- *Site Investigations*
- *Slope Stability*
- *Rock Mechanics*
- *Soil Mechanics*
- *Foundations*
- *Borrow Pits and Materials*
- *Geotechnical Instrumentation*
- *Groundwater*
- *NHBRC*
- *Mine Stability*

The Results of a Geotechnical Investigation for a Proposed Extension to the Tiffany's Shopping Centre at Salt Rock, KwaZulu-Natal

Client: SiVEST Consulting

Reference: 21-030

Dated: 11th February 2022

GeoZone GeoServices
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Reference: 21-030 **Dated: 11th February 2022**

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The Results of a Geotechnical Investigation for a Proposed Extension to the Tiffany's Shopping Centre at Salt Rock, KwaZulu-Natal

Reference: 21-030 **Date: 11th February 2022**

1. INTRODUCTION & TERMS OF REFERENCE

The proposed extension is located adjacent to and to the northeast of the existing Tiffany's Shopping Centre, close to the N3/Salt Rock interchange on the KwaZulu Natal north coast. The proposed development is anticipated to comprise an extension to the existing retail space with associated roads and parking areas. To accomplish this, bulk earthworks will need to be carried out on the site and the correct founding solutions selected. To this end Ms L Naidoo of SiVEST Consulting requested GeoZone GeoServices to provide a cost estimate for carrying out geotechnical investigation for the site. This cost estimate, referenced 042-21, was submitted on 12th July 2021 and was accepted by the client, following which GeoZone GeoServices was appointed to carry out the work as per their proposal on the 12th November 2021.

This report presents the findings of the geotechnical investigation and discusses the results of the fieldwork, geology, laboratory testing and sub-surface conditions. Based on the fieldwork and laboratory data, recommendations are provided for the bulk earthworks, roads, drainage and founding.

2. AVAILABLE INFORMATION

The following information was drawn upon for the purposes of the investigation:

- The 1:250 000 Geological Map titled *"Durban*" as compiled by the South African Geological Survey, 1988.
- The outside footprint of the site as provided by SiVEST in a Google Earth KML image of the site.

3. SITE DESCRIPTION

The site comprises a parallelogram with a truncated eastern corner. It is bounded to the north, northeast and west by undeveloped land, to the west by the N3 National Road, and to the south by the existing Tiffany's shopping centre. The site occupies an area of approximately 5.5 hectares. Access to the site is via a dirt road from the east. Topographically the property slopes towards the north at gradients of approximately 1:22,

vertical to horizontal. The highest point of 87 masl is located in the southern corner with the lowest point of 70 m being located in the northern corner. These elevations have been derived from Google Earth and may be subject to error.

The site is vegetated with veld grass and indigenous forest and occasional scattered casuarina trees.

At the time of the investigation the site was undeveloped. The layout of the site is shown in Figure 1.

4. FIELDWORK

The fieldwork was carried out on the 14th December 2021 and comprised the excavation, logging and sampling of test pits and light Dynamic Cone Penetrometer (DPL) testing. The positions of the tests are shown in Figure 1.

Twelve test pits, designated TP1 to TP12, were excavated across the site with a TLB to depths ranging from 2.4 m to 3.0 m below existing ground level to allow for logging and sampling of the soils that underlie the site. These test pits were profiled, sampled and backfilled on completion and the soil samples submitted to a soils laboratory for testing.

5. GEOLOGY

The site is underlain by alluvium, colluvium, residual soils and shales and sandstones of the Vryheid Formation.

Alluvium was encountered in TPs 1, 2, 6 and 9 and was seen to extend to depths ranging from at least 1.1 m to in excess of 3.0 m below existing ground level. The alluvium comprises brown, loose, fine to fine-to-medium Sand.

Colluvium occurs ubiquitously across the site except in the alluvial areas. It comprises greyish brown clayey, fine Sand and extends to depths ranging from 0.3 m to 0.9 m below existing ground level.

Residual soils, derived from the weathering of the underlying bedrock, extend to depths ranging from 1.7 m to in excess of 3.0 m below existing ground level. The material comprises orange brown to reddish brown, firm, becoming stiff with depth, silty Clay. Some shale gravel was encountered within the residual soil horizon in TP3

Rock head was encountered at depths ranging from 1.7 to 2.4 m in only five of the twelve test pits dug on the site. The depth to rock and the refusal depths are shown on the site plan

in Figure 1. Shale bedrock comprises completely to highly weathered, thinly laminated, very soft rock and was encountered in TP's 3, 4, 5 and 11. Sandstone bedrock was encountered only in TP10 at a depth of 1.7 m and comprises light orange brown, completely to highly weathered, very soft rock.

6. GROUNDWATER & SURFACE WATER

Slight groundwater seepage was encountered in TP1, TP8 and TP11 at depths of 2.8 m, 2.8 m and 2.4 m respectively.

No surface water was encountered on the site.

7. RESULTS OF THE INVESTIGATION

In order to evaluate the engineering properties of the soils for use as fill material, selected samples were taken from some of the test pits and submitted to a soils laboratory for testing for Indicator, Modified AASHTO Density and California Bearing Ratio (CBR) Testing.

The results of the laboratory test are summarised in Table 1 below and the detailed results are included in Appendix C.

Table 1: Summary of Laboratory Test Results

TP No.	Depth (m)	Description	Particle Size Percent retained			Atterberg Limits (%)			GM	MDD (kg/m^3)	OMC (%)	CBR Values					Swell (%)	Heave	Group Index and Class
			Clay & Silt	Sand	Gravel	LL	PI	LS				Compaction MDD %							
												90	93	95	98	100			
TP9	0 – 2.5	Moist brown loose intact fine to medium grained SAND. Alluvium	22	77	1	-	NP	0.0	0.86	1857	9.9	3.8	6.0	8.1	11	13	0	Low	A-2-4(0) G10
TP11	0.8 – 2.4	Moist orange brown to reddish brown and grey firm becoming stiff with depth intact CLAY. Residual Shale	72	27	1	35	15	7.5	0.33	1690	16.4	0.9	1.6	2.3	3.1	3.5	7.4	Low	A-6(10) <G10
TP12	0.0-0.9	Moist dark greyish brown loose to medium dense intact clayey fine SAND. Colluvium.	53	47	0	29	10	5.0	0.50	1677	19.0	1.0	2.2	3.2	4.2	5.0	1.7	Low	A-4(4) <G10

Key

LL	-	Liquid Limit	OMC	-	Optimum Moisture Content	NA	-	Not Applicable
PI-		Plasticity Index	MDD	-	Maximum Dry Density	CBR	-	California Bearing Ratio
LS	-	Linear Shrinkage	G8	-	Classification in Terms of TRH14 (1985)	NP	-	Non-Plastic
SP	-	Slightly Plastic	CBD	-	Cannot be Determined			

8. DEVELOPMENT RECOMMENDATIONS

8.1 Proposed Development

It is understood that the Tiffany's shopping centre is to be extended out towards the east and to accomplish this, earthworks will need to be carried out to create the platforms for the proposed structures and access roads. These platforms will then need to be able to support the imposed loads of the new buildings.

8.2 Rippability & Trenchability

Soft excavation in terms of SABS 1200 is anticipated to at least a depth of 3.6 m below existing ground level using light earthmoving equipment due to the soft nature of the underlying soils and the highly weathered nature of the rockhead. However, the DPL tests refused at depths between 3.6 m and 6.3 m and it is entirely possible for soft conditions to extend to these depths.

8.3 Earthworks

8.3.1 Laboratory Test Results & their Influence on the Development

The laboratory results show that the material ranges from G10 to less than G10 in quality according to the TRH 14 (1985) classification. Table 2 below provides guidance on the suitability of various materials for different purposes.

Table 2: TRH14 Material Code Requirements for Various Pavement Layers

Layer	Material Code
Subbase	G5 and G6
Selected Layer	G6, G7, G8, G9
Subgrade and General Fills	G8, G9, G10

Modified AASHTO maximum dry densities range from 1677 kg/m^3 to 1857 kg/m^3 with optimum moisture contents ranging from 9.9 to 19.0 percent, with the upper range occurring in the more clayey material. CBR values are quite low and this is reflected in the TRH 14 classification, with the clayey material not meeting the G10 standard at all.

In terms of the soils' heave potential, they all classify as 'low' as per the van der Merwe criteria and as such heave is not considered to be a problem. However, it must be borne in mind that total heave is a function of both the activity of the clay and the thickness thereof.

8.3.2 Soil Types and their Suitability as Fill Material

The laboratory test results indicate that the alluvial sands are slightly better quality in terms of their use for subgrade and selected layer material for road and pavement construction.

The more clayey materials which underlie the site may be used as general fill material provided that they are engineered to support structural foundations. However, it would make sense to set aside a portion of the upper, more sandy horizons for use as selected layer and subgrade when the time comes to construct the roads and paved areas. At this stage the layout of the project is not available and as a result the volumes of material that would be required for this purpose is not known.

It is recommended that an assessment of the required volumes be carried out prior to the commencement of the earthworks so that a suitable quantity of sand can be stockpiled for later use.

8.3.3 Construction Recommendations

The alluvial sands need to be treated with caution as they may saturate easily if drainage is not attended to, with associated slumping and failure. In addition, they may be highly erodible and any uncontrolled surface run off will quickly generate erosion gullies in the material.

The colluvial soils which underlie the remainder of the site are also loose and will need to be treated with caution.

In view of the above constraints some precautions will need to be taken to ensure the integrity of the fill platforms and cut and fill faces.

In this regard it is considered that once a suitable quantity of better-quality material, i.e., the sandier horizons, has been stripped and stockpiled for use as selected layers or subgrade, then the remaining fill material should be selectively placed in a way that tries ensure that material of similar properties is grouped in the same fill prisms. This will assist in predicting settlement characteristics and will mitigate the development of preferential flow paths and potential planes of weakness at the interface of these zones. Furthermore, it is important to know the Modified AASHTO maximum dry density for a particular source of fill being emplaced to ensure that the correct compaction is being attained based on the laboratory-derived figure for that particular soil type.

It may prove that the upper sandy horizons, due to their loose voided structure, may well compact down to a density greater than their *in situ*, natural density. This is not considered to be a problem apart from the fact that the yield of borrow material may be slightly less than anticipated. The deeper residual clays are not expected to be voided.

All vegetation should be cleared from the areas that will be subject to earthworks. In addition, it is important to preserve the topsoil and, in this light, at least the upper 200 mm of topsoil should be removed and stockpiled and thereafter used to rehabilitate the site after construction is complete.

Care must be exercised when creating permanent cuts in the upper sandy horizons. These should be battered back at gradients of 1 vertical in 2 horizontal (slope angles of 27 degrees) to promote their long-term stability, as this should be less than the internal friction angles of the sands. Any slopes greater than 2.0 m in height will need to be analysed in terms of their global stability and should be discussed with GeoZone GeoServices prior to any construction taking place. Consideration should be given to a biojute or similar covering to assist in establishing vegetation on these cut slopes, thereby preventing surface runoff and associated erosion of the slope. In the alluvial areas the slopes may need to be battered back at shallower angles due to the very loose nature of these sands. Alternatively retaining structures may be required to support these materials.

During embankment and fill construction, the fills should be placed in layers not exceeding 200 mm loose thickness, and compacted to a minimum of 93% Modified AASHTO dry density. Any boulders or material larger than two-thirds of the layer thickness must not be included in the fill material. In addition, the fill material should be worked within - 2% either side of the optimum moisture content to reduce the danger of the material heaving during compaction, which would make it difficult to attain the specified 93% degree of compaction. It may prove that the *in-situ* moisture contents are above optimum, particularly for the clayey material and may need to be dried out prior to compaction.

Where fills are to support structural foundations, the material should be compacted to 95 percent Modified AASHTO dry density.

The front face of fills should be battered back at gradients of 1 vertical in 2 horizontal (slope angles of 27 degrees) to promote their long-term stability. Should excessively high fills be envisaged, then an assessment of their stability should be undertaken to ensure long-term stability.

Where material of different properties is to be placed adjacent to one another, good overlaps between the various soil types must be ensured to prevent the development of preferential drainage paths or possible zones of lower shear strength along which failures may occur.

It is recommended that a more comprehensive laboratory testing programme be put in place to ascertain more fully the engineering properties of the *in-situ* materials available. Representative samples of all of the materials should be taken and tested to determine the maximum Modified AASHTO dry density against which the compaction for that particular soil type needs to be compared.

8.4 Drainage

One of the most important factors in the promotion of a stable site is the control and removal of both surface and groundwater from the property. It is important that the design of the stormwater management system allow for the drainage of accumulated surface water and that it is collected and disposed of in a responsible manner.

Both during and after construction, the site should be well graded to permit water to readily drain from the site, and to prevent ponding of water anywhere on the surface. All terraces and earthworks in general should be graded to prevent ponding and ingress of water into the subsurface soils.

8.4.1 Surface Drainage

Surface water collected on any hardened areas or driveways should be directed to and collected in open, lined drains or piped off the site downslope of the platforms. Run-off from roofs should be piped from gutters through downpipes and similarly discharged into the stormwater system. Care must be taken not to affect properties downslope of the development as volumes of run-off can be significant and lead to damage and erosion further downstream.

8.4.2 Sub-Surface Drainage

The need for subsurface soil drainage will have to be assessed on site during development although significant groundwater flows are not expected. However, there may be some seepage in the valley invert and some kind of drainage solution may be required to prevent saturation of the lower fill horizons in this area. Should groundwater be encountered it is recommended that subsoil drains be installed and that these are designed according to the filter criteria of the *in-situ* soils to prevent piping. The design of subsoil drains should be discussed in detail with GeoZone GeoServices.

8.5 Evaluation of Founding Conditions & Foundation Recommendations

From the DPL results the depth to material of stiff/dense consistency, and the refusal depths have been compiled and are presented in Table 3 below.

Table 3: Depth to Material of Stiff/Dense Consistency and Depth to Refusal

DPL No.	Depth to material of stiff/dense consistency (m)	Refusal Depth (m)
1	3.3	4.8
2	4.5	5.4
3	1.8	3.6
4	3.3	3.9
5	4.5	4.8
6	5.4	6.3
7	3.0	4.5
8	3.6	4.2
9	3.9	5.1
10	3.0	3.9
11	3.0	4.5
12	3.0	5.1

The DPL results also show that the upper sandy soils and the alluvial soils are loose to very loose and collapse settlement cannot be ruled out.

The depths given in Table 3 above indicate that normal strip footings will not work as the depth to a suitable founding horizon exceeds the depth at which the foundations can be safely and efficiently cast. This is borne out by the collapsing pit sidewalls that was noted during the geotechnical investigation. Groundwater may also present a challenge in some instances.

At this stage the bulk earthworks drawings are not available and therefore specific recommendations for founding are difficult to make. Suffice to say that, if the earthworks are carried out according to the required standards and according to the recommendations given above, then the engineered fills should suitable for founding lightly loaded structures thereon. This comes with a host of caveats, which include an understanding of the column loads, foundation pressures and how these relate to the local geology and the fill wedge thickness.

For example, foundations located on areas of shallow fill may need a special approach as the bulbs of pressure from the structure may extend through the fill and into the uncompacted *in situ* material. In addition, bridging effects will also come into play, with thicker, well compacted zones bridging smaller, softer zones in the underlying substrate or fill material.

The following recommendations are made for single storey and multi storey structures.

8.5.1 Single Storey

Due to the mantle of loose soils overlying the site it is recommended that one of the in-situ following founding methods be considered based on the NHBRC requirements for C2 site classes:

- Stiffened strip footings
- Stiffened reinforced concrete raft
- Soil raft
- Normal foundations on compacted soils, or
- Piled foundations

Provided that the fill is compacted to at least 95% MDD for the required thickness (as per NHBRC guidelines) beneath the selected foundation type given above, a maximum allowable bearing pressure of 80kPa may be adopted. This recommendation is based on the proviso that the fill is of sufficient thickness for the applied foundation pressures to have dissipated sufficiently within the fill horizon itself, rather than being transferred down to the loose, in-situ soils which may then lead to settlement.

Should it necessary to found on material close to the existing ground level, then it is recommended that a stiffened raft be used to found the structure, or that a soil raft comprising recompacted material below the footprint of the building be emplaced prior to the casting of the footings.

8.5.2 Multi- Storey Buildings

Multi-storey buildings will need to be supported on piled foundations unless the buildings are founded in deep cuts or box cuts, say about 4 m below ground level and in places possibly deeper. This would then allow the footings to be founded on the denser/stiffer *in situ* soils which occur below an average depth of approximately 4 m. Such founding would be facilitated if the new building(s) were to have parking basements. This may come with its own challenges in terms of supporting the excavation sidewalls and dealing with groundwater.

However, should this option not be available, then piles will be required. These will in all likelihood comprise CFA (continuous flight auger) piles. These should be taken down to the weathered shale and sandstone bedrock – socketed into material at a depth where the auger pile rig refuses. As such they can be designed as end bearing piles.

Typical CFA pile details are given in Table 4 below.

Table 4: CFA Pile Guideline Capacities

Pile Diameter (mm)	Axial Compressive Working Load (kN)
250	200 - 275
300	300 - 425
400	500 - 750

It is important to note that the required length of the piles will likely exceed the refusal depths at which the DPL tests. The piles may well refuse at depths in excess of the DPL refusal depth given in Table 3 above. For any pile design there is a design pile socket length, and should the machine refuse on shallower material then this design socket length may not be possible to achieve. To remove some of this uncertainty it may be worthwhile conducting a number of exploratory trial holes using the piling rig once it has established on site to confirm that the piles can in fact be drilled to their full design length.

The piles should be designed to limit differential settlement to a maximum of 5 mm between columns. Where the piles are installed through new fill then they should be designed to carry the additional loads imposed by the down-drag forces of the fill due to the consolidation of the fill over time. A well compacted fill could be expected to settle between 10 and 20 percent of the height of the fill due to self-weight consolidation.

A detailed pile design should be carried out by an experienced geotechnical engineer taking all loads into account.

It is strongly recommended that integrity testing be carried out on all piles installed to confirm pile shaft uniformity.

8.6 Roads and Paved Areas

Once the platforms have been constructed it is recommended that the soils below the roads and paved areas are undercut to a depth of at least 200 mm below platform level and replaced by G8 or better material, compacted to 93% Modified AASHTO Dry Density. As a general rule of thumb, the highest quality material that is economically available should always be used.

9. SUMMARY & CONCLUSIONS

This report presents the findings of a geotechnical investigation carried out for the proposed extension to the Tiffany's shopping centre located at the Salt Rock/N3 interchange, in KwaZulu-Natal.

The site is underlain by loose colluvial and alluvial sands and which are underlain by clays and subordinate clayey sands derived from the weathering of the shales and sandstones of the Vryheid Formation. Some slight groundwater seepage was observed in three of the test pits.

Soft excavation in terms of SABS 1200 is generally anticipated to depths ranging from 3.6 to 6.3 m below existing ground level. Completely to highly weathered rock was encountered in five of the pits dug on site.

The soils are suitable for the construction of fills, with the upper sand horizons appearing to be of better quality than the deeper clays. In this regard then it may be prudent to stockpile some of this material for later use as selected layer and subgrade material. The deeper more clayey material does not meet a G10 standard and is not suitable for subgrade use. An additional suite of testing is recommended to determine more accurately the Modified AASHTO dry density and optimum moisture content of the *in-situ* materials. This will assist greatly in ensuring that the specified compaction is being attained.

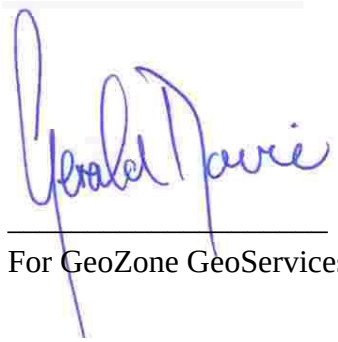
It is recommended that all earthworks be carried out in accordance with SABS 1200 (current version). The soils should be placed in 300 mm layers and compacted to the density given above. No debris, boulders or other foreign material larger than 2/3 of the layer thickness should be allowed in the fill.

One of the more important factors in the promotion of a stable site is the control and removal of surface water from the property. It is important that the design of the stormwater management system allows for the drainage of accumulated surface water from the platform and into the stormwater system or natural drainage lines.

In terms of roads and hardened areas, these materials need to be undercut to a depth of 200 mm and replaced with material of at least G7 material, compacted to a density of 93 percent Modified AASHTO.

The site has been classified as C2 and collapse settlement of the upper soil horizons may occur when loaded and if wetted up. As such precautions should be taken when founding the shallow structures to ensure that the bearing capacity of the soils is not exceeded. In terms of founding multistorey structures, these should be founded on piles, socketed into the underlying shales or sandstones.

Finally, the ground conditions described in this report refer specifically to those encountered at the test positions on the site. It is therefore possible that conditions at variance with those discussed above may be encountered elsewhere on the property. In this regard it is important that GeoZone GeoServices carry out periodic inspections of the site during construction to ensure that any variation in the anticipated ground conditions can be assessed and revised recommendations made to avoid unnecessary delays and expense. Furthermore, it is important that the construction phase of the project be treated as an augmentation of the geotechnical investigation.



For GeoZone GeoServices

11th February 2022

Figures

Appendix A
(Test Pit Logs)

GeoZone GeoServices		Test Pit No. **TP1**

1 Mansfield Road, Howick, 3290 Tel: +27 (0)33 3433915 e-mail: info@geozone.co.za

Co-ordinates:	**Job Description:**	Tiffany's Shopping Centre Extension
x:	**Job No.:**	21-030
y:	**Client:**	SiVEST Consulting
Elevation:	**Machine:**	TLN
Co-ord System:	**Logged by:**	SR
	Date:	14-Dec-21 **Sheet:** 1 of 1

From:	To:	Thickness (m)	Description
0.00	1.10	1.10	Moist dark greyish brown loose to medium dense intact clayey fine SAND. Alluvium
1.10	3.00	1.90	Moist orange brown to reddish brown and grey firm becoming stiff with depth intact CLAY. Residual Shale

Notes:
1) Slight groundwater seepage at 2.80m.
2) No samples
3) Final depth 3.0 m

GeoZone GeoServices		Test Pit No. **TP2**

1 Mansfield Road, Howick, 3290 Tel: +27 (0)33 3433915 e-mail: info@geozone.co.za

Co-ordinates:	**Job Description:**	Tiffany's Shopping Centre Extension
x:	**Job No.:**	21-030
y:	**Client:**	SiVEST Consulting
Elevation:	**Machine:**	TLN
Co-ord System:	**Logged by:**	SR
	Date:	14-Dec-21 **Sheet:** 1 of 1

From:	To:	Thickness (m)	Description
0.00	2.40	2.40	Moist brown becoming light brown with depth fine grained SAND. Alluvium.

Notes:

1) No groundwater encountered
2) Sidewall collapse between 0.0 m and 2.0 m.
3) No samples
4) Final depth 2.4 m

GeoZone GeoServices		Test Pit No. **TP3**

1 Mansfield Road, Howick, 3290 Tel: +27 (0)33 3433915 e-mail: info@geozone.co.za

Co-ordinates:	**Job Description:**	Tiffany's Shopping Centre Extension
x:	**Job No.:**	21-030
y:	**Client:**	SiVEST Consulting
Elevation:	**Machine:**	TLN
Co-ord System:	**Logged by:**	SR
	Date:	14-Dec-21 **Sheet:** 1 of 1

From:	To:	Thickness (m)	Description
0.00	0.30	0.30	Moist dark greyish brown loose to medium dense intact clayey fine SAND. Colluvium.
0.30	1.70	1.40	Moist orange brown to dark grey firm becoming stiff intact gravelly CLAY. Gravel becomes more abundant with depth. Gravel comprises subangular to angular completely weathered medium to coarse shale fragments.
1.70	3.00	1.30	Greyish brown to grey completely to highly weathered very thinly bedded very soft rock SHALE. Vryheid Formation.

Notes:
1) No groundwater encountered
2) No samples
3) Final depth 3.0 m

GeoZone GeoServices		Test Pit No. **TP4**

1 Mansfield Road, Howick, 3290 Tel: +27 (0)33 3433915 e-mail: info@geozone.co.za

Co-ordinates:	**Job Description:**	Tiffany's Shopping Centre Extension
x:	**Job No.:**	21-030
y:	**Client:**	SiVEST Consulting
Elevation:	**Machine:**	TLN
Co-ord System:	**Logged by:**	SR
	Date:	14-Dec-21 **Sheet:** 1 of 1

From:	To:	Thickness (m)	Description
0.00	0.50	0.50	Moist dark greyish brown loose to medium dense intact clayey fine SAND. Colluvium.
0.50	1.70	1.20	Moist orange brown to reddish brown and grey firm becoming stiff with depth intact CLAY. Residual Shale.
1.70	3.00	1.30	Greyish brown to grey completely to highly weathered very soft rock SHALE. Vryheid Formation. Note: Structure not easily observed.

Notes:
1) No groundwater encountered
2) No samples
3) Final depth 3.0 m

GeoZone GeoServices		Test Pit No. **TP5**

1 Mansfield Road, Howick, 3290 Tel: +27 (0)33 3433915 e-mail: info@geozone.co.za

Co-ordinates:	**Job Description:**	Tiffany's Shopping Centre Extension
x:	**Job No.:**	21-030
y:	**Client:**	SiVEST Consulting
Elevation:	**Machine:**	TLN
Co-ord System:	**Logged by:**	SR
	Date:	14-Dec-21 **Sheet:** 1 of 1

From:	To:	Thickness (m)	Description
0.00	0.60	0.60	Moist dark greyish brown loose to medium dense intact clayey fine SAND. Colluvium.
0.60	2.00	1.40	Moist orange brown to reddish brown and grey firm becoming stiff with depth intact CLAY. Residual Shale.
2.00	3.00	1.00	Greyish brown to grey completely to highly weathered very soft rock SHALE. Vryheid Formation. Note: Structure not easily observed.

Notes:
1) No groundwater encountered
2) No samples
3) Final depth 3.0 m

GeoZone GeoServices		Test Pit No. **TP6**

1 Mansfield Road, Howick, 3290 Tel: +27 (0)33 3433915 e-mail: info@geozone.co.za

Co-ordinates:	**Job Description:**	Tiffany's Shopping Centre Extension
x:	**Job No.:**	21-030
y:	**Client:**	SiVEST Consulting
Elevation:	**Machine:**	TLN
Co-ord System:	**Logged by:**	SR
	Date:	14-Dec-21 **Sheet:** 1 of 1

From:	To:	Thickness (m)	Description
0.00	2.60	2.60	Moist brown loose intact fine to medium grained SAND. Alluvium.

Notes:

1) No groundwater encountered
2) No samples
3) Sidewall collapses between 0.0 m and 2.3 m
3) Final depth 2.6 m

GeoZone GeoServices		Test Pit No. **TP7**

1 Mansfield Road, Howick, 3290 Tel: +27 (0)33 3433915 e-mail: info@geozone.co.za

Co-ordinates:	**Job Description:**	Tiffany's Shopping Centre Extension
x:	**Job No.:**	21-030
y:	**Client:**	SiVEST Consulting
Elevation:	**Machine:**	TLN
Co-ord System:	**Logged by:**	SR
	Date:	14-Dec-21 **Sheet:** 1 of 1

From:	To:	Thickness (m)	Description
0.00	0.80	0.80	Moist dark greyish brown loose to medium dense intact clayey fine SAND. Colluvium.
0.80	3.00	2.20	Moist orange brown to reddish brown and grey firm becoming stiff with depth intact CLAY. Residual Shale.

Notes:
1) No groundwater encountered
2) No samples
3) Final depth 3.0 m

GeoZone GeoServices		Test Pit No. **TP8**

1 Mansfield Road, Howick, 3290 Tel: +27 (0)33 3433915 e-mail: info@geozone.co.za

Co-ordinates:	**Job Description:**	Tiffany's Shopping Centre Extension
x:	**Job No.:**	21-030
y:	**Client:**	SiVEST Consulting
Elevation:	**Machine:**	TLN
Co-ord System:	**Logged by:**	SR
	Date:	14-Dec-21 **Sheet:** 1 of 1

From:	To:	Thickness (m)	Description
0.00	0.90	0.90	Moist dark greyish brown loose to medium dense intact clayey fine SAND. Colluvium.
0.90	3.00	2.10	Moist orange brown to reddish brown and grey firm becoming stiff with depth intact CLAY. Residual Shale.

Notes:

1) Slight groundwater seepage at 2.80 m
2) No samples
3) Final depth 3.0 m

GeoZone GeoServices		Test Pit No. **TP9**

1 Mansfield Road, Howick, 3290 Tel: +27 (0)33 3433915 e-mail: info@geozone.co.za

Co-ordinates:	**Job Description:**	Tiffany's Shopping Centre Extension
x:	**Job No.:**	21-030
y:	**Client:**	SiVEST Consulting
Elevation:	**Machine:**	TLN
Co-ord System:	**Logged by:**	SR
	Date:	14-Dec-21 **Sheet:** 1 of 1

From:	To:	Thickness (m)	Description
0.00	2.50	2.50	Moist brown loose intact fine to medium grained SAND. Alluvium

Notes:

1) No groundwater encountered
2) Bulk samples taken from 0.0 to 2.5 m.
3) Sidewall collapse between 0.0 and 2.2 m.
3) Final depth 2.5 m

GeoZone GeoServices		Test Pit No. **TP10**

1 Mansfield Road, Howick, 3290 Tel: +27 (0)33 3433915 e-mail: info@geozone.co.za

Co-ordinates:	**Job Description:**	Tiffany's Shopping Centre Extension
x:	**Job No.:**	21-030
y:	**Client:**	SiVEST Consulting
Elevation:	**Machine:**	TLN
Co-ord System:	**Logged by:**	SR
	Date:	14-Dec-21 **Sheet:** 1 of 1

From:	To:	Thickness (m)	Description
0.00	0.40	0.40	Moist dark greyish brown loose to medium dense intact clayey fine SAND. Colluvium.
0.40	2.20	1.80	Moist orange brown to reddish brown and grey firm becoming stiff with depth intact CLAY. Residual Shale.
2.20	3.00	0.80	Light orange brown completely to highly weathered very soft rock SANDSTONE. Vryheid Formation.

Notes:

1) No groundwater encountered
2) No samples
3) Final depth 3.0 m

GeoZone GeoServices		Test Pit No. **TP11**

1 Mansfield Road, Howick, 3290 Tel: +27 (0)33 3433915 e-mail: info@geozone.co.za

Co-ordinates:	**Job Description:**	Tiffany's Shopping Centre Extension
x:	**Job No.:**	21-030
y:	**Client:**	SiVEST Consulting
Elevation:	**Machine:**	TLN
Co-ord System:	**Logged by:**	SR
	Date:	14-Dec-21 **Sheet:** 1 of 1

From:	To:	Thickness (m)	Description
0.00	0.80	0.80	Moist dark greyish brown loose to medium dense intact clayey fine SAND. Colluvium.
0.80	2.40	1.60	Moist orange brown to reddish brown and grey firm becoming stiff with depth intact CLAY. Residual Shale.
2.40	3.00	0.60	Greyish brown to grey completely to highly weathered very soft rock SHALE. Vryheid Formation. Note: Structure not easily observed.

Notes:

1) Slight groundwater seepage at 2.4 m.
2) Bulk samples taken from 0.8 m and 2.4 m
3) Final depth 3.0 m

GeoZone GeoServices		Test Pit No. **TP12**

1 Mansfield Road, Howick, 3290 Tel: +27 (0)33 3433915 e-mail: info@geozone.co.za

Co-ordinates:	**Job Description:**	Tiffany's Shopping Centre Extension
x:	**Job No.:**	21-030
y:	**Client:**	SiVEST Consulting
Elevation:	**Machine:**	TLN
Co-ord System:	**Logged by:**	SR
	Date:	14-Dec-21 **Sheet:** 1 of 1

From:	To:	Thickness (m)	Description
0.00	0.90	0.90	Moist dark greyish brown loose to medium dense intact clayey fine SAND. Colluvium.
0.90	2.40	1.50	Moist yellowish brown to reddish brown medium dense clayey SAND. Residual Sandstone.
2.40	3.00	0.60	Light yellowish brown to grey stiff becoming very stiff intact CLAY. Residual Sandstone.

Notes:

1) No groundwater encountered
2) Bulk samples taken from 0.0 m and 0.94 m
3) Final depth 3.0 m

Appendix B
(DPL Test Results)

GeoZone GeoServices

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Tel: (082) 9260626 Email: info@geozone.co.za www.geozone.co.za

Client:	**SiVEST Consulting**	**Ref.No.**	**21-030**
Project:	**Tiffany's Expansion Project**	**Date:**	
Section:		**Operator:**	**EN**

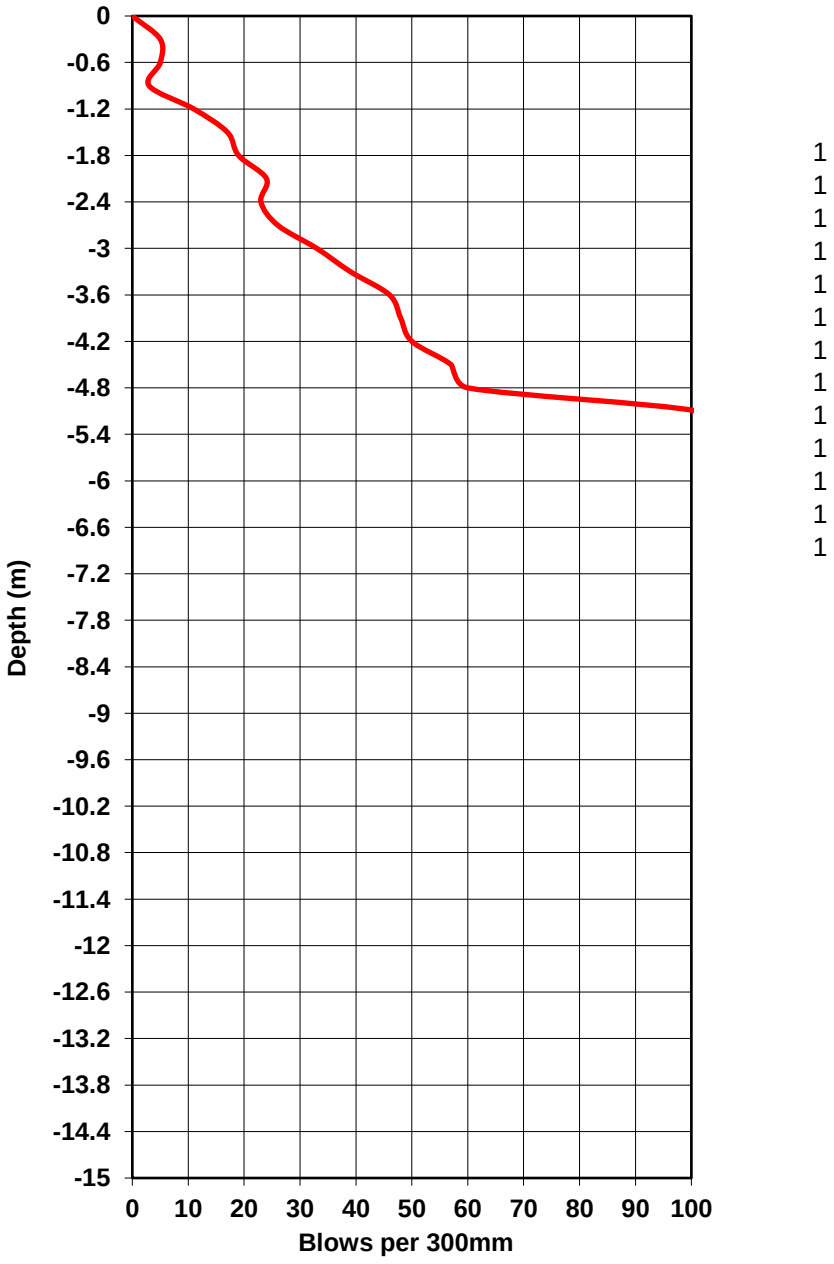
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 1***

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 angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	5	Very Loose
0.6	5	Very Loose
0.9	3	Very Loose
1.2	11	Soft
1.5	17	Firm
1.8	19	Firm
2.1	24	Firm
2.4	23	Firm
2.7	26	Firm
3	33	Firm
3.3	39	Stiff
3.6	46	Stiff
3.9	48	Stiff
4.2	50	Stiff
4.5	57	Stiff
4.8	60	Stiff
	Ref	



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Client:	**SiVEST Consulting**	**Ref.No.**	**21-030**
Project:	**Tiffany's Expansion Project**	**Date:**	
Section:		**Operator:**	**EN**

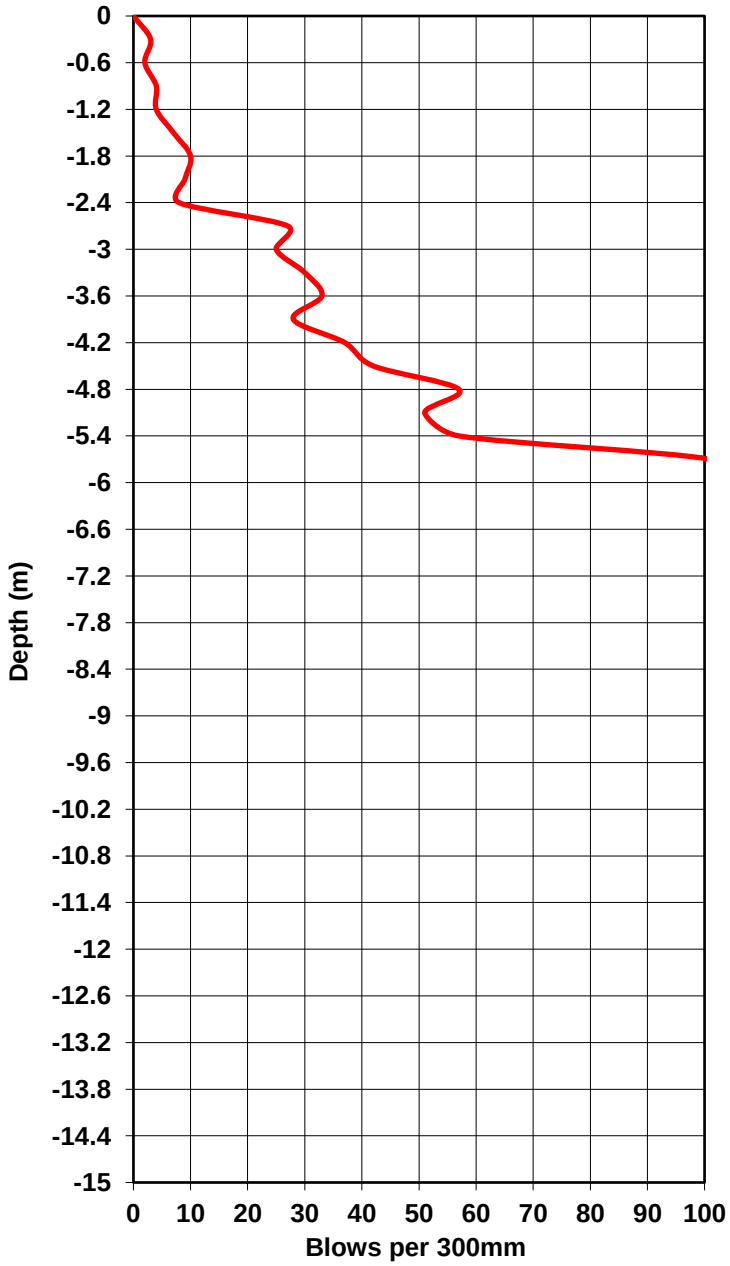
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 2***

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 angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	3	Very Loose
0.6	2	Very Loose
0.9	4	Very Loose
1.2	4	Very Loose
1.5	7	Loose
1.8	10	Loose
2.1	9	Loose
2.4	8	Loose
2.7	27	Med.Dense
3	25	Med.Dense
3.3	30	Med.Dense
3.6	33	Med.Dense
3.9	28	Med.Dense
4.2	37	Med.Dense
4.5	42	Dense
4.8	57	Dense
5.1	51	Dense
5.4	57	Dense
	Ref	



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Client:	**SiVEST Consulting**	**Ref.No.**	**21-030**
Project:	**Tiffany's Expansion Project**	**Date:**	
Section:		**Operator:**	**EN**

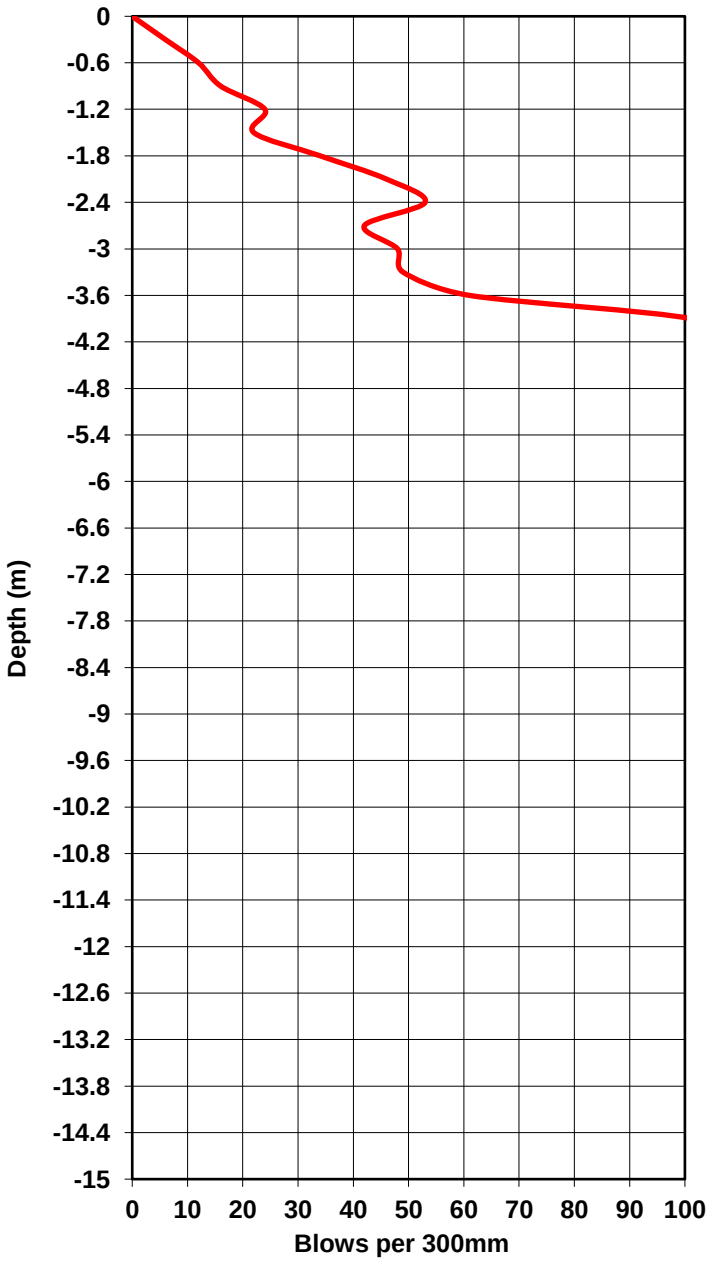
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 3***

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 angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	6	Very Loose
0.6	12	Soft
0.9	16	Soft
1.2	24	Firm
1.5	22	Firm
1.8	34	Stiff
2.1	46	Dense
2.4	53	Dense
2.7	42	Dense
3	48	Dense
3.3	49	Dense
3.6	61	Dense
	Ref	



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Project:	**Tiffany's Expansion Project**	**Date:**	
Section:		**Operator:**	**EN**

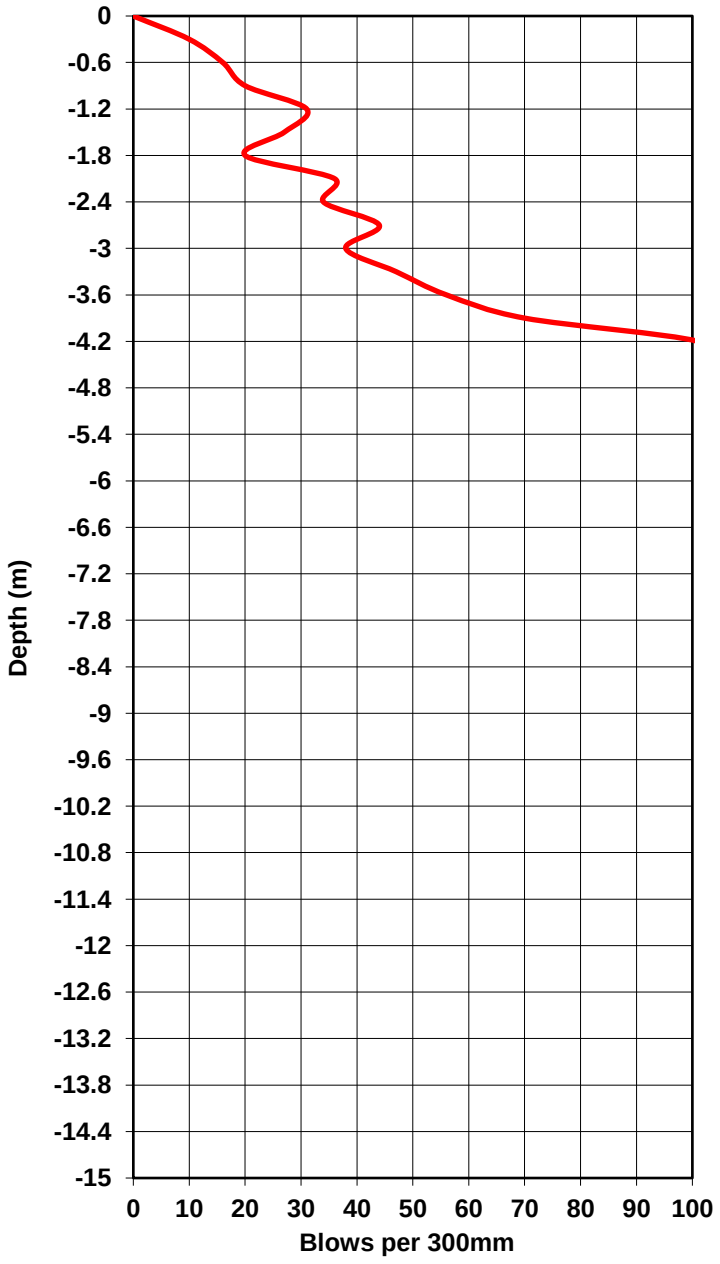
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 4***

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 angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	10	Loose
0.6	16	Med.Dense
0.9	20	Firm
1.2	31	Firm
1.5	27	Firm
1.8	20	Med.Dense
2.1	36	Med.Dense
2.4	34	Med.Dense
2.7	44	Dense
3	38	Med.Dense
3.3	47	Dense
3.6	56	Dense
3.9	70	Dense
	Ref	



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Section:		**Operator:**	**EN**

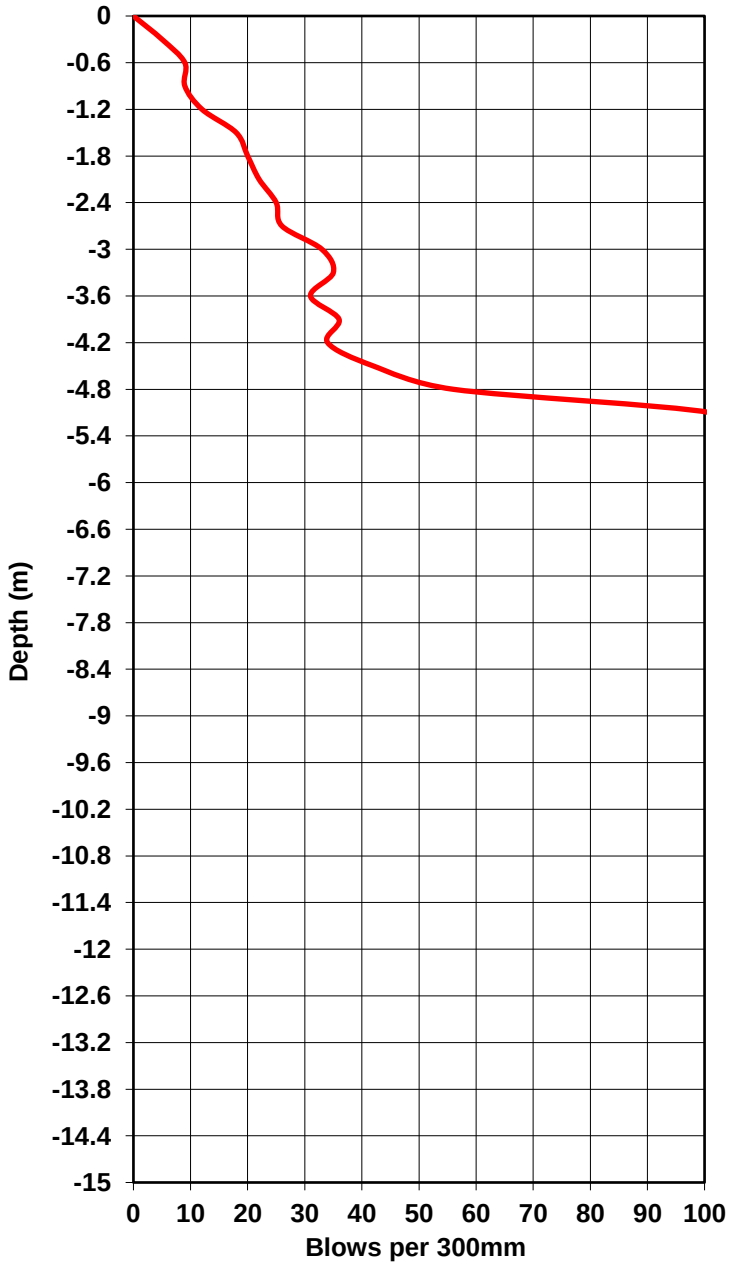
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 5***

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 angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	5	Very Loose
0.6	9	Loose
0.9	9	Soft
1.2	12	Soft
1.5	18	Firm
1.8	20	Firm
2.1	22	Firm
2.4	25	Med.Dense
2.7	26	Med.Dense
3	33	Med.Dense
3.3	35	Med.Dense
3.6	31	Med.Dense
3.9	36	Med.Dense
4.2	34	Med.Dense
4.5	42	Dense
4.8	56	Dense
	Ref	



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Section:		**Operator:**	**EN**

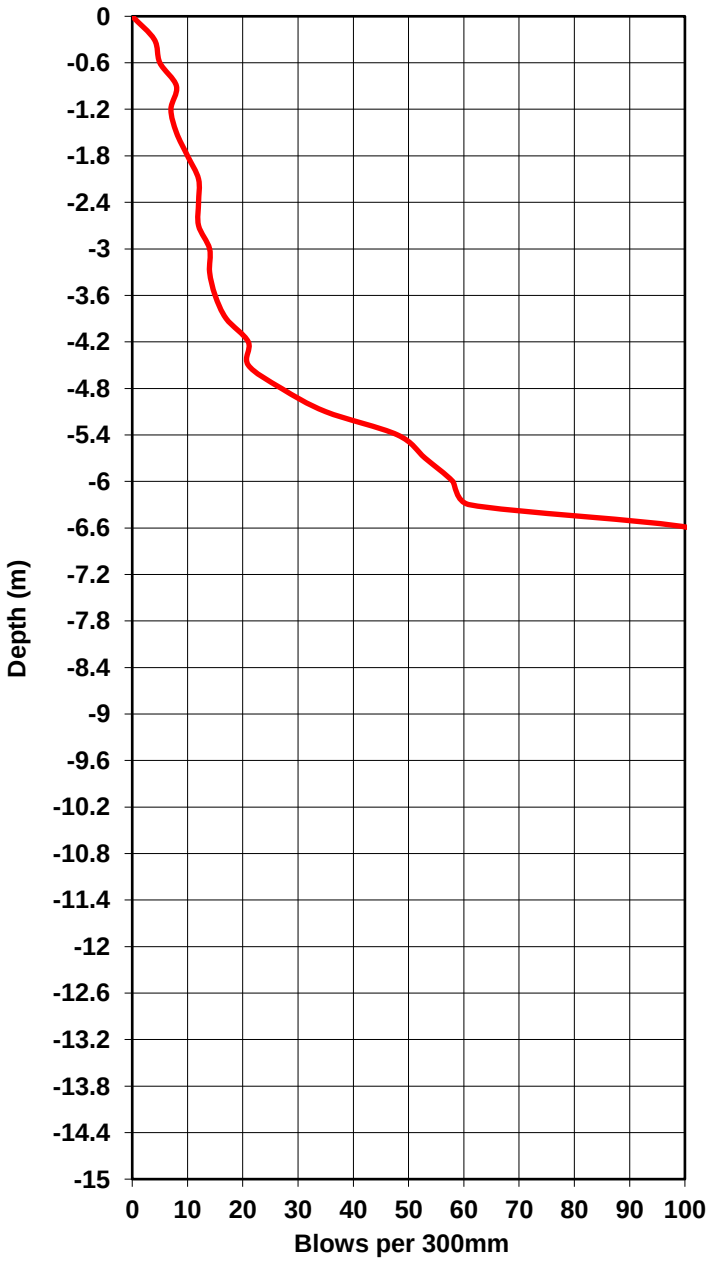
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 6***

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 angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	4	Very Loose
0.6	5	Very Loose
0.9	8	Loose
1.2	7	Loose
1.5	8	Loose
1.8	10	Loose
2.1	12	Loose
2.4	12	Loose
2.7	12	Loose
3	14	Loose
3.3	14	Loose
3.6	15	Loose
3.9	17	Med.Dense
4.2	21	Med.Dense
4.5	21	Med.Dense
4.8	27	Med.Dense
5.1	35	Med.Dense
5.4	48	Dense
5.7	53	Dense
6	58	Dense
6.3	61	Dense
	Ref	



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Section:		**Operator:**	**EN**

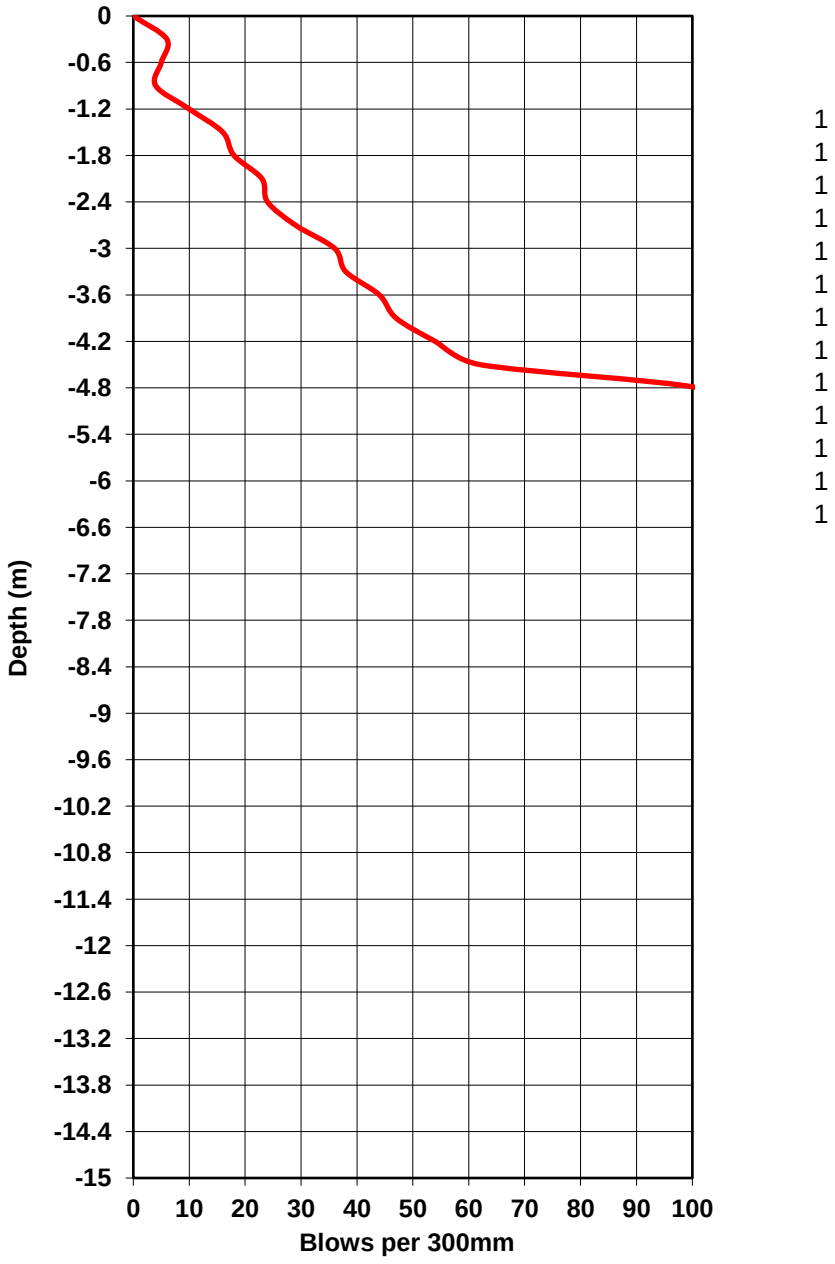
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 7***

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 angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	6	Very Loose
0.6	5	Very Loose
0.9	4	Very Soft
1.2	10	Soft
1.5	16	Soft
1.8	18	Firm
2.1	23	Firm
2.4	24	Firm
2.7	29	Firm
3	36	Stiff
3.3	38	Stiff
3.6	44	Stiff
3.9	47	Stiff
4.2	54	Stiff
4.5	62	Stiff
	Ref	



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Client:	**SiVEST Consulting**	**Ref.No.**	**21-030**
Project:	**Tiffany's Expansion Project**	**Date:**	
Section:		**Operator:**	**EN**

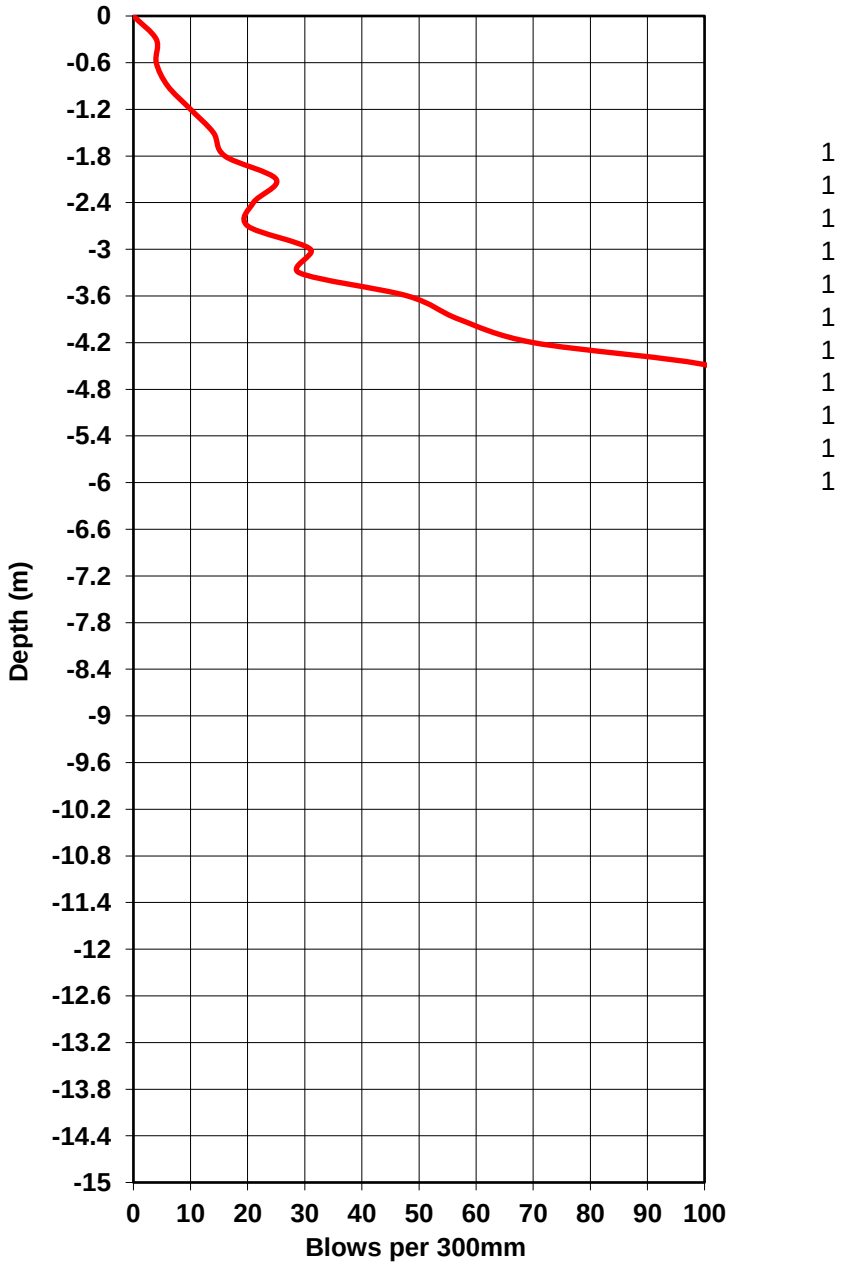
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 8***

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 angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	4	Very Loose
0.6	4	Very Loose
0.9	6	Very Loose
1.2	10	Soft
1.5	14	Soft
1.8	16	Soft
2.1	25	Firm
2.4	21	Firm
2.7	20	Firm
3	31	Firm
3.3	29	Firm
3.6	48	Stiff
3.9	57	Stiff
4.2	70	Very Stiff
	Ref	



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Client:	**SiVEST Consulting**	**Ref.No.**	**21-030**
Project:	**Tiffany's Expansion Project**	**Date:**	
Section:		**Operator:**	**EN**

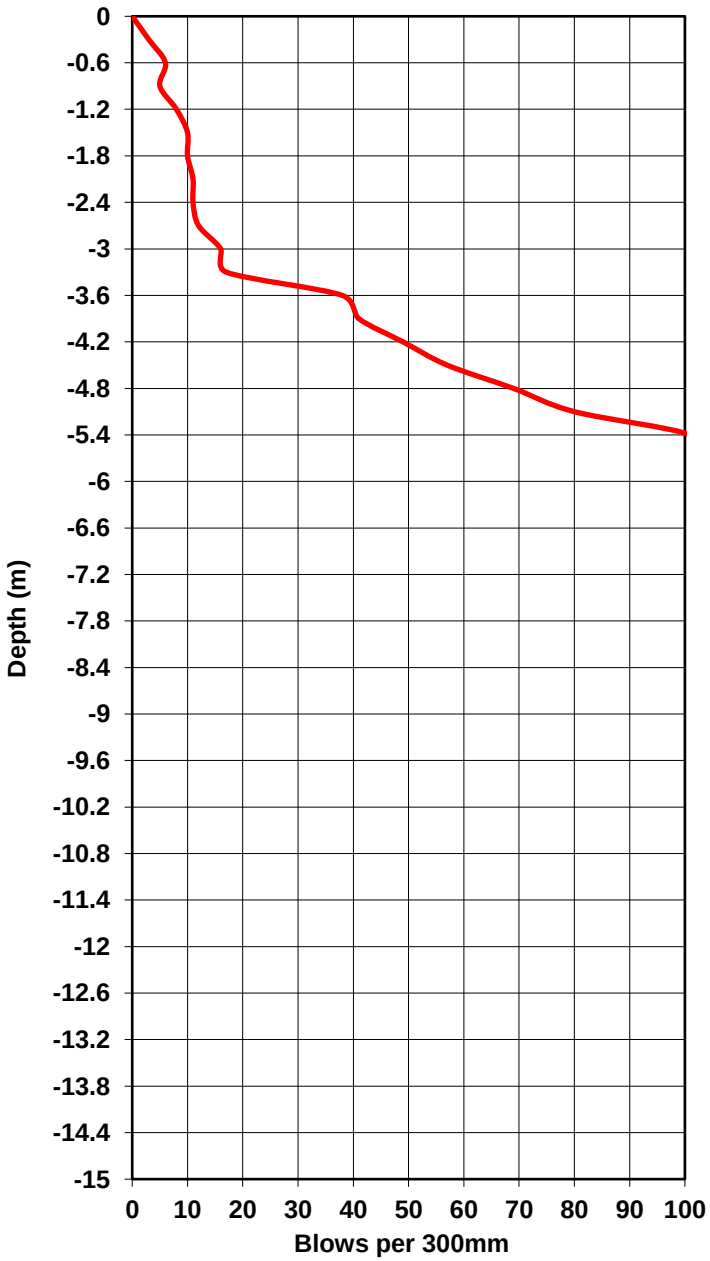
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 9***

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 angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	3	Very Loose
0.6	6	Very Loose
0.9	5	Very Loose
1.2	8	Loose
1.5	10	Loose
1.8	10	Loose
2.1	11	Loose
2.4	11	Loose
2.7	12	Loose
3	16	Med.Dense
3.3	17	Med.Dense
3.6	38	Med.Dense
3.9	41	Dense
4.2	49	Dense
4.5	57	Dense
4.8	69	Dense
5.1	80	Dense
	Ref	



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Client:	**SiVEST Consulting**	**Ref.No.**	**21-030**
Project:	**Tiffany's Expansion Project**	**Date:**	
Section:		**Operator:**	**EN**

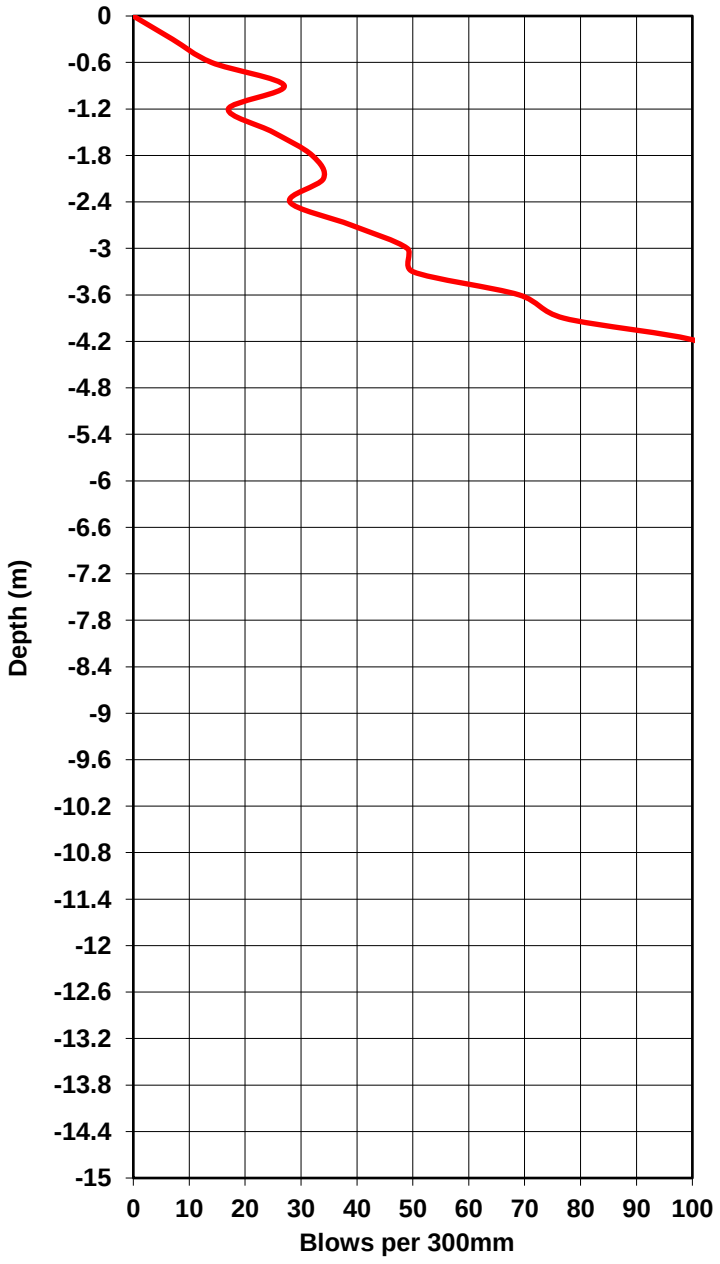
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 10***

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 angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	7	Loose
0.6	14	Soft
0.9	27	Firm
1.2	17	Firm
1.5	25	Firm
1.8	32	Firm
2.1	34	Stiff
2.4	28	Med.Dense
2.7	39	Med.Dense
3	49	Dense
3.3	50	Dense
3.6	69	Dense
3.9	77	Dense
	Ref	



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Tel: (082) 9260626 Email: info@geozone.co.za www.geozone.co.za

Client:	**SiVEST Consulting**	**Ref.No.**	**21-030**
Project:	**Tiffany's Expansion Project**	**Date:**	
Section:		**Operator:**	**EN**

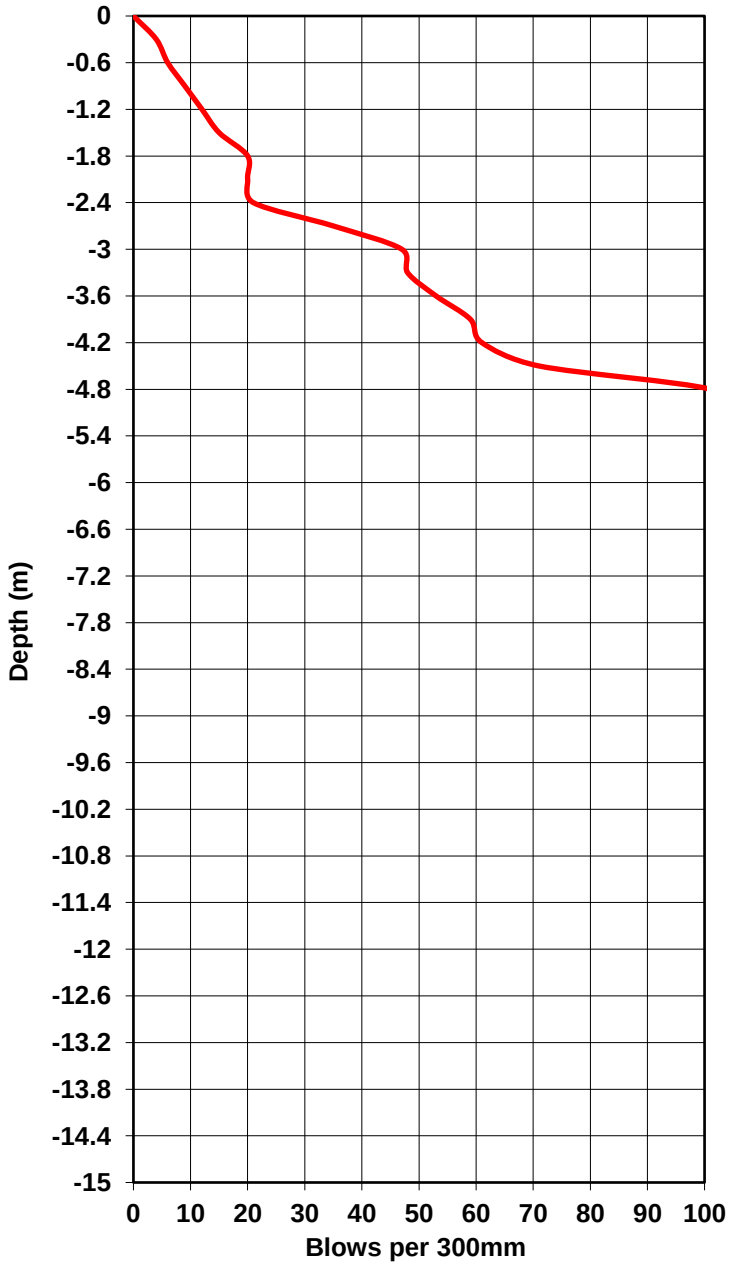
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 11***

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 angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	4	Very Loose
0.6	6	Very Loose
0.9	9	Soft
1.2	12	Soft
1.5	15	Soft
1.8	20	Firm
2.1	20	Firm
2.4	21	Firm
2.7	35	Med.Dense
3	47	Dense
3.3	48	Dense
3.6	53	Dense
3.9	59	Dense
4.2	61	Dense
4.5	71	Dense
	Ref	



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Client:	**SiVEST Consulting**	**Ref.No.**	**21-030**
Project:	**Tiffany's Expansion Project**	**Date:**	
Section:		**Operator:**	**EN**

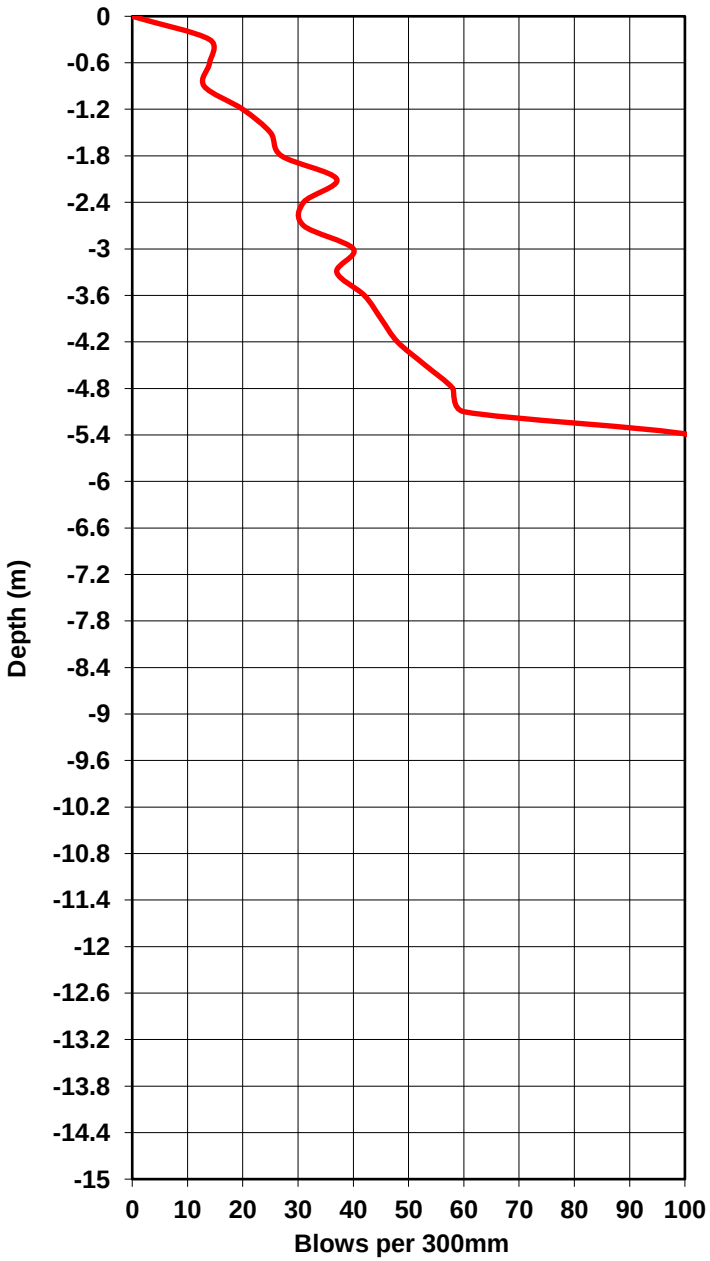
Light Dynamic Penetrometer Probe ---------- ***Test No. DPL 12***

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 angle
Rods: 16mm diameter, 22mm diameter couplings

C=1
Phi=0

Depth metres	Blows per 300mm	Inferred Consistency
0		
0.3	14	Loose
0.6	14	Loose
0.9	13	Loose
1.2	20	Med.Dense
1.5	25	Med.Dense
1.8	27	Med.Dense
2.1	37	Med.Dense
2.4	31	Med.Dense
2.7	31	Firm
3	40	Stiff
3.3	37	Stiff
3.6	42	Stiff
3.9	45	Stiff
4.2	48	Stiff
4.5	53	Stiff
4.8	58	Stiff
5.1	60	Stiff
	Ref	



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Appendix C
(Laboratory Test Results)

SGS MATROLAB

SGS MATROLAB (PTY) LTD
- CIVIL ENGINEERING SERVICES -
Reg.No.: 2003/029180/07 - VAT. Reg.No.: 4040210587
a SANAS Accredited Testing Laboratory, No. T 0239

60 Columbine Place, Glen Anil, Durban North, 4051

Tel. : (031) 579 1220/1
Fax : (031) 579 1344
Email : rasalis.bhikam@sgs.com

sanas Testing Laboratory T 0239

CLIENT :	Gondwana Geo Solutions (Pty) Ltd	OUR REF.:	37946
ADDRESS :	17 Kingmead Drive Westville, Durban 3629	YOUR REF.:	21-141/1
ATTENTION :	Mr Mark Richter	DATE :	21.01.2022

PROJECT : Tiffany's Shopping Centre

SGS MATROLAB

a SANAS Accredited Testing Laboratory, No. T 0239

Tests marked * "Not SANAS Accredited" in this Report are not included in the SANAS Schedule of Accreditation for the laboratory.

TEST REPORT / RESULTS

Sample/s:

Sampled by : -
Date Received / Sampled : 15.12.2021
Date Tested : 05.01.2022

Sampling method : -

Section / Position tested identified by : Customer

Number of pages in this Report : 9

General :

Technical Signatory : Rasalis Bhikam

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T 0239

TEST RESULTS

Gondwana Geo Solutions (Pty) Ltd 17 Kingmead Drive Westville, Durban 3629 Attention: Mr Mark Richter	Project : Tiffany's Shopping Centre Your Ref : 21-141/1 Our Ref : 37946 Date Reported : 21.01.2022

SIEVE ANALYSIS, ATTERBERG LIMITS, CBR(SANS 3001:GR1,GR10,GR12,GR20,GR30,GR40)

SAMPLE NO.	15263	15264	15265		Preparation Method:
HOLE NO.	TP 9	TP 11	TP 12		Sample was scalped on the 37.5mm sieve
ROAD NO.	-	-	-		
DEPTH	0 - 2.50m	0.80 - 2.40m	0 - 0.90m		
CHAINAGE	TP 9	TP 11	TP 12		
LAYER TYPE	-	-	-		
STABILISED WITH	Natural	Natural	Natural		
SUPPLIER	-	-	-		
CURING METHOD	-	-	-		
DATE TESTED	05.01.2022	05.01.2022	05.01.2022		
DESCRIPTION	Br to Lt Br Medium Grained Sand	Dk Or Br, Reddish Br and Grey Clay	Dark Grey Clayey Sand		Specification Min : Max
SIEVE ANALYSIS (% PASSING)					
100 mm					
75 mm					
63 mm					
50 mm					
37.5 mm					
28.0 mm					
20.0 mm					
14.0 mm	100				
5.0 mm	100	100	100		
2.0 mm	99	99	100		
0.425 mm	93	95	97		
0.075 mm	22	72	53		
SOIL MORTAR					
COARSE SAND <2.0mm >0.425mm	5	3	3		
FINE SAND <0.425mm >0.075mm	73	23	44		
MATERIAL <0.075mm	22	74	53		
CONSTANTS					
GRADING MODULUS	0,86	0,33	0,50		
PRA CLASSIFICATION	A-2-4(0)	A-6(10)	A-4(4)		
COLTO CLASSIFICATION	---	---	---		
TRH Class.(INSITU |93%|90%|)	G10|G10	- | -	- | -		
LIQUID LIMIT (%)	-	35	29		
PLASTICITY INDEX (0.425mm)	NP	15	10		
LINEAR SHRINKAGE (%)	0,0	7,5	5,0		
MDD					
MAXIMUM DRY DENSITY (kg/m^3)	1857	1690	1677		
OPTIMUM MOISTURE CONTENT(%)	9,9	16,4	19,0		
MOULDING MOISTURE (%)	9,7	16,7	18,9		
TYPE OF TEST	CBR	CBR	CBR		
CBR-UCS @ 100% MDD	13	3,5	5,0		
CBR-UCS @ 98% MDD	11	3,1	4,2		
CBR-UCS @ 97% MDD	10	2,9	3,9		
CBR-UCS @ 95% MDD	8,1	2,3	3,2		
CBR-UCS @ 93% MDD	6,0	1,6	2,2		
CBR-UCS @ 90% MDD	3,8	0,9	1,0		

CBR-UCS @ % MDD derived from calculation.

% SWELL MOULD [A][B][C]	0,00	0,00	0,00	7,10	7,20	7,40	1,60	1,70	1,70						

Remarks :

FORM: GR40

4.4.1(SGS)(2019.12.04)

Technical Signatory : Rasalis Bhikam

MATROLAB IS NOW PART OF SGS, THE WORLDS'S LEADING INSPECTION, VERFICATION, TESTING AND CERTIFICATION COMPANY.

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sanas Testing Laboratory T 0239

TEST RESULTS

Gondwana Geo Solutions (Pty) Ltd 17 Kingmead Drive Westville, Durban 3629 Attention: Mr Mark Richter	Project : Tiffany's Shopping Centre Your Ref : 21-141/1 Our Ref : 37946 Date Reported : 21.01.2022

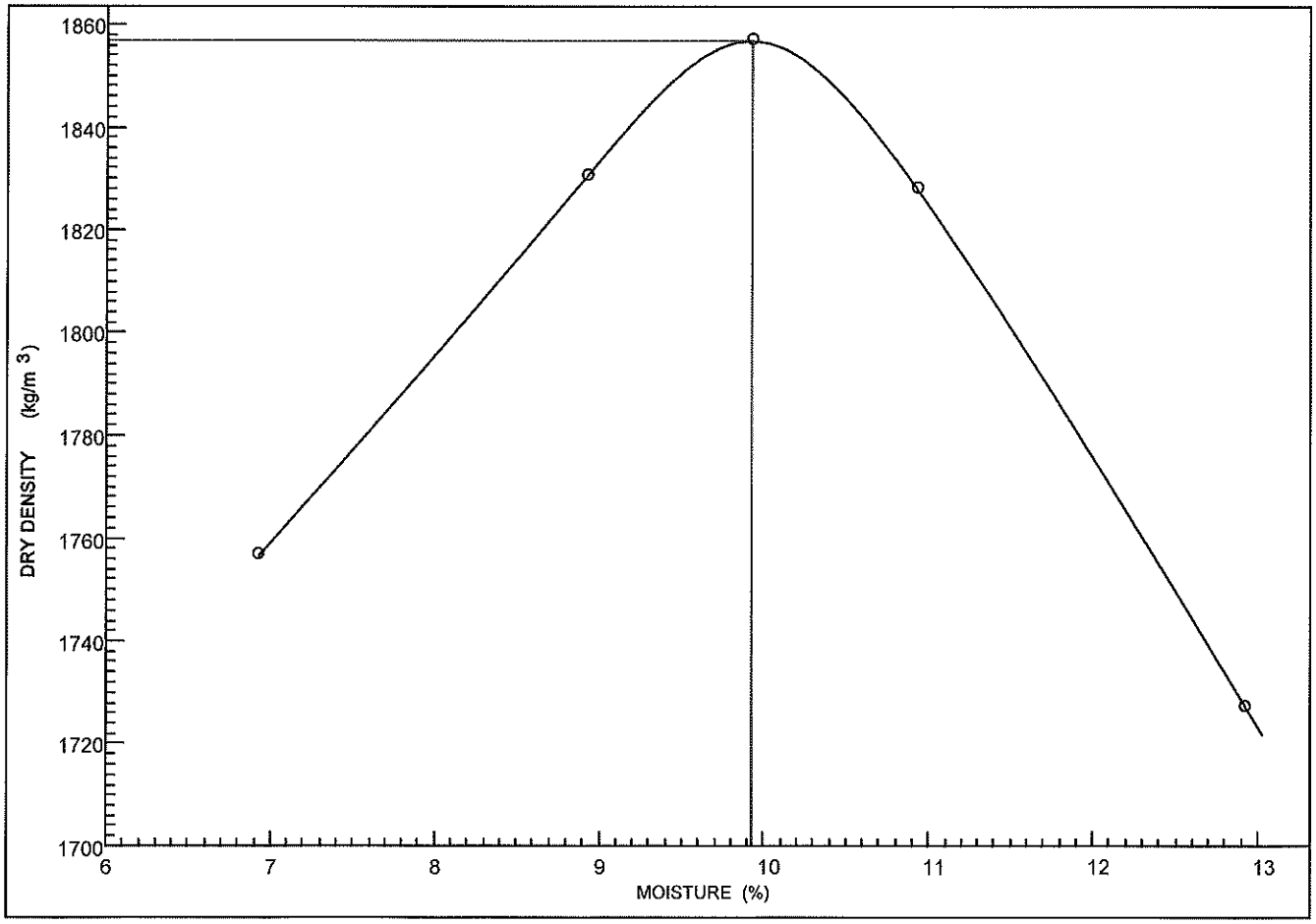
MOISTURE / DENSITY RELATIONSHIP(SANS 3001: GR30)

Sample No.: 15263	Hole No. : TP 9	Depth (mm) : 0 - 2.50m
Origin : TP 9	Stabilized With : Natural	Compaction Energy : MDD
Material Description : Brown to Light Brown Medium Grained Sand		

Maximum Dry Density (kg/m^3): 1857

Optimum Moisture Content (%) : 9,9

Point No.	1	2	3	4	5			
Moisture (%)	6,9	8,9	9,9	10,9	12,9			
Density (kg/m^3)	1757	1831	1857	1828	1727			



Remarks :

FORM: GR30

4.4.1(SGS)(2019.12.04)

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TEST RESULTS

Gondwana Geo Solutions (Pty) Ltd 17 Kingmead Drive Westville, Durban 3629 Attention: Mr Mark Richter	Project : Tiffany's Shopping Centre Your Ref : 21-141/1 Our Ref : 37946 Date Reported : 21.01.2022

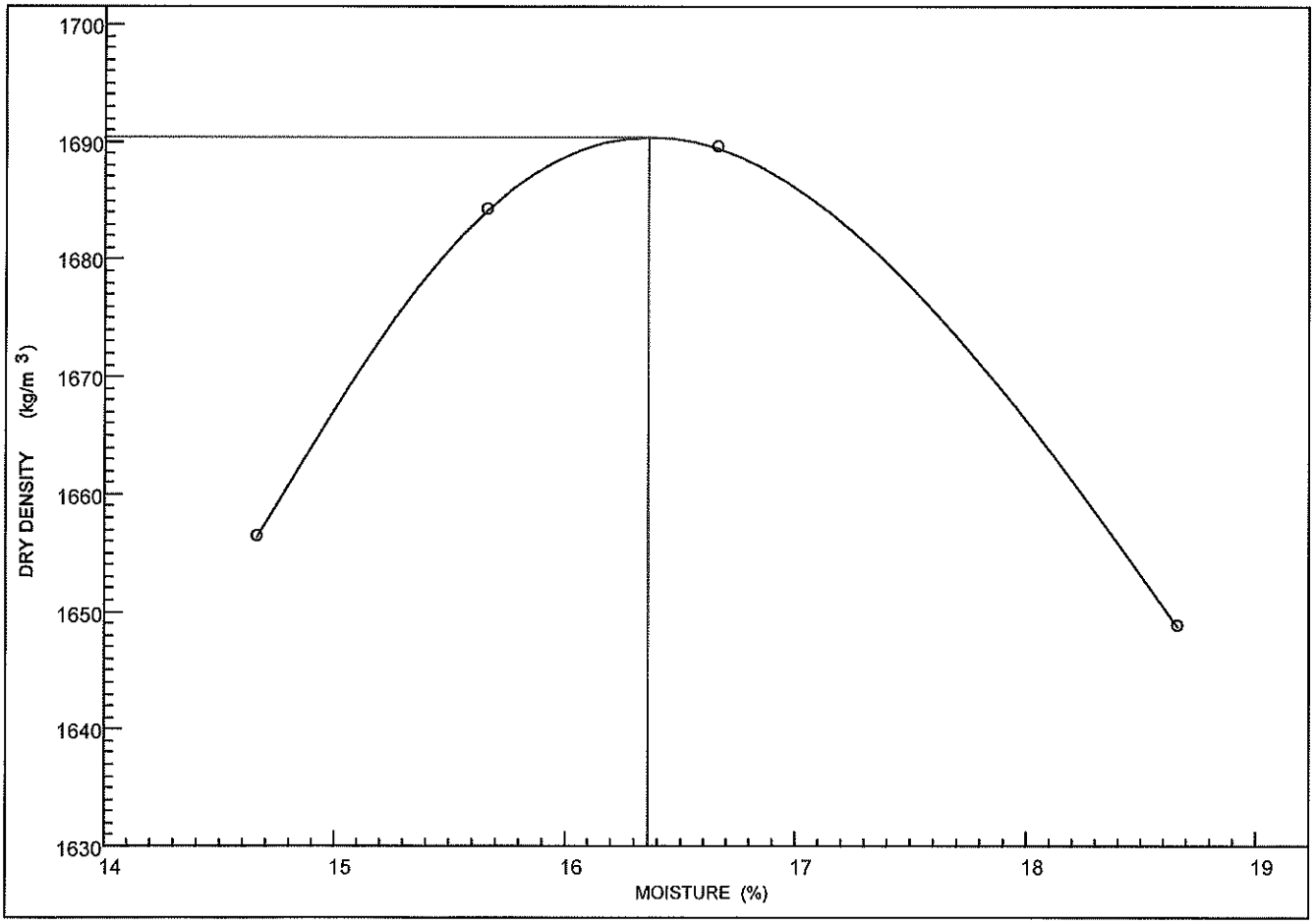
MOISTURE / DENSITY RELATIONSHIP(SANS 3001: GR30)

Sample No.: 15264	Hole No. : TP 11	Depth (mm) : 0.80 - 2.40m
Origin : TP 11	Stabilized With : Natural	Compaction Energy : MDD
Material Description : Dark Orangey Brown, Reddish Brown and Grey Clay		

Maximum Dry Density (kg/m^3): 1690

Optimum Moisture Content (%) : 16,4

Point No.	1	2	3	4				
Moisture (%)	14,7	15,7	16,7	18,7				
Density (kg/m^3)	1656	1684	1689	1649				



Remarks :

FORM: GR30

4.4.1(SGS)(2019.12.04)

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TEST RESULTS

Gondwana Geo Solutions (Pty) Ltd 17 Kingmead Drive Westville, Durban 3629 Attention: Mr Mark Richter	Project : Tiffany's Shopping Centre Your Ref : 21-141/1 Our Ref : 37946 Date Reported : 21.01.2022

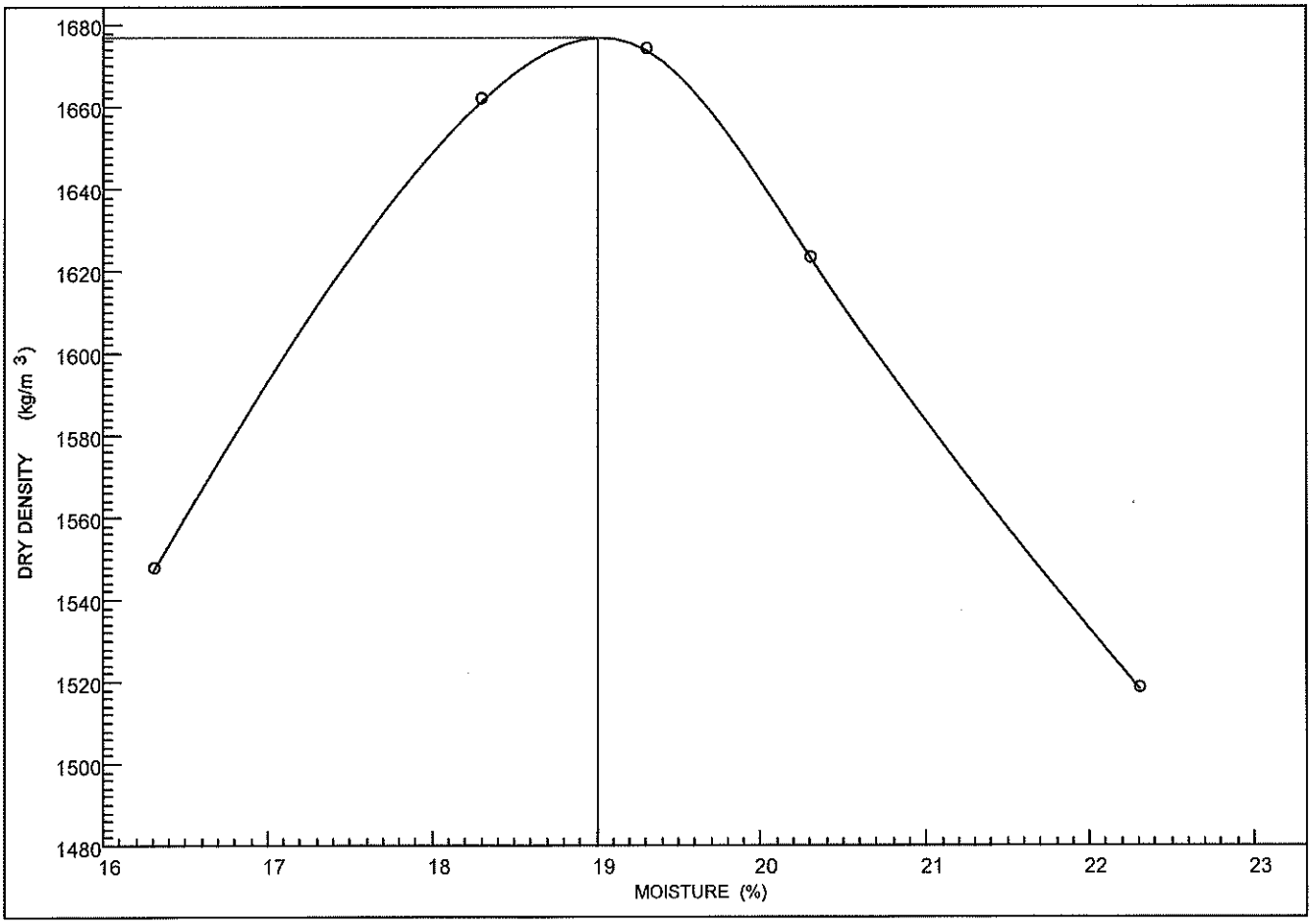
MOISTURE / DENSITY RELATIONSHIP(SANS 3001: GR30)

Sample No.: 15265	Hole No. : TP 12	Depth (mm) : 0 - 0.90m
Origin : TP 12	Stabilized With : Natural	Compaction Energy : MDD
Material Description : Dark Brown Clayey Sand		

Maximum Dry Density (kg/m^3): 1677

Optimum Moisture Content (%) : 19,0

Point No.	1	2	3	4	5			
Moisture (%)	16,3	18,3	19,3	20,3	22,3			
Density (kg/m^3)	1547	1662	1674	1623	1518			



Remarks :

FORM: GR30

4.4.1(SGS)(2019.12.04)

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TEST RESULTS

Gondwana Geo Solutions (Pty) Ltd
17 Kingmead Drive
Westville, Durban
3629
Attention: Mr Mark Richter

Project : Tiffany's Shopping Centre

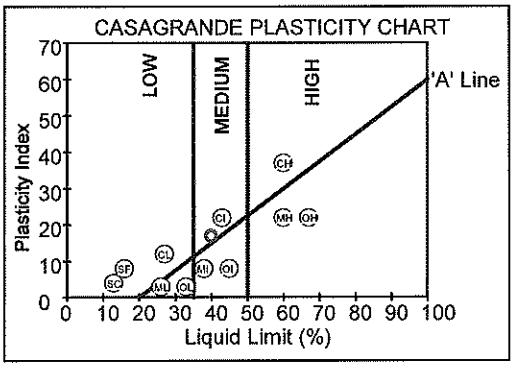
Your Ref : 21-141/1
Our Ref : 37946
Date Reported : 17.01.2022

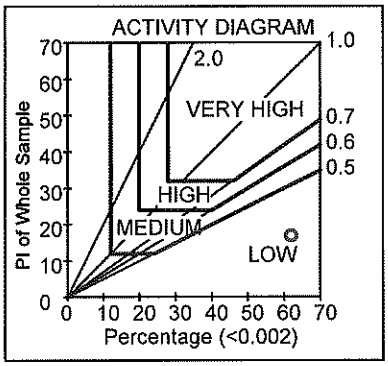
FOUNDATION INDICATOR (ASTM: D422)

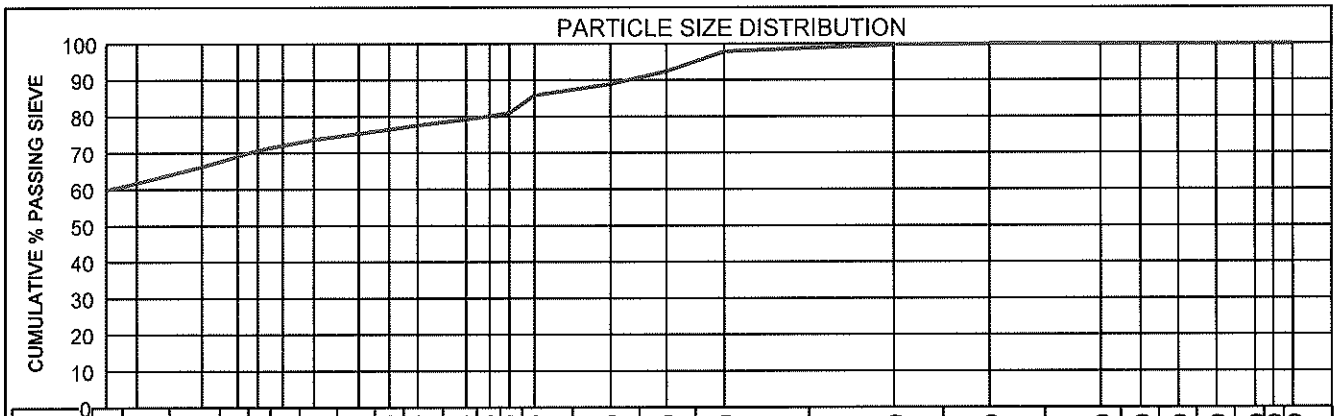
Sample No.	: 15262
Hole No.	: TP 4
Depth	: 0 - 0.50m
Liquid Limit (%)	: 40
Plasticity Index	: 17
Linear Shrinkage (%)	: 8,5
PI of Whole Sample	: 17
P.R.A. Classification	: A-7-6(11)
Unified Soil Classificati	: CL
Activity	: 0,27
Heave Classification	: LOW
Grading Modulus	: 0,16
Percentage (<0.002)	: 62,0
Moisture Content (%)	: 37,9

Material Description : Dark Brown CLAY

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	69,1	11,1	19,5	0,3	CLAY
Astm	69,1	16,7	14,2	0,0	CLAY
British Standard	61,9	19,2	18,6	0,3	CLAY







Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0260	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	60	62	66	69	71	72	74	75	77	78	79	80	81	86	89	93	98	100	100	100	100	100	100	100	100	100

JENN	CLAY		SILT		SAND				GRAVEL		
ASTM	CLAY		SILT			FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL		
BS	CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	MEDIUM GRAVEL	COARSE GRAVEL	

Remarks :

FORM: A6

4.4.1(SGS)(2019.12.04)

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60 Columbine Place, Glen Anil, Durban North, 4051

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TEST RESULTS

Gondwana Geo Solutions (Pty) Ltd
17 Kingmead Drive
Westville, Durban
3629
Attention: Mr Mark Richter

Project : Tiffany's Shopping Centre

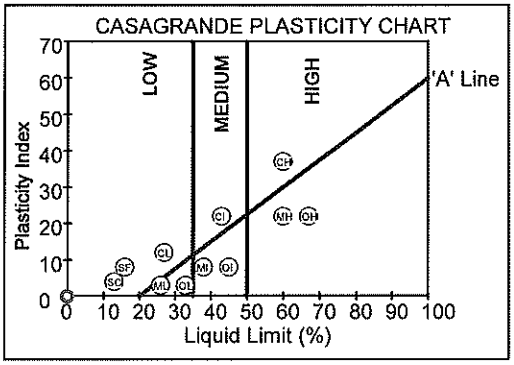
Your Ref : 21-141/1
Our Ref : 37946
Date Reported : 17.01.2022

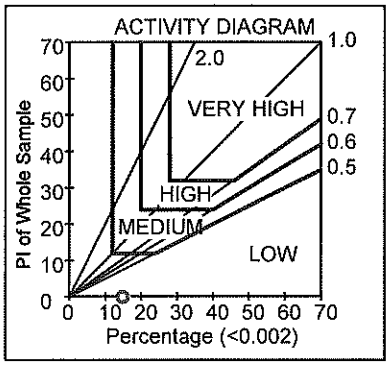
FOUNDATION INDICATOR (ASTM: D422)

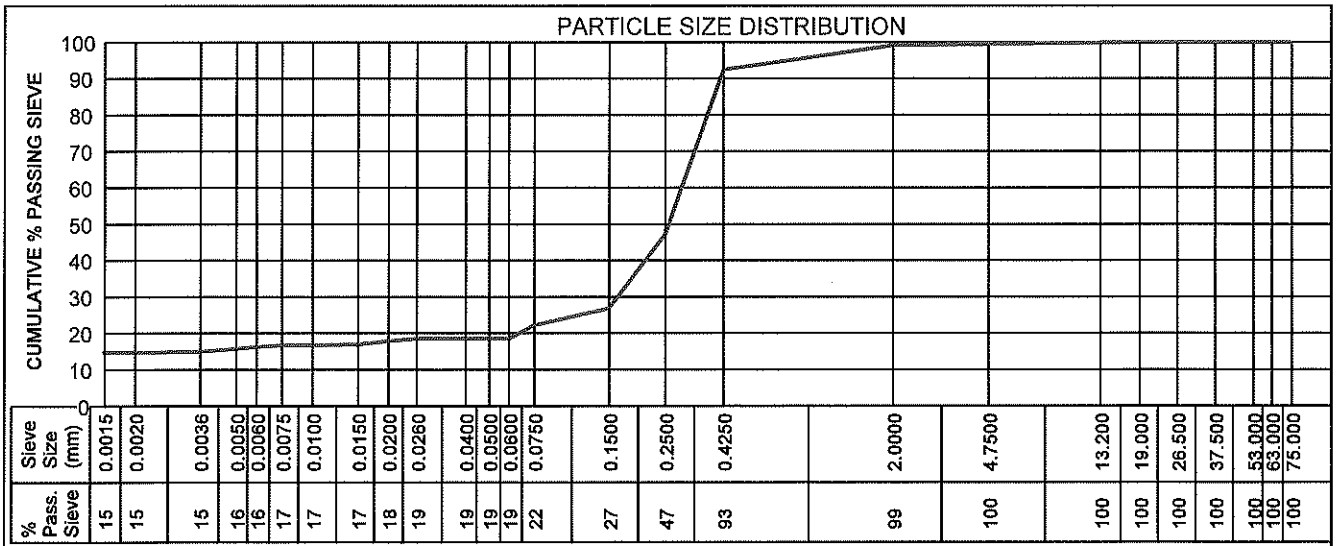
Sample No.	: 15263
Hole No.	: TP 9
Depth	: 0 - 2.50m
Liquid Limit (%)	: -
Plasticity Index	: NP
Linear Shrinkage (%)	: 0,0
PI of Whole Sample	: 0
P.R.A. Classification	: A-2-4(0)
Unified Soil Classificati	: SC
Activity	: 0,00
Heave Classification	: LOW
Grading Modulus	: 0,86
Percentage (<0.002)	: 15,0
Moisture Content (%)	: 2,4

Material Description : Brown to Light Brown SILTY SAND

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	15,8	2,8	80,7	0,7	SAND
Astm	15,8	6,5	77,3	0,4	SILTY SAND
British Standard	14,9	3,7	80,7	0,7	SAND







Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0260	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	15	15	15	16	16	17	17	17	18	19	19	19	19	22	27	47	93	99	100	100	100	100	100	100	100	100

JENN	CLAY		SILT		SAND			GRAVEL		
ASTM	CLAY		SILT			FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL	
BS	CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	MEDIUM GRAVEL	COARSE GRAVEL

Remarks :

FORM: A6

4.4.1(SGS)(2019.12.04)

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TEST RESULTS

Gondwana Geo Solutions (Pty) Ltd
17 Kingmead Drive
Westville, Durban
3629
Attention: Mr Mark Richter

Project : Tiffany's Shopping Centre

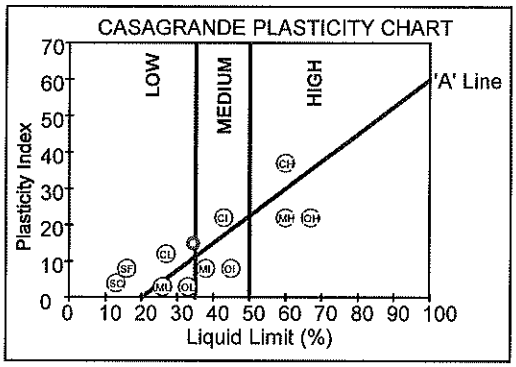
Your Ref : 21-141/1
Our Ref : 37946
Date Reported : 17.01.2022

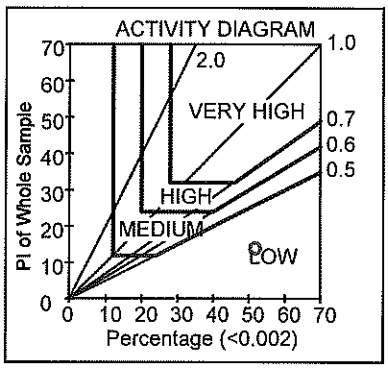
FOUNDATION INDICATOR (ASTM: D422)

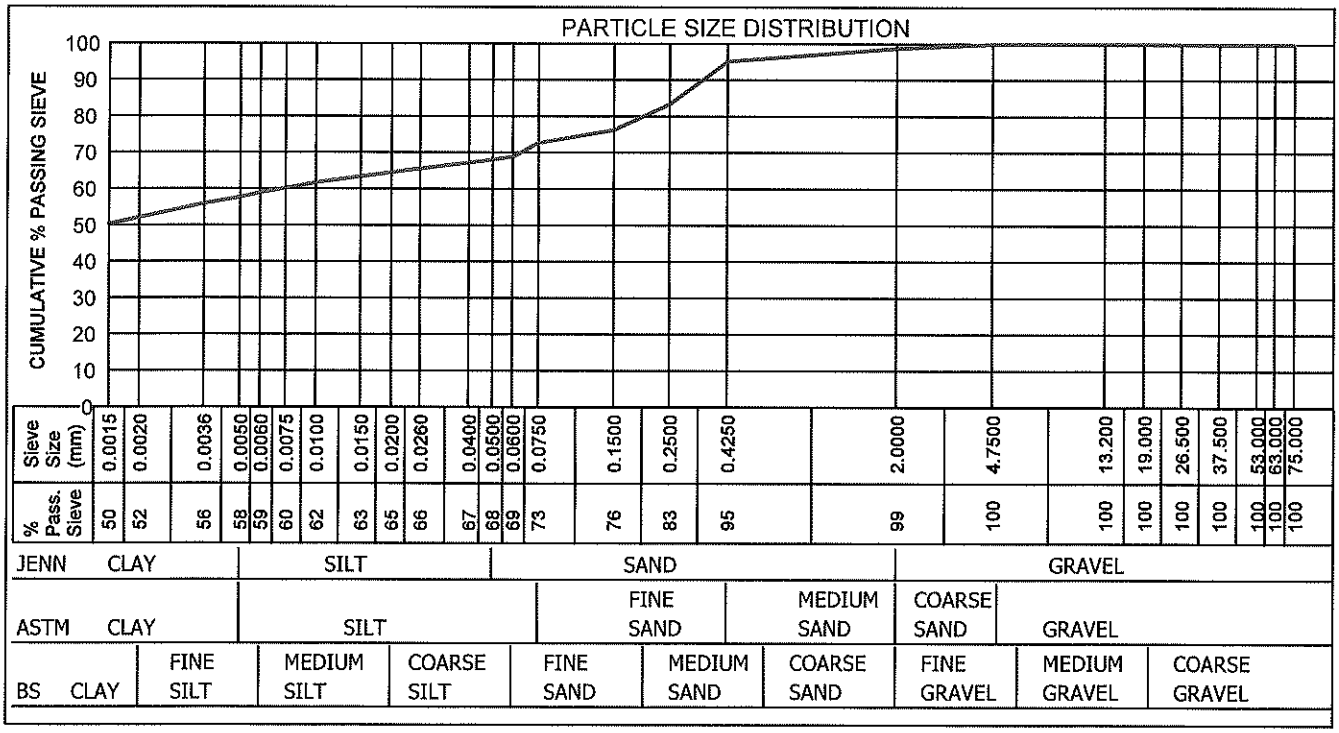
Sample No.	: 15264
Hole No.	: TP 11
Depth	: 0.80 - 2.40m
Liquid Limit (%)	: 35
Plasticity Index	: 15
Linear Shrinkage (%)	: 7,5
PI of Whole Sample	: 14
P.R.A. Classification	: A-6(10)
Unified Soil Classificati	: CL
Activity	: 0,27
Heave Classification	: LOW
Grading Modulus	: 0,33
Percentage (<0.002)	: 52,0
Moisture Content (%)	: 21,6

Material Description : Orangey Brown, Reddish Brown and Grey CLAY

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	57,8	10,3	30,8	1,1	CLAY
Astm	57,8	14,9	27,3	0,0	CLAY
British Standard	52,2	16,7	29,9	1,1	CLAY







Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0260	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	50	52	56	58	59	60	62	63	65	66	67	68	69	73	76	83	95	99	100	100	100	100	100	100	100	100

JENN	CLAY	SILT		SAND			GRAVEL			
ASTM	CLAY	SILT		FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL			
BS	CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	MEDIUM GRAVEL	COARSE GRAVEL

Remarks :

FORM: A6

4.4.1(SGS)(2019.12.04)

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TEST RESULTS

Gondwana Geo Solutions (Pty) Ltd
17 Kingmead Drive
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3629
Attention: Mr Mark Richter

Project : Tiffany's Shopping Centre

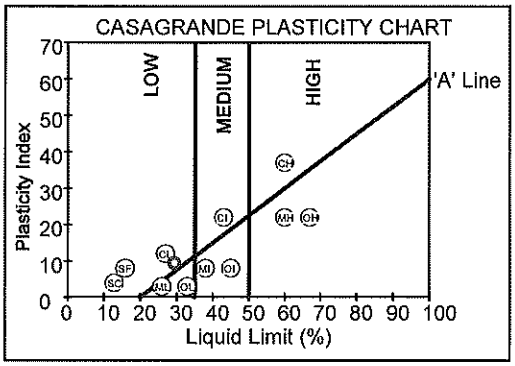
Your Ref : 21-141/1
Our Ref : 37946
Date Reported : 17.01.2022

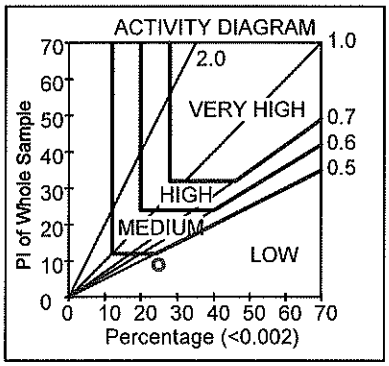
FOUNDATION INDICATOR (ASTM: D422)

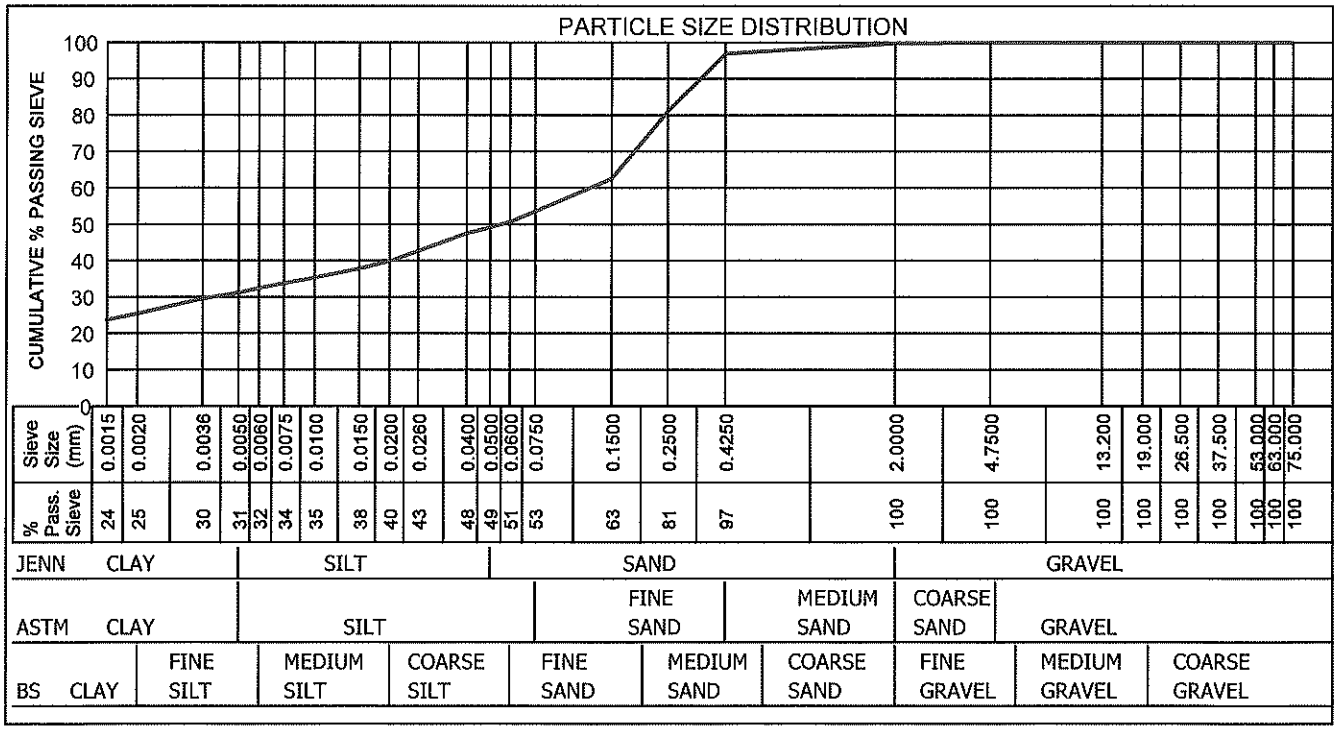
Sample No.	: 15265
Hole No.	: TP 12
Depth	: 0 - 0.90m
Liquid Limit (%)	: 29
Plasticity Index	: 10
Linear Shrinkage (%)	: 5,0
PI of Whole Sample	: 9
P.R.A. Classification	: A-4(4)
Unified Soil Classificati	: CL
Activity	: 0,36
Heave Classification	: LOW
Grading Modulus	: 0,50
Percentage (<0.002)	: 25,0
Moisture Content (%)	: 16,8

Material Description : Dark Brown SANDY CLAY

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Classification
Jennings	31,2	17,9	50,7	0,2	SANDY CLAY
Astm	31,2	22,2	46,6	0,0	SANDY CLAY
British Standard	25,5	25,3	49,0	0,2	CLAYEY SAND







Sieve Size (mm)	0.0015	0.0020	0.0036	0.0050	0.0060	0.0075	0.0100	0.0150	0.0200	0.0260	0.0400	0.0500	0.0600	0.0750	0.1500	0.2500	0.4250	2.0000	4.7500	13.200	19.000	26.500	37.500	53.000	63.000	75.000
% Pass. Sieve	24	25	30	31	32	34	35	38	40	43	48	49	51	53	63	81	97	100	100	100	100	100	100	100	100	100

JENN	CLAY		SILT			SAND			GRAVEL		
ASTM	CLAY		SILT			FINE SAND		MEDIUM SAND	COARSE SAND	GRAVEL	
BS	CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	MEDIUM GRAVEL	COARSE GRAVEL	

Remarks :

FORM: A6

4.4.1(SGS)(2019.12.04)

Technical Signatory : Rasalis Bhikam

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