PHASE 1 GEOTECHNICAL REPORT

PROPOSED NEW DEVELOPMENT ON ERF 21028 & 21029 GEORGE, WESTERN CAPE (THE VILLAGE RIDGE)

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Iain Paton has a Bachelor's degree with Honours in Geology and a Master's degree in Geotechnical Engineering with over 20 years' experience in the construction, mining and energy industries. Iain Paton is a registered professional with the South African Council for Natural Scientific Professions (SACNSP) and the Engineering Council of South Africa (ECSA), and is a member of the South African Institute of Engineering and Environmental Geologists (SAIEG), the Geotechnical Division of the South African Institute of Civil Engineering (SAICE) and the Institute of Municipal Engineering of South Africa (IMESA).

Declaration of independence:

The author of this report is independent professional consultant with no vested interest in the project, other than remuneration for work associated with the compilation of this report.

General limitations:

1. The investigation has been conducted in accordance with generally accepted engineering practice, and the opinions and conclusions expressed in the report are 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 or 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. Unless otherwise stated, 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.
4. The investigation is conducted within the constraints of the budget and time and therefore limited information was available. 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 re-evaluate recommendations in this report. Therefore, it is recommended that Outeniqua Geotechnical Services is retained to provide specialist geotechnical engineering services during construction in order to observe compliance with the design concepts, specifications and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction. Any significant deviation from the expected geotechnical conditions should be brought to the author's attention for further investigation.
5. The assessment and interpretation of the geotechnical information and the design of structures and services and the management of risk is the responsibility of the appointed engineer.

EXECUTIVE SUMMARY

Outeniqua Geotechnical Services Outeniqua Geotechnical Services was appointed by the Power Group to undertake a Phase 1 geotechnical site investigation for a proposed residential development on Erf 210289 & 21029, George in the Western Cape Province (The Village Ridge), which is located approximately 1km west of the town centre of George.

The site investigation involved a desk-top study of existing geotechnical data, a walk over survey of the site and detailed subsurface investigation. The subsurface investigation including the excavation of test pits with a TLB/Back-actor to a maximum depth of 2.5m or refusal. Test pits were profiled in accordance with standard methods, and samples of various soil horizons were collected for laboratory tests. Insitu DCP penetration tests were conducted from ground level next to each test pit.

The topography of the area is characterised by gently sloping terrain, which drains south east into the Camfersdrift River. The site was vacant at the time of the investigation and was covered in long grass.

According to the geological map of the area, the area is underlain granitic rock of the Maalgaten Suite.

The investigations revealed that the general soil profile recorded in test pits consists of one or more horizons of transported silty sand (colluvium/topsoil), which is underlain by pedogenic ferricrete gravel (nodules), which is in turn underlain by residual clay, silt and/or clayey sand/gravel (variable) derived from the insitu weathering of the Maalgaten Suite granite. The soils are generally dense/stiff at normal shallow founding depths but are considered slightly compressible and/or collapsible. Lab tests indicate that the residual soils (silt/clay) are potentially active, with estimated total heave of up to 15mm. The residential site classification for the entire site is H1/C1.

The recommended foundation system for the proposed single/double storey structures is reinforced strip foundations or light rafts at a nominal founding depth of 600mm below NGL on well compacted insitu soil with bearing pressure limited to 100kPa.

In terms of the general geological stability and geotechnical conditions, the site is deemed to be suitable for development with precautions taken for the expected geotechnical constraints, for which recommendations are provided.

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1. Introduction and terms of reference

Outeniqua Geotechnical Services Outeniqua Geotechnical Services was appointed by the Power Group to undertake a Phase 1 geotechnical site investigation for a proposed residential development (The Village Ridge) on Erf 210289 & 21029 George in the Western Cape Province (see locality map in **Figure 1**). The site is located approximately 1km west of the town centre of George.

The physical and geotechnical nature of the site was investigated for the civil engineering design and project planning process, and the investigation was carried out in general accordance with SANS 634.

The general purpose of the investigation was to:

- Describe the location, topography and geology of the proposed site.
- Investigate and describe the soil types and expected founding conditions for new structures.
- Highlight any problem soils, slope stability or drainage issues.
- Estimate the bearing capacity, settlement and/or swell potential of the soil.
- Classify the excavations in terms of SABS 1200D.
- Determine the suitability of the site for housing purposes and make recommendations for the design of earthworks, foundations and engineering services.
- Classify the site in terms of the residential site designations under SANS10400-H for project enrolment purposes with the NHBRC.

Figure 1: Locality map of site

2. Information available

The following maps and plans were available for reference purposes and may be reproduced in this report:

- Digital topo-cadastral and aerial photography data, obtained from the National Geospatial Information Department.
- 1:250 000 Geological map of the area, obtained from the Council for Geoscience.
- 1:1000000 Seismic Hazard Map of SA, obtained from the Council for Geoscience.
- Site development plan, produced by Power Construction.

3. Nature of the investigation

The site investigation involved a desk-top study of existing geotechnical data, a walk over survey of the site, and a detailed subsurface investigation.

The subsurface investigation involved conducting a total of 4 test pits with a TLB/Backactor to a maximum depth of 2.5m in order to determine the geology, soil & groundwater conditions on the site. The number of test pits was determined primarily by the size of the site, in accordance with SANS 634, the expected complexity of the geology, and access across the site. The number of test positions was deemed sufficient in order to classify the soil conditions with a high degree of confidence.

Test pits were profiled according to the standard MCCSSO method, and samples of various soil horizons were collected for laboratory tests at a SANAS accredited laboratory. Insitu DCP penetration tests were conducted from ground level next to each test pit.

Soil samples were taken for the following lab tests to determine the engineering characteristics of the soil:

- Indicator tests (TMH1 and ASTM) to determine gradings, Atterberg limits and potential expansiveness (tested at Outeniqua Lab in George);
- MOD/CBR/Indicator tests (SANS 3001) to determine the compaction/strength properties (tested at Outeniqua Lab in George);
- Handheld Dynamic Cone Penetrometer (DCP) tests (TMH6 ST6) to determine soil consistency and bearing capacity (tested on site).

The confidence in the information gained from the investigation is high as it generally concurs with expected conditions and information gained from previous site investigations in the area. Further investigations are not deemed necessary at this stage of the project.

4. Site description

The site consists of the consolidation of two erven (21028 & 20129), with a combined extent of 4.6Ha. The topography of the site is characterised by gently sloping terrain with slight undulations, which drains south east into the Camfersdrift River. The site was vacant at the time of the investigation and was covered in long grass (see **Figures 2-5**).

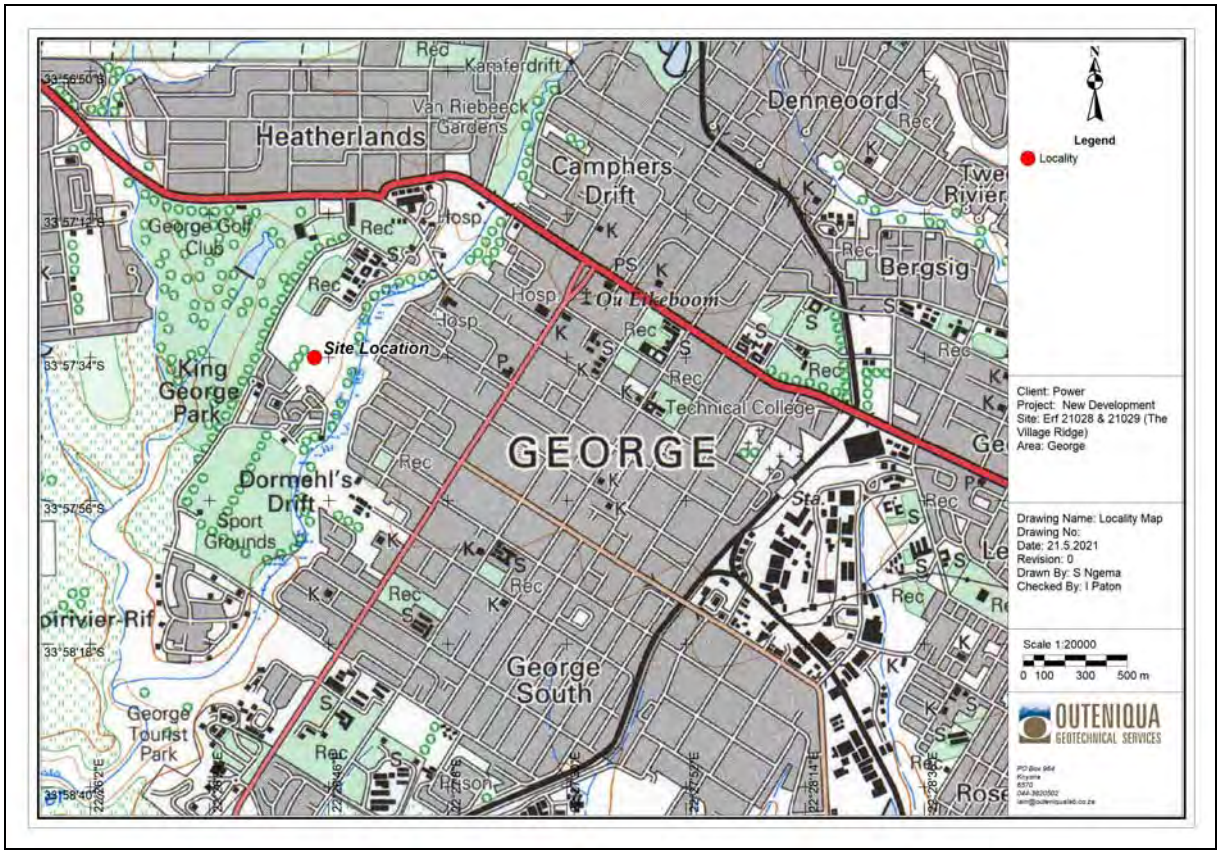


Figure 2: Topographical map of the site

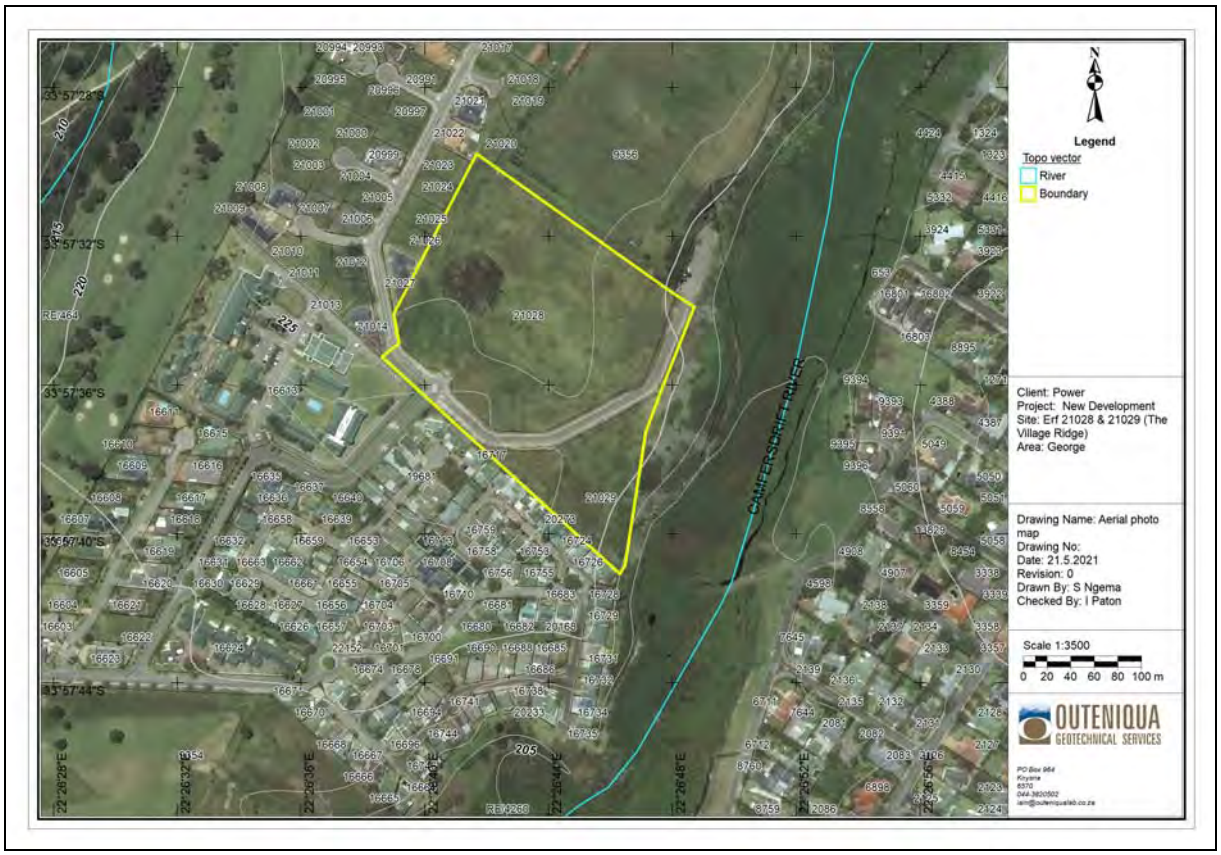


Figure 3: Aerial photo of site

Figure 4: Typical topography and vegetation looking south towards Erf 21029

Figure 5: Typical topography and vegetation looking North towards Erf 21028

5. Geology

According to the official geological maps, the site is underlain by granite of the Maalgaten Suite of the George pluton (**Figure 6**). The George pluton consists of several granitic bodies that were intruded into older country rocks of the Kaaimans Group of meta-sediments during the Cambrian era (~525 million years ago). Younger meta-sedimentary rocks of the Peninsula Formation (Table Mountain group) occur to the north of the George area.

The George pluton has been subjected to intense deformation, similar to that of the older country rocks of the Kaaimans Formation and typically exhibit strong penetrative planar and linear fabrics (structural features). In some places the granite has been intensely sheared, mainly along its margins. There are no major geological faults in the immediate vicinity of the site, and there is a low risk of seismic activity in the area (max peak horizontal ground acceleration 0.05g).

The Maalgaten granite is the most voluminous lithological unit of the George pluton which underlies most of the George area. The granite rock is poorly exposed in the George area and is typically covered by a thick soil overburden including colluvium, alluvium and residual saprolite.

The geology of the general area is generally considered macro stable for urban development purposes with due consideration given to potential geotechnical constraints on a site-level.

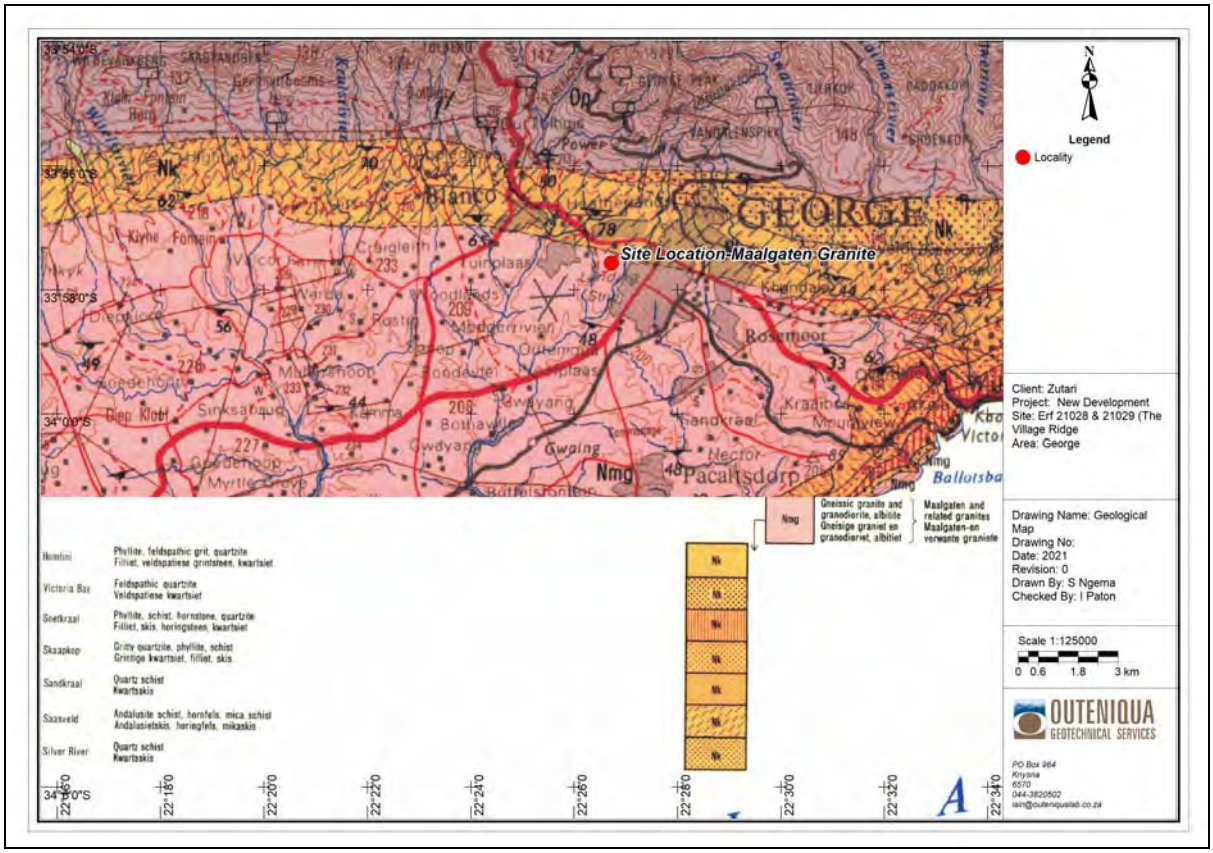


Figure 6: Geological map

6. Geotechnical Evaluation

6.1 Engineering and material characteristics

6.1.1 Topography, slopes and vegetation cover

Results of the investigation

The site is broadly characterised by gently sloping terrain, which drains to the southeast into the Camfersdrift river, which flows adjacent to the site. The northern portion of the site (Erf 21028) is slightly uneven with some hummocky ground which indicates some sporadic historical minor dumping or slightly uneven filling (See **Figure 7**). The natural vegetation predominantly consists of long grass.

Effect on the proposed development

Site clearance and earthworks operations, including construction of roads and services will have to shape the slightly variable surface topography of the site to create suitable platforms for the proposed houses, but this shouldn't severely affect cost of the earthworks. Minimal bush clearing will be required.

Figure 7: Typical hummocky topography and vegetation looking North across Erf 21028

6.1.2 Soil types and rock

Results of the investigation

The general soil profile recorded in test pits consists of a mantle of transported silty sand (colluvium/topsoil), which is underlain by pedogenic ferricrete gravel (nodules), which is in turn underlain by residual clay, silt and/or clayey sand/gravel (variable) derived from the insitu weathering of the Maalgaten Suite Granite. Bedrock was not encountered in any of the test positions and is not expected to affect foundations or earthworks. Although not encountered in any of the test pits at the time of the investigation, some sporadic superficial fill soil and rubble/rubbish (P) can be expected across the entire site (max expected 1m thick). A summary of the test pit data and the thickness of the different soil horizons is provided in **Table 1**.

The residual soils are cohesive and considered potentially slightly active (assume medium level), with total potential heave likely to be less than 15mm – H1 Category. No other horizons are active, and the conditions will only improve with depth. All soils are potentially slightly compressible and collapsible with total maximum settlement of 10mm (C1). DCP test were slightly variable, but generally indicate stiff/dense soils at normal shallow founding depths.

Table 1: Summary of soil horizons recorded in test pits (in mm)

Test pos. No.	*Imported (fill) soil*	*Transported soil*	*Pedogenic*	*Residual soil*	*Rock*	*Total depth of test pit*	*Refusal?*
TP1	-	1400	200	400	-	2000	No
TP2	-	1200	500	300	-	2000	No
TP3	-	1100	400	5000	-	2000	No
TP4	-	1000	200	800	-	2000	No

Effect on the proposed development

Fine-grained soils are moisture sensitive and potentially compressible and/or collapsible under increasing moisture content. Clayey soils may be active and are also not ideal for use as natural fill materials. Uncontrolled fill will require attention. The geotechnical

properties of the soil types are discussed in further detail below, and recommendations are presented in **Chapter 8**.

6.1.3 Grading, Atterberg limits and potential expansiveness

Results of the investigation

Representative samples of different soil horizons were collected for Indicator tests in order to determine the index properties of the soil and evaluate their potential activity and suitability as a founding medium. A summary of the results of the tests are shown in **Table 2**. The tests indicate that the soils are grouped into the following categories according to the Universal Soil Classification system:

CL – Inorganic clays of low to medium plasticity, gravelly, sandy and silty clays.
ML – Silty soils of high plasticity.
SM – Silty Sand mixtures.
GC – Clayey gravels.
GM – Silty gravels.

The tests indicate that the total clay & silt contents range from 16 to 93%, plasticity indices range from zero (Non-plastic - NP) to 11 (medium), and liquid limits up to 23%. Generally, the tests indicate that the soils are moderately problematic in terms of dimensional stability, with potential expansiveness low to medium in all samples.

Table 2: Grading and Atterberg limits test results summary

	Sample Depth (mm)	Atterberg Limits			Particle Analysis (%)		MC*	USC ***
		PI	LL	LS	Clay & Silt	Fine & Coarse Sand		
TP1	140-800	SP	SP	0.5	57	43	6.0	ML
TP1	800-1400	NP	NP	0	55	45	3.7	SM
TP1	1600-2000	11	11	5.5	62	38	7.2	GC
TP2	200-900	SP	SP	0.5	93	7	6.6	ML
TP2	900-1200	SP	SP	0.5	55	45	4.2	ML
TP2	1200-1400	NP	NP	0	57	43	3.7	GM
TP2	1400-1700	6	23	23	46	54	7.0	GM-GC
TP3	1100-1500	9	21	5	56	44	12.2	CL
TP3	1500-2000	14	28	7	56	66	12.2	CL
TP4	500-1000	NP	NP	0	46	54	5.2	GM
TP4	1000-1200	SP	SP	0.5	59	41	4.0	GM
TP4	1200-1400	6	19	3	16	84	7.4	SM-SC

Notes: 1 Moisture content 2 Potential expansiveness (Skempton's activity chart) 3 Unified Soil Classification System

Effect on the proposed development

Conventional improved/modified foundation systems are envisaged to cater for the expected soil movements, including reinforced strip foundations or light rafts. Compaction of founding medium will mitigate differential settlement. Bulk earthworks to

create platforms may require treatment of poor-quality insitu soils and/or imported selected fill to make up shortfalls. Recommendations are provided in **Chapter 8**.

6.1.4 Moisture/density relationship and CBR

Results of the investigation

Representative soil samples were collected for Mod. AASHTO density, CBR and Road Indicator tests in order to determine the moisture-density relationship, compaction and CBR properties for road subgrade and/or general filling purposes. The results of the tests are summarized in **Table 3**.

Table 3: CBR test results summary

Test Pit No	Sample Depth (mm)	CBR at					Swell (%)	PI (%)	GM	MDD/ OMC	TRH 14 Class
		100 %	98%	95%	93%	90%					
TP1	140-800	12	11	10	9	9	0.54	SP	0.46	1773/10.3	<G10
TP1	800-1400	47	30	15	9	5	0	NP	0.76	1961/6.0	G9
TP2	1200-1400	23	19	15	12	9	0	NP	1.98	2430/6.8	G8
TP2	1400-1700	4	3	2	2	1	0	6	2.04	2385/2.04	<G10
TP3	1100-1500	4	4	4	4	3	3	9	0.57	2322/7	<G10
TP3	1500-2000	4	3	1	1	0	2.04	14	0.67	1940/12	<G10
TP4	1000-1200	23	16	13	11	4	0.15	SP	1.41	2552/5.7	G8
TP4	1200-2000	18	14	10	8	5	0.31	6	1.13	2042/10.2	G9

The test results indicate generally marginal to poor quality insitu soils, which display typically low CBR values and moderate to high plasticity/swell.

Effect on the proposed development

Imported materials will be required, including selected subgrade material (SSG), subbase, base course for roads and selected granular material for pipe cradles, platforms and retaining walls. Recommendations for earthworks and roads are given in **Chapter 8**.

6.1.5 Compressibility, collapse potential and bearing capacity

Results of the investigation

No undisturbed samples were possible due to the friable and fractured nature of the cohesive soils. DCP tests generally indicated a gravelly, stiff soil cohesive (clayey) soil. No major bearing capacity issues were detected in these tests, but cohesive soils are moisture sensitive and compressibility, settlement potential and bearing capacity are functions of shear strength and moisture content, which can vary over time. All soils are considered slightly compressible and/or collapsible (C1 category).

Effect on the proposed development

Improved/modified foundation systems will be required to accommodate the expected soil movements. Foundation recommendations are discussed in more detail in **Chapter 8**.

6.1.6 Swell / heave

Results of the investigation

Test results indicate variable clay content, with low to high PI, resulting in low to medium total potential expansiveness (H-H1 Category).

Effect on the proposed development

Improved/modified foundations are envisaged for the site to cater for potential heave.

6.1.7 Soil moisture, permeability and drainage

Results of the investigation

The site is located in an area with a typically wet, temperate climate (Weinert N-value ~1-2) with all-year rain and average monthly minimum winter temperatures of 9°C and maximum summer temperatures of 25°C. Heavy rainfall events of up to 100mm in a 24hour period occur infrequently. Perched water tables were not encountered in any of the test pits at the time of the investigation but can be expected within the ferricrete gravel horizon and a pure sandy horizon at an average depth of 0.7m. This is caused by infiltration of rainwater which percolates into the upper soil layers and rests on the underlying relatively impermeable clay. In winter perched water tables may rise to surface in low lying or flat areas due to the low permeability of the clayey residual stratum. The overall soil permeability is low.

The ground surface is quite uneven in some areas with localized depressions with poor drainage. Subsequent visits to site indicate the ground can be significantly soggy during wet periods. There is an existing pond on site which has since been overgrown with weeds and a drainage trench with drains from the pond (see **Figure 8**).

Effect on the proposed development

The design of stormwater systems should take into account the location and topography of the site and the low soil permeability which can lead to high volumes of run-off and periodic surface flooding. Stormwater systems will be required to collect, control, divert and discharge run-off in suitable locations into natural water courses. Site drainage recommendations are provided in Chapter 9.

Figure 8: Aerial photo of the pond feature encountered on site

6.1.8 Existing structures

Results of the investigation

The site is currently vacant and there are no existing structures on the site requiring demolition/relocation.

Effect on the proposed development

No special measures are required to relocate residents and demolish existing informal structures.

6.2 Slope stability and erosion

The natural slope gradient of the site is gentle to moderate and there were no signs of any macro instability at the time of the investigation. Temporary shallow excavations (<1m deep) are likely to be generally stable at near vertical angles for short periods, but permanent excavations/slopes exceeding 35° will require retaining walls. Erosion is unlikely to be a significant issue on the site, but contractors must take normal precautions to minimise erosion.

6.3 Excavation classification with respect to services

All excavations to 3m are classified as “Soft” in terms of SABS1200D.

6.4 Impact of the geotechnical character of the site on residential developments

The applicable geotechnical subsidy variations are tabulated in **Table 4**.

Table 4: Site specific geotechnical subsidy variations

Geotechnical Conditions	*Category or type*	*Criteria*	*Precautionary measures*	*Applicable areas*	*Comment*
Seepage / groundwater	Category 1	Permanent or perched water tables less than 1.0m below ground surface	Subsurface drainage/improved damp-proofing measures to houses, service trenches to be dewatered during construction	ALL	
	Category 2	Permanent or perched water tables more than 1m but less than 1.5m below ground level	Service trenches to be dewatered during construction	N/A	
Erodability of soil	Category 1	High risk (Erodability index 1-8)	Retaining walls & earthworks to reduce slopes & surface drainage	N/A	
	Category 2	Medium risk (Erodability index 9-15)	Retaining walls & earthworks to reduce slopes	N/A	
Hard excavation	Category 1	Hard rock excavation to a depth of 1.5m	Additional cost of trench and foundation excavation	N/A	
	Category 2	Boulder excavation to a depth of 1.5m	Additional cost of trench, foundation and road excavation	Y N/A	
Dolomite	Category 1	Risk class 1&2 (Dolomite area class D2)	Additional cost of foundations	N/A	
	Category 2	Risk class 3&4 (Dolomite area class D3)	Additional cost of foundations	N/A	
Expansive Clays	Category 1	H1	Foundation design, building procedures and precautionary measures: Modified normal	Yes	
	Category 2	H2	Foundation design, building procedures and precautionary measures: Stiffened raft	No	
	Category 3	H3	Foundation design, building procedures and precautionary measures: Cellular rafts/piles	No	
Compressible and Collapsible soils	Category 1	C1	Foundation design, building procedures and precautionary measures: Modified normal	Yes	
	Category 2	C2	Foundation design, building procedures and precautionary measures: Light or heavy raft	No	
Compressible soils	Category 1	S1	Foundation design, building procedures and precautionary measures: Modified normal	No	

Geotechnical Conditions	Category or type	Criteria	Precautionary measures	Applicable areas	Comment
	Category 2	S2	Foundation design, building procedures and precautionary measures: Light or heavy raft	No	
Mining subsidence	Category 1	Old undermining to a depth of between 90-240m below surface where stope closure has ceased	Additional cost of foundations: Compaction below footings or raft	No	
	Category 2	Old undermining to a depth of between 90-240m below surface where total extraction has taken place	Additional cost of foundations: additional earthworks or soil reinforcement	No	
Seismic activity	Category 1	Mining induced seismic activity > 100cm/s^2	Additional cost of foundations: Stiffened strip footings or raft	No	
	Category 2	Natural seismic activity > 100cm/s^2	Additional cost of foundations: Stiffened strip footings or raft	No	
Topography	Category 1	Average ground slope flatter than 1:20	Increase depth of sewer & provision of pump station	No	
	Category 2	Average ground slope of between 1:11 and 1:20	Terracing for houses & additional earthworks to roads & storm water control measures	40% of site	*Estimated
	Category 3	Average ground slope of between 1:7.5 and 1:10	Terracing for houses & additional earthworks to roads & storm water control measures	60% of site	*Estimated
	Category 4	Average ground slope of between 1:5 and 1:7.4	Terracing for houses & additional earthworks to roads & storm water control measures	No	
	Category 5	Average ground slope steeper than 1:5	Terracing for houses & additional earthworks to roads & storm water control measures	No	
SCCCA	Southern Cape Coastal Condensation Area	Area subjected to severe condensation conditions	Plaster and paint on all external walls & 6.4mm gypsum plasterboard ceilings & 80mm thick glass fibre insulation	Yes	
Location of development site		Site more than 20km from major centres	Additional cost of transportation	No	

7. Site classification

The site has been broadly mapped into distinguishable terrains according to SANS10400-H soil classifications assigned in **Table 5,** and the mapping is illustrated in **Figure 9**.

Table 5: Geotechnical terrain mapping

Terrain Unit	*Geotechnical Constraint*	*Expected movement (mm)*	*NHBRC Site Classification*
Terrain 1	Potentially compressible soil	5-10	C1
	Potentially expansive	7.5-15	H1
	Uncontrolled fill/disturbed ground		P

Figure 9: Geotechnical terrain map

8. Foundation recommendations and solutions

8.1 Earthworks and structural foundations

Earthworks should be designed and conducted in accordance with SABS 1200D, COLTO 3300 or any site-specific specifications provided by the engineer. Foundations should be designed and constructed in accordance with the NHBRC Home Builders Manual, SANS 10400-H and/or as specified by the structural engineer.

If any uncontrolled fill material is uncovered, such as rubble, plastic, etc., it should be completely removed from house platforms or treated as per the engineers instructions. Some bulk earthworks and possibly low retaining walls may be required to create level platforms on sites where slopes exceed 1:10. In cut to fill operations, all organic matter should be removed from the footprint area before bulk earthworks. The insitu soils may not be suitable for use in bulk fills, unless the material is approved by the engineer and can be effectively compacted to the specified level.

The recommended foundation system for the proposed single storey structures is reinforced strip foundations on well compacted insitu soils at a nominal founding depth of

600mm below GL with design bearing pressures limited to 100kPa. Alternative suitable methods include light rafts on compacted/engineered platforms. All founding mediums should be compacted with a roller or trench rammer to achieve a minimum of 93% of the Mod. AASHTO density (<30mm/blow of DCP).

8.2 Road pavements

Access roads should be constructed in accordance with SABS 1200, COLTO, TRH4, TRH14, The Red Book or other applicable specifications and standards, or as directed by the engineer.

Test results indicate that the insitu soil is typically poor-quality material and improvement of the subgrade is recommended with lower and upper SSG layers included in the design of roads at the engineer's discretion.

General preparation of the roadbed should include the following:

- Cut to line and level.

- Compact to 90% MDD. Recommended moisture content before rolling is optimum moisture content (OMC) minus 2%.

- Remove any incompressible or wet soil and reinstate with G9 material or as directed by the engineer.

Table 6 serves as a guideline (to be checked by the engineer) for the design of a Category C flexible pavement in a wet region with a design life of 15 years with traffic loading of less than 3 x 10^6 E80s over 20 years (as per TRH4).

Table 6: Road layerworks recommendations (Cat C in wet climate)

Layer	*Material*	*Thickness mm*	*Required Compaction*
Seal	HMA or Cape Seal	TBD by engineer	
Base	Imported G2/3	150	100% MDD
Subbase	Imported G5/C4	150	95% MDD
USSG	Imported G7	150	93% MDD
LSSG	Imported G7/9	150	90% MDD
OR			
Seal	n/a	n/a	n/a
Base	Interlocking cement pavers	80	n/a
Subbase	Imported G5/C4	150	95% MDD
USSG	Imported G7	150	93% MDD
LSSG	Imported G7/9	150	93% MDD

9. Storm water drainage recommendations

The design and construction of storm water drainage should be carried out in accordance with SABS 1200LE, COLTO, The Red Book or other applicable standards, or as directed by the engineer.

Minor flood events can be handled with kerb inlets and underground pipes, which discharge at suitable points into existing stormwater network or natural drainage lines,

as directed by the engineer. Stormwater from major flood events can be contained within the road prism but should not overflow into adjacent erven. Well-designed access roads with sufficient level difference from the adjacent property, and adequate side drains and culverts is recommended. Subsoil drains are not envisaged along roads as the subgrade is generally well drained.

The ponding of storm water around the exterior of houses can be avoided by shaping the ground levels around the exterior to create a fall away from the house and constructing a 1m wide a concrete apron with a 10% fall away from the house. This will also assist in minimizing erosion around the house. The finished floor level of all houses should be a minimum of 150mm above final ground level to prevent flooding.

10. Special precautionary measures

The following special measures are recommended as a precaution:

- A geotechnical specialist should be involved in earthworks and the construction of foundations to assist the engineer with quality control.
- Compaction control testing is essential during construction.

11. Conclusions

The site is generally suitable for residential development purposes, but there are some geotechnical constraints which may have an impact on the engineering design, and some preliminary recommendations are provided for consideration by the civil and structural engineers.

The ponding of storm water around the exterior of houses can be avoided by shaping the ground levels around the exterior to create a fall away from the house and constructing a 1m wide a concrete apron with a 10% fall away from the house. This will also assist in minimizing erosion around the house. The finished floor level of all houses should be a minimum of 150mm above final ground level to prevent flooding.

10. Special precautionary measures

The following special measures are recommended as a precaution:

- A geotechnical specialist should be involved in earthworks and the construction of foundations to assist the engineer with quality control.
- Compaction control testing is essential during construction.

11. Conclusions

The site is generally suitable for residential development purposes, but there are some geotechnical constraints which may have an impact on the engineering design, and some preliminary recommendations are provided for consideration by the civil and structural engineers.

Appendix 1

Maps

Client: Zutari
Project: New Development
Site: Erf 21028 & 21029 (The Village Ridge
Area: George

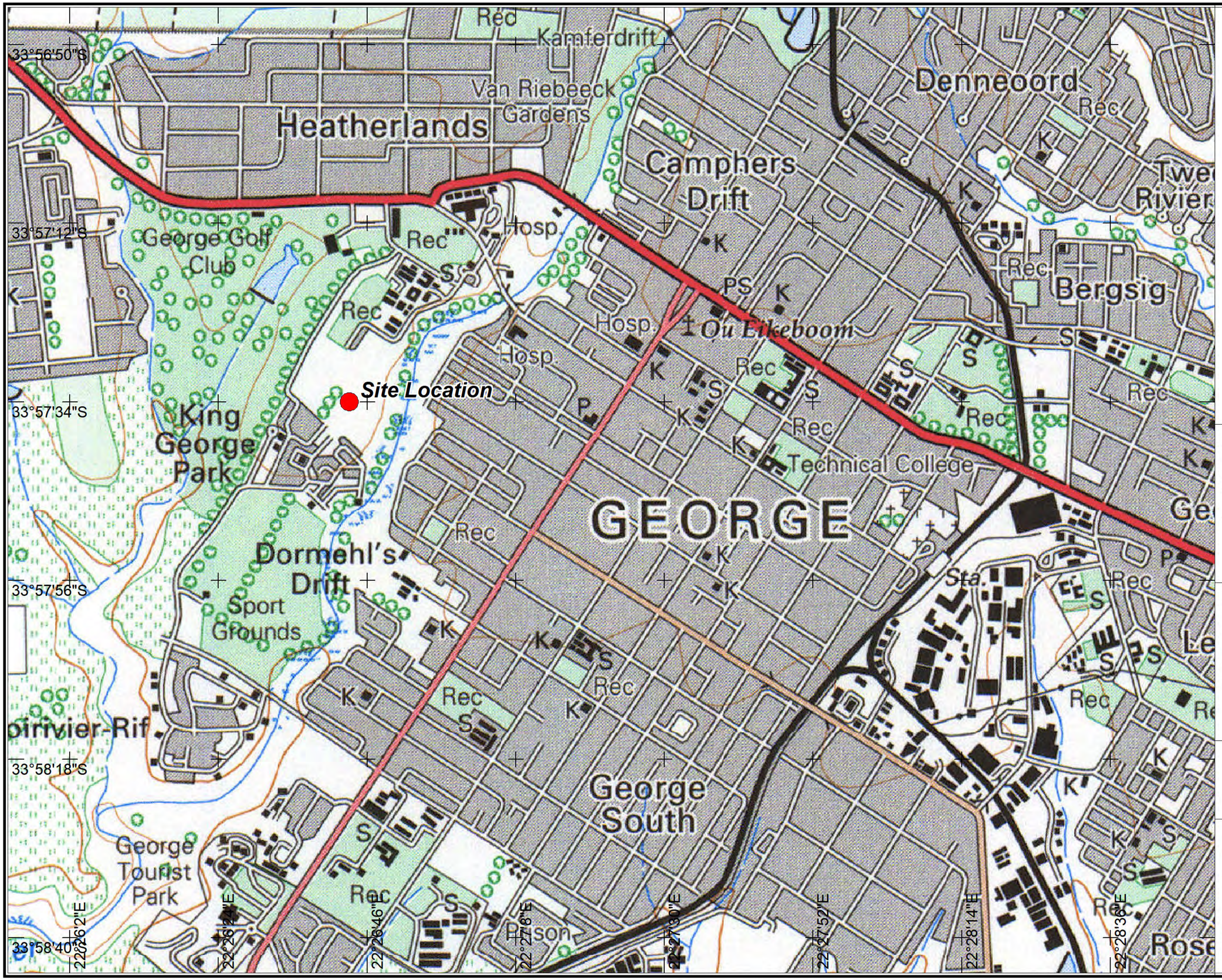
Drawing Name: Locality Map
Drawing No:
Date: 2021
Revision: 0
Drawn By: S Ngema
Checked By: I Paton

Scale 1:2000000

0 10 20 30 40 50 km

OUTENIQUA GEOTECHNICAL SERVICES

PO Box 964
Knysna
6570
044-3820502
iain@outeniqualab.co.za



N

Legend

Locality

Client: Power
Project: New Development
Site: Erf 21028 & 21029 (The Village Ridge)
Area: George

Drawing Name: Locality Map
Drawing No:
Date: 21.5.2021
Revision: 0
Drawn By: S Ngema
Checked By: I Paton

Scale 1:20000

0 100 300 500 m

OUTENIQUA GEOTECHNICAL SERVICES

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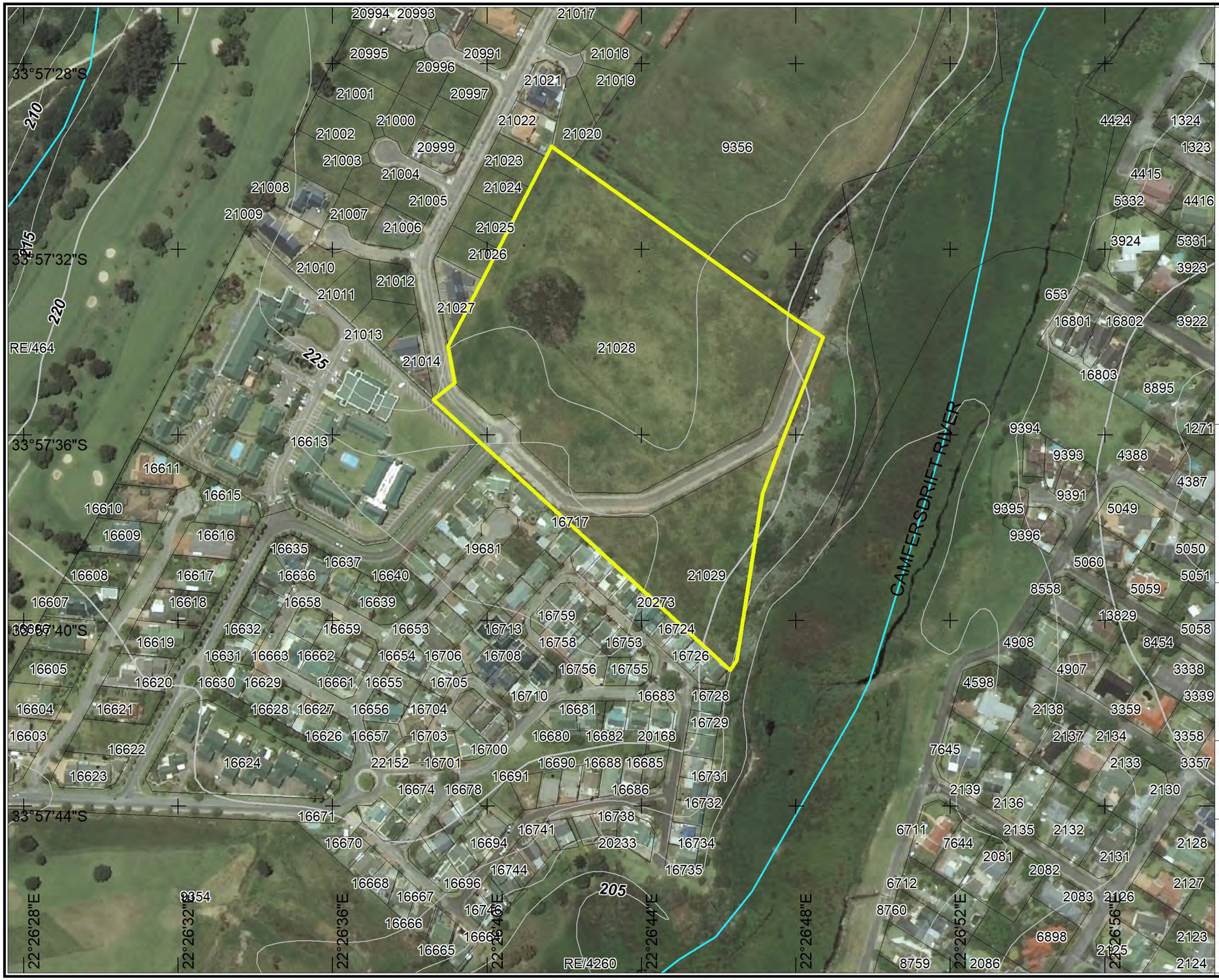
iain@outeniqualab.co.za


N
Legend
Topo vector
River
Boundary
33°57'28"S
33°57'32"S
33°57'36"S
33°57'40"S
33°57'44"S
22°26'28"E
22°26'32"E
22°26'36"E
22°26'40"E
22°26'44"E
22°26'48"E
22°26'52"E
22°26'56"E
CAMFERSDRIFT RIVER
RE/464
RE/4260
20994
20993
21017
20995
20991
21018
20996
21021
21019
21001
20997
21000
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21012
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225
220
215
210
205
9356
4424
1324
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4415
5332
4416
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5331
3923
653
16801
16802
3922
16803
8895
9394
1271
9393
4388
4387
9391
9395
5049
9396
5050
5060
5051
8558
5059
13829
5058
4908
8454
4907
3338
4598
3339
2138
3359
2137
2134
3358
7645
2133
3357
2139
2130
2136
6711
2135
2132
7644
2128
2081
2131
2082
6712
2127
2083
2126
8760
6898
2123
2125
8759
2086
2124
16611
16615
16610
16609
16616
16717
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16704
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16729
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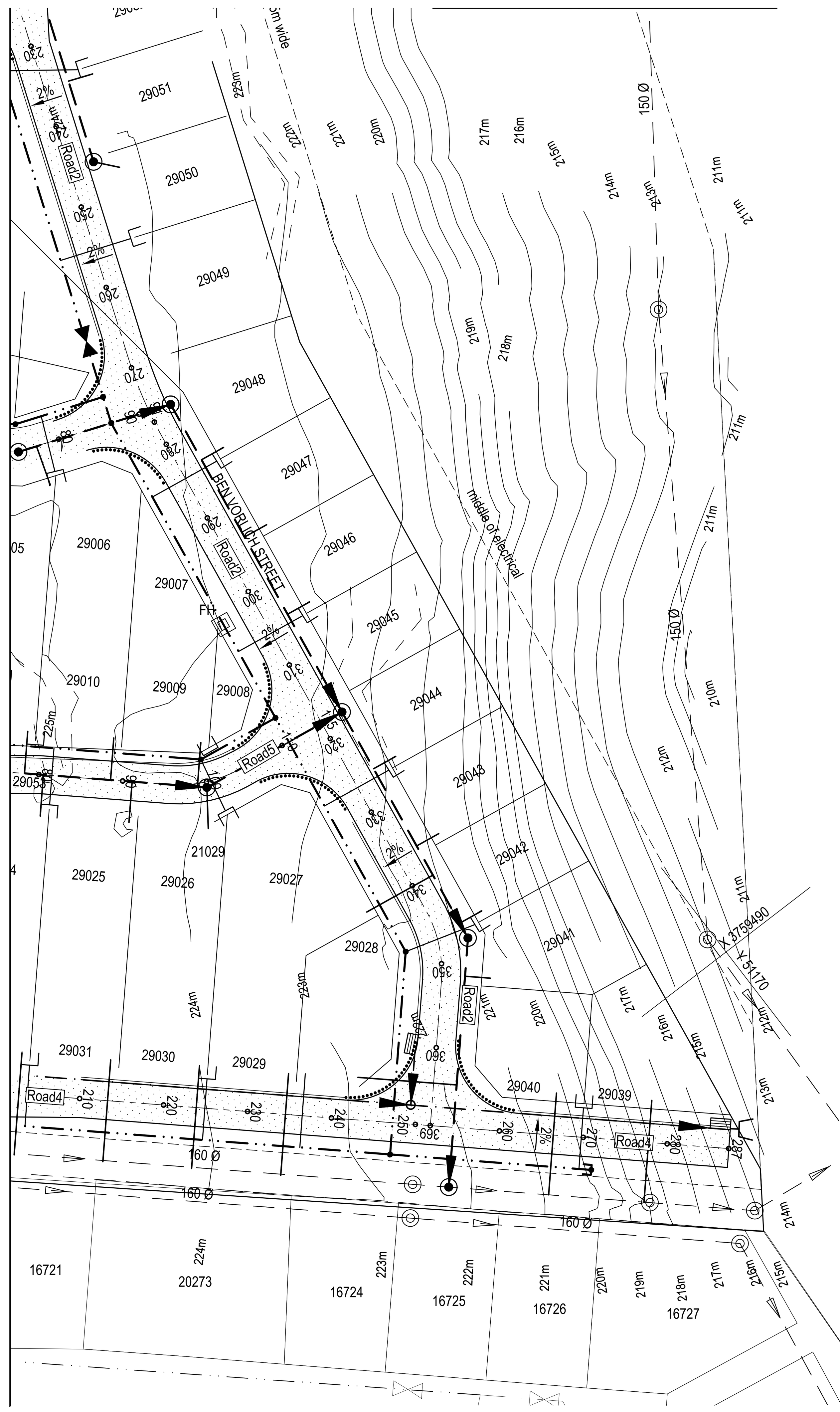
16657
16703
16680
16682
20168
16622
16700
16624
22152
16701
16690
16688
16685
16623
16691
16731
16674
16678
16686
16732
16671
16738
16741
16670
16694
20233
16734
16744
16735
16668
16696
16667
16745
16666
16665
16613
16654
Client: Power
Project: New Development
Site: Erf 21028 & 21029 (The Village Ridge)
Area: George
Drawing Name: Aerial photo map
Drawing No:
Date: 21.5.2021
Revision: 0
Drawn By: S Ngema
Checked By: I Paton
Scale 1:3500
0 20 40 60 80 100 m
OUTENIQUA
GEOTECHNICAL SERVICES
PO Box 964
Knysna
6570
044-3820502
iain@outeniqualab.co.za



CHECKED

ZUTARI
IMPACT. ENGINEERED.

CLIENT

POWER GROUP

REV	DATE	REVISION DETAILS	APPROVED
A	15/10/2020	FOR APPROVAL	AC KEYSER

SCALE	SIZE	
1:500	A1	FOR APPROVAL NOT FOR CONSTRUCTION

DRAWN A VAN WYK

DESIGNED G COETZEE

REVIEWED M BOTHA

APPROVED DATE

AC KEYSER ECSA-200670108

PROJECT

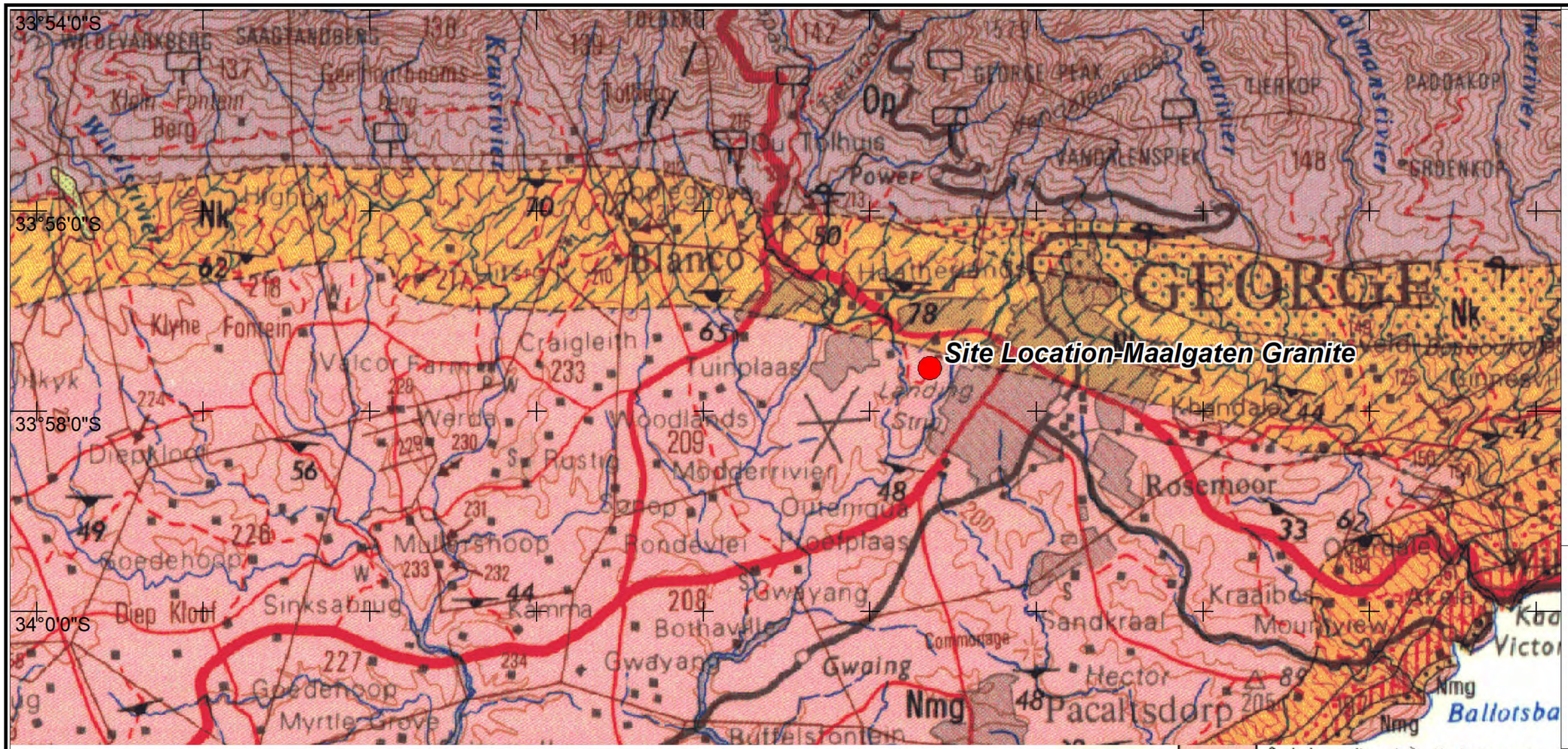
THE VILLAGE RIDGE

TITLE

GENERAL SERVICES LAYOUT

DRAWING NUMBER

PROJECT No.		WBS		TYPE		DISC		NUMBER		REV
503048	-	0000	-	DRG	-	CC	-	0001	-	A



N

Legend

Locality

Client: Zutari
Project: New Development
Site: Erf 21028 & 21029 (The Village Ridge
Area: George

Drawing Name: Geological Map
Drawing No:
Date: 2021
Revision: 0
Drawn By: S Ngema
Checked By: I Paton

Scale 1:125000

0 0.6 1.8 3 km

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PO Box 964
Knysna
6570
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iain@outeniqualab.co.za

Legend

Topo vector

- River
- Test Positions
- Terrain 1 (C1/H1/P)
- Boundary

Client: Power
Project: New Development
Site: Erf 21028 & 21029 (The Village Ridge)
Area: George

Drawing Name: Geotechnical map
Drawing No:
Date: 21.5.2021
Revision: 0
Drawn By: S Ngema
Checked By: I Paton

Scale 1:2000

0 6 24 36 48 60 m

OUTENIQUA GEOTECHNICAL SERVICES

PO Box 964
Knysna
6570
044-3820502
iain@outeniqualab.co.za

Appendix 2

Test pit profiles

Outeniqua Lab (Pty) Ltd.

Materials Testing Laboratory

Registration No. 95/07742/07

6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za

R-PROF-1-5

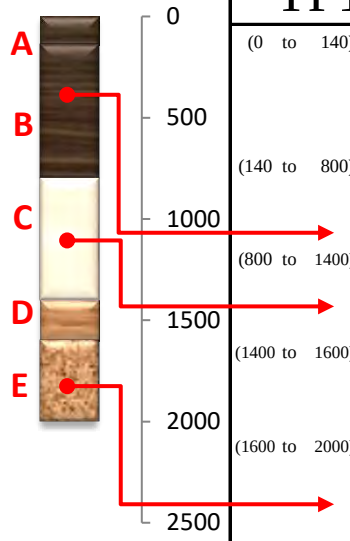
Dec-14

Customer :	Aurecon 65 York Street George 6530
Project :	Erf 21028 & 21029 - Village Ridge Estate - George
Date Reported :	15/06/18

TP1

Datum: @ Natural Ground Level | Co-ordinates: S533*57.488' - E022*26.829'

Key to symbols: Sample taken | Water seepage



(0 to 140)	Slightly moist, dark brown, loose, intact, **SILTY SAND AND GRASS**, transported.
(140 to 800)	Slightly moist, dark brown, medium dense, intact, **SILTY SAND**, transported.
	Mod / CBR / Indicator / Moisture
(800 to 1400)	Slightly moist, light yellow, medium dense, intact, **SANDY SILT**, transported.
	Mod / CBR / Indicator / Moisture
(1400 to 1600)	Slightly moist to moist, dark reddish orange, dense, intact, **FERRICRETE**, pedogenic.
(1600 to 2000)	Slightly moist to moist, light reddish orange, firm, intact, **CLAY**, residual.
	Indicator / Moisture

Dynamic Cone Penetrometer (DCP)

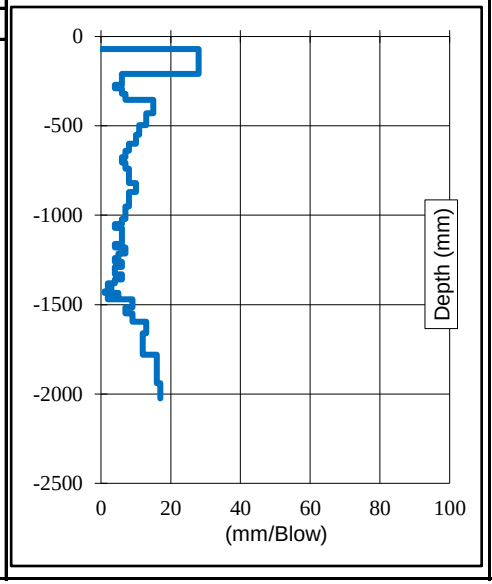
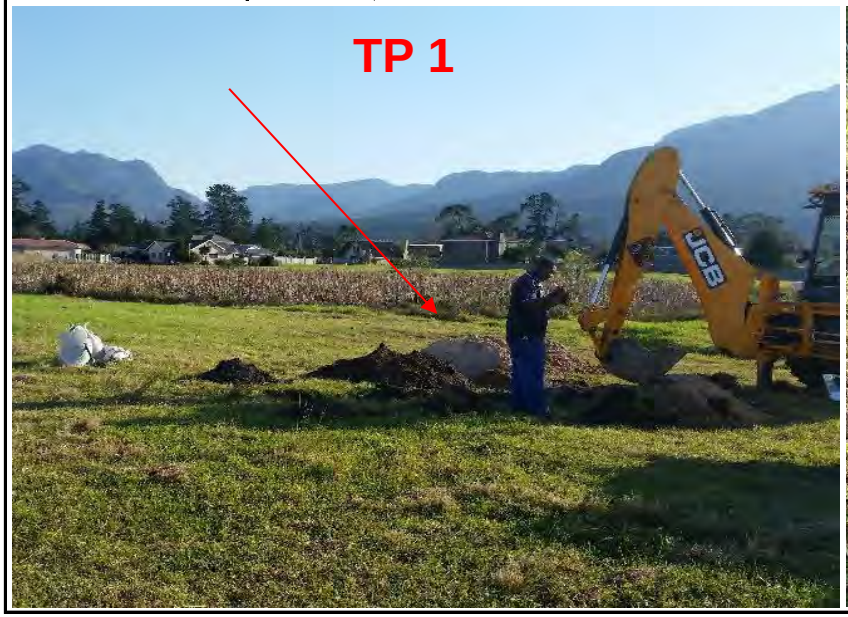


Photo of Test Pit



Outeniqua Lab (Pty) Ltd.

Materials Testing Laboratory

Registration No. 95/07742/07

6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za

R-PROF-1-5

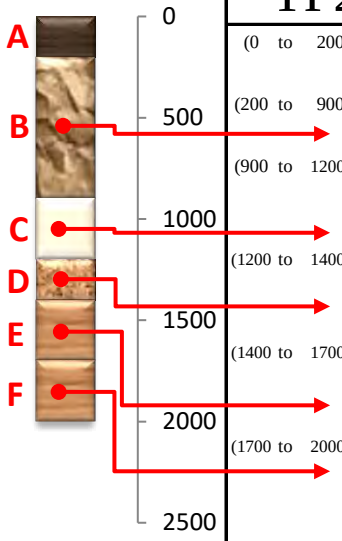
Dec-14

Customer :	Aurecon 65 York Street George 6530
Project :	Erf 21028 & 21029 - Village Ridge Estate - George
Date Reported :	15/06/18

TP2

Datum: @ Natural Ground Level | Co-ordinates: S33*57.519' - E022*26.692'

Key to symbols: Sample taken | Water seepage



(0 to 200)	Slightly moist to moist, dark brown, loose, intact, **TOP SOIL WITH ROOTS AND WOODSHIPS**, transported.
(200 to 900)	Slightly moist , light brown, loose, intact, **SILTY SAND**, transported.
	Indicator / Moisture
(900 to 1200)	Slightly moist, light yellow, medium dense, intact, **SANDY SILT**, transported.
	Indicator / Moisture
(1200 to 1400)	Slightly moist to moist, light reddish yellow, dense, intact, **SILTY SAND WITH FERRICRETE**, pedogenic.
	Mod / CBR / Indicator / Moisture
(1400 to 1700)	Slightly moist to moist, dark reddish orange, dense, intact, **CLAY WITH FERRICRETE**, pedogenic.
	Mod / CBR / Indicator / Moisture
(1700 to 2000)	Slightly moist to moist, dark reddish orange, firm, intact, **CLAY**, residual.
	Indicator / Moisture

Dynamic Cone Penetrometer (DCP)

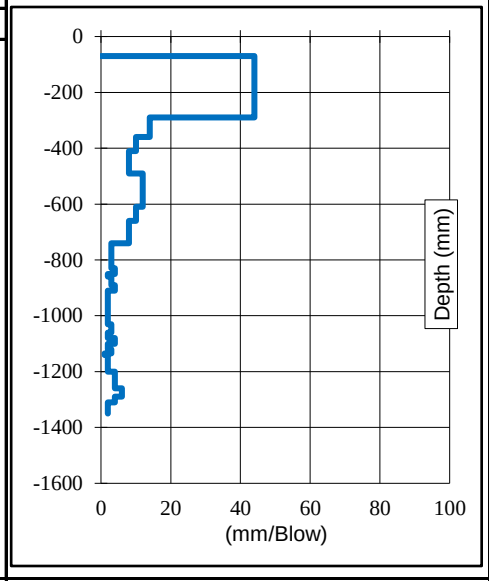
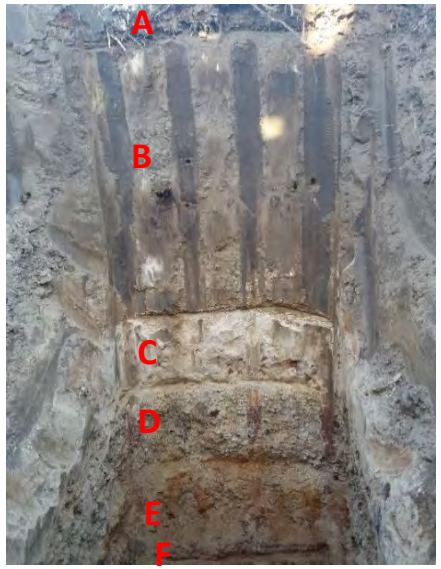
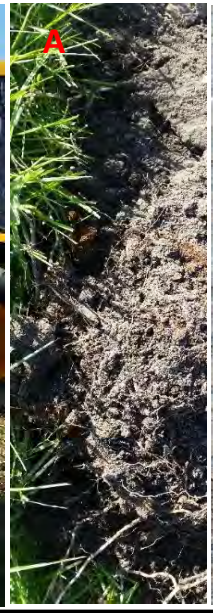
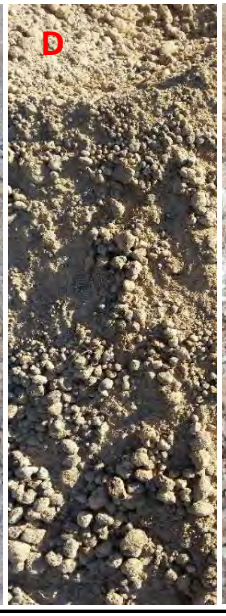


Photo of Test Pit







Outeniqua Lab (Pty) Ltd.

Materials Testing Laboratory

Registration No. 95/07742/07

6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za

R-PROF-1-5

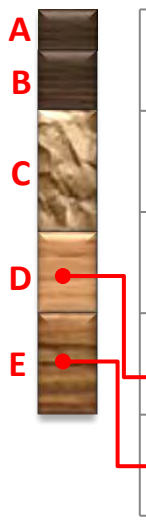
Dec-14

Customer :	Aurecon 65 York Street George 6530
Project :	Erf 21028 & 21029 - Village Ridge Estate - George
Date Reported :	15/06/18

TP3

Datum: @ Natural Ground Level | Co-ordinates: S33*57.552' - E022*26.759'

Key to symbols: Sample taken | Water seepage



(0 to 200)	Slightly moist to moist, dark brown, soft, intact, **TOPSOIL WITH ROOTS AND GRASS**, transported.
(200 to 500)	Slightly moist, dark brown, medium dense, intact, **SILTY SAND**, transported.
(500 to 1100)	Slightly moist, light brown, medium dense, intact, **SANDY SILT**, transported.
(1100 to 1500)	Slightly moist to moist, dark reddish orange,medium dense to dense, intact, **SILTY CLAY WITH FERRICRETE**, pedogenic. **Mod / CBR / Indicator / Moisture**
(1500 to 2000)	Slightly moist to moist, dark red, firm, intact, **CLAY**, residual. **Mod / CBR / Indicator / Moisture**

Dynamic Cone Penetrometer (DCP)

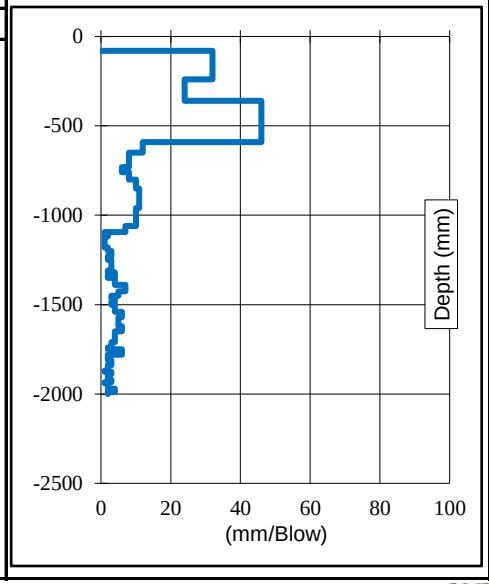


Photo of Test Pit

Outeniqua Lab (Pty) Ltd.

Materials Testing Laboratory

Registration No. 95/07742/07

6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za

R-PROF-1-5

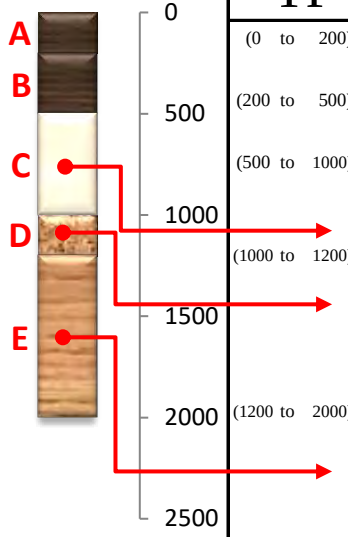
Dec-14

Customer :	Aurecon 65 York Street George 6530
Project :	Erf 21028 & 21029 - Village Ridge Estate - George
Date Reported :	15/06/18

TP4

Datum: @ Natural Ground Level | Co-ordinates: S33*57.640' - E022*26.754'

Key to symbols: Sample taken | Water seepage



(0 to 200)	Slightly moist to moist, dark brown, soft, intact, **TOP SOIL WITH ROOTS AND GRASS**, transported.
(200 to 500)	Slightly moist, dark brown, medium dense, intact, **SILTY SAND**, transported.
(500 to 1000)	Slightly moist, light yellow, medium dense, intact, **SANDY SILT**, transported.
	Indicator / Moisture
(1000 to 1200)	Slightly moist to moist, light reddish orange, dense, intact, **SILTY CLAY WITH FERRICRETE**, pedogenic.
	Mod / CBR / Indicator / Moisture
(1200 to 2000)	Slightly moist to moist, dark reddish ornage, firm, intact, **CLAY**, residual.
	Mod / CBR / Indicator / Moisture

Dynamic Cone Penetrometer (DCP)

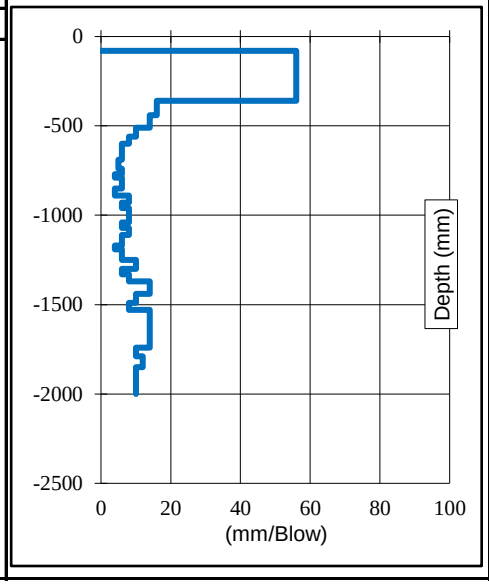
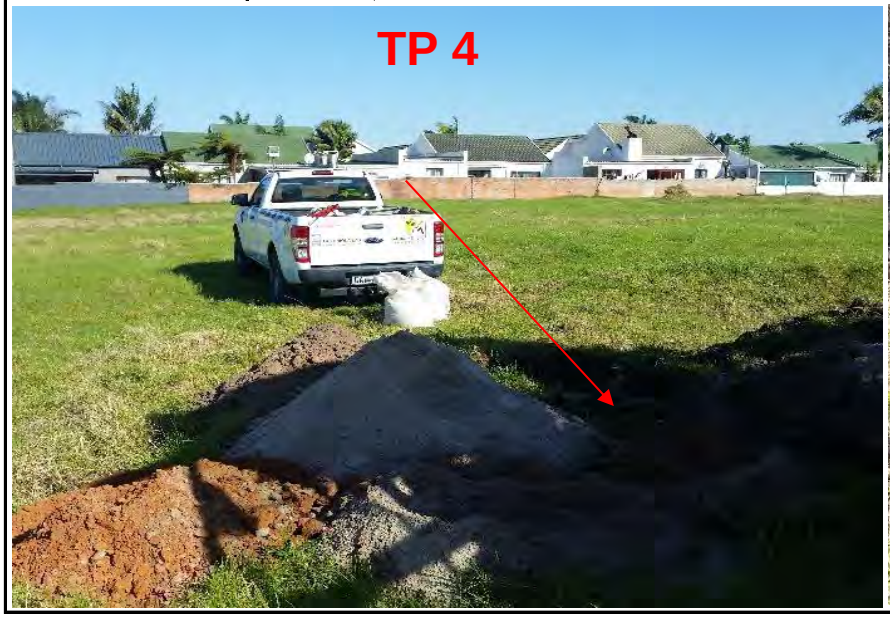


Photo of Test Pit



Appendix 3

Lab test data

OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

Materials Testing Laboratory

6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za

Customer :	Aurecon	Project :	Erf 21028 & Erf 21029 - Village Ridge Estate - George
	65 York Street	Date Received :	14/06/18
	George	Date Reported :	03/07/18
	6530	Req. Number :	2024/18
Attention :	Garvin Coetzee	No. of Pages :	2/8

TEST REPORT

CALIFORNIA BEARING RATIO - (SANS 3001 Method GR1,GR5,GR10,GR20,GR30,GR40)

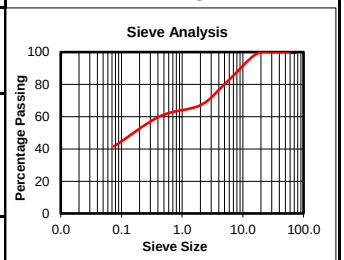
Material Indicators		71243		
Sample Position (SV)	TP 1 - Layer 5	COLTO:		
Depth (mm)	1600-2000	Not		
Sample No	**71243**	Classified		
Materials Description: Source	In-Situ			
Colour	Light Reddish Orange			
Soil Type	Clay			
Classification	Existing			

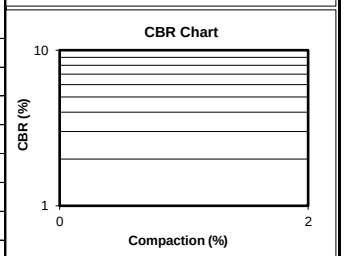
Max. Stone size in hole (mm)			Opinion			
Percentage Passing	75.0mm	100				
	63.0mm	100				
	50.0mm	100				
	37.5mm	100				
	28.0mm	100				
	20.0mm	100				
	14.0mm	97				
	5.00mm	80				
	2.00mm	67				
	0.425mm	60				
	0.075mm	41.5				

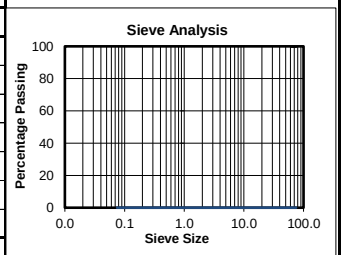
Soil Mortar & Constants						
Grading Modulus	1.31					
Coarse Sand (%)	10					
Fine Sand (%)	28					
Silt & Clay (%)	62					
Liquid Limit (%)	23					
Plasticity Index (%)	11					
Linear Shrinkage (%)	5.5					

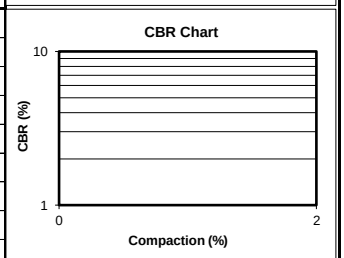
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)						
	Opt Moisture Content (%)						
	Mould Moisture Con. (%)						
	@100% Mod AASHTO						
	Swell (%)						
Proc NRB	100% NRB						
	Swell (%)						
Proc	100% Proctor						
	Swell (%)						
CBR	@ 100% Mod AASHTO						
	@ 98% Mod AASHTO						
	@ 95% Mod AASHTO						
	@ 93% Mod AASHTO						
	@ 90% Mod AASHTO						
Insitu Moisture Content (%)		7.2					

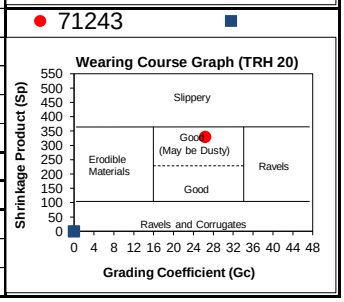
Soil Classification Achieved By The Material						
COLTO:	Not Classified					
AASTHO System	A-6					
Unified System	GC					











- **Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 or MC1.**
- **Specimens sampled by Waldo McClune**
- **The weather conditions were such that there was no detrimental effect on the sample/s taken.**

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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 (Í) and uncertain (Ú) opinion indicators are based on an approximate 95% level of confidence with reference to SAMM GUIDANCE 1, Issue 2 : 20 June 2007 Section 2.
2. The uncertain (Ú) indicates that the test result is either equal to or is above / below the specified limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliant (P) or non compliant (Í) based on a 95% level of confidence with reference to SAMM GUIDANCE 1, Issue 2 : 20 June 2007 Section 2.
3. This report (with attachments) is the correct record of all measurements made, and may not be reproduced other than with full written approval from the Director of Outeniqua Lab (Pty) Ltd.
4. Measuring Equipment, traceable to National Standards is used where applicable. Results reported in this Test Report relate only to the items tested and are an indication only of the sample provided and/or taken.
5. While every care is taken to ensure the correctness of all tests and reports, neither Outeniqua Lab (Pty) Ltd nor its employees shall be liable in any way whatever for any error made in the execution or reporting of tests or any erroneous conclusions drawn therefrom or for any consequence thereof.

OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

Materials Testing Laboratory

6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za

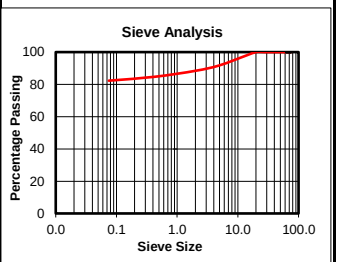
Customer :	Aurecon	Project :	Erf 21028 & Erf 21029 - Village Ridge Estate - George
	65 York Street	Date Received :	14/06/18
	George	Date Reported :	
	6530	Req. Number :	2024/18
Attention :	Garvin Coetzee	No. of Pages :	3/8

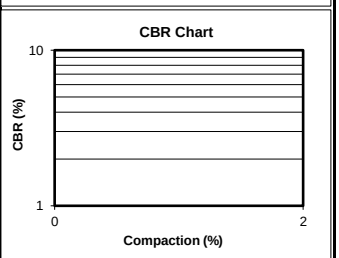
TEST REPORT

CALIFORNIA BEARING RATIO - (SANS 3001 Method GR1,GR5,GR10,GR20,GR30,GR40)

Material Indicators							
Sample Position (SV)		TP 2 - Layer 2	COLTO: Not Classified		TP 2 - Layer 3	COLTO: Not Classified	
Depth (mm)		200-900			900-1200		
Sample No		71244			71245		
Materials Description	Source	In-Situ			In-Situ		
	Colour	Light Brown			Light Yellow		
	Soil Type	Silty Sand			Sandy Silt		
	Classification	Existing			Existing		
Max. Stone size in hole (mm)				Opinion			Opinion
Percentage Passing	75.0mm	100			100		
	63.0mm	100			100		
	50.0mm	100			100		
	37.5mm	100			100		
	28.0mm	100			100		
	20.0mm	100			100		
	14.0mm	98			100		
	5.00mm	92			99		
	2.00mm	88			99		
	0.425mm	85			97		
	0.075mm	82.3			53.8		
Soil Mortar & Constants							
Grading Modulus		0.45			0.51		
Coarse Sand (%)		4			2		
Fine Sand (%)		3			44		
Silt & Clay (%)		93			55		
Liquid Limit (%)		SP			SP		
Plasticity Index (%)		SP			SP		
Linear Shrinkage (%)		0.5			0.5		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)						
	Opt Moisture Content (%)						
	Mould Moisture Con. (%)						
	@100% Mod AASHTO						
	Swell (%)						
Proc NRB	100% NRB						
	Swell (%)						
Proc	100% Proctor						
	Swell (%)						
CBR	@ 100% Mod AASHTO						
	@ 98% Mod AASHTO						
	@ 95% Mod AASHTO						
	@ 93% Mod AASHTO						
	@ 90% Mod AASHTO						
Insitu Moisture Content (%)		6.6			4.2		
Soil Classification Achieved By The Material							
COLTO:		Not Classified			Not Classified		
AASTHO System		A-4			A-4		
Unified System		MH			ML		

71244





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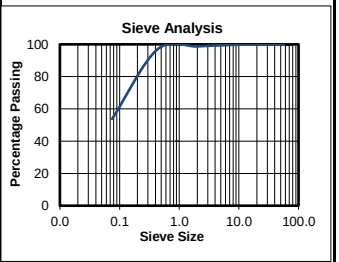

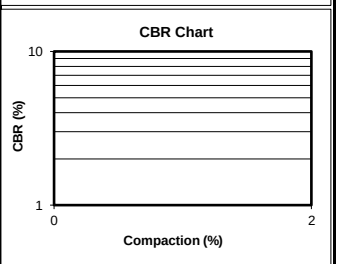

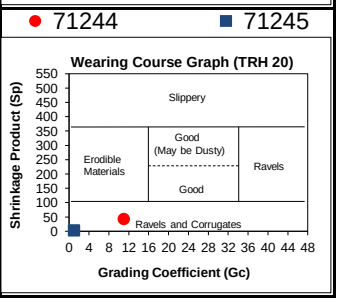

- **Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 or MC1.**
- **Specimens sampled by Waldo McClune**
- **The weather conditions were such that there was no detrimental effect on the sample/s taken.**

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za

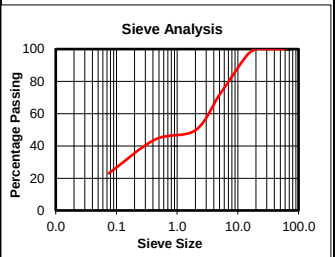
Customer :	Aurecon	Project :	Erf 21028 & Erf 21029 - Village Ridge Estate - George
	65 York Street	Date Received :	14/06/18
	George	Date Reported :	03/07/18
	6530	Req. Number :	2024/18
Attention :	Garvin Coetzee	No. of Pages :	7/8

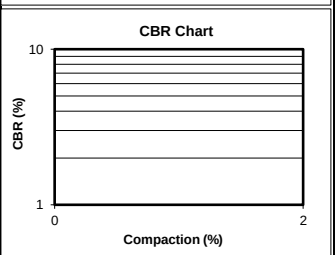
TEST REPORT

CALIFORNIA BEARING RATIO - (SANS 3001 Method GR1,GR5,GR10,GR20,GR30,GR40)

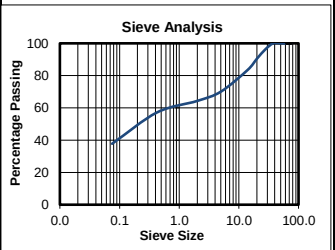
Material Indicators								
Sample Position (SV)		TP 4 - Layer 3	COLTO:		TP 4 - Layer 4	COLTO:		
Depth (mm)		500-1000	Not		1000-1200	G8 SSG		
Sample No		71251	Classified		71252			
Materials Description	Source	In-Situ			In-Situ			
	Colour	Light Yellow			Light Reddish Orange			
	Soil Type	Sandy Silty			Silty Clay with Ferricrete			
	Classification	Existing			Existing			
Max. Stone size in hole (mm)				Opinion			Opinion	
Percentage Passing	75.0mm	100			100			
	63.0mm	100			100			
	50.0mm	100			100			
	37.5mm	100			100			
	28.0mm	100			96			
	20.0mm	100			90			
	14.0mm	96			84			
	5.00mm	72			70			
	2.00mm	50			64			
	0.425mm	44			57			
	0.075mm	23.0			37.8			
Soil Mortar & Constants								
Grading Modulus		1.84			1.41	0.75 - 2.70	✓	
Coarse Sand (%)		12			11			
Fine Sand (%)		42			30			
Silt & Clay (%)		46			59			
Liquid Limit (%)		NP			SP			
Plasticity Index (%)		NP			SP	≤ 12	✓	
Linear Shrinkage (%)		0.0			0.5			
CBR / Density Relationship								
MOD	Max Dry Density (kg/m^3)				2552			
	Opt Moisture Content (%)				5.7			
	Mould Moisture Con. (%)				5.9			
	@100% Mod AASHTO				100.0			
	Swell (%)				0.05	≤ 1.5	✓	
Proc NRB	100% NRB				95.6			
	Swell (%)				0.08			
Proc	100% Proctor				91.2			
	Swell (%)				0.15			
CBR	@ 100% Mod AASHTO				23			
	@ 98% Mod AASHTO				20			
	@ 95% Mod AASHTO				16			
	@ 93% Mod AASHTO				13	≥ 10		
	@ 90% Mod AASHTO				11			
Insitu Moisture Content (%)		5.2			4.0			
Soil Classification Achieved By The Material								
COLTO:		Not Classified			G8 SSG			
AASTHO System		A-1-b / A-2-4			A-4			
Unified System		GM			GM			

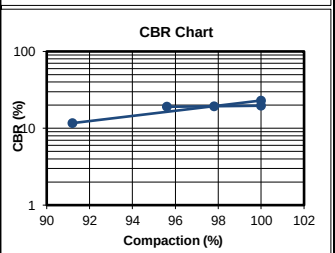
71251

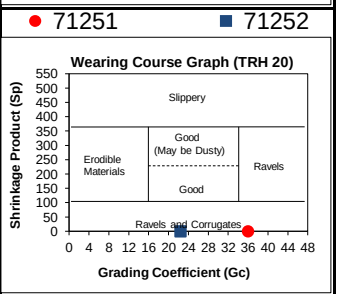




71252







- **Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 or MC1.**
- **Specimens sampled by Waldo McClune**
- **The weather conditions were such that there was no detrimental effect on the sample/s taken.**

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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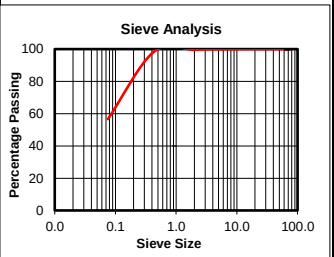
Customer :	Aurecon	Project :	Erf 21028 & Erf 21029 - Village Ridge Estate - George
	65 York Street	Date Received :	14/06/18
	George	Date Reported :	26/06/18
	6530	Req. Number :	2024/18
Attention :	Garvin Coetzee	No. of Pages :	1/8

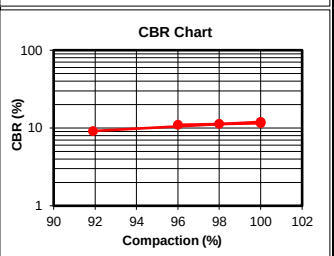
TEST REPORT

CALIFORNIA BEARING RATIO - (SANS 3001 Method GR1,GR5,GR10,GR20,GR30,GR40)

Material Indicators								
Sample Position (SV)		TP 1 - Layer 2	COLTO: Not Classified		TP 1 - Layer 3	COLTO: G9 Subgrade		
Depth (mm)		140-800			800-1400			
Sample No		71241			71242			
Materials Description	Source	In-Situ			In-Situ			
	Colour	Dark Brown			Light Yellow			
	Soil Type	Silty Sand			Sandy Silt			
	Classification	Existing			Existing			
Max. Stone size in hole (mm)				Opinion			Opinion	
Percentage Passing	75.0mm	100			100			
	63.0mm	100			100			
	50.0mm	100			100			
	37.5mm	100			100			
	28.0mm	100			100			
	20.0mm	100			100			
	14.0mm	100			98			
	5.00mm	100			92			
	2.00mm	100			89			
	0.425mm	98			85			
	0.075mm	56.6			49.1			
Soil Mortar & Constants								
Grading Modulus		0.46			0.76	0.75 - 2.70	✓	
Coarse Sand (%)		1			4			
Fine Sand (%)		42			41			
Silt & Clay (%)		57			55			
Liquid Limit (%)		SP			NP			
Plasticity Index (%)		SP			NP	≤ 12	✓	
Linear Shrinkage (%)		0.5			0.0			
CBR / Density Relationship								
MOD	Max Dry Density (kg/m^3)	1883			1961			
	Opt Moisture Content (%)	10.3			6.0			
	Mould Moisture Con. (%)	10.0			6.2			
	@100% Mod AASHTO	100.0			100.0			
	Swell (%)	0.54			0.00	≤ 1.5	✓	
Proc NRB	100% NRB	96.0			95.8			
	Swell (%)	0.61			0.00			
Proc	100% Proctor	91.9			91.2			
	Swell (%)	0.75			0.00			
CBR	@ 100% Mod AASHTO	12			47			
	@ 98% Mod AASHTO	11			30			
	@ 95% Mod AASHTO	10			15			
	@ 93% Mod AASHTO	9			9	≥ 7	✳	
	@ 90% Mod AASHTO	9			5			
Insitu Moisture Content (%)		6.0			3.7			
Soil Classification Achieved By The Material								
COLTO:		Not Classified			G9 Subgrade			
AASTHO System		A-4			A-4			
Unified System		MH			SM			

71241





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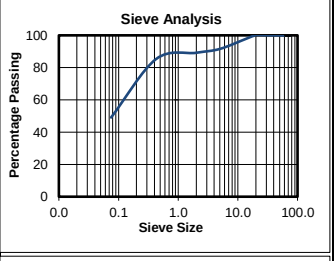
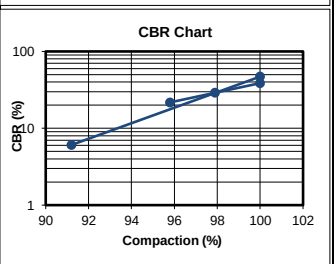
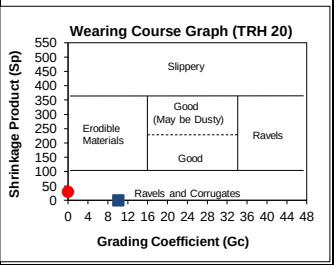




● 71241 ■ 71242



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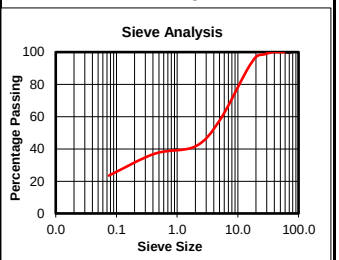
	65 York Street	Date Received :	14/06/18
	George	Date Reported :	26/06/18
	6530	Req. Number :	2024/18
Attention :	Garvin Coetzee	No. of Pages :	4/8

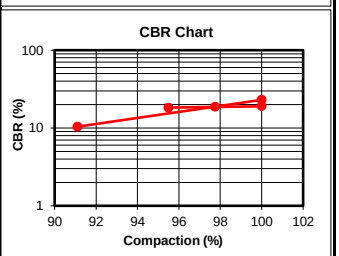
TEST REPORT

CALIFORNIA BEARING RATIO - (SANS 3001 Method GR1,GR5,GR10,GR20,GR30,GR40)

Material Indicators							
Sample Position (SV)		TP 2 - Layer 4	COLTO: G8 SSG		TP 2 - Layer 5	COLTO: Not Classified	
Depth (mm)		1200-1400			1400-1700		
Sample No		71246			71247		
Materials Description	Source	In-Situ			In-Situ		
	Colour	Light Reddish Yellow			Light Reddish Orange		
	Soil Type	Silty Sand with Ferricrete			Clay with Ferricrete		
	Classification	Existing			Existing		
Max. Stone size in hole (mm)				Opinion			Opinion
Percentage Passing	75.0mm	100			100		
	63.0mm	100			100		
	50.0mm	100			100		
	37.5mm	100			100		
	28.0mm	99			100		
	20.0mm	97			98		
	14.0mm	89			96		
	5.00mm	58			69		
	2.00mm	42			43		
	0.425mm	37			33		
	0.075mm	23.5			19.7		
Soil Mortar & Constants							
Grading Modulus		1.98	0.75 - 2.70	✓	2.04		
Coarse Sand (%)		11			23		
Fine Sand (%)		33			32		
Silt & Clay (%)		57			46		
Liquid Limit (%)		NP			23		
Plasticity Index (%)		NP	≤ 12	✓	6		
Linear Shrinkage (%)		0.0			3.0		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	2430			2385		
	Opt Moisture Content (%)	6.8			8.6		
	Mould Moisture Con. (%)	7.0			8.9		
	@100% Mod AASHTO	100.0			100.0		
	Swell (%)	0.00	≤ 1.5	✓	0.00		
Proc NRB	100% NRB	95.5			95.1		
	Swell (%)	0.00			0.00		
	100% Proctor	91.1			92.1		
	Swell (%)	0.00			0.00		
CBR	@ 100% Mod AASHTO	23			4		
	@ 98% Mod AASHTO	19			3		
	@ 95% Mod AASHTO	15			2		
	@ 93% Mod AASHTO	12	≥ 10	✳	2		
	@ 90% Mod AASHTO	9			1		
Insitu Moisture Content (%)		3.7			4.0		
Soil Classification Achieved By The Material							
COLTO:		G8 SSG			Not Classified		
AASTHO System		A-1-b / A-2-4			A-1-b / A-2-4		
Unified System		GM			GM-GC		

71246





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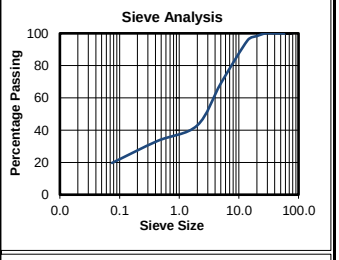

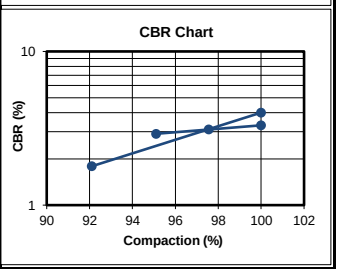

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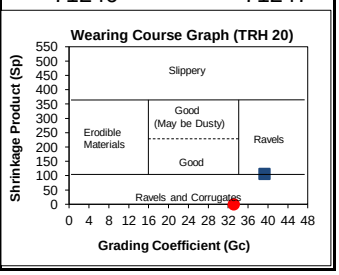

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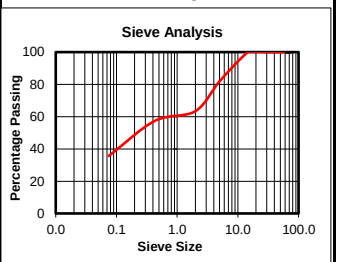
Attention :	Garvin Coetzee	No. of Pages :	6/8

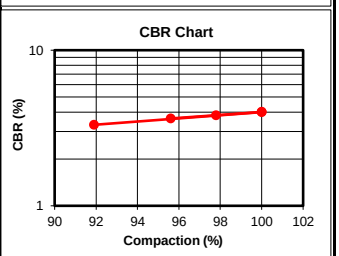
TEST REPORT

CALIFORNIA BEARING RATIO - (SANS 3001 Method GR1,GR5,GR10,GR20,GR30,GR40)

Material Indicators							
Sample Position (SV)		TP 3 - Layer 4	COLTO: Not Classified		TP 3 - Layer 5	COLTO: Not Classified	
Depth (mm)		1100-1500			1500-2000		
Sample No		71249			71250		
Materials Description	Source	In-Situ			In-Situ		
	Colour	Dark Reddish Orange			Dark Red		
	Soil Type	Silty Clay with Ferricrete			Clay		
	Classification	Existing			Existing		
Max. Stone size in hole (mm)				Opinion			Opinion
Percentage Passing	75.0mm	100			100		
	63.0mm	100			100		
	50.0mm	100			100		
	37.5mm	100			100		
	28.0mm	100			99		
	20.0mm	100			99		
	14.0mm	99			98		
	5.00mm	82			93		
	2.00mm	63			89		
	0.425mm	57			85		
	0.075mm	35.7			58.9		
Soil Mortar & Constants							
Grading Modulus		1.44			0.67		
Coarse Sand (%)		10			5		
Fine Sand (%)		34			29		
Silt & Clay (%)		56			66		
Liquid Limit (%)		21			28		
Plasticity Index (%)		9			14		
Linear Shrinkage (%)		5.0			7.0		
CBR / Density Relationship							
MOD	Max Dry Density (kg/m^3)	2322			1940		
	Opt Moisture Content (%)	7.0			12.4		
	Mould Moisture Con. (%)	7.2			12.1		
	@100% Mod AASHTO	100.0			100.0		
	Swell (%)	0.08			1.02		
Proc NRB	100% NRB	95.6			95.6		
	Swell (%)	0.15			1.28		
	100% Proctor	91.9			92.4		
	Swell (%)	0.21			2.04		
CBR	@ 100% Mod AASHTO	4			4		
	@ 98% Mod AASHTO	4			3		
	@ 95% Mod AASHTO	4			1		
	@ 93% Mod AASHTO	3			1		
	@ 90% Mod AASHTO	3			0		
Insitu Moisture Content (%)		6.5			12.2		
Soil Classification Achieved By The Material							
COLTO:		Not Classified			Not Classified		
AASTHO System		A-4			A-6		
Unified System		GC			CL		

71249





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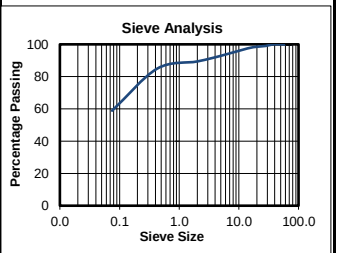
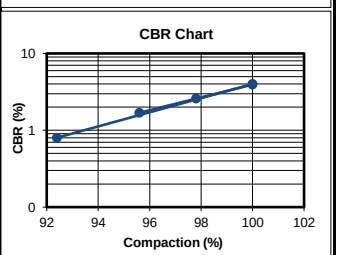
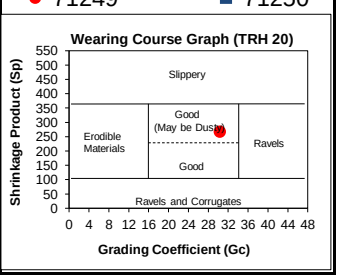




● 71249 ■ 71250



- **Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 or MC1.**
- **Specimens sampled by Waldo McClune**
- **The weather conditions were such that there was no detrimental effect on the sample/s taken.**

Llewelyn Heathcote
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

Materials Testing Laboratory

6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

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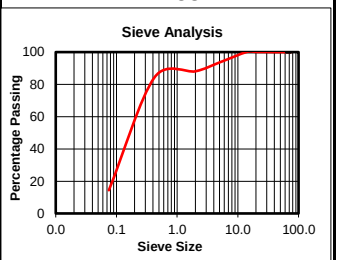
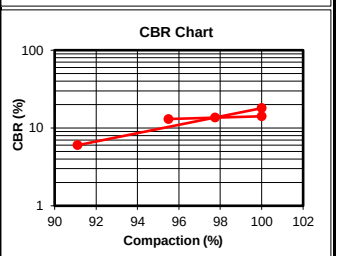
Customer :	Aurecon	Project :	Erf 21028 & Erf 21029 - Village Ridge Estate - George
	65 York Street	Date Received :	14/06/18
	George	Date Reported :	26/06/18
	6530	Req. Number :	2024/18
Attention :	Garvin Coetzee	No. of Pages :	8/8

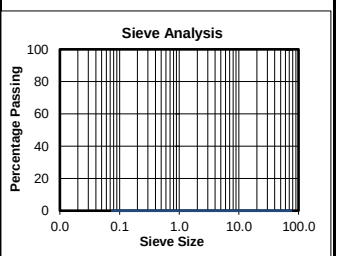
TEST REPORT

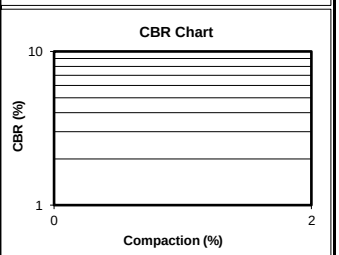
CALIFORNIA BEARING RATIO - (SANS 3001 Method GR1,GR5,GR10,GR20,GR30,GR40)

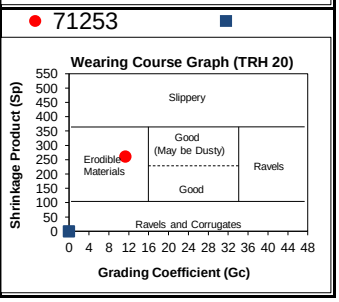
Material Indicators								71253
Sample Position (SV)		TP 4 - Layer 5	COLTO:					
Depth (mm)		1200-2000	G9					
Sample No		71253	Subgrade					
Materials Description	Source	In-Situ						
	Colour	Dark Reddish Orange						
	Soil Type	Clay						
	Classification	Existing						
Max. Stone size in hole (mm)				Opinion				
Percentage Passing	75.0mm	100						
	63.0mm	100						
	50.0mm	100						
	37.5mm	100						
	28.0mm	100						
	20.0mm	100						
	14.0mm	100						
	5.00mm	94						
	2.00mm	88						
	0.425mm	84						
	0.075mm	14.4						
Soil Mortar & Constants								
Grading Modulus		1.13	0.75 - 2.70	✓				
Coarse Sand (%)		4						
Fine Sand (%)		80						
Silt & Clay (%)		16						
Liquid Limit (%)		19						
Plasticity Index (%)		6	≤ 12	✓				
Linear Shrinkage (%)		3.0						
CBR / Density Relationship								
MOD	Max Dry Density (kg/m^3)	2042						
	Opt Moisture Content (%)	10.2						
	Mould Moisture Con. (%)	10.2						
	@100% Mod AASHTO	100.0						
	Swell (%)	0.31	≤ 1.5	✓				
Proc NRB	100% NRB	95.5						
	Swell (%)	0.59						
Proc	100% Proctor	91.1						
	Swell (%)	0.69						
CBR	@ 100% Mod AASHTO	18						
	@ 98% Mod AASHTO	14						
	@ 95% Mod AASHTO	10						
	@ 93% Mod AASHTO	8	≥ 7	✳				
	@ 90% Mod AASHTO	5						
Insitu Moisture Content (%)		7.4						
Soil Classification Achieved By The Material								
COLTO:		G9 Subgrade						
AASTHO System		A-2-4						
Unified System		SM-SC						











- **Specimens sampled by Outeniqua Lab according to sampling Plan TMH 5 Methods MB1 or MC1.**
- **Specimens sampled by Waldo McClune**
- **The weather conditions were such that there was no detrimental effect on the sample/s taken.**

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Appendix 4

DCP test data

Outeniqua Lab (Pty) Ltd.

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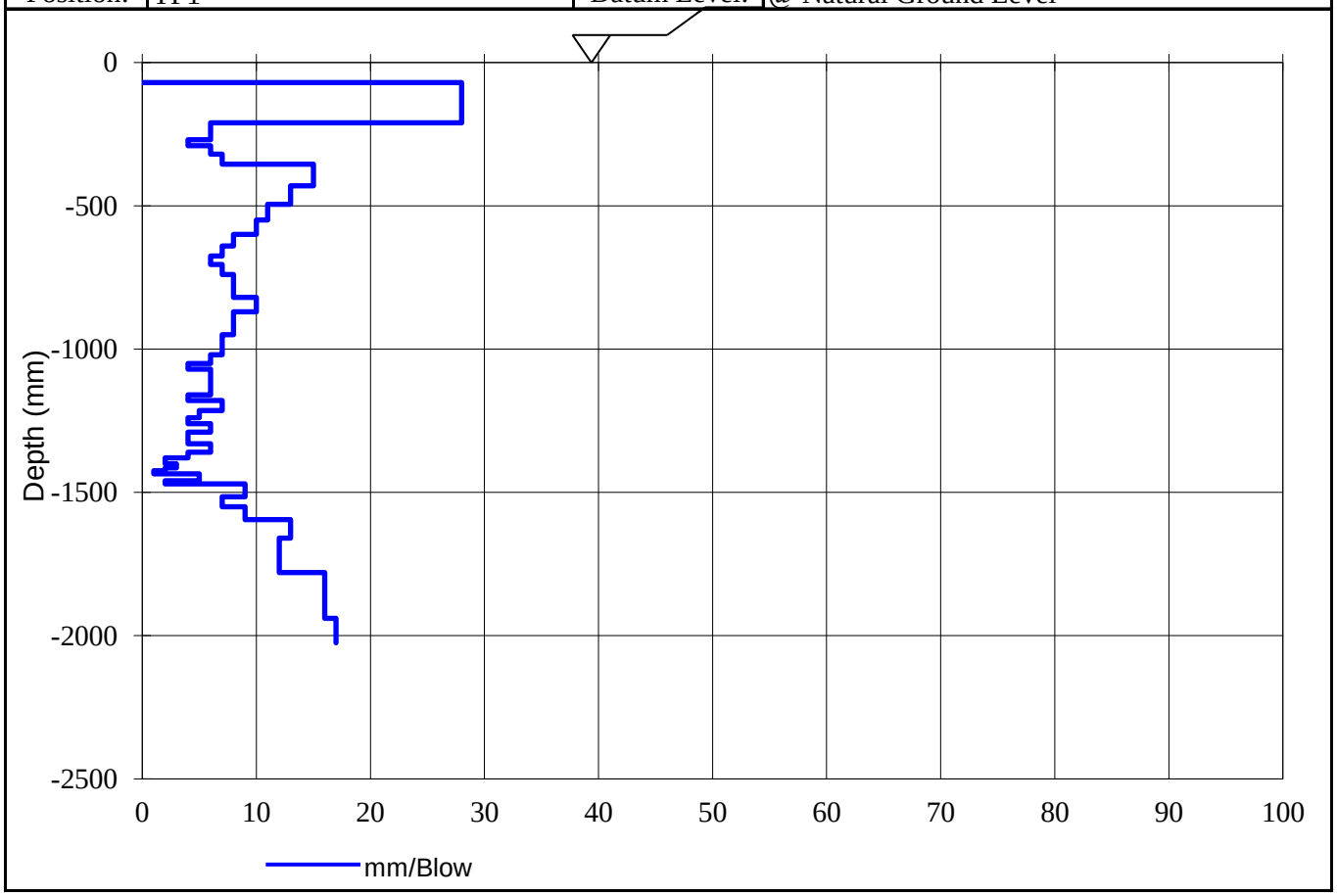
		Date Received :	14/06/18
		Date Reported :	15/06/18
		Req. Number :	2024/18
Attention :	Garvin Coetzee	No. of Pages :	1 of 4

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position: TP1 Datum Level: @ Natural Ground Level



Notes:

L Heathcote (Director)
For Outeniqua Lab (Pty) Ltd
Technical Signatory

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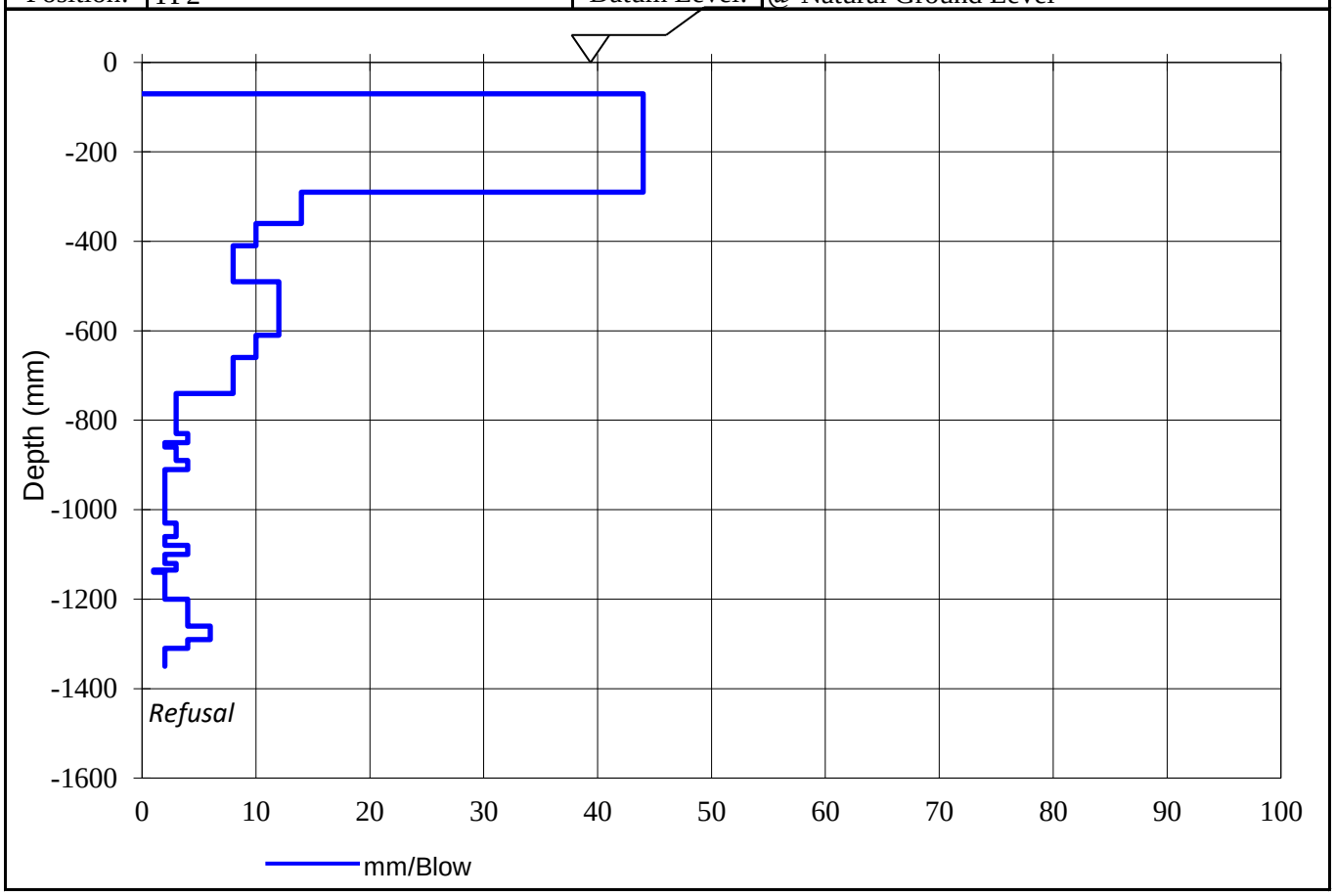
		Req. Number :	2024/18
Attention :	Garvin Coetzee	No. of Pages :	2 of 4

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TP2	Datum Level:	@ Natural Ground Level



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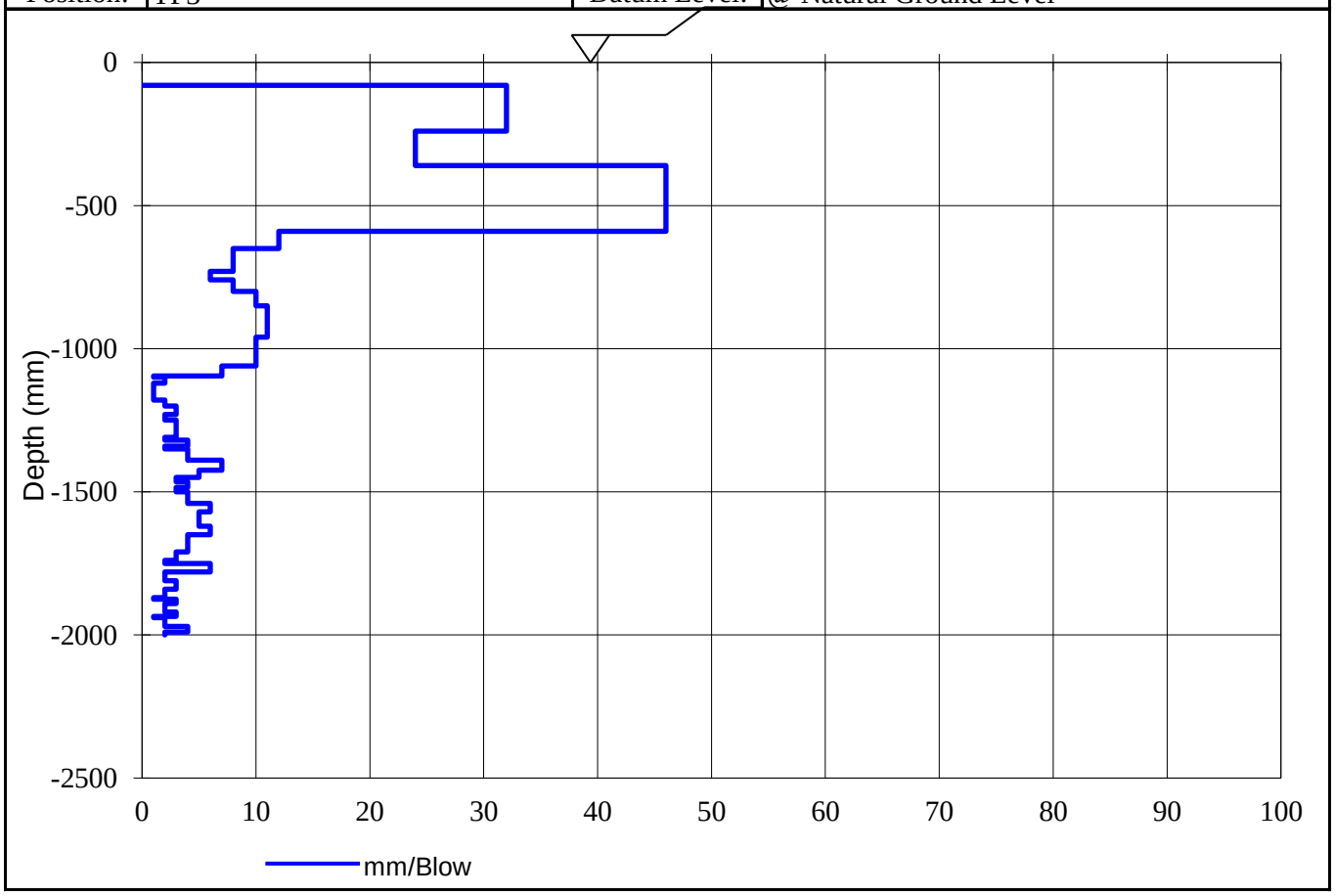
		Date Reported :	15/06/18
		Req. Number :	2024/18
Attention :	Garvin Coetzee	No. of Pages :	3 of 4

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TP3	Datum Level:	@ Natural Ground Level



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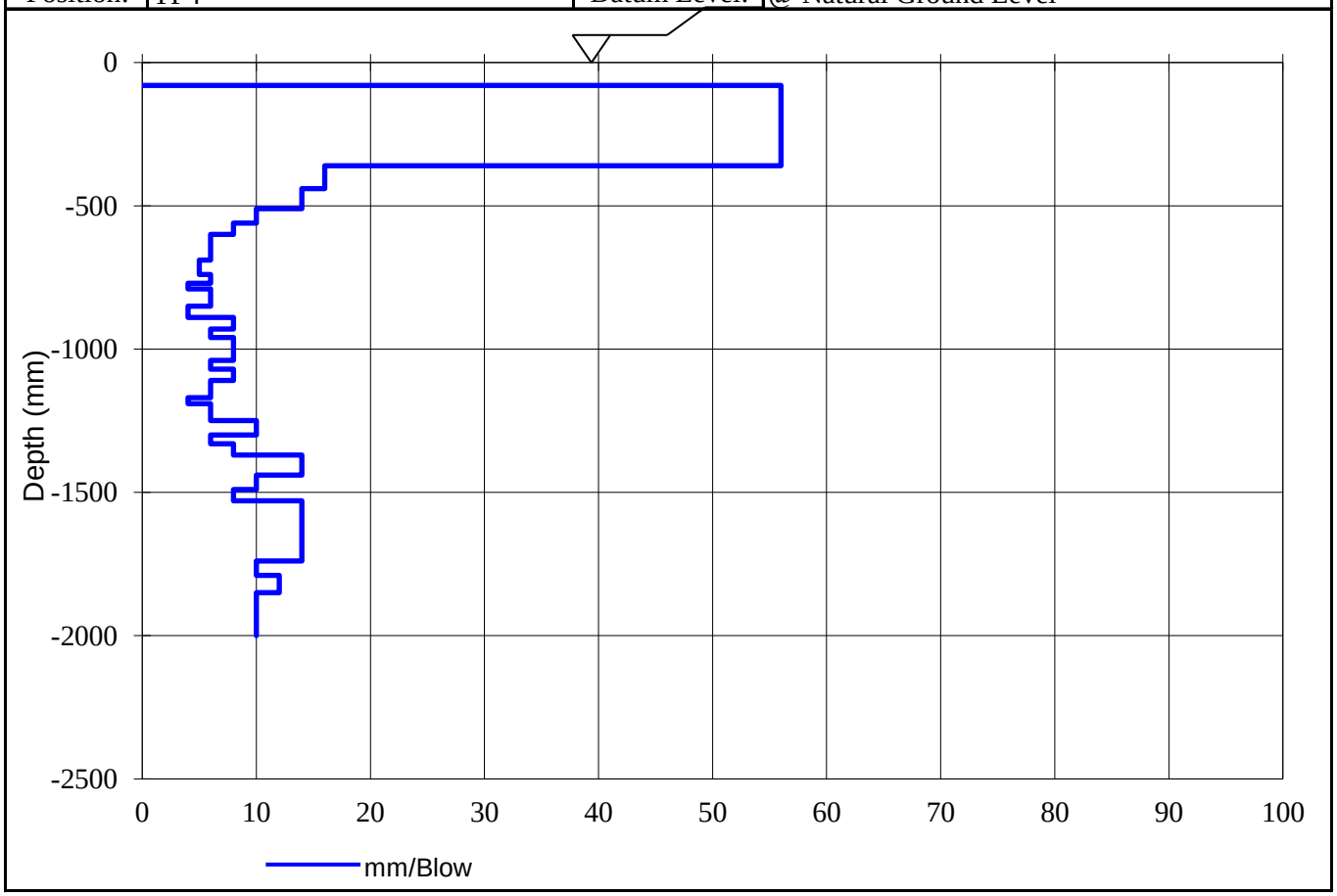
		Date Received :	14/06/18
		Date Reported :	15/06/18
		Req. Number :	2024/18
Attention :	Garvin Coetzee	No. of Pages :	4 of 4

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position: TP4 | Datum Level: @ Natural Ground Level



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