REPORT TO

DAN SPARES CC

ON A PHASE 1

GEOTECHNICAL INVESTIGATION

FOR THE PROPOSED

KINGSBURGH EXTENSION 9

RESIDENTIAL HOUSING PROJECT,

KINGSBURGH

DRENNAN MAUD (PTY) LTD

GEOTECHNICAL ENGINEERS &

ENGINEERING GEOLOGISTS

Ref № 31873

SEPTEMBER 2017

Durban Head Office

68 Peter Mokaba Ridge, Tollgate, 4001

P.O. Box 30464, Mayville, 4058

Tel : +27 31 201 8992 Fax : +27 31 201 7920

www.drennanmaud.com

CONTENTS

Page № 1

CONTENTS

EXECUTIVE SUMMARY

The proposed Kingsburgh Extension 9 Residential Housing Project has been investigated by means of mechanically-excavated inspection pits and DCP testing.

The results of the Phase 1 geotechnical investigation for the proposed development may be summarised as follows;

1. A total of 29 № inspection pits (IP1 - 29) were excavated to depths of up to 2-3m, spread over the footprint of the proposed housing development. In addition a further 2 № hand augers (AH1 - 2) and 2 № exposure profiles (EXP1 - 2) were examined to identify the prevailing subsoil conditions below the site and depth to bedrock.
2. The site is underlain predominantly by Dwyka Group tillite and the conformably overlying shale bedrock of the Pietermaritzburg Formation which generally caps the more elevated ridge/hill top areas of the site, these parent rock types having been weathered *in-situ* to produce a clayey mantle of colluvial and residual material.
3. The combined thickness of the various clayey horizons averages approximately 1,5m, but locally exceeds 3m.
4. The generally very clayey nature of the site mantle and shale bedrock points toward a dearth of road making materials and good-quality structural fill. Road pavement layerworks will have to be imported whilst structural platform design should aim to position structures predominantly upon cut *in-situ*.
5. The clays in the subsoil profile are shown to be of medium to high expansivity, it being forecast that seasonal heave thereupon of well in excess of 30mm may occur beneath light structures on well-developed soil profiles.
6. The majority of the investigated areas thus classifies as H1/R although more deeply weathered areas classifying as H2 occur locally.
7. Apart from the uppermost relatively gently sloping ridge tops, moderately to steeply sloping sideslopes will require significant cutting to create building platforms. Earthworks should aim to avoid major filling on steep slopes owing to the adverse stability problems associated therewith.
8. In terms of the above, structures should be placed ideally entirely in cut on normal strip footings/column bases or stiffened raft foundations for the founding of the proposed structures.
9. The internal road design must account for a heaving *in-situ* subgrade. Undercutting of such material to a pre-determined depth in the order of 300mm is likely to be required in mitigation thereof.
10. Although weathered bedrock is generally intersected at depths in the order of 1.0 - 1.5m below existing ground level, the highly weathered nature thereof generally dictates that the depth of “soft excavation” as defined by SABS 1200D is considered to depths in the order of at least 2 - 3m below existing ground level becoming potentially intermediate thereunder and as such hard bedrock will unlikely be encountered in conventional platform construction (< 3m cutting).
11. Notwithstanding the above, although not encountered, less weathered hard tillite corestones are possible and will require greater effort and possible localised blasting to remove if encountered.

1. TERMS OF REFERENCE AND SCOPE OF WORK

1.1 Terms of Reference

Drennan Maud (Pty) Ltd was requested to carry out the Phase 1 geotechnical investigation with regards to the above mentioned proposed housing development.

Following submission of our work proposal and cost estimate addressed to Mr G. Sims of Sivest (Pty) Ltd, Ref 91, dated 22nd March 2017, Drennan Maud (Pty) Ltd received notice of our appointment from Dan Spares cc, on the 6th April 2017.

1.2 Scope of Work

The proposed Kingsburgh Extension 9 Residential Housing development spans a combined area of some 10 hectare, of which approximately only 3.6Ha is developable due to the prevailing severe site topography.

The Phase 1 Geotechnical Site Investigation was carried out in terms of the Project Linked Greenfield Subsidy Housing Projects, Generic Specifications, GFSH-2 requirements, which dictated the following field and laboratory testing as a minimum;

Field testing:

- Excavation of 17№ inspection pits, supplemented by
- 17 № DCP (dynamic cone penetrometer) Tests

Laboratory testing:

- 9 № Foundation indicator tests
- 6 № consolidation/swell tests
- 6 № chemistry test
- 10 № Road Indicator tests
- 10 № Mod AASHTO density tests
- 10 № CBR tests

The site investigative work was carried out intermittently over a three month period from June to early August 2016, the staggered timing due to the dense bush requiring partial clearing prior to the site assessment to grant access and aid in mobilisation across the respective areas. The field work comprised the mechanical excavation of inspection pits, dynamic cone penetrometer testing and representative subsoil sampling.

This report details the factual data assimilated during the site investigation and provides recommendations to assist in the planning and design of the proposed development.

2. INFORMATION PROVIDED

For the purpose of the investigation, Mr Andre Wolfaard of Meridian Planning supplied Drennan Maud (Pty) Ltd with the following information;

- Contoured site plans of Erven 2954, 2955 and 2956.
- Sustainable Development & City Engineers Development Planning, Environment and Management Unit Draft Basic Assessment report for the Proposed Housing development on Kingsburgh Extension 9 and appendices, dated 12 September 2014 including Architect Elevation view indicating the number and type of units proposed on the respective sites and prevailing 1:3, 1:4 and 1:5 slopes.
- Ecological report carried out by the Afzelia Environmental Consultants titled "Ecological Assessment for the Proposed Cluster Housing Development on Erven 2954, 2955 and 2956 Kingsburgh Extension 9", dated February 2017.

The context plan included in the Draft Basis Assessment report has been used as the locality plan Drawing № 31873/01 of this report whilst the contoured site plans listed above have been used as the basis for the attached geological and geotechnical site plans of this report.

3. INFORMATION REVIEWED

Drennan Maud (Pty) Ltd, formerly Drennan Maud and Partners, have carried out a number of geotechnical investigations in the Kingsburgh area, most notably, the preliminary desktop geotechnical investigation for the Kingsburgh Extension 9 site, titled "Phase 1 Geotechnical Investigation : Kingsburgh Extension 9 comprising Erf 2954, 2955 and 2956" reference 22962 dated 24th April 2012 supplied to Sivest (Pty) Ltd.

The preliminary report, along with the following information also available to Drennan Maud (Pty) Ltd, was consulted during the compilation of this Phase 1 report.

- 1:250 000 scale Geological series Durban Map (2930)
- Google Earth aerial imagery of the relevant erven.
- Ethekweni GIS system

4. SITE DESCRIPTION

4.1 Location

The location of the Phase 1 development site is shown on the attached Locality plan, Drawing № 31873/01, it being located some 2km inland to the north west of the Kingsburgh/Warner beach area.

Also shown on the site plan are the internal project boundaries of the three erven which make up the proposed Kingsburgh Extension 9 development area, namely Erf 2954, 2955 and 2956, hereafter referred to as Sites A, B and C respectively.

4.2 Topography and Drainage

4.2.1 Site A (Erf 2954)

The northern most positioned site within the project area, comprises the upper and mid sideslopes of a roughly north east - south west trending ridge. The natural ground along the crest of the ridge is generally gently sloping however, gives way to moderately to steeply sloping mid to lower, north west and south easterly facing sideslopes that generally reflect a planar to slightly convex or concave slope conformation across the central and southern parts of the site. The northern most portion of the site is characterised by a convex moderately steep to steep slope which abuts against a steeply incised, north westerly plunging drainage line.

The site is currently undeveloped and is densely vegetated with grass, shrubs and mature trees across the vast majority of its area.

The northern portion of the site abuts directly against the Doon Heights Primary school. The site can be accessed via Vaugh Goodwin (cul-de-sac) road.

4.2.2 Site B (Erf 2955)

The site is located to the south east of Site A and comprises the upper to mid sideslope areas to the north, west and south west of the cul-de-sac at the western limit of the Boekenhout road. The site comprises the western most limit of a west-east trending ridge, along the spine of which Boekenhout Road is positioned.

The site is characterised by medium to steep slopes (10 - >18°) which face in a north westerly to westerly direction with a planar to convex conformation across the northern and central portions of the site and southerly to easterly direction with a convex to concave slope conformation towards the southern and south eastern portion of the site.

The site is accessed via the centrally located Boekenhout Road or at the western most end of Chestnut lane positioned towards the northern most limit of the area.

The site is currently densely vegetated with thick bush and mature trees.

4.2.3 Site C (Erf 2956)

The site is located to the south west and west of Sites A and B respectively along the mid to lower slope portions of a roughly north-south trending ridge line. Across its northern portion the site comprises the upper to mid sideslopes which slope moderately to steeply in a north easterly direction with a planar to slightly convex conformation.

The southern half of the site comprises the steeply sloping, south easterly facing mid sideslope which reflects a general planar to convex slope conformation. The steep terrain gives way towards the southern-most extent of the site to a relatively level area comprising the flood plain of the Little Amanzimtoti river.

The site is densely vegetated with thick bush and mature trees across the majority of its area with typical flood plain (water loving) vegetation noted on the lowermost southern portion of the site.

5. DEVELOPMENT PROPOSAL

With reference to an Architectural layout plan included in the Basic Assessment report provided, the proposed development across the overall site comprises some 361 residential units including double and triple storey structures with partial basement levels positioned primarily along the mid to upper side slopes and hilltop areas.

A network of internal roads running along the ridge tops and upper sideslopes will facilitate access within the respective erven comprising the overall site.

6. FIELD WORK

Geotechnical works presently conducted conformed to or exceeded the minimum requirements set out in the scope of work, defined under Section 1.2.

The approximate field test positions are indicated on the attached site plans.

It should be noted that bush clearing and thus field work was concentrated to relatively less steeply sloping upper slope areas of the site were potential development is more likely to be feasible.

The field work carried out across Sites A, B and C comprised the following.

6.1 Subsoil Excavations and Exposures

A total of 29 Nº field inspection pits (IP1 - 29) were excavated in order to examine, log and sample the shallow subsoils.

IP1 - 10 were excavated across Site A, IP11 - 20 across Site B and IP 21 - 29 across Site C. All of the inspection pits were mechanically excavated with IP's 1 - 10 excavated with a TLB (JCB 3DX Super) with approximate 3m reach. Owing to the steep nature of the topography across Sites B and C and dense vegetation, the inspection pits thereon were excavated using a 14ton tracked excavator (Doosan DX 140 LE) with maximum reach of approximately 5m.

In addition to the above, two manually excavated hand augers, designated AH 1 - 2, were carried out on Site A where TLB access was not achievable, the approximate positions of which are indicated on the relevant site plan.

Furthermore, a natural and man made exposure, designated Exp 1 and 2 respectively, were encountered across Site C at the approximate locations indicated on the relevant site plan.

The subsoils so exposed were profiled by an Engineering Geologist in accordance with the Guidelines for Soil and Rock Logging in South Africa, edited by A.B.A Brink and R.M.H Bruin, 2nd Impression 2002.

All inspection pit profiles are included in Appendix A herewith.

6.2 Dynamic Cone Penetrometer Testing

A total of 37 № DCP tests, designated DCP 1 - 37, were carried out across the three investigated erven with DCP' 1 - 17 positioned across Site A, DCP's 18 - 27 across Site B and DCP's 28 - 37 on Site C at the approximate positions indicated on the respective site plans.

The DCP probes were driven into the ground to determine the subsoil consistency and depth to inferred bedrock at refusal depth. The DCP's achieved an average depth of approximately 1.5m depth (ranging between 0.3 and 3.0m) prior to refusal being met.

The graphical results of the penetrometer testing are included in Appendix B herewith, whilst Table 1 is provided as a guideline to facilitate interpretation of the data.

The DCP test results should be used very cautiously in general as the field investigation was conducted during a time of prolonged drought, such having effected a baking of the prevailing clay subsoils.

Table 1 : Guideline to Interpreting Drennan Maud's DCP Test Data

Non-Cohesive Soils		Cohesive Soils	
DCP Blow Count Blows /300mm	Subsoil Consistency	DCP Blow Count Blows /300mm	Subsoil Consistency
<8	Very Loose	<4	Very Soft
8 -18	Loose	4 - 8	Soft
18 - 54	Medium Dense	8 - 15	Firm
54 - 90	Dense	15 - 24	Stiff
>90	Very Dense	24 - 54	Very Stiff
		>54	Hard

6.3 Subsoil Sampling

Representative subsoil samples were obtained and submitted to Thekwini Soils Laboratory in Durban, where they underwent various analyses to determine the material engineering properties.

The aim of the laboratory testing was as follows;

- Foundation indicator, pH, conductivity and swell testing were carried out to determine the material textural classification, potential activity and aggressiveness.

- Road indicator (sieve analysis to 75µm), Mod AASHTO moisture-density and California Bearing Ratio (CBR) tests were carried out to determine the suitability of the site materials in road and platform design.

Table 2 below is provided as a schedule of the type of materials sampled, the position and depth at which they were sampled and the suite of testing carried out thereon.

Table 2 : Schedule of Laboratory Testing

Site	Pos.	Depth (m)	Description	Laboratory Tests				
				Ind	Mod	CBR	Swell	pH/Cond
Site A	IP1	1.2 - 1.8	Highly weathered SILTSTONE - Passage Beds	✓	✓	✓		
	IP2	0.3 - 1.0	Grey, silty CLAY - Res siltstone	✓				✓
	IP5	0.0 - 0.3	Dark brown, silty CLAY - Colluvium	✓			✓	✓
	IP5	0.3 - 1.2	Orange brown, silty CLAY - Res tillite	✓				
	IP8	0.0 - 0.4	Dark brown, silty CLAY - Colluvium	✓	✓	✓		
	IP10	0.5 - 1.2	Highly weathered TILLITE- Dwyka Group	✓	✓	✓		
	AH2	0.0 - 2.0	Orange, silty CLAY - Res tillite	✓				✓
Site B	IP11	1.4 - 1.9	Grey mottled red, silty CLAY - Res siltstone	✓				
	IP12	1.6 - 2.0	Highly weathered SILTSTONE - Passage beds	✓*	✓	✓		
	IP14	0.4 - 1.5	Grey mottled orange, silty CLAY - Res tillite	✓	✓	✓	✓	
	IP16	0.5 - 1.6	Highly weathered, TILLITE - Dwyka Group	✓*	✓	✓	✓	✓
	IP20	0.1 - 0.7	Red brown, silty CLAY - Res tillite	✓*	✓	✓	✓	✓
Site C	IP22	0.3 - 2.3	Highly weathered SHALE-Pass Beds/Pmb Fm	✓*	✓	✓		
	IP24	0.0 - 0.7	Orange brown, sandy CLAY - Res tillite	✓*	✓	✓	✓	
	IP25	1.5 - 2.0	Highly weathered TILLITE - Dwyka Group	✓*	✓	✓		
	IP26	0.0 - 0.5	Dark brown, sandy, silty CLAY - Colluvium	✓				✓
	IP27	0.5 - 1.3	Grey, silty CLAY - Alluvium	✓			✓	✓

Detailed laboratory analyses are included in Appendix C and discussed in summary under Section 8 of this report.

7. SITE GEOLOGY AND SOILS

7.1 Regional Geology

According to the Port Shepstone (3030) 1:250 000 scale Geological series map, the site area is underlain by tillite bedrock of the Dwyka Group with shale bedrock of the Pietermaritzburg Formation conformably overlying the tillite bedrock towards the east and capping the elevated hill/ridge tops.

Although not indicated on the geological plan, from previous experience with the above mentioned bedrock types it is known that there exists a member of the Dwyka Group known as the 'Passage beds' which occurs locally and represents a transitional material between the older Dwyka tillite and younger overlying Pietermaritzburg Formation shale.

The above mentioned parent rock materials are overlain by variable amounts of colluvial and residual material derived from the natural weathering thereof.

Furthermore, lower lying areas along the base of drainage lines or areas adjacent to the Little Amanzimtoti River and its flood plain are underlain by alluvial material.

7.2 Geological Structures

Although not depicted on the geological map of the area, a minor north west - south east trending is inferred towards the northern portion of the Site A due to the juxtaposition of weathered tillite bedrock and shale bedrock at similar elevations as well as occurrence of a steeply incised drainage line.

7.3 Dwyka Tillite

The weathered tillite encountered across all three sites generally occurs as khaki brown to yellow brown, highly weathered, very close to closely jointed, very soft rock.

The weathered bedrock generally occurs at depths ranging between 1.0 - 1.5m along elevated sideslopes and between 2.0 - 2.5m where locally more deeply weathered. However, along the elevated ridge lines within Sites A and B highly weathered bedrock occurs at relatively shallower depths of 0.3 - 0.8m.

Across the mid to upper northern and central portions of Sites A and B the bedrock material comprised highly weathered, very close to closely jointed, thinly bedded very soft rock containing small drops stones. The material which resembles a bedded shale/siltstone material comprises the upper member of the Dwyka Group, known as the 'Passage Beds'. The material occurs at depths ranging between 1.5 - 2.0m below existing ground level where present. No clear occurrences of Passage bed material was encountered on Site C.

The highly weathered bedrock was found to be occasionally mantled by completely weathered material recovered as gravelly, clayey silt to silty clay. The mantle of completely weathered material, most commonly present along the flanks of minor drainage lines towards the north of Site A and sideslopes of Site A and C was encountered to be generally ~1m thick where present.

Although no indication of relatively less weathered, hard rock tillite corestones were encountered, the present thereof cannot be completely excluded.

7.4 Pietermaritzburg Formation Shale

The weathered shale bedrock was found to generally cap the more elevated hill/ridge tops of the respective site areas.

Highly weathered shale bedrock occurs as grey weathered brown, very close to closely jointed, thinly bedded, very soft rock at depths ranging between ~1.0 - 1.6m below existing ground level, being locally encountered at shallower depths in the order of 0.3m below the ground surface (Elevated central portion of Site C). The highly weathered shale bedrock is generally mantled by a <0.5m thick horizon of completely weathered material recovered as gravelly clayey sand to sandy clay in places.

The shale bedrock where encountered was observed to dip at between 15 - 45° in an easterly, south easterly to southerly direction (120 - 180°) which coincides with the general regional dip of inclined strata along the Kwa-Zulu Natal coast line.

7.5 Soils

In addition to the occasional occurrence of completely weathered horizons noted above, the bedrock is further mantled by an approximately 0.5 - 1.0m horizon of residual clay subsoil which generally presents brown and grey brown mottled orange, stiff to very stiff, silty clay.

In some instances the thickness of the residual soils is seen to exceed 3m, this likely defining weathering "pockets" etched into the bedrock along preferential groundwater paths (i.e heads of drainage lines or deeply weathered sideslopes).

Within virgin residual soils, adverse soil structure in the form of fissuring and local slickensiding, was noted. This is strong evidence for the clay soils being active.

Capping the residual soils and being generally <0,5m in thickness, is a transported colluvial soil. This material ranges from a brown, gravelly clayey sand (generally the re-worked topsoil), through to a dark grey brown, strongly fissured sandy silty clay.

Alluvial soils encountered along the southern, lower lying portions of Site C ranged from orange mottled grey, stiff to very stiff, very weakly cemented, silty clay to light brown, loose, fine to medium grained sand, both ranging between ~1.0 - >2.5m thick.

8. LABORATORY ANALYSES

8.1 Grading Analyses

Grading analyses were carried out by Thekwini Soils Laboratory on disturbed, representative subsoil samples recovered from within the inspection pits. Combinations of Foundation Indicator testing (which includes hydrometer analysis to 2μm particle size) and Road Indicator testing (sieve analysis to 75μm particle size) were carried out.

The detailed results of the grading analyses, including the summary sheets and grading curves, are included in Appendix C.

For ease of reference, Table 3 below provides a summary of the material textural properties recorded by the grading analyses;

Table 3 : Summary of Grading Analyses

IP	Depth (m)	Description	LL %	PI	LS %	% Clay	Unified Class.	Revised US Class.	
								Group	SG Rating
1	1.2 - 1.8	HW SILTSTONE - Passage Beds	33	8.9	5.3	4.6	GP-GM	A-2-4	Good
5	0.0 - 0.3	Dark brown, silty CLAY - Coll	51.3	14.4	10	55.4	MH/OH	A-7-5	V. Poor
5	0.3 - 1.2	Orange silty CLAY - Res tillite	55.8	20.2	6	66.1	MH/OH	A-7-5	V. Poor
8	0.0 - 0.4	Dark brown, silty CLAY - Coll	45.8	12.7	8	41	ML/OL	A-7-5	V. Poor
10	0.5 - 1.2	HW TILLITE- Dwyka Group	27.7	20	5.3	10.8	SC	A-2-6	Good
AH2	0.0 - 2.0	Orange, silty CLAY - Res tillite	49	21	8.7	56.3	ML/OL	A-7-6	V. Poor
11	1.4 - 1.9	Grey, silty CLAY - Res siltstone	59	20.7	8	68.1	MH/OH	A–7-5	V. Poor
12	1.6 - 2.0	HW SILTSTONE - Passage beds	28	8.8	4	13.0*	-	-	-
14	0.4 - 1.5	Grey, silty CLAY - Res tillite	29.5	8	5.3	30.5	CL/OL	A-4	Poor
16	0.5 - 1.6	HW, TILLITE - Dwyka Group	26.3	7.5	4.7	3.2*	GP	A-2-4	Good
20	0.1 - 0.7	Red, silty CLAY - Res tillite	44.2	14.2	8.7	47.2*	-	A-7-5	V. Poor
22	0.3 - 2.3	HW SHALE-Pass Beds/Pmb Fm	31.4	7.6	4	35.1*	-	A-2-4	Good
24	0.0 - 0.7	Orange, sandy CLAY - Res tillite	41.9	11	6.7	65.8*	-	A-7-5	V. Poor
25	1.5 - 2.0	HW TILLITE - Dwyka Group	25.3	8.2	4	40.1*	-	A-4	Poor
26	0.0 - 0.5	Brown, sandy, silty CLAY - Coll	22.9	6.7	2.7	23.9	CL-ML	A-4	Poor
27	0.5 - 1.3	Grey, silty CLAY - Alluvium	35.5	11.9	6	51	CL/OL	A–6	Poor

H.W = Highly weathered Coll = Colluvium Res = Residual LL= Liquid Limit LS=Linear Shrinkage
PI = Plasticity Index * - Denotes combined clay and silt %

8.2 Mod AASHTO Moisture-Density and CBR Determinations

Mod AASHTO moisture-density relationship and CBR determinations were carried out on representative, disturbed bulk samples recovered from the inspection pits, to determine the engineering properties of the prevailing subgrade.

The test results are included in Appendix C on the laboratory summary sheets, and summarised in Table 4 below.

Table 4 : Summary of Mod AASHTO Density and CBR Test Results

IP	Depth (m)	Material	Mod AASHTO Density (kg/m^3)	OMC (%)	CBR Results			TRH 14
					90 %	98 %	Swell %	
1	1 .2 - 1.8	HW siltstone/shale	1953	10.7	2	6	2.02	G10+
8	0 .0 - 0.4	Colluvium	1953	19	1	7	4.02	G10+
10	0.5 - 1.2	HW tillite	2001	8.5	6	11	1.01	G9
12	1 .6 - 2.0	HW siltstone/shale	1941	10.7	2.4	2.7	2.24	G10+
14	0 .4 - 1.5	Residual tillite	1877	10.5	0.52	0.75	5.75	G10+
16	0.5 - 1.6	HW tillite	1974	10.3	17	23	0	G7
20	0 .1 - 0.7	Residual tillite	1746	17.5	1	3	3.35	G10+
22	0.3 - 2.3	HW shale	1891	12.1	6	11	0.79	G9
24	0 .0 - 0.7	Residual tillite	1653	18.9	3	7	2.37	G10+
25	1 .5 - 2.0	CW - HW tillite	1943	9.7	2.9	3.7	2.41	G10+

H.W = Highly weathered CW = Completely weathered

8.3 Swell Testing

Brackley swell tests were carried out on representative samples of the residual and alluvial clay subsoils to determine the likely potential for swell therein.

The swell test results are included in Appendix C and summarised in Table 5 overleaf. Also indicated in Table 5 is the anticipated magnitude of swell to be expected under light structural loads during periods of subsoil saturation. Soil shrinkage of a similar magnitude can be expected during periods of prolonged drought.

Table 5 : Summary of Swell Test Results

IP №	Depth (m)	Description	% Fines (Clay+Silt)	Swell %	Predicted Swell (mm) in specified Horizon Under 10kPa Structural Load
5	0.3 - 1.2	Orange silty CLAY - Res tillite	96.9	6.44	58
14	0.4 - 1.5	Grey, silty CLAY - Res tillite	50.9	8.74	96
16	0.5 - 1.6	HW, TILLITE - Dwyka Group	3.2	4.63	51
20	0.1 - 0.7	Red, silty CLAY - Res tillite	47.2	0.46	3
24	0.0 - 0.7	Orange, sandy clay - Res tillite	35.1	3.51	25
27	0.5 - 1.3	Grey, silty CLAY - Alluvium	77.4	14.02	112

All of the swell test results, with the exception of IP 20, confirm the moderate to highly active nature of the clay subsoils underlying the site.

It is considered likely that an average swell of some 4 - 8% may be generally attributable to the clayey subsoils i.e. 40 - 80mm of swell per metre of expansive horizon thickness.

8.4 Chemical Testing (pH/Conductivity)

Soil pH and Conductivity tests were carried out on select disturbed subsoil samples, in order to determine the materials potential aggressiveness toward new foundations or service pipes.

Detailed results are included in Appendix C and summarised in Table 6.

Table 6: Summary of Soil pH and Conductivity Testing

Pos.	Material Type	Depth (m)	pH	Conductivity (ms/m)	Potential Corrosiveness
IP5	Orange silty CLAY - Res tillite	0.3 - 1.2	3.9	29	Very severe
AH2	Orange, silty CLAY - Res tillite	0.0 - 2.0	3.1	33	Very severe
IP16	HW, TILLITE - Dwyka Group	0.5 - 1.6	5.7	36	Severe
IP20	Red, silty CLAY - Res tillite	0.1 - 0.7	4.8	38	Severe
IP26	Brown, sandy, silty CLAY - Coll	0.0 - 0.5	6.5	60	Slight
IP27	Grey, silty CLAY - Alluvium	0.5 - 1.3	4.2	45	Very Severe

The generally very low conductivity values obtained for the various materials on site indicate that these materials have a low attack potential on concrete and are therefore deemed non-corrosive.

However, in terms of the pH of the prevailing subsoils, the generally low (acidic) values obtained for the residual and weathered tillite material indicates the materials may be potentially severely corrosive to concrete material placed therein.

The higher (neutral) pH value obtained for the typical colluvium material indicates this material is relatively less corrosive to non-corrosive in nature to concrete.

9. GEOTECHNICAL ASSESSMENT

9.1 General

Drawings 31873-A/02, B/02 and C/02 of this report has been produced to illustrate the variation in geotechnical conditions across the site.

The National Department of Housing requires that sites be classified in accordance with the residential site class designations set out in the NHBRC standards and guidelines.

The designation of the various portions of the site are indicated on the above mentioned geotechnical site plans, upon which Table 1 of Part 1, Section 2 of the NHBRC document has been included for ease of reference.

The residential site class designations depicted on the geotechnical plans take into account the depth to bedrock and thickness of the various below mentioned problematic soils encountered across the project area i.e. in general (H1/R is <1.5m thick, H2 is > 1.5 <3.0m thick, H3 is > 3.0m thick)

However, given the difficulty of inferring information between inspection pits, the site class designations are deemed broadly representative and subject to confirmation and minor alteration if necessary during subsequent Phase 2 investigations and site specific investigations once identified.

Founding recommendations with regard to the residential site class designations are provided and further discussed in section 10.3 below.

9.2 Problem Soils

9.2.1 *Active Soils*

The clayey colluvial, residual and alluvial material were found to typically display high clay contents and PI values (clay contents ranging between approximately 23 - 68% and PI's typically in the order of 10 - 20%) as well as fissured and occasional slicken-sided soil structure. As such the material is considered to be moderately to high active in the sense that it will undergo a volume change with fluctuations in the materials in-situ moisture content (swell when wet and shrink when dry).

Furthermore, swell testing carried out on selected samples of the residual and alluvial materials confirms the materials fall within the limits of a moderately to highly active material.

The extent and severity of these active soils can be appreciated from the broad NHBRC classifications of the project area as illustrated on the attached geotechnical site plans Drawing № 31873/A02 through C/02.

9.2.2 *Compressible and Potentially Collapsible Soils*

There is no evidence obtained during the present investigation to suggest highly compressible or collapsible soils within the majority of the project area with the exception of the lower lying flood plain area adjacent to the Little Amanzimtoti River towards the southern limit of Site C.

The clayey alluvial soils where encountered within the drainage lines or flood plain areas are likely to be moderately compressible under load whilst sandy alluvial material is considered likely to display a moderate to high collapse potential due to the loose consistency thereof and granular nature of the material. This should be accounted for in the design of any roads or building platforms spanning the lower lying area or drainage lines in general.

9.2.3 *Soil Erodibility*

Only the uppermost relatively sandy topsoil/colluvial material occurring across the elevated hilltops and sideslopes has any significant erosion potential when subject to flowing water or wind forces. The likelihood of such erosion is likely to be further exacerbated once covering vegetation, which has a binding effect on the soils has been removed prior to platform development.

In this regard all due caution should be exercised during and post construction to avoid concentrated water run-off and thus minimise potential soil erosion.

A review of Google Earth imagery reveals no dongas in the area, providing a good indication that the subsoils are neither dispersive nor erodible to any significant degree.

9.2.4 *NHBRC Classification*

The implications of the NHBRC site classes for the proposed development are shown in Table 7 overleaf.

Table 7: NHBRC Site Classifications

Typical Founding Material	Character of Founding	Expected Range of Total Soil Movement (mm)	Assumed Differential Movement (% of Total)	Site Class
Rock	Stable	Negligible		R
Fine grained active clay soils with a moderate to high plasticity	Expansive Soils	< 7.5 7.5-15 15-30 >30	50% 50% 50% 50%	H H1 H2 H3
Silty sands and gravelly soil	Compressible & potentially collapsible soils	<5 5.0-10 >10	75% 75% 75%	C C1 C2
Fine grained sands clayey silts and clayey sands of low plasticity	Compressible Soils	<10 10-20 >20	50% 50% 50%	S S1 S2
Seepage zones (permanent and seasonal)				P1
Potential previous/ongoing slope instability				P2
Steep slopes (>1:3)				P3

9.3 Slope Stability

During the field assessment of the three sites, no obvious signs of any previous or on-going slope instability was noted. However, given the dense vegetation covering the site and only partial clearing thereof along upper relatively gently sloping area, evidence of slope instability may have been obscured.

That being said the weathered tillite bedrock underlying the majority of the moderately to steeply sloping areas is generally considered to be inherently stable given the massive structure within the bedrock. As such failures, where present are likely to be joint controlled or relatively shallow failures within the overlying colluvial and residual material and thus more likely as a result of earthworks (i.e. cutting of slopes or placement of fill on sideslopes).

As such it is recommended that where cutting occurs across the mid to upper moderately steep to steep sideslopes, that continual assessment thereof by an experienced Geotechnical Engineer or Engineering geologist is carried out and that filling on sideslopes is kept to a minimum or alternatively suitably retained.

The Pietermaritzburg Formation shale bedrock is typically more prone to slope instability, especially where deeply weathered or adversely dipping out of moderate to steep sideslopes.

Bedding within the shale bedrock was found to typically dip in a south easterly to easterly direction at between 15 - 45° conforming to the tilt of the fault blocks developed along the Kwa-Zulu Natal coast line during major tectonic events in the past.

In this regard, where shale bedrock occurs the dip thereof is generally dipping favourably into the slope, with the localised exceptions of the upper central south easterly facing areas of Site B and C.

Areas of potential slope instability (P2) have been indicated on the geotechnical site plans, these generally comprising areas potentially underlain by shale bedrock dipping adversely out of the slope or where deeply weathered residual tillite material prevails to considerable depth.

Areas steeper than 1 in 3 are expected to be very costly to develop due to the expensive stability measures deemed necessary for stable cut/fill platforms and retaining structures deemed necessary to avoid chasing slopes. Such areas have been designated as P3 zones on the geotechnical plan.

Taking into consideration the nature of the site in terms of geology, topography, drainage and the likely need for significant cutting and/or filling for proposed development, slope stability will be a chief cause for concern and will need to be considered prior to and during any proposed development.

In this regard recommendations with respect to cutting and filling and general earthworks have been provided and discussed further in section 10.1 of this report.

9.4 Seepage Zones

The natural major drainage lines occurring between Sites A, B and C are likely to attain a permanent seepage zones/wetland status and as such, development therein will likely to be prohibited.

However, with regard to the assessed elevated ridge tops and sideslopes of the project area no ground water seepage or day-lighting thereof was encountered within the inspection pits or at ground surface.

Notwithstanding the above, there exists the possibility of seasonally perched groundwater across the entire project area at the contact of the upper colluvial and less permeable residual material, the soil rock interface or out of open joints within the rock mass, during times of prolonged heavy rainfall.

In addition, zones of potential seepage (P1) are inferred along the flanks of minor drainage lines towards the northern portion of Site A and central eastern portion of Site B. Though no groundwater seepage was encountered in these areas during the present investigation, the heads of drainage lines are generally found to harbour ground water during wetter summer months. Furthermore, the lush vegetation in addition to being underlain by mottled clay soils is suggestive of seasonal groundwater seepage.

A zone of further potential seepage (P1) is included across the lower lying, level flood plain area towards the southern portion of Site C. Though no ground water seepage was encountered therein the mottled and weakly cemented nature of the soils suggests seasonal ground water seepage whilst the areas proximity to the nearby Little Amanzimtoti River and relative elevation thereto suggests it is likely this area is prone to potential water-logging during heavy seasonal rains.

9.5 Excavatability

9.5.1 *Mechanical Excavation*

Inspection pitting indicated that colluvial, residual and completely weathered bedrock for all encountered rock types classifies as "soft" excavation (SABS 1200D standards).

Similarly, excavation within areas underlain by sandy and clayey alluvial sediment will classify as "soft" through the materials entire depth, although were potentially weakly cemented or alluvial boulders are encountered, greater effort may be required for its removal.

Areas underlain by weathered Pietermaritzburg Formation Shale/Passage Beds material and Dwyka Group tillite encountered at relatively shallow depths on ridge tops and side slopes (designated "R" on geotechnical plans) vary somewhat in excavatability. In general depths in the order of 2.0 - 3.0m below existing ground level were easily achieved (soft) however, localised occurrences of dull refusal (slow penetration) on less weathered bedrock were met at depths ranging between 1.5 - 2.0m below existing ground level below which "intermediate" excavation with depth can be expected.

These depths are considered applicable both to service trench excavation and, more conservatively, to unconfined earthworks.

Intermediate to hard excavation may be encountered within the tillite bedrock should relatively large unweathered corestones be intersected within cuts. Where such boulders occur, excavation rates will likely be slower and depending on their size may require localised blasting to remove.

9.5.2 *Manual Excavation*

Only the uppermost topsoil/colluvium will be readily excavated by hand means, the underlying very stiff clayey residuum and weathered bedrock all requiring mechanical assistance for their efficient removal.

9.6 Subsoil Percolation

No percolation testing was carried out across the three investigated site areas. However, given the generally clayey nature of the colluvial and residual material and reltively shallow depth to weathered bedrock across elevated development areas, the percolation characterisitics of the subsoils underlying the site are inferred as poor. As such disposal of effluent and stormwater through the clayey subsoils is therefore considered generally unfeasible.

9.7 Material Suitability

Soil and rock sampling was undertaken in part to determine the suitability of the materials encountered through out the investigated area for use as construction material. In this regard the suitability of the prevailing material in terms of TRH 14 - 1985 standards is summarised below.

9.7.1 Pietermaritzburg Formation

Residual/colluvial clays derived from Pietermaritzburg Formation shale classify as A-7-5 and MH/OH (after AASHTO and Unified Classifications). No density testing was carried out on these materials however due their clayey nature will likely not meet the minimum requirements of a G10 type material.

Highly weathered shale of the Pietermaritzburg Formation classifies as G9-G10+ type material and therefore ranges from suitable for subgrade and lower selected layer material to not suitable for use depending on the degree of weathering.

However, experience has shown that the material generally ranges between G10/>G10 type material and hence is not considered suitable at lower selected layer level and marginally suitable as engineered fill/subgrade material.

9.7.2 Dwyka Tillite / Passage Beds Bedrock

Samples of residual and colluvial tillite material classify between A-4 to A-7-6 type material after the AASHTO classification and as MH/OH to ML/OL type material after the Unified classification system. Furthermore, density testing on the residual tillite material indicates the residuum does not meet the minimum requirements of a G10 soil due to high clay content percentages and associated high swell and low CBR readings. As such these materials are not suitable as engineered fill/subgrade material.

Laboratory testing indicates the highly weathered tillite bedrock ranges between G7 - G10 type material and therefore suitable as engineered fill/subgrade and lower to upper selected layers material. More deeply weathered (completely) tillite bedrock classifies as G10+ type material and therefore considered in general unsuitable as construction material.

9.7.3 Alluvium

The clayey alluvial material encountered within IP 37 classifies and A-6 soil according to the AASHTO classification system. Although no density testing was carried out on this material, given its clayey nature and high swell percentage, it is highly likely the material will fail to meet the minimum requirements of a G10 type material and thus is considered unsuitable as bulk fill or subgrade material. Granular sandy alluvial material where encountered will likely classify as A-2-4 and G10 type material and therefore may be used as bulk fill or subgrade material where required.

9.8 Development Areas

In general areas in which development should be **avoided** are included as the following in the geotechnical plans accompanying this report:

- Seepage zones and drainage valley lines/depressions - (P1)
- Slopes in which shale/siltstone dip adversely out of the slope and/or show signs/characteristics or previous or on-going slope instability - (P2)
- Steep Slopes greater than 1 : 3 (18°) - (P3)

These areas will likely prove uneconomical to develop, especially in terms of ensuring slope stability. The areas in particular have been broadly identified on the geological plans and in general exclude the steeply sloping mid to lower sideslopes of the respective areas, south easterly facing slopes underlain by dipping shale bedrock and lower lying flood plain/drainage line areas.

Across the remainder of the sites (i.e. elevated relatively gently to moderately sloping ridge/hilltops) development in general is considered feasible provided the recommendations included below in Section 10 are applied in both the planning and construction phases of the development. These amount to no more than sound building practices appropriate for the prevailing subsoil conditions.

10. DEVELOPMENT RECOMMENDATIONS

10.1 Earthworks

10.1.1 General

Due to the poor on-site materials it should be sought to limit the volumes of fill constructed on site.

Given the moderate to steep gradient of the developable sideslopes significant earthworks will be required for the preparation of normal residential platforms.

As discussed in Section 7.4 above, due to the severity of the sloping topography and the prevailing geology, the site is highly susceptible to slope instability especially if injudiciously disturbed by earthworks (cutting and filling).

In light of the stability concerns, and based on experience from similar sites, the following is recommended with regards to cutting and filling.

10.1.2 Cuts and Temporary Excavations

Cut embankments in all soils and bedrock should be restricted to a maximum slope batter of 1:2 (26°).

With regard to Pietermaritzberg Formation shale/siltstone slope failure is often associated with sliding on adversely dipping bedding or joint planes, especially when lubricated by clay and water. Typical joint shear strength parameters vary from 27° for fresh shale on shale contact (wet / planar) to 12° for clay (wet) in joints and bedding.

Therefore, for slopes cut back to 1:2 (26°) or gentler the potential for planar/wedge failure in fresh shale is greatly reduced/avoided and failure is limited to clay lenses on joints and beds. Once cut to the recommended batter, it is recommended that slopes also be visually inspected (joint survey) to identify potential unstable areas with clay in joints and bedding, followed by kinematic slope stability analysis (Stereonet) where necessary to determine the appropriate remedial solutions if necessary (i.e gabions, rockbolts, anchors, low walls with drop zones, etc).

Where it is necessary for batters steeper than 1 in 2 in all soil and rock types, slopes will have to be supported by a suitably designed retaining structure.

Temporary service or foundation trenches greater than 1.2m depth, especially in loose unconsolidated sandy alluvium or more sandy colluvium must be battered back to a maximum of 1:1.75 (30°) or alternatively suitably shored to ensure safe working conditions. Cut faces in such material may stand at steep angles upon initial cutting due to the in-situ moisture content however will likely collapse once the material becomes saturated or dries out.

All cut embankments, especially those within any sandy material prone to erosion, must be vegetated as soon as possible after construction to reduce the likelihood and severity of potential soil erosion.

Cut-off drainage is recommended above cuts with backslopes to avoid stormwater adversely affecting the cut stability.

10.1.3 Fill Stability

From proposed 1:3, 1:4 and 1:5 slope platform sections it is evident that the majority of the platforms will be located in cut with only minor filling envisaged. This practice is strongly advocated given the likely stability issues associated with extensive filling on the steep sideslopes and underlying subsoils. Furthermore, given the steepness of the sideslopes fills will likely 'chase' the slope for considerable distance downslope.

However, where filling is required, for preliminary design purposes ALL fill embankments should not exceed a maximum slope batter of 1:2 (26°) and should ideally be limited to a maximum height of 2m.

Slope instability is known to occur in areas where fills are placed on side slopes which comprise variably thick clays overlying typically Pietermaritzberg Formation shale or deeply weathered residual clays.

As such, stability measures are required which vary from removal of the clay and founding into competent shale/siltstone/tillite, to rock fill toes coupled with drainage measures; to a combination of rockfill and basal geogrid reinforcement where clays are excessively thick and thus unfeasible to entirely remove.

Fills founded on shale/siltstone/tillite sideslopes overlain by varying amounts of clay typically require the following stability earthworks measures;

- Where fill embankments are intended on slopes with clay profiles less than 3.0m thick; then either removal of the clay and founding the fill toe onto competent bedrock, or the use of a rockfill toe key is likely to be necessary.

- Where filling is required on slopes characterised by clayey soils exceeding 3m thick, the removal of clay to competent bedrock will likely prove impractical and uneconomical, In these areas a thin basal rockfill toe (1m thick) has proven successful in conjunction with geogrids placed at designated spacing in the basal portions of the new fill. The function of the geogrids is to prevent deep seated circular failures developing through the new fill and underlying clay.

In the above regard, a site specific geotechnical investigation comprising test pitting along proposed fill toes followed by stability analysis is considered crucial at the detailed design stage for each proposed fill embankment to determine the site specific founding requirements.

10.1.4 Fills General

Any fill embankments constructed on this site should assume an outer slope batter of 1:2 (26°) to ensure the long-term stability thereof.

All new fills should be constructed using a suitable material (G10 or better after TRH 14, 1985) placed and compacted in uniform layers of 200 to 300mm loose thickness, with each layer being compacted to 93% Mod AASHTO prior to placement of the next layer.

Prior to placing the new fill, the natural ground should be stripped of the upper organic topsoil and grubbed of any deleterious materials.

Due to the steepness of the slopes and recommended maximum fill slope batters it is recommended that unsupported filling on site is avoided as much as possible.

Apart from highly weathered tillite bedrock suitable fill material will be difficult to source on this site with it being recommended that all overlying colluvial, residual and completely weathered material being removed to spoil.

10.2 Site Drainage

Soak pits should not be used for stormwater or effluent disposal as the clayey subsoils are considered insufficiently permeable for this purpose.

Storm water from all roofed and paved areas will need to be collected in gutters and surface drains to be discharged into the stormwater system ultimately approved for the proposed development.

Individual platforms should be suitably graded post-construction, to facilitate the runoff of stormwater away from the structures.

Where perched seepage is encountered during construction, it will need to be addressed symptomatically. Attention is however drawn to the designated P1 areas on the attached geotechnical plans. Seasonal seepage here is expected to be potentially more problematic than elsewhere and is likely to require long term subsoil drainage.

In terms of the prevailing clayey soils, there would be every merit in providing a structural apron around the new dwellings where only minor cutting is required for platform preparation and active clay are not entirely removed to bedrock across the footprint of the platform.

10.3 Founding

Generalised founding solutions for light structures founded *in-situ* across the proposed development site are summarised in Table 8 below, which is an excerpt from the NHBRC home building manual, Part 1.

Table 8 : Summary of Founding Conditions

Site Class	Appropriate Foundation Types
H	Normal strip footings / column bases or slab on ground
H1	Modified normal or soil raft
H2/H3	Stiffened or cellular raft / piles / split construction / soil raft

It is reiterated that the site class designation is at this stage broadly representative and provided as a general guideline to assist in planning. The site classifications are subject to verification and possible amendment during the site-specific Phase 2 investigations.

With regard to the various founding options provided in Table 8 developers and/or engineers at the design phase should opt for the most feasible foundation design taking into account the worst case conditions in areas where composite site classifications are provided.

Furthermore, the sloping nature of the site should be considered with regard to cut to fill platforms and is likely to result in variable depth to competent founding between cut and fill portions. Foundations must be taken down to similar competent founding medium across the platform to minimise differential settlement/heave effects.

With regards to the site earthworks it should be noted that judicious cutting of the site could be considered by the project Engineers, to assist in reducing the overall thickness of the active clay subsoils where more deeply developed and thereby improving the overall founding conditions.

When founding on sloping ground, as will occur across the majority of the site, where the depth to competent bedrock and the filling in front of the units combines to exceed a general depth of 2.5m below platform level, the following is recommended to reduce differential settlement;

- Founded entirely in cut, or
- Found on a stiffened raft capable of accommodating the expected differential settlement, or
- Found on rafts/ground beams supported on piles or pad columns taken through the entire depth of the fill, colluvium, residual and completely weathered bedrock into competent weathered bedrock.

Surface beds (where used) should be isolated from all walls, columns and foundations and underlain by a layer (minimum 300mm) of inert granular material to soften heave and differential settlement effects in the respective “H” areas where active clays have not been entirely removed from below the footprint of the platform.

10.4 Road Construction

The present laboratory testing shows the *in-situ* site materials to be generally unsuitable as subgrade in terms of TRH 14 (1985). As such, along ridge tops/gently sloping area where significant cutting is unlikely to be required for the construction of road platforms (i.e. entire removal of poor quality material to bedrock) it will be necessary therefore, to carry out a degree of subgrade improvement prior to constructing the new road layerworks, or alternatively, to thicken the new road layerworks accordingly.

As a preliminary indication to the subgrade improvement that might be required, it could be considered by the design Engineer to box out the *in-situ* subgrade materials(heaving clays) to a depth of approximately 300mm, thereafter back-filling the box cut with a selected granular fill material (G7) compacted to 95% Mod AASHTO density at optimum moisture ±2%.

This general recommendation must be confirmed or refined by the design Engineer in terms of the proposed traffic loading and pavement design life for the internal roads.

Provision should be made for subsoil drainage along the entire length of the internal roads, where the layerworks formation level is either at or below natural ground level.

10.5 Site Materials

The laboratory test data and field observations all indicate that the majority of unconsolidated in-situ clayey material and weathered shale bedrock is considered poor quality in terms of TRH 14 1985 standards for construction use and thus the use thereof is considered unsuitable.

The only material that may find consistent use as a general fill, subgrade and possibly selected granular fill is the highly weathered tillite. It is noted however that even this material varies considerably in its composition and is often very clayey.

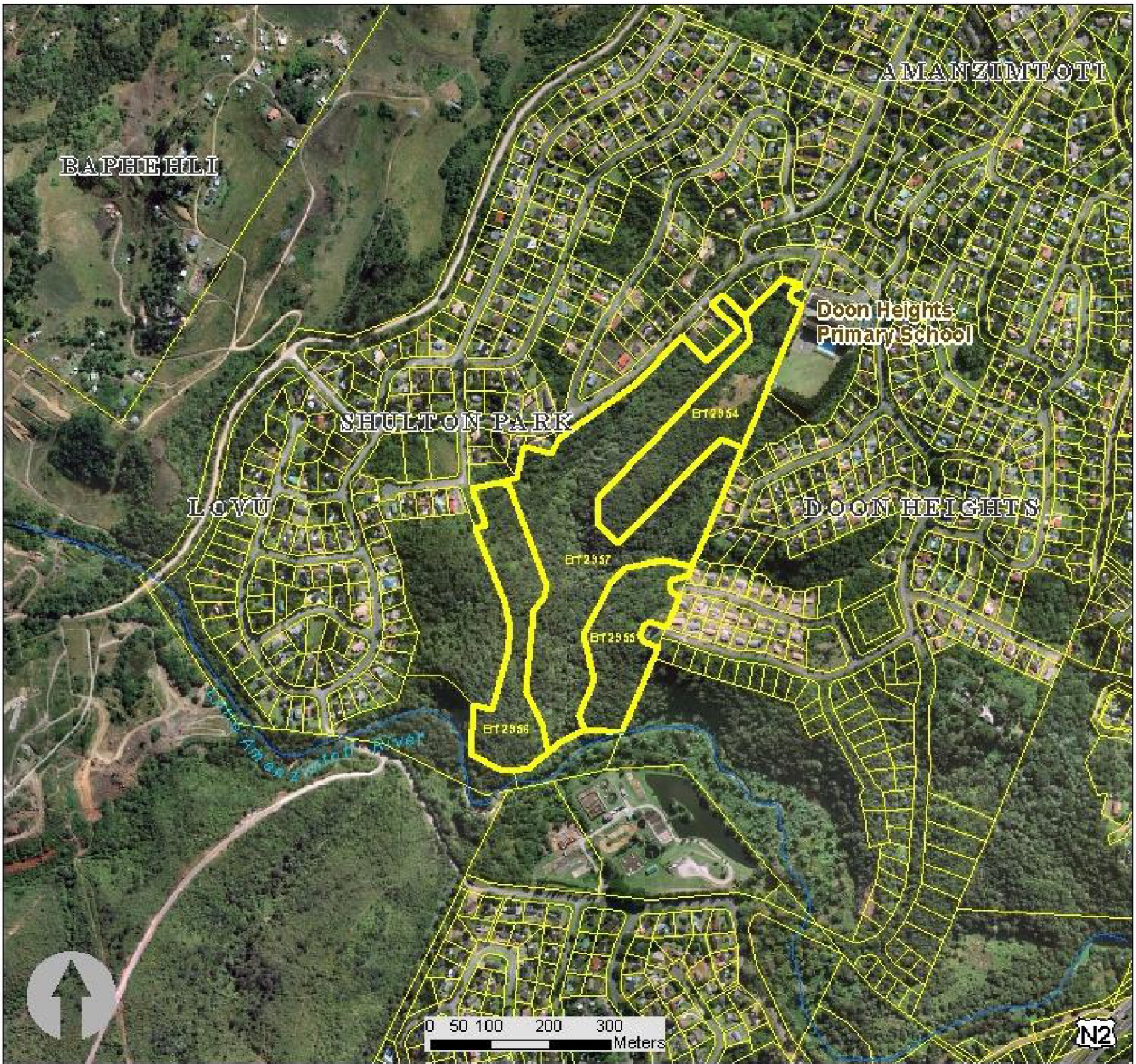
In terms of the above although sufficient quantities of general fill material and subgrade material may be acquired from cuts in the tillite bedrock, selected fill and sub-base/base layer materials will need to be imported to site from a suitable nearby commercial source.

A. JOUBERT Pr.Sci.Nat.

REFERENCE 31873
SEPTEMBER 2017
/kc

DRENNAN MAUD (PTY) LTD
68 Peter Mokaba Ridge, Tollgate,
DURBAN, 4001

DRAWING 31873-01
Locality Plan



LOCALITY MAP *1:50,000*

GEOTECHNICAL INVESTIGATION PROPOSED KINGSBURG EXT. 9 HOUSING DEVELOPMENT LOCALITY PLAN

DRENNAN MAUD(PTY) LTD
Geotechnical Engineers & Engineering Geologists

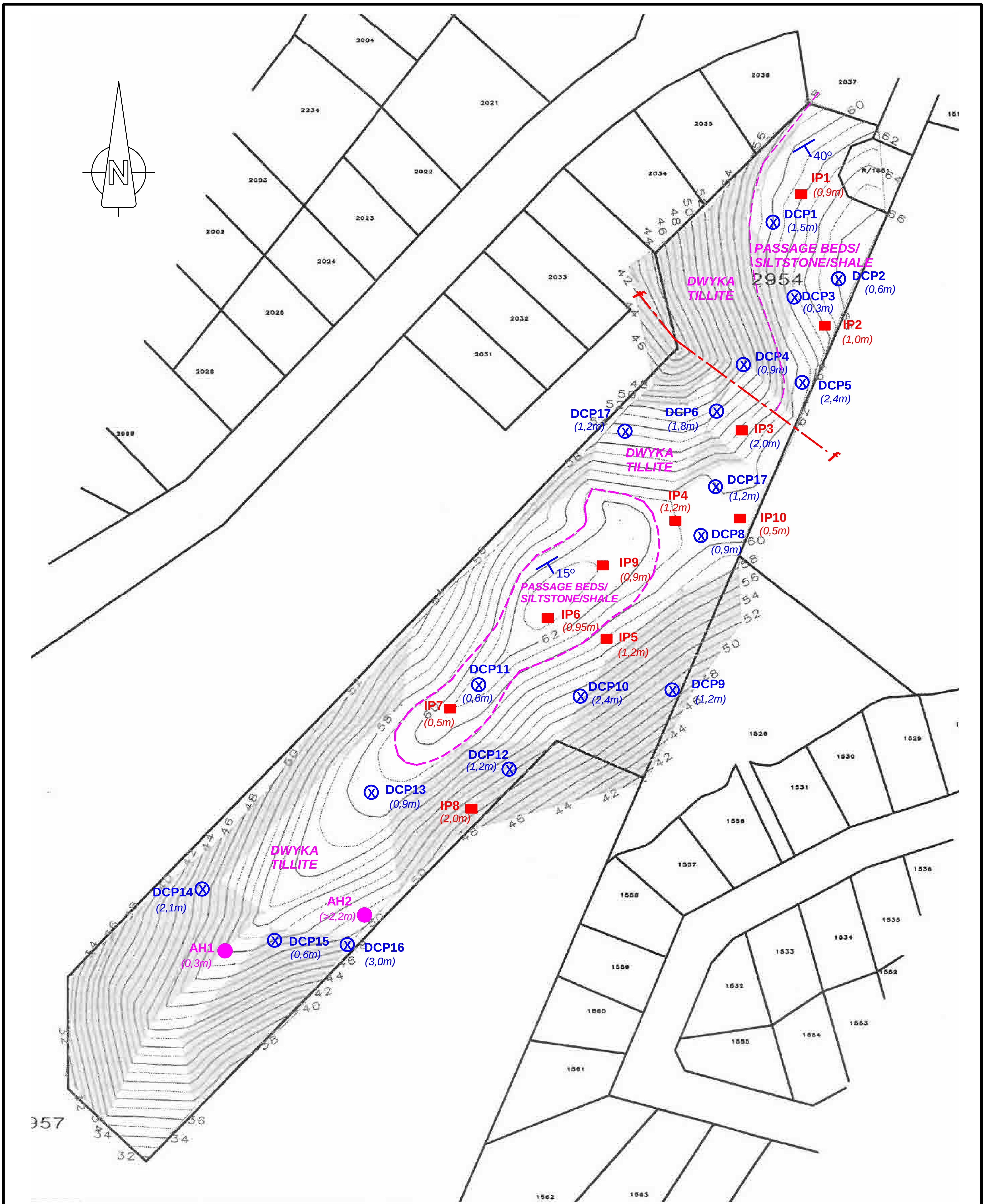
68 Peter Mokaba Ridge
Tollgate
DURBAN
4001
Telephone 031-201-8992

P.O. Box 30464
MAYVILLE
4058
Telefax 031-201-7920
e-mail:info@drennanmaud.com

DESIGNED	A.J.	DRAWING NO.
DRAWN	S.P.	
DATE	15/09/2017	31873-01
SCALE	N.T.S.	
CHECKED		

DRAWINGS 31873-A/01, B/01 & C/01

Geological Site Plans



KEY

DCP1 (1,5m) — **APPROX. POSITION OF DYNAMIC CONE PENETROMETER TESTS**
(DEPTH TO REFUSAL)

IP1 (0,9m) — **APPROX. POSITION OF INSPECTION PITS**
(DEPTH TO BEDROCK)

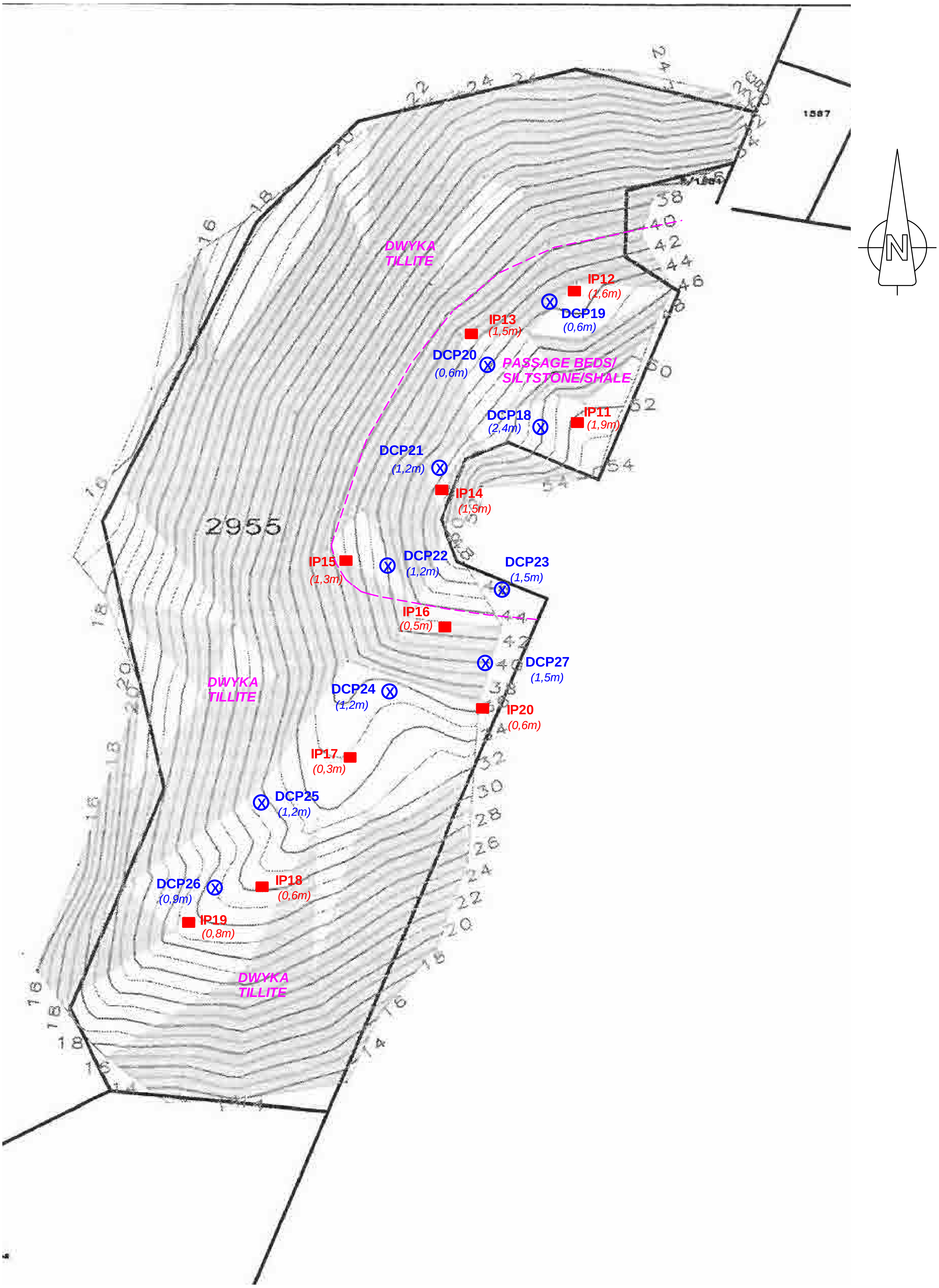
AH1 (0,3m) — **APPROX. POSITION OF AUGER HOLES**
(DEPTH TO BEDROCK)

INFERRED GEOLOGICAL CONTACT

f — f **INFERRED GEOLOGICAL FAULT**

15º **BEDDING DIP & STRIKE**

DRENNAN MAUD (PTY) LTD. Geotechnical Engineers & Engineering Geologists	DESIGNED : A.J. DRAWN : S.P. DATE : 12/9/2017 SCALE : N.T.S. CHECKED :	**GEOTECHNICAL INVESTIGATION PROPOSED KINGSBURG EXT. 9 HOUSING DEVELOPMENT - SITE A GEOLOGICAL PLAN**	DRAWING NO. **31873-A/01**



KEY

DCP27 (0,6m) — **APPROX. POSITION OF DYNAMIC CONE PENETROMETER TESTS** *(DEPTH TO REFUSAL)*

INFERRED GEOLOGICAL CONTACT

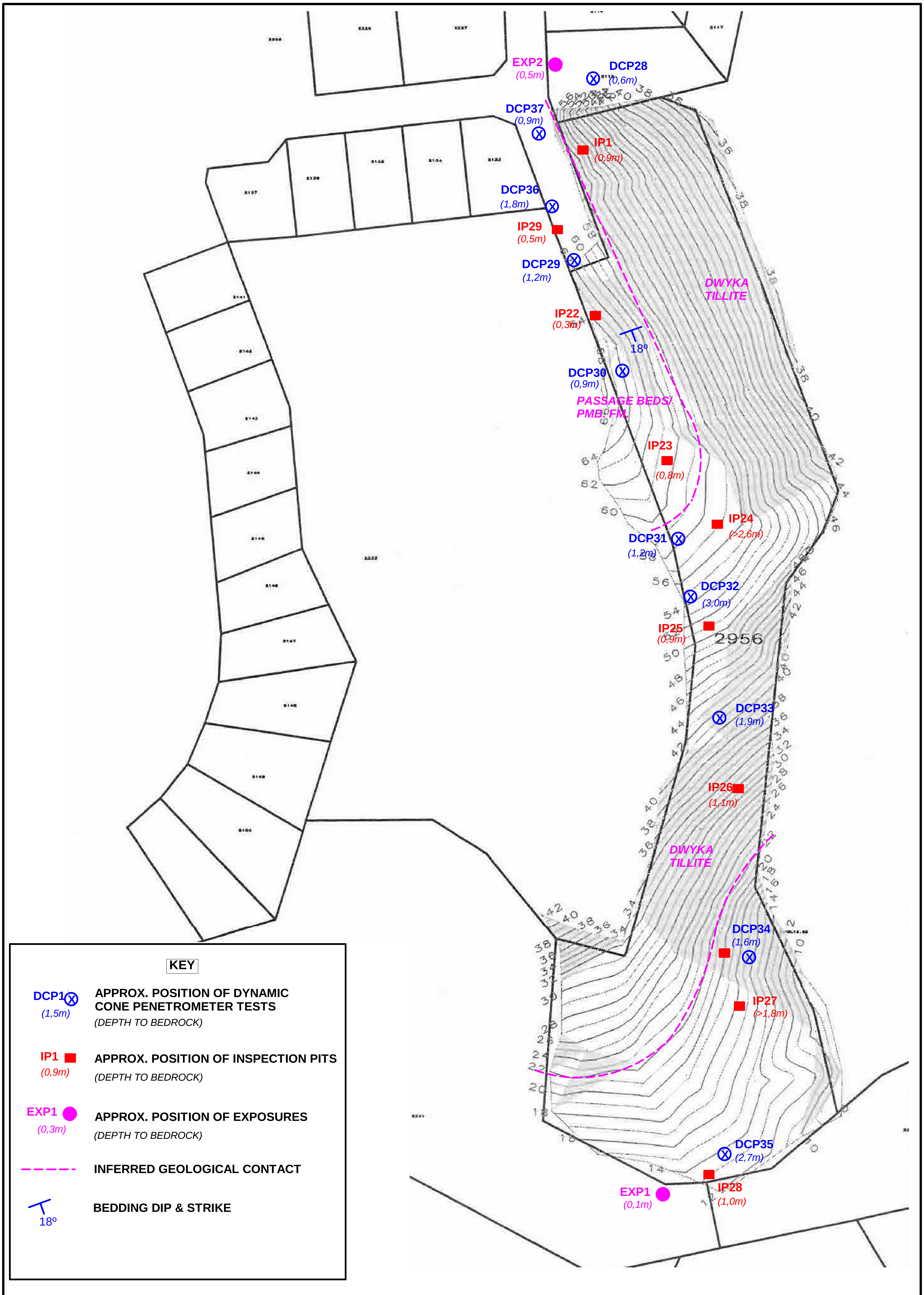
IP17 (0,3m) — **APPROX. POSITION OF INSPECTION PITS** *(DEPTH TO BEDROCK)*

DRENNAN MAUD (PTY) LTD.
Geotechnical Engineers & Engineering Geologists

DESIGNED :	A.J.
DRAWN :	S.P.
DATE :	12/9/2017
SCALE :	N.T.S.
CHECKED :	

GEOTECHNICAL INVESTIGATION PROPOSED KINGSBURG EXT. 9 HOUSING DEVELOPMENT - SITE B GEOTECHNICAL PLAN

DRAWING NO. **31873-B/01**



KEY

DCP1 ⓧ (1,5m)	APPROX. POSITION OF DYNAMIC CONE PENETROMETER TESTS *(DEPTH TO BEDROCK)*
IP1 ■ (0,9m)	APPROX. POSITION OF INSPECTION PITS *(DEPTH TO BEDROCK)*
EXP1 ● (0,3m)	APPROX. POSITION OF EXPOSURES *(DEPTH TO BEDROCK)*
– – – –	INFERRED GEOLOGICAL CONTACT
18°	BEDDING DIP & STRIKE

DRENNAN MAUD (PTY) LTD.
Geotechnical Engineers &
Engineering Geologists

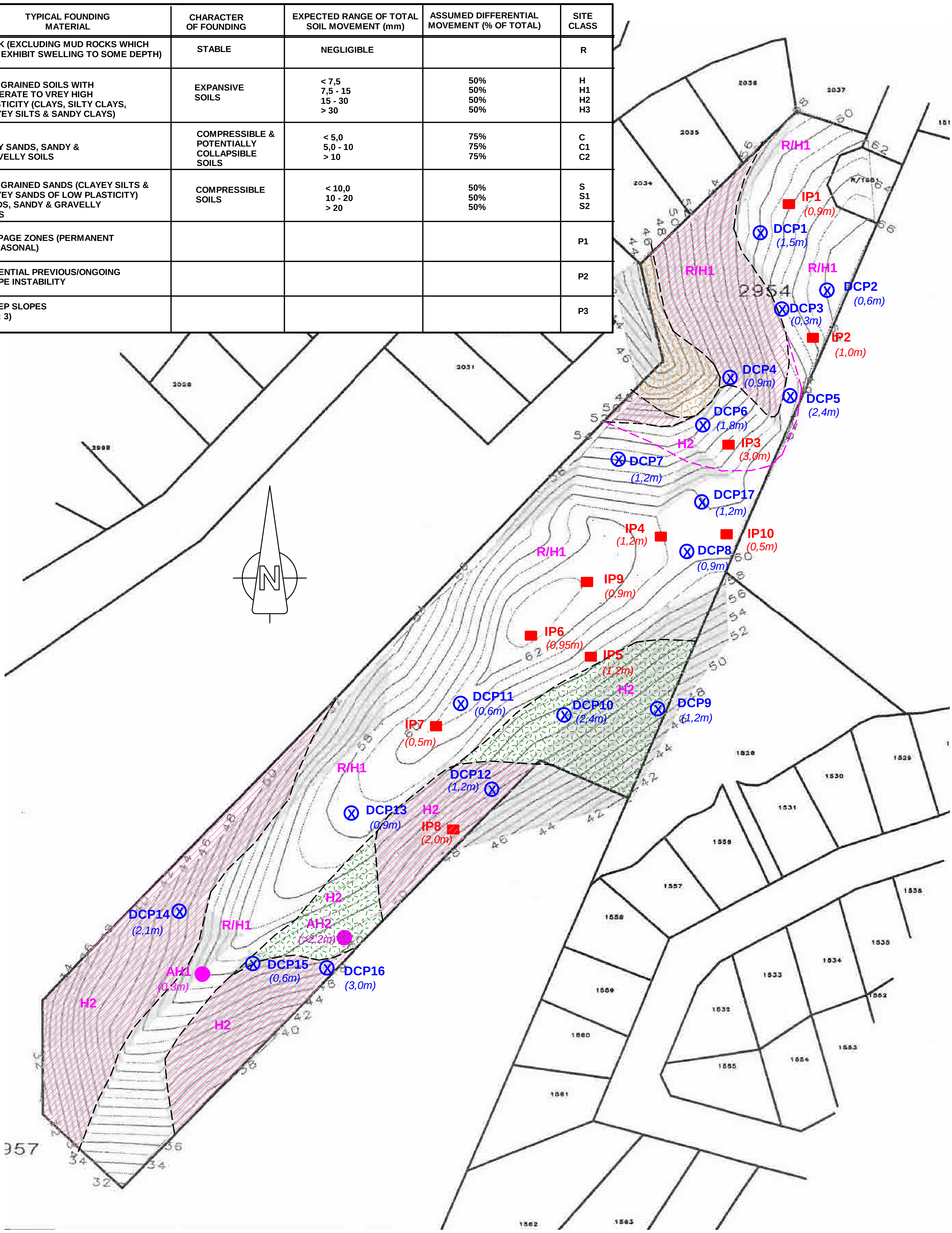
DESIGNED :	A.J.
DRAWN :	S.P.
DATE :	12/9/2017
SCALE :	N.T.S.
CHECKED :	

GEOTECHNICAL INVESTIGATION
PROPOSED KINGSBURG EXT. 9
HOUSING DEVELOPMENT - SITE C
GEOLOGICAL PLAN

DRAWING NO.
31873-C/01

DRAWINGS 31873-A/02, B/02 & C/02
Geotechnical Site Plans

TYPICAL FOUNDING MATERIAL	CHARACTER OF FOUNDING	EXPECTED RANGE OF TOTAL SOIL MOVEMENT (mm)	ASSUMED DIFFERENTIAL MOVEMENT (% OF TOTAL)	SITE CLASS
ROCK (EXCLUDING MUD ROCKS WHICH MAY EXHIBIT SWELLING TO SOME DEPTH)	STABLE	NEGLIGIBLE		R
FINE GRAINED SOILS WITH MODERATE TO VREY HIGH PLASTICITY (CLAYS, SILTY CLAYS, CLAYEY SILTS & SANDY CLAYS)	EXPANSIVE SOILS	< 7,5 7,5 - 15 15 - 30 > 30	50% 50% 50% 50%	H H1 H2 H3
SILTY SANDS, SANDY & GRAVELLY SOILS	COMPRESSIBLE & POTENTIALLY COLLAPSIBLE SOILS	< 5,0 5,0 - 10 > 10	75% 75% 75%	C C1 C2
FINE GRAINED SANDS (CLAYEY SILTS & CLAYEY SANDS OF LOW PLASTICITY) SANDS, SANDY & GRAVELLY SOILS	COMPRESSIBLE SOILS	< 10,0 10 - 20 > 20	50% 50% 50%	S S1 S2
SEEPAGE ZONES (PERMANENT & SEASONAL)				P1
POTENTIAL PREVIOUS/ONGOING SLOPE INSTABILITY				P2
STEEP SLOPES (> 1 : 3)				P3



KEY

DCP1 (1,5m) — **APPROX. POSITION OF DYNAMIC CONE PENETROMETER TESTS** *(DEPTH TO REFUSAL)*

AH1 (0,3m) — **APPROX. POSITION OF AUGER HOLES** *(DEPTH TO BEDROCK)*

IP1 (0,9m) — **APPROX. POSITION OF INSPECTION PITS** *(DEPTH TO BEDROCK)*

POTENTIAL SEEPAGE ZONE (P1)

STEEP SLOPES > 18º (P3)

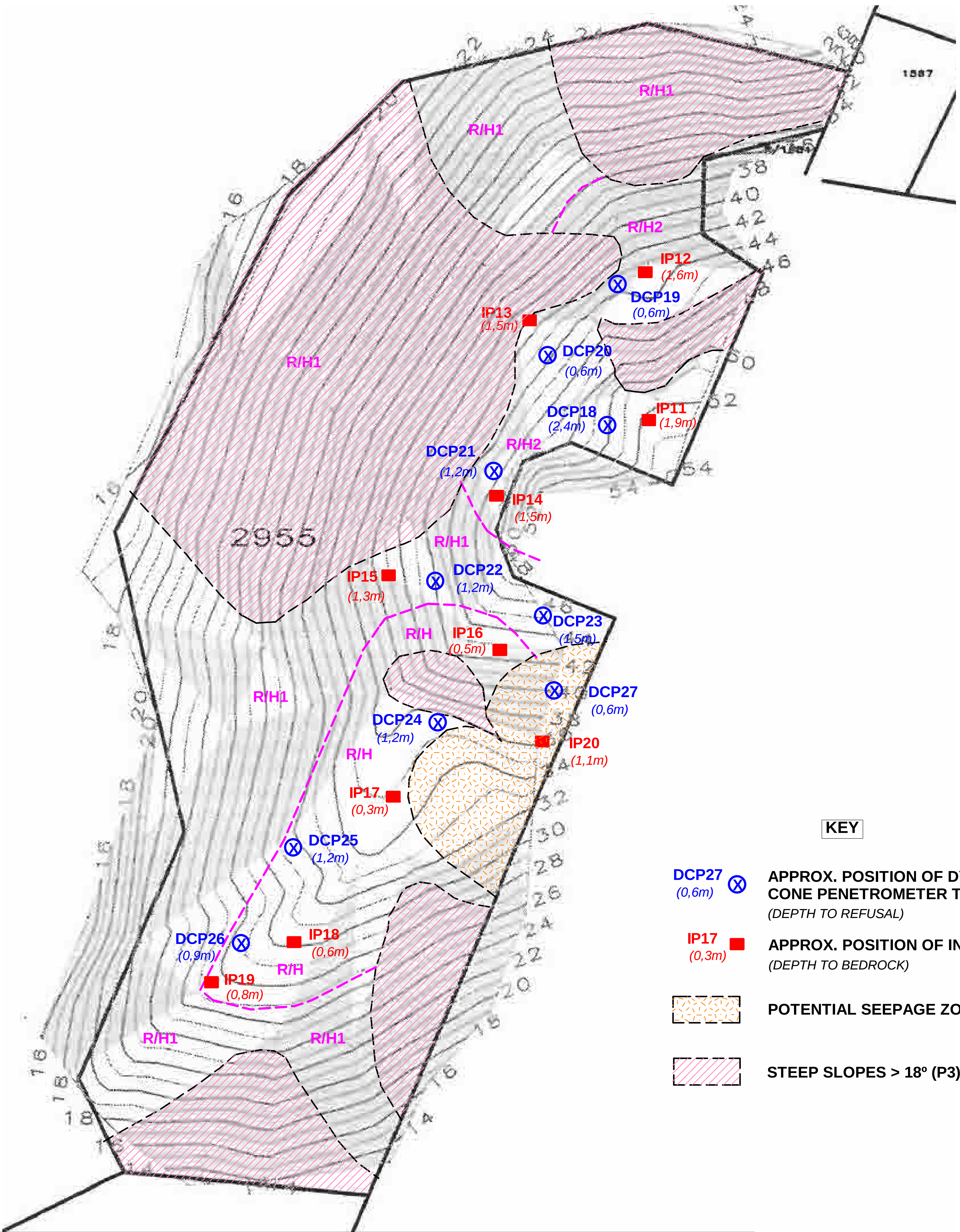
POTENTIAL UNSTABLE SLOPES (P2)

DRENNAN MAUD (PTY) LTD.
Geotechnical Engineers & Engineering Geologists

DESIGNED :	A.J.
DRAWN :	S.P.
DATE :	12/9/2017
SCALE :	N.T.S.
CHECKED :	

GEOTECHNICAL INVESTIGATION PROPOSED KINGSBURG EXT. 9 HOUSING DEVELOPMENT - SITE A GEOTECHNICAL PLAN

DRAWING NO. **31873-A/02**



KEY

DCP27 (0,6m) — **APPROX. POSITION OF DYNAMIC CONE PENETROMETER TESTS** *(DEPTH TO REFUSAL)*

IP17 (0,3m) — **APPROX. POSITION OF INSPECTION PITS** *(DEPTH TO BEDROCK)*

POTENTIAL SEEPAGE ZONE (P1)

STEEP SLOPES > 18° (P3)

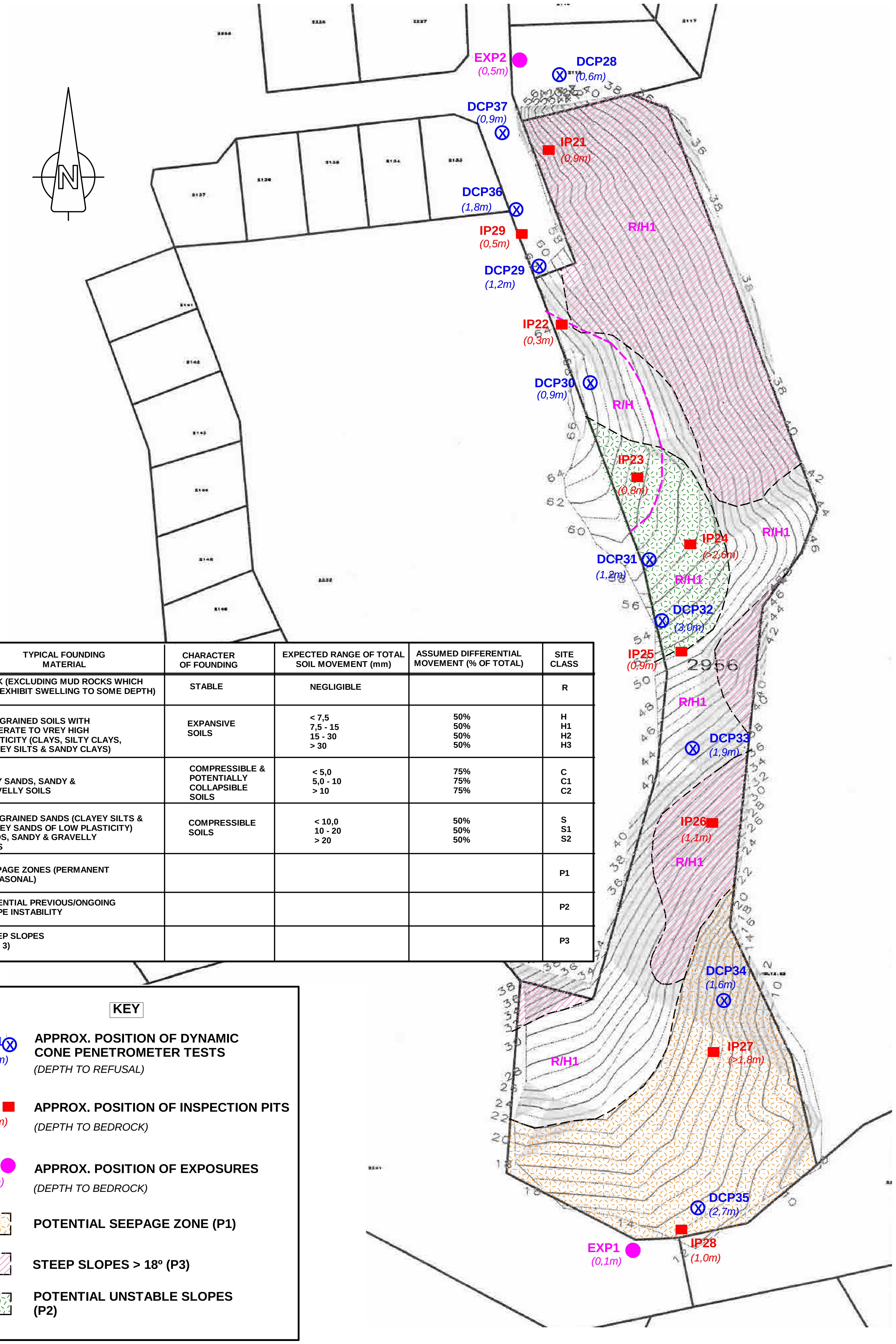
TYPICAL FOUNDING MATERIAL	CHARACTER OF FOUNDING	EXPECTED RANGE OF TOTAL SOIL MOVEMENT (mm)	ASSUMED DIFFERENTIAL MOVEMENT (% OF TOTAL)	SITE CLASS
ROCK (EXCLUDING MUD ROCKS WHICH MAY EXHIBIT SWELLING TO SOME DEPTH)	STABLE	NEGLIGIBLE		R
FINE GRAINED SOILS WITH MODERATE TO VREY HIGH PLASTICITY (CLAYS, SILTY CLAYS, CLAYEY SILTS & SANDY CLAYS)	EXPANSIVE SOILS	< 7,5 7,5 - 15 15 - 30 > 30	50% 50% 50% 50%	H H1 H2 H3
SILTY SANDS, SANDY & GRAVELLY SOILS	COMPRESSIBLE & POTENTIALLY COLLAPSIBLE SOILS	< 5,0 5,0 - 10 > 10	75% 75% 75%	C C1 C2
FINE GRAINED SANDS (CLAYEY SILTS & CLAYEY SANDS OF LOW PLASTICITY) SANDS, SANDY & GRAVELLY SOILS	COMPRESSIBLE SOILS	< 10,0 10 - 20 > 20	50% 50% 50%	S S1 S2
SEEPAGE ZONES (PERMANENT & SEASONAL)				P1
POTENTIAL PREVIOUS/ONGOING SLOPE INSTABILITY				P2
STEEP SLOPES (> 1 : 3)				P3

DRENNAN MAUD (PTY) LTD.
Geotechnical Engineers & Engineering Geologists

DESIGNED :	A.J.
DRAWN :	S.P.
DATE :	12/9/2017
SCALE :	N.T.S.
CHECKED :	

GEOTECHNICAL INVESTIGATION
PROPOSED KINGSBURG EXT. 9
HOUSING DEVELOPMENT - SITE B
GEOTECHNICAL PLAN

DRAWING NO.
31873-B/02



TYPICAL FOUNDING MATERIAL	CHARACTER OF FOUNDING	EXPECTED RANGE OF TOTAL SOIL MOVEMENT (mm)	ASSUMED DIFFERENTIAL MOVEMENT (% OF TOTAL)	SITE CLASS
ROCK (EXCLUDING MUD ROCKS WHICH MAY EXHIBIT SWELLING TO SOME DEPTH)	STABLE	NEGLIGIBLE		R
FINE GRAINED SOILS WITH MODERATE TO VREY HIGH PLASTICITY (CLAYS, SILTY CLAYS, CLAYEY SILTS & SANDY CLAYS)	EXPANSIVE SOILS	< 7,5 7,5 - 15 15 - 30 > 30	50% 50% 50% 50%	H H1 H2 H3
SILTY SANDS, SANDY & GRAVELLY SOILS	COMPRESSIBLE & POTENTIALLY COLLAPSIBLE SOILS	< 5,0 5,0 - 10 > 10	75% 75% 75%	C C1 C2
FINE GRAINED SANDS (CLAYEY SILTS & CLAYEY SANDS OF LOW PLASTICITY) SANDS, SANDY & GRAVELLY SOILS	COMPRESSIBLE SOILS	< 10,0 10 - 20 > 20	50% 50% 50%	S S1 S2
SEEPAGE ZONES (PERMANENT & SEASONAL)				P1
POTENTIAL PREVIOUS/ONGOING SLOPE INSTABILITY				P2
STEEP SLOPES (> 1 : 3)				P3

KEY

DCP1 (1,5m) — APPROX. POSITION OF DYNAMIC CONE PENETROMETER TESTS *(DEPTH TO REFUSAL)*

IP1 (0,9m) — APPROX. POSITION OF INSPECTION PITS *(DEPTH TO BEDROCK)*

EXP1 (0,3m) — APPROX. POSITION OF EXPOSURES *(DEPTH TO BEDROCK)*

POTENTIAL SEEPAGE ZONE (P1)

STEEP SLOPES > 18º (P3)

POTENTIAL UNSTABLE SLOPES (P2)

DRENNAN MAUD (PTY) LTD.
Geotechnical Engineers & Engineering Geologists

DESIGNED :	A.J.
DRAWN :	S.P.
DATE :	12/9/2017
SCALE :	N.T.S.
CHECKED :	

GEOTECHNICAL INVESTIGATION
PROPOSED KINGSBURG EXT. 9
HOUSING DEVELOPMENT - SITE C
GEOTECHNICAL PLAN

DRAWING NO.
31873-C/02

APPENDIX A

Soil Profiles

(IP 1 - 29, AH 1 - 2 & Exp 1 - 2)

DRENNAN MAUD (PTY) LTD

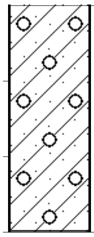
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9
SITE A

HOLE No: AH 1
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:10



Depth (m)	Description
0.00 – *0.30*	Slightly moist, dark brown, fissured, stiff, gravelly sandy CLAY to silty clay – (Colluvium)

NOTES

1) Hand auger refusal encountered at 0.3m on inferred weathered bedrock

2) No groundwater seepage encountered

SAMPLE	*DEPTH (m)*

CONTRACTOR : NA
MACHINE :
DRILLED BY : NA
PROFILED BY : AJ
TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 22/06/2017
DATE : 20/09/17 07:00
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: AH 1

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9
SITE A

HOLE No: AH 2
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:15

SAMPLE	DEPTH (m)	Depth	Description
IND		0.00	Slightly moist, red and orange brown, stiff to very stiff, silty CLAY – (Residual tillite)
		2.20	

NOTES

1) Hand auger refusal encountered in stiff material.

2) No groundwater seepage encountered

3) Samples taken from 0.00–2.20m (INDICATOR)

CONTRACTOR : NA
MACHINE :
DRILLED BY : NA
PROFILED BY : AJ
TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 22/06/2017
DATE : 20/09/17 07:00
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: AH 2

DRENNAN MAUD (PTY) LTD

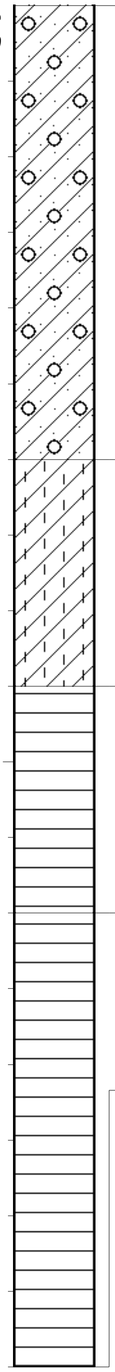
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9
SITE A

HOLE No: IP 1
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:10



SAMPLE	DEPTH (m)	Depth	Description
		0.00	Slightly moist, dark brown, fissured, stiff, gravelly sandy CLAY containing platey, gravel to cobble size fragments of weathered shale – (Colluvium)
		0.60	Moist, dark grey and brown mottled orange and yellow, fissured, firm to stiff, slightly gravelly silty CLAY – (Residual)
	1	0.90	Yellow and grey, completely weathered, highly fractured, extremely soft rock, SILTSTONE/SHALE recovered as gravelly clay to clayey gravel – (Passage Beds/Pietermaritzburg Formation shale)
MOD		1.20	Grey weathered brown stained orange and red on joints, highly weathered, thinly bedded, very close to closely jointed, slight clay infill on joints, very soft rock, SILTSTONE/SHALE – (Passage Beds/Pietermaritzburg Formation shale)
IMC		1.80	

NOTES

1) No TLB refusal encountered - Easy excavation within very soft rock

2) No groundwater seepage encountered

3) No sidewall collapse encountered

4) Samples taken from 1.20–1.80m (IND, MOD, CBR)

5) Dip/Dip Direction 40-45°/120°

6) Dip/Strike JS1 85/310°, 70/210°, 65/260°

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : AJ

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION : NA
DIAM : NA
DATE : NA
DATE : 22/06/2017

DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 1

DRENNAN MAUD (PTY) LTD

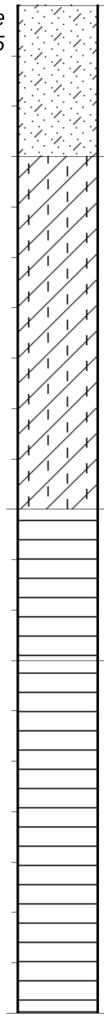
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9
SITE A

HOLE No: IP 2
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:15



Depth (m)	Description
0.00	Slightly moist, dark brown mottled orange and dull grey, fissured, clayey SAND to sandy clay containing round cobbles and pebbles – (Residual)
0.30	Slightly moist to moist, grey mottled and patched orange and yellow, fissured, stiff, slightly cemented in places, slightly sandy silty CLAY – (Residual)
1.00	Grey weathered khaki brown stained orange and red on joints, completely weathered, thinly bedded, very close to closely jointed, slight clay infill on joints, very soft rock, SILTSTONE/SHALE – (Passage Beds/Pietermaritzburg Formation)
1.30	Khaki brown and grey stained orange and grey, highly weathered, thinly bedded, very close to closely jointed, no clay infill, very soft rock, SILTSTONE/SHALE – (Passage Beds/Pietermaritzburg Formation)
2.00	

NOTES

1) Dull refusal of TLB at 2.0m - Blunt teeth on TLB bucket.

2) No groundwater seepage encountered

3) Shale bedrock dips in a south easterly direction

SAMPLE | *DEPTH (m)*

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 22/06/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 2

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

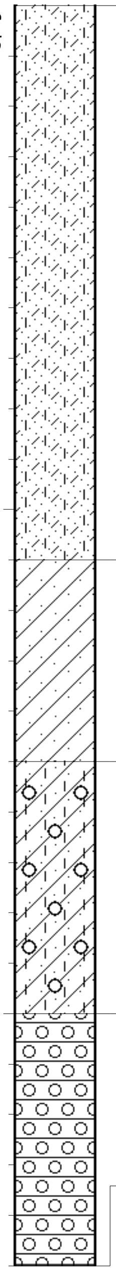
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9
SITE A

HOLE No: IP 3
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:15



Depth (m)	Description
0.00	Slightly moist, dark brown, intact, loose to medium dense, clayey silty SAND – (Colluvium)
1.10	Slightly moist, orange, red, yellow and brown, shattered, slightly gravelly sandy CLAY – (Residual Tillite)
1.50	Slightly moist, yellow, brown, dark brown, red and orange, fissured, stiff, gravelly silty sandy CLAY containing occasional relic structures – (Completely weathered /residual Tillite)
2.00	Yellow, highly weathered, very closely jointed, very soft rock, TILLITE recovered as gravely silty sand with rock fragments containing occasional small inclusions and small drop stones – (Dwyka Group)
2.50	

1
2

NOTES

1) No TLB refusal encountered.

2) No groundwater seepage encountered

3) No sidewall collapse encountered

4) Head of steep drainage valley that may harbour ground water during wetter summer months.

SAMPLE | *DEPTH (m)*

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 22/06/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 3

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

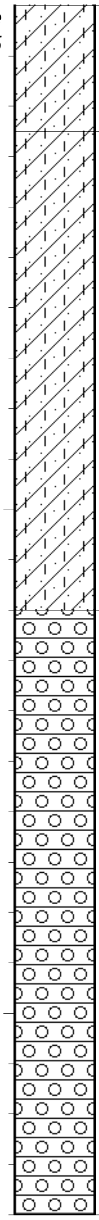
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9
SITE A

HOLE No: IP 4
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:15



Depth (m)	Description
0.00	Slightly moist, dark brown, fissured, stiff, silty sandy CLAY to clayey silty sand in places – (Colluvium)
0.25	Slightly moist, yellow brown mottled brown and orange brown, stiff, fissured, sandy silty CLAY gradually becoming more completely weathered with depth containing relic structures and more gravelly with depth – (Residual/Completely weathered Tillite)
1.20	Yellow brown, weathered brown, highly weathered to completely weathered in places, very closely to closely jointed, extremely soft to very soft rock TILLITE – (Dwyka Group)
2.40	

Depth scale: 1, 2

NOTES

1) No TLB refusal encountered

2) No groundwater seepage encountered

3) No sidewall collapse encountered

SAMPLE	DEPTH (m)

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 22/06/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 4

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9
SITE A

HOLE No: IP 5
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:15

SAMPLE	DEPTH (m)	Depth	Description
IND		*0.00*	Slightly moist, very dark brown, strongly fissured, silty CLAY – (Colluvium/Residual)
I, Swell		*0.30*	Slightly moist to moist, orange brown and brown to yellow brown with depth, fissured, slickensided, firm to soft, slightly sandy silty CLAY – (Residual tillite)
	1	*1.20*	Yellow and khaki brown, highly weathered, very closely to closely jointed, extremely soft to very soft rock, TILLITE – (Dwyka Group)
	2	*2.50*	

NOTES

1) No TLB refusal encountered

2) No groundwater seepage encountered

3) No sidewall collapse encountered

4) Samples taken from 0.00–0.30m (INDICATOR)

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : AJ

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 22/06/2017

DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 5

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9
SITE A

HOLE No: IP 6
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:15

Depth (m)	Description
0.00	Slightly moist, dark brown, fissured, stiff, silty CLAY – (Colluvium)
0.35	Slightly moist, grey mottled orange, fissured, stiff, slightly gravelly slightly sandy CLAY – (Residual Shale/Siltstone)
0.95	Grey weathered brown, highly weathered, thinly bedded, very closely to closely jointed, joints stained with no infill, very soft rock SHALE – (Pietermaritzburg Formation)
2.00	

NOTES

1) Semi refusal of TLB at 2.0m. Slow penetration in Shale/Siltstone bedrock

2) No groundwater seepage encountered

3) No sidewall collapse encountered

4) Dip and Dip Direction 14°/120°

5) Dip and Strike JS1 80°/110° JS2 90°/180° JS3 90°/250°

SAMPLE	DEPTH (m)

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : AJ

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 22/06/2017

DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 6

DRENNAN MAUD (PTY) LTD

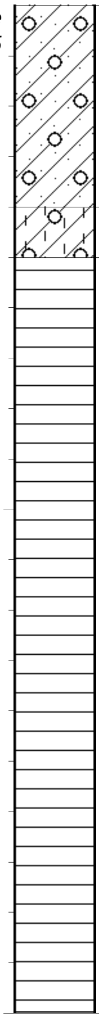
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9
SITE A

HOLE No: IP 7
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:15



Depth (m)	Description
0.00	Slightly moist, dark brown, fissured, stiff, gravelly sandy CLAY to silty clay – (Colluvium)
0.40	Slightly moist, light grey and yellow brown, fissured, gravelly silty CLAY – (Residual/Completely weathered Shale/Siltstone)
0.50	Khaki brown, weathered brown, highly weathered, very closely to closely jointed, thinly bedded, stained, no infill in joints, inclined, very soft rock SILTSTONE / SHALE – (Passage Beds /Pietermaritzburg Formation)
2.00	

Depth scale: 1, 2

NOTES

1) No TLB refusal encountered but slow excavation due to blunt teeth.

2) No groundwater seepage encountered

3) No sidewall collapse encountered

SAMPLE | *DEPTH (m)*

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 22/06/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 7

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET
DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

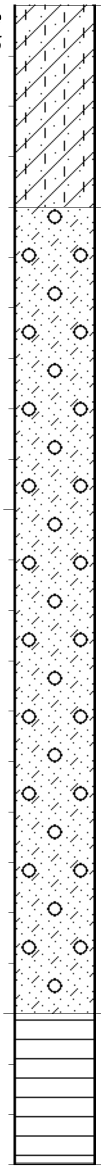
RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9
SITE A

HOLE No: IP 8
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:15

IMC



Depth (m)	Description
0.00	Slightly moist, very dark brown, fissured, slightly gravelly sandy silty CLAY – (Colluvium)
0.40	Slightly moist, brown and grey brown, intact, medium dense, gravelly clayey SAND to silty sand containing fragments of weathered rock – (Residual/completely weathered Rock)
2.00	Olive grey stained red and orange, highly weathered, highly fractured, very closely jointed, thin clay infill on joints, extremely soft to very soft rock, SHALE / SILTSTONE – (Passage Beds / Pietermaritzburg Formation)
2.30	

NOTES

1) No TLB refusal encountered.

2) No groundwater seepage encountered

3) Samples taken from 0.00–0.40m (INDICATOR, MOD, CBR)

SAMPLE | *DEPTH (m)*

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 22/06/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 8

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9
SITE A

HOLE No: IP 9
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:10

Depth (m)	Description
0.00	Slightly moist, brown, fissured, stiff, silty CLAY – (Colluvium)
0.35	Slightly moist, dark brown mottled red, orange and grey, fissured, stiff, silty CLAY – (Residual)
0.90	Grey weathered brown, completely to highly weathered, thinly bedded, closely jointed, extremely soft to very soft rock SHALE – (Pietermaritzburg Formation)
1.50	

NOTES

1) No TLB refusal encountered

2) No groundwater seepage encountered

SAMPLE	*DEPTH (m)*

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 22/06/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 9

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET
DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

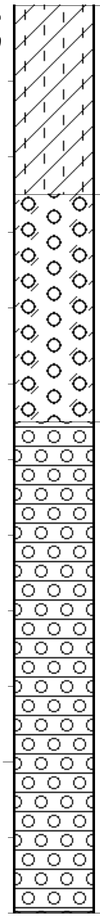
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9
SITE A

HOLE No: IP 10
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:10



Depth (m)	Description
0.00 – 0.25	Slightly moist, dark brown, fissured, stiff silty CLAY – (Colluvium)
0.25 – 0.55	Slightly moist, orange, brown and yellow, intact, medium dense, clayey GRAVEL – (Residual/Completely weathered tillite)
0.55 – 1.20	Yellow and brown, highly weathered, very closely to closely jointed, very soft rock, TILLITE – (Dwyka Group)

MOD (at 0.55 m)

IMC

1

NOTES

1) No TLB refusal encountered

2) No groundwater seepage encountered

3) Samples taken from 0.55–1.20m (INDICATOR, MOD, CBR)

SAMPLE *DEPTH (m)*

CONTRACTOR : NA
MACHINE : TLB
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 22/06/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 10

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET
DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGSBURGH EXT 9 - SITE B

HOLE No: IP 11
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:15

Depth (m)	Description
0.00–0.40	Slightly moist, dark brown, fissured, stiff, gravelly sandy CLAY containing roots and occasional foreign material – (Topsoil/Fill)
0.40–1.20	Slightly moist, grey brown and brown, intact, medium dense, gravelly clayey SAND to sandy clay containing platey shale fragments occasional round pebbles and foreign material – (Fill/Colluvium)
1.20–1.40	Slightly moist, dark brown, fissured, stiff, sandy CLAY – (Colluvium)
1.40–1.90	Slightly moist, grey mottled red, orange and yellow brown, fissured, slickensided, silty CLAY – (Residual)
1.90–2.10	Grey and olive grey weathered yellow brown, highly weathered, thinly bedded, very closely to closely jointed, very soft rock, SILTSTONE – (Vryheid Formation)

Sample: IND at 1.40–1.90m

SAMPLE	DEPTH (m)
IND	1.40–1.90m

NOTES

1) No excavator refusal encountered

2) No groundwater seepage encountered

3) Samples taken from 1.40–1.90m (INDICATOR)

CONTRACTOR : NA
MACHINE : Excavator
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION : NA
DIAM : NA
DATE : NA
DATE : 24/07/2017

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET
DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

HOLE No: IP 11

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGSBURGH EXT 9 - SITE B

HOLE No: IP 12
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:15

Depth (m)	Description
0.00	Slightly moist, dark brown to reddish brown, fissured, stiff, sandy CLAY – (Colluvium/Topsoil)
0.30	Slightly moist, red brown mottled orange and yellow, fissured, stiff, silty CLAY – (Residual/Colluvium)
1.00	Slightly moist, grey mottled orange and yellow, fissured, stiff, silty CLAY containing occasional completely weathered zones – (Residual)
1.60	Grey weathered brown, completely to highly weathered, very soft rock, SHALE/SILTSTONE containing occasional zones of residual grey, stiff clay – (Pietermaritzburg Formation/Passage Beds)
2.00	

MOD (sample at 1.60 m)

IMC

1

2

NOTES

1) No excavator refusal encountered – hole stopped at 2.0m due to access restrictions

2) No groundwater seepage encountered

3) Samples taken from 1.60–2.00m (IND, MOD, CBR)

SAMPLE *DEPTH (m)*

CONTRACTOR : NA
MACHINE : EXCAVATOR
DRILLED BY : NA
PROFILED BY : AJ
TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 24/07/2017
DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 12

DRENNAN MAUD (PTY) LTD

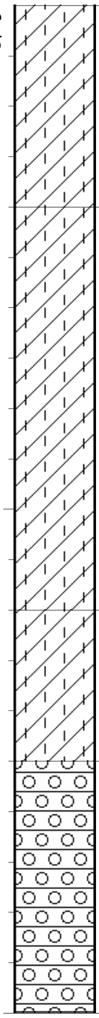
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGSBURGH EXT 9 - SITE B

HOLE No: IP13
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:15



Depth (m)	Description
0.00	Slightly moist, brown and dark brown, fissured, stiff, slightly sandy silty CLAY – (Topsoil/Colluvium)
0.40	Slightly moist, red mottled yellow, fissured, stiff, silty CLAY – (Residual)
1.20	Slightly moist, red mottled yellow orange, fissured, stiff, silty CLAY containing occasional fragments of rock – (Completely weathered Tillite/siltstone)
1.50	Olive khaki brown, highly weathered, very closely to closely jointed, thinly bedded, very soft to soft rock TILLITE / SILTSTONE – (Dwyka Group / Passage Beds)
2.00	

NOTES

1) Dull refusal of excavator encountered at 2.0m.

2) No groundwater seepage encountered

SAMPLE	DEPTH (m)
	1
	2

CONTRACTOR : NA
MACHINE : EXCAVATOR
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 24/07/2017

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

HOLE No: IP13

DRENNAN MAUD (PTY) LTD

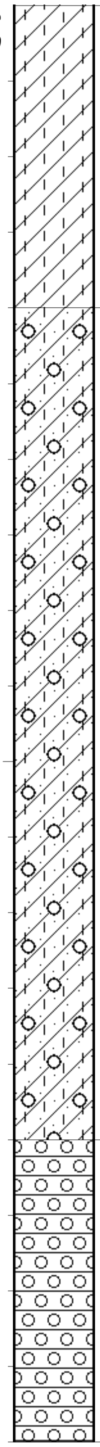
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGSBURGH EXT 9 - SITE B *Sheet 1 of 1*

HOLE No: IP 14

JOB NUMBER: 31873

Scale 1:10



Depth (m)	Description
0.00	Slightly moist, dark brown, fissured, stiff, silty CLAY – (Colluvium)
0.40	Slightly moist, grey mottled orange, fissured, stiff, gravelly, sandy, silty CLAY – (Residual Tillite)
1.50	Khaki and olive brown, highly weathered, very closely to closely jointed, very soft rock, TILLITE – (Dwyka Group / Passage Beds)
1.90	

S1 (0.40)

IMC, SWELL (1)

NOTES

1) No excavator refusal encountered – pit halted at 1.9m due to access restrictions

2) No groundwater seepage encountered

3) Samples taken S1 0.40–1.50m (IND, MOD, CBR, SWELL)

4) Base of cal de sac fill embankment, relatively level near upper slope but drops off quickly downslope.

SAMPLE	*DEPTH (m)*

CONTRACTOR : NA
MACHINE : EXCAVATOR
DRILLED BY : NA
PROFILED BY : AJ
TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 24/07/2017
DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 14

DRENNAN MAUD (PTY) LTD

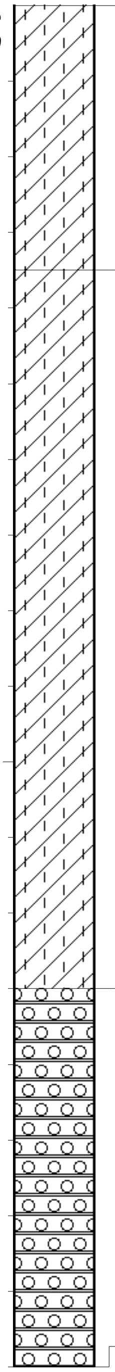
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGSBURGH EXT 9 - SITE B *Sheet 1 of 1*

HOLE No: IP 15

JOB NUMBER: 31873

Scale 1:10



Depth (m)	Description
0.00	Slightly moist, dark brown, fissured, stiff, silty CLAY – (Colluvium)
0.35	Slightly moist, grey mottled orange, fissured, stiff, slightly sandy silty CLAY – (Residual)
1.30	Grey weathered khaki brown and olive green, highly weathered, platey, fissile, very soft rock to soft rock with depth SILTSTONE/TILLITE recovered as platey sandy silty gravel – (Passage Beds/Dwyka Group)
1.80	

1

NOTES

1) Dull refusal of excavator met at 1.8m.

2) No groundwater seepage encountered

SAMPLE	*DEPTH (m)*

CONTRACTOR : NA
MACHINE : EXCAVATOR
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 24/07/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 15

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

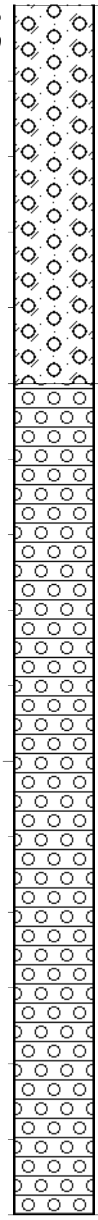
RESIDENTIAL DEVELOPMENT KINGSBURGH EXT 9 - SITE B

HOLE No: IP 16

Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:10



0.00

Slightly moist, orange and red brown, intact, medium dense, clayey sandy GRAVEL to gravelly clayey sand, containing fragments of highly weathered tillite – (Colluvium/Residual)

MOD 0.50

Olive green and khaki to yellow brown, highly weathered, very close to closely jointed, very soft to occasionally soft rock, TILLITE – (Dwyka Group)

1

IMC

1.60

NOTES

1) Dull refusal of excavator met at 1.6m.

2) No groundwater seepage encountered

3) Samples taken from 0.50–1.60m (IND, MOD, CBR)

SAMPLE	*DEPTH (m)*

CONTRACTOR : NA
MACHINE : EXCAVATOR
DRILLED BY : NA
PROFILED BY : AJ
TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 24/07/2017
DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 16

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

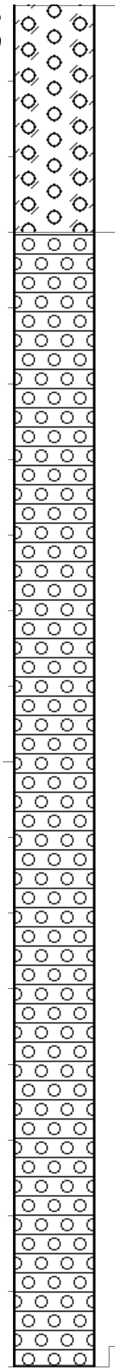
RESIDENTIAL DEVELOPMENT KINGSBURGH EXT 9 - SITE B

HOLE No: IP 17

Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:10



Depth (m)	Description
0.00	Slightly moist, orange and red brown, medium dense, intact, clayey GRAVEL containing fragments of weathered tillite – (Colluvium)
0.30	Olive and khaki brown, highly weathered, very closely jointed, very soft rock, TILLITE recovered as blocky gravel – (Dwyka Group)
1.80	

1

NOTES

1) Dull refusal of excavator met at 1.8m

2) No groundwater seepage encountered

SAMPLE	*DEPTH (m)*

CONTRACTOR : NA
MACHINE : EXCAVATOR
DRILLED BY : NA
PROFILED BY : AJ

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 24/07/2017

DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 17

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGSBURGH EXT 9 - SITE B

HOLE No: IP 18
Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:10

Depth (m)	Description
0.00	Slightly moist, dark brown, fissured, stiff sandy CLAY – (Colluvium)
0.20	Slightly moist, orange and red mottled yellow, fissured, stiff, silty CLAY – (Residual)
0.60	Olive green yellow and khaki brown, highly weathered, very closely jointed, very soft rock, TILLITE – (Dwyka Group)
1.50	

NOTES

1) Dull refusal of excavator met at 1.5m.

2) No groundwater seepage encountered

SAMPLE	DEPTH (m)

CONTRACTOR : NA
MACHINE : EXCAVATOR
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 24/07/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 18

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET
DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

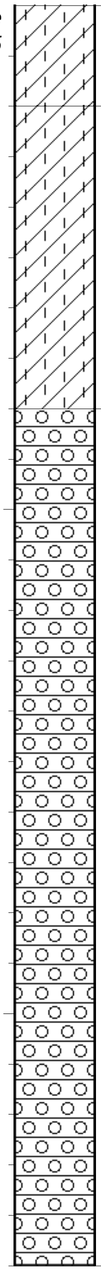
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGSBURGH EXT 9 - SITE B *Sheet 1 of 1*

HOLE No: IP 19

JOB NUMBER: 31873

Scale 1:15



DEPTH (m)	Description
0.00 – 0.20	Slightly moist, brown, fissured, stiff, slightly sandy, silty CLAY – (Topsoil/Colluvium)
0.20 – 0.80	Slightly moist, red mottled yellow, fissured, stiff, slightly gravelly silty CLAY – (Residual)
0.80 – 2.50	Yellow and khaki brown, completely weathered quickly becoming highly weathered with depth, very closely to closely jointed, extremely soft to very soft rock TILLITE recovered at clayey silty gravel – (Dwyka Group)

NOTES

1) Dull refusal of excavator met at 2.5m in weathered tillite.

2) No groundwater seepage encountered.

SAMPLE	DEPTH (m)

CONTRACTOR : NA
MACHINE : EXCAVATOR
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 24/07/2017

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

HOLE No: IP 19

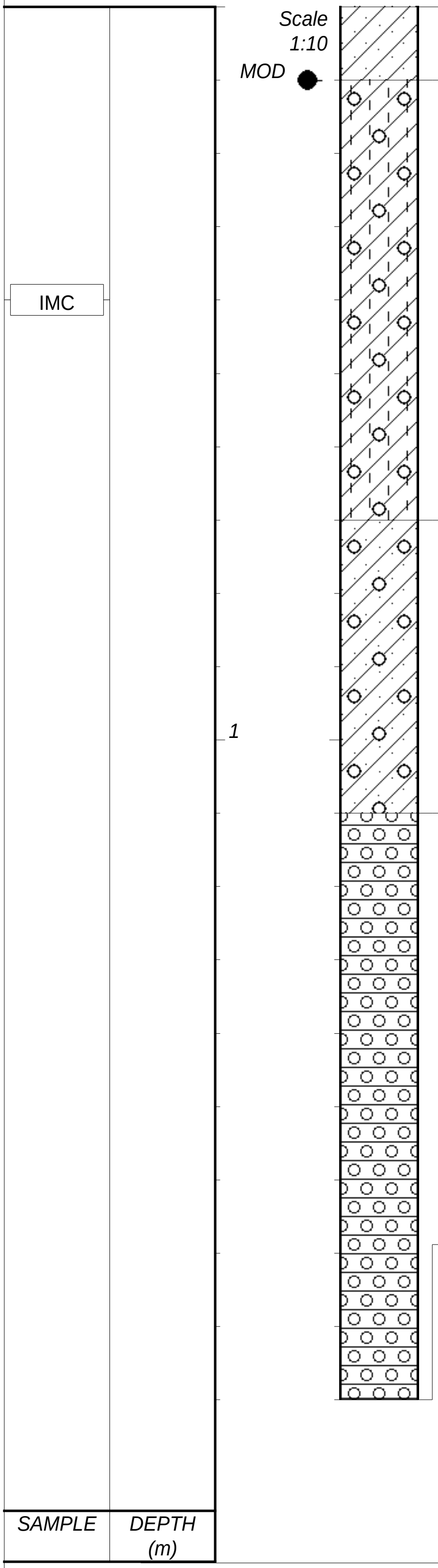
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGSBURGH EXT 9 - SITE B *Sheet 1 of 1*

HOLE No: IP 20

JOB NUMBER: 31873



0.00 Slightly moist, brown, fissured, stiff, sandy CLAY – (Topsoil)

0.10 Slightly moist, red brown, fissured, stiff, gravelly, silty CLAY – (Residual)

0.70 Slightly moist, yellow and grey, stiff, fissured gravelly sandy CLAY containing fragments of weathered tillite – (Completely weathered)

1.10 Olive and khaki brown, highly weathered, very closely jointed, very soft rock, TILLITE containing occasional zones of clayey residuum – (Dwyka Group)

1.90

NOTES

1) No excavator refusal encountered.

2) No groundwater seepage encountered

3) Samples taken from 0.10–0.70m (INDICATOR, MOD, CBR)

SAMPLE | *DEPTH (m)*

CONTRACTOR : NA
MACHINE : EXCAVATOR
DRILLED BY : NA
PROFILED BY : AJ
TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 24/07/2017
DATE : 20/09/17 07:01
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 20

DRENNAN MAUD (PTY) LTD

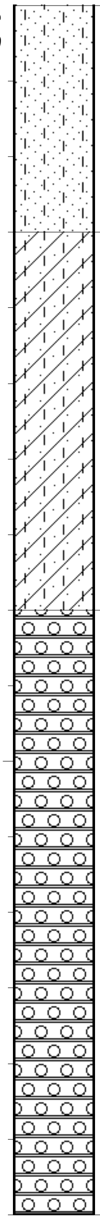
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9 - SITE C *Sheet 1 of 1*

HOLE No: IP 21

JOB NUMBER: 31873

Scale 1:10



Depth (m)	Description
0.00	Slightly moist, brown, intact, loose, slightly gravelly, slightly clayey silty SAND – (Topsoil/Colluvium)
0.30	Slightly moist, orange and red brown mottle yellow, fissured, stiff, slightly gravelly sandy silty CLAY – (Residual Tillite)
0.80	Yellow brown and khaki to olive brown, highly weathered, very close to closely jointed, staining and clay infilling on some joints, very soft rock, TILLITE/SILTSTONE containing small drop stones and occasional relic bedding – (Dwyka Group/Passage Beds)
1.60	

NOTES

1) Dull refusal of excavator encountered at 1.6m.

2) Pit located at the base of a steep fill embankment.

3) No groundwater seepage encountered

SAMPLE	DEPTH (m)

CONTRACTOR : NA
MACHINE : Excavator
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION : NA
DIAM : NA
DATE : NA
DATE : 03/08/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 21

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

DATE : 20/09/17 07:03
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9 - SITE C *Sheet 1 of 1*

HOLE No: IP 22

JOB NUMBER: 31873

Scale 1:15

Depth (m)	Description
0.00	Slightly moist, grey brown and brown, intact, silty clayey gravelly SAND – (Topsoil)
0.30	Grey weathered brown, highly weathered, very thinly bedded, very closely jointed, stained to thin infilling in places, inclined, very soft rock, SHALE recovered as a clayey gravel – (Pietermaritzburg Formation)
2.30	

MOD (sample at 0.30)

IMC

NOTES

1) No excavator refusal encountered - easy excavation.

2) No groundwater seepage encountered

3) Minor sidewall collapse encountered within inclined shale bedrock

4) Samples taken from 0.30–2.30m (IND, MOD, CBR)

5) Shale dip and dip direction - 15-20° / 150-180°

SAMPLE | *DEPTH (m)*

CONTRACTOR : NA
MACHINE : Excavator
DRILLED BY : NA
PROFILED BY : AJ
TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03/08/2017
DATE : 20/09/17 07:03
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 22

DRENNAN MAUD (PTY) LTD

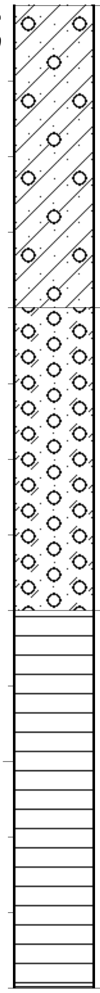
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9 - SITE C *Sheet 1 of 1*

HOLE No: IP 23

JOB NUMBER: 31873

Scale 1:10



SAMPLE	DEPTH (m)	Depth	Description
		0.00 – 0.40	Slightly moist, brown and orange brown, fissured, firm to stiff, gravelly sandy CLAY containing platey fragments of weathered shale – (Colluvium)
		0.40 – 0.80	Slightly moist, orange and grey, sandy clayey GRAVEL containing lenses of residual clay and completely weathered shale – (Completely weathered to residual Shale)
	1	0.80 – 1.30	Grey weathered brown, highly weathered to medium weathered, thinly bedded, sub-horizontal, no clear clay infilling, slight staining, very soft rock, SHALE – (Pietermaritzburg Formation)

NOTES

1) Semi refusal of excavator met at 1.3m in weathered shale.

2) No groundwater seepage enccountered

CONTRACTOR : NA
MACHINE : Excavator
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03/08/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 23

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET
DATE : 20/09/17 07:03
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9 - SITE C *Sheet 1 of 1*

HOLE No: IP 24

JOB NUMBER: 31873

MOD

Scale 1:15

IMC

Depth (m)	Description
0.00	Slightly moist to moist, orange brown, intact to slightly fissured, firm to stiff, slightly gravelly clayey SAND – (Residual tillite/colluvium)
0.70	Slightly moist, orange brown and pinkish red mottled yellow, intact to slightly fissured in places, firm to stiff, slightly gravelly sandy CLAY to clayey silty in places – (Residual to completely weathered tillite)
1.30	Yellow grey and pinkish orange, fissured, stiff, gravelly clayey sandy SILT to silty sandy clay containing relic structures containing occasional zones of highly weathered, extremely to very soft rock tillite – (Completely weathered Tillite)
2.60	

NOTES

1) No excavator refusal encountered – easy excavation.

2) No groundwater seepage encountered

3) Samples taken from 0.01–0.70m (IND, MOD, CBR)

SAMPLE *DEPTH (m)* 1 2

CONTRACTOR : NA
MACHINE : Excavator
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03/08/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 24

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET
DATE : 20/09/17 07:03
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9 - SITE C *Sheet 1 of 1*

HOLE No: IP 25

JOB NUMBER: 31873

Scale 1:15

Depth (m)	Description
0.00	Slightly moist, brown, intact to slightly fissured, medium dense, clayey silty SAND containing root material – (Topsoil/Colluvium)
0.40	Slightly moist, red brown and orange brown, fissured, stiff, silty CLAY – (Residual Tillite)
0.90	Yellow brown, completely weathered to highly weathered, very closely jointed, extremely soft rock, TILLITE – (Dwyka Group)
1.50	Yellow brown, highly weathered, very closely to closely jointed, very soft rock, TILLITE – (Dwyka Group)
2.00	

MOD (sample at 1.50 m)

IMC

NOTES

1) Dull refusal of excavator met at 2.0m.

2) No groundwater seepage encountered

3) Samples taken from 1.50–2.00m (IND, MOD, CBR)

SAMPLE | *DEPTH (m)*

CONTRACTOR : NA
MACHINE : Excavator
DRILLED BY : NA
PROFILED BY : AJ
TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03/08/2017
DATE : 20/09/17 07:03
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 25

DRENNAN MAUD (PTY) LTD

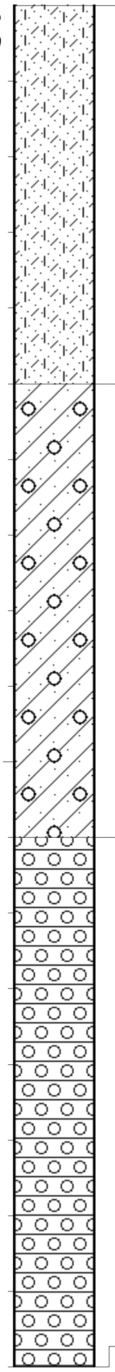
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9 - SITE C *Sheet 1 of 1*

HOLE No: IP 26

JOB NUMBER: 31873

Scale 1:10



SAMPLE	DEPTH (m)	Depth	Description
		0.00	Slightly moist, dark brown, fissured, loose to medium dense, clayey silty SAND – (Colluvium)
		0.50	Slightly moist, yellow brown, brown, and grey, fissured, stiff, gravelly sandy CLAY to clayey sand in places – (Completely weathered Tillite)
	1	1.10	Yellow brown weathered brown, highly weathered, very close to closely jointed, very soft rock, TILLITE – (Dwyka Group)
		1.80	

NOTES

1) No excavator refusal encountered but slow penetration at 1.8m in weathered tillite.

2) No groundwater seepage encountered

CONTRACTOR : NA
MACHINE : Excavator
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03/08/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 26

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET
DATE : 20/09/17 07:03
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

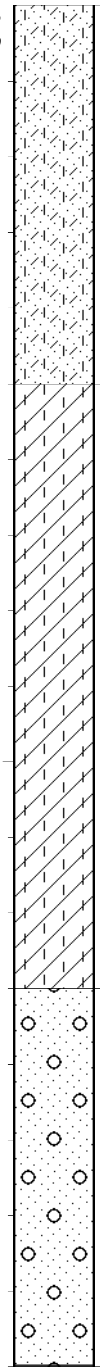
RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9 - SITE C

HOLE No: IP 27

Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:10



SAMPLE	*DEPTH (m)*	Depth	Description
		0.00	Slightly moist, dark brown, intact, loose, clayey silty SAND containing organic material – (Topsoil/Colluvium)
SWELL, pH, COND (*0.50–1.30m*)		*0.50*	Slightly moist, grey mottled khaki brown, stiff, fissured, slickensided, slightly sandy silty CLAY – (Alluvium)
	1	*1.30*	Slightly moist, orange patched grey, very weakly cemented, slightly clayey gravelly fine to medium grained SAND containing randomly orientated fragments of tillite – (Alluvium)
		1.80	

NOTES

1) No refusal encountered but slow digging in weakly cemented alluvium.

2) No groundwater seepage encountered

3) Samples taken from 0.50–1.30m (Swell, pH, Conductivity)

CONTRACTOR : NA
MACHINE : Excavator
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03/08/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 27

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

DATE : 20/09/17 07:03
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9 - SITE C *Sheet 1 of 1*

HOLE No: IP 28

JOB NUMBER: 31873

Scale 1:10

Depth (m)	Description
0.00 – 1.00	Slightly moist, brown, intact, loose, fine to medium grained SAND – (Alluvium)
1.00 – 1.30	Khaki brown, highly to medium weathered, close to medium jointed, soft to medium hard rock, TILLITE – (Dwyka Group)

NOTES

1) Excavator refusal encountered at 1.3m on medium weathered tillite.

2) No groundwater seepage encountered

3) Pit located on river/stream bank approximately 3m above water level

SAMPLE	*DEPTH (m)*

CONTRACTOR : NA
MACHINE : Excavator
DRILLED BY : NA
PROFILED BY : AJ
TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03/08/2017
DATE : 20/09/17 07:03
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 28

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

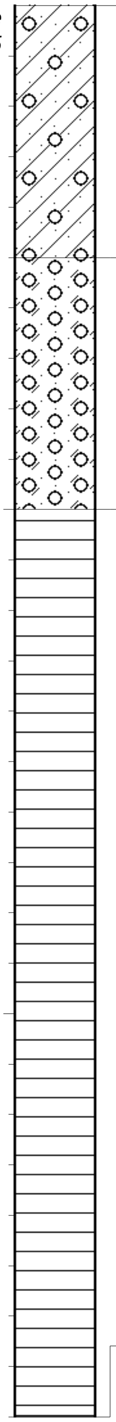
RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9 - SITE C

HOLE No: IP 29

Sheet 1 of 1

JOB NUMBER: 31873

Scale 1:15



0.00 Slightly moist, brown and red brown, fissured, stiff, gravelly sandy CLAY – (Colluvium/Residual Shale)

0.50 Slightly moist, yellow and grey, fissured, medium dense, clayey sandy GRAVEL – (Completely weathered shale)

1.00 Khaki brown, highly weathered, very thinly bedded, very closely jointed, stained to thin infilling in places, inclined, very soft rock SHALE – (Pietermaritzburg Formation)

2.80

NOTES

1) No excavator refusal encountered.

2) No groundwater seepage encountered

SAMPLE	*DEPTH (m)*
	1
	2

CONTRACTOR : NA
MACHINE : Excavator
DRILLED BY : NA
PROFILED BY : AJ
TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03/08/2017
DATE : 20/09/17 07:03
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: IP 29

DRENNAN MAUD (PTY) LTD

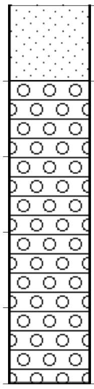
Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9 - SITE C *Sheet 1 of 1*

HOLE No: EXP1

JOB NUMBER: 31873

Scale 1:10



Depth (m)	Description
0.00 – *0.10*	Slightly moist, brown, intact, loose, fine to medium grained SAND – (Alluvium)
0.10 – *0.50*	Olive grey, medium weathered, very close to medium jointed, medium to hard rock, TILLITE – (Dwyka Group)

NOTES

1) Exposure in river channel bed.

SAMPLE	*DEPTH (m)*

CONTRACTOR : NA
MACHINE :
DRILLED BY : NA
PROFILED BY : AJ

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03/08/2017

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: EXP1

TYPE SET BY : KJR
SETUP FILE : DMPSP.SET
DATE : 20/09/17 07:03
TEXT : ..C:\DOTIN\SPMASTER.DOC

DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

RESIDENTIAL DEVELOPMENT KINGS BURGH EXT 9 - SITE C *Sheet 1 of 1*

HOLE No: EXP2

JOB NUMBER: 31873

Scale 1:20

Depth (m)	Description
0.00 – 0.50	Slightly moist, brown, intact, loose, clayey SAND containing foreign material including refuse, glass, plastic – (Colluvium/Fill)
0.50 – 3.00	Yellow and khaki brown, highly weathered, very close to medium jointed, very soft to soft rock, TILLITE – (Dwyka Group)

SAMPLE	DEPTH (m)

CONTRACTOR : NA
MACHINE :
DRILLED BY : NA
PROFILED BY : AJ
TYPE SET BY : KJR
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 03/08/2017
DATE : 20/09/17 07:03
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: EXP2

APPENDIX B
DCP Test Results
(DCP 1 - 37)

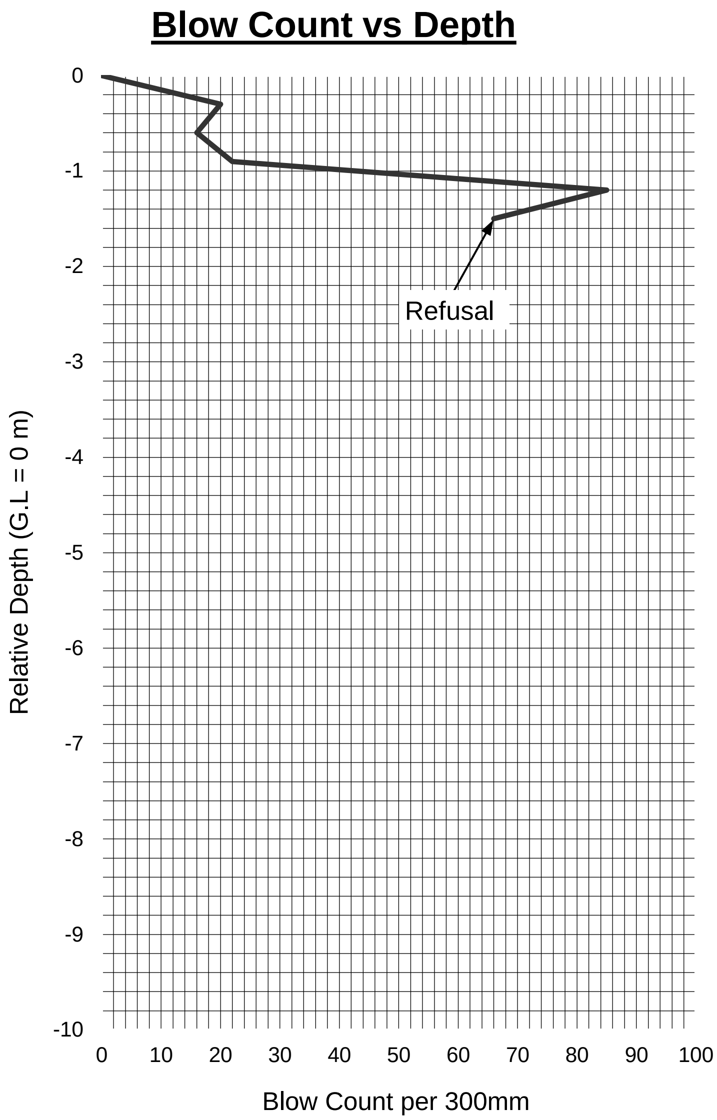
Dynamic Cone Penetrometer

Test No. : 1

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date: 22/06/2017 Remarks: -
Test Location: Site A -
Date of Test: 22/06/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	20
-0.6	16
-0.9	22
-1.2	85
-1.5	66
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

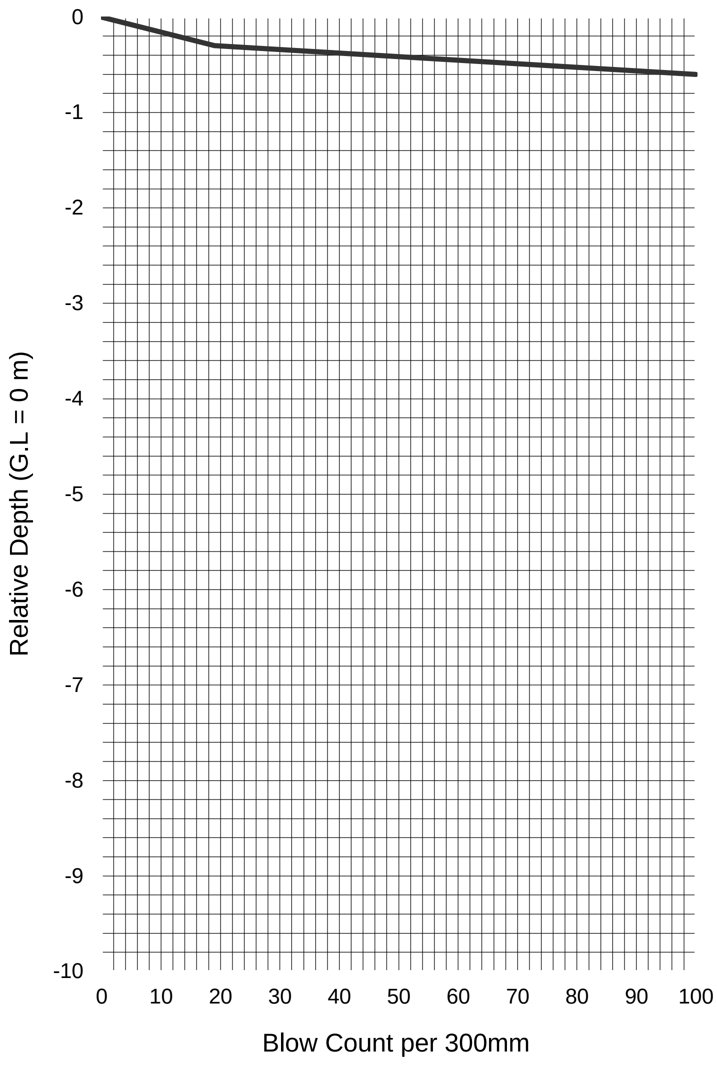
Test No. : 2

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	19
-0.6	100
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

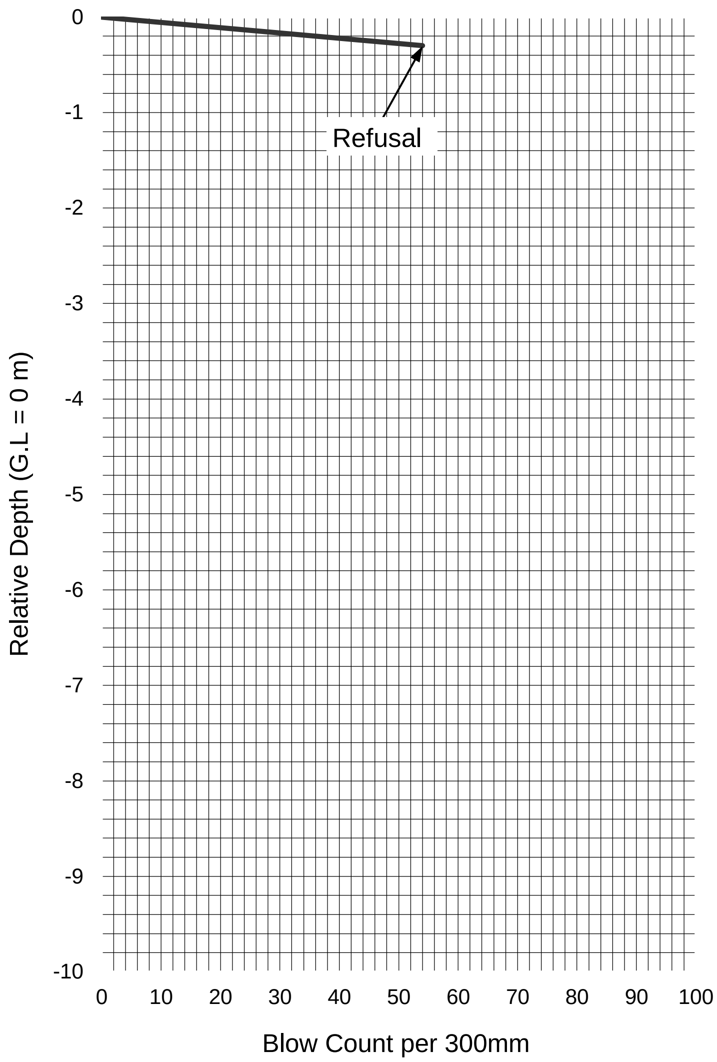
Test No. : 3

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	54
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

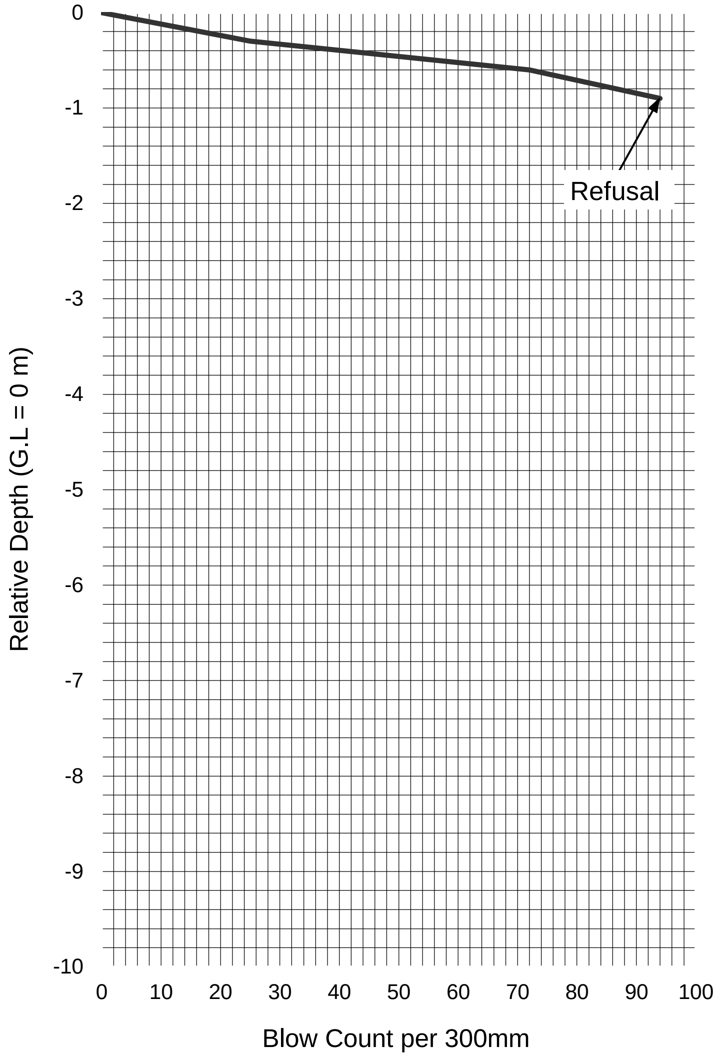
Test No. : 4

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	25
-0.6	72
-0.9	94
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

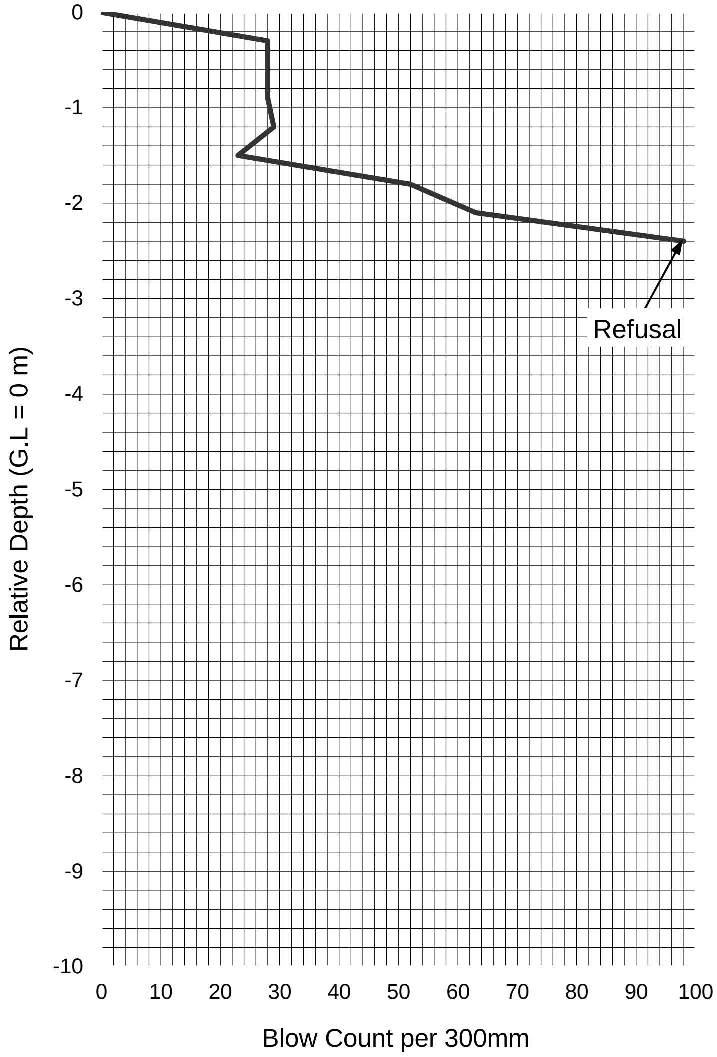
Test No. : 5

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	28
-0.6	28
-0.9	28
-1.2	29
-1.5	23
-1.8	52
-2.1	63
-2.4	98
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

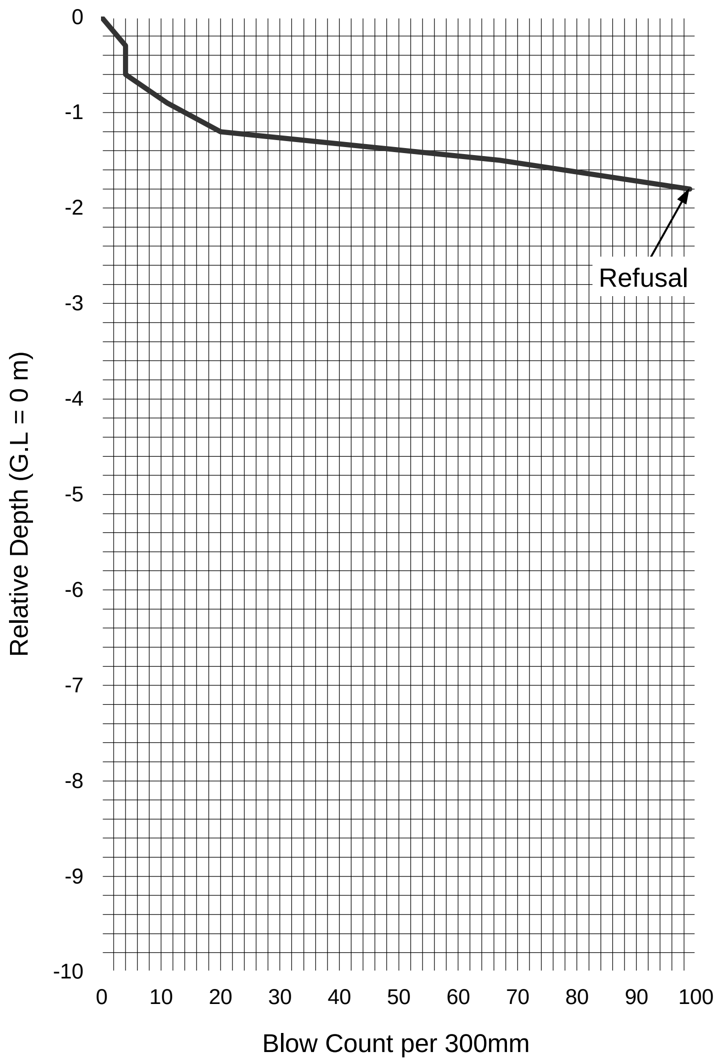
Test No. : 6

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	4
-0.6	4
-0.9	11
-1.2	20
-1.5	67
-1.8	99
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

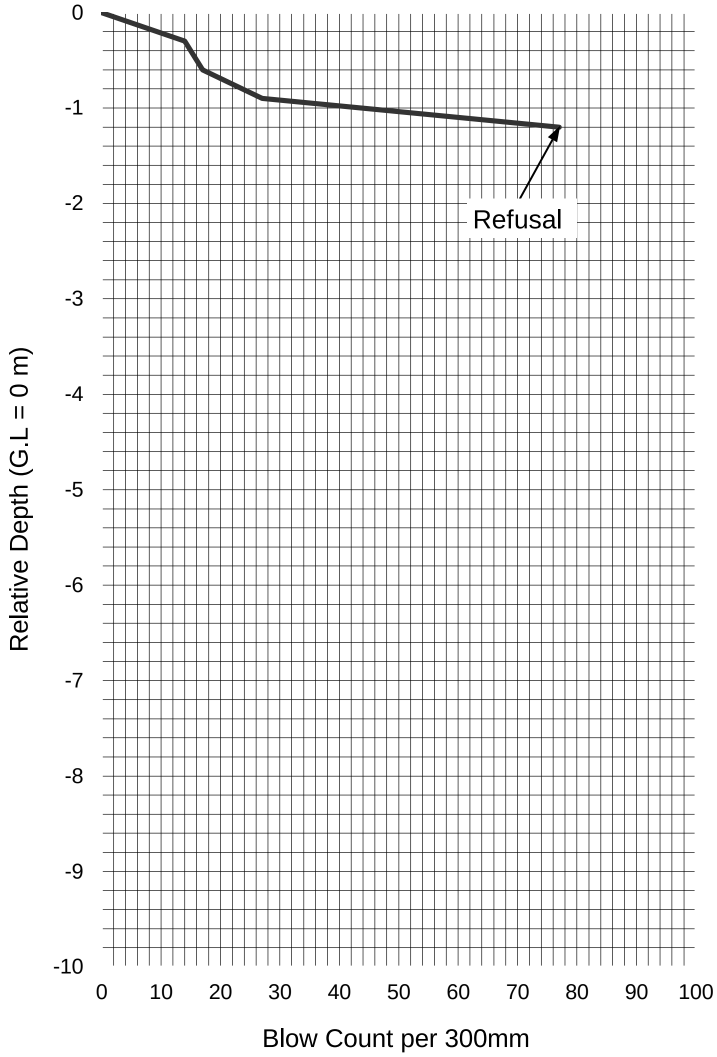
Dynamic Cone Penetrometer

Test No. : 7

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**
Date: 22/06/2017 Remarks: -
Test Location: Site A -
Date of Test: 22/06/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	14
-0.6	17
-0.9	27
-1.2	77
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873 **Drennan Maud & Partners.**

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

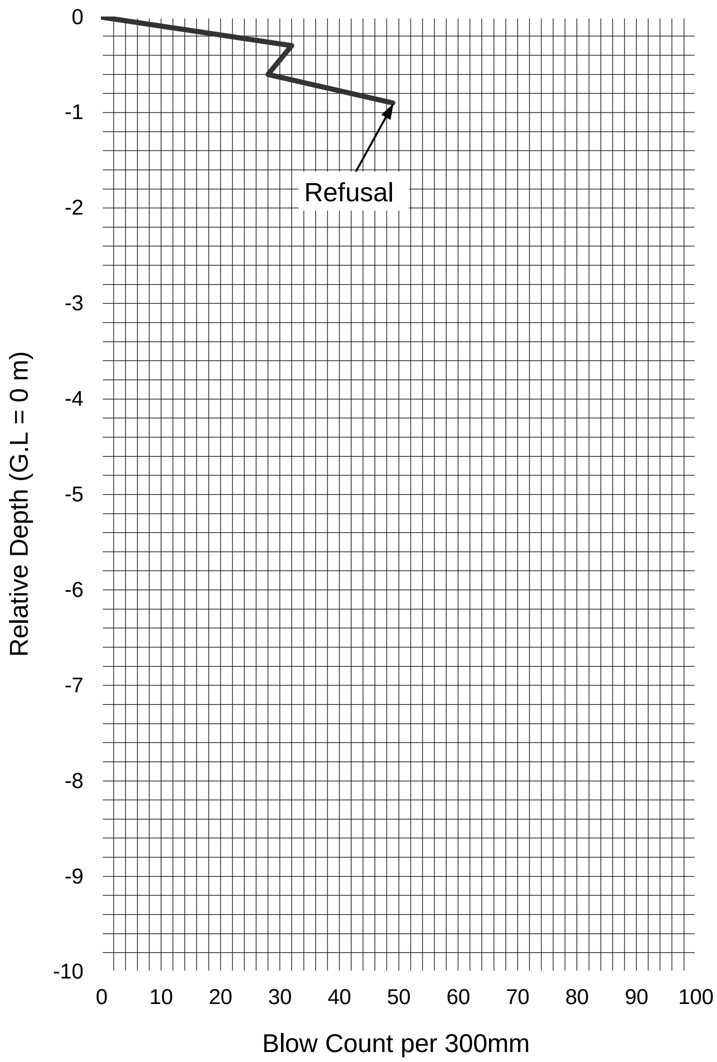
Test No. : 8

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	32
-0.6	28
-0.9	49
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

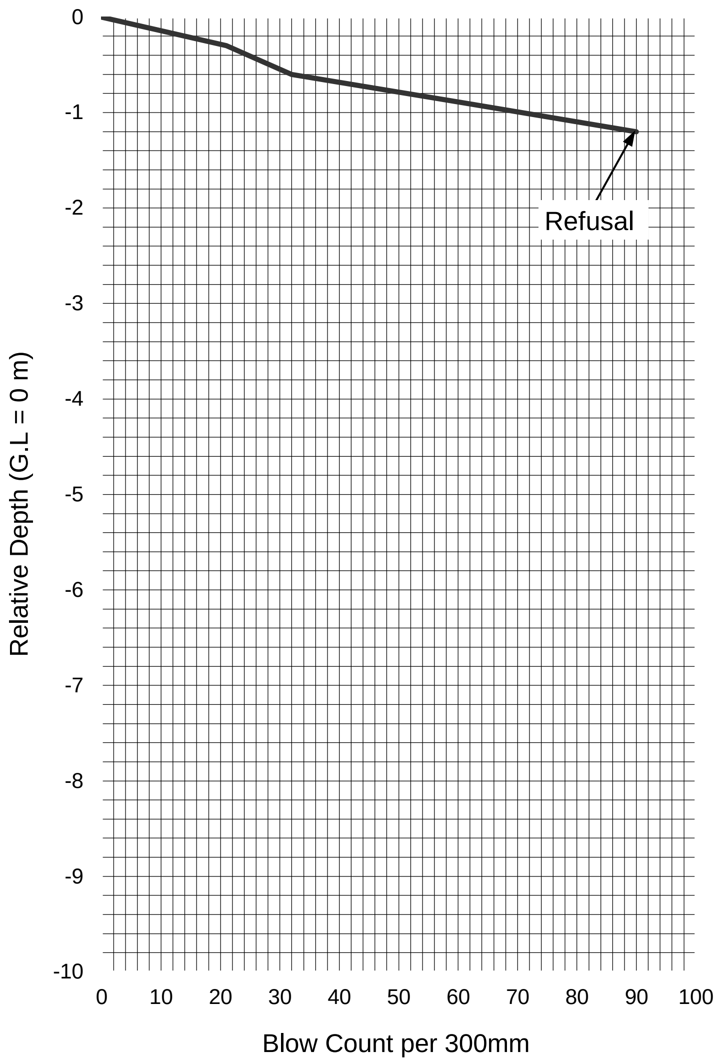
Test No. : 9

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	21
-0.6	32
-0.9	61
-1.2	90
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

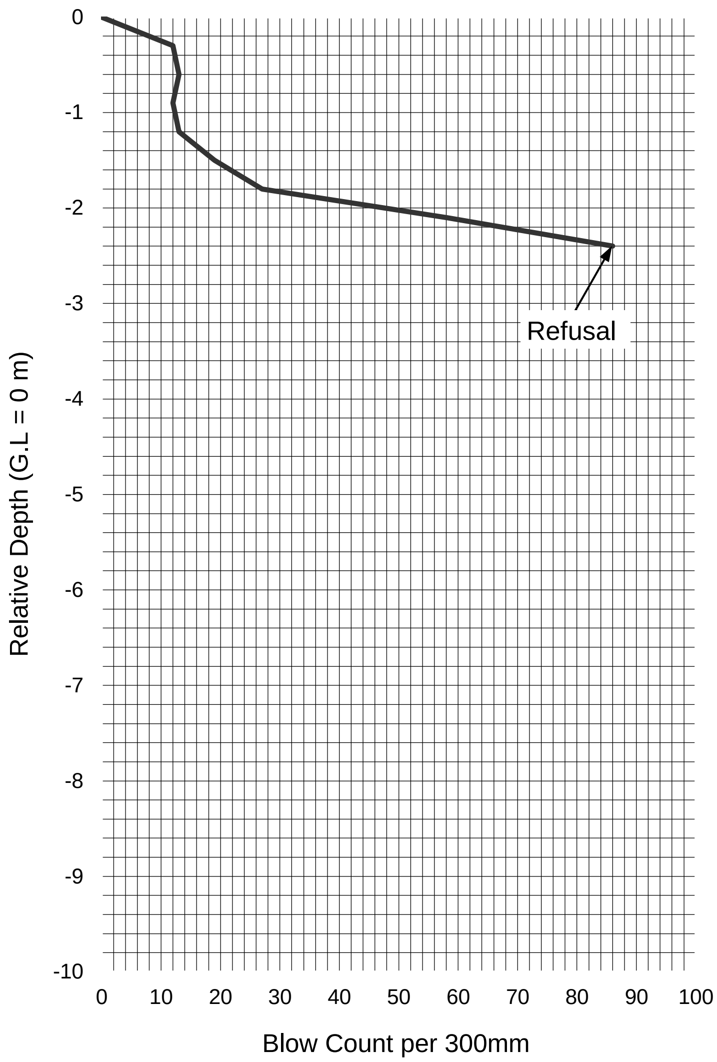
Test No. : 10

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	12
-0.6	13
-0.9	12
-1.2	13
-1.5	19
-1.8	27
-2.1	58
-2.4	86
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

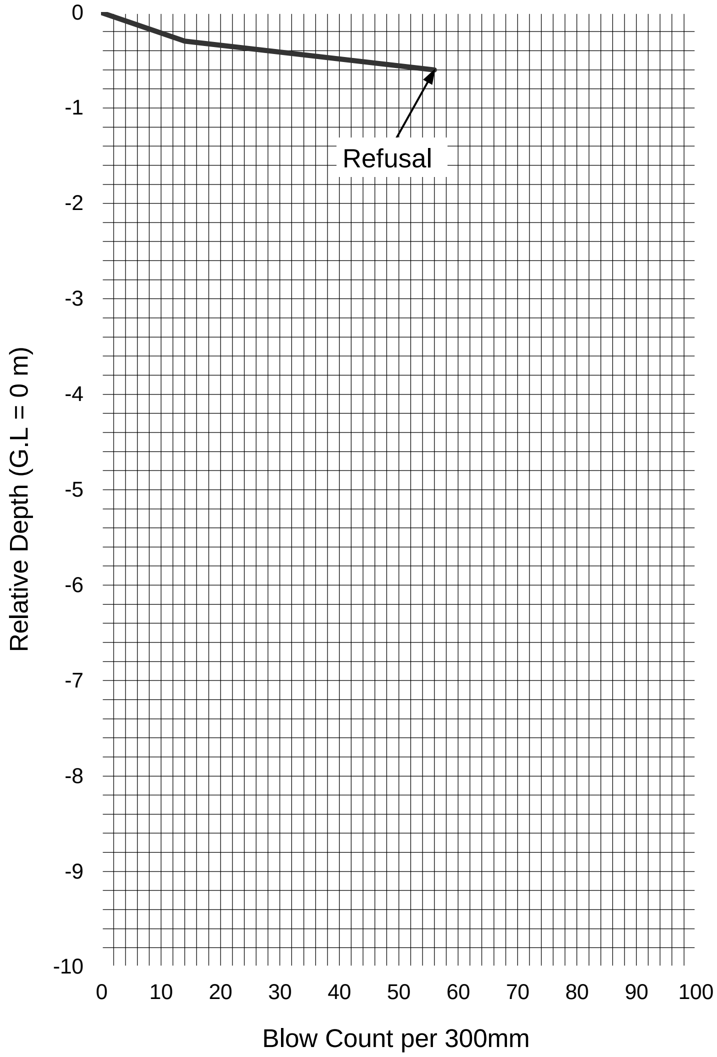
Test No. : 11

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	14
-0.6	56
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

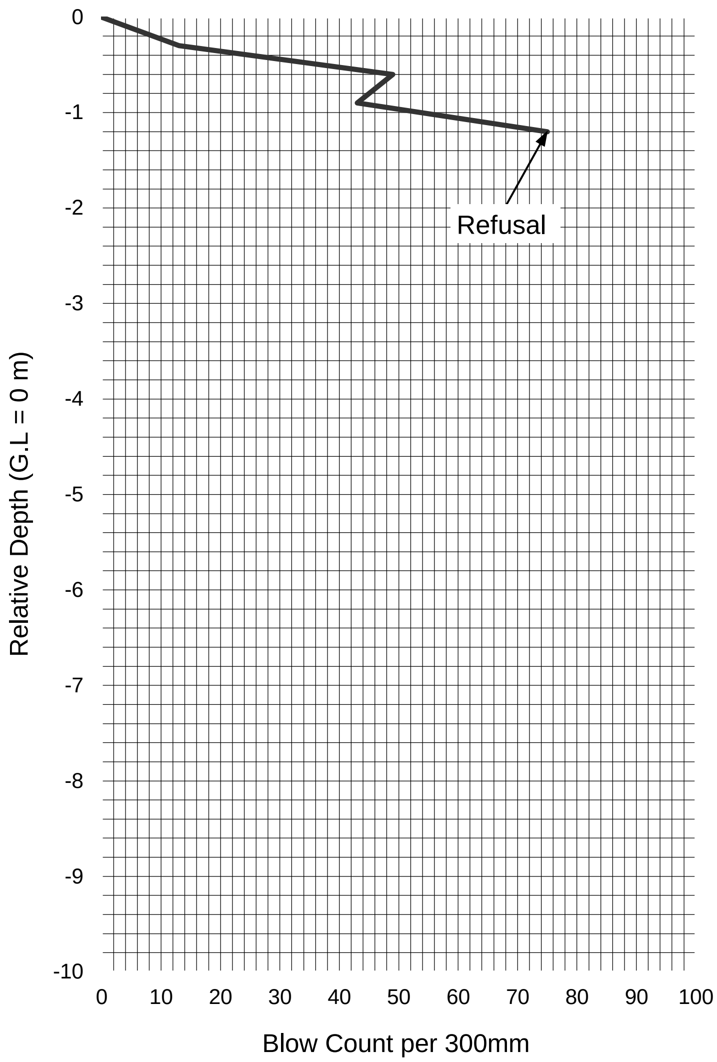
Test No. : 12

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	13
-0.6	49
-0.9	43
-1.2	75
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

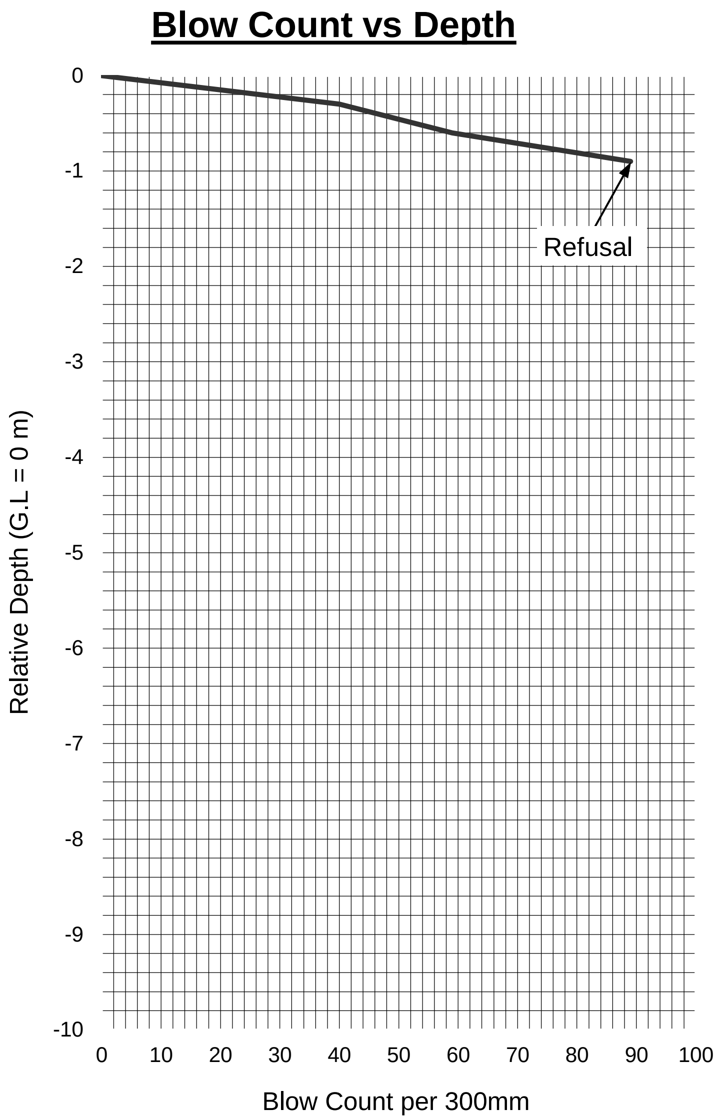
Dynamic Cone Penetrometer

Test No. : 13

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	40
-0.6	59
-0.9	89
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

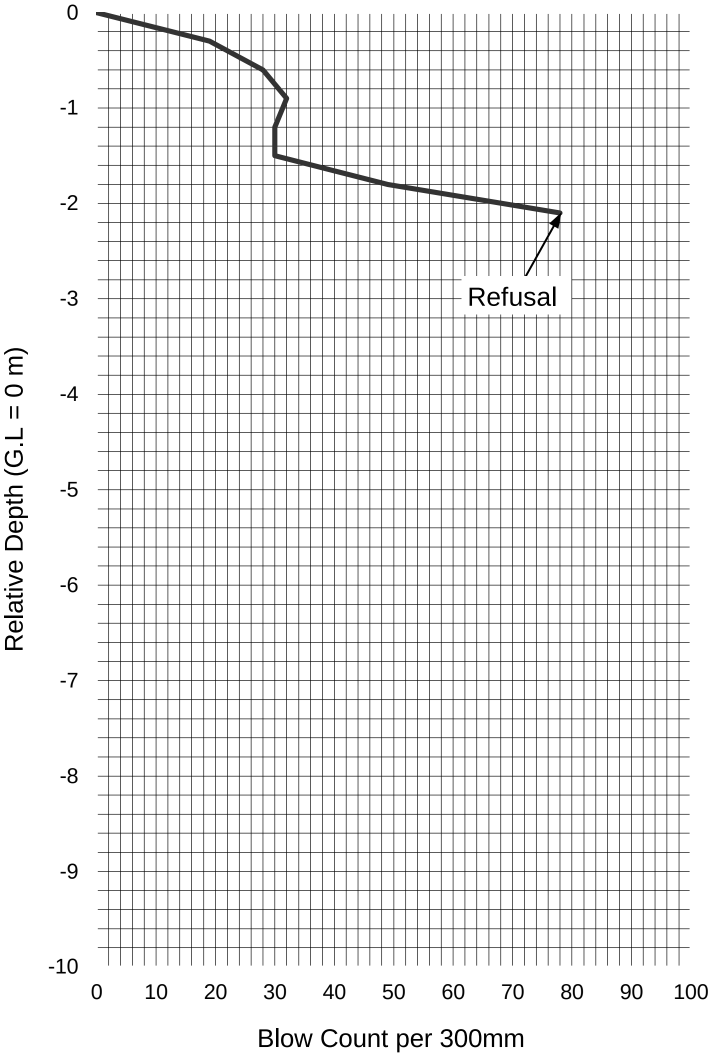
Test No. : 14

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date: 22/06/2017 Remarks: -
Test Location: Site A -
Date of Test: 22/06/2017 Depth Interval (m) : 0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	19
-0.6	28
-0.9	32
-1.2	30
-1.5	30
-1.8	49
-2.1	78
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873 **Drennan Maud & Partners.**

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

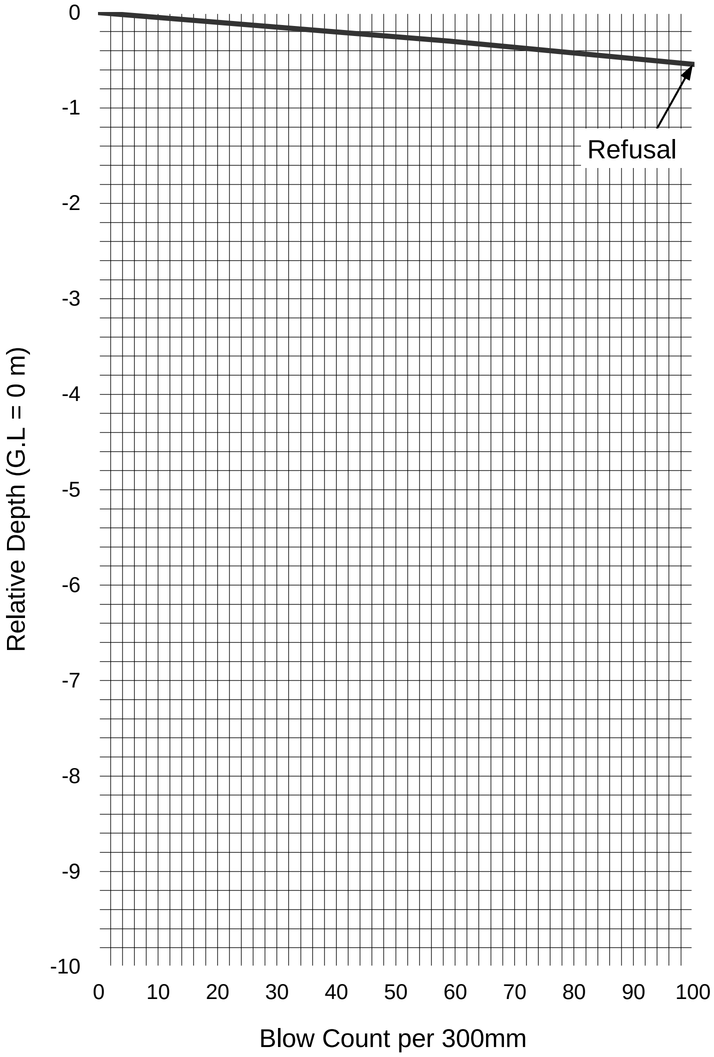
Test No. : 15

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	59
-0.6	110
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

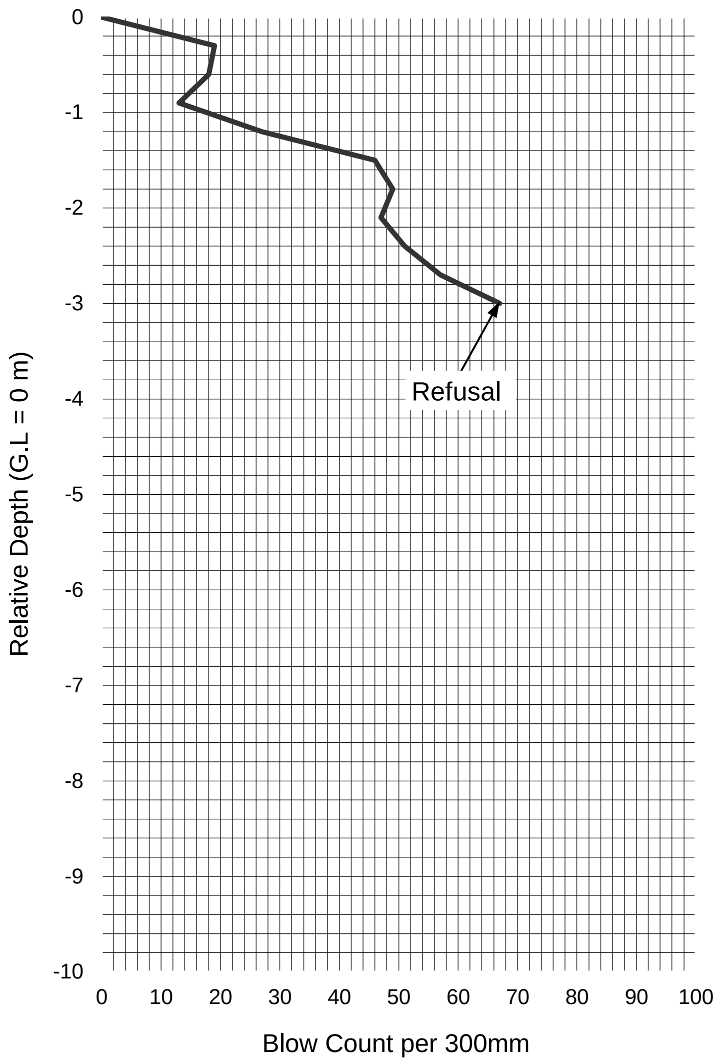
Test No. : 16

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	22/06/2017	Remarks:	-
Test Location:	Site A		-
Date of Test:	22/06/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	19
-0.6	18
-0.9	13
-1.2	27
-1.5	46
-1.8	49
-2.1	47
-2.4	51
-2.7	57
-3.0	67
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

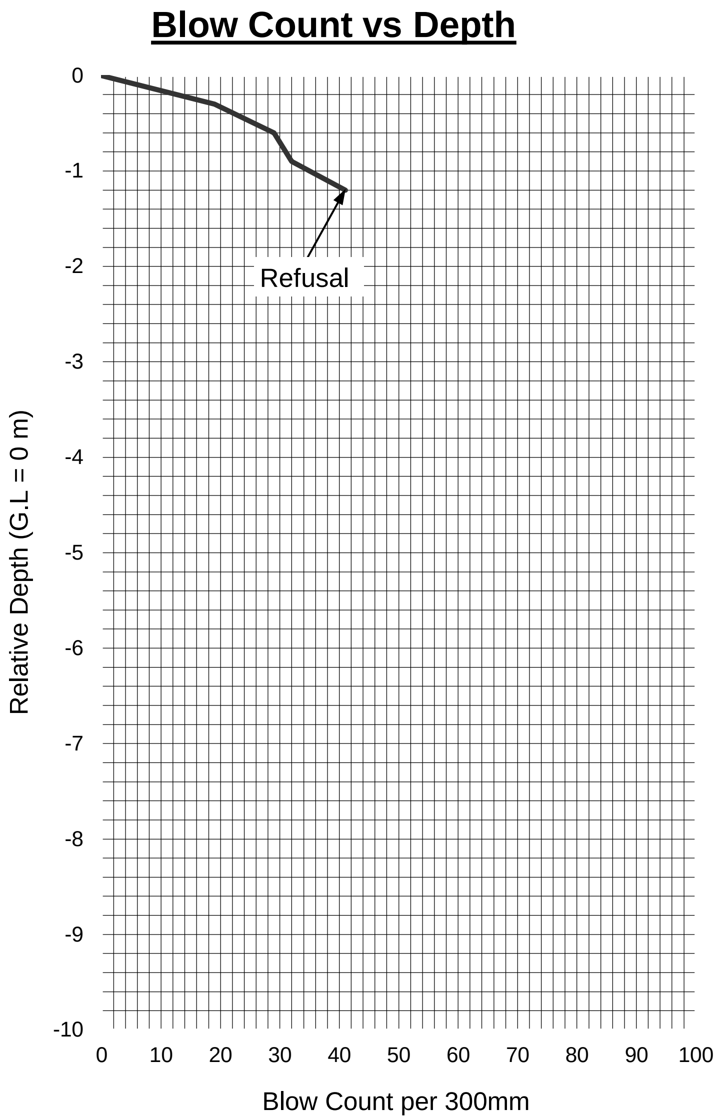
Dynamic Cone Penetrometer

Test No. : 17

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date: 22/06/2017 Remarks: -
Test Location: Site A -
Date of Test: 22/06/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	19
-0.6	29
-0.9	32
-1.2	41
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	



Reference No. : 31873 **Drennan Maud & Partners.**

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

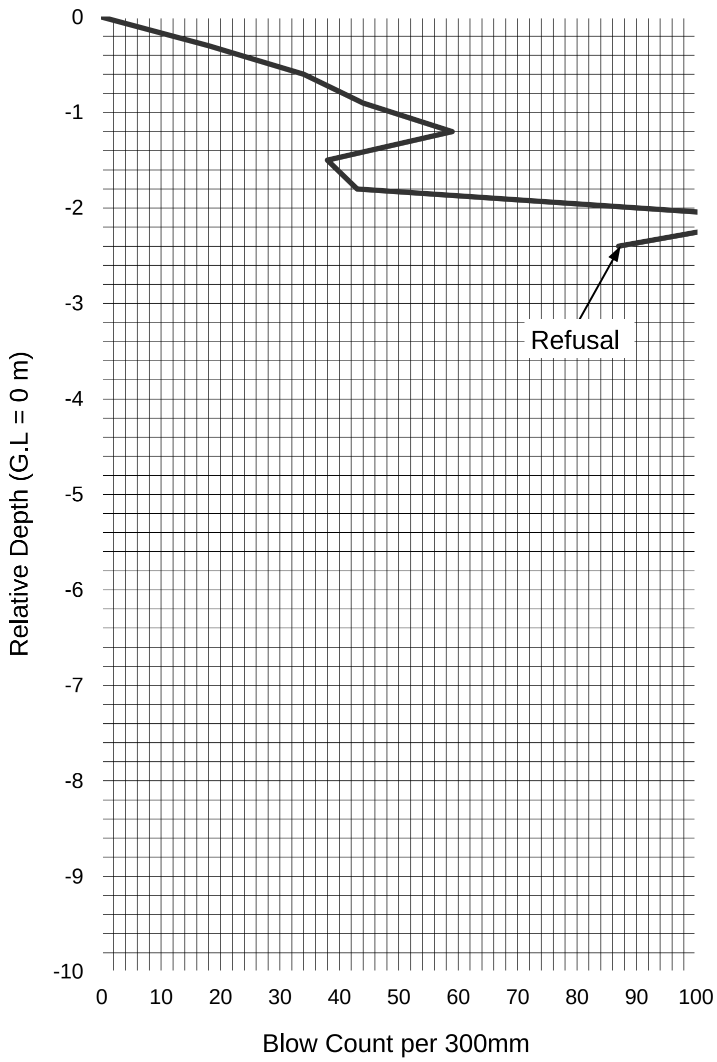
Test No. : 18

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	24/07/2017	Remarks:	-
Test Location:	Site B		-
Date of Test:	24/07/2017	Depth Interval (m) :	0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	18
-0.6	34
-0.9	44
-1.2	59
-1.5	38
-1.8	43
-2.1	114
-2.4	87
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

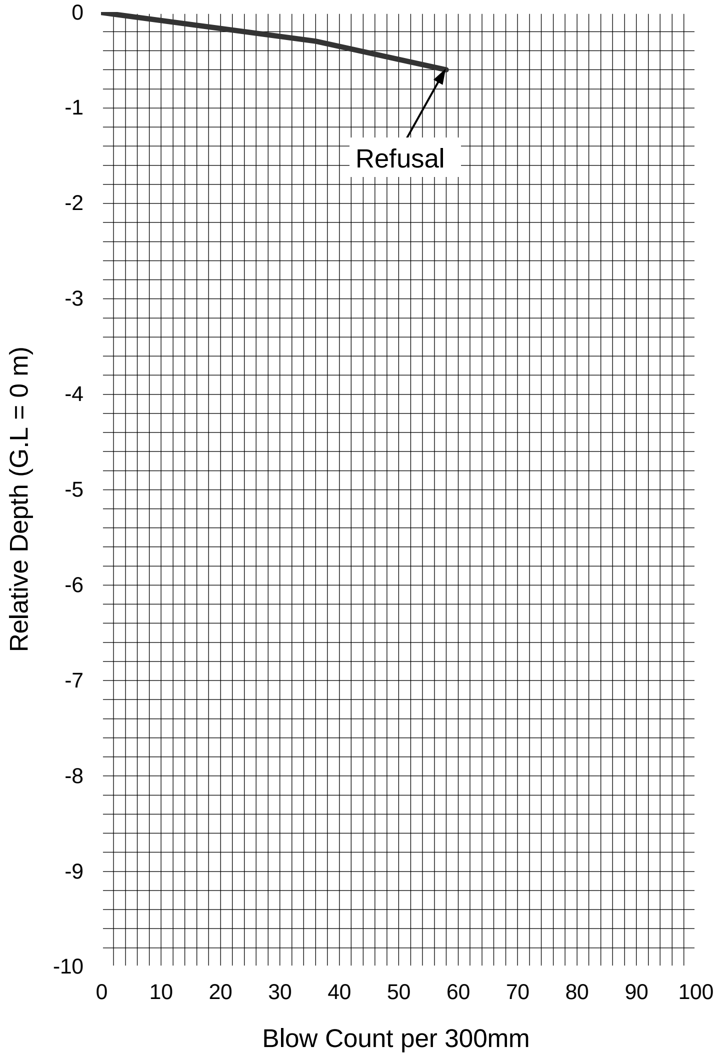
Test No. : 19

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date: 24/07/2017 — Remarks: -
Test Location: Site B — -
Date of Test: 24/07/2017 — Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	36
-0.6	58
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

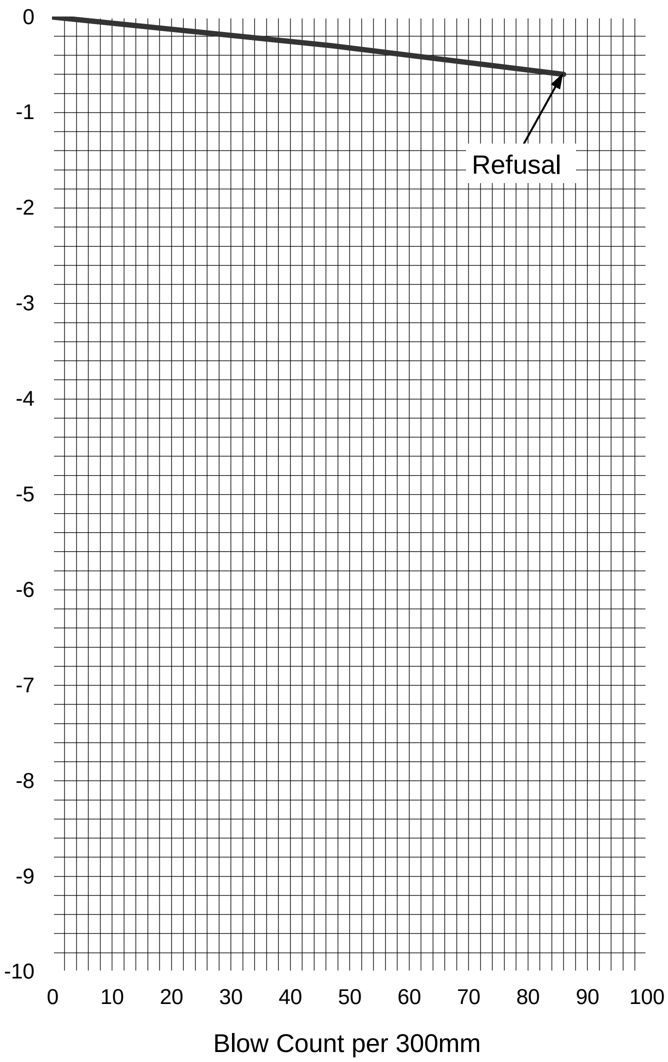
Test No. : 20

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	24/07/2017	Remarks:	-
Test Location:	Site B		-
Date of Test:	24/07/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	47
-0.6	86
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

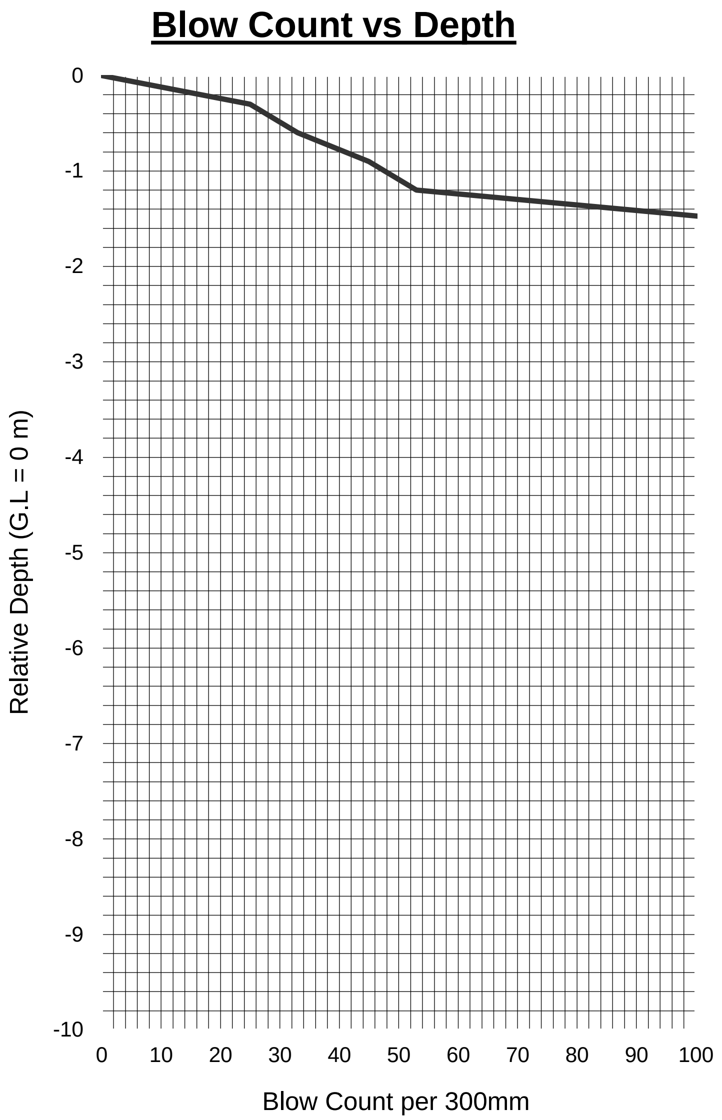
Dynamic Cone Penetrometer

Test No. : 21

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	24/07/2017	Remarks:	-
Test Location:	Site B		-
Date of Test:	24/07/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	25
-0.6	33
-0.9	45
-1.2	53
-1.5	105
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

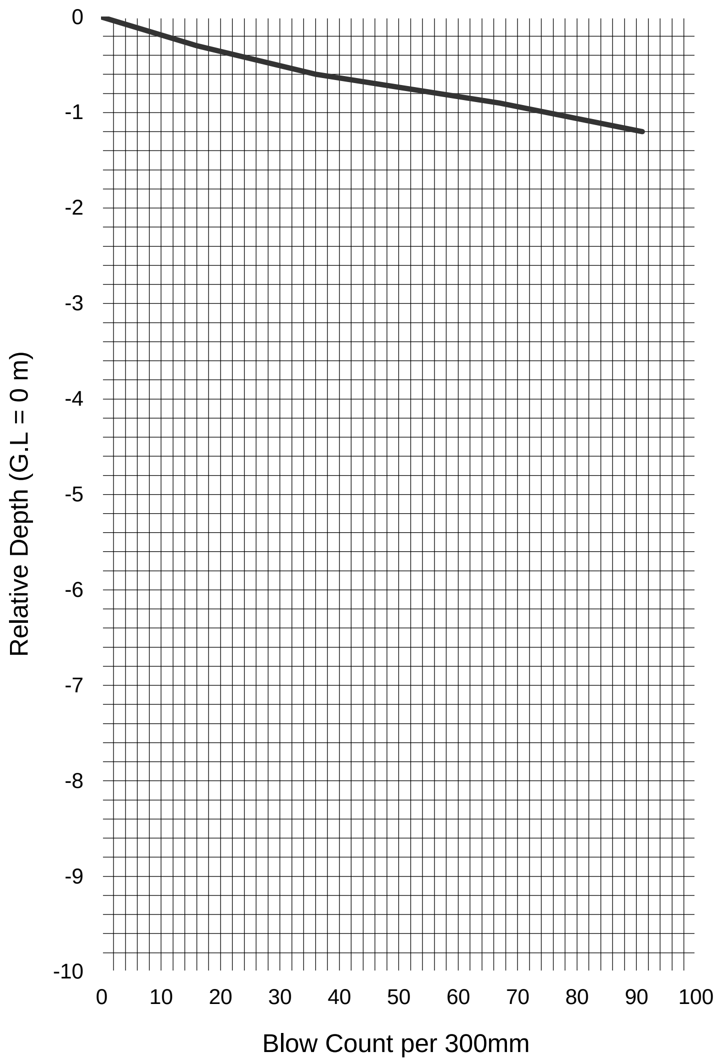
Test No. : 22

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	24/07/2017	Remarks:	-
Test Location:	Site B		-
Date of Test:	24/07/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	16
-0.6	36
-0.9	67
-1.2	91
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

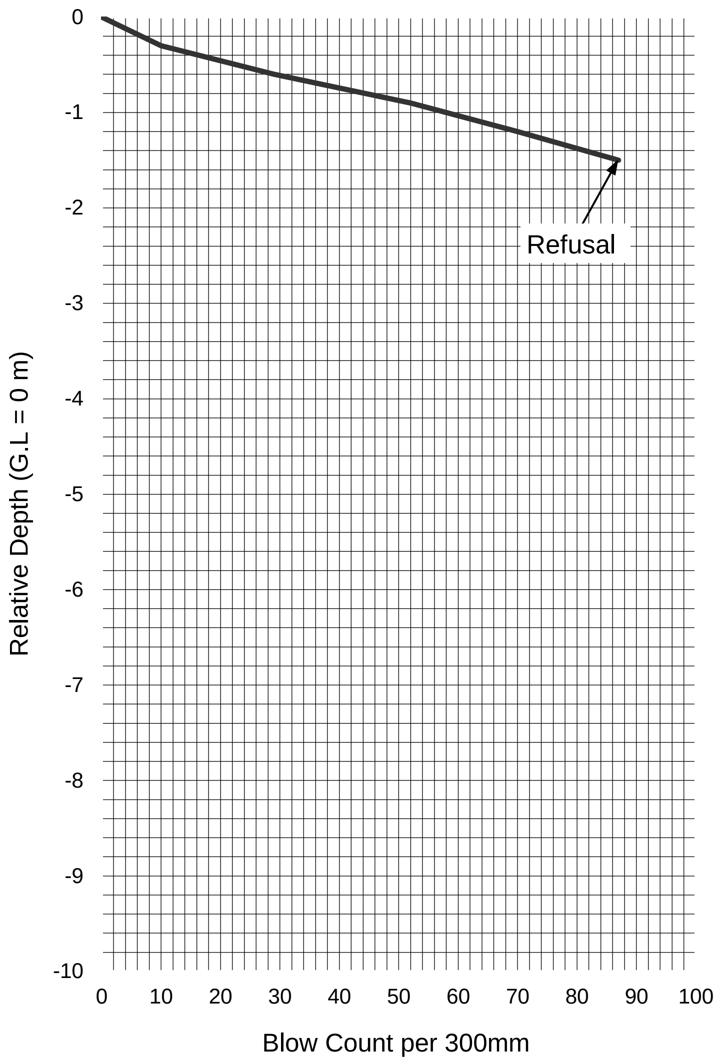
Dynamic Cone Penetrometer

Test No. : 23

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**
Date: 24/07/2017 Remarks: -
Test Location: Site B -
Date of Test: 24/07/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	10
-0.6	29
-0.9	52
-1.2	70
-1.5	87
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

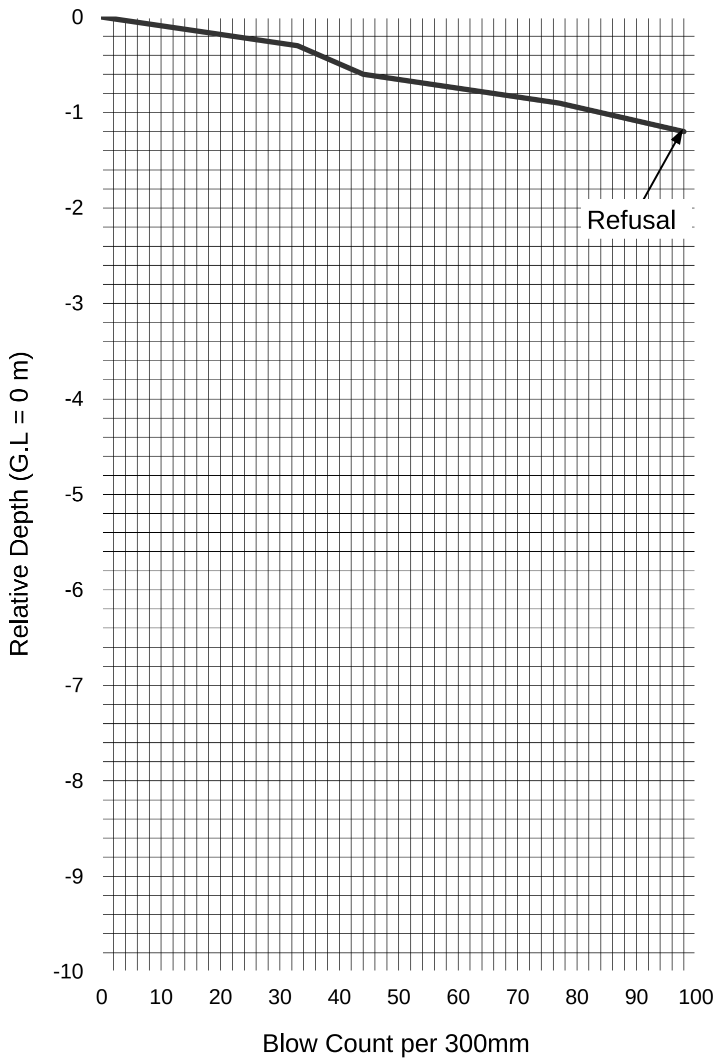
Test No. : 24

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	24/07/2017	Remarks:	-
Test Location:	Site B		-
Date of Test:	24/07/2017	Depth Interval (m) :	0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	33
-0.6	44
-0.9	77
-1.2	98
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

Dynamic Cone Penetrometer

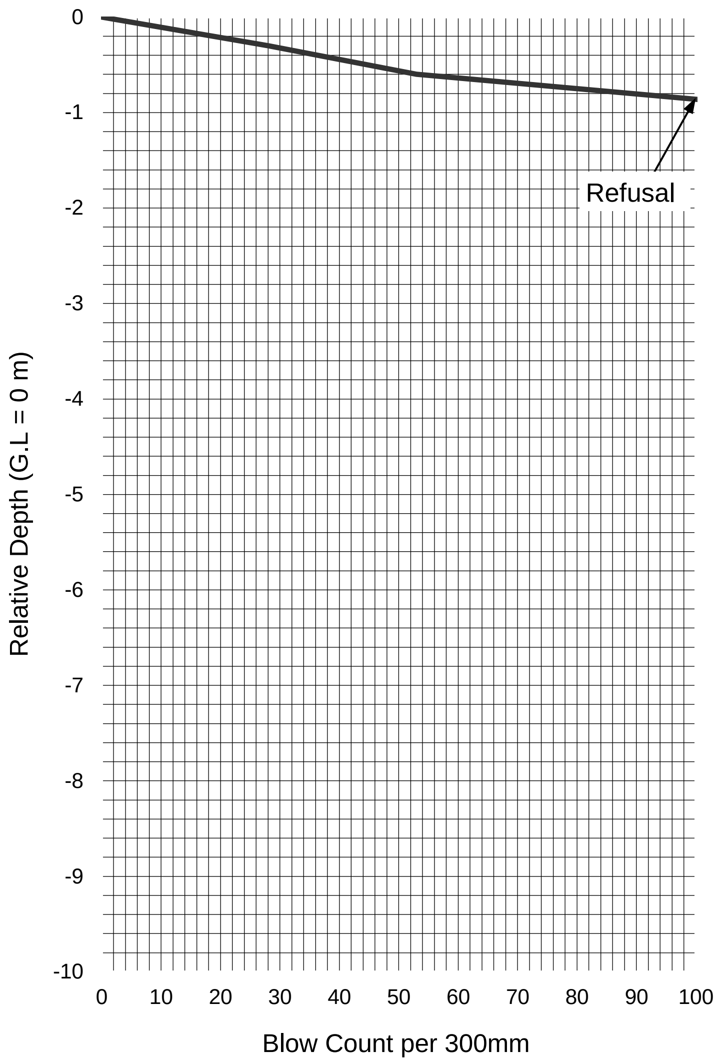
Test No. : 25

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date: 24/07/2017 Remarks: -
Test Location: Site B -
Date of Test: 24/07/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	28
-0.6	53
-0.9	107
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

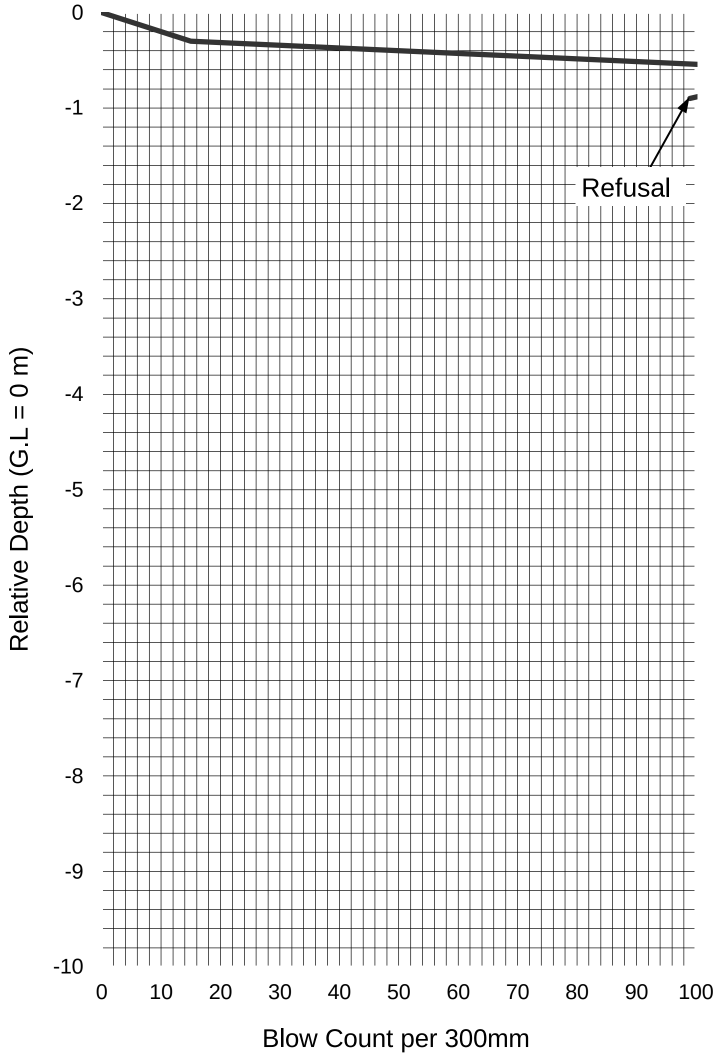
Dynamic Cone Penetrometer

Test No. : 26

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**
Date: 24/07/2017 Remarks: -
Test Location: Site B -
Date of Test: 24/07/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	15
-0.6	120
-0.9	99
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

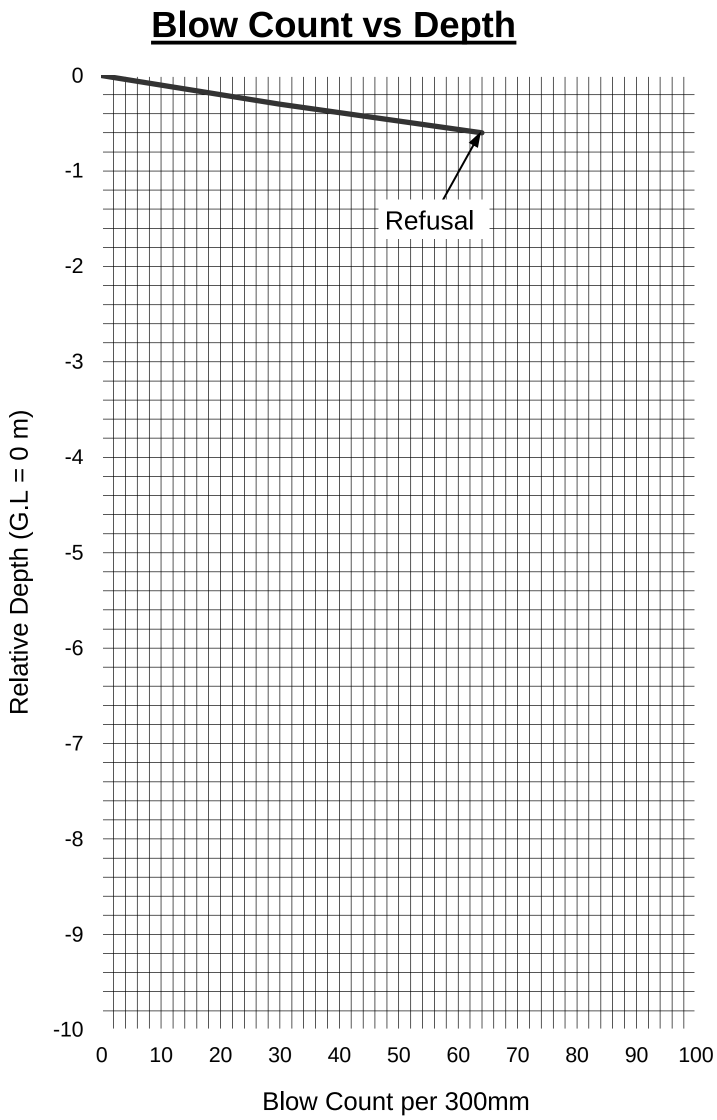
Dynamic Cone Penetrometer

Test No. : 27

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	24/07/2017	Remarks:	-
Test Location:	Site B		-
Date of Test:	24/07/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	30
-0.6	64
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

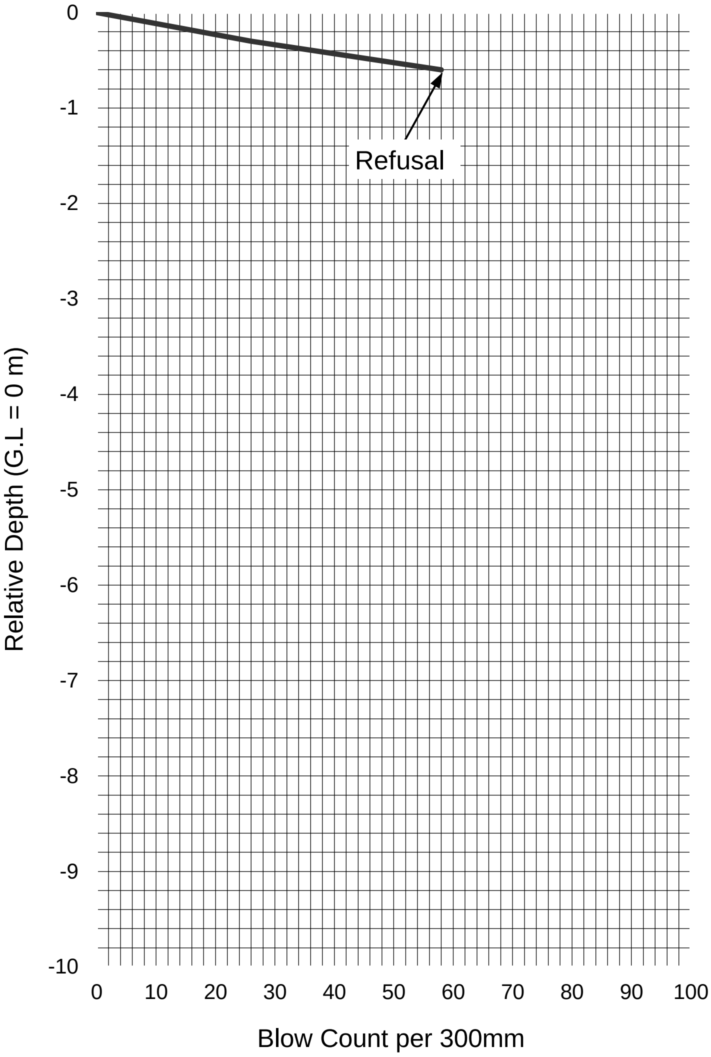
Dynamic Cone Penetrometer

Test No. : 28

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**
Date: 03/08/2017
Test Location: Site C
Date of Test: 03/08/2017
Remarks: -
-
Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	26
-0.6	58
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

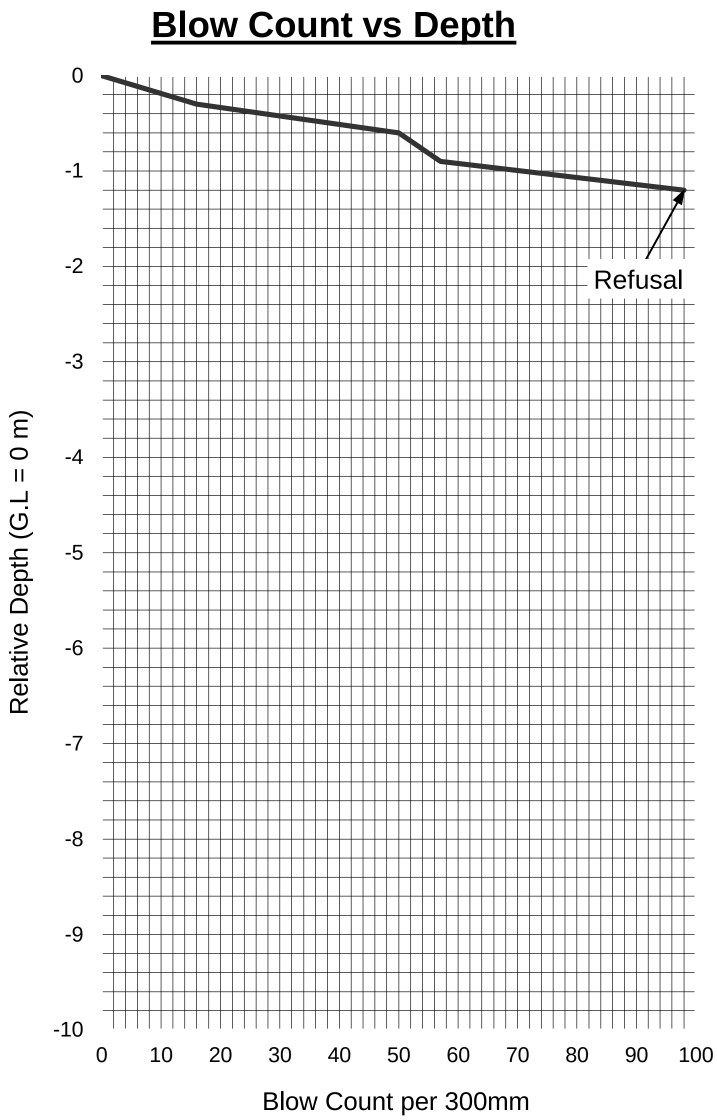
Dynamic Cone Penetrometer

Test No. : 29

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	03/08/2017	Remarks:	-
Test Location:	Site C		-
Date of Test:	03/08/2017	Depth Interval (m) :	0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	16
-0.6	50
-0.9	57
-1.2	98
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

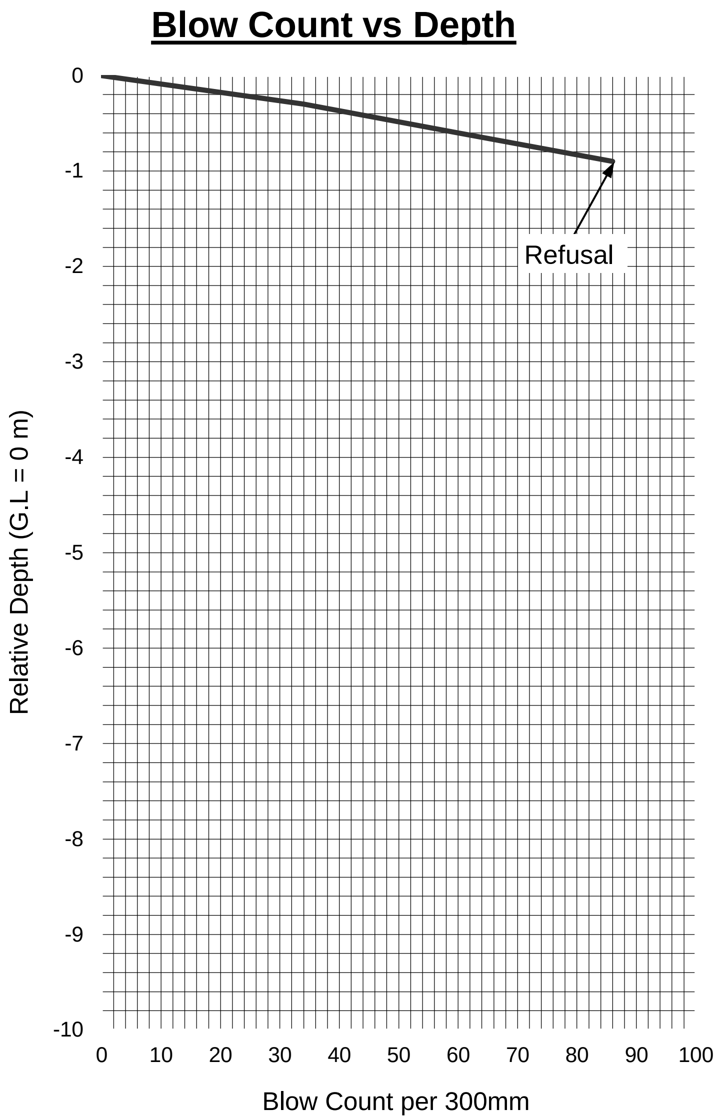
Dynamic Cone Penetrometer

Test No. : 30

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	03/08/2017	Remarks:	-
Test Location:	Site C		-
Date of Test:	03/08/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	34
-0.6	60
-0.9	86
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

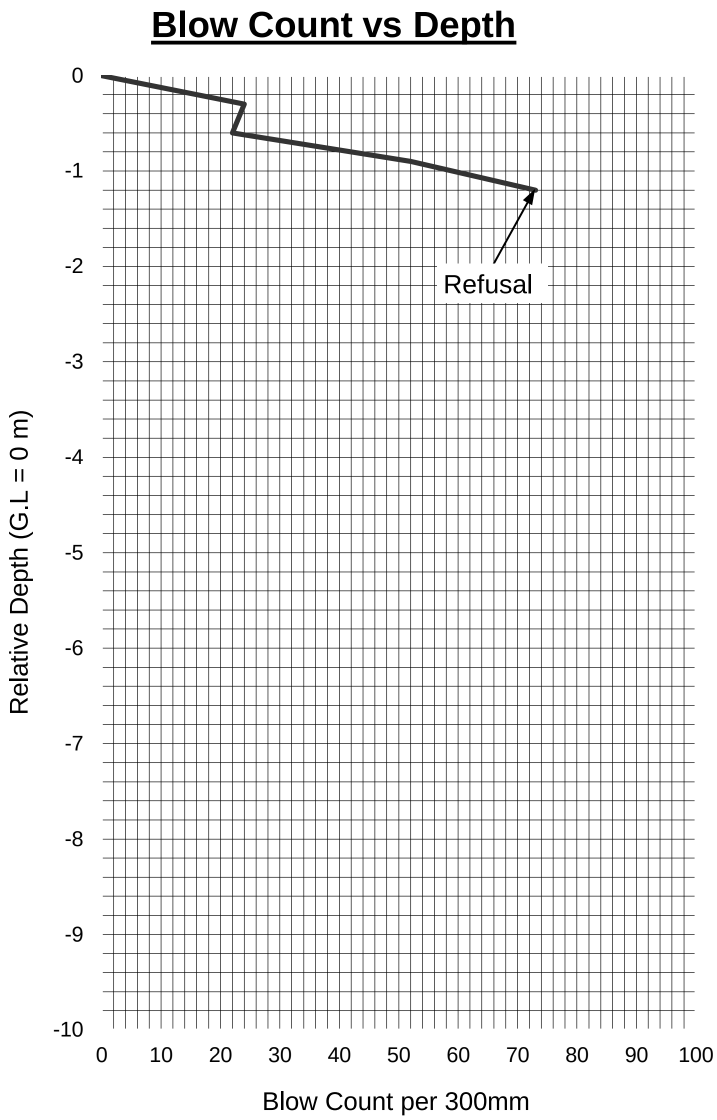
Dynamic Cone Penetrometer

Test No. : 31

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	03/08/2017	Remarks:	-
Test Location:	Site C		-
Date of Test:	03/08/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	24
-0.6	22
-0.9	52
-1.2	73
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

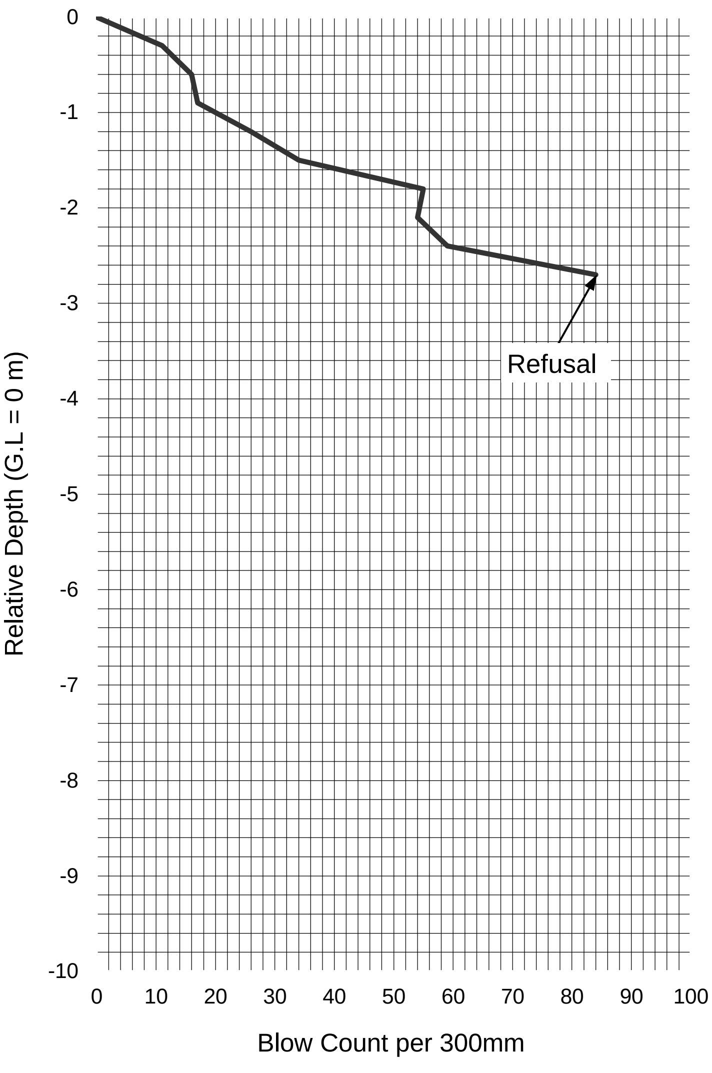
Test No. : 32

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	03/08/2017	Remarks:	-
Test Location:	Site C		-
Date of Test:	03/08/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	11
-0.6	16
-0.9	17
-1.2	26
-1.5	34
-1.8	55
-2.1	54
-2.4	59
-2.7	84
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

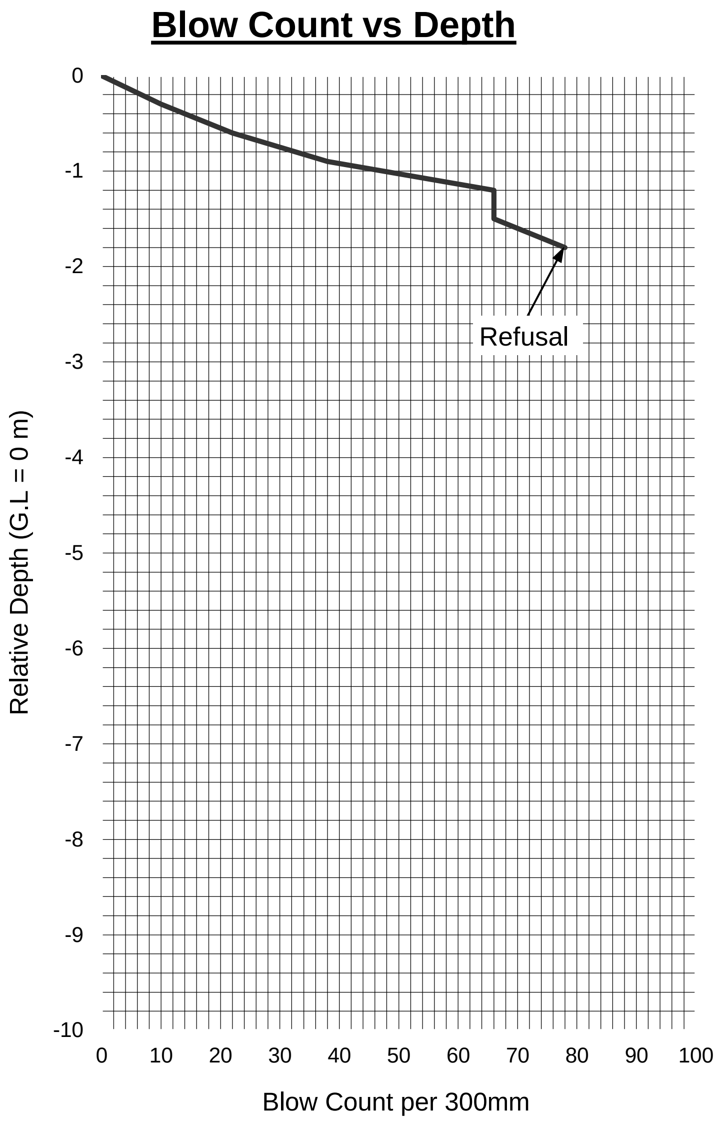
Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

Test No. : 33

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**
Date: 03/08/2017 Remarks: -
Test Location: Site C -
Date of Test: 03/08/2017 Depth Interval (m) : 0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	10
-0.6	22
-0.9	38
-1.2	66
-1.5	66
-1.8	78
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

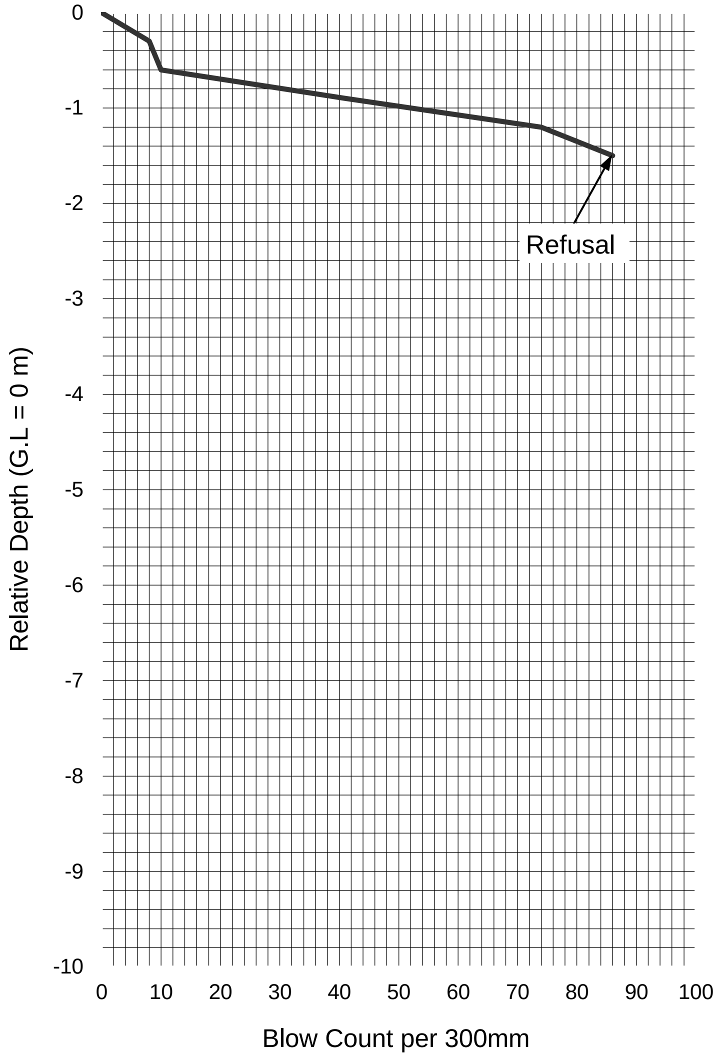
Test No. : 34

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	03/08/2017	Remarks:	-
Test Location:	Site C		-
Date of Test:	03/08/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	8
-0.6	10
-0.9	41
-1.2	74
-1.5	86
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

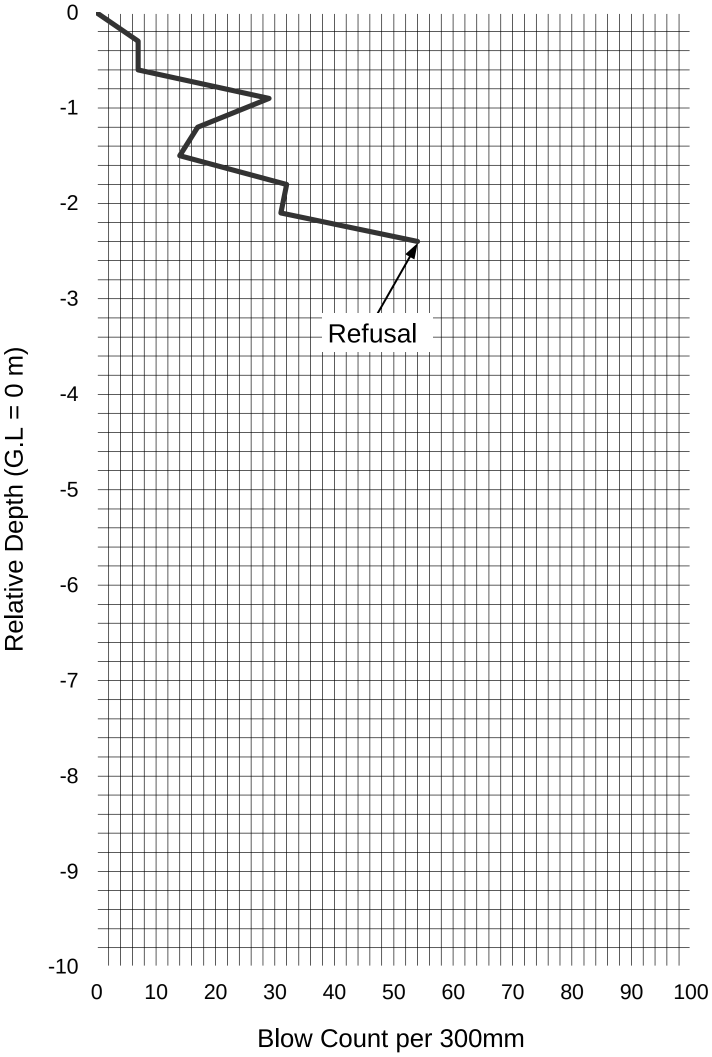
Test No. : 35

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	03/08/2017	Remarks:	-
Test Location:	Site C		-
Date of Test:	03/08/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	7
-0.6	7
-0.9	29
-1.2	17
-1.5	14
-1.8	32
-2.1	31
-2.4	54
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

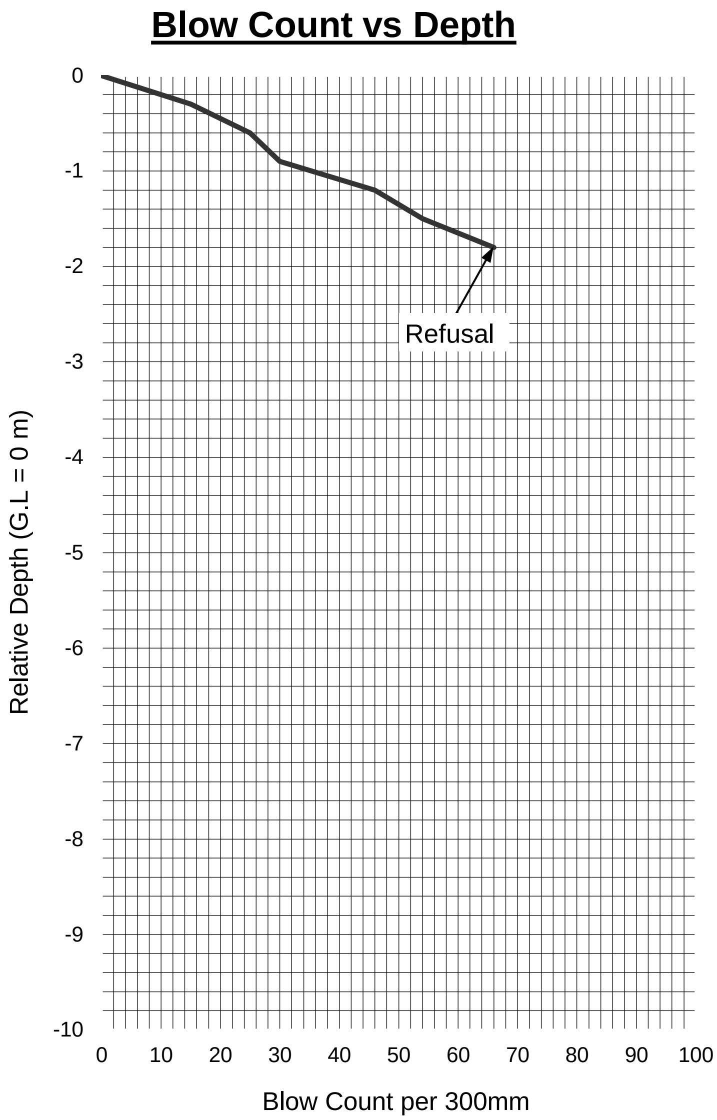
Dynamic Cone Penetrometer

Test No. : 36

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	03/08/2017	Remarks:	-
Test Location:	Site C		-
Date of Test:	03/08/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	15
-0.6	25
-0.9	30
-1.2	46
-1.5	54
-1.8	66
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60° cone a distance of 300mm.

Dynamic Cone Penetrometer

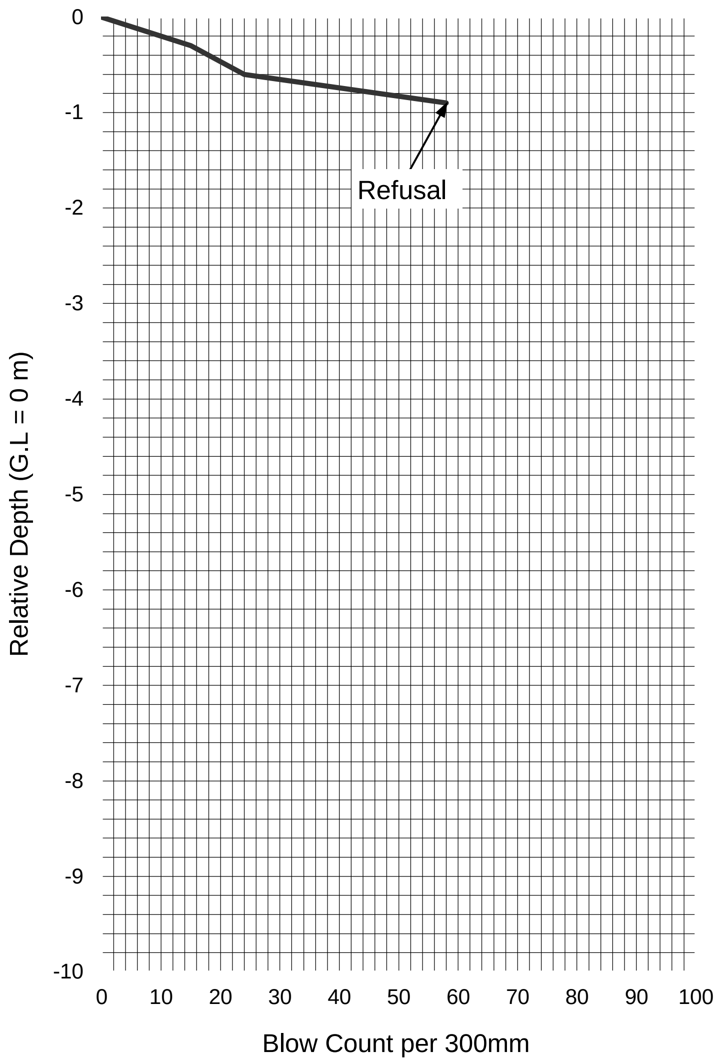
Test No. : 37

Project : **Proposed Residential Development KingsBurgh EXT 9**
Client: **-**

Date:	03/08/2017	Remarks:	-
Test Location:	Site C		-
Date of Test:	03/08/2017	Depth Interval (m) :	0.3

Depth (m)	**Count** Blows/0.3m
0	0
-0.3	15
-0.6	24
-0.9	58
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	
-	

Blow Count vs Depth



Reference No. : 31873

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

APPENDIX C
Laboratory Test Results Summary

Laboratory Test Summary

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Job Description: Kingsburgh - Ref.31873
Job no.: 8476(A)
Date: 21-07-2017

Lab no.		07046	07047	07048	07050	07051	07052
Location		IP.8	IP.1	IP.10	IP.5	AH.2	IP.5
Depth		0.0 - 0.4	1.2 - 1.8	0.5 - 1.0	0.3 - 1.2	0.0 - 2.0	0.0 - 0.3
Description		Colluvium	Weath siltstone	Weath tillite	Residual tillite	Residual tillite	Colluvium
		-	/ shale	-	-	-	-
Binder Material		-	-	-	-	-	-
Particle Size (mm) – Cumulative % Passing	75		97	100			
	53		85	96			
	37.5		72	89			
	26.5		59	79			
	19	100	48	69			
	13.2	93	43	68			100
	9.5	90	35	67		100	99
	4.75	86	23	61	100	99	98
	2	84	15	52	100	99	97
	0.425	83	10	40	99	96	95
	0.25	82	10	36	99	94	93
	0.15	81	10	32	99	90	90
	0.075	80	9	26	98	85	86
Hydrometer – % Passing	0.05	80	9	24	96	82	83
	0.02	69	8	18	91	75	74
	0.005	56	6	15	78	66	65
	0.002	41	5	11	66	56	55
Soil Mortar – % Passing	Coarse Sand <2.0 >0.425mm	1.7	30.4	22.0	0.5	2.6	1.8
	Fine Sand <0.425>0.05mm	20.0	63.4	59.6	4.0	17.3	16.3
	Silt <0.05 >0.005	23.0	2.1	6.8	18.3	16.1	18.3
	Clay <0.005	55.3	4.0	11.6	77.3	64.0	63.6
Atterberg Limits	Liquid Limit % (m/m)	45.8	33	27.7	55.8	49	51.3
	Plasticity Index	12.7	8.9	20	20.2	21	14.4
	Linear Shrinkage %	8	5.3	5.3	6	8.7	10
	Natural MC %	-	-	-	-	-	-
Mod AASHTO Density	Dry Density kg/m^3	1953	1953	2001			
	OMC %	19	10.7	8.5			
CBR	100% MDD	11	6	12			
	98%	7	6	11			
	95%	3	5	10			
	93% (Inferred) *	2	3	8			
	90%	1	2	6			
	CBR Swell (%)	4.02	2.02	1.01			
AASHTO Soil Classification *		A - 7 - 5 (12)	A - 2 - 4 (0)	A - 2 - 6 (1)	A - 7 - 5 (26)	A - 7 - 6 (20)	A - 7 - 5 (16)
Grading Modulus		0.54	2.65	1.82	0.02	0.20	0.23
TRH 14 (1985) *		>G10	>G10	G9			
pH					3.9	3.1	
Conductivity ms/m					29	33	

Technical Signitory: ....

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Project: Kingsburgh - Ref.31873

Ref no.: 8476(A) **Lab no.:** 07046 **Borehole/Pit no.:** IP.8
Description: -
Depth: 0.0 - 0.4 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	93.0
9.5	90.1
4.75	86.3
2	84.0
0.425	82.6
0.25	81.9
0.15	80.8
0.075	79.6
0.05	79.6
0.02	68.7
0.005	56.3
0.002	41.0

M.I.T SIZE CLASSIFICATION *

Cobble%		0.0
Gravel%	16.0	
Coarse		0.0
Medium		12.7
Fine		3.3
Sand%	4.4	
Coarse		1.3
Medium		1.4
Fine		1.7
Silt%	38.6	
Coarse		10.9
Medium		11.6
Fine		16.1
Clay%	41.0	

PLASTICITY

Liquid Limit, %	45.8
Plasticity Index	12.7
Linear Shrinkage, % (L/L)	8

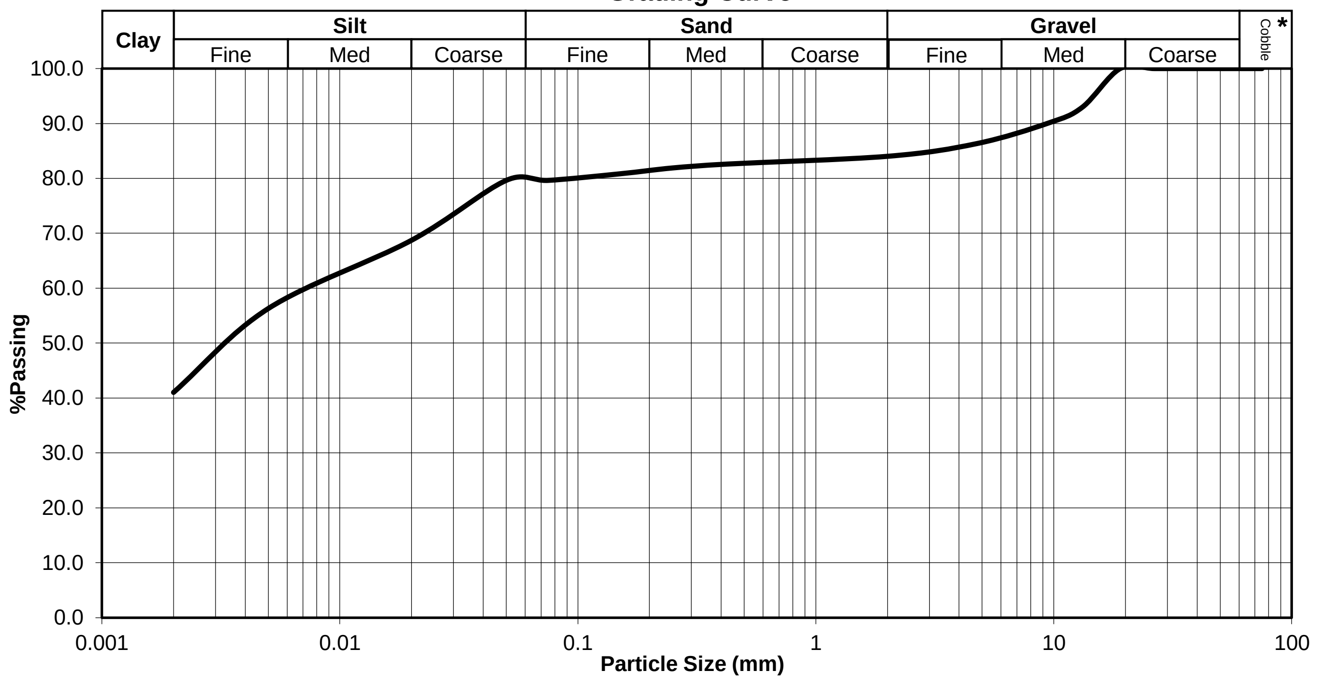
GRADING

D10 Size (mm)	<0.002
Uniformity Coefficient	*
Grading Modulus	0.54

CLASSIFICATION *

Potential Expansiveness	Low
Group Index	12
AASHTO Soil Classification	A - 7 - 5
Unified Classification	ML or OL

Grading Curve



Ref no.: 8476(A) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Project: Kingsburgh - Ref.31873

Ref no.: 8476(A) **Lab no.:** 07047 **Borehole/Pit no.:** IP.1
Description: -

Depth: 1.2 - 1.8 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	97.1
53	85.0
37.5	72.4
26.5	59.1
19	47.6
13.2	42.8
9.5	34.8
4.75	23.4
2	14.9
0.425	10.4
0.25	10.0
0.15	9.7
0.075	9.4
0.05	8.8
0.02	7.6
0.005	5.8
0.002	4.6

M.I.T SIZE CLASSIFICATION *

Cobble%		11.2
Gravel%	73.9	
Coarse		39.7
Medium		22.7
Fine		11.5
Sand%	5.9	
Coarse		4.0
Medium		1.1
Fine		0.8
Silt%	4.5	
Coarse		1.5
Medium		1.6
Fine		1.4
Clay%	4.6	

PLASTICITY

Liquid Limit	33
Plasticity Index	8.9
Linear Shrinkage	5.3

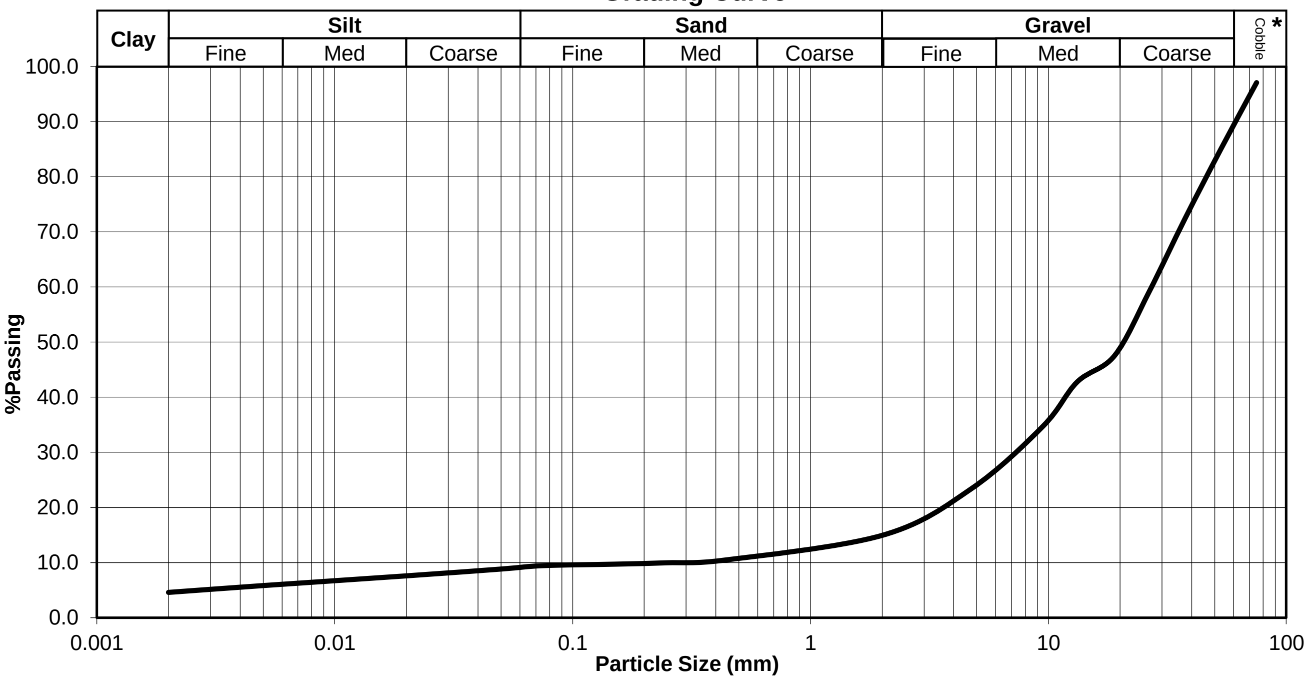
GRADING

D10 Size (mm)	0.26
Uniformity Coefficient	>99
Grading Modulus	2.65

CLASSIFICATION *

Potential Expansiveness	Low
Group Index	0
AASHTO Soil Classification	A - 2 - 4
Unified Classification	GP - GM

Grading Curve



Ref no.: 8476(A) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058 Fax : (031) 201-7920

Project: Kingsburgh - Ref.31873

Ref no.: 8476(A) **Lab no.:** 07048 **Borehole/Pit no.:** IP.10

Description: -

Depth: 0.5 - 1.0 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	96.2
37.5	89.1
26.5	78.9
19	69.3
13.2	68.4
9.5	66.8
4.75	60.7
2	51.7
0.425	40.4
0.25	36.2
0.15	31.7
0.075	25.6
0.05	23.6
0.02	17.6
0.005	14.9
0.002	10.8

M.I.T SIZE CLASSIFICATION *

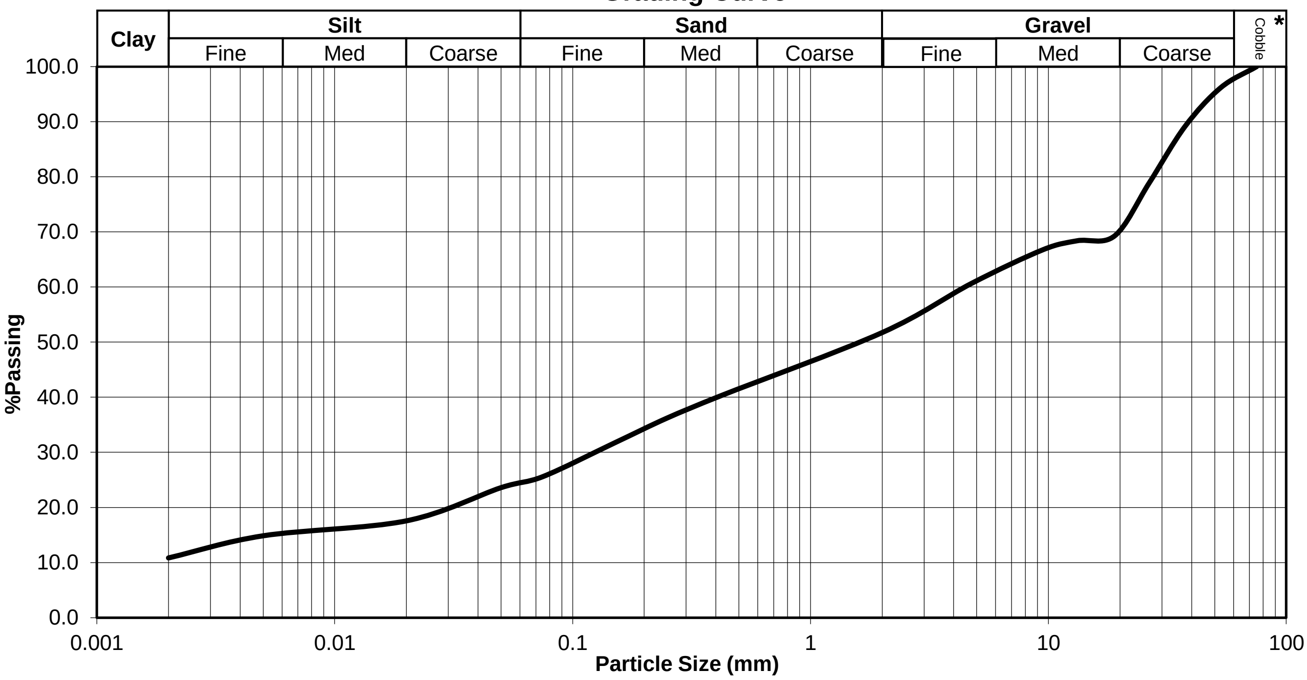
Cobble%		2.6
Gravel%	45.7	
Coarse		26.8
Medium		8.3
Fine		10.5
Sand%	27.3	
Coarse		10.1
Medium		7.6
Fine		9.6
Silt%	13.6	
Coarse		6.8
Medium		2.5
Fine		4.2
Clay%	10.8	

PLASTICITY	
Liquid Limit	27.7
Plasticity Index	20
Linear Shrinkage	5.3

GRADING	
D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	1.82

CLASSIFICATION	*
Potential Expansiveness	Low
Group Index	1
AASHTO Soil Classification	A - 2 - 6
Unified Classification	SC

Grading Curve



Ref no.: 8476(A) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058 Fax : (031) 201-7920

sanas Testing Laboratory

Project: Kingsburgh - Ref.31873

Ref no.: 8476(A) **Lab no.:** 07050 **Borehole/Pit no.:** IP.5

Description: -

Depth: 0.3 - 1.2 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	100.0
4.75	100.0
2	99.9
0.425	99.5
0.25	99.1
0.15	98.8
0.075	98.3
0.05	96.0
0.02	91.4
0.005	77.6
0.002	66.1

M.I.T SIZE CLASSIFICATION *

Cobble%		0.0
Gravel%	0.1	
Coarse		0.0
Medium		0.0
Fine		0.1
Sand%	3.0	
Coarse		0.4
Medium		0.6
Fine		2.0
Silt%	30.8	
Coarse		5.5
Medium		12.9
Fine		12.4
Clay%	66.1	

PLASTICITY

Liquid Limit	55.8
Plasticity Index	20.2
Linear Shrinkage	6

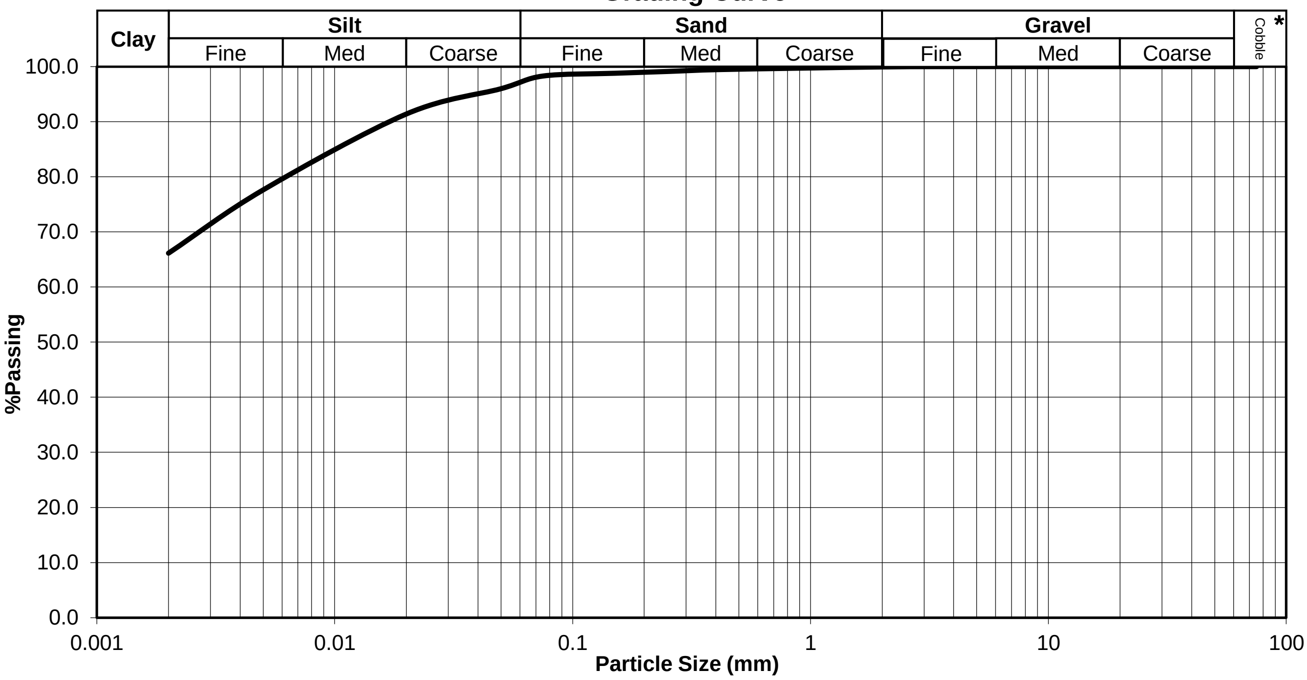
GRADING

D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	0.02

CLASSIFICATION *

Potential Expansiveness	Low
Group Index	26
AASHTO Soil Classification	A - 7 - 5
Unified Classification	MH or OH

Grading Curve



Ref no.: 8476(A) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Project: Kingsburgh - Ref.31873

Ref no.: 8476(A) **Lab no.:** 07051 **Borehole/Pit no.:** AH.2
Description: -

Depth: 0.0 - 0.2 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	100.0
4.75	99.3
2	98.8
0.425	96.2
0.25	93.6
0.15	89.7
0.075	84.7
0.05	82.3
0.02	75.2
0.005	65.7
0.002	56.3

M.I.T SIZE CLASSIFICATION *

Cobble%		0.0
Gravel%	1.2	
Coarse		0.0
Medium		0.5
Fine		0.7
Sand%	15.5	
Coarse		2.3
Medium		4.9
Fine		8.4
Silt%	27.0	
Coarse		8.0
Medium		8.8
Fine		10.1
Clay%	56.3	

PLASTICITY

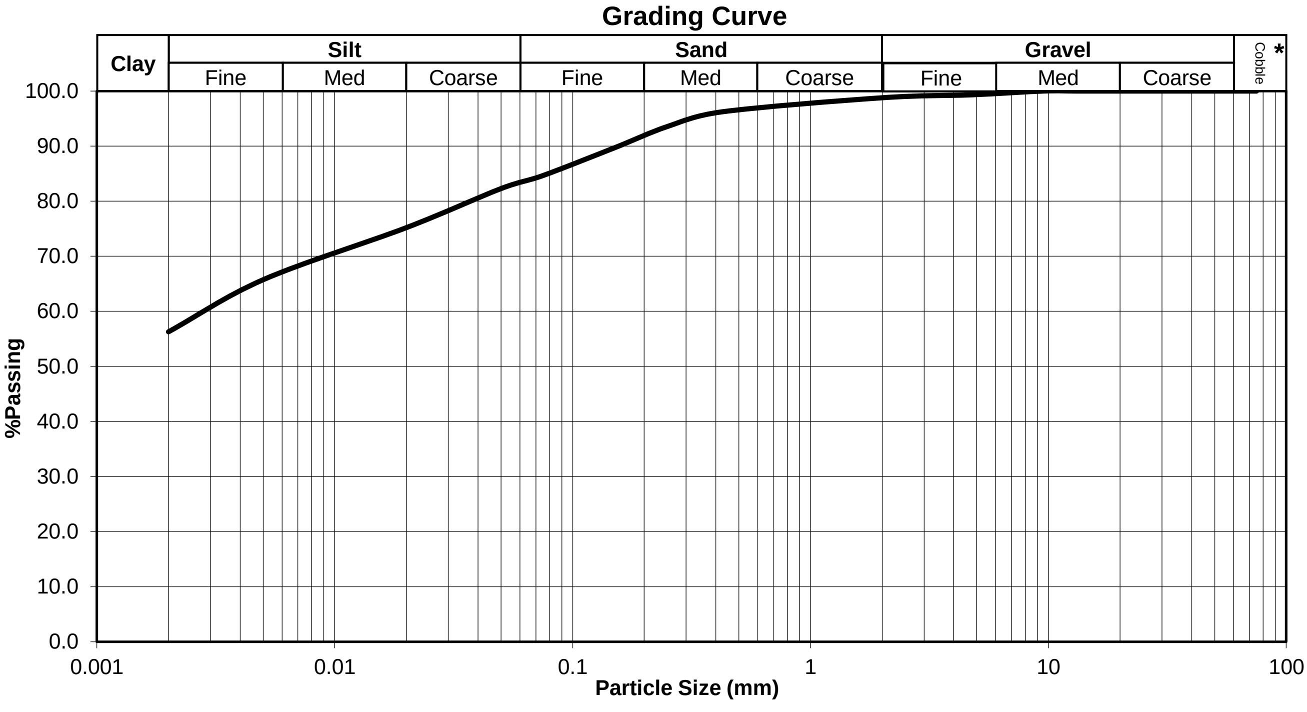
Liquid Limit	49
Plasticity Index	21
Linear Shrinkage	8.7

GRADING

D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	0.20

CLASSIFICATION *

Potential Expansiveness	Low
Group Index	20
AASHTO Soil Classification	A - 7 - 6
Unified Classification	ML or OL



Ref no.: 8476(A) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Project: Kingsburgh - Ref.31873

Ref no.: 8476(A) **Lab no.:** 07052 **Borehole/Pit no.:** IP.5
Description: -

Depth: 0.0 - 0.3 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	99.0
4.75	97.7
2	96.7
0.425	94.9
0.25	93.1
0.15	90.1
0.075	85.7
0.05	83.4
0.02	74.1
0.005	64.8
0.002	55.4

M.I.T SIZE CLASSIFICATION *

Cobble%		0.0
Gravel%	3.3	
Coarse		0.0
Medium		1.9
Fine		1.4
Sand%	12.3	
Coarse		1.6
Medium		3.5
Fine		7.2
Silt%	28.9	
Coarse		10.3
Medium		8.7
Fine		9.9
Clay%	55.4	

PLASTICITY

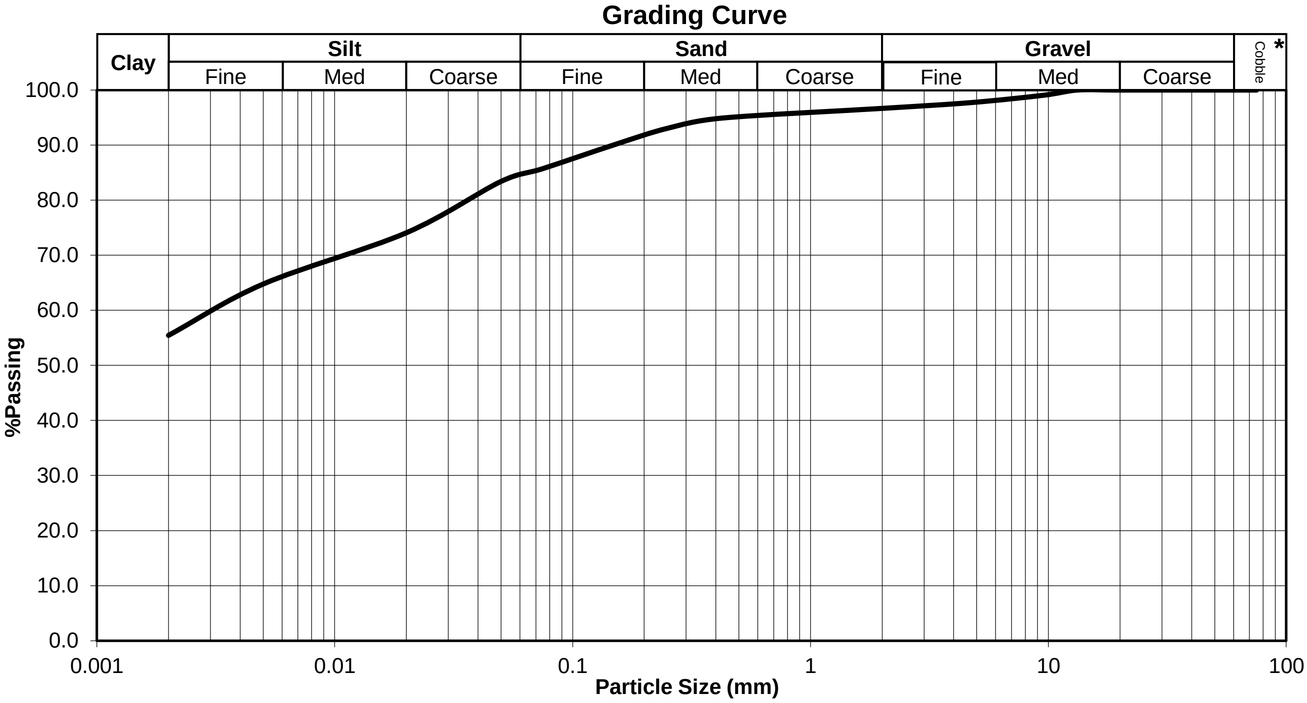
Liquid Limit	51.3
Plasticity Index	14.4
Linear Shrinkage	10

GRADING

D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	0.23

CLASSIFICATION *

Potential Expansiveness	Low
Group Index	16
AASHTO Soil Classification	A - 7 - 5
Unified Classification	MH or OH



Ref no.: 8476(A) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

Laboratory Test Summary

sanas Testing Laboratory

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058 Fax : (031) 201-7920

Job Description: KingsBurgh EXT9
Job no.: 8476(B)
Date: 25-08-2017

Lab no.		08050	08051	08052	08059	08053	08054				
Location		IP11	IP12	IP14	IP26	IP16	IP20				
Depth		1.4 - 1.9	1.6 - 2.0	0.4 - 1.5	0.01 - 0.5	0.5 - 1.6	0.1 - 0.7				
Description		Residual	Weathered	Residual	Colluvium	Weathered	Residual Tillite				
		Clay	Passage Beds	Tillite	0	Tillite	-				
Binder Material		-	-	-	-	-	-				
Particle Size (mm) / Cumulative % Passing	75		98			100					
	53		88			88					
	37.5		80			78					
	26.5		69			67					
	19		60	100		59	100				
	13.2	100	54	98		43	84				
	9.5	99	47	95	100	29	78				
	4.75	95	35	82	99	16	68				
	2	91	25	74	98	9	58				
	0.425	86	18	67	91	4	52				
	0.25	86	16	64	84	4	51				
	0.15	85	15	59	74	3	49				
	0.075	84	13	53	62	3	47				
Hydrometer / % Passing	0.05	84		49	57						
	0.02	82		44	43						
	0.005	76		38	33						
	0.002	68		30	24						
Soil Mortar / % Passing	Coarse Sand <2.0 >0.425mm	5.4	30.2	9.6	7.4	49.6	10.3				
	Fine Sand <0.425>0.05mm	15.0	60.7	45.7	39.9	48.9	47.4				
	Silt <0.05 >0.005	7.6		10.3	21.9						
	Clay <0.005	72.0		34.4	30.8						
Atterberg Limits	Liquid Limit % (m/m)	59	28	29.5	22.9	26.3	44.2				
	Plasticity Index	20.7	8.8	8	6.7	7.5	14.2				
	Linear Shrinkage %	8	4	5.3	2.7	4.7	8.7				
	Natural MC %	-	-	-	-	-	-				
Mod AASHTO Density	Dry Density kg/m^3		1941	1877		1974	1746				
	OMC %		10.7	10.5		10.3	17.5				
CBR	100% MDD		2.9	0.75		24	5				
	98%		2.7	0.75		23	3				
	95%		2.5	0.74		22	2				
	93% (Inferred) *		2	1		20	2				
	90%		2.4	0.52		17	1				
	CBR Swell (%)		2.24	5.75		0.00	3.35				
AASHTO Soil Classification *		A - 7 - 5 (22)	A - 2 - 4 (0)	A - 4 (2)	A - 4 (2)	A - 2 - 4 (0)	A - 7 - 5 (4)				
Grading Modulus		0.38	2.44	1.05	0.49	2.84	1.42				
TRH 14 (1985) *			>G10	>G10		G7	>G10				
pH					5.7	4.8	6.5				
Conductivity ms/m					36	38	60				

Technical Signitory: ....

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058 Fax : (031) 201-7920

Project: KingsBurgh EXT9

Ref no.: 8476(B) **Lab no.:** 08050 **Borehole/Pit no.:** IP11
Description: Residual Clay
Depth: 1.4 - 1.9

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	99.0
4.75	95.3
2	91.2
0.425	86.3
0.25	85.6
0.15	84.9
0.075	84.1
0.05	84.1
0.02	82.1
0.005	76.1
0.002	68.1

M.I.T SIZE CLASSIFICATION *

Cobble%		0.0
Gravel%	8.8	
Coarse		0.0
Medium		3.7
Fine		5.1
Sand%	7.1	
Coarse		4.3
Medium		1.6
Fine		1.1
Silt%	16.0	
Coarse		2.0
Medium		5.6
Fine		8.4
Clay%	68.1	

PLASTICITY

Liquid Limit, %	59
Plasticity Index	20.7
Linear Shrinkage, % (L/L)	8

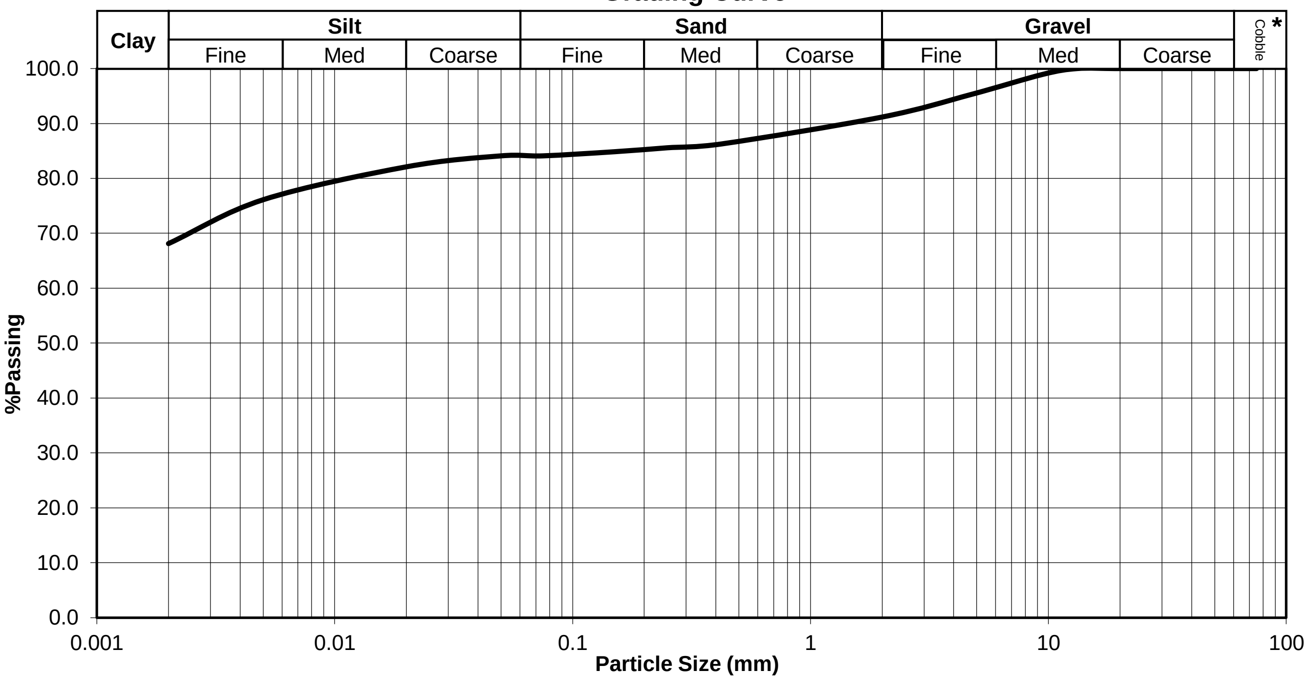
GRADING

D10 Size (mm)	<0.002
Uniformity Coefficient	*
Grading Modulus	0.38

CLASSIFICATION *

Potential Expansiveness	Low
Group Index	22
AASHTO Soil Classification	A - 7 - 5
Unified Classification	MH or OH

Grading Curve



Ref no.: 8476(B) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058 Fax : (031) 201-7920
sanas Testing Laboratory

Project: KingsBurgh EXT9

Ref no.: 8476(B) **Lab no.:** 08051 **Borehole/Pit no.:** IP12
Description: Weathered Passage Beds

Depth: 1.6 - 2.0

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	98.5
53	88.1
37.5	80.2
26.5	68.9
19	60.1
13.2	54.4
9.5	47.4
4.75	35.4
2	25.3
0.425	17.6
0.25	16.3
0.15	15.2
0.075	13.0
0.05	13.0
0.02	
0.005	
0.002	

M.I.T SIZE CLASSIFICATION *

Cobble%		8.6
Gravel%	66.1	
Coarse		30.2
Medium		22.7
Fine		13.3
Sand%	12.3	
Coarse		6.8
Medium		2.8
Fine		2.7
Silt%	0.0	
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY

Liquid Limit	28
Plasticity Index	8.8
Linear Shrinkage	4

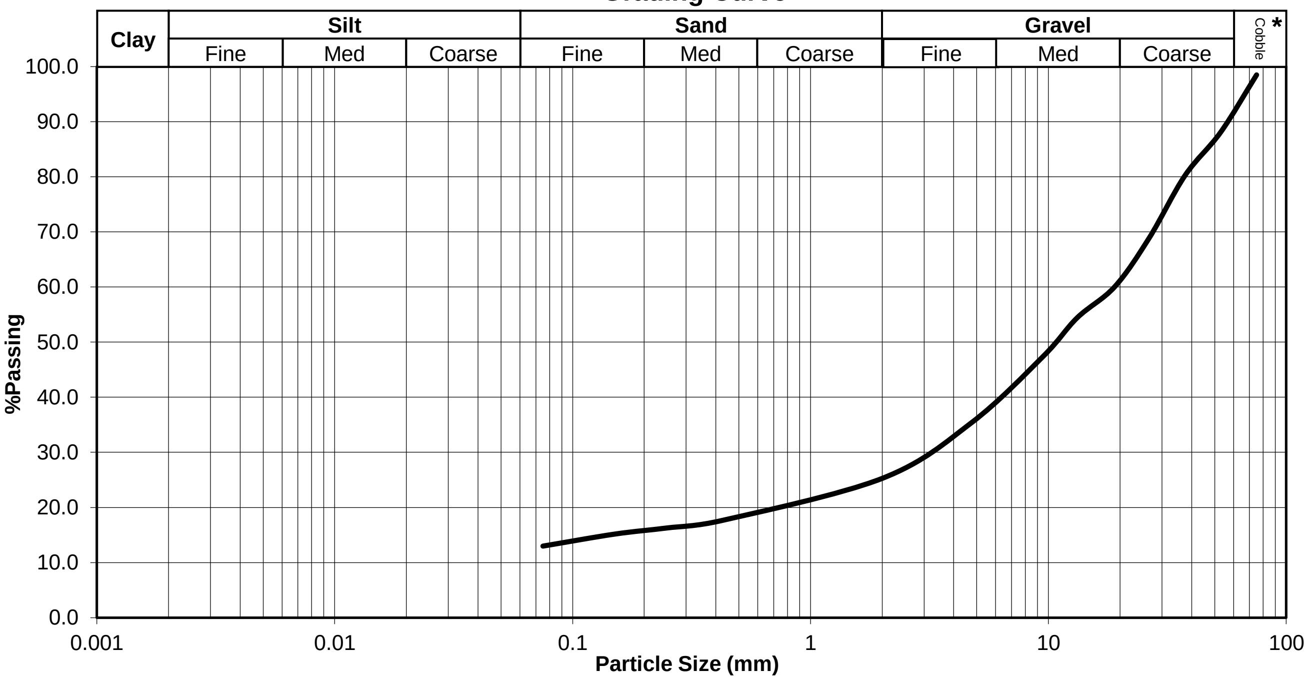
GRADING

D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	2.44

CLASSIFICATION *

Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 2 - 4
Unified Classification	

Grading Curve



Ref no.: 8476(B) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Project: KingsBurgh EXT9

Ref no.: 8476(B) **Lab no.:** 08052 **Borehole/Pit no.:** IP14

Description: Residual Tillite

Depth: 0.4 - 1.5

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	97.5
9.5	94.6
4.75	82.2
2	74.4
0.425	67.3
0.25	63.5
0.15	59.3
0.075	53.2
0.05	49.4
0.02	43.7
0.005	38.0
0.002	30.5

M.I.T SIZE CLASSIFICATION *

Cobble%		0.0
Gravel%	25.6	
Coarse		0.0
Medium		14.6
Fine		11.0
Sand%	23.5	
Coarse		6.4
Medium		6.7
Fine		10.5
Silt%	20.4	
Coarse		7.2
Medium		5.3
Fine		7.9
Clay%	30.5	

PLASTICITY

Liquid Limit	29.5
Plasticity Index	8
Linear Shrinkage	5.3

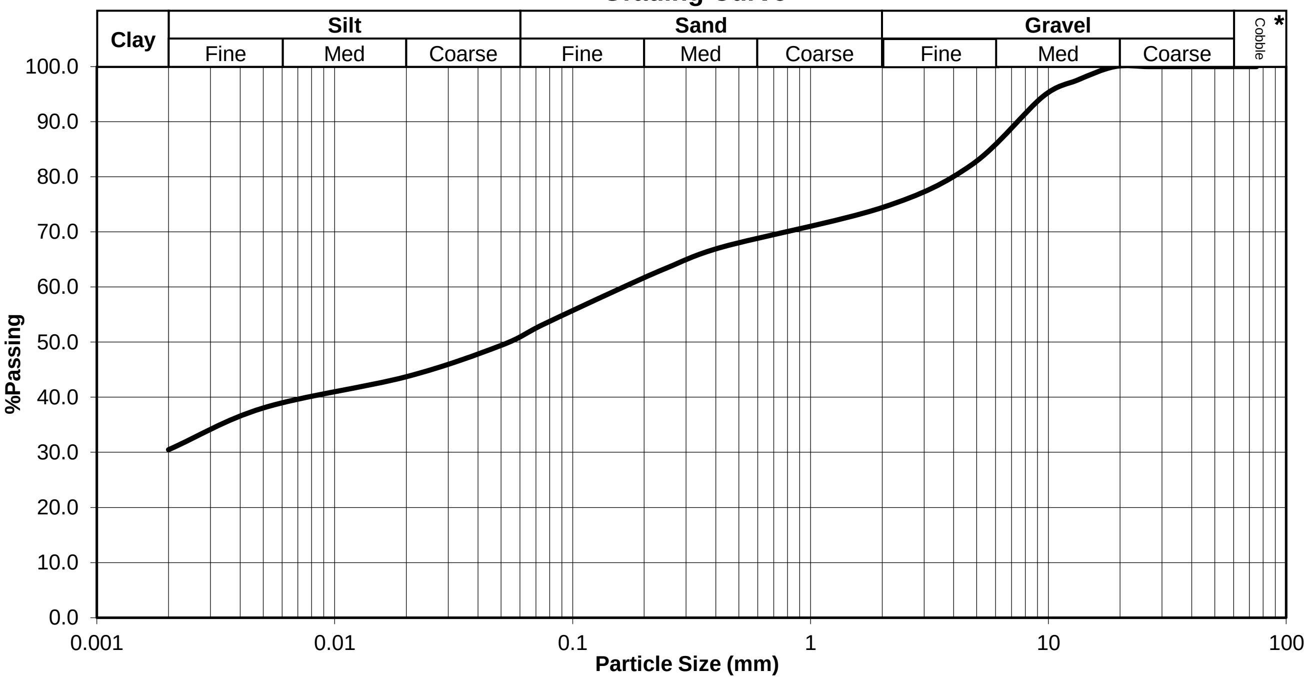
GRADING

D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	1.05

CLASSIFICATION *

Potential Expansiveness	Low
Group Index	2
AASHTO Soil Classification	A - 4
Unified Classification	CL or OL

Grading Curve



Ref no.: 8476(B) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058 Fax : (031) 201-7920

Project: KingsBurgh EXT9

Ref no.: 8476(B) **Lab no.:** 08059 **Borehole/Pit no.:** IP26
Description: Colluvium

Depth: 0.01 - 0.5 0

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	100.0
4.75	99.3
2	98.2
0.425	90.9
0.25	83.7
0.15	74.4
0.075	61.6
0.05	56.9
0.02	42.7
0.005	33.3
0.002	23.9

M.I.T SIZE CLASSIFICATION *

Cobble%		0.0
Gravel%	1.8	
Coarse		0.0
Medium		0.5
Fine		1.3
Sand%	39.3	
Coarse		6.5
Medium		12.6
Fine		20.2
Silt%	35.0	
Coarse		16.1
Medium		8.8
Fine		10.1
Clay%	23.9	

PLASTICITY

Liquid Limit	22.9
Plasticity Index	6.7
Linear Shrinkage	2.7

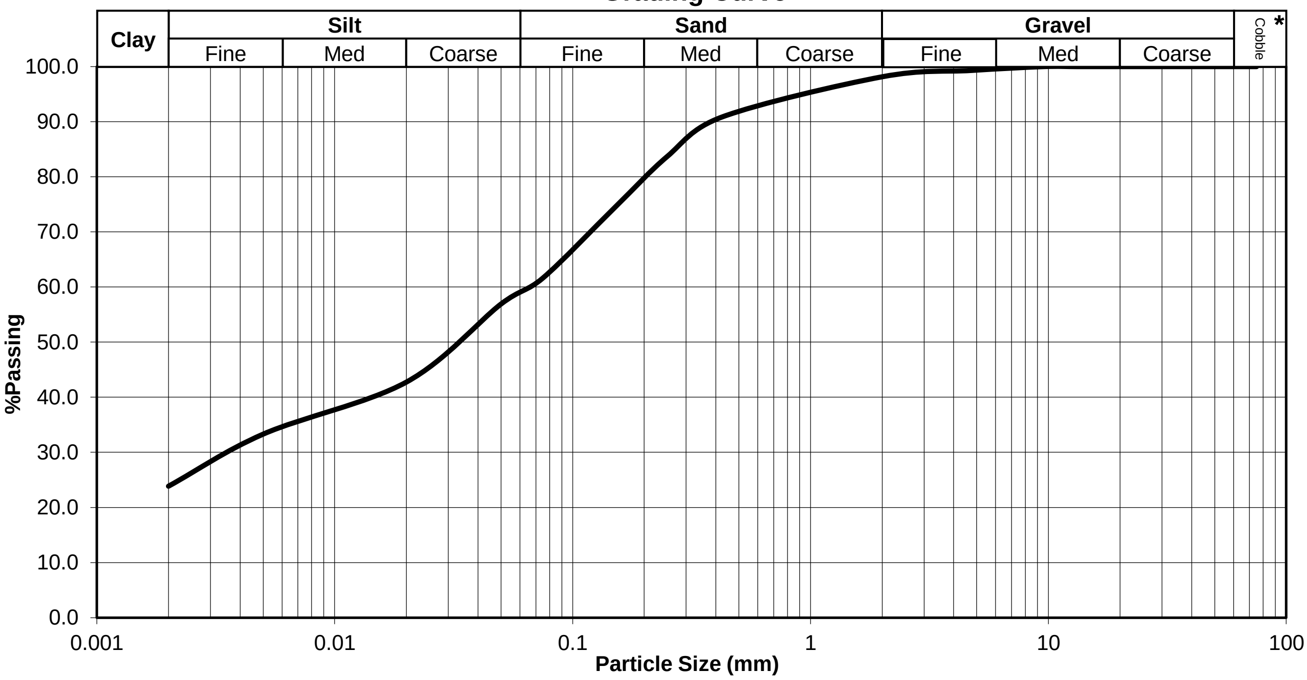
GRADING

D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	0.49

CLASSIFICATION *

Potential Expansiveness	Low
Group Index	2
AASHTO Soil Classification	A - 4
Unified Classification	CL - ML

Grading Curve



Ref no.: 8476(B) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058 Fax : (031) 201-7920
sanas Testing Laboratory

Project: KingsBurgh EXT9

Ref no.: 8476(B) **Lab no.:** 08053 **Borehole/Pit no.:** IP16
Description: Weathered Tillite

Depth: 0.5 - 1.6

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	87.6
37.5	78.5
26.5	66.6
19	58.9
13.2	42.5
9.5	29.5
4.75	15.6
2	8.7
0.425	4.4
0.25	3.9
0.15	3.5
0.075	3.1
0.05	3.1
0.02	
0.005	
0.002	

M.I.T SIZE CLASSIFICATION *

Cobble%		8.4
Gravel%	82.8	
Coarse		31.6
Medium		40.7
Fine		10.5
Sand%	5.6	
Coarse		3.8
Medium		1.2
Fine		0.6
Silt%	0.0	
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY

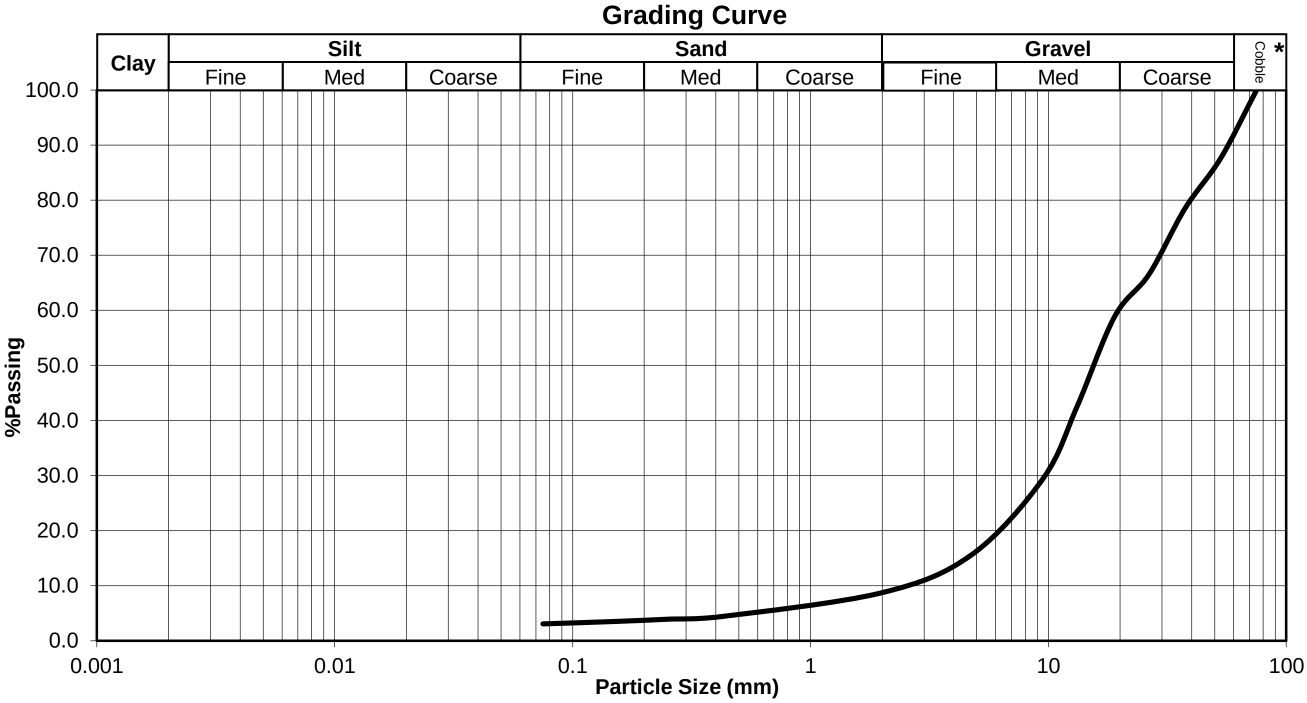
Liquid Limit	26.3
Plasticity Index	7.5
Linear Shrinkage	4.7

GRADING

D10 Size (mm)	453.9
Uniformity Coefficient	0.10
Grading Modulus	2.84

CLASSIFICATION *

Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 2 - 4
Unified Classification	GP



Ref no.: 8476(B) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058 Fax : (031) 201-7920
sanas Testing Laboratory

Project: KingsBurgh EXT9

Ref no.: 8476(B) **Lab no.:** 08054 **Borehole/Pit no.:** IP20
Description: Residual Tillite

Depth: 0.1 - 0.7 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	84.1
9.5	78.3
4.75	67.9
2	58.2
0.425	52.2
0.25	50.7
0.15	49.0
0.075	47.2
0.05	47.2
0.02	
0.005	
0.002	

M.I.T SIZE CLASSIFICATION *

Cobble%		0.0
Gravel%	41.8	
Coarse		0.0
Medium		29.4
Fine		12.5
Sand%	11.0	
Coarse		5.3
Medium		3.0
Fine		2.6
Silt%	0.0	
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY

Liquid Limit	44.2
Plasticity Index	14.2
Linear Shrinkage	8.7

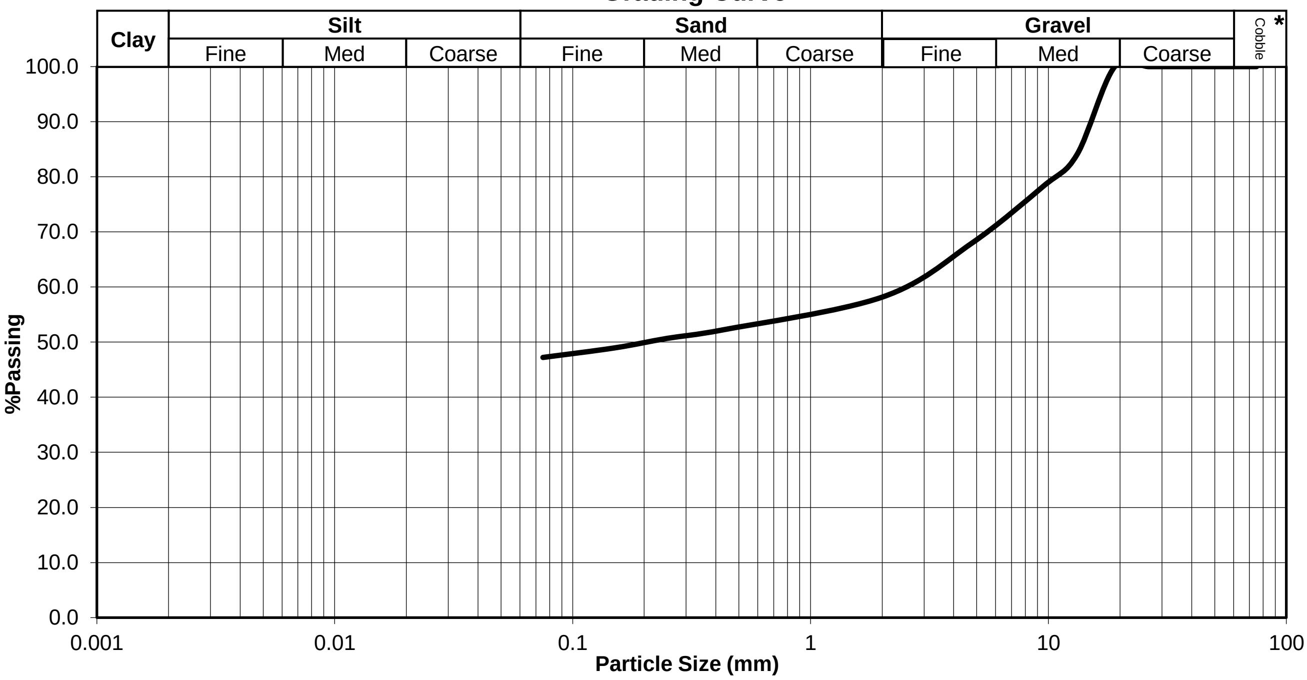
GRADING

D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	1.42

CLASSIFICATION *

Potential Expansiveness	
Group Index	4
AASHTO Soil Classification	A - 7 - 5
Unified Classification	

Grading Curve



Ref no.: 8476(B) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

Laboratory Test Summary

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Job Description: KingsBurgh - Ref.31873
Job no.: 8476(C)
Date: 25-08-2017

Lab no.		08056	08055	08057	08058						
Location		IP24	IP22	IP25	IP27						
Depth		0.0 - 0.7	0.3 - 2.3	0.5 - 2.0	0.5 - 1.3						
Description		Residual	Weathered	Weathered	Alluvial						
		Tillite	Shale	Tillite	Clay						
Binder Material		-	-	-	-						
Particle Size (mm) / Cumulative % Passing	75		100	100							
	53		97	97							
	37.5		93	94							
	26.5		84	89							
	19	100	79	84							
	13.2	92	74	84							
	9.5	89	67	83	100						
	4.75	85	56	82	100						
	2	80	46	78	99						
	0.425	76	39	66	96						
	0.25	73	38	59	93						
	0.15	70	37	51	88						
	0.075	66	35	40	79						
Hydrometer / % Passing	0.05				76						
	0.02				69						
	0.005				59						
	0.002				51						
Soil Mortar / % Passing	Coarse Sand <2.0 >0.425mm	5.7	16.2	15.2	2.9						
	Fine Sand <0.425>0.05mm	32.2	54.3	50.8	23.0						
	Silt <0.05 >0.005				17.2						
	Clay <0.005				56.8						
Atterberg Limits	Liquid Limit % (m/m)	41.9	31.4	25.3	35.5						
	Plasticity Index	11	7.6	8.2	11.9						
	Linear Shrinkage %	6.7	4	4	6						
	Natural MC %	-	-	-	-						
Mod AASHTO Density	Dry Density kg/m^3	1653	1891	1943							
	OMC %	18.9	12.1	9.7							
CBR	100% MDD	9.6	12	3.7							
	98%	7	11	3.5							
	95%	4.4	10	3.2							
	93% (Inferred) *	4	8	3							
	90%	3	6	2.9							
	CBR Swell (%)	2.37	0.79	2.41							
AASHTO Soil Classification *		A - 7 - 5 (7)	A - 2 - 4 (0)	A - 4 (0)	A - 6 (9)						
Grading Modulus		0.79	1.80	1.16	0.25						
TRH 14 (1985) *		>G10	G9	>G10							
pH					4.2						
Conductivity ms/m					45						

Technical Signitory: ....

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Project: KingsBurgh - Ref.31873

Ref no.: 8476(C) **Lab no.:** 08056 **Borehole/Pit no.:** IP24
Description: Residual Tillite
Depth: 0.0 - 0.7

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	91.5
9.5	89.2
4.75	85.0
2	80.1
0.425	75.5
0.25	73.1
0.15	69.9
0.075	65.8
0.05	65.8
0.02	
0.005	
0.002	

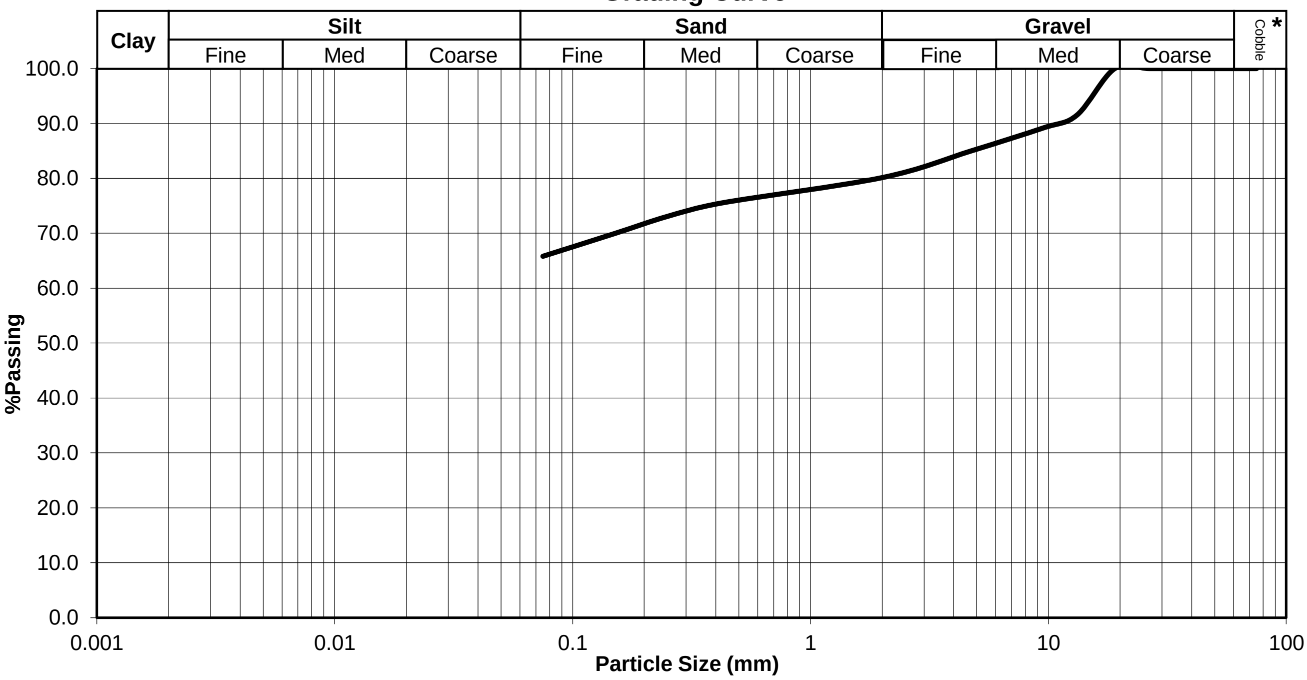
M.I.T SIZE CLASSIFICATION *		
Cobble%		0.0
Gravel%	19.9	
Coarse		0.0
Medium		13.9
Fine		6.0
Sand%	14.3	
Coarse		4.1
Medium		4.5
Fine		5.7
Silt%	0.0	
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY	
Liquid Limit, %	41.9
Plasticity Index	11
Linear Shrinkage, % (L/L)	6.7

GRADING	
D10 Size (mm)	
Uniformity Coefficient	*
Grading Modulus	0.79

CLASSIFICATION *	
Potential Expansiveness	
Group Index	7
AASHTO Soil Classification	A - 7 - 5
Unified Classification	

Grading Curve



Ref no.: 8476(C) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058 Fax : (031) 201-7920

Project: KingsBurgh - Ref.31873

Ref no.: 8476(C) **Lab no.:** 08055 **Borehole/Pit no.:** IP22
Description: Weathered Shale
Depth: 0.3 - 2.3

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	97.4
37.5	93.0
26.5	83.8
19	78.6
13.2	74.2
9.5	66.6
4.75	55.8
2	46.2
0.425	38.7
0.25	37.6
0.15	36.6
0.075	35.2
0.05	35.2
0.02	
0.005	
0.002	

M.I.T SIZE CLASSIFICATION *

Cobble%		1.8
Gravel%	52.1	
Coarse		19.0
Medium		20.6
Fine		12.5
Sand%	11.0	
Coarse		6.7
Medium		2.4
Fine		1.9
Silt%	0.0	
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY

Liquid Limit	31.4
Plasticity Index	7.6
Linear Shrinkage	4

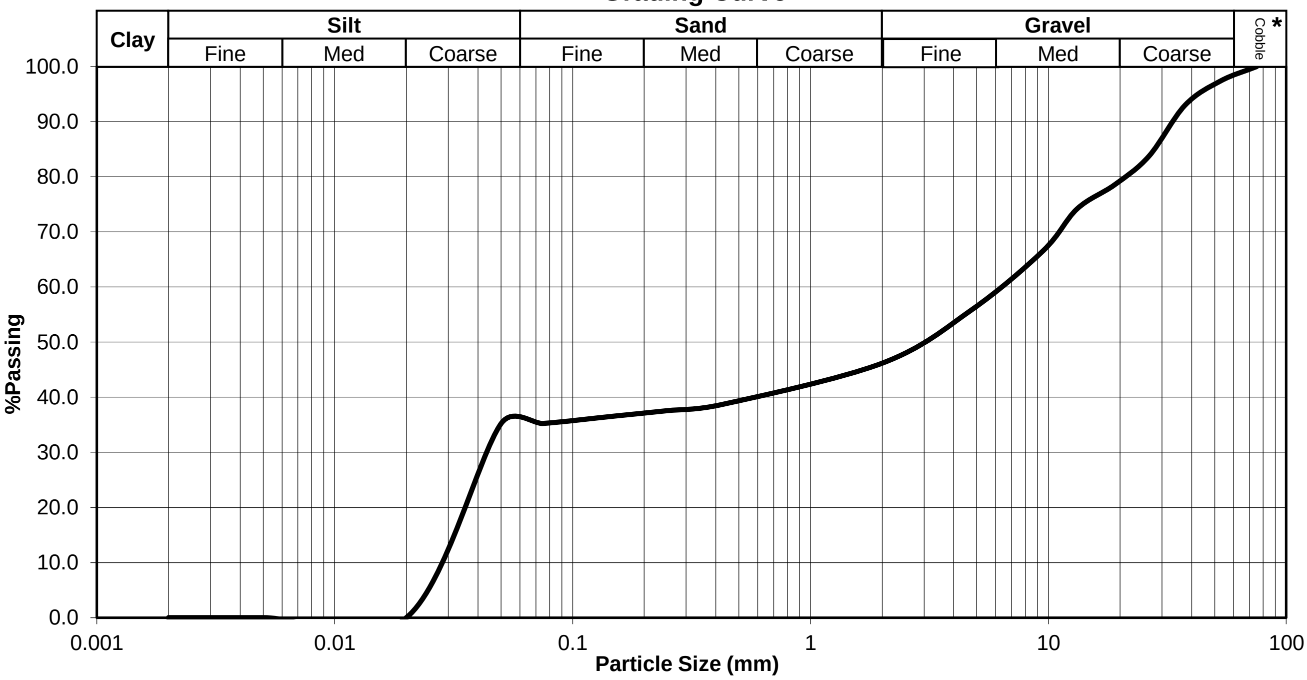
GRADING

D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	1.80

CLASSIFICATION *

Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 2 - 4
Unified Classification	

Grading Curve



Ref no.: 8476(C) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058 Fax : (031) 201-7920

Project: KingsBurgh - Ref.31873

Ref no.: 8476(C) **Lab no.:** 08057 **Borehole/Pit no.:** IP25
Description: Weathered Tillite
Depth: 0.5 - 2.0

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	97.2
37.5	93.6
26.5	88.5
19	84.0
13.2	84.0
9.5	83.3
4.75	82.1
2	78.0
0.425	66.1
0.25	59.0
0.15	50.9
0.075	40.1
0.05	40.1
0.02	
0.005	
0.002	

M.I.T SIZE CLASSIFICATION *

Cobble%		1.9
Gravel%	20.1	
Coarse		13.5
Medium		2.2
Fine		4.4
Sand%	37.9	
Coarse		10.5
Medium		12.5
Fine		14.8
Silt%	0.0	
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY

Liquid Limit	25.3
Plasticity Index	8.2
Linear Shrinkage	4

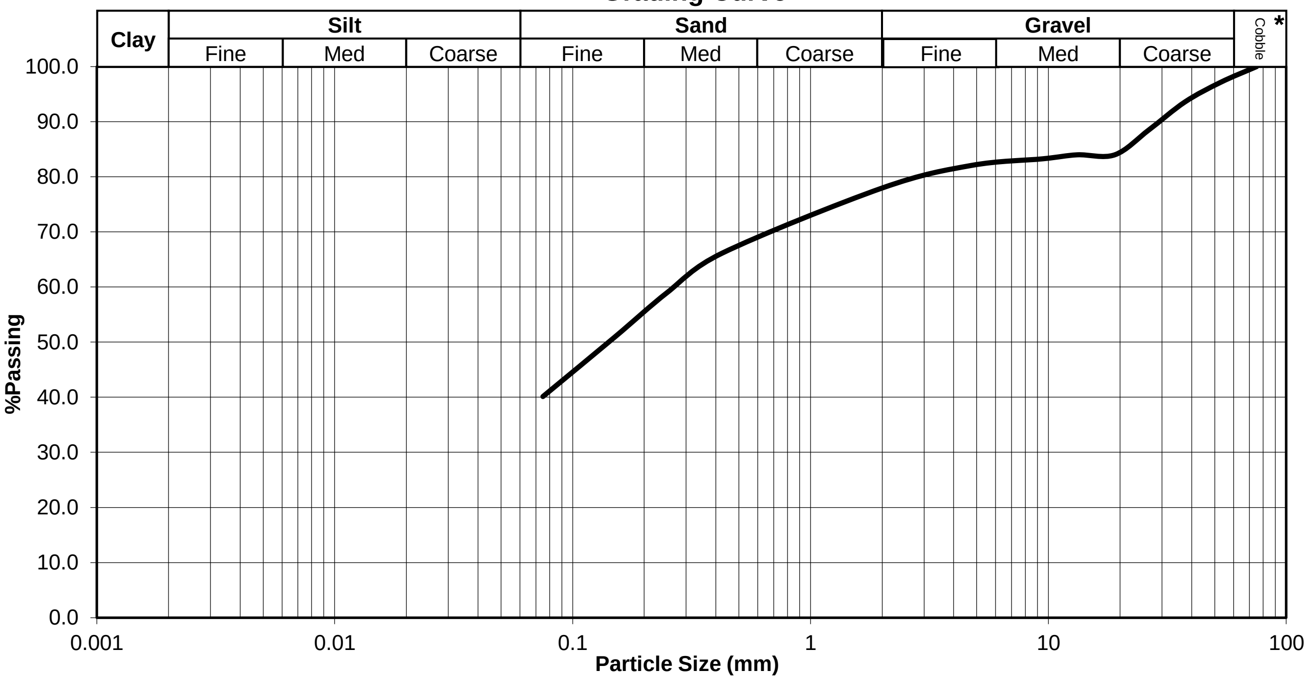
GRADING

D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	1.16

CLASSIFICATION *

Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 4
Unified Classification	

Grading Curve



Ref no.: 8476(C) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4590210961.
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

Project: KingsBurgh - Ref.31873

Ref no.: 8476(C) **Lab no.:** 08058 **Borehole/Pit no.:** IP27
Description: Alluvial Clay
Depth: 0.5 - 1.3

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis

Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	100.0
4.75	99.9
2	99.4
0.425	96.5
0.25	93.2
0.15	87.7
0.075	78.8
0.05	76.3
0.02	68.7
0.005	58.6
0.002	51.0

M.I.T SIZE CLASSIFICATION *

Cobble%		0.0
Gravel%	0.6	
Coarse		0.0
Medium		0.0
Fine		0.6
Sand%	22.1	
Coarse		2.6
Medium		6.3
Fine		13.1
Silt%	26.4	
Coarse		8.6
Medium		9.5
Fine		8.3
Clay%	51.0	

PLASTICITY

Liquid Limit	35.5
Plasticity Index	11.9
Linear Shrinkage	6

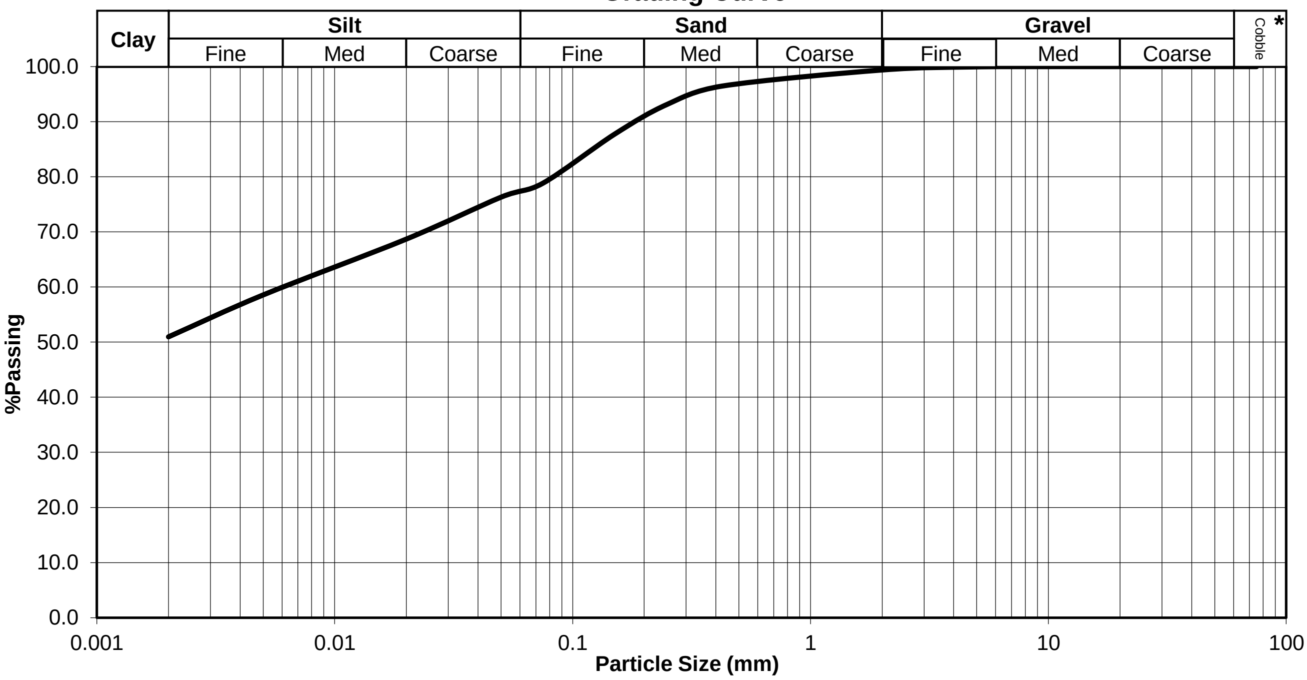
GRADING

D10 Size (mm)	<0.002
Uniformity Coefficient	NA
Grading Modulus	0.25

CLASSIFICATION *

Potential Expansiveness	Low
Group Index	9
AASHTO Soil Classification	A - 6
Unified Classification	CL or OL

Grading Curve



Ref no.: 8476(C) Fig no.: -

* Information marked with an asterisk is outside the scope of Accreditation.
The results only relate to the samples tested.
The report may not be reproduced except in full.

Swell.

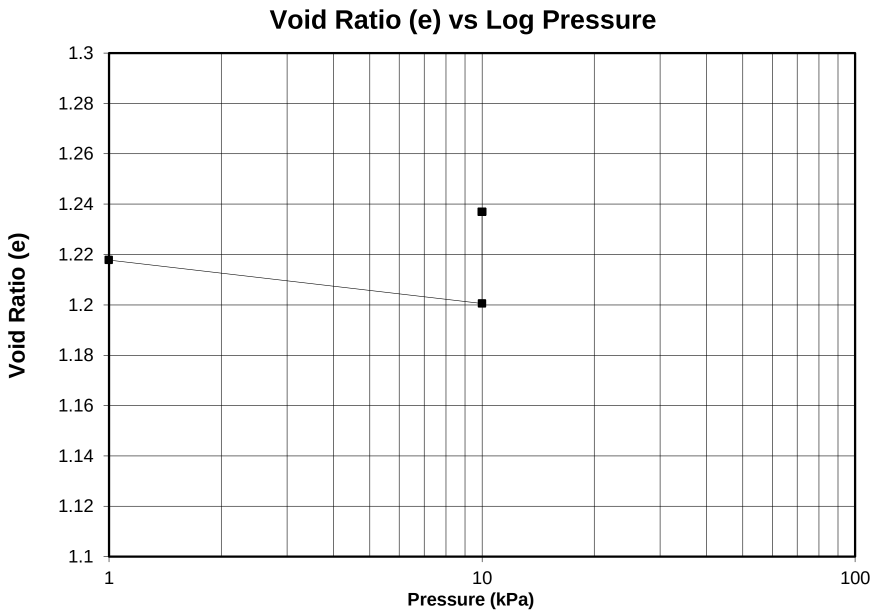
Project:	Kingsburgh			
Client.:	Drennan Maud (Pty) Ltd		**Hole/Block:**	IP 5
Date:	14-09-2017		**Depth (m):**	0.3 - 1.2
Sample No.:	07050		**Consol No.:**	2
Sample Description:	-		**Ring Dial. (mm):**	76.25
			Gauge Divs.(mm):	0.002
			Specific Gravity:	2.673

Container No.:	-	Moisture content before testing (%):	**14.89**
Mass of container (g):	82.75	Moisture content after testing (%):	**17.09**
Mass of wet sample + container before testing (g):	202.9	Dry density before testing (kg/m3):	**1762**
Mass of wet sample + container after testing (g):	205.2	Bulk density before testing (kg/m3):	**2024**
Mass of dry sample + container (g):	187.33	Percentage saturation before test (%):	**32.68**
		Percentage saturation after test (%):	**36.93**

Applied Pressure (KPa)	Dial Reading (divs)	Void Ratio	Modulus of Compressibility Mv Stress Range(kPa)	Mv (kPa-1)	Stress Range(kPa	Mv (kPa-1)
1	2500	1.218				
10	2423	1.201	1 - 10	**8.62E-04**	1 - 10	**8.62E-04**
10	2579	1.237	10 - 10			

Swell (%)

6.44



Reference no.: 8476 **Drennan Maud and Partners**

Fig. no. -

Swell.

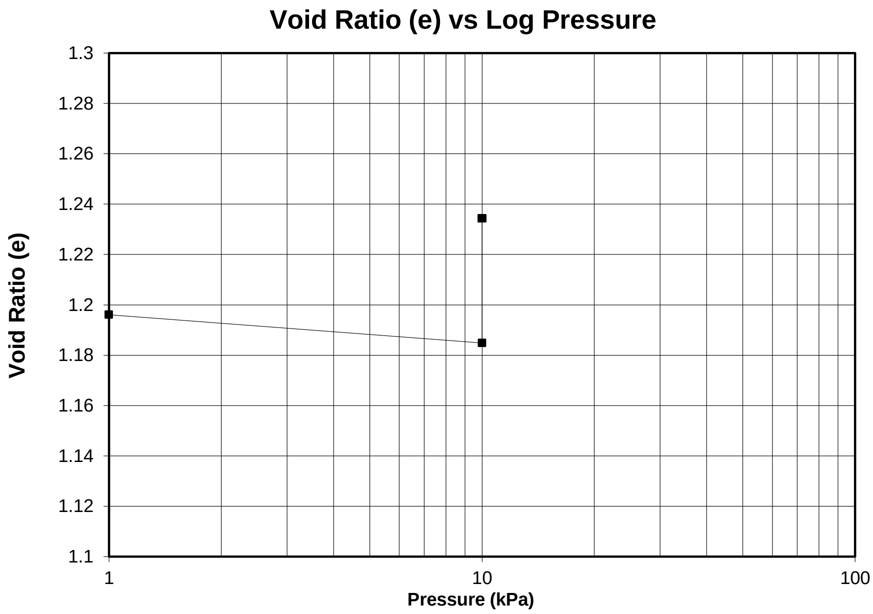
Project:	Kingsburgh			
Client.:	Drennan Maud (Pty) Ltd		**Hole/Block:**	IP 14
Date:	14-09-2017		**Depth (m):**	0.4 - 1.5
Sample No.:	08052		**Consol No.:**	7
Sample Description:	-		**Ring Dial. (mm):**	76.15
			Gauge Divs.(mm):	0.002
			Specific Gravity:	2.679

Container No.:	-	Moisture content before testing (%):	**10.50**
Mass of container (g):	0	Moisture content after testing (%):	**15.45**
Mass of wet sample + container before testing (g):	116.65	Dry density before testing (kg/m3):	**1783**
Mass of wet sample + container after testing (g):	121.88	Bulk density before testing (kg/m3):	**1970**
Mass of dry sample + container (g):	105.57	Percentage saturation before test (%):	**23.51**
		Percentage saturation after test (%):	**33.53**

Applied Pressure (KPa)	Dial Reading (divs)	Void Ratio	Modulus of Compressibility Mv Stress Range(kPa)	Mv (kPa-1)	Stress Range(kPa	Mv (kPa-1)
1	2500	1.196				
10	2448	1.185	1 - 10	**5.69E-04**	1 - 10	**5.69E-04**
10	2662	1.234	10 - 10			

Swell (%)

8.74



Reference no.: 8476

Drennan Maud and Partners

Fig. no. -

Swell.

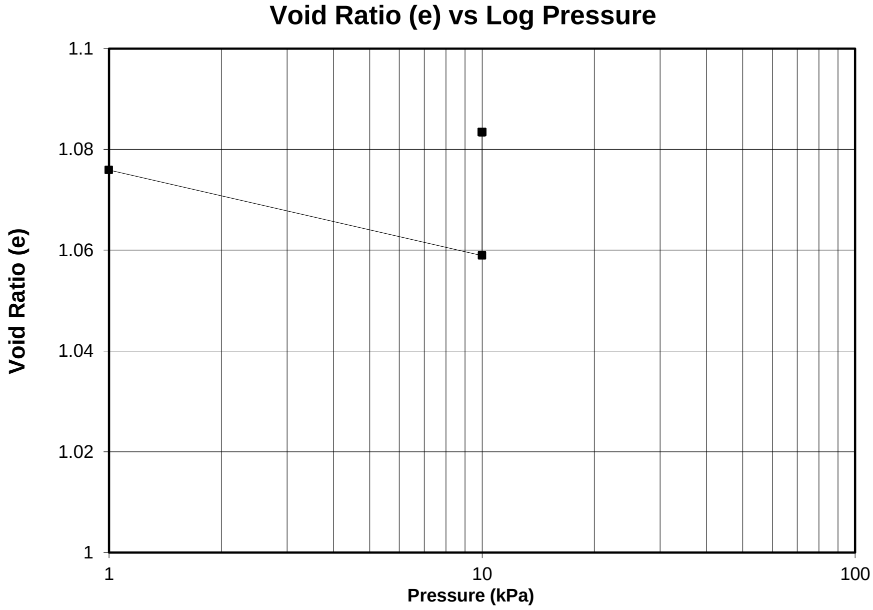
Project:	Kingsburgh			
Client.:	Drennan Maud (Pty) Ltd		**Hole/Block:**	IP 16
Date:	14-09-2017		**Depth (m):**	0.5 - 1.6
Sample No.:	08053		**Consol No.:**	8
Sample Description:	-		**Ring Dial. (mm):**	76.1
			Gauge Divs.(mm):	0.002
			Specific Gravity:	2.663

Container No.:	-	Moisture content before testing (%):	**10.30**
Mass of container (g):	0	Moisture content after testing (%):	**10.82**
Mass of wet sample + container before testing (g):	122.29	Dry density before testing (kg/m3):	**1875**
Mass of wet sample + container after testing (g):	122.87	Bulk density before testing (kg/m3):	**2068**
Mass of dry sample + container (g):	110.87	Percentage saturation before test (%):	**25.49**
		Percentage saturation after test (%):	**26.60**

Applied Pressure (KPa)	Dial Reading (divs)	Void Ratio	Modulus of Compressibility Mv: Stress Range(kPa)	Mv (kPa-1)	Stress Range(kPa	Mv (kPa-1)
1	2500	1.076				
10	2419	1.059	1 - 10	**9.09E-04**	1 - 10	**9.09E-04**
10	2531	1.083	10 - 10			

Swell (%)

4.63



Reference no.: 8476

Drennan Maud and Partners

Fig. no. -

Swell.

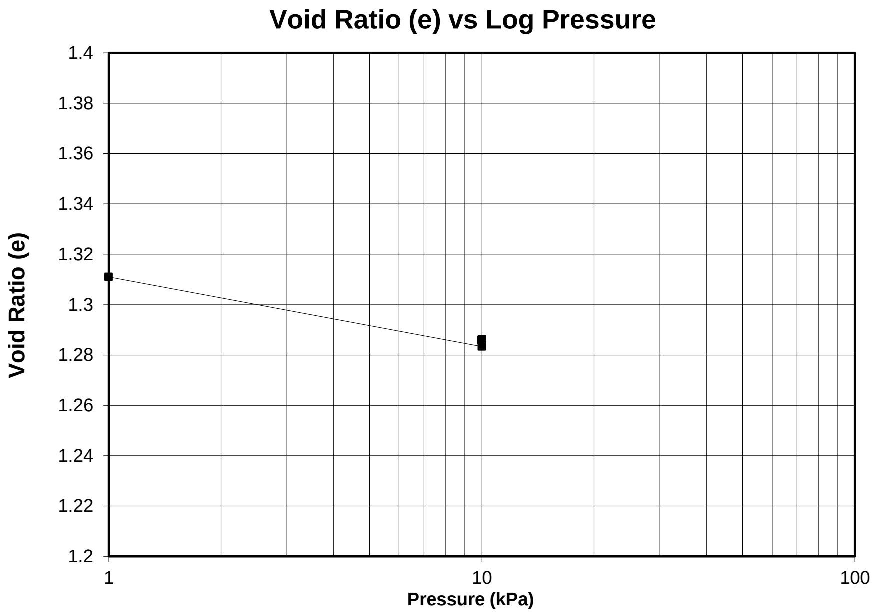
Project:	Kingsburgh			
Client.:	Drennan Maud (Pty) Ltd		**Hole/Block:**	IP 20
Date:	14-09-2017		**Depth (m):**	0.1 - 0.7
Sample No.:	08054		**Consol No.:**	4
Sample Description:	-		**Ring Dial. (mm):**	76.45
			Gauge Divs.(mm):	0.002
			Specific Gravity:	2.623

Container No.:	-	Moisture content before testing (%):	**17.51**
Mass of container (g):	0	Moisture content after testing (%):	**20.14**
Mass of wet sample + container before testing (g):	116.33	Dry density before testing (kg/m3):	**1659**
Mass of wet sample + container after testing (g):	118.94	Bulk density before testing (kg/m3):	**1949**
Mass of dry sample + container (g):	99	Percentage saturation before test (%):	**35.02**
		Percentage saturation after test (%):	**41.08**

Applied Pressure (KPa)	Dial Reading (divs)	Void Ratio	Modulus of Compressibility Mv Stress Range(kPa)	Mv (kPa-1)	Stress Range(kPa	Mv (kPa-1)
1	2500	1.311				
10	2383	1.283	1 - 10	**1.33E-03**	1 - 10	**1.33E-03**
10	2394	1.286	10 - 10			

Swell (%)

0.46



Reference no.: 8476

Drennan Maud and Partners

Fig. no. -

Swell.

Project: Kingsburgh
Client.: Drennan Maud (Pty) Ltd
Date: 14-09-2017
Sample No.: 08056
Sample Description: -

Hole/Block: IP 24
Depth (m): 0.0 - 0.7
Consol No.: 3
Ring Dial. (mm): 76.1
Gauge Divs.(mm): 0.002
Specific Gravity: 2.669

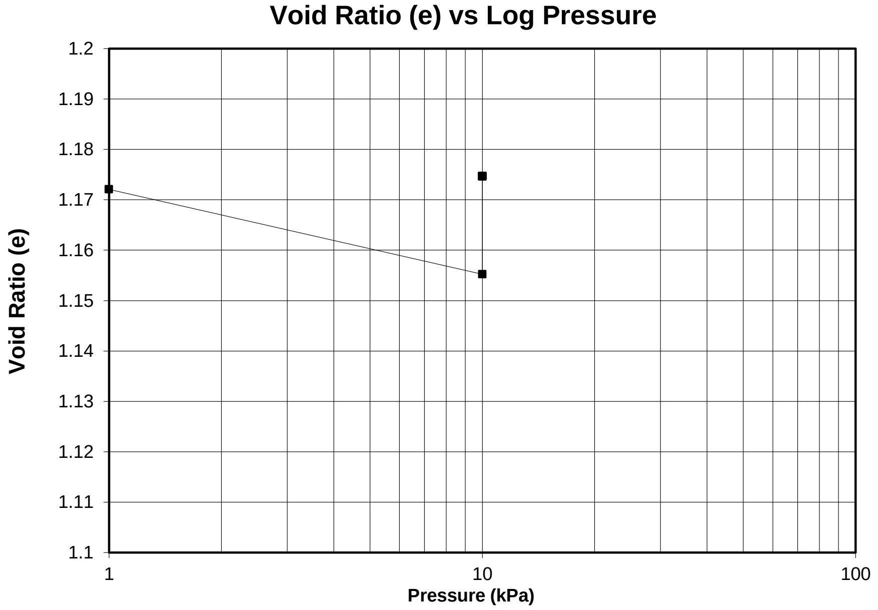
Container No.:	36
Mass of container (g):	0
Mass of wet sample + container before testing (g):	119.05
Mass of wet sample + container after testing (g):	122.3
Mass of dry sample + container (g):	106.2

Moisture content before testing (%):	**12.10**
Moisture content after testing (%):	**15.16**
Dry density before testing (kg/m3):	**1796**
Bulk density before testing (kg/m3):	**2013**
Percentage saturation before test (%):	**27.55**
Percentage saturation after test (%):	**34.45**

Applied Pressure (KPa)	Dial Reading (divs)	Void Ratio	Modulus of Compressibility Mv Stress Range(kPa)	Mv (kPa-1)	Stress Range(kPa	Mv (kPa-1)
1	2500	1.172				
10	2423	1.155	1 - 10	**8.62E-04**	1 - 10	**8.62E-04**
10	2508	1.175	10 - 10			

Swell (%)

3.51



Reference no.: 8476

Drennan Maud and Partners

Fig. no. -

Swell.

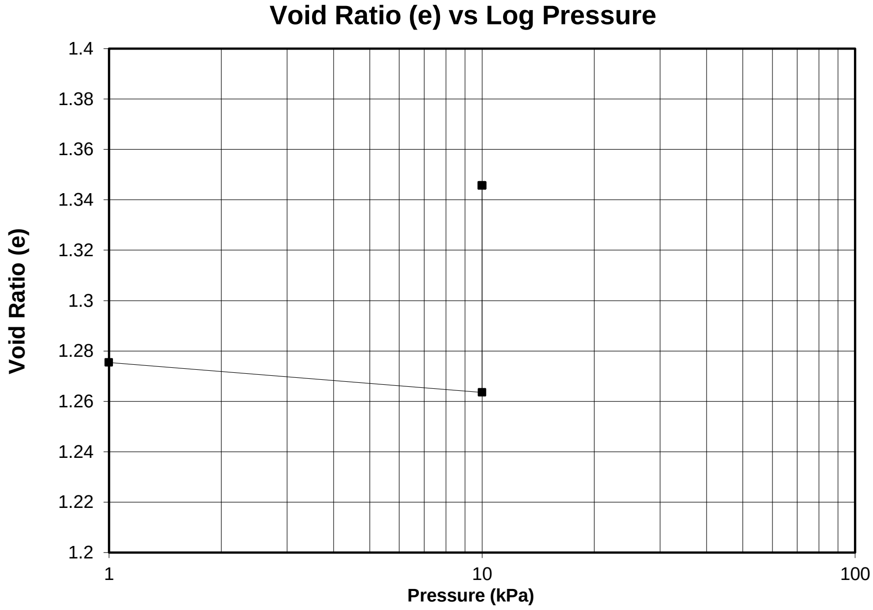
Project:	Kingsburgh			
Client.:	Drennan Maud (Pty) Ltd		**Hole/Block:**	IP 27
Date:	14-09-2017		**Depth (m):**	0.5- 1.3
Sample No.:	08058		**Consol No.:**	1
Sample Description:	-		**Ring Dial. (mm):**	76.15
			Gauge Divs.(mm):	0.002
			Specific Gravity:	2.663

Container No.:	36	Moisture content before testing (%):	**16.85**
Mass of container (g):	81.69	Moisture content after testing (%):	**24.55**
Mass of wet sample + container before testing (g):	200.04	Dry density before testing (kg/m3):	**1711**
Mass of wet sample + container after testing (g):	207.83	Bulk density before testing (kg/m3):	**1999**
Mass of dry sample + container (g):	182.97	Percentage saturation before test (%):	**35.19**
		Percentage saturation after test (%):	**48.57**

Applied Pressure (KPa)	Dial Reading (divs)	Void Ratio	Modulus of Compressibility Mv: Stress Range(kPa)	Mv (kPa-1)	Stress Range(kPa	Mv (kPa-1)
1	2500	1.275				
10	2447	1.264	1 - 10	**5.81E-04**	1 - 10	**5.81E-04**
10	2790	1.346	10 - 10			

Swell (%)

14.02



Reference no.: 8476

Drennan Maud and Partners

Fig. no. -