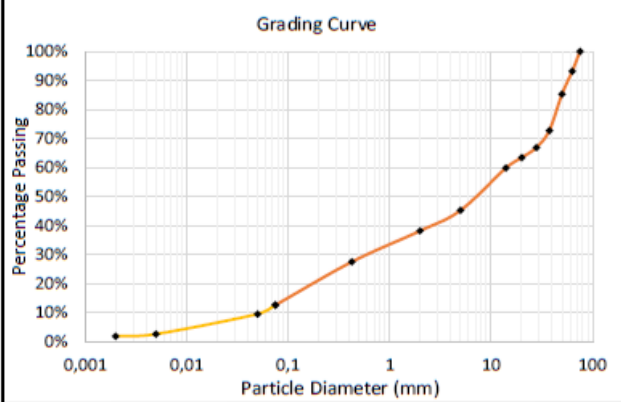
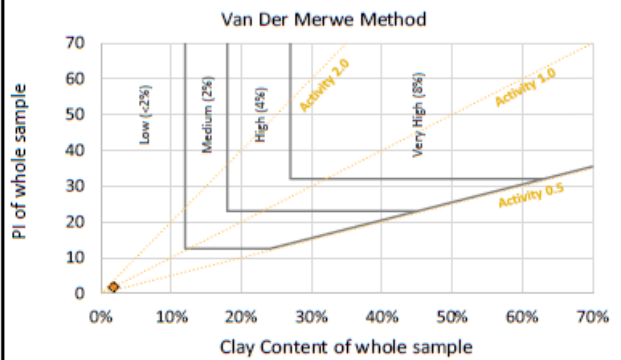
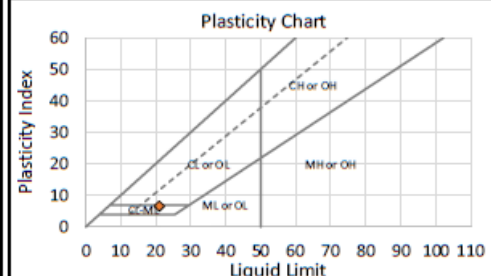
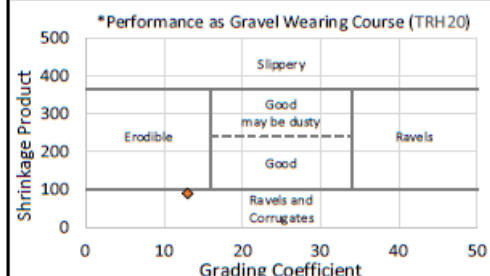
Does not meet G6 requirements due to: CBR @ 95% < 25

Results in this report only relate to the item(s) tested by Tzaneen Civil Lab. Results and advice are subject to correct sampling being followed. Tzaneen Lab does not accept responsibility for any matter arising from the further use of these results. This report is confidential and is only intended for the use of the individual or entity to which it is addressed.


 Digitally signed by
 Hermias Cornelius
 Nolte
 Date: 2025.04.24
 13:02:48 +02'00'

Technical Signatory



 Tzaneen Lab CIVIL MATERIALS TESTING LABORATORIES		 																									
Hanco Investments T/A Tzaneen Lab P.O. Box 3784, Tzaneen, 0850 1992 Industria Road, Tzaneen www.tzaneenlab.co.za admin@tzaneenlab.co.za 015 307 1661																											
Client: Geo Equilibria		Sample No. T04751/1																									
Project: Musina SEZ		Date Sampled: 2025/03/28																									
Address: Office No 3, 2010 Centre, Thohoyandou 0950		Date Tested: 2025/03/28																									
Description: Client Ref: Pos 2 Test Pit 10 from 0,15 - 0,60m		Date Reported: 2025/04/23																									
Foundation Indicator Test Report: SANS 3001																											
Particle Size Analysis (SANS 3001-GR1) <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Diameter (mm)</th> <th>% Passing</th> </tr> </thead> <tbody> <tr><td>75,0</td><td>100%</td></tr> <tr><td>63,0</td><td>93%</td></tr> <tr><td>50,0</td><td>85%</td></tr> <tr><td>37,5</td><td>73%</td></tr> <tr><td>28,0</td><td>67%</td></tr> <tr><td>20,0</td><td>63%</td></tr> <tr><td>14,0</td><td>60%</td></tr> <tr><td>5,0</td><td>45%</td></tr> <tr><td>2,0</td><td>38%</td></tr> <tr><td>0,425</td><td>27,5%</td></tr> <tr><td>0,075</td><td>12,6%</td></tr> </tbody> </table>		Diameter (mm)	% Passing	75,0	100%	63,0	93%	50,0	85%	37,5	73%	28,0	67%	20,0	63%	14,0	60%	5,0	45%	2,0	38%	0,425	27,5%	0,075	12,6%	Description: Dark Brown silty/clayey Gravel 	
Diameter (mm)	% Passing																										
75,0	100%																										
63,0	93%																										
50,0	85%																										
37,5	73%																										
28,0	67%																										
20,0	63%																										
14,0	60%																										
5,0	45%																										
2,0	38%																										
0,425	27,5%																										
0,075	12,6%																										
*Hydrometer Analysis (SANS 3001-GR3) <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Diameter (mm)</th> <th>% Passing</th> </tr> </thead> <tbody> <tr><td>0,05</td><td>9,5%</td></tr> <tr><td>0,005</td><td>2,6%</td></tr> <tr><td>0,002</td><td>1,8%</td></tr> </tbody> </table>		Diameter (mm)	% Passing	0,05	9,5%	0,005	2,6%	0,002	1,8%	Van Der Merwe Method 																	
Diameter (mm)	% Passing																										
0,05	9,5%																										
0,005	2,6%																										
0,002	1,8%																										
*Grading Characteristics <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td>Grading Modulus</td><td>GM</td><td>2,22</td></tr> <tr><td>Effective Size</td><td>D₁₀</td><td>0,05</td></tr> <tr><td>Uniformity Coef.</td><td>C_u</td><td>266,93</td></tr> <tr><td>Curvature Coef.</td><td>C_c</td><td>0,49</td></tr> </tbody> </table>		Grading Modulus	GM	2,22	Effective Size	D ₁₀	0,05	Uniformity Coef.	C _u	266,93	Curvature Coef.	C _c	0,49														
Grading Modulus	GM	2,22																									
Effective Size	D ₁₀	0,05																									
Uniformity Coef.	C _u	266,93																									
Curvature Coef.	C _c	0,49																									
*Soil Mortar Analysis (SANS 3001-PR5) <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td>Coarse Sand</td><td>2.0 - 0.425 mm</td><td>28%</td></tr> <tr><td>Fine Sand</td><td>0.425 - 0.075 mm</td><td>39%</td></tr> <tr><td>Silt</td><td>0.075 - 0.002 mm</td><td>26%</td></tr> <tr><td>Clay</td><td><0.002</td><td>7%</td></tr> </tbody> </table>		Coarse Sand	2.0 - 0.425 mm	28%	Fine Sand	0.425 - 0.075 mm	39%	Silt	0.075 - 0.002 mm	26%	Clay	<0.002	7%	Plasticity Chart 													
Coarse Sand	2.0 - 0.425 mm	28%																									
Fine Sand	0.425 - 0.075 mm	39%																									
Silt	0.075 - 0.002 mm	26%																									
Clay	<0.002	7%																									
Atterberg Limits (SANS 3001-GR10) <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td>Liquid Limit</td><td>LL</td><td>21%</td></tr> <tr><td>Plasticity Index</td><td>PI</td><td>7%</td></tr> <tr><td>Linear Shrinkage</td><td>LS</td><td>3,24%</td></tr> </tbody> </table>		Liquid Limit	LL	21%	Plasticity Index	PI	7%	Linear Shrinkage	LS	3,24%																	
Liquid Limit	LL	21%																									
Plasticity Index	PI	7%																									
Linear Shrinkage	LS	3,24%																									
*Performance as Gravel Wearing Course (TRH20) 		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td rowspan="3" style="text-align: center; vertical-align: middle;">*Classifications</td> <td style="text-align: center;">Unified Soil Classification- USCS</td> <td style="text-align: center;">GM-GC</td> </tr> <tr> <td style="text-align: center;">COLTO Classification</td> <td style="text-align: center;">G8</td> </tr> <tr> <td style="text-align: center;">US Highway</td> <td style="text-align: center;">A-2-4 (0)</td> </tr> </table>		*Classifications	Unified Soil Classification- USCS	GM-GC	COLTO Classification	G8	US Highway	A-2-4 (0)																	
*Classifications	Unified Soil Classification- USCS				GM-GC																						
	COLTO Classification	G8																									
	US Highway	A-2-4 (0)																									
Comments: Test methods marked *, does not form part of our schedule of accreditation. Does not meet G7 requirements due to: CBR @ 93%<15		 Digitally signed by Hermias Cornelius Nolte Date: 2025.04.24 13:06:15 +02'00'																									
Results in this report only relate to the item(s) tested by Tzaneen Civil Lab. Results and advice are subject to correct sampling being followed. Tzaneen Lab does not accept responsibility for any matters arising from the further use of these results. This report is confidential and is only intended for the use of the individual or entity to which it is addressed.																											



Tzaneen Lab CIVIL MATERIALS TESTING LABORATORIES																											
Hariko Investments T/A Tzaneen Lab P.O. Box 3784, Tzaneen, 0850 1992 Industria Road, Tzaneen www.tzaneenlab.co.za admin@tzaneenlab.co.za 015 307 1661																											
Client: Geo Equilibria		Sample No.: T04751/2																									
Project: Musina SEZ		Date Sampled: 2025/03/28																									
Address: Office No 3, 2010 Centre, Thohoyandou 0950		Date Tested: 2025/03/28																									
Description: Client Ref: Pos 3 Test Pit 15 from 0,7 - 0,9m		Date Reported: 2025/04/23																									
Foundation Indicator Test Report: SANS 3001																											
Particle Size Analysis (SANS 3001-GR1) <table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <thead> <tr> <th>Diameter (mm)</th> <th>% Passing</th> </tr> </thead> <tbody> <tr><td>75,0</td><td>96%</td></tr> <tr><td>63,0</td><td>91%</td></tr> <tr><td>50,0</td><td>86%</td></tr> <tr><td>37,5</td><td>77%</td></tr> <tr><td>28,0</td><td>72%</td></tr> <tr><td>20,0</td><td>68%</td></tr> <tr><td>14,0</td><td>65%</td></tr> <tr><td>5,0</td><td>48%</td></tr> <tr><td>2,0</td><td>37%</td></tr> <tr><td>0,425</td><td>23,1%</td></tr> <tr><td>0,075</td><td>8,4%</td></tr> </tbody> </table>		Diameter (mm)	% Passing	75,0	96%	63,0	91%	50,0	86%	37,5	77%	28,0	72%	20,0	68%	14,0	65%	5,0	48%	2,0	37%	0,425	23,1%	0,075	8,4%	Description: Dusky Red poorly-graded silty Gravel 	
Diameter (mm)	% Passing																										
75,0	96%																										
63,0	91%																										
50,0	86%																										
37,5	77%																										
28,0	72%																										
20,0	68%																										
14,0	65%																										
5,0	48%																										
2,0	37%																										
0,425	23,1%																										
0,075	8,4%																										
*Hydrometer Analysis (SANS 3001-GR3) <table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <thead> <tr> <th>Diameter (mm)</th> <th>% Passing</th> </tr> </thead> <tbody> <tr><td>0,05</td><td>6,1%</td></tr> <tr><td>0,005</td><td>2,6%</td></tr> <tr><td>0,002</td><td>2,0%</td></tr> </tbody> </table>		Diameter (mm)	% Passing	0,05	6,1%	0,005	2,6%	0,002	2,0%																		
Diameter (mm)	% Passing																										
0,05	6,1%																										
0,005	2,6%																										
0,002	2,0%																										
*Grading Characteristics <table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <tbody> <tr><td>Grading Modulus</td><td>GM</td><td>2,32</td></tr> <tr><td>Effective Size</td><td>D₃₀</td><td>0,09</td></tr> <tr><td>Uniformity Coef.</td><td>C_u</td><td>115,20</td></tr> <tr><td>Curvature Coef.</td><td>C_c</td><td>0,92</td></tr> </tbody> </table>		Grading Modulus	GM	2,32	Effective Size	D ₃₀	0,09	Uniformity Coef.	C _u	115,20	Curvature Coef.	C _c	0,92														
Grading Modulus	GM	2,32																									
Effective Size	D ₃₀	0,09																									
Uniformity Coef.	C _u	115,20																									
Curvature Coef.	C _c	0,92																									
*Soil Mortar Analysis (SANS 3001-PR5) <table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <tbody> <tr><td>Coarse Sand</td><td>2,0 - 0,425 mm</td><td>37%</td></tr> <tr><td>Fine Sand</td><td>0,425 - 0,075 mm</td><td>40%</td></tr> <tr><td>Silt</td><td>0,075 - 0,002 mm</td><td>16%</td></tr> <tr><td>Clay</td><td><0,002</td><td>7%</td></tr> </tbody> </table>		Coarse Sand	2,0 - 0,425 mm	37%	Fine Sand	0,425 - 0,075 mm	40%	Silt	0,075 - 0,002 mm	16%	Clay	<0,002	7%														
Coarse Sand	2,0 - 0,425 mm	37%																									
Fine Sand	0,425 - 0,075 mm	40%																									
Silt	0,075 - 0,002 mm	16%																									
Clay	<0,002	7%																									
Atterberg Limits (SANS 3001-GR10) <table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <tbody> <tr><td>Liquid Limit</td><td>LL</td><td>-</td></tr> <tr><td>Plasticity Index</td><td>PI</td><td>SP</td></tr> <tr><td>Linear Shrinkage</td><td>LS</td><td>1,33%</td></tr> </tbody> </table>		Liquid Limit	LL	-	Plasticity Index	PI	SP	Linear Shrinkage	LS	1,33%																	
Liquid Limit	LL	-																									
Plasticity Index	PI	SP																									
Linear Shrinkage	LS	1,33%																									
*Performance as Gravel Wearing Course (TRH20) 		Plasticity Chart 																									
*Classifications		Unified Soil Classification- USCS GP-GM																									
		COLTO Classification G6																									
		US Highway A-1-a (0)																									
Comments: Test methods marked *, does not form part of our schedule of accreditation. Does not meet G5 requirements due to: Max Particle Size>63mm																											
Results in this report only relate to the item(s) tested by Tzaneen Civil Lab. Results and advice are subject to correct sampling being followed. Tzaneen Lab does not accept responsibility for any matters arising from the further use of these results. This report is confidential and is only intended for the use of the individual or entity to which it is addressed.																											

Digitally signed by
 Hermas Cornelius Nolte
 Date: 2025.04.24
 13:04:17 +02'00'

Technical Signatory



<b style="font-size: 24px; margin-right: 10px;">Tzaneen lab CIVIL MATERIALS TESTING LABORATORIES			
Hanco Investments T/A Tzaneen Lab P.O. Box 3784, Tzaneen, 0850 1992 Industria Road, Tzaneen www.tzaneenlab.co.za admin@tzaneenlab.co.za 015 307 1661			
Client: Geo Equilibria		Sample No. T04751/3	
Project: Musina SEZ		Date Sampled: 2025/03/28	
Address: Office No 3, 2010 Centre, Thohoyandou 0950		Date Tested: 2025/03/28	
Description: Client Ref: Pos 3 Test Pit 18 from 1,4 - 1,6m		Date Reported: 2025/04/23	
Foundation Indicator Test Report: SANS 3001			

Particle Size Analysis (SANS 3001-GR1) <table border="1" style="width: 100%; border-collapse: collapse; font-size: 10px;"> <thead> <tr> <th>Diameter (mm)</th> <th>% Passing</th> </tr> </thead> <tbody> <tr><td>75,0</td><td>-</td></tr> <tr><td>63,0</td><td>-</td></tr> <tr><td>50,0</td><td>100%</td></tr> <tr><td>37,5</td><td>96%</td></tr> <tr><td>28,0</td><td>93%</td></tr> <tr><td>20,0</td><td>91%</td></tr> <tr><td>14,0</td><td>87%</td></tr> <tr><td>5,0</td><td>57%</td></tr> <tr><td>2,0</td><td>41%</td></tr> <tr><td>0,425</td><td>27,2%</td></tr> <tr><td>0,075</td><td>17,2%</td></tr> </tbody> </table> *Hydrometer Analysis (SANS 3001-GR3) <table border="1" style="width: 100%; border-collapse: collapse; font-size: 10px;"> <thead> <tr> <th>Diameter (mm)</th> <th>% Passing</th> </tr> </thead> <tbody> <tr><td>0,05</td><td>11,8%</td></tr> <tr><td>0,005</td><td>2,1%</td></tr> <tr><td>0,002</td><td>1,3%</td></tr> </tbody> </table> *Grading Characteristics <table border="1" style="width: 100%; border-collapse: collapse; font-size: 10px;"> <tbody> <tr><td>Grading Modulus</td><td>GM</td><td>2,14</td></tr> <tr><td>Effective Size</td><td>D_{30}</td><td>0,03</td></tr> <tr><td>Uniformity Coef.</td><td>C_u</td><td>166,57</td></tr> <tr><td>Curvature Coef.</td><td>C_c</td><td>1,85</td></tr> </tbody> </table> *Soil Mortar Analysis (SANS 3001-PR5) <table border="1" style="width: 100%; border-collapse: collapse; font-size: 10px;"> <tbody> <tr><td>Coarse Sand</td><td>2,0 - 0,425 mm</td><td>34%</td></tr> <tr><td>Fine Sand</td><td>0,425 - 0,075 mm</td><td>24%</td></tr> <tr><td>Silt</td><td>0,075 - 0,002 mm</td><td>37%</td></tr> <tr><td>Clay</td><td><0,002</td><td>5%</td></tr> </tbody> </table> Atterberg Limits (SANS 3001-GR10) <table border="1" style="width: 100%; border-collapse: collapse; font-size: 10px;"> <tbody> <tr><td>Liquid Limit</td><td>LL</td><td>31%</td></tr> <tr><td>Plasticity Index</td><td>PI</td><td>10%</td></tr> <tr><td>Linear Shrinkage</td><td>LS</td><td>5,21%</td></tr> </tbody> </table>	Diameter (mm)	% Passing	75,0	-	63,0	-	50,0	100%	37,5	96%	28,0	93%	20,0	91%	14,0	87%	5,0	57%	2,0	41%	0,425	27,2%	0,075	17,2%	Diameter (mm)	% Passing	0,05	11,8%	0,005	2,1%	0,002	1,3%	Grading Modulus	GM	2,14	Effective Size	D_{30}	0,03	Uniformity Coef.	C_u	166,57	Curvature Coef.	C_c	1,85	Coarse Sand	2,0 - 0,425 mm	34%	Fine Sand	0,425 - 0,075 mm	24%	Silt	0,075 - 0,002 mm	37%	Clay	<0,002	5%	Liquid Limit	LL	31%	Plasticity Index	PI	10%	Linear Shrinkage	LS	5,21%	Description: Dark Yellowish Orange clayey Sand Grading Curve Van Der Merwe Method Plasticity Chart <table border="1" style="width: 100%; border-collapse: collapse; font-size: 10px;"> <tr> <td rowspan="3" style="width: 30%;">*Classifications</td> <td style="text-align: center;">Unified Soil Classification- USCS</td> <td style="text-align: center;">SC</td> </tr> <tr> <td style="text-align: center;">COLTO Classification</td> <td style="text-align: center;">G7</td> </tr> <tr> <td style="text-align: center;">US Highway</td> <td style="text-align: center;">A-2-6 (0)</td> </tr> </table>	*Classifications	Unified Soil Classification- USCS	SC	COLTO Classification	G7	US Highway	A-2-6 (0)
Diameter (mm)	% Passing																																																																								
75,0	-																																																																								
63,0	-																																																																								
50,0	100%																																																																								
37,5	96%																																																																								
28,0	93%																																																																								
20,0	91%																																																																								
14,0	87%																																																																								
5,0	57%																																																																								
2,0	41%																																																																								
0,425	27,2%																																																																								
0,075	17,2%																																																																								
Diameter (mm)	% Passing																																																																								
0,05	11,8%																																																																								
0,005	2,1%																																																																								
0,002	1,3%																																																																								
Grading Modulus	GM	2,14																																																																							
Effective Size	D_{30}	0,03																																																																							
Uniformity Coef.	C_u	166,57																																																																							
Curvature Coef.	C_c	1,85																																																																							
Coarse Sand	2,0 - 0,425 mm	34%																																																																							
Fine Sand	0,425 - 0,075 mm	24%																																																																							
Silt	0,075 - 0,002 mm	37%																																																																							
Clay	<0,002	5%																																																																							
Liquid Limit	LL	31%																																																																							
Plasticity Index	PI	10%																																																																							
Linear Shrinkage	LS	5,21%																																																																							
*Classifications	Unified Soil Classification- USCS	SC																																																																							
	COLTO Classification	G7																																																																							
	US Highway	A-2-6 (0)																																																																							

Comments:

Test methods marked *, does not form part of our schedule of accreditation.

Does not meet G6 requirements due to: LS>5

Results in this report only relate to the item(s) tested by Tzaneen Civil Lab. Results and advice are subject to correct sampling being followed. Tzaneen Lab does not accept responsibility for any matters arising from the further use of these results. This report is confidential and is only intended for the use of the individual or entity to which it is addressed.

Digitally signed by
Hermas Cornelius Nolte
Date: 2025.04.24
13:03:26 +02'00'

Technical Signatory



<b style="font-size: 24px; margin: 0;">Tzaneen Lab CIVIL MATERIALS TESTING LABORATORIES																										
Hako Investments T/A Tzaneen Lab P.O. Box 3784, Tzaneen, 0850 1992 Industria Road, Tzaneen www.tzaneenlab.co.za admin@tzaneenlab.co.za 015 307 1661																										
Client: Geo Equilibria	Sample No. T04751/4																									
Project: Musina SEZ	Date Sampled: 2025/03/28																									
Address: Office No 3, 2010 Centre, Thohoyandou 0950	Date Tested: 2025/03/28																									
Description: Client Ref: Po S3 - Test Pit 26 from 0,9 - 1,4m	Date Reported: 2025/04/23																									
Foundation Indicator Test Report: SANS 3001																										
Particle Size Analysis (SANS 3001-GR1) <table border="1" style="width: 100%; border-collapse: collapse; font-size: 10px;"> <thead> <tr> <th>Diameter (mm)</th> <th>% Passing</th> </tr> </thead> <tbody> <tr><td>75,0</td><td>-</td></tr> <tr><td>63,0</td><td>100%</td></tr> <tr><td>50,0</td><td>95%</td></tr> <tr><td>37,5</td><td>86%</td></tr> <tr><td>28,0</td><td>82%</td></tr> <tr><td>20,0</td><td>79%</td></tr> <tr><td>14,0</td><td>75%</td></tr> <tr><td>5,0</td><td>50%</td></tr> <tr><td>2,0</td><td>38%</td></tr> <tr><td>0,425</td><td>26,2%</td></tr> <tr><td>0,075</td><td>10,7%</td></tr> </tbody> </table>	Diameter (mm)	% Passing	75,0	-	63,0	100%	50,0	95%	37,5	86%	28,0	82%	20,0	79%	14,0	75%	5,0	50%	2,0	38%	0,425	26,2%	0,075	10,7%	Description: Dark Olive poorly-graded silty Gravel 	
Diameter (mm)	% Passing																									
75,0	-																									
63,0	100%																									
50,0	95%																									
37,5	86%																									
28,0	82%																									
20,0	79%																									
14,0	75%																									
5,0	50%																									
2,0	38%																									
0,425	26,2%																									
0,075	10,7%																									
*Hydrometer Analysis (SANS 3001-GR3) <table border="1" style="width: 100%; border-collapse: collapse; font-size: 10px;"> <thead> <tr> <th>Diameter (mm)</th> <th>% Passing</th> </tr> </thead> <tbody> <tr><td>0,05</td><td>6,3%</td></tr> <tr><td>0,005</td><td>1,3%</td></tr> <tr><td>0,002</td><td>0,6%</td></tr> </tbody> </table>	Diameter (mm)	% Passing	0,05	6,3%	0,005	1,3%	0,002	0,6%																		
Diameter (mm)	% Passing																									
0,05	6,3%																									
0,005	1,3%																									
0,002	0,6%																									
*Grading Characteristics <table border="1" style="width: 100%; border-collapse: collapse; font-size: 10px;"> <tbody> <tr><td>Grading Modulus</td><td>GM</td><td>2,26</td></tr> <tr><td>Effective Size</td><td>D_{10}</td><td>0,07</td></tr> <tr><td>Uniformity Coef.</td><td>C_u</td><td>109,05</td></tr> <tr><td>Curvature Coef.</td><td>C_c</td><td>0,95</td></tr> </tbody> </table>	Grading Modulus	GM	2,26	Effective Size	D_{10}	0,07	Uniformity Coef.	C_u	109,05	Curvature Coef.	C_c	0,95														
Grading Modulus	GM	2,26																								
Effective Size	D_{10}	0,07																								
Uniformity Coef.	C_u	109,05																								
Curvature Coef.	C_c	0,95																								
*Soil Mortar Analysis (SANS 3001-PR5) <table border="1" style="width: 100%; border-collapse: collapse; font-size: 10px;"> <tbody> <tr><td>Coarse Sand</td><td>2.0 - 0.425 mm</td><td>30%</td></tr> <tr><td>Fine Sand</td><td>0.425 - 0.075 mm</td><td>41%</td></tr> <tr><td>Silt</td><td>0.075 - 0.002 mm</td><td>25%</td></tr> <tr><td>Clay</td><td><0.002</td><td>4%</td></tr> </tbody> </table>	Coarse Sand	2.0 - 0.425 mm	30%	Fine Sand	0.425 - 0.075 mm	41%	Silt	0.075 - 0.002 mm	25%	Clay	<0.002	4%	Atterberg Limits (SANS 3001-GR10) <table border="1" style="width: 100%; border-collapse: collapse; font-size: 10px;"> <tbody> <tr><td>Liquid Limit</td><td>LL</td><td>32%</td></tr> <tr><td>Plasticity Index</td><td>PI</td><td>8%</td></tr> <tr><td>Linear Shrinkage</td><td>LS</td><td>4,06%</td></tr> </tbody> </table>		Liquid Limit	LL	32%	Plasticity Index	PI	8%	Linear Shrinkage	LS	4,06%			
Coarse Sand	2.0 - 0.425 mm	30%																								
Fine Sand	0.425 - 0.075 mm	41%																								
Silt	0.075 - 0.002 mm	25%																								
Clay	<0.002	4%																								
Liquid Limit	LL	32%																								
Plasticity Index	PI	8%																								
Linear Shrinkage	LS	4,06%																								
*Performance as Gravel Wearing Course (TRH20) 	Plasticity Chart 																									
*Classifications	Unified Soil Classification- USCS	GP-GM																								
	COLTO Classification	G7																								
	US Highway	A-2-4 (0)																								
Comments: Test methods marked *, does not form part of our schedule of accreditation. Does not meet G6 requirements due to: CBR @ 95%<25																										
Results in this report only relate to the item(s) tested by Tzaneen Civil Lab. Results and advice are subject to correct sampling being followed. Tzaneen Lab does not accept responsibility for any matters arising from the further use of these results. This report is confidential and is only intended for the use of the individual or entity to which it is addressed.																										

Digitally signed by
 Hermias Cornelius Nolte
 Date: 2025.04.24
 13:03:05 +02'00'

Technical Signatory



<b style="font-size: 24px; margin-right: 10px;">Tzaneen CIVIL MATERIALS TESTING LABORATORIES		 Testing Laboratory TOP06																								
Hanks Investments T/A Tzaneen Lab P.O. Box 3784, Tzaneen, 0850 1992 Industria Road, Tzaneen www.tzaneenlab.co.za admin@tzaneenlab.co.za 015 307 1661																										
Client: Geo Equilibria		Sample No. T04751/5																								
Project: Musina SEZ		Date Sampled: 2025/03/28																								
Address: Office No 3, 2010 Centre, Thohoyandou 0950		Date Tested: 2025/03/28																								
Description: Client Ref: Pos S8 - Test Pit 35 from 0,5 - 1,0m		Date Reported: 2025/04/23																								
Foundation Indicator Test Report: SANS 3001																										
Particle Size Analysis (SANS 3001-GR1) <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Diameter (mm)</th> <th>% Passing</th> </tr> </thead> <tbody> <tr><td>75,0</td><td>-</td></tr> <tr><td>63,0</td><td>100%</td></tr> <tr><td>50,0</td><td>97%</td></tr> <tr><td>37,5</td><td>95%</td></tr> <tr><td>28,0</td><td>92%</td></tr> <tr><td>20,0</td><td>89%</td></tr> <tr><td>14,0</td><td>88%</td></tr> <tr><td>5,0</td><td>69%</td></tr> <tr><td>2,0</td><td>53%</td></tr> <tr><td>0,425</td><td>31,9%</td></tr> <tr><td>0,075</td><td>15,6%</td></tr> </tbody> </table>		Diameter (mm)	% Passing	75,0	-	63,0	100%	50,0	97%	37,5	95%	28,0	92%	20,0	89%	14,0	88%	5,0	69%	2,0	53%	0,425	31,9%	0,075	15,6%	Description: Dusky Red silty/clayey Sand
Diameter (mm)	% Passing																									
75,0	-																									
63,0	100%																									
50,0	97%																									
37,5	95%																									
28,0	92%																									
20,0	89%																									
14,0	88%																									
5,0	69%																									
2,0	53%																									
0,425	31,9%																									
0,075	15,6%																									
*Hydrometer Analysis (SANS 3001-GR3) <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Diameter (mm)</th> <th>% Passing</th> </tr> </thead> <tbody> <tr><td>0,05</td><td>12,1%</td></tr> <tr><td>0,005</td><td>4,2%</td></tr> <tr><td>0,002</td><td>2,8%</td></tr> </tbody> </table>		Diameter (mm)	% Passing	0,05	12,1%	0,005	4,2%	0,002	2,8%																	
Diameter (mm)	% Passing																									
0,05	12,1%																									
0,005	4,2%																									
0,002	2,8%																									
*Grading Characteristics <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td>Grading Modulus</td><td>GM</td><td>2,00</td></tr> <tr><td>Effective Size</td><td>D₁₀</td><td>0,03</td></tr> <tr><td>Uniformity Coef.</td><td>C_u</td><td>109,21</td></tr> <tr><td>Curvature Coef.</td><td>C_c</td><td>1,47</td></tr> </tbody> </table>		Grading Modulus	GM	2,00	Effective Size	D ₁₀	0,03	Uniformity Coef.	C _u	109,21	Curvature Coef.	C _c	1,47													
Grading Modulus	GM	2,00																								
Effective Size	D ₁₀	0,03																								
Uniformity Coef.	C _u	109,21																								
Curvature Coef.	C _c	1,47																								
*Soil Mortar Analysis (SANS 3001-PR5) <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td>Coarse Sand</td><td>2.0 - 0.425 mm</td><td>39%</td></tr> <tr><td>Fine Sand</td><td>0.425 - 0.075 mm</td><td>31%</td></tr> <tr><td>Silt</td><td>0.075 - 0.002 mm</td><td>22%</td></tr> <tr><td>Clay</td><td><0.002</td><td>8%</td></tr> </tbody> </table>		Coarse Sand	2.0 - 0.425 mm	39%	Fine Sand	0.425 - 0.075 mm	31%	Silt	0.075 - 0.002 mm	22%	Clay	<0.002	8%													
Coarse Sand	2.0 - 0.425 mm	39%																								
Fine Sand	0.425 - 0.075 mm	31%																								
Silt	0.075 - 0.002 mm	22%																								
Clay	<0.002	8%																								
Atterberg Limits (SANS 3001-GR10) <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td>Liquid Limit</td><td>LL</td><td>19%</td></tr> <tr><td>Plasticity Index</td><td>PI</td><td>6%</td></tr> <tr><td>Linear Shrinkage</td><td>LS</td><td>2,94%</td></tr> </tbody> </table>		Liquid Limit	LL	19%	Plasticity Index	PI	6%	Linear Shrinkage	LS	2,94%																
Liquid Limit	LL	19%																								
Plasticity Index	PI	6%																								
Linear Shrinkage	LS	2,94%																								
*Performance as Gravel Wearing Course (TRH20) 																										
*Classifications		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Unified Soil Classification- USCS</td> <td>SM-SC</td> </tr> <tr> <td>COLTO Classification</td> <td>G7</td> </tr> <tr> <td>US Highway</td> <td>A-2-4 (0)</td> </tr> </table>	Unified Soil Classification- USCS	SM-SC	COLTO Classification	G7	US Highway	A-2-4 (0)																		
Unified Soil Classification- USCS	SM-SC																									
COLTO Classification	G7																									
US Highway	A-2-4 (0)																									
Comments: Test methods marked *, does not form part of our schedule of accreditation. Does not meet G6 requirements due to: CBR @ 95% < 25																										
Results in this report only relate to the item(s) tested by Tzaneen Civil Lab. Results and advice are subject to correct sampling being followed. Tzaneen Lab does not accept responsibility for any matters arising from the further use of these results. This report is confidential and is only intended for the use of the individual or entity to which it is addressed.		Digitally signed by Hermias Cornelius Nolte Date: 2025.04.24 13:02:36 +0200 Technical Signatory																								



APPENDIX: C SOIL BEARING CAPACITY CHART

SOIL BEARING CAPACITY CHART		Ultimate Ground Bearing Capacity			Allowable Ground Bearing Capacity		
Ground Type	Density of State	Tons s/f	PSF	PSI	Tons s/f	PSF	PSI
Rock (not shale unless hard)	Bedrock	60	120,000	833	30	60,000	417
Rock (not shale unless hard)	Layers	15	30,000	208	7.5	15,000	104
Rock (not shale unless hard)	Soft	8	16,000	111	4	8,000	56
Hardpan, cemented sand or gravel	All	10	20,000	139	5	10,000	69
Gravel or Sand	Compact	8	16,000	111	4	8,000	56
Gravel or Sand	Firm	6	12,000	83	3	6,000	42
Gravel or Sand	Loose	4	8,000	56	2	4,000	28
Sand, coarse to medium	Compact	6	12,000	83	3	6,000	42
Sand, coarse to medium	Firm	4.5	9,000	63	2.25	4,500	31
Sand, coarse to medium	Loose	3	6,000	42	1.5	3,000	21
Sand, fine, silty or with trace of clay	Compact	4	8,000	56	2	4,000	28
Sand, fine, silty or with trace of clay	Firm	3	6,000	42	1.5	3,000	21
Sand, fine, silty or with trace of clay	Loose	1	2,000	14	0.5	1,000	7
Silt	Compact	3	6,000	42	1.5	3,000	21
Silt	Firm	2.5	5,000	35	1.25	2,500	17
Silt	Loose	2	4,000	28	1	2,000	14
Clay	Compact	4	8,000	56	2	4,000	28
Clay	Firm	2.5	5,000	35	1.25	2,500	17
Clay	Loose	1	2,000	14	0.5	1,000	7

Anderson, J.K. (2013). Rigging Engineering Basics (1st ed., p.139). Shapiro Table



APPENDIX D: TEST PITS PICTURES





