CLANWILLIAM IRDP & UISP HOUSING PROJECT

REMAINDER OF ERF 279, CLANWILLIAM, WITHIN THE CEDERBERG MUNICIPAL AREA, WESTERN CAPE

ENGINEERING SERVICES REPORT

REVISION 01

SEPTEMBER 2024

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ENGINEERING SERVICES REPORT FOR THE PROPOSED CLANWILLIAM IRDP AND UISP HOUSING DEVELOPMENT, REMAINDER OF ERF 279, CLANWILLIAM, WITHIN THE CEDERBERG MUNICIPAL AREA

1. Background

UDS Africa was appointed by ASLA DEVCO (Pty) Ltd to compile a services report in support of the proposed IRDP and UISP Housing Development planned on the remainder of erf 279 in Clanwilliam. The site covers an area of 49.159 ha and is currently undeveloped. The site is zoned for agricultural use.

The purpose of this report is to address the requirements of Cederberg Municipality with regard to the provision of engineering services for the proposed development. The infrastructure design of the development is based on the technical requirements and guidelines as stated in the Guidelines for Human Settlements Planning and Design (Red Book: July 2019) and to the requirements and standards of Cederberg Municipality.

2. Locality

The site is located Clanwilliam, within the Cederberg Municipal area. The site is bordered to the north and east by existing residential developments; to the south and west by undeveloped land. Refer to **Annexure A** for a locality map. Below is a locality plan for reference (outlined in red, area highlighted in yellow).

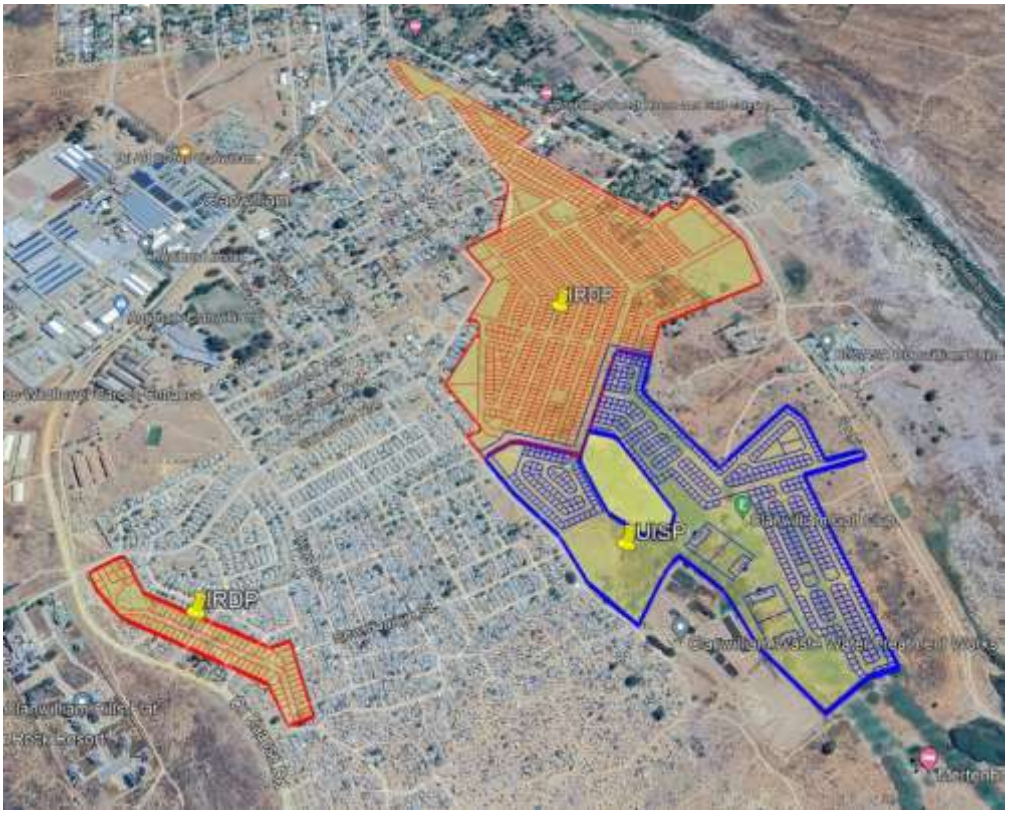


Figure 1: Locality map of erf 279

3. The development

The proposed development will be largely residential in nature, with community and business facilities. Please refer to **Annexure B** for a copy of the site development plan produced by C.K. Rumboll & Vennote. Below is a summary of the land uses to from part of the proposed development:

USE	UNITS
IRDP - Residential Zone 1 (±208m^2)	160
IRDP - Residential Zone 2 (±150m^2)	692
IRDP – Community Zone 2	7 379m^2
IRDP – Community Zone 1	27 588m^2
IRDP – Community Zone 3	739 m^2
IRDP – Business Zone 2	3 575m^2
UISP – Residential Zone 2 (±120m^2)	463
UISP – Community Zone 1	1 408m^2
UISP – Community Zone 2	1 382m^2
UISP – Business Zone 2	2 487m^2

Table 1: Summary of land uses

A capacity analysis was completed by GLS Consulting (Pty) Ltd for the proposed development in August 2024. A copy of the report can be found under **Annexure C**.

4. Water Demand

4.1 Water demand for proposed development

The water demand for the proposed development is calculated (in accordance with the Guidelines for Human Settlement Planning and Design) as follows:

WATER DEMAND						
DEVELOPMENT	**Units**	**GLA (m^2)**	**l/ unit/ day**	**kl/ha**	**TOTAL (l/d)**	**TOTAL (l/s)**
IRDP - Residential Zone 1 (±208m^2)	160		600		96 000	1.111
IRDP - Residential Zone 2 (±150m^2)	692		400		276 800	3.204
IRDP – Community Zone 2	7 379m^2			12.8	9 445.12	0.109
IRDP – Community Zone 1	12 471m^2			12.8	15 962.88	0.185
IRDP – Community Zone 1 (School)	15 117m^2			12.0	18 140.40	0.210
IRDP – Community Zone 3	739 m^2			12.8	945.92	0.011
IRDP – Business Zone 2	3 575m^2			20.8	7 436	0.086
UISP – Residential Zone 2 (±120m^2)	463		500		231 500	2.679
UISP – Community Zone 1	1 408m^2			12.8	1 802.24	0.021
UISP – Community Zone 2	1 382m^2			12.8	1 768.96	0.020
UISP – Business Zone 2	2 487m^2			20.8	5 172.96	0.060
TOTAL					**663 205.52**	**7.68**
Annual Average Daily Demand (AADD)	663 205.52 l/d 7.676 l/s					
Peak factor	4.00					
Peak demand	2 652 822 l/d 30.70 l/s					
Fire flow requirement	15 l/s @ 7m					

Table 2: Water demand calculation

The internal water reticulation network of the proposed development to comply with the minimum specifications as indicated in the “Red Book - Guidelines for Human Settlement Planning and Design” and the municipal standards from Cederberg Municipality. The construction of the services will be specified to be in accordance with SANS 1200.

4.2 Existing services

The proposed development can be divided into three areas based on their location:

- Area A – Consisting of 42 single residential erven (IRDP), 20 single residential erven (GAP)
- Area B – Consisting of 650 single residential erven (IRDP), 130 single residential erven (GAP), 1.51ha School land use, 3 575m^2 of Business land use & 18 563m^2 of community land use
- Area C – Consisting of 462 single residential erven (UISP), 2 487m^2 of Business land use & 2 790m^2 of Community land use

Below is a summary of the existing network, bulk supply, reservoir and water treatment plant capacity.

Network capacity

Cederville booster PS zone (Development area A)

The existing water reticulation pipes within the Cederville booster PS water distribution zone has sufficient capacity to accommodate the proposed development. The booster pumps of the Cederville booster PS are at capacity and should be upgraded (upgrade from current capacity of 12 L/s to future capacity of 30 L/s).

There are two existing 110 mm Ø pipes running through the proposed development area and it is proposed that these pipes are abandoned and replaced with a new internal pipe network for the development area.

Platdammetjies PRV zone (Northern portion of development area B)

The existing water reticulation system of the Platdammetjies PRV water distribution zone has sufficient capacity to accommodate the portion of development area B which falls within the Platdammetjies PRV water distribution zone.

An existing 160 mm Ø pipe runs through the proposed development area and it is proposed that this pipe is abandoned and replaced with a new internal 160 mm Ø pipe in Reservoir Street (link services item 4).

Cederville reservoir zone (development areas B & C)

The existing water reticulation system of the Cederville reservoir water distribution zone has insufficient capacity to accommodate the proposed development.

Reservoir capacity

The criteria for the total reservoir volume used in the Water Master Plan is 48 hours of the AADD (of the reservoir supply zone).

Development areas A, B & C will be accommodated within the reticulation networks of the Platdammetjies PRV, Cederville reservoir and Cederville booster PS water distribution zones. The Platdammetjies reservoir and Platdammetjies PRV water distribution zones are supplied with water from the Platdammetjie reservoirs (2x 640 kL reservoirs) and the Cederville reservoir and Cederville booster PS water distribution zones are supplied with water from the Cederville reservoir (1 000 kL reservoir).

The capacities of the existing reservoirs to accommodate the proposed development areas can be summarised as follows:

Platdammetjies reservoir

The 2x 640 kL Platdammetjie reservoirs (Top Water Level (TWL) of 159,2 metres above mean sea level m a.s.l.) and the 1 500 kL and 3 000 kL Grootmaat reservoirs (TWL of 179,4 m a.s.l.) are operated as a single reservoir system and supplies the Platdammetjies reservoir, Platdammetjies PRV, Grootmaat reservoir and Grootmaat booster water distribution zones. The total AADD of the areas supplied is 1 123 kL/d and the storage capacity of the system (total storage capacity of 5 780 kL) is 123,5 hours x AADD supplied.

There is therefore sufficient reservoir spare capacity available in the system to accommodate the small portion of development area B which falls within the Platdammetjies PRV water distribution zone.

Cederville reservoir

The 1,0 ML Cederville reservoir currently only has 22,3 hours of storage capacity and therefore has insufficient storage capacity available to accommodate the proposed development.

Bulk supply

The existing Grootmaat reservoirs in Clanwilliam (which supply bulk water to the Platdammetjies and Cederville reservoirs) are supplied with bulk water from the Jan Dissel reservoir (through the Jan Dissel PS and existing 200 mm diameter dedicated bulk pipeline) and from the Clanwilliam dam (through the Dam PS and existing 200 mm diameter dedicated bulk pipeline). The combined capacity of these bulk pumping stations and pipelines are insufficient to accommodate the existing peak water demand of Clanwilliam during the summer months.

In the water master plan for Clanwilliam it is proposed that bulk water supply to the Grootmaat reservoirs is augmented through the upgrading of the bulk system from the Clanwilliam dam to the Grootmaat reservoirs, as discussed in paragraph 1.4 further in the report.

Raw water abstracted from the Clanwilliam dam is currently dosed with chlorine gas before it is pumped to the Grootmaat reservoirs. Raw water abstracted from the Jan Dissels River is stored in the Jan Dissels reservoir where the raw water is dosed with chlorine gas before it pumped to the Grootmaat reservoirs.

In the water master plan a new Water Treatment Plant (WTP) is proposed for Clanwilliam at the Grootmaat reservoir site in order to treat raw water received from the Clanwilliam dam and Jan Dissels PS.

Below is a summary of the master plan items that will be required to accommodate the proposed development:

Network upgrade

- Item 1 – 190m x 200mm diameter; replace existing 160mm pipe
- Item 2 – 90m x 160m diameter; replace existing 75mm pipe
- Item 3 – 285m x 160mm diameter internal water pipes
- Item 4 – 550mm x 160mm diameter internal water pipes
- CCIW2.1 – 220m x 315mm new supply pipe
- CCIW2.2 – 320m x 315mm; replace existing 75mm pipe
- CCIW2.3 – 260m x 315mm; replace existing 75mm pipe
- CCIW2.6 – 190m x 110mm new supply pipe

Reservoir

- CClW.B1: 3 000 kL additional storage capacity for Cederville reservoir site
- CClW.B12: 90 m x 315 mm Ø New feeder pipe to Cederville no. 2 reservoir
- CClW.B16: 90 m x 315 mm Ø link pipe between Cederville no. 1 & 2 reservoirs
- CClW.B17: 5 m x 160 mm Ø inter-connection pipe between 2x bulk pipes

Bulk infrastructure upgrades

- CCIW.B2 – Upgrade capacity of the Cederville PS to 30 l/s
- CCIW.B8 – New bulk PS (Capacity of 95 l/s)
- CCIW.B9 – 950m x 355mm diameter bulk pipeline to Grootmaat Reservoir site

For the development of Area A items CCIW.B2, CCIW.B1, CClW.B12, CClW.B16 & CClW.B17 is required.

For the development of Area B items CCIW.B1, CClW.B12, CClW.B16, CClW.B17, CClW2.1, CClW2.2, CClW2.3, CClW2.6, item 2, item 3, item 4, CCIW2.10, CCIW.B8 & CCIW.B9 is required.

For the development of Area C items CCIW.B1, CCIW.B12, CCIW.B16, CCIW.B17, CCIW2.1, CCIW2.2, CCIW2.3, CCIW2.10, CCIW2.11, CCIW.B8 & CCIW.B9 is required. Master plan item 1 will be required before the full development of both development areas B & C has commenced.

5. Sewerage

5.1 Sewer demand for proposed development

The sewerage flow for the proposed development is calculated (in accordance with the Guidelines for Human Settlement Planning and Design) as follows:

SEWER FLOW	
Average Dry Weather Flow (ADWF) (70% of annual average daily water demand)	464 243.90 l/d (5.373 l/s)
Peak Factor	4.00
Peak Dry Weather Flow (PDWF)	21.49 l/s
Peak Wet Weather Flow (PWWF)	24.72 l/s

Table 3: Sewer demand calculation

The internal sewer reticulation network of the proposed development to comply with the minimum specification as given in the “Red Book - Guidelines for Human Settlement Planning and Design” and the municipal standards from Cederberg Municipality. Construction of the services will be specified to be in accordance with SANS 1200.

5.2 Existing services

Development area A falls within the existing Clanwilliam Gravity drainage area. Development areas B and C falls outside the existing sewer drainage areas of Clanwilliam and in the sewer master plan a new sewer drainage area (the so-called “Future Clanwilliam Pump Station (PS) Cl2 drainage area”) is proposed for these areas with a new PS at the lowest point of the larger drainage area, which pumps directly to the existing Clanwilliam Wastewater Treatment Plant (WWTP).

A few erven within development area B (erven to the far north-west of the development next to Viooltjie Street) however drains towards the existing Milner Street PS drainage area and should be accommodated within the network of the Milner Street PS drainage area.

The proposed connection points to the existing sewer system are as follows:

Area A

Connect to the existing sewer infrastructure on the development area.

Area B

The erven to the far north-west of the development area which drains towards the Milner Street PS drainage area should connect to the existing 150 mm diameter outfall sewers in Viooltjie and Milner Streets.

The rest of the development area should drain to the west through link services items CClS4.1 & CClS4.2 to the proposed new sewer PS (master plan item CClS4.4). From the PS sewage should be pumped directly to the Clanwilliam WWTP through master plan item CClS4.5.

Area C

The development area should drain to the north-west through link services items CClS4.2 & CClS4.3 to the proposed new sewer PS (master plan item CClS4.4). From the PS sewage should be pumped directly to the Clanwilliam WWTP through master plan item CClS4.5.

The existing Clanwilliam WWTP (with a treatment capacity of 2,4 ML/d) has insufficient spare capacity to accommodate the proposed development. The Cederberg Municipality is however in the process to upgrade the existing plant with an additional 1,5 ML/d to a capacity of 3,9 ML/d, which will be sufficient to accommodate the total development..

The following upgrades are required:

- CCIS6.1 – 380 m x 450 mm Ø Upgrade existing 150 mm Ø outfall sewer
- CCIS6.2 – 950 m x 200 mm Ø Upgrade existing 160 mm Ø outfall sewer
- CCIS6.3 – 475 m x 525 mm Ø Upgrade existing 150 mm Ø bulk sewer
- CCIS2.2 – 370 m x 200 mm Ø Upgrade existing 150 mm Ø outfall sewer
- CCIS2.3 – Upgrade capacity of Milner Street PS to 55 L/s
- CCIS2.4 – 780 m x 315 mm Ø Upgrade existing 200 mm Ø rising main
- CCIS4.1 – 260 m x 200 mm Ø New outfall sewer
- CCIS4.2 – 270 m x 250 mm Ø New outfall sewer
- CCIS4.3 – 350 m x 200 mm Ø New outfall sewer
- CCIS4.4 – New 20 L/s Future PS Cl2
- CCIS4.5 – 1 005 m x 160 mm Ø New rising main

For the development of Area A the following upgrades are required:

- Master plan items CCIS6.2 & CCIS6.3 to reinforce the capacity of the existing gravity system between the proposed development and the Clanwilliam WWTP.

For the development of Area B the following upgrades are required:

- Link services items CCIS4.1 & CCIS4.2 to connect the internal sewer network of the development area to future PS Cl2, and
- Future PS Cl2 (master plan item CCIS4.4) and rising main (master plan item CCIS4.5) to service the larger drainage area.
- A small portion of the development drains towards the existing Milner Street PS, which discharges into the Clanwilliam Gravity drainage areas. The bulk sewer downstream of the Milner Street PS is at capacity and should be upgraded (master plan items CCIS6.1 & CCIS6.3).
- The existing Milner Street PS drainage area has spare capacity to accommodate the erven within development area B which drains towards the Milner Street PS. In the sewer master plan for Clanwilliam upgrading of the Milner Street PS and accommodating rising main is however proposed (refer to master plan items CCIS2.3 & CCIS2.4), as well as upgrading of the main outfall sewer gravitating toward the Milner Street PS (refer to master plan item CCIS2.2). It can be considered to upgrade the PS, rising main and outfall sewer (master plan items CCIS2.2, CCIS2.3 & CCIS2.4) as part of the construction of the development as these items runs through the development area.

For the development of Area C the following upgrades are required:

- Link services items CCIS4.2 & CCIS4.3 to connect the internal sewer network of the development area to future PS Cl2, and
- Future PS Cl2 (master plan item CCIS4.4) and rising main (master plan item CCIS4.5) to service the larger drainage area.

6. Stormwater

The site has a gentle slope, draining from the west and south-west, towards the east and north-east at an average slope of 5.3%. A topographical survey of the site was completed by C.K. Rumboll & Vennote, refer to **Annexure D** for a copy of the site survey.

The catchment area is relatively small and the rational method is deemed to be a suitable method to calculate flood peaks (catchment area is smaller than 15km^2). For hydrological calculations a MAP of 237mm is recommended to be used as per the Design Rainfall Estimator in South Africa, version 3.

A Geotechnical Investigation was completed by Core Geotechnical Consultants. The investigation indicated the presence of intermediate and hard rock (deeper sandstone and very dense calcrete layers) excavations at various depths. This will have an impact on various construction activities w.r.t. trenches, earthworks and roadworks. Refer to **Annexure E** for the complete report.

An underground piped stormwater system will be provided to accommodate for the minor storm events (up to RI 1: 5 years). The major storm events will be accommodated within the street reserves. Stormwater run-off will be channeled to the existing Jan Dissels River flowing to the east of the proposed development.

7. Road Network

Access to the proposed development will be provided from the existing Bloekom Avenue, south of the proposed development, Denne and Buitekant Street to the west and from Oranje, Protea and Viooltjie Streets to the north. The internal roads will consist of surfaced streets.

A full traffic impact assessment was completed by UDS Africa to model the impact of the development on the existing road network. This will be submitted as a separate report.

8. Solid waste

Refuse removal will occur on refuse collection days as per the schedule of Cederberg Municipality. Accommodation for their vehicles will be ensured and be in line with the municipality's relevant requirements.

9. Conclusion

From the abovementioned information provided, it is concluded that the site can be serviced from an engineering perspective provided the required bulk upgrades are constructed. We trust that the information provided will be sufficient for the purposes of the application.

All aspects of this report will be confirmed in the detail design stage of the project.

Please do not hesitate to contact the undersigned should you require any additional information.

Yours faithfully,

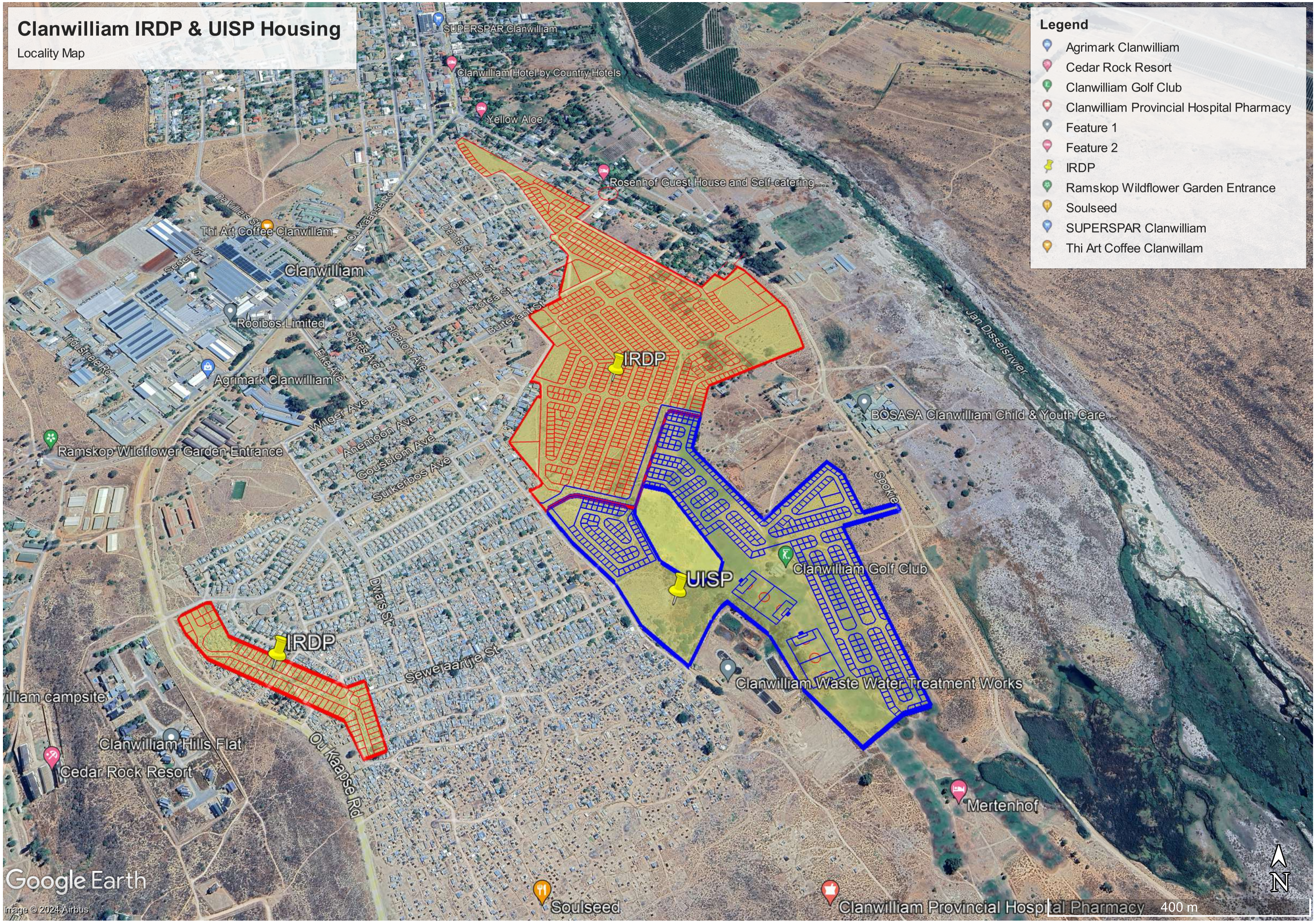


Ruaan Siebrits (Pr Tech Eng)

Attachments:

Annexure A – Locality map
Annexure B – Site development plan
Annexure C – GLS Report
Annexure D – Topographical survey
Annexure E – Geotechnical report

ANNEXURE A



Clanwilliam IRDP & UISP Housing
Locality Map
Legend
Agrimark Clanwilliam
Cedar Rock Resort
Clanwilliam Golf Club
Clanwilliam Provincial Hospital Pharmacy
Feature 1
Feature 2
IRDP
Ramskop Wildflower Garden Entrance
Soulseed
SUPERSPAR Clanwilliam
Thi Art Coffee Clanwillam
SUPERSPAR Clanwilliam
Clanwilliam Hotel by Country Hotels
Yellow Aloe
Rosenhof Guest House and Self-catering...
Thi Art Coffee Clanwillam
Clanwilliam
Rooibos Limited
Agrimark Clanwilliam
Ramskop Wildflower Garden Entrance
IRDP
UISP
IRDP
BOSASA Clanwilliam Child & Youth Care...
Clanwilliam Golf Club
Clanwilliam Waste Water Treatment Works
Clanwilliam Hills Flat
Cedar Rock Resort
Mertenhof
Soulseed
Clanwilliam Provincial Hospital Pharmacy
Jan Disselsrivier
Ou Kaapse Rd
Dwars St
Sewejaartje St
Spokie
Google Earth
Image © 2024 Airbus
400 m
N

ANNEXURE B

CLANWILLIAM HOUSING IRDP PROJECT - DRAFT 7

LEGEND

- DEVELOPMENT AREA — Total area: ±26.8767 ha
- DEVELOPMENT AREA — Total area: ±2.5113 ha
- 160 Single Residential Zone I erven — Average erf size: ±208m²
- 692 Single Residential Zone II erven — Average erf size: ±150m²
- 13 Open Space Zone I erven
- 5 Community Zone II (church) erven
- 1 Community Zone I (crèche) erven
- 1 Community Zone I (school) erf
- 1 Community Zone I (community center) erf
- 1 Community Zone III (clinic) erf
- 3 Local Business Zone II erven
- 2 Authority & Utility Zone erf
- Transport Zone II erven

CLANWILLIAM HOUSING UISP PROJECT - DRAFT 9

LEGEND

- DEVELOPMENT AREA — Total area: ±19.7680 ha
- 463 Single Residential Zone II erven — Average erf size: ±120m²
- 3 Open Space Zone I erven
- 2 Community Zone II (church) erven
- 2 Community Zone I (crèche) erven
- 1 Local Business Zone II erven
- Transport Zone II erven

NOTE:
ALL AREAS AND DISTANCES ARE SUBJECTED TO SURVEYING

COMPILED BY:
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DATE: JULY 2024

SCALE: 1:5000 (A3)

REF: CED/11931/ZN

ANNEXURE C

GLS

Infrastructure planning

22 August 2024

UDS Africa
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Attention: Mr Cobus Louw

Dear Sir,

UISP HOUSING DEVELOPMENT IN CLANWILLIAM: CAPACITY ANALYSIS OF THE BULK WATER AND SEWER SERVICES

Your request regarding comments on the bulk water supply and sewage discharge of the proposed development on Erf 3813 and a portion of Erf 279, Clanwilliam, refers.

This document should inter alia be read in conjunction with the Water Master Plan (performed for the Cederberg Municipality) dated February 2023 and the Sewer Master Plan dated February 2023.

Future development areas CW16b, CW22, CW28 & CCW30 and informal development area CW1-INF, which included the proposed development areas, were conceptually taken into consideration for the February 2023 master plans for the Clanwilliam water and sewer networks.

1. WATER DISTRIBUTION SYSTEM

1.1 Distribution zone

The water master planning indicated that the development area on Erf 279 ("Area B" & " Area C" as indicated on Figure 1 attached) should be accommodated in the existing Cederville reservoir and Platdammetjies Pressure Reducing Valve (PRV) water distribution zones and the development area on Erf 3813 ("Area A" on Figure 1) should be accommodated (in the short to medium term) in the existing Cederville booster pump station (PS) water distribution zone.

In the water master plan a new higher lying reservoir is, however, proposed to the south of the existing Cederville suburb in order to accommodate potential development to the south of Clanwilliam (refer to future development areas CW19a, CW19b, CW23, CW25 & SW29 in the February 2023 master plan) when these areas develop. It is proposed that the existing Cederville booster PS is then decommissioned and that the areas that are currently supplied with water pressure from the existing booster PS are incorporated in the future higher lying reservoir zone (so-called "Cederville Upper" reservoir as indicated in the June 2023 water master plan).

Ultimately, the proposed development on Erf 3813 should therefore be accommodated within the future so-called "Cederville Upper reservoir zone". As part of this investigation it is however proposed that the development area on Erf 3813 ("Area A" on Figure 1) is accommodated within the existing Cederville booster PS zone.

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Directors: Flip du Plessis, Tsolane Mokoena

The water connections for the proposed development areas should be made as follows:

Development on Erf 3813 (Refer to Figure 2a attached)

- Connect to the existing 160 mm Ø pipe in Magnolia Avenue to the north of the development.
- Connect to the existing 160 mm Ø pipe in Dwars Street to the south-east of the development.

There are existing 110 mm Ø pipes running through the proposed development area and it is proposed that these pipes are abandoned and replaced with new internal pipes for the development area.

Development on Erf 279 (Refer to Figure 2b attached)

- It is proposed that the northern portion of the proposed development area (development area north of the Jan Dissel reservoir and pump station) is accommodated within the existing Platdammetjie PRV water distribution zone through connections to the 75 mm Ø and 160 mm Ø pipes in Viooltjie Street and 2x connections to the existing 160 mm Ø pipe between Reservoir Street and the Jan Dissel reservoir.
- There is an existing 160 mm Ø pipe which runs through the proposed development area and it is proposed that this pipe is abandoned, as indicated on Figure 2b.
- It is proposed that the development area south of the Jan Dissel reservoir is accommodated within the existing Cederville reservoir water distribution network through 2x connections to the 75 mm Ø pipe in Buitekant Street, through a connection to the 160 mm Ø pipe in Denne Street and through a connection to the existing 75 mm Ø pipe in Bloekom Avenue.
- The existing 75 mm Ø pipe in Buitekant Street, the 160 mm Ø pipe in Denne Street and the 75 mm Ø pipe in Bloekom Avenue should, however, be upgraded to larger diameter pipes as discussed in paragraph 1.4 further on in the report.

The proposed development areas are situated inside the water priority area.

1.2 Water demand

The original water analysis for the master plan was performed with a total annual average daily demand (AADD) of 39,8 kL/d for the proposed development area on Erf 3813 (portion of informal development area CW1-INF in the February 2023 water master plan) and 1 080,4 kL/d for the proposed development area on Erf 279 (future development areas CW16b, CW22, CW28 & CCW30 in the February 2023 water master plan).

Total water demand allowed for the proposed development areas in the February 2023 water master plan is therefore 1 120,2 kL/d.

For this re-analysis of the master plan, the AADD and fire flow for the proposed development areas were calculated as follows:

Development on Erf 3813 (Area A on Figure 1)

Area A:

• 42 Single residential erven (IRDP) @ 0,4 kL/d/erf		=	16,8 kL/d
• 30 Single residential erven (GAP) @ 0,6 kL/d/erf		=	18,0 kL/d
	Sub-total	=	34,8 kL/d

Development on Erf 279 (Areas B & C on Figure 1)

Area B:

• 650 Single residential erven (IRDP) @ 0,4 kL/d/erf	=	260,0 kL/d
• 130 Single residential erven (GAP) @ 0,6 kL/d/erf	=	78,0 kL/d
• 1,51 ha School land use area @ 12,0 kL/d/ha	=	18,1 kL/d
• 3 575 m² of Business/commercial land use area @ 20,8 kL/d/ha	=	7,4 kL/d
• 18 563 m² of Community land use area @ 12,8 kL/d/ha	=	23,8 kL/d
Sub-total	=	387,3 kL/d

Area C:

• 463 Single residential erven (UISP) @ 0,50 kL/d/erf	=	231,5 kL/d
• 2 487 m² of Business/commercial land use area @ 20,8 kL/d/ha	=	5,2 kL/d
• 2 790 m² of Community land use area @ 12,8 kL/d/ha	=	3,6 kL/d
Sub-total	=	240,3 kL/d
Total	=	662,4 kL/d

- Fire flow criteria (Low risk) = 15 L/s @ 7 m

1.3 Present situation

1.3.1 Reticulation network

The internal reticulation networks of areas A, B & C will be accommodated within the reticulation networks of the Platdammetjies PRV, Cederville reservoir and Cederville booster PS water distribution zones. The capacities of the existing networks to accommodate the proposed development areas can be summarised as follows:

Cederville booster PS zone (Development area A)

The existing water reticulation pipes within the Cederville booster PS water distribution zone has sufficient capacity to accommodate the proposed development. The booster pumps of the Cederville booster PS are, however, at capacity and should be upgraded (upgrade from current capacity of 12 L/s to future capacity of 30 L/s).

There are 2x existing 110 mm Ø pipes running through the proposed development area and it is proposed that these pipes are abandoned and replaced with a new internal pipe network for the development area.

Platdammetjies PRV zone (northern portion of development area B)

The existing water reticulation system of the Platdammetjies PRV water distribution zone has sufficient capacity to accommodate the portion of development area B which falls within the Platdammetjies PRV water distribution zone.

An existing 160 mm Ø pipe runs through the proposed development area and it is proposed that this pipe is abandoned and replaced with a new internal 160 mm Ø pipe in Reservoir Street (link services item 4), as indicated on Figure 2b.

Internal pipes:

- Item 4 : 285 m x 160 mm Ø Internal water pipe = R 516 000 *

(* Including P & G, Contingencies and Fees, but excluding VAT - Year 2024/25 Rand Value. This is a rough estimate, which does not include major unforeseen costs).

The route of the proposed pipeline is shown schematically on Figure 2b attached but must be finalised subsequent to a detailed pipeline route investigation.

Cederville reservoir zone (development areas B & C)

The existing water reticulation system of the Cederville reservoir water distribution zone has insufficient capacity to accommodate the proposed development. The proposed upgrades to reinforce the existing reticulation network is discussed in paragraph 1.4 further on in the report.

The following internal reticulation pipes will be required within development areas B & C, as indicated on Figure 2b.

Internal pipes:

- Item 3 : 550 m x 160 mm Ø Internal ring main = R 952 000 *
- CCIW2.10 : 700 m x 200 mm Ø Internal ring main = R 1 541 000 *
- CCIW2.11 : 465 m x 160 mm Ø Internal water pipe = R 812 000 *

Sub-total = R 3 305 000 *

(* Including P & G, Contingencies and Fees, but excluding VAT - Year 2024/25 Rand Value. This is a rough estimate, which does not include major unforeseen costs).

The routes of the proposed pipelines are shown schematically on Figure 2b attached but must be finalised subsequent to detailed pipeline route investigations.

1.3.2 Reservoir capacity

The criteria for total reservoir volume used in the Water Master Plan is 48 hours of the AADD (of the reservoir supply zone).

Development areas A, B & C will be accommodated within the reticulation networks of the Platdammetjies PRV, Cederville reservoir and Cederville booster PS water distribution zones. The Platdammetjies reservoir and Platdammetjies PRV water distribution zones are supplied with water from the Platdammetjie reservoirs (2x 640 kL reservoirs) and the Cederville reservoir and Cederville booster PS water distribution zones are supplied with water from the Cederville reservoir (1 000 kL reservoir).

The capacities of the existing reservoirs to accommodate the proposed development areas can be summarised as follows:

Platdammetjies reservoir

The 2x 640 kL Platdammetjie reservoirs (Top Water Level (TWL) of 159,2 metres above mean sea level m a.s.l.) and the 1 500 kL and 3 000 kL Grootmaat reservoirs (TWL of 179,4 m a.s.l.) are operated as a single reservoir system and supplies the Platdammetjies reservoir, Platdammetjies PRV, Grootmaat reservoir and Grootmaat booster water distribution zones. The total AADD of the areas supplied is 1 123 kL/d and the storage capacity of the system (total storage capacity of 5 780 kL) is 123,5 hours x AADD supplied.

There is therefore sufficient reservoir spare capacity available in the system to accommodate the small portion of development area B which falls within the Platdammetjies PRV water distribution zone.

Cederville reservoir

The 1,0 ML Cederville reservoir currently only has 22,3 hours of storage capacity and therefore has insufficient storage capacity available to accommodate the proposed development.

1.3.3 Bulk supply

The existing Grootmaat reservoirs in Clanwilliam (which supply bulk water to the Platdammetjies and Cederville reservoirs) are supplied with bulk water from the Jan Dissel reservoir (through the Jan Dissel PS and existing 200 mm diameter dedicated bulk pipeline) and from the Clanwilliam dam (through the Dam PS and existing 200 mm diameter dedicated bulk pipeline). The combined capacity of these bulk pumping stations and pipelines are insufficient to accommodate the existing peak water demand of Clanwilliam during the summer months.

In the water master plan for Clanwilliam it is proposed that bulk water supply to the Grootmaat reservoirs is augmented through the upgrading of the bulk system from the Clanwilliam dam to the Grootmaat reservoirs, as discussed in paragraph 1.4 further in the report.

Raw water abstracted from the Clanwilliam dam is currently dosed with chlorine gas before it is pumped to the Grootmaat reservoirs. Raw water abstracted from the Jan Dissels River is stored in the Jan Dissels reservoir where the raw water is dosed with chlorine gas before it pumped to the Grootmaat reservoirs.

In the water master plan a new Water Treatment Plant (WTP) is proposed for Clanwilliam at the Grootmaat reservoir site in order to treat raw water received from the Clanwilliam dam and Jan Dissels PS. The cost of this treatment facility is not included in the master plan and should be determined through a specialised study.

1.4 Implementation of the master plan

The following master plan items will be required to reinforce the existing Clanwilliam reticulation network in order to accommodate the proposed development areas, as shown on Figures 1 and 2b attached:

Network upgrades:

• Item 1	: 190 m x 200 mm Ø Replace existing 160 mm Ø water pipe	= R	469 000 *
• Item 2	: 90 m x 160 mm Ø Replace existing 75 mm Ø water pipe	= R	195 000 *
• CClW2.1	: 220 m x 315 mm Ø New water pipe	= R	1 021 000 *
• CClW2.2	: 320 m x 315 mm Ø Replace existing 75 mm Ø water pipe	= R	1 410 000 *
• CClW2.3	: 260 m x 315 mm Ø Replace existing 75 mm Ø water pipe	= R	1 178 000 *
• CClW2.6	: 190 m x 110 mm Ø New water pipe	= R	260 000 *
	Sub-total	= R	4 533 000 *

The following master plan items will be required to augment reservoir storage capacity for the Cederville reservoir and Cederville booster water networks, as shown on Figure 2a attached:

Reservoir storage capacity augmentation:

• CClW.B1	: 3 000 kL additional storage capacity for Cederville reservoir site (proposed position for reservoir as indicated on Figure 2a)	= R	13 426 000 *
• CClW.B12	: 90 m x 315 mm Ø New feeder pipe to Cederville no. 2 reservoir	= R	516 000 *
• CClW.B16	: 90 m x 315 mm Ø link pipe between Cederville no. 1 & 2 reservoirs	= R	516 000 *
• CClW.B17	: 5 m x 160 mm Ø inter-connection pipe between 2x bulk pipes	= R	186 000 *
	Sub-total	= R	14 644 000 *

The following master plan item will be required to upgrade the capacity of the existing booster pumps at the Cederville booster PS in order to accommodate the proposed development on Area A in the existing Cederville booster PS water network, as shown on Figure 2a attached:

PS upgrades:

- CClW.B2 : Upgrade capacity of Cederville PS to 30 L/s = R 818 000 *

The following master plan items will be required to upgrade the bulk supply from the Clanwilliam dam to the Grootmaat reservoir site, as shown on Figure 3 attached:

Bulk supply upgrades:

- CClW.B8 : New bulk PS (capacity of 95 L/s) = R 2 784 000 *
- CClW.B9 : 950 m x 355 mm Ø bulk pipeline to Grootmaat reservoir site = R 4 291 000 *

Sub-total = R 7 075 000 *

Total = R 27 070 000 *

(* Including P & G, Contingencies and Fees, but excluding VAT - Year 2024/25 Rand Value. This is a rough estimate, which does not include major unforeseen costs).

The routes and locations of the proposed pump stations, pipelines, reservoirs and water treatment facilities are shown schematically on Figures 1, 2a, 2b & 3 attached but must be finalised subsequent to detailed investigations.

In the water master plan a new Water Treatment Plant is proposed for Clanwilliam at the Grootmaat reservoir site in order to treat raw water received from the Clanwilliam dam and Jan Dissels PS. The cost of this treatment facility is not included in the master plan and should be determined through a specialised study. Refer to master plan item CClW.B10 as indicated on Figure 3.

1.5 Phasing of master plan items

The following minimum upgrades are required to accommodate the proposed development in the existing water system:

Development area A:

- Master plan item CCLW.B2 to upgrade the capacity of the booster pumps of the Cederville booster PS,
- master plan item CClW.B1 to augment reservoir storage capacity, and
- master plan items CClW.B12, CClW.B16 & CClW.B17 to supply bulk water to the Cederville no. 2 reservoir and to link the new Cederville no. 2 reservoir to the existing Cederville reservoir no. 1 reservoir.

Development area B:

- Master plan item CClW.B1 to augment reservoir storage capacity,
- master plan items CClW.B12, CClW.B16 & CClW.B17 to supply bulk water to the Cederville no. 2 reservoir and to link the new Cederville no. 2 reservoir to the existing Cederville reservoir no. 1 reservoir,
- master plan items 2, CClW2.1, CClW2.2, CClW2.3 & CClW2.6 to improve network conveyance to the development area,
- internal ring feed pipes items 3 & CClW2.10 to connect to the existing network,
- internal pipe item 4 to improve network conveyance in the network after the existing 160 mm diameter pipe within the development area is abandoned, and
- master plan items CClW.B8 & CClW.B9 to augment bulk water supply to the Grootmaat reservoir site.

Development area C:

- Master plan item CCIW.B1 to augment reservoir storage capacity,
- master plan items CCIW.B12, CCIW.B16 & CCIW.B17 to supply bulk water to the Cederville no. 2 reservoir and to link the new Cederville no. 2 reservoir to the existing Cederville reservoir no. 1 reservoir,
- master plan items CCIW2.1, CCIW2.2 & CCIW2.3 to improve network conveyance to the development area,
- a portion of internal ring feed pipe item CCIW2.10 to connect to the existing network,
- internal pipe item CCIW2.11 to feed water into the internal network of the development, and
- master plan items CCIW.B8 & CCIW.B9 to augment bulk water supply to the Grootmaat reservoir site.

Master plan item 1 will be required before full development of both development areas B & C has commenced.

2. SEWER NETWORK

2.1 Drainage area

See Figure 4 attached:

Development area A falls within the existing Clanwilliam Gravity drainage area. Development areas B and C falls outside the existing sewer drainage areas of Clanwilliam and in the sewer master plan a new sewer drainage area (the so-called “Future Clanwilliam Pump Station (PS) CI2 drainage area” is proposed for these areas with a new PS at the lowest point of the larger drainage area, which pumps directly to the existing Clanwilliam Wastewater Treatment Plant (WWTP).

A few erven within development area B (erven to the far north-west of the development next to Viooltjie Street) however drains towards the existing Milner Street PS drainage area and should be accommodated within the network of the Milner Street PS drainage area.

The proposed connection points to the existing sewer system are as follows:

Area A

Connect to the existing sewer infrastructure on the development area.

Area B

The erven to the far north-west of the development area which drains towards the Milner Street PS drainage area should connect to the existing 150 mm diameter outfall sewers in Viooltjie and Milner Streets.

The rest of the development area should drain to the west through link services items CCIS4.1 & CCIS4.2 to the proposed new sewer PS (master plan item CCIS4.4). From the PS sewage should be pumped directly to the Clanwilliam WWTP through master plan item CCIS4.5.

Area C

The development area should drain to the north-west through link services items CCIS4.2 & CCIS4.3 to the proposed new sewer PS (master plan item CCIS4.4). From the PS sewage should be pumped directly to the Clanwilliam WWTP through master plan item CCIS4.5.

The development is inside the sewer priority area.

2.2 Sewer flow

The original sewer analysis for the master plan was performed with a total peak day dry weather flow (PDDWF) of 23,9 kL/d for the proposed development area on Erf 3813 (portion of informal development area CW1-INF in the February 2023 sewer master plan) and 791,6 kL/d for the proposed development area on Erf 279 (future development areas CW16b, CW22, CW28 & CCW30 in the February 2023 sewer master plan).

Total sewage demand allowed for all the development areas in the February 2023 sewer master plan is therefore 815,5 kL/d

For this re-analysis, the PDDWF for the proposed development areas was calculated as follows:

Area A	=	24,4 kL/d
Area B	=	271,1 kL/d
Area C	=	168,2 kL/d
Total	=	463,7 kL/d

2.3 *Present situation*

Development area A falls within the existing Clanwilliam Gravity drainage area and a small portion of development area B falls within the Milner Street PS drainage area. Development area C and the balance of development area B falls outside the existing drainage area and it is proposed that a new PS with a dedicated rising main which discharges at the existing Clanwilliam WWTP is constructed for these areas.

Sewage from the Milner Street PS drainage area gravitates towards the Milner Street PS, from where sewage is pumped into the Clanwilliam drainage area.

Sewage from the Clanwilliam Gravity drainage area gravitates towards the Clanwilliam WWTP.

The capacities of the existing drainage areas to accommodate the proposed development can be summarised as follows:

Milner Street PS drainage area (portion of development area B)

Only a small portion of development area B will be accommodated within the existing Milner Street PS drainage area. In the sewer master plan for Clanwilliam upgrading of the Milner Street PS and accommodating rising main is proposed (refer to master plan items CCIS2.3 & CCIS2.4), as well as upgrading of the main outfall sewer gravitating toward the Milner Street PS (refer to master plan item CCIS2.2). The existing system, however, has spare capacity to accommodate the erven within development area B which drains towards the Milner Street PS.

It can however be considered to upgrade the PS, rising main and outfall sewer (master plan items CCIS2.2, CCIS2.3 & CCIS2.4) as part of the construction of the development as these items runs through the development area.

The main outfall sewer downstream of the discharge point of the Milner PS's rising main gravitating towards the Clanwilliam WWTP is at capacity and should be upgraded, as discussed in paragraph 2.4 further on in the report.

Clanwilliam Gravity drainage area (development area A)

The Clanwilliam Gravity drainage area downstream of development area A gravitating towards the Clanwilliam WWTP is at capacity and should be upgraded as per the sewer master plan in order to accommodate the proposed development area.

Future Clanwilliam PS Cl2 drainage area (development areas B & C)

New bulk sewer infrastructure (new outfall sewers, PS and accompanying rising main) is required to accommodate development areas B & C which can not gravitate to the existing sewer infrastructure of Clanwilliam.

2.4 *Implementation of the master plan*

The following master plan items will be required to reinforce the existing sewer reticulation network in order to accommodate the proposed development, as shown on Figure 4 attached:

Network upgrades: (Clanwilliam Gravity)

• CClS6.1 : 380 m x 450 mm Ø Upgrade existing 150 mm Ø outfall sewer		= R 2 016 000 *
• CClS6.2 : 950 m x 200 mm Ø Upgrade existing 160 mm Ø outfall sewer		= R 2 820 000 *
• CClS6.3 : 475 m x 525 mm Ø Upgrade existing 150 mm Ø bulk sewer		= R 2 774 000 *
	Sub-total	= R 7 610 000 *

Network upgrades: (Milner Stret PS)

• CClS2.2 : 370 m x 200 mm Ø Upgrade existing 150 mm Ø outfall sewer		= R 1 197 000 *
• CClS2.3 : Upgrade capacity of Milner Street PS to 55 L/s		= R 2 528 000 *
• CClS2.4 : 780 m x 315 mm Ø Upgrade existing 200 mm Ø rising main		= R 3 199 000 *
	Sub-total	= R 6 924 000 *

New sewer infrastructure: (Future PS Cl2)

• CClS4.1 : 260 m x 200 mm Ø New outfall sewer		= R 525 000 *
• CClS4.2 : 270 m x 250 mm Ø New outfall sewer		= R 724 000 *
• CClS4.3 : 350 m x 200 mm Ø New outfall sewer		= R 695 000 *
• CClS4.4 : New 20 L/s Future PS Cl2		= R 4 313 000 *
• CClS4.5 : 1 005 m x 160 mm Ø New rising main		= R 1 518 000 *
	Sub-total	= R 7 775 000 *
	Total	= R 22 309 000 *

(* Including P & G, Contingencies and Fees, but excluding VAT - Year 2024/25 Rand Value. This is a rough estimate, which does not include major unforeseen costs).

The routes of the proposed outfall sewers and the position of the proposed pumping station are shown schematically on Figure 4 attached but have to be finalised subsequent to detailed pipeline route and pumping station location investigations.

2.5 Wastewater Treatment Plant

The existing Clanwilliam WWTP (with a treatment capacity of 2,4 ML/d) has insufficient spare capacity to accommodate the proposed development. The Cederberg Municipality is however in the process to upgrade the existing plant with an additional 1,5 ML/d to a capacity of 3,9 ML/d, which will be sufficient to accommodate the total development.

2.6 Phasing of master plan items

The following minimum upgrades are required to accommodate the proposed development in the existing sewer system:

Development area A:

- Master plan items CCIS6.2 & CCIS6.3 to reinforce the capacity of the existing gravity system between the proposed development and the Clanwilliam WWTP.

Development area B:

- Link services items CCIS4.1 & CCIS4.2 to connect the internal sewer network of the development area to future PS CI2, and
- Future PS CI2 (master plan item CCIS4.4) and rising main (master plan item CCIS4.5) to service the larger drainage area.
- A small portion of the development drains towards the existing Milner Street PS, which discharges into the Clanwilliam Gravity drainage areas. The bulk sewer downstream of the Milner Street PS is at capacity and should be upgraded (master plan items CCIS6.1 & CCIS6.3).

The existing Milner Street PS drainage area has spare capacity to accommodate the erven within development area B which drains towards the Milner Street PS. In the sewer master plan for Clanwilliam upgrading of the Milner Street PS and accommodating rising main is however proposed (refer to master plan items CCIS2.3 & CCIS2.4), as well as upgrading of the main outfall sewer gravitating toward the Milner Street PS (refer to master plan item CCIS2.2). It can be considered to upgrade the PS, rising main and outfall sewer (master plan items CCIS2.2, CCIS2.3 & CCIS2.4) as part of the construction of the development as these items runs through the development area.

Development area C:

- Link services items CCIS4.2 & CCIS4.3 to connect the internal sewer network of the development area to future PS CI2, and
- Future PS CI2 (master plan item CCIS4.4) and rising main (master plan item CCIS4.5) to service the larger drainage area.

3. CONCLUSION

The developer of the UISP Housing development in Clanwilliam, may be liable for the payment of a Development Contribution (as calculated by the Cederberg Municipality) for bulk water and sewer infrastructure as per Council Policy.

There is insufficient capacity available in the existing Clanwilliam water reticulation and bulk supply networks to accommodate the total development areas.

The following minimum upgrades are required to accommodate the proposed development in the existing water system:

Development area A:

- Master plan item CCLW.B2 to upgrade the capacity of the booster pumps of the Cederville booster PS,
- master plan item CCIW.B1 to augment reservoir storage capacity, and
- master plan items CCIW.B12, CCIW.B16 & CCIW.B17 to supply bulk water to the Cederville no. 2 reservoir and to link the new Cederville no. 2 reservoir to the existing Cederville reservoir no. 1 reservoir.

Development area B:

- Master plan item CCIW.B1 to augment reservoir storage capacity,
- master plan items CCIW.B12, CCIW.B16 & CCIW.B17 to supply bulk water to the Cederville no. 2 reservoir and to link the new Cederville no. 2 reservoir to the existing Cederville reservoir no. 1 reservoir,
- master plan items 2, CCIW2.1, CCIW2.2, CCIW2.3 & CCIW2.6 to improve network conveyance to the development area,
- internal ring feed pipes item 3 & CCIW2.10 to connect to the existing network,
- internal pipe item 4 to improve network conveyance in the network after the existing 160 mm diameter pipe within the development area is abandoned, and
- master plan items CCIW.B8 & CCIW.B9 to augment bulk water supply to the Grootmaat reservoir site.

Development area C:

- Master plan item CCIW.B1 to augment reservoir storage capacity,
- master plan items CCIW.B12, CCIW.B16 & CCIW.B17 to supply bulk water to the Cederville no. 2 reservoir and to link the new Cederville no. 2 reservoir to the existing Cederville reservoir no. 1 reservoir,
- master plan items CCIW2.1, CCIW2.2 & CCIW2.3 to improve network conveyance to the development area,
- a portion of internal ring feed pipe item CCIW2.10 to connect to the existing network,
- internal pipe item CCIW2.11 to feed water into the internal network of the development, and
- master plan items CCIW.B8 & CCIW.B9 to augment bulk water supply to the Grootmaat reservoir site.

Master plan item 1 will be required before full development of both development areas B & C has commenced:

In the sewer system development area A falls within the existing Clanwilliam Gravity drainage area. The sewer network of the Clanwilliam Gravity drainage area is at capacity and should be upgraded to accommodate the proposed development.

Development areas B and C fall outside the existing sewer drainage areas of Clanwilliam and in the sewer master plan a new sewer drainage area (the so-called “Future Clanwilliam PS CI2 drainage area” is proposed for these areas with a new PS at the lowest point of the larger drainage area which pumps directly to the existing Clanwilliam Wastewater Treatment Plant (WWTP).

A few erven within development area B (erven to the far north-west of the development next to Viooltjie Street) however drains towards the existing Milner Street PS drainage area and should be accommodated within the network of the Milner Street PS drainage area.

The following minimum upgrades are required to accommodate the proposed development in the existing sewer system:

Development area A:

- Master plan items CCIS6.2 & CCIS6.3 to reinforce the capacity of the existing gravity system between the proposed development and the Clanwilliam WWTP.

Development area B:

- Link services items CCIS4.1 & CCIS4.2 to connect the internal sewer network of the development area to Future PS CI2,
- Future PS CI2 (master plan item CCIS4.4) and rising main (master plan item CCIS4.5) to service the larger drainage area.
- A small portion of the development drains towards the existing Milner Street PS, which discharges into the Clanwilliam Gravity drainage area. The bulk sewer downstream of the Milner Street PS is at capacity and should be upgraded (master plan items CCIS6.1 & CCIS6.3).

The existing Milner Street PS drainage area has spare capacity available to accommodate the erven within development area B which drains towards the Milner Street PS. In the sewer master plan for Clanwilliam upgrading of the Milner Street PS and accommodating rising main is however proposed (refer to master plan items CCIS2.3 & CCIS2.4), as well as upgrading of the main outfall sewer gravitating toward the Milner Street PS (refer to master plan item CCIS2.2). It can be considered to upgrade the PS, rising main and outfall sewer (master plan items CCIS2.2, CCIS2.3 & CCIS2.4) as part of the construction of the development as these items runs through the development area.

Development area C:

- Link services items CCIS4.2 & CCIS4.3 to connect the internal sewer network of the development area to Future PS CI2, and
- Future PS CI2 (master plan item CCIS4.4) and rising main (master plan item CCIS4.5) to service the larger drainage area.

Cederberg Municipality is in the process to upgrade the existing WWTP to a capacity of 3,9 ML/d, which will be sufficient to accommodate the proposed total development.

We trust that you find this of value.

Yours sincerely,

GLS CONSULTING (PTY) LTD
REG. NO.: 2007/003039/07



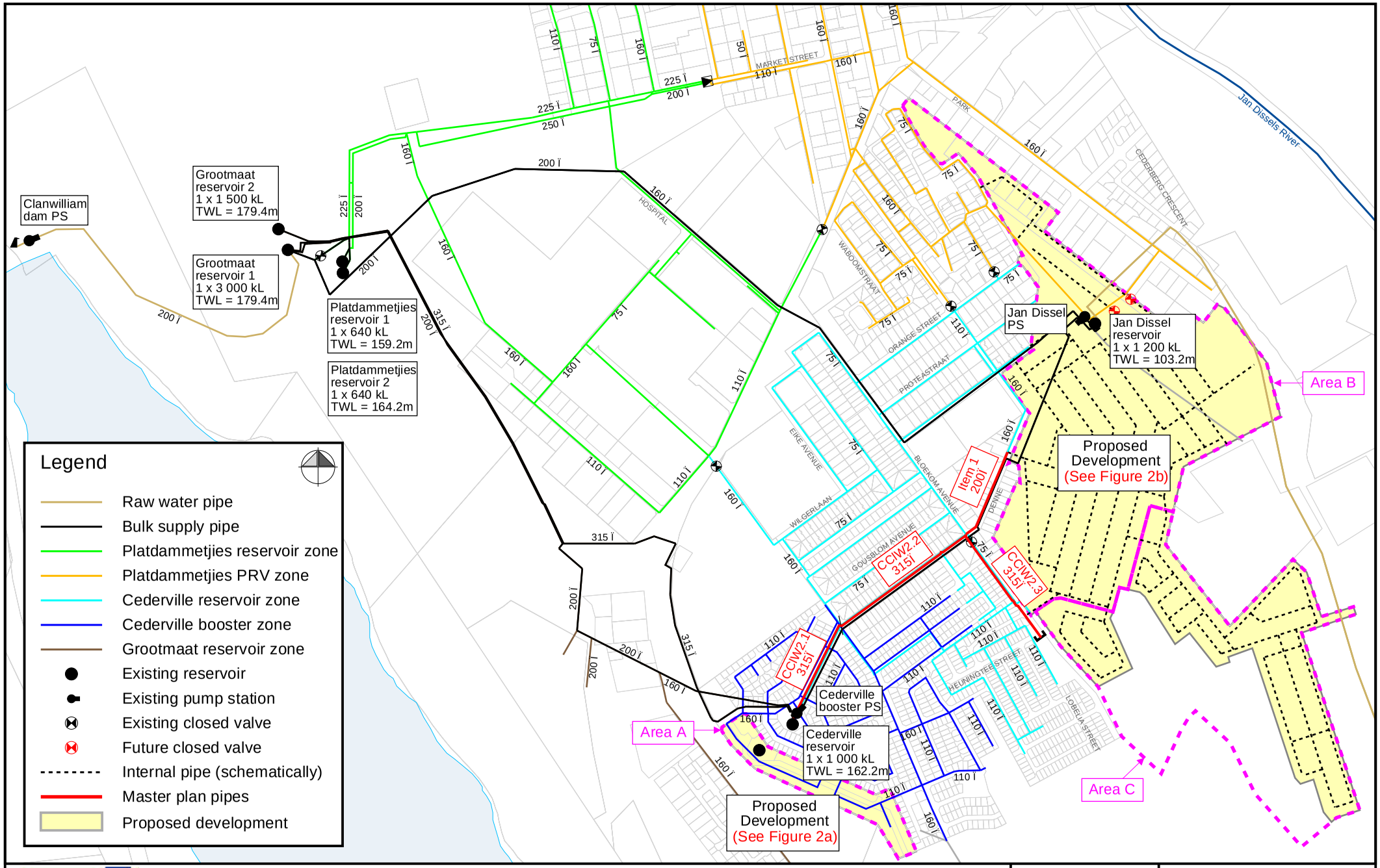
_____
Per: PC DU PLESSIS

cc. Manager Water Services
Engineering & Planning Services
Cederberg Municipality
Private Bag X2
CLANWILLIAM
8135

Attention: Mr Riaan de Ridder

ASLA DEVCO
25 Jan Conradie Crescent
ASLA Park
Strand
7140

Attention: Ms Belinda Swart

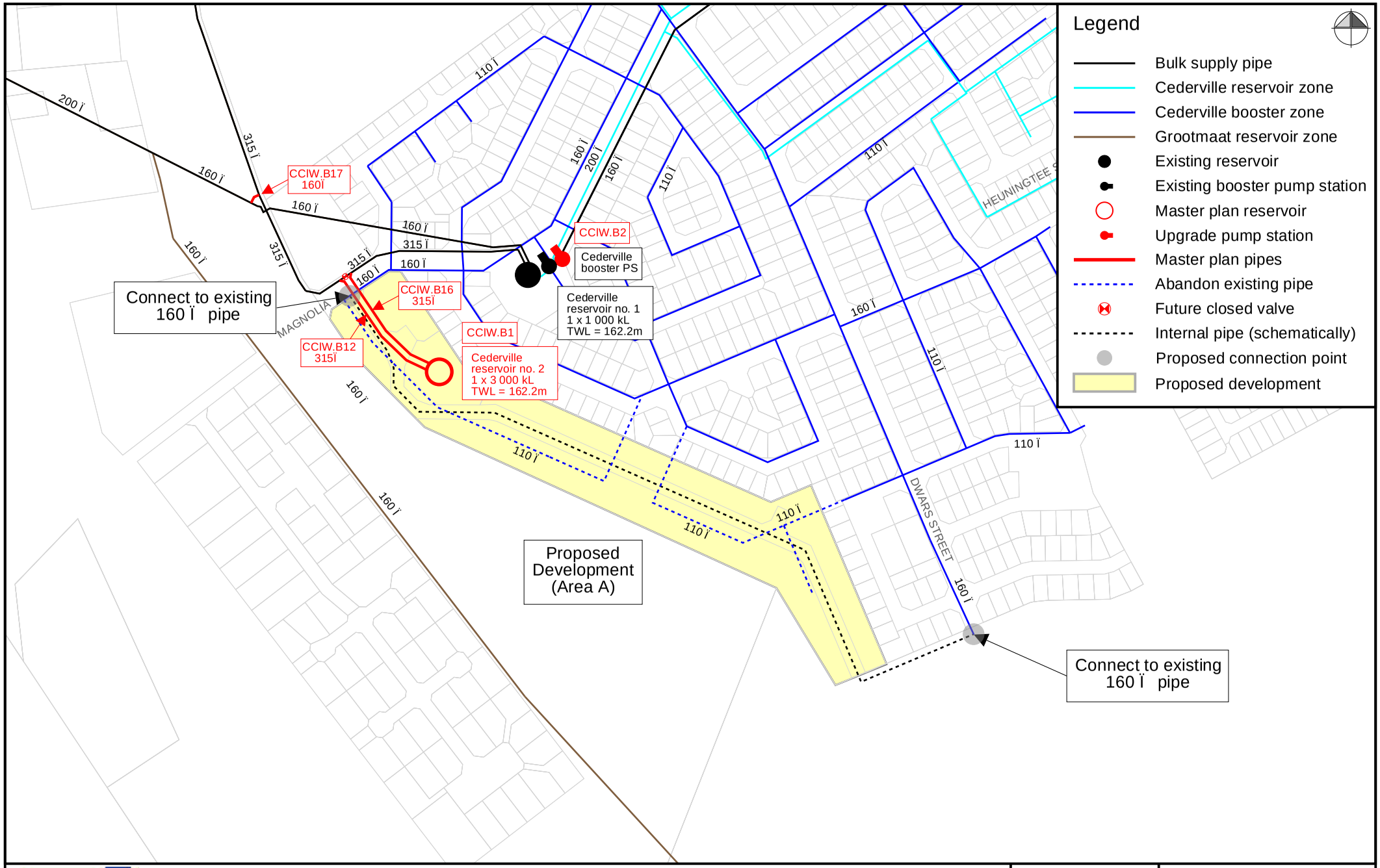


August 2024

Proposed UISP Housing Development - Clanwilliam

GLS Infrastructure planning

Figure 1
Proposed development
UISP Housing - Clanwilliam
Water master plan

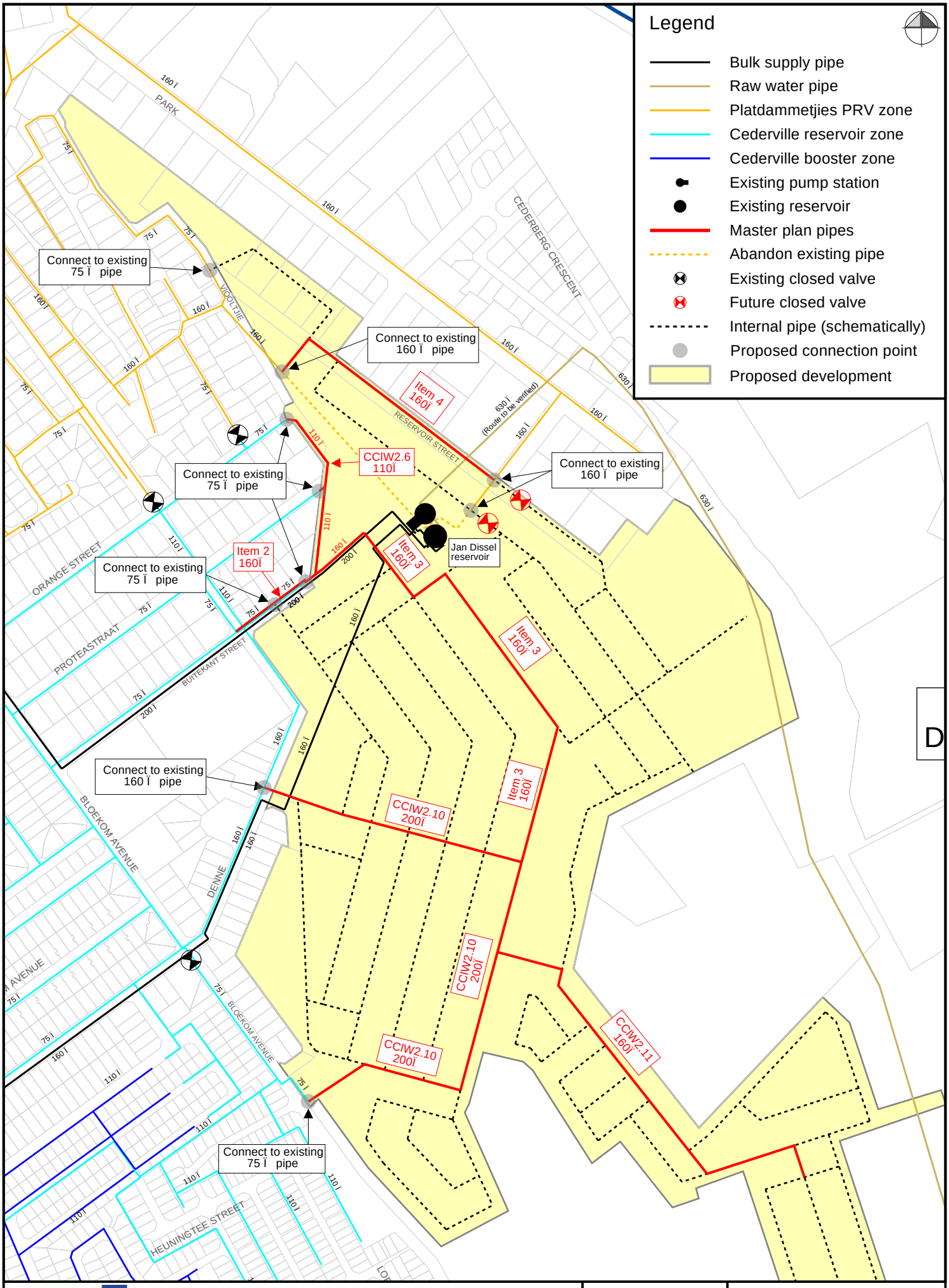


August 2024

Proposed UISP Housing Development - Clanwilliam

Figure 2a

Proposed development
UISP Housing - Clanwilliam
Existing water connections

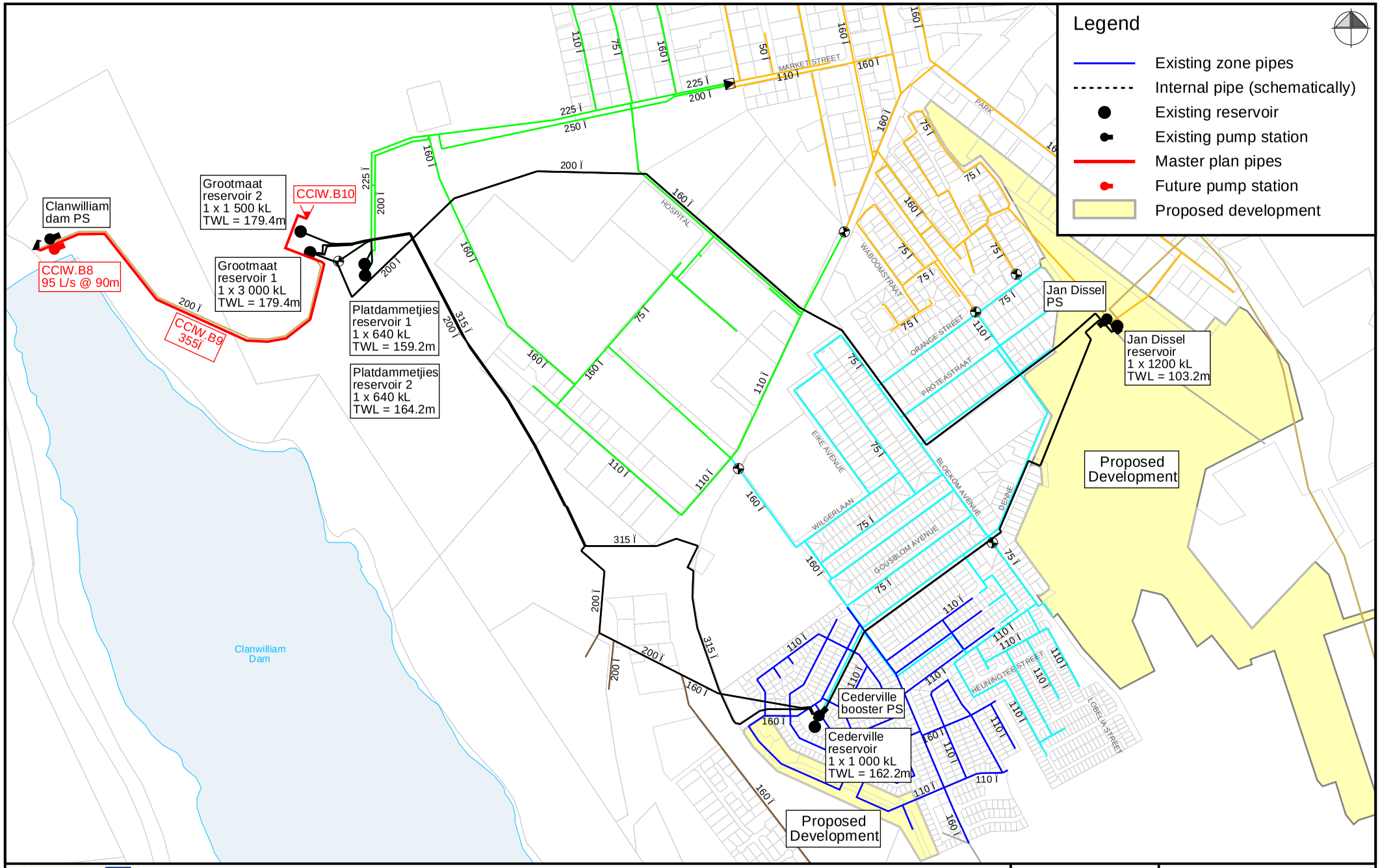


August 2024

Proposed UISP Housing Development - Clanwilliam

Figure 2b

Proposed development
UISP Housing - Clanwilliam
Existing water connections

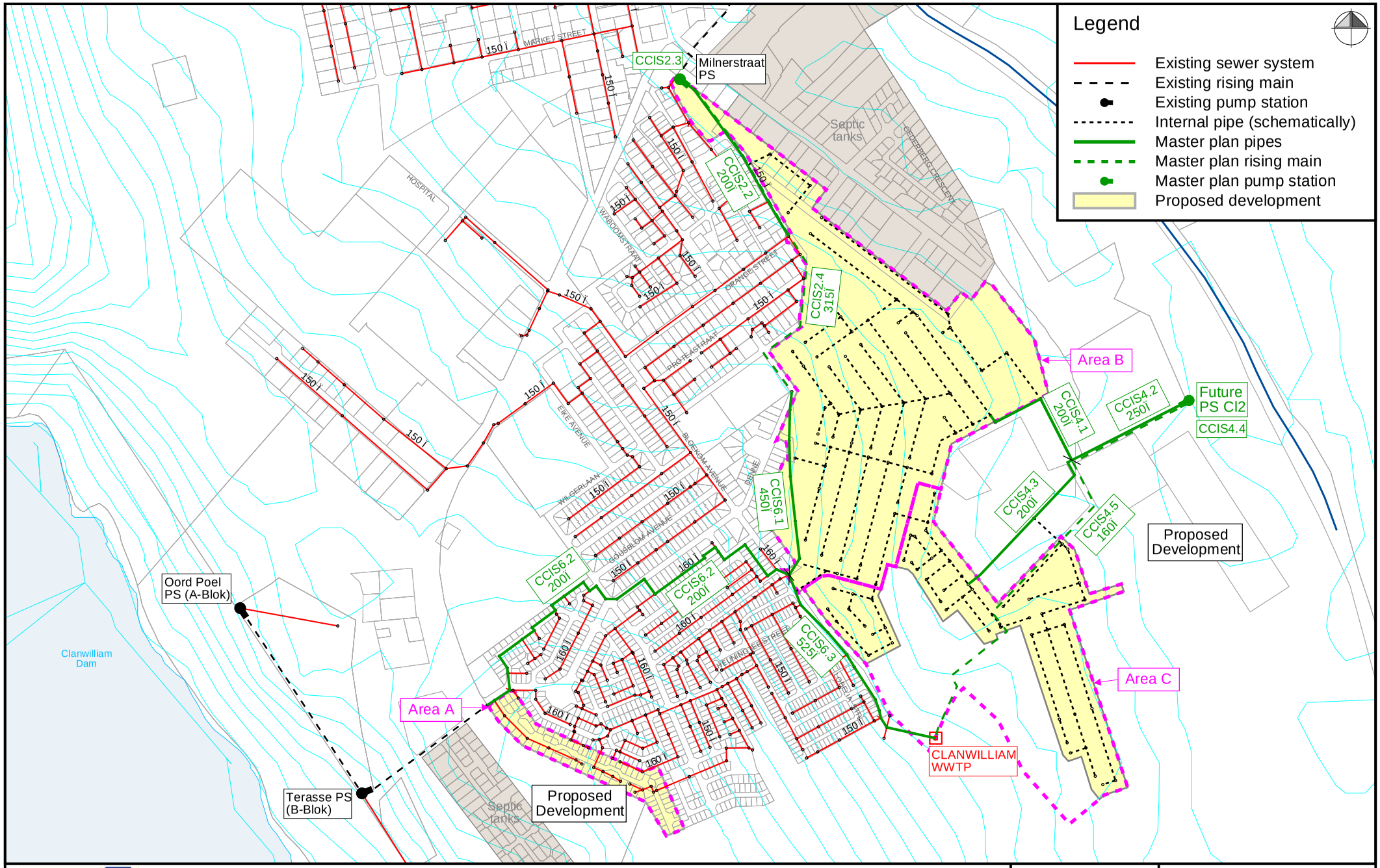


August 2024

Proposed UISP Housing Development - Clanwilliam

Figure 3

Proposed development
UISP Housing - Clanwilliam
Bulk water upgrades



August 2024

Proposed UISP Housing Development - Clanwilliam

Figure 4

Proposed development
UISP Housing - Clanwilliam
Existing sewer system

ANNEXURE D

CLANWILLIAM HOUSING IRDP PROJECT - DRAFT 7

LEGEND

DEVELOPMENT AREA
Total area: ±26.8767 ha

DEVELOPMENT AREA
Total area: ±2.5113 ha

- 160 Single Residential Zone I erven — Average erf size: ±208m²
- 692 Single Residential Zone II erven — Average erf size: ±150m²
- 13 Open Space Zone I erven
- 5 Community Zone II (church) erven
- 1 Community Zone I (crèche) erven
- 1 Community Zone I (school) erf
- 1 Community Zone I (community center) erf
- 1 Community Zone III (clinic) erf
- 3 Local Business Zone II erven
- 2 Authority & Utility Zone erf
- Transport Zone II erven

CLANWILLIAM HOUSING UISP PROJECT - DRAFT 9

LEGEND

DEVELOPMENT AREA
Total area: ±19.7680 ha

- 463 Single Residential Zone II erven — Average erf size: ±120m²
- 3 Open Space Zone I erven
- 2 Community Zone II (church) erven
- 2 Community Zone I (crèche) erven
- 1 Local Business Zone II erven
- Transport Zone II erven

NOTE:
ALL AREAS AND DISTANCES ARE SUBJECTED TO SURVEYING

COMPILED BY:
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DATE: JULY 2024

SCALE: 1:5000 (A3)

REF: CED/11931/ZN

NORTH

ANNEXURE E

PHASE I

GEOTECHNICAL SITE INVESTIGATION

CLANWILLIAM HOUSING UISP PROJECT
PORTION RE/279

FOR

ASLA DEVCO

CORE GEOTECHNICAL CONSULTANTS

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PHASE 1 GEOTECHNICAL INVESTIGATION FOR CLANWILLIAM HOUSING UISP PROJECT, PORTION RE/279
FOR
ASLA DEVCO

APRIL 2024 Project no: 006-24

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1. Introduction

A Phase 1 geotechnical site investigation has been conducted as part of the Clanwilliam Housing UISP Project on a Portion of RE/279, located in Clanwilliam.

The aimed development will comprise:

- New GAP housing structures.
- New sportsfields
- A new Creche and Church
- Area zoned for business development
- Associated infrastructure and roads across the site area.

The objectives of this investigation were as follows:

a) Identify any potential hazards.

b) Define the ground conditions and provide site classifications including detailed soil profiles and groundwater occurrences within the zone of influence of foundations.

c) Provide the geotechnical basis for safe and appropriate land use planning, infrastructure design, housing unit design and the formulation of precautionary measures and risk management procedures.

d) Broadly classify the land that is to be developed for subsidy housing in terms of the Housing Code's Residential Site Class Designations as per SANS 10400-H and GFSH-2.

e) Gather factual data that has a bearing on the determination of housing subsidy variations and the installation of services.

This report has been prepared in accordance with the South African National Standard for Geotechnical investigations for township development (SANS 634:2012) with additional information provided, where applicable, to also comply with the requirements as per the National Housing Code for Project Linked Greenfield Subsidy Housing Projects (Standard Specification GFSH-2).

2. Terms of reference

Core Geotechnical Consultants (Pty) Ltd ("Core Geotech") was appointed by ASLA Devco to carry out a Phase 1 Geotechnical Investigation for the Clanwilliam Housing Project located on portion of RE/279. A quotation dated 19 February 2024 was sent via email, which was subsequently accepted. The geotechnical investigation was carried out on 19-21 March 2024.

3. Information used in the study

The following information sources were used in the investigation:

a) Proposed erven layout provided by client entitled: "Clanwilliam Housing UISP Draft 7_February 2024_topo".

b) Google Earth Remote imagery (2002-2024).

c) The 1:250 000 geological map – 3218 Clanwilliam (Council for Geoscience).

d) Cape Farm Mapper version 2.6.11 of the Western Cape Department of Agriculture.

e) National Department of Housing: GEOTECHNICAL SITE INVESTIGATIONS FOR HOUSING DEVELOPMENTS, Project Linked Greenfield Subsidy Project Developments Generic Specification GFSH-2 September 2002.

f) SANS 10160-4: 2017-Basis of structural design and actions for buildings and industrial structures Part 4: Seismic actions and general requirements for buildings.

g) SANS 634:2012-Geotechnical investigations for township development.

h) SANS 10400-H:2012-The Application of the National Building Regulations — Part H: foundations.

i) Committee of Transport Officials (COTO) Standard Specifications for Road and Bridge Works for South African Road Authorities, Draft Standard (2020).

4. Site description

The properties of the site under investigation is summarized in Table 4.1 below.

Table 4.1 Site characteristics and project details

Erf details	Erf 134501
Approx. Size (Ha)	13.16
Location (refer to Figure 4.1)	Clanwilliam (east) around the existing golf course.
Approx. Address	Irregular shaped development extending from Bloekom Avenue (western boundary), towards the east and north-east. The development extends across a portion of the golf course and across the slightly elevated rise east of the golf course. The Clanwilliam WWTW is located just south of the site. A wetland/natural drainage line (to be left undeveloped) runs in a North-west to south-easterly direction through the central part of the site, just west of the existing golf course.
Site coordinates	32°11'26.53"S 18°53'56.96"E
Proposed development	Single storey / possibly duplex residential
Number of units	326 new residential erven
Site topography (refer to Figure 4.3)	The proposed development can be broadly characterized into 3 main areas: **1) Western area just east of Bloekom Avenue**. Site topography slopes down from the higher lying west (Bloekom Avenue) and north-west, located at a maximum elevation of approx 116m amsl, down towards the lower lying central and north-eastern parts of the site (close to the drainage line/wetland area) with minimum elevation level of approx 103m amsl. This area has a sloping topography of approx. 1(v) : 9(h). There are smaller limited areas where steeper slopes are encountered Some erosion has taken place in unvegetated areas and topographical undulations are also present in this area. **2) Central area along the existing golf course.** Topography drops from the higher lying north-west (approx 102m amsl) and south (approx 100m amsl) towards the lower lying east (approx 94m amsl), with sloping topography of approx 1(v) : 18(h). Some bulk earthworks for leveling of the golf course fairway may have taken place in the past. **3) East to south-east, beyond the eastern edge of the golf course** The elevation rises again slightly towards the east and south-east, to an elevated rise (koppie), with a maximum elevation of approximately 101m amsl, with a slope of approx up to 1(v) : 15(h) in areas. There are smaller limited areas where steeper slopes are encountered. Along the north-eastern edge of the golf course and site boundary, an embankment drops down towards what appears to be a man-made pond/excavation (north-east of TP10). This pond is fed from a drainage line running further towards the north-east. A man-made elevated fill terrace stockpile is located just west of Bloekom Avenue, but south of the proposed new erven of the development (just south of TP1).

Erf details	Erf 134501
Current status (refer to Figure 4.2)	The proposed site are extends across undeveloped land, as encountered towards the west (just east of Bloekom Avenue) in the are of Test pits TP1-TP5. The central part of the site is occupied by the golf course, while undeveloped land is located further east of the golf course and around the outer edges of the golf course fairways. The Clanwilliam Golf Club building is located just south of the site area.
Vegetation	Short grass along the golf course, while fynbos is located largely in undeveloped areas.
Drainage lines	A natural drainage line (termed a wetland in the topographical layout plan) runs north-west to south-east, through the lower lying central part of the site (just west of the golf course). No development is planned in this area. What appears to be a man-made pond with drainage channel, is located in a topographically lower lying area, just east of the sloping embankment and site boundary at Test pit TP10. Some erosion is visible along the embankment of the golf course at this location. Man-made drainage channels/erosion channels are also present in the far western parts of the site, drainage towards the central drainage line/wetland area. The Clanwilliam WWTW is located further south to south-west of the site location.
Nearby structures	The structures of the nearby community housing, located west of the site (and Bloekom Avenue) appear to be in a sound condition and show no evidence of structural distress or potential problematic soils. Similarly the golf course club house also appears to be in a sound condition.
Climate	The area has a mean annual rainfall of approximately 221mm with the majority of precipitation during winter months (June-August). Average maximum temperatures range from 34° in summer (February) to 19° in winter (July).



Figure 4.1: General site locality



Figure 4.2: General site layout

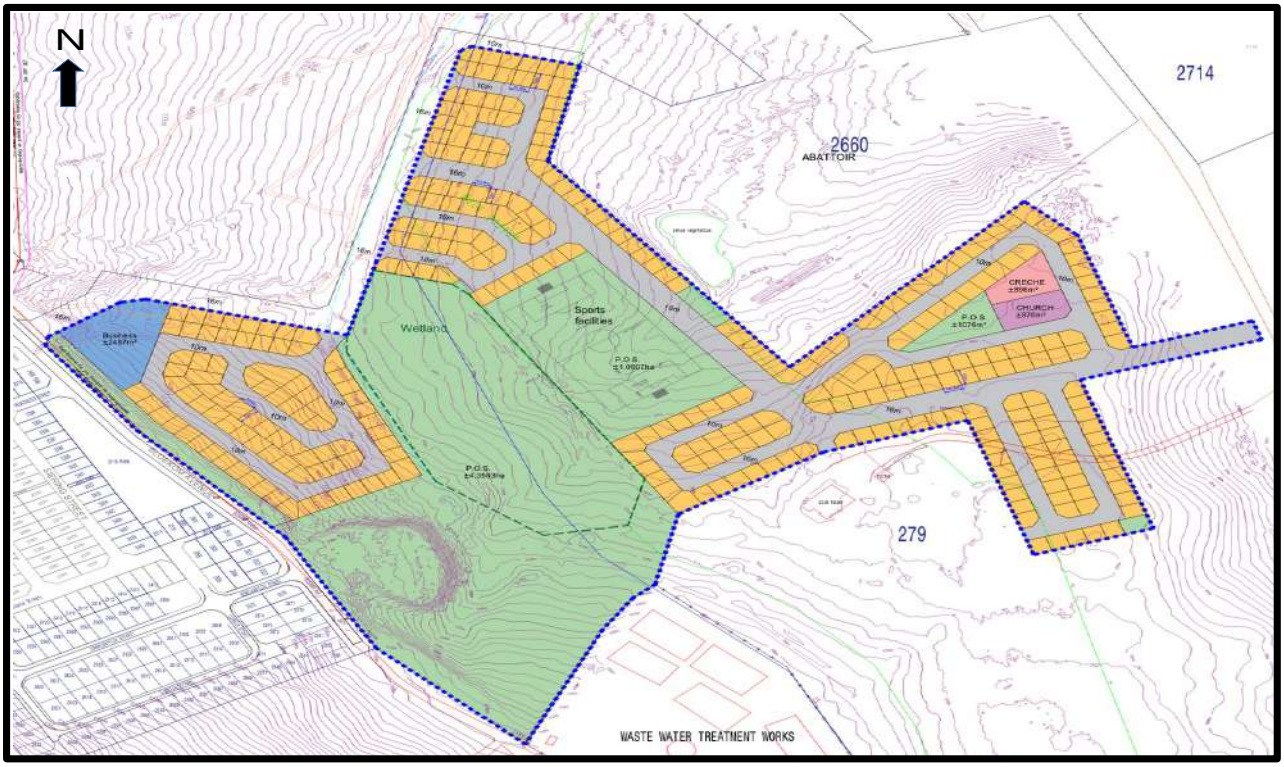


Figure 4.3: Development layout and topography

5. Nature of investigation

5.1 Test pits and dynamic cone penetrometer (DCP) tests

The investigation comprised:

a) A background and desktop study to assess the site, previous works, possible test positions and access points/limitations.

b) Inspection and formal profiling of eighteen test pits excavated using a 20 ton tracked excavator.

c) Sampling of representative material from the test pits for relevant laboratory testing.

d) Dynamic Cone Penetrometer (DCP) testing across the site in order to assess the in-situ densities and compressibility of the shallow subsurface materials.

The test point coordinates are summarized in Table 5.1, while positions are shown in the site plan included in Appendix A. Copies of the recorded test pit profiles, DCP test results are included in Appendices B and C respectively.

Table 5.1 Test position coordinates

Test pit & DCP location	Latitude	Longitude	Test pit & DCP location	Latitude	Longitude
TP1/DCP1	32°11'32.09"S	18°53'52.78"E	**TP10/DCP10**	32°11'25.43"S	18°53'59.91"E
TP2/DCP2	32°11'28.48"S	18°53'50.10"E	**TP11/DCP11**	32°11'28.30"S	18°54'4.45"E
TP3/DCP3	32°11'30.72"S	18°53'54.59"E	**TP12/DCP12**	32°11'32.06"S	18°54'0.66"E
TP4/DCP4	32°11'30.44"S	18°53'52.22"E	**TP13/DCP13**	32°11'29.27"S	18°54'1.79"E
TP5/DCP5	32°11'27.77"S	18°53'52.58"E	**TP14/DCP14**	32°11'31.00"S	18°54'7.83"E
TP6/DCP6	32°11'26.53"S	18°53'56.96"E	**TP15/DCP15**	32°11'25.22"S	18°54'7.51"E
TP7/DCP7	32°11'24.74"S	18°53'56.85"E	**TP16/DCP16**	32°11'28.44"S	18°54'7.25"E
TP8/DCP8	32°11'22.70"S	18°53'56.64"E	**TP17/DCP17**	32°11'32.32"S	18°54'9.63"E
TP9/DCP9	32°11'20.83"S	18°53'58.45"E	**TP18/DCP18**	32°11'33.64"S	18°54'8.82"E

5.2 Laboratory testing

The following laboratory tests were carried out on selected soil samples:

a) Indicator tests in the form of moisture content, grading and Atterberg Limits analyses to determine basic soils engineering properties.

b) Compaction testing in the form of CBR and Mod AASHTO tests to determine material compaction characteristics.

c) Geochemical testing (pH and conductivity) to indicate possible deleterious effects of soils on concrete and buried services.

Copies of the full laboratory test results are included in Appendix D.

6. Site geology and geohydrology

6.1 General

Geological maps of the area indicate that regionally, the site is underlain by weathered quartzitic sandstone, shale and conglomerate rocks of the Table Mountain Group.

The regional geology of the area, with the approximate site area, is indicated in Figure 6.1.

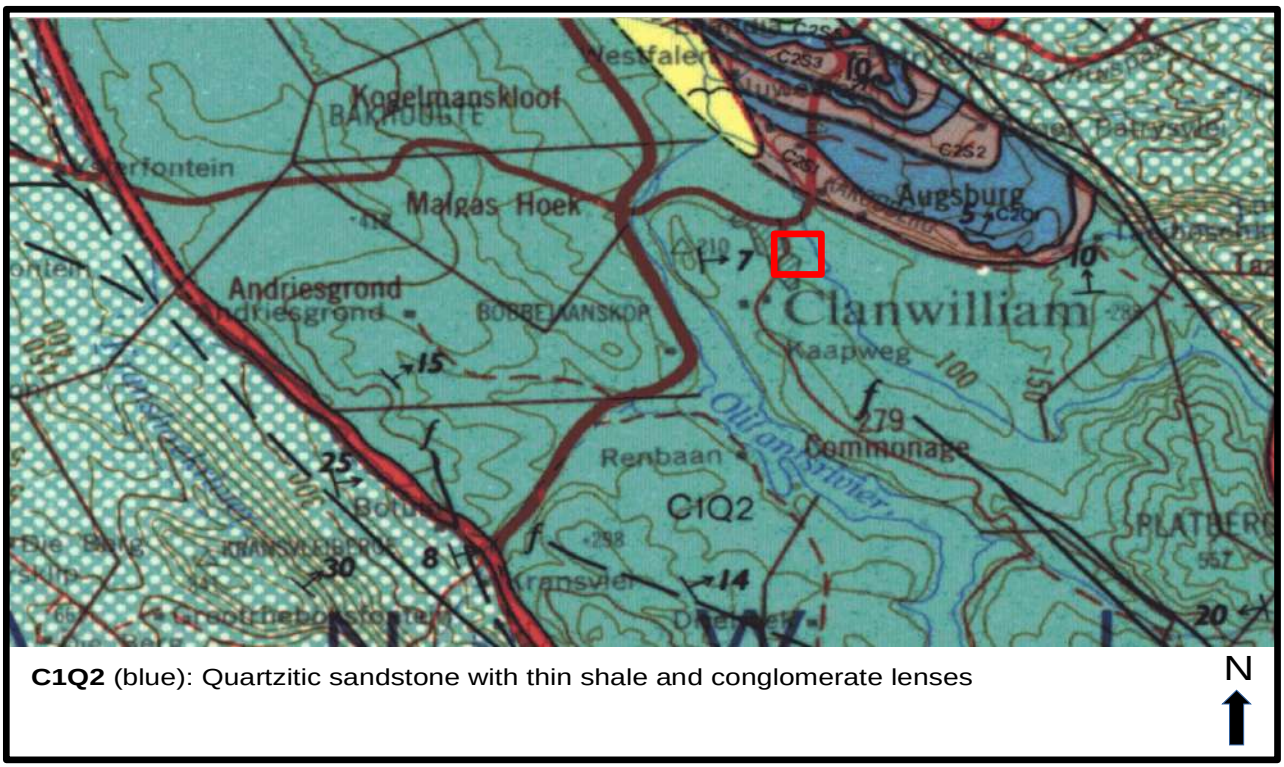


Figure 6.1: Regional geology map (3218 Clanwilliam-Council for Geoscience) showing regional site location (red)

6.2 Seismicity

There is a small seismic risk in the greater Western Cape area and appropriate design precautions need to be taken with regards to structural design in order to accommodate this. This needs to be done in accordance with municipal and national regulations as set out in SANS 10160-4 (2017). Essentially this code calls for designing for a peak ground acceleration of between 0.1 and 0.15 g (10% probability of not being exceeded in 50 years) for the Western Cape area. A value of 0.1 g is generally recommended.

Table 2.1 provides a summary of soil classification, taken from SANS 10160-4 (2009), to assist in choosing the appropriate design criteria, such as the acceleration response spectra, when designing the structures for the appropriate seismic action.

Given the presence of sandstone bedrock generally within 1.0m to 2.0m of natural ground level, the site would generally classify as "Ground type 1".

Table 2.1 Soil Classification with regards to SANS 10160(2009) with design response spectra

Ground type	Description of stratigraphic profile	Parameters		
		$Vs_{,30}$	N_{SPT} blows/30cm	C_u kPa
1	Rock or other rock-like geological formation, including at most 5m of weaker material at the surface	>800	-	-
2	Deposits of very dense sand, gravel, or very stiff clay, at least several tens of m in thickness, characterized by a gradual increase of mechanical properties with depth	360-800	>50	>250
3	Deep deposits of dense or medium dense sand, gravel or stiff clay with thickness from several tens to many hundreds of metres	180-360	15-50	70-250
4	Deposits of loose-to-medium cohesionless soil (with or without some soft cohesive layer) or of predominantly soft-to-firm cohesive soil	<180	<15	<70

6.3 Soil profile

A graphical representation of the soil profile across the site is shown in Figure 6.2 below.

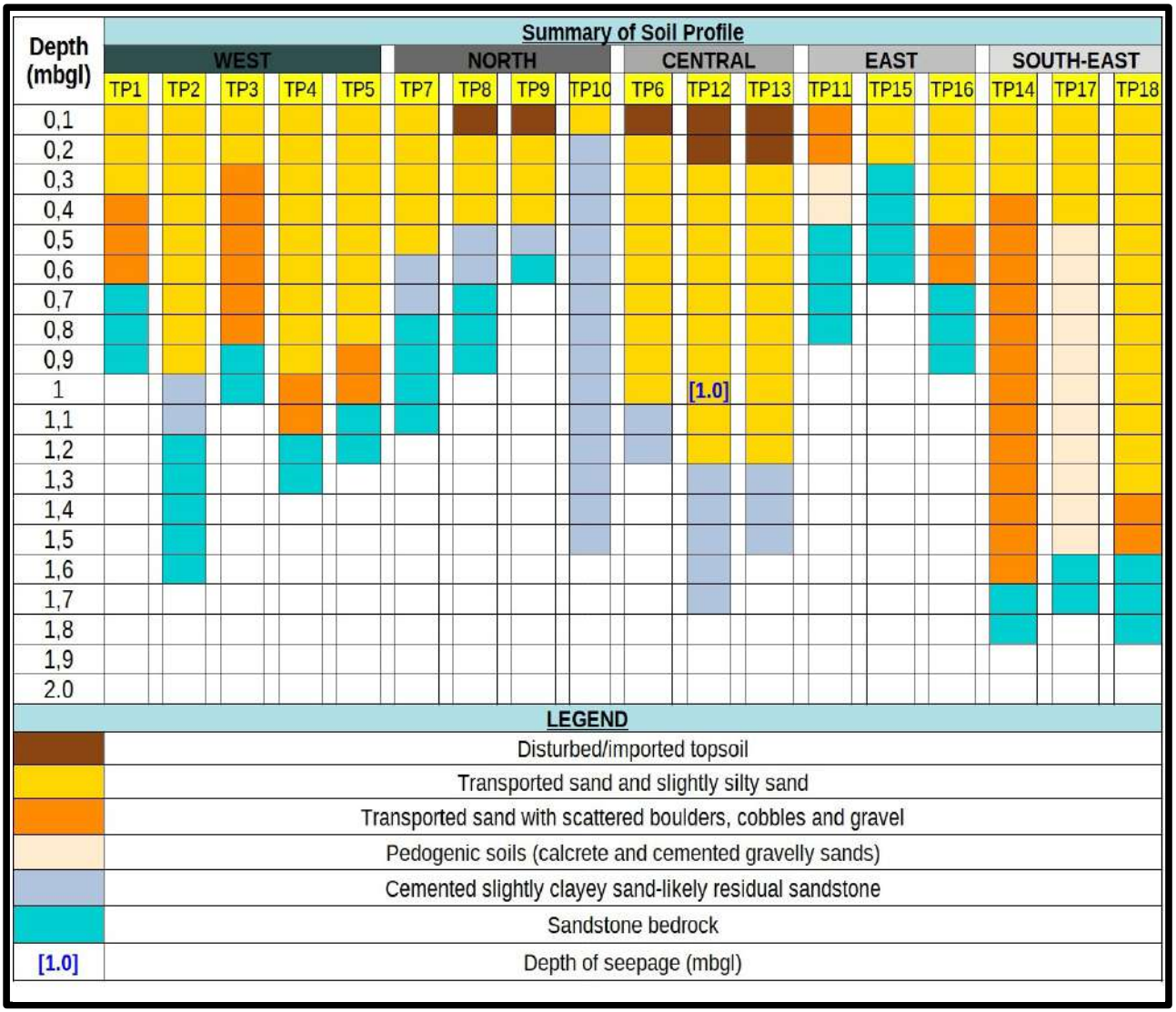


Fig 6.2 Summary of soil profile for each test pit with depth. Refusal was generally met within bedrock/strongly cemented residual soils

Based on the soil profiles from the test pits excavated during this investigation, the following can be noted:-

- The natural profile generally comprises transported soils overlying residual and weathered sandstone bedrock.
- The transported profile comprises sand and slightly silty sand, near surface, becoming gravelly, cobbly and bouldery sands (due to presence of angular to sub rounded sandstone gravel, cobbles and boulders) with increased depth closer to the underlying bedrock.
- Naturally occurring pedogenic soils (calcrete and cemented gravelly sands) were encountered in limited extent, and mostly in the area east and south-east of the golf course.
- The sandstone bedrock comprised a closely to medium jointed mostly medium to hard rock quartzitic sandstone. The hard nature of the bedrock generally resulted in refusal, but some ripping was possible in areas where the bedrock was more closely jointed. Excavation depth within the bedrock was however generally limited.

There were areas however, where a strongly cemented, slightly clayey sand (likely residual sandstone) was encountered and resulted in excavation difficulty. This was mostly in and around the golf course (central parts of the site) and closer to the natural drainage line/wetland, where greater degree of weathering would generally be expected.

Depth of the bedrock varied from 0.4m to 1.7m across the site area.

- Imported topsoils (clayey and silty sands) were also encountered at surface, in and around the golf course.

6.4 Groundwater table

- Groundwater in the area generally occurs within the deeper fractured aquifer, at depths in excess of 30.0m. Borehole yields are generally low (2-5 l/s), with water quality also generally moderate with electrical conductivity (>70-150mS/m).
- The investigation was carried out towards the end of the dry summer period. Seepage was however encountered in test pit TP12, at a depth of 1.0m. Seepage rates were low, but could increase during the peak of the winter season.
- This test pit was located close to the natural drainage line/wetland area and thus shallow seepage may also develop close to the upper contact of the residual/weathered sandstone in other flatter lower lying areas adjacent/close to this drainage line.
- For most of the western and eastern parts of the site, a shallow perched groundwater table is not expected, due to the sloping topography and shallow bedrock.
- The potential for erosion exists in and along steeper sloping parts of the site, where loose sandy soils are encountered at surface (such as along the western parts of the site), and limited to no vegetation is present.
- Some evidence of erosion due to stormwater runoff was also present along the sloped embankment on the eastern side of the golf course, just east of TP10.

7. Geotechnical evaluation

7.1 Engineering and material characteristics

Relevant soils engineering properties are summarized in Table 7.1a & b. On the basis of the field investigation and existing soils engineering data, the following points relating to the geotechnical engineering conditions can be made:

a) Any disturbed soils or uncontrolled fill containing rubble, refuse or soils rich in organic matter (if encountered during construction), are unsuitable for founding purposes, or for use in construction. Foundations would either need to extend through this material, or it would need to be removed and replaced with a suitable quality granular material.

b) DCP testing was conducted from surface at each of the test positions to provide an indication of the in-situ material strength and densities (subgrade). Results are plotted both as penetration rate (mm/blow) with depth, as well as N10 (blows per 100mm) with depth (in accordance with international guidelines: EN1997-2), and are attached in Appendix C. The following can be noted in this regard:-

- The upper transported sandy soils are generally highly compressible. Due to the variable thickness of this horizon, depth of the highly compressible zone varies from 0.2m to 1.1m. This highly compressible horizon may thus affect individual erven or areas of erven where this horizon is deeper developed.

  The high compressibility in the transported sandy soils also indicates a low in-situ CBR and will thus affect surface beds and access roads. Subgrade improvement through compaction from surface will thus be recommended.

  Areas where raised engineered terraces are required will also require the in-situ soils to be compacted over the full thickness of this zone of high compressibility, prior to the construction of any overlying engineered terrace.

- DCP refusal was generally met within the residual sandstone and medium hard rock to hard rock sandstone bedrock. This material will form a competent founding horizon, but excavation difficulties are anticipated.

c) With reference to laboratory testing results summarized in Table 7.1 a& b, the following may be noted, in terms of material properties:

- **Transported sandy and gravelly sandy soils (USCS class: SM/SP)**

  The transported sands, as encountered at surface in the western parts of the site, as well as the sands and gravelly sands encountered in the south-eastern parts of the site, are granular, non-plastic and generally have a low to moderate post compaction strength. Due to a variable gravel content, classification varies from a G7 to G9 quality selected layer material. Some variability in grading, with variable fines content and coarser boulder, cobble and gravel fractions, is expected across the site. Selecting out of scattered larger boulder, cobble and gravel fractions will be required, where encountered.

  These soils should be suitable for use as a general fill and possibly a lower quality selected layer (at least G9) quality material. Coarser fractions will require crushing or selecting out in stockpile before use. Due to variability, additional testing from a thoroughly blended stockpile is also recommended so as to confirm material classification before use, especially if use as a better quality G7 or G8 quality material is required (only limited occurrences across the site). The addition of crushed gravel (from crushed sandstone bedrock) could be considered to slightly improve strength characteristics, but additional testing would also be required to confirm material final material class.

  As a subgrade, this material should classify as a moderate quality subgrade (SG2-Table 7.3). Due to high compressibility (as indicated by DCP testing) in-situ CBR values will however be low and soil improvement (compaction) of the in-situ subgrade (recommended to at least 95% MDD) will be required prior to raising levels or constructing of the upper pavement layer works.

  It should also be suitable for use as a selected fill for pipe bedding (SANS 1200), provided coarser fractions >30mm are removed or crushed.

- **Transported clayey silty sands and sandy silty clay (USCS class: SM/SC)**

  These soils are generally encountered near surface in the central to northern parts of the site, closer to the natural drainage line/wetland area. A higher clay and silt content has resulted in a low to moderate plasticity index.

  As an engineering material these soils do not meet the requirements for a selected layer due to low post compaction strength (CBR). Use of this material in construction or as a pipe bedding material is not recommended, unless the material can be improved through blending with a gravel (possibly crushed sandstone bedrock) or better quality selected layer material. Additional testing would be required in this regard.

  Poor drainage properties are expected and this material should classify as a Fair quality subgrade (SG3-Table 7.3). Ripping, recompaction and the use of overlying better quality selected layers will be required for pavement layer works.

- **Residual sandstone(USCS class: SC)**

  The residual sandstone horizon is generally also only encountered in the central lower lying parts of the site, in and around the golf course and closer to the natural drainage line, where greater degrees of weathering was experienced. These soils have a variable fines content and comprise a cemented sandy clay to clayey sand with a low to moderate plasticity (PI: 8-15). Due to variability in the fines content, use in construction is not recommended.

  In-situ these soils are generally cemented and will have very poor permeability and drainage properties and low strength once disturbed/excavated. They are generally not expected to be particularly active (low potential for heave). As a subgrade they are best left undisturbed,

but a better quality imported granular subgrade, overlying this horizon, is generally recommended, before placing the upper pavement layer works.

It is also not recommended for use a pipe bedding.

- **Sandstone bedrock**

  The sandstone bedrock generally comprises a medium hard rock to hard rock quartzitic sandstone that resulted in refusal of the excavator within 1.5m to 2.0m across the site. Hard rock excavation will mostly be required within this material.

  Once excavated, crushing of the boulders, cobbles, gravel sized particles could be considered in order to create a suitable quality granular material. This could potentially either be used as a subbase or base coarse material or blended with other materials encountered across the site, so as to create a better quality selected layer material, where required. Additional testing would however be required in this regard.

d) The pH of the transported soils and residual sandstone soils are generally neutral (pH: 6.8-8, Table 7.1). Electrical conductivity is generally <10mS/m (after Duligal, 1996). Soils are thus not considered particularly corrosive.

e) No difficulty in excavation was encountered within the transported soils. Difficulty in excavation was however encountered within limited occurrences of pedogenic calcrete, within strongly cemented residual clayey sands and within the medium to hard rock quartztic sandstone encountered within 0.5-1.7m of ground level across the site.

f) As a result of the sloping topography, especially in the western and eastern parts of the site, extensive bulk earthworks will be required to create level platforms/terraces. Bulk earthworks cuts will experience difficulties in excavation in areas of shallow sandstone bedrock, while embankments and terraces will require suitable lateral support and erosion protection measures.

g) Seepage was only encountered in TP12, at shallow depth (1.0m). Shallow seepage is generally not expected in the sloping site areas in the west and east, but may develop in and around the lower lying areas, especially close to the natural drainage line/wetland area located west of the golf course.

h) No evidence of ponding was encountered. The investigation was however conducted at the end of the dry summer period. During periods of heavy rain, ponding may occur in limited lower and flatter lying areas, especially where low permeable residual/cemented soils or bedrock is close to surface (within 1.0m). Site stormwater drainage will need to be carefully designed.

i) Stormwater runoff may occur during heavy rains in sloping areas, especially where bedrock or cemented soils are within 0.5-1.0m of ground level, where very minimal infiltration will occur. Sloping areas, embankments and unvegetated areas with sandy soils at surface on site are thus also prone to erosion by wind and water and will need erosion protection in the long term.

Table 7.1a Summarized soils basic engineering properties

Test pit	TP2	TP6	TP7	TP9	TP14	TP18
Depth of Sample (m)	0-1.0m	0.1-1.0m	0-0.5m	0.1-0.4m	0.3-1.6m	0-1.1m
Soil Description	Yellow brown sand	Light brown sand	Silty clayey sand	Slightly silty sand	Gravelly sand	Yellow brown sand
Origin	Transported	Transported	Transported	Transported	Transported	Transported
USCS Soil Class	SM/SP	SM/SP	SC/SM	SM	SM/SP	SM/SP
Liquid Limit	-	-	20	-	-	-
Plastic Index	NP	NP	4.5	NP	NP	NP
Linear Shrinkage	-	-	2.4	-	-	-
Moisture content %	1.2	0.5	4.2	4.5	1.7	0.2

Test pit	TP2	TP6	TP7	TP9	TP14	TP18
Grading Modulus	1.18	1.2	1.12	1.22	1.47	1.26
pH	6.8	-	-	-	-	-
-Conductivity $s.m^{-1}$	0.063	-	-	-	-	-
MOD AASHTO (Kg/m3)	1774	1667	1996	1909	2029	1721
Optimum Moisture content %	12.4	14.5	10.4	12.5	8.4	16.3
CBR @93%	12	9	3	12	28	8
CBR @95%	14	12	4	15	35	10
Swell (max) %	0	0	0.34	0	0	0
TRH14/COTO classification	G8	G9	Does not meet classification criteria for selected layer (low CBR)	G8	G7 (does not meet the minimum grading modulus requirements for G6	G9
Typical Expected permeability: K (m/s) * Swiss Standard SN 670 010b ** from grading analysis	**1.0E-04	**4.0E-04	*5.0E-06 to 5.50E-09	*5.50E-06 to 5.50E-09	**1.6E-03	**1.0E-04
Heave potential (van der Merwe)	low	Low	Low	Low	Low	Low

Table 7.1b Summarized soils basic engineering properties

Test pit	TP7	TP10	TP13
Depth of Sample (m)	0.5-0.7m	0.1-0.5	0.2-1.2m
Soil Description	Sandy silty clay	Clayey sand	Yellow brown sand
Origin	Residual sandstone	Residual sandstone	Transported
USCS Soil Class	SC	SC	SM/SP
Liquid Limit	31	24	-
Plastic Index	15	8.8	NP
Linear Shrinkage	7	4.2	-
Moisture content %	8.8	7.1	0.9
Grading Modulus	0.97	0.89	1.19
pH	-	8	8
-Conductivity $s.m^{-1}$	-	0.074	0.074
MOD AASHTO (Kg/m3)	-	-	-

Test pit	TP7	TP10	TP13
Typical Expected permeability: K (m/s) * Swiss Standard SN 670 010b ** from grading analysis	*5.50E-06 to 5.50E-09	*5.50E-06 to 5.50E-09	**4.0E-04
Heave potential (van der Merwe)	Low	Low	Low

Table 7.2 Soil conductivity guidelines (after Duligal, 1996)

Soil conductivity (mS/m)	Corrosivity classification
>50	Extremely corrosive
25-50	Very corrosive
20-25	Corrosive
10-20	Mildly corrosive
<10	Not generally corrosive

Table 7.3 Preparation of subgrade/roadbed and required selected layers for the different subgrade design CBRs (as taken from TRH4)

Subgrade CBR class	SG4	SG3	SG2	SG1
Design CBR of subgrade	<3	3-7	7-15	>15
Material quality	Poor	Fair	Moderate	Good
Add selected layers: Upper Lower:	Not applicable	 150mm G7 150mm G9	 150mm G7 -	 - -
Treatment of in-situ subgrade	Special treatment required	Rip and recompact to 150mm G10	Rip and recompact to 150mm G9	Rip and recompact to 150mm G7

7.2 Slope stability and erosion

Sidewall collapse generally occurred within the loose transported sandy and bouldery sandy soils, once disturbed, although due to the shallow depth of bedrock and residual soils, this depth did not generally exceed 1.0-1.5m. The following should however be noted with regards to sidewall stability for excavations:-

- Table 7.4 provides a summary of recommended cut/excavation slope angles in varying soil types as recommended by the OSHA (Occupational Safety and Health Administration, U.S. Department of Labor).
- Any transported soils, given their compressible and cohesionless nature, will classify as Type C soils.
- The pedogenic soils (calcrete), residual sandstone and sandstone bedrock are generally competent, but variable jointing and bedding plane spacing (close to medium spaced) was encountered within the sandstone. In areas where ripping was possible, some raveling of disturbed and loose rock pieces (gravel to boulder size) did occur. Thus unless this material can

be assessed on site, the residual sandstone, sandstone bedrock (due to presence of jointing and bedding planes that act as planes of weakness within the rockmass) and cemented pedogenic soils (calcrete) would generally classify as Type A material.

a) <u>For excavations >1.0m and up to a maximum of 3m deep.</u>

i. For any temporary excavations within the natural soil profile for bulk earthworks and services it is recommended that sidewalls are sloped to an angle of not more than 35 degrees within the sandy and bouldery transported soils. This can be steepened within the bedrock, to an initial angle of 53 degrees, in accordance with the OSHA guidelines. Where stable unjointed rock is encountered, this could potentially be steepened to vertical, but would first need to be assessed on site by a suitably competent professional, as blasting, chemical breaking or use of hydraulic pickers may affect stability of the rockmass along the excavation faces.

ii. If any shallow seepage is encountered, further flattening of sidewalls may be required. Dewatering and the use of sandbagging or formal shoring may be required, even for shallow excavations <1.0m deep.

iii. Excavated soils are to be stockpiled at least 1.50m away from the edge of the crest of cut faces so as to prevent additional surcharge on the cut sidewalls. Surcharge from any plant equipment, moving close to the crest of the cut slopes should also be avoided.

iv. Cuts/excavations deeper than 3.0m will require individual assessment and may require formal shoring or further flattening of sidewalls.

Table 7.4 Recommended cut/excavation slope angles in varying soil types as recommended by OSHA

Soil Type	*Description	Height/Depth ratio	Slope angle (degrees)
Stable rock	Stable rock	Generally vertical, but will depend on the degree of weathering and also the presence of any jointing.	90
Type A	Includes firm to stiff clay (UCS>150kPa) and cohesive or cemented sands and gravels (hardpan) above the groundwater table which have no fissures, weak layers, or inclined layers that dip into the trench.	¾:1	53
Type B	Include cohesive soils with an unconfined compressive strength between 50 - 150kPa and include angular gravel, silt and soils that meet compressive strength requirements of Type A soil but that are fissured. Layered material sloping into the trench will also classify as Soil Type B .	1:1	45
Type C	Include cohesive soils with an unconfined compressive strength of <50kPa. Type C soils typically consist gravel, sand and submerged soil, soil from which water freely seeps and submerged rock.	1,5:1	34-35

***Certain exceptions/construction or site conditions may result in a lower soil type classification than described.**

b) <u>Terrace embankments</u>

Due to the sloping topography, especially in the western (approx. 1(v) : 9(h)) and eastern (approx. 1(v) : 15(h)) parts of the site, extensive bulk earthworks will be required to level topography and create terraces for future housing. At this stage is it unknown whether terrace construction will include cut, cut and fill or mostly fill terraces. The following should however be noted in this regard:-

i. Any engineered terrace will need to be constructed using a suitable quality granular material, compacted to at least 95% MDD.

ii. In-situ transported sandy soils are generally highly compressible in the upper 0.2 to 1.0m (depending on the thickness of the transported horizon). In order to limit long term settlement of the engineered fill and any structures founded in the engineered fill overlying these soils, compaction of these in-situ soils will also be required prior to construction of overlying engineered terrace fill. This will require over-excavation and additional compaction of these in-situ soils. DCP testing across the footprint of the engineered terraces is recommended prior to earthworks, in order to identify the aerial extent and depth of highly compressible in-situ soils and where greater depth of soil improvement is required.

iii. Adequate lateral support (formal retaining walls) or suitably sloped embankments (with adequate erosion protection) are required for terraces to prevent lateral soil movement under load (resulting in additional settlement) and also prevent long term erosion.

iv. For sloped terrace embankments, the engineered fill would need to be constructed in accordance with SANS 10400-H. This generally requires the toe of foundations (strip footings or slab-on-the-ground foundations) to be at least 1.0m from the edge of the 1(v): ≥1(h) sloped engineered fill embankment, with an additional erosion protection support berm (preferably vegetated) sloped of not less than 1(v): ≥2(h) extending beyond the engineered fill section. If vegetation is not possible, more formal erosion support or lateral measures would be recommended (block retaining walls, gabion walls).

v. Any formal lateral support, permanent retaining walls (if applicable) or sloped embankments should be designed assessed in terms of internal stability (formal retaining walls) and global slope stability, using appropriate soil shear strength parameters (as provided in Table 7.5), as well as taking any temporary and permanent surcharge loading (from future structures) into consideration. Full drainage should be provided behind all retaining walls.

vi. For lateral support design for any areas of deep cut (>3.0m), additional investigation, likely in the form of rotary core drilling, will be required for design and excavation purposes.

vii. Earthworks and lateral support would all need to be designed and carried out in accordance with the SAICE code of practice for lateral support in surface excavations (1989).

viii. Site classifications provided in this report are based on in-situ conditions. Large scale bulk earthworks will alter the existing soil profile, possibly requiring re-evaluation of site classifications during the Phase 2 Geotechnical Investigation, which should be conducted following bulk earthworks.

Table 7.5 Expected soil shear strength engineering properties (with reference to laboratory test results and NAVFAC DM7 (1971))

Soil type	USCS Soil class	Mohr-Coulomb		Dry unit weight (kN/m^3)	Saturated unit weight (kN/m^3)	Tan Ø'
		Cohesion c' (kPa)	Angle of internal friction Ø' (degrees)			
Transported sandy soils	SM/SP	0 **[0]**	30-35 **[30]**	16.5-19.7 **[18]**	18-20 **[20]**	0.57
Residual sandstone	SC/SM	0-10 **[5]**	30-38 **[33]**	16.5-19.7 **[18]**	18-20 **[20]**	0.64
Notes: [Values in brackets indicate recommended values and values used in analysis where applicable]						

7.3 Excavation classification with respect to services

With reference to the encountered soil profile as indicated in Figure 6.2, "Soft Excavation" in terms of SANS 634:2012 will be applicable for any topsoils and transported soils.

Excavation within the bouldery transported soils, pedogenic and upper cemented residual soils should classify as "soft to intermediate" excavation.

Test pits generally met refusal within the medium to hard rock quartzitic sandstone bedrock, which depth varies across the site (encountered within 0.5m to 1.7m of ground level). Excavation within the sandstone bedrock can be classified as hard rock excavation, with occasional, but very limited zones of intermediate excavation (where close jointing and bedding planes allowed ripping with the larger excavator).

Depending on the depth of excavation required, the use of rock buckets, pneumatic breakers, power tools and blasting (or possibly chemical fracturing if blasting is not allowed) may be required. Ripping with rock buckets is however only expected to have limited success, depending on the orientation of the joint and bedding planes (planes of weakness in the rockmass).

7.4 Impact of the geotechnical character of the site on subsidy housing developments

The geotechnical character of the site is expected to have some impact on subsidy housing development and subsidy variations. Although not a requirement for SANS 634, in accordance with GSFH-2 Specifications (as required by the Department of Human Settlements), a schedule of generic subsidy variations applicable to the site is outlined in Table 7.6.

Table 7.6 Factors to Consider in Subsidy Variations

Category of subsidy Variation	Verification Criteria	Factors Affecting Amount of Subsidy Variation
Seepage / ground water Limited potential for Category 1	Permanent or perched water table less than 1.0m below ground surface. **Seepage was encountered at 1.0m in one test pit (TP12) in the area close to the drainage line/wetland. This level may rise during winter. Shallow seepage may also develop in other lower, flatter lying areas close to this drainage line during winter.**	Potential for limited requirement of subsurface drainage / improved damproofing measures to houses Service trenches to be dewatered during construction.
2 Erodability of soil (limited occurrences across the site)	Uppermost soil horizon (0 to 750mm) over erf is classified in terms of the Unified Soil Classification as SP, SM, CL or CH and average slope of erf measured in any direction is steeper than or equal to 1:7,5. **Although the general slopes across the site are less, there are smaller areas cross the site with a slope steeper than 1:7,5.**	Provision of retaining wall and earthworks required to reduce slopes.
Difficulty of servicing of land due to slopes: a) Type 2 site b) Type 3 site c) Type 4 site	a)Average slope measured across the erf in any direction exceeds 1:20 but is flatter than or equal to 1:10. **Mostly applicable to the central and eastern to south-eastern parts of the site** b)Average slope measured across the erf in any direction exceeds 1:10 but is flatter than or equal to 1:7,5 **Mostly applicable to the western parts of the site** c)Average slope measured across the erf in any direction exceeds 1:7,5 but is flatter than or equal to 1:5. **Only applicable to small limited parts of the site**	-Terracing for houses required. -Additional earthworks to roads and storm water control measures. -Formal erosion protection measures and possibly formal lateral support required for terrace embankments embankments, depending on positioning of housing and surcharge loads.

Category of subsidy Variation	Verification Criteria	Factors Affecting Amount of Subsidy Variation
d) Type 5 site	d)Average slope measured across the erf in any direction exceeds 1:5. **Only applicable to small limited parts of the site**	
Difficulty of excavation: **Due to variable slope and depth of bedrock the following conditions are expected across the site**		
a)Type 1 condition	a) Average slope measured across the erf in any direction is flatter than or equal to 1:10 and between 10 and 40% of material to a depth of 1,5 metres below pre-development level is classified as hard rock excavation	-Additional cost of trench excavation.
b)Type 2 condition	b) Average slope measured across the erf in any direction is flatter than or equal to 1:10 and in excess of 40% of material to a depth of 1,5 metres below pre-development level is classified as hard rock excavation.	-Additional cost of trench excavation.
c)Type 4 condition	c) Average slope measured across the erf in any direction is steeper than 1:10 and the material to a depth of 1,5 metres below pre-development level is classified as Boulder Class A or Hard Rock excavation.	-Additional cost of trench excavation. Additional cost of road excavation.
Founding conditions: 3. Compressive soils Class S1 at surface in certain areas on site	Site class designations classified in accordance with 2.5 of Part 1 Section2 of the NHBRC Home Building Manual	Masonry houses will require foundation design, building procedures and precautionary measures to be in accordance with Tables 5, 6 and 7 of Part 1 Section2 of the NHBRC Home Building Manual

8. Site class designations

In accordance with SANS 10400-H, a conventional site classification is generally based on strip footings, either 0.60m (single storey) or 0.80m (double storey) wide, with a load limited to 50kPa founded at a depth of not less than 0.4m.

a) Due to variability in depth of bedrock and pockets of deeper highly compressible soils in all parts of the site, expected settlement was assessed at each test location.

b) An analysis of total elastic settlement using the above loading conditions and parameters, together with the results of the penetration testing and the method of Burland and Burbidge, as well as the appropriate depth ranges, would result in expected settlement varying from:

i. <3mm, in areas where founding would take place in or just above the shallow bedrock). Applicable site class of **R**.

ii. 5-10m, in areas of shallow residual sandstone or sandsotne bedrock located within 0.5-1.0m of surface. Applicable site class of **S.**

iii. 10-12mm in areas of deeper transported sandy soils (close to 1.0m or greater in depth). Applicable site class of **S1**.

c) Due to the variability in depth of bedrock and occurrences of pockets of deeper highly compressible soils, a site class of **S1-S/R** is assigned to the western parts (TP1-TP5), central parts (TP6, TP12 & TP13) and south-eastern parts (TP14, TP17 & TP18) of the site.

d) In the northern parts (TP7, TP8, TP9 & TP10) and far eastern part of the site (TP 11, TP15 & TP16) where shallow calcrete and shallow residual sandstone or sandstone bedrock is fairly consistent, a site class **S/R** is applicable.

Aerial extent of the site classes is provided in the site plan in Appendix A.

It is important to note the following:-

As per SANS 10400-H, the above classifications are based on a nominal 50kPa bearing pressure (for conventional strip foundations). Where shallow bedrock or residual soils are encountered, bearing pressures could easily be increased, with little increase in expected settlement. In areas of deeper pockets of transported soils, bearing pressures could also be increased, but increased settlement can be expected, which may alter the applicable site class. For example, a bearing pressure of up to approximately 80kPa for conventional strip footings could be used with no change in site class (although this would increase expected settlement from 12mm to 20mm in the worst case, but a site class of S1 would still applicable). Higher bearing pressures (>80kPa) may however increase expected settlement to >20mm (in which case a site class of S2 would then be applicable) in the worst case scenario.

Bulk earthworks are also expected to alter site topography with cut and fill terraces in large parts of the site. Final allowable bearing pressures would thus depend on bulk earthworks, depths of cuts and fill (where applicable) and material quality and compaction achieved.

This can be assessed separately if required, once design loads for structures are finalized and during the Phase 2 Geotechnical Investigation, following completion of bulk earthworks.

9. Foundation recommendations and solutions

Table 9.1 summarized potential founding options based on applicable site classes identified in Section 8, in accordance with SANS 10400-H. Relevant options for each site class are discussed further below:-

a) **Site Class S/R**

- For areas with a site class S/R, conventional strip footings with normal construction could be considered.
- In these areas, if required, the allowable bearing pressures could easily be increased with no change in site classification.
- For example, a bearing pressure of 120kPa could still expect settlement of <10mm.
- If founding directly on sandstone bedrock, even greater allowable bearing pressures are obtainable.
- Bulk earthworks with terrace construction may however be required in sloping areas. Allowable bearing pressures on engineered terraces would need to be assessed following completion of bulk earthworks (depending on depth if fill, material used and compaction achieved), as founding on a combination of sandstone bedrock (in cut) and engineered fill terrace, would increase the risk of differential settlement. A lower site class (such as S1) may then be applicable requiring modified normal construction methods or alternative foundation options (raft foundations) to account for potential differential settlement.

  For sloped terrace embankments, the engineered fill would need to be constructed in accordance with SANS 10400-H. This generally requires the toe of foundations (strip footings or slab-on-the-ground foundations) to be at least 1.0m from the edge of the 1(v): ≥1(h) sloped engineered fill embankment, with an additional erosion protection support berm (preferably vegetated) sloped of not less than 1(v): ≥2(h) extending beyond the engineered fill section.

- Surface beds can be founded conventionally on in-situ soils (in accordance with SANS 10400-J), following removal of any topsoil, uncontrolled fill (if encountered) and following compaction of the subgrade to at least 93% MDD, to account for high compressibility in the upper 0.2-0.5m of the profile. Due to variability in the classification of the transported sands (G7-G9) and presence of poor quality clayey sandy soils in certain areas, an imported granular sand layer (free draining clean sand from outside source or from an adequate material stockpile created on site) may also be required to directly underlie the surface beds. Surface beds should be isolated from the walls and contain suitable reinforcement in accordance with national standards.

b) **Site Class S1-S/R**

- Due to the variability in depth of bedrock and random pockets of deeper highly compressible sandy soils, greater variability in settlement and potential differential settlement exists.
- Erven may need to be assessed on an individual basis, but this cannot be done at this stage, taking into account the bulk earthworks still required to create engineered terraces.
- The simplest option applicable to all erven would be the use of modified construction to design structures to accommodate the expected settlement of up to 10-15mm for bearing pressures of 50kPa and potentially up to 20mm for bearing pressures of 80kPa (if applicable). Expected settlement may however change following terrace construction.
- An alternative would be the use of conventional strip foundations to deepened strip footings, extending through the full thickness of any compressible sandy soils where encountered and founding within the cemented residual sandstone or sandstone bedrock. Suitable founding material is generally expected within 1.0m to 1.2m of ground level. If founding in similarly competent material using deepened strip footings where required, allowable bearing pressures could easily be increased, with little additional settlement expected. Settlement values would be similar to those mentioned in the site class S/R.
- Founding on compacted soils (option 2 or 4 Table 9.1) could also be considered, but could likely be negated through the construction of adequately compacted engineered fill terraces (in areas of sloping topography). Depending on the thickness of the engineered fill and the proposed foundation size and founding depth, depth of compaction should extend below foundations to a depth of at least 1.5 x foundation width (900mm for 600mm strip footings and 1200mm for 800mm strip footings), as is indicated for options 2 & 4 in Table 9.1. This may require over excavation and compaction of in-situ soils prior to terrace fill construction.

  For sloped terrace embankments, the engineered fill would need to be constructed in accordance with SANS 10400-H. This generally requires the toe of foundations (strip footings or slab-on-the-ground foundations) to be at least 1.0m from the edge of the 1(v): ≥1(h) sloped engineered fill embankment, with an additional erosion protection support berm (preferably vegetated) sloped of not less than 1(v): ≥2(h) extending beyond the engineered fill section.

  Under these conditions settlement is not likely to exceed 10mm for 50kPa. Heavier loads could also be considered, but can would first need assessment of the engineered fill terraces following bulk earthworks so as to assess potential for differential settlement. This would need to be assessed during the Phase 2 Geotechnical Investigation.
- Surface beds can be founded conventionally on engineered terrace soils (where applicable). Alternatively they can be founded conventionally (in accordance with SANS 10400-J) following removal of any topsoil, uncontrolled fill (if encountered) and following compaction of highly compressible in-situ transported soils (where encountered). Due to variability in the classification of the transported sands (G7-G9) an imported granular sand layer (free draining clean sand) may also be required to directly underlie the surface beds. Surface beds should

be isolated from the walls and contain suitable reinforcement in accordance with national standards.

Alternatively they can be designed as suspended slabs.

Table 9.1 Foundation recommendations for single/double storey masonry structures (limited to 50kPa bearing pressures) based on site classification in accordance with SANS 10400-H

a) Site class S/R				
Most Applicable Site class	**Estimated range settlement (mm)**	**Founding Option**	**Construction type**	**Foundation design and building procedures (expected damage limited to category 1 of expected damage**
S	<10	1	Normal	• Normal construction (strip footing or slab-on-the-ground) foundation • Foundation bearing pressure not to exceed 50 kPa • Good site drainage
b) Site Class S1-S/R				
S1	10-20	1	Modified normal construction	• Reinforced strip footings • Articulation joints at some internal doors and all external doors • Light reinforcement in masonry • Site drainage and service and plumbing precautions • Foundation pressure not to exceed 50 kPa
		2	Compaction of in-situ soils below individual footings	• Remove in-situ material below foundations to a depth and width of 1,5 times the foundation width or to a suitable soil horizon and replace with material compacted to 93 % MOD AASHTO density at −1 % to +2 % of optimum moisture content • Normal construction with lightly reinforced strip foundations and light reinforcement in masonry
		3	Deep strip foundations	• Normal construction with drainage precautions when founding on a suitable soil horizon below the problem soil horizon • mesh reinforcement in floor slabs
		4	Soil raft	• Remove in-situ material to 1,0 m beyond the perimeter of the building to a depth of 1,5 times the widest foundation or to a suitable soil horizon and replace with material compacted to 93 % MOD AASHTO density at −1 % to +2 % of optimum moisture content • Normal construction with lightly reinforced strip footings and light reinforcement in masonry

10. Drainage

The investigation was conducted at the end of the dry summer period. Seepage from a perched water table was only encountered in test pit TP12, located close to the natural drainage line/wetland area, at a depth of 1.0m. This level could potentially rise during the wet winter season.

Shallow seasonal seepage could also develop in other lower lying areas and close to the natural drainage line during the wet season. Transported sandy soils are expected to have moderate to good permeability properties (refer to expected permeability values in Table 7.1a & b). Seepage will thus likely develop within these soils, close to the upper contact of the very low permeability cemented clayey residual soils or sandstone bedrock.

In sloping areas limited infiltration will occur and stormwater runoff towards lower lying areas is likely (with associated erosion).

In flatter lower lying areas, where the low permeability cemented soils or bedrock, are close to surface (within 0.5-1.0m) low infiltration rates are also expected and limited ponding my occur during periods of heavy rainfall.

Careful consideration to overall site drainage design and stormwater management is thus required.

The following should be noted in this regard:-

- Conventional dewatering measures such as pumping from sumps should provide the most efficient means of dewatering in limited areas if seepage is encountered and where required. Although unlikely, the need for more extensive dewatering measures would need to be assessed during construction.
- Limited dewatering may also be required if construction commences during winter and heavy rain spells cause flooding of foundation trenches (where applicable).
  Flooded foundation trenches could potentially result in softening of soils at trench invert level (depending on material encountered). Removal of any softened soils (if applicable) or the use of a blinding layer may be required.
- Sound water management in the control and disposal of storm water is required and will also minimize the risk of water ingress and consequential settlement occurring in soils below foundations, pavements and surface beds.
- Given the risk of standing water in limited areas and stormwater runoff from sloping areas towards lower lying areas, sound water management in the control and disposal of storm water is required and will also minimize the risk of water ingress and consequential settlement and rutting occurring in soils below pavements and surface beds.
- The grading of slopes to promote run-off away from structures and towards storm water collection points is recommended.
- Sloping areas, embankments and engineered terraces should be constructed with adequate erosion protection measures. This may include catchment drains above the crest of the slope/embankment, and adequate vegetation or formal erosion protection across the slope face.
- Full drainage should be installed behind any new retaining walls (if applicable).
- Adequate stormwater drains are required across the site.
- Ensuring the efficient collection and disposal of storm water and water from downpipes off-site and regular checking of wet services for leaks.
- Access roads and parking areas should also be constructed with adequate additional drainage to assist in stormwater catchment and assist in transported stormwater away from structures.
- Structures will require standard damp-proofing measures.
- All drainage and storm water services should be designed in accordance with sound engineering practice.

11. Special precautionary measures

As outlined above, the most significant special precautionary measures required are:

- Extensive bulk earthworks will be required due to the variably sloping topography.
- Shallow bedrock will provide good founding conditions where encountered, but will result in additional excavation costs.
- Due to pockets of highly compressible sandy soils across parts of the site, founding options will vary across the site.
- Adequate site stormwater, site drainage and erosion protection measures will be required.
- A comprehensive Phase 2 Geotechnical Investigation will be required to confirm allowable bearing pressures and foundation recommendations following bulk earthworks.

12. Conclusions

The Phase 1 geotechnical site investigation indicates that the site is generally suitable for project linked subsidy housing development. The shallow bedrock should provide a competent founding horizon for future structures, but depth of bedrock varies across the site. Additional costs relate to:-

- Subgrade improvement (compaction) for access roads and surface beds.
- Modified construction/deepened strip footings or the creation of suitably compacted engineered terraces in sloping areas or areas of deeper highly compressible sandy soils
- High cost of excavation in shallow bedrock.
- Adequate stormwater and erosion management across the site.

13. Recommendations

The Phase 1 geotechnical investigation indicates a site classification of **S/R,** and **S1-S/R** was assigned to the site.

Applicable foundation options are discussed in Section 9.

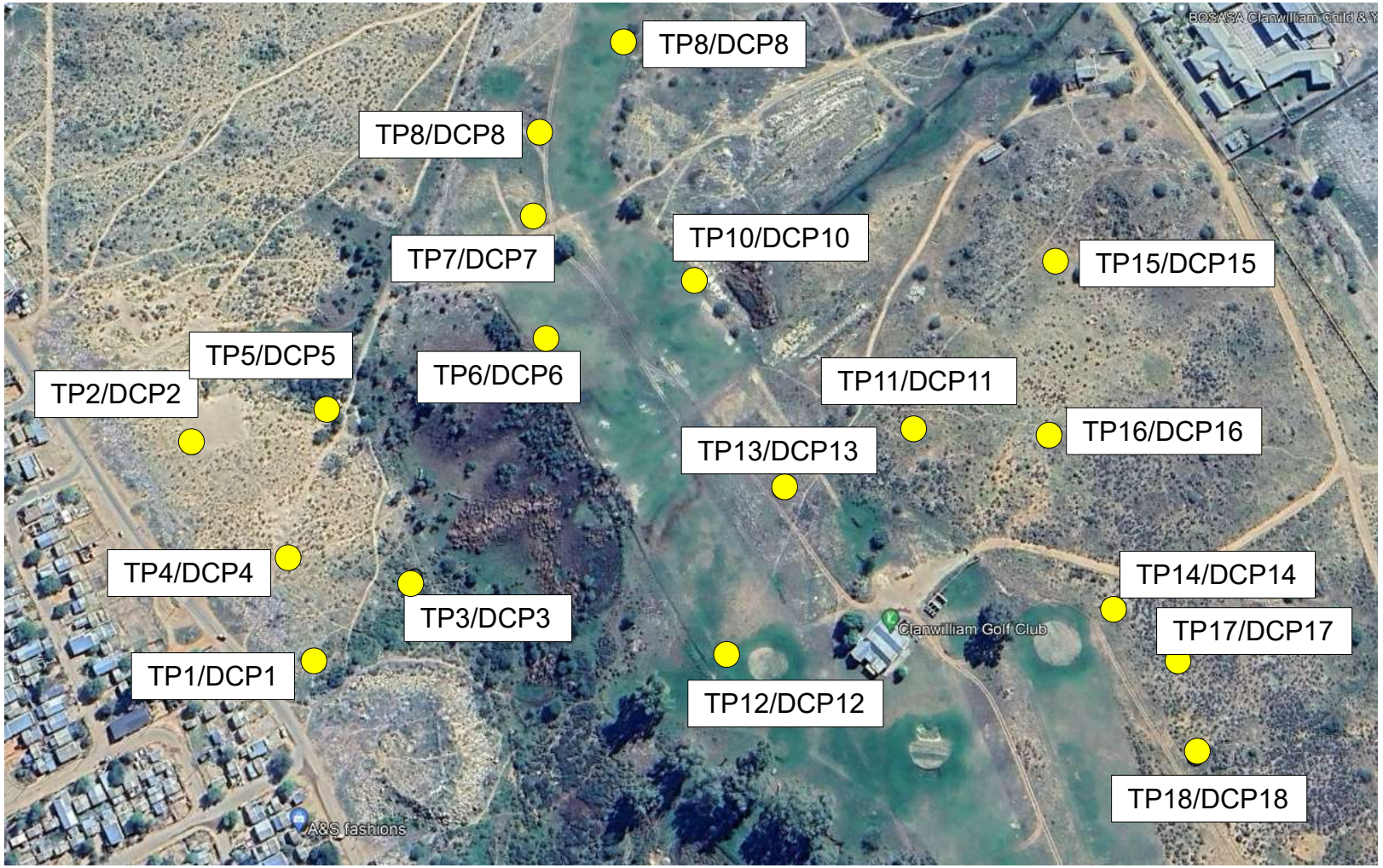
On-site material engineering properties are discussed in Section 7.1, while recommendations for site drainage are also discussed in Section 10.



EUGENE LAUBSCHER

Appendix A

Site plan
Site Class Designations



Key

Test pit, DCP location

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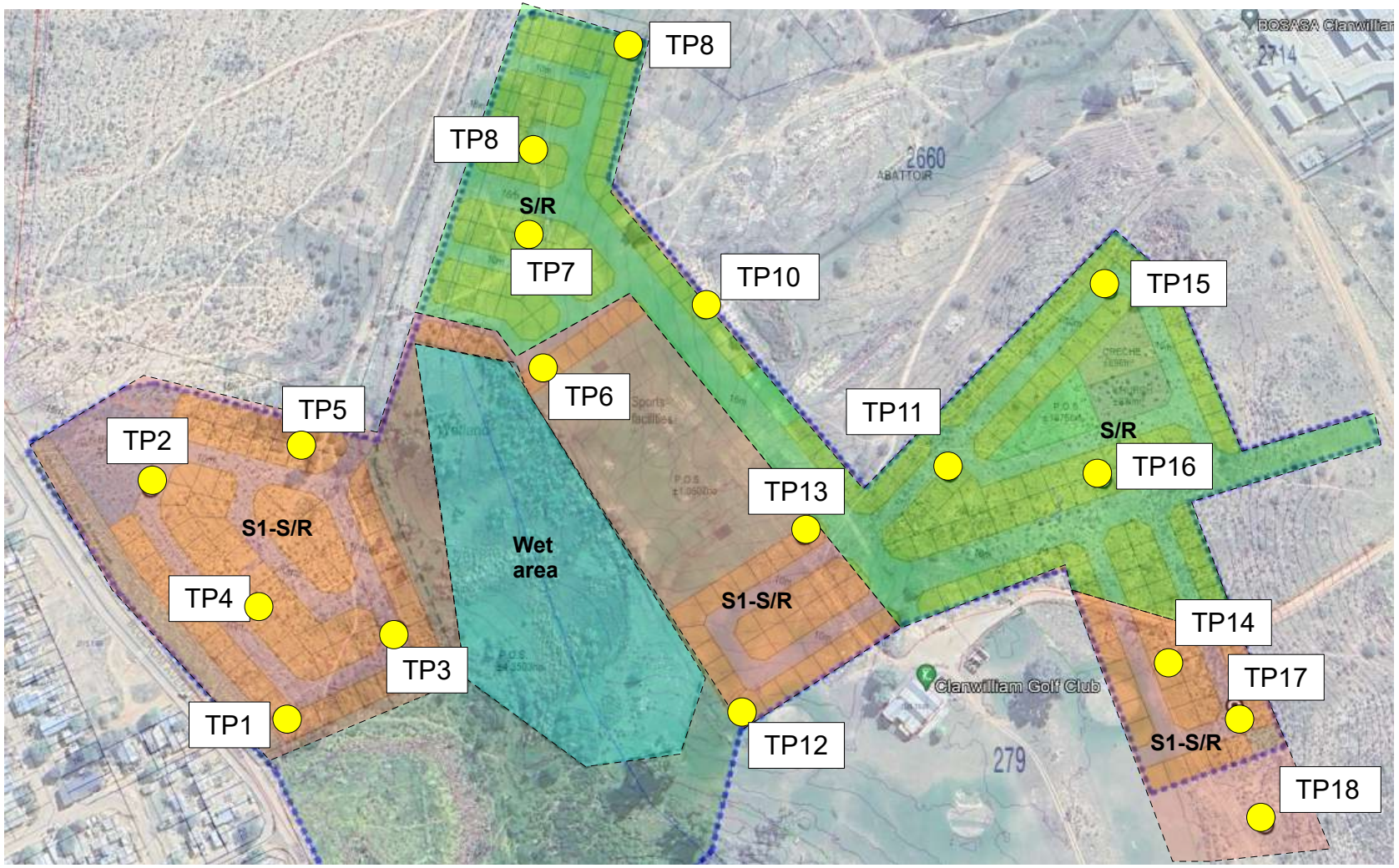
Client:	**ASLA Devco**				
Project title:	Clanwilliam housing UISP project				
Drawing title:	Site plan with test positions				
Date:	04/2024	**Traced by:**		EL	
Scale:	NTS	**Fig no.:**	1a	**Job no.:**	006-24



Key

Test pit, DCP location

Natural Drainage line/wet area as indicated on Topo plan provided by client

Site class

S/R

S1-S/R

Client:	**ASLA Devco**				
Project title:	Clanwilliam housing UISP project				
Drawing title:	Site layout plan with test positions and site classifications				
Date:	04/2024	**Traced by:**		EL	
Scale:	NTS	**Fig no.:**	1b	**Job no.:**	006-24

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Appendix B

Soil profiles

CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

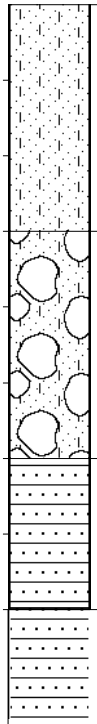
CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP01
Sheet 1 of 1

JOB NUMBER: 006-24

Scale 1:10



0.00 Dry light brown loose weakly cemented slightly silty fine to medium grained sand. Transported.
* Some termite holes present.

0.30 Dry brown medium dense angular sandstone cobbles and boulders in slightly silty sand matrix. Transported.

0.60 Orange and brown moderately weathered fine to medium grained medium jointed medium hard rock to hard rock sandstone.

0.80 Refusal on medium hard rock to hard rock sandstone.

NOTES

1) No seepage.
2) Sidewall collapse in loose sand.
3) Refusal on hard rock sandstone.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP01
CLANWILLIAM

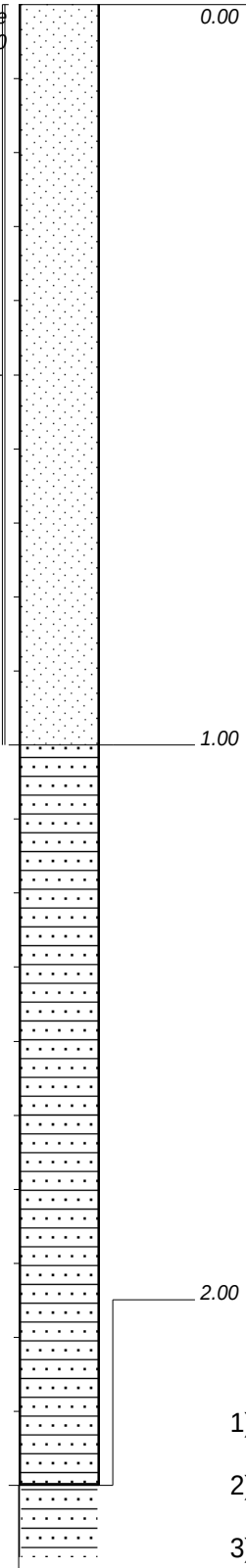
CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP02
Sheet 1 of 1

JOB NUMBER: 006-24



Dry light brown very loose to loose fine to medium grained sand. Transported.
* Has low silt content.

Dry light brown and orange fine to medium grained moderately weathered closely to medium jointed medium hard rock sandstone - rippable due to jointing orientation.

Refusal on medium hard rock sandstone.

NOTES

1) No seepage.
2) Sidewall collapse in loose sand.
3) Refusal on medium hard rock sandstone.
4) SMALL&BULK samples at 0.0--1.0m.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP02

CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

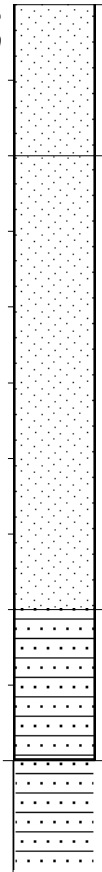
CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP03
Sheet 1 of 1

JOB NUMBER: 006-24

Scale 1:10



0.00 Dry light brown very loose fine to medium grained sand with scattered sandstone gravel and cobbles. Transported.
* High root content.

0.20 Dry light brown loose fine to medium grained sand with scattered angular sandstone cobbles.

0.80 Orange and brown moderately weathered fine to medium grained medium jointed medium hard rock to hard rock sandstone.

1.00 Refusal on medium hard rock to hard rock sandstone.

NOTES

1) No seepage.
2) Sidewall collapse in loose sand.
3) Refusal on sandstone bedrock.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP03

CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

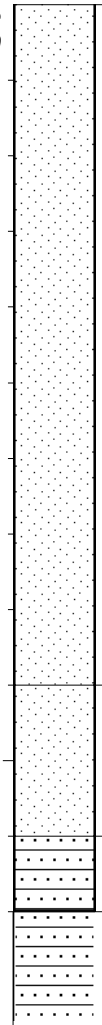
CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP04
Sheet 1 of 1

JOB NUMBER: 006-24

Scale 1:10



0.00 Dry light brown very loose fine to medium grained sand with low silt content. Transported.
* Scattered roots in upper 0.1m.

0.90 Dry light brown loose fine to medium grained sand with scattered angular sandstone cobbles.

1.10 Orange and brown moderately weathered fine to medium grained medium jointed medium hard rock to hard rock sandstone.

1.20 Refusal on medium hard rock to hard rock sandstone.

NOTES

1) No seepage.
2) Sidewall collapse in loose sand.
3) Refusal on sandstone bedrock.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP04

CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

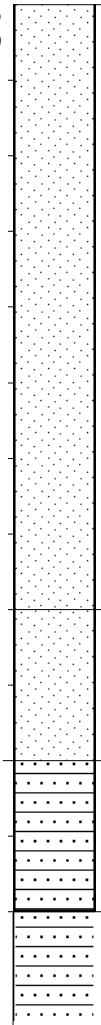
CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP05
Sheet 1 of 1

JOB NUMBER: 006-24

Scale 1:10



0.00 Dry light brown very loose to loose fine to medium grained sand. Transported.
* Has low silt content.

0.80 Dry light brown medium dense fine to medium grained sand with scattered angular sandstone boulders and cobbles. Transported.

1.00 Orange and brown moderately weathered fine to medium grained medium jointed medium hard rock to hard rock sandstone.

1.20 Refusal on medium hard rock to hard rock sandstone.

NOTES

1) No seepage.
2) Sidewall collapse in loose sand.
3) Refusal on sandstone bedrock.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP05

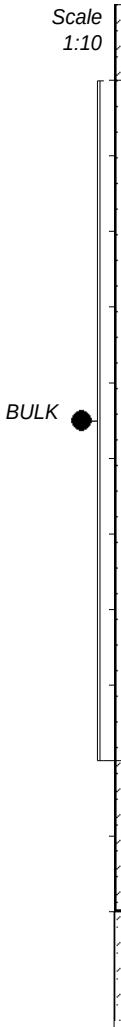
CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP06
Sheet 1 of 1

JOB NUMBER: 006-24



0.00 – Moist dark brown very loose clayey silty sand. Topsoil - likely imported.
* High root content.

0.10 – Dry cream very loose to loose fine to medium grained sand. Likely transported.

1.00 – Dry grey and yellow orange very dense strongly cemented clayey sand. Possibly residual sandstone.
* Scattered fine roots.

1.20 – End of test pit strongly cemented clayey sand.

NOTES

1) No seepage.
2) Sidewall collapse in loose sand.
3) Excavator experienced difficulty in strongly cemented sand.
4) BULK sample at 0.1--1.0m.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP06

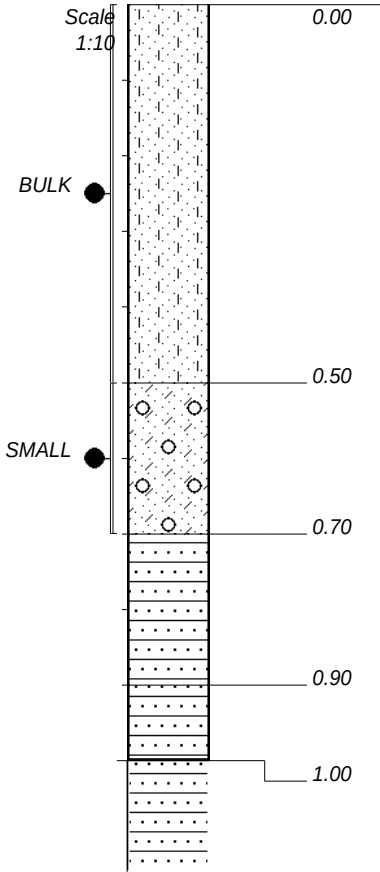
CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP07
Sheet 1 of 1

JOB NUMBER: 006-24



0.00 Dry light brown loose to medium dense weakly cemented silty fine to medium grained sand. Transported.

0.50 Slightly moist yellow brown with orange speckles stiff gravelly clayey sand. Possibly residual sandstone.

0.70 Orange with white speckles highly weathered fine to medium grained very soft rock sandstone.

0.90 Cream and orange moderately weathered fine to medium grained closely to medium jointed medium hard rock sandstone.

1.00 Refusal on medium hard rock sandstone.

NOTES

1) No seepage.
2) No sidewall collapse.
3) Refusal on sandstone bedrock.
4) SMALL sample at 0.5--0.7m.
5) BULK sample at 0.0--0.5m.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP07

CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

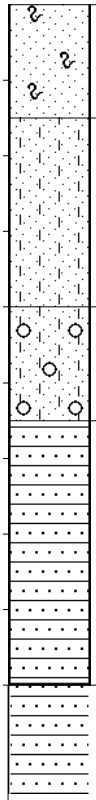
CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP08
Sheet 1 of 1

JOB NUMBER: 006-24

Scale 1:10



0.00	Dry to slightly moist light brown very loose slightly silty fine to medium grained sand. Transported topsoil. * Contains roots.
0.15	Dry light brown loose slightly silty fine to medium grained sand. Transported.
0.40	Dry orange and yellow dense weakly cemented (ferruginised) gravelly silty sand. Pedogenic.
0.55	Orange with white speckles highly weathered fine to medium grained very soft rock sandstone.
0.90	Refusal on medium hard rock sandstone.

NOTES

1) No seepage.
2) No sidewall collapse.
3) Refusal on medium hard rock sandstone bedrock.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP08

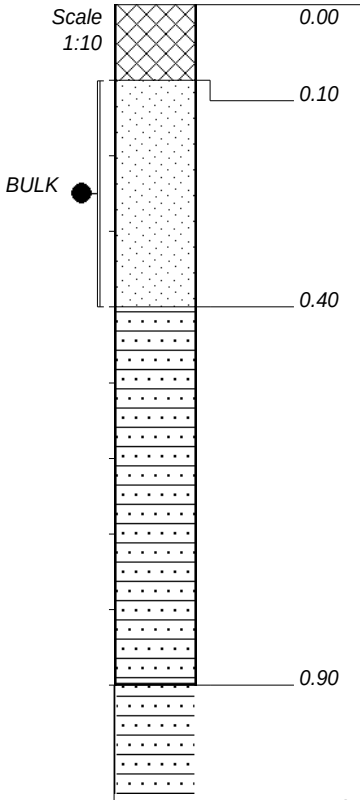
CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP09
Sheet 1 of 1

JOB NUMBER: 006-24



0.00 – 0.10: Slightly moist brown silty sand. Fill - topsoil.
* Contains isolated pieces of plastic.

0.10 – 0.40: Slightly moist brown loose medium grained sand. Transported.

0.40 – 0.90: Orange with white speckles highly weathered fine to medium grained very soft rock sandstone.

0.90: Refusal on very soft rock sandstone.

NOTES

1) No seepage.
2) No sidewall collapse.
3) Refusal on sandstone bedrock.
4) BULK sample at 0.1--0.4m.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP09

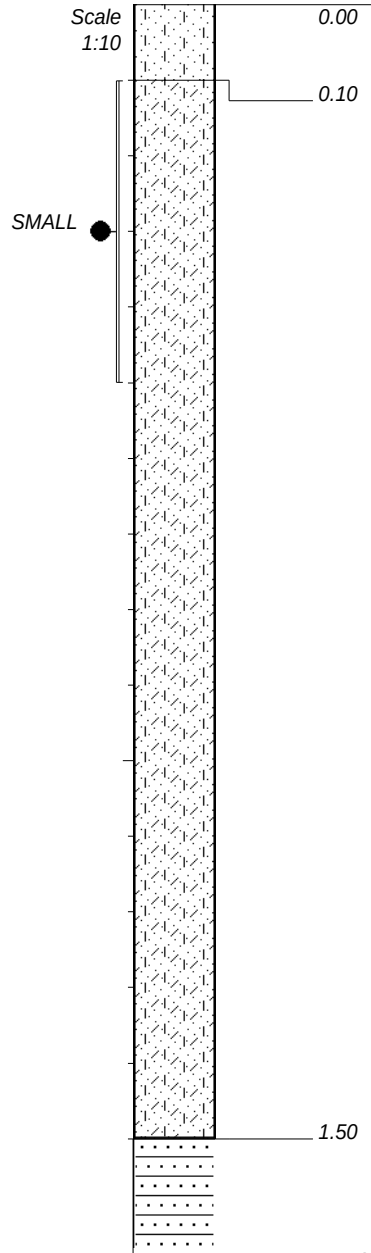
CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP10
Sheet 1 of 1

JOB NUMBER: 006-24



Dry light brown loose to medium dense weakly cemented silty fine to medium grained sand. Transported.

Dry yellow brown dense weakly cemented relict jointing visible slightly clayey silty fine to medium grained sand. Residual sandstone.
* Breaks down into clayey silty sand with excavated.

End of test pit on very soft rock sandstone.

NOTES

1) No seepage.
2) No sidewall collapse.
3) Not refusal but excavator experienced difficulty (ripping required).
4) SMALL sample at 0.1--0.5m.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP10

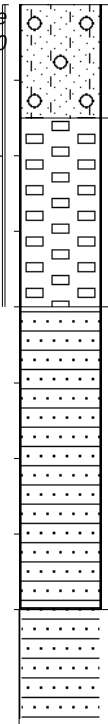
CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP11
Sheet 1 of 1

JOB NUMBER: 006-24



0.00 Dry brown loose to medium dense weakly cemented gravelly silty sand. Transported.

0.15 Dry cream very dense strongly cemented hardpan calcrete.

0.40 Orange and brown moderately weathered fine to medium grained closely to medium jointed medium rock to hard rock sandstone.

0.80 Refusal on medium rock to hard rock sandstone.

NOTES

1) No seepage.
2) No sidewall collapse.
3) Not refusal but excavator experienced difficulty (ripping required).
4) BULK sample at 0.0--0.4m.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP11

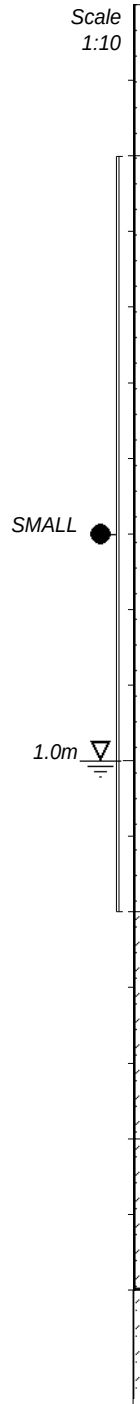
CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP12
Sheet 1 of 1

JOB NUMBER: 006-24



0.00

Moist brown very loose silty sand. Topsoil - possibly transported.
* High root content.

0.20

Very moist to wet creamy orange loose fine to medium grained sand. Transported.

1.20

Very moist green and brown firm clayey sand. Likely transported.

1.50

Dry grey and yellow orange very dense strongly cemented clayey sand. Possibly residual sandstone.
* Scattered fine roots.

1.70

End of test pit on strongly cemented clayey sand.

NOTES

1) Low seepage at 1.0m.
2) Sidewall collapse in loose wet sand.
3) Not refusal but excavator experienced difficulty in strongly cemented soils.
4) SMALL sample at 0.2--1.2m.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP12

CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

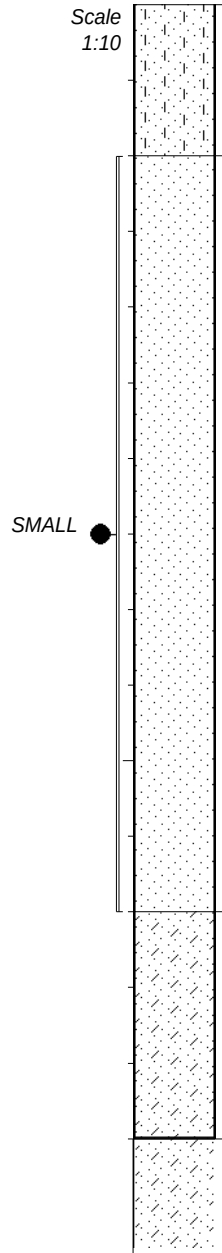
CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP13
Sheet 1 of 1

JOB NUMBER: 006-24

Scale 1:10



0.00 Slightly moist dark brown very loose slightly silty sand with isolated gravel. Transported - topsoil.
* Contains root growth.

0.20 Dry to slightly moist creamy light brown loose to medium dense weakly cemented in zones fine to medium grained sand. Transported.
* Scattered roots present.

1.20 Dry grey and yellow orange very dense strongly cemented clayey sand. Possibly residual sandstone.
* Scattered fine roots.

1.50 End of test pit on strongly cemented clayey sand.

NOTES

1) No seepage.
2) No sidewall collapse.
3) Not refusal but excavator experienced difficulty in strongly cemented soils.
4) SMALL sample at 0.2--1.2m.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP13

CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

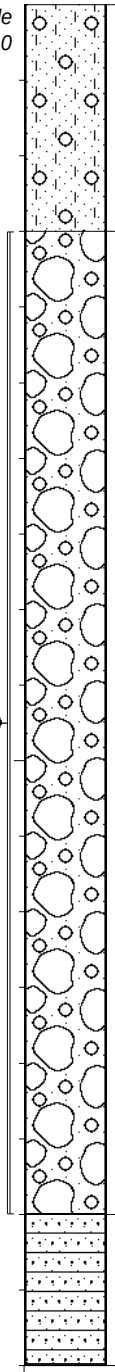
CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP14
Sheet 1 of 1

JOB NUMBER: 006-24

Scale 1:10



0.00 Dry light brown loose gravelly silty sand. Transported.
* Some root growth in upper 0.15m.

0.30 Dry orange and brown medium dense to dense angular sandstone boulders, (0.6x0.8x0.4m), cobbles with sandy gravel to gravelly sand. Likely transported.

1.60 Creamy orange moderately weathered fine to medium grained sand closely to medium bedded and jointed medium hard rock sandstone.

1.80

NOTES

1) No seepage.
2) No sidewall collapse.
3) Refusal on sandstone bedrock.
4) BULK sample at 0.3--1.6m.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP14

CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

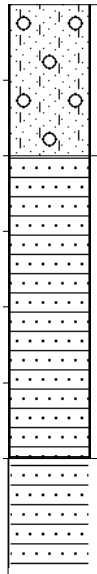
CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP15
Sheet 1 of 1

JOB NUMBER: 006-24

Scale 1:10



0.00 Dry light brown loose to medium dense weakly cemented gravelly slightly silty fine grained sand.

0.20 Creamy orange moderately weathered fine to medium grained closely to medium bedded and jointed medium hard rock sandstone.

0.60 Refusal on medium hard rock sandstone.

NOTES

1) No seepage.
2) Sidewall collapse in loose sand.
3) Refusal on sandstone bedrock.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP15

CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

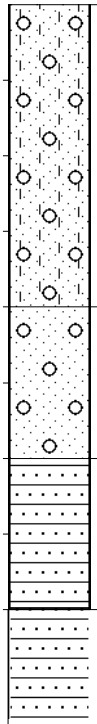
CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP16
Sheet 1 of 1

JOB NUMBER: 006-24

Scale 1:10



0.00 Dry light brown loose to medium dense weakly cemented gravelly slightly silty fine grained sand.

0.40 Dry light brown medium dense gravelly cobbly (angular sandstone) sand. Transported.

0.60 Orange and brown moderately weathered fine to medium grained closely to medium jointed medium rock to hard rock sandstone.

0.80 Refusal on medium rock to hard rock sandstone.

NOTES

1) No seepage.
2) Sidewall collapse in loose sand.
3) Refusal on sandstone bedrock.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP16

CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

CLANWILLIAM HOUSING UISP

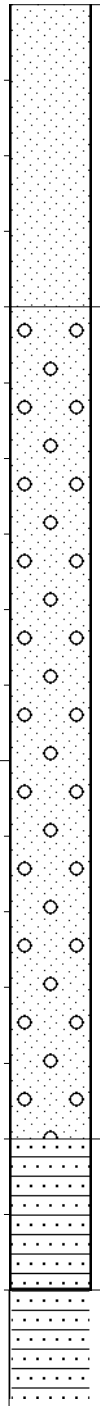
TEST PIT SOIL PROFILES

HOLE No: TP17
Sheet 1 of 1

JOB NUMBER: 006-24

Scale 1:10

SMALL



0.00 Dry orange brown very loose to loose fine to medium grained sand with low fines content. Transported.

0.40 Dry cream dense to very dense moderately to strongly cemented zones of calcrete with zones of weakly calcretised gravelly sand and sandy gravel. Pedogenic.

1.50 Creamy orange moderately weathered fine to medium grained closely to medium bedded and jointed medium hard rock sandstone.

1.70 Refusal on medium hard rock sandstone.

NOTES

1) No seepage.
2) Sidewall collapse in loose sand.
3) Refusal on sandstone bedrock.
4) SMALL sample at 0.0--0.4m.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP17

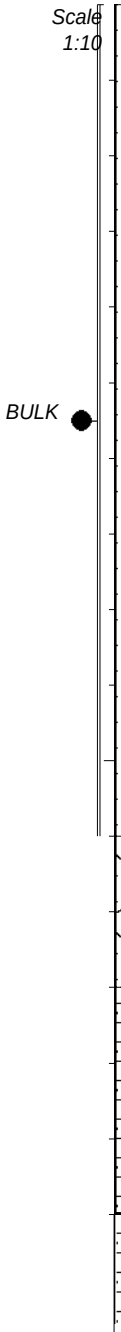
CORE GEOTECHNICAL CONSULTANTS
Engineering Geology and Geohydrology

CLANWILLIAM HOUSING UISP

TEST PIT SOIL PROFILES

HOLE No: TP18
Sheet 1 of 1

JOB NUMBER: 006-24



0.00

Dry orange brown very loose to loose fine to medium grained sand with low fines content and isolated gravel. Transported.
* Root material in upper 0.2m.

1.10

As above but with small to medium angular sandstone boulders and cobbles. Transported.

1.30

Creamy orange moderately weathered fine to medium grained closely to medium bedded and jointed medium hard rock sandstone.

1.60

Refusal on medium hard rock sandstone.

NOTES

1) No seepage.
2) Sidewall collapse in loose sand.
3) Refusal on sandstone bedrock.
4) BULK sample at 0.0--1.1m.

CONTRACTOR :
MACHINE : KOMATSU PC200
DRILLED BY :
PROFILED BY : Eugene Laubscher
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 March 2024
DATE : 11/04/2024 06:52
TEXT : ..ngPhase1soilprofiles.txt

ELEVATION : Ground level
X-COORD :
Y-COORD :

HOLE No: TP18

Appendix C

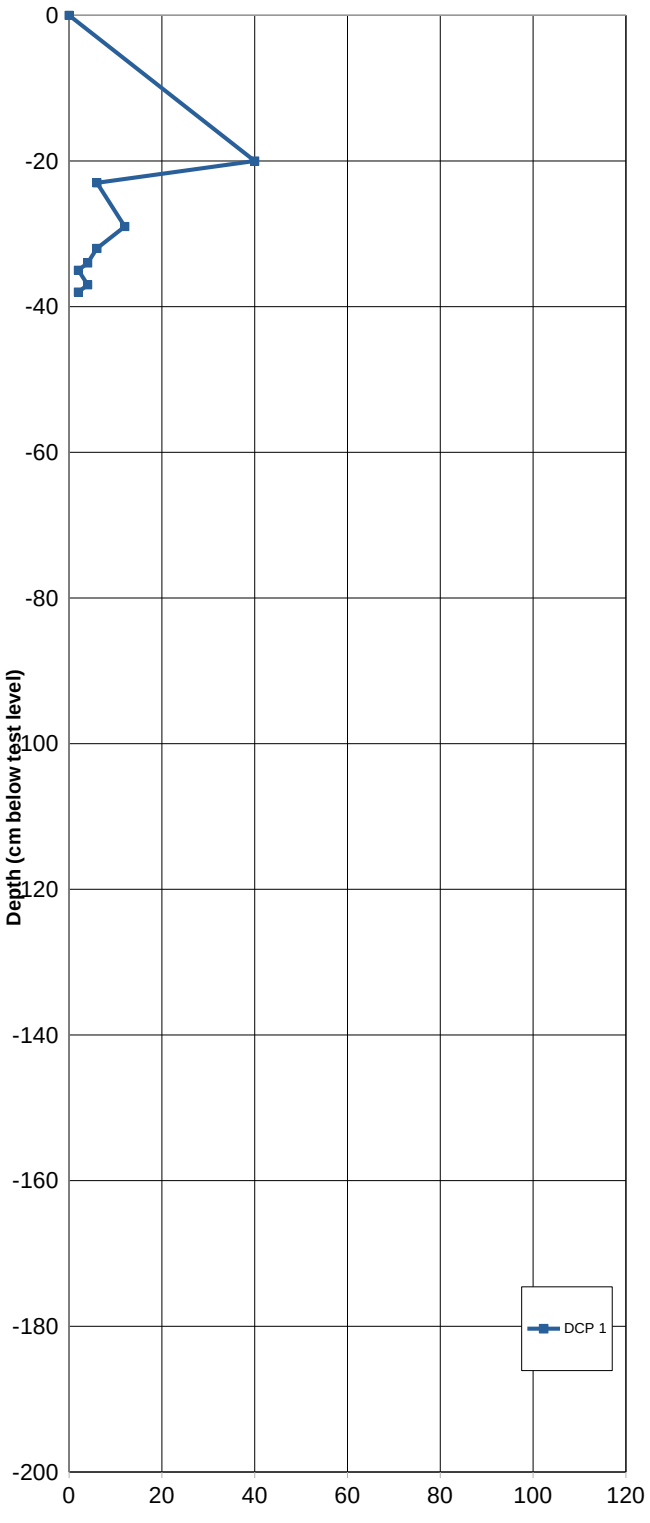
DCP test results
(Dynamic Cone Penetrometer)

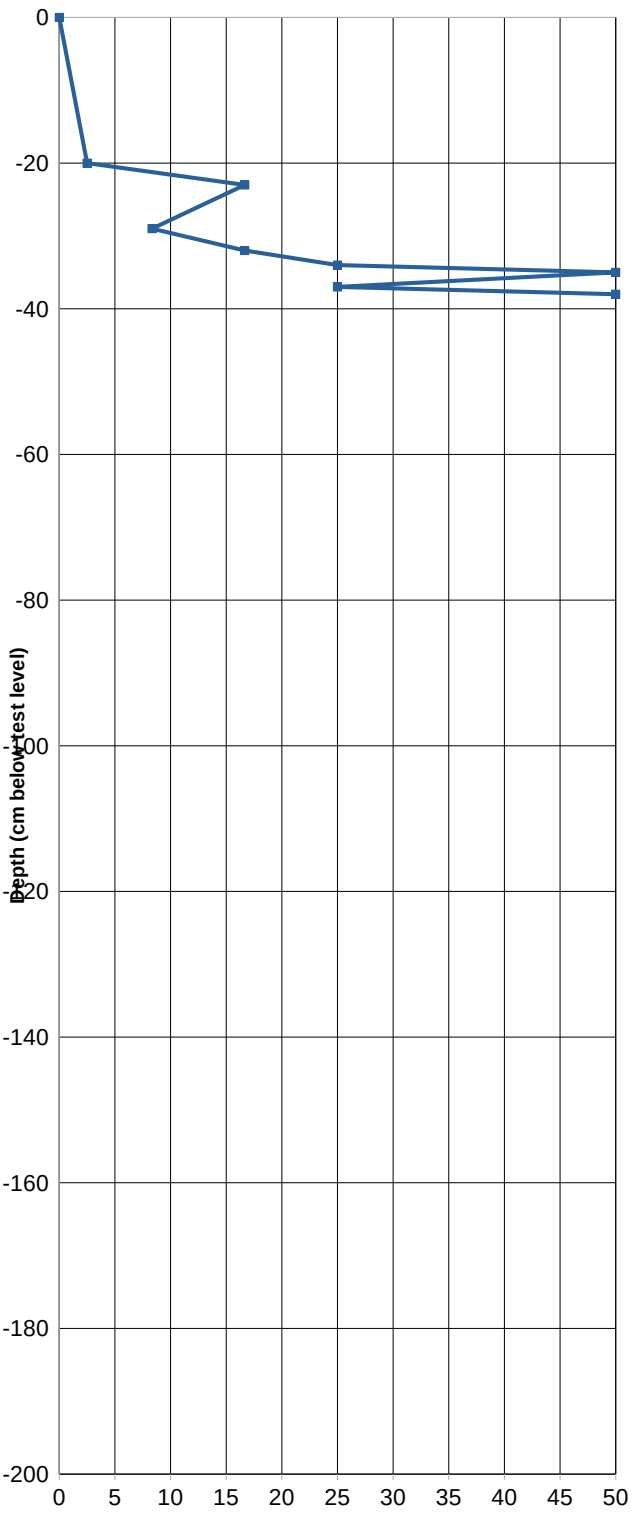
CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 1**

LEVEL: GL



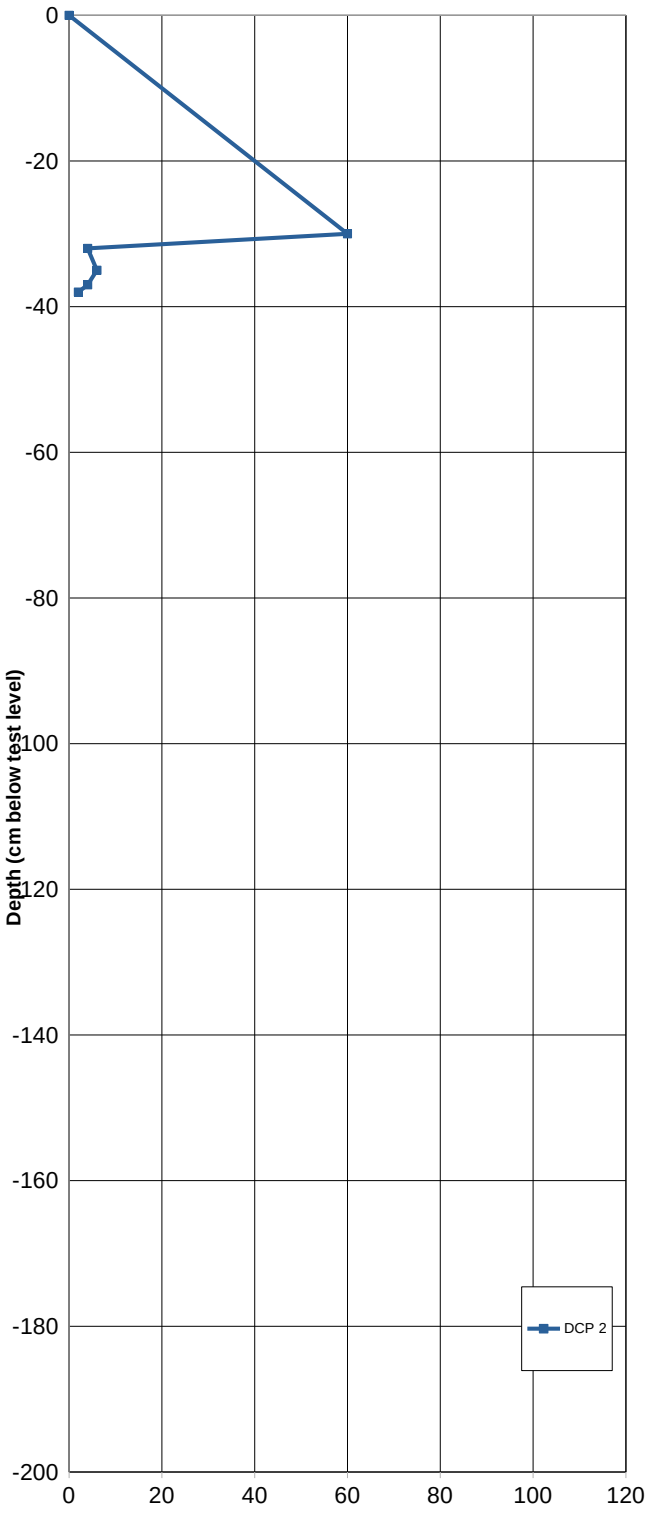


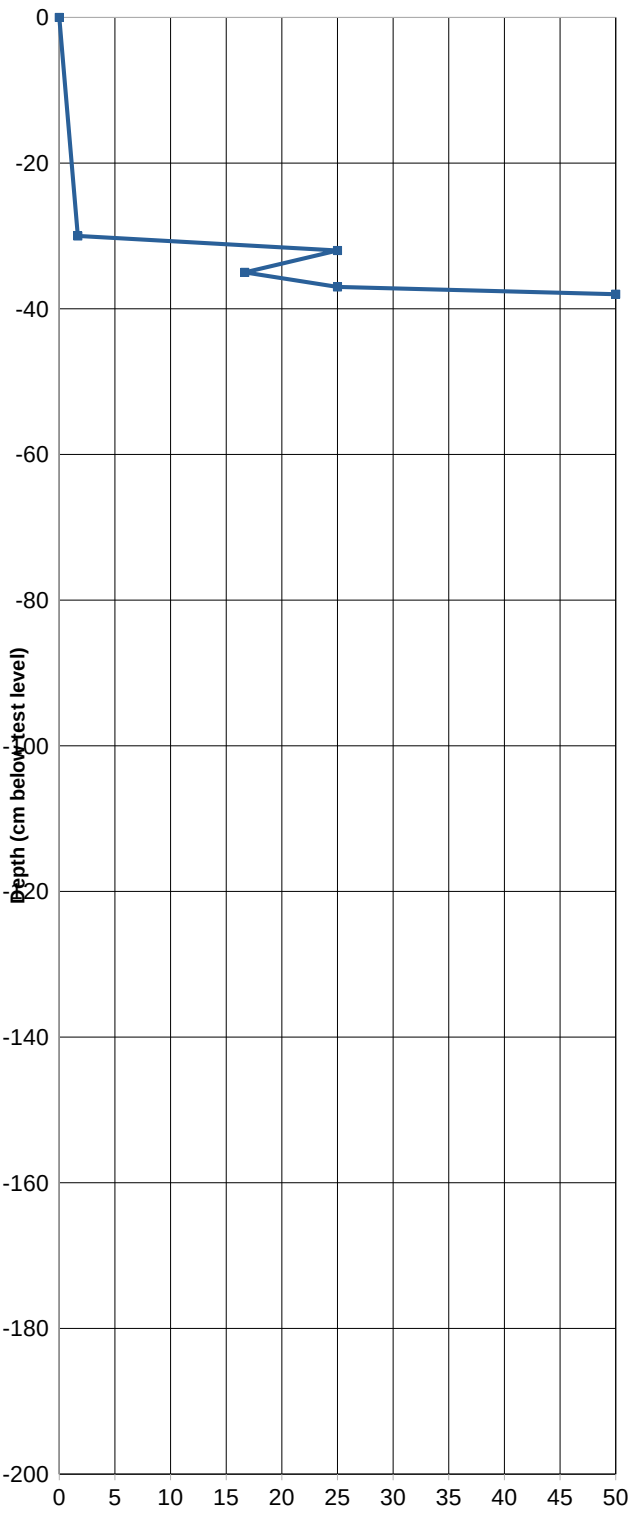
CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 2**

LEVEL: GL





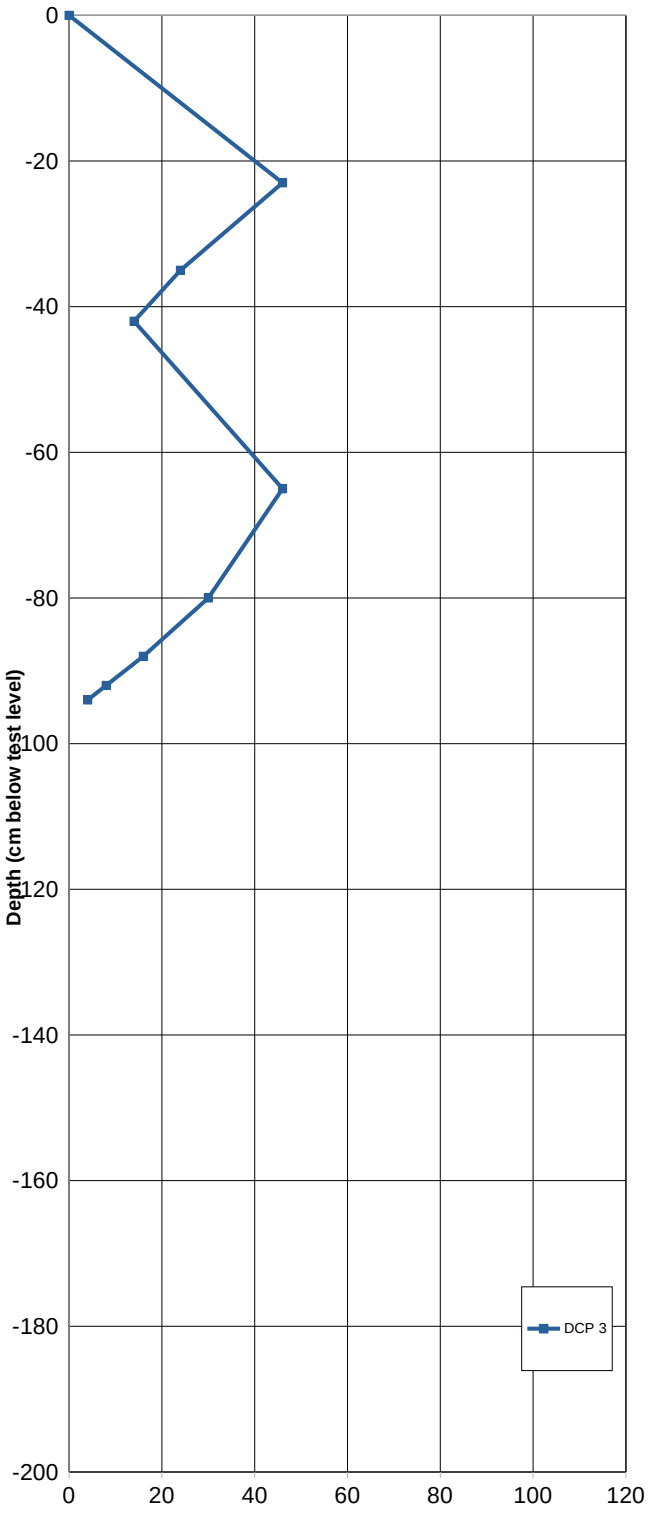
CORE GEOTECHNICAL CONSULTANTS

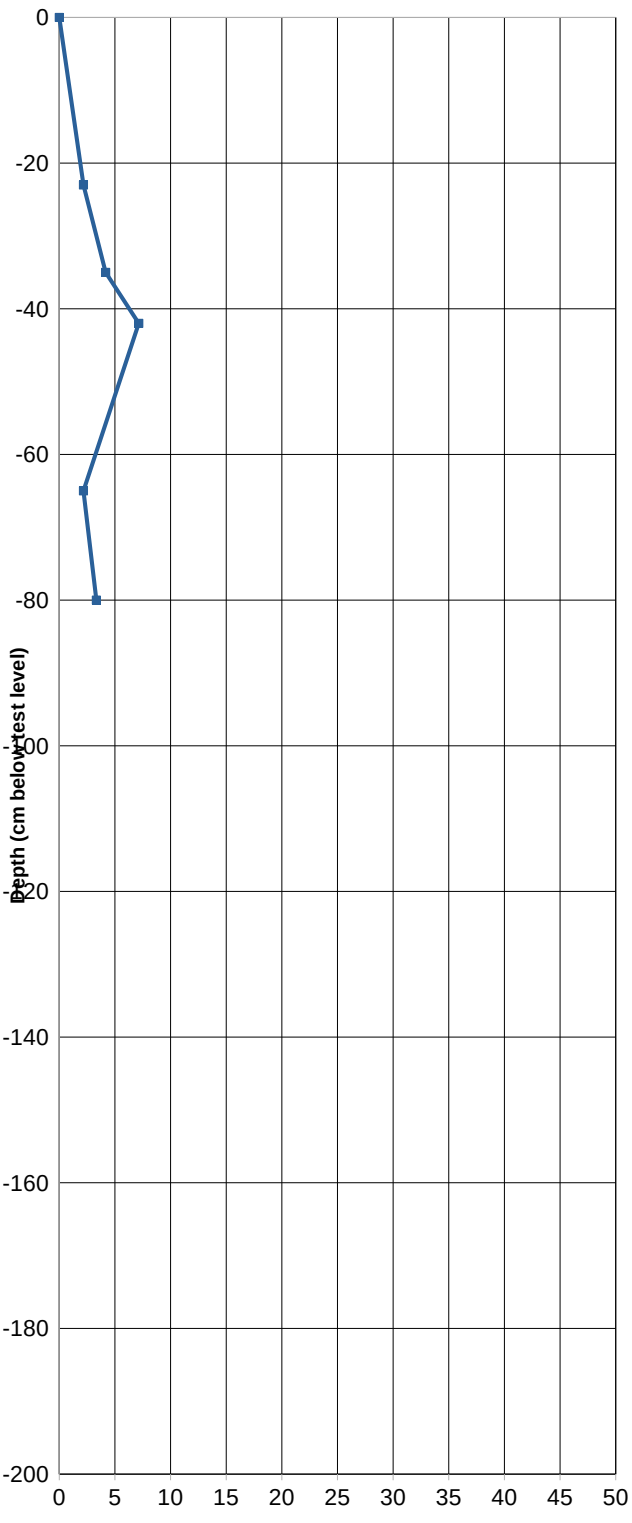
CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 3**

LEVEL: GL

4



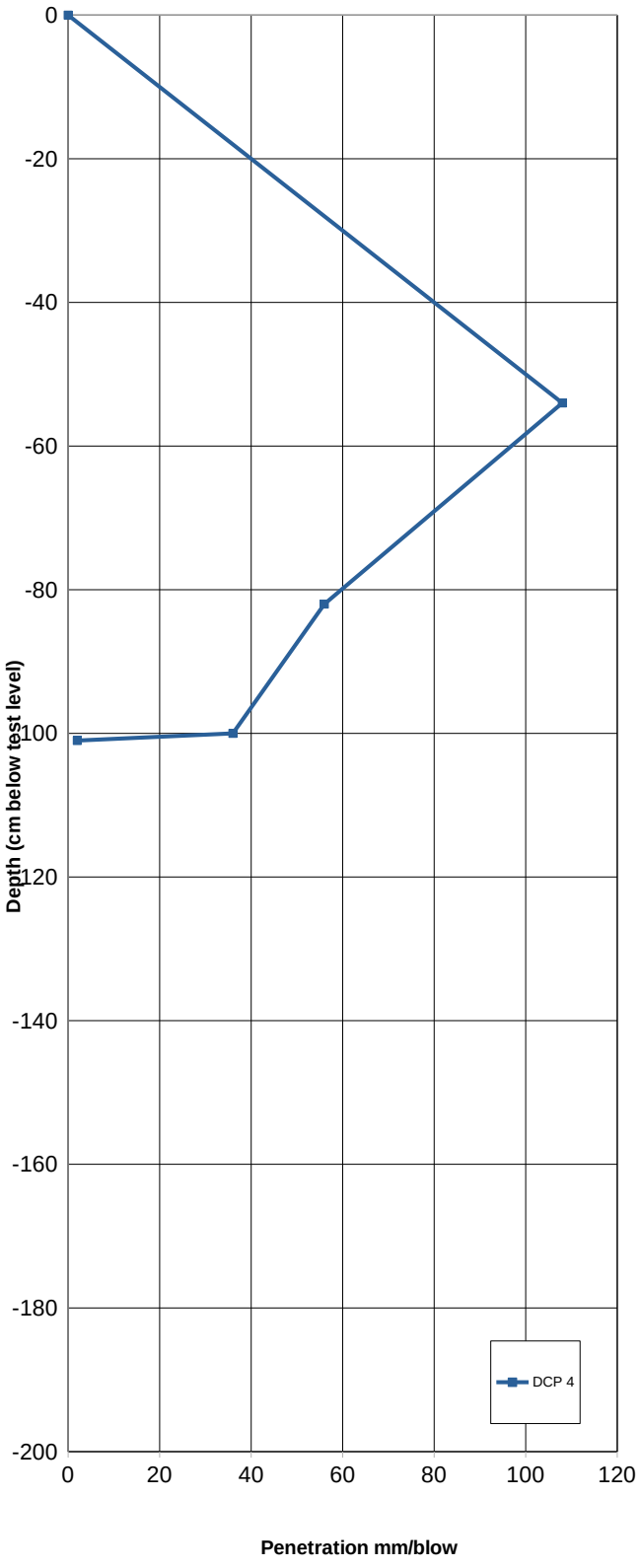


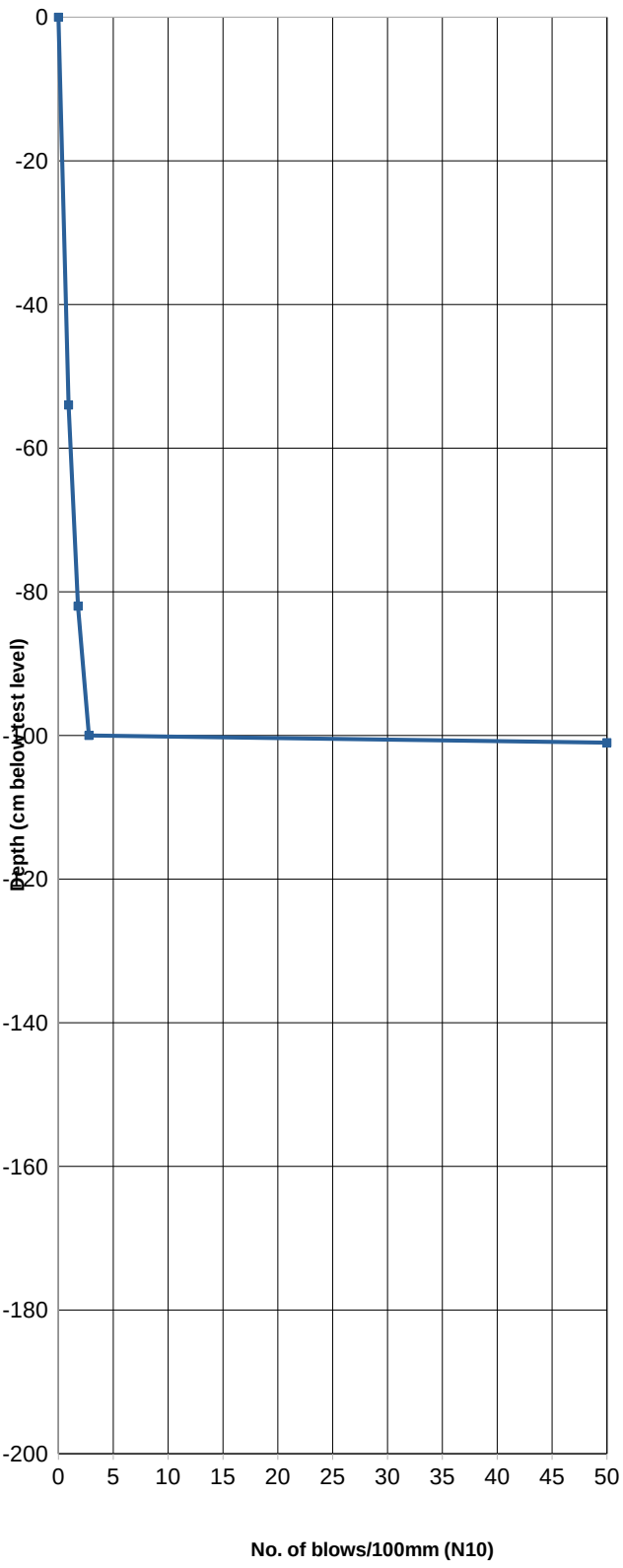
CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 4**

LEVEL: GL





CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 5**

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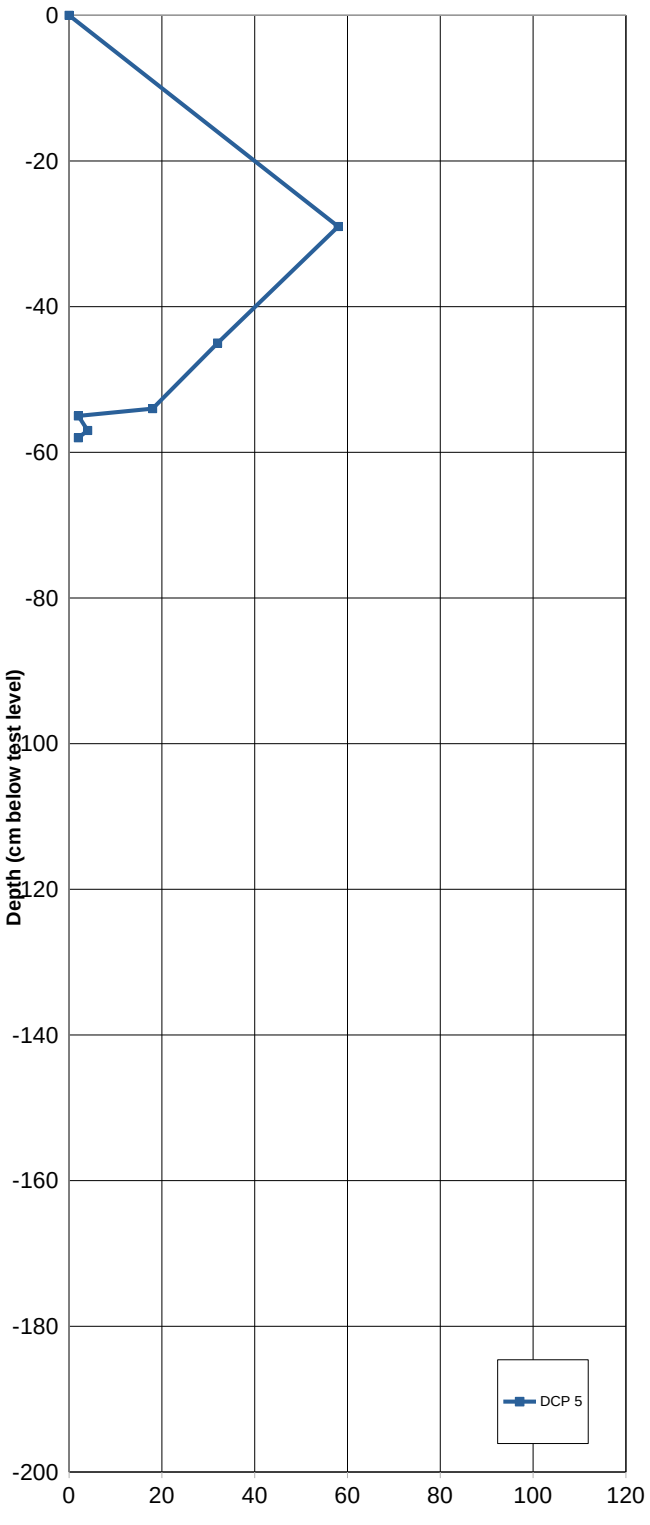
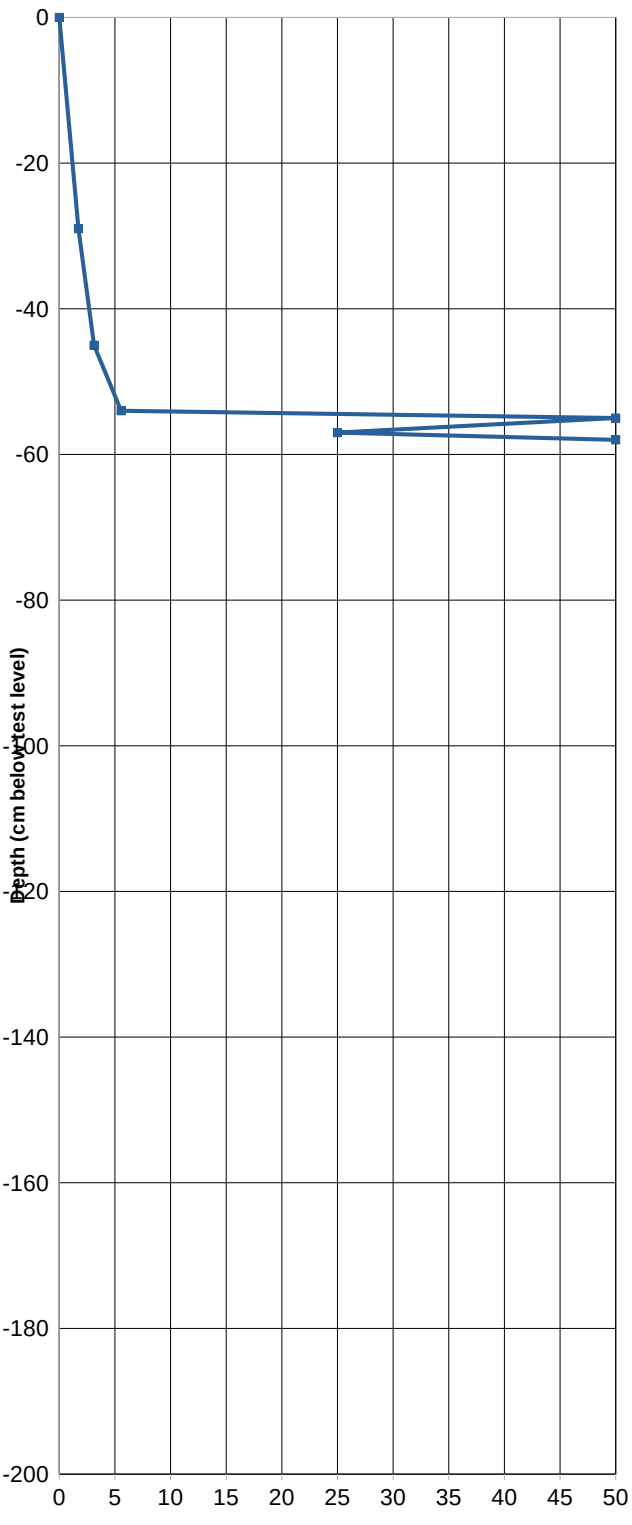


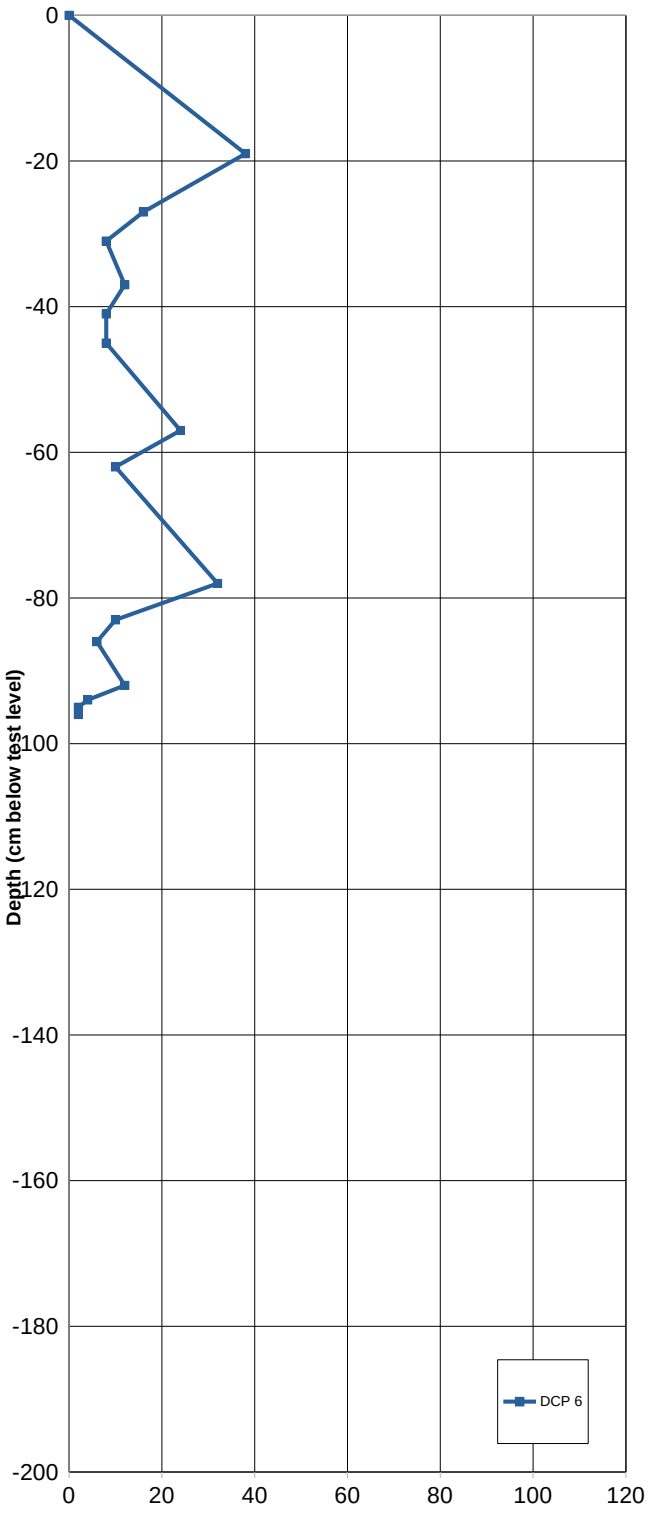


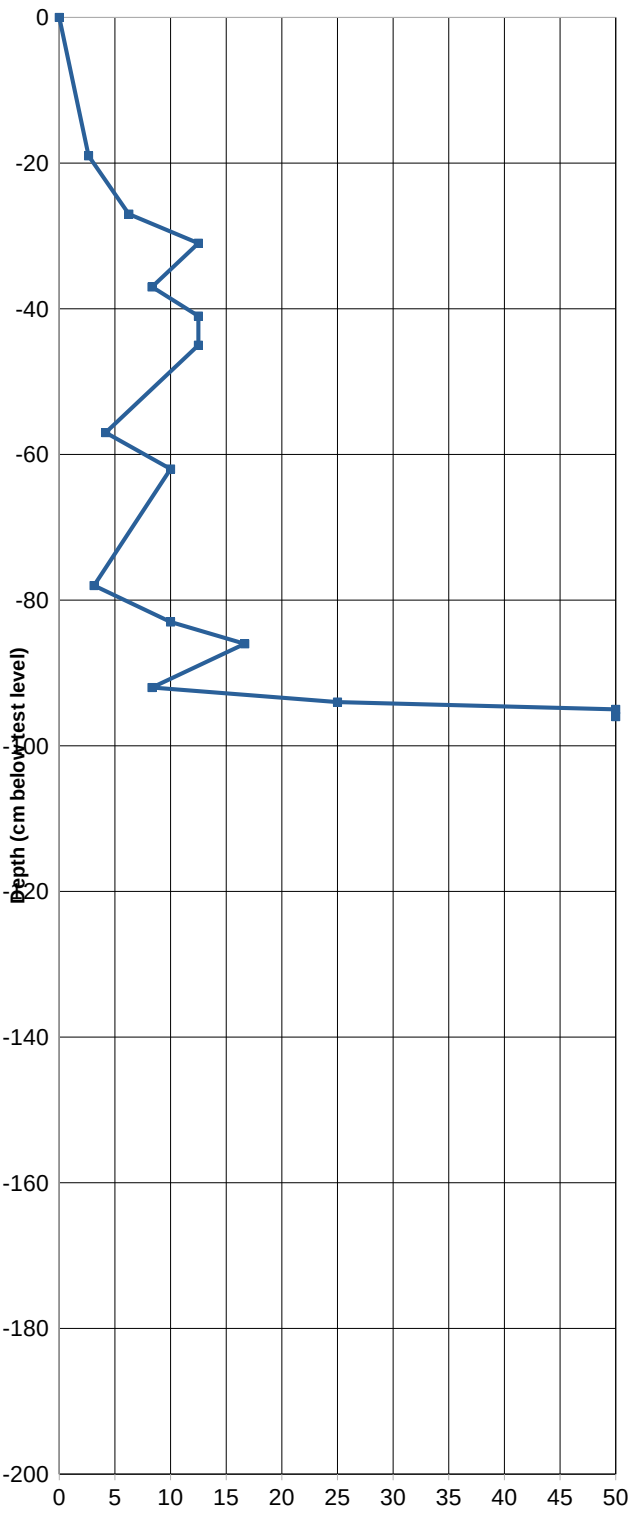
CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 6**

LEVEL: GL



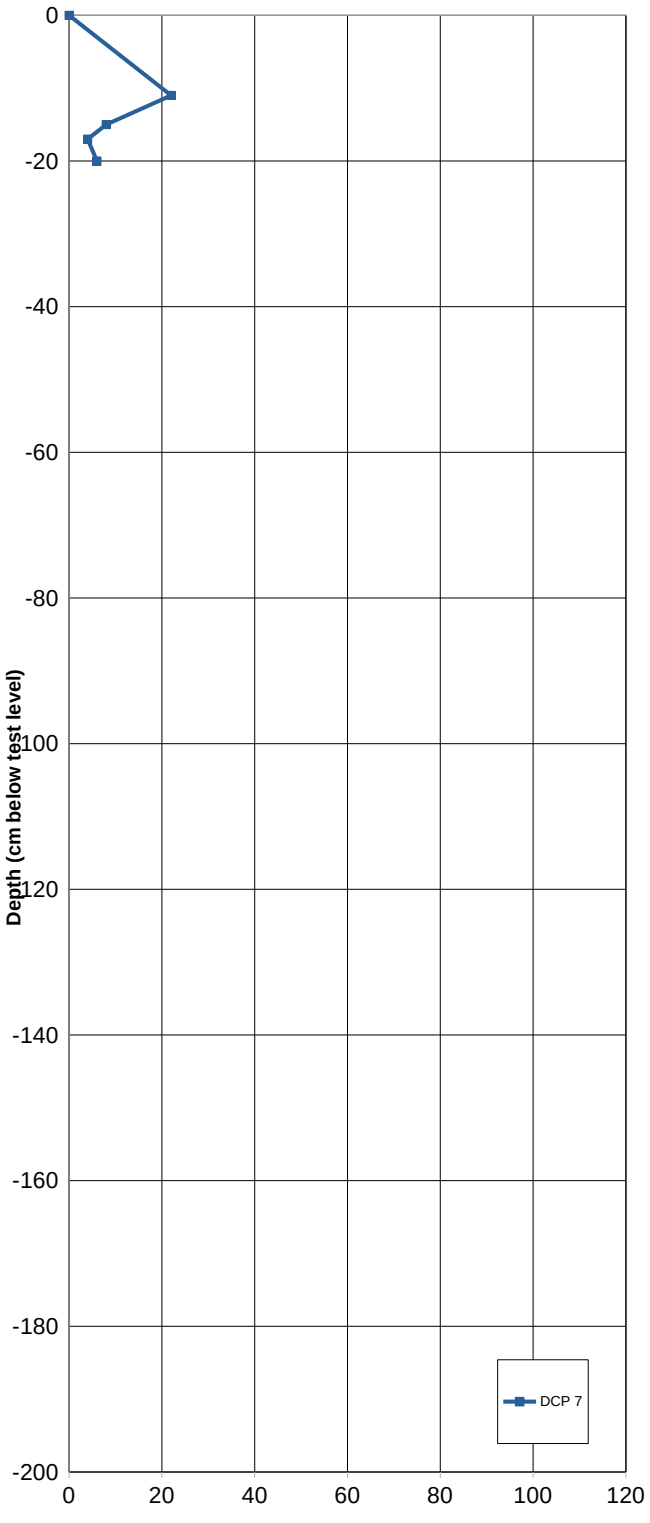


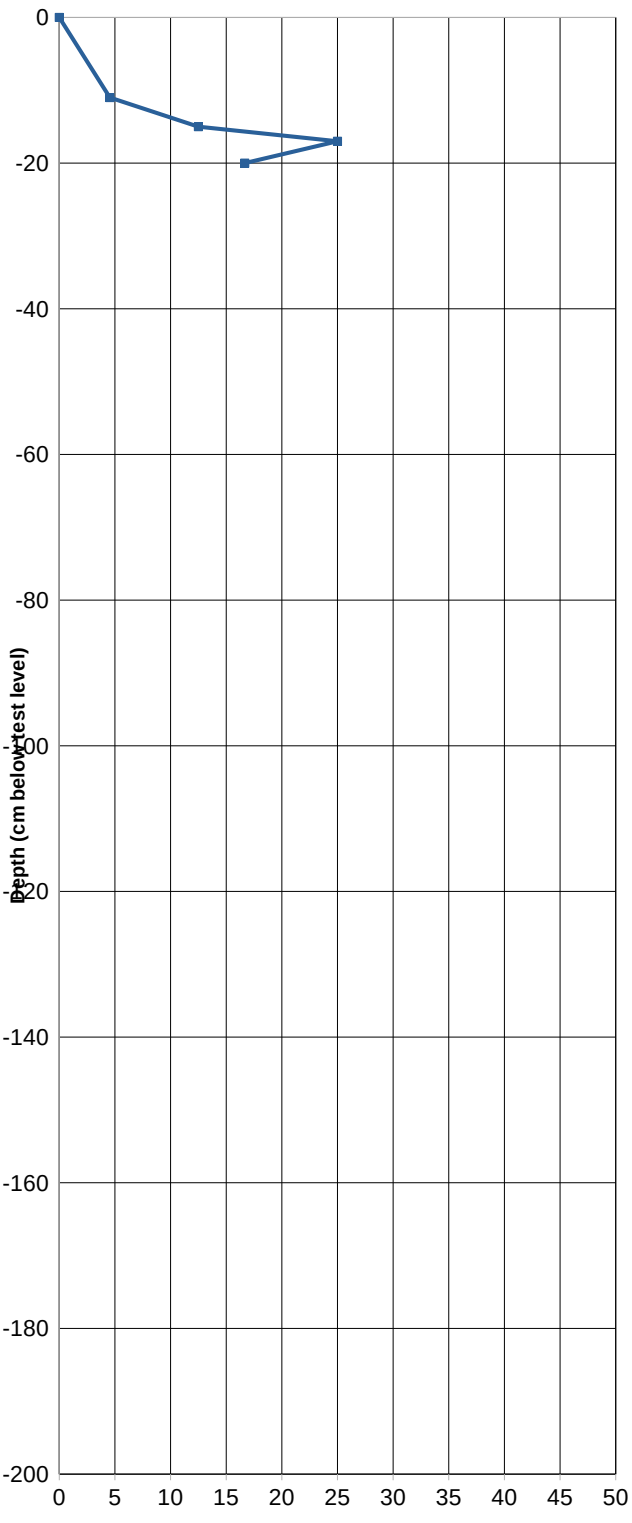
CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 7**

LEVEL: GL



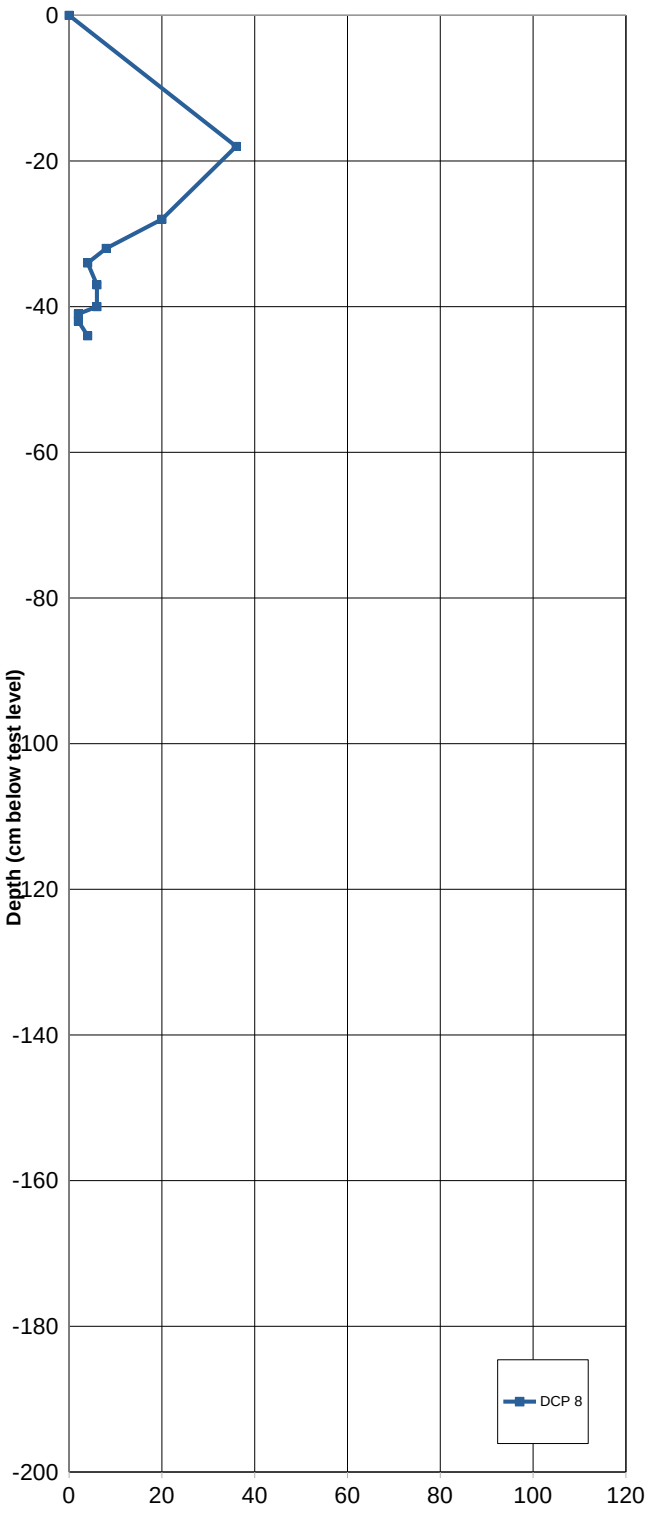


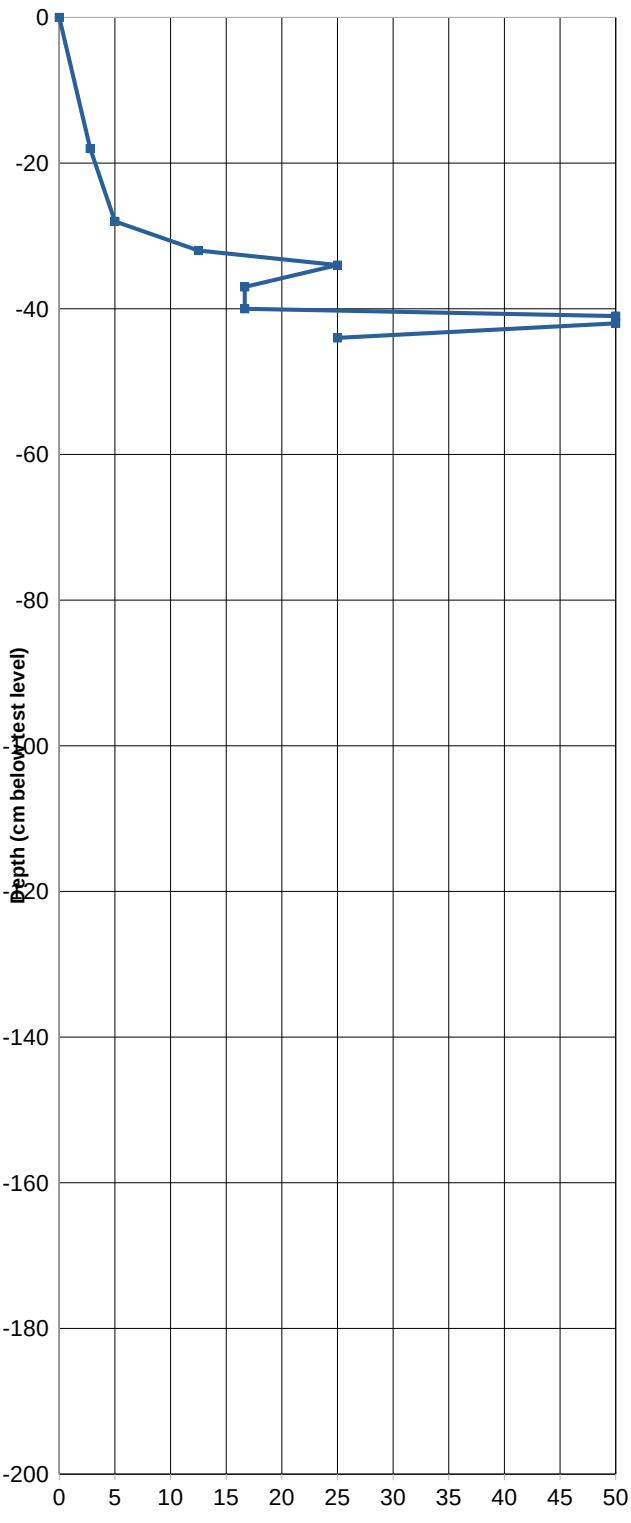
CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 8**

LEVEL: GL



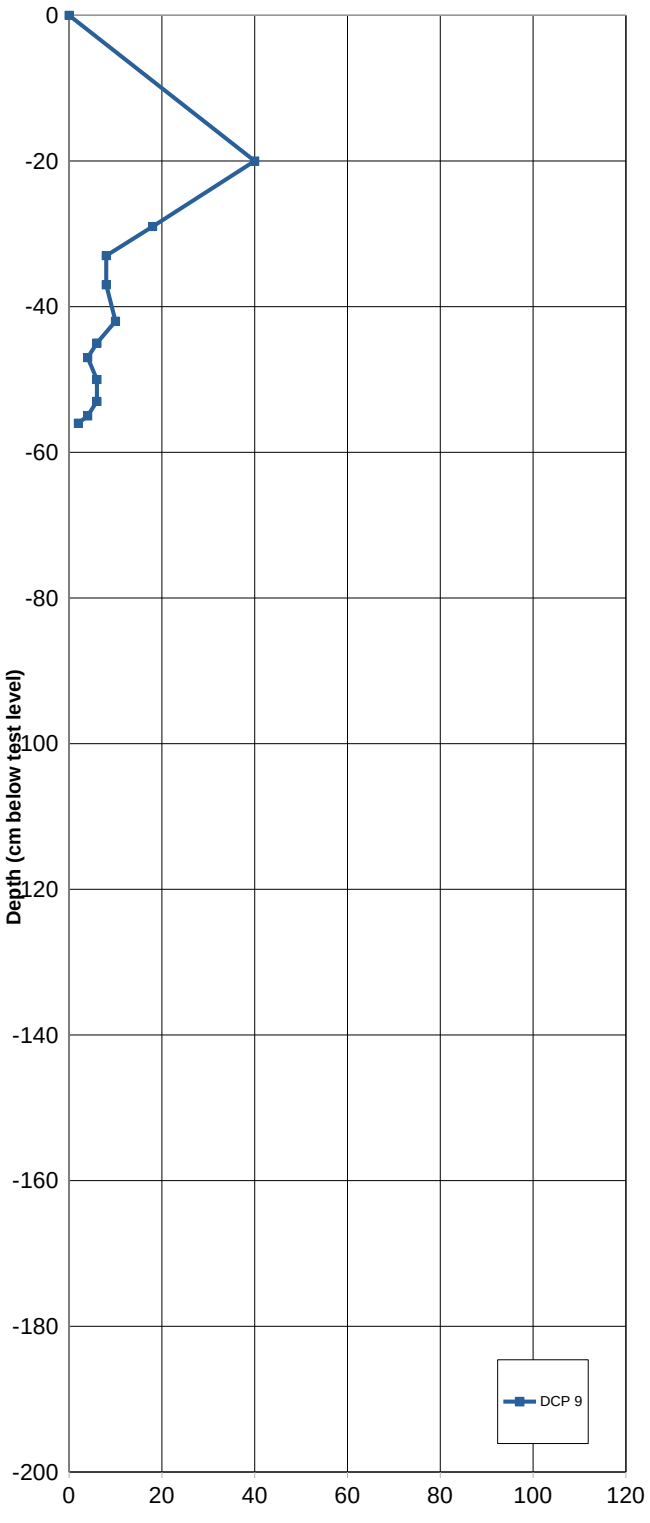


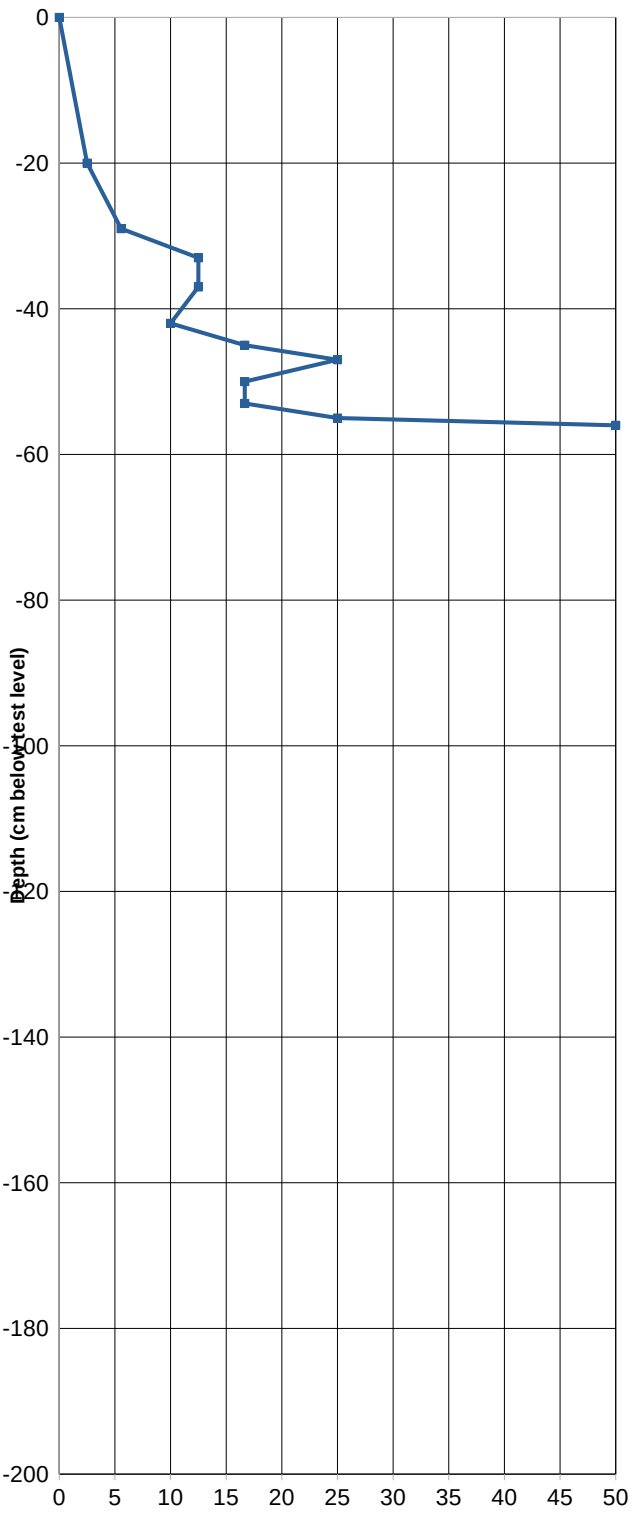
CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 9**

LEVEL: GL





CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 10**

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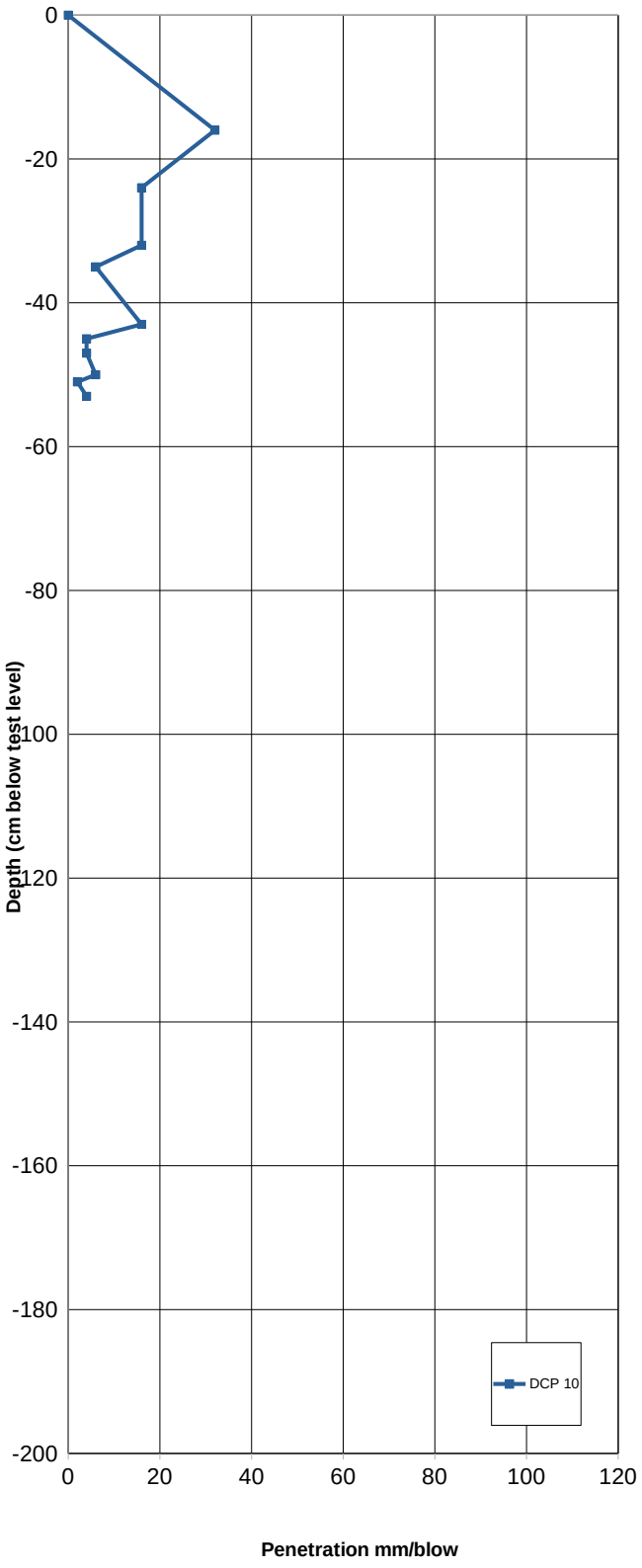

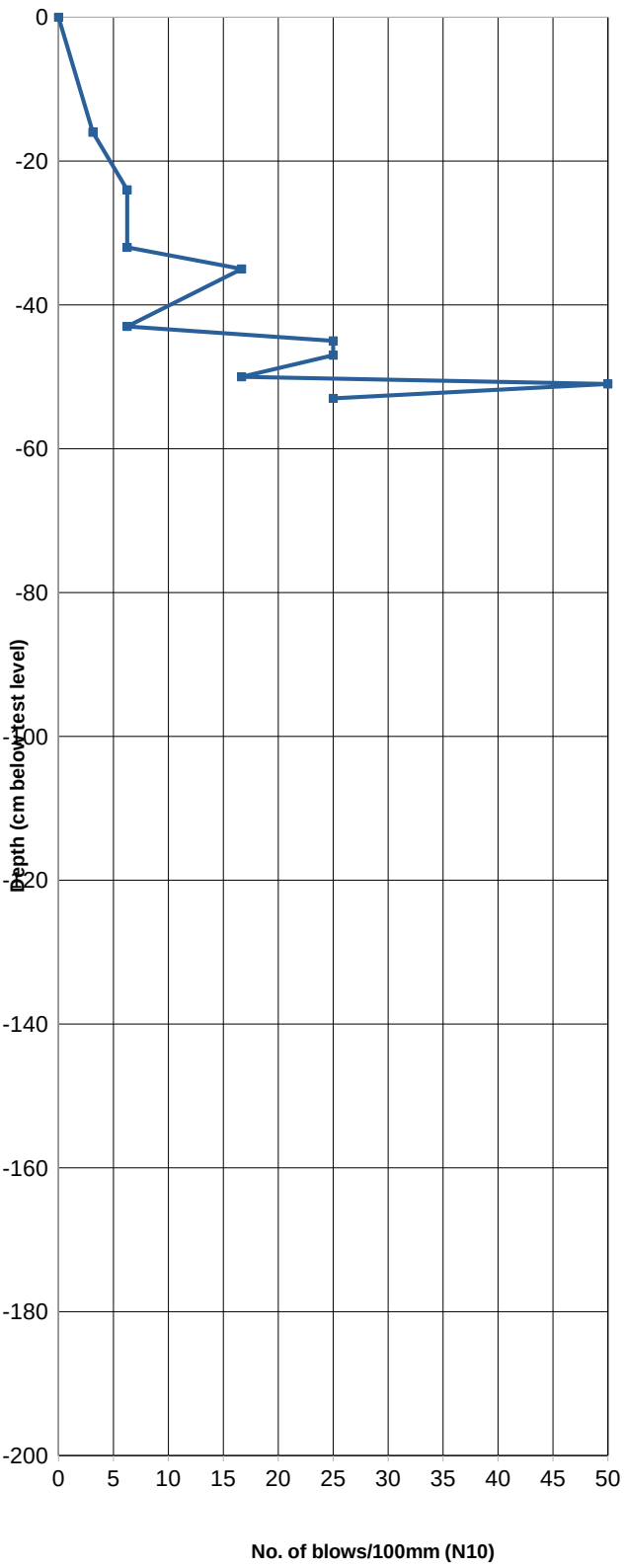

CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 11**

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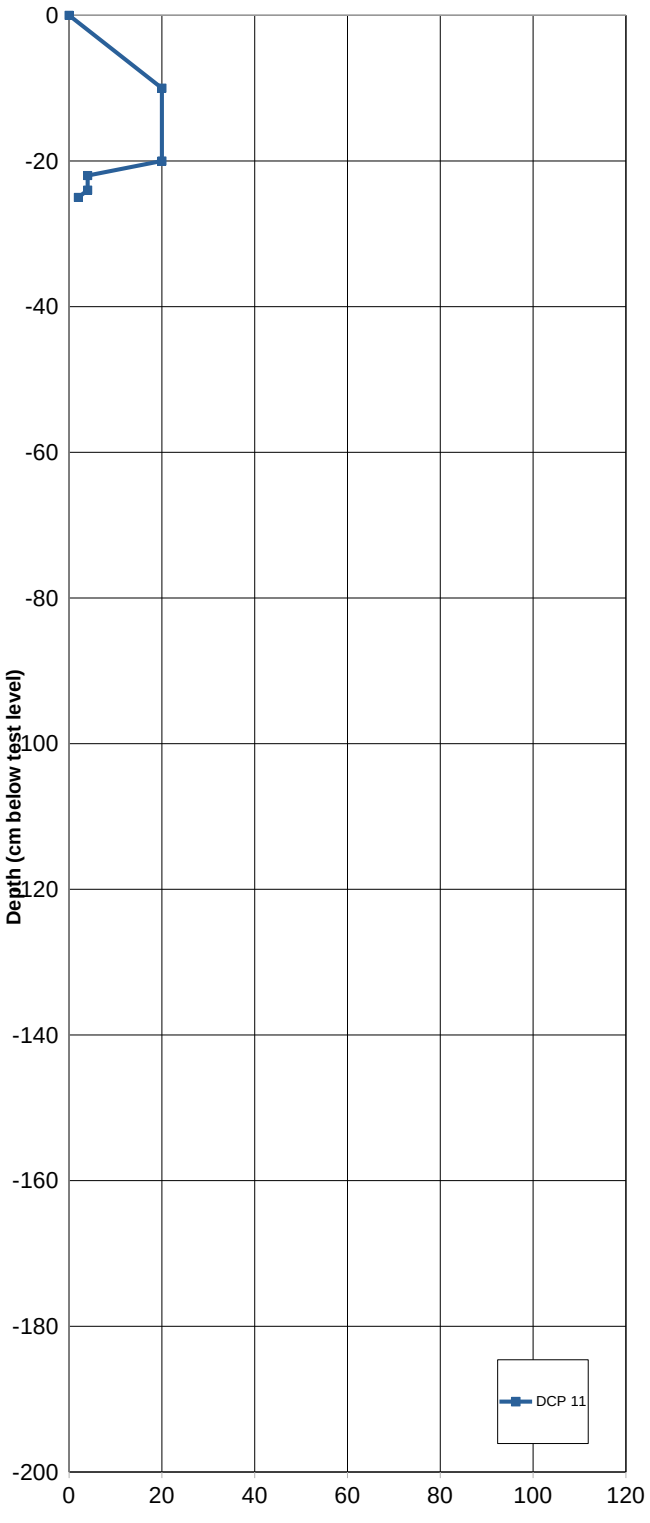

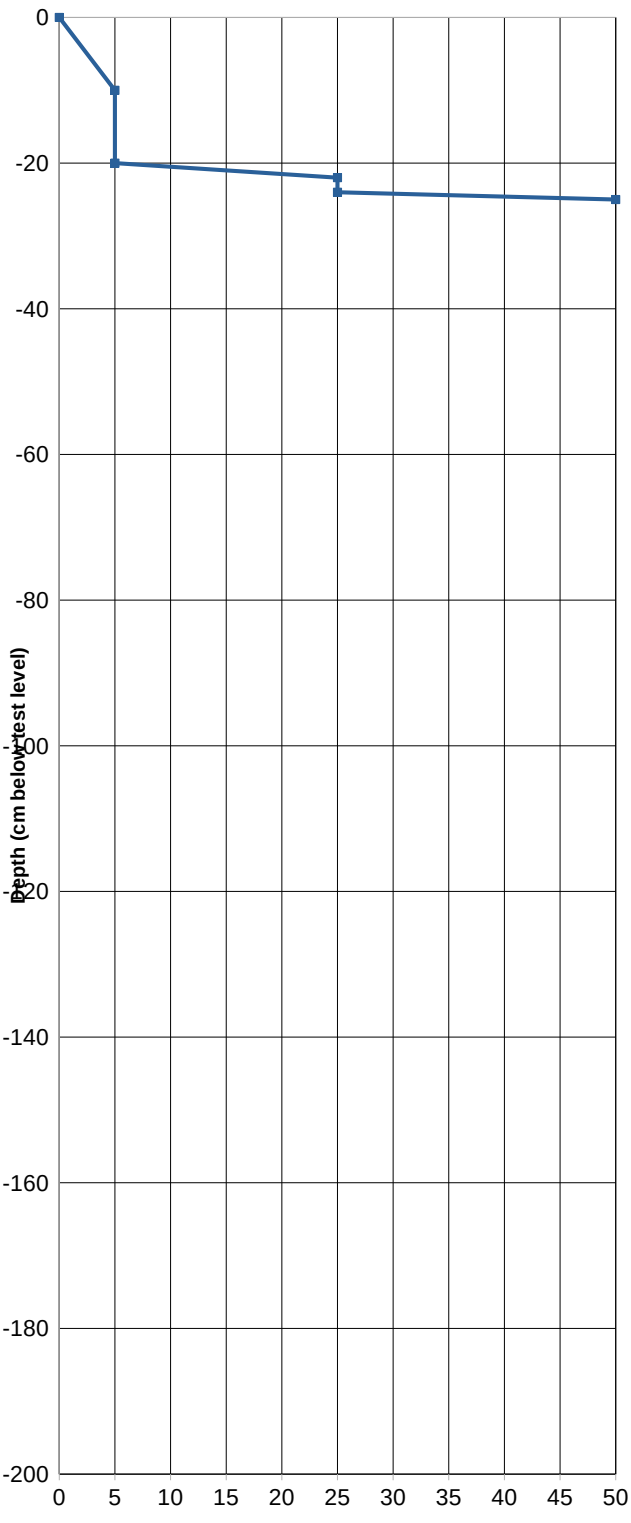

CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 12**

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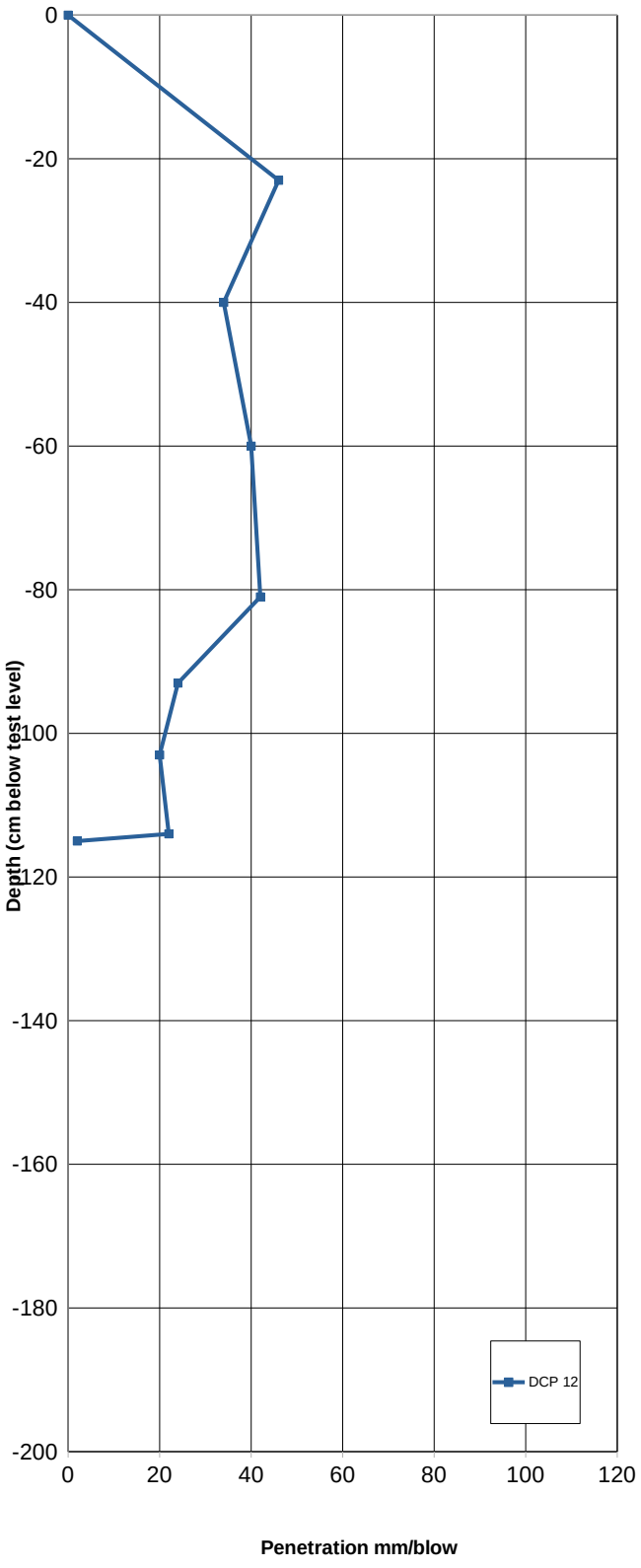

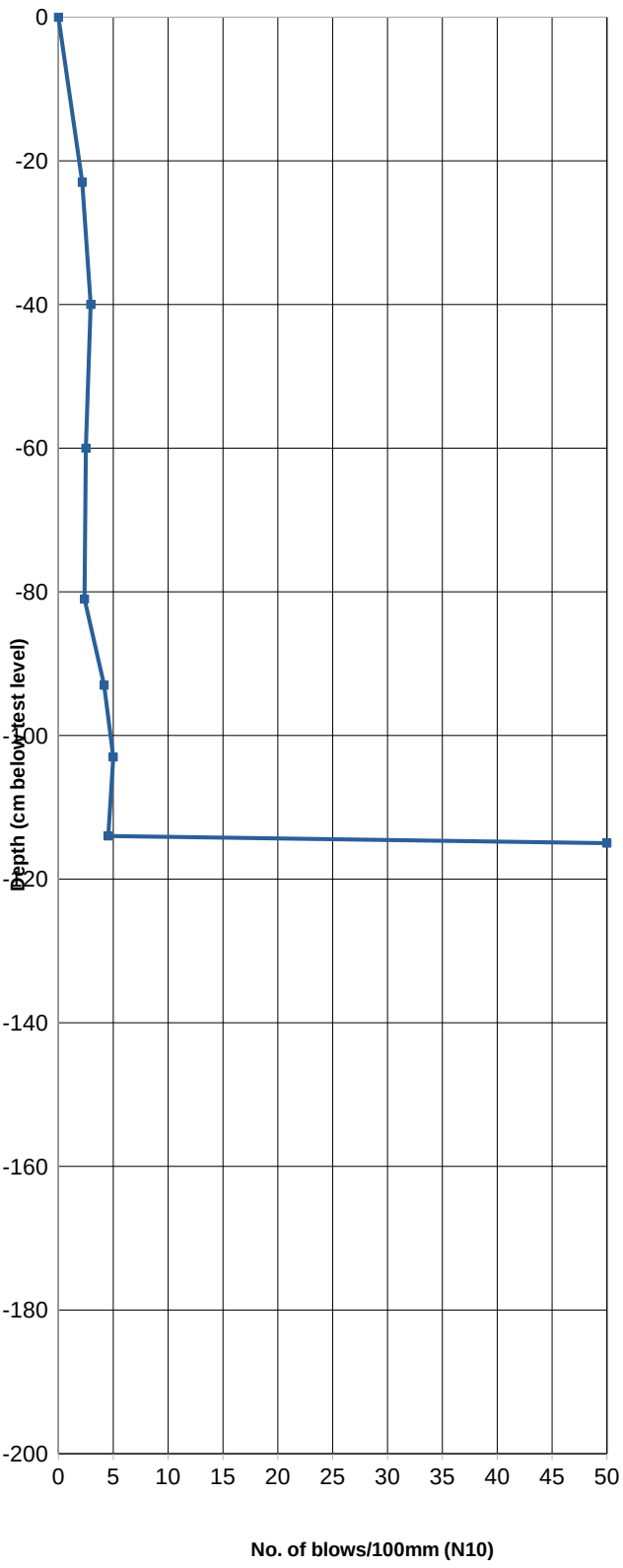

CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 13**

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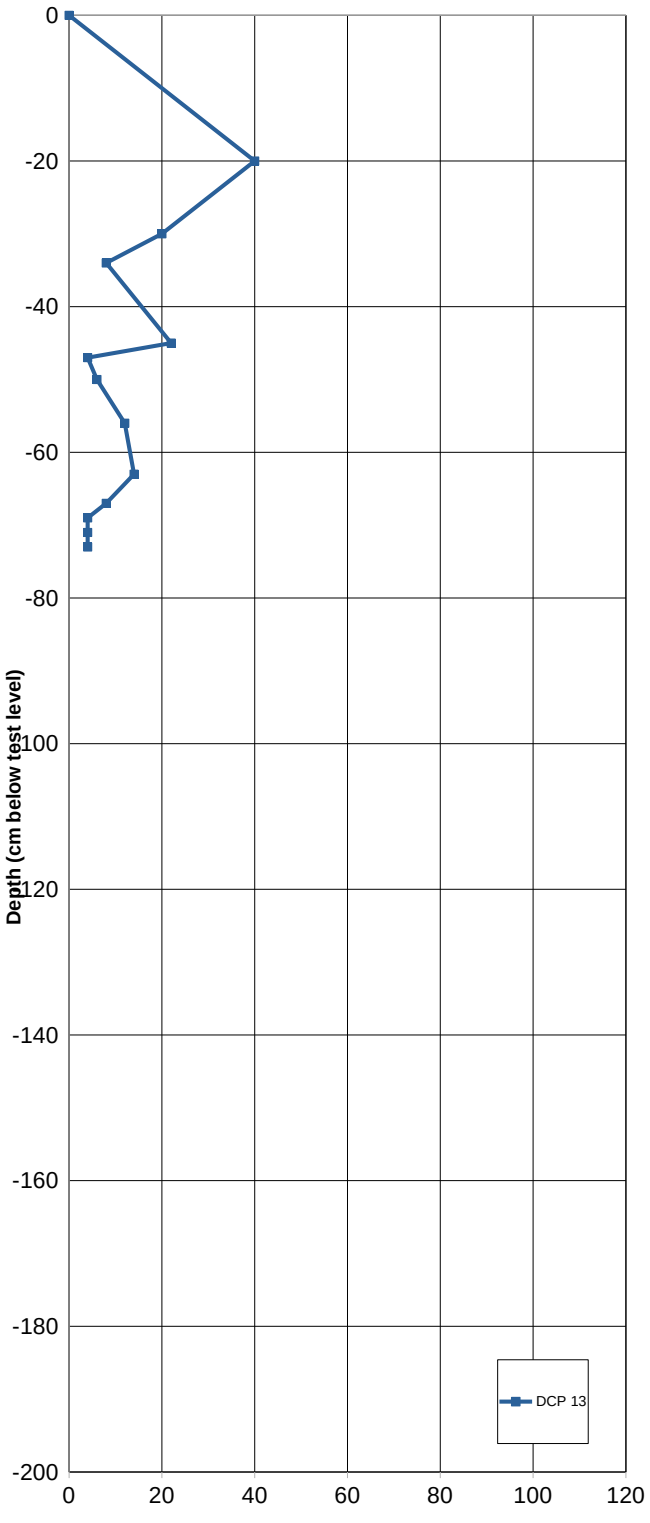

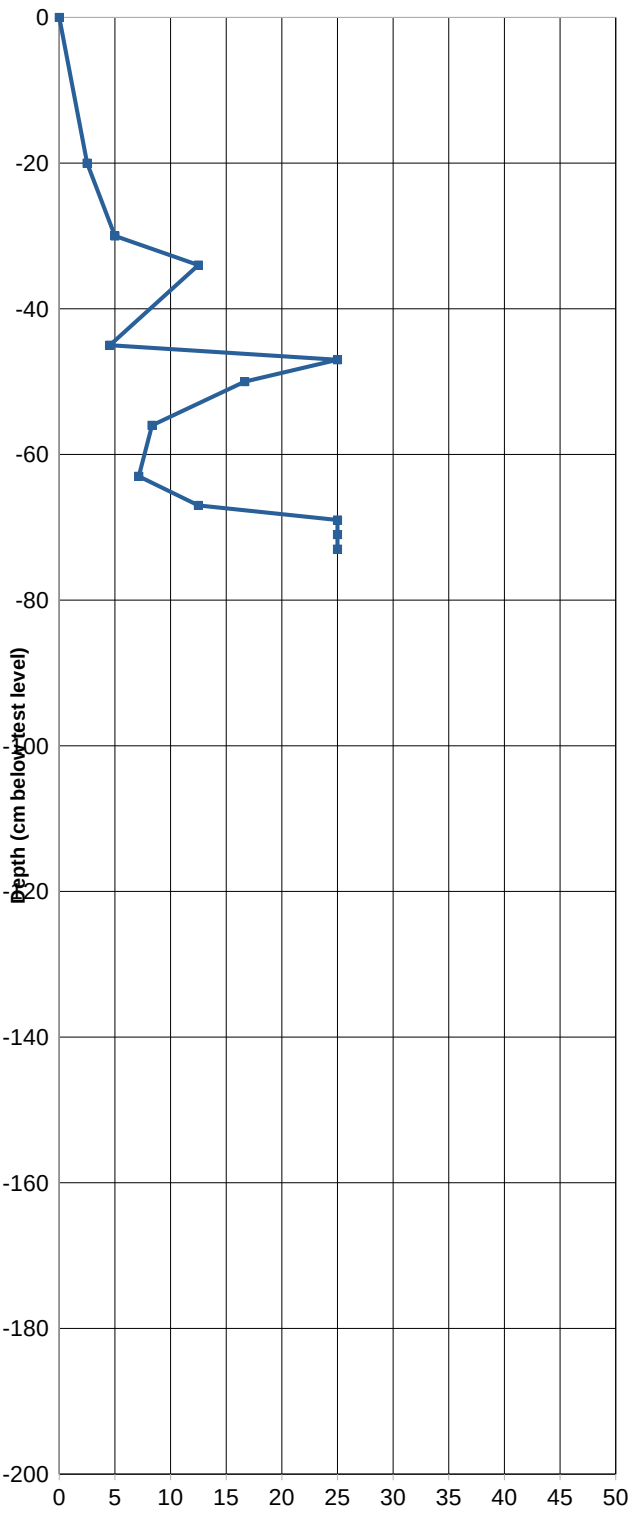

CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 14**

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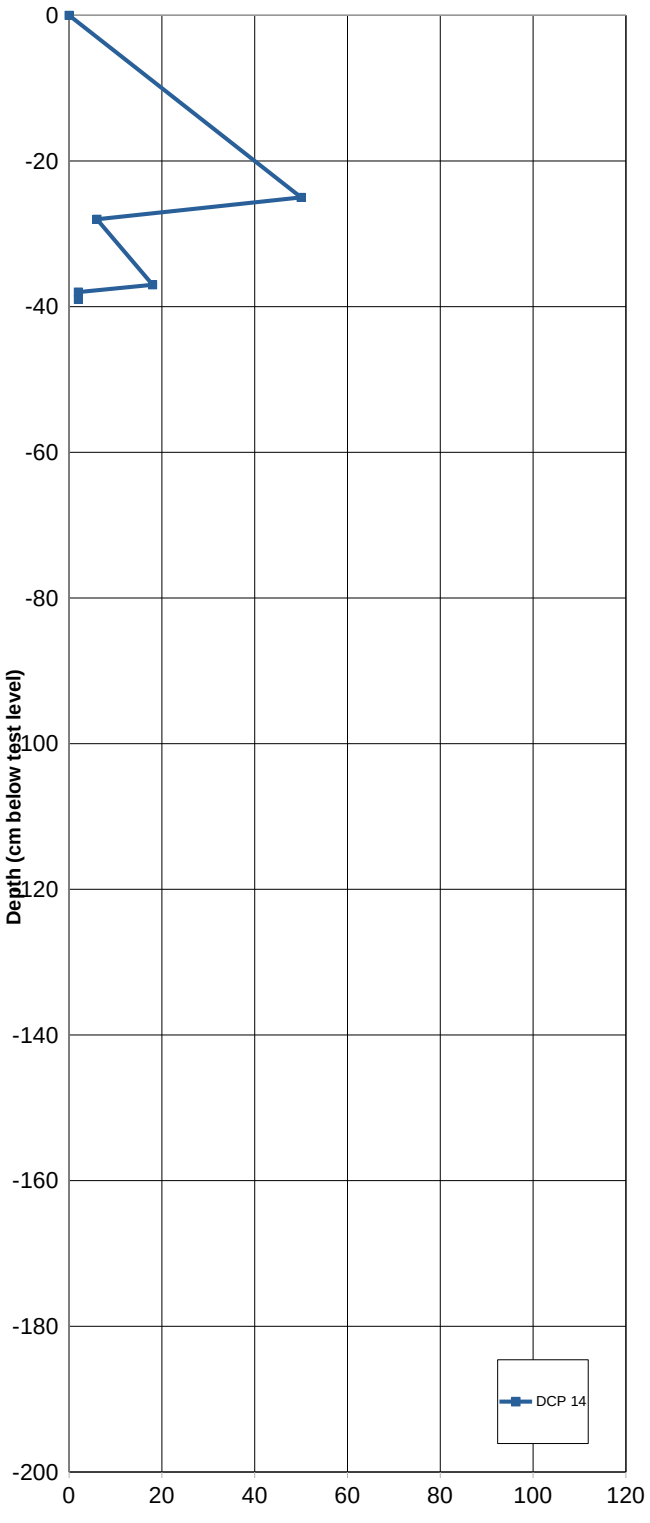

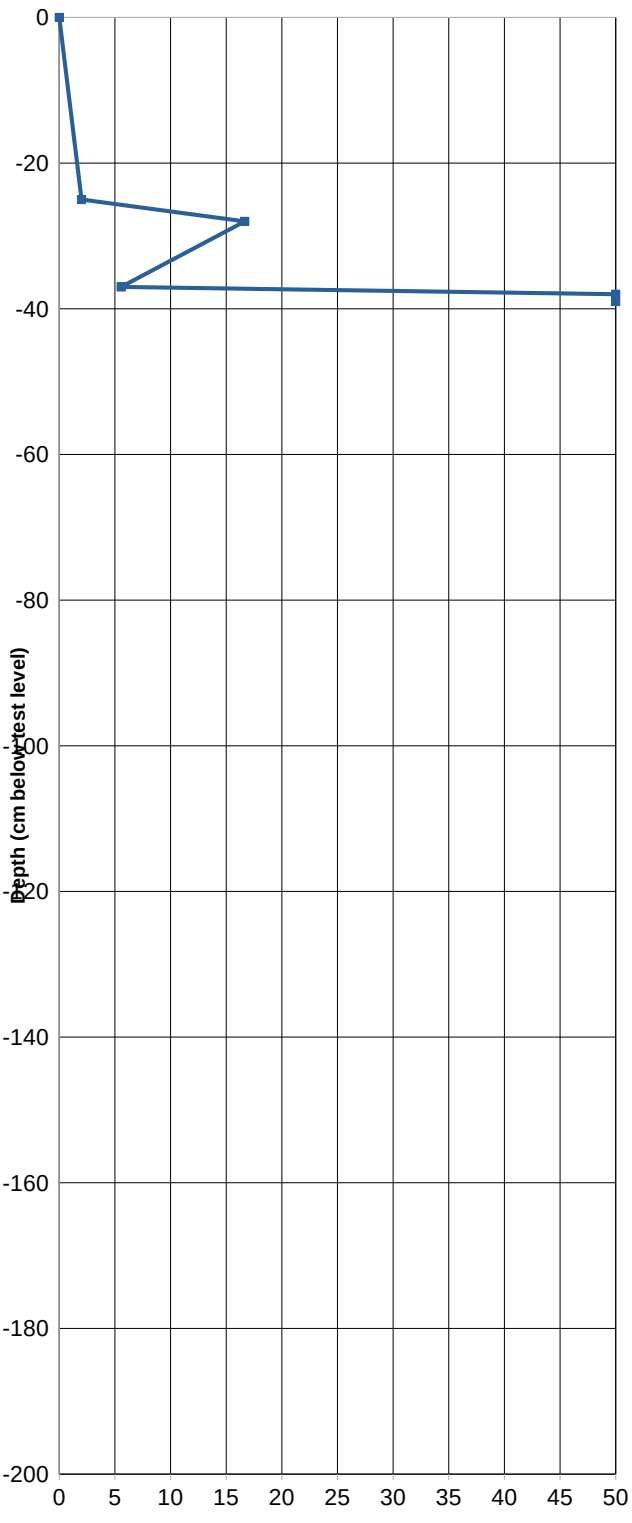

CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 15**

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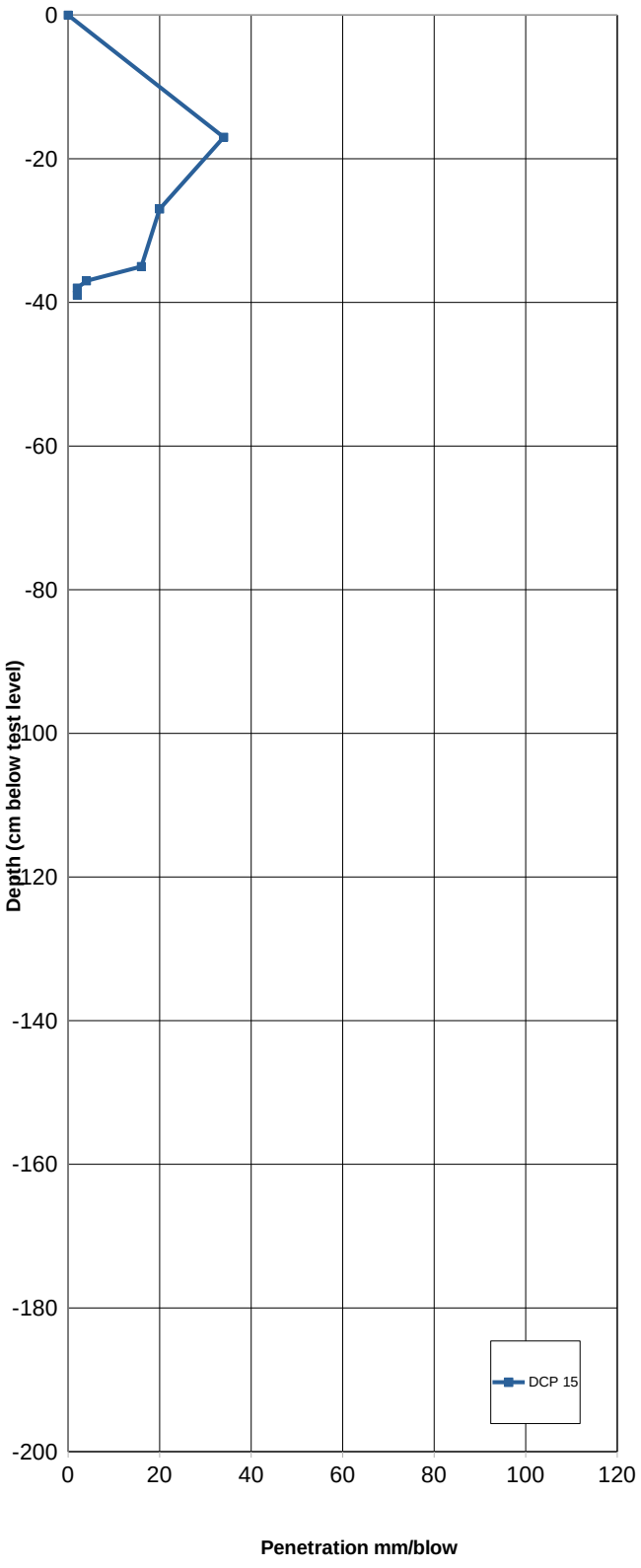

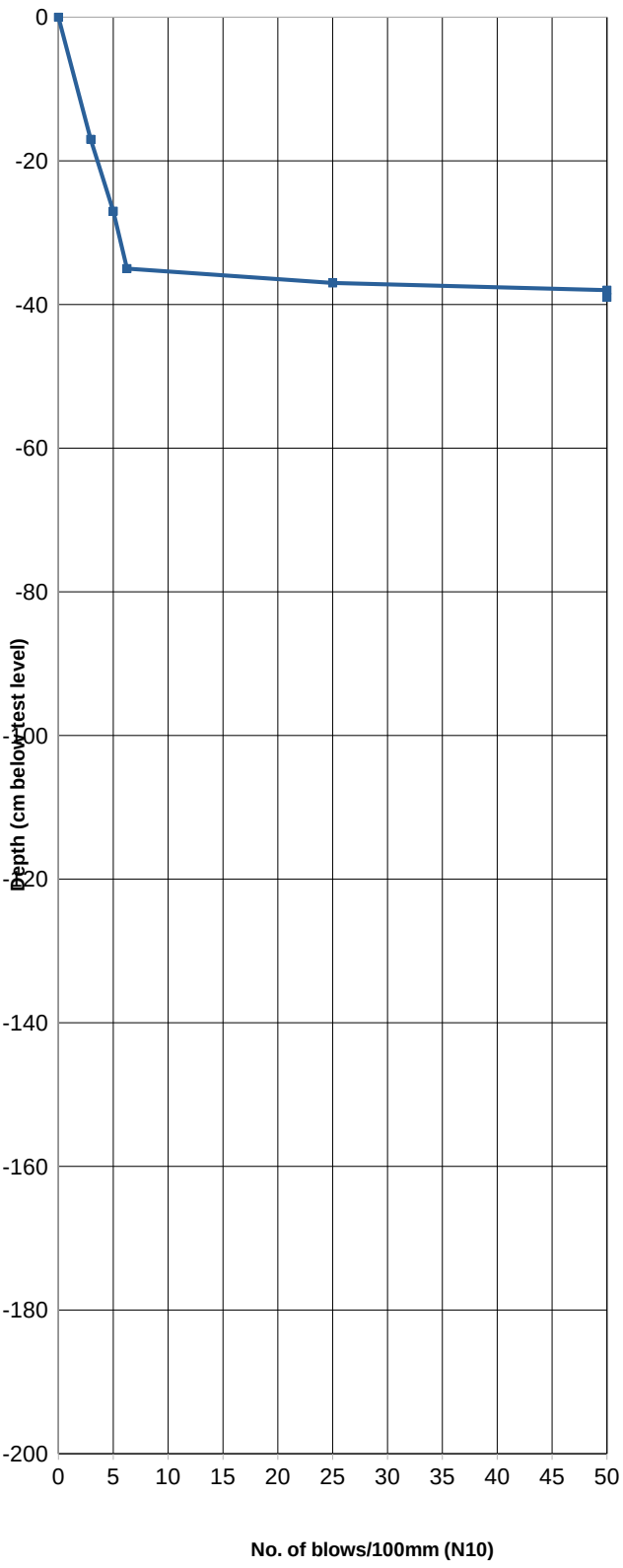

CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 16**

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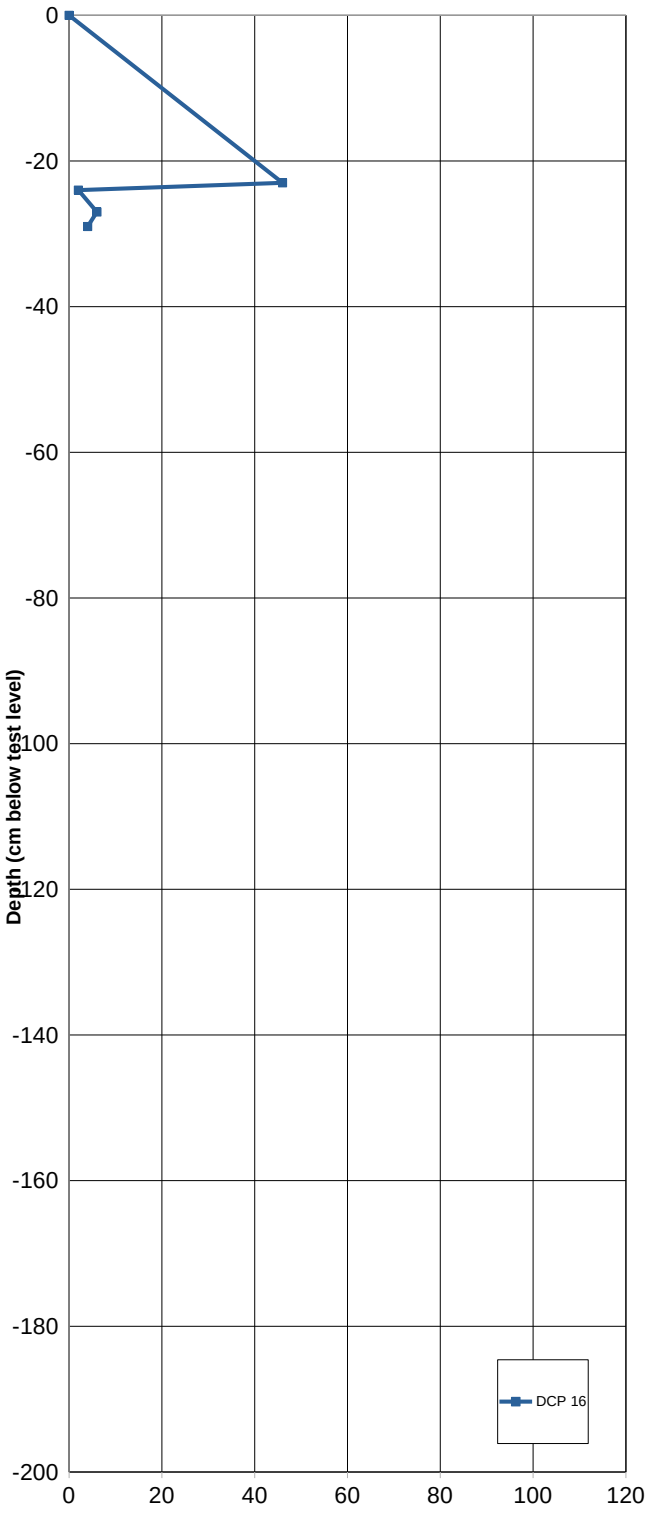

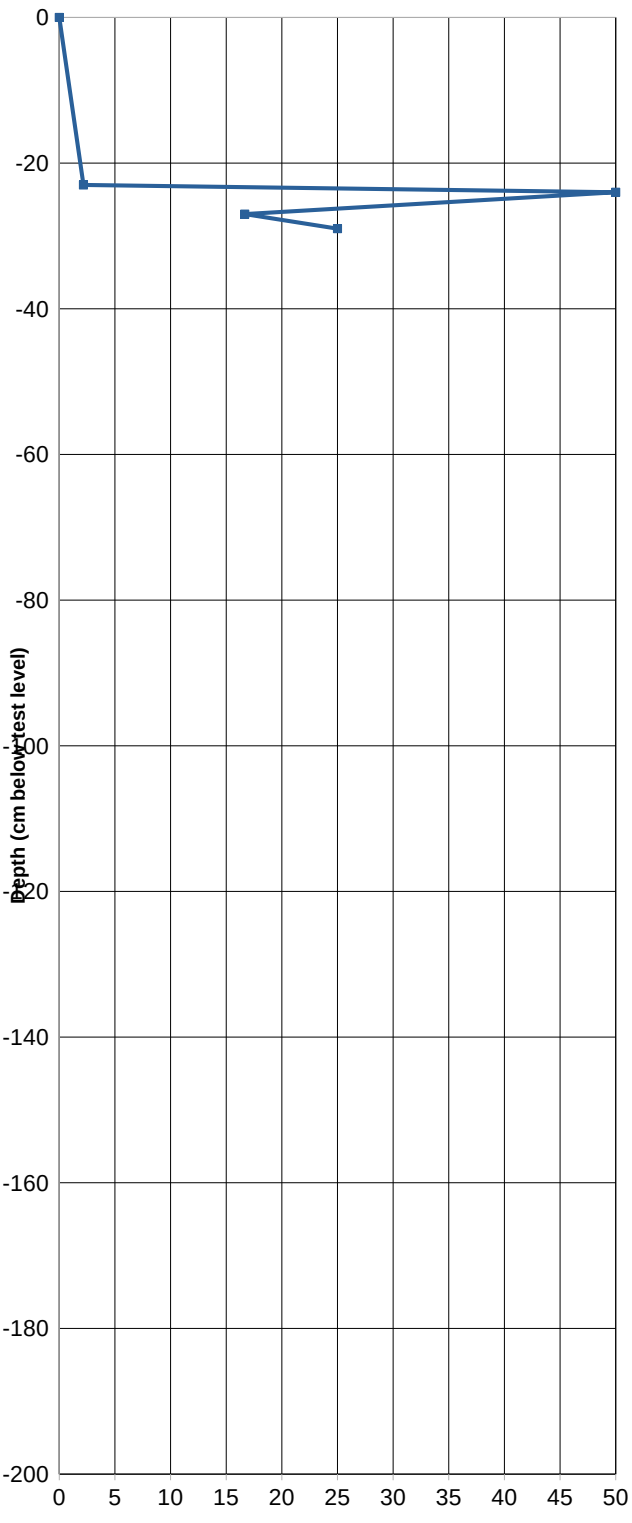

CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 17**

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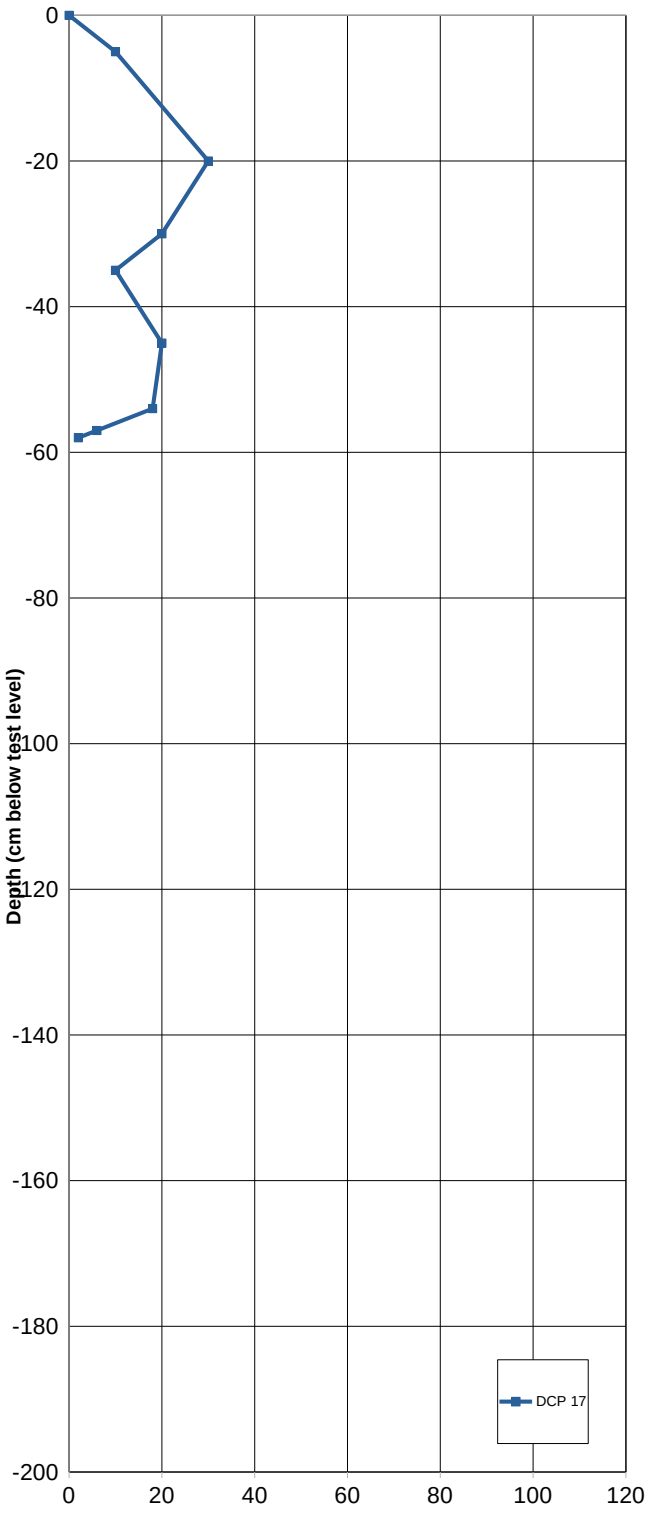
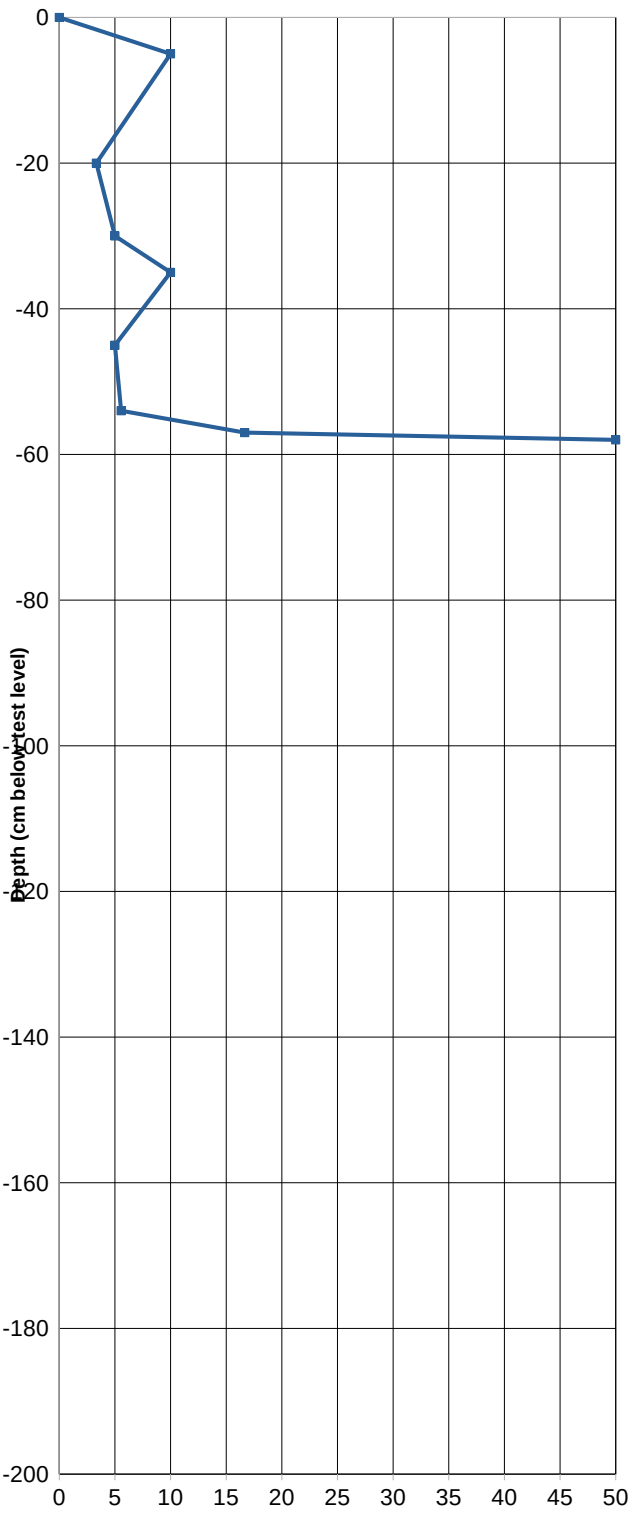


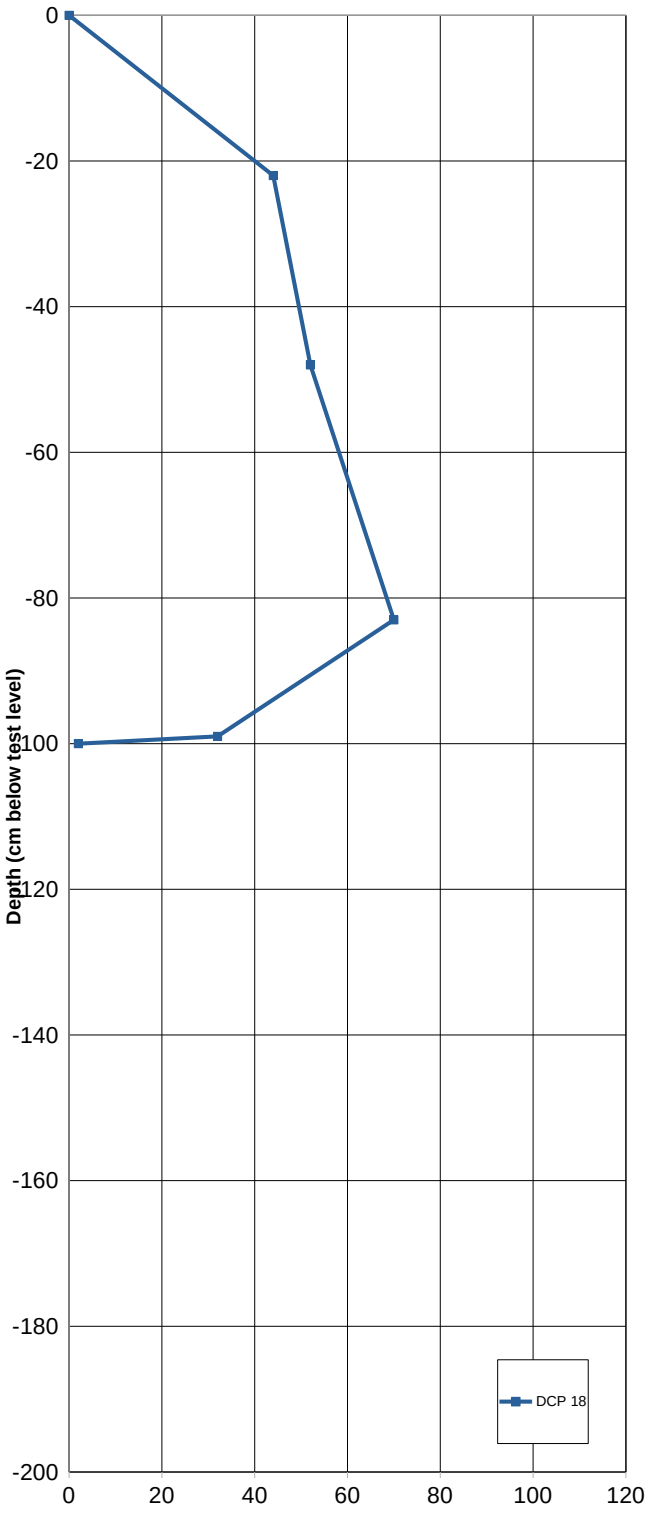


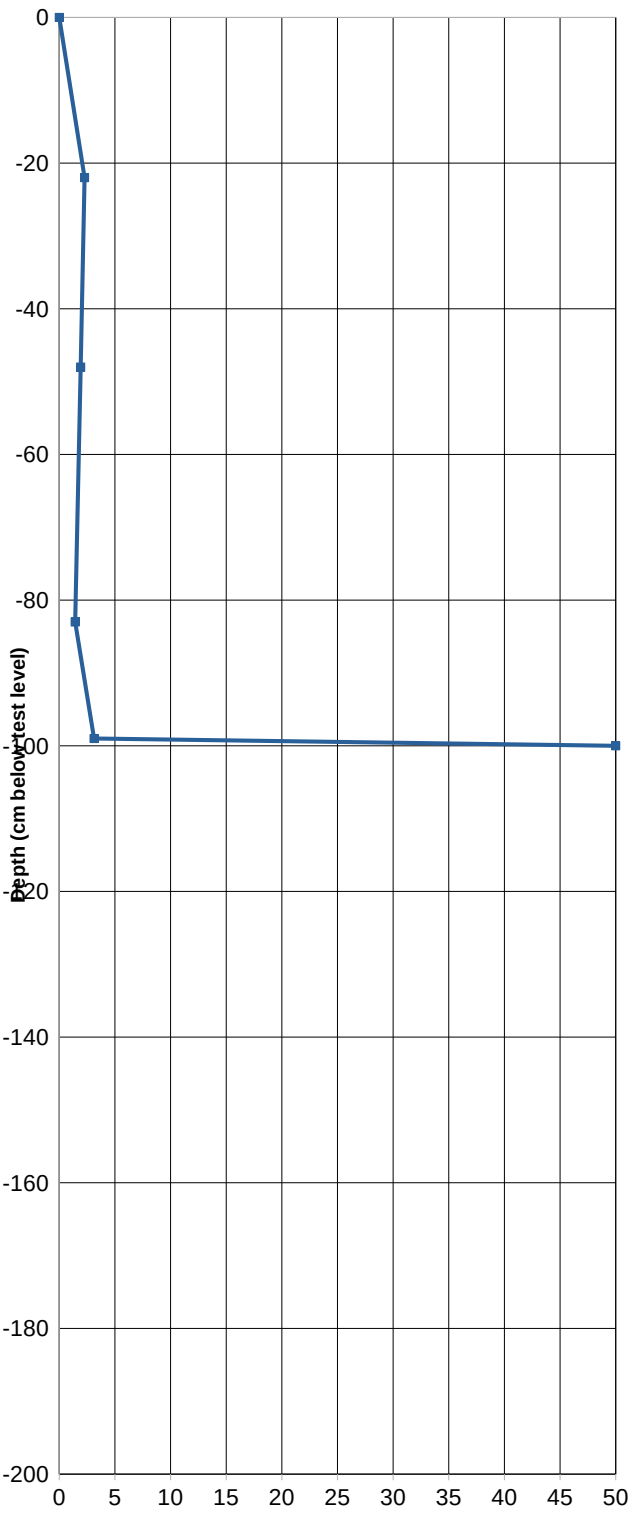
CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **DCP 18**

LEVEL: GL

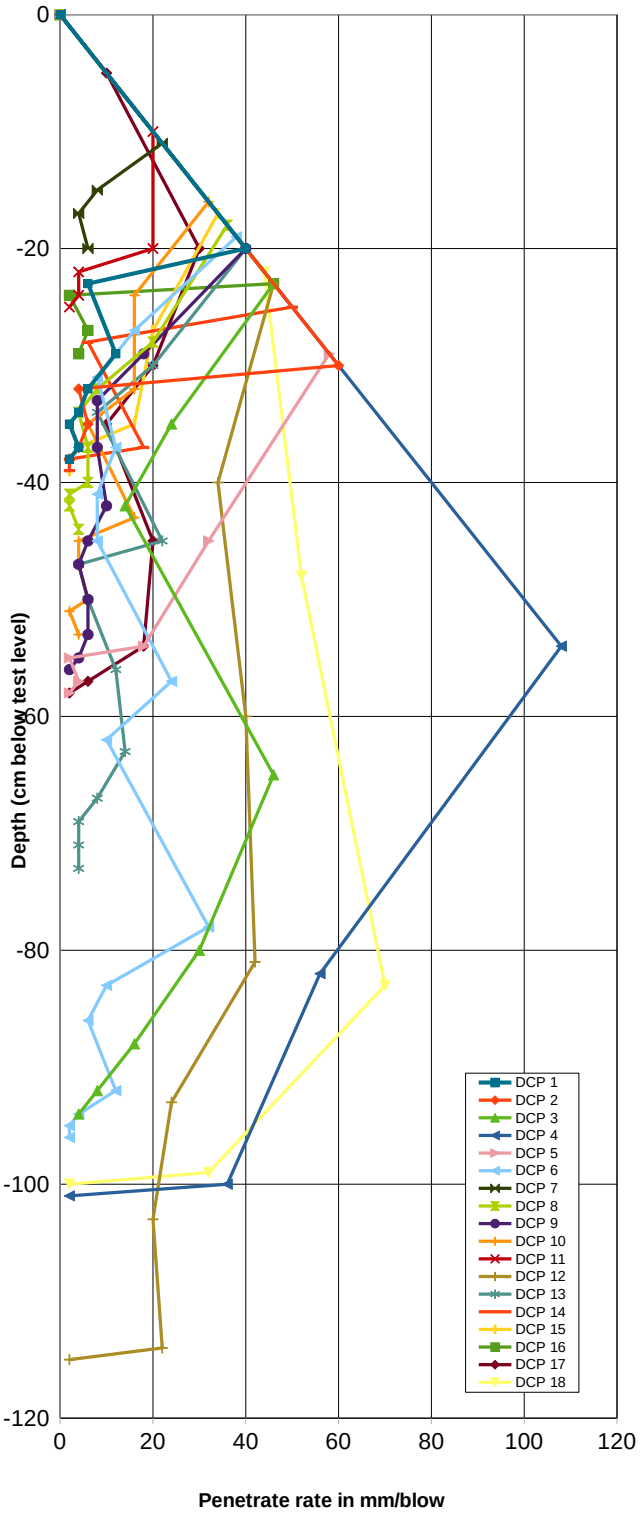


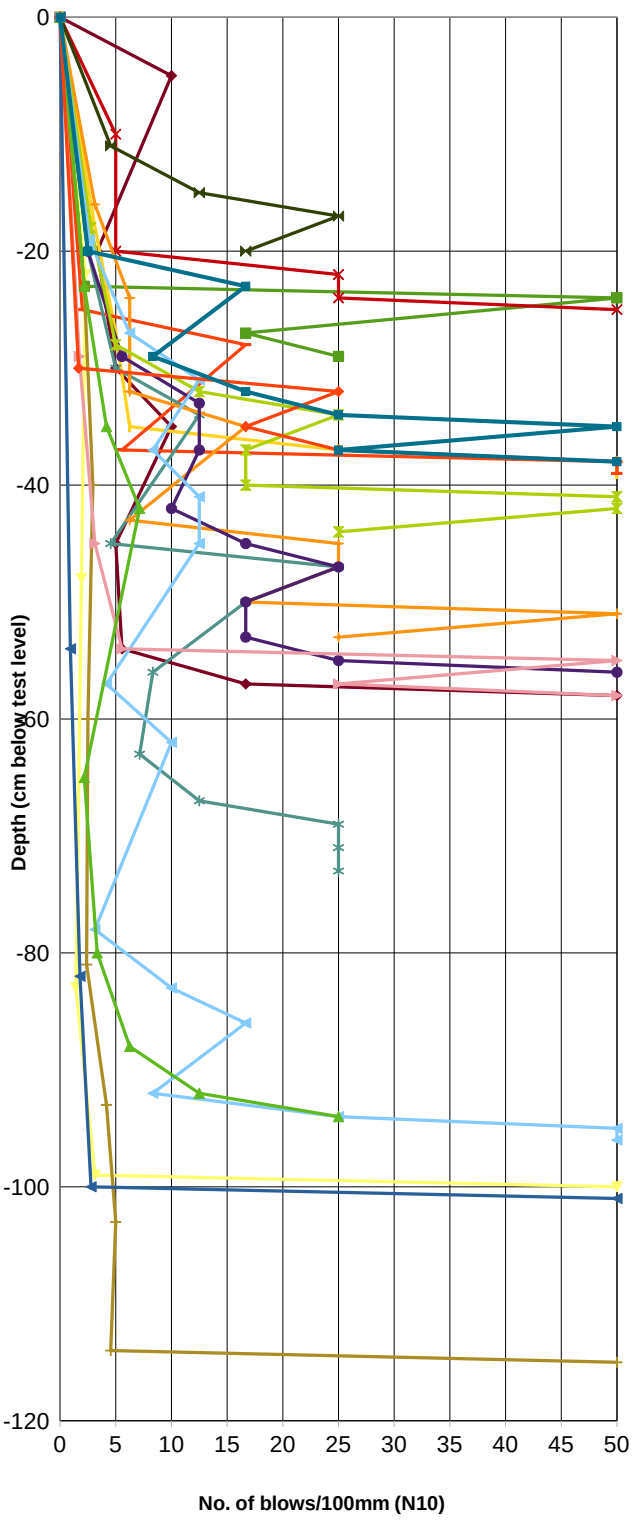


CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **Combined-all**

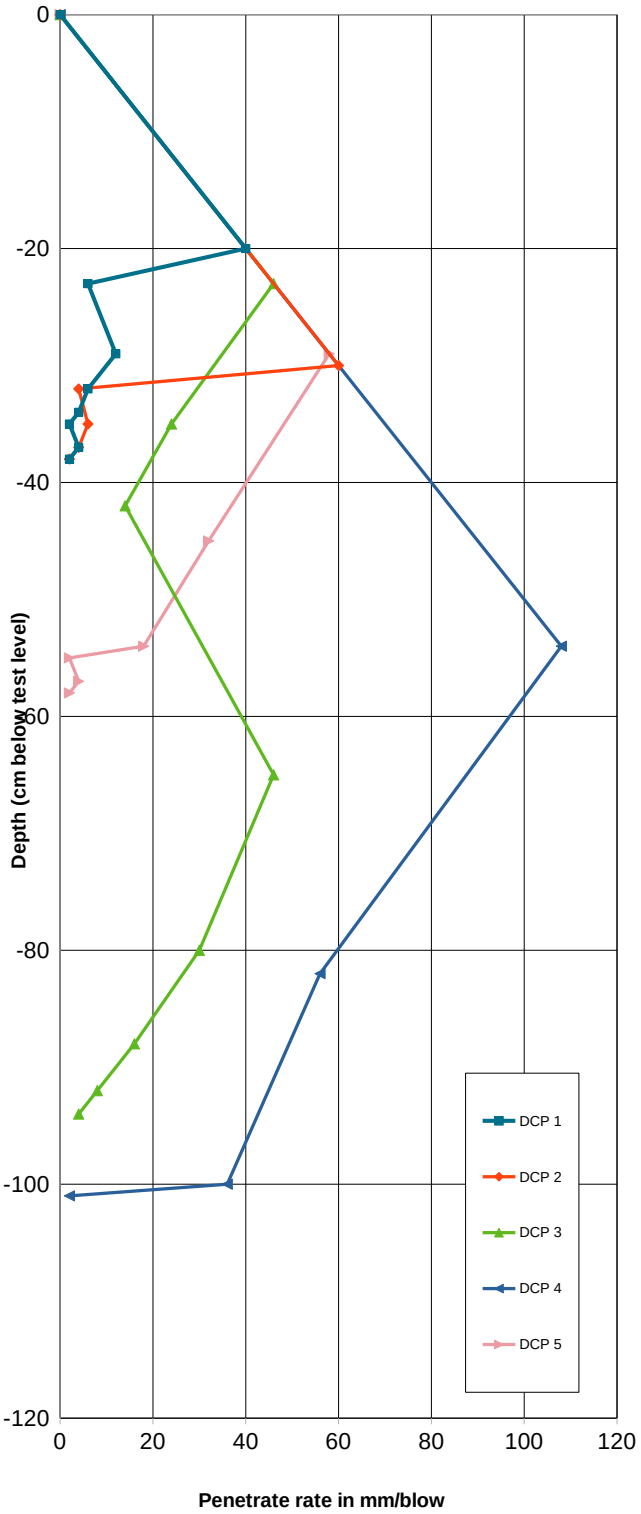


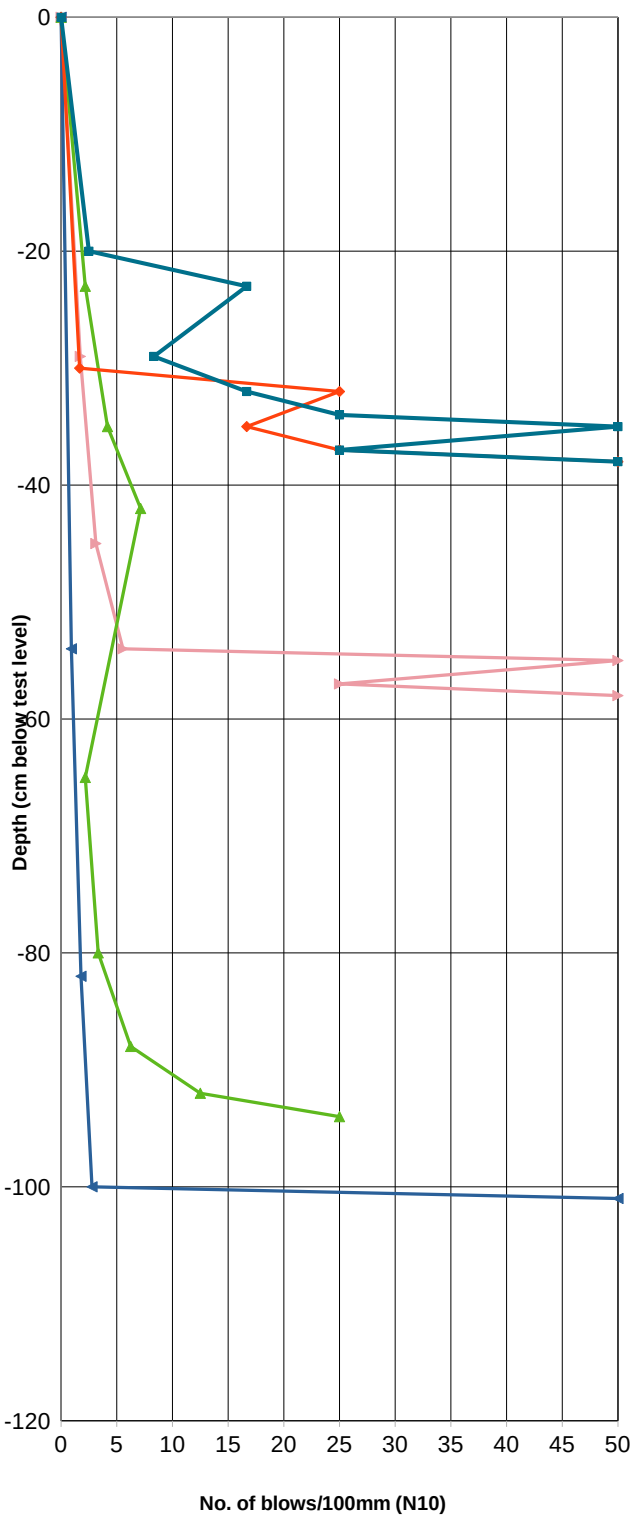


CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **West**

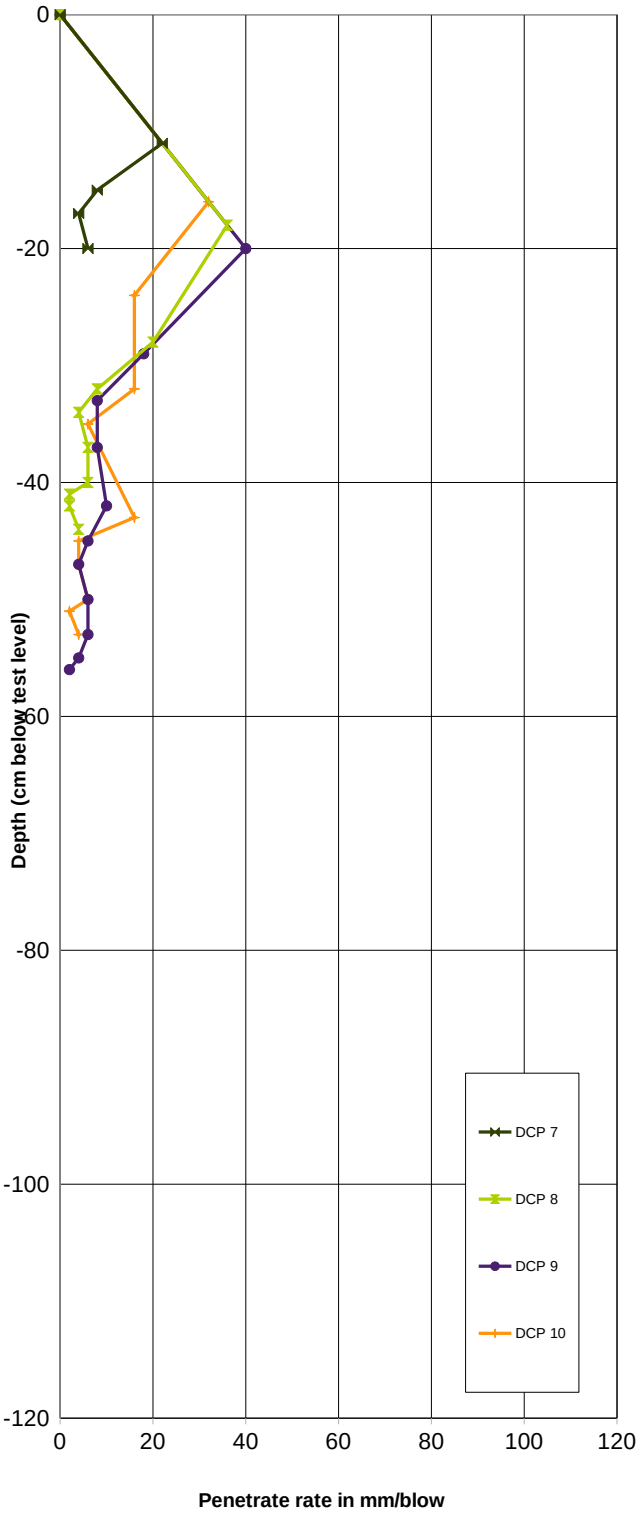


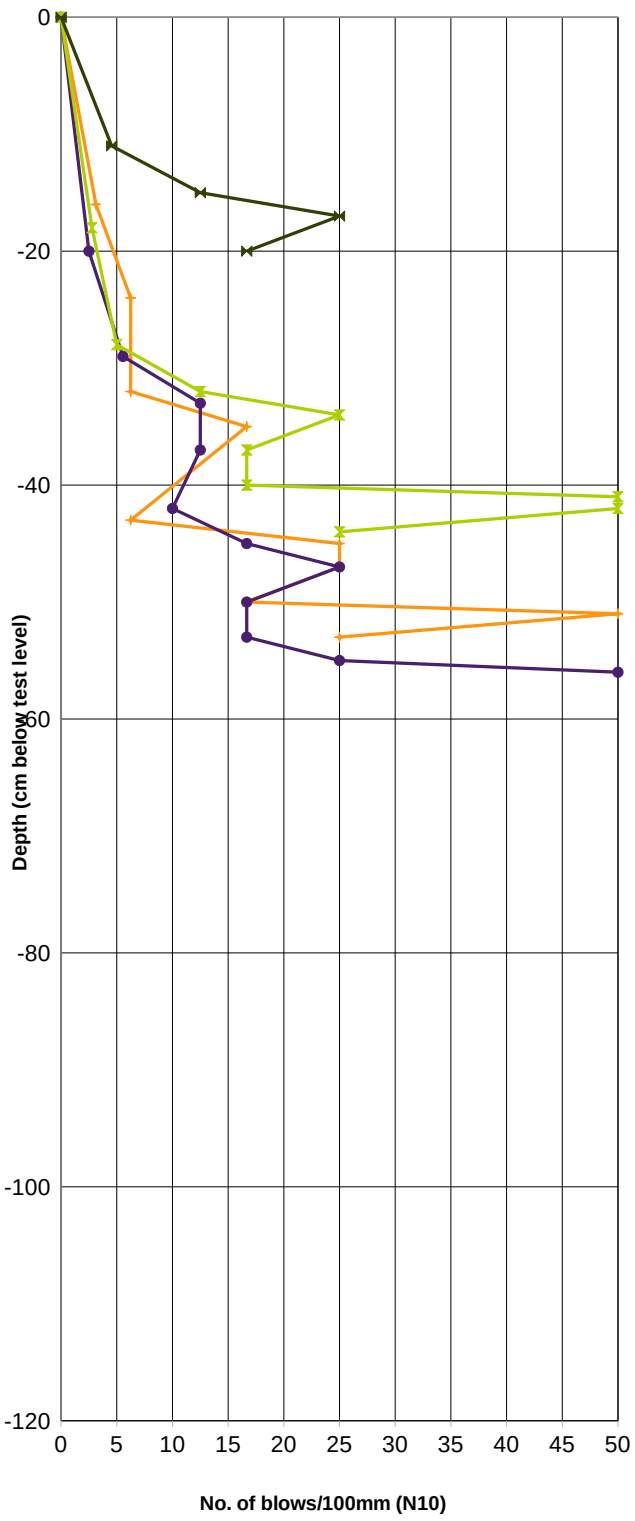


CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **North**

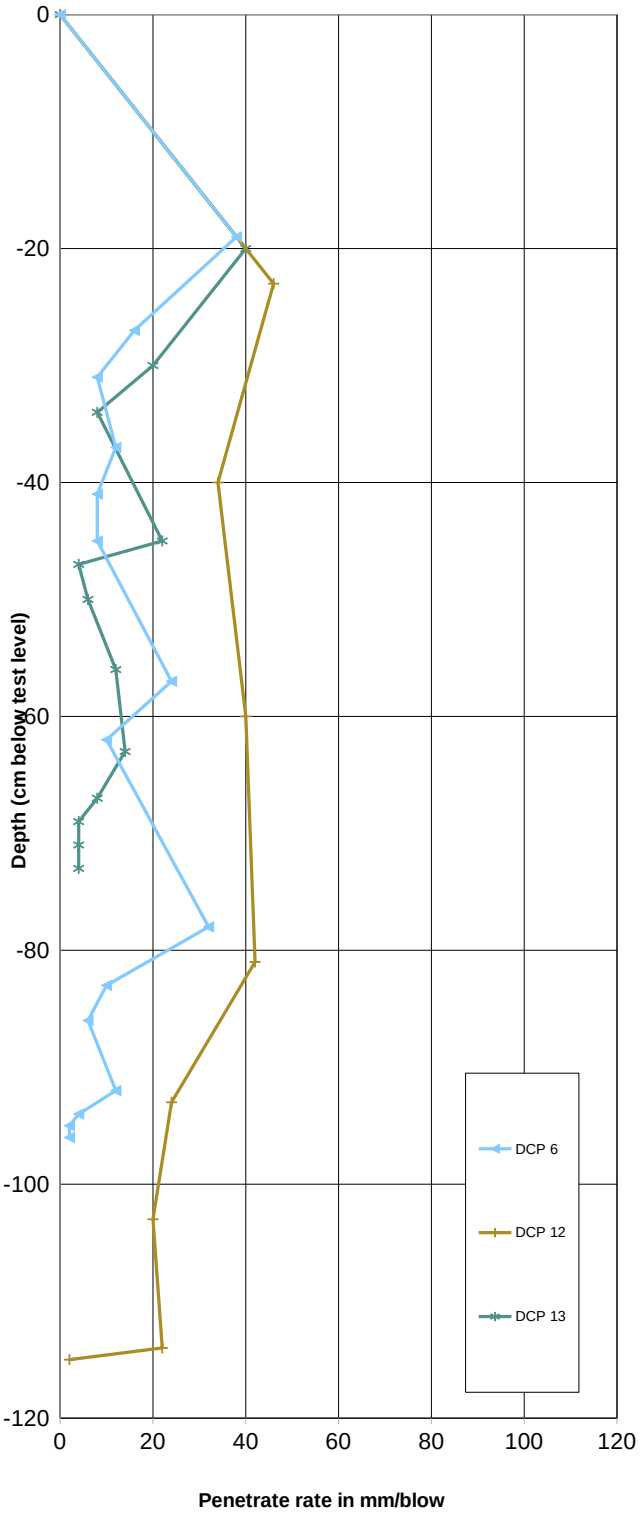


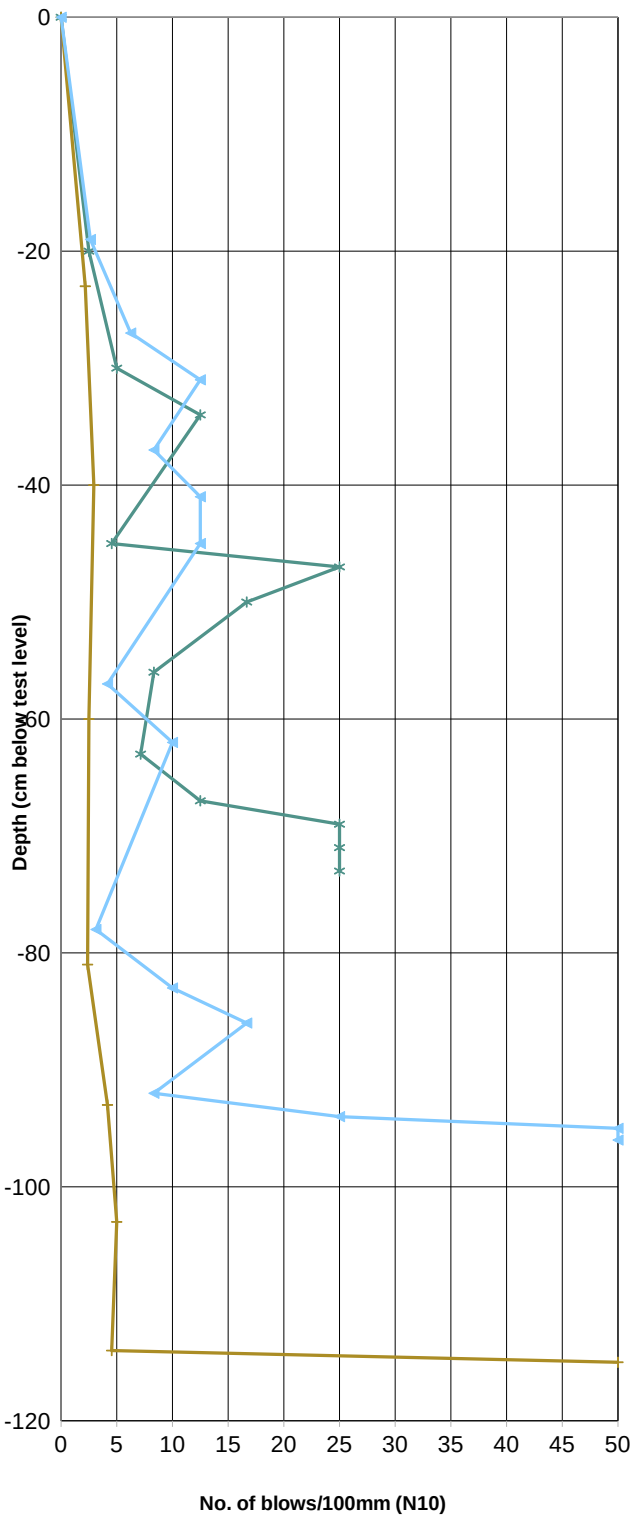


CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP) **Central**

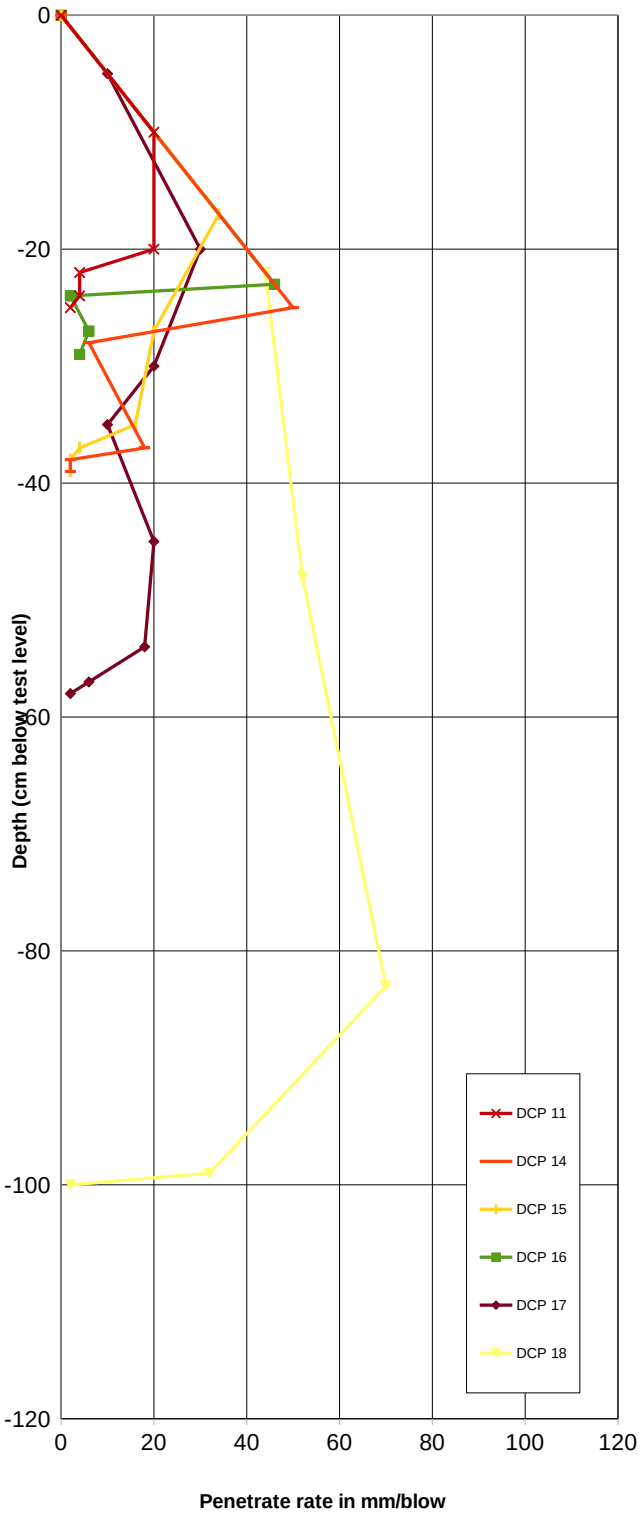


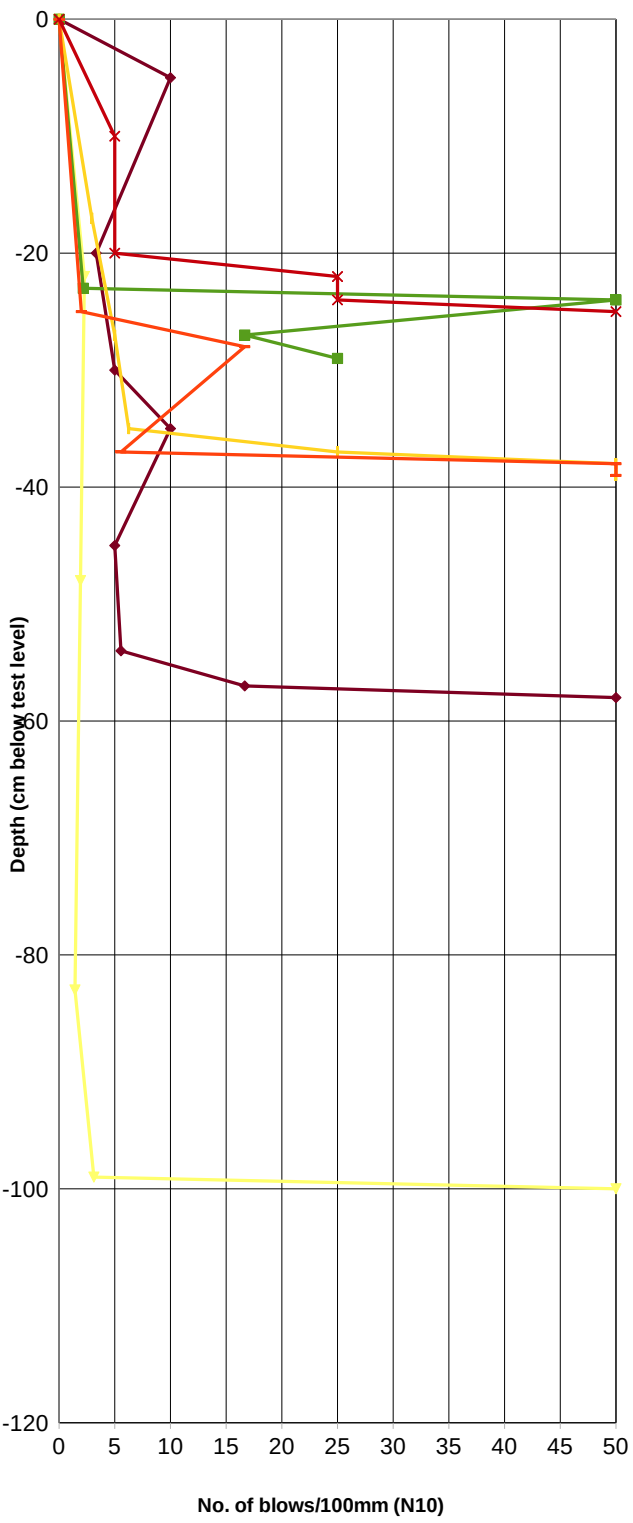


CORE GEOTECHNICAL CONSULTANTS

CLANWILLIAM HOUSING **JOB NO.:** 006-24

DYNAMIC CONE PENETROMETER (DCP)





Appendix D

Laboratory test results

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

11 Gooderson Road Blackheath
PO Box 58 Blackheath 7581
Tel: 021 905 0435
Fax: 086 499 9482
Email: info@steynwilson.co.za
Web: www.steynwilson.co.za

Client: **Core Geotechnical Consultants (Pty) Ltd**

Project: Clanwilliam Housing

Attention: Eugene Laubscher

Your Ref. No: -

Date Reported 03/04/24

TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL33207

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

Test Requested

3 x	*MOD / CBR*
4 x	*FOUNDATION INDICATORS*
1 x	*PH*
1 x	*CONDUTCIVITY*

Site Sampling and Materials Information

Sampling Method	*Specimens delivered to Steyn Wilson Laboratory.*
Environmental Condition	*Sunny*
Deviation from the prescribed test method	*No deviation from standard test method.*
Responsibility of information disclaimer	*The sample information was received from the customer. Results apply to the sample as received from the Customer.*

FINAL REPORT

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

Mr. R.Wilson
Technical Signatory

Remarks:

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to ASTM.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request. It is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.

DIRECTORS: **Mr. J. Steyn ND-Civil (Managing) | Mr. R. Wilson B-Tech Civil (Operations)**

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

sanas Testing Laboratory T0835

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PO Box 58 Blackheath 7581
Tel: 021 905 0435
Fax: 086 499 9482
Email: info@steynwilson.co.za
Web: www.steynwilson.co.za

Customer : **Core Geotechnical Consultants (Pty) Ltd**
4C Manor Mews, 4 Lancaster Road
Kenilworth
7708
Attention : Eugene Laubscher

Project : Clanwilliam Housing
Date Received : 25/03/24
Date Reported : 03/04/24
Req. Number : -

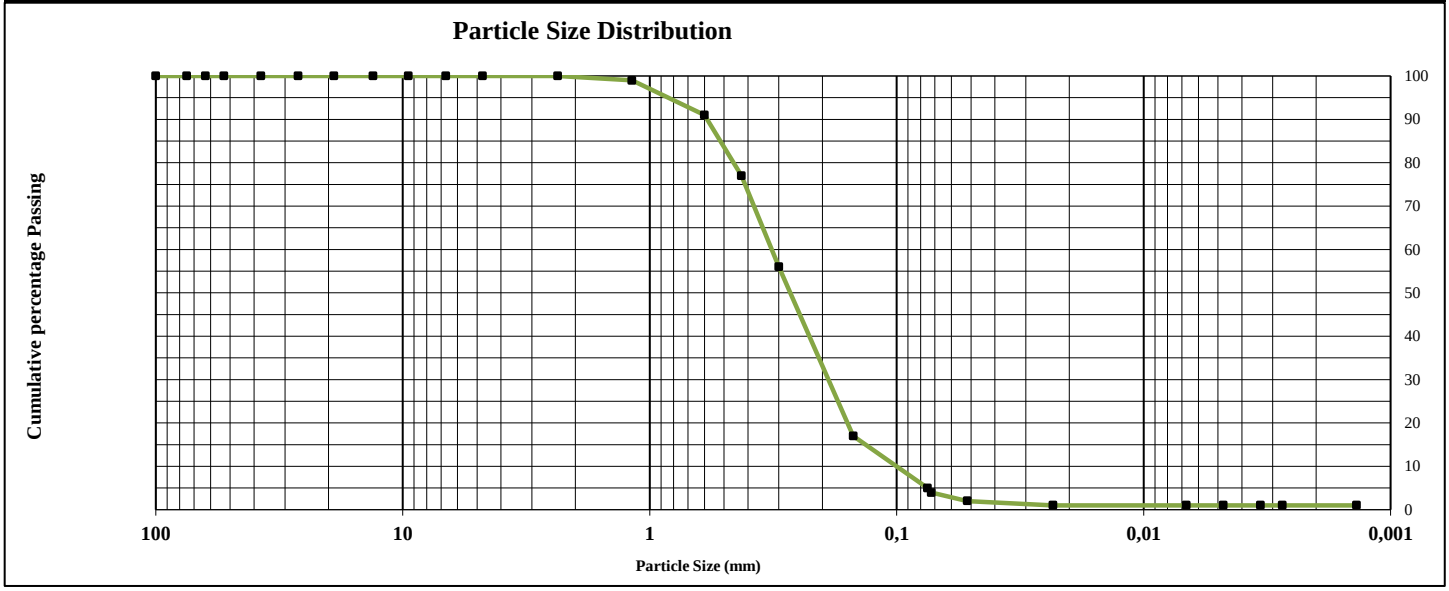
MOD / CBR / FOUNDATION INDICATOR - ASTM D422 / SANS 3001 GR10 / SANS 3001 GR12 / SANS 3001 GR30 / SANS 3001 GR40 / TMH1 A1* / TMH1 A12T*

Material Description:	Light Yellowish Brown Sand	Sample Number:	33207 / 1			
Position:	TP2	Liquid Limit	**NP**	Linear Shrinkage	**0,0**	
Depth:	0 - 1.0m	Plasticity Index	**NP**	Insitu M/C%	**1,2**	

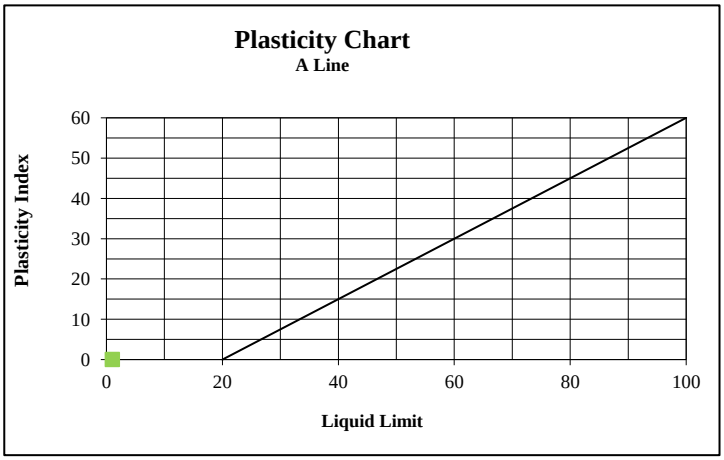
pH (TMH1 A20)	6,8	Conductivity s.m^{-1} (TMH1 A21T)	0,063	SG (TMH1 A12T)*	2,643

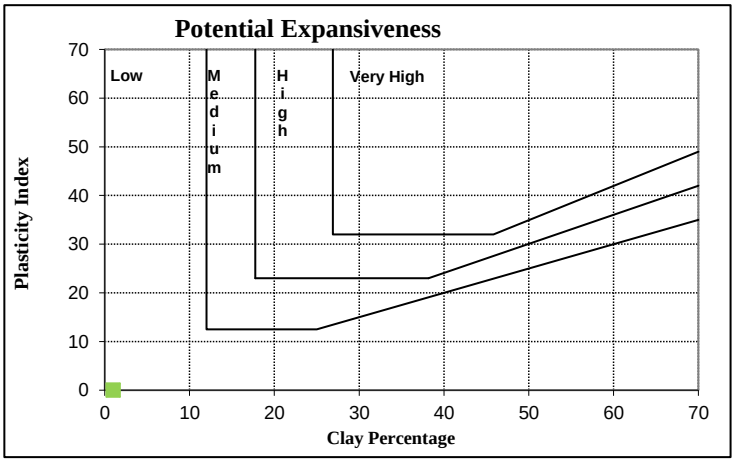
SIEVE ANALYSIS (TMH 1 A1a)*																		HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,072	0,052	0,023	0,007	0,005	0,003	0,003	0,001
100	100	100	100	100	100	100	100	100	100	100	100	99	91	77	56	17	5	3,96	1,98	0,99	0,99	0,99	0,99	0,99	0,99
% Passing																									

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	12,4	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	1774	12,3	0,0	24	20	17	14	12	8



% Gravel		% Sand	95	% Silt	4	% Clay	1





NOTE: All tests marked with (*) means that those test methods are not accredited.

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

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Fax: 086 499 9482
Email: info@steynwilson.co.za
Web: www.steynwilson.co.za

Customer : **Core Geotechnical Consultants (Pty) Ltd**
4C Manor Mews, 4 Lancaster Road
Kenilworth
7708
Attention : Eugene Laubscher

Project : Clanwilliam Housing
Date Received : 25/03/24
Date Reported : 03/04/24
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MOD / CBR / FOUNDATION INDICATOR - ASTM D422 / SANS 3001 GR10 / SANS 3001 GR12 / SANS 3001 GR30 / SANS 3001 GR40 / TMH1 A1* / TMH1 A12T*

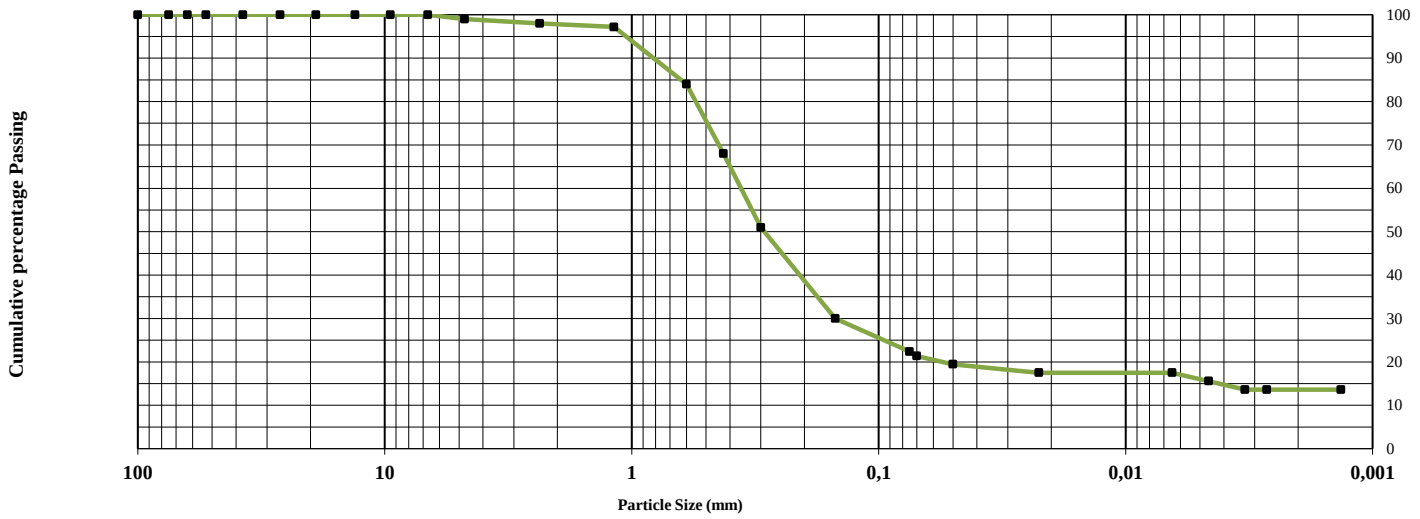
Material Description:	Light Brown Silty Soil	Sample Number:	33207 / 2			
Position:	TP7	Liquid Limit	**20,2**	Linear Shrinkage	**2,4**	
Depth:	0 - 0.5m	Plasticity Index	**4,5**	Insitu M/C%	**4,2**	

pH (TMH1 A20)		Conductivity s.m^{-1} (TMH1 A21T)		SG (TMH1 A12T)*	2,604

SIEVE ANALYSIS (TMH 1 A1a)*																		HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,070	0,050	0,022	0,006	0,005	0,003	0,003	0,001
100	100	100	100	100	100	100	100	100	100	99	98	97,2	84	68	51	30	22,4	21,38	19,44	17,5	17,5	15,55	13,61	13,61	13,61
% Passing																									

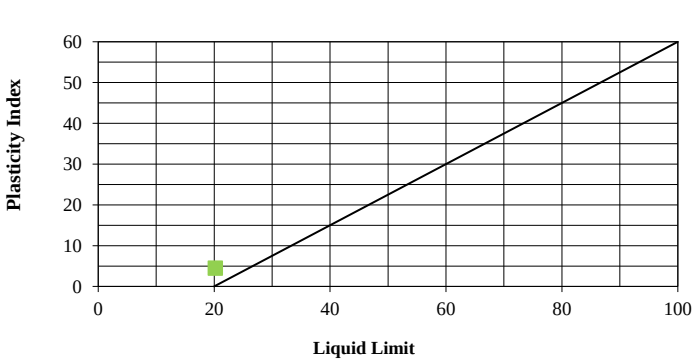
MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	10,5	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	1996	10,4	0,34	7	5	5	4	3	2

Particle Size Distribution

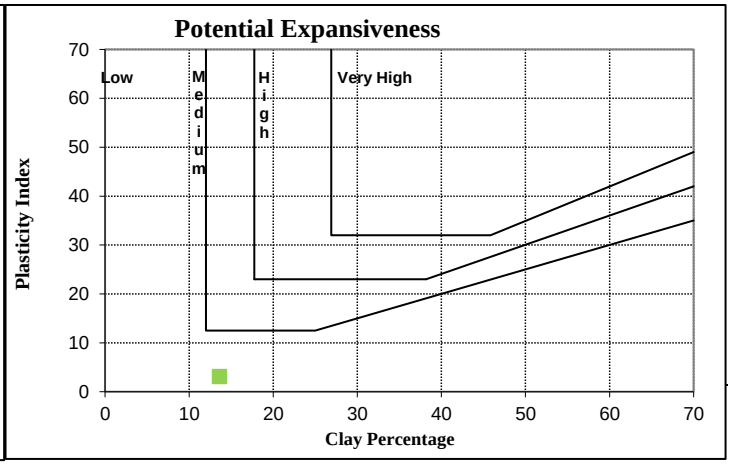


% Gravel	1	% Sand	77	% Silt	8	% Clay	14

Plasticity Chart



Potential Expansiveness



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Attention : Eugene Laubscher

Project : Clanwilliam Housing
Date Received : 25/03/24
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MOD / CBR / FOUNDATION INDICATOR - ASTM D422 / SANS 3001 GR10 / SANS 3001 GR12 / SANS 3001 GR30 / SANS 3001 GR40 / TMH1 A1* / TMH1 A12T*

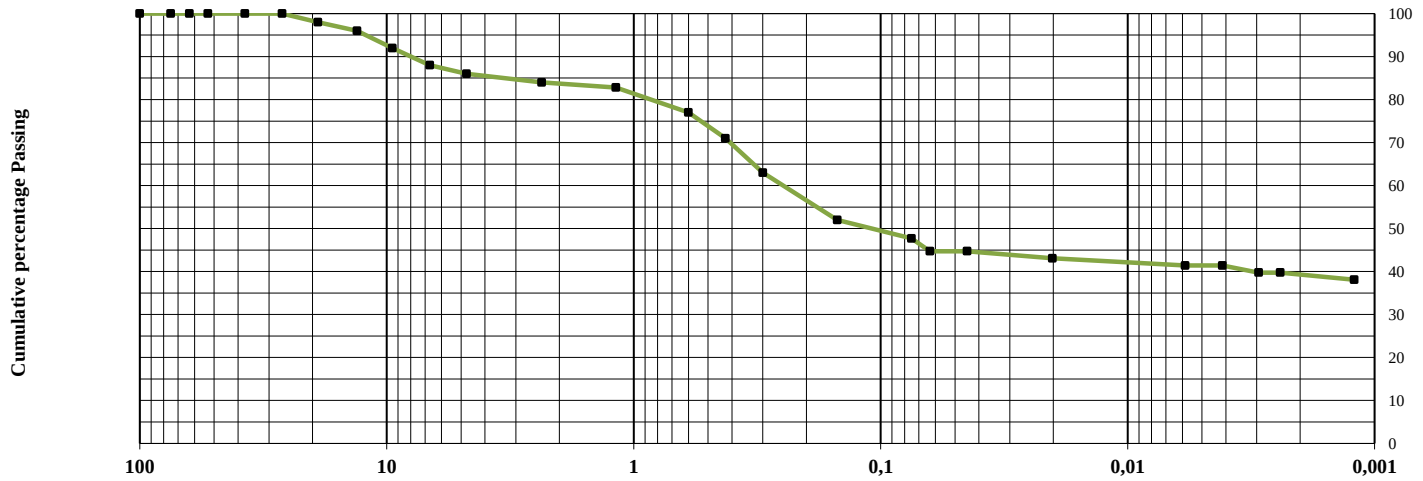
Material Description:	Dark Brown Orange Silty Clay	Sample Number:	33207 / 3			
Position:	TP7	Liquid Limit	**31**	Linear Shrinkage	**7,1**	
Depth:	0.5 - 0.7m	Plasticity Index	**14,9**	Insitu M/C%	**8,8**	

pH (TMH1 A20)		Conductivity s.m^{-1} (TMH1 A21T)		SG (TMH1 A12T)*	2,601

SIEVE ANALYSIS (TMH 1 A1a)*																		HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,063	0,045	0,020	0,006	0,004	0,003	0,002	0,001
100	100	100	100	100	100	98	96	92	88	86	84	82,8	77	71	63	52	47,7	44,71	44,71	43,06	41,4	41,4	39,74	39,74	38,09
% Passing																									

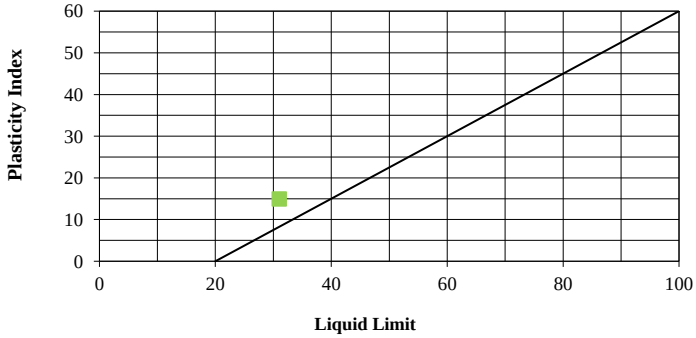
MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%		COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)									

Particle Size Distribution

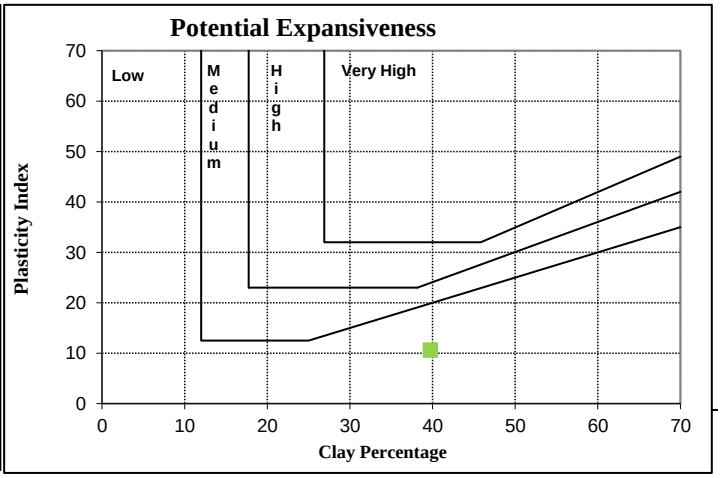


% Gravel	14	% Sand	40	% Silt	7	% Clay	40

Plasticity Chart
A Line



Potential Expansiveness



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4C Manor Mews, 4 Lancaster Road
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7708
Attention : Eugene Laubscher

Project : Clanwilliam Housing
Date Received : 25/03/24
Date Reported : 03/04/24
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MOD / CBR / FOUNDATION INDICATOR - ASTM D422 / SANS 3001 GR10 / SANS 3001 GR12 / SANS 3001 GR30 / SANS 3001 GR40 / TMH1 A1* / TMH1 A12T*

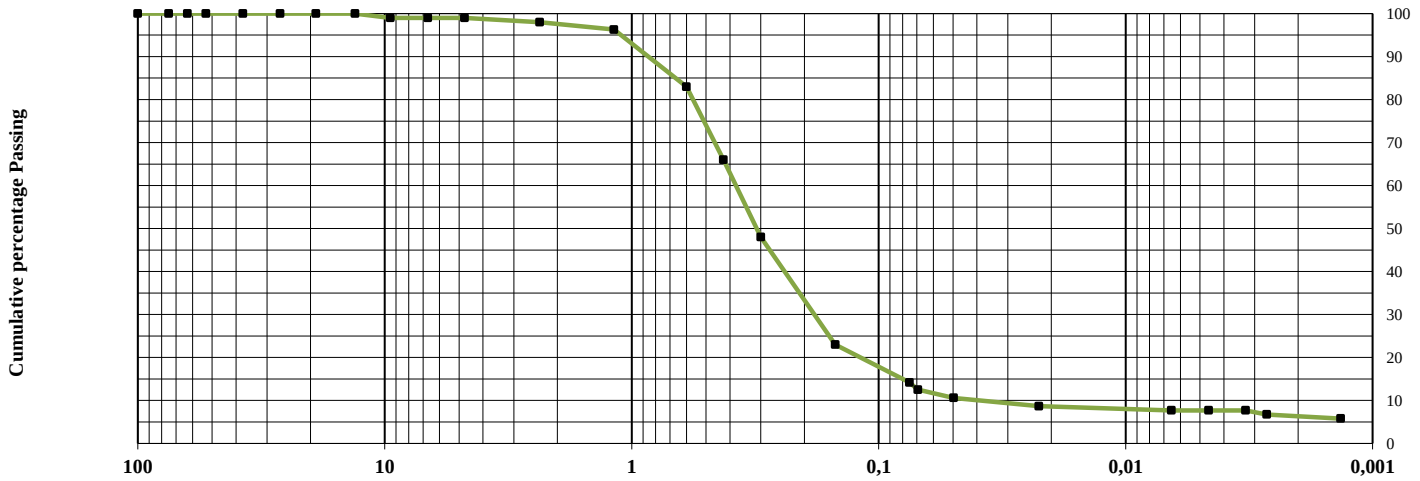
Material Description:	Dark Brown Sand	Sample Number:	33207 / 4			
Position:	TP9	Liquid Limit	NP	Linear Shrinkage	0,0	
Depth:	0.1 - 0.4m	Plasticity Index	NP	Insitu M/C%	4,5	

pH (TMH1 A20)		Conductivity s.m^{-1} (TMH1 A21T)		SG (TMH1 A12T)*	2,604

SIEVE ANALYSIS (TMH 1 A1a)*																		HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,069	0,050	0,022	0,007	0,005	0,003	0,003	0,001
100	100	100	100	100	100	100	100	99	99	99	98	96,3	83	66	48	23	14,2	12,52	10,59	8,667	7,704	7,704	7,704	6,741	5,778
% Passing																									

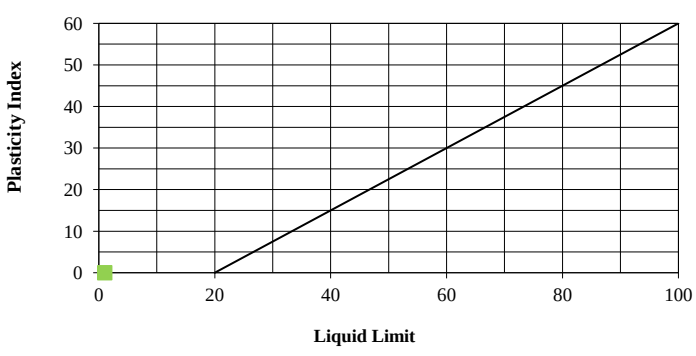
MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	12,5	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	1909	12,4	0,0	22	19	18	15	12	9

Particle Size Distribution

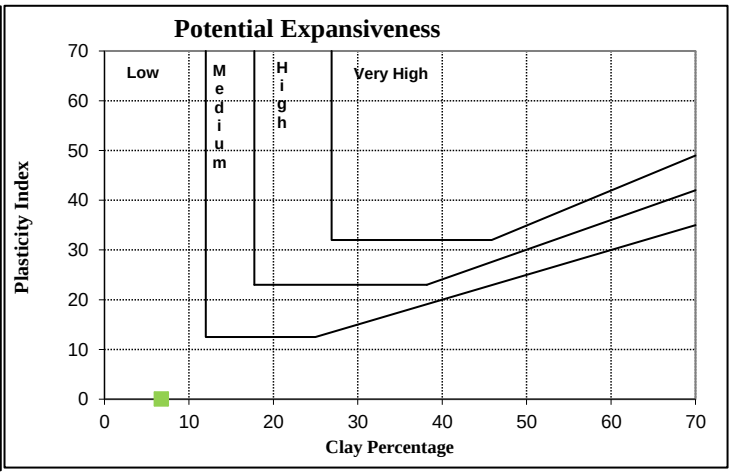


% Gravel	1	% Sand	86	% Silt	7	% Clay	7

Plasticity Chart



Potential Expansiveness



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Web: www.steynwilson.co.za

Client: **Core Geotechnical Consultants (Pty) Ltd**

Project: Clanwilliam Housing

Attention: Eugene Laubscher

Your Ref. No: -

Date Reported 03/04/24

TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL33207

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

Test Requested

2 x	*MOD / CBR*
4 x	*FOUNDATION INDICATORS*
2 x	*PH*
2 x	*CONDUTCIVITY*

FINAL REPORT

Site Sampling and Materials Information

Sampling Method	*Specimens delivered to Steyn Wilson Laboratory.*
Environmental Condition	*Sunny*
Deviation from the prescribed test method	*No deviation from standard test method.*
Responsibility of information disclaimer	*The sample information was received from the customer. Results apply to the sample as received from the Customer.*

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

Mr. R.Wilson
Technical Signatory

Remarks:

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to ASTM.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request. It is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.

DIRECTORS: **Mr. J. Steyn ND-Civil (Managing) | Mr. R. Wilson B-Tech Civil (Operations)**

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CIVIL ENGINEERING TESTING LABORATORIES

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Customer :	**Core Geotechnical Consultants (Pty) Ltd**	Project :	Clanwilliam Housing
	4C Manor Mews, 4 Lancaster Road	Date Received :	25/03/24
	Kenilworth	Date Reported :	03/04/24
	7708	Req. Number :	-
Attention :	Eugene Laubscher		

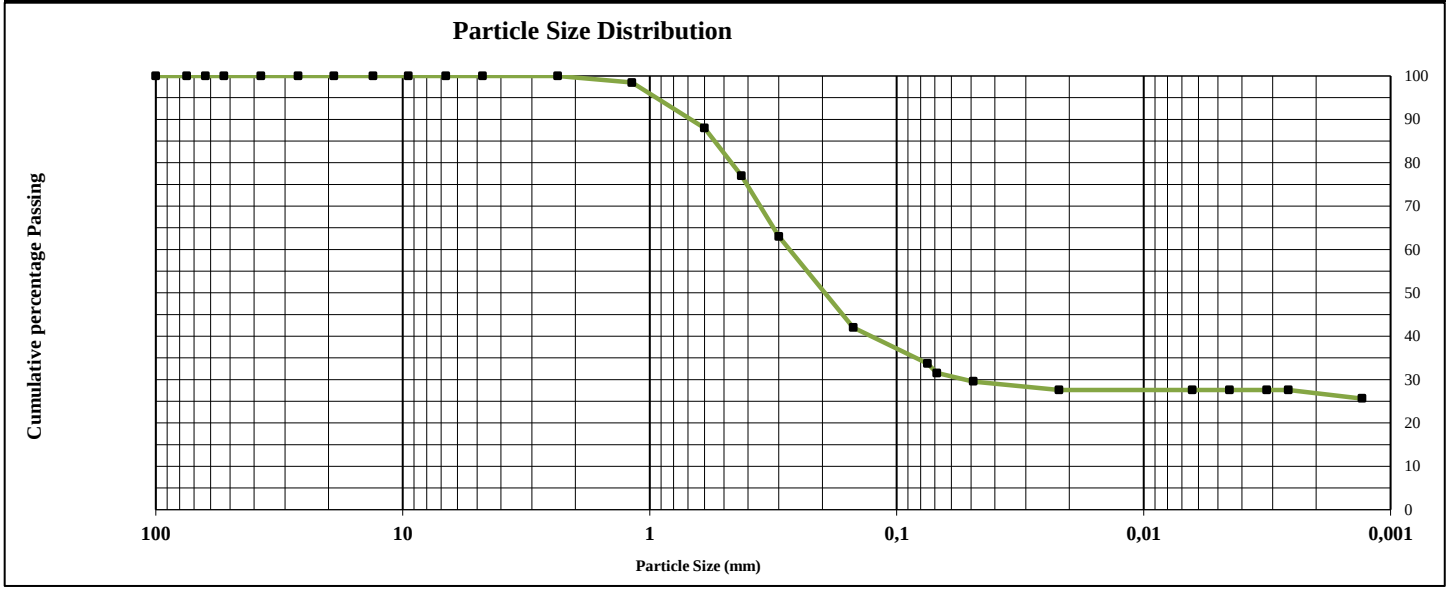
MOD / CBR / FOUNDATION INDICATOR - ASTM D422 / SANS 3001 GR10 / SANS 3001 GR12 / SANS 3001 GR30 / SANS 3001 GR40 / TMH1 A1* / TMH1 A12T*

Material Description:	Dark Brown Yellowish Silty Sand	Sample Number:	33207 / 5			
Position:	TP10	Liquid Limit	**24,4**	Linear Shrinkage	**4,2**	
Depth:	0.1 - 0.5m	Plasticity Index	**8,8**	Insitu M/C%	**7,1**	

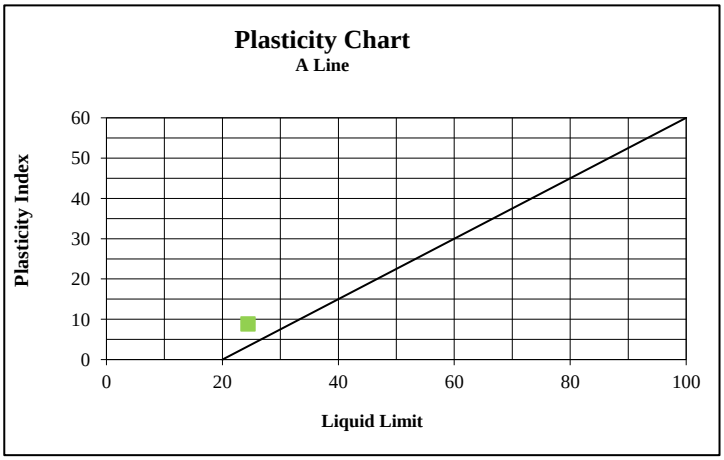
pH (TMH1 A20)	8,0	Conductivity s.m^{-1} (TMH1 A21T)	0,074	SG (TMH1 A12T)*	2,577

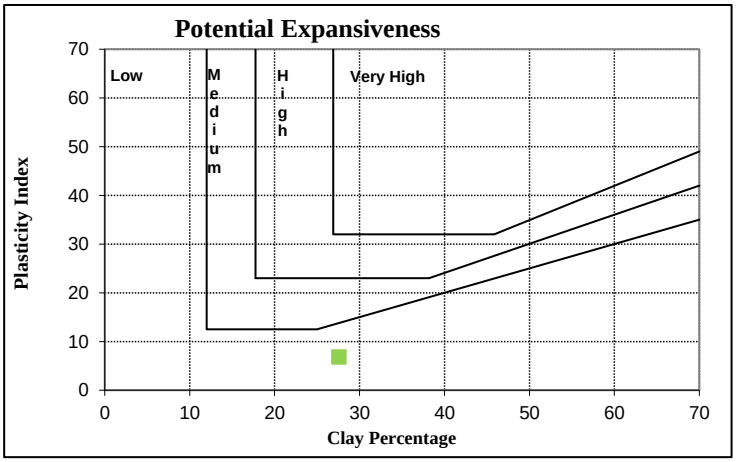
SIEVE ANALYSIS (TMH 1 A1a)*																		HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,069	0,049	0,022	0,006	0,004	0,003	0,003	0,001
100	100	100	100	100	100	100	100	100	100	100	100	98,5	88	77	63	42	33,7	31,52	29,55	27,58	27,58	27,58	27,58	27,58	25,61
% Passing																									

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%		COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)									



% Gravel		% Sand	67	% Silt	5	% Clay	28





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MOD / CBR / FOUNDATION INDICATOR - ASTM D422 / SANS 3001 GR10 / SANS 3001 GR12 / SANS 3001 GR30 / SANS 3001 GR40 / TMH1 A1* / TMH1 A12T*

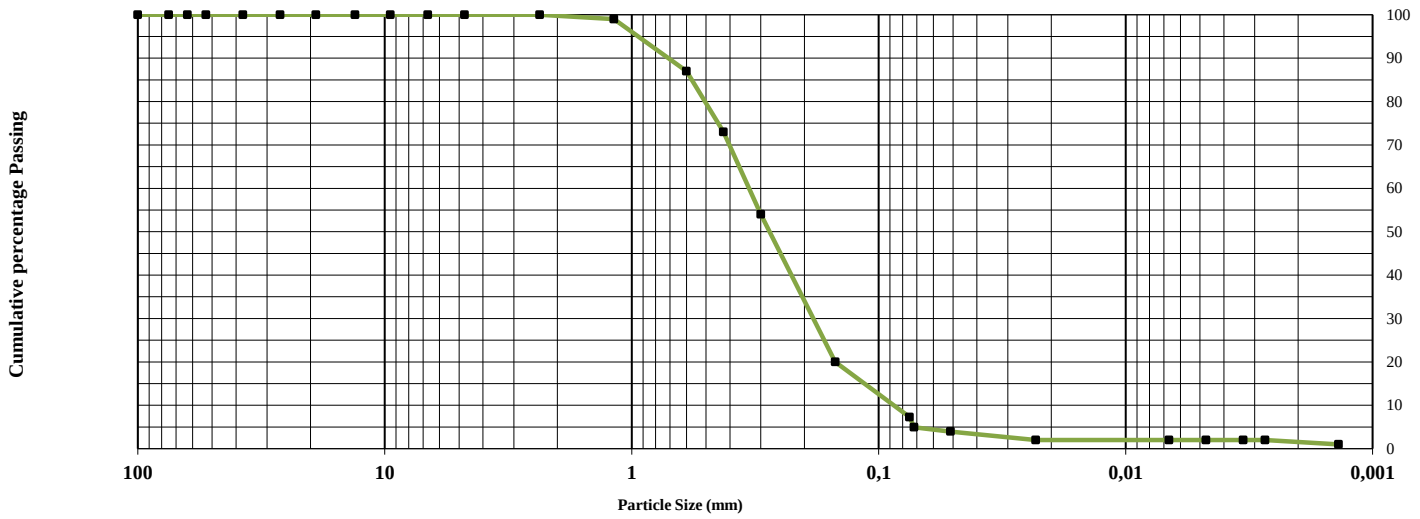
Material Description:	Light Brown Sand	Sample Number:	33207 / 6			
Position:	TP6	Liquid Limit	NP	Linear Shrinkage	0,0	
Depth:	0.1 - 1.0m	Plasticity Index	NP	Insitu M/C%	0,5	

pH (TMH1 A20)		Conductivity s.m^{-1} (TMH1 A21T)		SG (TMH1 A12T)*	2,643

SIEVE ANALYSIS (TMH 1 A1a)*																		HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,072	0,051	0,023	0,007	0,005	0,003	0,003	0,001
100	100	100	100	100	100	100	100	100	100	100	100	99	87	73	54	20	7,3	4,95	3,96	1,98	1,98	1,98	1,98	1,98	0,99
% Passing																									

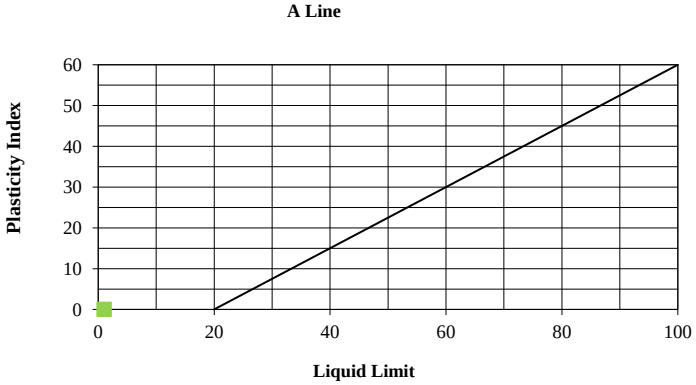
MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	14,5	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	1667	14,3	0,0	18	15	14	12	9	7

Particle Size Distribution

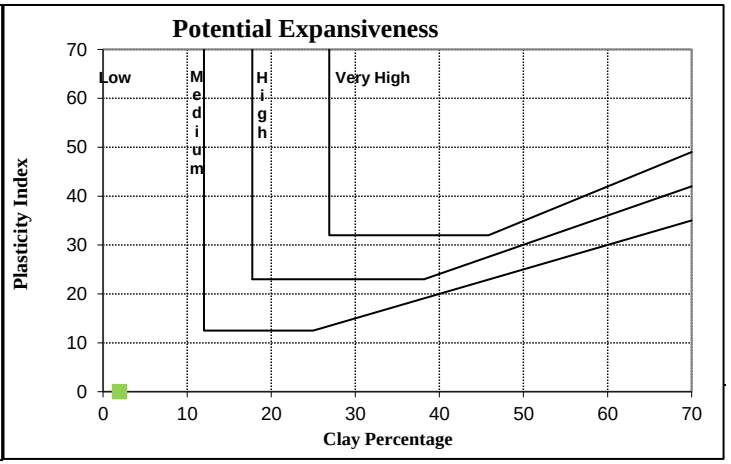


% Gravel		% Sand	94	% Silt	4	% Clay	2

Plasticity Chart



Potential Expansiveness



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Date Received : 25/03/24
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MOD / CBR / FOUNDATION INDICATOR - ASTM D422 / SANS 3001 GR10 / SANS 3001 GR12 / SANS 3001 GR30 / SANS 3001 GR40 / TMH1 A1* / TMH1 A12T*

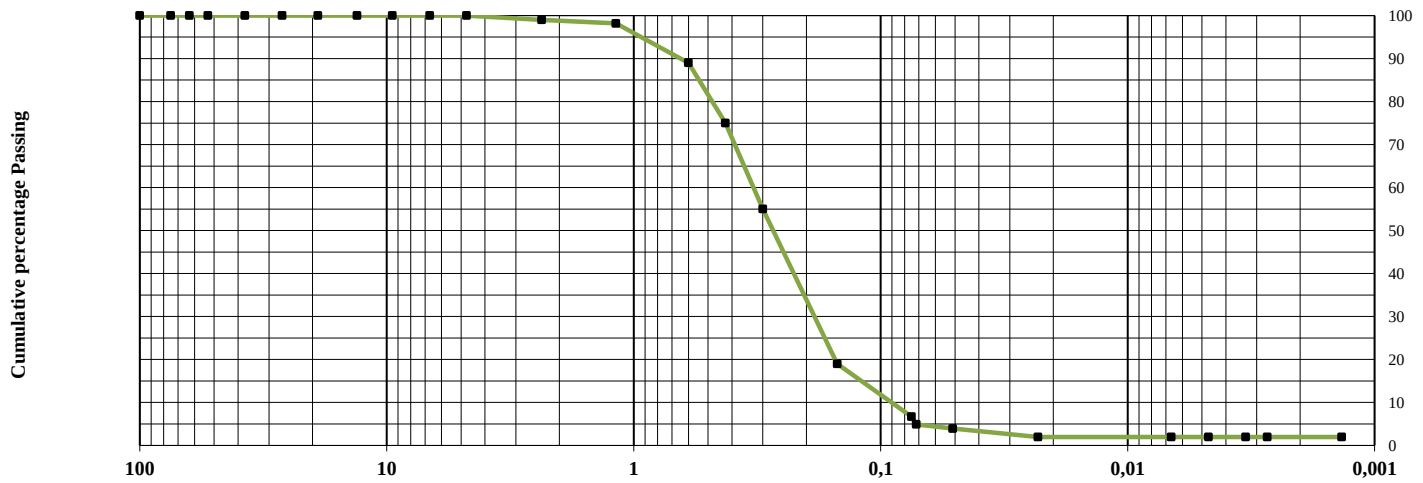
Material Description:	Light Yellowish Brown Sand	Sample Number:	33207 / 7			
Position:	TP13	Liquid Limit	NP	Linear Shrinkage	0,0	
Depth:	0.2 - 1.2m	Plasticity Index	NP	Insitu M/C%	0,9	

pH (TMH1 A20)	8,1	Conductivity s.m^{-1} (TMH1 A21T)	0,074	SG (TMH1 A12T)*	2,654

SIEVE ANALYSIS (TMH 1 A1a)*																		HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,072	0,051	0,023	0,007	0,005	0,003	0,003	0,001
100	100	100	100	100	100	100	100	100	100	100	99	98,2	89	75	55	19	6,7	4,91	3,928	1,964	1,964	1,964	1,964	1,964	1,964
% Passing																									

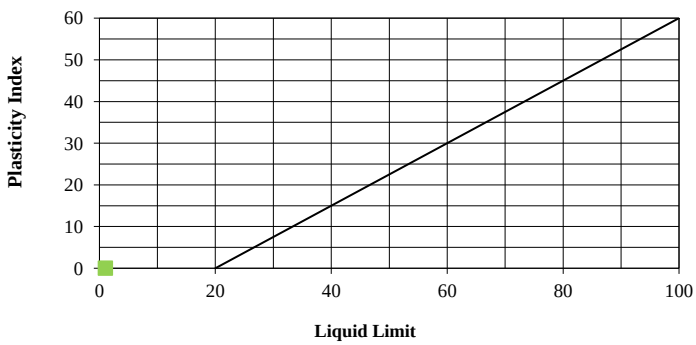
MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%		COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)									

Particle Size Distribution

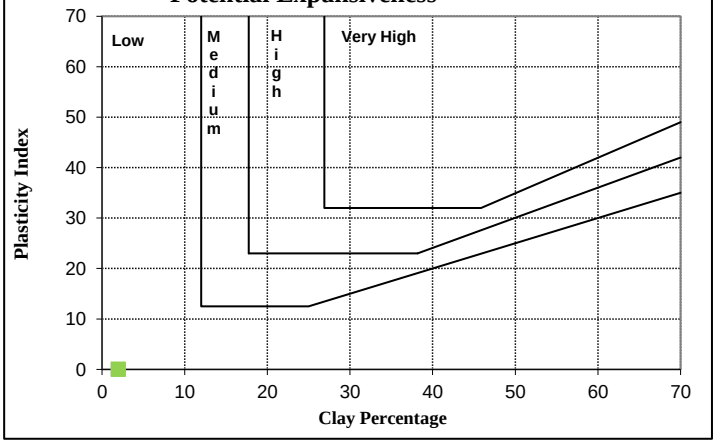


% Gravel		% Sand	94	% Silt	4	% Clay	2

Plasticity Chart
A Line



Potential Expansiveness



NOTE: All tests marked with (*) means that those test methods are not accredited.

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES
sanas Testing Laboratory T0835

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Fax: 086 499 9482
Email: info@steynwilson.co.za
Web: www.steynwilson.co.za

Customer : **Core Geotechnical Consultants (Pty) Ltd**
4C Manor Mews, 4 Lancaster Road
Kenilworth
7708
Attention : Eugene Laubscher

Project : Clanwilliam Housing
Date Received : 25/03/24
Date Reported : 03/04/24
Req. Number : -

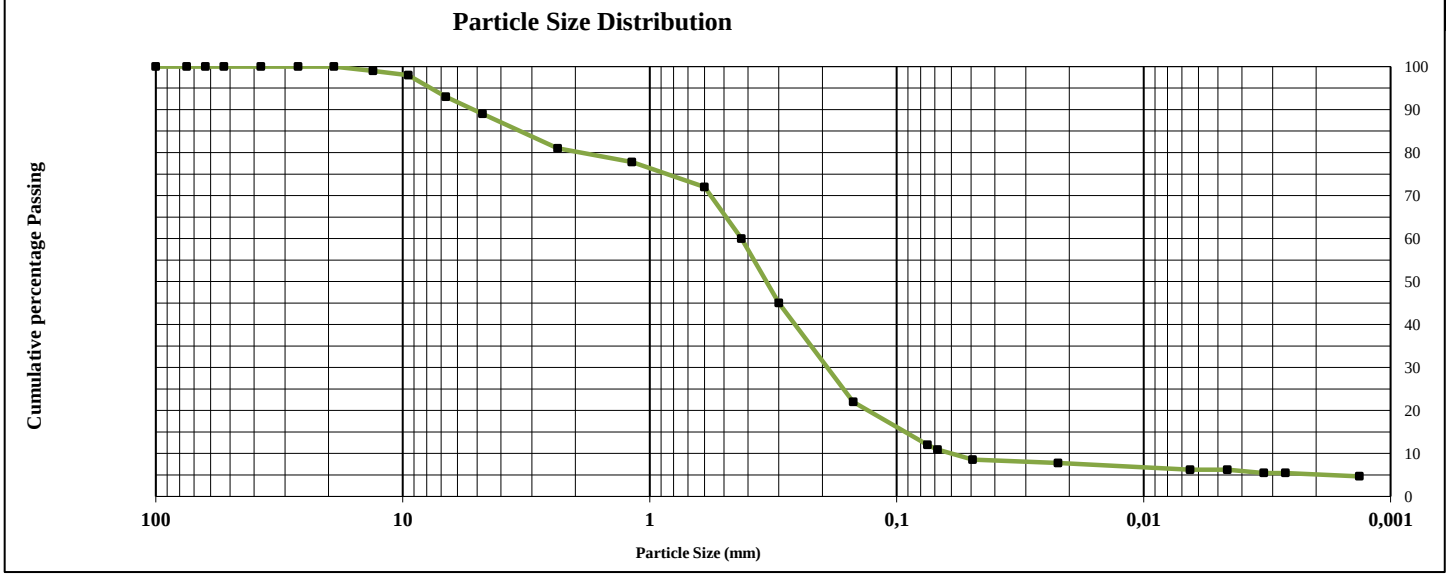
MOD / CBR / FOUNDATION INDICATOR - ASTM D422 / SANS 3001 GR10 / SANS 3001 GR12 / SANS 3001 GR30 / SANS 3001 GR40 / TMH1 A1* / TMH1 A12T*

Material Description:	Dark Brown Reddish Sand + Pebble	Sample Number:	33207 / 9			
Position:	TP14	Liquid Limit	NP	Linear Shrinkage	0,0	
Depth:	0.3 - 1.6m	Plasticity Index	NP	Insitu M/C%	1,7	

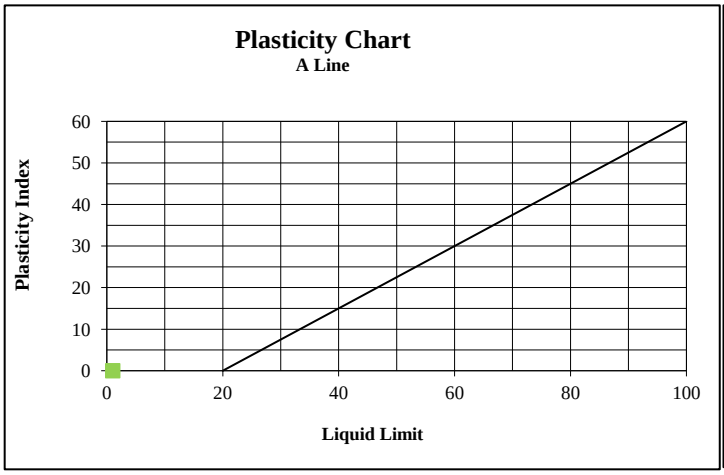
pH (TMH1 A20)		Conductivity s.m^{-1} (TMH1 A21T)		SG (TMH1 A12T)*	2,632

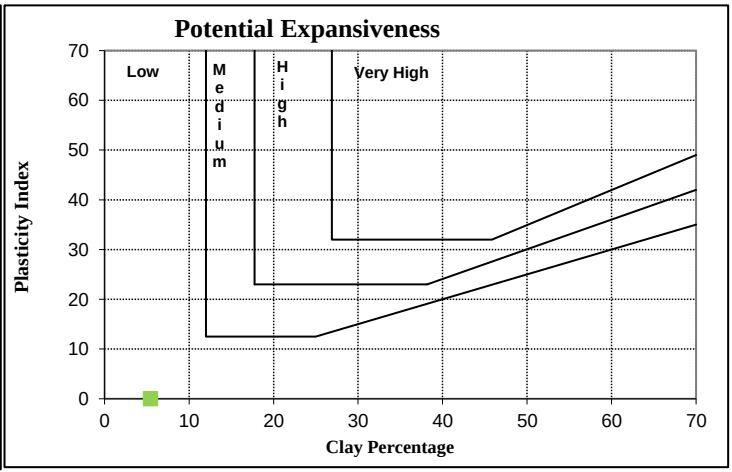
SIEVE ANALYSIS (TMH 1 A1a)*																		HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,068	0,049	0,022	0,006	0,005	0,003	0,003	0,001
100	100	100	100	100	100	100	99	98	93	89	81	77,8	72	60	45	22	12	10,89	8,558	7,78	6,224	6,224	5,446	5,446	4,668
% Passing																									

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	8,5	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	2029	8,4	0,0	61	48	43	35	28	20



% Gravel	11	% Sand	77	% Silt	6	% Clay	5





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Web: www.steynwilson.co.za

Client: **Core Geotechnical Consultants (Pty) Ltd**

Project: Clanwilliam Housing

Attention: Eugene Laubscher

Your Ref. No: -

Date Reported 03/04/24

TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL33207

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

Test Requested

1 x MOD / CBR / FOUNDATION INDICATOR

Site Sampling and Materials Information

Sampling Method	*Specimens delivered to Steyn Wilson Laboratory.*
Environmental Condition	*Sunny*
Deviation from the prescribed test method	*No deviation from standard test method.*
Responsibility of information disclaimer	*The sample information was received from the customer. Results apply to the sample as received from the Customer.*

FINAL REPORT

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

Mr. R.Wilson
Technical Signatory

Remarks:

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to ASTM.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request. It is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.

DIRECTORS: **Mr. J. Steyn ND-Civil (Managing) | Mr. R. Wilson B-Tech Civil (Operations)**

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

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4C Manor Mews, 4 Lancaster Road
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7708
Attention : Eugene Laubscher

Project : Clanwilliam Housing
Date Received : 25/03/24
Date Reported : 03/04/24
Req. Number : -

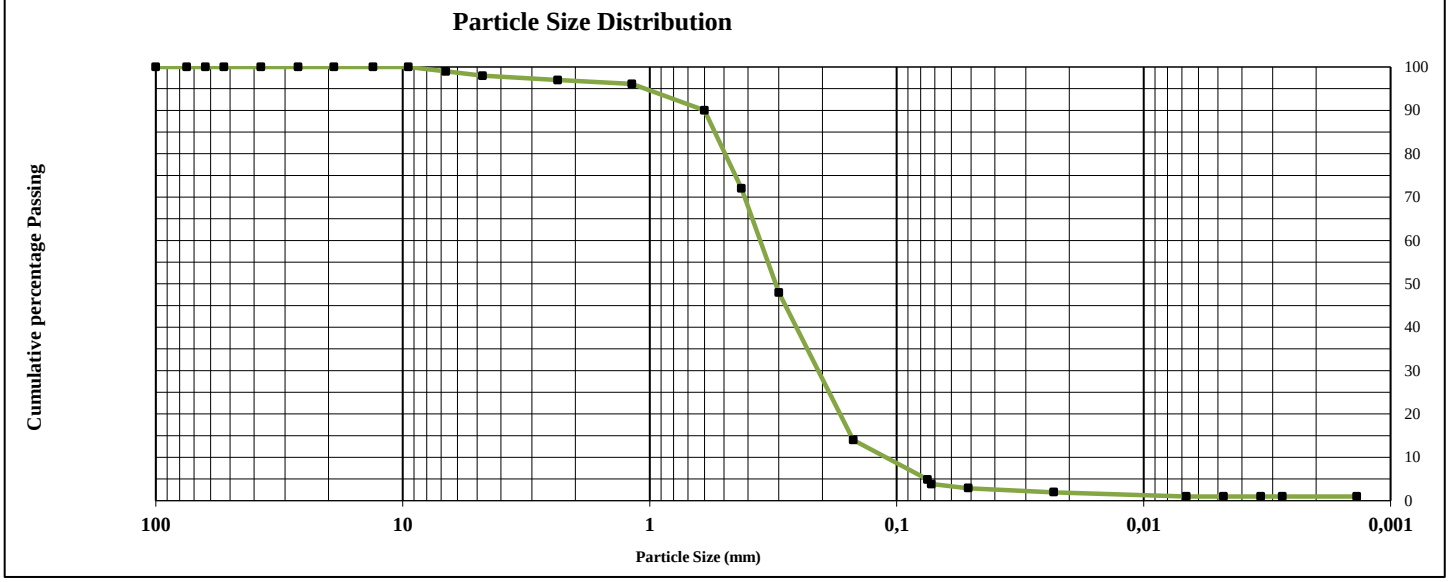
MOD / CBR / FOUNDATION INDICATOR - ASTM D422 / SANS 3001 GR10 / SANS 3001 GR12 / SANS 3001 GR30 / SANS 3001 GR40 / TMH1 A1* / TMH1 A12T*

Material Description:	Light Yellowish Brown Sand	Sample Number:	33207 / 11			
Position:	TP18	Liquid Limit	**NP**	Linear Shrinkage	**0,0**	
Depth:	0 - 1.1m	Plasticity Index	**NP**	Insitu M/C%	**0,2**	

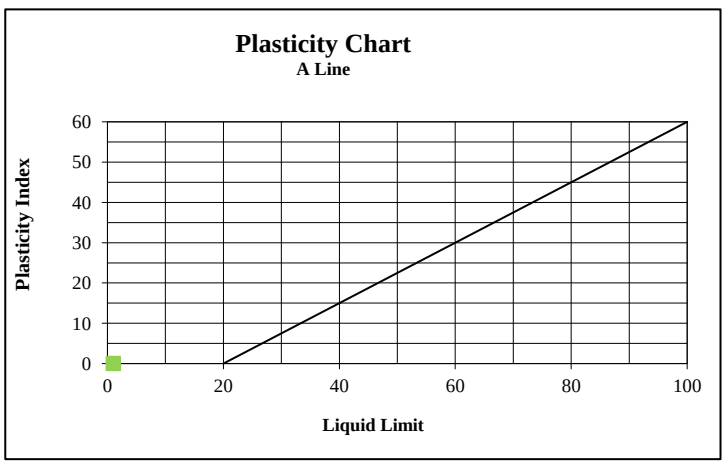
pH (TMH1 A20)		Conductivity s.m^{-1} (TMH1 A21T)		SG (TMH1 A12T)*	2,646

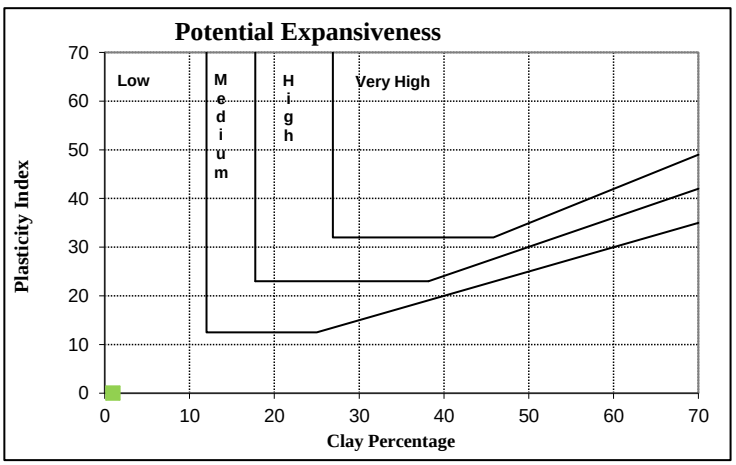
SIEVE ANALYSIS (TMH 1 A1a)*																		HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,072	0,051	0,023	0,007	0,005	0,003	0,003	0,001
100	100	100	100	100	100	100	100	100	99	98	97	96,1	90	72	48	14	4,9	3,844	2,883	1,922	0,961	0,961	0,961	0,961	0,961
% Passing																									

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	16,3	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	1721	16,3	0,0	18	15	13	10	8	6



% Gravel	2	% Sand	94	% Silt	3	% Clay	1





NOTE: All tests marked with (*) means that those test methods are not accredited.

Appendix E

Site and test pit photos

Appendix: Clanwilliam Housing – Test pit & Site photos

TP1



TP2



TP3



TP4



TP5



TP6



TP7



TP8



TP9



TP10



TP11



TP12



TP13



TP14



TP15



TP16



TP17



TP18



Appendix: Clanwilliam Housing – Test pit & Site photos

Looking North from TP1



Looking NE from TP1



Looking South from TP1.



Looking NW from TP11



Looking South across golf course from TP7



Looking North across golf course from TP7



Looking south from TP10



Looking SE from TP10



Looking South from TP11



Looking SW from TP11



Looking South towards TP18



Appendix F

Calculations

SETTLEMENT CALCULATIONS BASED ON CONVENTIONAL FOUNDING SOLUTIONS USING Burland and Burbidge

Test point	Founding solution	Penetration (mm/blow) Average DCP below founding level [1]0.5-1.0m	[2]1.0-1.5m					Correlation of SPT N is equal to DCP penetration of 300mm x 0.3 SPT(N)0.5-1.0m	SPT(N)1.0-1.5m				AverageN	Wieghted average	Ic=(1.71/N^1.4)	q(load in kPa)	B(foundation width in m)	Elastic Settlement in mm(si = qB^0.7*Ic)	Site Class
DCP1	Conventional Strip footings on in-situ soils	5,00	1,00					18,00	90,00				54,00	28,544156	0,016	50,000	0,800	0,67	S
DCP2		20,00	5,00					4,50	18,00				11,25	6,4770292	0,125	50,000	0,800	5,35	S
DCP3		40,00	5,00					2,25	18,00				10,13	4,5565341	0,205	50,000	0,800	8,75	S
DCP4		70,00	5,00					1,29	18,00				9,64	3,7334648	0,270	50,000	0,800	11,57	S1
DCP5		20,00	5,00					4,50	18,00				11,25	6,4770292	0,125	50,000	0,800	5,35	S
DCP6		25,00	5,00					3,60	18,00				10,80	5,7088312	0,149	50,000	0,800	6,38	S
DCP7		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	50,000	0,800	0,67	S
DCP8		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	50,000	0,800	0,67	S
DCP9		10,00	5,00					9,00	18,00				13,50	10,318019	0,065	50,000	0,800	2,79	S
DCP10		10,00	1,00					9,00	90,00				49,50	20,862175	0,024	50,000	0,800	1,04	S
DCP11		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	50,000	0,800	0,67	S
DCP12		40,00	8,00					2,25	11,25				6,75	3,5680195	0,288	50,000	0,800	12,32	S1
DCP13		10,00	5,00					9,00	18,00				13,50	10,318019	0,065	50,000	0,800	2,79	S
DCP14		10,00	5,00					9,00	18,00				13,50	10,318019	0,065	50,000	0,800	2,79	S
DCP15		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	50,000	0,800	0,67	S
DCP16		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	50,000	0,800	0,67	S
DCP17		20,00	5,00					4,50	18,00				11,25	6,4770292	0,125	50,000	0,800	5,35	S
DCP18		60,00	5,00					1,50	18,00				9,75	3,9163691	0,253	50,000	0,800	10,82	S1
Mean		26,42857143	3,85714286					3,41	23,33				13,37	6,3237829	0,129	50,000	0,800	5,53	S

Test point	Founding solution	Penetration (mm/blow) Average DCP below founding level [1]0.5-1.0m	[2]1.0-1.5m					Correlation of SPT N is equal to DCP penetration of 300mm x 0.3 SPT(N)0.5-1.0m	SPT(N)1.0-1.5m				AverageN	Wieghted average	Ic=(1.71/N^1.4)	q(load in kPa)	B(foundation width in m)	Elastic Settlement in mm(si = qB^0.7*Ic)	Site Class
DCP1	Conventional Strip footings on in-situ soils	5,00	1,00					18,00	90,00				54,00	28,544156	0,016	80,000	0,800	1,07	S
DCP2		20,00	5,00					4,50	18,00				11,25	6,4770292	0,125	80,000	0,800	8,56	S
DCP3		40,00	5,00					2,25	18,00				10,13	4,5565341	0,205	80,000	0,800	14,00	S1
DCP4		70,00	5,00					1,29	18,00				9,64	3,7334648	0,270	80,000	0,800	18,51	S1
DCP5		20,00	5,00					4,50	18,00				11,25	6,4770292	0,125	80,000	0,800	8,56	S
DCP6		25,00	5,00					3,60	18,00				10,80	5,7088312	0,149	80,000	0,800	10,21	S1
DCP7		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	80,000	0,800	1,07	S
DCP8		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	80,000	0,800	1,07	S
DCP9		10,00	5,00					9,00	18,00				13,50	10,318019	0,065	80,000	0,800	4,46	S
DCP10		10,00	1,00					9,00	90,00				49,50	20,862175	0,024	80,000	0,800	1,66	S
DCP11		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	80,000	0,800	1,07	S
DCP12		40,00	8,00					2,25	11,25				6,75	3,5680195	0,288	80,000	0,800	19,72	S1
DCP13		10,00	5,00					9,00	18,00				13,50	10,318019	0,065	80,000	0,800	4,46	S
DCP14		10,00	5,00					9,00	18,00				13,50	10,318019	0,065	80,000	0,800	4,46	S
DCP15		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	80,000	0,800	1,07	S
DCP16		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	80,000	0,800	1,07	S
DCP17		20,00	5,00					4,50	18,00				11,25	6,4770292	0,125	80,000	0,800	8,56	S
DCP18		60,00	5,00					1,50	18,00				9,75	3,9163691	0,253	80,000	0,800	17,31	S1
Mean		26,42857143	3,85714286					3,41	23,33				13,37	6,3237829	0,129	80,000	0,800	8,85	S

SITE CLASS S/R

SETTLEMENT CALCULATIONS BASED ON CONVENTIONAL FOUNDING SOLUTIONS USING Burland and Burbidge

Test point	Founding solution	Penetration (mm/blow) Average DCP below founding level [1]0.5-1.0m	[2]1.0-1.5m					Correlation of SPT N is equal to DCP penetration of 300mm x 0.3 SPT(N)0.5-1.0m	SPT(N)1.0-1.5m				AverageN	Wieghted average	Ic=(1.71/N^1.4)	q(load in kPa)	B(foundation width in m)	Elastic Settlement in mm(si = qB^0.7*Ic)	Site Class
DCP7		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	50,000	0,800	0,67	S
DCP8		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	50,000	0,800	0,67	S
DCP9		10,00	5,00					9,00	18,00				13,50	10,318019	0,065	50,000	0,800	2,79	S
DCP10		10,00	1,00					9,00	90,00				49,50	20,862175	0,024	50,000	0,800	1,04	S
DCP11		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	50,000	0,800	0,67	S
DCP15		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	50,000	0,800	0,67	S
DCP16		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	50,000	0,800	0,67	S
Mean		5	1					18,00	90,00				54,00	28,544156	0,016	50,000	0,800	0,67	S

Test point	Founding solution	Penetration (mm/blow) Average DCP below founding level [1]0.5-1.0m	[2]1.0-1.5m					Correlation of SPT N is equal to DCP penetration of 300mm x 0.3 SPT(N)0.5-1.0m	SPT(N)1.0-1.5m				AverageN	Wieghted average	Ic=(1.71/N^1.4)	q(load in kPa)	B(foundation width in m)	Elastic Settlement in mm(si = qB^0.7*Ic)	Site Class
DCP7		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	80,000	0,800	1,07	S
DCP8		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	80,000	0,800	1,07	S
DCP9		10,00	5,00					9,00	18,00				13,50	10,318019	0,065	80,000	0,800	4,46	S
DCP10		10,00	1,00					9,00	90,00				49,50	20,862175	0,024	80,000	0,800	1,66	S
DCP11		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	80,000	0,800	1,07	S
DCP15		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	80,000	0,800	1,07	S
DCP16		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	80,000	0,800	1,07	S
Mean		5	1					18,00	90,00				54,00	28,544156	0,016	80,000	0,800	1,07	S

Test point	Founding solution	Penetration (mm/blow) Average DCP below founding level [1]0.5-1.0m	[2]1.0-1.5m					Correlation of SPT N is equal to DCP penetration of 300mm x 0.3 SPT(N)0.5-1.0m	SPT(N)1.0-1.5m				AverageN	Wieghted average	Ic=(1.71/N^1.4)	q(load in kPa)	B(foundation width in m)	Elastic Settlement in mm(si = qB^0.7*Ic)	Site Class
DCP7		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	120,000	0,800	1,61	S
DCP8		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	120,000	0,800	1,61	S
DCP9		10,00	5,00					9,00	18,00				13,50	10,318019	0,065	120,000	0,800	6,69	S
DCP10		10,00	1,00					9,00	90,00				49,50	20,862175	0,024	120,000	0,800	2,50	S
DCP11		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	120,000	0,800	1,61	S
DCP15		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	120,000	0,800	1,61	S
DCP16		5,00	1,00					18,00	90,00				54,00	28,544156	0,016	120,000	0,800	1,61	S
Mean		5	1					18,00	90,00				54,00	28,544156	0,016	120,000	0,800	1,61	S

SITE CLASS S1-S/R

SETTLEMENT CALCULATIONS BASED ON CONVENTIONAL FOUNDING SOLUTIONS USING Burland and Burbidge

Test point	Founding solution	Penetration (mm/blow) Average DCP below founding level [1]0.5-1.0m	[2]1.0-1.5m	Correlation of SPT N is equal to DCP penetration of 300mm x 0.3 SPT(N)0.5-1.0m	SPT(N)1.0-1.5m	AverageN	Wieghted average	Ic= (1.71/N^1.4)	q(load in kPa)	B(foundation width in m)	Elastic Settlement in mm(si = qB^0.7*Ic)	Site Class
DCP1	footings on in-situ	5,00	1,00	18,00	90,00	54,00	28,544156	0,016	50,000	0,800	0,67	S
DCP2		20,00	5,00	4,50	18,00	11,25	6,4770292	0,125	50,000	0,800	5,35	S
DCP3		40,00	5,00	2,25	18,00	10,13	4,5565341	0,205	50,000	0,800	8,75	S
DCP4		70,00	5,00	1,29	18,00	9,64	3,7334648	0,270	50,000	0,800	11,57	S1
DCP5		20,00	5,00	4,50	18,00	11,25	6,4770292	0,125	50,000	0,800	5,35	S
DCP6		25,00	5,00	3,60	18,00	10,80	5,7088312	0,149	50,000	0,800	6,38	S
DCP12		40,00	8,00	2,25	11,25	6,75	3,5680195	0,288	50,000	0,800	12,32	S1
DCP13		10,00	5,00	9,00	18,00	13,50	10,318019	0,065	50,000	0,800	2,79	S
DCP14		10,00	5,00	9,00	18,00	13,50	10,318019	0,065	50,000	0,800	2,79	S
DCP17		20,00	5,00	4,50	18,00	11,25	6,4770292	0,125	50,000	0,800	5,35	S
DCP18		60,00	5,00	1,50	18,00	9,75	3,9163691	0,253	50,000	0,800	10,82	S1
Mean		30	4,33333333	3,00	20,77	11,88	5,6022436	0,153	50,000	0,800	6,55	S

Test point	Founding solution	Penetration (mm/blow) Average DCP below founding level [1]0.5-1.0m	[2]1.0-1.5m	Correlation of SPT N is equal to DCP penetration of 300mm x 0.3 SPT(N)0.5-1.0m	SPT(N)1.0-1.5m	AverageN	Wieghted average	Ic= (1.71/N^1.4)	q(load in kPa)	B(foundation width in m)	Elastic Settlement in mm(si = qB^0.7*Ic)	Site Class
DCP1	footings on in-situ	5,00	1,00	18,00	90,00	54,00	28,544156	0,016	80,000	0,800	1,07	S
DCP2		20,00	5,00	4,50	18,00	11,25	6,4770292	0,125	80,000	0,800	8,56	S
DCP3		40,00	5,00	2,25	18,00	10,13	4,5565341	0,205	80,000	0,800	14,00	S
DCP4		70,00	5,00	1,29	18,00	9,64	3,7334648	0,270	80,000	0,800	18,51	S1
DCP5		20,00	5,00	4,50	18,00	11,25	6,4770292	0,125	80,000	0,800	8,56	S
DCP6		25,00	5,00	3,60	18,00	10,80	5,7088312	0,149	80,000	0,800	10,21	S
DCP12		40,00	8,00	2,25	11,25	6,75	3,5680195	0,288	80,000	0,800	19,72	S1
DCP13		10,00	5,00	9,00	18,00	13,50	10,318019	0,065	80,000	0,800	4,46	S
DCP14		10,00	5,00	9,00	18,00	13,50	10,318019	0,065	80,000	0,800	4,46	S
DCP17		20,00	5,00	4,50	18,00	11,25	6,4770292	0,125	80,000	0,800	8,56	S
DCP18		60,00	5,00	1,50	18,00	9,75	3,9163691	0,253	80,000	0,800	17,31	S1
Mean		30	4,33333333	3,00	20,77	11,88	5,6022436	0,153	80,000	0,800	10,48	S