PHASE 1 NEAR SURFACE GEOTECHNICAL INVESTIGATION FOR THE PROPOSED TOWNSHIP ESTABLISHMENT SITUATED ON THE REMAINDER OF PORTION 1 AND 2 OF THE FARM SEVILLE 224 KU

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REPORT REFERENCE

MGS/Seville-3/001

SITE LOCATION

FARM NAME	CO-ORDINATES	
	LATITUDE	LONGITUDE
SEVILLE 224 KU	24°39'44.78"S	31°24'16.53"E

REV	DATE	PREPARED BY AND REVIEWED BY		STATUS
01	10/11/2022	Lavhelesani Mavhetha (Pr.Sci.Nat)		Final Report

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ACRONYMS AND ABBREVIATIONS

AASHTO : American Association of State Highway and Transportation Officials

ARS : Acceleration Response Spectra

Cand.Sci.Nat **:** Candidate Natural Scientist

CBR : Californian Bearing Ratio

CL : Clay

DCP : Dynamic Cone Penetrometer

M : Meter

MBGL : Meters Below Ground Level

MASL : Meters Above Sea Level

MDD : Maximum Dry Density

NHBRC : The National Home Builders Registration Council

OMC : Optimum Moisture Content

Pr.Sci.Nat : Professional Natural Scientist

SACNASP : South African Council Natural Scientific Professions

SANAS : South African National Accreditation System

SANS : South African National Standards

TLB : Tractor Loader Backhoe

TP : Trial Pit

USC : Unified Soil Classification

EXECUTIVE SUMMARY

Consultant Company	Mutali Geoscience Solutions Pty Ltd
Site location	The general Geographical Positioning System (GPS) coordinates for proposed development are 24°39'44.78"S 31°24'16,53"E at an average elevation of 418m meters above sea level.
Purpose of investigation	Phase 1 near surface geotechnical investigation for the proposed Township establishment situated on the Remainder of portion 1 and 2 of the farm Seville 224 KU. The main objective of the investigation was aimed at defining the founding materials and establishing broader geotechnical conditions and their suitability to the development.
Regional geology	Extract of regional geological map 2431CB in figure 2 indicates that, the site is located within the lithologies covered by Metamorphic makhutswi Gneiss rocks. The site geological examination reveal the phaneritic texture granatoid rocks which are predominately composed of felsic minerals such as quartz, plagioclase feldspars and mafic (amphiboles and pyroxene) accessory minerals. Based on the physical properties of the rock samples and geological maps review of the site; the lithology of the site is coarse grained Gneiss of Makhutswi formation. The site had some highly weathered exposed Gneiss outcrops, majority of the site overlaid by thick strata of sandy silt at the top and medium to coarse gravel before to the base of the Gneiss bedrock.
Excavation conditions	The in-situ soils and highly weathered Makhutswi Gneiss bedrock were excavated to a maximum depth of 1.9m below ground level. Based on the test pits excavations, it is anticipated that site should classify as “soft excavation” throughout, in accordance with SANS 1200 DA classification using similar plant as employed during this investigation. This means it can easily be removed by a tractor loader backhoe (TLB) of flywheel power >0.10 kW per mm of tined bucket width.

Laboratory Results	Nine bulk samples were collected from the Slightly moist, light brown, intact, _Medium dense, Coarse grained ~Gravelly ~sand. The parent metamorphic rock (Makhutswi Gneiss) grade varies with depth from highly weathered hard rock to consolidated high strength bedrock. Homogeneity of material underlying the site was observed hence a choice of nine bulk representative samples. The samples were found to be non-plastic. The PI along with the clay content indicated that the samples exhibit low potential expansiveness. The sample indicated CBR of 29 at 95% MOD AASHTO with a grading modulus of 1.84 for TP2, a CBR of 49 at 95% MOD AASHTO with a grading modulus of 1.79 for TP10. Based on COLTO classification the samples of TP2 and TP10 were classified as G6 and G5 respectively.
Construction material suitability	The intention is to be able to recommend for the founding levels for the foundation design for the proposed development. The soil was mainly composed of granular soils which are ideal for construction.
Site classification designation	Soil class is **"SC", and "SC1"** in NHBRC Standards and manuals.
Foundation Design	The recommended Foundation types in accordance with SANS 10400H- Foundation: *Normal Strip Foundation / Reinforced Strip Foundation.*

1. INTRODUCTION

Mutali Geoscience Solutions (Pty) Ltd conducts a Phase 1 near surface geotechnical investigation for the proposed Township establishment situated on the Remainder of portion 1 and 2 of the farm Seville 224 KU for Bushbuckridge Local Municipality. The area under investigation measures approximately 25.50 hectares.

2. OBJECTIVES OF THE STUDY

This report evaluates the geotechnical characteristics associated with the underlying geology and any geotechnical constraints that might affect structural integrity of the proposed Township establishment. However, it is also essential to Identify engineering properties' potential influence on the design, construction and operation of the intended infrastructures.

The main objective of the investigation was aimed at defining the founding materials and establishing broader geotechnical conditions and their suitability to the development.

The following are some of the objectives of the conducted geotechnical investigation:

- To determine the geology of the site
- To establish in broad terms, the nature and relevant engineering properties of the upper soil and rock strata underlying the site.
- To ascertain the soil chemistry including pH determination and electrical conductivity of the soil.
- To comment on suitable excavation procedures for the installation of services.
- To present general foundation recommendations for the proposed development.
- To comment on any other geotechnical aspects as these may affect the development.
- Determine the presence or occurrence of groundwater from the surface to a maximum depth of 3 meters.
- Classification of the site material according to the TRH14 classification system

The geotechnical investigation was carried out in accordance with SAIEG and GFSH-2 guidelines and all NHBRC Home Building Manuals. This report presents findings on the geotechnical properties and characteristics of the surficial soils underlying the site, the investigation methodology and discusses recommendations for earthworks, drainage, ease of excavation and foundations.

3. INFORMATION USED IN THIS STUDY

The geotechnical investigation commenced with a desktop study using the existing geotechnical databases and maps pertaining, structural engineer specifications of the site were reviewed.

The following information was reviewed and consulted during the site investigation:

- Expansive Roadbed Treatment for Southern Africa: D J Weston (1980) 4th Int. Conf. on Expansive Soils, Vol. 1, Denver pp 339-360;
- Geological Map of South Africa from the database of Council For Geoscience: Scale 1: 100 000 Sheet – Geological series 2431CB
- National Home Builders Registration Council: Home Builders Manual 2015;
- SAICE's Guidelines for Urban Engineering Geological Investigations;
- Schwartz, K. (1985). Collapsible soils. The Civil Engineer in South Africa, July, p379-393 and;
- South African Weather Service
- Technical Recommendations for Highways – TRH14 Guidelines for Road Construction Materials by the National Institute for Transport and road research of the Council for Scientific and Industrial Research, (1985);

4. SITE DESCRIPTION

4.1. Location

The general Geographical Positioning System (GPS) coordinates for proposed development are 24°39'44.78"S 31°24'16,53"E at an average elevation of 418m meters above sea level.

The proposed site for the development is located on the Remainder of portion 1 and 2 of the farm Seville 224 KU, under Bushbuckridge Local Municipality, Mpumalanga Province of South Africa. The site can be generally described as rural residential area with schools, shopping complex, and other spatial features within the 40km radius. The general geographical positioning system (GPS) coordinates of the proposed development site are as follows:

Table 1: general geographical positioning system (GPS) coordinates

FARM NAME	CO-ORDINATES	
	LATITUDE	LONGITUDE
SEVILLE 224 KU	24°39'44.78"S	31°24'16.53"E

The proposed site locality map is shown in Figure 1 below.

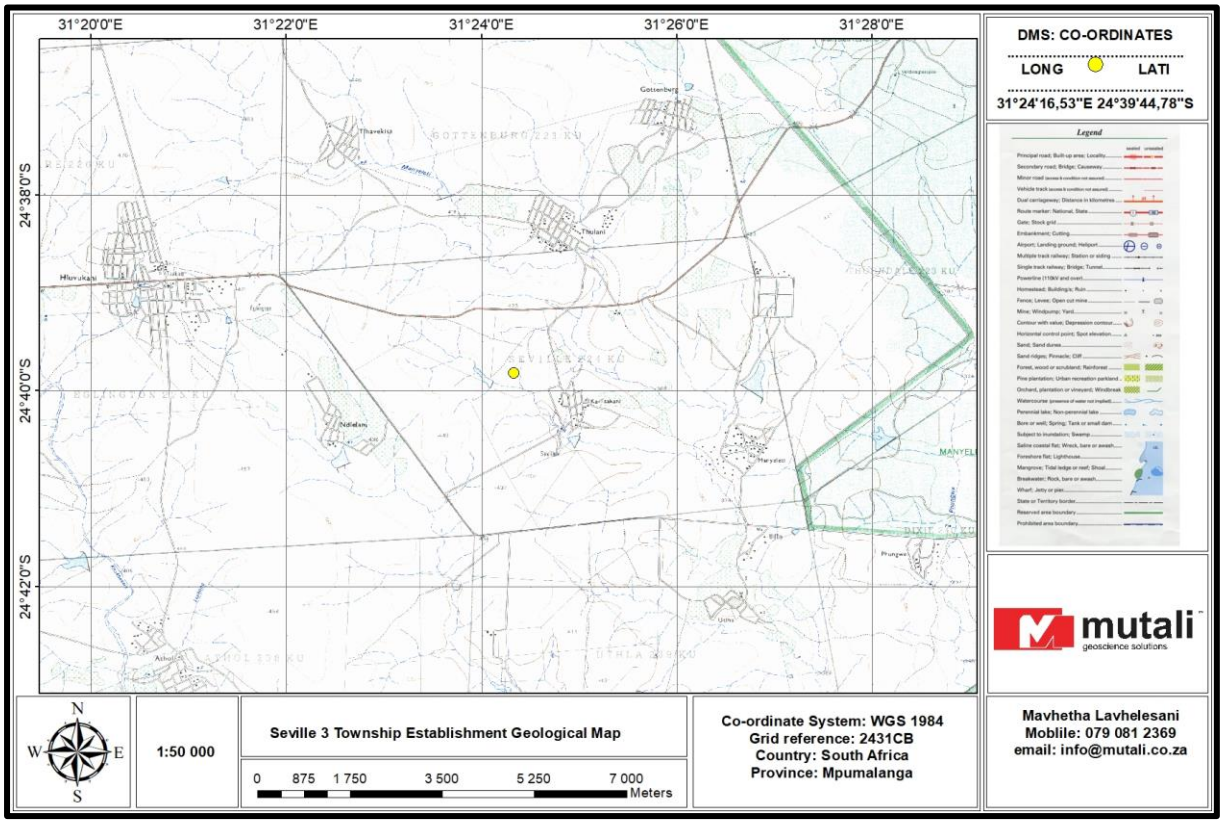

Figure 1: Locality Map of the site

4.2. Topography and drainage

It was noted during site observation survey and actual geotechnical fieldwork procedures that the site topography is generally flat. This was expected since the engineering geologist conducted geological and topographic studies using ArcGISpro software prior site visit. During the investigation the proposed site was accessible by a four-wheeled drive vehicle as there are few tracks or trails on site.

4.3. Climate

The study area falls within the Summer Rainfall Climatic Zone with the mean annual precipitation of 843 mm per annum. The warmest month is January with an average maximum temperature of 32°C. The driest month of the year is August with an average of

10mm of precipitation. The wettest month is February having an average 149mm of precipitation

During site investigations, the weather was Sunny no precipitation (rainfall) occurred.

The climatic condition plays a fundamental role in the development of a soil profile and the weathering of rock. Chemical decomposition is the predominant mode of rock weathering in areas where the climatic “N-value” is less than 5. In areas where the climatic N-value is between 5 and 10, disintegration is the predominant form of weathering, although some chemical decomposition of the primary rock minerals still takes place. Where the climatic N-value is greater than 10, secondary minerals do not develop to an appreciable extent and all weathering takes place by mechanical disintegration of the rock.

Weinert’s climatic N-value for the study area is less than 5. This implies that rocks are extensively weathered, often to depths of several metres, and decomposition is pronounced.

4.4. Land Use

The current land use for the proposed site for the development is a vacant land utilised for crop farming and animal grazing

5. SITE GEOLOGY

Table 2: Geological attributes of the site

Lithology	Formation	Strata Genetic	Chronology
Granite Gneiss	Makhutswi Gneiss	Archean Basement	swazian

Extract of regional geological map 2431CB in figure 2 indicates that, the site is located within the lithologies covered by Metamorphic makhutswi Gneiss rocks. The two main types of gneiss are found in the lowveld, South of the Murchison greenstone belt. Firstly is the layered composite makhutswi Gneiss which extend 60km South of the Murchison greenstone belt and also south of Klaserie gneiss. Karoo and Transvaal sediments covers Makhutswi Gneiss in the east and west respectively. The Makhutswi Gneiss is complex folded, and in some areas intruded by younger, unmigmatised biotite gneiss of tonalitic composition. It is also intruded by the Timbavati Gabbro.

The site geological examination reveal the phaneritic texture granatoid rocks which are predominately composed of felsic minerals such as quartz, plagioclase feldspars and mafic

(amphiboles and pyroxene) accessory minerals. Based on the physical properties of the rock samples and geological maps review of the site; the lithology of the site is coarse grained Gneiss of Makhutswi formation. The site had some highly weathered exposed Gneiss outcrops, majority of the site overlaid by thick strata of sandy silt at the top and medium to coarse gravel before to the base of the Gneiss bedrock. The geological map in figure 2 indicates the geological setting of the site and its surrounding.

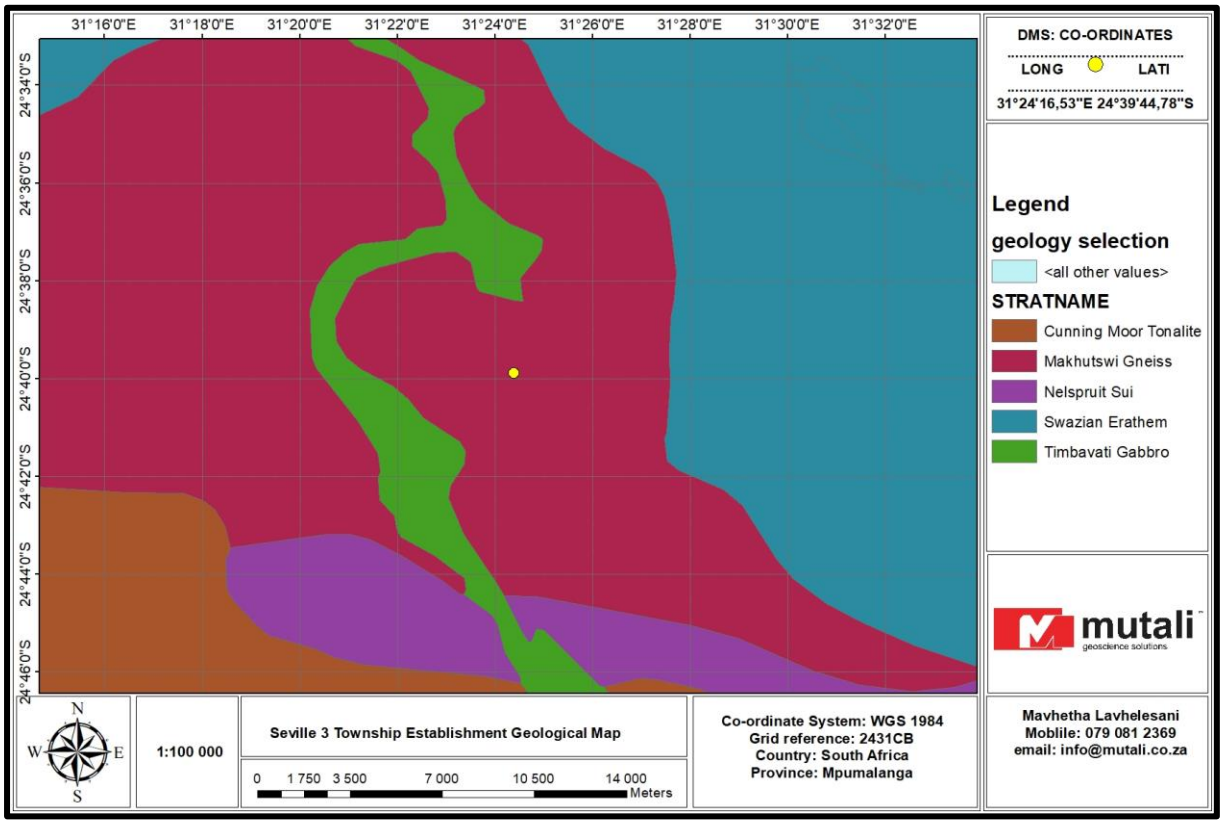

Figure 2: Extract of regional geological map (2431CB) of the proposed site

6. SOIL PROFILES

Strata that were encountered in the test pits during the field investigations are given below. Moreover, the summary of the test pit profiles is shown in Table 2.

Top soils

The topsoil is characterised by an upper stratum of Sandy silty which have an average thickness of 0.41m in the range 0 to 0.55m below ground level. It is characterised by non-cohesive materials typically described as “Slightly moist, greyish, intact, _Dense, ~Sandy ~Silty.”

Residual soils

Residual soil was encountered in all test pit with an average thickness of 1.35m in the range 0.3m to 1.66m below ground level. These soils originate from the in-situ weathering of the metamorphic rock (Makhutswi Gneiss) which is underlined the site. This stratum is typically described as “Slightly moist, light brown, intact, _Medium dense, Coarse grained ~Gravelly ~sand”.

Gneiss Bedrock

Gneiss bedrock was found at a range between 0.9m to 1.9m. It must be noted that the flywheel TLB had a difficult time excavating in depth exceeding 1.66m. It must be noted that excavating beyond this depth may require power tools since the bedrock can be classified as hard excavation

Table 3: Summary of the test pit profiles

Test Pit ID.	Handheld GPS Coordinates			Depth (m)			Water seepage(m)	Comment
	Longitude (E)	Latitude (S)	Altitude (m)	Topsoil	Residual Soil	Bedrock (Sandstone)		
TP1	31°24'34.40"E	24°39'57.91"S	407	0- 0.4	0.4-1.5	1.5-1.7	-	Gravelly sand
TP2	31°24'30.68"E	24°39'53.88"S	411	0-0.33	0.33-0.9	0.9-1.6	-	Gravelly sand
TP3	31°24'24.46"E	24°39'49.80"S	411	0-0.3	0.3-0.84	0.84-1.2	-	Gravelly sand
TP4	31°24'19.48"E	24°39'45.74"S	416	0-0.34	0.34-1.08	1.08-1.3	-	Gravelly sand
TP5	31°24'26.82"E	24°39'44.03"S	416	0-0.45	0.45-1.27	1.27- 1.4	-	Gravelly sand
TP6	31°24'23.12"E	24°39'36.12"S	418	0-0.48	0.48-1.33	1.33-1.62	-	Gravelly sand

TP7	31°24'16.04"E	24°39'37.44"S	425	0-0.55	0.55-1.2	1.2- 1.5	-	Gravelly sand
TP8	31°24'11.49"E	24°39'42.95"S	427	0-0.35	0.35-1.66	1.66-1.74	-	Gravelly sand
TP9	31°24'11.87"E	24°39'29.78"S	420	0-0.48	0.48-1.33	1.33-1.58	-	Gravelly sand
TP10	31°24'21.11"E	24°39'28.76"S	415	0-0.44	0.44-1.08	1.08-1.9	-	Gravelly sand
TP11	31°24'19.07"E	24°39'21.63"S	410	0-0.4	0.4-1.5	1.5-1.6	-	Gravelly sand
TP12	31°24'16.54"E	24°39'15.11"S	420	0-0.37	0.37-1.56	1.56-1.7	-	Gravelly sand
TP13	31°24'11.26"E	24°39'18.44"S	420	0-0.4	0.4-1.24	1.24-1.47	-	Gravelly sand

7. HYDROGEOLOY

7.1. Drainage patterns

Natural ground water seepage was not encountered in any of the test pits and there is no indication of temporary perched water tables in the soil profile, not even at the contact between soil and bedrock. It is therefore expected that if temporary perched water was to at the site, it would occur at bedrock level and only after unusually prolonged and substantial rain. Groundwater seepage is not expected to be problematic at shallow depths on this site.

8. METHOD OF INVESTIGATION

The fieldwork was undertaken on the 29 July 2022 and comprised of the following:

- Desktop study
- Walk over survey and Pit excavations
- Test Pits profiling
- Soil Sampling

8.1. Desktop Study

The desk study comprises the review of existing regional, site and surface information. Sources of information include:

- Topographic maps, geological data such as lithology of nearby rock outcrops, landforms and erosion patterns;
- Existing geotechnical reports prepared for areas in close proximity to the site;
- Data on seismic aspects, such as ground motion and liquefaction potential.

8.2. Field Mapping

A walk-over survey was carried out on the proposed site to obtain as much information as possible of the subsurface conditions from existing soil. A Gneiss outcrop was identified during the investigation.

8.3. Inspection of the test pits

The field investigation was conducted on the 29 July 2022. Based on the “Site Investigation Code of Practice” (SAICE Geotechnical Division, 2010), which provides standards for “acceptable engineering practice”, a total of 13 (Thirteen) test pits were planned for the proposed development.

This chapter of the report describes the field work and activities that were conducted in order to assess the geotechnical conditions at the proposed site. Test pits were positioned using a hand held GPS and the position of the test pits is shown on figure 3. The method of investigation was based on excavation of the surface to a maximum depth of 3 m below existing ground level using fly wheel TLB (Tractor-Loader-Backhoe) in order to obtain information on the subsurface soil; each pit was marked, photographed and profiled by a field engineering geologist in accordance with the current standard procedures proposed by Brink and Bruin (2002). The test pit photographs are presented in Appendix A of this report.

These included the following components:

- Excavation of 13 (Thirteen) test pits with an aid of a fly wheel TLB (Tractor-Loader-Backhoe)
- Representative samples were retrieved from the test pits for laboratory testing at SANAS accredited laboratory.

9. LABORATORY RESULTS

The field work indicated a general homogeneity of the subsurface soils comprising of Slightly moist, light brown, intact, Medium dense, Coarse grained ~Gravelly ~sand. Representative disturbed subsoil samples retrieved from the inspection pits during the investigation were taken to a commercial laboratory for testing. These tests aid in assessing the behavior of soils due to moisture changes particularly below foundations. The following tests were conducted on soil samples taken during the field work phase by a suitable SANAS accredited soils laboratory (Civilab, Johannesburg (Booysens): Gauteng Province):

Standard foundation indicator tests were conducted on disturbed soil samples in order to determine its composition, to evaluate the heave and compressibility potential of these soils, and to calculate the maximum heave and/or differential settlement that can be expected. The following tests were conducted:

- 9 Atterberg Limits (plastic limit, liquid limit and plasticity index);
- 9 Grading analysis and;
- 2 MOD and 2 CBR,
- 2 pH and 2 Conductivity

The laboratory tests were conducted in order to assist with the classification, description, and delineation of homogenous zones. The results of the foundation indicator, MOD and CBR tests are presented in Appendix B and are summarized in Table 4 and Table 5 respectively. The samples were taken from the test pit position denoted in the same manner.

Topsoil Material – Topsoil layer was observed in all of the trial pits. The material didn't show road bearing capacity. There was no sample taken from this layer. The layer has an average thickness of 0.41m in the range 0 to 0.55m below ground level. It is characterised by non-cohesive materials typically described as "Slightly moist, greyish, intact, _Dense, ~Sandy ~Silty."

Residual soils Nine bulk samples were collected from the Slightly moist, light brown, intact, _Medium dense, Coarse grained ~Gravelly ~sand. The parent metamorphic rock (Makhutswi Gneiss) grade varies with depth from highly weathered hard rock to consolidated high strength bedrock. Homogeneity of material underlying the site was observed hence a choice of nine bulk representative samples. The samples were found to be non-plastic. The PI along with the clay content indicated that the samples exhibit low potential expansiveness. The sample indicated CBR of 29 at 95% MOD AASHTO with a grading modulus of 1.84 for TP2, a CBR of 49 at 95% MOD AASHTO with a grading modulus of 1.79 for TP10. Based on

COLTO classification the samples of TP2 and TP10 were classified as G6 and G5 respectively.

PH and Conductivity – pH measurements conducted indicated that the pH of the area is 5.89 for TP02 at a depth of 0.9-1.6m and 7.4 for TP10 at depth of 1.08-1.9m. Conductivity measurements indicated that the conductivity of the area is 0.0043 S/m for TP02 at a depth of 0.9-1.6m, 0.0143 S/m for TP10 at depth of 1.08-1.9m. The area can be classified as Slightly-corrosive (SC). Therefore, corrosive materials (pipelines) installation must include measures against corrosion.

Table 4: Summary of the foundation indicator test results

Sample No.	HRB (AASHTO)	Depth (m)	Atterberg Limit			GM	Grading analysis (%)				Potential expansiveness
			LL %	LS %	PI %		Clay	Silt	Sand	Gravel	
TP02	A-1-a(0)	0.33-0.9	-	0.0	NP	2.22	1	6	38	55	LOW
TP02	A-1-b(0)	0.9-1.6	1	0.0	NP	1.84	1	9	62	28	LOW
TP04	A-1-b(0)	0.34-1.08	-	0.0	NP	2.11	2	6	43	49	LOW
TP06	A-2-7(2)	0.48-1.33	52	11.0	28	1.73	10	14	41	35	LOW
TP08	A-1-b(0)	0.35-1.66	-	0.0	NP	2.02	1	7	53	39	LOW
TP09	A-1-b(0)	0.48-1.33	-	0.0	NP	2.13	1	6	45	48	LOW
TP10	A-1-b(0)	1.08-1.9	-	0.0	NP	1.79	2	9	58	31	LOW
TP12	A-1-b(0)	0.37-1.56	-	0.0	NP	2.08	1	7	48	45	LOW

TP13	A-1-a(0)	0.4-1.24	-	0.0	NP	2.21	1	5	42	57	LOW

LL: Liquid Limit **PI**: Plasticity Index **LS:** Linear Shrinkage **GM:** Grading Modulus **NP: Non**-Plastic

Table 5: Summary of the MOD & CBR test results

Sample No.	HRB (AASHTO)	Depth (m)	CBR @						GM	Max. Swell (%)	OMC (%)	Max Dry Density (kg/m^3)	COLTO Classification
			90 %	93%	95%	97%	98%	100%					
TP2	A-1-a(0)	0.9-1.6	19	25	29	35	38	45	2.22	0.1	7.4	2068	G6
TP10	A-1-b(0)	1.08-1.9	29	40	49	60	66	81	2.08	0.1	7.8	2078	G5

PI: Plasticity Index **GM:** Grading Modulus **OMC:** Optimum Moisture Content **CBR: California** Bearing Ratio

10. GEOHAZARDS

10.1. Seismic Hazard / Activities

The seismic zones are determined from the seismic hazard map which represents peak ground acceleration with a 10% probabilistic of being exceeded in a 50-year period.

Two types of seismic activities occur in South Africa, namely:

- Regions of natural seismic activity (Zone I), and
- Regions of mining-induced and natural seismic activity (Zone II).

In accordance with the seismic hazard zones contained in SANS 10160-4, the site fall within Zone I, as shown in Figure 3

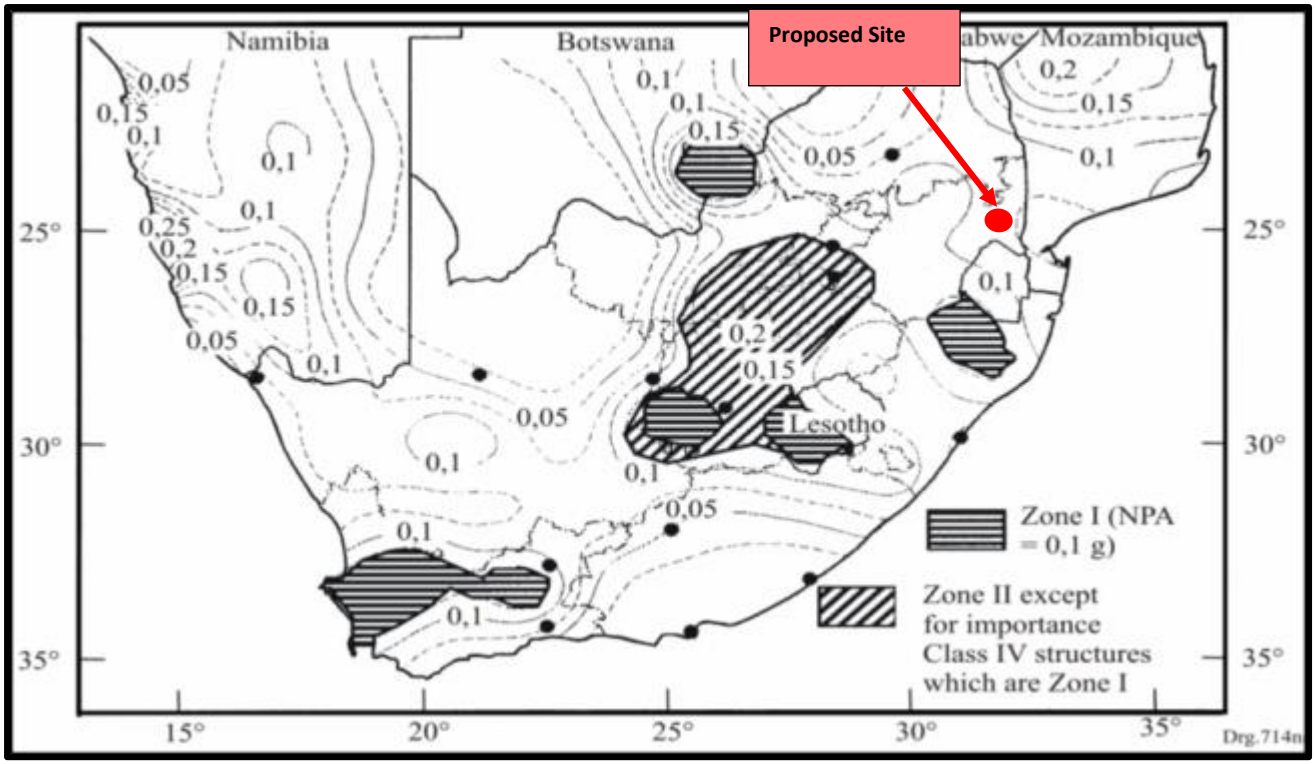

Figure 3: Seismic Hazard Zones of South Africa

Both the seismic hazard zones and the seismic hazard maps of South Africa produced by Kijko (2003), show the site is situated in the area where the peak ground acceleration is great than 10% probability of occurrence in a 50-year period is, approximately 0.16g to 0.24g. The seismic hazard map of South Africa is shown in Figure 4.

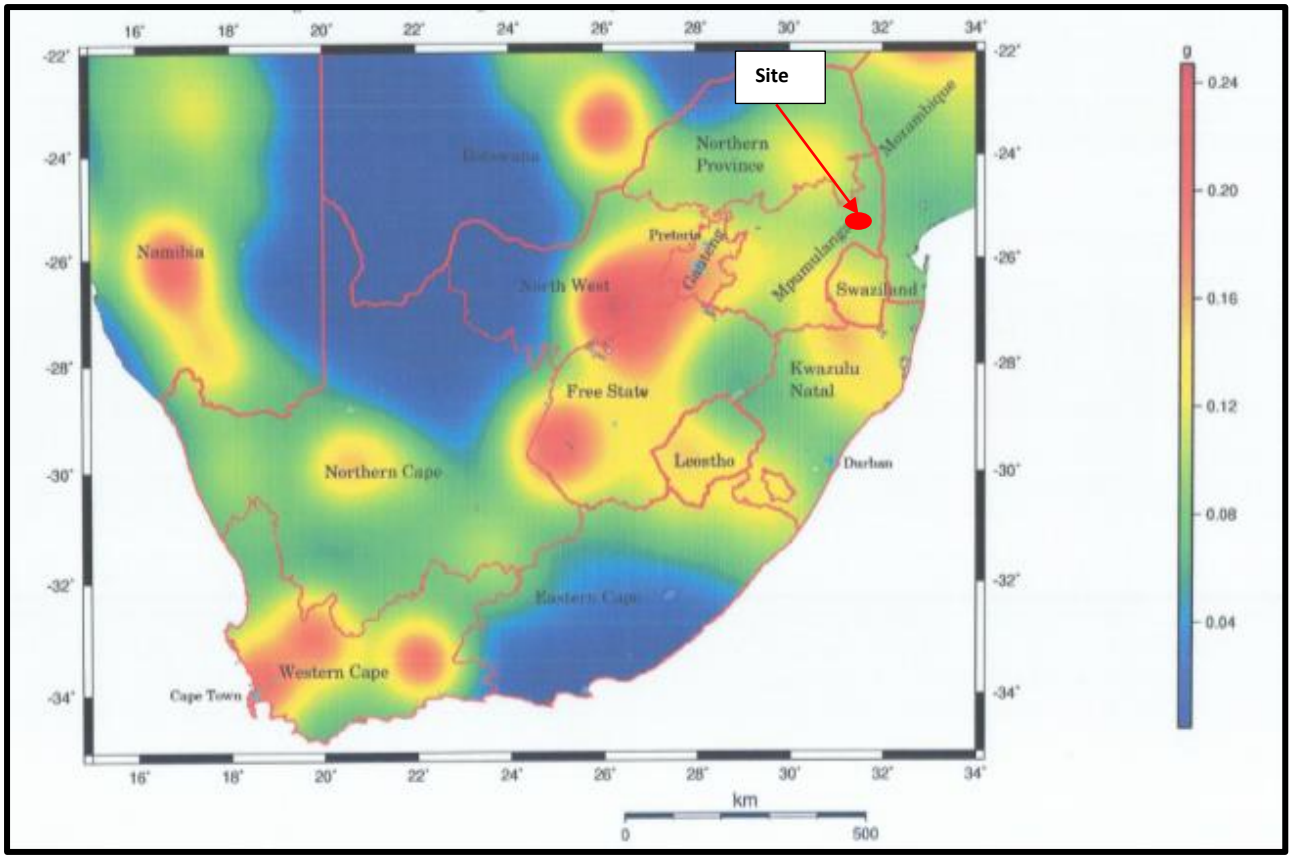

Figure 4: Seismic Hazard Map of South Africa, Kijko et. al. (2003)

10.2. Ground Subsidence

Subsidence occurs in areas with large underground cavities typically resulting from large scale shallow to very shallow underground mining and from dolomite/limestone dissolution. It may also appear where thick deposits of unconsolidated material exist.

No signs of previous subsidence were evident during the site investigation. The site can be classified as a mining active area, however, there are no underground mining directly below the site. Should the new information relating to mining activity or seismic activity later uncovered, the Department of Mineral Resources (DMR) will be consulted.

10.3. Sinkhole Formation

Similar to subsidence, sinkhole formation occurs in areas with very large to extremely large underground cavities resulting from poorly designed shallow underground activities. Dissolution of dolomites or limestone, over millions of years, may lead to cavity formations which later manifest as sinkholes.

The available geological maps and geological mapping from site investigations indicate that the site is not underlain by dolomite or soluble rocks/minerals.

10.4. Landslides and Mudslides

The probability of landslides and mudslides occurring within this area are remote. This is primarily due to the low relief and relatively flat gradient that have angle less than that of critical angle of repose.

10.5. Falls and Rockslides

The probability of the occurrence of rock falls and rockslides is low.

10.6. Volcanic Activities

South Africa has seen its last volcanic activity approximately 65 million years ago during the massive historical eruption of the Drakensberg Lava forming the Basaltic Drakensberg Mountain Ranges that we see today. Recent studies showed no signs for the possibility of volcanic eruption in the foreseeable future.

11. GEOTECHNICAL EVALUATION

This report focuses on the geotechnical site investigation and is aimed at determining various geotechnical properties of the near surface soil horizons in accordance with SAICE Code of Practice, SANS guidelines and NHBRC guidelines and the GFSH-2 document. Table 6 gives the basis of the soil site classification that was applied during the investigation and Table 7 gives the geotechnical classification for urban development.

Table 6: Residential site class designations

TYPICAL FOUNDING MATERIAL	CHARACTER OF FOUNDING MATERIAL	EXPECTED RANGE OF TOTAL SOIL MOVEMENTS (mm)	ASSUMED DIFFERENTIAL MOVEMENT (%OF TOTAL)	SITE CLASS
Rock (excluding mud rocks which may exhibit swelling to some depth)	STABLE	NEGLIGIBLE	-	R
Fine grained soils with moderate to very high plasticity (clays, silty clays, clayey silts and sandy clays)	EXPANSIVE SOILS	<7,5 7,5-15 15-30 >30	50% 50% 50% 50%	H H1 H2 H3
Silty sands, sands, sandy and gravelly soils	COMPRESSIBLE AND POTENTIALLY COLLAPSIBLE SOILS	<5,0 5,0-10 >10	75% 75% 75%	C C1 C2
Fine grained soils (clayey silts and clayey sands of low plasticity), sands, sandy and gravelly soils	COMPRESSIBLE SOIL	<10 10-20 >20	50% 50% 50%	S S1 S2
Contaminated soils, Controlled fill, Dolomitic areas, Landslip Land fill, Marshy areas Mine waste fill Mining subsidence Reclaimed areas Very soft silt/silty clays Uncontrolled fill	VARIABLE	VARIABLE		P

Table 7: Geotechnical Classification for Urban Development (GFSH-2 Document)

Geotechnical Sub-Area	Definition
1	Areas recommended or favorable for development
2	Areas where development can be considered with certain precautionary measures.
3	Areas that are not recommended for development

Other related engineering geological characteristics such as collapse settlement, compressibility, slope stability groundwater etc. were evaluated. The geotechnical properties relevant to the development are discussed below.

11.1. Expansive soils

Active/expansive soils are defined as fine grained soils (generally with high clay content) that change in volume in response to the change in moisture content. These soils may increase in volume (heave/swell) upon wetting and decrease in volume (shrink) upon drying out. These soils are classified as (H) according to the SAICE site classes. Depending on the severity of the predicted movement, expansive soils can be classified as H, H1, H2 or H3 (Table 6).

The site does exhibit expansive soils; therefore, this class **H** is not applicable.

11.2. Collapsible soils

Collapsible soils are defined as soils that have a potential for collapse and are commonly open textured with a high void ratio (Brink, 1985). These soils are typically silty sands, sands, sandy and gravelly soils commonly found in colluvial and aeolian sands. Soils which exhibit potentially collapsible characteristics are classified with the soil site class 'C' according to the SAICE site classification system (Table 6)

The soils encountered on the site typically comprise of gravelly sand with no visual open-textured structures such as voids and pinholes which indicate collapse potential.

From the site observations it can be said that the site exhibit low to medium collapse potential. Therefore, the **site is classified as site class C/C1** according to the GFSH-2 classification.

11.3. Compressible soils

Compressible soils are soils in which the bulk volume of the soil may gradually decrease with time when subjected to an applied load. These soils typically comprise fine grained soils such as clay, clayey sand and clayey silt with low plasticity, gravelly and sandy soil. According to the SAICE soil site class these soils are denoted as class 'S' and may very (S, S1, S2) depending on the severity of the bulk volume change (Table 6).

The site does exhibit compressible soil, therefore, this class **S**.

11.4. Soil site classification

A review of the test pit data indicates that the site is generally underlain by residual gravelly sand. The laboratory tests indicated that material underlying the site exhibits low potential expansiveness. The development potential has been broadly classified in terms of a Geotechnical Sub-Area based on field observations/investigation (geological, hydrogeological, and geomorphological) and laboratory soil testing of soil samples. From the above discussion the site is classified into main soil area namely compressible and potential collapsible soils: **The foundation design options as per SANS10400 H- soil class is "SC", and "SC1" in NHBRC Standards and manuals. The recommended Foundation types in accordance with** SANS 10400H- Foundation: ***Normal Strip Foundation / Reinforced Deep Strip Foundation.***

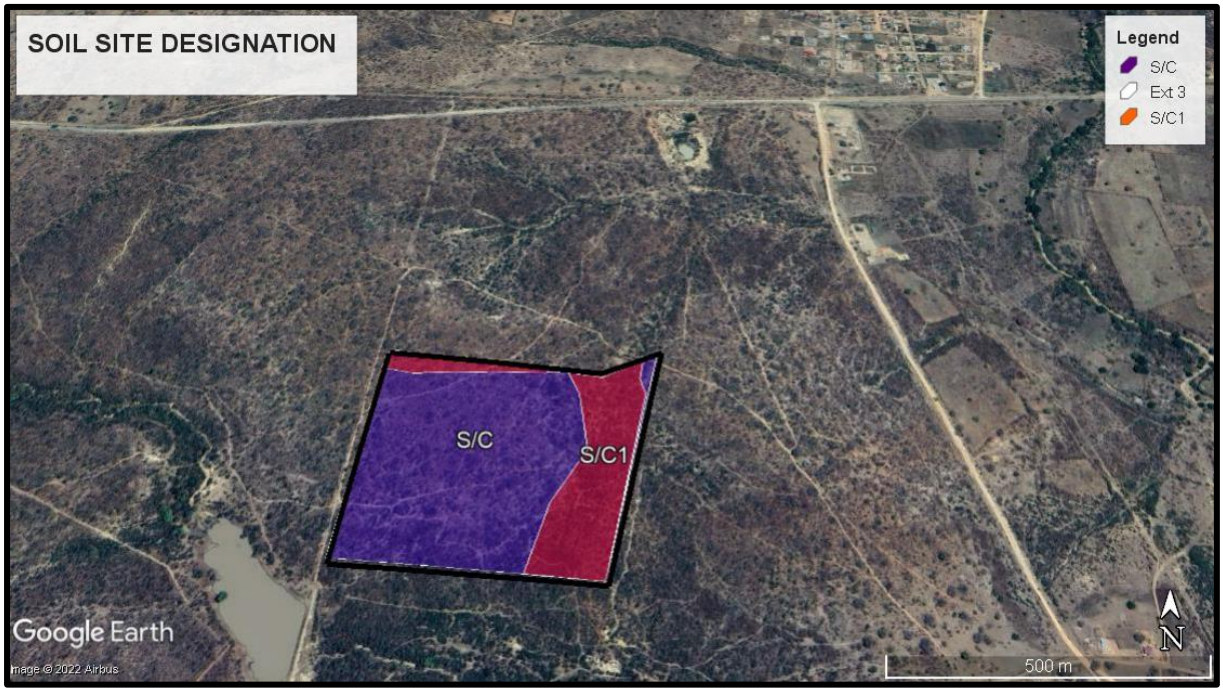

Figure 5: Soil Site Classification Map

Table 8: Geotechnical zones & NHBRC classification

SITE CLASS	DESCRIPTION	DEVELOPMENT POTENTIAL	CONSTRUCTION TYPE	FOUNDATION RECOMMENDATION	EXCAVABILITY
S/C	Residual soils	Favourable	Normal	Normal Strip Foundation	Soft excavation
S/C1	Residual soils	Intermediate	Modified	Reinforced strip foundation	Soft excavation

11.5. Excavation Classification

The in-situ soils and highly weathered Makhutswi Gneiss bedrock were excavated to a maximum depth of 1.9m below ground level.

Based on the test pits excavations, it is anticipated that site should classify as “soft excavation” throughout, in accordance with SANS 1200 DA classification using similar plant as employed during this investigation. This means it can easily be removed by a tractor loader backhoe (TLB) of flywheel power >0.10 kW per mm of tined bucket width.

11.6. Stability of excavations sidewalls

It was noted during trail pit excavations that the sidewalls retain its initial condition without crumbling. This is a good indication for the behaviour of the materials; excavated ground must retain its stature vertically without unsupported.

For safety reasons, sidewalls of excavations deeper than 1.5 m should be battered back to 1:1 in dry conditions. Should oblique jointing or any seepage be noted, then the sidewalls may need to be battered at a much flatter gradient. This is only acceptable for excavation depths restricted to less than 3.0 m. All safety precautions should be adhered to. Should battering be deemed unpractical due to some site conditions, sidewalls should be supported by suitably designed shoring technique.

11.7. Construction Material suitability

The aim of this geotechnical site investigation report was to determine the different engineering geological properties of the surface and subsurface soils in accordance with the

GFSH–2 guidelines of the NHBRC. The intention is to be able to recommend for the founding levels for the foundation design for the proposed development. The soil was mainly composed of granular soils which are ideal for construction.

12. RECOMMENDATIONS

The following foundation recommendations are based on information gathered on site through field observations; test pitting and laboratory testing. Although this investigation was conducted with all reasonable skill, care and diligence, some degree of variation may be expected between data points and design engineers should take cognizance of this. The design of structures and services remains the responsibility of the design engineers. Site specific investigations must be conducted for structures greater than the intended purpose.

It is important to note that foundation recommendations are based on fieldwork and laboratory test results interpretation. Based on site conditions and evaluation described in this report the following foundation types are recommended. ***Normal Strip Foundation / Reinforced Strip Foundation***

12.1. Foundations on soil class "S/C"

The gravelly sand residual soils were classified as "S/C". The recommended foundation type for this soil class is a ***normal strip foundation***. The following construction procedures apply:

- All topsoil to be stripped to spoil;
- Foundation excavation to the moderately weathered, highly fractured, medium hard rock at an average depth of 1.6 m below existing ground level;
- The excavation onto the weathered Gneiss to be hand cleaned and all loose material to be removed;
- A concrete blinding to be cast to onto cleaned rock surface prior to casting foundations;
- The allowable bearing capacity should be limited to 250kPa on the weathered Gneiss bedrock.

12.2. Foundations on Soil Class "S/C1"

Residual soils on this portion are highly weathered due to the moisture content onsite and the portion of the site is classified as "S/C1" and indicated in figure 6.

Therefore, the recommended foundation type for this portion is a ***Reinforced strip foundation***. The in-situ material can be utilised for founding material as there are of G5/G6 material. Reinforcement should be designed by a competent person. The following construction procedures apply.

- All topsoil to be stripped to spoil;
- Foundation trenches for 500mm wide strip footing to be over-excavated to 1.0m wide by 1.6m deep below existing ground level;
- Excavation to be backfill with G6 quality material to a depth of 0.6m existing ground level;
- G6 material to be compacted in 150mm thick layers to 93% Mod AASHTO density at –1% to +2% OMC;
- Strip footings 500mm wide and adequately reinforced should be constructed at a depth of 0.6m;
- The allowable bearing capacity should be limited to 150kPa on the engineered soil mattress;
- Articulation joints at some internal doors and all external doors;
- Light reinforcement in masonry;
- Good site drainage requirements.

13. REFERENCE

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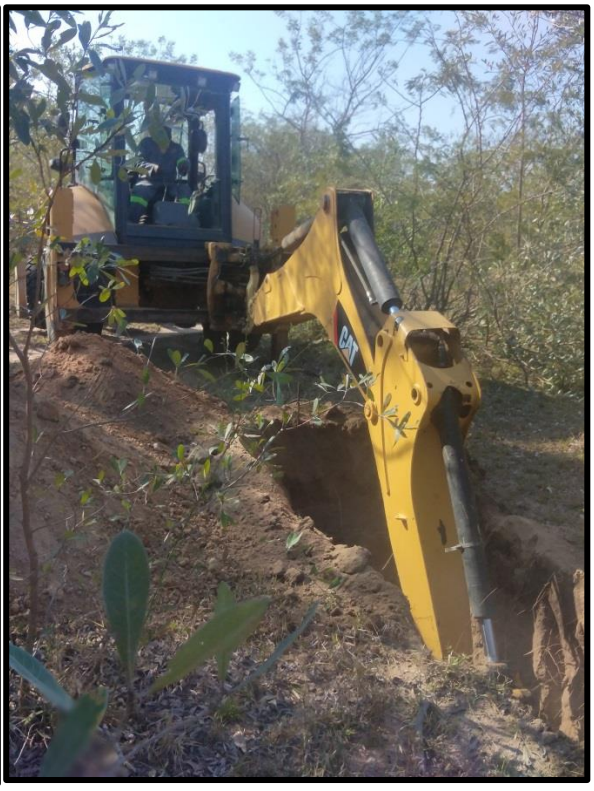
- NP Richards and L Croukamp (2004). Geotechnical Investigation Guidelines for Cemetery Site Selection. Council for Geoscience

14. APPENDIX A: SITE PHOTOS







CAT

15. APPENDIX B: LABORATORY RESULTS

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Address	:	R533 GRASKOP ROAD OPPOSITE	**Client No.**	:	NKA004
	:	MAPULANENG DLTC	**Client Reference**	:	
	:	BUSHBUCKRIDGE, 1280	**Order No.**	:	Mavhetha
Attention	:		**Date Received**	:	01/08/2022
Telephone	:	013 004 0291	**Date Tested**	:	03/08/2022-17/08/2022
E-mail	:	isishabela@yahoo.co.uk	**Date Reported**	:	19/08/2022
Project	:	Seville 3			
Project No.	:	2022-B-860	**Report Status**	:	Final
			Page	:	1 of 11

Herewith please find the test report(s) pertaining to the above project. All tests were conducted in accordance with prescribed test method(s). Information herein consists of the following:

Test(s) conducted / Item(s) measured	Qty.	Test Method(s)	Authorized By**	Page(s)
Sieve Analysis to 0.045 mm	9.000	SANS 3001:GR1	S Pullen/ B Mvubu	2-6; 9-10
Atterberg Limits	9.000	SANS 3001:GR10	S Pullen/ B Mvubu	2-6; 9-10
Hydrometer Analysis	9.000	SANS 3001:GR3	S Pullen/ B Mvubu	2-6
Moisture Density Relationship: Mod. AASHTO	2.000	SANS 3001:GR30	S Pullen	7-8
Califonia Bearing Ratio	2.000	SANS 3001:GR40	S Pullen	9-10
pH*	2.000	TMH1:A20	S Pullen	11
Conductivity of Saturated Soil Paste*	2.000	TMH1:A21T	S Pullen	11

Any test results contained in this report and marked with * in the table above are "not SANAS accredited" and are not included in the schedule of accreditation for this laboratory.

Any information contained in this test report pertain only to the areas and/or samples tested. Documents may only be reproduced or published in their full context.

While every care is taken to ensure that all tests are carried out in accordance with recognised standards, neither **Civilab** (Proprietary) Limited nor its employess shall be liable in any way whatsoever for any error made in the execution or reporting of tests or any erroneous conclusions drawn therefrom or for any consequences thereof.

All interpretations, Interpolations, Opinions and/or Classifications contained in this report falls outside our scope of accreditation.

The following parameters, where applicable, were excluded from the classification procedure: Chemical modifications, Additional fines, Fractured Faces, Soluble Salts, pH, Conductivity, Coarse Sand Ratio, Durability (COLTO: G4-G9).

The following parameters, where applicable, were assumed: Rock types were assumed to be of an Arenaceous nature with Siliceous cementing material.

Unless otherwise requested or stated, all samples will be discarded after a period of 3 months.

This report is completely confidential between the parties (**Civilab** and **Civilab**`s client) and shall not be disclosed to anybody else, unless agreed upon in writing or made publicly available by the client or required to make available by law. As part of the SANAS accreditation arrangement and Internal audit policy, **Civilab** will be assessed and audited on an ongoing basis to ensure continuous compliance to ISO/IEC 17025 and SANAS policies and procedures. All service providers (including SANAS) have signed a Non-disclosure Agreement/ Confidentiality Agreement as part of our contractual agreement in order to have access to these results if needed.

Deviations in Test Methods:

Technical Signatory:	
Signature:	

**All results are authorized electronically by approved managers and/or technical signatories.

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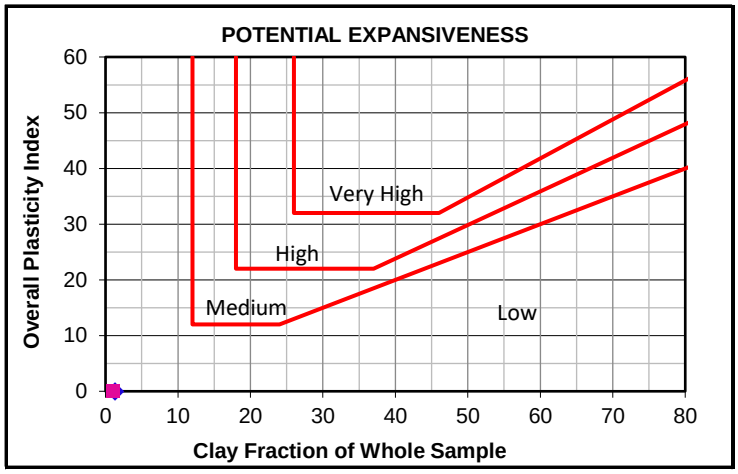
Project	:	Seville 3	Date Reported:	19/08/2022
Project No	:	2022-B-860	Page No. :	2 of 11

FOUNDATION INDICATOR

Laboratory Number		S860-1 ◆	S860-2 ■
Field Number		TP2	TP2
Client Reference			
Depth (m)		0.33-0.9	0.9-1.6
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed Stabilizing Agent			

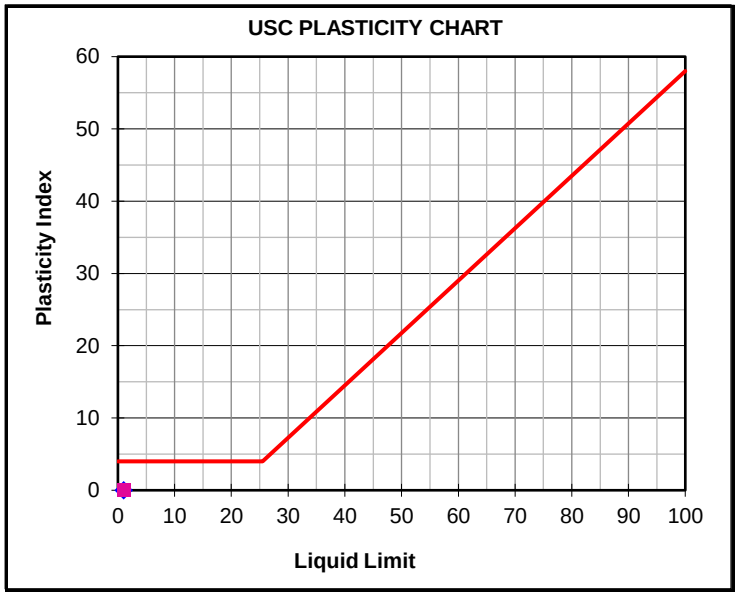


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep)

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	98	99
	5 mm	72	87
	2 mm	45	72
	1 mm	37	49
	0.425 mm	25	32
	0.250 mm	16	23
	0.150 mm	11	16
	0.075 mm	8	12
Grading Modulus		2.22	1.84



Hydrometer Analysis

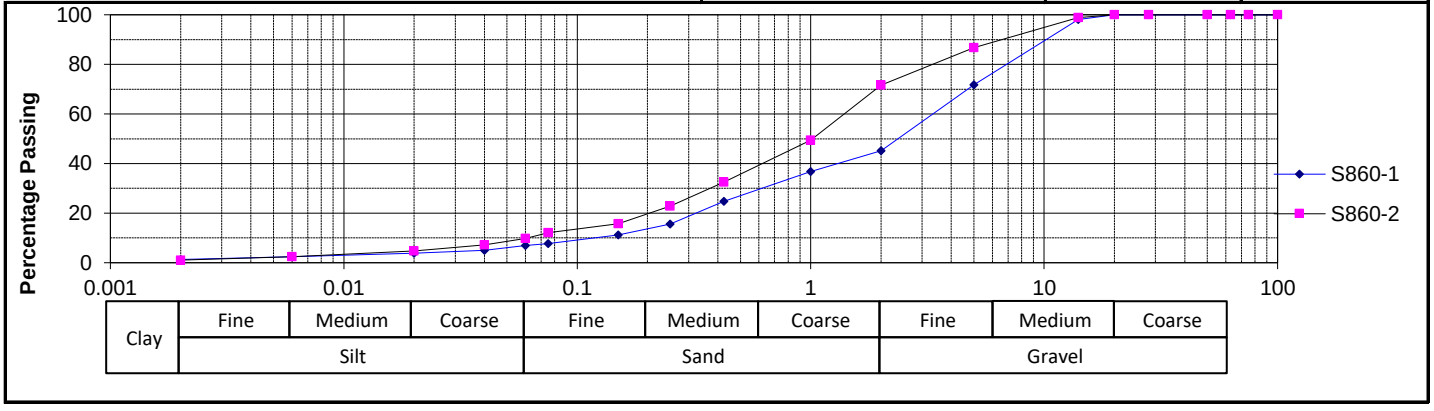
Percentage Passing	0.060 mm	7	10
	0.040 mm	5	7
	0.020 mm	4	5
	0.006 mm	2	2
	0.002 mm	1	1
Gravel	%	55	28
Sand	%	38	62
Silt	%	6	9
Clay	%	1	1

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		S860-1 ◆	S860-2 ■
Atterberg Limits -425µ			
Liquid Limit	%		
Plasticity Index	%	NP	NP
Linear Shrinkage	%	0.0	0.0
Overall PI	%		

Classifications

HRB (AASHTO)	A-1-a(0)	A-1-b(0)
Unified (ASTM D2487)	SP-SM	SM
Weston Swell @ 1 kPa		



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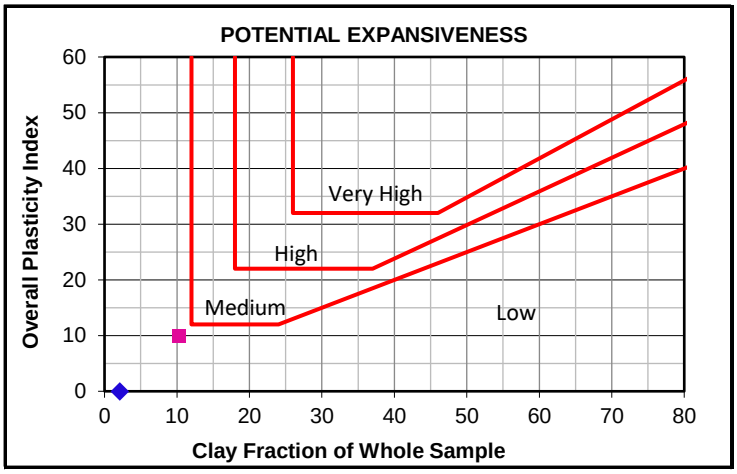
Project No	:	2022-B-860	Page No. :	3 of 11

FOUNDATION INDICATOR

Laboratory Number		S860-3 ◆	S860-4 ■
Field Number		TP4	TP6
Client Reference			
Depth (m)		0.34-1.08	0.48-1.33
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed Stabilizing Agent			

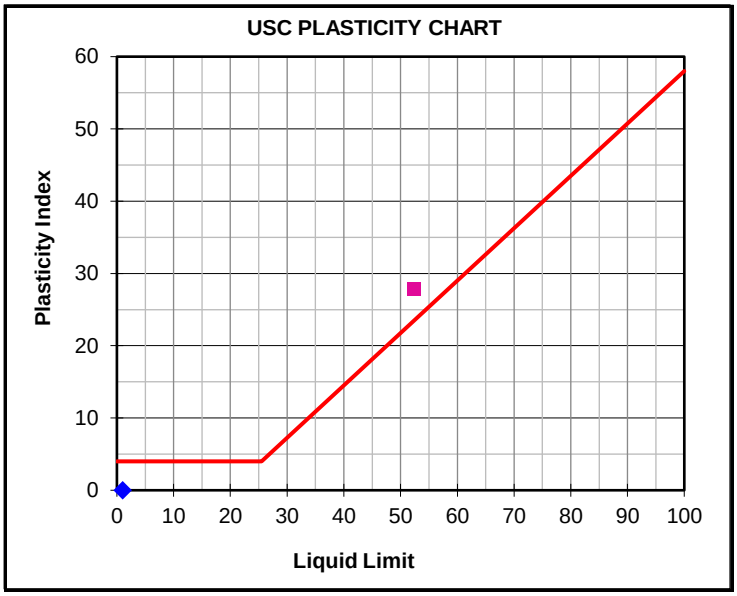


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep)

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	99	100
	20 mm	98	100
	14 mm	89	98
	5 mm	70	87
	2 mm	51	65
	1 mm	42	49
	0.425 mm	29	37
	0.250 mm	20	33
	0.150 mm	13	29
	0.075 mm	9	25
Grading Modulus		2.11	1.73



Hydrometer Analysis

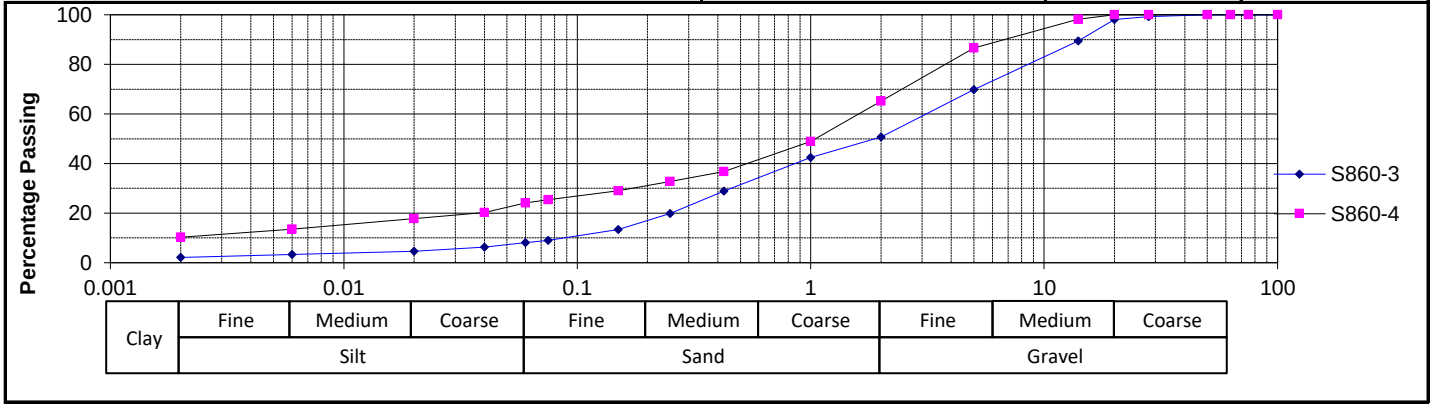
Percentage Passing	0.060 mm	8	24
	0.040 mm	6	20
	0.020 mm	5	18
	0.006 mm	3	14
	0.002 mm	2	10
Gravel	%	49	35
Sand	%	43	41
Silt	%	6	14
Clay	%	2	10

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		S860-3 ◆	S860-4 ■
Atterberg Limits -425µ			
Liquid Limit	%		52
Plasticity Index	%	NP	28
Linear Shrinkage	%	0.0	11.0
Overall PI	%		10

Classifications

HRB (AASHTO)	A-1-b(0)	A-2-7(2)
Unified (ASTM D2487)	SP-SM	SC
Weston Swell @ 1 kPa		



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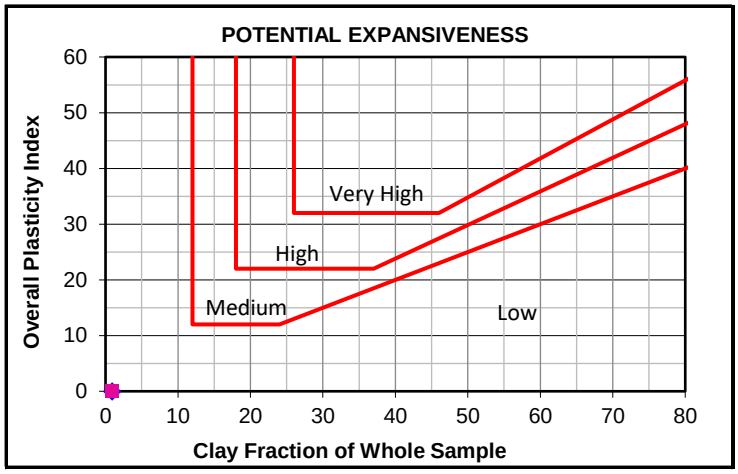
FOUNDATION INDICATOR

Laboratory Number		S860-5 ◆	S860-6 ■
Field Number		TP8	TP9
Client Reference			
Depth (m)		0.35-1.66	0.48-1.33
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed Stabilizing Agent			

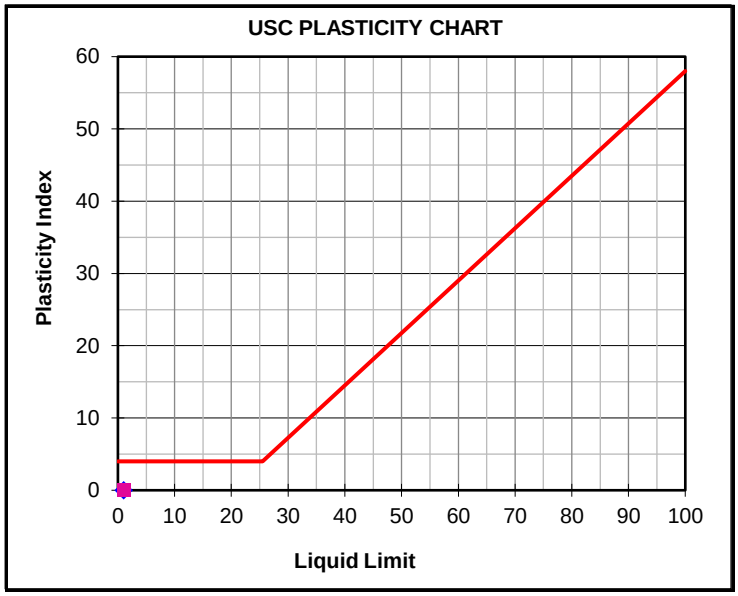


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep)

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	99	97
	5 mm	82	75
	2 mm	61	52
	1 mm	44	39
	0.425 mm	27	25
	0.250 mm	19	18
	0.150 mm	14	14
	0.075 mm	10	10
Grading Modulus		2.02	2.13



Hydrometer Analysis

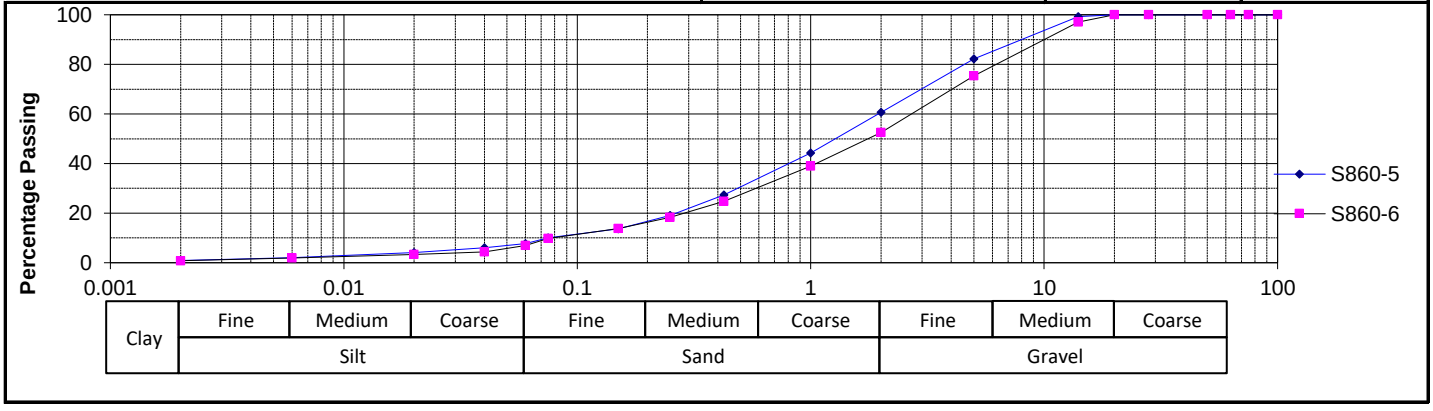
Percentage Passing	0.060 mm	8	7
	0.040 mm	6	4
	0.020 mm	4	3
	0.006 mm	2	2
	0.002 mm	1	1
Gravel	%	39	48
Sand	%	53	45
Silt	%	7	6
Clay	%	1	1

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		S860-5 ◆	S860-6 ■
Atterberg Limits -425µ			
Liquid Limit	%		
Plasticity Index	%	NP	NP
Linear Shrinkage	%	0.0	0.0
Overall PI	%		

Classifications

HRB (AASHTO)	A-1-b(0)	A-1-b(0)
Unified (ASTM D2487)	SW-SM	SW-SM
Weston Swell @ 1 kPa		



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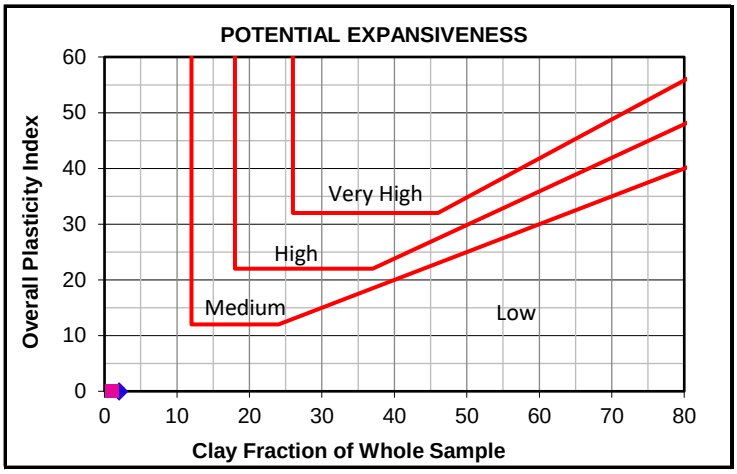
FOUNDATION INDICATOR

Laboratory Number		S860-7 ◆	S860-8 ■
Field Number		TP10	TP12
Client Reference			
Depth (m)		1.08-1.9	0.37-1.56
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed			
Stabilizing Agent			

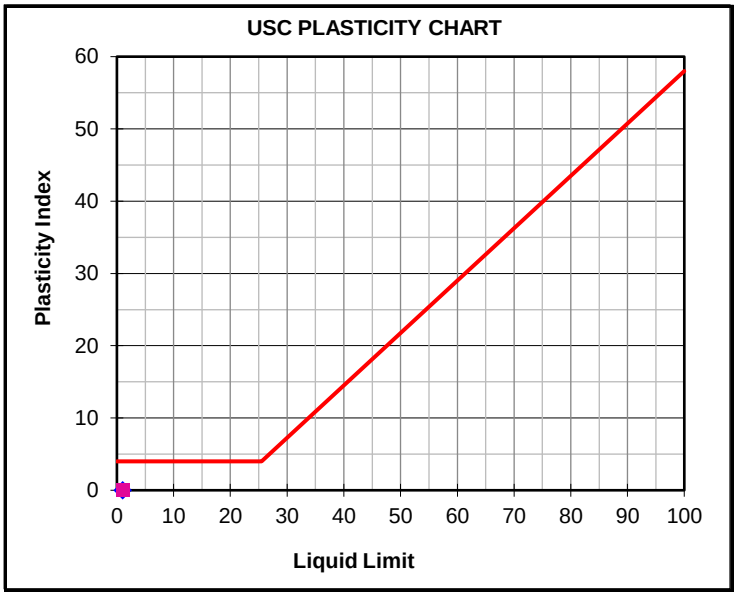


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep)

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	50 mm	100	100
	37.5 mm	100	99
	28 mm	100	97
	20 mm	100	95
	14 mm	95	89
	5 mm	85	72
	2 mm	69	55
	1 mm	55	42
	0.425 mm	38	27
	0.250 mm	27	19
	0.150 mm	20	14
	0.075 mm	14	10
Grading Modulus		1.79	2.08



Hydrometer Analysis

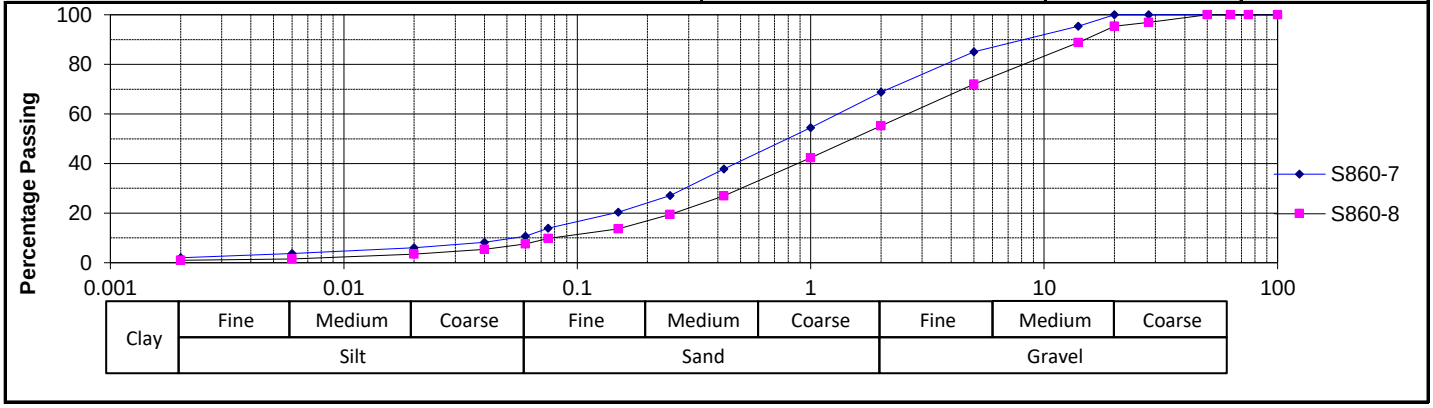
Percentage Passing	0.060 mm	11	8
	0.040 mm	8	5
	0.020 mm	6	3
	0.006 mm	4	2
	0.002 mm	2	1
Gravel	%	31	45
Sand	%	58	48
Silt	%	9	7
Clay	%	2	1

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

Laboratory Number		S860-7 ◆	S860-8 ■
Atterberg Limits -425µ			
Liquid Limit	%		
Plasticity Index	%	NP	NP
Linear Shrinkage	%	0.0	0.0
Overall PI	%		

Classifications

HRB (AASHTO)	A-1-b(0)	A-1-b(0)
Unified (ASTM D2487)	SM	SW-SM
Weston Swell @ 1 kPa		



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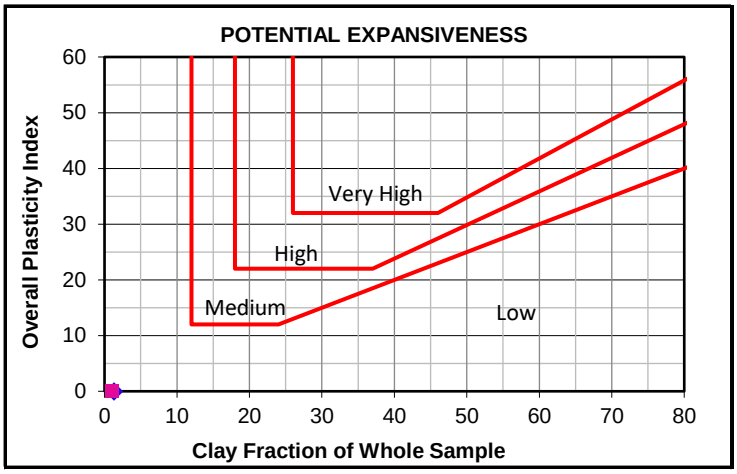
Project No	:	2022-B-860	Page No. :	6 of 11

FOUNDATION INDICATOR

Laboratory Number		S860-9 ◆	■
Field Number		TP13	
Client Reference			
Depth (m)		0.4-1.24	
Position			
Coordinates	X		
	Y		
Description			
Aditional Information			
Calcrete / Crushed			
Stabilizing Agent			

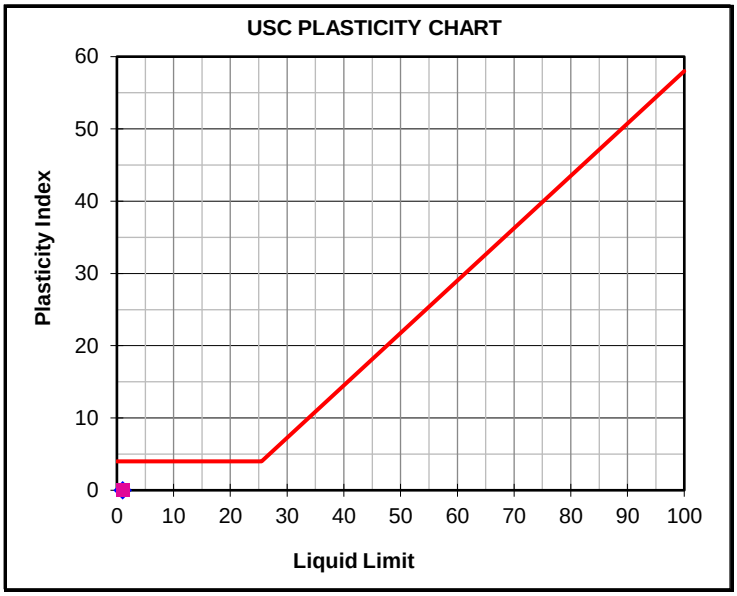


Moisture Content & Relative Density

Moisture Content (%)		
Relative Density (S.G.)		

Sieve Analysis (Wet Prep)

Percentage Passing	100 mm	100
	75 mm	100
	63 mm	100
	50 mm	100
	37.5 mm	100
	28 mm	100
	20 mm	100
	14 mm	94
	5 mm	69
	2 mm	49
	1 mm	36
	0.425 mm	23
	0.250 mm	16
	0.150 mm	11
	0.075 mm	7
Grading Modulus		2.21



Hydrometer Analysis

Percentage Passing	0.060 mm	6
	0.040 mm	5
	0.020 mm	3
	0.006 mm	2
	0.002 mm	1
Gravel	%	51
Sand	%	42
Silt	%	5
Clay	%	1

Note: An assumed S.G. may be used in Hydrometer Analysis calculations

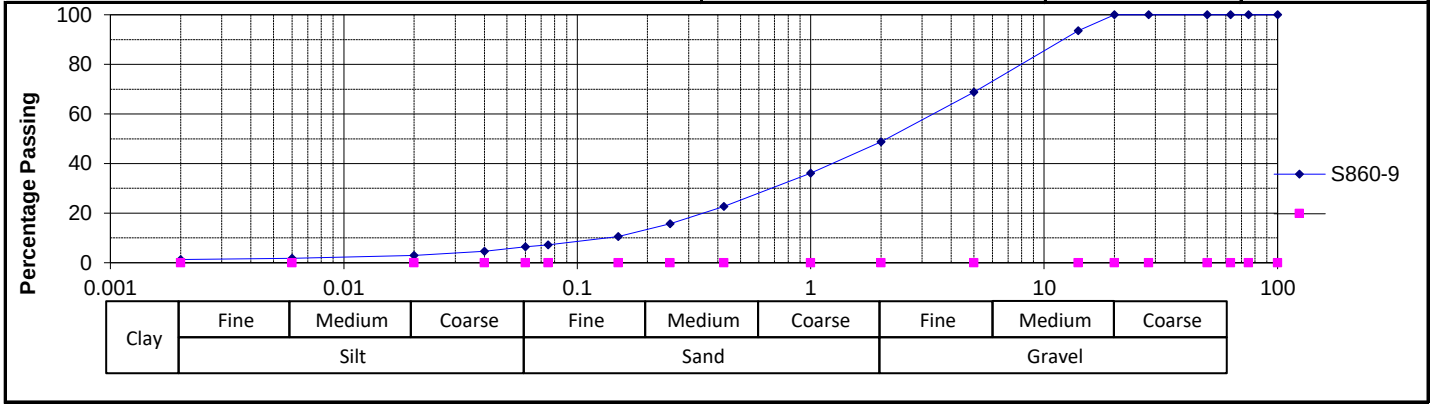
Laboratory Number	S860-9 ◆	■

Atterberg Limits -425µ

Liquid Limit	%	
Plasticity Index	%	NP
Linear Shrinkage	%	0.0
Overall PI	%	

Classifications

HRB (AASHTO)	A-1-a(0)
Unified (ASTM D2487)	SW-SM
Weston Swell @ 1 kPa	



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Civil Engineering Testing Laboratories

Client	: BUSHBUCKRIDGE LOCAL MUNICIPALITY	Date Received:	01/08/2022
Project	: Seville 3	Date Reported:	19/08/2022
Project No:	2022-B-860	Page No. :	7 of 11

MOISTURE DENSITY RELATIONSHIP

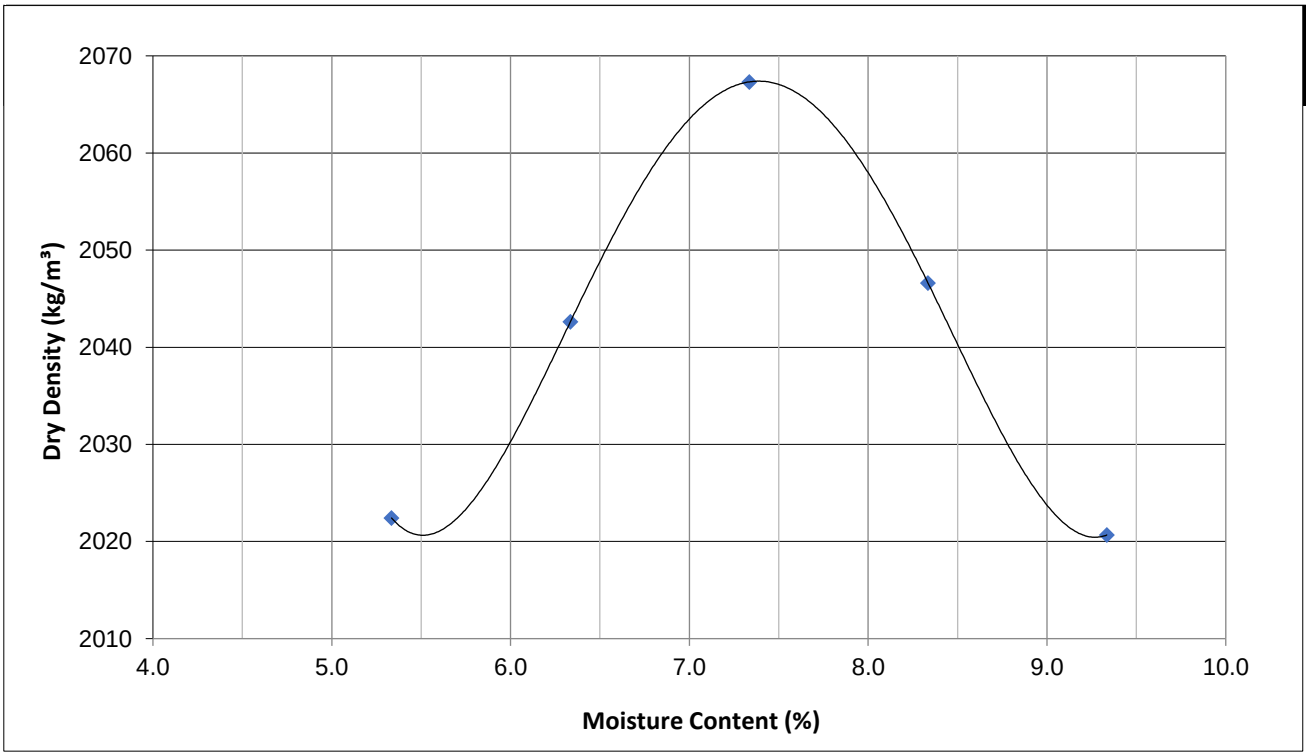
Laboratory Number		S860-2
Field Number		TP2
Client Reference		
Depth (m)		0.9-1.6
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
% of Sample Scalped		
Stabilizing Agent		

Maximum Dry Density & Optimum Moisture Content - SANS 3001 GR30

Compactive Effort:	Modified AASHTO

Dry Density	kg/m³	2067	2047	2043	2021	2022	
Moisture Content	%	7.3	8.3	6.3	9.3	5.3	

Max. Dry Density	kg/m³	2068
Optimum Moisture	%	7.4



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Project	: Seville 3	Date Reported:	19/08/2022
Project No:	2022-B-860	Page No. :	8 of 11

MOISTURE DENSITY RELATIONSHIP

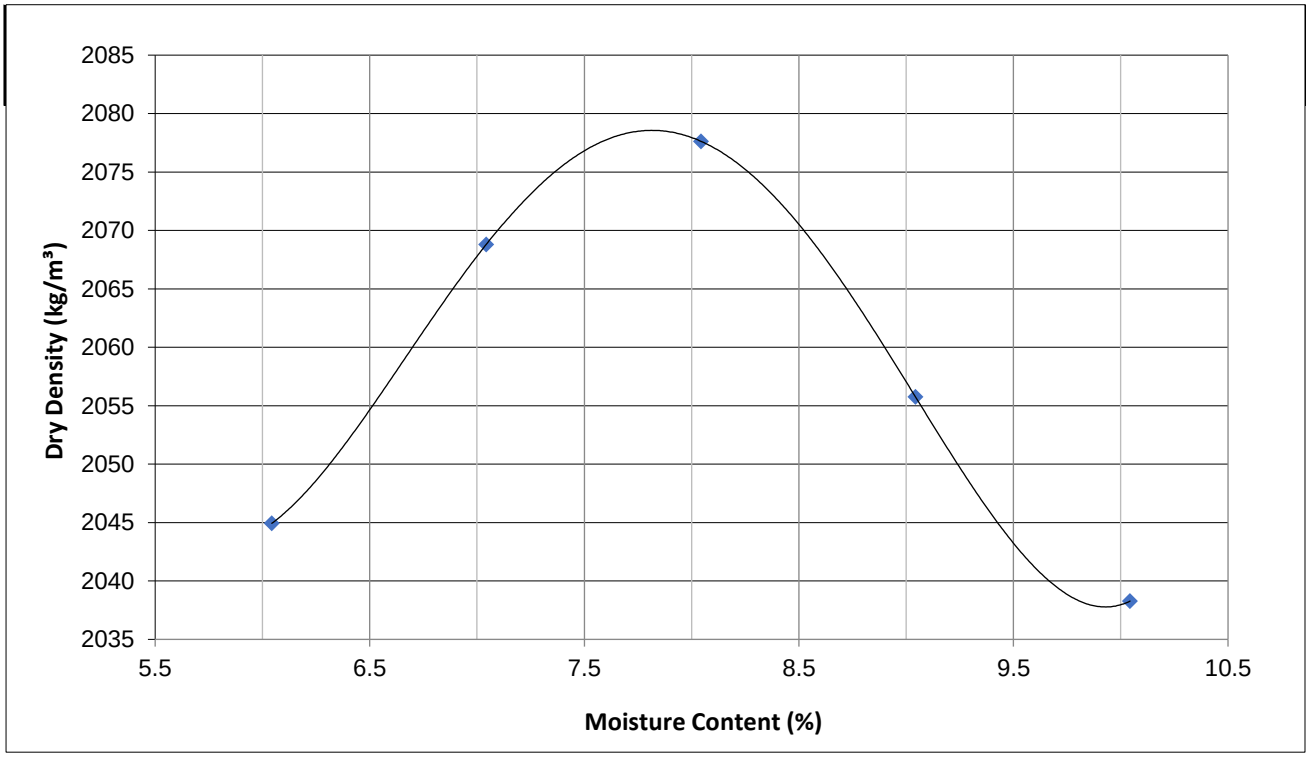
Laboratory Number		S860-7
Field Number		TP10
Client Reference		
Depth (m)		1.08-1.9
Position		
Coordinates	X	
	Y	
Description		
Additional Information		
% of Sample Scalped		
Stabilizing Agent		

Maximum Dry Density & Optimum Moisture Content - SANS 3001 GR30

Compactive Effort:	Modified AASHTO

Dry Density	kg/m³	2045	2069	2078	2056	2038	
Moisture Content	%	6.0	7.0	8.0	9.0	10.0	

Max. Dry Density	kg/m³	2078
Optimum Moisture	%	7.8



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Client	:	BUSHBUCKRIDGE LOCAL MUNICIPALITY	Date Received	:	01/08/2022
Project	:	Seville 3	Date Reported	:	19/08/2022
Project No.	:	2022-B-860	Page No.	:	9 of 11

CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

Laboratory No.		S860-1 ◆	S860-2 ■
Field Number		TP2	TP2
Client Reference			
Depth (m)		0.33-0.9	0.9-1.6
Position			
Coordinates	X		
	Y		
Description			
Additional information			
Calcrete/Crushed			
Stabilizing Agent			

Sieve Analysis (Wet preparation)

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	53 mm	100	100
	37.5 mm	100	100
	28 mm	100	100
	20 mm	100	100
	14 mm	98	99
	5 mm	72	87
	2 mm	45	72
	1 mm	37	49
	0.425 mm	25	32
	0.250 mm	16	23
	0.150 mm	11	16
	0.075 mm	8	12
Grading Modulus		2.22	1.84

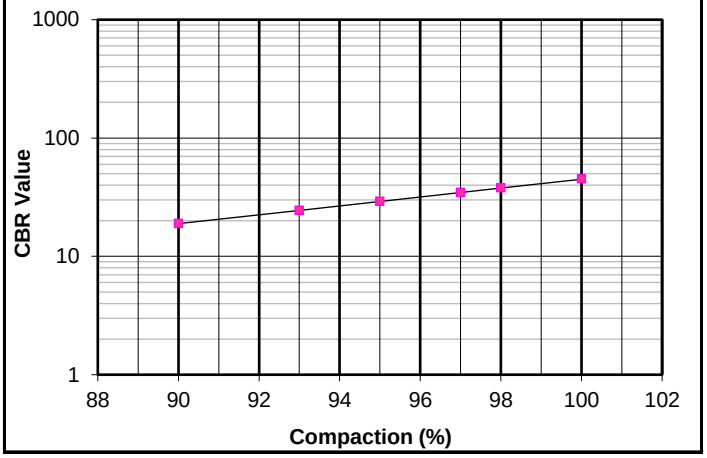
Soil Mortar Analysis

Coarse Sand	45	55
Coarse Fine Sand	20	13
Medium Fine Sand	10	10
Fine Fine Sand	8	5
Silt and Clay	17	17

Atterberg Limits

Liquid Limit (%)		
Plasticity Index (%)	NP	NP
Linear Shrinkage (%)	0.0	0.0

Laboratory No.		S860-1 ◆			S860-2 ■		
Maximum Dry Density & Optimum Moisture Content							
MDD	kg/m^3				2068		
OMC	%				7.4		
California Bearing Ratio							
Compaction Data							
Moisture	%				7.5		
Dry Density	kg/m^3				2085	1979	1878
Compaction	%				100.0	94.9	90.1
Penetration Data							
CBR at	2.54 mm				62	21	19
	5.08 mm				94	28	27
	7.62 mm				106	31	30
Swell	%				0.0	0.1	0.1
Final Moisture (%)					8.9	12.8	17.1

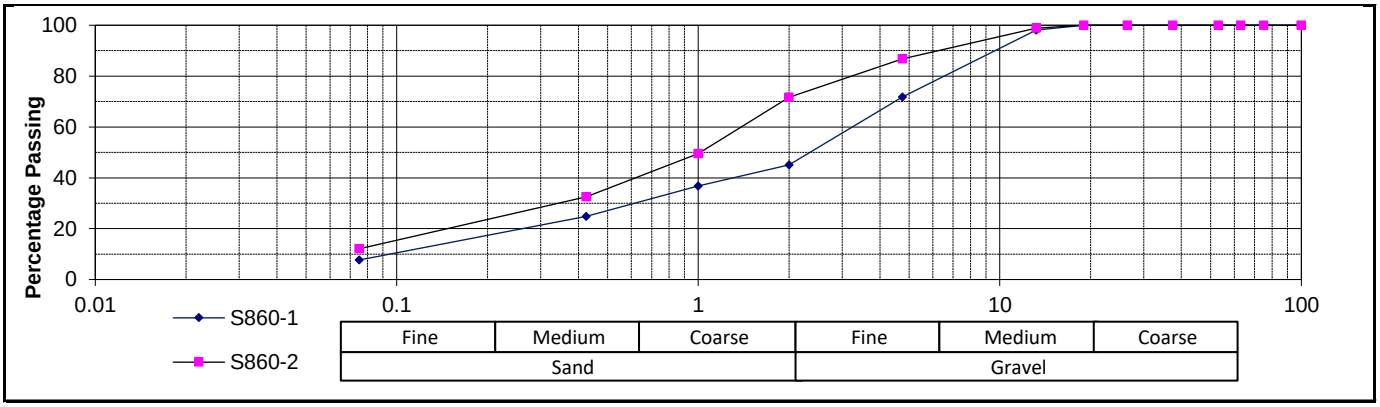


Interpolated CBR Data

CBR Mod. AASHTO	@ 100%		45
	@ 98%		38
	@ 97%		35
	@ 95%		29
	@ 93%		25
	@ 90%		19
	@ SANS3001 Midpoint		36

Classifications

HRB (AASHTO)	A-1-a(0)	A-1-b(0)
COLTO		G6
TRH14		G7



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Project	:	Seville 3	Date Reported	:	19/08/2022
Project No.	:	2022-B-860	Page No.	:	10 of 11

CALIFORNIA BEARING RATIO (CBR) & ROAD INDICATOR REPORT

Laboratory No.		S860-7 ◆	S860-8 ■
Field Number		TP10	TP12
Client Reference			
Depth (m)		1.08-1.9	0.37-1.56
Position			
Coordinates	X		
	Y		
Description			
Additional information			
Calcrete/Crushed			
Stabilizing Agent			

Sieve Analysis (Wet preparation)

Percentage Passing	100 mm	100	100
	75 mm	100	100
	63 mm	100	100
	53 mm	100	100
	37.5 mm	100	99
	28 mm	100	97
	20 mm	100	95
	14 mm	95	89
	5 mm	85	72
	2 mm	69	55
	1 mm	55	42
	0.425 mm	38	27
	0.250 mm	27	19
	0.150 mm	20	14
	0.075 mm	14	10
Grading Modulus		1.79	2.08

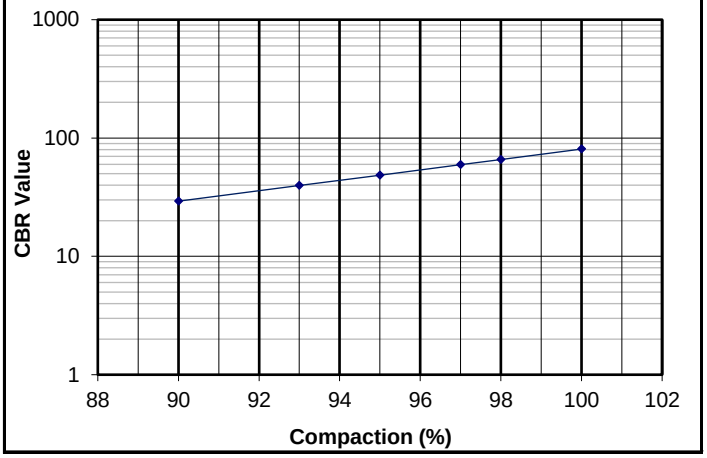
Soil Mortar Analysis

Coarse Sand	45	51
Coarse Fine Sand	16	13
Medium Fine Sand	10	11
Fine Fine Sand	9	7
Silt and Clay	20	18

Atterberg Limits

Liquid Limit (%)		
Plasticity Index (%)	NP	NP
Linear Shrinkage (%)	0.0	0.0

Laboratory No.		S860-7 ◆			S860-8 ■		
Maximum Dry Density & Optimum Moisture Content							
MDD	kg/m^3	2078					
OMC	%	7.8					
California Bearing Ratio							
Compaction Data							
Moisture	%	7.8					
Dry Density	kg/m^3	2090	1987	1888			
Compaction	%	100.0	95.0	90.3			
Penetration Data							
CBR at	2.54 mm	98	40	29			
	5.08 mm	137	51	42			
	7.62 mm	156	49	42			
Swell	%	0.0	0.1	0.1			
Final Moisture (%)		9.0	12.2	16.6			

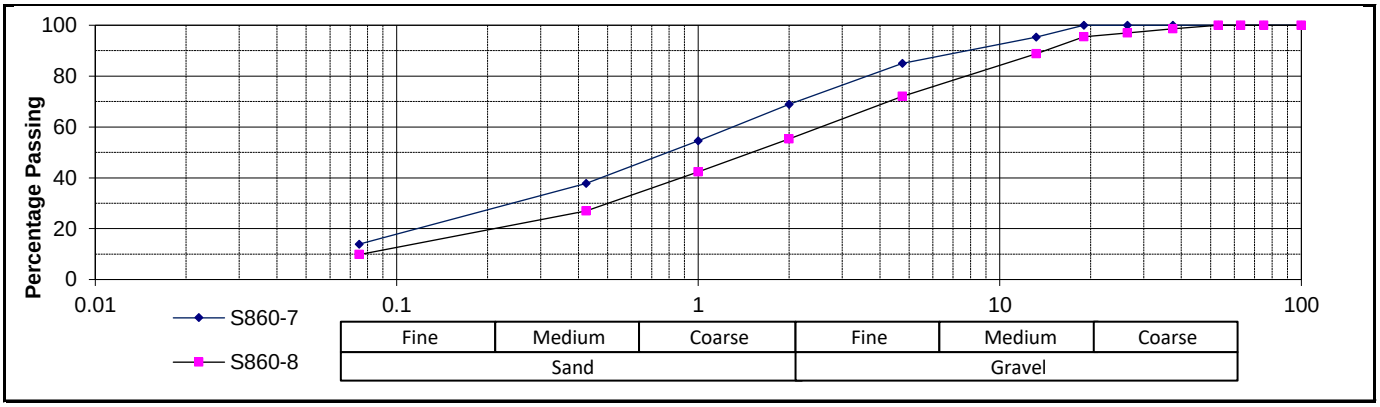


Interpolated CBR Data

CBR Mod. AASHTO	@ 100%	81	
	@ 98%	66	
	@ 97%	60	
	@ 95%	49	
	@ 93%	40	
	@ 90%	29	
	@ SANS3001 Midpoint	63	

Classifications

HRB (AASHTO)	A-1-b(0)	A-1-b(0)
COLTO	G5	
TRH14	G5	



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Client : BUSHBUCKRIDGE LOCAL MUNICIPALITY
Project : Seville 3
Project No: 2022-B-860

Date Received : 01/08/2022
Date Reported : 19/08/2022

pH, CONDUCTIVITY, RESISTIVITY and ORGANIC IMPURITIES

Lab No	Field No	Depth (m)		Coordinates	Description / Additional Information	pH	Electrical Conductivity (S/m)	Electrical Resistivity (Ω/m) *	Organic Impurities
S860-2	TP2	0.9-1.6	X: Y:			5.89	0.0043	232.558	
S860-7	TP10	1.08-1.9	X: Y:			7.4	0.0143	69.930	
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						
			X: Y:						

Note : * Electrical resistivity is calculated from the elecrical conductivity

16. APPENDIX C: SOIL PROFILES

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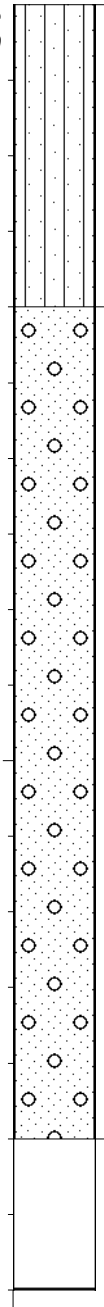
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 01
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Slightly moist to moist, greyish, intact, Dense, Sandy Silt. **TOPSOIL.**

0.40 Slightly moist, light brown,intact, Medium dense to dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

1.50 Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Roots inclusion from a depth of 0.0 - 0.5m
2) Stable side walls
3) No water seepage encountered
4) Refusal encountered at 1.7m
5) No Disturbed sample taken
6) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022

ELEVATION : 407m
X-COORD : 31°24'34.40"E
Y-COORD : 24°39'57.91"S

HOLE No: TP 01

TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

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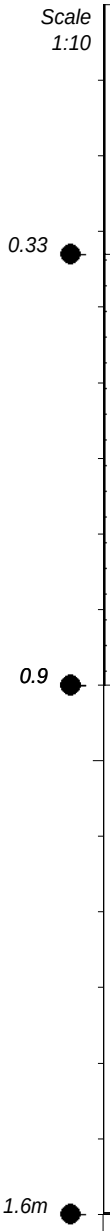
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 02
Sheet 1 of 1

JOB NUMBER: 000



Slightly moist to moist, light brown, intact, Dense, Gravelly sand. **TOPSOIL.**

Moist, light brown,intact, Medium dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Roots inclusion from a depth of 0.0 - 0.65m
2) Stable side walls
3) No water seepage encountered
4) Refusal encountered at 1.1 m
5) Disturbed sample taken at 0.33 - 0.9 m & 0.9 - 1.6m
6) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022

ELEVATION : 411m
X-COORD : 31°24'30.68"E
Y-COORD : 24°39'53.88"S

HOLE No: TP 02

TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

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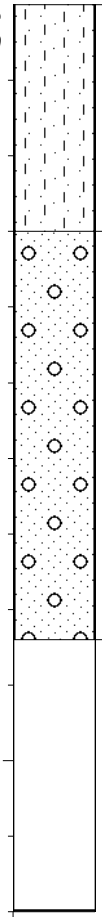
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 03
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Slightly moist, greyish, intact, Dense, Sandy Silty. **TOPSOIL.**

0.30 Slightly moist, light brown,intact, Medium dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

0.84 Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Roots inclusion from a depth of 0.0 - 0.5m
2) Stable side walls
3) No water seepage encountered
4) Refusal encountered at 1.2 m
5) No Disturbed sample taken
6) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022

ELEVATION : 411m
X-COORD : 31°24'24.46"E
Y-COORD : 24°39'49.80"S

HOLE No: TP 03

TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

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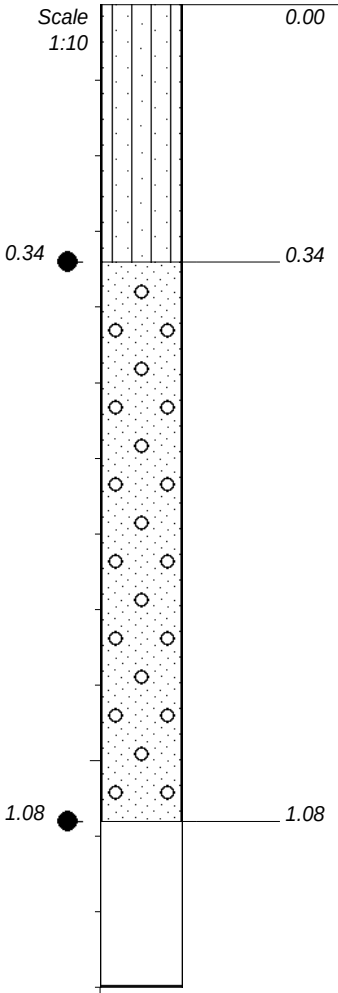
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 04
Sheet 1 of 1

JOB NUMBER: 000



0.00 Moist, greyish, intact, Loose, Sandy Silt. **TOPSOIL.**

0.34 Moist, light brown,intact, Medium dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

1.08 Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Roots inclusion from a depth of 0 - 0.6m
2) Stable side walls
3) No water seepage encountered
4) Refusal encountered at 1.3 m
5) Disturbed sample taken at 0.34 - 1.08 m
6) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022

ELEVATION : 416m
X-COORD : 31°24'19.48"E
Y-COORD : 24°39'45.74"S

HOLE No: TP 04

TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

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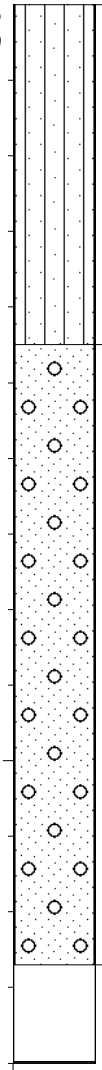
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 05
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Slightly moist, greyish, intact, Dense, Sandy Silt. **TOPSOIL.**

0.45 Slightly moist, light brown,intact, Medium dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

1.27 Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Stable side walls
2) No water seepage encountered
3) No refusal encountered at 1.8 m
4) No Disturbed sample taken
5) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani
TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022
DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

ELEVATION : 416m
X-COORD : 31°24'26.82"E
Y-COORD : 24°39'44.03"S

HOLE No: TP 05

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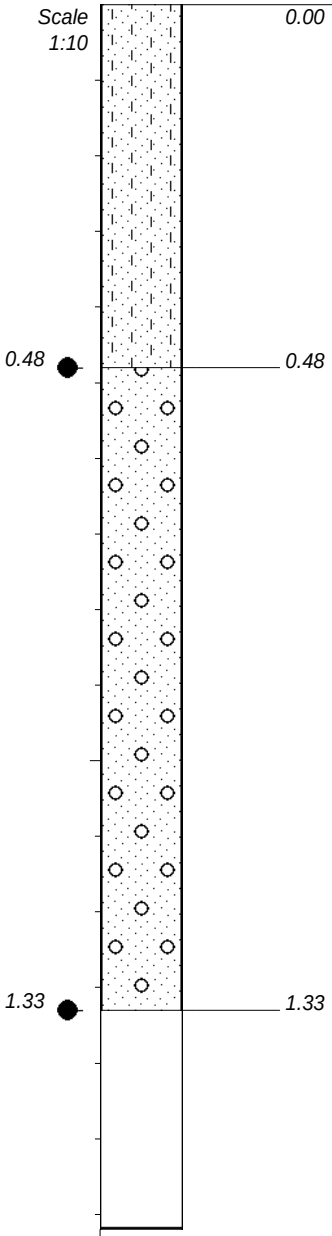
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 06
Sheet 1 of 1

JOB NUMBER: 000



Slightly moist to moist, brownish, Medium dense, intact, Silty sand. **TOPSOIL.**

Slightly moist, light brown,intact, Medium dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Roots inclusion from a depth of 0 - 0.66m
2) Stable side walls
3) No water seepage encountered
4) Refusal encountered at 1.62 m
5) Disturbed sample taken 0.48 - 1.33 m
6) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022

ELEVATION : 418m
X-COORD : 31°24'23.12"E
Y-COORD : 24°39'36.12"S

HOLE No: TP 06

TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

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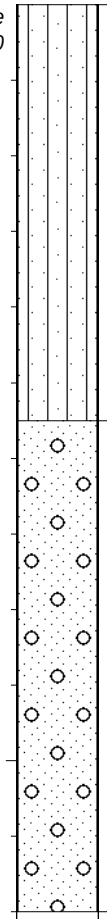
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 07
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00 Slightly moist to moist, whitish, intact, Medium dense, Sandy Silt. **TOPSOIL.**

0.55 Slightly moist, light brown,intact, Medium dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

1.20 Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Roots inclusion from a depth of 0 - 0.8m
2) Stable side walls
3) No water seepage encountered
4) Refusal encountered at 1.5 m
5) No Disturbed sample taken
6) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022

ELEVATION : 425m
X-COORD : 31°24'16.04"E
Y-COORD : 24°39'37.44"S

HOLE No: TP 07

TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

dotPLOT 7022

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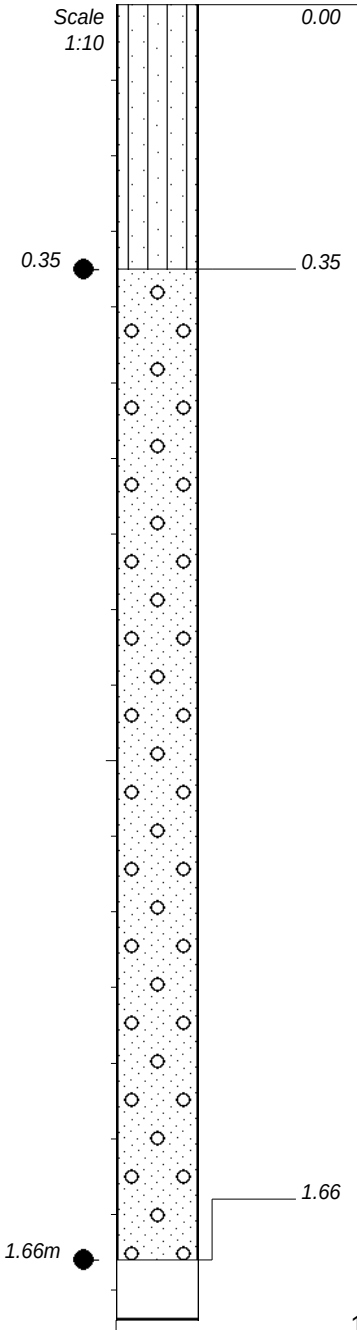
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 08
Sheet 1 of 1

JOB NUMBER: 000



0.00 – 0.35: Slightly moist to moist, whitish, intact, Medium dense, Sandy Silt. **TOPSOIL.**

0.35 – 1.66: Slightly moist, light brown,intact, Medium dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

1.66: Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Roots inclusion from a depth of 0 - 0.55m
2) Stable side walls
3) No water seepage encountered
4) Refusal encountered at 1.74 m
5) Disturbed sample taken at 0.35 - 1.66m
6) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022

ELEVATION : 427m
X-COORD : 31°24'11.49"E
Y-COORD : 24°39'42.95"S

HOLE No: TP 08

TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

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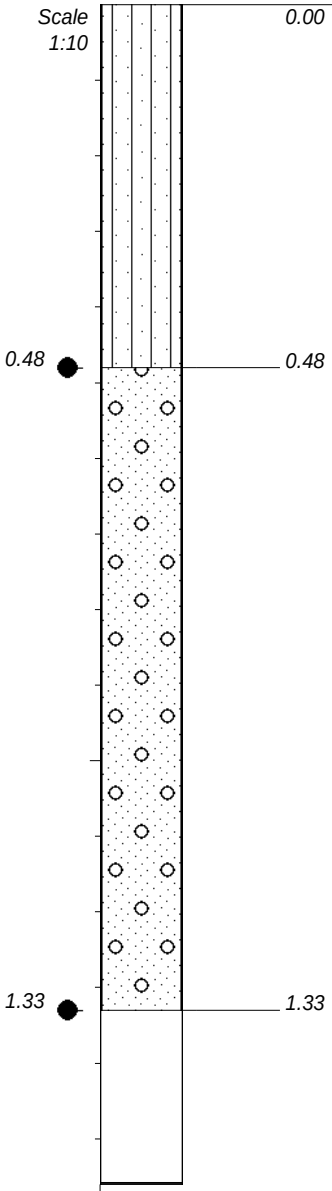
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 09
Sheet 1 of 1

JOB NUMBER: 000



Slightly moist to moist, greyish, intact, Medium dense, Sandy Silt. **TOPSOIL.**

Slightly moist, light brown,intact, Medium dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Roots inclusion from a depth of 0 - 0.5m
2) Stable side walls
3) No Water seepage encountered
4) Refusal encountered at 1.56 m
5) Disturbed sample taken 0.48 - 1.33 m
6) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022

ELEVATION : 420m
X-COORD : 31°24'11.87"E
Y-COORD : 24°39'29.78"S

HOLE No: TP 09

TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

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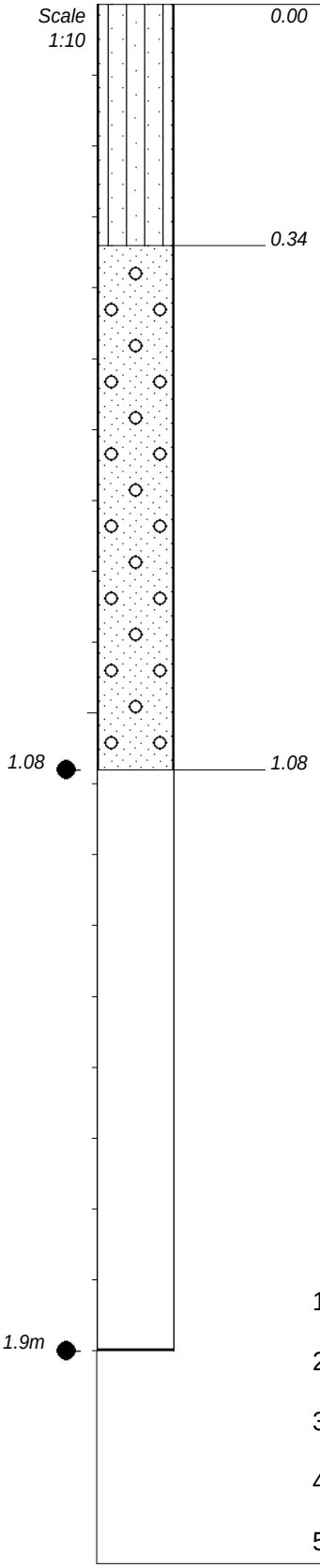
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 10
Sheet 1 of 1

JOB NUMBER: 000



0.00 — Slightly moist to moist, greyish, intact, Medium dense, Sandy Silt. **TOPSOIL.**

0.34 — Slightly moist, light brown,intact, Medium dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

1.08 — Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Stable side walls
2) No water seepage encountered
3) Refusal encountered at 1.9 m
4) Disturbed sample taken at 1.08 - 1.9m
5) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022

ELEVATION : 415m
X-COORD : 31°24'21.11"E
Y-COORD : 24°39'28.76"S

HOLE No: TP 10

TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

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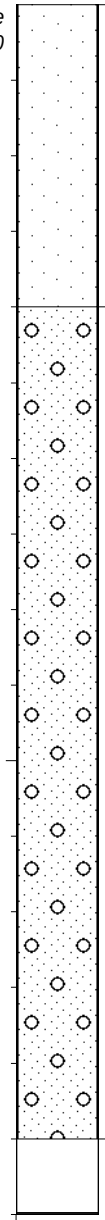
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 11
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10



0.00

Slightly moist to moist, greyish, intact, Medium dense, Sandy Silt. **TOPSOIL.**

0.40

Slightly moist, light brown,intact, Medium dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

1.50

Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Stable side walls
2) No water seepage encountered
3) Refusal encountered at 1.6 m
4) No Disturbed sample taken
5) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani
TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022
DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

ELEVATION : 410m
X-COORD : 31°24'19.07"E
Y-COORD : 24°39'21.63"S

HOLE No: TP 11

dotPLOT 7022

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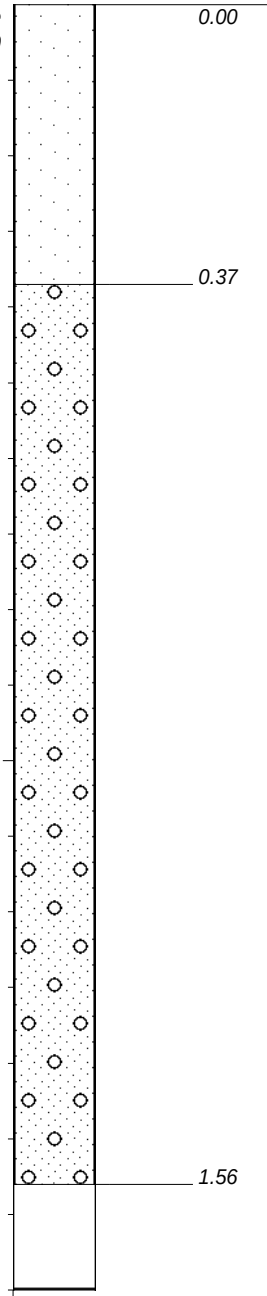
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 12
Sheet 1 of 1

JOB NUMBER: 000



Slightly moist to moist, greyish, intact, Medium dense, Sandy Silt. **TOPSOIL.**

Slightly moist, light brown,intact, Medium dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Stable side walls
2) No water seepage encountered
3) Refusal encountered at 1.7 m
4) Disturbed sample taken at 0.37 - 1.56m
5) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani
TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022
DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

ELEVATION : 420m
X-COORD : 31°24'16.54"E
Y-COORD : 24°39'15.11"S

HOLE No: TP 12

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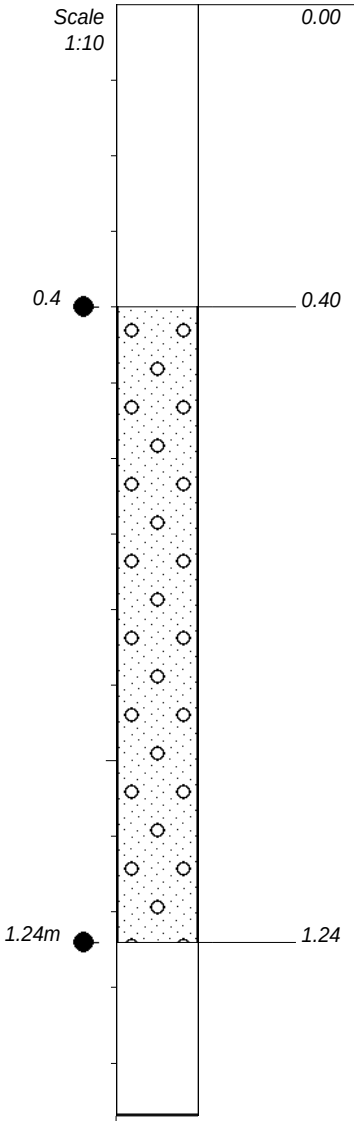
Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

HOLE No: TP 13
Sheet 1 of 1

JOB NUMBER: 000



0.00 – 0.40: Slightly moist, light brown, intact, Medium dense, Coarse Sand. **TOPSOIL.**

0.40 – 1.24: Slightly moist, light brown,intact, Medium dense, Coarse grained Gravelly sand. **RESIDUAL SOIL.**

1.24+: Weathered yellowish hardrock Gneiss. **BEDROCK.**

NOTES

1) Roots inclusion from a depth of 0 - 0.9m
2) Stable side walls
3) No water seepage encountered
4) Refusal encountered at 1.47 m
5) Disturbed sample taken at 0.4 - 1.24m
6) No Unditurbed sample taken

CONTRACTOR :
MACHINE : Tractor Loader Backhoe (TLB).
DRILLED BY :
PROFILED BY : Mavhetha Lavhelesani
TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 0.7 m
DATE :
DATE : 29/07/2022
DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

ELEVATION : 420m
X-COORD : 31°24'11.26"E
Y-COORD : 24°39'18.44"S

HOLE No: TP 13

dotPLOT 7022

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Bushbuckridge Local Municipality
Phase 1 Near surface geotechnical investigation

LEGEND
Sheet 1 of 1

JOB NUMBER: 000

	GRAVELLY	{SA03}
	SAND	{SA04}
	SANDY	{SA05}
	SILT	{SA06}
	SILTY	{SA07}
Name	DISTURBED SAMPLE	{SA38}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : Mavhetha Lavhelesani
SETUP FILE : STANDARD.SET

DATE : 21/08/2022 22:39
TEXT : ..00\Examples\Examples.TXT

LEGEND
SUMMARY OF SYMBOLS