CORE GEOTECHNICAL CONSULTANTS

27 May 2021

Arc Timbers cc
17 Steenbras Street
Athlone Industria 2

ATTENTION: MR R COLEMIM

Dear Rory

PROJECT NO 043-21 WETTON: 5 BLOEMHOF ROAD ERF511- GEOTECHNICAL INVESTIGATION

1. Introduction

1.1 Terms of reference

Core Geotechnical Consultants (Pty) Ltd was appointed by Rory Colemim of Arc Timbers cc to undertake a geotechnical investigation for a proposed new residential development to be constructed on erf511 Wetton.

1.2 Objectives and methodology

A geotechnical investigation is required to assess the current ground conditions to aid in the design and construction of double-storey houses, access roads, and parking areas.

The objectives of this investigation can be summarised as follows:

- Determine ground conditions and note the presence of material incompatible with the development.
- Sample material for laboratory testing and classify material to determine suitability for use in construction.
- Assess excavation conditions and comment on potential difficulties in this regard and determine and comment on the level of the groundwater table.
- Provide recommendations for foundation and surface bed design of houses as well as recommendations for access roads and parking areas.

The methodology can be summarised as follows:

- A site walkover together with review of existing geotechnical and geological information.
- Formal profiling of one test pit (limited due to site conditions) excavated with a JCB digger loader (TLB), and sampling of material for laboratory testing and classifying material to determine suitability for use in construction.
- Conducting of a DCP (dynamic cone penetrometer) test at surface to assess and determine the density of in-situ soils.

1.3 Proposed development

Email correspondence with the client and layout plans provided, indicate that the development will comprise 19 or 20 double-storey duplex houses. In addition, a new access road as well as parking areas will need to be constructed. It is assumed that no major excavations will be required.

1.4 Scope of limitations of assessment

The field investigation was conducted on 19 May 2021. The site has no formal access, as the access road, Bloemhof Road, has not been constructed yet and is presently only a servitude. Initially, Core Geotechnical Consultants tried to access the site from the south-east using Thristle Close. This proved very difficult as the area was completely waterlogged and the digger-loader could not reach the site. On a second attempt the site was reached via Bloemhof Road from the west. However, the digger-loader only managed to excavate one test pit on the south western corner of the site due to waterlogged conditions encountered. After several attempts it was established that the digger loader would not be able to reach the northern and eastern parts of the site due to extremely wet and muddy conditions. Establishment on the rest of the site will either need to occur during drier summer months or a tracked excavator could be used instead.

The client representative, Mr Rory Colemim, was present on site and was informed about the limitations of the digger loader in the conditions on site. Subsequently it was decided to continue with the geotechnical report based on limited information, provided a secondary investigation takes place once clearing of the site has commenced. The geotechnical conditions have been determined from one digger-loader excavated test pit and one DCP test only. Varying conditions may thus occur which are different to those described in this report. This report has been prepared for the use of the client indicated. This report is furthermore limited to the scope described herein.

1.5 Codes of practice

This report has been set out according to applicable standards and the investigation was carried out according to SAICE and SAIEG recommendations with some limitations as described herein.

1.6 Information sources

The following information was used for the purpose of the field investigation and this geotechnical report.

- Email correspondence from the client and proposed layout plans.
- Geology map 3318 Cape Town – Council for Geoscience.
- Stormwater management plan 2019-09-18_SWMP_Erf_511_Wetton_REV_01_Final
- 2020-02-18_Addendum_to_freshwater_assessment_Erf_511_Wetton_2020

2. Site characterisation

2.1 Site location and description

The site is square shaped and is situated north of the Bloemhof Road servitude. As described earlier, the site has no formal access, as access roads leading to the site still need to be constructed. The site is undeveloped and covered in very thick reeds as well as alien Port-Jackson bushes. Informal housing structures are situated along the eastern boundary of the site. The site is furthermore very wet, with surface conditions being waterlogged. In addition, it appears that a lower lying stream traverses the site along the Bloemhof Road servitude from west to east. The location of the site is indicated in Figure 2.1.

2.2 Topography

With regards to topography, the site and general surrounding area is generally flat, approximately 15 - 20 m above mean sea level (masl).

2.3 Climate

The area has a mean annual rainfall of approximately 917 mm with majority of precipitation during winter months (June – August). Average maximum temperatures range from 25° in summer (December – March) to 16° in winter (June-August). Weathering is determined by climate. Climate will also determine the rate of weathering and the ultimate effect it has on the formation and deformation of soils and rock. The climatic N-value defined by Weinert (1980) provides a scale to which weathering processes can be characterised.

According to Weinert, physical weathering (disintegration) will predominate in areas where the N-value is larger than 5 and chemical weathering (decomposition) will predominate in areas where the N-values are less than 5. The general area has a Weinert N-value of 1,6 indicating mainly decomposition.

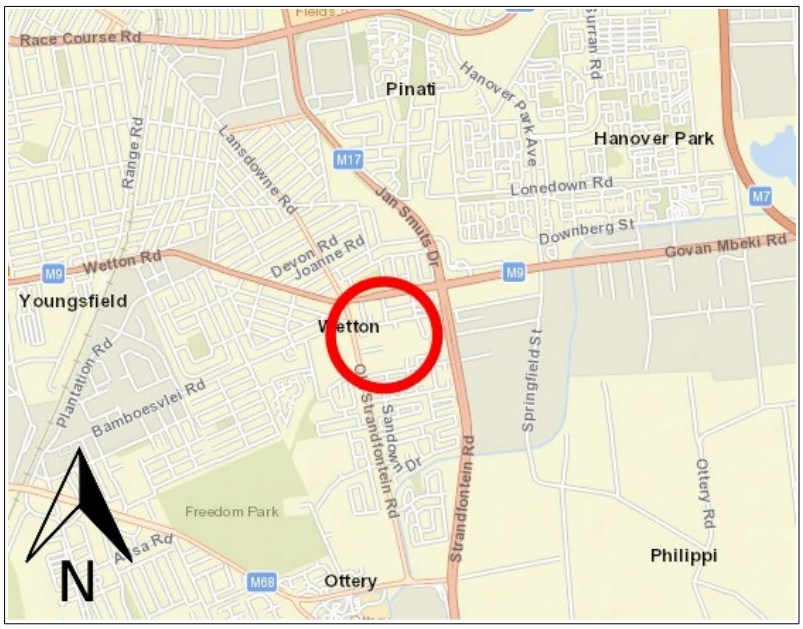


Figure 2.1: Location of the site indicated in red

2.4 Neighbouring structure behaviour

Neighbouring structures all appear to be in good condition structurally. However, hairline cracks and general poor maintenance of some surrounding structures are apparent.

2.5 Geology

The site is underlain by transported sands of colluvial origin of the Springfontein Formation (Qs). Pedogenic calcrete is also typical of the area, forming in inconsistent lenses. With increasing depth, residual shale soils and rock of the Malmesbury Group are know to underlie the pedogenic and transported soils.

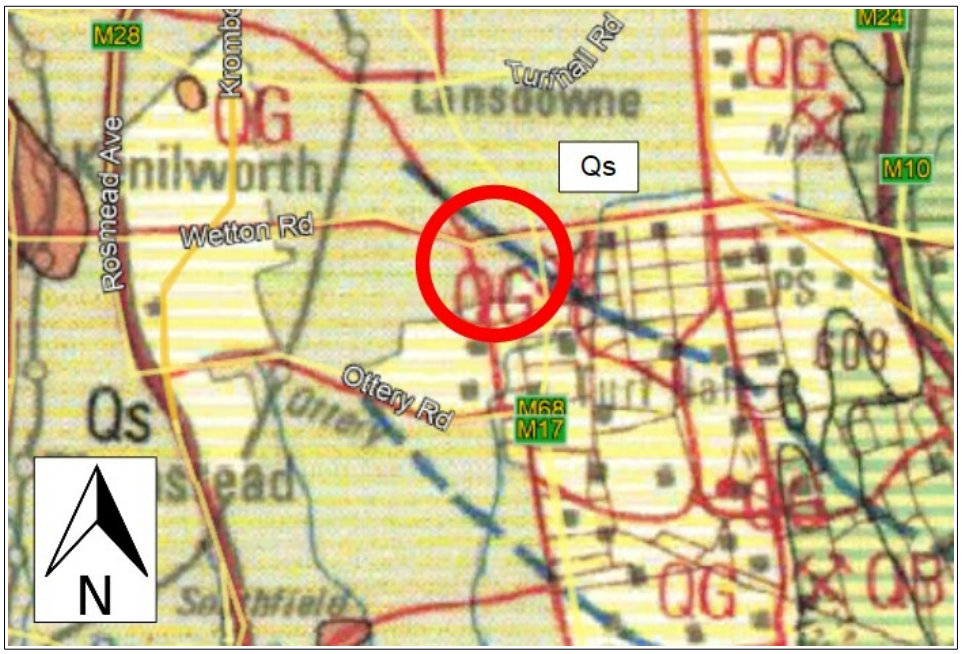


Figure 2.2: Regional geology (Map – Cape Town 3318 Council for Geoscience)

2.6 Seismicity

There is a small seismic risk in the area and structures will need to be designed to accommodate this, mainly because municipal and national regulations require design to cater for seismic loading. Essentially this code calls for designing for a peak ground acceleration of 0,15 g (10% probability of not being exceeded in 50 years). Taken from SANS 10160-4:2017 (SANS, 2017).

3. Investigation methodology

3.1 Overview

- A site walkover along with review of existing geotechnical and geological information.
- Profiling of one test pits excavated using a JCB digger-loader
- Sampling material for laboratory testing and classifying material to determine suitability for use in construction.
- Conducting of one DCP test at surface to assess and determine the density of in-situ soils.
- The test position on site are indicated in Figure 3.1, and Figure 3.2 and 3.3 features current site conditions.

Figure 3.1: Test positions

3.2 Soil profile and summary of stratigraphy

Soils encountered in the test pit is briefly summarised in Table 3.1 and is described in further detail in the attached soil profile.

From surface a fill layer with no waste is present. The fill comprises fine sandy clayey silt and extends to a depth of approximately 0,80 m below ground level (bgl). A clayey sandy fill layer underlie the surface fill, extending to a depth of approximately 1,30 m. This layer comprises fine to medium grained sand and clayey sand with isolated amounts of builders waste.

Medium grained sands and clayey sands, likely that of transported origin, underlie the fill layers and extend to a depth in excess of 2,30 m bgl.

The typical soil profile, as encountered in TP1, is indicated in Figure 3.4.

Figure 3.2: Present site conditions south-eastern portion

Figure 3.3: Present site conditions south-western portion

3.3 Laboratory testing

The following laboratory tests were conducted at Control Geosciences (PTY) Ltd in order to determine basic soils engineering properties and suitability of material for use in construction. Results are summarised in Table 3.2.

- Laboratory grading
- Atterberg Limits

Laboratory test results indicate that the fine grained fill soils at surface are moderately plastic and will not be suitable for use in construction.

With increasing depth medium grained transported sands are encountered. These sands are expected to exhibit moderate to good compaction characteristics and will be suitable for use in construction, if dry.

Transported sands that are above optimum moisture content may need to be stabilised with cement in order to improve workability and final CBR strength. Soils are not active or problematic with regards to heave.

Table 3.1 Soil profile summary

Test Pit	1
Groundwater encountered	Ponding at surface and strong flow at 1,9m
Final test pit depth (m)	2,30m
Sidewall stability	Collapsed completely
Light grey clayey sands and gravelly clayey sands - Fill	0,0 – 0,80
Dark grey clayey sands with some builders waste – Fill	0,80 – 1,30
Dark grey and brown clayey sand – Likely colluvium	1,30 – 2,30

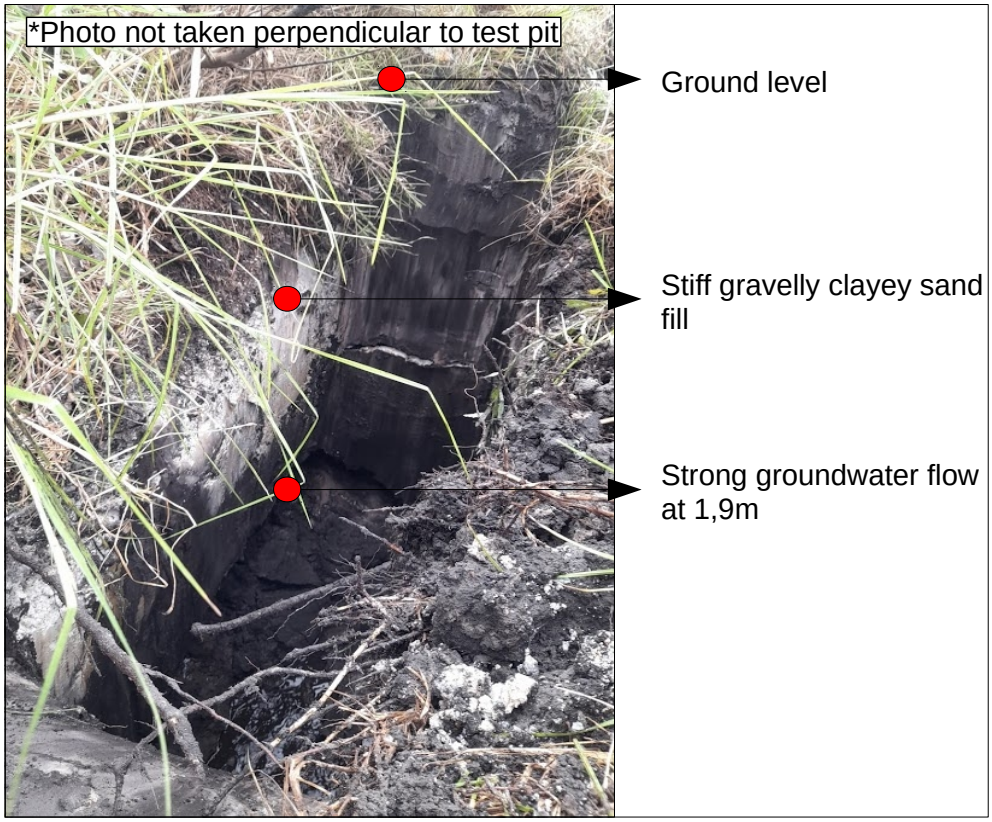


Figure 3.4: Soil profile TP1

Table 3.2 Summarised soils engineering properties

Depth of Sample (m)	0,50	1,50
Soil Description	Clayey silty sand	Clayey sand
USCS Soil Class	ML / CL	SW / SP
Liquid Limit	30	-
Plastic Index	10	Non-plastic
Linear Shrinkage	5,0	-
Moisture content %	26,6	44,5
Grading Modulus	0,62	0,99

3.4 Dynamic Cone Penetrometer (DCP) testing

One DCP test was carried out adjacent to the test pit. The purpose of the DCP test is to determine the consistency of soils with depth. Results are plotted graphically in Figure 3.5 (as penetration rate mm/blow, with depth). Results indicate that soils can generally be classified as medium dense to a depth of at least 1,90 m bgl. For reference, in cohesionless soils a loose consistency is considered when achieving a penetration rate of more than 30 mm/blow, medium dense is 20mm/blow and dense is 10mm/blow. It is important to note that only one DCP test was carried out, and consistency of soils across the site may vary.

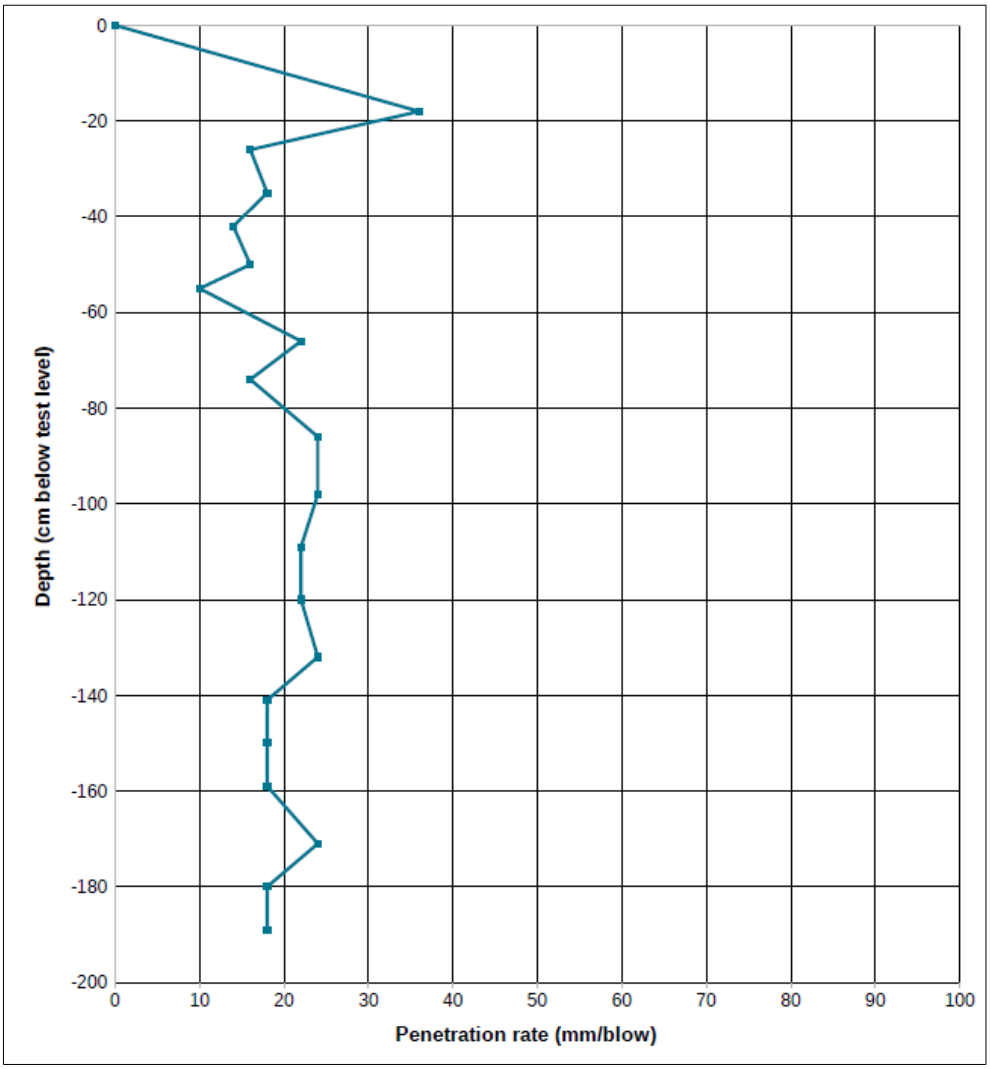


Figure 3.5: Summary of DCP results

4. Geotechnical investigation

4.1 Overview

With reference to the soil profile summary (Table 3.1), laboratory test results (Table 3.2), and the DCP test results (Figure 3.5), the following geotechnical aspects of the site are pertinent to the planned structure:

a) Fill material presently at surface is variable with regards to consistency and composition. These soils will not be suitable for use below load-bearing foundations and floors. Any fill material containing rubble or waste materials, if encountered, is unsuitable for use in construction or for founding purposes.

b) Transported sands are generally medium dense and slightly variable with regards to consistency. These soils can be described as moderately compressible and will be suitable for load-bearing structures provided bearing pressures are suitably limited. Strip foundations should still be strengthened with steel reinforcement in order to span potential soft spots that may be present.

c) Limited to the inspection of one test pit, the site has a NHBRC site class classification of **P(fill)/S**.

4.2 Recommendations for foundations

The following foundation recommendations can be considered and are summarised in Table 4.1. Founding recommendations must be reassessed following a secondary site inspection. A secondary site inspection will also allow for other foundation recommendations to be made, once additional information regarding site conditions are known.

Currently, these options are:

1. Strip foundations in in-situ sands
2. Strip foundation in recompacted soil mattress
3. Reinforced concrete raft founded at surface

Table 4.1 Summary of proposed founding solutions

Founding option	Founding depth and footing size (m)	Proposed bearing capacity (kPa)	Expected settlement (mm)	Notes
Strip foundations in medium dense sands	1,0-1,5m deep Depending on depth of fill, which should be confirmed during the Phase 2 investigation <0,8m wide	120	<10-20 and up to 50% differential settlement	Settlement is based on foundations founded through any uncontrolled fill and within the medium dense sands near surface. Trenches can be nominally compacted with a trench compactor, if dry, and cement (stabilisation) could be added to improve compaction.
Strip foundations in recompacted soil mattress	<0,50 deep <0,80m wide	120	<10 and up to 50% differential settlement	Excavate across the entire building footprint to 1,00-1,50m below final ground level, to get through any uncontrolled fill and stripping fill to spoil. Compact the base of the excavation, using cement stabilisation in wet conditions and to increase CBR were required. Import granular material of G7 quality and compact in layers up to founding level.
Reinforced concrete raft	At surface	50	Dependent on final pressure, compaction and raft stiffness.	From ground level, remove unsuitable fill, compact the underlying soils. Imported granular material and compact to final founding layer.

In addition to foundation options above, one should consider the marshy conditions. One will likely need to formalise and create extensive site drainage.

Another alternative would be to raise elevation levels across the site using engineered fill terraces. In this case one would either need to:

- Create the terrace (at least 1,00 m high) above the existing ground level using suitable quality and compacted material and then found using rafts, or;
- Remove and replace the fill with suitable material and then create terraces. One can then consider strip footings.

Allowable bearing pressures and spread foundations should be limited to those given in Table 4.1, due to limited information available on the deeper soil profile. Larger foundations could potentially be considered, but have a greater depth of influence and are not recommended without additional testing into the nature and compressibility of the deeper soil profile.

Foundations should be stiffened to accommodate potential soft spots and resulting differential movements.

Compaction can be done using a heavy vibrator roller and one should consider the effect of a roller on nearby properties. Any compaction for load-bearing foundations should be compacted to at least 95 % MOD AASHTO.

4.3 Subgrade conditions and material utilisation

The following points regarding subgrade conditions and material usage can be made:

- Clayey and silty fill material encountered at surface will not be suitable for use in construction at all. It is possible that this material is only encountered in a small area on-site and will need to be confirmed with additional field testing. This material will need to be stripped to spoil to make use of transported soils underlying it, and may require the importing of suitable quality granular material.
- The fine to medium grained transported sand and clayey sand is generally medium dense in-situ and is expected to achieve fair to good CBR when recompacted. Soils at various depths might be moist to wet and cement could be added to increase compaction.
- In areas where the fine clayey soils are not encountered at surface, it is expected that in-situ and undisturbed sands will be suitable for use below floors and as a fair to moderate quality subgrade for road and paving areas for light traffic. Cement can be added to increase recompaction strength, if required.
- For roads and parking areas, material for sub-base and base course will need to be imported. Allowance will also need to be made to remove unsuitable fine grained soils as well as fill and to import a suitable quality subgrade material.
- Extensive road drainage will be required unless elevation levels are raised.

4.4 Groundwater

Soils at surface across the site were very moist. This is likely due to recent rains and a moderately impermeable layer of fine grained soils at surface resulting in water to accumulate on surface. A strong flowing water table was observed at a depth of approximately 1,90 m bgl.

Apart from poor drainage conditions at surface, a localised perched groundwater table may develop within 1,00 m from the surface during wet periods and following periods of heavy rain. Damp-proofing measures for structures are thus suggested.

Water inflow into excavations is expected to be moderate to strong and should be manageable with sump pumps to some extent. The need for dewatering wells or other more sophisticated dewatering techniques is best assessed and determined during excavation.

The supplied stormwater management form indicates the use of permeable pavers. Permeable pavers will likely not be practical when considering the clayey soils encountered at surface, and impermeable pavers with good drainage is suggested. However, as indicated before, it is likely that this clayey layer is not encountered across the entire site and, thus, permeable pavers may be suitable in other areas. Additional test pits are required to confirm this. Extensive site surface and subsurface drainage will likely be required.

4.5 Excavation conditions

No particular excavation difficulties are anticipated within the fill and transported material. However, a digger-loader (TLB) has limited moveability due to the present waterlogged conditions on-site. Therefore, a tracked excavator is suggested. Excavations deeper than 1,50 m (but not in excess of 2,00 m deep) will need to be battered to at least 40° to the horizontal, for safety purposes.

Excavation to within at least 2,30 m bgl classifies as “soft excavation” in terms of the SANS 1200 D (COLTO 1998) Earthworks Specification. In practice, these materials can probably be excavated and worked using conventional earthmoving equipment. Excavation by hand is also relatively easy within 1,00 m bgl.

Furthermore, slumping may occur in wet areas or where the shallow water table is present. Excavations here will need to be battered to at least 30° to the horizontal. In addition, sandbagging may also be used to limit excessive slumping. This is best assessed on-site during construction.

4.6 Stability of trenches

Sidewall collapse was experienced, essentially due to wet conditions. Trenches are expected to be marginally stable up to 1,00 - 1,50 m deep during dry conditions.

It is likely that sidewall collapse will occur in excavations deeper than 1,00 - 1,50 m. Normal safety precautions should be taken in this regard, especially relating to personnel working in trench excavations deeper than 1,50 m or below the groundwater level. As mentioned above, excavations deeper than 1,50 m (but not in excess of 2,00 m deep) will need to be battered to at least 40° to the horizontal, for safety purposes.

4.7 Further works, recommendations, and conclusion

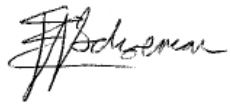
Information provided in this report is limited to the soil profile from one test pit, one DCP test, and laboratory test results.

Additional fieldwork, including test pits, DCPs and soil sampling will be required and can be carried out during clearing of the site.

A geotechnical specialist should inspect all trenches and foundation excavations to ensure that founding takes place below fill material and to ensure compatibility of founding soils with the foundation design.

We trust that this report meets your present requirements and would be pleased to discuss any aspects with you.

Kind regards



JURGENS SCHOEMAN EUGENE LAUBSCHER

Encl. Test pit soil profiles (1)
Laboratory results (2)
DCP test results (1)

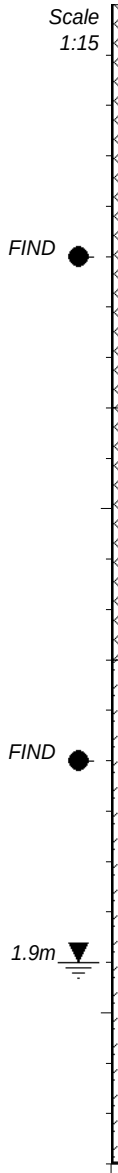
CORE GEOTECHNICAL CONSULTANTS

WETTON ERF511
5 BLOEMHOF AVENUE

TEST PIT SOIL PROFILES

HOLE No: TP01
Sheet 1 of 1

JOB NUMBER: 043-21



0.00 Wet light grey very soft intact gravelly clayey sand. Fill.

0.80 Wet dark grey medium dense intact clayey sand. Fill - contains some builders waste.

1.30 Wet dark grey and brown appears medium dense intact clayey sand. Transported (colluvium)?

2.30

NOTES

1) Strong flow from water table at 1.9m. Water at surface.
2) Sidewall collapse.
3) Refusal due to collapse.
4) FIND sample at 0.5m.
5) FIND sample at 1.5m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : Jurgens Schoeman
TYPE SET BY :
SETUP FILE : STANDARD.SET

LOCATION:
DIAM :
DATE :
DATE : 19 May 2021
DATE : 25/05/2021 08:53
TEXT : ..omhofRoadsoilprofile.txt

COLLAR LEVEL : Ground level
X COORD :
Y COORD :

HOLE No: TP01

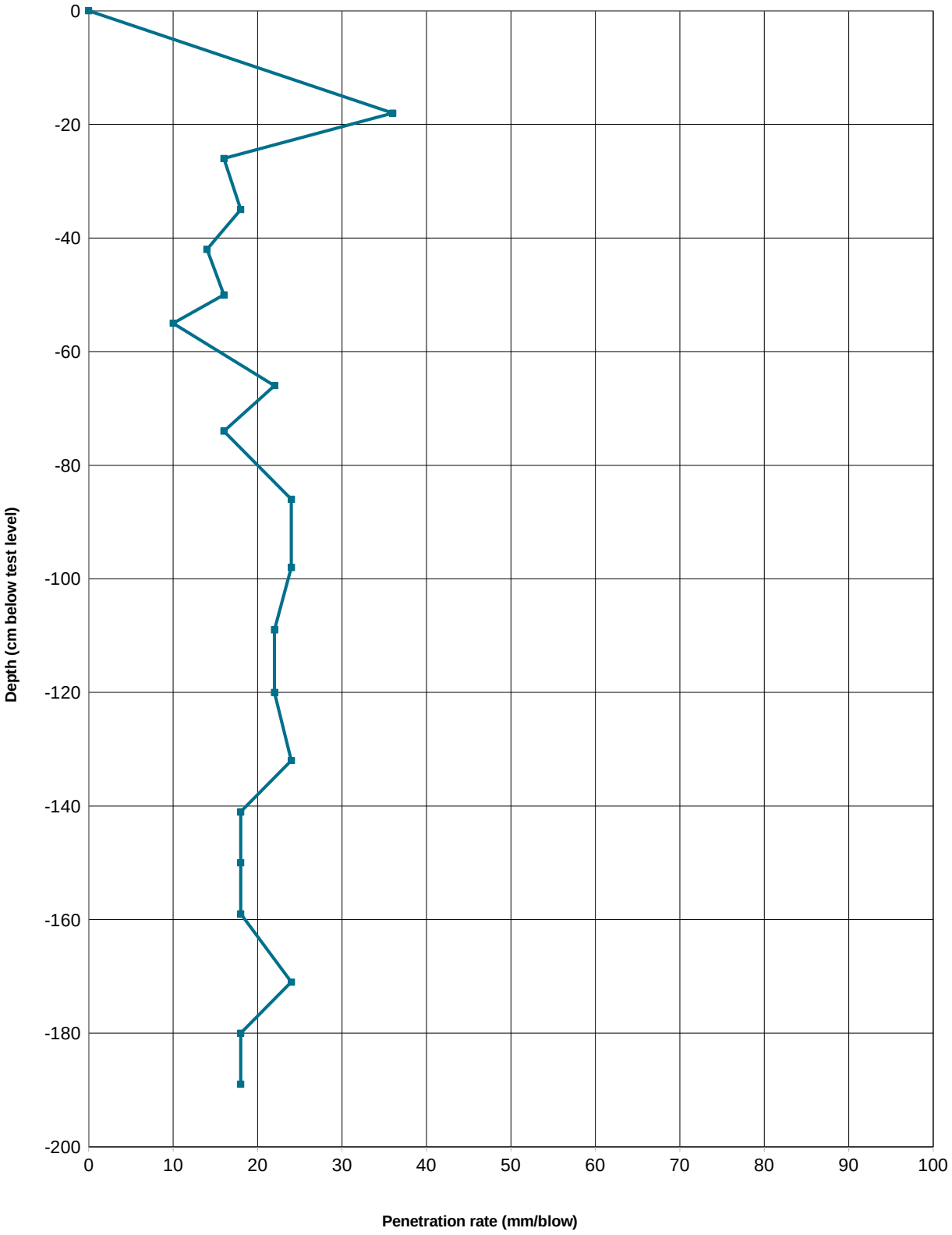
CORE GEOTECHNICAL CONSULTANTS

WETTON ERF511
5 BLOMHOF ROAD

JOB NO.: 043-21

DYNAMIC CONE PENETROMETER (DCP)

DCP NO: 1
LEVEL: GL



CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

A division of ControLab South Africa (Pty) Ltd – Accreditation Number: T0308

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OTHER CONTROLAB BRANCH OFFICES: East London, Johannesburg, Mthatha, Kokstad, Queenstown, Lusaka - Zambia

CLIENT: Core Geotechnical
4c Lancaster Mews
Lancaster Road
Kenilworth
7708

PROJECT: Wetton

DATE: 25-05-2021

REF: L210521

ASTM D422 SIEVE ANALYSIS

DESCRIPTION :	off-white sandy silt	**SAMPLE NO. :**	33595
POSITION :	TP 1 @ 0.5m	**CLIENT SAMPLE NO. :**	

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	
	13,20	
	9,50	
	6,70	
	4,75	100
	2,36	99
	2,00	98
	1,18	95
	0,600	88
	0,425	84
	0,300	75
	0,150	57
	0,0750	52

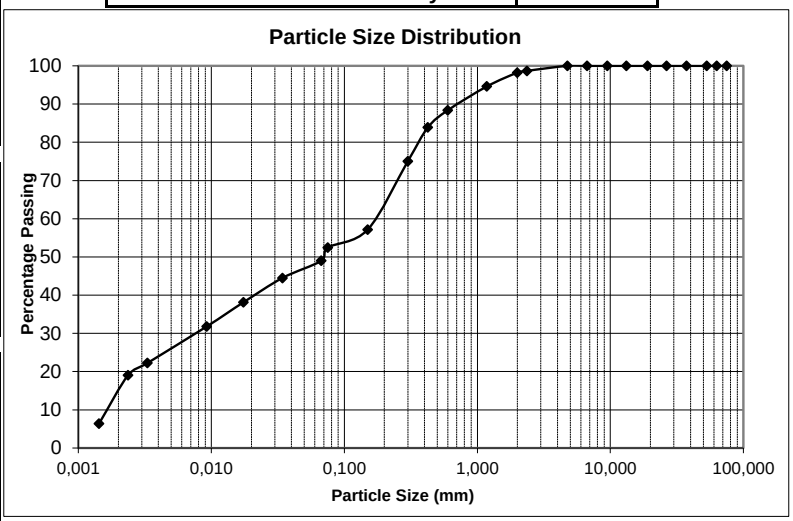
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0671	49
0,0343	45
0,0175	38
0,0092	32
0,0033	22
0,0024	19
0,0014	6

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	26,6
pH:	
Conductivity mS/m:	

Atterberg Limits (SANS3001-GR10)	
Liquid Limit	30
Plastic Index	10
Linear Shrinkage	5,0

MOD (SANS3001- GR30) & CBR (SANS3001-GR40)	
MOD AASHTO (Kg/m³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	0
Sand : Percentage - 4.75mm and + 0.075mm	48
Silt : Percentage - 0.075mm and + 0.005mm	31
Clay : Percentage - 0.005mm	21

The above test results are pertinent to the samples received and tested only. Technical Signatory: M Hofman

Remarks:

CONTROL GEOSCIENCES (PTY) LTD

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CLIENT: Core Geotechnical
4c Lancaster Mews
Lancaster Road
Kenilworth
7708

PROJECT: Wetton

DATE: 25-05-2021

REF: L210521

ASTM D422 SIEVE ANALYSIS

DESCRIPTION :	dark grey sand	**SAMPLE NO. :**	33596
POSITION :	TP 1 @ 1.5m	**CLIENT SAMPLE NO. :**	

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	
	13,20	
	9,50	
	6,70	
	4,75	
	2,36	
	2,00	
	1,18	100
	0,600	96
	0,425	89
	0,300	73
	0,150	32
	0,0750	12

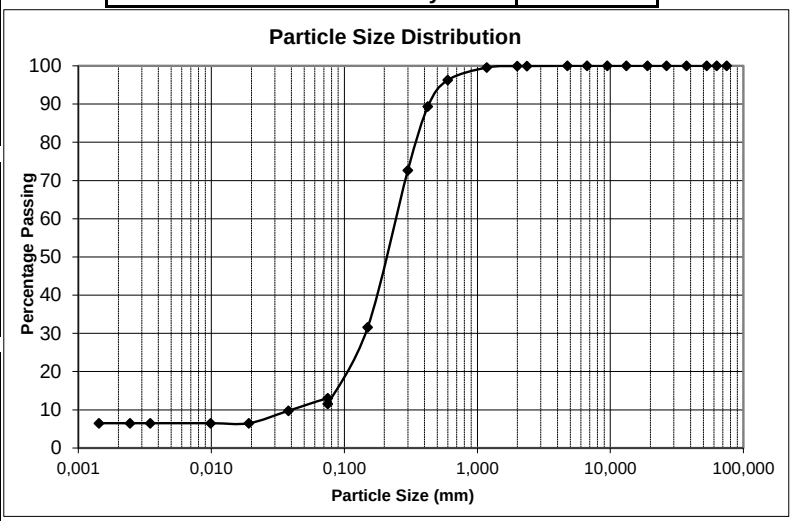
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0753	13
0,0380	10
0,0192	6
0,0099	6
0,0035	6
0,0025	6
0,0014	6

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	44,5
pH:	
Conductivity mS/m:	

Atterberg Limits (SANS3001-GR10)	
Liquid Limit	
Plastic Index	N-P
Linear Shrinkage	

MOD (SANS3001- GR30) & CBR (SANS3001-GR40)	
MOD AASHTO (Kg/m³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	0
Sand : Percentage - 4.75mm and + 0.075mm	88
Silt : Percentage - 0.075mm and + 0.005mm	6
Clay : Percentage - 0.005mm	6

Technical Signatory: M Hofman

Remarks: