

***Report to Escongweni BPH Engineers (Pty) Ltd on the
Results of a Geotechnical Investigation for the Proposed
Construction of the Thokozani Water Supply Scheme,
uMshwathi Local Municipality, uMgungundlovu
District Municipality, Kwa-Zulu Natal***

Reference: 085-20.R02 Revision 0

Dated: 15 June 2020

LEVEL 1 BEE CONTRIBUTOR

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Report Title		Report to Escongweni BPH Engineers (Pty) Ltd on the Results of a Geotechnical Investigation for the Proposed Construction of the Thokozani Water Supply Scheme, uMshwathi Local Municipality, uMgungundlovu District Municipality, Kwa-Zulu Natal		
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FIGURES

Figure 085-20.R02.001:

Site Plan (Entire Site)

Figure 085-20.R02.002:

Site Plan (1ML Reservoir)

ABBREVIATIONS AND DEFINITIONS

Abbreviation	Definition
AASHTO	American Association of State Highway and Transportation
CBR	California Bearing Ratio
DCP	Dynamic Cone Penetrometer
DPL	Dynamic Cone Penetrometer - Light
E	east
EGL	existing ground level
EXP	exposure
Geosure	Geosure (Pty) Ltd
GM	grading modulus
GPS	Global Positioning System
h	horizontal
IMC	insitu moisture content
IP	inspection pit
km	kilometre(s)
kN/m ²	kilonewtons per metre square
LL	liquid limit
LS	linear shrinkage
m	metre (s)
m/s	metres per second
MDD	maximum dry density
Ml	Mega litre
mm	Millimetre(s)
mPa	MegaPascal
No.	number
NP	non plastic
PI	plasticity index
SANS	South African National Standards
S	south
TLB	Tractor Loader Backhoe
TMH	Technical Manual for Highways
TRH	Technical Recommendations for Highways (1985)
UCS	unconfined compressive strength
USCS	Unified Soil Classification System
v	vertical
Unified Soil Classification System	
CL	Inorganic clays of low to medium plasticity
GM	Silty GRAVELS
ML	Inorganic silts and very fine sand
MH	Inorganic silts and micaceous fine sands
OH	Organic clays of medium to high plasticity
OL	Organic silt and clay of low plasticity

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1. TERMS OF REFERENCE

Geosure was invited by Escongweni BPH Engineers (Pty) Ltd to tender on the provision of professional services for the geotechnical investigation of the proposed Mpolweni and Thokozani Water Supply Schemes in uMshwathi Local Municipality, uMgungundlovu District Municipality, Kwa-Zulu Natal.

The proposed Scope of Works and Bill of Quantities were set out in a Request for Quotation document referenced 03-2101-01-07 and 09 April 2020, titled “*Request For Quotation: Mpolweni and Thokozani Water Supply Scheme Tender for Site Geotechnical Investigation Services*”, attached to an electronic mail dated 09 April 2020 and prepared by Escongweni BPH Engineers (Pty) Ltd.

In an electronic mail dated 15 April 2020 and prepared by Escongweni BPH Engineers (Pty) Ltd, additional information relating to the scope of works was set out in documentation dated 15 April 2020 and titled “*Request For Quotation: Mpolweni and Thokozani Water Supply Scheme Tender for Site Geotechnical Investigation Services-Addendum No.1*”.

Accordingly, Geosure submitted a proposal and supporting documentation under the cover of a letter referenced p209-20 (Mpolweni WSS)/mb and dated 23 April 2020.

Subsequently, Geosure was authorised by Escongweni BPH Engineers (Pty) Ltd to carry out the geotechnical investigation as proposed in an unreferenced appointment letter, titled “*Re: Appointment for Geotechnical Investigations Required for the Construction of the Mpolweni and Thokozani Water Supply Schemes, within uMgungundlovu District Municipality*”, dated 20 April 2020. Signed acceptance of the above proposal by Geosure is dated 06 May 2020. The appointment of Geosure was followed up with the signing of a sub-consultancy agreement between Escongweni BPH Engineers (Pty) Ltd and Geosure dated 07 May 2020. The scope of geotechnical specialist services is set out in Schedule 2 of the above sub-consultancy document.

2. SCOPE OF REPORT

This report details the results of a geotechnical investigation for the proposed pipelines, reservoir and elevated tank of the Thokozani Water Supply Scheme, within uMshwathi Local Municipality, uMgungundlovu District Municipality, Kwa-Zulu Natal, and hereafter referred to as the site.

Subsurface conditions identified on the site are described and assessed. General comment is made on the inferred stability of the site, excavation conditions and founding conditions. Recommendations for reservoir and elevated tank foundations, material usage, lateral support, and drainage are also provided to guide engineering design.

3. GUIDELINES FOR INVESTIGATION METHODOLOGY

The formation and weathering of geological materials are discontinuous processes and unexpected variations in soil, rock and groundwater regimes may occur even on sites where the conditions seem to be uniform or consistent. Variations in what is reported here may become evident or construction. It is thus imperative that an appropriately qualified and experienced Competent Person inspects all critical stages of development including, but not limited to, excavations to assess the conditions identified, as well as conditions from the final depths investigated to those at the deepest construction levels, and to assist in the interpretation of observations at variance with the information supplied in this report.

This report was prepared for use by Escongweni BPH Engineers (Pty) Ltd and their professional team, for the purpose stated, and as such should not be relied upon for any other purpose.

4. INFORMATION SUPPLIED/UTILISED

The following information was consulted to assist with the field investigation and preparation of this report:

- i. Request for Quotation document referenced 03-2101-01-07 and 09 April 2020, titled "*Request For Quotation: Mpolweni and Thokozani Water Supply Scheme Tender for Site Geotechnical Investigation Services*", attached to an electronic mail dated 09 April 2020 and prepared by Escongweni BPH Engineers (Pty) Ltd;
- ii. Documentation prepared by Escongweni BPH Engineers (Pty) Ltd dated 15 April 2020 and titled "*Request For Quotation: Mpolweni and Thokozani Water Supply Scheme Tender for Site Geotechnical Investigation Services- Addendum No.1*";
- iii. Electronic (.dwg) files of the site inclusive of contours in .pdf;
- iv. Electronic file of Drawing Sheet 1 of 1 Revision A, titled "*Lindokuhle, Mpolweni Ext. and Esihalbathini Water Supply Scheme Thokozani Reticulation Design Overall Water Layout*" by Escongweni BPH Engineers (Pty) Ltd;
- v. Electronic file of Drawing 2101-02-300-SC02 Revision A dated 15 May 2020, titled "*Lindokuhle, Mpolweni Ext. and Esihalbathini Water Supply Scheme Sections and Details 1000 KL*" by Escongweni BPH Engineers (Pty) Ltd;
- vi. Details of proposed layerworks beneath the proposed reservoir and pipe invert levels included in electronic mails dated 11 June 2020 from Escongweni BPH Engineers (Pty) Ltd;
- vii. Regional geological map sheet titled "*2930 Durban*", dated 1988 and published by the Council for Geoscience of South Africa to scale 1:250 000; and
- viii. Low-resolution aerial imagery sourced from Google Earth (2019).

5. SITE/ROUTE DESCRIPTION

The proposed bulk and reticulation pipelines, and reservoir, are located near to Albert Falls to the west of the site, uMgungundlovu District Municipality, within Kwa-Zulu Natal. The R33 occurs some 1km to the east of the site, and the provincial administrative capital, Pietermaritzburg, is located approximately 50km to the south of the site.

The regional and local settings of the site are shown below in Plate 1 and Plate 2, respectively.

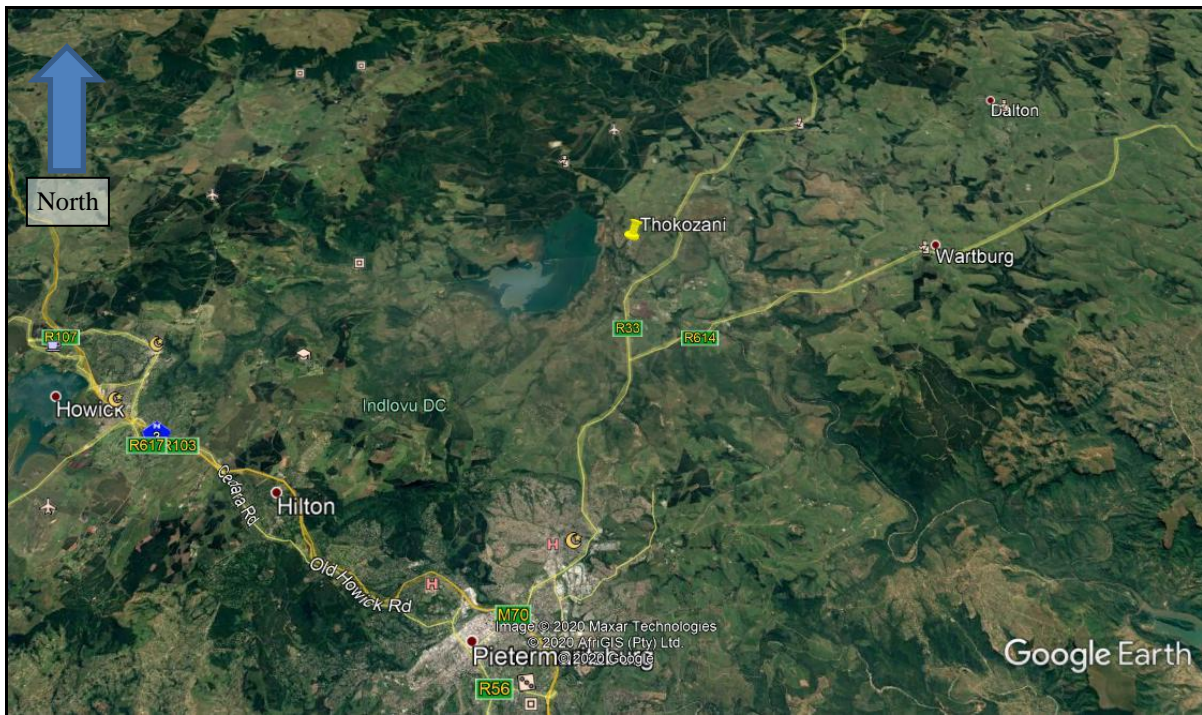


Plate 1: Regional setting of the site (Google Earth, 2018)



Plate 2: Local setting of the site (Google Earth, 2020)

It is understood from information indicated by a representative of Escongweni BPH Engineers (Pty) Ltd to Geosure personnel at the site that the proposed bulk pipeline is aligned along the edge of an existing gravel road formed along hillside terrain in the eastern portion of the site and generally displaying mild to moderate gradients to the southeast and southwest.

The balance of the proposed pipeline network traverses more variable terrain including hillsides of mild to moderate grades steepening in the vicinity of 2No. drainage lines in the central and western portions of the site.

The proposed 1ML reservoir is located on a hillside exhibiting a mild south-westerly slope grade approximately 0.3km to the northeast of the site adjacent to the same road along which the bulk pipeline is to be constructed. Proposed construction of the reservoir is to occur in the general area of an existing circular reservoir which is to be decommissioned.

The site has been designated by others into Zone 1A, Zone 1B and Zone 2.

Plate 3 depicts the aerial image and proposed overall layout of the bulk and reticulation pipelines at the site.



Plate 3: Aerial image showing overall water layout at the site

The overall site layout inclusive of contours and Zones 1A, 1B and 2 is shown in Figure 085-20.R02.001, attached.

Approximate latitude and longitude coordinates of the start and end points of the bulk pipeline and the proposed reservoir position are summarised in Table 1, below.

Table 1: Proposed Thokozani Water Supply Scheme – Summary of Coordinates of Bulk Pipeline and Reservoir

Description	Latitude (South)	Longitude (East)	Description
Start	29°25'18.70"	30°26'53.00"	Start point of bulk pipeline adjacent to 1ML Reservoir
End	29°26'05.10"	30°26'29.00"	End point of bulk pipeline
Reservoir	29°25'18.30"	30°26'53.20"	1ML Reservoir

General views across the site are given in Plate 4 to Plate 6, below.



Plate 4: General view of route of bulk pipeline



Plate 5: General view of mild terrain at site



Plate 6: General view of terrain at proposed 1ML reservoir site

6. FIELDWORK

Following a desktop appraisal of aerial and regional geological records, the fieldwork for the investigation was carried out from 17 May 2020 to 18 May 2020, and comprised the following scope of works:

- i. Terrain Appraisal;
- ii. Inspection Pits;
- iii. CBR Dynamic Cone Penetrometer (DCP) Tests; and
- iv. Dynamic Cone Penetrometer – Light (DPL) Tests.

The extent of the fieldwork was defined in the RfQ Addendum document by Escongweni BPH Engineers (Pty) Ltd and referenced above in Section 4, paragraph ii), and latitude and longitude coordinates were recorded by means of a handheld GPS unit in the field, and indicated on inspection pits. X, Y and Z values are included in Figures 085-20.R02.001 and 085-20.R02.002, attached.

6.1 Terrain Appraisal

Prior to commencing with the subsurface investigation, a reconnaissance of the site was carried out to identify the topography and associated landforms, map the surface geology and note and photograph allied features of geotechnical significance.

During the terrain appraisal, three exposures designated EXP1 through EXP3 were profiled along the proposed pipeline routes.

The approximate positions of the exposures profiled are shown in Figure 085-20.R02.001, attached.

The exposures were profiled using the South African Geoterminology Guidelines (Brink & Bruin, 2002).

Copies of the exposure profiles are given in Appendix A.

6.2 Inspection Pits

Four inspection pits designated IP1 to IP4 and nineteen inspection pits, designated IP5 through IP23, were excavated across the site for the reservoir and pipelines, respectively, by means of TLB at the approximate positions given in Figure 085-20.R02.001 and 085-20.R02.002, attached.

Final / refusal depths of the inspection pits ranged from 0.39m (IP19 refers) to 3.5m (IP1-IP5, IP10 – IP12, and IP15 – IP16 refer) below EGL.

The inspection pits were profiled using the South African Geoterminology Guidelines (Brink & Bruin, 2002), sampled and backfilled on completion.

Copies of the inspection pit profiles are given in Appendix A.

6.3 CBR Dynamic Cone Penetrometer (DCP) Tests

Four DCP tests designated DC1 to DC4 and nineteen DCP tests, designated DC5 through DC23, were carried out across the site for the reservoir and pipelines, respectively, at the approximate positions given in Figure 085-20.R02.001 and 085-20.R02.002, attached.

DCP tests were advanced to final/refusal depths in the range 0.2m (DC19 refers) to 3.5m (DC10, DC11 and DC12 refer) below EGL.

Graphs of the DCP tests are given in Appendix B.

6.4 Dynamic Cone Penetrometer Light (DPL) Tests

Two DPL tests, designated DPL1 to DPL2, were carried out at the approximate positions given in Figure 085-20.R02.002, attached.

DPL tests were advanced to final/refusal depths at 3.3m below EGL.

Graphs of the DPL tests are given in Appendix B.

7. REGIONAL GEOLOGY AND INFERRED SOILS

Inferring from the regional geological sheet “2930”, prepared by the Council for Geoscience to scale 1: 250 000, the regional geology of the site and surrounds comprises interbedded shale (mudrock) of the Pietermaritzburg Formation, Ecca Group, Karoo Supergroup. At least one body of Jurassic Age dolerite has intruded regionally into the beds of shale. Tillite / diamictite of the Dwyka Group regionally occurs directly to the south of the site.

An excerpt from the above referenced geological sheet is given below in Plate 7.

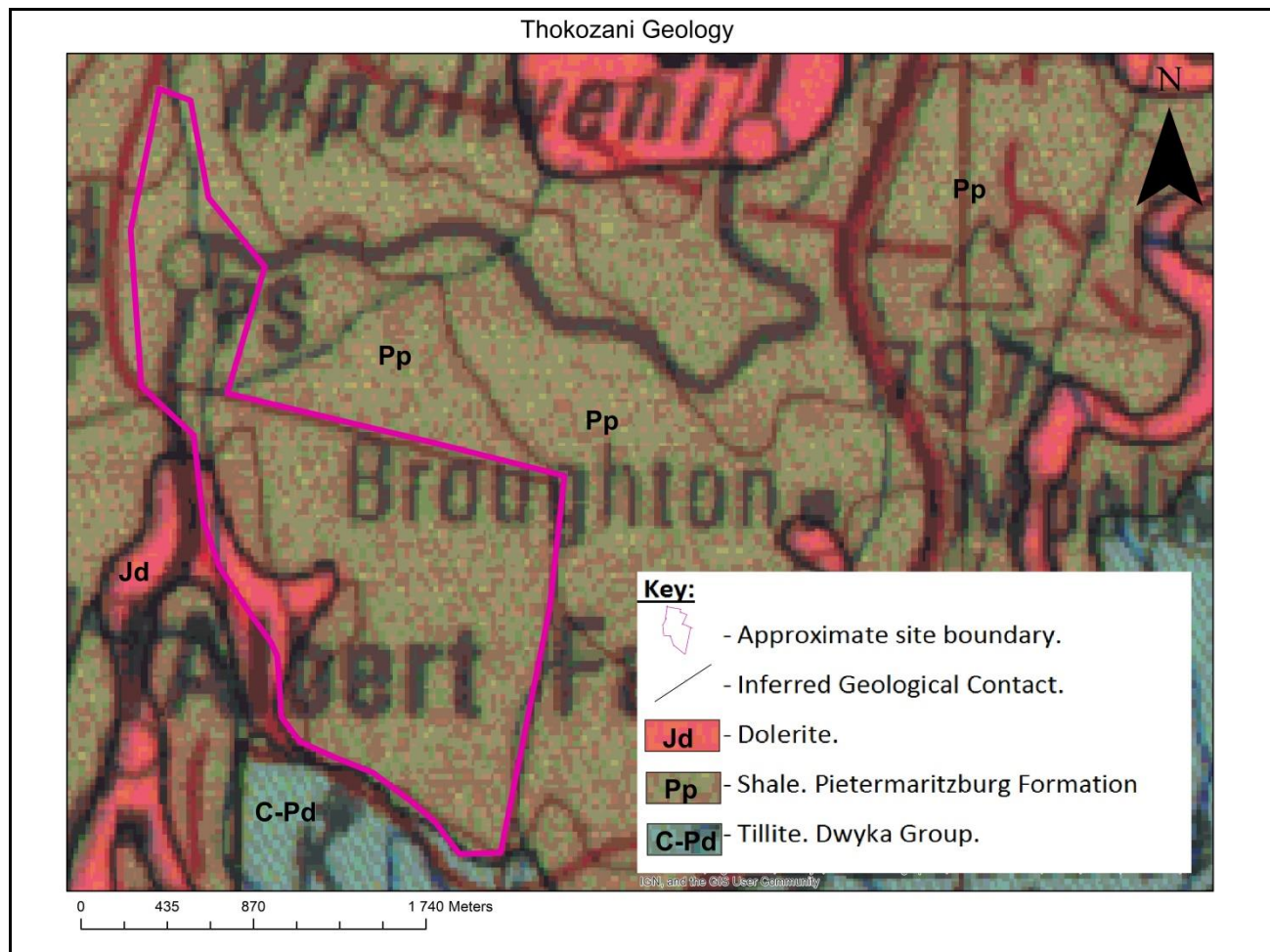


Plate 7: Regional geological map of the site and surrounds from “2930 Durban”, (Council for Geoscience, 1988)

8. INFERRED SUBSURFACE CONDITIONS

At the positions investigated, the site is observed to be underlain by the following geological units:

- i. Fill;
- ii. Colluvium;
- iii. Residual dolerite;
- iv. Residual shale;
- v. Weathered rock shale.

Subsurface conditions and typical profiles observed along the proposed bulk pipeline (referenced according to inspection pits), reticulation pipework (referenced according to Zone 1A, 1B and 2), and reservoir site are summarised below in Section 11.2, Table 3, of this report.

Plate 7 to Plate 10 below show general ground profiles observed during the field investigation.



Plate 7: Indicative view of reddish brown residual dolerite clay at IP4



Plate 8: Indicative view of residual soils and weathered shale rock at IP13



Plate 9: Indicative view of residual soils and deeply weathered shale rock at IP17



Plate 10: Indicative view of residual dolerite (top) and grey weathered shale rock at EXP1 (bottom)

9. GROUNDWATER

Groundwater seepage activity was not observed at the positions and to the depths profiled.

However, the occurrence of deep residual dolerite clay soils, e.g. at IP1 – IP5, IP10 - IP12, IP15 and IP16 to at least 3.5m below EGL, and stained shale rock where rock was profiled, is indicative of intermittent perched groundwater activity.

The risk of encountering such a condition is also considered to increase towards any low-lying/weakly to poorly drained areas near drainage lines and/or geological contacts. Conversely, the risk of encountering perched groundwater activity is generally assessed to decrease across well-drained/elevated portions of the site associated with hillside terrain where underlain by rock within depths of 1m – 1.5m below EGL e.g. IP6 IP8 and IP13.

Perched groundwater activity is most likely to occur during and after periods of sustained/high rainfall generally, intensifying where subject to the above topographical and geological controls.

10. LABORATORY TEST RESULTS

The following laboratory tests were carried out on soil and rock samples retrieved during the field investigation from the site and from the borrow pits identified during the investigation:

- i. Grading Analysis to 0.075mm sieve with Atterberg Limit Determinations;
- ii. Modified AASHTO tests;
- iii. California Bearing Ratio (CBR) tests;
- iv. Hydrometer Analysis;
- v. Soil Moisture Content; and

vi. Compactibility Factor.

Results of the laboratory tests above are given in Appendix C and summarised in Table 2.

Table 2: Pipeline and Reservoir for Thokozani Water Supply Scheme - Summary of Results of Particle Size Distribution Analysis, Hydrometer, Atterberg Limit Determinations, Compactibility Factor, Insitu Moisture Contents and Materials Classification

IP	Depth (m)	Description	Particle Size %				Atterberg Limits %			OMC (%)	GM	MDD kg/m ³	CBR Values			Swell %	MC	CF	Material Code & Classification
			Clay	Silt	Sand	Gravel	LL	PI	LS				Compaction MDD %						
													90	93	95				
COLLUVIUM																			
IP16	0.01 – 0.72	Dark brownish grey clayey SAND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21.5	0.432	-
IP21	0.01 – 0.46	Medium brownish grey clayey SAND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16.3	0.417	-
IP23	0.01 – 0.54	Medium brownish grey clayey SAND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16.2	0.392	-
RESIDUAL DOLERITE																			
IP1	0.76 – 3.50	Dark reddish brown, silty sandy CLAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29.6	0.372	-
IP2	0.68 – 3.50	Dark reddish brown CLAY	57	24	13	6	53	13	6.5	20.8	0.38	1661	3.4	6.0	8.7	1.7	30.0	-	A-7-5 (15) MH/OH‡ Poorer than G10 *Low
IP3	0.61 – 3.50	Dark reddish brown, slightly silty sandy CLAY	32	31	28	9	43	14	7.0	23.0	0.62	1677	12	16	20	0.1	29.1	-	A-7-6 (9) ML/OL‡ Poorer than G10 *Low/Medium
WEATHERED SHALE ROCK																			
IP13	1.46 – 2.07	Light grey stained light yellow, highly weathered, very soft rock	11	20	8	61	37	11	5.5	13.7	1.90	1962	11	13	15	1.0	14.5	-	A-2-6 (0) GM G8 *Low

LL	-	Liquid Limit	A-7-6 (9)	-	Revised US Classification	CF	-	Compactibility Factor
PI	-	Plasticity Index	LS	-	Linear Shrinkage	GM	-	Grading Modulus
SC	-	Unified Classification	-	-	Not Tested	*Low	-	Potential Expansiveness (van der Merwe, 1964)
G8	-	Classification in terms of TRH14						

11. DISCUSSION

11.1 Proposed Development

It is understood from information confirmed with Geosure that the proposed development is to comprise the following:

- i. Approximately 40km of reticulation pipeline (combination of HDPE and uPVC and rigid steel pipelines) including 7km of bulk pipeline;
- ii. Invert levels shall not exceed 2m below EGL, unless there are special circumstances or obstacles;
- iii. One Reinforced Concrete (RC) 1ML reservoir, comprising a 200mm RC slab, thickening to 350mm beneath the reservoir external columns, established on 100mm no-fines blanket layer with 75mm diameter subsoil pipes formed on a damp proof course, 150mm G5 compacted layer, and existing insitu materials ripped and re-compacted. The reservoir is expected to be positioned above ground level with the floor slab on a level platform relative to natural ground level to ensure minimal earthworks.

Further details with regards to the proposed development, including anticipated foundation design loads for the proposed reservoir structure, were not confirmed with Geosure at the time of preparation of this report. Considering the relatively limited storage capacity of the reservoir structure, a relatively low to moderate design foundation bearing capacity not exceeding 150kPa has, however, been assumed for the purpose of foundation recommendations in this report.

There is merit in affording Geosure the opportunity to review the recommendations in this report, under an extension of the current appointment, once detailed information regarding foundation design loads and any proposed earthworks for the reservoir are made available. Amendments to certain of the recommendations may be necessary.

11.2 Inferred Geological and Geotechnical Conditions along Proposed Pipeline Route

A summary of inferred excavation requirements, and general geological and other site conditions influencing construction referenced according to the approximate footprints of Zone 1A, Zone 1B and Zone 2 included in Figure 085-20.R01.001, attached, is given in Table 3, overleaf.

Table 3: Pipelines and Reservoir for Thokozani Water Supply Scheme - Summary of Site Descriptions, Fieldwork, Geological and Trenchability Conditions Inferred along the Pipeline Route and Reservoirs

Field Tests	Depth Range and (Position) (m below EGL)	Abbreviated Inferred Profile	Depth to Rock (m below EGL)	Refusal Depth of Inspection Pits and (DCPs/DPLs) (m below EGL)	Observed Groundwater Seepage (m below EGL)	Depth (m below EGL)	Inferred Trenchability (Excavation Classes in terms of SANS 1200D)	Comments
ZONE 1A: PROPOSED 1ML RESERVOIR								
IP1 to IP4 DC1 to DC4 DPL1; DPL2	0.0 – 0.68/0.72 (IP1 – IP2)	Dark brownish grey, firm to stiff, silty sandy CLAY - <i>Colluvium</i>	> 3.5	>3.5 (2.2-2.9/>3.3)	None	0 – 2.2	SOFT with allowance for BOULDER CLASS B	i. Sandy soil cover considered susceptible to erosion by uncontrolled surface water flows
	0 – 0.76 (IP3 – IP4)	Medium brownish grey, loose to medium dense, clayey SAND - <i>Colluvium</i>						ii. Potentially unstable sidewall conditions anticipated.
	0.68 – 3.50 (IP1 – IP4)	Dark reddish brown, firm to stiff, CLAY/silty sandy CLAY – <i>Residual dolerite</i> (almost classifies as a saprolyte)				>2.2	SOFT to INTERMEDIATE with allowance for BOULDER CLASS B	iii. While not observed during the field investigation, hard boulder size corestones are known to be associated with residual dolerite/weathered dolerite on sites elsewhere. An allowance should therefore be made for BOULDER CLASS B excavation iv. Loosely consolidated and weakly cohesive sandy Colluvium exhibits collapse settlement potential. v. Geological variations may result in INTERMEDIATE to HARD excavation classes at shallower depths vi. Potential for intermittent shallow perched groundwater activity vii. Potentially active and compressible clay founding conditions of low bearing capacity within soil cover
ZONE 1A: PROPOSED PIPELINES								
IP5 to IP9 DC5 to DC9	0.0 – 0.46/0.88 (IP5/IP6 only)	Dark reddish orange, firm to stiff, sandy silty CLAY / Medium brownish grey, loose to medium dense, clayey SAND, with pieces of wire - <i>FILL</i>	From 0.60 (IP9) and 1.61 (IP7)	0.82 (IP14) to >3.50 (IP5) (0.7 to 2.3)	None; At least 4 No. drainage lines	0 – 0.8	SOFT with allowance for BOULDER CLASS B	i. Sandy soil cover considered susceptible to erosion by uncontrolled surface water flows
	0 – 0.44 (IP7 only)	Medium brownish grey, loose to medium dense, clayey SAND - <i>Colluvium</i>						ii. Potentially unstable sidewall conditions anticipated.
	0 – 0.60 (IP8; IP9)	Medium brownish grey, firm to stiff, sandy CLAY - <i>Colluvium</i>						iii. While not observed during the field investigation, hard boulder size corestones are known to be associated with residual dolerite/weathered dolerite on sites elsewhere. An allowance should therefore be made for BOULDER CLASS B excavation
	0.0 – 0.69/0.84/1.0/1.61/3.50 (IP6-IP8)	Dark reddish orange / dark reddish brown / dark yellowish orange, firm to stiff, sandy silty CLAY, with shale fragments – <i>Residual dolerite</i>						iv. Loosely consolidated and weakly cohesive sandy Colluvium exhibits collapse settlement potential.
	0.60 – 1.00/1.26/1.08/2.80 (IP6-IP9)	Dark bluish grey stained rusty brown / light grey stained yellowish brown and light yellow, highly weathered, highly fractured, very soft rock - <i>SHALE</i>						v. Geological variations may result in INTERMEDIATE to HARD excavation classes at shallower depths vi. Potential for intermittent shallow perched groundwater activity

Field Tests	Depth Range and (Position) (m below EGL)	Abbreviated Inferred Profile	Depth to Rock (m below EGL)	Refusal Depth of Inspection Pits and (DCPs/DPLs) (m below EGL)	Observed Groundwater Seepage (m below EGL)	Depth (m below EGL)	Inferred Trenchability (Excavation Classes in terms of SANS 1200D)	Comments
ZONE 1B: PROPOSED PIPELINES								
IP15 to IP23 EXP2; EXP3 DC15 to DC23	0.0 – 0.97 (IP23 only)	Medium brown, loose, silty SAND / Light grey, loose, silty SAND with boiler ash - <i>FILL</i>	From 0.24 and 1.84	0.39 (IP19)- >3.50 (IP15; IP16) (0.2 – 3.3)	None At least 1 No. drainage line	0 – 0.4	SOFT	i. Sandy soil cover considered susceptible to erosion by uncontrolled surface water flows
	0.00 – 0.36/0.46/0.54 (IP15-IP17; IP21; IP23)	Medium and dark brownish grey, loose to medium dense, clayey SAND – <i>Colluvium</i>						ii. Potentially unstable sidewall conditions anticipated.
	0.0 – 0.24/0.43 (IP18; IP20; EXP2)	Medium brownish grey, firm to stiff, sandy CLAY - <i>Colluvium</i>				iii. While not observed during the field investigation, hard boulder size corestones are known to be associated with residual dolerite/weathered dolerite on sites elsewhere. An allowance should therefore be made for BOULDER CLASS B excavation		
	0.24 – 0.64/0.87/ 0.94/0.98/ 1.16/1.40/ 1.84/3.50 (IP15-IP18; IP20- IP23)	Dark reddish orange / dark reddish brown / dark yellowish orange, firm to stiff, sandy silty CLAY, with shale fragments – <i>Residual dolerite</i>				iv. Loosely consolidated and weakly cohesive sandy Colluvium exhibits collapse settlement potential. v. Geological variations may result in INTERMEDIATE to HARD excavation classes at shallower depths vi. Potential for intermittent shallow perched groundwater activity		
	0.24 - 0.39/0.84/ 0.91/1.40/ 1.64/1.94/ 2.24/2.80 (IP17-IP23; EXP2; EXP3)	Dark bluish grey stained rusty brown / light grey stained light yellow, highly weathered, highly fractured, very soft rock - <i>SHALE</i>				>0.4	SOFT to INTERMEDIATE with allowance for HARD and BOULDER CLASS B	
ZONE 2: PROPOSED PIPELINES								
IP9; IP11 – IP14 EXP1 DC9; DC11- DC14	0.0 – 0.46/0.57/0.60 (IP9; IP11; IP12)	Medium brown, firm to stiff, sandy CLAY / sandy silty CLAY – <i>Colluvium</i>	From 0.60 and 0.64	0.82 (IP14) ->3.50 (IP11; IP12) (0.6 – >3.5)	None 1 No. drainage line	0 – 0.8	SOFT with allowance for BOULDER CLASS B	i. Sandy soil cover considered susceptible to erosion by uncontrolled surface water flows
	0.00 – 1.46/5.0 (IP11-IP14)	Dark reddish orange / dark greyish orange / dark yellowish orange, firm to stiff, sandy silty CLAY – <i>Residual dolerite</i>						ii. Potentially unstable sidewall conditions anticipated. iii. While not observed during the field investigation, hard boulder size corestones are known to be associated with residual dolerite/weathered dolerite on sites elsewhere. An allowance should therefore be made for BOULDER CLASS B excavation
	0 - 0.54 (IP13 only)	Medium brown, firm to stiff, sandy silty CLAY – <i>Residual shale</i>				iv. Loosely consolidated Colluvium exhibits collapse settlement potential. v. Geological variations may result in INTERMEDIATE to HARD excavation classes at shallower depths		

Field Tests	Depth Range and (Position) (m below EGL)	Abbreviated Inferred Profile	Depth to Rock (m below EGL)	Refusal Depth of Inspection Pits and (DCPs/DPLs) (m below EGL)	Observed Groundwater Seepage (m below EGL)	Depth (m below EGL)	Inferred Trenchability (Excavation Classes in terms of SANS 1200D)	Comments
	0.60 - 0.64/14.0 (IP9; IP14; EXP1)	Light grey stained yellowish brown rusty brown and light Yellow / dark bluish grey stained rusty brown, highly weathered, highly fractured, very soft rock – <i>SHALE</i>						vi. Potential for intermittent shallow perched groundwater activity

11.3 General Stability

Based on the results of the current field investigation, it is considered that the site appears to be generally stable and suitable for the proposed development, provided the recommendations given below in Sections 11.4 to 11.11 of this report are adhered to. Measures amount to no more than sound development controls appropriate to the site conditions inferred and the development proposals confirmed with Geosure at the time of reporting.

11.4 General Earthworks at Reservoir Site

Information received by Geosure indicates that the reservoir is likely to be constructed above ground level with the floor slab on a level platform relative to natural ground level to ensure minimal earthworks.

It is recommended that all earthworks be carried out in accordance with SANS 1200D (current version).

The inferred excavation requirements at the proposed reservoir site have been appraised according to the guidelines provided in SANS 1200D and summarised in Section 11.2, Table 3, above.

As a guide, temporary batters for any proposed cuts at the reservoir sites should be restricted to the following:

- i. **Soils** - 1 (vertical): 2 (horizontal) i.e. $\leq 26^\circ$, limited to a height / depth of approximately 1.5m from EGL.
- ii. **Weathered Shale Rock** - 1 (vertical): 1 (horizontal) i.e. $\leq 45^\circ$, limited to a depth / height of approximately 2m from EGL. Should planes of weakness formed along either the bedding and / or fracture surfaces be exposed during excavation, it is recommended that a geotechnical specialist, such as Geosure, be appointed to assess the effects thereof on both the stability of the cutting and the overall global stability of the slope.

Workers should not enter any excavations deeper than 1.5m that are not shored or battered back as described above. All excavations are to be inspected on a daily basis by a competent person to confirm stability. These inspections should be formally documented. It remains the responsibility of the contractor, however, to ensure compliance with the current Occupational Health and Safety Act and Construction Regulations (Google Earth, 2019).

11.5 Trench Stability

It is considered that trenches excavated in the soil cover encountered during the fieldwork should be regarded as potentially unstable and will require lateral support to engineer's detail or battering of slopes to stable temporary angles, as will trenches excavated in areas with groundwater seepage, if encountered. Trenches deeper than 1.5m should be shored in any event, particularly if left open indefinitely.

As a guide, temporary side slopes of trench excavations should be restricted to the following:

- i. **Fill and colluvial / any alluvial soils** – 1v:1h to a depth of 2m. For greater depths up to 3m, batters should be formed to 1v:2h ($\leq 26^\circ$) provided there is no groundwater seepage. If seepage is observed, then trenches will need to be temporarily shored to engineer's detail.
- ii. **Residual clay / silt soils** – 1v:0.5h ($\leq 63^\circ$); for excavations to a depth of 1.5m, for depths up to 3m, batter to 1v:2h ($\leq 26^\circ$).
- iii. **Highly to moderately weathered, tightly jointed rock** – 1v:0.5h ($\leq 63^\circ$), provided that either no day-lighting bedding planes or planes of weakness such as clay gouge are visible.
- iv. **Unweathered to slightly weathered, tightly jointed rock, if present** – Vertical, if either no day-lighting bedding planes or planes of weakness such as clay gouge is visible.

It is recommended that excavations be carried out in the dry season as far as possible and backfilled with the minimum of delay.

It is recommended that both the geotechnical professional and contractor carry out regular documented inspections of the trenches in order to detect unstable sidewall conditions during the construction phase.

Trenches should be temporarily shored to Engineer's detail in all situations where groundwater is encountered or instability is observed.

Workers should not enter or work below any excavations/cuts deeper than 1.5m that is not shored or battered back as described above. It remains the responsibility of the contractor, however, to fully comply with the requirements of the current Occupational Health and Safety (OHS) Act.

11.6 Inferred Subsurface Conditions and Trenchability Assessment along the Proposed Pipelines

The inferred excavation requirements within Zones 1A 1B and 2 have been appraised according to the guidelines provided in SANS 1200D and summarised in Section 11.2, Table 3, above.

In areas where soils and highly “very soft” rock are encountered, excavations down to pipe invert design levels should be relatively easy, in terms of hardness, to achieve using light earthmoving equipment.

In any areas where “soft” rock with limited fractures is encountered, it is anticipated that excavation with a 20 tonne or 30 tonne tracked excavator and/or pneumatic tools should be allowed for the necessary depths to be achieved.

Limited blasting may be required in areas if either “medium hard”, “hard”, “very hard” or “extremely hard” rock is encountered.

In the event that blasting is carried out, the difficulties, disruption and safety issues surrounding a blasting programme, as well as damage that may occur to adjacent structures will need to be considered.

A risk of perched groundwater activity has been inferred intermittently for the site. Generally, the risk is inferred to increase near any low-lying/weakly drained areas and be exacerbated during and after rains / late spring and summer. Where groundwater activity is encountered, trenches/excavations are considered prone to rapid sidewall collapse, as well as flooding of excavations. Excavation rates within areas with the above features are likely to be variable, furthermore, shoring and temporary dewatering of excavations to engineer's detail is likely to be required in order to allow for practical and safe working conditions.

11.7 Materials Evaluation and Pipe Bedding

It is understood that the proposed bulk pipeline, at least, and potentially also the reticulation pipelines, require a bedding cradle of "*Selected Granular Material / Bedding Material*", a fill blanket of "*Select Fill*" (only for the bulk pipeline), and thereafter a "*Main Fill*" as defined by SANS 1200 LB (1983) and the specification given in the document referenced in Item i, Section 4, above.

Select Granular Material is defined as "granular, non-cohesive and singularly graded between 0.6 and 19mm. The material must be free draining and have a compactability factor not exceeding 0.4". Furthermore, specification referenced above provides additional requirements in terms of grading (based on percentage passing specific particle size range), absence of organic material, stiffness ratio of less than 5.0MPa, and preference for river transported material.

Select Fill is defined as "a material with a Plasticity Index (PI) not exceeding 6, free from lumps, vegetation and stones of a diameter exceeding 30mm".

Main Fill is the approved filling material placed in a pipe trench after the pipe has been laid and surrounded by a layer of selected fill blanket. It generally comprises the material removed from the pipe trench during excavation.

11.7.1 Evaluation of Insitu Materials for Use in Construction of Pipelines

The following general evaluation is made regarding the inferred suitability of the in-situ materials for use in the construction of the pipeline based upon the laboratory test results summarised above in Section 10 and included in full as Appendix C:

- i. The materials tested from the site are considered unsuitable for use as "*Selected Granular Material*". In general, it is considered that bedding material meeting the above requirements will need to be imported to the site.
- ii. The insitu materials encountered on site are considered unlikely to meet the "*Select Fill*" requirements due to the plasticity indices of the material tested exceeding a value of 6. However, these materials can be utilised for "*Main Fill*" requirements over the select fill.
- iii. Caution should be exercised when using clayey materials such as colluvium and residuum soils as these are moisture-sensitive and will heave and will be difficult to compact when wet. These materials may also require a long time to dry out and it may

not be economically feasible to wait for such in which case material should be spoiled and replaced with a granular backfill.

From experience, the *Selected Granular Material* requirements in terms of SANS 1200 LB (1983) and are seldom met by natural soils. The very strict grading requirements generally only coincide with specially designed, blended sands and gravels. Furthermore, the natural variability in composition within the in-situ materials will make the establishment of a consistent quality very difficult. This could be problematic where the bedding is relied upon for foundation support and additional hoop strength (where required) in the design of pipelines.

11.7.2 Evaluation of Insitu Materials for Use in Construction of Reservoir

A general assessment of materials encountered on site for use in the construction of any fills for bulk earthworks to the proposed reservoir has been based on the visual assessment made on site and laboratory test results.

The characteristics of the materials and their suitability for use in construction are summarised below in Table 4.

Table 4: Pipelines and Reservoir for Thokozani Water Supply Scheme - Classification of Materials and Recommendations for Usage

Material Description	USC (TRH14)	Remarks on Usage
FILL (UNCONTROLLED)		
Dark reddish orange, sandy silty CLAY	Note Tested (Not Tested)	i. Considered poor subgrade material in terms of TRH14 (Committee of State Road Authorities, 1985) due to particle contamination
Medium brownish grey, clayey SAND, with pieces of wire		ii. Will generally require undercutting and replacement with a suitable select granular soil where encountered at or below subgrade level
Medium brown, silty SAND / Light grey, silty SAND with boiler ash		iii. Not considered suitable for use as select fill or general due to the clay nature and particle contamination
COLLUVIUM		
Medium and dark brownish grey, clayey SAND	Not Tested (Not Tested)	i. Not considered suitable for use as select or general fill due to the likelihood of organic content and clay nature ii. Will require undercutting and replacement with a suitable select granular soil where encountered at or below subgrade level iii. Consideration should be given to stockpiling this material for use as topsoil

Material Description	USC (TRH14)	Remarks on Usage
RESIDUAL DOLERITE		
Dark reddish brown, silty sandy CLAY	- (Not Tested)	i. Considered poor quality subgrade material (potentially including saprolyte) in terms of TRH14 (Committee of State Road Authorities, 1985)
Dark reddish brown CLAY	MH/OH‡ (Poorer than G10)	ii. Not considered suitable for use as select or general fill due to the clayey nature identified during fieldwork
Dark reddish brown, slightly silty sandy CLAY	ML/OL‡ (Poorer than G10)	iii. Will require undercutting and replacement with a suitable select granular soil where encountered at or below subgrade level
WEATHERED SHALE ROCK		
Light grey stained light yellow, highly weathered, very soft rock	GM (G8)	<p>i. Materials classify as fair quality subgrade material in terms of TRH14 (Committee of State Road Authorities, 1985)</p> <p>ii. Suitable for use as general fill</p> <p>iii. Unsuitable for use select fill subject to verification by laboratory testing;</p> <p>iv. Materials will require undercutting and replacement with a suitable select granular soil where encountered at or below subgrade level</p>

The classification of materials on the site should be confirmed by laboratory testing to be undertaken during construction, as part of process and acceptance control monitoring, prior to the material being considered for use in construction.

11.7.3 Evaluation of Potential Commercial Material Sources

No borrow pit sites were identified at the site as potential construction material sources for the project.

A source for the supply of potential bedding material has been identified at Mpolweni to the east of the site.

These potential material sources, type of material available and comment on suitability for usage during construction is given in Table 4 below.

Table 5: Proposed Thokozani Water Supply Scheme – Summary of Potential Material Source, Location, Material Available and Comment on Suitability of Material for Use in Construction in Terms of TRH14, SANS1200LB and the Umgeni Water Particular Amendments to SANS1200LB Bedding Specification

Source	Geological Unit	Unified Classification	(TRH14 Classification)	General Comments and Comment on Suitability for Use During Construction
Lethingcebo Pit / Quarry, Mpolweni	Silty SAND (Residual Gneiss)	Tested separately for Mpolweni Water Supply Scheme	Not Tested	<ul style="list-style-type: none"> i. Sample tested from Mpolweni is not suitable for use as “Select Granular Material” in terms of SANS1200LB ii. Sample suitable for use as “Selected Fill” in terms of SANS1200LB iii. This material may also meet the above referenced requirements for use as “Select Granular Material” with careful design, screening and blend in order to achieve the relevant grading analysis range, subject to laboratory verification.

11.8 Backfill and Erosion Aspects

Areas underlain by fill, transported deposits (colluvium) and residual soils are generally susceptible to erosion due to uncontrolled runoff. The pipe trench line can also become a route for on-going erosion, and with time could develop into erosion features (dongas) with resultant failure of the proposed pipeline.

Where the pipelines are formed perpendicular to contours, over gradients steeper than about 1v:6h ($> 9^\circ$), it is recommended that at intervals of every 3m to 5m, a section of the backfill be stabilised with cement or lime (about 4% by mass). The section of stabilised soil should be about 1m to 2m in length. It is also recommended that a grass cover be reinstated as soon as possible over the trench in order to prevent erosion.

Consideration can also be given to using geotextiles to help with the prevention of erosion especially along the steep approaches along drainage lines.

Compaction of the general backfill soils in trenches over the bedding layer and select fill should be carried out in layers of maximum loose thickness 200mm (depending on capability of compaction equipment) and compacted to minimum 90% of Modified AASHTO maximum dry density within 1 – 2 percent (wet/dry) of Optimum Moisture Content (OMC). This is critical to ensure that potential settlements over pipes and within the limits of the trench are kept to a minimum.

If soft and compressible clays and saturated soils are encountered during construction, these materials may require undercutting when exposed at or near formation level in the trench to improve working conditions.

11.9 Road Crossings

Information concerning the proposed design methodologies for any road crossings was not confirmed with Geosure at the time of preparation of this report.

The inferred soil conditions, excavation conditions and groundwater conditions along the pipelines routes are given above in Section 11.2, Table 3.

Should pipe jacking be adopted for the proposed crossing, it is critical that the design and construction follow guidelines set out in SANS 1200 LG (1983).

It is necessary to carry out the thrust and reception pits and pipe jack to the very best standards to ensure that railway lines and any underground services, if present, are unaffected by the pipe jacking and associated operations.

In particular, where pipes are to be jacked under fills, precautions must be taken to ensure that thrust and reception pits and the jacking operation do not in any way cause the slope face of fills to erode, slide, slump or move. Consideration should be given to introducing lateral support into the jacking pits and/or reception and thrust pits.

Settlement above the pipe is to be kept to a minimum. Both stormwater runoff and groundwater seepage is to be controlled during construction. In this regard, dewatering options will depend on the locations and depths of the thrust and receptor pit works and should consider interceptor drains, or well points in extreme instances. In particular, surface drainage must be controlled to prevent runoff entering the jacking or reception pits and all pipe joints should be sealed to prevent groundwater seepage into the jacked pipes.

Backfilling of the thrust and reception pits and pipe trenches should be done using, where possible, *in situ* material, provided this material is not predominantly boulders or rock fragments and can be uniformly compacted to the required compaction. Final layers of backfilling should be raised above the natural ground level to compensate for long-term settlement and to prevent ponding of stormwater at the pit positions once settlement is complete.

The backfill in thrust and reception pits must be compacted to a minimum of 95% of Modified AASHTO maximum dry density throughout the full depth of the pits. Other fills should be compacted to a minimum of 93% of Modified AASHTO maximum dry density.

During the jacking operation, excavation must be such that overbreak is kept to a minimum.

Should the proposed crossings comprising trenching across existing roads, it is critical that the backfill of the trench and reinstatement of layerworks/surfacing be carried out to engineer's detail, the design of which should take into account insitu ground conditions, existing layerworks and design life of the road.

11.10 Inferred Founding Conditions and Foundation Recommendations for the Proposed Reservoir

Inferring from field data at the positions investigated to the inferred founding conditions and recommended foundation solutions for consideration by the design engineers are given in Table 6, overleaf.

Table 6: Proposed Thokozani Water Supply Scheme – Summary of Inferred Founding Conditions at the Proposed Reservoir Site and Foundation Recommendations for Consideration by the Design Engineer

Description	Inferred Shallow Founding Conditions	Foundation Recommendations
<p>Reservoir (IML)</p>	<p>Inferring for the inspection pit profiles IP1 to IP4, the inferred founding conditions at the proposed Reservoir site are characterised by the following:</p> <ul style="list-style-type: none"> i. The occurrence of a deep soil cover comprising residual firm to stiff dolerite clay profiled to a depth of 3.5m below EGL overlain by a mantle of loose to medium dense / firm to stiff colluvium to observed depths of between 0.68m and 0.76m below EGL. ii. The type and depths to weathered rock were not confirmed to the depths of refusal by DPL and inspection pit profiles down to 3.3m and 3.5m below EGL, respectively; iii. Relatively low bearing capacities of the colluvial and residual materials encountered to depths of between approximately 1.5m and 1.8m below EGL; iv. Risk of a saprolytic condition in the residual dolerite clay. Such a condition can result in collapse related settlement in residual / rock profiles. v. Potentially active colluvial and residual soils that classify with a Low to Medium potential expansiveness i.e. the potential for limited to moderate volumetric changes in response to cyclical fluctuations in ground moisture content; and vi. Risk of an intermittent perched groundwater condition. 	<p>Foundations are not to be formed directly on the colluvial / residual soils profiled.</p> <p>For a relatively lightly to moderately loaded reservoir structure with a bearing pressure not exceeding 150kPa, provision may instead be made for the establishment of the reservoir foundation on structural fill / improved ground to geotechnical engineer's design detail.</p> <p>General guidelines with regards to an improved ground solution are presented below, as follows:</p> <ul style="list-style-type: none"> i. Undercut and spoil all poorly consolidated soils from beneath foundation level to a level to be confirmed in a geotechnical design layout. All remnants of the existing reservoir foundation must be removed to spoil off site from the footprint of the structural fill. ii. Should the excavation intersect groundwater seepage, the excavation should then be backfilled with clean free draining sand to engineer's detail; iii. The excavation will need to be backfilled with imported select granular material to engineer's specification compacted to well above average compaction specification; iv. Installation of foundation may then proceed. <p>Anticipated total settlements in response to an applied foundation pressures up to 150kN/m² are unlikely to exceed 10mm to 15mm, with differential settlement taken as 50% of total settlement. Actual settlements will vary proportionately to the sizing of the foundation as well as the confirmed foundation design load.</p> <p>The design of the ground improvement is to be carried out by an experienced geotechnical specialist such as Geosure. Furthermore, this option requires on-going process control/quality monitoring during construction.</p> <p>The surrounding ground should be graded away from structures to limit infiltration of water into the ground below floor level.</p>

11.11 Drainage

One of the critical factors in the stable development of the site is the control and removal of both surface and groundwater from the site, to engineer's detail.

Any loosely consolidated sandy and clayey / clay soils encountered during construction are considered susceptible to rapid and severe erosion by uncontrolled / channelled surface water runoff.

Earthworks and drainage measures are to be designed to prevent ponding of, or high concentrations of, stormwater or groundwater anywhere on the site, both during and after the development.

12. SUMMARY OF FINDINGS AND DEVELOPMENT RECOMMENDATIONS

This report details the results of a geotechnical investigation for the proposed Bulk and Reticulation Pipelines and IML Reservoir for the Thokozani Water Supply Scheme, within uMshwati Local Municipality, mGungundlovu District Municipality, central Kwa-Zulu Natal.

The following observations, conclusions and recommendations are made to inform engineering design:

- i. Based on the results of the field investigation and inferred ground conditions the site/route it is considered that this site appears to be generally stable and suitable for development as proposed, provided the recommendations given in this report are adhered to.
- ii. At the positions investigated, the site is observed to be underlain by shale of the Pietermaritzburg Formation, which is capped by a mostly clay soil cover, comprising residual shale, residual dolerite, colluvium and occasional uncontrolled fill materials of varying thicknesses.
- iii. Groundwater seepage activity was not observed at the positions and to the depths profiled. A risk of intermittent perched groundwater activity has, however, been identified.
- iv. The materials observed and tested are not considered suitable for use as "Selected Granular Material" or "Select Fill", but are generally suitable for use as "Main Fill".
- v. A potential commercial source has been identified in the neighbouring area of Mpolweni, which may be able to supply material suitable for use as "Selected Fill" in terms of SANS1200LB, but is likely to require careful design, screening and blending in order to achieve the relevant grading analysis range.
- vi. Recommendations for construction of the foundation to the proposed reservoir on structural fill are given in Section 11.10, Table 6, of this report.

The ground conditions given in this report refer specifically to the field tests carried out on site. It is therefore, quite possible that conditions at variance with those given in this report

can be encountered during subsequent supplementary investigation and/or elsewhere on site during construction. It is therefore important that Geosure be appointed to carry out periodic inspections during construction of the proposed development. Any change from the anticipated ground conditions can also be taken into account to avoid unnecessary expense.

There is merit in affording Geosure the opportunity to review the recommendations in this report, under an extension of the current appointment, once detailed information regarding foundation design loads and position of the proposed building structures are confirmed.

The design of the ground improvement is to be carried out by an experienced geotechnical specialist such as Geosure, with allowance for on-going process control/quality monitoring during construction.

13. BIBLIOGRAPHY

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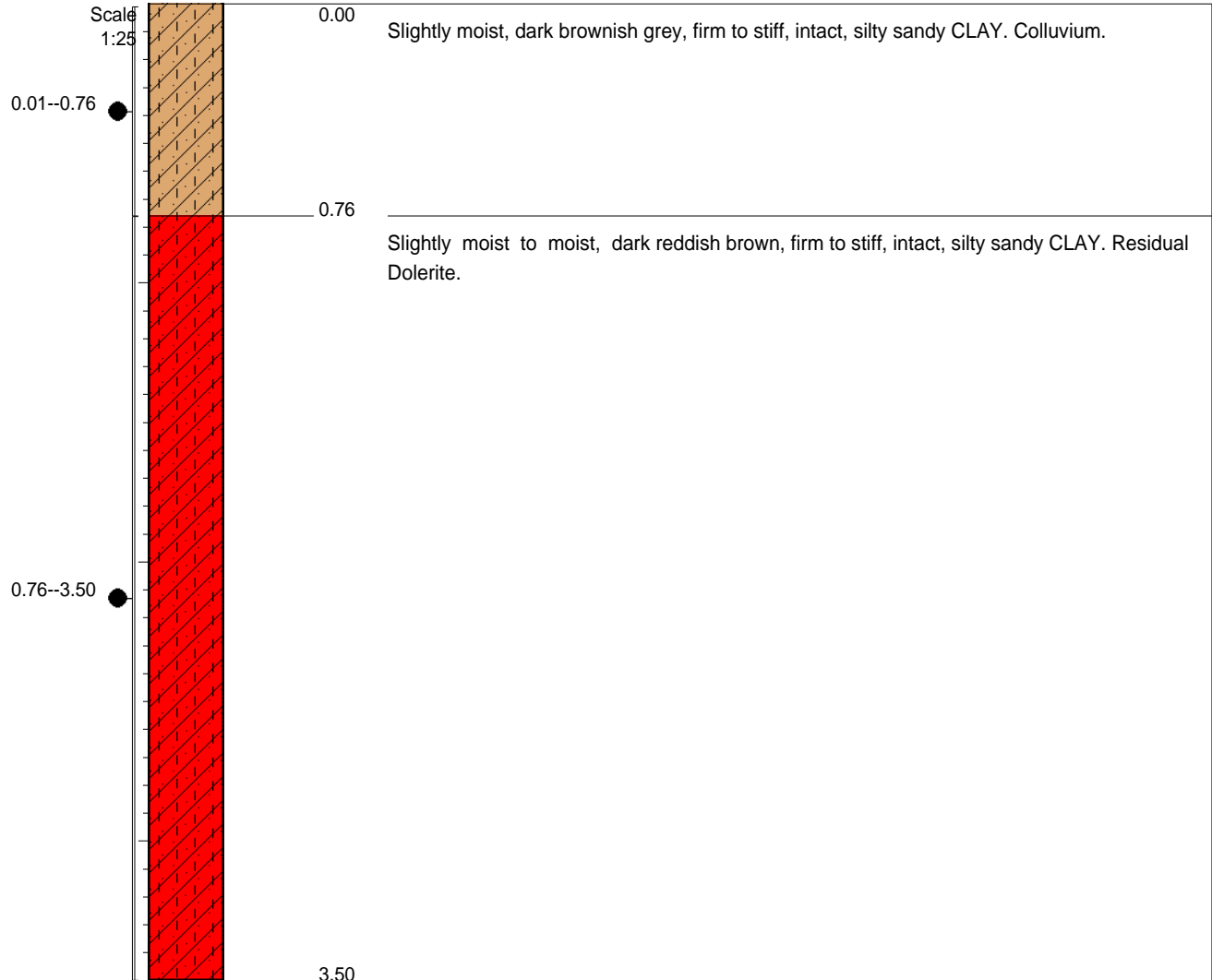


APPENDIX A



**PROFILES OF INSPECTION PITS
AND EXPOSURES**





NOTES

- 1) No groundwater seepage observed.
- 2) Next to existing reservoir.
- 3) Samples taken at:
 S1 0,01--0,76 (2 x Bulk)
 S2 0,76--3,50 (1 x Ind)
- 4) Final depth at 3,50m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'53.4"E
 Y-COORD : 29 25'18.5"S



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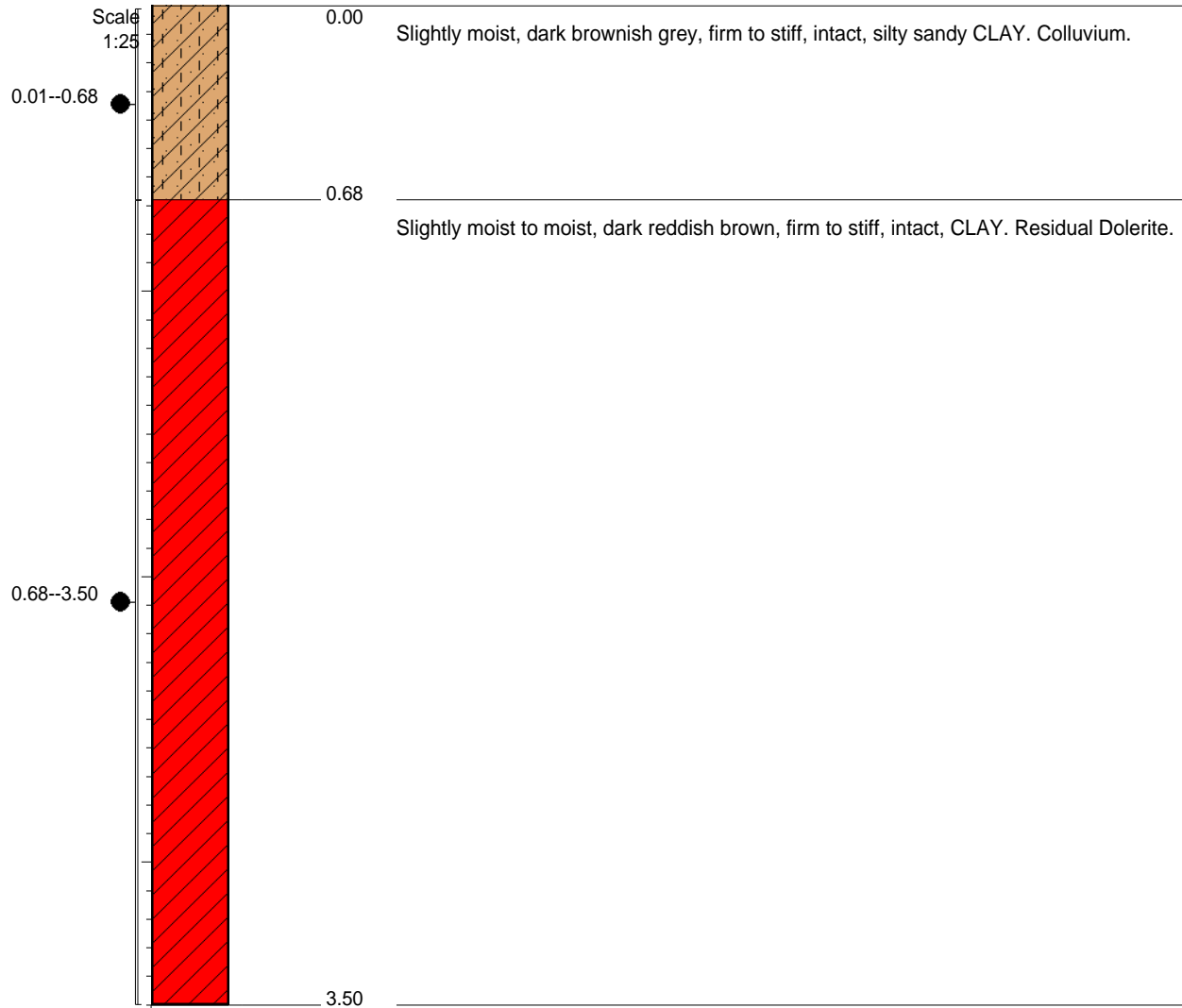
Geotechnical, Environmental &
Groundwater Engineering
Pile Integrity Testing & Civil
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Escongweni BPH Engineers (Pty) Ltd
Proposed Water Supply Scheme at Thokozani,
KwaZulu-Natal within Umgungundlovu
District Municipality

HOLE No: IP2
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Samples taken at:
S1 0,01--0,68 (1 x Ind)
S2 0,68--3,50 (2 x Bulk)
- 3) Final depth at 3,50m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : E. Dada Mia
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 17 May 2020
DATE : 18 May 2020
DATE : 15/06/20 09:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : 30 26'53.2"E
Y-COORD : 29 25'18.3"S

HOLE No: IP2



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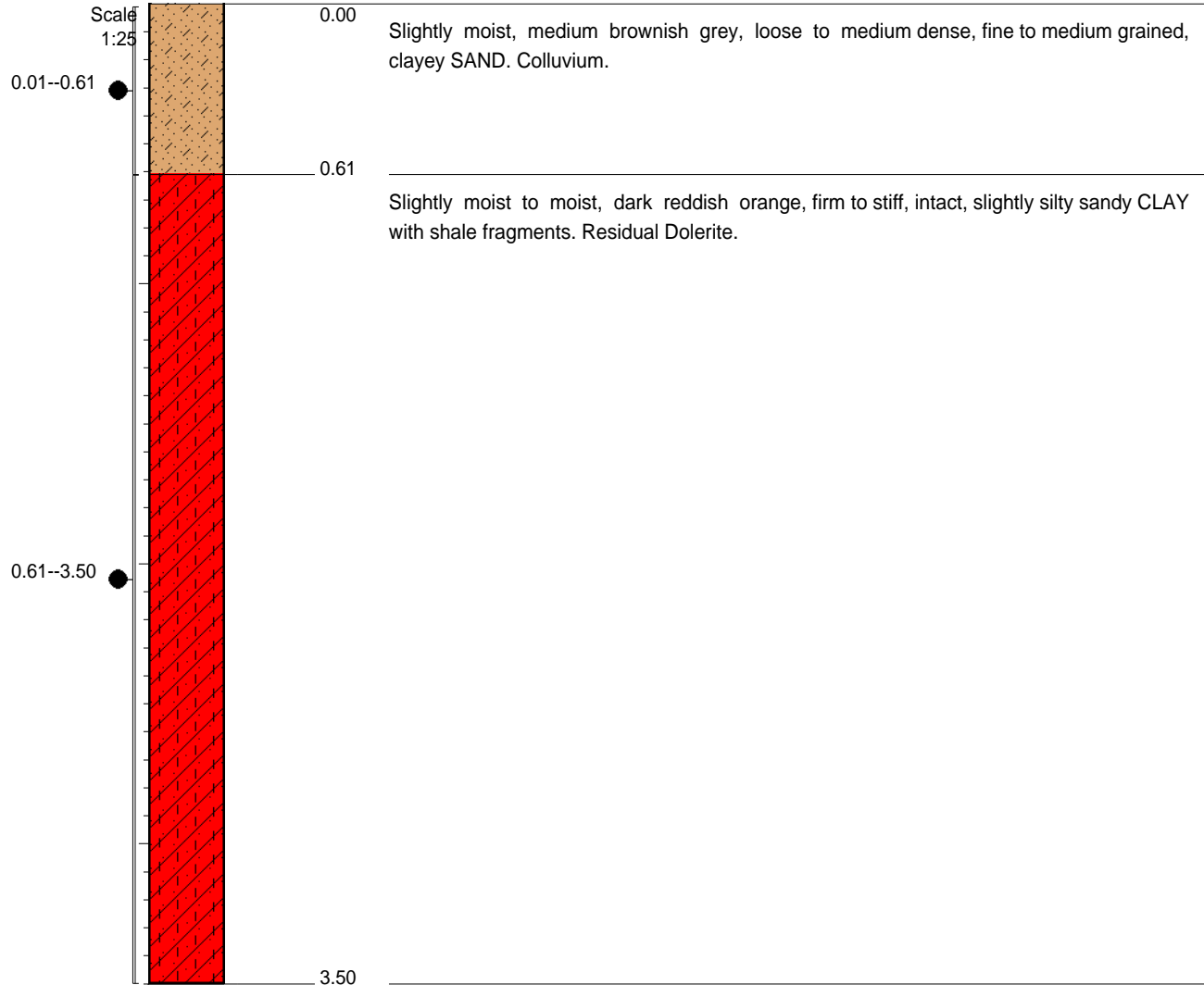
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 Proposed Water Supply Scheme at Thokozani,
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 District Municipality

HOLE No: IP3
 Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Next to existing reservoir.
- 3) Samples taken at:
 S1 0,01--0,61 (1 x Ind)
 S2 0,61--3,50 (2 x Bulk)
- 4) Final depth at 3,50m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'52.9"E
 Y-COORD : 29 25'18.5"S

HOLE No: IP3



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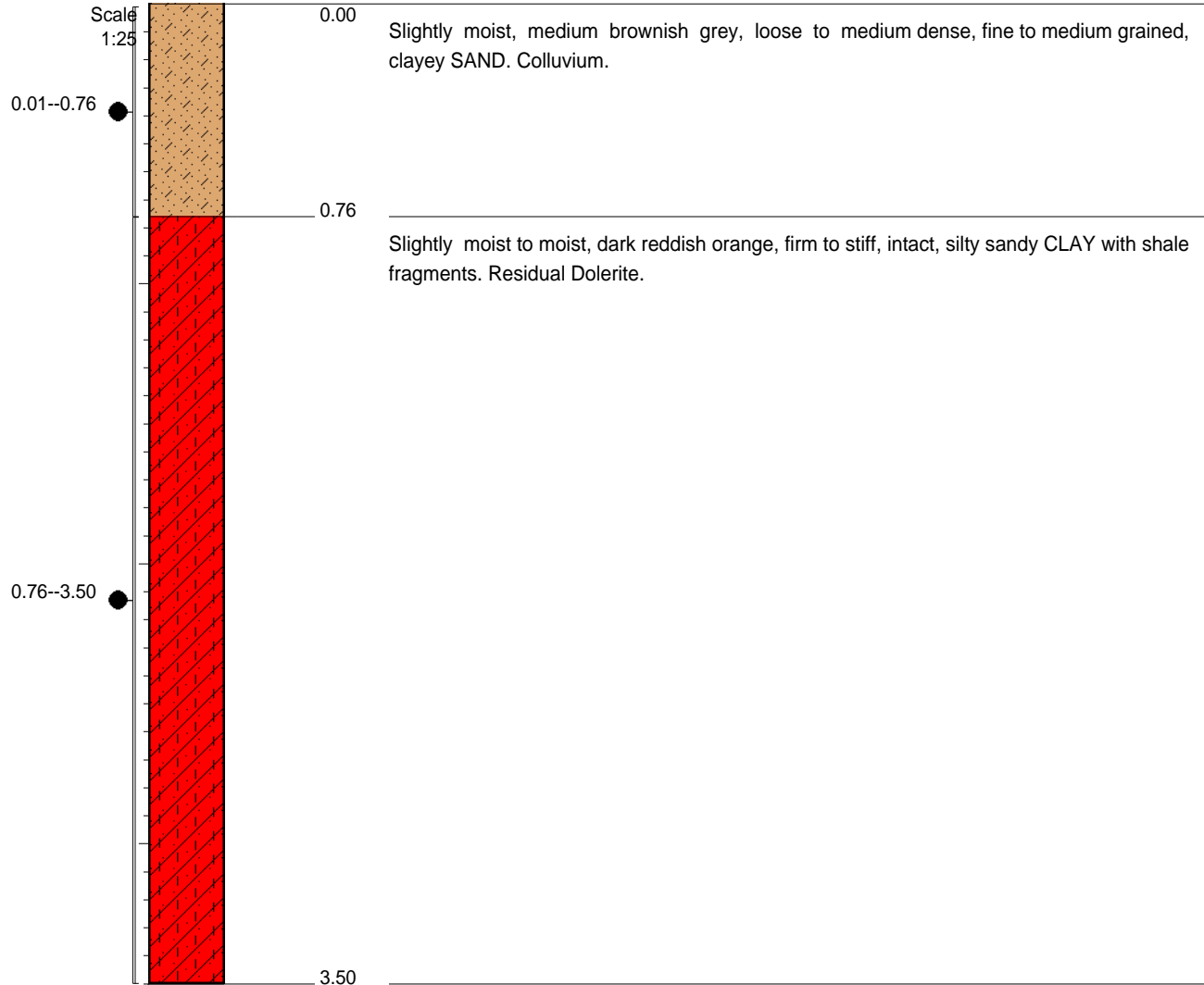
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 District Municipality

HOLE No: IP4
 Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Next to existing reservoir.
- 3) Samples taken at:
 S1 0,01--0,76 (2 x Bulk)
 S2 0,76--3,50 (1 x Ind)
- 4) Final depth at 3,50m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'53.0"E
 Y-COORD : 29 25'18.7"S

HOLE No: IP4



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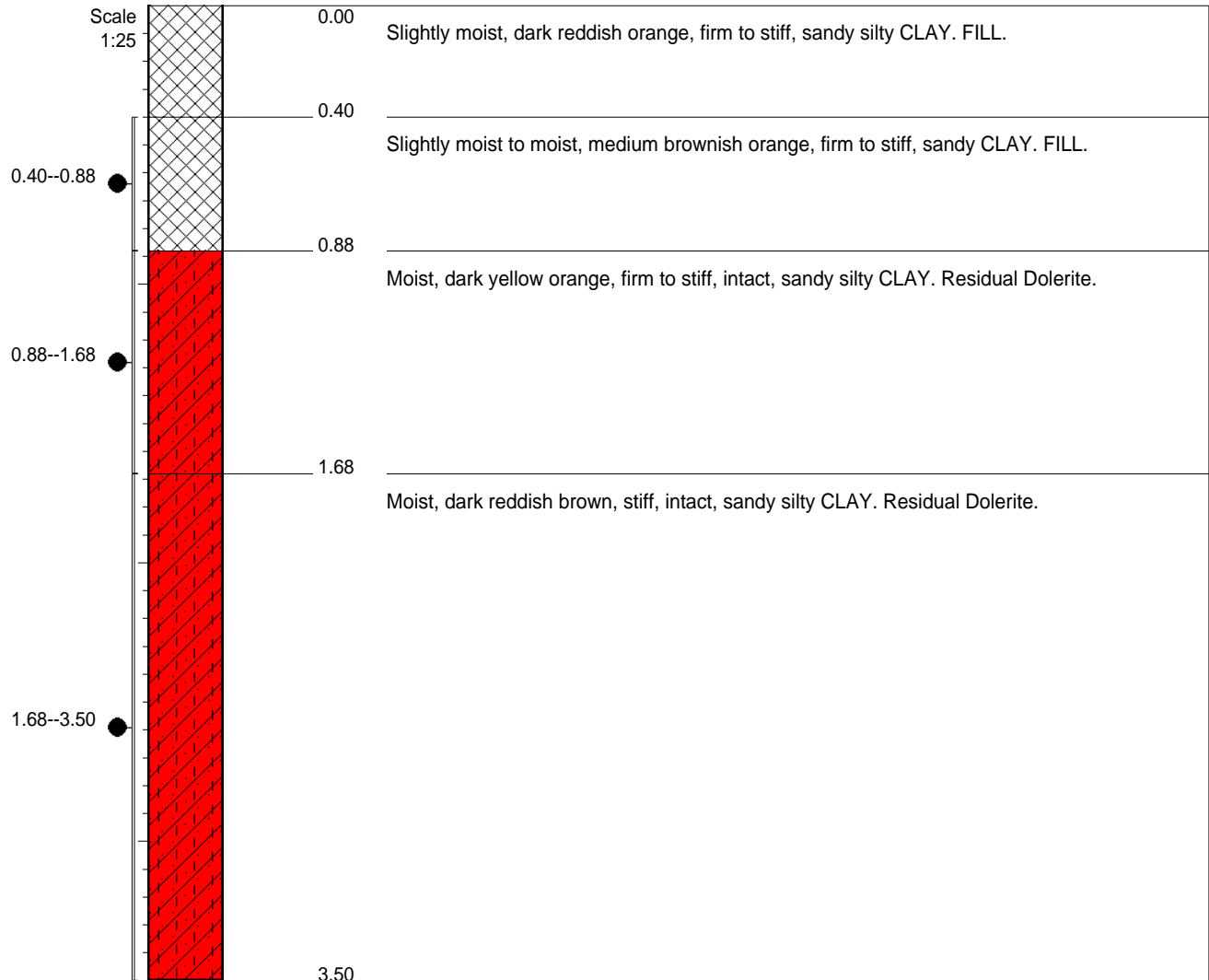
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HOLE No: IP5
 Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) In sugar cane field.
- 3) Samples taken at:
 S1 0,40--0,88 (1 x Ind)
 S2 0,88--1,68 (1 x Ind)
 S3 1,68--3,50 (1 x Ind)
- 4) Final depth at 3,50m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'49.0"E
 Y-COORD : 29 25'23.6"S

HOLE No: IP5



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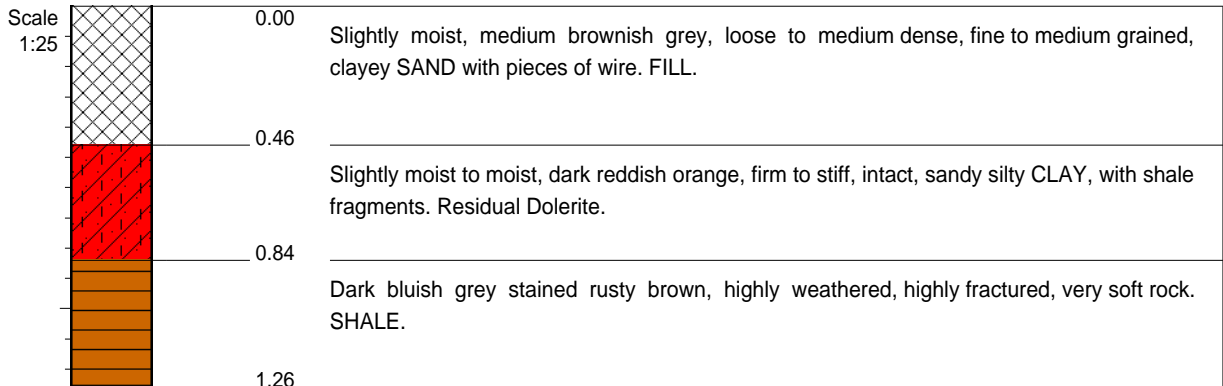
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HOLE No: IP6
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Refusal depth at 1,26m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'30.1"E
 Y-COORD : 29 25'30.7"S

HOLE No: IP6



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HOLE No: IP7
 Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Samples taken at:
 S1 0,01--0,44 (1 x Bulk)
 S2 0,44--1,61 (1 x Ind)
- 3) Refusal depth at 2,80m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26' 29.9"E
 Y-COORD : 29 25' 38.6"S

HOLE No: IP7



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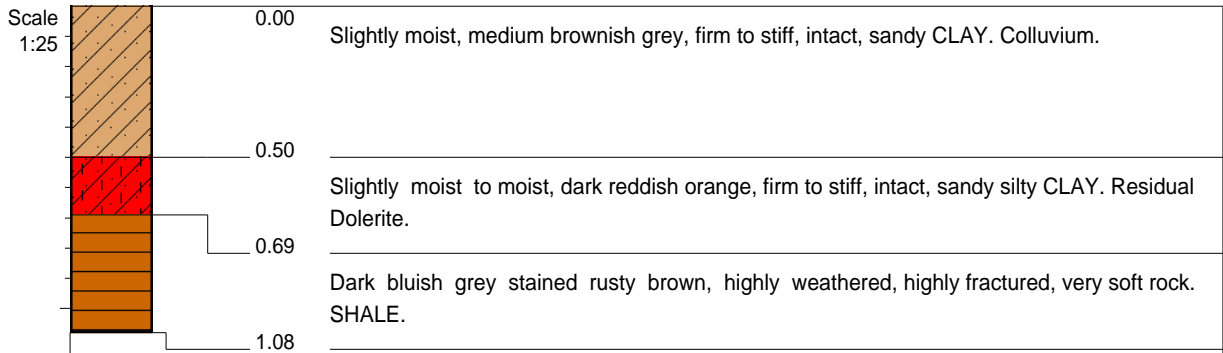
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HOLE No: IP8
 Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Refusal depth at 1,08m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'18.2"E
 Y-COORD : 29 25'40.8"S

HOLE No: IP8



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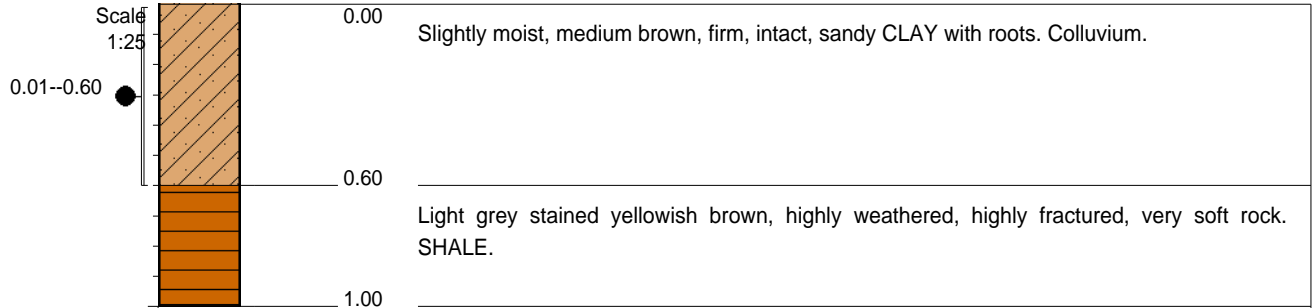
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HOLE No: IP9
 Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,01--0,60 (1 x Bulk)
- 3) Final depth at 1,00m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'15.5"E
 Y-COORD : 29 5'53.9"S

HOLE No: IP9



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HOLE No: IP10
 Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Final depth at 3,50m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'34.6"E
 Y-COORD : 29 25'53.1"S

HOLE No: IP10



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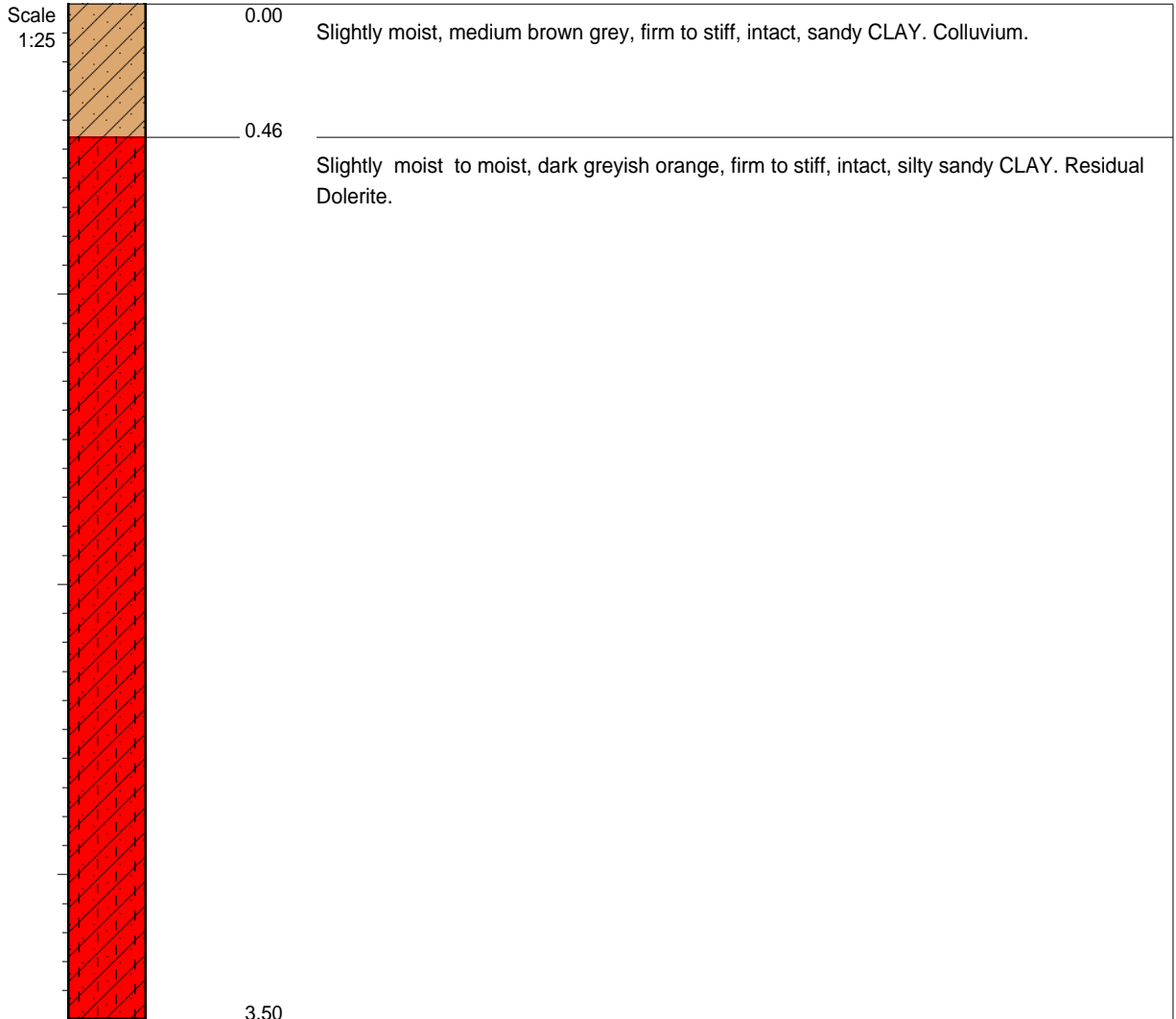
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HOLE No: IP11
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Final depth at 3,50m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'29.0"E
 Y-COORD : 29 26'05.1"S

HOLE No: IP11



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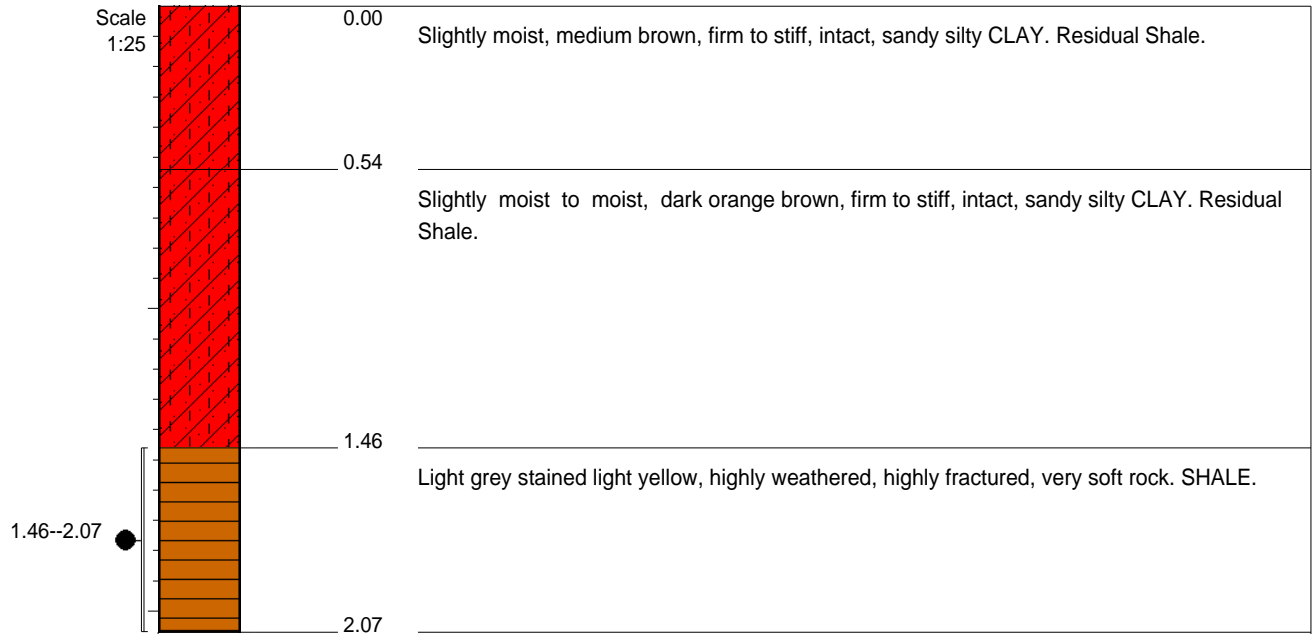
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HOLE No: IP12
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 1,46--2,07 (2 x Bulk)
- 3) Refusal depth at 2,07m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : E. Dada Mia
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 17 May 2020
DATE : 18 May 2020
DATE : 15/06/20 09:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : 30 26'34.7"E
Y-COORD : 29 26'13.9"S

HOLE No: IP12



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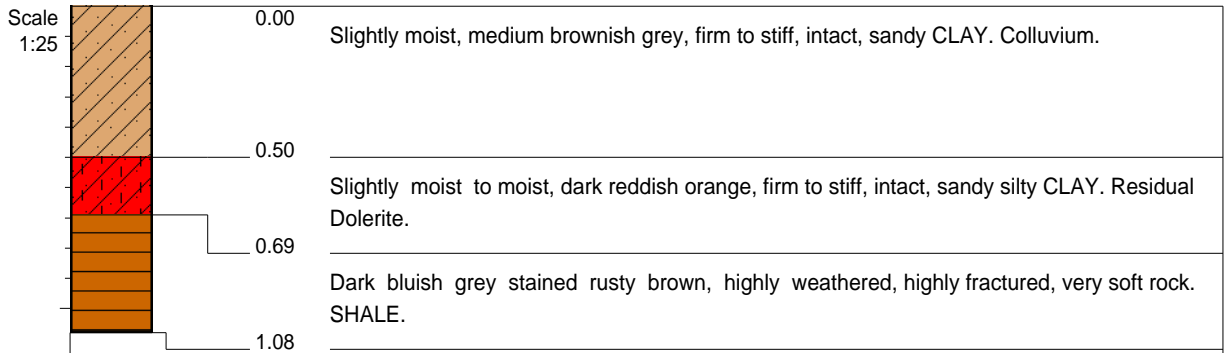
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HOLE No: IP13
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Refusal depth at 1,08m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : E. Dada Mia
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 17 May 2020
DATE : 18 May 2020
DATE : 15/06/20 09:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : 30 26'18.2"E
Y-COORD : 29 25'40.8"S

HOLE No: IP13



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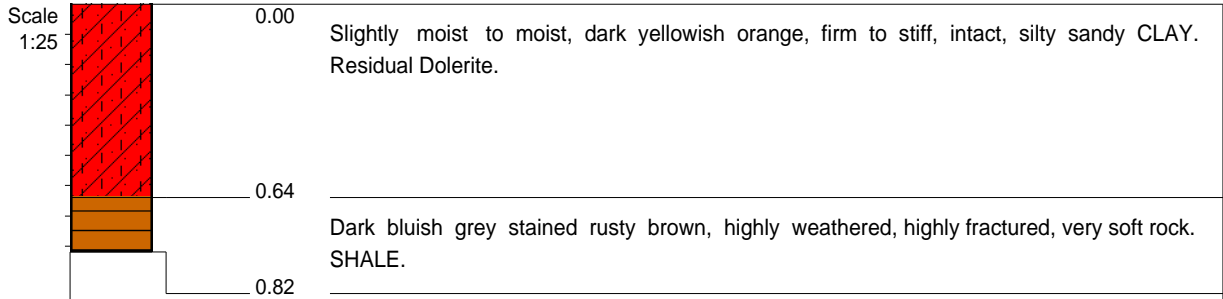
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HOLE No: IP14
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Refusal depth at 0,82m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'15.0"E
 Y-COORD : 29 26'06.4"S

HOLE No: IP14



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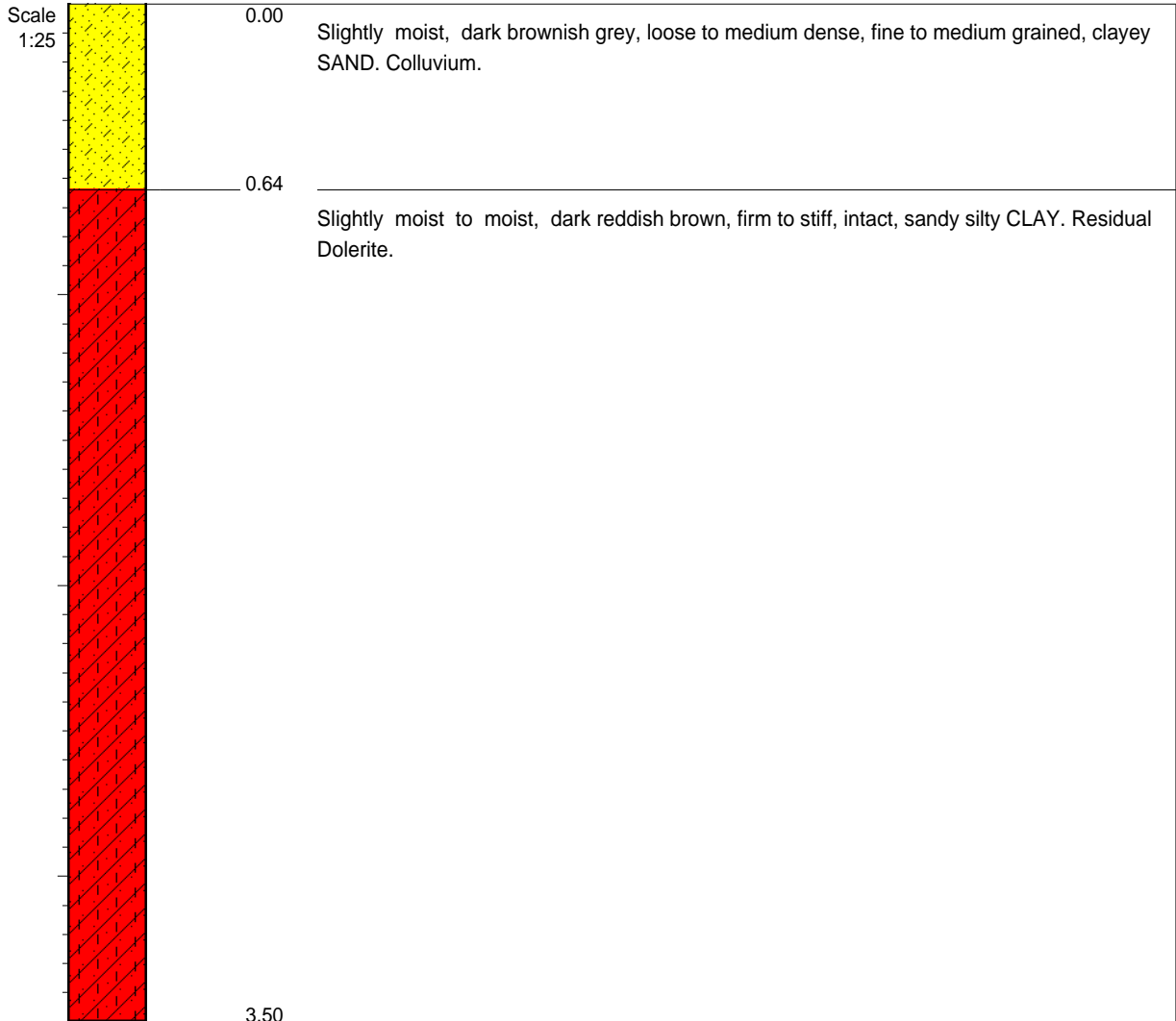
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HOLE No: IP15
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Final depth at 3,50m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'09.9"E
 Y-COORD : 29 25'20.9"S

HOLE No: IP15



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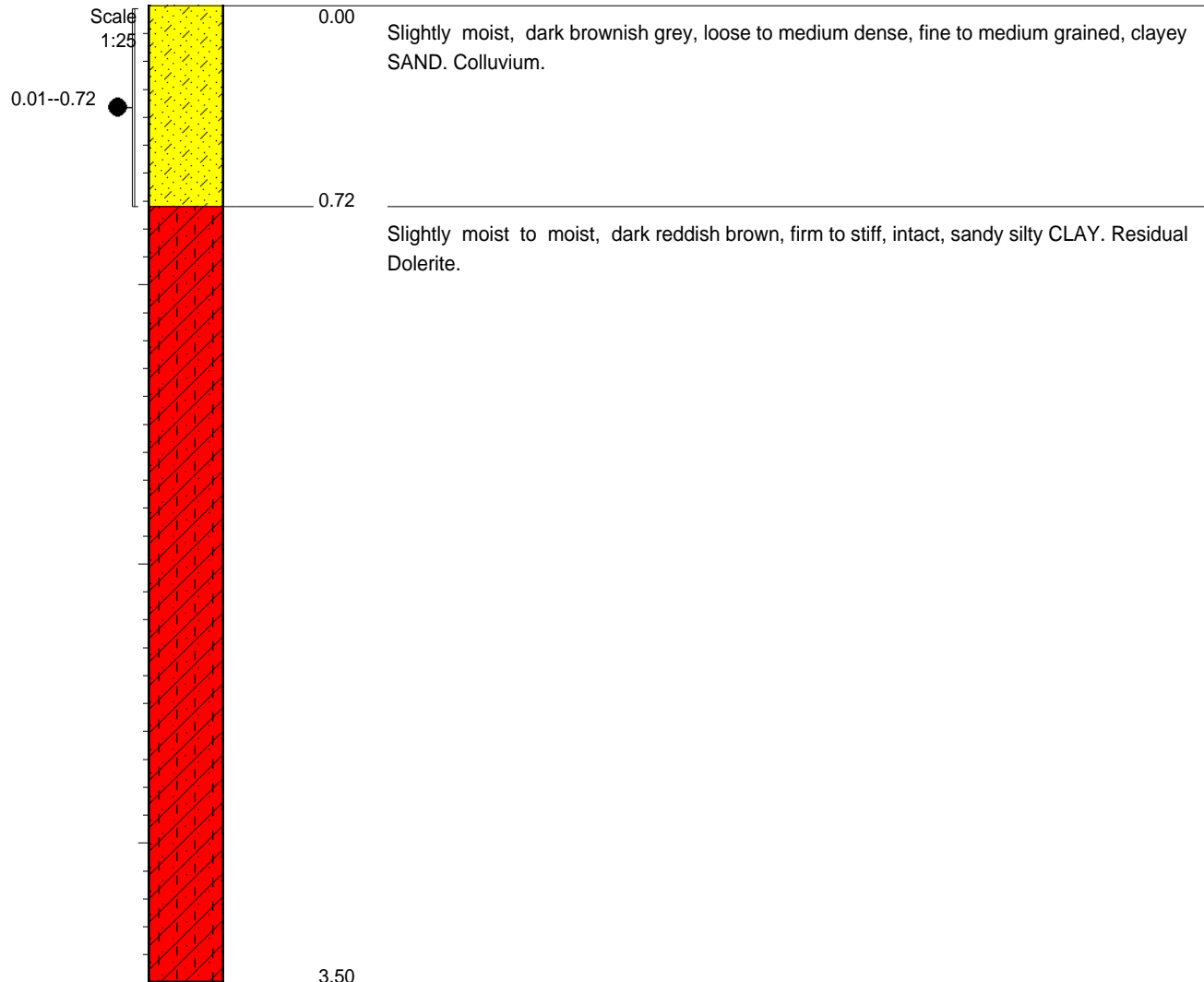
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HOLE No: IP16
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,01--0,72 (1 x Bulk)
- 3) Final depth at 3,50m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : E. Dada Mia

TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 17 May 2020
DATE : 18 May 2020
DATE : 15/06/20 09:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : 30 26'20.7"E
Y-COORD : 29 25'21.6"S

HOLE No: IP16



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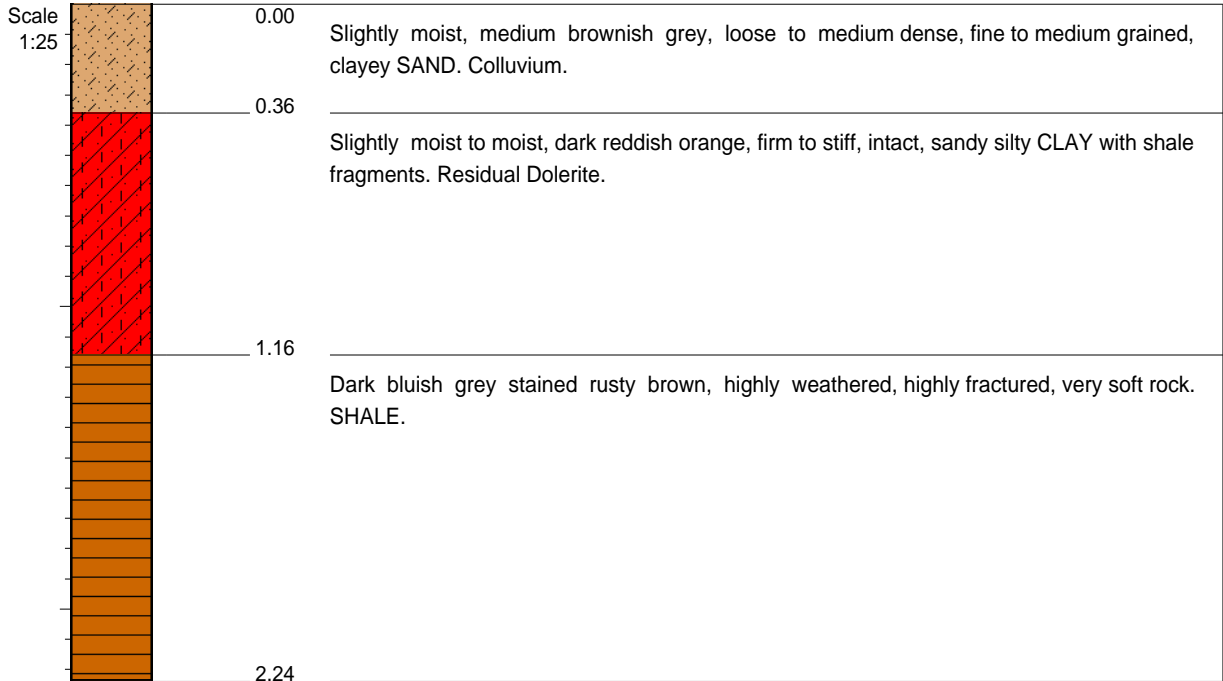
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HOLE No: IP17
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Refusal depth at 2,24m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'00.1"E
 Y-COORD : 29 25'18.5"S

HOLE No: IP17



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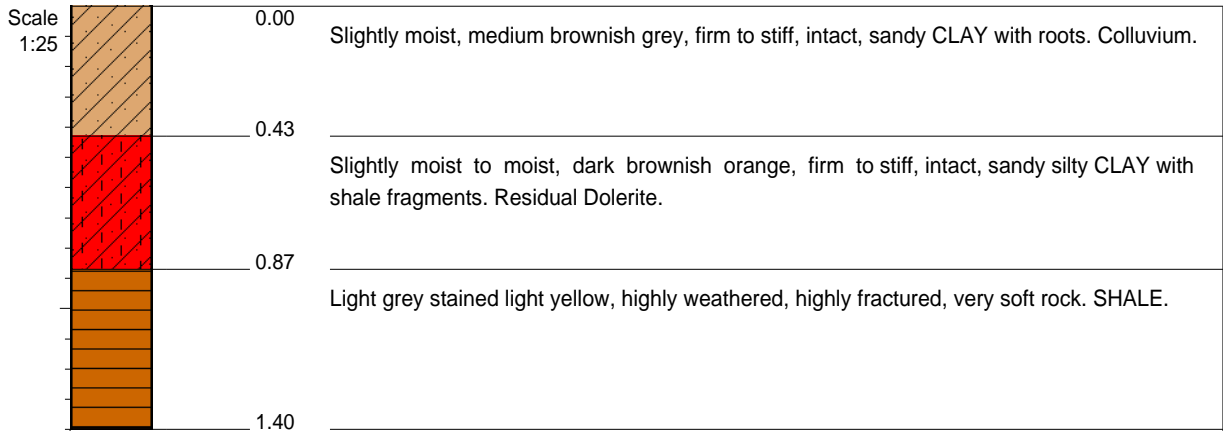
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HOLE No: IP18
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Refusal depth at 1,40m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 26'02.5"E
 Y-COORD : 29 25'31.5"S

HOLE No: IP18



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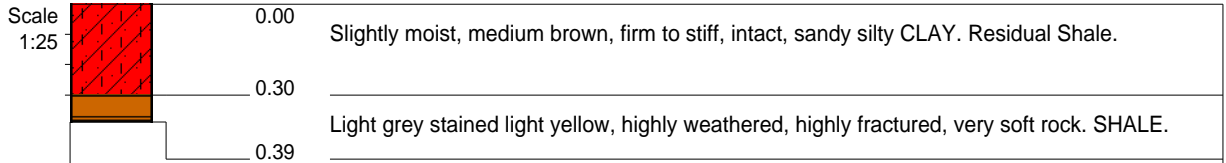
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HOLE No: IP19
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JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Refusal depth at 0,39m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : E. Dada Mia
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 17 May 2020
DATE : 18 May 2020
DATE : 15/06/20 09:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : 30 25'59.7"E
Y-COORD : 29 25'41.6"S

HOLE No: IP19



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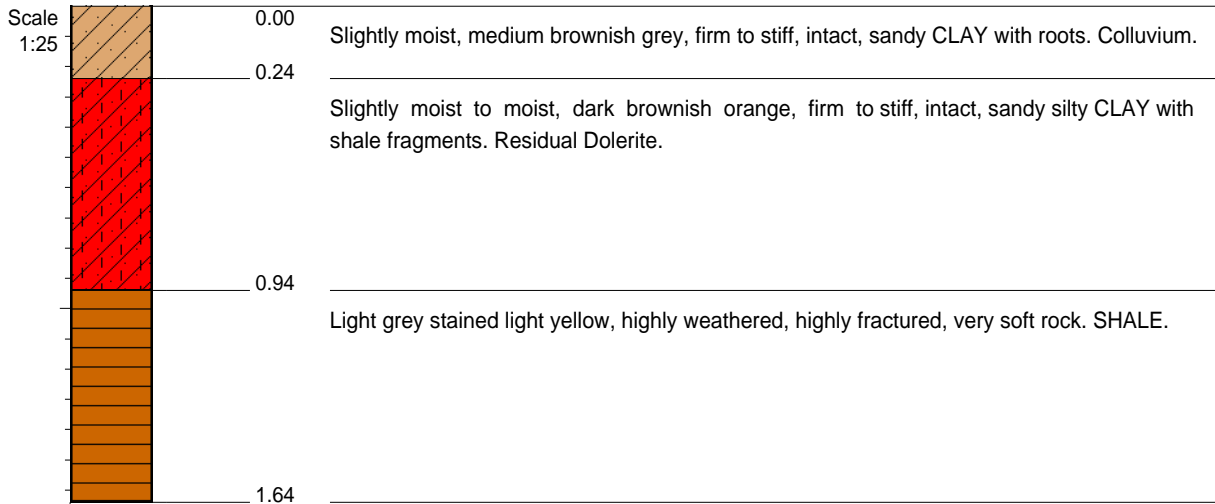
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District Municipality

HOLE No: IP20
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Refusal depth at 1,64m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : E. Dada Mia
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 17 May 2020
DATE : 18 May 2020
DATE : 15/06/20 09:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : 30 25'53.9"E
Y-COORD : 29 25'25.8"S

HOLE No: IP20



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email: geosure@iafrica.com

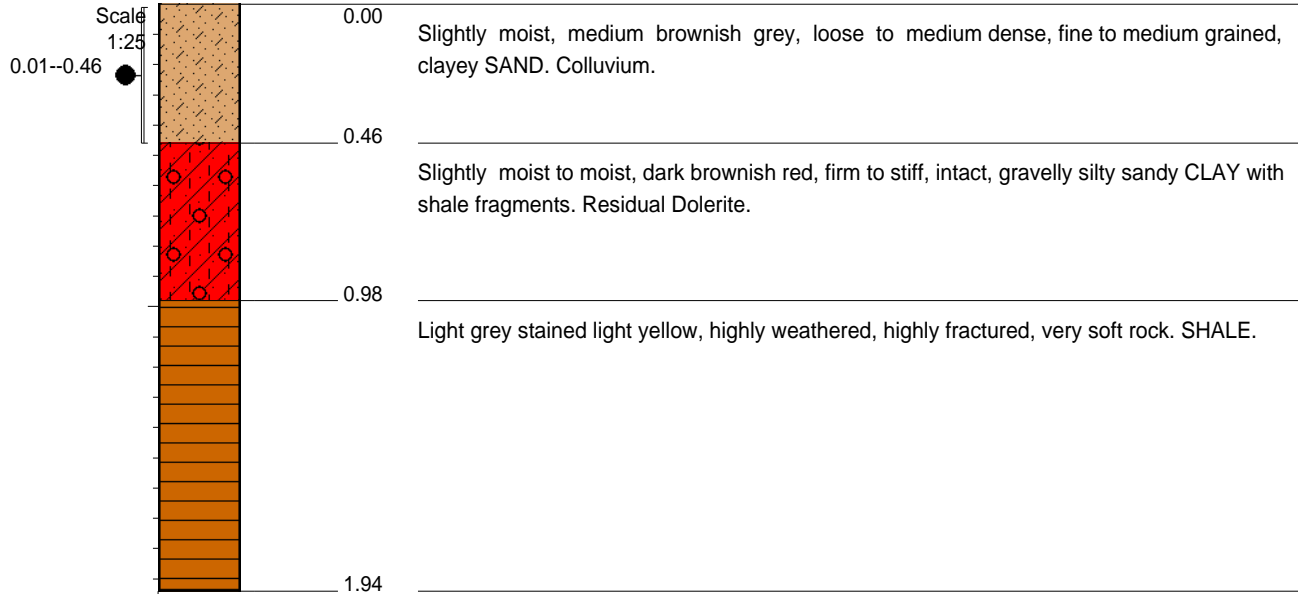
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HOLE No: IP21
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
S1 0,01--0,46 (1 x Bulk)
- 3) Refusal depth at 1,94m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : E. Dada Mia
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 17 May 2020
DATE : 18 May 2020
DATE : 15/06/20 09:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : 30 25'44.9"E
Y-COORD : 29 25'15.2"S

HOLE No: IP21



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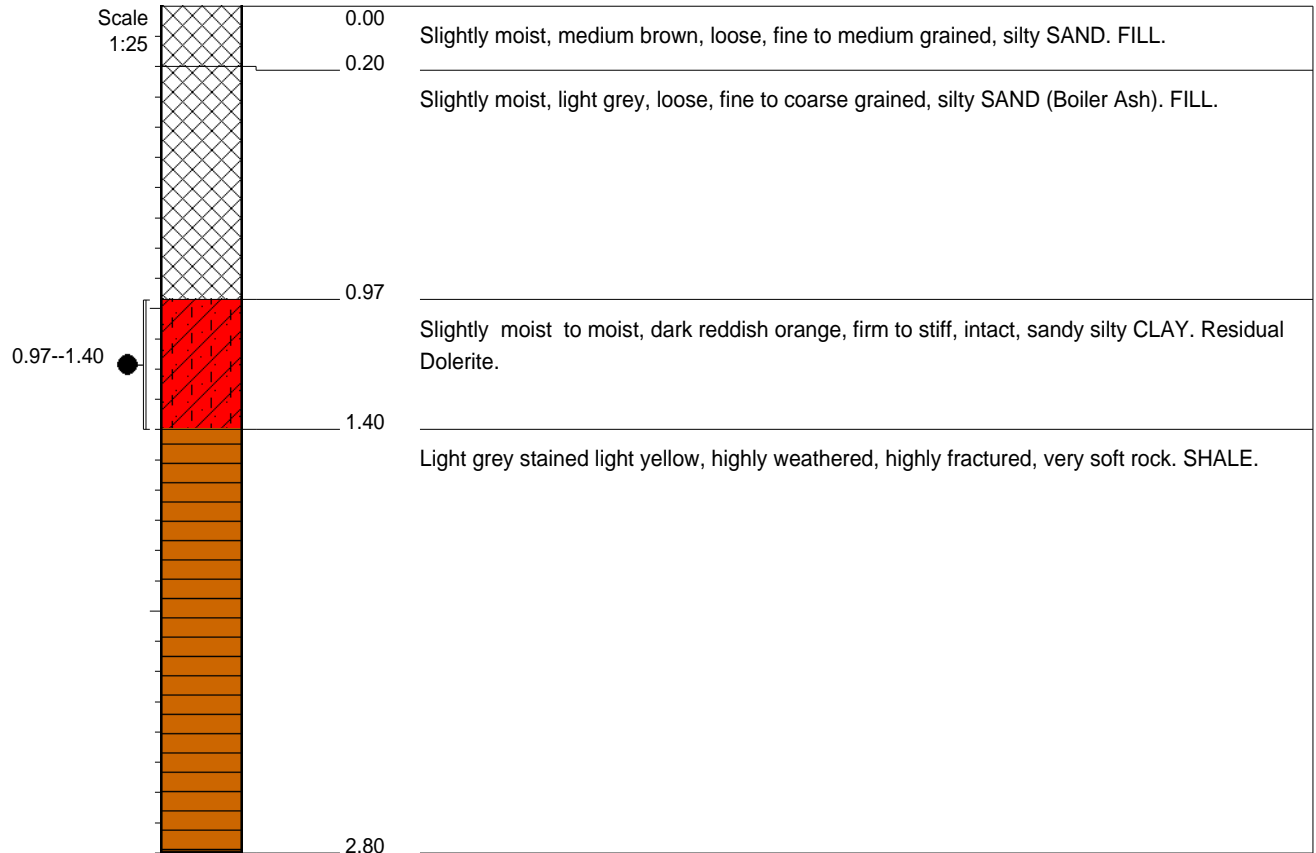
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 District Municipality

HOLE No: IP22
 Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Next to railway line.
- 3) Sample taken at:
S1 0,97--1,40 (1 x Ind)
- 4) Refusal depth at 2,80m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30 25'47.5"E
 Y-COORD : 29 24'57.3"S

HOLE No: IP22



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HOLE No: IP23
 Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Sample taken at:
 S1 0,01--0,54 (1 x Bulk)
- 3) Refusal depth at 2,80m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PIITS.TXT

ELEVATION : -
 X-COORD : 30 25'38.8"E
 Y-COORD : 29 24'49.8"S

HOLE No: IP23



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District Municipality

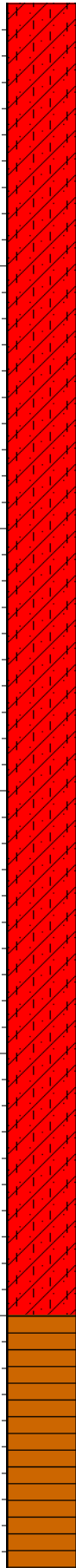
HOLE No: EXP1
Sheet 1 of 3

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JOB NUMBER: 085-20

Scale
1:25



0.00

Slightly moist, dark yellowish orange, firm to stiff, fissured, sandy silty CLAY. Residual Dolerite.

5.00

Dark bluish grey stained rusty brown, highly weathered, highly fractured, very soft rock. SHALE.



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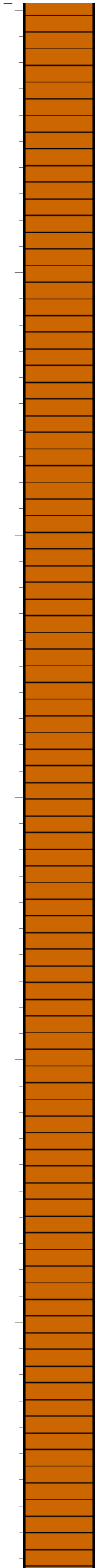
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HOLE No: EXP1
Sheet 2 of 3

JOB NUMBER: 085-20





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HOLE No: EXP1
Sheet 3 of 3

JOB NUMBER: 085-20



14.00

NOTES

- 1) No groundwater seepage observed.
- 2) Final depth at 14,00m.

CONTRACTOR :
 MACHINE : TLB
 DRILLED BY :
 PROFILED BY : E. Dada Mia
 TYPE SET BY : K.Kistasamy
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE : 17 May 2020
 DATE : 18 May 2020
 DATE : 15/06/20 09:01
 TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
 X-COORD : 30.4382229 E
 Y-COORD : -29.4351278 S

HOLE No: EXP1



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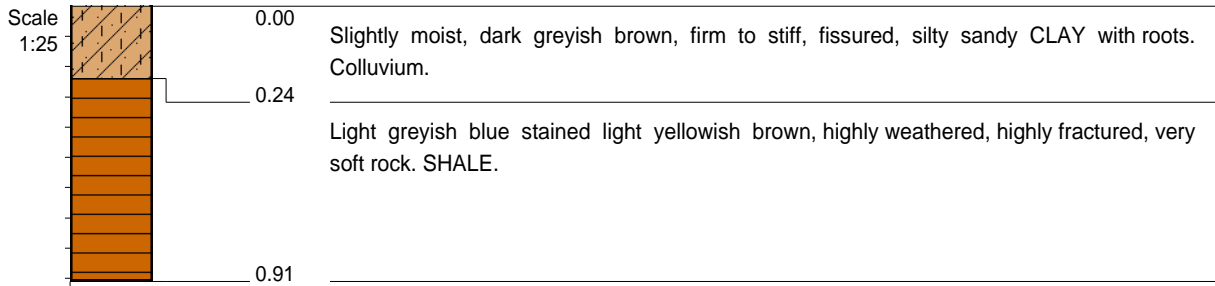
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HOLE No: EXP2
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Final depth at 0,91m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : E. Dada Mia
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 17 May 2020
DATE : 18 May 2020
DATE : 15/06/20 09:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : 30.4376341 E
Y-COORD : -29.4243485 S

HOLE No: EXP2



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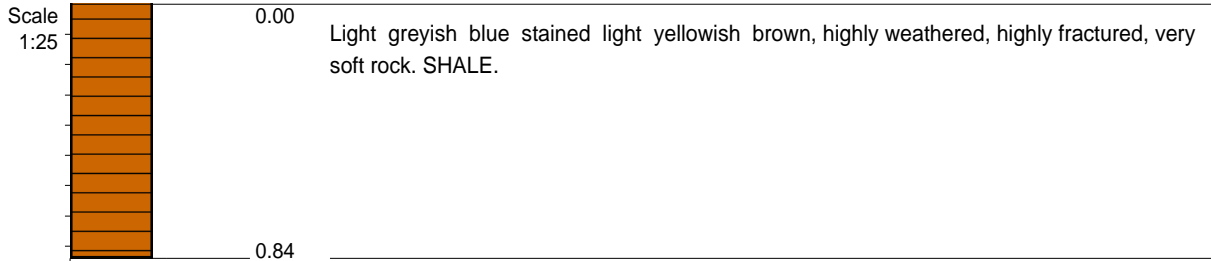
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HOLE No: EXP3
Sheet 1 of 1

JOB NUMBER: 085-20



NOTES

- 1) No groundwater seepage observed.
- 2) Final depth at 0,84m.

CONTRACTOR :
MACHINE : TLB
DRILLED BY :
PROFILED BY : E. Dada Mia
TYPE SET BY : K.Kistasamy
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE : 17 May 2020
DATE : 18 May 2020
DATE : 15/06/20 09:01
TEXT : ..C:\LOGS\PITS.TXT

ELEVATION : -
X-COORD : E
Y-COORD : S

HOLE No: EXP3



APPENDIX B



**CBR DYNAMIC CONE
PENETROMETER (DCP) TEST
RESULTS (PIPELINE AND 1ML
RESERVOIR)**

.....

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Date: 17.05.2020

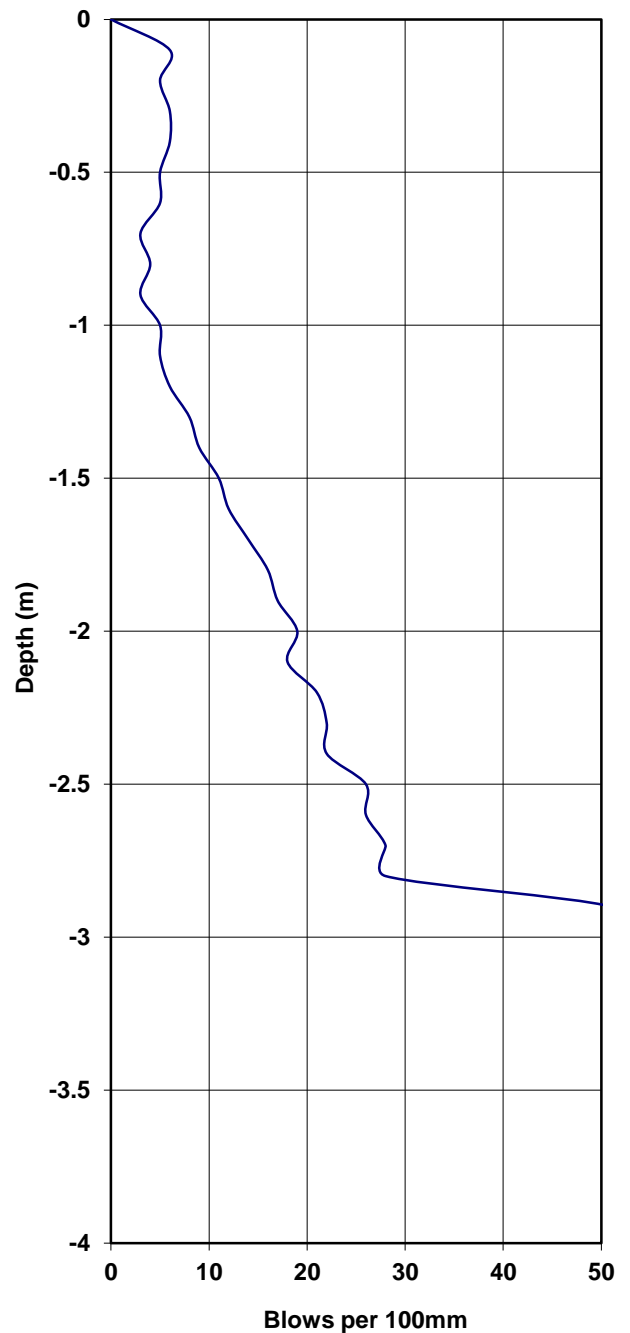
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 1

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	6	Firm	50 kPa	10
0.2	5	Firm	40 kPa	8
0.3	6	Firm	50 kPa	10
0.4	6	Firm	50 kPa	10
0.5	5	Firm	40 kPa	8
0.6	5	Firm	40 kPa	8
0.7	3	Soft	25 kPa	5
0.8	4	Soft	35 kPa	7
0.9	3	Soft	25 kPa	5
1	5	Firm	40 kPa	8
1.1	5	Firm	40 kPa	8
1.2	6	Firm	50 kPa	10
1.3	8	Firm	65 kPa	14
1.4	9	Stiff	75 kPa	15
1.5	11	Stiff	90 kPa	19
1.6	12	Stiff	100 kPa	21
1.7	14	Stiff	115 kPa	25
1.8	16	Stiff	130 kPa	29
1.9	17	Stiff	140 kPa	31
2	19	Very Stiff	>150 kPa	35
2.1	18	Stiff	150 kPa	33
2.2	21	Very Stiff	>150 kPa	40
2.3	22	Very Stiff	>150 kPa	42
2.4	22	Very Stiff	>150 kPa	42
2.5	26	Very Stiff	>150 kPa	51
2.6	26	Very Stiff	>150 kPa	51
2.7	28	Very Stiff	>150 kPa	>55
2.8	28	Very Stiff	>150 kPa	>55
	Refusal			



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Date: 17.05.2020

Section: Umgungundlovu District Municipality

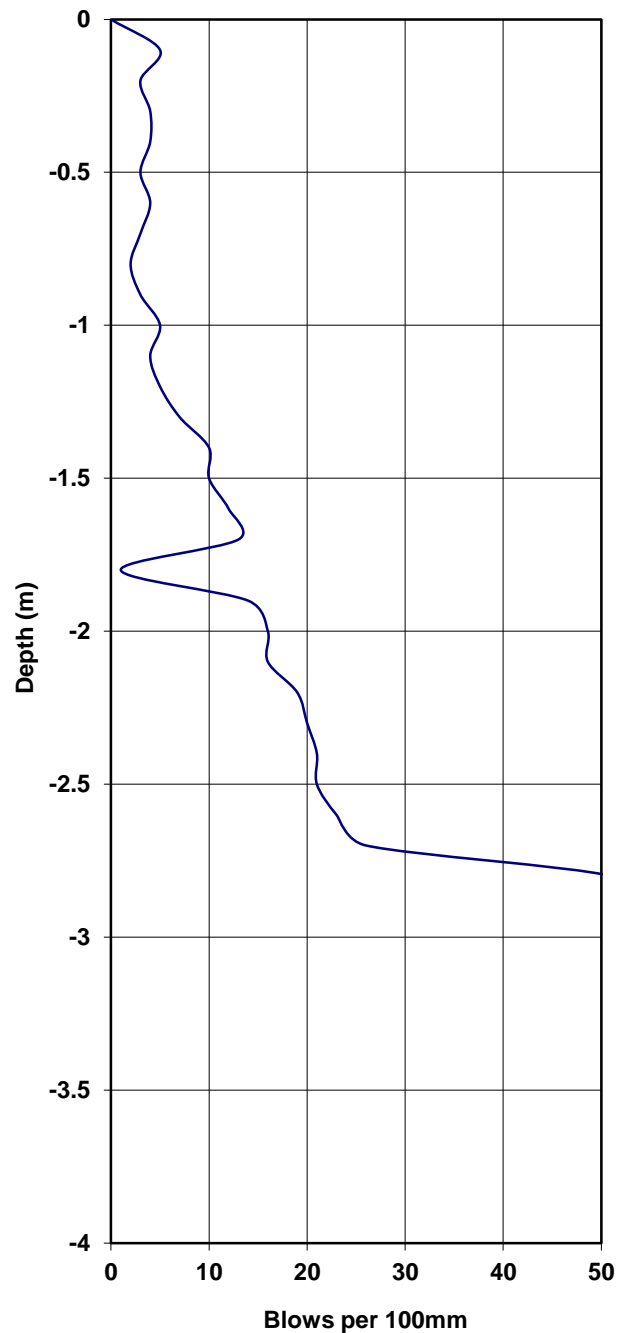
Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 2

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	5	Firm	40 kPa	8
0.2	3	Soft	25 kPa	5
0.3	4	Soft	35 kPa	7
0.4	4	Soft	35 kPa	7
0.5	3	Soft	25 kPa	5
0.6	4	Soft	35 kPa	7
0.7	3	Soft	25 kPa	5
0.8	2	Soft	20 kPa	3
0.9	3	Soft	25 kPa	5
1	5	Firm	40 kPa	8
1.1	4	Soft	35 kPa	7
1.2	5	Firm	40 kPa	8
1.3	7	Firm	60 kPa	12
1.4	10	Stiff	85 kPa	17
1.5	10	Stiff	85 kPa	17
1.6	12	Stiff	100 kPa	21
1.7	13	Stiff	110 kPa	23
1.8	1	Very Soft	<20 kPa	2
1.9	14	Stiff	115 kPa	25
2	16	Stiff	130 kPa	29
2.1	16	Stiff	130 kPa	29
2.2	19	Very Stiff	>150 kPa	35
2.3	20	Very Stiff	>150 kPa	37
2.4	21	Very Stiff	>150 kPa	40
2.5	21	Very Stiff	>150 kPa	40
2.6	23	Very Stiff	>150 kPa	44
2.7	26	Very Stiff	>150 kPa	51

Refusal



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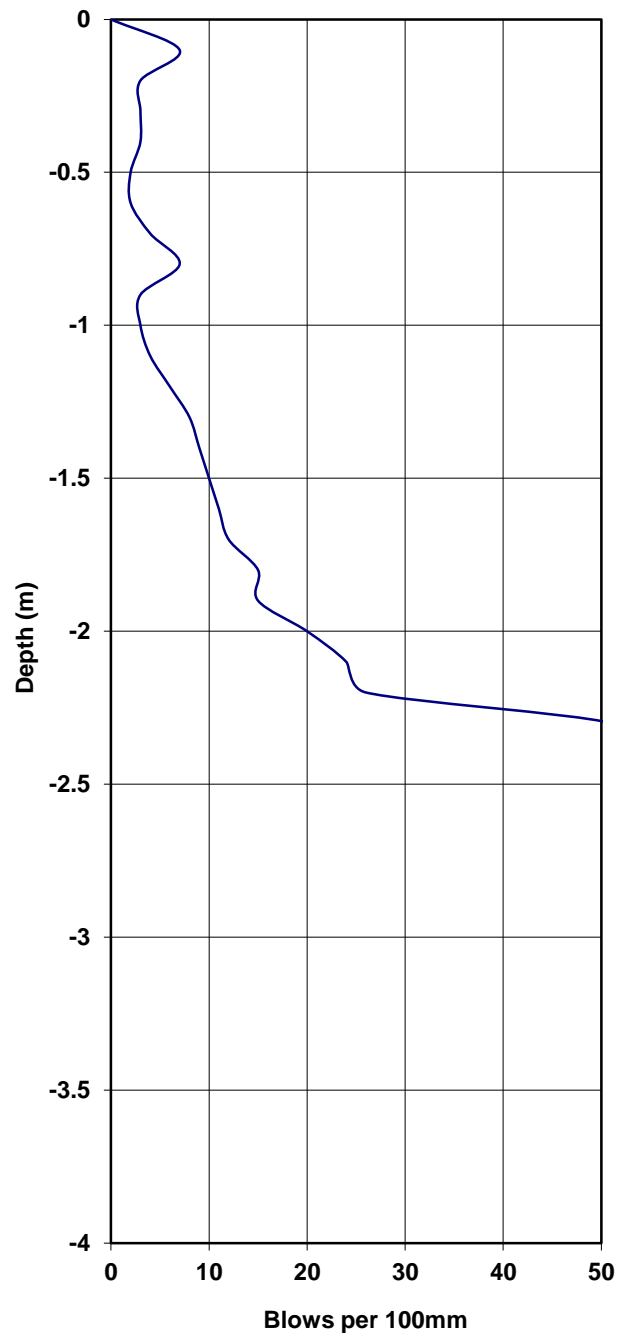
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 3

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	7	Med.Dense	34 deg	12
0.2	3	Loose	<30 deg	5
0.3	3	Loose	<30 deg	5
0.4	3	Loose	<30 deg	5
0.5	2	Loose	<30 deg	3
0.6	2	Soft	20 kPa	3
0.7	4	Soft	35 kPa	7
0.8	7	Firm	60 kPa	12
0.9	3	Soft	25 kPa	5
1	3	Soft	25 kPa	5
1.1	4	Soft	35 kPa	7
1.2	6	Firm	50 kPa	10
1.3	8	Firm	65 kPa	14
1.4	9	Stiff	75 kPa	15
1.5	10	Stiff	85 kPa	17
1.6	11	Stiff	90 kPa	19
1.7	12	Stiff	100 kPa	21
1.8	15	Stiff	125 kPa	27
1.9	15	Stiff	125 kPa	27
2	20	Very Stiff	>150 kPa	37
2.1	24	Very Stiff	>150 kPa	47
2.2	26	Very Stiff	>150 kPa	51
	Refusal			



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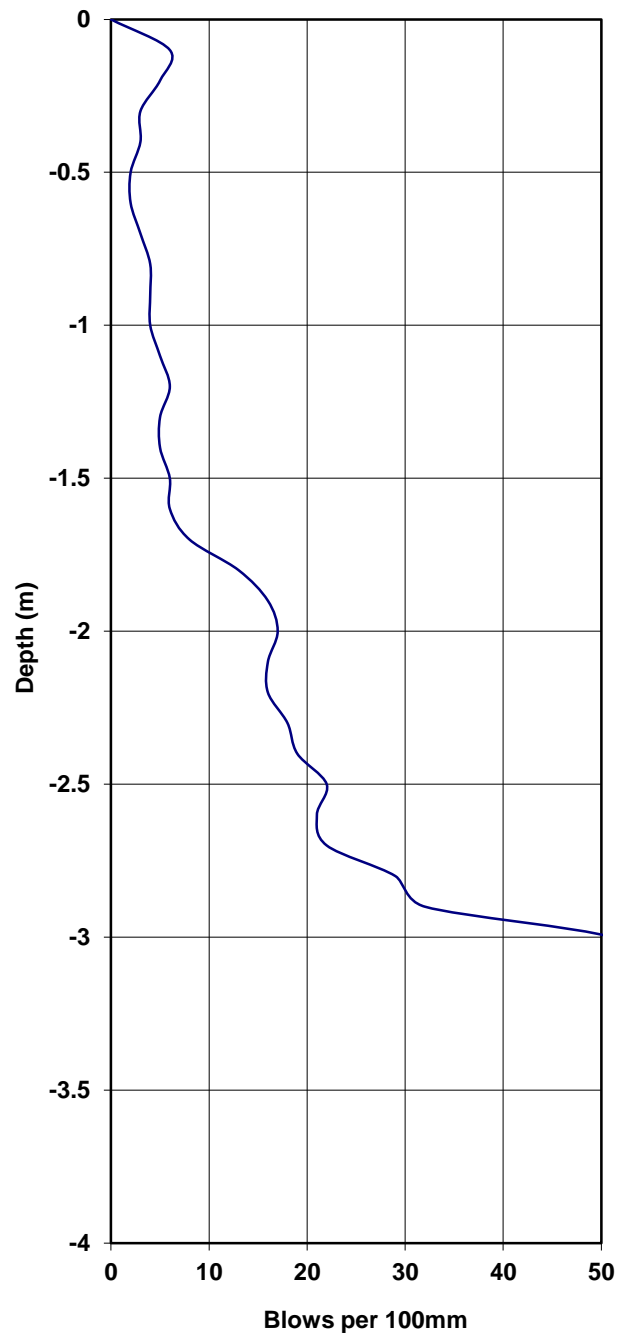
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 4

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	6	Med.Dense	33 deg	10
0.2	5	Med.Dense	32 deg	8
0.3	3	Loose	<30 deg	5
0.4	3	Loose	<30 deg	5
0.5	2	Loose	<30 deg	3
0.6	2	Loose	<30 deg	3
0.7	3	Loose	<30 deg	5
0.8	4	Med.Dense	30 deg	7
0.9	4	Med.Dense	30 deg	7
1	4	Med.Dense	30 deg	7
1.1	5	Med.Dense	32 deg	8
1.2	6	Med.Dense	33 deg	10
1.3	5	Med.Dense	32 deg	8
1.4	5	Med.Dense	32 deg	8
1.5	6	Med.Dense	33 deg	10
1.6	6	Med.Dense	33 deg	10
1.7	8	Med.Dense	35 deg	14
1.8	13	Dense	37 deg	23
1.9	16	Dense	37 deg	29
2	17	Dense	37 deg	31
2.1	16	Dense	37 deg	29
2.2	16	Dense	37 deg	29
2.3	18	Dense	37 deg	33
2.4	19	Dense	37 deg	35
2.5	22	Dense	38 deg	42
2.6	21	Dense	38 deg	40
2.7	22	Dense	38 deg	42
2.8	29	Very Dense	>38 deg	>55
2.9	32	Very Dense	>38 deg	>55
	Refusal			



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Date: 17.05.2020

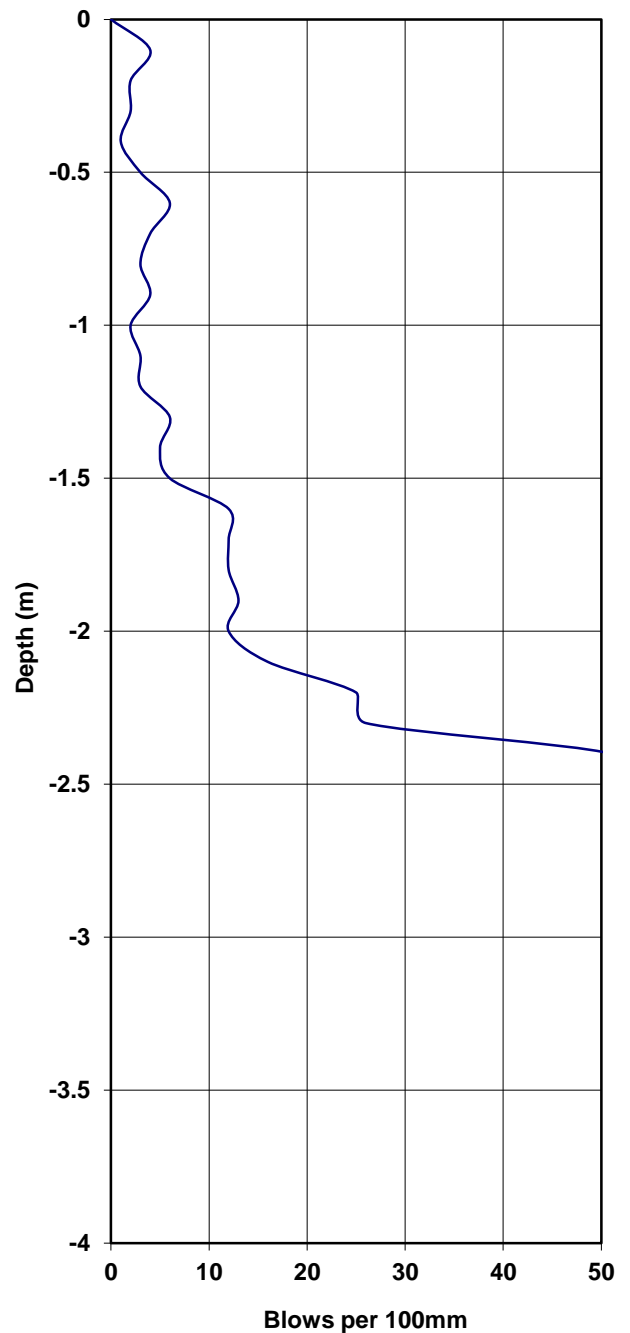
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 5

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	4	Soft	35 kPa	7
0.2	2	Soft	20 kPa	3
0.3	2	Soft	20 kPa	3
0.4	1	Very Soft	<20 kPa	2
0.5	3	Soft	25 kPa	5
0.6	6	Firm	50 kPa	10
0.7	4	Soft	35 kPa	7
0.8	3	Soft	25 kPa	5
0.9	4	Soft	35 kPa	7
1	2	Soft	20 kPa	3
1.1	3	Soft	25 kPa	5
1.2	3	Soft	25 kPa	5
1.3	6	Firm	50 kPa	10
1.4	5	Firm	40 kPa	8
1.5	6	Firm	50 kPa	10
1.6	12	Stiff	100 kPa	21
1.7	12	Stiff	100 kPa	21
1.8	12	Stiff	100 kPa	21
1.9	13	Stiff	110 kPa	23
2	12	Stiff	100 kPa	21
2.1	16	Stiff	130 kPa	29
2.2	25	Very Stiff	>150 kPa	49
2.3	26	Very Stiff	>150 kPa	51
	Refusal			



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Date: 17.05.2020

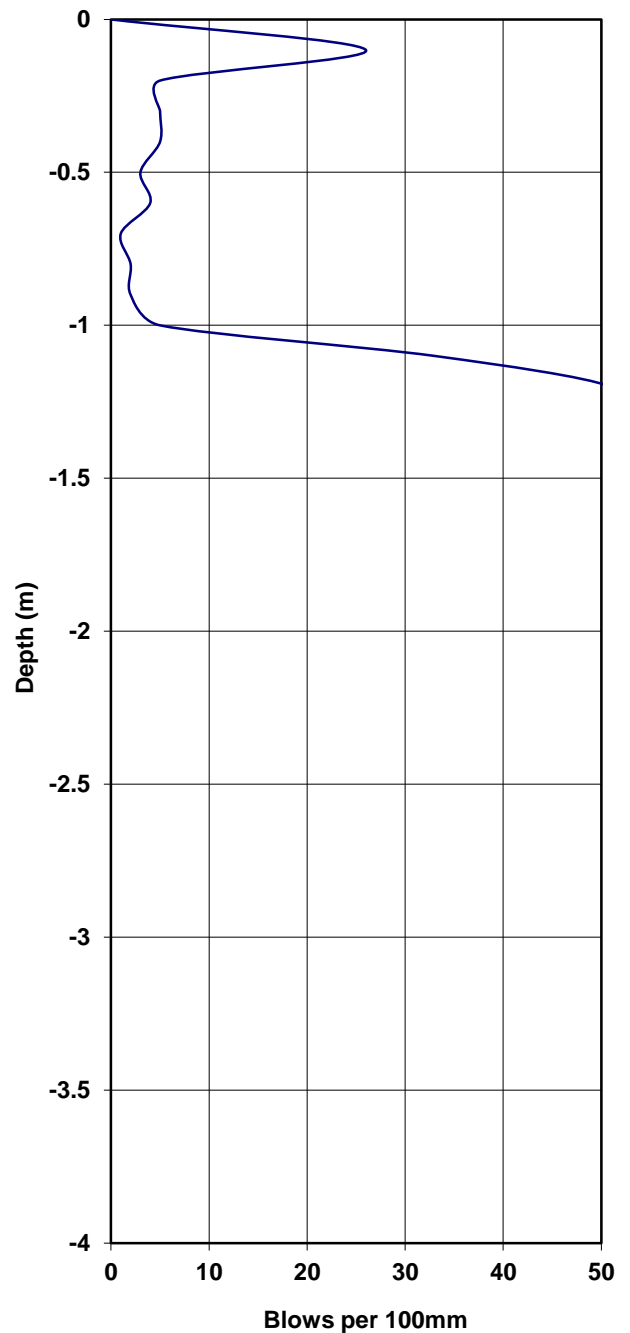
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 6

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	26	Very Dense	>38 deg	51
0.2	5	Med.Dense	32 deg	8
0.3	5	Med.Dense	32 deg	8
0.4	5	Med.Dense	32 deg	8
0.5	3	Soft	25 kPa	5
0.6	4	Soft	35 kPa	7
0.7	1	Very Soft	<20 kPa	2
0.8	2	Soft	20 kPa	3
0.9	2	Loose	<30 deg	3
1	5	Med.Dense	32 deg	8
1.1	33	Very Dense	>38 deg	>55
	Refusal			



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Date: 17.05.2020

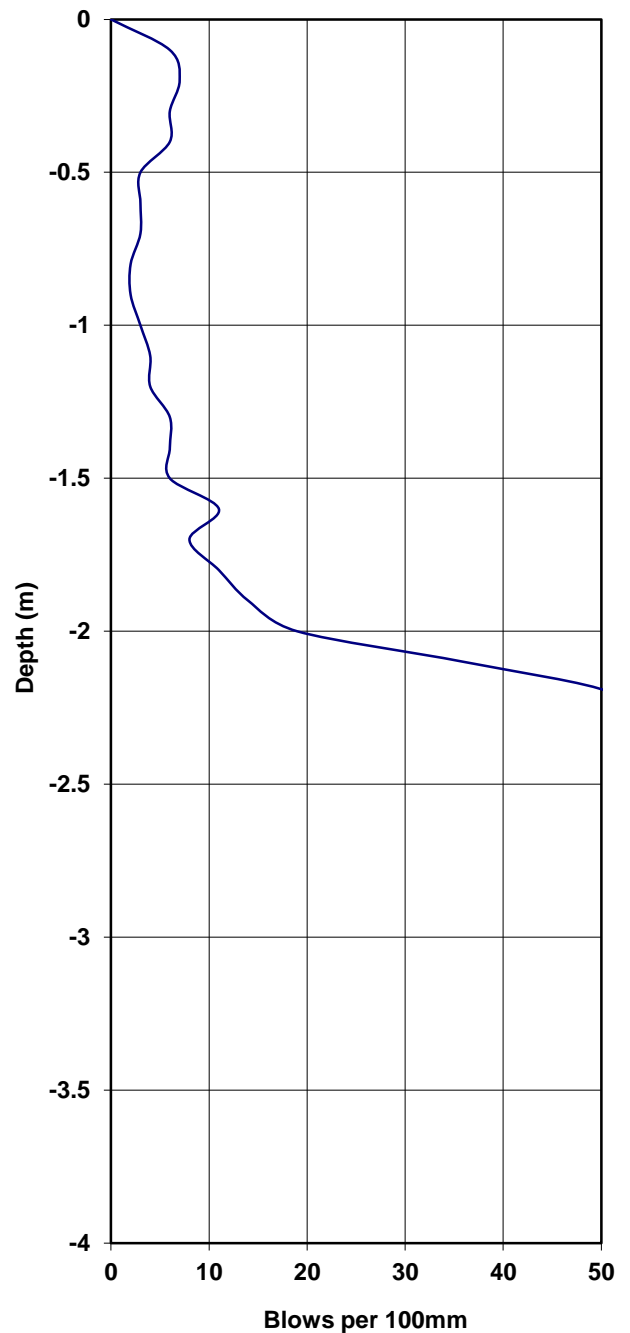
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 7

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	6	Med.Dense	33 deg	10
0.2	7	Med.Dense	34 deg	12
0.3	6	Med.Dense	33 deg	10
0.4	6	Firm	50 kPa	10
0.5	3	Soft	25 kPa	5
0.6	3	Soft	25 kPa	5
0.7	3	Soft	25 kPa	5
0.8	2	Soft	20 kPa	3
0.9	2	Soft	20 kPa	3
1	3	Soft	25 kPa	5
1.1	4	Soft	35 kPa	7
1.2	4	Soft	35 kPa	7
1.3	6	Firm	50 kPa	10
1.4	6	Firm	50 kPa	10
1.5	6	Firm	50 kPa	10
1.6	11	Stiff	90 kPa	19
1.7	8	Med.Dense	35 deg	14
1.8	11	Dense	36 deg	19
1.9	14	Dense	37 deg	25
2	19	Dense	37 deg	35
2.1	36	Very Dense	>38 deg	>55
	Refusal			



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Date: 17.05.2020

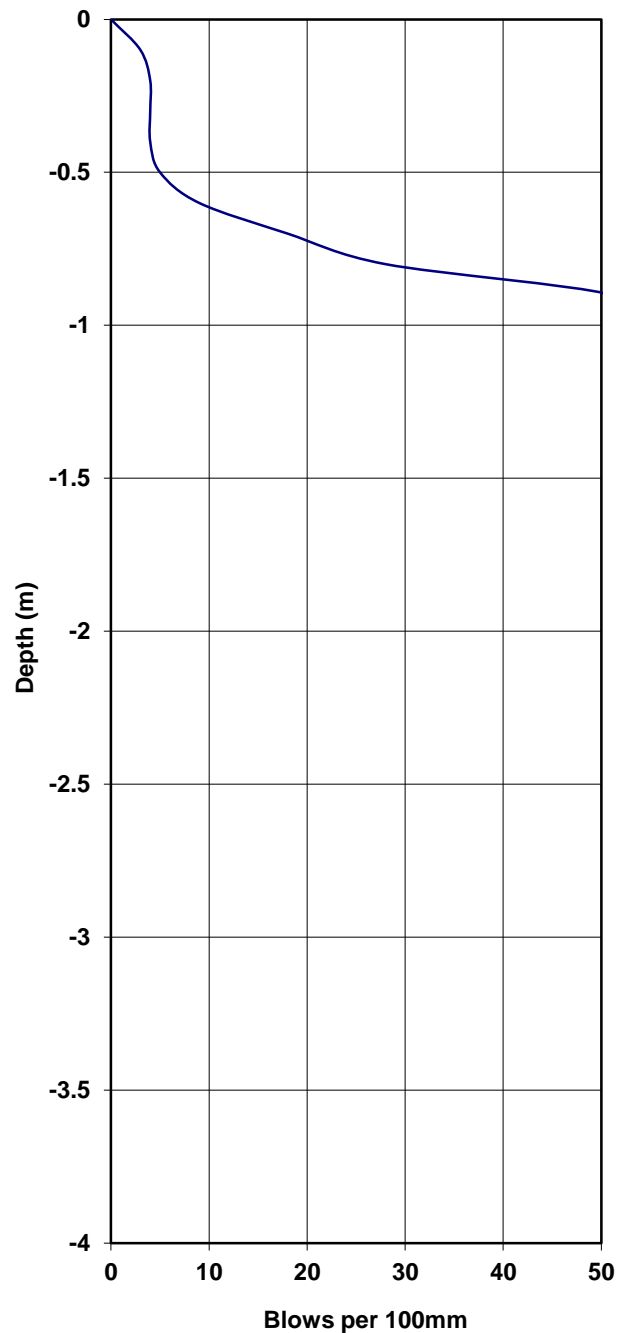
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 8

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	3	Soft	25 kPa	5
0.2	4	Soft	35 kPa	7
0.3	4	Soft	35 kPa	7
0.4	4	Soft	35 kPa	7
0.5	5	Firm	40 kPa	8
0.6	9	Stiff	75 kPa	15
0.7	18	Stiff	150 kPa	33
0.8	28	Very Dense	>38 deg	>55
	Refusal			



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Ref.No. 085-20

Project: Proposed Water Supply Scheme at Thokozani

Date: 17.05.2020

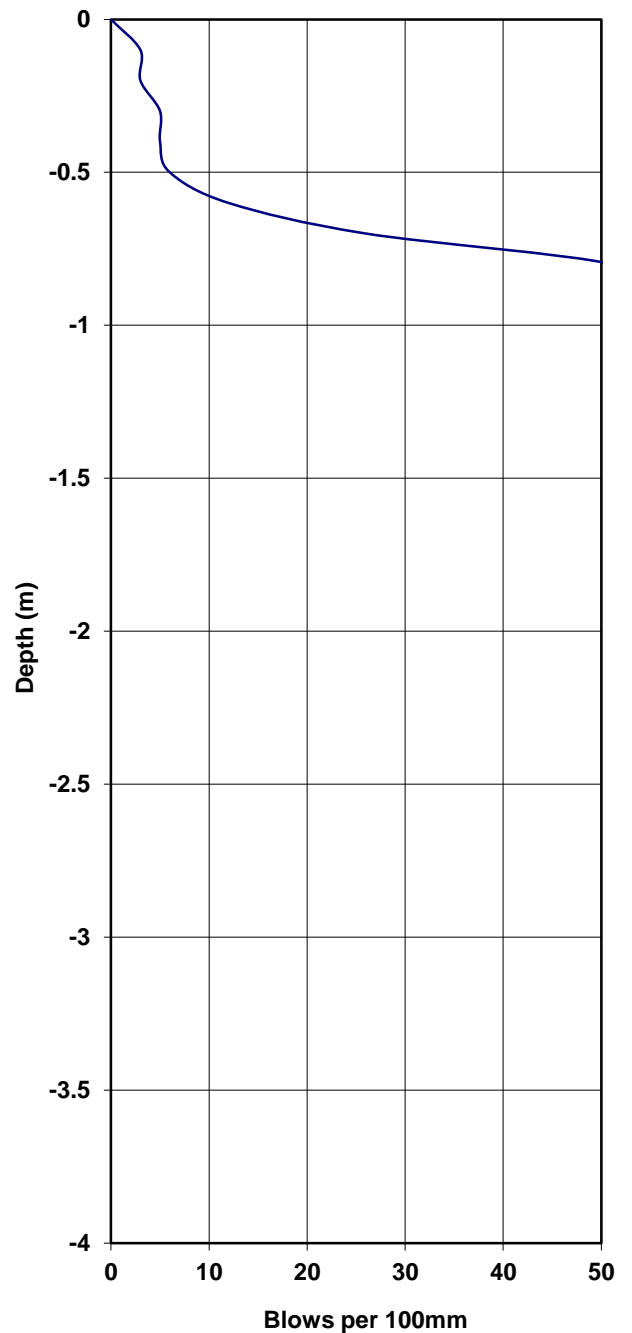
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 9

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	3	Soft	25 kPa	5
0.2	3	Soft	25 kPa	5
0.3	5	Firm	40 kPa	8
0.4	5	Firm	40 kPa	8
0.5	6	Firm	50 kPa	10
0.6	12	Stiff	100 kPa	21
0.7	26	Very Dense	>38 deg	51
	Refusal			



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Client: Escongweni BPH Engineers (Pty) Ltd

Ref.No. 085-20

Project: Proposed Water Supply Scheme at Thokozani

Date: 17.05.2020

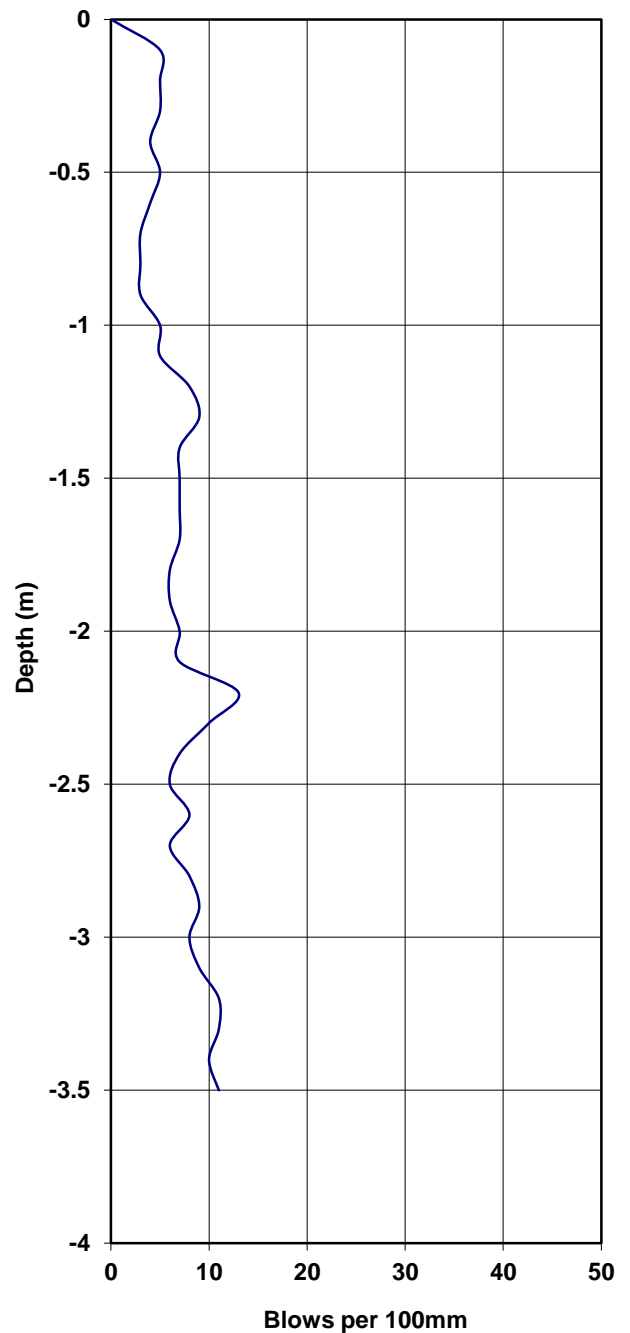
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 10

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	5	Firm	40 kPa	8
0.2	5	Firm	40 kPa	8
0.3	5	Firm	40 kPa	8
0.4	4	Soft	35 kPa	7
0.5	5	Firm	40 kPa	8
0.6	4	Soft	35 kPa	7
0.7	3	Soft	25 kPa	5
0.8	3	Soft	25 kPa	5
0.9	3	Soft	25 kPa	5
1	5	Firm	40 kPa	8
1.1	5	Firm	40 kPa	8
1.2	8	Firm	65 kPa	14
1.3	9	Stiff	75 kPa	15
1.4	7	Firm	60 kPa	12
1.5	7	Firm	60 kPa	12
1.6	7	Firm	60 kPa	12
1.7	7	Firm	60 kPa	12
1.8	6	Firm	50 kPa	10
1.9	6	Firm	50 kPa	10
2	7	Firm	60 kPa	12
2.1	7	Firm	60 kPa	12
2.2	13	Stiff	110 kPa	23
2.3	10	Stiff	85 kPa	17
2.4	7	Firm	60 kPa	12
2.5	6	Firm	50 kPa	10
2.6	8	Firm	65 kPa	14
2.7	6	Firm	50 kPa	10
2.8	8	Firm	65 kPa	14
2.9	9	Stiff	75 kPa	15
3	8	Firm	65 kPa	14
3.1	9	Stiff	75 kPa	15
3.2	11	Stiff	90 kPa	19
3.3	11	Stiff	90 kPa	19
3.4	10	Stiff	85 kPa	17
3.5	11	Stiff	90 kPa	19
	End			



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Ref.No. 085-20

Project: Proposed Water Supply Scheme at Thokozani

Date: 17.05.2020

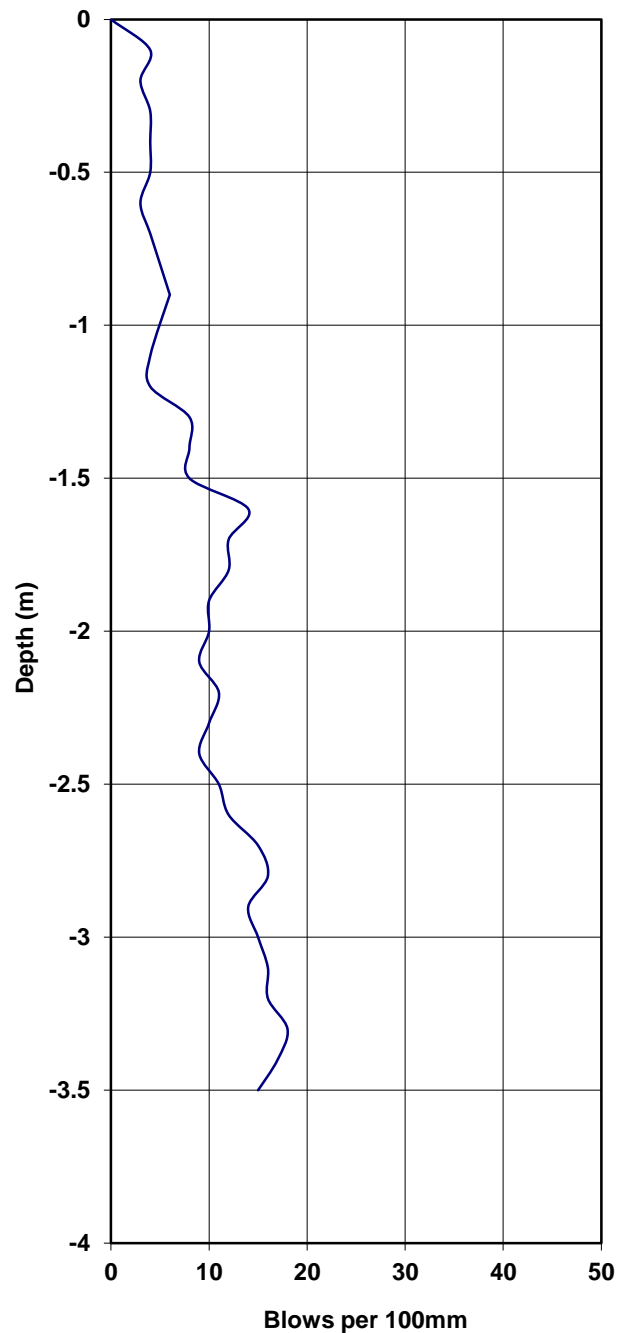
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 11

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	4	Soft	35 kPa	7
0.2	3	Soft	25 kPa	5
0.3	4	Soft	35 kPa	7
0.4	4	Soft	35 kPa	7
0.5	4	Soft	35 kPa	7
0.6	3	Soft	25 kPa	5
0.7	4	Soft	35 kPa	7
0.8	5	Firm	40 kPa	8
0.9	6	Firm	50 kPa	10
1				
1.1	4	Soft	35 kPa	7
1.2	4	Soft	35 kPa	7
1.3	8	Firm	65 kPa	14
1.4	8	Firm	65 kPa	14
1.5	8	Firm	65 kPa	14
1.6	14	Stiff	115 kPa	25
1.7	12	Stiff	100 kPa	21
1.8	12	Stiff	100 kPa	21
1.9	10	Stiff	85 kPa	17
2	10	Stiff	85 kPa	17
2.1	9	Stiff	75 kPa	15
2.2	11	Stiff	90 kPa	19
2.3	10	Stiff	85 kPa	17
2.4	9	Stiff	75 kPa	15
2.5	11	Stiff	90 kPa	19
2.6	12	Stiff	100 kPa	21
2.7	15	Stiff	125 kPa	27
2.8	16	Stiff	130 kPa	29
2.9	14	Stiff	115 kPa	25
3	15	Stiff	125 kPa	27
3.1	16	Stiff	130 kPa	29
3.2	16	Stiff	130 kPa	29
3.3	18	Stiff	150 kPa	33
3.4	17	Stiff	140 kPa	31
3.5	15	Stiff	125 kPa	27
	End			



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Date: 17.05.2020

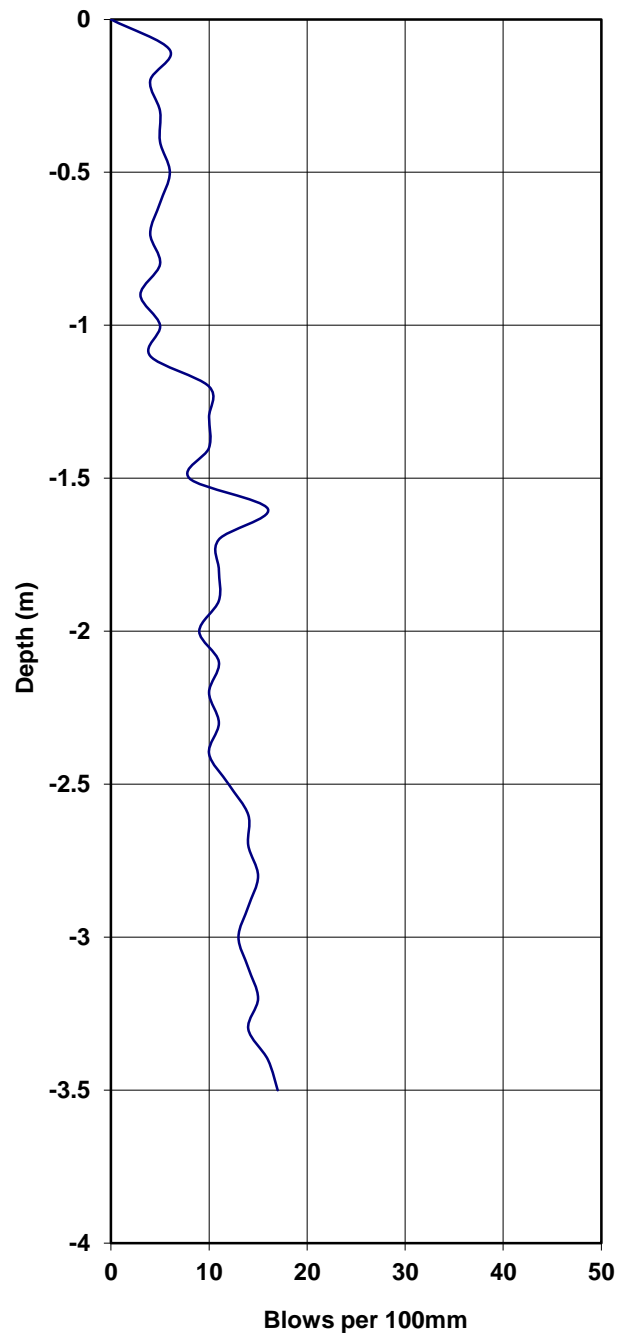
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 12

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	6	Firm	50 kPa	10
0.2	4	Soft	35 kPa	7
0.3	5	Firm	40 kPa	8
0.4	5	Firm	40 kPa	8
0.5	6	Firm	50 kPa	10
0.6	5	Firm	40 kPa	8
0.7	4	Soft	35 kPa	7
0.8	5	Firm	40 kPa	8
0.9	3	Soft	25 kPa	5
1	5	Firm	40 kPa	8
1.1	4	Soft	35 kPa	7
1.2	10	Stiff	85 kPa	17
1.3	10	Stiff	85 kPa	17
1.4	10	Stiff	85 kPa	17
1.5	8	Firm	65 kPa	14
1.6	16	Stiff	130 kPa	29
1.7	11	Stiff	90 kPa	19
1.8	11	Stiff	90 kPa	19
1.9	11	Stiff	90 kPa	19
2	9	Stiff	75 kPa	15
2.1	11	Stiff	90 kPa	19
2.2	10	Stiff	85 kPa	17
2.3	11	Stiff	90 kPa	19
2.4	10	Stiff	85 kPa	17
2.5	12	Stiff	100 kPa	21
2.6	14	Stiff	115 kPa	25
2.7	14	Stiff	115 kPa	25
2.8	15	Stiff	125 kPa	27
2.9	14	Stiff	115 kPa	25
3	13	Stiff	110 kPa	23
3.1	14	Stiff	115 kPa	25
3.2	15	Stiff	125 kPa	27
3.3	14	Stiff	115 kPa	25
3.4	16	Stiff	130 kPa	29
3.5	17	Stiff	140 kPa	31
	End			



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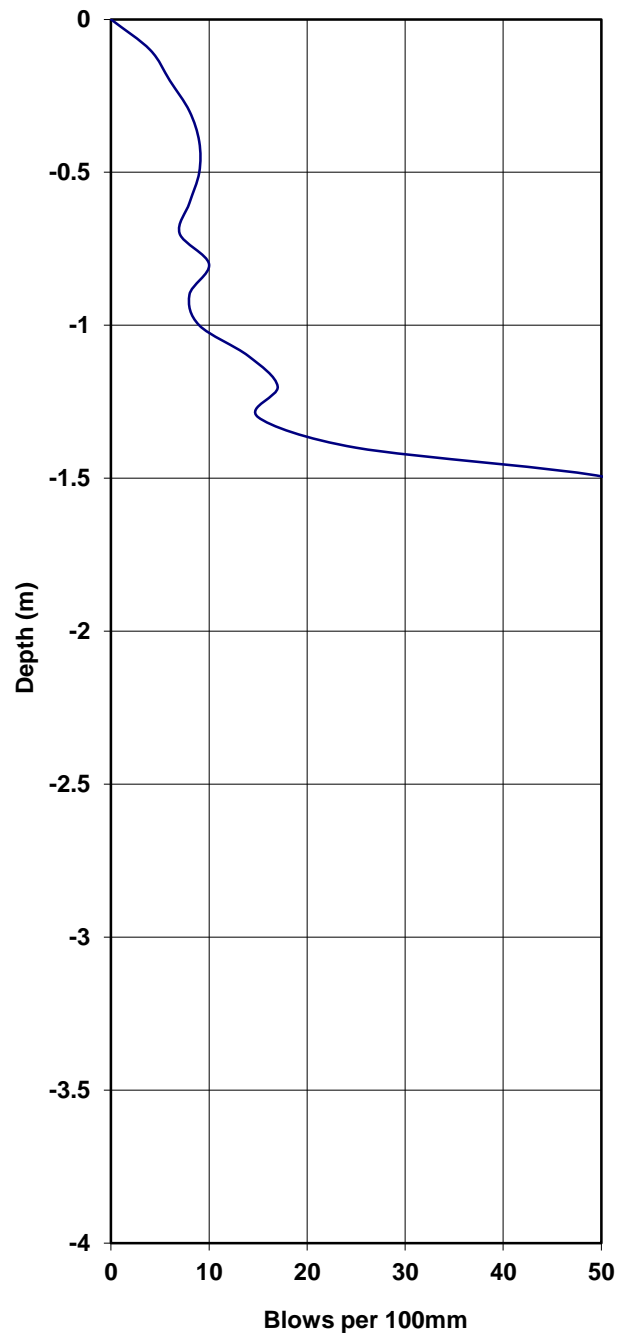
Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 13

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	4	Soft	35 kPa	7
0.2	6	Firm	50 kPa	10
0.3	8	Firm	65 kPa	14
0.4	9	Stiff	75 kPa	15
0.5	9	Stiff	75 kPa	15
0.6	8	Firm	65 kPa	14
0.7	7	Firm	60 kPa	12
0.8	10	Stiff	85 kPa	17
0.9	8	Firm	65 kPa	14
1	9	Stiff	75 kPa	15
1.1	14	Stiff	115 kPa	25
1.2	17	Stiff	140 kPa	31
1.3	15	Stiff	125 kPa	27
1.4	25	Very Stiff	>150 kPa	49

Refusal



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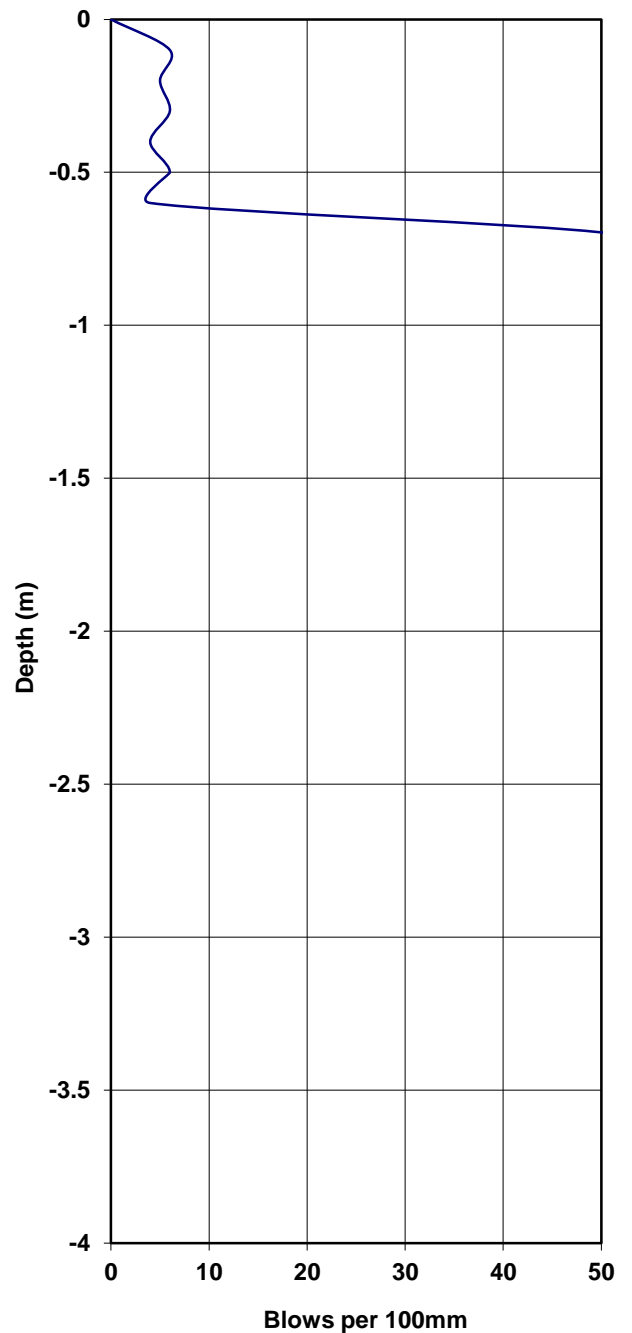
Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 14

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	6	Firm	50 kPa	10
0.2	5	Firm	40 kPa	8
0.3	6	Firm	50 kPa	10
0.4	4	Soft	35 kPa	7
0.5	6	Firm	50 kPa	10
0.6	4	Soft	35 kPa	7

Refusal



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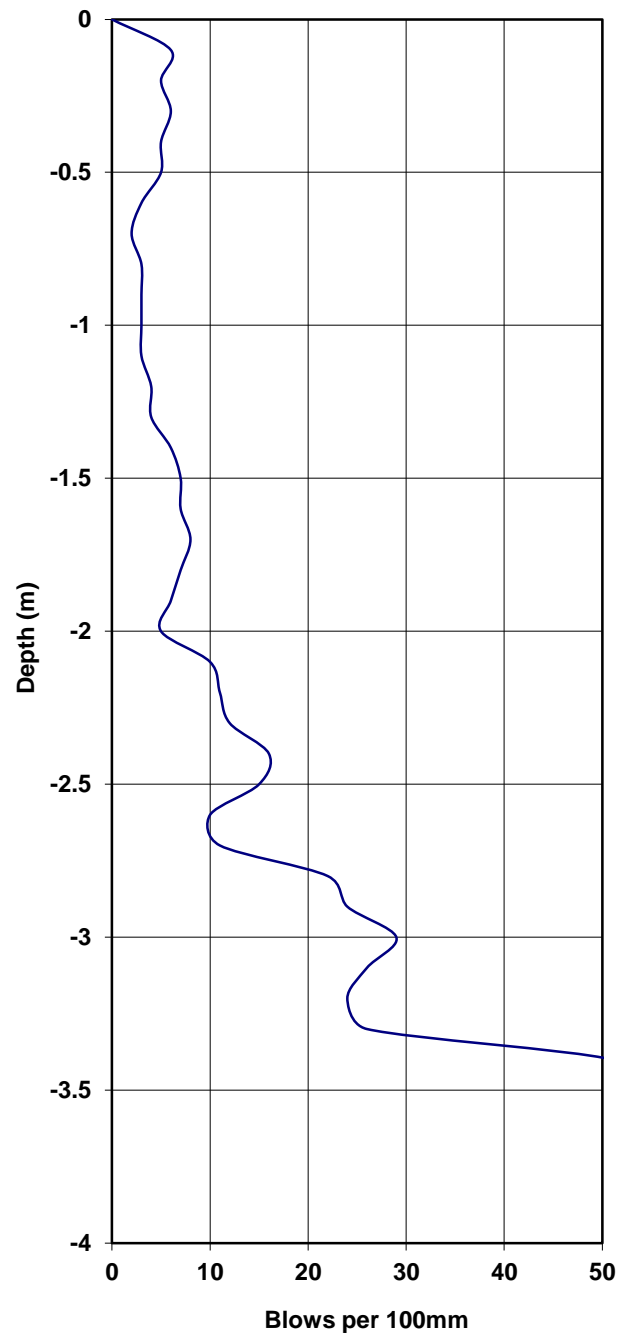
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 15

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	6	Med.Dense	33 deg	10
0.2	5	Med.Dense	32 deg	8
0.3	6	Med.Dense	33 deg	10
0.4	5	Med.Dense	32 deg	8
0.5	5	Med.Dense	32 deg	8
0.6	3	Soft	25 kPa	5
0.7	2	Soft	20 kPa	3
0.8	3	Soft	25 kPa	5
0.9	3	Soft	25 kPa	5
1	3	Soft	25 kPa	5
1.1	3	Soft	25 kPa	5
1.2	4	Soft	35 kPa	7
1.3	4	Soft	35 kPa	7
1.4	6	Firm	50 kPa	10
1.5	7	Firm	60 kPa	12
1.6	7	Firm	60 kPa	12
1.7	8	Firm	65 kPa	14
1.8	7	Firm	60 kPa	12
1.9	6	Firm	50 kPa	10
2	5	Firm	40 kPa	8
2.1	10	Stiff	85 kPa	17
2.2	11	Stiff	90 kPa	19
2.3	12	Stiff	100 kPa	21
2.4	16	Stiff	130 kPa	29
2.5	15	Stiff	125 kPa	27
2.6	10	Stiff	85 kPa	17
2.7	11	Stiff	90 kPa	19
2.8	22	Very Stiff	>150 kPa	42
2.9	24	Very Stiff	>150 kPa	47
3	29	Very Stiff	>150 kPa	>55
3.1	26	Very Stiff	>150 kPa	51
3.2	24	Very Stiff	>150 kPa	47
3.3	26	Very Stiff	>150 kPa	51
	Refusal			



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Date: 17.05.2020

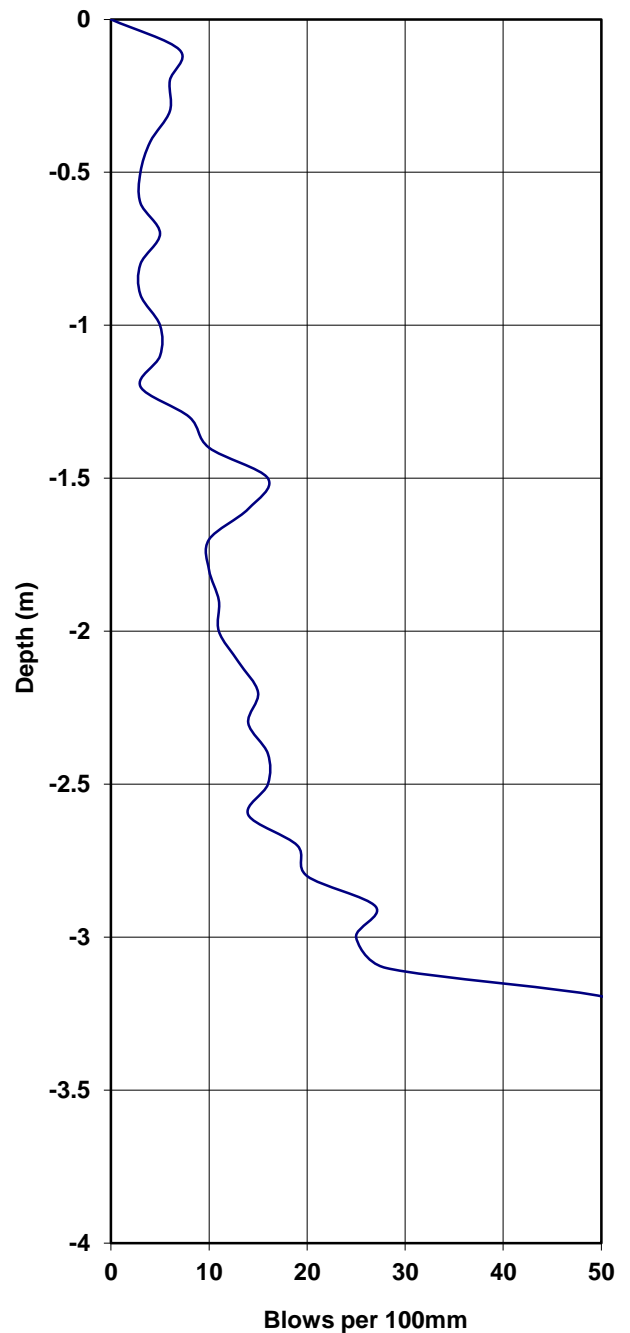
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 16

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	7	Med.Dense	34 deg	12
0.2	6	Med.Dense	33 deg	10
0.3	6	Med.Dense	33 deg	10
0.4	4	Med.Dense	30 deg	7
0.5	3	Loose	<30 deg	5
0.6	3	Loose	<30 deg	5
0.7	5	Firm	40 kPa	8
0.8	3	Soft	25 kPa	5
0.9	3	Soft	25 kPa	5
1	5	Firm	40 kPa	8
1.1	5	Firm	40 kPa	8
1.2	3	Soft	25 kPa	5
1.3	8	Firm	65 kPa	14
1.4	10	Stiff	85 kPa	17
1.5	16	Stiff	130 kPa	29
1.6	14	Stiff	115 kPa	25
1.7	10	Stiff	85 kPa	17
1.8	10	Stiff	85 kPa	17
1.9	11	Stiff	90 kPa	19
2	11	Stiff	90 kPa	19
2.1	13	Stiff	110 kPa	23
2.2	15	Stiff	125 kPa	27
2.3	14	Stiff	115 kPa	25
2.4	16	Stiff	130 kPa	29
2.5	16	Stiff	130 kPa	29
2.6	14	Stiff	115 kPa	25
2.7	19	Very Stiff	>150 kPa	35
2.8	20	Very Stiff	>150 kPa	37
2.9	27	Very Stiff	>150 kPa	54
3	25	Very Stiff	>150 kPa	49
3.1	28	Very Stiff	>150 kPa	>55
	Refusal			



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Date: 17.05.2020

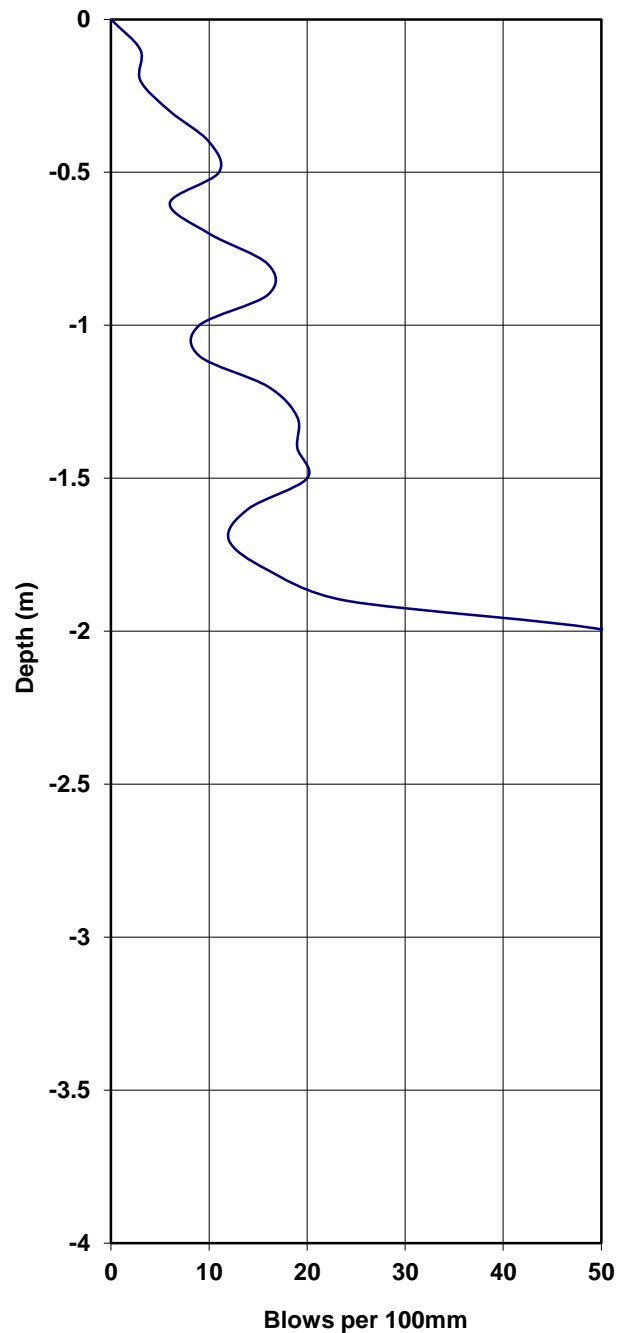
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 17

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	3	Loose	<30 deg	5
0.2	3	Loose	<30 deg	5
0.3	6	Med.Dense	33 deg	10
0.4	10	Stiff	85 kPa	17
0.5	11	Stiff	90 kPa	19
0.6	6	Firm	50 kPa	10
0.7	10	Stiff	85 kPa	17
0.8	16	Stiff	130 kPa	29
0.9	16	Stiff	130 kPa	29
1	9	Stiff	75 kPa	15
1.1	9	Stiff	75 kPa	15
1.2	16	Dense	37 deg	29
1.3	19	Dense	37 deg	35
1.4	19	Dense	37 deg	35
1.5	20	Dense	38 deg	37
1.6	14	Dense	37 deg	25
1.7	12	Dense	36 deg	21
1.8	16	Dense	37 deg	29
1.9	24	Dense	38 deg	47
	Refusal			



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Section: Umgungundlovu District Municipality

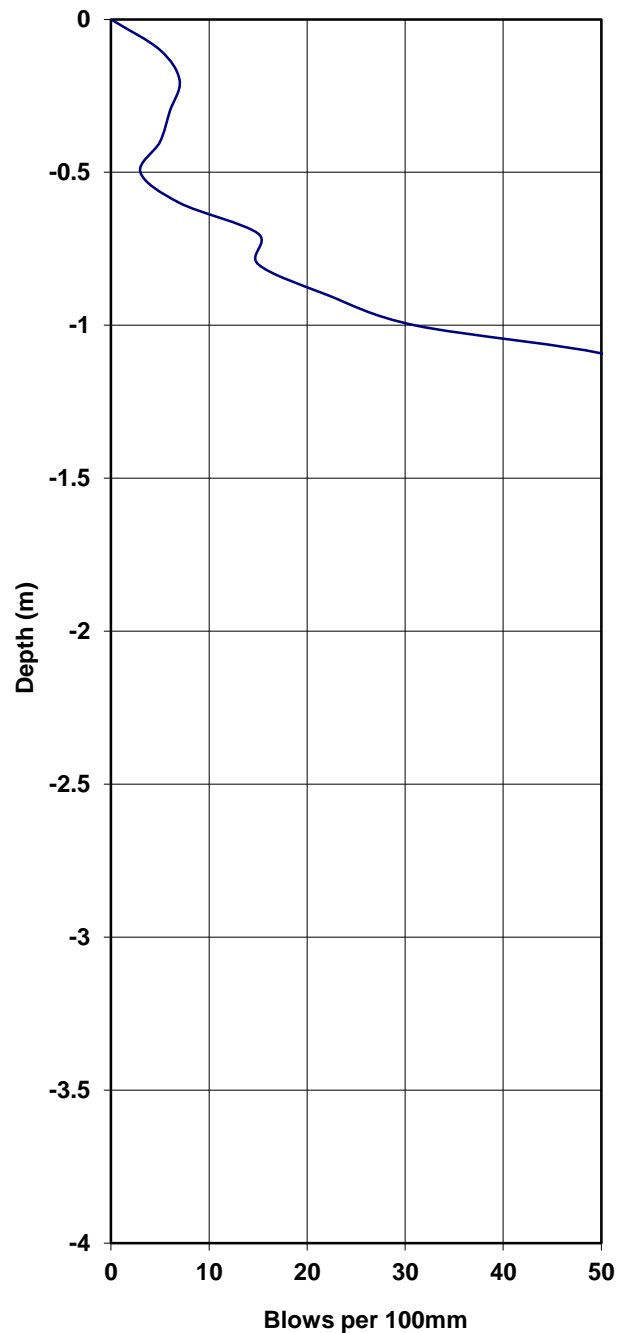
Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 18

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	5	Firm	40 kPa	8
0.2	7	Firm	60 kPa	12
0.3	6	Firm	50 kPa	10
0.4	5	Firm	40 kPa	8
0.5	3	Soft	25 kPa	5
0.6	7	Firm	60 kPa	12
0.7	15	Stiff	125 kPa	27
0.8	15	Stiff	125 kPa	27
0.9	22	Very Stiff	>150 kPa	42
1	31	Very Dense	>38 deg	>55

Refusal



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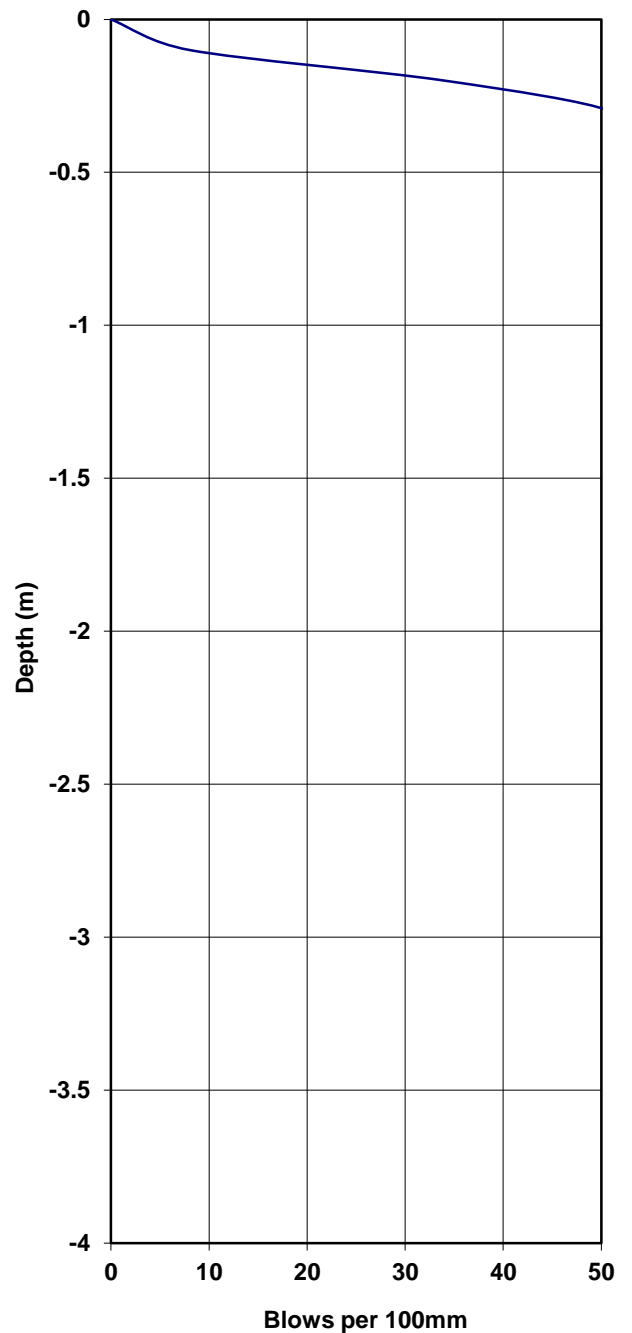
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 19

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	8	Firm	65 kPa	14
0.2	34	Very Stiff	>150 kPa	>55
	Refusal			



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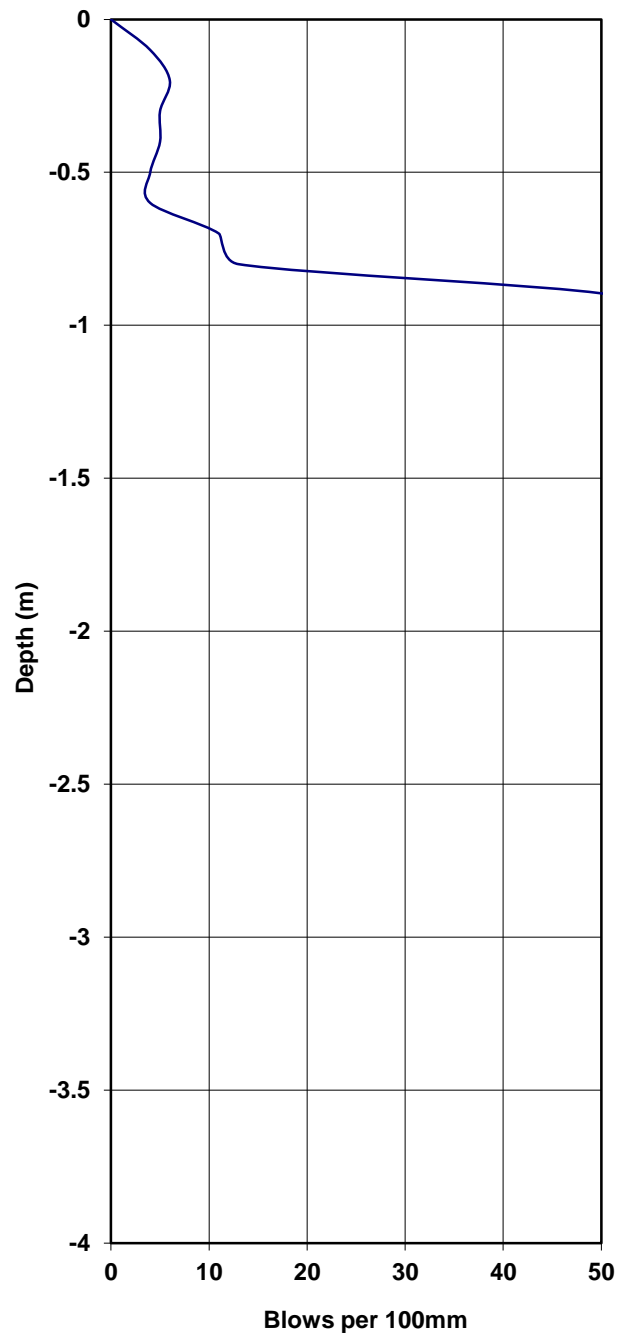
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 20

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	4	Soft	35 kPa	7
0.2	6	Firm	50 kPa	10
0.3	5	Firm	40 kPa	8
0.4	5	Firm	40 kPa	8
0.5	4	Soft	35 kPa	7
0.6	4	Soft	35 kPa	7
0.7	11	Stiff	90 kPa	19
0.8	13	Stiff	110 kPa	23
	Refusal			



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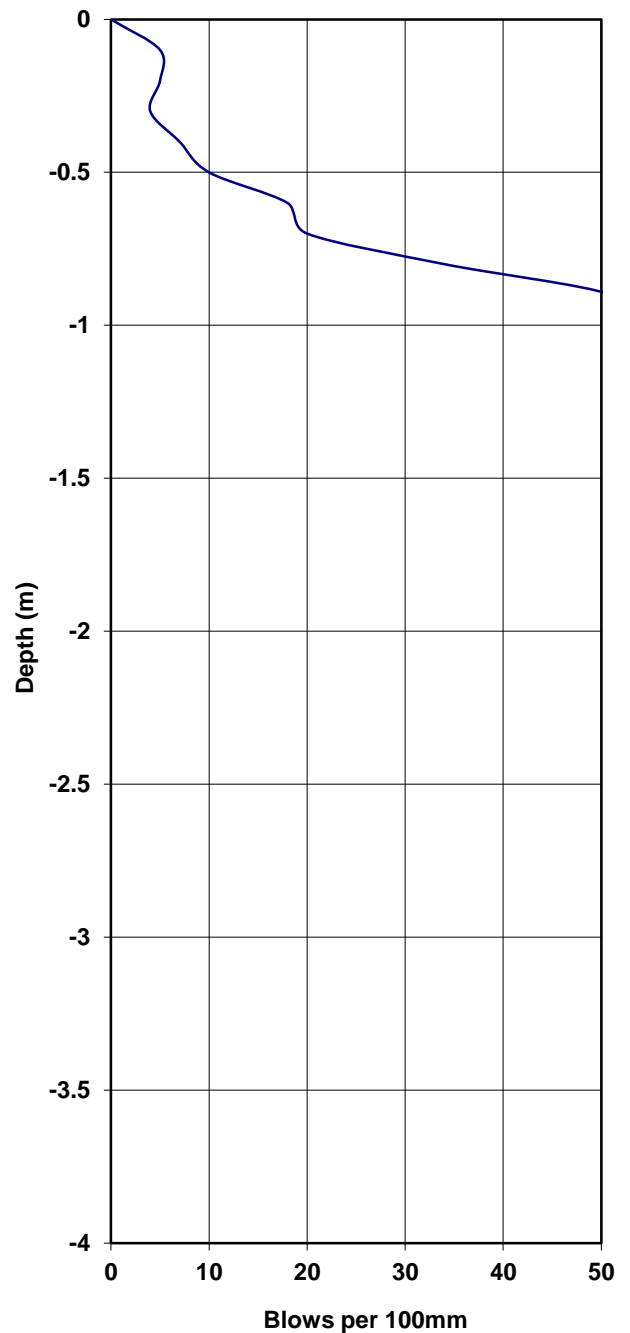
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 21

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	5	Med.Dense	32 deg	8
0.2	5	Med.Dense	32 deg	8
0.3	4	Med.Dense	30 deg	7
0.4	7	Med.Dense	34 deg	12
0.5	10	Stiff	85 kPa	17
0.6	18	Stiff	150 kPa	33
0.7	20	Very Stiff	>150 kPa	37
0.8	34	Very Stiff	>150 kPa	>55
	Refusal			



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Project: Proposed Water Supply Scheme at Thokozani

Date: 17.05.2020

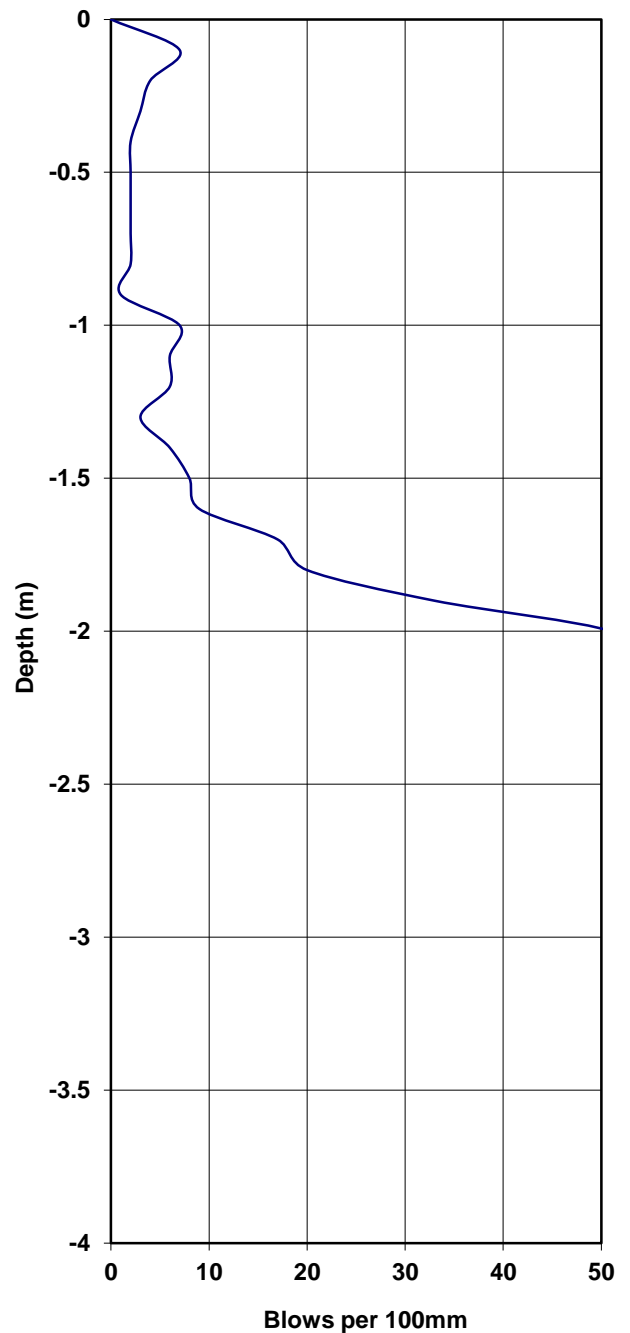
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 22

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	7	Med.Dense	34 deg	12
0.2	4	Med.Dense	30 deg	7
0.3	3	Loose	<30 deg	5
0.4	2	Loose	<30 deg	3
0.5	2	Loose	<30 deg	3
0.6	2	Loose	<30 deg	3
0.7	2	Loose	<30 deg	3
0.8	2	Loose	<30 deg	3
0.9	1	Very Loose	<29 deg	2
1	7	Med.Dense	34 deg	12
1.1	6	Med.Dense	33 deg	10
1.2	6	Med.Dense	33 deg	10
1.3	3	Loose	<30 deg	5
1.4	6	Med.Dense	33 deg	10
1.5	8	Med.Dense	35 deg	14
1.6	9	Med.Dense	35 deg	15
1.7	17	Dense	37 deg	31
1.8	20	Dense	38 deg	37
1.9	33	Very Dense	>38 deg	>55
	Refusal			



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Geotechnical Engineering Consultants

Tel: (031) 266 0458

Fax: 086 689 5506

Email: info@geosure.co.za



Client: Escongweni BPH Engineers (Pty) Ltd

Ref.No. 085-20

Project: Proposed Water Supply Scheme at Thokozani

Date: 17.05.2020

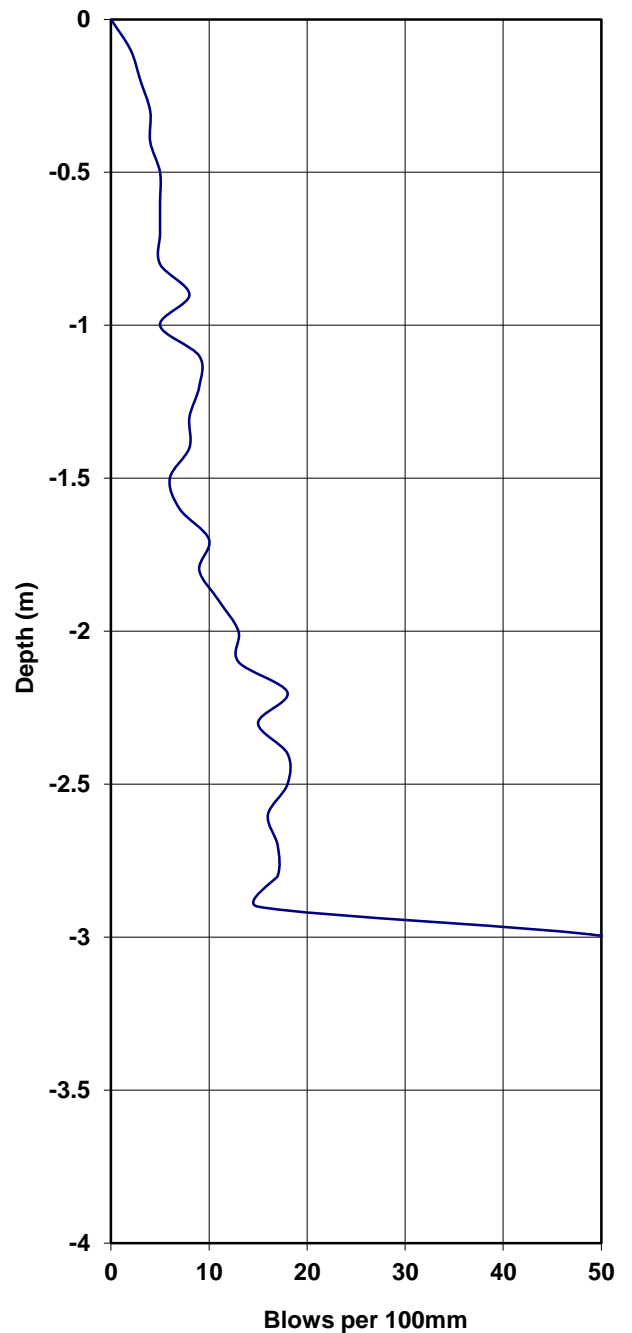
Section: Umgungundlovu District Municipality

Operator: E.Dada-Mia

CBR Penetrometer Probe ----- Test No. DC 23

THE STRENGTH AND CBR VALUES ARE EMPIRICAL AND DEPEND ON FACTORS SUCH AS MOISTURE CONTENT WHICH HAVE NOT BEEN DETERMINED. THEY ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Depth (m)	Blows/100mm	Inferred Consistency	Shear Strength	CBR %
0				
0.1	2	Loose	<30 deg	3
0.2	3	Loose	<30 deg	5
0.3	4	Med.Dense	30 deg	7
0.4	4	Med.Dense	30 deg	7
0.5	5	Firm	40 kPa	8
0.6	5	Firm	40 kPa	8
0.7	5	Firm	40 kPa	8
0.8	5	Firm	40 kPa	8
0.9	8	Firm	65 kPa	14
1	5	Firm	40 kPa	8
1.1	9	Stiff	75 kPa	15
1.2	9	Stiff	75 kPa	15
1.3	8	Firm	65 kPa	14
1.4	8	Firm	65 kPa	14
1.5	6	Firm	50 kPa	10
1.6	7	Firm	60 kPa	12
1.7	10	Stiff	85 kPa	17
1.8	9	Stiff	75 kPa	15
1.9	11	Dense	36 deg	19
2	13	Dense	37 deg	23
2.1	13	Dense	37 deg	23
2.2	18	Dense	37 deg	33
2.3	15	Dense	37 deg	27
2.4	18	Dense	37 deg	33
2.5	18	Dense	37 deg	33
2.6	16	Dense	37 deg	29
2.7	17	Dense	37 deg	31
2.8	17	Dense	37 deg	31
2.9	15	Dense	37 deg	27
	Refusal			





APPENDIX C



**DYNAMIC CONE PENETROMETER –
LIGHT (DPL) TEST RESULTS (1ML
RESERVOIR)**



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Email: info@geosure.co.za



Client: Escongweni BPH Engineers (Pty) Ltd	Ref.No. 085-20
Project: Proposed Water Supply Scheme at Thokozani	Date: 17.05.2020
Section: Umgungundlovu District Municipality	Operator: E.Dada-Mia
<i>Light Dynamic Penetrometer Probe ----- Test No. DPL 1</i>	

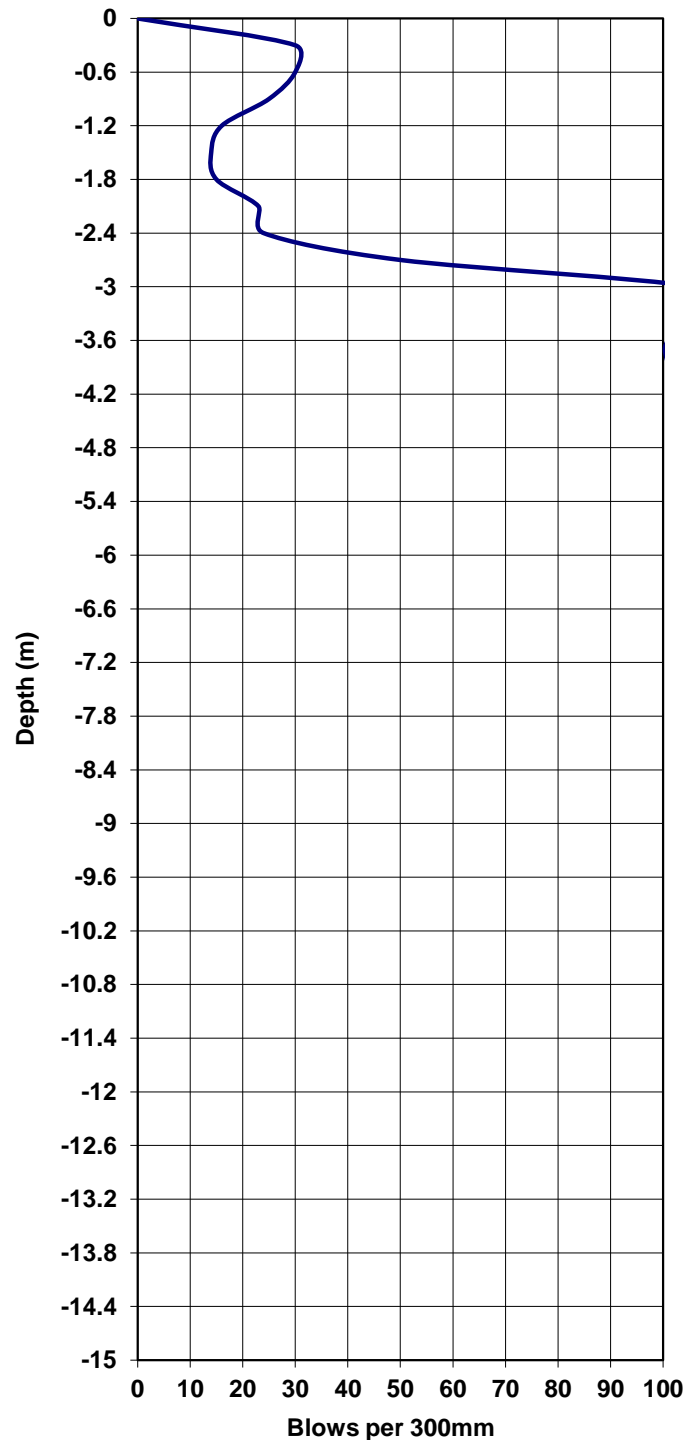
THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm

Cone: 25mm diameter with 60 degree apex angel

Rods: 16mm diameter, 22mm diameter couplings

Depth metres	Blows per 300mm	Inferred Consistency	Insitu Shear Strength
0			
0.3	30	Stiff	130 kPa
0.6	30	Stiff	130 kPa
0.9	25	Stiff	110 kPa
1.2	16	Firm	75 kPa
1.5	14	Firm	65 kPa
1.8	15	Firm	70 kPa
2.1	23	Stiff	105 kPa
2.4	24	Stiff	105 kPa
2.7	50	Very Stiff	215 kPa
3	106	Hard	>300 kPa
3.3	110	Hard	>300 kPa
	Refusal		



GEOSURE (PTY) LTD.

Geotechnical Engineering Consultants

Tel: (031) 266 0458

Fax: 086 689 5506

Email: info@geosure.co.za



Client: Escongweni BPH Engineers (Pty) Ltd	Ref.No. 085-20
Project: Proposed Water Supply Scheme at Thokozani	Date: 17.05.2020
Section: Umgungundlovu District Municipality	Operator: E.Dada-Mia
<i>Light Dynamic Penetrometer Probe ----- Test No. DPL 2</i>	

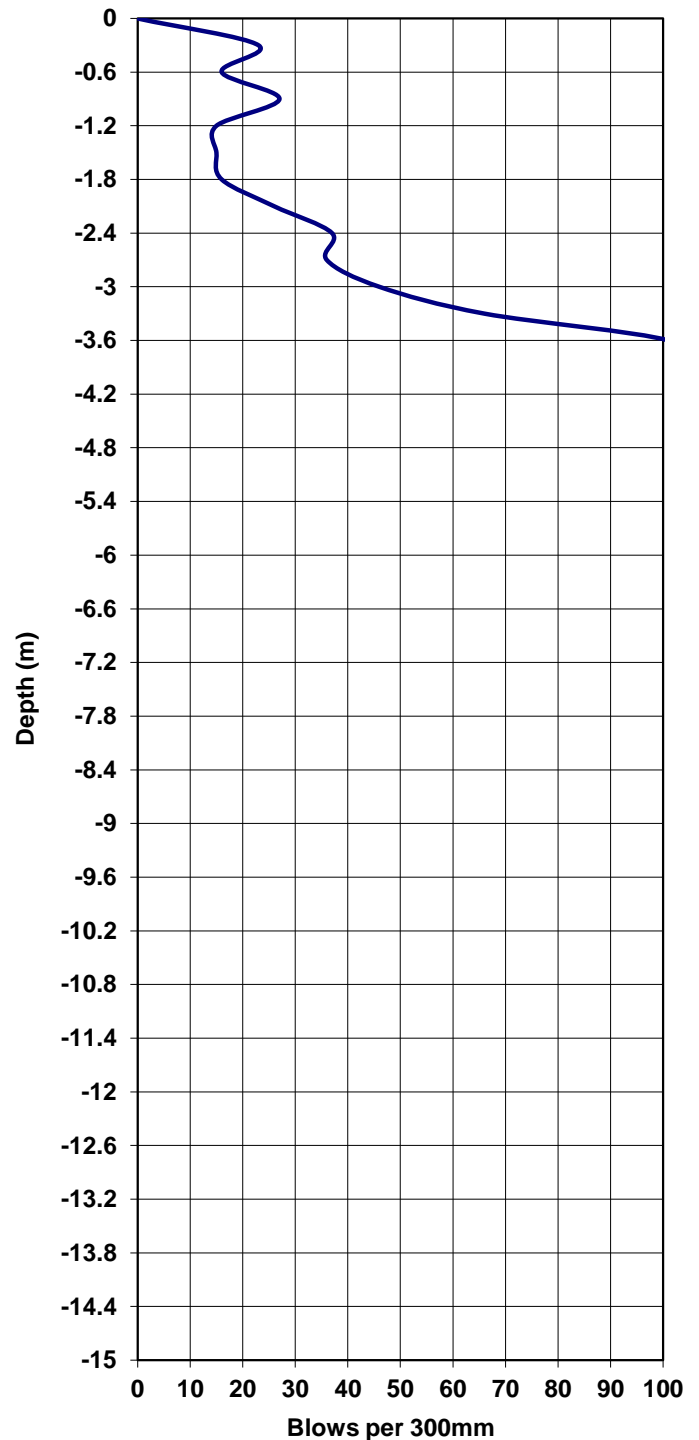
THE INSITU STRENGTH DEPENDS ON SOIL MOISTURE CONTENT AND GRAIN STRUCTURE WHICH HAVE NOT BEEN ASSESSED AND MAY CHANGE. THE VALUES GIVEN ARE THEREFORE INDICATIVE ONLY AND SHOULD BE VERIFIED BY TEST OR OBSERVATION

Hammer: 10kg falling 550mm

Cone: 25mm diameter with 60 degree apex angel

Rods: 16mm diameter, 22mm diameter couplings

Depth metres	Blows per 300mm	Inferred Consistency	Insitu Shear Strength
0			
0.3	23	Stiff	105 kPa
0.6	16	Firm	75 kPa
0.9	27	Stiff	120 kPa
1.2	15	Firm	70 kPa
1.5	15	Firm	70 kPa
1.8	16	Firm	75 kPa
2.1	26	Stiff	115 kPa
2.4	37	Very Stiff	160 kPa
2.7	36	Very Stiff	155 kPa
3	46	Very Stiff	200 kPa
3.3	66	Very Stiff	280 kPa
	Refusal		





APPENDIX D



RESULTS OF LABORATORY TESTS



CLIENT : Geosure (Pty) Ltd
 PHYSICAL ADDRESS : 122 Intersite Avenue, Springfield Park,
 Umgeni
 Durban, 4001
 ATTENTION : Mr D. Naidoo
 PROJECT : Proposed Water Supply Scheme at Thokozani

TEST REPORT REFERENCE NUMBER: 49173-2

Dear Sir/Madam,

Enclosed herewith, please find the original reports pertaining to the above-mentioned project.

Date Received	25.05.2020		
Date Tested	29.05.2020 to 08.06.2020		
Sample Location	Refer to Report		
Sampling Method	N/A		
Sample Condition	Moist		
Sampling Environmental Condition	N/A		
Sampler(s) Name	Client		
Total Number of Pages	13		
Test Carried Out			
SANS3001 GR1	<input checked="" type="checkbox"/>	TMH1 Method C3	
SANS3001 GR10, GR12	<input checked="" type="checkbox"/>	TMH1 Method C4a	
SANS3001 GR30	<input checked="" type="checkbox"/>	TMH1 Method B6	
SANS3001 GR40	<input checked="" type="checkbox"/>	Hydrometer Analysis - ASTM D422	<input checked="" type="checkbox"/>
TMH1 Method A10(b)		SABS1200 (Compactibility Factor)#	
TMH1 Method A13T + A14app		SANS 5862-1	
TMH1 Method A15d		SANS 5860, 5861-1, 5861-2, 5861-3	
TMH1 Method A13T + A16T		TMH1 Method B9	
<input checked="" type="checkbox"/> - Tick denotes tests that were carried out. #Denotes non accredited tests			

**We would like to take this opportunity of thanking you for your continued support.
 Should you have any queries please do not hesitate to contact me.**

Yours faithfully



**Technical Signatory,
 Dheeran Ramcharan for Geosure (Pty) Ltd.**

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<p>Head Office 122 Intersite Avenue, Umgeni Business Park, Durban 4091, South Africa PO Box 1461, Westville, 3630, South Africa Tel.: +27 (0)861 GEOSURE / 0861 436 7873 Fax: +27 (0)86 689 5506 Mobile: +27 (0)82 784 0544 E-mail: geosure@iafrica.com</p>	<p>Civil Engineering Laboratory 122 Intersite Avenue, Umgeni Business Park, Durban, 4091, South Africa PO Box 1461, Westville, 3630, South Africa Tel: 031 701 9732 Fax: +27 (0) 86 684 9785 Mobile: 072 870 2621 E-mail: lab@geosure.co.za</p>	<p>Gauteng Branch P. O. Box 32381, Kyalami 1684 Tel.: 0861 GEOSURE / 0861 436 7873 Fax: 086 689 8327 Mobile: 083 377 6559 Email: gauteng@geosure.co.za</p>
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	122 Intersite Avenue, Umgeni Business Park, Durban, 4091	
LABORATORY CONTACT INFO.:	Tel.: +27(0) 31 701 9732	Fax: 086 684 9785
	Mobile: +27(0) 72 870 2621	e-mail: lab@geosure.co.za
HEAD OFFICE CONTACT INFO.:	Tel.: +27(0) 31 266 0458	Fax: 086 689 5506
	Mobile: +27(0) 82 784 0544	e-mail: geosure@iafrica.com
WEBSITE:	www.geosure.co.za	

Client	: Geosure (Pty) Ltd	Our Ref. : 49173-2
Project	: Proposed Water Supply at Thokozani	Your Ref. : 085-20
		Date Tested : 29.05.2020 to 03.06.2020
Attention	: Mr D. Naidoo	Date Reported : 05.06.2020

Sample No.	T25108	T25109	T25110
Field No.	IP2	IP3	IP13
Position in Field	Layer 2	Layer 2	Layer 3
Depth (m)	0.68-3.50	0.61-3.5	1.46-2.07
Material Description	Dark reddish brown silty sandy CLAY. Residual Dolerite	Dark reddish orange silty sandy CLAY. Residual Dolerite	Light grey stained light yellow highly weathered very soft rock. SHALE

Sieve Analysis (Wet Preparation) - SANS3001 GR 1 - Percent Passing Sieve Size

	Sieve Size (mm)	T25108 (%)	T25109 (%)	T25110 (%)
% Passing	100.0	100	100	84
	75.0	100	100	79
	63.0	100	100	77
	50.0	100	100	71
	37.5	100	100	65
	28.0	100	100	60
	20.0	100	100	55
	14.0	100	100	52
	5.00	100	99	44
	2.00	94	91	39
	0.425	85	80	36
	0.250	84	77	36
0.150	84	73	35	
0.075	83	67	34	

Hydrometer Analysis - ASTM - D422 - Percent Passing Particle Diameter (<0.425mm)

	Particle Diameter (mm)	T25108 (%)	T25109 (%)	T25110 (%)
% Passing	0.060	81	63	31
	0.050	79	60	29
	0.040	78	57	27
	0.026	76	53	24
	0.015	73	49	21
	0.010	68	45	18
	0.0074	65	41	16
	0.0036	60	37	13
	0.0020	57	32	11
	0.0015	55	30	10

Mechanical analysis - SANS3001 GR1 - Percent of Soil Mortar (<2 mm) for Grain Size range

Grain Size	%	T25108 (%)	T25109 (%)	T25110 (%)
Coarse Sand	%	10	12	8
Coarse Fine Sand	%	0	3	1
Medium Fine Sand	%	1	5	2
Fine Fine Sand	%	1	6	2
Silt & Clay	%	88	74	87
Grading Modulus		0.38	0.62	1.90

Atterberg Limits - SANS3001 GR10, GR12 (<0.425mm)

Parameter	%	T25108 (%)	T25109 (%)	T25110 (%)
Liquid Limit	%	53	43	37
Plasticity Index	%	13	14	11
Linear Shrinkage	%	6.5	7.0	5.5
AASHTO Classification (Group Index)*		A-7-5 (15)	A-7-6 (9)	A-2-6 (0)
Unified Classification*		MH/OH \ddagger	ML/OL \ddagger	GM
Moisture Content	%	30.0	29.1	14.5

Remarks:	Date Received: 25.05.2020
	Sampled by Client.
	*Opinions expressed herein fall outside the scope of SANAS accreditation.

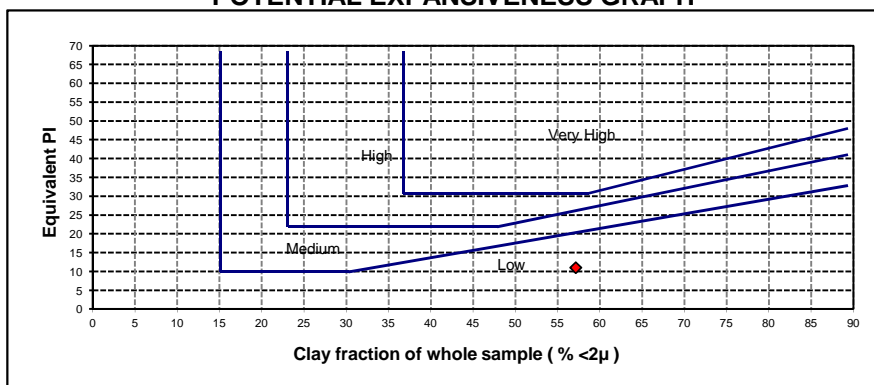
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HEAD OFFICE CONTACT INFO.:	Tel.: +27(0) 31 266 0458 Mobile: +27(0) 82 784 0544	Fax: 086 689 5506 e-mail: geosure@iafrica.com
WEBSITE:	www.geosure.co.za	

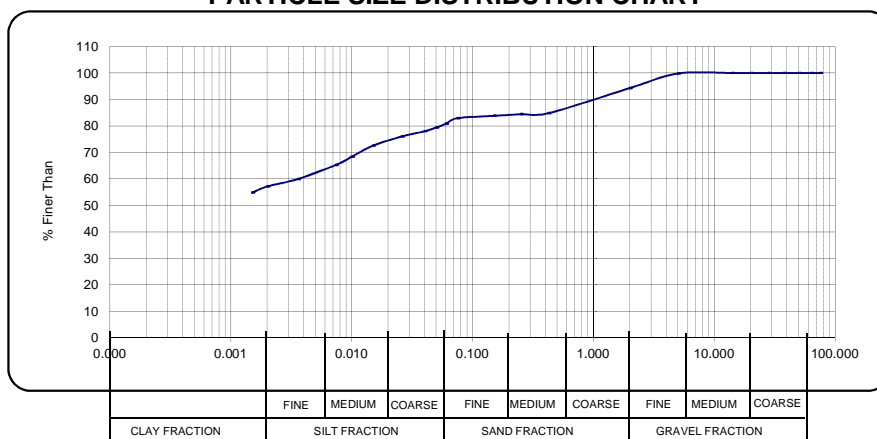
Client : Geosure (Pty) Ltd	Job No. : 49173-2
Project : Proposed Water Supply at Thokozani	Your Ref.No. : 085-20
	Date Tested : 29.05.2020 to 03.06.2020
Attention : Mr D. Naidoo	Date Reported : 05.06.2020

Sample Number : T25108	
Field No. : IP2	
Sample Description : Dark reddish brown silty sandy CLAY. Residual Dolerite	
Equivalent PI : 11 Clay fraction of whole sample (% <2μ) : 57	

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



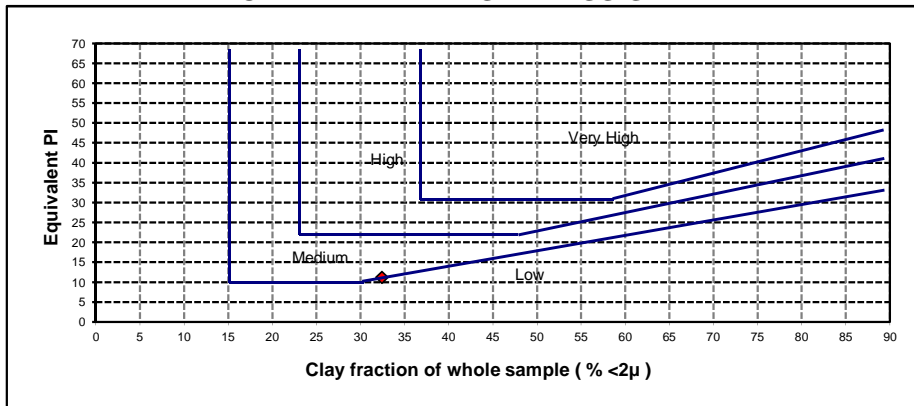
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HEAD OFFICE CONTACT INFO.:	Tel.: +27(0) 31 266 0458 Fax: 086 689 5506 Mobile: +27(0) 82 784 0544 e-mail: geosure@iafrica.com
WEBSITE:	www.geosure.co.za

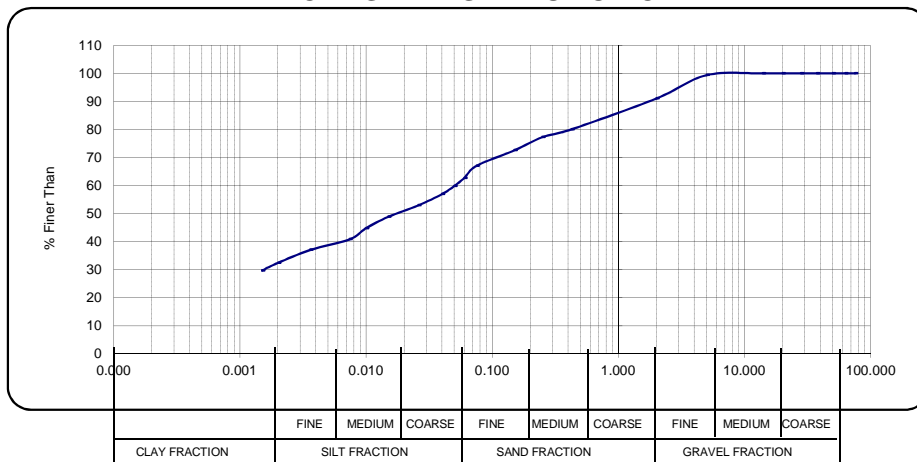
Client : Geosure (Pty) Ltd	Job No. : 49173-2
Project : Proposed Water Supply at Thokozani	Your Ref.No. : 085-20
	Date Tested : 29.05.2020 to 03.06.2020
Attention : Mr D. Naidoo	Date Reported : 05.06.2020

Sample Number	: T25109
Field No.	: IP3
Sample Description	: Dark reddish orange silty sandy CLAY. Residual Dolerite
Equivalent PI	: 11 Clay fraction of whole sample (% <2μ) : 32

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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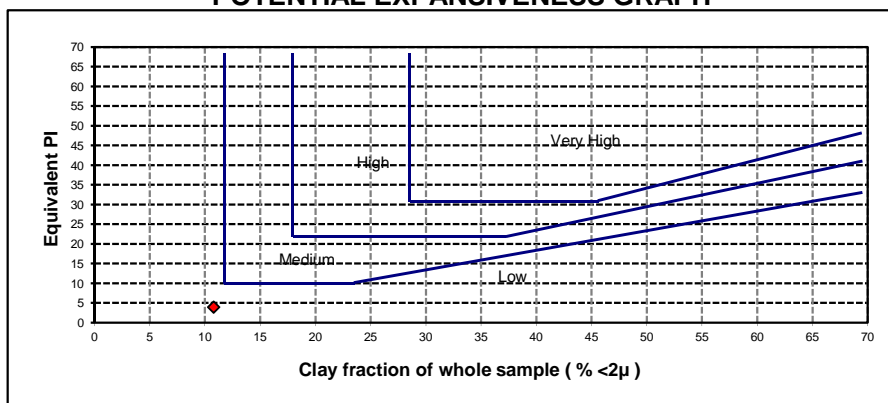
HEAD OFFICE CONTACT INFO.: Tel.: +27(0) 31 266 0458 Fax: 086 689 5506
 Mobile: +27(0) 82 784 0544 e-mail: geosure@iafrica.com

WEBSITE: www.geosure.co.za

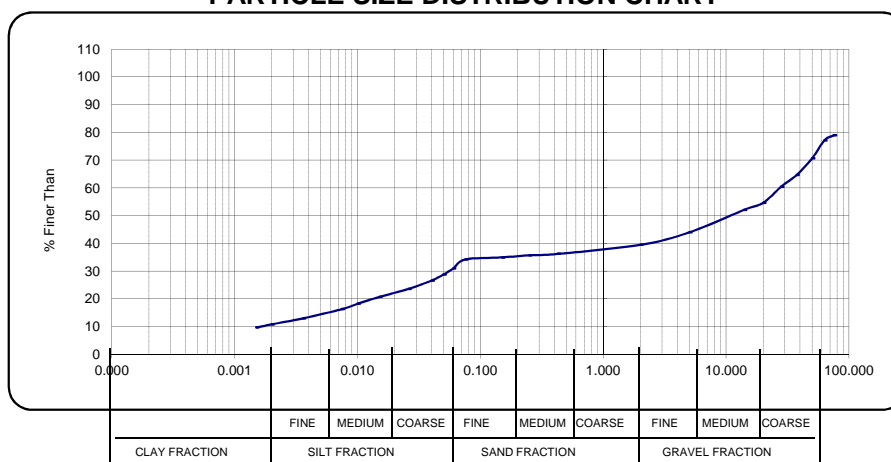
Client : Geosure (Pty) Ltd Job No. : 49173-2
 Project : Proposed Water Supply at Thokozani Your Ref.No. : 085-20
 Date Tested : 29.05.2020 to 03.06.2020
 Attention : Mr D. Naidoo Date Reported : 05.06.2020

Sample Number : T25110
 Field No. : IP13
 Sample Description : Light grey stained light yellow highly weathered very soft rock. SHALE
 Equivalent PI : 4 Clay fraction of whole sample (% <2 μ) : 11

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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Client : Geosure (Pty) Ltd Project : Proposed Water Supply Scheme at Thokozani Attention : Mr D. Naidoo	Your Ref No. : 085-20 Our Ref No. : 49173-2 Date Reported : 10/06/2020
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Test Report - SANS 3001

Sample No.	T25108	T25109	T25110		
Field No.	IP2	IP3	IP13		
Position	Layer 2	Layer 2	Layer 3		
Depth (m)	0.68-3.50	0.61-3.5	1.46-2.07		
Method of Preparation	N/A	N/A	Scalped		
Material Description	Dark reddish brown silty sandy CLAY. Residual Dolerite	Dark reddish orange silty sandy CLAY. Residual Dolerite	Light grey stained light yellow highly weathered very soft rock. SHALE		

Sieve Analysis - Percent Passing Sieve Size						
Sieve Aperture (mm)	100.00			84		
	75.00			79		
	63.00			77		
	53.00			77		
	50.00			71		
	37.50			65		
	28.00			60		
	26.50			60		
	20.00			55		
	19.00			55		
	14.00			52		
	13.20		100	52		
	5.00		99	44		
	4.750	100	99	44		
	2.000	94	91	39		
0.425	85	80	36			
0.075	83	67	34			
Grading Modulus	0.38	0.62	1.90			
Mechanical analysis - Percent of Soil Mortar (<2 mm) for Grain Size range						
Coarse Sand	2.000 - 0.425	10	12	8		
Coarse-Fine Sand	0.425 - 0.250	0	3	1		
Medium-Fine Sand	0.250 - 0.150	1	5	2		
Fine-Fine Sand	0.150 - 0.075	1	6	2		
Silt and Clay	< 0.075	88	74	87		
Atterberg Limits SANS 3001 on <0.425 mm fraction						
Liquid Limit	% or symbol	53	43	37		
Plasticity Index	% or symbol	13	14	11		
Linear Shrinkage	%	6.5	7.5	5.5		
Maximum Dry Density and Optimum Moisture Content						
Maximum Dry Density (kg/m³)		1661	1677	1962		
Optimum moisture content (%)		20.8	23.0	13.7		
California Bearing Ratio						
CBR @ 100% Compaction	%	23	33	19		
CBR @ 98% Compaction	%	15	27	17		
CBR @ 97% Compaction	%	13	24	16		
CBR @ 95% Compaction	%	8.7	20	15		
CBR @ 93% Compaction	%	6.0	16	13		
CBR @ 90% Compaction	%	3.4	12	11		
Swell @ 100% Compaction	%	1.7	0.1	1.0		
COLTO Classification (1998)**		Cannot be Determined	Cannot be Determined	G8 (#)		
TRH 14 Classification (1985)**		Poorer than G10.	G8	G8		
AASHTO Classification (Group Index)**		A-7-5 (15)	A-7-6 (9)	A-2-6 (0)		
Unified Classification **		MH/OH‡	ML/OL‡	GM		
‡ If LL _(oven dried) / LL _(not dried) < 0.75 then use O-symbol (Organic Material).						

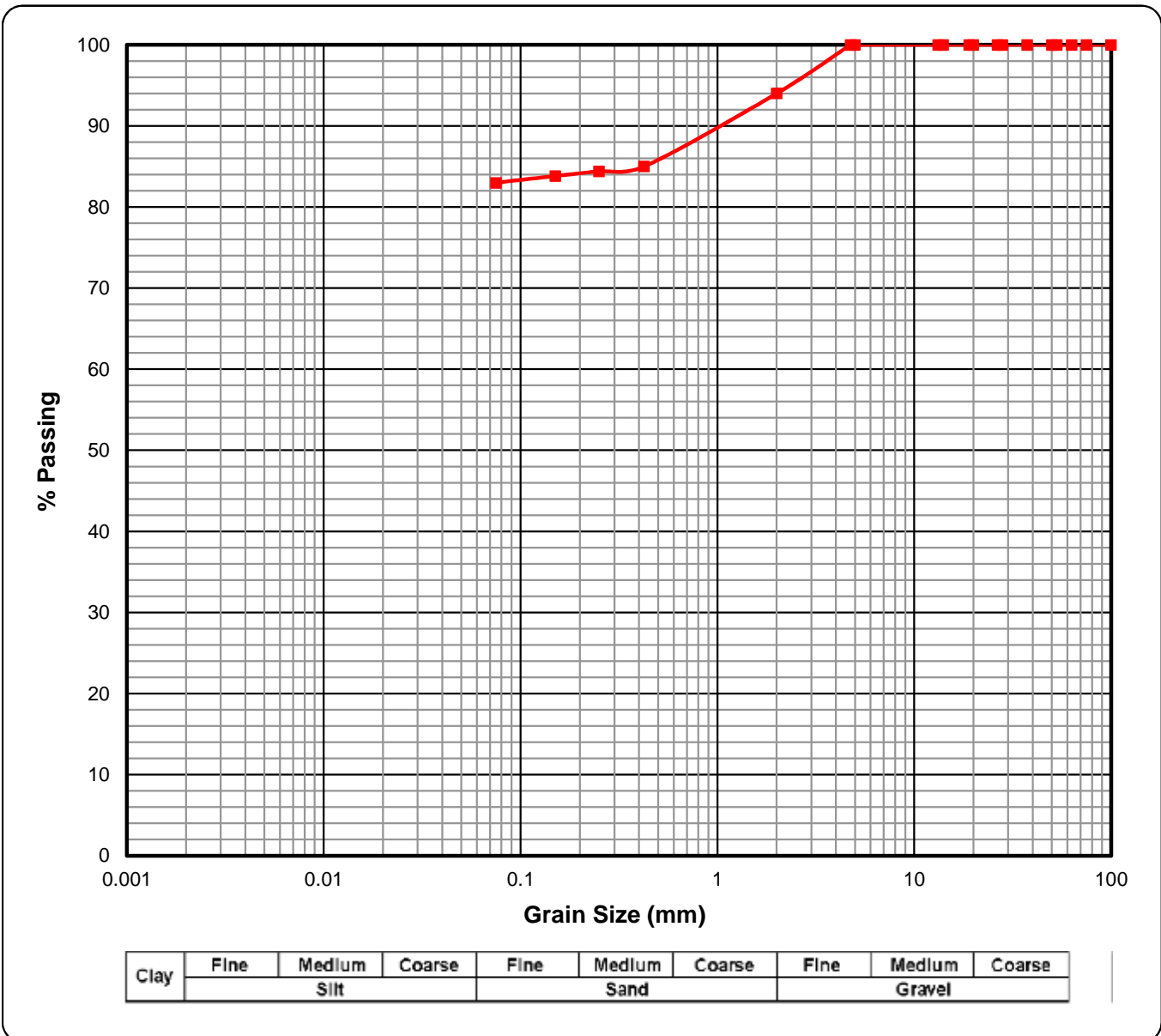
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Remarks: *Subject to further testing as required by TRH14.
 † Subject to further testing as required by COLTO. COLTO above uses only: Atterberg Limits (<0.425 mm fraction; not arithmetic mean), Nominal Max Size, Grading Curve, Coarse Sand Ratio, Grading Modulus, Strength (CBR), and Swell.
 # Check that Max Size <= 2/3 of compacted layer thickness.

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Client : Geosure (Pty) Ltd Project : Proposed Water Supply Scheme at Thokozani Attention : Mr D. Naidoo	Your Ref No.: 085-20 Our Ref No. : 49173-2 Date Reported : 10/06/2020
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Grading Curve for Sample T25108 – SANS 3001



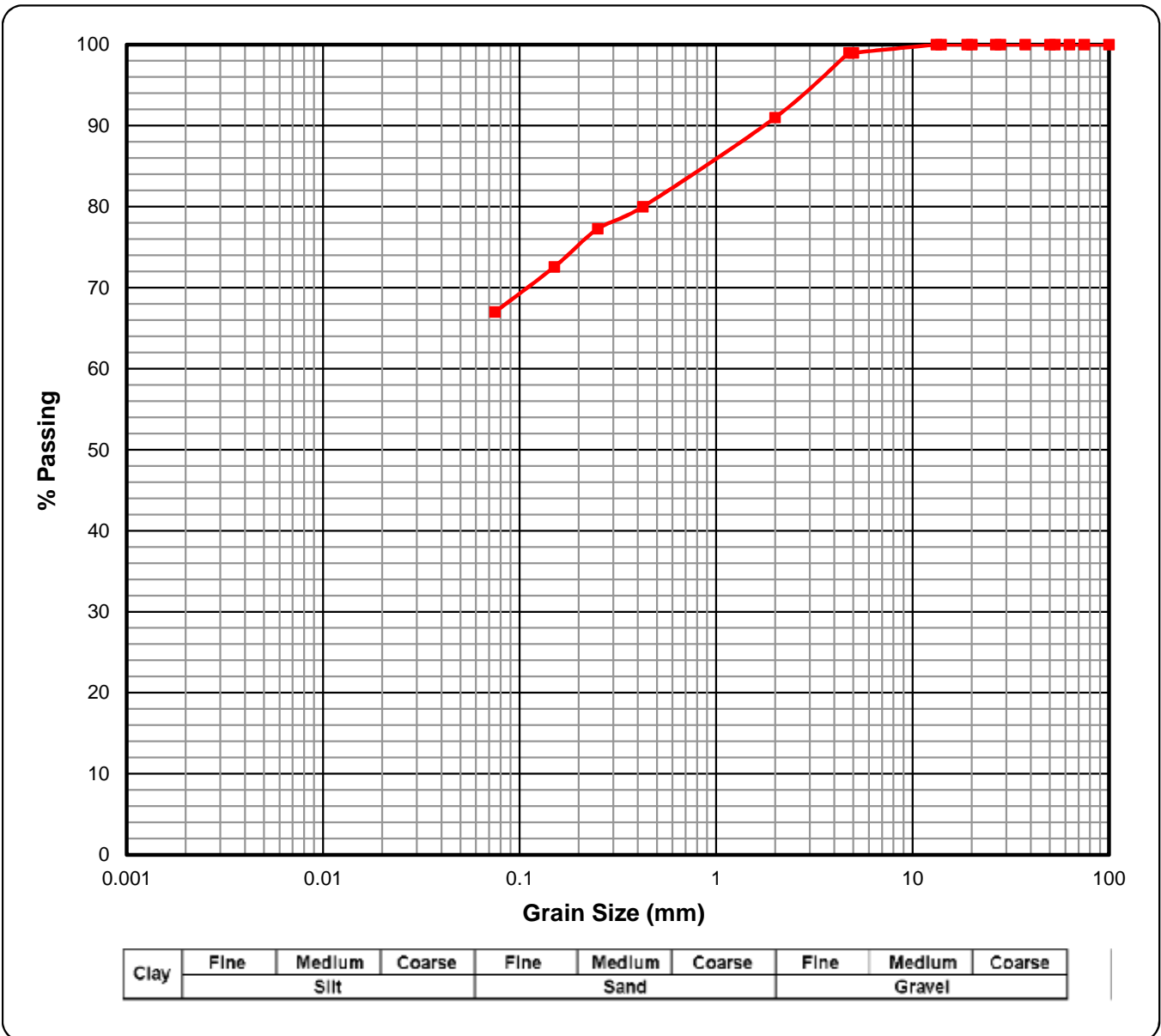
ck Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = Poorer than G1

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	83%	84%	84%	85%	94%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

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--	------------------------	--

Client : Geosure (Pty) Ltd Project : Proposed Water Supply Scheme at Thokozani Attention : Mr D. Naidoo	Your Ref No.: 085-20 Our Ref No. : 49173-2 Date Reported : 10/06/2020
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Grading Curve for Sample T25109 – SANS 3001



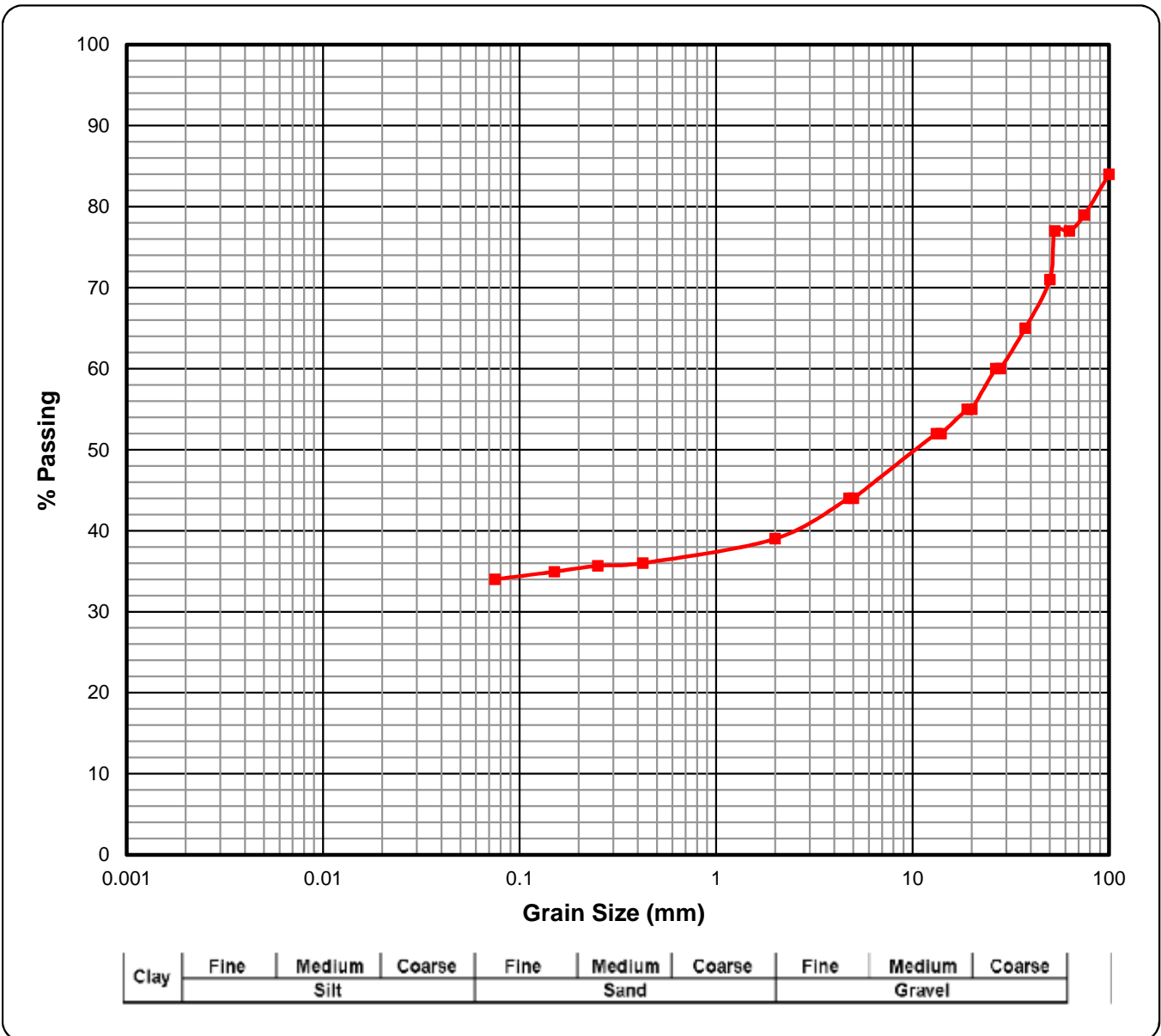
Thick Red Line is the Grading Curve (COLTO Classification = Cannot be Determined) (TRH 14 Classification = G8)

Sieve Aperture Size	0.075	0.150	0.015	0.026	0.05	0.06	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	67%	73%	77%	80%	91%	99%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

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--	------------------------	--

Client : Geosure (Pty) Ltd Project : Proposed Water Supply Scheme at Thokozani Attention : Mr D. Naidoo	Your Ref No.: 085-20 Our Ref No. : 49173-2 Date Reported : 10/06/2020
--	--

Grading Curve for Sample T25110 – SANS 3001



Thick Red Line is the Grading Curve (COLTO Classification = G8 (#)) (TRH 14 Classification = G8)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	5.00	13.20	14.00	19.00	20.00	26.50	28.0	37.5	50.0	53.0	63	75	100
Percentage Passing	34%	35%	36%	36%	39%	44%	44%	52%	52%	55%	55%	60%	60%	65%	71%	77%	77%	79%	84%

<i>Reg.No.: 92/03145/07</i>	
LABORATORY AND HEAD OFFICE ADDRESS:	122 Intersite Avenue, Umgeni Business Park, Durban, 4091
LABORATORY CONTACT INFO.:	Tel.: +27(0) 31 701 9732 Fax: 086 684 9785 Mobile: +27(0) 72 870 2621 e-mail: lab@geosure.co.za
HEAD OFFICE CONTACT INFO.:	Tel.: +27(0) 31 266 0458 Fax: 086 689 5506 Mobile: +27(0) 82 784 0544 e-mail: geosure@iafrica.com
WEBSITE:	www.geosure.co.za

Client	: Geosure (Pty) Ltd	Our Ref. : 49173-2
	: Proposed Water Supply Scheme at	Your Ref. : 085-20
Project	Thokozani	
Attention	: Mr D. Naidoo	Date Reported : 09.06.2020

TEST REPORT : COMPACTIBILITY FACTOR
(METHOD: SABS 1200)

Sample No.	Field No.	Depth (m)	Material Description	Moisture Content	Compactibility Factor
T25107	IP1	0.76-3.50	Dark reddish brown silty sandy CLAY. Residual Shale	29.6	0.372
T25111	IP16	0.01-0.72	Dark brownish grey clayey SAND. Colluvium	21.5	0.432
T25112	IP21	0.01-0.46	Medium brownish grey clayey SAND. Colluvium	16.3	0.417
T25113	IP23	0.01-0.54	Medium brownish grey clayey SAND. Colluvium	16.2	0.392

Remarks:	Date Received: 25.05.2020
	Date Tested: 28.05.2020

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Client : Geosure (Pty) Ltd Project : Proposed Water Supply Scheme at Thokozani Attention : Mr D. Naidoo	Your Ref No. : 085-20 Our Ref No. : 49173-2 Date Reported : 09.06.2020
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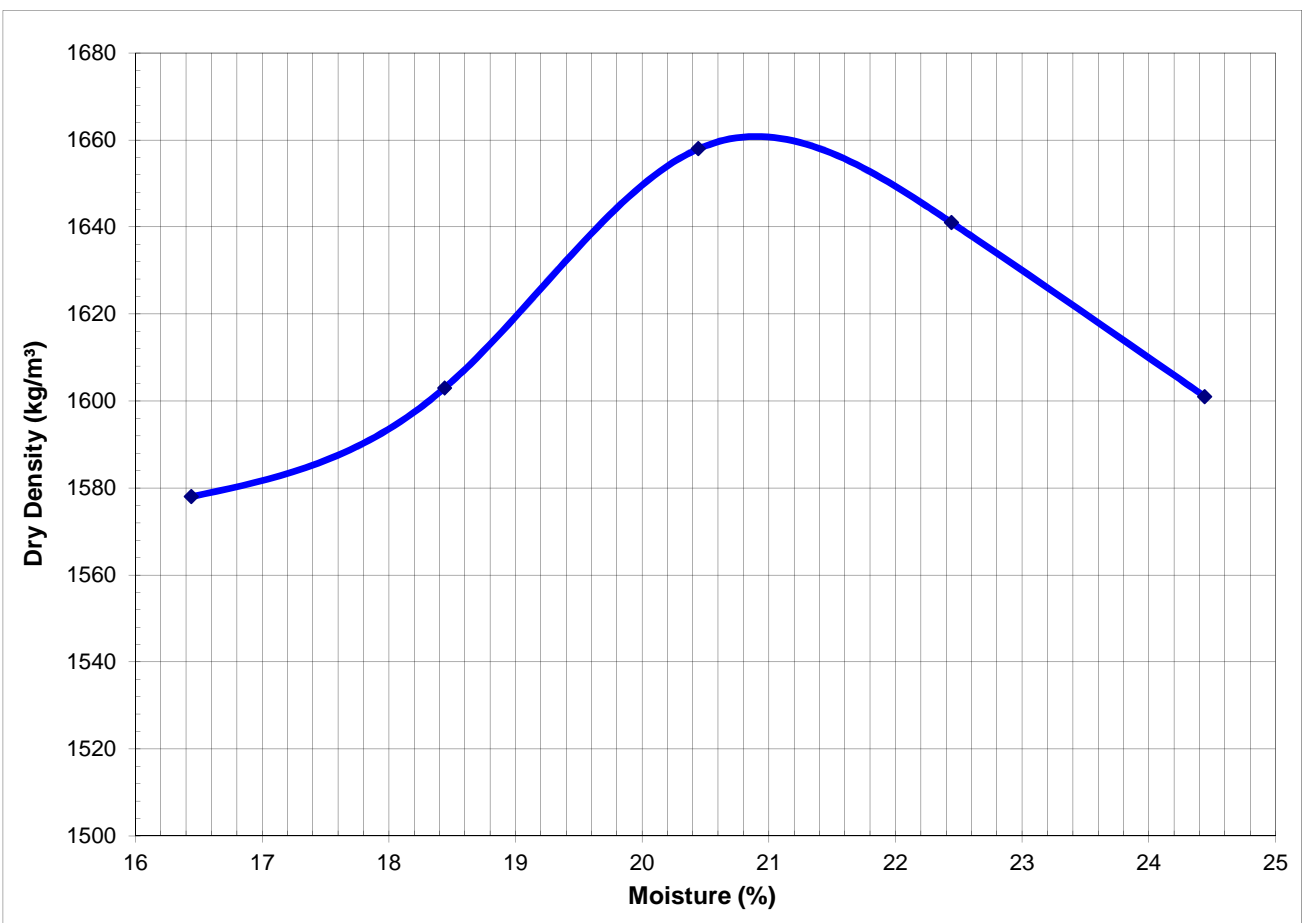
SANS 3001 Moisture/Density Relationship

Sample No. : T25108 Method of preparation : N/A Natural/Stabilised : Natural Material Description : Dk.Red.Br.silty sandy CLAY. Res. Dolerite	Field No. : IP2 Depth (m) : 0.68-3.50 Origin : Layer 2 Compaction Effort : Mod AASHTO
--	--

Maximum Dry Density (kg/m³) 1661
Optimum Moisture Content (%) 20.8

Plotted Values:

Moisture (%)	16.4	18.4	20.4	22.4	24.4
Dry Density (kg/m ³)	1578	1603	1658	1641	1601



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Client : Geosure (Pty) Ltd Project : Proposed Water Supply Scheme at Thokozani Attention : Mr D. Naidoo	Your Ref No. : 085-20 Our Ref No. : 49173-2 Date Reported : 09.06.2020
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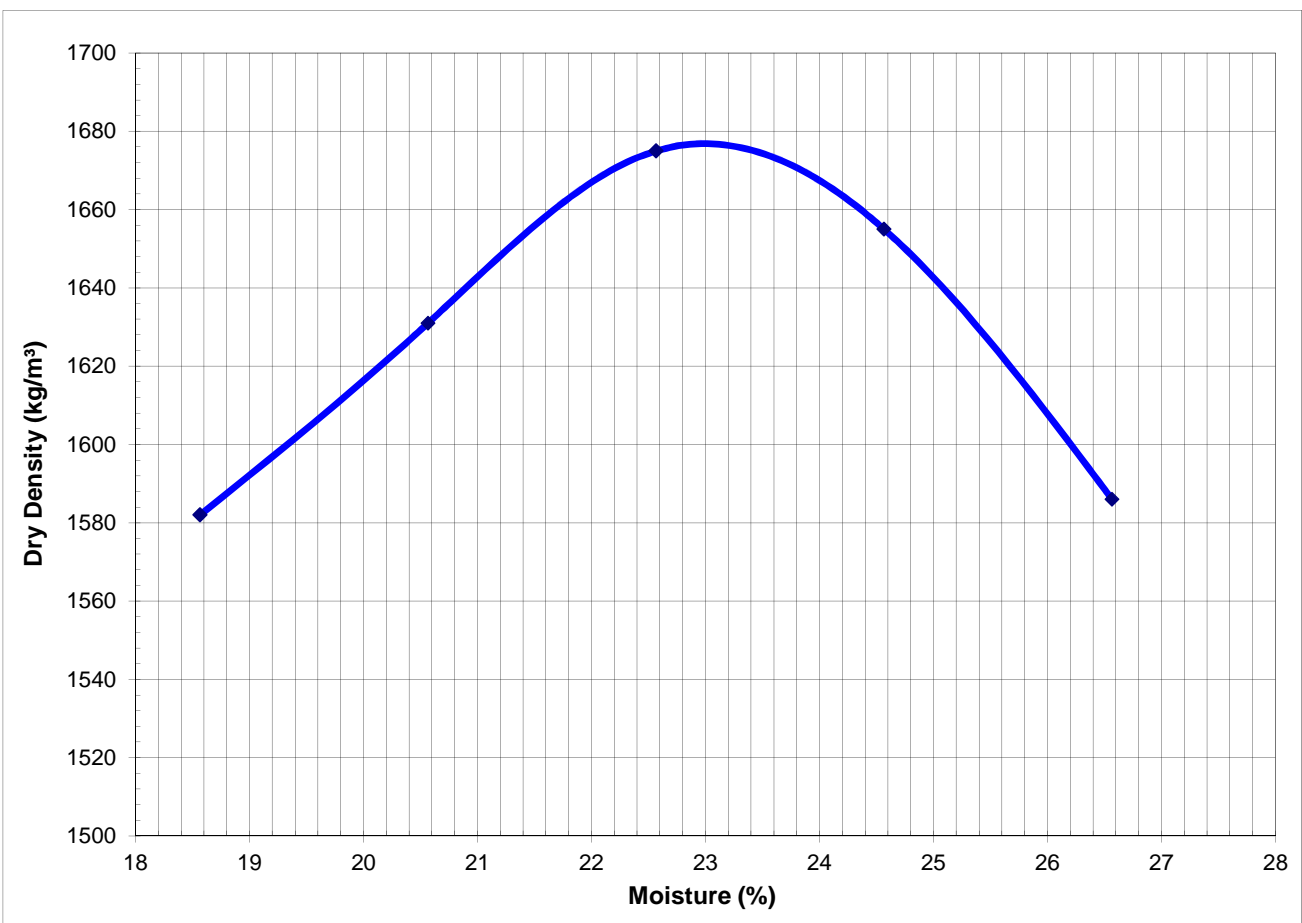
SANS 3001 Moisture/Density Relationship

Sample No. : T25109 Method of preparation : N/A Natural/Stabilised : Natural Material Description : Dk.Red.Br.silty sandy CLAY. Res. Dolerite	Field No. : IP3 Depth (m) : 0.61-3.50 Origin : Layer 2 Compaction Effort : Mod AASHTO
--	--

Maximum Dry Density (kg/m³) : 1677
Optimum Moisture Content (%) : 23.0

Plotted Values:

Moisture (%)	18.6	20.6	22.6	24.6	26.6
Dry Density (kg/m ³)	1582	1631	1675	1655	1586



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Client : Geosure (Pty) Ltd
Project : Proposed Water Supply Scheme at Thokozani
Attention : Mr D. Naidoo

Your Ref No. : 085-20
Our Ref No. : 49173-2
Date Reported : 09.06.2020

SANS 3001 Moisture/Density Relationship

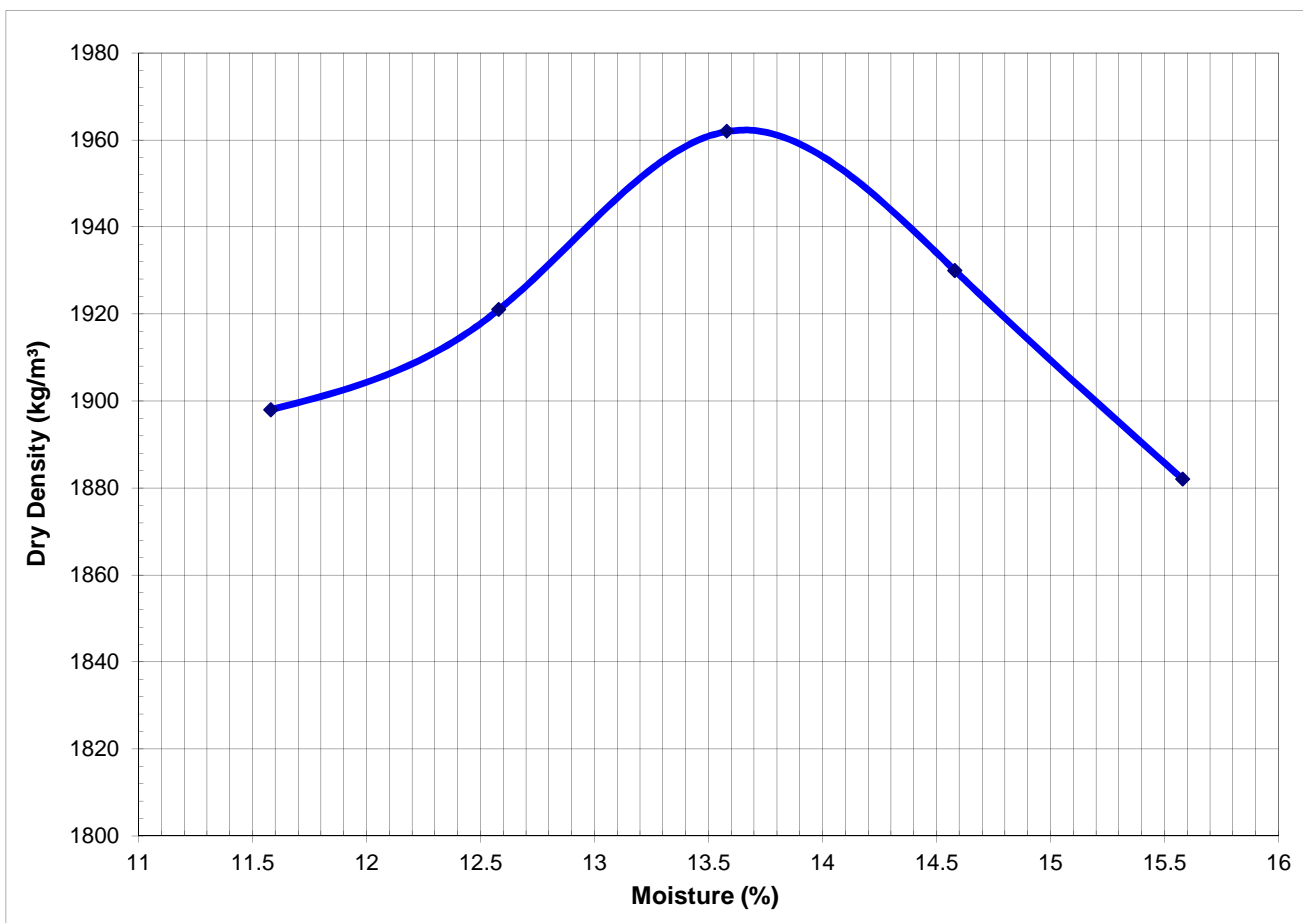
Sample No. : T25110	Field No. : IP13
Method of preparation : Scalped	Depth (m) : 1.46-2.07
Natural/Stabilised : Natural	Origin : Layer 3
Material Description : Lt.Gr.St.Lt.Yell.Hi.Wth.very soft rock. SHALE	Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) 1962

Optimum Moisture Content (%) 13.7

Plotted Values:

Moisture (%)	11.6	12.6	13.6	14.6	15.6
Dry Density (kg/m ³)	1898	1921	1962	1930	1882



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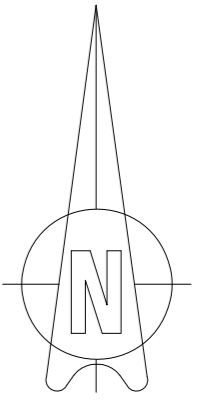


FIGURE 085-20.R02.001:



**SITE PLAN
(ENTIRE SITE)**





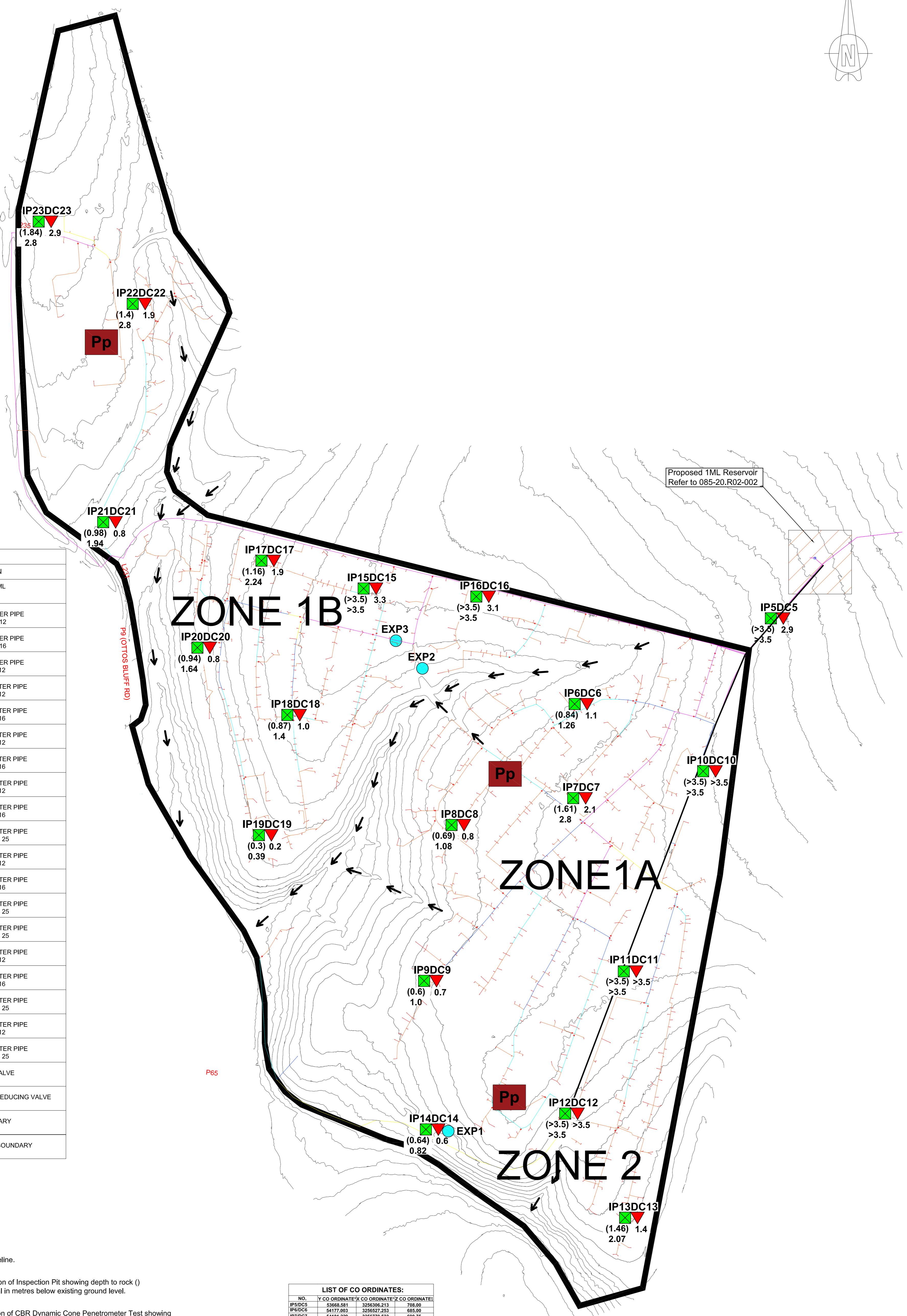
WATER LEGEND	
SYMBOL	DESCRIPTION
	PROPOSED 1ML RESERVOIR
	25mm DIAMETER PIPE HDPE, CLASS 12
	50mm DIAMETER PIPE HDPE, CLASS 16
	75mm DIAMETER PIPE uPVC, CLASS 12
	110mm DIAMETER PIPE uPVC, CLASS 12
	110mm DIAMETER PIPE uPVC, CLASS 16
	160mm DIAMETER PIPE uPVC, CLASS 12
	160mm DIAMETER PIPE uPVC, CLASS 16
	200mm DIAMETER PIPE uPVC, CLASS 12
	200mm DIAMETER PIPE uPVC, CLASS 16
	200mm DIAMETER PIPE STEEL, CLASS 25
	250mm DIAMETER PIPE uPVC, CLASS 12
	250mm DIAMETER PIPE uPVC, CLASS 16
	250mm DIAMETER PIPE STEEL, CLASS 25
	300mm DIAMETER PIPE STEEL, CLASS 25
	315mm DIAMETER PIPE uPVC, CLASS 12
	315mm DIAMETER PIPE uPVC, CLASS 16
	350mm DIAMETER PIPE STEEL, CLASS 25
	355mm DIAMETER PIPE uPVC, CLASS 12
	400mm DIAMETER PIPE STEEL, CLASS 25
	ISOLATING VALVE
	PRESSURE REDUCING VALVE
	ZONE BOUNDARY
	THOKOZANI BOUNDARY

KEY:

- Site boundary.
 - Proposed Bulk Pipeline.
 - Approximate position of Inspection Pit showing depth to rock (I) and depth to refusal in metres below existing ground level.
 - Approximate position of CBR Dynamic Cone Penetrometer Test showing depth to refusal in metres below existing ground level.
 - Approximate position of Exposure Profile.
 - Approximate alignment and direction of flow of drainage course.
- INFERRED GEOLOGY:**
- Approximate area underlain by Shale. Pietermaritzburg Formation.

LIST OF CO ORDINATES:			
NO.	X CO ORDINATE	Y CO ORDINATE	Z CO ORDINATE
IP9/DC5	53669.581	3256306.213	708.00
IP6/DC6	54173.003	3256527.553	685.00
IP7/DC7	54161.229	3255770.523	690.75
IP8/DC8	54496.276	3256339.777	681.25
IP9/DC9	54567.109	3257043.482	683.00
IP10/DC10	53844.615	3255701.176	698.75
IP11/DC11	54052.408	3257216.379	690
IP12/DC12	54201.580	3257586.586	682.75
IP13/DC13	54046.653	3257856.808	666.5
IP14/DC14	54562.557	3257628.350	658.00
IP15/DC15	54723.964	3256228.126	684.25
IP16/DC16	54431.733	3256248.276	686.75
IP17/DC17	54987.494	3256155.510	671.50
IP18/DC18	54920.856	3256555.471	675.75
IP19/DC19	54994.820	3256866.822	661.00
IP20/DC20	55153.528	3256381.093	654.75
IP21/DC21	55397.729	3256055.899	660.75
IP22/DC22	55321.304	3257351.835	675.75
IP23/DC23	55566.004	3255274.628	687.50
EXP1	54508.642	3257629.938	664.75
EXP2	54571.546	3256435.236	674.74
EXP3	54638.783	3256364.138	682.25

NOTE:
 * - Read from Hand Held GPS
 † - Approximate elevation inferred from contour survey



Site plan showing co ordinates and approximate positions of:
 Inspection Pits;
 CBR Dynamic Cone Penetrometer (DCP) Tests;
 Exposure Profiles;
 Drainage Courses; and
 Inferred Geology.

Escongweni BPH Engineers (Pty) Ltd
 Proposed Water Supply Scheme at Thokozani,
 Umgungundlovu District Municipality
 Geotechnical Investigation

GEOSURE (PTY) LTD
 Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians
 and Geotechnical Quality Assurance Specialists

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 Tel: +27 (0)31 266 0000 Fax: +27 (0)31 266 0000 Cell: 082 796 0564
 E-Mail: info@geosure.co.za Website: www.geosure.co.za

DATE: 03-06-2020
 DRAWN BY: V.G
 CHECKED BY: E.B / F.S
 REFERENCE NO: 085-20
 085-20.R02-001

SCALE 1:5000

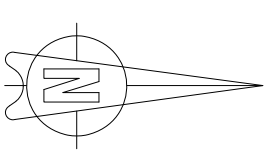
.....

Figure 085-20.R02.002:



**SITE PLAN
(1ML RESERVOIR)**

.....



KEY:

- IP1** (3.5) >3.5
Approximate position of Inspection Pit showing depth to rock () and depth to refusal in metres below existing ground level.
- DC1** 2.8
Approximate position of CBR Dynamic Cone Penetrometer Test showing depth to refusal in metres below existing ground level.
- DPL1** 3.3
Approximate position of Dynamic Cone Penetrometer Light (DPL) Test showing depth to refusal in metres below existing ground level.

LIST OF CO ORDINATES:

NO.	Y CO ORDINATE*	X CO ORDINATE*	Z CO ORDINATE*
IP1/DC1/DPL1	53550.717	3256148.621	718.00
IP2/DC2	53556.137	3256142.488	717.75
IP3/DC3/DPL2	53564.195	3256148.684	717.75
IP4/DC4	53561.470	3256154.830	717.75

NOTE:
 * - Read from Hand Held GPS
 * - Approximate elevation Inferred from contour survey

Co ordinate: 29°25'18.50"S 30°26'53.40"E
 Aerial imagesourced from Google Earth

Site plan showing co ordinates and approximate positions of:

Inspection Pits:
 CBR Dynamic Cone Penetrometer (DCP) Tests; and
 Dynamic Cone Penetrometer Light (DPL) Tests.

SCALE 1:200



Escongweni BPH Engineers (Pty) Ltd Proposed Water Supply Scheme at Thokozani, Umgunqundlovu District Municipality, Proposed 11ML Reservoir - Geotechnical Investigation	DATE:	03-30-2020
	DRAWN BY:	V.G
GEOSURE (PTY) LTD <small>Consulting Engineers, Geospatial, Geotechnical Engineers, Geotechnicians and Geotechnical Quality Assurance Specialists</small> P O Box 1481, Westville, 3601, 122 Sparrow Avenue, Umgungundlovu District, Durban, 4001 T: +27 (0)31 266 0456, Fax: +27 (0)86 689 5506, Cell: +27 784 0544 EMAIL: info@geosure.co.za, Website: www.geosure.co.za	CLIENT BY:	E.B./F.S
	REFERENCE NO.	085-20
		0855-20, R02-002