A PHASE 1 ENGINEERING GEOLOGICAL INVESTIGATION ON ERF 2006, PARSONS VLEI (GSE Ref: EGI7/07/2024)

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Lawrence Greene is an experienced Professional Engineering Technologist with over 14 years of experience in the Civil Engineering industry, with a specific focus on Structural-Bridge, Road, Material, Water and Geotechnical Engineering, this includes performing and supervising geotechnical investigations for deep foundations, the setting up and managing of multiple material testing laboratories on Road & Bridge projects, 100's of km's of centre line soil surveys and the establishment of numerous borrow pit locations. He holds a National Diploma in Civil Engineering, a Baccalaureus Technologiae focusing on Urban Engineering, and a Baccalaureus Technologiae focusing on Structural Engineering. Additionally, he has a postgraduate diploma in civil engineering and construction management, focusing on Eurocodes, Sustainability, Geotechnical, Water, and Structural engineering, which he obtained from Heriot-Watt University in the UK.

Lawrence Greene is a registered with the Engineering Council of South Africa (ECSA), with the NHBRC as a competent person and is a member of the South African Institute of Civil Engineering (SAICE) and its geotechnical division.

Declaration of independence: The author of this report is an independent professional consultant who has no personal interest in the project other than receiving compensation for the work done in preparing this report.

General limitations

1. The investigation was conducted in accordance with SAICE's "Site investigation Code of Practice", and the opinions and conclusions expressed in the report were made in good faith based on the information at hand at the time of the investigation.

2. The contents of this report are valid as of the date of preparation. However, changes in the condition of the site can occur over time as a result of either natural processes or human activity. In addition, advancements in the practice of geotechnical engineering and changes in applicable practice codes may affect the validity of this report. Consequently, this report should not be relied upon after an eclipsed period of one year without a review by this firm for verification of validity. This warranty is in lieu of all other warranties, either expressed or implied.

3. The investigation did not include any specialist studies, including but not limited to the evaluation or assessment of any potential environmental hazards or groundwater contamination that may be present, unless otherwise stated.

4. The investigation was conducted within the constraints of the budget and allocated time. Although the confidence in the information is reasonably high, some variation in the geotechnical conditions should be expected during and after construction. The nature and extent of variations across the site may not become evident until construction. If variations then become apparent, this could affect the proposed project, and it may be necessary to reevaluate recommendations in this report.

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EXECUTIVE SUMMARY

This geotechnical investigation contains the findings and development recommendations for the construction of the proposed housing development on Erf 2006, Parsons Vlei.

It is considered that the conditions prevailing on site are such that the majority of the site is considered suitable for the proposed development, provided the recommendations outlined in this review are adhered to.

9 Trial pits were excavated throughout the proposed area, to an attempted depth of 3m+ and or refusal. Soil profiles were recorded, samples taken and Dynamic Cone penetrometer (DCP) results are included in Appendix 2 – 4, respectively.

The site is underlain by residual soil, Quartzite, Quartzitic gravel and sand stone, alluvial based gravel of mudstone and shale, with a clay deposit identified in the North West Corner. (Fig 7 – BETH6)

The water table is expected to be perched in the rain season and permanent in the lower lying areas. The average level across the lower end of the site after 3 hours of infiltration/seepage is 1.0m, with average intersection during excavation at 1.2m. It must be noted that the area is known for a high-water table, excessive ponding of storm water due to the flat nature of the area is a concern. Rising damp will be a major factor as well as corrosion risk to foundations that do not have sufficient cover to steel. A subsoil drain and stormwater management system will be a must to prevent flooding and or water logging.

Excavation in terms of SABS 1200 D is generally anticipated in excess of 0.6 – 0.9m below natural ground level over the site increasing in depth towards the North West. It must be noted the site has been used for dumping and the top 0.5m contains construction rubble and rubbish.

*The NHBRC Site Classification is **R,** if rock as a competent horizon is reached, for majority of the site the top **0.6m to 0.9m** of overburden is very soft and the classification **varies from S/C1**.* (Figure 10)

Refer to figure for site classification locations

The options for suitable foundations are:

- *Engineered fill, import of at least G7 and above material compacted in layers of not more than 150mm at 93% mod AASHTO founded on a competent horizon to ground level. Use of geotextiles as a separation and or reinforcement layer has many added benefits.*
- *Strip Foundations lightly reinforced (single storey)*
- *Reinforced Strip Footings (single & double-storey)*
- *Stiffened Raft (single & double-storey)*
- *Soil / RC Raft (single & double-storey)*
- *Combined footing (double-storey)*

Suggested limits

- *Design bearing pressure is limited to a minimum 150kPa*
- *Settlement is predicted at 5 – 10mm*
- *Special attention to be given to BETH8 an encountered alluvial clay layer*

NB: It must be noted that the ground conditions described in this report refer specifically to those encountered at the test positions on site. It is therefore possible that conditions at variance with those discussed above may be encountered elsewhere on the property.

1. INTRODUCTION

GSENG (Pty) Ltd was appointed to perform a Phase 1, engineering geotechnical investigation for the proposed Burchell Estate Housing development, Parsons Vlei, Port Elizabeth. The purpose of the investigation was to determine the suitability of the site for the proposed development and determine a geotechnical, SANS & NHBRC classification.

The work conducted is briefly summarized below:

- Desktop study focussing on the local topography, regional geology and hydrological conditions.
- A site investigation performed according to The Geotechnical Division of SAICE – "Site Investigation Code of Practise"
- Machine excavation, of Nine (9) trial holes to depths exceeding 3m or refusal.
- Soil profiling according to "Guidelines for soil and rock logging in South Africa" 2002.
- The collection of disturbed but representative samples from the excavated trial holes and analysis of the following:
  - Soil structure examination,
  - SANAS Laboratory tests Mod/CBR/Indicators, Foundation Indicator at an Accredited Laboratory
- Compilation of an Engineering Geological Report.

2. TERMS OF REFERENCE

GSENG was approached by Mr Antonio Kerspay to perform an engineering geotechnical investigation for the proposed Burchell Estate development, an investigation was performed on the 10th of July 2024, nine (9) trial hole positions were chosen and excavated. Specific parameters requested were, ground water, Foundation bearing and indicators, material classification, pH and EC.

3. SITE DESCRIPTION

3.1. Locality

The investigation area is located in Parsons Vlei, GQ, in the Eastern Cape Province of South Africa and falls under the Nelson Mandela Metropolitan Municipality.

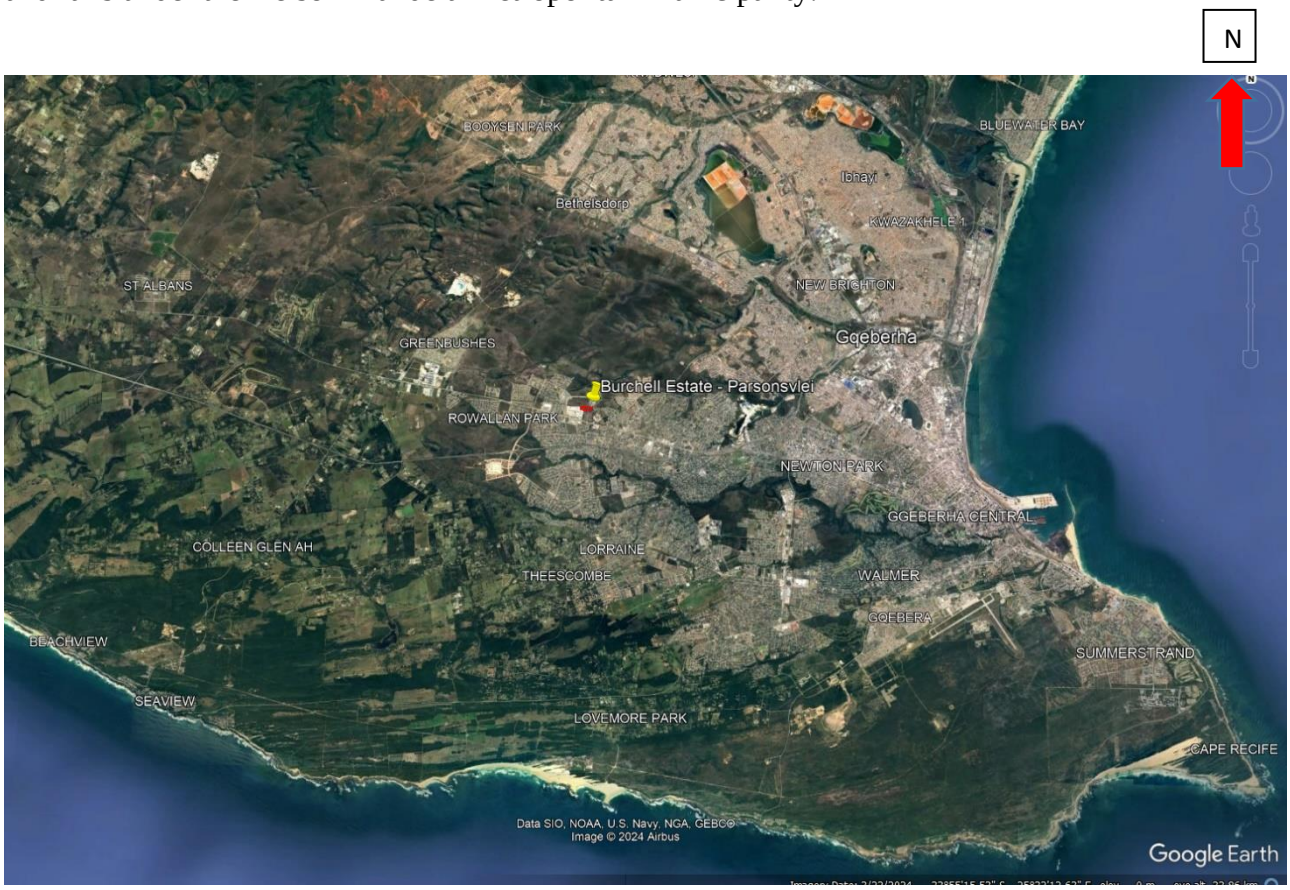

Figure 1: Regional Locality 33°56'4.40"S, 25°29'23.78"E

3.2. Climate

Qgeberha's (Port Elizabeth) climate is characterized by its temperate conditions, with an annual average temperature of approximately 19°C. Situated along the Eastern Cape coast of South Africa, this city experiences a Mediterranean climate with mild, pluvial winters and warm, arid summers. During the winter months, temperatures rarely fall below freezing, while in the summer season, they generally remain below 30°C. Precipitation is evenly distributed throughout the year, with the most substantial rainfall occurring between June and August. These climatic attributes significantly impact the local ecology, agriculture, and overall quality of life. A comprehensive understanding of Port Elizabeth's climate is essential for various sectors, encompassing agriculture, tourism, and urban planning, as it plays an instrumental role in guiding sustainable development and strategies for climate resilience in the city and its periphery. Figure 4.

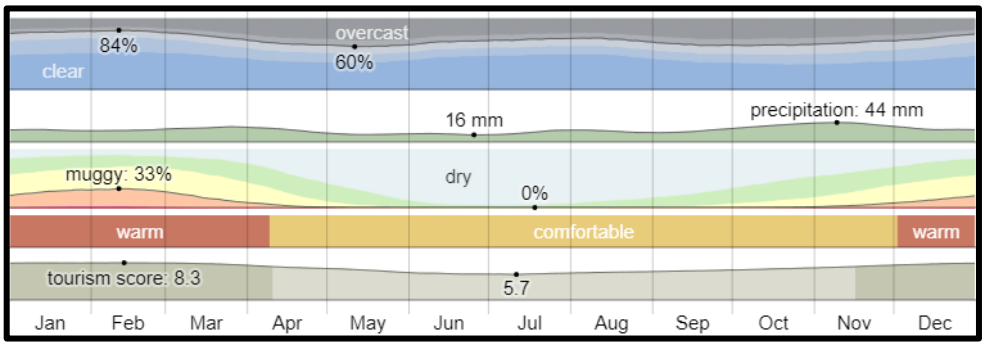

Figure 2: Climate GQ (WeatherSpark.com, 2023)

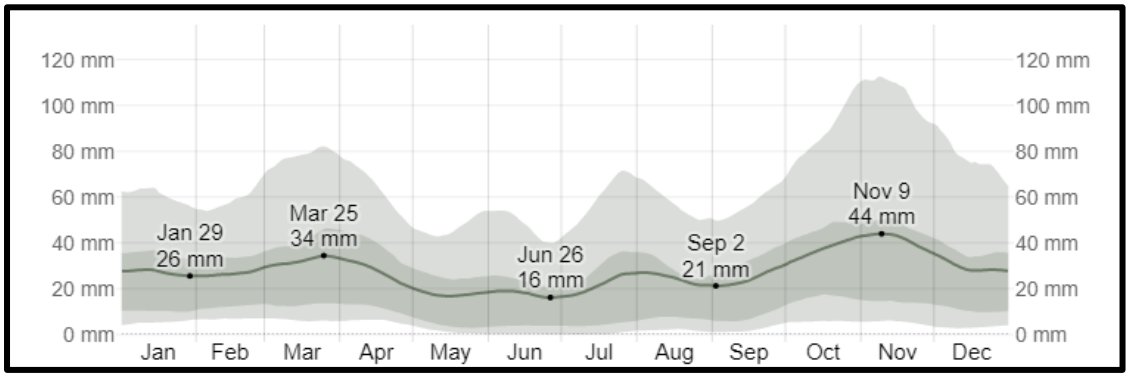

Figure 3: Average Monthly Precipitation in GQ (Weatherspark.com, 2023)

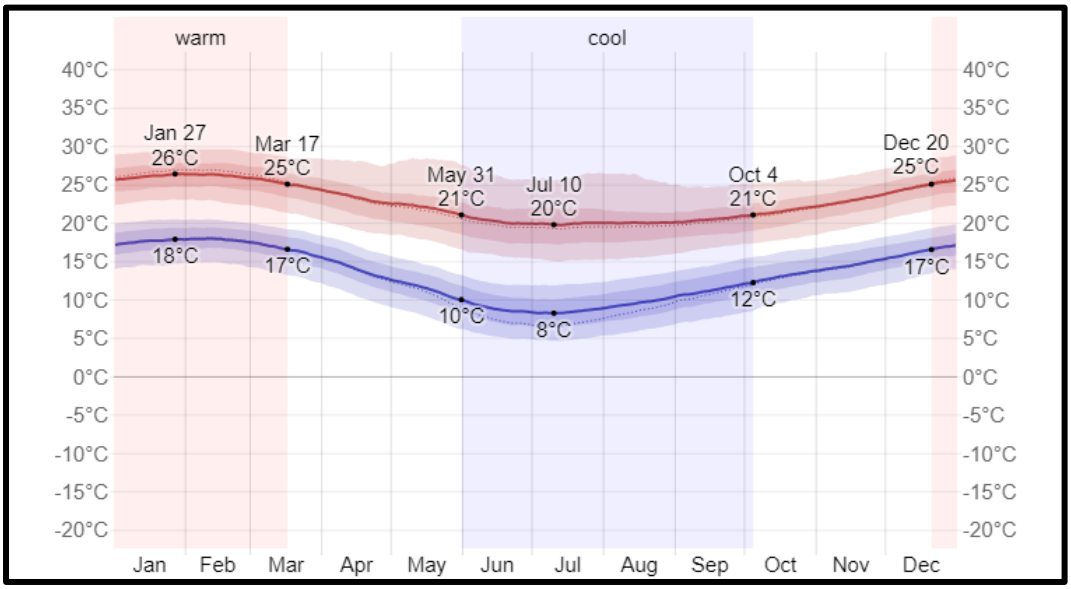

Figure 4: Average High & Low in GQ (Weathespark.com, 2023)

3.3. Seismicity

According to the 1:6 000 000 Seismic Hazard Map of Southern Africa, indicated in Figure 5. The site falls within a level five area on the Modified Mercalli Scale (MMS). Peak horizontal ground acceleration of 50 - 100 cm/s^2 has been recorded, with a 10% probability of this being exceeded at least once in a 50-year period.

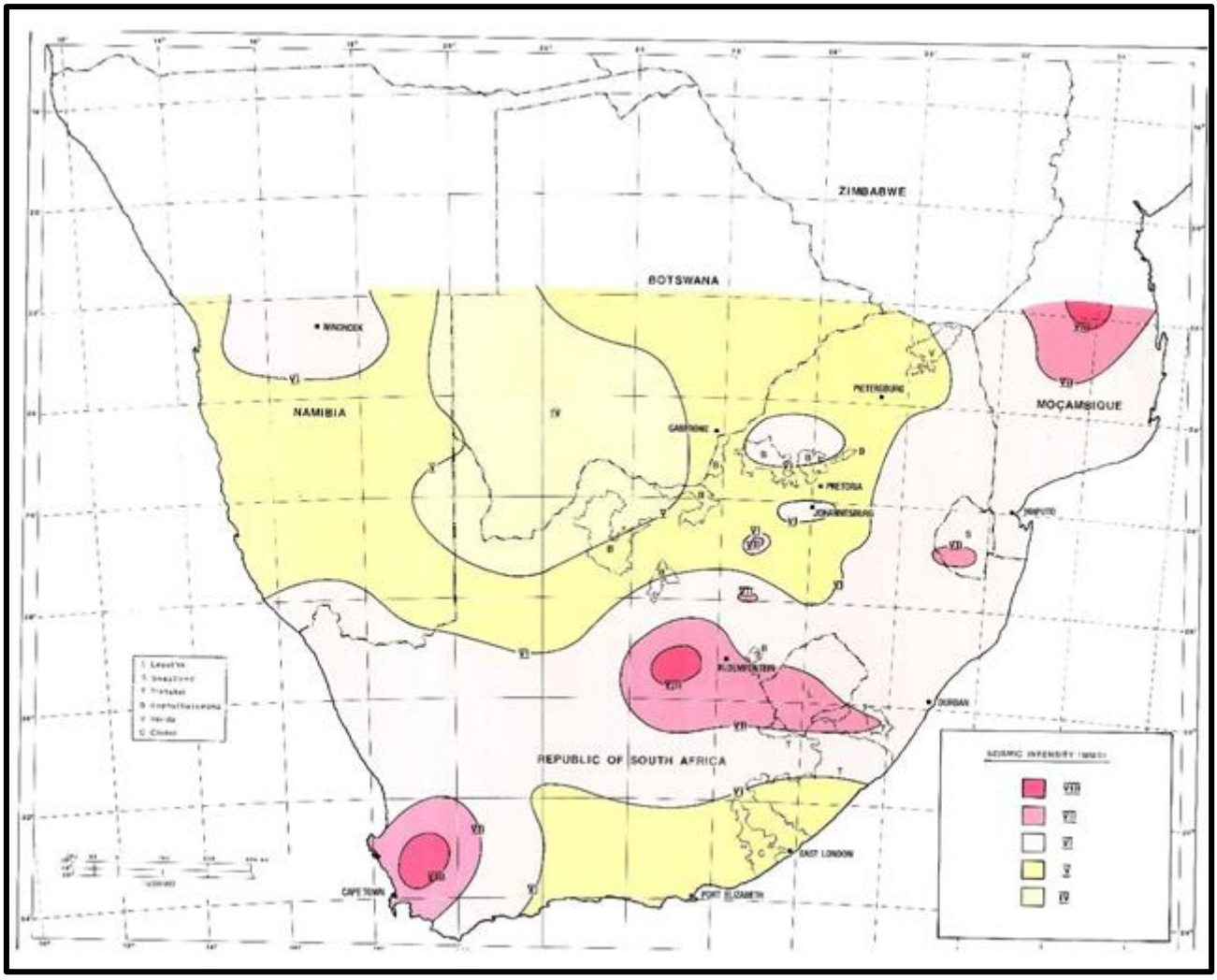

Figure 5: Seismic Intensities (Modified Mercalli Scale) with a 10% probability of being exceeded in a period of at least 50 years

4. GEOMORPHOLOGY

The geology of the study area is indicated on the 1: 50 000 sheet 3325 Port Elizabeth (Council for Geoscience, Pretoria; Toerien & Hill 1989) (Fig. 6). The greater part of this area is underlain by lime-rich coastal deposits of the Algoa Group (Le Roux 1990, Maud & Botha 2000, Roberts *et al.*, 2006). These range in age from Late Pliocene to Recent, corresponding to roughly the last two and a half million years or so.

Over almost the entire central and northern portion of the area there are coastal aeolianites (ancient or "fossil" dune sands) of the Nanaga Formation (Fig 2, T-Qn) of Pliocene to Early Pleistocene age that crop out extensively to the west of Port Elizabeth (Le Roux 1992). The sediments here comprise large-scale cross-bedded, calcareous sandstones and sandy limestones that may reach thicknesses of 150m or more (Maud & Botha 2000). These beds are partially too well-consolidated, although unconsolidated sands also occur west of Port Elizabeth (Le Roux 2000). The upper surface of the aeolianites weathers to calcrete and red, clay-rich soil. The age of the palaeodunes decreases towards the modern coastline, reflecting marine regression (relative sea level fall) during the period of deposition. The more highly elevated, inland outcrops may even be Miocene in age (Roberts *et al.*, 2006). Typically, the ancient dunes are preserved as undulating ridges of rounded hills trending parallel to the modern shoreline (Le Roux 1992).

Parsons Vlei, located in Port Elizabeth, South Africa, is situated within the geological context of the Table Mountain Super Group and its associated subgroups. The geological composition of Parsons Vlei primarily comprises sedimentary rock formations, including sandstone, siltstone, and shale. These sedimentary strata are emblematic of the Table Mountain Super Group's rich geological history and offer significant insights into the area's ancient marine affiliations, particularly within the Cape Super group. The presence of such sedimentary rocks suggests a history of deposition in shallow marine environments, such as river deltas or coastal plains, over extended geological epochs. This intricate geological tapestry within Parsons Vlei invites further investigation into its sedimentary layers and potential fossils of marine organisms, providing a compelling lens through which to explore the region's geological evolution within the broader context of the Table Mountain Super Group and its subgroups.

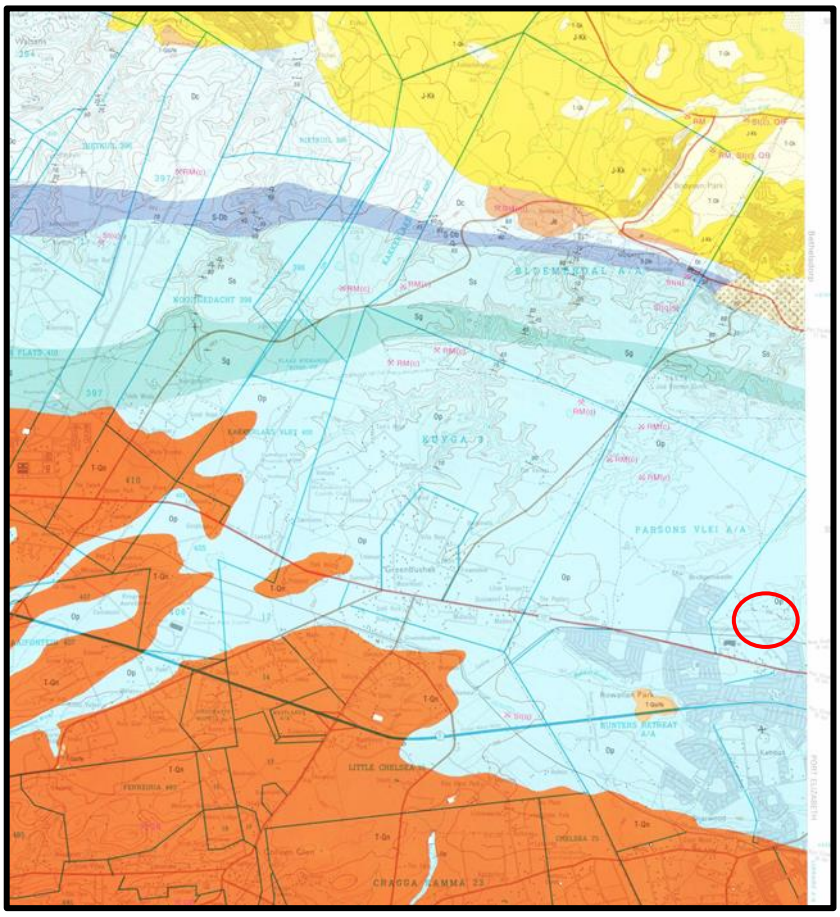

Figure 6: Uitenhage 3325cd 3425AB Geology 50k (Geoscience, 2023)

- Refer to appendix 1 for PE 3325DC 425BA complete with legend
- Teal blue area / OP – Thick-Bedded quartz arenite, conglomerate, reddish sandstone, siltstone and shale, phyllite and small-pebble conglomerate

5. INVESTIGATION METHODOLOGY

5.1. Desk Study Investigation

Background information gained during previous investigations conducted in the area were used during the planning stages of this investigation and provided an indication of what soil conditions to predict across the site, which also assists when trying to determine the most suitable geotechnical testing procedures to be carried out during the study.

5.2. Trial Hole Positions

The trial hole positions were located across the proposed footprint of the development, a total of (9) trial holes were mechanically excavated at the positions shown in figure 7, by means of a TLB (Tractor, Loader, back actor), labelled BETH1, BETHTH2, BETH3, BETH4, BETH5, BETH6 & BETH7, BETH8 & BETH9. Trail holes were excavated to depths of between 0.9m and 2.00m. All trial holes were profiled on site and DCP tests were performed next to the trial pits where possible, due to the water table being intersected and or refusal on excavation, some DCP tests were unable to be performed within the trial pits.

Disturbed yet representative soil samples were retrieved from all trial holes to be sent for MOD, CBR and Foundation indicator testing at a SANAS accredited Civil Engineering Soil testing laboratory.

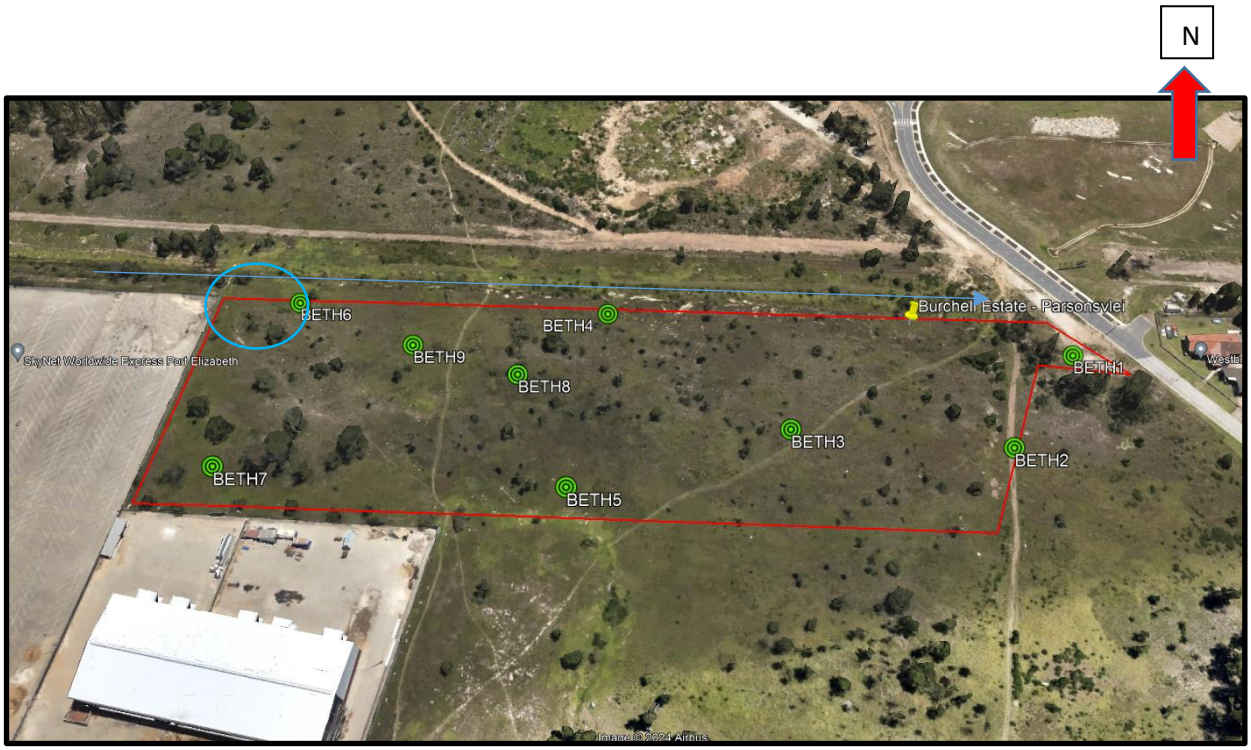

Figure 7: Trial hole Locality Plan

Blue – water course / water logged area of concern
Green – trial pit locations
Red – Property border

Figure 8: Runoff pathway / Area of concern 33°56'4.95"S, 25°29'14.43"E

6. FIELD INVESTIGATION AND LABORATORY TESTING

6.1. Trial Holes

Nine (9) trial holes were mechanically excavated, to depths ranging from 0.2 – 2.0m, as indicated in Figure 7 by a TLB and were soil logged according to SAICE'S "Guidelines for soil and rock logging in South Africa" and presented in Appendix 2.

6.2. Insitu Testing

DCP testing

A Dynamic Cone Penetrometer (DCP) test is a simple and effective field test used to assess the strength and compaction of in-situ soil, particularly in road construction and geotechnical investigations. The test is widely used in South Africa and conforms to the SANS (South African National Standards) for geotechnical testing.

Description:

The DCP test involves driving a metal cone into the ground using a standard weight dropped from a fixed height. The penetration of the cone into the soil is measured after 5 blows. The rate of penetration in mm per blow or DN value provides an indication of the soil's resistance to penetration. The rate of penetration, known as mm per blow, is used to estimate the California Bearing Ratio (CBR), unconfined compressive strength (UCS) and bearing capacitary this assists to determine the suitability of the soil for supporting loads.

Weights and Equipment:

- Cone: A 60° metal cone with a base diameter of 20 mm.
- Hammer: An 8 kg hammer is dropped from a height of 575 mm for 5 blows.
- Rod: A steel rod, typically 16 mm in diameter, connects the cone to the hammer.
- Measuring Guide – A measuring guide is placed next to the rod to determine (mm) penetration per 5 blows.

Method:

A total of nine (9) DCP'S were conducted on the proposed footprint of the structure, results are available in Appendix 1.

DCPs were taken adjacent and where possible, if refusal did not occur, within the trial hole.

DCP's performed adjacent to trial hole positions all showed increasing bearing capacity after the first 0,5m.

Generally accepted soil consistency classes regard DCP penetration values of between;

- 30 and 100 mm per blow as "Very Loose" and
- 10 to 30 mm per blow as "Loose". "
- 3 and 10 mm per blow as "Moderately Dense"
- 0 and 3mm per blow as "Dense"

The minimum bearing capacity achieved across the site below 0.5m – 1.0m is 65 kPa as defined below-

Results:

Table 1: DCP Average Bearing Capacities (P Paige-Green, 2009)

Position	Average mm per blow	Average bearing capacity (kPa)	Minimum Bearing Capacity (kPa)
BETH1	19	266	94
BETH2	5.8	853	561
BETH3	18	300	100
BETH4		Rocky area	
BETH5	26	140	128
BETH6	29	169	118
BETH7		*Rocky area	
BETH8	127	169	69
BETH9	35	120	65

**An aspect of DCP testing that should always be borne in mind is that results are affected by the moisture content of the soil profile, as well as any gravel, cobbles, rock fragments or fill material that may be present in the soil profile. A horizon saturated due to heavy rainfall will provide a lower set of results than a similar test in the dry season. Moisture content should thus always be noted and made mention of in any DCP investigation. Soil moisture content varied and was profiled as slightly moist to moist*

Table *2: DCP Average CBR Values (P Paige-Green, 2009)*

Position	Average CBR	Minimum CBR
BETH1	17	*4.5
BETH2	76	42.1
BETH3	20	4.8
BETH4	Rocky area	
BETH5	7	6.5
BETH6	10	6.5
BETH7	*Rocky area	
BETH8	10	6
BETH9	6	*2.8
	20.8	**10.45**

*Indicates a very poor, soft material.

6.3. Soil Testing Laboratory Data

Description

6.3.1. Modified California Bearing Ratio (Mod. CBR)

- **Purpose:** Evaluates subgrade soil strength and load-bearing capacity.
- **Relevance:** Critical for road pavement design, informing layer thickness based on soil strength. Used in foundation design to assess subgrade suitability.
- **Standard Reference:** Conducted per **TMH1 Method A8**.

6.3.2. Foundation Indicator Tests

- **Purpose:** Determines soil behaviour under load, including plasticity, shear strength, and compressibility.
- **Relevance:** Guides foundation design, ensuring stability and minimizing settlement risks. Key for classifying soils and predicting performance.
- **Standard Reference:** Tests follow **TMH1 Method A1-A5 & ASTM D422**.

6.3.3. Road Indicator Tests

- **Purpose:** Assesses material suitability for road construction, including particle size distribution and compaction.
- **Relevance:** Ensures road materials meet design requirements, preventing structural failures. Supports material selection and pavement layer design.
- **Standard Reference:** Adheres to **TMH1 Methods A1-A7**

Sampling

80 kg disturbed but representative samples were taken from each trial hole from depths below 0.5m – 2m, these were sent to a SANAS accredited laboratory, Outeniqua Labs. Details regarding depth, laboratory tests conducted are indicated in the table below;

Summary of Results

Table 3: Disturbed Soil Sample Testing details

Trial Hole No	Sampling Depth (below surface) mm	Laboratory Testing
BETH3	700-1500	MOD, CBR, Foundation Indicator
BETH6	900-1200	MOD, CBR, Foundation Indicator
BETH7	1300-1700	MOD, CBR, Foundation Indicator

Table 4: CBR Summary

Trial Hole	Sample No	CBR @ Mod AASHTO					GM	MDD/OMC
		100%	98%	98%	93%	90%		
BETH3	18439	6	5	4	3	2	1.64	1900 / 12.6
BETH6	18437	11	8	5	3	2	1.75	2100 / 7.3
BETH7	18438	20	17	14	12	9	1.68	2112/ 7.9

*Refer to 7.6

Table 5: Grading and Atterberg Limits

	Sample No	Depth (mm)	Sieve Analysis (%)				Atterberg Limits			TRH14	USC	MC	PE
			Clay	Silt	Sand	Gravel	LL	LS	PI				
BETH3	18439	700-1500	1	18	13	68	43	10	20	G9	SM-SC	10.8	LOW
BETH6	18437	900-1200	1	20	28	51	22	3	6	NC	GM-GC	6.1	LOW
BETH7	18438	1300-1700	1	18	13	68	43	10	20	NC	GC	4	LOW

*PE – Potential Expansiveness (Skemptons activity chart)
*USC – Unified Soil Classification System
*TRH – Technical Recommendations for Highways, material classification system
*MC – Moisture Content
*NP – Non-plastic, of significant importance, indicating no active clay present
*NC – No classification

The soils are classified using the Universal Soil Classification System and are as below;

SP – Poorly graded Sand.
SM-SC – Sand contains silt & Clay
SM – Sand with Silty fines
GM-GC – Silty gravel, clayey gravel
ML – Sandy silts

*The Sites PE is LOW.

6.3.4 EC & pH Testing

Electrical Conductivity (EC)

- **Purpose:** Soil Salinity; EC measures the ability of soil to conduct electrical current, which is directly related to the concentration of soluble salts in the soil.
- **Relevance:** High salinity levels can lead to corrosion of underground structures and affect the soil's bearing capacity. Soil Permeability; EC can provide insights into the soil's permeability and its potential to retain or drain water, which is crucial for determining drainage requirements and the stability of slopes and embankments.

pH Testing:(pH)

- **Purpose:** Soil Acidity or Alkalinity: The pH of soil influences the chemical environment and the solubility of minerals,
- **Relevance:** This affects the durability of construction materials (e.g., concrete and steel). Highly acidic or alkaline soils may require special treatment or protective measures.

Table 6: EC level of Corrosiveness

EC Level (dS/m)	Corrosiveness	Description
< 0.2	Very Low Corrosiveness	Minimal risk to concrete, metals, and underground utilities. Safe for most construction materials.
0.2 - 0.8	Low Corrosiveness	Slightly corrosive; generally safe but may require some protective measures for sensitive materials.
0.8 - 2.0	Moderate Corrosiveness	Noticeable corrosion risk; protective measures recommended for metals and concrete.
2.0 - 4.0	High Corrosiveness	Significant corrosion risk; requires special materials or coatings to prevent damage to structures.
> 4.0	Very High Corrosiveness	Severe corrosion risk; necessitates the use of highly resistant materials and comprehensive protection.

References:

- Eurocode EN 206-1: "Concrete - Specification, Performance, Production and Conformity"
- SANS 10100-2: "The Structural Use of Concrete - Part 2: Materials and Execution of Work"

Table 7: pH Level and Risk to Concrete Foundations

pH Level	Risk to Concrete Foundations	Description
< 4.5	Very High Risk	Strongly acidic soil; very aggressive towards concrete, leading to rapid deterioration and loss of strength.
4.5 - 5.5	High Risk	Acidic soil; significant risk of concrete degradation, requiring protective measures like special mix designs or coatings.
5.5 - 6.5	Moderate Risk	Slightly acidic soil; moderate risk to concrete, may require enhanced concrete mix or protective coatings.
6.5 - 7.5	Low Risk	Neutral soil; minimal risk to concrete, generally safe without special measures.
7.5 - 8.5	Moderate Risk	Slightly alkaline soil; moderate risk to concrete, particularly in the presence of soluble salts.
8.5 - 9.5	High Risk	Alkaline soil; high risk of chemical reactions that can weaken concrete over time, protective measures needed.
> 9.5	Very High Risk	Strongly alkaline soil; very high risk of chemical attack on concrete, leading to severe deterioration.

References:

- Eurocode EN 206-1: "Concrete - Specification, Performance, Production and Conformity"
- SANS 10100-2: "The Structural Use of Concrete - Part 2: Materials and Execution of Work"

Table 8: EC & pH Levels

Trial Hole	EC (µS/cm)	pH
BETH1	156	7.9
BETH2	60	7.8
BETH4	132	7.8
BETH5	350	7.3
BETH7	144	7.4
BETH8	2100	8.2

7. ENGINEERING GEOLOGICAL EVALUATION

The engineering geological evaluation is based on the results of the desk study, observations and interpretations made on site as well as analysis of the laboratory results.

A broad overview of the geotechnical constraints that are predicted to occur within the study area based on the findings during this investigation are as follows:

7.1. Expansive Soil

No expansive soil was encountered in any of the trial holes. Any potential heave will be low according to Van der Merwe's heave and activity graph and Potential Expansiveness (Skemptons activity chart. (Appendix 3 – Foundation indicators)

Due to the uniformity of the material, no presence of active clay or collapsible soils, shear & Consolidation tests are not needed.

7.2. Dispersive Soil

Clay is an assemblage of microscopic platelets, which are held together by various forces. A high percentage of sodium cations in the clay cause the platelets to be loosely bound. Should water with a low concentration of dissolved salts (such as rainwater) find an initial micro-channel in such a soil mass, the loosely held platelets will disperse and be carried away resulting in soil erosion and piping.

An active alluvial silt/clay deposit is present in the North West corner of the development, it is recommended the material is removed and replaced, use of separation geotextiles will increase overall bearing capacity and the required depth of fill.

Due to the flat nature of the terrain and perched water table a storm water management plan will need to be designed and a permanent drainage system implemented.

7.3. Potentially Collapsible Soil

A soil with a collapsible fabric is defined as a soil that can withstand relatively large imposed stresses with small settlements at low *in situ* soil moisture content, but which will exhibit a decrease in volume and associated settlement with no increase in the applied stress if wetting up occurs. The change in volume is associated with a change in the soil fabric (collapse of grain structure) and is applied to an additional settlement, which occurs due to the wetting up of partially saturated subsoil, which has a collapsible fabric.

Due to the area being underlain by residual soil, Quartzitic sand stone, alluvial based gravel of mudstone and shale the settlement risk is low to medium of a collapse potential due to the alluvial nature of the gravels.

Adequate compaction will generally be sufficient to counter any collapse potential problems, which may occur if collapsible soils were encountered.

Using NHBRC recommendations as found in table 2, the site is classified as an **S/C1 in defined portions**, with 5 – 10mm settlement predicted.

7.4. Differential Settlement

Differential settlement problems have a low to medium margin of occurring at this site. Foundations placed partially over horizons of varying consistency would be subjected to differential settlement. Founding over a contact between sandy & silty alluvial (non-expansive) and clayey residual (potentially medium expansive) could also result in differential heave movement under variable moisture conditions.

It must be noted a soft clay area was encountered at BETH8, this was isolated either side at 15m and found to be localised. It is advised that this area is investigated further and a competent person inspect once the area has been cleared and the overburden material removed, the area may need removal and replacement, or designed stiffened foundations are implemented to counter excessive differential settlement.

Due to the gravely nature of the material in identified area, and presence of cobbles, including the visible layers of alluvium, due to the "Vlei" nature of the area, there is a low to medium risk of settlement, **5 – 10 mm** is predicted, the site can therefore be classified as a **S/C1** where shallow refusal

hasn't occurred and **R** for shallow refusal under 1.2m.

All root structures should be thoroughly removed where surface infrastructure is proposed. Roots and other organic material decays over time, which may result in voids and cavities developing beneath foundations, ultimately leading to settlement-induced structural damage.

7.5. Bearing Capacity

The strength or load bearing capacity of the soil is expected to be constant in the study area where indicated.

Table 4 below gives an indication of the presumed safe bearing capacity range of each material type. SANS (ex-SABS standard) 0161-1980 was used to predict these presumed safe bearing capacities for normal conditions based on soil consistencies determined during soil profiling. *This information is generalised per horizon and is given as a guide only.*

As in the below table, the material is defined as **rock** in identified areas and non-cohesive in the rest, compact poorly graded gravel, gravel sands at presumed safe bearing capacities of **200 – 400 kN/m^2 dry** and **100 – 200 kN/m^2 submerged**.

The bearing capacities as shown by the DCP results (appendix 4) are in the low range and indicate a highly weathered overburden over a firm stratum, this overburden will have to be removed in most cases and brought to grade with minimum G7 quality material and or a sufficient foundation design. Each dwelling unit should be assessed on a case-by-case and its relation in depth to a firm stratum.

Table 9: Generalised safe Bearing capacities (SANS10161)

Type of supporting ground	Description of rock, soils and fills	Presumed safe bearing capacity (kN/m^2)	
		Dry	Submerged
Rock	Fresh rock, massively bedded, intact (igneous, metamorphic, or sedimentary) and requiring blasting for excavation	5 000	5 000
	Fresh rock, fractured or jointed, which can be excavated with difficulty by pneumatic picks, but which normally requires light blasting	1 000	1 000
	Shale, of hard rock consistency	200 - 400	200 - 400
	Decomposed rock, to be assessed as a soil as below	-	-
Non-cohesive	Compact, well graded gravels, very dense silty sand, sands, gravel-sand mixtures	400 - 600	200 - 300
	Compact but poorly graded gravels, gravel-sand, dense sands, silty sands, sandy silt, silt mixtures	200 - 400	100 - 200
	Medium dense sands, silty sands, sandy silts, and silts, clayey sands, clayey silts	100 - 150	50 - 75
	Loose and very loose sand, silty sands, sandy silts, clayey sands, clayey silts	By test only	By test only
Cemented soils	Cemented gravel, hard 'ouklip' (ferricrete), hard calcrete, and hard silcrete	400 - 600	400 - 600
	Weakly cemented soils of medium and low (loose) density	100 - 150	By test only
Cohesive soils	Very stiff sandy or silty clays	400 - 500	300 - 400
	Stiff clays, sandy clays, silty clays	200 - 400	150 - 200
	Firm clays, sandy clays, silty clays	100 - 200	75 - 150
	Soft clays, sandy clays, silty clays	50 - 100	50 -100
	Compacted fill or selected material	0 - 50	0 - 50
Compacted selected ill	Compacted fill or selected material	By test only	By test only
Random fills	Made-up ground, waste dumps, and other uncompacted fills	By test only	-

Note: Most foundation loads in buildings are applied vertically to the centre of the foundation. However, where the load is applied eccentrically or inclined from the vertical or both, the safe bearing capacity will require modification.
The presumed safe bearing capacities should be taken at a depth of not less than 600 mm below the top of natural supporting ground.

Table 10: Residential site class designation (adopted from the NHBRC Home Building Manual and the COP)

GEOTECHNICAL CATEGORY AND SITE CLASS DESIGNATION	**GEOTECHNICAL CHARACTERISTICS**
Active soils (heave/shrink) - (H) H H1 H2 H3	Expected range of total movement at surface: < 5 mm 5 – 15 mm 15 – 30 mm > 30mm
Collapsible Soils – (C) C C1 C2	Expected range of total movement at surface: < 5 mm 5 – 10 mm > 10 mm
Compressible soils (S) S S1 S2	Expected range of total movement at surface: < 5 mm 5 – 15 mm > 15 mm
Excavation – (R) r1 r2 r3	 sub outcrop scattered outcrop and sub-outcrop outcrop, scattered outcrop and sub-outcrop
P – Problem soils	Dolomitic Areas, marshy areas, contaminated areas, abandoned borrow areas, land fill, mining subsidence and mine waste fill, shallow undermined areas, exploration pits or audits.
Inundation and seepage – (W)	Wet area, drainage line, seepage zone

Table 11: Experience Based Bearing Capacity Limits

Material Type	Limiting Bearing Capacity
Hard Rock	1000 kPa >
Stiff Clay	300 – 600 kPa
Compact Gravel	150 – 300 KPa
Dense Sand	150 – 300 KPa
Loose Gravel	75 – 150 KPa
Medium Clay	75 – 150 KPa
Soft Clay	30 – 75 KPa
Silt	30 – 75 KPa
Loose Sand	30 – 75 KPa

Table 12: Site Class Designation SANS10400-H

Table 1 — Site class designations of single-storey and double-storey type 1 masonry buildings

1	2	3	4	5
Typical founding material	**Nature of founding material**	**Expected range of total soil movements** mm	**Assumed differential movement** % of total	**Site class designation**
Rock (excluding mud rocks which might 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 to 15 15 to 30 > 30	50 50 50 50	H H1 H2 H3
Silty sands, clayey sands, sands, sandy and gravelly soils	Compressible and potentially collapsible soils	< 5 5 to 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 soils	< 10 10 to 20 > 20	50 50 50	S S1 S2
Contaminated soils[a], controlled fill, dolomite land, landslip, landfill, marshy areas, mine waste fill, mining subsidence reclaimed areas, uncontrolled fill, very soft silts/silty clays	Variable	Variable	–	P[b]

NOTE 1 A composite description is more appropriate to describe a site more fully, for example, C1/H2 or S1 or H2 (or both). Composite site classes might lead to higher differential movements and result in design solutions appropriate to a higher range of differential movement, for example, a class R/S1 may be described as a class S2 site. Alternatively, a further site investigation might be necessary as the final design solution might depend on the location of the housing unit on a particular site.

NOTE 2 Where it is not possible to provide a single site designation and a composite description is inappropriate, sites may be given multiple descriptions to indicate the range of possible conditions, for example, H1-H2 or C1-C2.

NOTE 3 Soft silts and clays usually exhibit high consolidation and low bearing characteristics. Structures founded on these horizons might experience high settlements and such sites should be designated as class S1 or S2, as relevant and appropriate.

[a] Sites that contain contaminated soils include those associated with reclaimed mine land, land down the slopes of mine tailings, and old landfills.

[b] Where sites are designated as class P, the reason for such classification should be placed in brackets immediately after the suffix, i.e. P (contaminated soils). Dolomite land should be designated as class P (dolomite-D2/H2) or class P (limestone-D2/H2) where the first designation after dolomite/limestone is the designation obtained from SANS 1936-1.

4.2.2 The competent person (geotechnical) shall document and formulate all opinions in such a manner that a peer review, if conducted on the same basic data, will arrive at a substantially similar opinion.

4.2.3 Site class designations shall be derived from an estimation of the expected range of total soil movements experienced by single-storey and double-storey type 1 masonry buildings, where the foundation load on a foundation that has a width that does not exceed 0,6 m in respect of single-storey buildings and 0,8 m in respect of double-storey buildings, does not cause the soil bearing pressure to exceed 50 kPa.

7.6. Suitability

The soils reached use classifications of G9 and non-classification (appendix 3), G9 and non-classified material is not suitable for subbase or general filling and is not recommended for use.

Using the below guideline the average insitu CBR obtained from the DCP tests was **20%, with an average minimum of 10.8%.**

*The **California Bearing Ratio** (CBR) is a measure of the strength of a material relative to its resistance to penetration by a standard plunger under specific testing conditions. The CBR value is often used in geotechnical engineering to assess the suitability of materials for road construction and foundation design.*

For foundation materials, including those used in residential and commercial construction, the minimum CBR value can vary based on the specific requirements of the project, local soil conditions, and applicable building codes. However, there are some general guidelines you can consider:

*Subgrade Material: The subgrade soil directly beneath the foundation should ideally have a higher CBR value, typically around **20%** or more and be constant across the structural footprint, to minimize settlement and potential issues.*

It's important to note that the minimum CBR values can vary depending on the type of foundation, the weight of the structure, and the local soil conditions.

7.7. Ground water

Groundwater seepage is encountered mainly on the northern border of the site, mainly intersected at 1.2m. The water table appears to sit underneath a layer of ferricrete/sandstone/shale gravel. Once disturbed the trial pits quickly fill and stabilise to 1.0m from the surface. This represents a significant permanent water table with a high possibility of a perched water table occurring across the site, the area is known for flooding and high ground water levels. Due to the drought period the
It is safe to presume that the foundation material is to be treated as submerged when assessing bearing capacity.

- It is advised that any concrete containing steel that is in contact with the ground have significant concrete cover, specialised concrete mix designs and be further protected by painting water proofing compounds on their surface.

8. *CONCLUSIONS AND RECOMMENDATIONS:*

- It is considered that the conditions prevailing on site during the site investigation are such that the majority of the site is considered suitable for the proposed development, provided that the recommendations outlined in this report are adhered to. The main geotechnical constraints to the development are the permanent water table, high risk of a perched water table across the site and an identified clay deposit in the North West corner.

- The site is extremely flat but is bordered by a water course and a large volume of runoff from the next-door parking lot is occurring, a suitable drainage and storm water management system will need to be initiated to prevent ponding of water and flooding of the area. Soft spots as encountered at BETH8 are highly susceptible to moisture, effecting bearing capacity. It is crucial that the water course be cleared of alien vegetation and rubbish so that its flow is not restricted, it appears that a large volume of water flows through it in times of heavy rains.

- A minimum of 0.5m of overburden will have to be removed due to the presence of organics, dumped rubbish and building rubble.

- A further 0.6m – 0.9m is advised to be removed in the softer S/C1 sites as indicated in (Figure 10)

  – The SANS 10400 – H / NHBRC Site Classification is therefore **R/S/C1**. (Table 12, Table 10)

  – Settlement is predicted to be in the range of **5 – 10mm**

  – Bearing Capacity not to exceed **150kPa**

1. **Soil Raft**
   - *Removal of in-situ material 1.5 times the widest foundation and 1m beyond the building perimeter or to a competent horizon and replaced with at least G7 quality material compacted to 93% MOD AASHTO at -1% to 2% of optimum moisture content.*
   - *Normal foundation construction, reinforced strip footings and reinforcement in masonry.*

2. **Strip foundations – (Single-story only)**
   - *Bearing Pressure not to exceed 100kPa.*
   - *Light reinforcement recommended*

3. **Stiffened Strip Foundations / Stiffened-Cellular Raft – (double-storey)**
   - *Bearing Pressure not to exceed 180kPa,*
   - *Reinforced masonry or articulation joints*

4. **Combined footing (double-storey)**
   - *Bearing Pressure not to exceed 100 – 200kPa*
   - *Reinforced concrete*

Option 1.1: Reinforced Raft Foundations

Applicability: Suitable for single/double-storey structures with a maximum allowable design bearing pressure of 100kPa.

Support Requirement: Requires engineered fill support as specified below.

Excavation: Remove in-situ material to a depth of 0.50-0.80m below ground level.

Replacement Material: Replace with G7 quality material, compacted in 150mm layers to achieve 93% Mod A.A.S.T.O maximum dry density.

Construction: Raft foundations should adhere to engineer's specifications and guidelines outlined in SANS 10400-H: 2012.

Option 2: Strip foundations / Reinforced Strip Footing Foundations

Applicability: Suitable for single-storey structures with a maximum allowable design bearing pressure of 100kPa.

Support Requirement: Requires engineered fill support as specified.

Excavation: Remove in-situ material from the structure's footprint.

Replacement Material: Replace with minimum G7 quality material to a depth of 1.5 times the foundation width below the footings and 0.5 times the width on each side to minimize differential settlement.

Compaction: Material should be compacted in layers not exceeding 150mm, achieving at least 93% Mod A.A.S.T.O maximum dry density.

Design Limit: Design bearing pressure limited to 100kPa.

Construction: Reinforced strip footing foundations must meet engineer's specifications and adhere to guidelines in SANS 10400-H: 2012.

Surface Bed Preparation (Both Options):

For the floor area, remove 300mm of subsoil material.
Replace with loosely compacted minimum G7 quality material in 100mm layers to attain at least 93% Mod AASHTO maximum dry density.

Prompt Concrete Placement: Ensure concrete is poured promptly into the excavation to avoid exposure of foundation trenches for more than 3 days, preventing mechanical and chemical deterioration.

- It is recommended that an experienced and competent engineering professional be appointed to inspect the earthworks and foundation excavations during the development of the site to confirm founding depths, bearing pressures and validate the recommendations provided in this report.

- One of the more important factors in the promotion of a stable site is the control and removal of surface water from the property. It is important that the design of the storm water management system, allow for the drainage of accumulated surface water from the platform and into the natural drainage lines, this needs to include a storm water management plan if engineering fill is used, due to the risk of the fill settling if fines are removed through the action of draining water.

- Finally, it must be understood that the ground conditions described in this report refer specifically to those encountered at the inspection positions on site. It is therefore possible that conditions at variance with those discussed above may be encountered elsewhere on the property.

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APPENDIX 1: MAP DATA

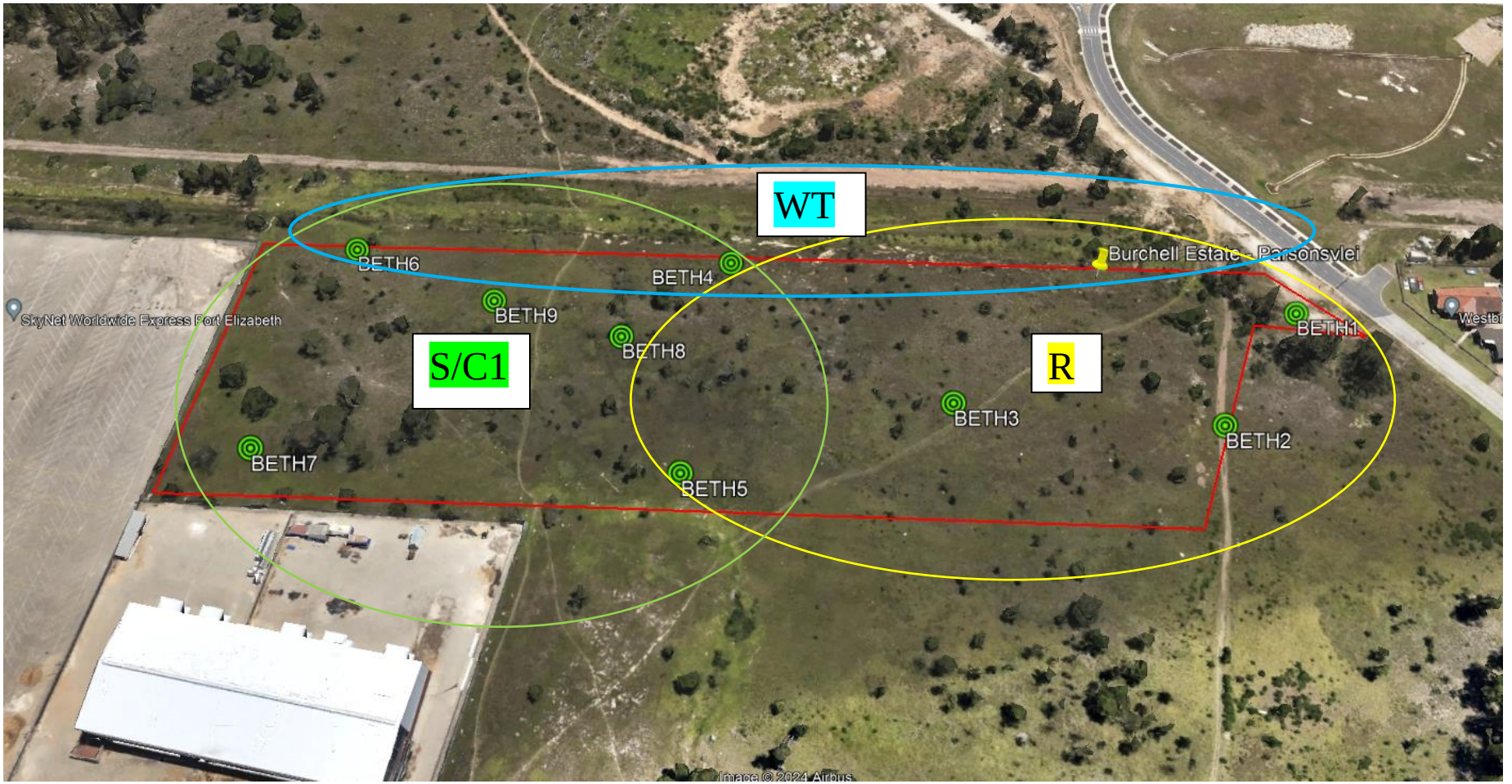


Figure 10: NBR/NHBRC Foundation Classification Groupings (Yellow - R, Green S/C1, Blue – WT <1m)

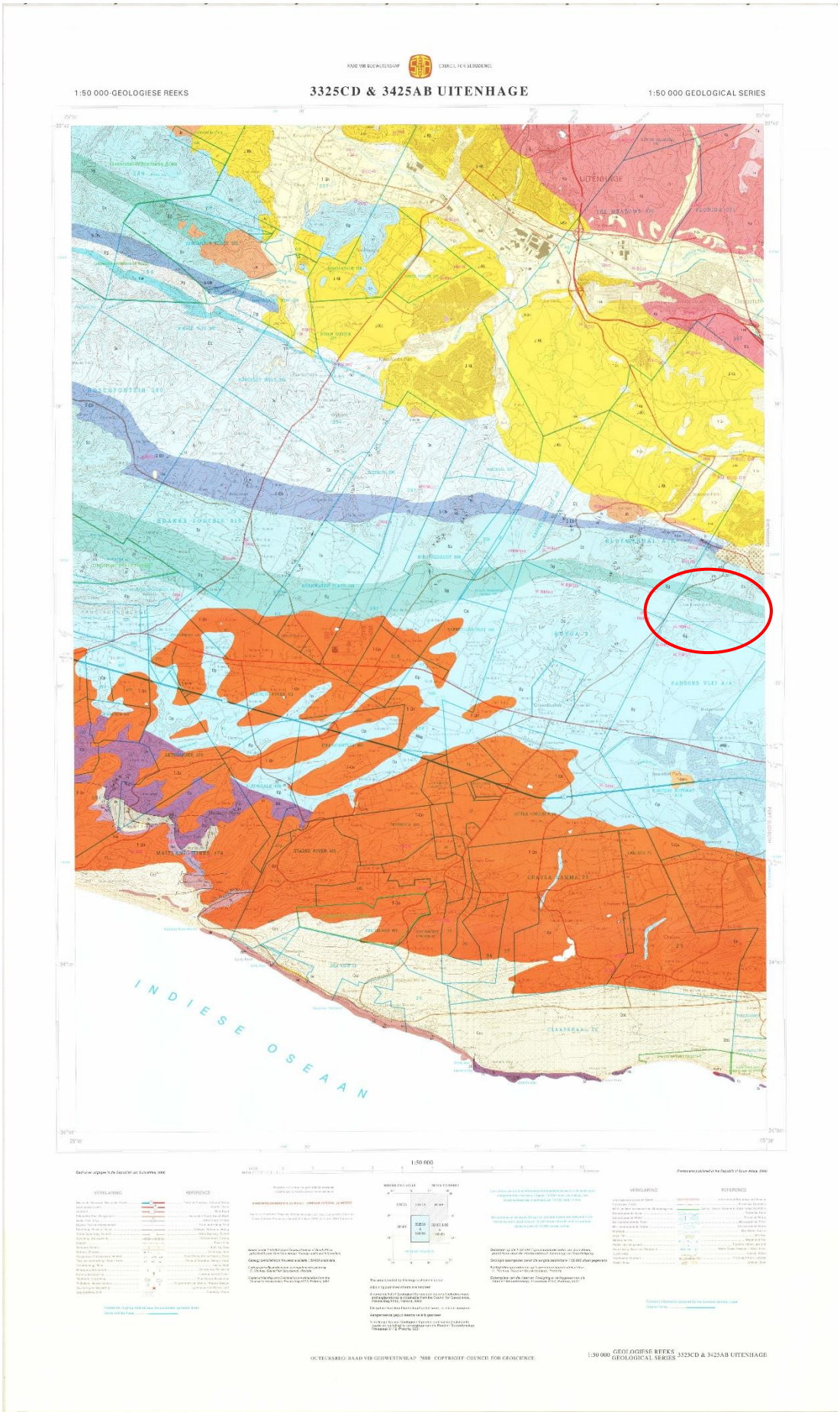


Figure 11: Uitenhage 3325CD 3425AB Geology 50K Map

Figure 12: Aerial Erven Overview

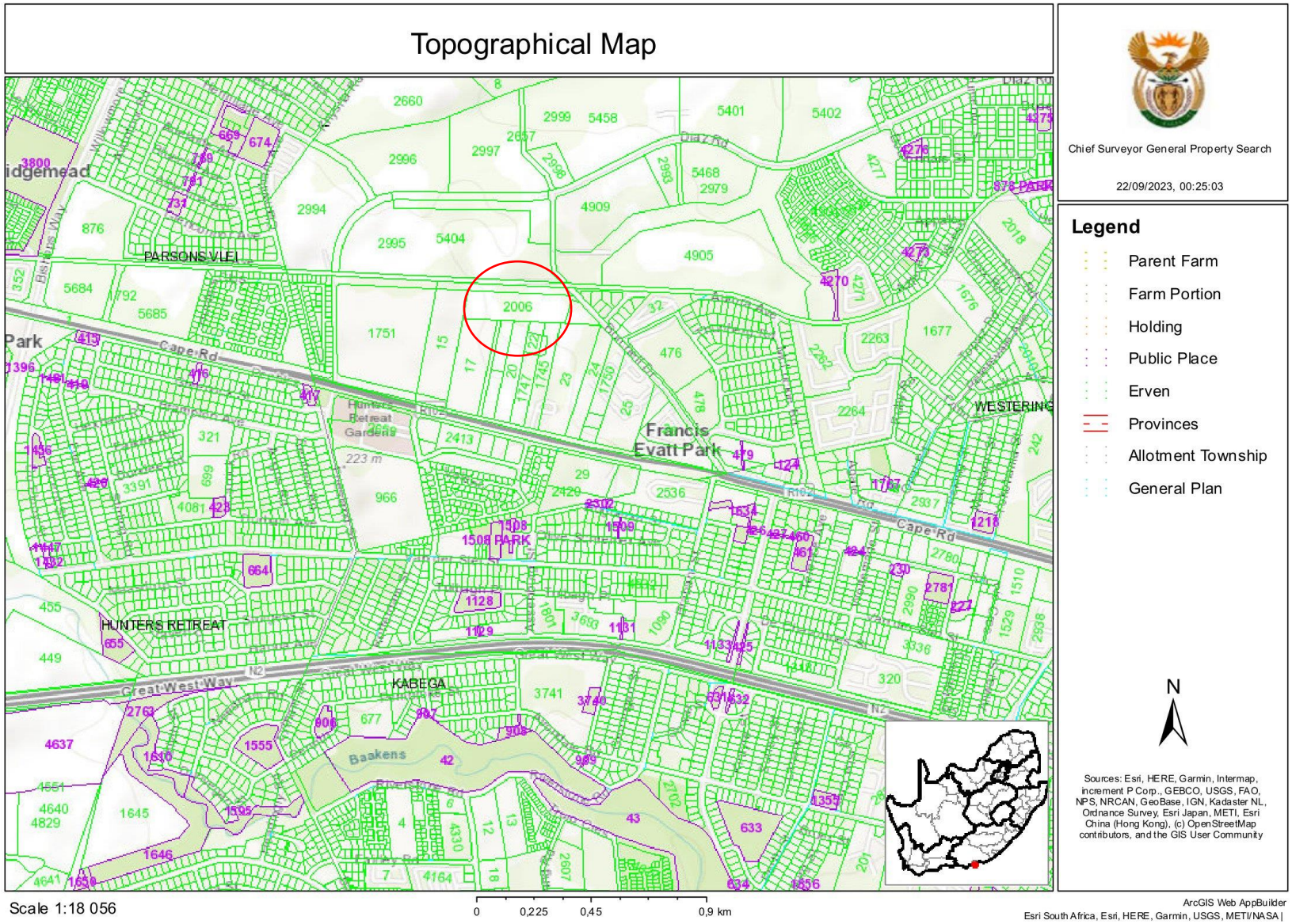


Figure 14: Topographical Map

APPENDIX 2. TRIAL HOLE PROFILES

TH01

Project Name: Burchell Estate
Job Number: 2006
Site: Parsons Vlei
Client:
Trial Pit: BETH1

GSENG - GeoTech
Email: info@gseng.co.za

Depth (m)	Lithology	Description	Sample	Photograph
0.00 – 0.50	0 - 0.5m	Moist, Light reddish brown silt with sandstone gravel- contains organics & rubble	BETH1	
0.50 – 1.00	0.5-0.9m	Moist, Light brown light gray, closely jointed, silt gravel, firm, **Residual Sandstone**		
1.00 – 3.50		Refusal, medium hard **SANDSTONE**		

Profiled By:	LG	**Latitude:**	33°56'4.90"S
Contractor:	Rademeyer Plant Hire	**Longitude:**	25°29'26.20"E
Machine:	JCB 3CX - TLB	**Samples:**	BETH1: 0.50 - 0.9m
Date Excavated:	10/07/2024		MS X 1, SS X 1
Date Profiled:	10/07/2024		
Notes:	Refusal @ 900mm	**Depth of Excavation (m):**	0.9
	Ease of excavation: medium to dense.		
	Duration: 10 mins		1 of 1

TH02

Project Name: Burchell Estate
Job Number: 2006
Site: Parsons Vlei
Client:
Trial Pit: BETH2

GSENG - GeoTech

Email: info@gseng.co.za

Depth (m)	Lithology	Description	Sample	Photograph
0.00 – 0.50	0 - 0.5m	Moist, Light reddish brown silt with sandstone gravel- contains organics & rubble	BETH2	
0.50 – 1.00	0.5-1.0m	Moist, Light reddish brown silty SAND with ferricrete/gravel, soft, closely jointed, **Residual Sandstone**		
1.00 – 3.50		Refusal, medium hard **SANDSTONE**		

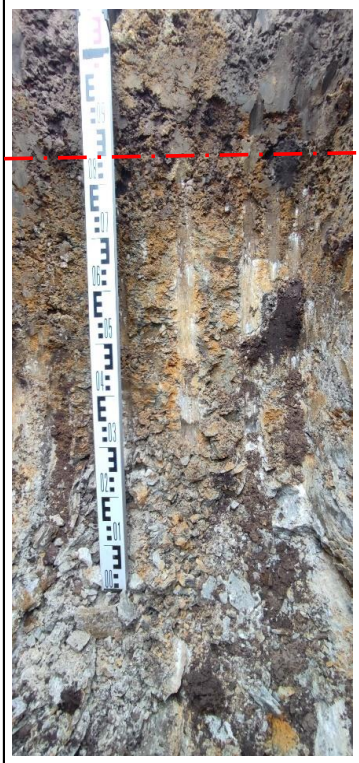
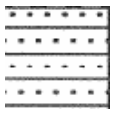
Profiled By:	LG	**Latitude:**	33°56'6.20"S
Contractor:	Rademeyer Plant Hire	**Longitude:**	25°29'25.10"E
Machine:	JCB 3CX - TLB	**Samples:**	BETH2: 0.50 - 1.0m
Date Excavated:	10/07/2024		MS X 1, SS X 1
Date Profiled:	10/07/2024		
Notes:	Refusal @ 1000mm	**Depth of Excavation (m):**	1
	Ease of excavation: medium to dense.		
	Duration: 10 mins		1 of 1

TH03

Project Name:	Burchell Estate
Job Number:	2006
Site:	Parsons Vlei
Client:	
Trial Pit:	BETH4

GSENG - GeoTech

Email: info@gseng.co.za

Depth (m)	Lithology	Description	Sample	Photograph
0.00		Moist, Light reddish brown silt with sandstone gravel- contains organics & rubble	BETH3	
0.50	0 - 0.5m			
		Moist, Light brown light gray, closely jointed, silt gravel, firm, **Residual Sandstone**		
1.00	0.5-1.0m			
		Refusal, medium hard **SANDSTONE**		
1.50				
2.00				
2.50				
3.00				
3.50				

Profiled By:	LG	**Latitude:**	33°56'6.00"S
Contractor:	Rademeyer Plant Hire	**Longitude:**	25°29'21.90"E
Machine:	JCB 3CX - TLB	**Samples:**	BETH3: 0.50 - 0.9m
Date Excavated:	10/07/2024		MS X 1, SS X 1
Date Profiled:	10/07/2024		18349
Notes:	No Water table intersected Ease of excavation: medium to dense. Duration: 10 mins	**Depth of Excavation (m):**	0.9

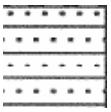
1 of 1

TH04

Project Name: Burchell Estate
Job Number: 2006
Site: Parsons Vlei
Client:
Trial Pit: BETH4

GSENG - GeoTech

Email: info@gseng.co.za

Depth (m)	Lithology	Description	Sample	Photograph
0.00	 0 - 0.5m	Moist, Light reddish brown silt with sandstone gravel- contains organics & rubble	BETH4	
0.50				
	0.9m	▼WT		
1.00	 0.5-1.3M	Moist, Light brown light gray, closely jointed, silt gravel, firm, **Residual sandstone**		
		Refusal, medium hard **SANDSTONE**		
1.50				
2.00				
2.50				
3.00				
3.50				

Profiled By:	LG	**Latitude:**	33°56'4.40"S
Contractor:	Rademeyer Plant Hire	**Longitude:**	25°29'19.20"E
Machine:	JCB 3CX - TLB	**Samples:**	BETH4: 0.50 - 1.3m
Date Excavated:	02/08/2023		MS X 1, SS X 1
Date Profiled:	02/08/2023		
Notes:	Water table intersected @ 0.9m. Ease of excavation: medium to dense. Duration: 10 mins	**Depth of Excavation (m):**	1.3

TH04

Project Name: Burchell Estate
Job Number: 2006
Site: Parsons Vlei
Client:
Trial Pit: BETH5

GSENG - GeoTech

Email: info@gseng.co.za

Depth (m)	Lithology	Description	Sample	Photograph
0.00	0 - 0.5m	Moist, Light reddish brown silt with sandstone gravel- contains organics & rubble	BETH5	
0.50	0.9m	▼ WT		
1.00	0.5-1.6m	Moist, Light brown light gray, closely jointed, silt gravel, soft, **Residual Sandstone**		
1.50		Refusal, medium hard **SANDSTONE**		
2.00				
2.50				
3.00				
3.50				

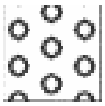
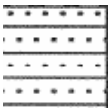
Profiled By:	LG	**Latitude:**	33°56'6.80"S
Contractor:	Rademeyer Plant Hire	**Longitude:**	25°29'18.70"E
Machine:	JCB 3CX - TLB	**Samples:**	BETH5: 0.50 - 1.6m
Date Excavated:	10/07/2024		MS X 1, SS X 1
Date Profiled:	10/07/2024		
Notes:	Water table intersected at 1.2m. Ease of excavation: medium to dense. Duration: 10 mins	**Depth of Excavation (m):**	1.6
			1 of 1

TH04

Project Name: Burchell Estate
Job Number: 2006
Site: Parsons Vlei
Client:
Trial Pit: BETH6

GSENG - GeoTech

Email: info@gseng.co.za

Depth (m)	Lithology	Description	Sample	Photograph
0.00		Moist, Light reddish brown silt, very soft with sandstone gravel- contains organics & rubble	BETH6	
0.50	0 - 0.5m			
		Wet, light grey, closely jointed, very soft, slicken sided, Transported clay. **Residual Sandstone**		
1.00	0.5-1.2m	▼ WT		
		Refusal, medium hard **SANDSTONE**		
1.50				
2.00				
2.50				
3.00				
3.50				

Profiled By:	LG	**Latitude:**	33°56'6.80"S
Contractor:	Rademeyer Plant Hire	**Longitude:**	25°29'18.70"E
Machine:	JCB 3CX - TLB	**Samples:**	BETH6: 0.50 - 1.2m
Date Excavated:	10/07/2024		MS X 1, SS X 1
Date Profiled:	10/07/2024		18437
Notes:	Water table intersected at 1.2m. Ease of excavation: medium to dense. Duration: 10 mins	**Depth of Excavation (m):**	1.2

1 of 1

TH04

Project Name: Burchell Estate
Job Number: 2006
Site: Parsons Vlei
Client:
Trial Pit: BETH7

GSENG - GeoTech
Email: info@gseng.co.za

Depth (m)	Lithology	Description	Sample	Photograph
0.00 – 0.50	0 - 0.5m	Moist, Light reddish brown silt, very soft with sandstone gravel- contains organics & rubble	BETH7	
0.50 – 1.00	1.4m	Wet, light grey, light reddish brown silt, closely jointed, very soft, slicken sided, Transported clay. **Residual Sandstone** ▼WT		
1.50	0.5-1.7m			
2.00 – 3.50		Refusal, medium hard SANDSTONE		

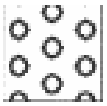
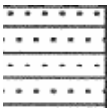
Profiled By:	LG	**Latitude:**	33°56'6.80"S
Contractor:	Rademeyer Plant Hire	**Longitude:**	25°29'18.70"E
Machine:	JCB 3CX - TLB	**Samples:**	BETH7: 0.50 - 1.6m
Date Excavated:	10/07/2024		MS X 1, SS X 1
Date Profiled:	10/07/2024		18438
Notes:	Water table intersected at 1.2m. Ease of excavation: medium to dense. Duration: 10 mins	**Depth of Excavation (m):**	1.6
			1 of 1

TH04

Project Name: Burchell Estate
Job Number: 2006
Site: Parsons Vlei
Client:
Trial Pit: BETH8

GSENG - GeoTech

Email: info@gseng.co.za

Depth (m)	Lithology	Description	Sample	Photograph
0.00		Moist, Light reddish brown silt, very soft with sandstone gravel- contains organics & rubble	BETH8	
0.50	0 - 0.5m			
		▼WT		
1.00	0.5-1.2m	Wet, light grey, closely jointed, very soft, slicken sided, Transported clay. Residual Sandstone		
1.50				
		Refusal, medium hard SANDSTONE		
2.00				
2.50				
3.00				
3.50				

Profiled By:	LG	**Latitude:**	33°56'5.30"S
Contractor:	Rademeyer Plant Hire	**Longitude:**	25°29'17.90"E
Machine:	JCB 3CX - TLB	**Samples:**	BETH8: 0.50 - 1.9m
Date Excavated:	10/07/2024		MS X 1, SS X 1
Date Profiled:	10/07/2024		
Notes:	Water table intersected at 0.9m. Ease of excavation: medium to dense. Duration: 10 mins	**Depth of Excavation (m):**	1.9
			1 of 1

TH09

Project Name: Burchell Estate
Job Number: 2006
Site: Parsons Vlei
Client:
Trial Pit: BETH9

GSENG - GeoTech

Email: info@gseng.co.za

Depth (m)	Lithology	Description	Sample	Photograph
0.00 – 0.50	0 - 0.5m	Moist, Light reddish brown silt, very soft with sandstone gravel- contains organics & rubble	BETH9	
0.50 – 1.00	0.5-1.2m	Moist, Light brown light gray, closely jointed, silt gravel, soft, **Residual Sandstone**		
1.00 – 1.50		Refusal, medium hard **SANDSTONE**		
1.50 – 2.00				
2.00 – 2.50				
2.50 – 3.00				
3.00 – 3.50				

Profiled By:	LG	**Latitude:**	33°56'4.90"S
Contractor:	Rademeyer Plant Hire	**Longitude:**	25°29'16.30"E
Machine:	JCB 3CX - TLB	**Samples:**	BETH8: 0.50 - 1.3m
Date Excavated:	10/07/2024		MS X 1, SS X 1
Date Profiled:	10/07/2024		
Notes:	No Water table intersected. Ease of excavation: medium to dense. Duration: 10 mins	**Depth of Excavation (m):**	1.3

1 of 1

APPENDIX 3. LABORATORY DATA

OUTENIQUA LAB EC cc.

R-CBR-1-8 Feb-21

Registration No. 2009/230653/23
Materials Testing Laboratory
170 Sidwell Avenue, Sidwell, Port Elizabeth : PO Box 3186, George Industria, 6536
Tel: 041 4512464 : Fax: 041 4534959 : e-mail: luwayne@outeniqualab.co.za

T0619

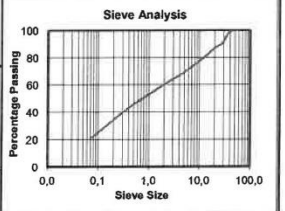
Customer :	Gseng Consult	Project :	Erf 2006 - Parsonsvlei
	172 Circular Drive	Date Received :	11/07/24
	Lorraine Eastern Cape - PE	Date Reported :	07/08/24
	6000	Req. Number :	1004/24
Attention :	L Greene - 0724977657	No. of Pages :	1/2

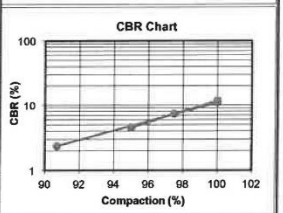
TEST REPORT

CALIFORNIA BEARING RATIO - (SANS 3001 Method GR1,PR5*,GR10,GR20,GR30,GR40)

Material Indicators				
Sample Position (SV)		Beth 6		Beth 7
Depth (mm)		900-1200		1300-1700
Sample No		**18437**		**18438**
Materials Description	Source	Unknown		Unknown
	Colour	Dark Grey to LIght Olive		Light Reddish Orange
	Soil Type	Sandstone Gravel		Sandstone Gravel
	Classification	Unknown		Unknown
Max. Stone size in hole (mm)				
Percentage Passing	75.0mm	100		100
	63.0mm	100		100
	50.0mm	100		100
	37.5mm	98		99
	28.0mm	91		93
	20.0mm	87		90
	14.0mm	82		87
	5.00mm	69		78
	2.00mm	60		71
	0.425mm	44		37
	0.075mm	21,3		24,0
Soil Mortar & Constants				
Grading Modulus		1,75		1,68
Coarse Sand (%)		27		48
Fine Sand (%)		37		19
Silt & Clay (%)		35		34
Liquid Limit (%)		23		21
Plasticity Index (%)		9		8
Linear Shrinkage (%)		5,0		4,0
CBR / Density Relationship				
MOD	Max Dry Density (kg/m³)	2100		2112
	Opt Moisture Content (%)	7,3		7,9
	Mould Moisture Con. (%)	7,3		7,8
	@100% Mod AASHTO	100,0		100,0
	Swell (%)	0,96		0,02
Proc NRB	100% NRB	95,0		96,0
	Swell (%)	0,98		0,06
	100% Proctor	90,7		91,3
	Swell (%)	1,32		0,09
CBR	@ 100% Mod AASHTO	11		20
	@ 98% Mod AASHTO	8		17
	@ 95% Mod AASHTO	5		14
	@ 93% Mod AASHTO	3		12
	@ 90% Mod AASHTO	2		9
Insitu Moisture Content (%)				
Soil Classification Achieved By The Material				
TRH 14:		Not Classified		G9 Subgrade
AASTHO System		A-2-4		A-2-4
Unified System		GC		SC

18437





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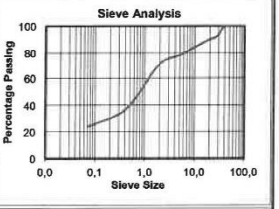
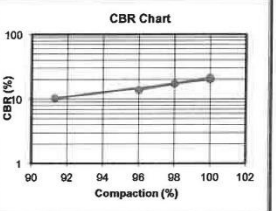
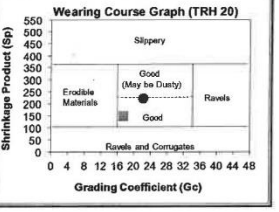




● 18437 ■ 18438



- **Specimens delivered to Outeniqua Lab in good order.**
- ***Non Accredited Test Method.**

Luwayne Malgraff
Technical Signatory
For Outeniqua Lab EC cc.

1. The opinion column is an interpretation of the direct comparison between the quoted specification and the single test sample results obtained. The compliant (P), non compliant (I) and uncertain (U) opinion indicators are based on an approximate 95% level of confidence with reference to SAMM GUIDANCE 1, Issue 2 : 20 June 2007 Section 2.
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Tel: 041 4512464 : Fax: 041 4534959 : e-mail: luwayne@outeniqualab.co.za

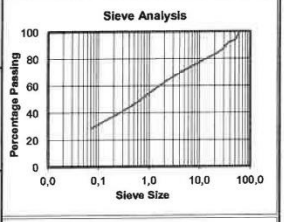
T0619

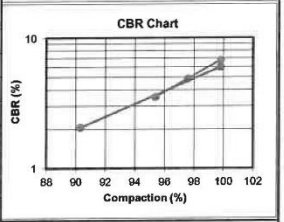
Customer :	Gseng Consult	Project :	Erf 2006 - Parsonsvlei
	172 Circular Drive	Date Received :	11/07/24
	Lorraine Eastern Cape - PE	Date Reported :	02/08/24
	6000	Req. Number :	1004/24
Attention :	L Greene - 0724977657	No. of Pages :	2/2

TEST REPORT

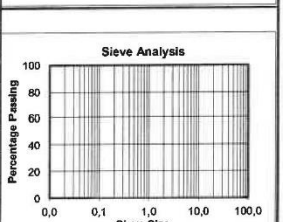
CALIFORNIA BEARING RATIO - (SANS 3001 Method GR1,PR5*,GR10,GR20,GR30,GR40)

Material Indicators		18439
Sample Position (SV)		Beth 3
Depth (mm)		700-1500
Sample No		**18439**
Materials Description	Source	Unknown
	Colour	Dark Olive
	Soil Type	Sandstone Gravel
	Classification	Unknown
Max. Stone size in hole (mm)		
Percentage Passing	75.0mm	100
	63.0mm	100
	50.0mm	94
	37.5mm	92
	28.0mm	87
	20.0mm	83
	14.0mm	80
	5.00mm	71
	2.00mm	63
	0.425mm	45
	0.075mm	28,9

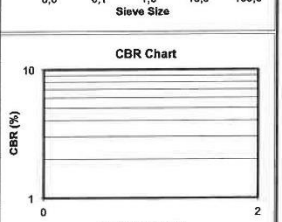




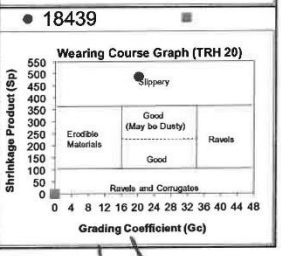
Soil Mortar & Constants	
Grading Modulus	1,64
Coarse Sand (%)	29
Fine Sand (%)	25
Silt & Clay (%)	46
Liquid Limit (%)	41
Plasticity Index (%)	21
Linear Shrinkage (%)	10,0



CBR / Density Relationship		
MOD	Max Dry Density (kg/m³)	1900
	Opt Moisture Content (%)	12,6
	Mould Moisture Con. (%)	12,8
	@100% Mod AASHTO	99,8
	Swell (%)	1,02
NRB	100% NRB	95,4
	Swell (%)	1,13
Proc	100% Proctor	90,3
	Swell (%)	1,69
CBR	@ 100% Mod AASHTO	6
	@ 98% Mod AASHTO	5
	@ 95% Mod AASHTO	4
	@ 93% Mod AASHTO	3
	@ 90% Mod AASHTO	2
Insitu Moisture Content (%)		



Soil Classification Achieved By The Material	
TRH 14:	Not Classified
AASTHO System	A-2-7
Unified System	GC



- **Specimens delivered to Outeniqua Lab in good order.**
- ***Non Accredited Test Method.**

Luwayne Malgraff
Technical Signatory
For Outeniqua Lab EC cc.

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R-FIND-1-6 Feb 21

Outeniqua Lab EC cc.

Materials Testing Laboratory

Registration No. 2009/230653/23

170 Sidwell Avenue, Sidwell, Port Elizabeth : PO Box 3186, George Industria, 6536

Tel: 041 4512464 : Fax: 041 4534959 : e-mail: luwayne@outeniqualab.co.za / agovender@outeniqualab.co.za

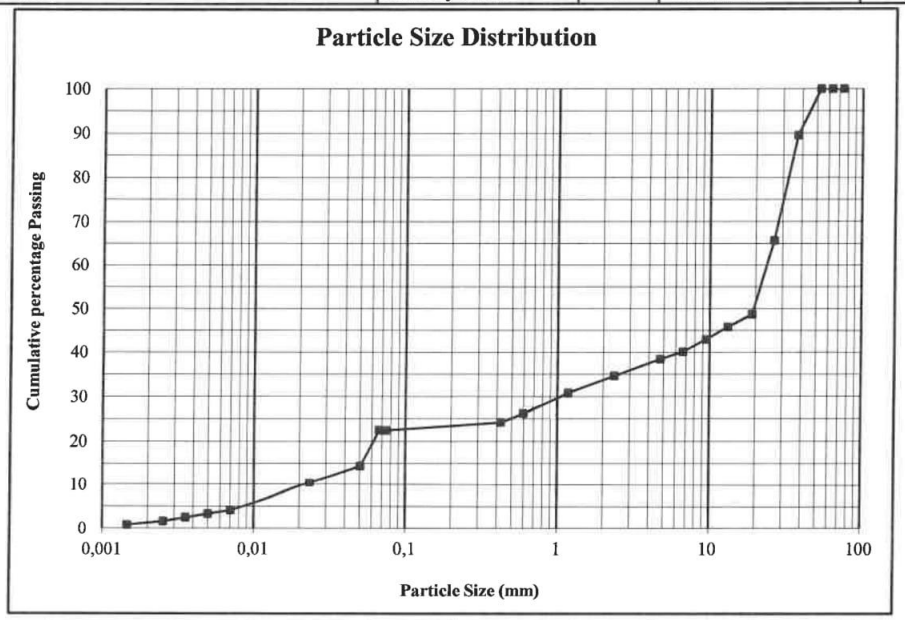
Customer :	Gseng Consult	Project :	Erf 2006 - Parsonsvlei
	172 Circular Drive	Date Received :	11/07/24
	Lorraine Eastern Cape - PE	Date Reported :	02/08/24
	6000	Req. Number :	1004/24
Attention :	L Greene - 0724977657	No. of Pages :	1/3

TEST REPORT

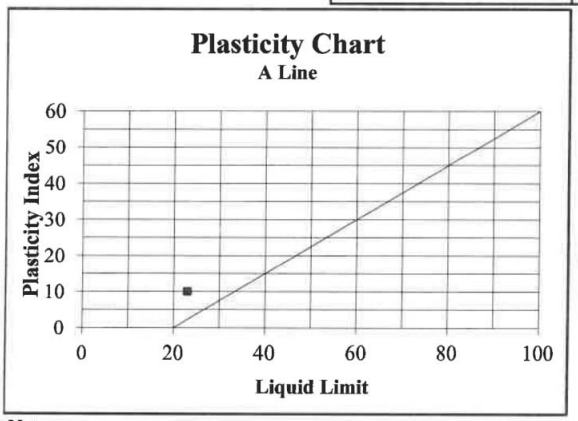
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

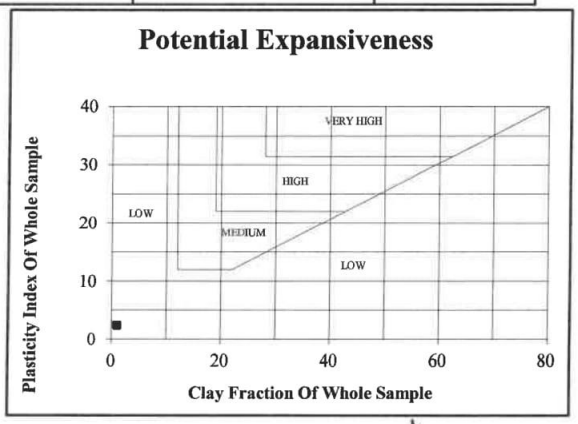
Material Description:	Dark Grey to Light Olive - Sandstone Gravel	Sample Number:	18437			
Position:	Beth 6	Liquid Limit	23	Linear Shrinkage	5	
Depth:	900-1200	Plasticity Index	10	Insitu M/C%	10,3	

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	90
26,5	66
19,0	49
13,2	46
9,5	43
6,7	40
4,75	38
2,36	35
1,18	31
0,600	26
0,425	24
0,075	22
0,0670	22
0,0505	14
0,0234	10
0,0070	4
0,0050	3
0,0036	2
0,0025	2
0,0015	1



% Clay	1	% Silt	18	% Sand	14	% Gravel	67
Unified Soil Classification		GC		PRA Soil Classification		A-2-4	





Notes:

- **Specimens delivered to Outeniqua Lab in good order.**

L Malgraff
For Outeniqua Lab EC cc.

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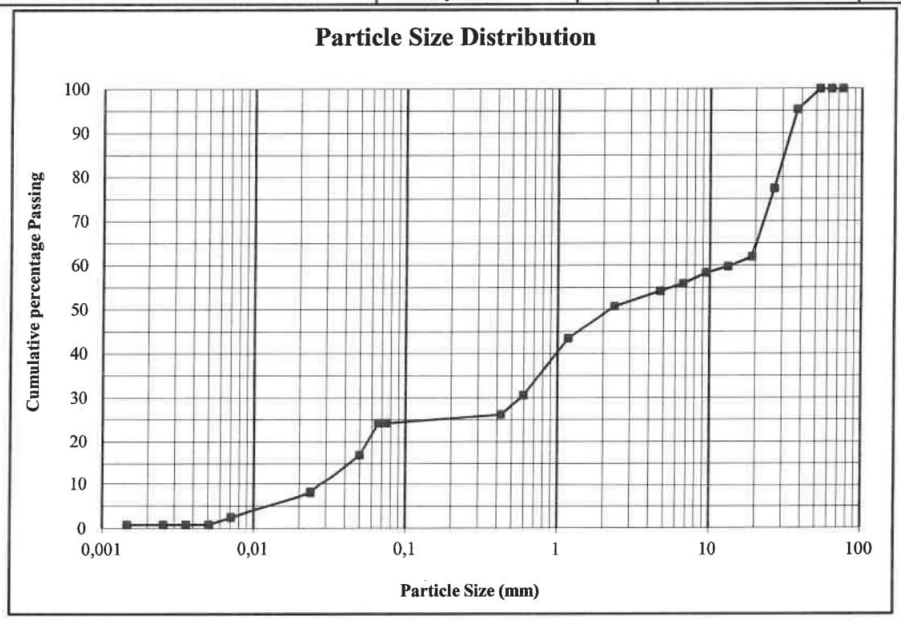
TEST REPORT

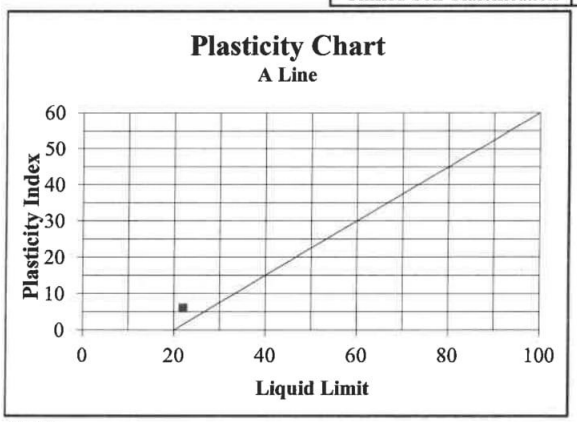
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

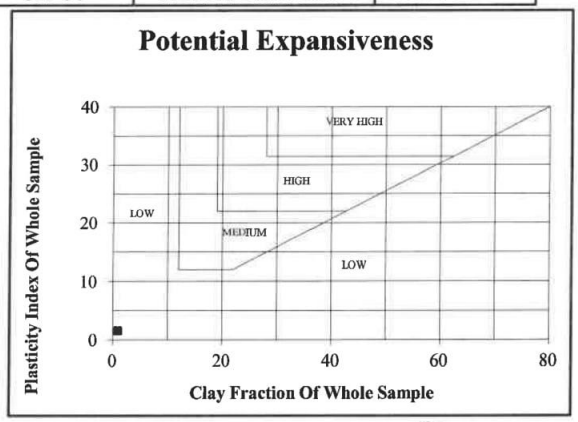
Material Description:	Light Reddish Orange - Sandstone Gravel	Sample Number:	18438			
Position:	Beth 7	Liquid Limit	22	Linear Shrinkage	3	
Depth:	1300-1700	Plasticity Index	6	Insitu M/C%	6,1	

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	95
26,5	77
19,0	62
13,2	60
9,5	58
6,7	56
4,75	54
2,36	51
1,18	44
0,600	31
0,425	26
0,075	24
0,0662	24
0,0498	17
0,0238	8
0,0071	2
0,0051	1
0,0036	1
0,0025	1
0,0015	1



% Clay	1	% Silt	20	% Sand	28	% Gravel	51
Unified Soil Classification		GM-GC		PRA Soil Classification		A-1-b / A-2-4	





Notes:

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For Outeniqua Lab EC cc.

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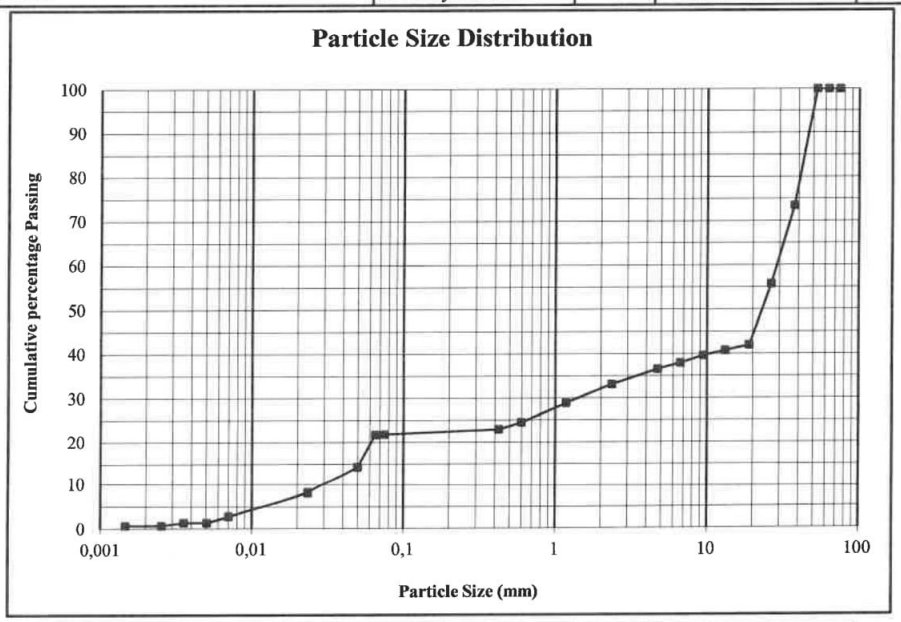
	6000	Req. Number :	1004/24
Attention :	L Greene - 0724977657	No. of Pages :	3/3

TEST REPORT

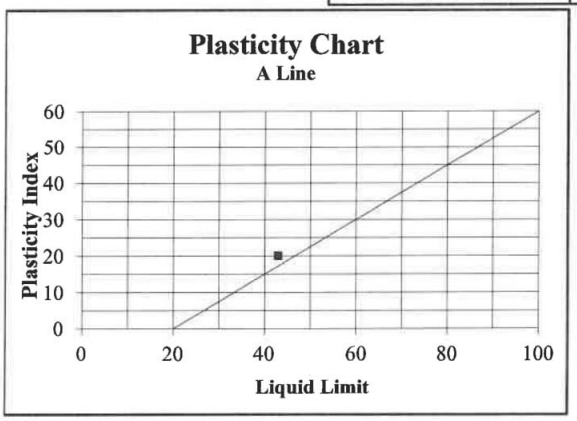
FOUNDATION INDICATOR - (TMH 1 Method A1(a),A2,A3,A4,A5) & (ASTM Method D422)

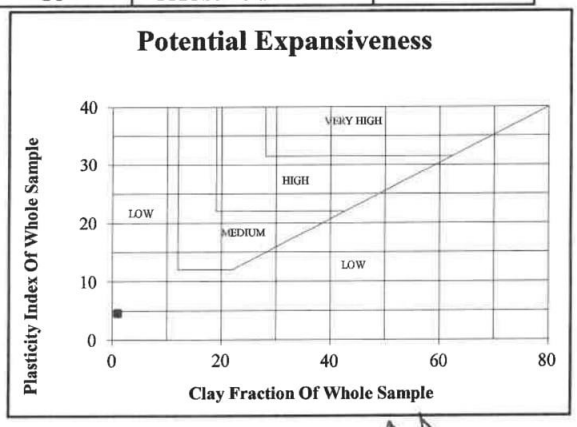
Material Description:	Dark Olive - Sandstone Gravel	Sample Number:	18438		
Position:	Beth 3	Liquid Limit	43	Linear Shrinkage	10
Depth:	700-1500	Plasticity Index	20	Insitu M/C%	10,8

Sieve Size(mm)	% Passing
75,0	100
63,0	100
53,0	100
37,5	73
26,5	56
19,0	42
13,2	41
9,5	40
6,7	38
4,75	37
2,36	33
1,18	29
0,600	25
0,425	23
0,075	22
0,0653	22
0,0498	14
0,0234	8
0,0071	3
0,0051	1
0,0036	1
0,0025	1
0,0015	1



% Clay	1	% Silt	18	% Sand	13	% Gravel	68
Unified Soil Classification		GC		PRA Soil Classification		A-2-7	





Notes:

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For Outeniqua Lab EC cc.

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APPENDIX 4. DCP RESULTS & PHOTOS

GSENG - GeoTech

Test Location: **2006 Parsons Vlei**

Erf:	**2006**	Weather condition:	**Partly Cloudy & Hot**
Position :	**BETH1**	Soil Condition:	**Moist**
Test date:	**2024/07/10**	Material:	**Brown, silty sand with gravel**

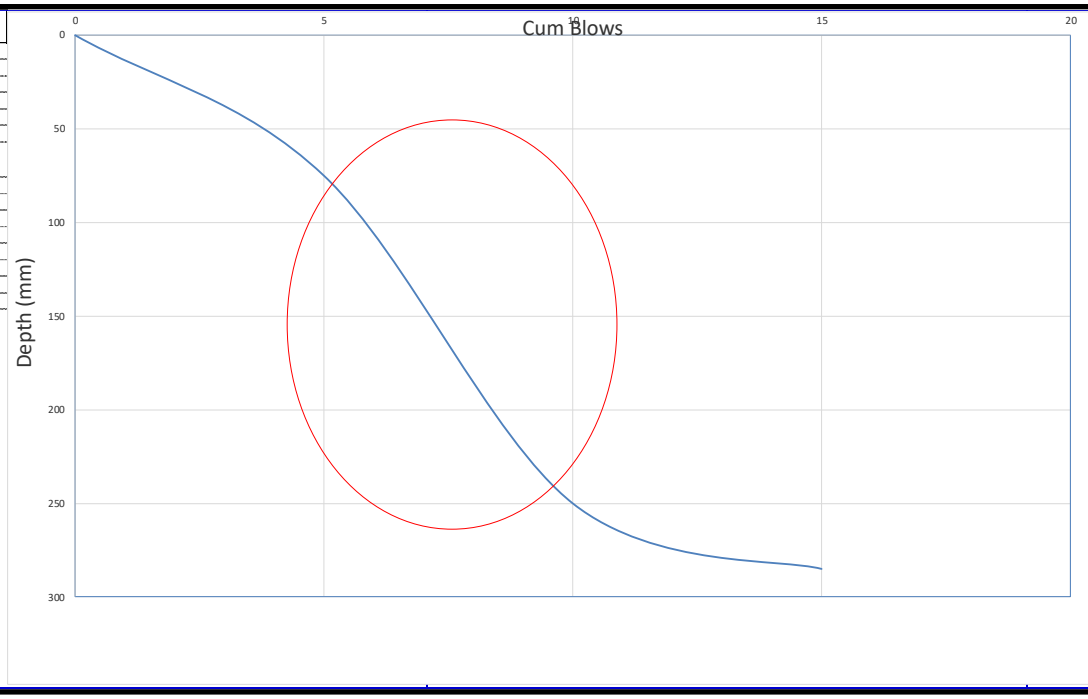
DYNAMIC CONE PENETROMETER (DCP)
DETERMINATION OF IN SITU SOIL STRENGTH

Range 0 - 285 mm

Blows	In Situ (mm)		Depth (mm)	mm / Blow DN	CBR (%) >2	Elastic Modulus (Mpa)	Bearing Capacity (Kpa)	UCS (Kpa)
5	215	290	75	15.0	**13.2**	63	222	145
10	290	465	175	35.0	**4.5**	26	94	56
15	465	500	35	7.0	**34.6**	141	480	340

Remarks: refusal at 285mm (possible rock or gravel impact).

Cum Blows	Depth
0	0
5	75
10	250
15	285



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Test Location: 2006 Parsons Vlei

Erf:	**2006**	Weather condition:	**Partly Cloudy & Hot**
Position :	**BETH2**	Soil Condition:	**Moist**
Test date:	**2024/07/10**	Material:	**brown, silty sand with gravel**

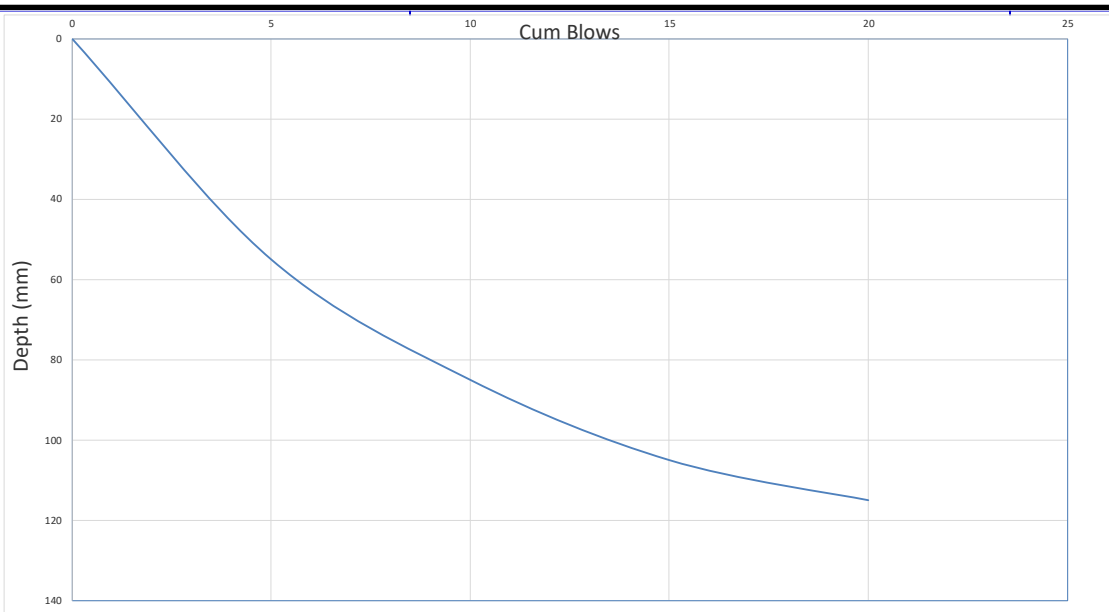
DYNAMIC CONE PENETROMETER (DCP)
DETERMINATION OF IN SITU SOIL STRENGTH

Range 0 - 115 mm

Blows	In Situ (mm)		Depth (mm)	mm / Blow DN	CBR (%) >2	Elastic Modulus (Mpa)	Bearing Capacity (Kpa)	UCS (Kpa)
5	215	270	55	11.0	**19.5**	87	304	205
10	270	300	30	6.0	**42.1**	167	561	403
15	300	320	20	4.0	**70.5**	256	845	635
20	320	330	10	2.0	**170.0**	535	1701	1377

Remarks: refusal at 116mm (possible rock or gravel impact).

Cum Blows	Depth
0	0
5	55
10	85
15	105
20	115



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Test Location: 2006 Parsons Vlei

Erf:	**2006**	Weather condition:	**Partly Cloudy & Hot**
Position :	**BETH3**	Soil Condition:	**Moist**
Test date:	**2024/07/10**	Material:	**Brown, silty sand, ferricrete**

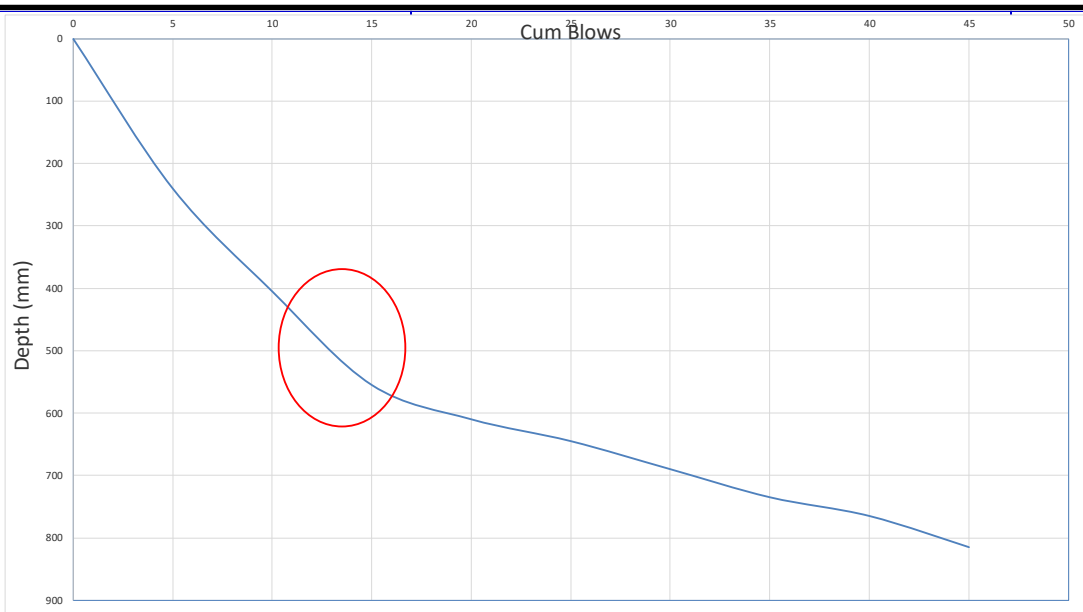
DYNAMIC CONE PENETROMETER (DCP)
DETERMINATION OF IN SITU SOIL STRENGTH

Range 0 - 815 mm

Blows	In Situ (mm)		Depth (mm)	mm / Blow DN	CBR (%) >2	Elastic Modulus (Mpa)	Bearing Capacity (Kpa)	UCS (Kpa)
5	215	455	240	48.0	**3.0**	18	69	39
10	455	620	165	33.0	**4.8**	27	100	60
15	620	770	150	30.0	**5.5**	30	110	67
20	770	825	55	11.0	**19.5**	87	304	205
25	825	860	35	7.0	**34.6**	141	480	340
30	860	905	45	9.0	**25.2**	108	372	256
35	905	950	45	9.0	**25.2**	108	372	256
40	950	980	30	6.0	**42.1**	167	561	403
45	980	1030	50	10.0	**22.0**	97	335	228

Remarks: Top 500mm is very soft, bearing capacity improves to a satisfactory level after.

Cum Blows	Depth
0	0
5	240
10	405
15	555
20	610
25	645
30	690
35	735
40	765
45	815



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Test Location: 2006 Parsons Vlei

Erf:	**2006**	Weather condition:	**Partly Cloudy & Hot**
Position :	**BETH5**	Soil Condition:	**Moist**
Test date:	**2024/07/10**	Material:	**Brown, silty sand with gravel**

DYNAMIC CONE PENETROMETER (DCP)
DETERMINATION OF IN SITU SOIL STRENGTH

Range 0 - 915 mm

Blows	In Situ (mm)		Depth (mm)	mm / Blow DN	CBR (%) >2	Elastic Modulus (Mpa)	Bearing Capacity (Kpa)	UCS (Kpa)
5	200	450	250	50.0	**2.9**	18	66	38
10	450	580	130	26.0	**6.5**	35	128	78
15	580	700	120	24.0	**7.2**	38	138	86
20	700	820	120	24.0	**7.2**	38	138	86
25	820	930	110	22.0	**8.1**	42	151	94
30	930	1030	100	20.0	**9.1**	46	166	105
35	1030	1115	85	17.0	**11.2**	55	196	126

Remarks: Refusal at 915mm

Cum Blows	Depth
0	0
5	250
10	380
15	500
20	620
25	730
30	830
35	915

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Test Location: 2006 Parsons Vlei

Erf:	**2006**	Weather condition:	**Partly Cloudy & Hot**
Position :	**BETH6**	Soil Condition:	**Moist**
Test date:	**2024/07/10**	Material:	**Brown, silty sand with gravel**

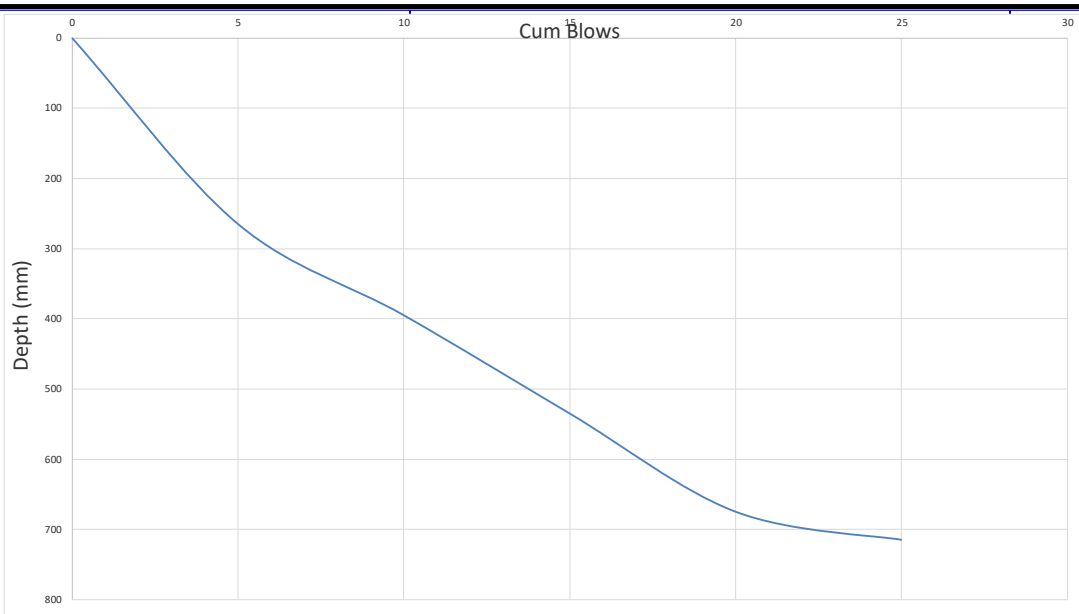
DYNAMIC CONE PENETROMETER (DCP)
DETERMINATION OF IN SITU SOIL STRENGTH

Range 0 - 715 mm

Blows	In Situ (mm)		Depth (mm)	mm / Blow DN	CBR (%) >2	Elastic Modulus (Mpa)	Bearing Capacity (Kpa)	UCS (Kpa)
5	275	540	265	53.0	**2.6**	16	62	35
10	540	670	130	26.0	**6.5**	35	128	78
15	670	810	140	28.0	**6.0**	32	118	72
20	810	950	140	28.0	**6.0**	32	118	72
25	950	990	40	8.0	**29.2**	123	419	292

Remarks: Refusal at 715mm

Cum Blows	Depth
0	0
5	265
10	395
15	535
20	675
25	715



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Test Location: **2006 Parsons Vlei**

Erf:	**2006**	Weather condition:	**Partly Cloudy & Hot**
Position :	**BETH8**	Soil Condition:	**Wet**
Test date:	**2024/07/10**	Material:	**Brown, silty sand, cobbles**

DYNAMIC CONE PENETROMETER (DCP)
DETERMINATION OF IN SITU SOIL STRENGTH

Range 0 - 930 mm

Blows	In Situ (mm)		Depth (mm)	mm / Blow DN	CBR (%) >2	Elastic Modulus (Mpa)	Bearing Capacity (Kpa)	UCS (Kpa)
5	210	600	390	78.0	**1.6**	11	42	23
	600	690	90	18.0	**10.4**	52	185	118
	690	830	140	28.0	**6.0**	32	118	72
10	830	955	125	25.0	**6.9**	37	133	82
5	955	1100	145	29.0	**5.7**	31	114	69
15	1100	1140	40	8.0	**29.2**	123	419	292

Remarks: Extremely soft, waterlogged area near storm water junction and water course.

Cum Blows	Depth
0	0
5	390
10	480
15	620
20	745
25	890
30	930

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Test Location: **2006 Parsons Vlei**

Erf:	**2006**	Weather condition:	**Partly Cloudy & Hot**
Position :	**BETH9**	Soil Condition:	**Moist**
Test date:	**2024/07/10**	Material:	**Light, reddish, silt with gravel**

DYNAMIC CONE PENETROMETER (DCP)
DETERMINATION OF IN SITU SOIL STRENGTH

Range 0 - 350 mm

Blows	In Situ (mm)		Depth (mm)	mm / Blow DN	CBR (%) >2	Elastic Modulus (Mpa)	Bearing Capacity (Kpa)	UCS (Kpa)
5	200	455	255	51.0	**2.8**	17	65	37
10	455	550	95	19.0	**9.7**	49	175	111

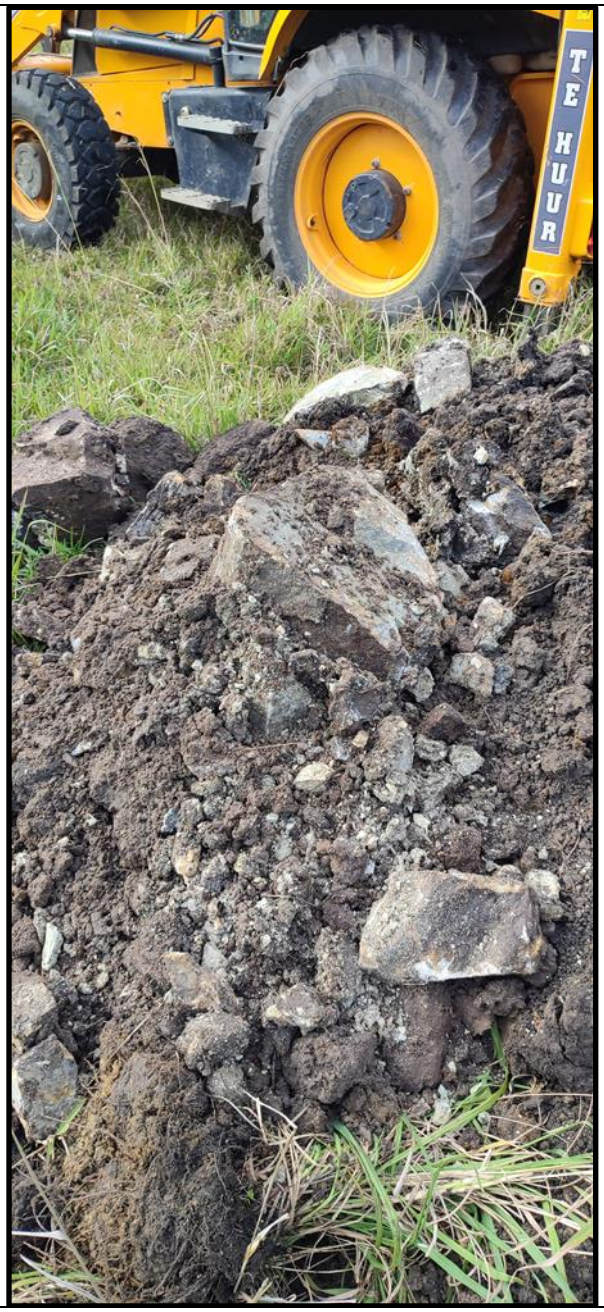
Remarks: Refusal at 350mm

Cum Blows	Depth
0	0
5	255
10	350

Remarks: First 400mm are

Observation:

- Ferricrete layer close to the surface indicating the water table fluctuates
- Sandstone / Quartzite layer very close to the surface.

	**Observation:** – Large Cobbles of mudstone, sandstone.

Observation:

BETH4

- Light, yellow silt, highly erodible with very little bearing capacity.

Observation:

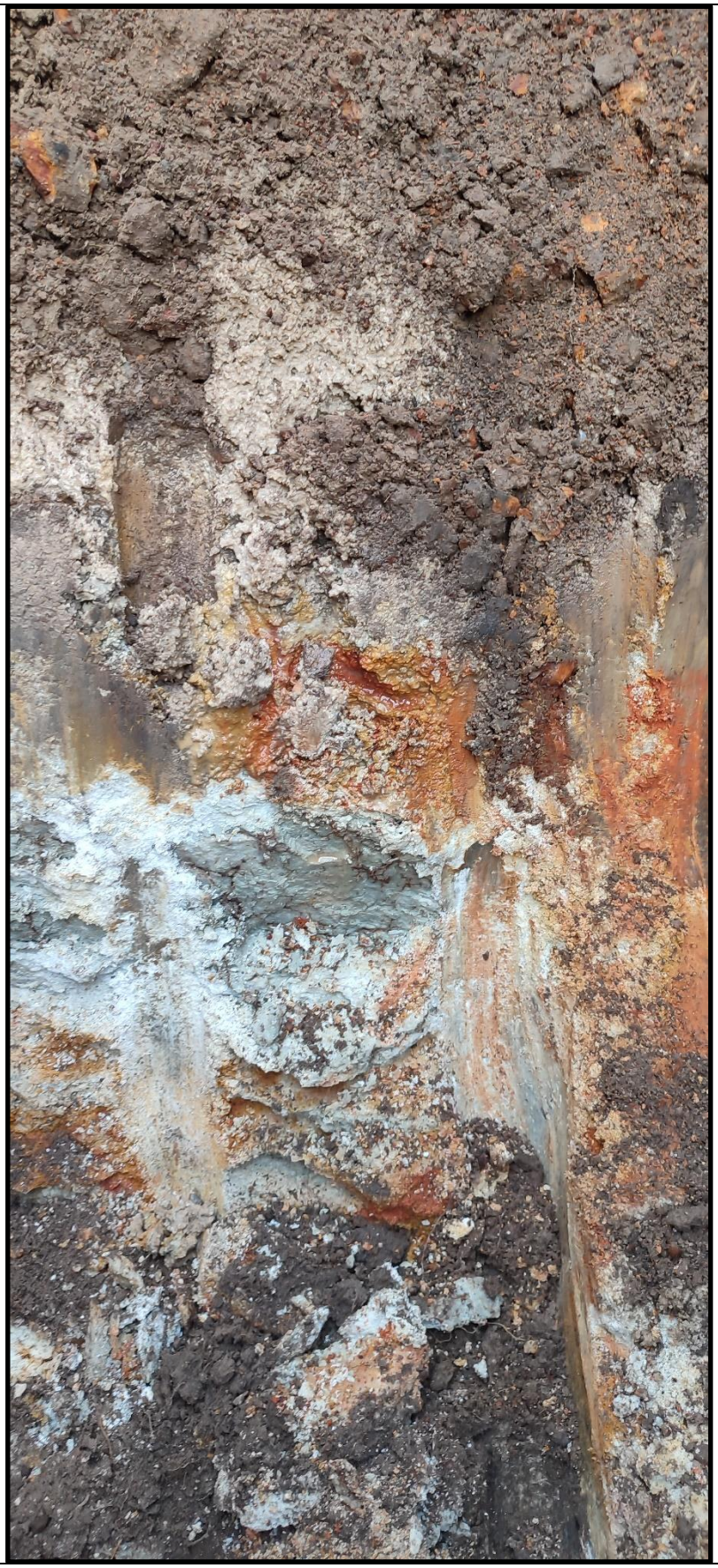
BETH9

- Moist, light yellowish, light grey, soft, micro-shattered, residual sandstone

Observation:

BETH6

- Cohesive but inactive

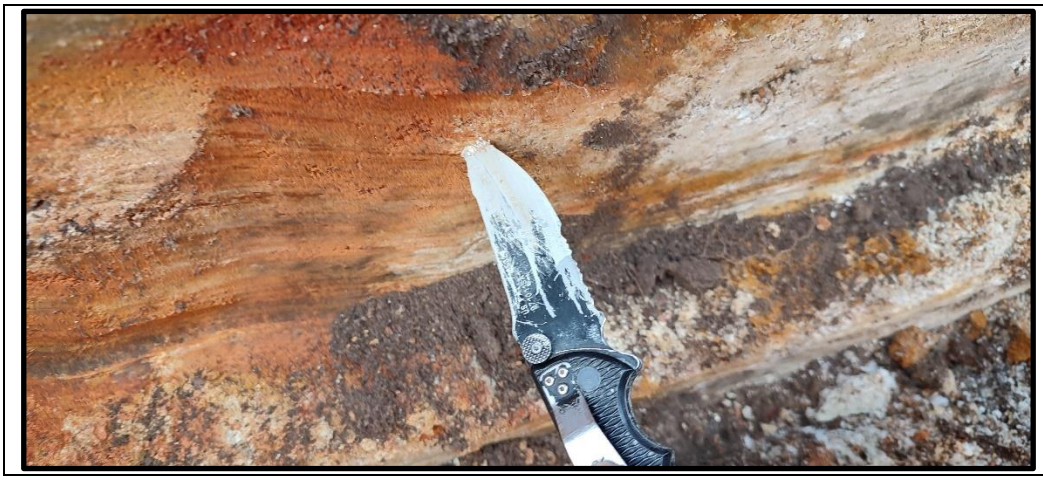


Observation:
BETH8

- Ferricrete and clay inclusion, slicken-sided.

Observation:
BETH7

- Very soft, Moist, reddish brown, micro shattered

	**Observation:** – Stiff, Ferricrete layer

Observation;

- Ground water infiltration

	**Observation:** – DCP testing being performed

Observation:

- Typical overburden material found in the area, silty sand, very soft with low bearing capacity