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Report on a Phase 1 Geotechnical Site Investigation on Portion 185 of the farm Diepsloot 388-JR, Johannesburg, Gauteng Province.

Prepared for: CENTURY PROPERTY DEVELOPMENTS

December 2010

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REPORT ON A PHASE 1 GEOTECHNICAL SITE INVESTIGATION ON PORTION 185 OF THE FARM DIEPSLOOT 388-JR, JOHANNESBURG, GAUTENG PROVINCE.

1. INTRODUCTION

A Phase 1 Geotechnical Site Investigation was undertaken at the request of Johann Jordaan of Century Property Development for township establishment on Portion 185 of the farm Diepsloot 388-JR, Johannesburg, Gauteng Province.

The investigation was undertaken according to the Guidelines for Urban Engineering Geological Investigations (SAIEG & SAICE, 1997) for urban development on sites larger than 10 hectares.

The objectives of the investigation were to:
1. To determine the geology and the relevant mechanical properties of the soil and rock horizons present on site.
2. To zone the site according to development suitability and to provide the NHBRC classification for each zone.
3. To give general foundation recommendations.
4. To comment on the excavation characteristics and possible uses of the materials underlying the site for installation of services as well as for use in layer works in paving and roads.
5. To comment on site water management aspects particularly pertaining to shallow groundwater or seepage.

2. AVAILABLE INFORMATION

At the time of the investigation the 1: 250 000 Geological Sheet 2528 Pretoria, 1:50 000 Geological Sheet 2528CC Lyttelton, 1:50 000 topocadastral map 2528CC Centurion, site locality and a satellite image were available.

Investigation results from previous investigations in the vicinity were also perused.

The guideline and specification documents by the South African Institute of Engineering and Environmental Geologists and South African Institution for Civil Engineers (1997), the National Department of Housing (2002), Draft SANS 634-2007 and the National Home Builders Registration Council (1999) were used in the execution of the investigation.

3. SITE DESCRIPTION

The investigated holding is located on the R511, William Nicol Drive directly northwest of the intersection with Caracal Road and to the north of Zeven Road forming the southern boundary (Figure 1, Appendix A).

The western part of the Holding is occupied by the Iterele Zenzele High School.

The general slope of the area is to the north with locally gradients towards the east and west due to a shallow stream channel running from south to north through the eastern part of the holding. The drainage feature has been modified due to storm water trenches, runoff from large concrete paved areas and septic tank drainage fields. A storm water drainage ditch runs through the central part of the holding into an earth dam on the central northern boundary with the golf driving range.
The shallow stream and dam areas will be prone to marshy conditions.

Locally levelled platforms were created via cut to fill to accommodate the large paved areas and buildings.

The site elevation is between 1 400 and 1 420 m above mean sea level.

The site is presently used by a number of different businesses amongst others a panel beating and car spray paint area and a dimension stone seller.
The northern parts have been left fairly undisturbed apart from the shallow dam in this area.
The school on the western part comprises of classrooms, sports fields and an open veldt area to the north.
The Lulamisa Eskom Substation is situated directly adjacent to and west of the property.

No rock outcrops or core stones were observed during the site walkover.

The surrounding area is serviced by tarred and dirt roads with limited municipal services.

The climatic N-value (Weinert, 1980) of the region is less than 5, which implies that chemical weathering is dominant.

4. METHOD OF INVESTIGATION

The fieldwork, entailing a site walkover, trial pitting and profile descriptions, was conducted on 16 November 2010. Ten trial pits were excavated using a BELL 315 SG TLB provided by Paul Heslop Plant Rental.

The test pits were excavated in accessible positions and are deemed representative of the sub-surface conditions prevailing on this holding. The test pit positions are indicated on the site plan (Figure 2, Appendix A). No test pits were excavated inside the school area as no measures were in place to control noise or children during formal school activities. Large areas of the site are also inaccessible to a TLB due to buildings and covered surface areas.

A registered Engineering Geologist inspected the test pits and recorded the soil profiles using the standard procedures as recommended by AEG/SAIEG/SAICE (2002). The soil profiles are included in Appendix B and photographs of each test pit are attached in Appendix C.

Two disturbed soil samples were retrieved from selected layers and submitted to Soillab (Pty) Ltd. of Pretoria for testing. Foundation indicator tests were performed on these samples to determine the particle size distribution and plasticity of the soil. The material was tested for foundation purposes and therefore the grading was carried out to 0,002 mm.
The pH and electrical conductivity was also determined to assess the corrosivity of the soils.

The laboratory test results are included in Appendix D.

5. GEOLOGY

5.1 GENERAL
According to the 1:50 000 geological sheet 2528 Pretoria, the site is underlain by granite-gneiss and granite of the Johannesburg Granite Dome and consists of poorly exposed biotite tonalite, trondjhemite, granodiorite and migmatite varieties.

This site is not underlain by dolomitic bedrock and a surface stability investigation is therefore not required.

According to the geological maps and accompanied explanation no specific mineral deposits are present on the site.

A linear structure, inferred from a surface magnetic survey, is indicated to the north of the site and may be due to an intrusive dyke. No evidence of any intrusive material was seen during the site investigation.

5.2 SOIL PROFILE
A brief description of the various soil horizons encountered during this investigation is given below with a summary in Table 1.

Due to site modifications over time large areas is underlain by fill and some areas are cut platforms. Test pits could not be positioned in most of the modified areas and the nature of the cut platforms and fills are not known.

Thin unnatural material, referred to as "fill" in the soil profiles cover parts of the undeveloped areas on site. Average thickness is 0,16 m and it varies from sand to ash clinker.

The natural profiles comprise of transported soils overlying residual granite or well-developed ferricrete horizons.

The colluvium is generally *dry, brown to grey, loose, intact, silty sand, with quartz gravel and Fe and Mn nodules in some parts with* abundant roots.
The average thickness of this horizon is 0,28 m.

The typical pebble marker, regarded as the boundary between the transported upper end deeper residual materials, is only in the two profiles on the higher-lying southern boundary of the site. This may be because most of the soils on site have been reworked with the destruction of the natural vertical sequence of layers in the profiles.
The pebble marker is generally abundant Fe and Mn nodules and quartz gravel in a matrix similar to the colluvial material.

Ferruginization is evident in all profiles in the upper residual granite horizons and across the entire site. In some instances this horizon has been removed for earthworks or road construction purposes.
The material varies from nodular to honeycomb to hardpan and refusal of the TLB generally occurred within this horizon.

The residual granite profile, occurring from an average depth of 0,3 m, is *dry, greyish white with orange discolouration, dense, pinholed, silty sand.*
This horizon is clearly leached with a voided structure, but becomes dense to very dense near surface where the TLB reached gradual refusal to refusal conditions.

Table 1: Test pit summary: Encountered depths of different materials (m)

Test Pit	Fill	Colluvium	Pebble Marker	Residual granite	Ferricrete	Test pit depth
TP01	0 - 0.08			0.08 - 0.65	0.65 - 0.95	0.95*
TP02		0 - 0.20			+0.20	+0.20**
TP03		0 - 0.47	0.47 - 0.54	0.54 - 0.80	0.80 - 0.95	0.95**
TP04	0 - 0.18	0.18-0.74	0.74 - 0.90	0.90 - 1.20		1.20
TP05		0 - 0.40		0.40 - 0.90		0.90*
TP06	0 - 0.20	0.20-0.36			0.36 - 0.70	0.70**
TP07		0 - 0.15		0.15 - 0.50		0.50**
TP08		0 - 0.14		0.14 - 0.50		0.50**
TP09		0 - 0.13		0.13 - 0.30		0.30**
TP10	0 - 0.17				0.17 - 0.40	0.40**

*Near refusal of TLB; **Refusal of TLB

5.3 GROUNDWATER

Groundwater seepage was only encountered in one of the test pits, namely TP3 on the southern boundary. This test pit is on the highest elevated part of the site en next to Zeven Road.

A number of wet surface areas have been identified with the major contributor to these wet conditions the storm water drains and ditches. Small septic tanks also serve the facilities and drainage fields also cause wet surface conditions in localized areas.

The zone adjacent to the storm water ditch running into the dam on the northern boundary is also wet and the vegetation in the slight depressed area occurring in the highly modified gulley head of a small tributary of the Diepsloot Spruit to the north also indicates possible surface seepage and/or wet conditions during the wet months.

The strong and consistent ferruginization in the profiles with mottling is also a good indicator of seasonal water movement through the profile as well as seasonal perching of percolating groundwater.

Perched water tables may therefore be expected during the wet months and the perched water table may fluctuate depending on the season and amount of precipitation experienced.

Surface seepage can also be expected in cuts, in the gulley head area and where drainage fields of septic tanks occur.

Surface runoff and groundwater flow will be towards the low-lying gulley area and dam to the north, in the direction of the site gradient.

The regional groundwater in this area occurs in inter-granular and fractured aquifers with an average depth to the regional groundwater table of between 10 and 20 m. Groundwater depth could be significantly shallower within the stream area.

6. GEOTECHNICAL EVALUATION

The geotechnical appraisal is based on the field observations, local knowledge of the area, interpretations on site and available laboratory test results obtained during this investigation. Information from previous investigations in the vicinity of this holding has also been used.

6.1 ENGINEERING AND MATERIAL CHARACTERISTICS

The foundation indicator test results conducted on the bulk samples retrieved from the various test pits are summarised in Table 2. Due to the shallow soil profiles and refusal

of the TLB at depths less than 0,5 m only limited samples were retrieved. These test results only reflects the properties of the in situ soils and no information is available of the fills below the platforms on site.

Table 2: Indicator test results

Test pit	Depth (m)	Description	Soil composition				Atterberg Limits		LS %	GM	Activity	AASHTO / Unified classification
			Clay %	Silt %	Sand %	Gravel %	LL %	PI %				
TP03	0.45	Colluvium	2	14	66	17	16	2	1.0	1.42	Low	A-2/SM
TP05	0.40	Residuum	2	19	70	8	13	3	0.5	1.25	Low	A-2/SM

LL - Liquid limit; PI - Plasticity index; LS - Linear shrinkage; GM - grading modulus; SP - slightly plastic; NP - non plastic

The test results on the soil samples indicate the following:

- Both the transported and residual materials grade as silty sand with a large gravel component in the transported layers due to the concentration of Fe and Mn nodules and quartz gravel.
- The soils have low or no plasticity, very low linear shrinkage and moderate grading modulus values.
- The potential expansiveness, based on the whole sample PI and percentage clay, is also low.
- According to the Unified Soil Classification and the PRA classification the soils, falling in the "SM" group will be good subgrade material, poor to good subbase and not suitable for base course in roads. The soils may have slight to medium compressibility/expansiveness, but it will be low when compacted. Drainage will be fair to practically impervious when compacted and the material will be reasonably stable for the use in embankments. The soils will have good shear strength when compacted and saturated with CBR values of between 10 and 40 at OMC of 11 - 16%.

The transported soils are corrosive due to low acidity (pH > 8) and high electrical conductivity.

Results from similar material in the vicinity indicate compaction test results as summarised in Table 3.

Table 3. Compaction test results

Material type	OMC (%)	MDD (kg/m³)	Swell (%)	CBR At various densities				TRH 14
				90%	93%	95%	97%	
Transported & residuum	6.2	2 100	0.0	23	35	46	62	G5

OMC = Optimum moisture content
MDD = Maximum dry density (Mod AASHTO)
Swell = soaked at 100% Mod AASHTO compaction

- The maximum dry density is 2 100 kg/m³ at optimum moisture content of 6,2 %.
- The transported soils, similar to the material in TP3, classify as G5 and will only be suitable for use up to subbase layers in roads, although the grading modulus of 1,42 % indicates marginal subbase material.

6.2 SLOPE STABILITY AND EROSION

The slope gradients are typically between 2° and 6° to the north but locally easterly and westerly towards the shallow gulley in the eastern half of the site.
Natural slope instabilities are not expected on this site.

Due to the site gradient cut to fill site preparation are expected and care must be taken to prevent differential settlements from occurring across the cut and fill parts of platforms. There is presently a number of cut to fill platforms on site.

It will be essential to implement good and effective surface and groundwater management practice to prevent wet soil profile conditions, perched groundwater tables and surface seepage.
Concentrated runoff will also cause erosion, especially after the vegetation has been cleared, as is already occurring in the south-eastern corner of the site.

6.3 EXCAVATION CLASSIFICATION WITH RESPECT TO SERVICES
No rock outcrop or corestones were seen during the walkover survey and the test pits were terminated in or near gradual refusal or refusal conditions at an average termination depth of 0,5 m below surface. Excavation depths varies between 0,2 m and 1,2 m.

The material on site may therefore be classified as intermediate from 0,5 m below surface (SANS 1200D, 1988) based on the trial pit excavations.
The TLB used could not penetrate the hardpan ferricrete horizon, but softer conditions are usually underlying this ferruginized horizon in the residual granite.

Due to the ferruginization the site soils they may be unsuitable for use as bedding and/or backfill in pipelines.

6.4 IMPACT OF THE GEOTECHNICAL CHARACTER OF THE SITE ON HOUSING DEVELOPMENTS
The impact of the geotechnical constraints on housing development may be evaluated according to Table 4, which is a summary of the general geotechnical constraints relevant to urban development (Partridge, Wood and Brink, 1993). The Class column indicates the severity of the specific constraints for this site.

Table 4. Geological classification for urban development

CONSTRAINT		SITE CONDITION	CLASS
A	Collapsible soil	Any collapsible horizon or consecutive horizons with a depth of less than 750 mm in thickness.	1
B	Seepage	Permanent or perched water table less than 1,5 m below ground surface	2
C	Active soil	Low soil heave potential expected.	1
D	Highly compressible soil	Moderate soil compressibility expected.	2
E	Erodability of soil	Intermediate	2
F	Difficulty of excavation to 1,5m depth	Rock or hardpan pedocretes more than 40 % of the total volume.	3
G	Undermined ground	No known undermined areas	1
H	Instability in areas of soluble rock	Soluble rocks not present	1
I	Steep slopes	Slopes between 2 and 6 degrees.	1
J	Areas of unstable natural slopes	Low risk.	1
K	Areas subject to seismic activity	This area is not a known natural seismic active zone. Induced seismicity may occur.	1
L	Areas subject to flooding	Areas within known drainage channel or floodplain	3

Class: 1 - Most favourable, 2 - Intermediate, 3 - Least favourable

The main expected geotechnical constraints for this site are:
- Thin collapsible/compressible soil horizons.

- Seasonal shallow ground water and/or perched groundwater tables and/or surface seepage.
- Intermediate erodability of surficial soil horizons.
- Difficult excavation conditions below 0,5 m.
- Flooding in the gulley running through the eastern part of the investigated site.

7. SITE CLASSIFICATION AND FOUNDATION RECOMMENDATIONS

The site has been classified into three Site Class Designation zones (Figure 2), based on the above constraints and the criteria as set out in the NHBRC (1999) guideline document of which the appropriate tables have been included in Appendix A. The classification and foundation recommendations are based on results from this and other nearby investigations.

ZONE I: Site Class Designation S1-C1
This zone covers most of the undeveloped part of Portion 185, but excludes the gulley and surface wet areas.
The residual profiles are leached and voided which may lead to additional settlements due to collapse and compressibility under load and increased moisture content.

Shallow (<0.5 m) perched groundwater tables are expected with seasonally wet surface conditions in cuts and on lower lying areas.
Surficial soils are erodible.

One of the following foundation options is recommended depending on the type of structure to be erected on site and the foundation depth as outlined within this report (SAICE, 1995):

Modified normal.
Compaction of in situ soils below individual footings
Deep strip foundations
Soil raft.

ZONE II: Site Class Designation P(controlled fill & cut platforms)
This zone encompasses the presently built-up and covered areas.
No information is available on the integrity of the cuts or fills, although it is assumed that these were constructed under controlled conditions due to their present use.

It is suggested that individual future structure footprint areas be investigated separately to determine the founding conditions.
If site reshaping will take place then the new cuts and fills must be properly designed and compacted for the specific purpose.

ZONE III: Site Class Designation P(flooding; marshy area)
This zone covers those areas that are prone to surface seepage and wet soil profile conditions as well as areas, where applicable, below the 1:100 year flood lines.
Special drainage, plumbing and water management precautions will be necessary to render these areas suitable for development, although no residential development is allowed in areas below the flood lines where present.

Similar foundation measures to those suggested in Zone I will be applicable.

The above foundation recommendations are according to the Joint Structural Division (SAICE, 1995) code of practice for single storey masonry structures founded below the loose upper horizons (Tables 5 to 8, Appendix A).

It is recommended that the structural engineers calculate the best economical foundation option for the proposed development based on the type of structure and the different available construction methods.

The boundaries between Zones I, II and III, as depicted on Figure 2 (Appendix A), are based on the visual changes in vegetation on site and the aerial photograph and must be finalized during further investigation work or by suitably qualified professionals.

8. SPECIAL PRECAUTIONARY MEASURES

The upper loose colluvium and various fill materials have low bearing capacity and may be compressible. The residual granite profile exhibits an open structure and due to the limited thickness intermediate collapse settlements are expected. The recommended foundation precautionary measures needs to be implemented to limit damage due to additional settlements under load and saturation of the profile.

Good site drainage and water precautionary measures will be necessary as a seasonal perched water table will occur and wet surface conditions are prevalent in cut faces and lower lying areas.
This may cause problems with dampness in surface structures and with installation of services. The saturation of the soil profile will also need special site drainage methods as this may lead to additional collapse settlements under load and render the site impassable during wet periods.

Large parts of the site have been modified with the construction of platforms and variable conditions are expected in both cut and fill platforms.

The test pits were positioned to cover the accessible parts in order to zone the site. The pits were backfilled by the TLB without proper compaction in layers. If structures are to be positioned over or across these pits proper compaction must be executed to prevent differential settlements from taking place. The same will apply to development across previous excavations, root areas of removed trees, septic tanks, waste pits, controlled and uncontrolled fill areas where levelling took place.

It is assumed that the development will be serviced by the usual municipal services and no recommendations are made on on-site sanitation, waste disposal, cemetery and storm water reticulation services.

The soils are corrosive and it will be good practice to use plastic pipes rather than steel pipes for services.

9. CONCLUSIONS

The appropriate foundation design and building procedures must be implemented to prevent damage to structures due to the geological conditions listed in this report.

The major geological factors that may influence residential development are the following:

- Thin collapsible/compressible soil horizons.
- Seasonal shallow ground water and/or perched groundwater tables and/or surface seepage.
- Intermediate erodability of surficial soil horizons.
- Difficult excavation conditions below 0,5 m.

- Flooding in the gulley running through the eastern part of the investigated site.

Special attention should be given to surface water and groundwater drainage and additional site investigations will be necessary to determine the conditions under present covered platform areas.

The site soils will not be suitable as fill and bedding for pipelines due to poor grading, but the upper gravelly materials may be suitable for subgrade and subbase road layers and in embankments.

10. REPORT PROVISIONS

While every effort is made during the fieldwork phase to identify the different soil horizons, areas subject to a perched water table, areas of poor drainage, areas underlain by hard rock and to estimate their distribution, it is impossible to guarantee that isolated zones of poorer foundation materials, or harder rock have not been missed.

For this reason this investigation has sought to highlight areas of potential foundation, groundwater and excavation problems, to provide prior warning to the developer.

A competent person should inspect foundation excavations for future structures at the time of construction or the open service trenches, to determine the variance from the above assessment of the site.

It is recommended that a Phase II Geotechnical Site Investigation be conducted to determine any variation in the material properties and zoning described in this report. NHBRC enrolment of the site can only be completed once this Phase II Geotechnical Site Investigation has been executed. This will especially be necessary to determine the condition under present fill and cut platforms for future development.

The determination of flood lines and delineation of wetland areas were not part of this investigation and should be addressed by suitably competent professionals prior to the compilation of the final site development plan.

The present site zoning is based on the NHBRC Manual with the guideline site class designation specifically for single-storey masonry residential units.

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11. REFERENCES

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APPENDIX A: FIGURES AND REFERENCE TABLES

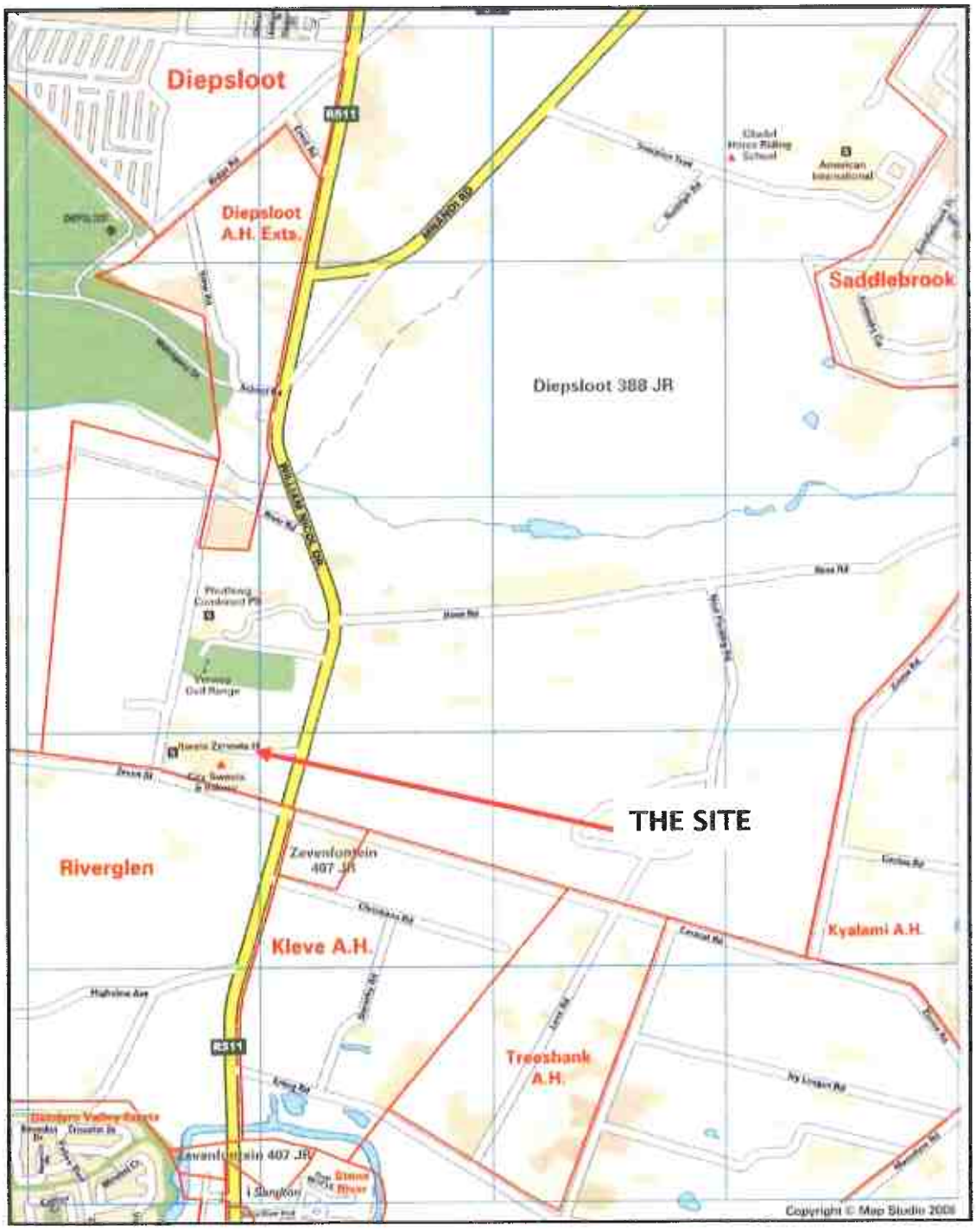

Figure 1: Locality Plan Portion 185; Diepsloot 388-JR, Midrand.

Figure 2: Test Pit positions & Geotechnical Zoning Ptn 185 Diepsloot 388-JR Midrand

Table 5. RESIDENTIAL SITE CLASS DESIGNATIONS (SAICE, 1995)

TYPICAL FOUNDATION MATERIAL	CHARACTER OF FOUNDING MATERIAL	EXPECTED RANGE OF TOTAL SOIL MOVEMENTS (mm)	ASSUMED DIFFERENTIAL MOVEMENT (% OF TOTAL)	SITE CLASS
Rock (excluding mud rocks which exhibit swelling to some depth)	STABLE	NEGLIGIBLE	-	R
Fine-grained soils with moderate to very high plasticity (clays, silty clays, clayey silts and sandy clays)	EXPANSIVE SOILS	< 7,5 7,5 – 15 15 – 30 > 30	50% 50% 50% 50%	H H1 H2 H3
Silty sands, sands, sandy and gravelly soils	COMPRESSIBLE AND POTENTIALLY COLLAPSIBLE SOILS	< 5,0 5,0 – 10 > 10	75% 75% 75%	C C1 C2
Fine-grained soils (clayey silts and clayey sands of low plasticity), sands, sandy and gravelly soils	COMPRESSIBLE SOIL	< 10 10 – 20 > 20	50% 50% 50%	S S1 S2
Contaminated soils Controlled fill Dolomitic areas Land fill Marshy areas Mine waste fill Mining subsidence Reclaimed areas Very soft silt/silty clays Uncontrolled fill	VARIABLE	VARIABLE		P

NOTES:

1. The classifications C, H, R and S are not intended for dolomitic area sites unless specific investigations are carried out to assess the stability (risk of sinkholes and doline formation) of the dolomites. Where this risk is found to be acceptable, the site shall be designated as Class P (dolomitic areas).
2. Site classes are based on the assumption that differential movements, experienced by single-storey residential buildings, expressed as a percentage of the total movements are equal to about 50% for soils that exhibit expansive or compressive characteristics and 75% for soils that exhibit both compressible and collapse characteristics. Where this assumption is incorrect or inappropriate, the total soil movements must be adjusted so that the resultant different movements implied by the table is equal to that which is expected in the field.
3. In some instances, it may be more appropriate to use a composite description to describe a site mote fully e.g. C1/H2 or S1 and/or H2. Composite Site Classes may lead to higher differential movements and result in design solutions appropriate to a higher range of differential movement e.g. a Class R/C1 site. Alternatively, a further site investigation may be necessary since the final design solution may depend on the location of the building on a particular site.
4. Where it is not possible to provide a single site designation and a composite description is inappropriate, sites may be given multiple descriptions to indicate the range of possible conditions e.g. H-H1-H2 or C1-C2.
5. Soft silts and clays usually exhibit high consolidation and low bearing characteristics. Structures founded on these horizons may experience high settlements and such sites should be designated as being Class S1 or S2 as relevant and appropriate.
6. Sites containing contaminated soils include those associated with reclaimed mine land, land down-slope of mine tailings and old land fills.
7. Where a site is designated as Class P, full particulars relating to the founding conditions on the site must be provided.
8. Where sites are designated as being Class P, the reason for such classification shall be placed in brackets immediately after the suffix – i.e. P(contaminated soils). Under certain circumstances, composite description may be more appropriate – e.g. P(dolomite areas)-C1.
9. Certain fills may contain contaminates which present a health risk. The nature of such fill should be evaluated and should be clearly demarcated as such.

Table 6. **FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES FOR SINGLE-STOREY RESIDENTIAL BUILDINGS FOUNDED ON HORIZONS SUBJECT TO BOTH CONSOLIDATION AND COLLAPSE SETTLEMENT** (SAICE, 1995)

SITE CLASS	ESTIMATED TOTAL SETTLEMENT (mm)	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES
C	<5	Normal	- Normal construction (strip footing or slab-on-the-ground foundations) - Good site drainage
C1	5 – 10	Modified normal	- Reinforced strip footings - Articulation joints at some internal and all external doors - Light reinforcement in masonry - Site drainage and service/plumbing precautions - Foundation pressure not to exceed 50 kPa
		Compaction of in situ soils below individual footings	- Remove in situ material below foundations to a depth and width of 1,5 times the foundation width or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip foundations and light reinforcement in masonry.
		Deep strip foundations	- Normal construction with drainage requirements. - Founding on a competent horizon below the problem horizon
		Soil raft	- Remove in situ material to 1,0m beyond perimeter of building to a depth and width of 1,5 times the widest foundation or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip footings and light reinforcement in masonry.
C2	>10	Stiffened strip footings, stiffened or cellular raft	- Stiffened strip footing or stiffened or cellular raft with articulation joints or solid lightly reinforced masonry. - Bearing pressure not to exceed 50kPa. - Fabric reinforcement in floor slabs. - Site drainage and service/plumbing precautions.
		Deep strip foundations	- As for C1 but with fabric reinforcement in floor slabs
		Compaction of in situ soils below individual footings	- As for C1.
		Piled or pier foundations	- Reinforced concrete ground beams or solid slabs on piled or pier foundations. - Ground slabs with fabric reinforcement. - Good site drainage.
		Soil raft	- As for C1.

NOTES:

1. Differential settlement assumed to equal 75% of total settlement
2. The relaxation of some of these requirements, e.g. the reduction or omission of steel or articulation joints, may result in a Category 2 level of expected damage.

Table 7. FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES FOR SINGLE-STOREY RESIDENTIAL BUILDINGS FOUNDED ON HORIZONS SUBJECT TO CONSOLIDATION SETTLEMENT (SAICE, 1995)

SITE CLASS	ESTIMATED TOTAL SETTLEMENT (mm)	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES
S	10	Normal	- Normal construction (strip footing or slab-on-the-ground foundations) - Good site drainage
S1	10-20	Modified normal	- Reinforced strip footings - Articulation joints at some internal and all external doors - Light reinforcement in masonry - Site drainage and service/plumbing precautions - Foundation pressure not to exceed 50 kPa
		Compaction of in situ soils below individual footings	- Remove in situ material below foundations to a depth and width of 1,5 times the foundation width or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip foundations and light reinforcement in masonry.
		Deep strip foundations	- Normal construction with drainage requirements. - Founding on a competent horizon below the problem horizon
		Soil raft	- Remove in situ material to 1,0m beyond perimeter of building to a depth and width of 1,5 times the widest foundation or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip footings and light reinforcement in masonry.
S2	>20	Stiffened strip footings, stiffened or cellular raft	- Stiffened strip footing or stiffened or cellular raft with articulation joints or solid lightly reinforced masonry. - Bearing pressure not to exceed 50kPa. - Fabric reinforcement in floor slabs. - Site drainage and service/plumbing precautions.
		Deep strip foundations	- As for S1 but with fabric reinforcement in floor slabs
		Compaction of in-situ soils below individual footings	- As for S1.
		Piled or pier foundations	- Reinforced concrete ground beams or solid slabs on piled or pier foundations. - Ground slabs with fabric reinforcement. - Good site drainage.
		Soil raft	- As for S1.

NOTES:

1. Differential settlement assumed to equal 50% of total settlement.
2. The relaxation of some of these requirements, e.g. the reduction or omission of steel or articulation joints, may result in a Category 2 level of expected damage.
3. Account must be taken on sloping site since differential fill heights may lead to greater differential settlements.
4. Settlements induced by loads imposed by deep filling beneath surface beds may necessitate the
5. adoption of a construction type appropriate to a more severe site class.

Table 8. **FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES FOR SINGLE-STOREY RESIDENTIAL BUILDINGS FOUNDED ON EXPANSIVE SOIL** (SAICE, 1995)

SITE CLASS	ESTIMATED TOTAL SETTLEMENT (mm)	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES
H	<7,5	Normal	- Normal construction (strip footing or slab-on-the-ground foundations) - Site drainage and service/plumbing precautions recommended
H1	7,5 – 15	Modified normal	- Reinforced strip footings - Articulation joints at all internal/external doors and openings - Light reinforcement in masonry - Site drainage and service/plumbing precautions
		Soil raft	- Remove all or part of expansive horizon to 1,0 m beyond the perimeter of the structure and replace with inert backfill, compacted to 93% MOD AASHTO density at –1% to +2% of optimum moisture content. - Normal construction with lightly reinforced strip footings and light reinforcement in masonry if residual movements are 7,5mm, or construction type appropriate to residual movements. - Site drainage and service/plumbing precautions.
H2	15 – 30	Stiffened or cellular raft	- Stiffened or cellular raft with articulation joints or lightly reinforced masonry. - Site drainage and service/plumbing precautions.
		Piled construction	- Piled foundations with suspended floor slabs with or without ground beams. - Site drainage and service/plumbing precautions.
		Split construction	- Combination of reinforced brickwork/block work and full movement joints. - Suspended floors of fabric-reinforced ground slabs acting independently from structure. - Site drainage and service/plumbing precautions.
		Soil raft	- As for H1.
H3	> 30	Stiffened or cellular raft	- As for H2
		Piled construction	- As for H2
		Soil raft	- As for H1

NOTES:

1. Differential heave assumed to equal 50% of total heave.
2. The relaxation of some of these requirements, e.g. the reduction or omission of steel or articulation joints, may result in a Category 2 level of expected damage.

APPENDIX B: SOIL PROFILES

J LOUIS VAN ROOY
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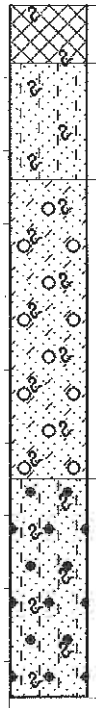
Engineering Geologist

Century Property
Ptn 185 Diepsloot 388-JR

HOLE No: TP01
Sheet 1 of 1

JOB NUMBER: 1040

Scale 1:10



0.00 Dry light brown medium dense intact silty gravelly SAND matrix with abundant coarse granite and quartz gravel, cobbles and concrete fragments. FILL. roots.

0.08 Slightly moist dark brown medium dense **slightly pinholed** silty fine SAND. Residual granite. Roots.

0.24 Slightly moist greyish brown mottled orange medium dense **pinholed** clayey gravelly fine SAND with Fe & Mn nodules. SLightly ferruginized reworked residual granite. roots.

0.65 Moist light grey with orange & grey patches dense **pinholed** silty fine to coarse SAND with Fe & Mn concretions. Honeycomb ferricrete. Few roots.

0.95

NOTES

1) Gradual refusal.

2) No seepage.

3) No sample.

4) No sidewall collapse.

CONTRACTOR : Paul Heslop Plant Hire
MACHINE : BELL 315 SG
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 16/11/2010
DATE : 16/12/10 17:43
TEXT : ..C:\DOT5000\1040DP.TXT

ELEVATION : 1384m
X-COORD : S25 58.119
Y-COORD : E28 01.038

HOLE No: TP01

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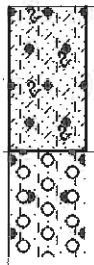
Century Property
Ptn 185 Diepsloot 388-JR

HOLE No: TP02
Sheet 1 of 1

JOB NUMBER: 1040

Scale 1:10



0.00 Dry light yellowish brown loose intact clayey silty fine SAND with coarse ferricrete and quartz gravel. Colluvium. Roots.

0.20 Dry orange mottled black & red dense **pinholed** silty sandy coarse GRAVEL with Fe & Mn concretions. Honeycomb ferricrete.

NOTES

1) Refusal.

2) No seepage.

3) No sample.

CONTRACTOR : Paul Heslop Plant Hire
MACHINE : BELL 315 SG
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 16/11/2010
DATE : 16/12/10 17:43
TEXT : ..C:\DOT5000\1040DP.TXT

ELEVATION : 1406m
X-COORD : S25 58.077
Y-COORD : E28 01.000

HOLE No: TP02

J LOUIS VAN ROOY
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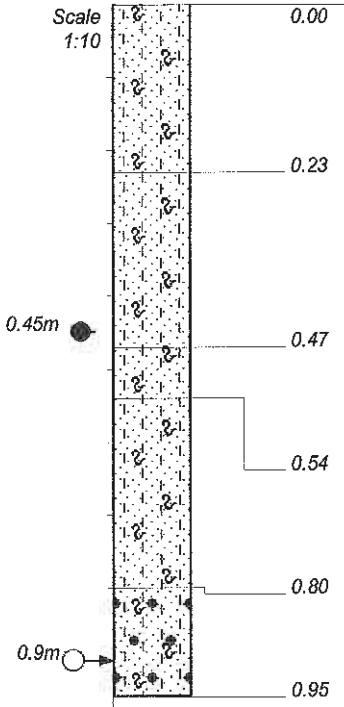
Engineering Geologist

Century Property
Ptn 185 Diepsloot 388-JR

HOLE No: TP03
Sheet 1 of 1

JOB NUMBER: 1040



0.00	Moist black loose intact silty fine SAND. Colluvium. Abundant roots.
0.23	Slightly moist dark brown medium dense **slightly pinholed** silty fine SAND. Colluvium? Roots.
0.47	Slightly moist dark brown medium dense **slightly pinholed** silty fine SAND with abundant medium and coarse quartz gravel. Pebble Marker? Roots.
0.54	Slightly moist dark brown loose **slightly pinholed** silty fine SAND with abundant medium and coarse quartz gravel and abundant Fe and Mn concretions. Residual granite. Roots.
0.80	Moist light grey with orange & grey patches dense **pinholed** silty fine to coarse SAND with Fe & Mn concretions. Honeycomb ferricrete. Few roots.
0.95	

NOTES

1) Refusal.

2) Slow water seepage from 0,9m.

3) Disturbed sample at 0.45m.

4) No sidewall collapse.

CONTRACTOR : Paul Heslop Plant Hire
MACHINE : BELL 315 SG
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 16/11/2010
DATE : 16/12/10 17:43
TEXT : ..C:\DOT5000\1040DP.TXT

ELEVATION : 1416m
X-COORD : S25 58.131
Y-COORD : E28 00.960

HOLE No: TP03

D04E J.Louis van Rooy

dot.PLOT 5005 J&W

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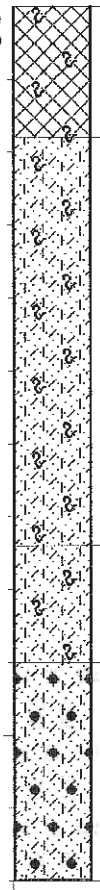
Century Property
Ptn 185 Diepsloot 388-JR

HOLE No: TP04
Sheet 1 of 1

JOB NUMBER: 1040

Scale 1:10



0.00 Dry black loose intact silty gravelly SAND with medium and coarse angular quartz gravel and building rubble. FILL. Roots.

0.18 Slightly moist light brown medium dense **pinholed** clayey silty fine to medium SAND. Colluvium. Roots.

0.74 Slightly moist light brown loose **pinholed** clayey silty fine to medium SAND with abundant medium and coarse angular quartz gravel. Pebble Marker. roots.

0.90 Moist orange mottled red medium dense **pinholed** clayey silty fine and medium SAND with scattered Fe & Mn nodules. Ferruginized reworked residual granite.

1.20

NOTES

1) Hole stopped.

2) No seepage.

3) No sample.

CONTRACTOR : Paul Heslop Plant Hire
MACHINE : BELL 315 SG
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 16/11/2010
DATE : 16/12/10 17:43
TEXT : ..C:\DOT5000\1040DP.TXT

ELEVATION : 1417m
X-COORD : S25 58.074
Y-COORD : E28 00.850

HOLE No: TP04

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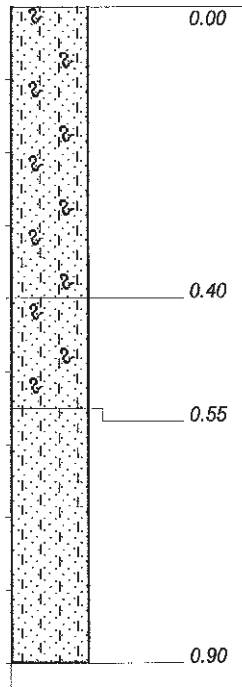
Ptn 185 Diepsloot 388-JR

HOLE No: TP05
Sheet 1 of 1

JOB NUMBER: 1040



Dry light greyish brown loose **slightly pinholed** silty fine to coarse SAND. Colluvium. Roots.

Dry greyish white with scattered orange mottled medium dense **pinholed** silty medium to coarse SAND with coarse angular translucent quartz gravel. Residual granite. Roots.

Dry greyish white with orange patches dense **pinholed** silty medium and coarse SAND. Residual granite.

NOTES

1) Gradual refusal.

2) No seepage.

3) Disturbed sample at 0.4m.

CONTRACTOR : Paul Heslop Plant Hire
MACHINE : BELL 315 SG
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 16/11/2010
DATE : 16/12/10 17:43
TEXT : ..C:\DOT5000\1040DP.TXT

ELEVATION : 1408m
X-COORD : S25 58.053
Y-COORD : E28 01.042

HOLE No: TP05

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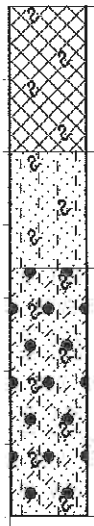
Century Property
Ptn 185 Diepsloot 388-JR

HOLE No: TP06
Sheet 1 of 1

JOB NUMBER: 1040

Scale 1:10



0.00 Dry light yellow loose intact sandstone waste layer. FILL. Roots.

0.20 Moist greyish brown medium dense **pinholed** silty fine and medium SAND with medium quartz gravel. Colluvium. Roots.

0.36 Moist greyish brown mottled orange, red & black dense **pinholed** clayey silty medium to coarse SAND with Fe & Mn nodules and concretions. Honeycomb ferricrete. Roots.

0.70

NOTES

1) Refusal.

2) No seepage.

3) No sample.

CONTRACTOR : Paul Heslop Plant Hire
MACHINE : BELL 315 SG
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 16/11/2010
DATE : 16/12/10 17:43
TEXT : ..C:\DOT5000\1040DP.TXT

ELEVATION : 1403m
X-COORD : S25 57.999
Y-COORD : E28 01.053

HOLE No: TP06

J LOUIS VAN ROOY
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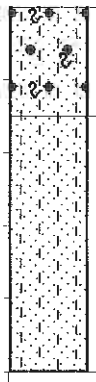
Engineering Geologist

Century Property
Ptn 185 Diepsloot 388-JR

HOLE No: TP07
Sheet 1 of 1

JOB NUMBER: 1040

Scale 1:10



0.00

Dry dark greyish brown loose intact silty fine and medium SAND matrix with abundant medium to coarse angular translucent quartz and weathered granite gravel and Fe & Mn nodules. Colluvium. Roots.

0.15

Dry greyish white with grey & orange patches medium dense to dense **pinholed** silty fine and medium SAND. Ferruginized residual leached granite.

0.50

NOTES

1) Refusal.

2) No seepage.

3) No sample.

CONTRACTOR : Paul Heslop Plant Hire
MACHINE : BELL 315 SG
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 16/11/2010
DATE : 16/12/10 17:43
TEXT : ..C:\DOT5000\1040DP.TXT

ELEVATION : 1399m
X-COORD : S25 57.944
Y-COORD : E28 01.075

HOLE No: TP07

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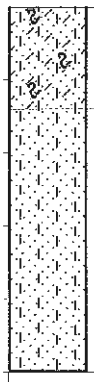
Engineering Geologist

Century Property
Ptn 185 Diepsloot 388-JR

HOLE No: TP08
Sheet 1 of 1

JOB NUMBER: 1040

Scale 1:10



0.00 Dry dark grey loose intact clayey silty fine and medium SAND. Colluvium. Roots.

0.14 Dry greyish white with grey & orange patches medium dense to dense **pinholed** silty fine and medium SAND. Ferruginized residual leached granite.

0.50

NOTES

1) Refusal.

2) No seepage.

3) No sample.

CONTRACTOR : Paul Heslop Plant Hire
MACHINE : BELL 315 SG
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 16/11/2010
DATE : 16/12/10 17:43
TEXT : ..C:\DOT5000\1040DP.TXT

ELEVATION : 1402m
X-COORD : S25 57.977
Y-COORD : E28 01.004

HOLE No: TP08

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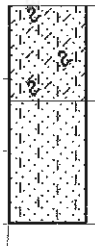
Engineering Geologist

Century Property
Ptn 185 Diepsloot 388-JR

HOLE No: TP09
Sheet 1 of 1

JOB NUMBER: 1040

Scale 1:10



0.00 Dry dark grey loose intact clayey silty fine and medium SAND. Colluvium. Abundant roots.

0.13 Dry greyish white with grey & orange patches medium dense to dense **pinholed** silty fine and medium SAND. Ferruginized residual leached granite.

0.30

NOTES

1) Refusal.

2) No seepage.

3) No sample.

CONTRACTOR : Paul Heslop Plant Hire
MACHINE : BELL 315 SG
DRILLED BY :
PROFILED BY : JL van Rooy

TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 16/11/2010

DATE : 16/12/10 17:43
TEXT : ..C:\DOT5000\1040DP.TXT

ELEVATION : 1402m
X-COORD : S25 57.939
Y-COORD : E28 00.942

HOLE No: TP09

J LOUIS VAN ROOY
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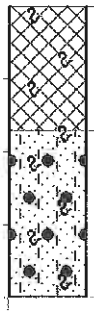
Engineering Geologist

Century Property
Ptn 185 Diepsloot 388-JR

HOLE No: TP10
Sheet 1 of 1

JOB NUMBER: 1040

Scale 1:10



0.00 Dry dark grey loose intact ash clinker. FILL. Abundant roots.

0.17 Dry light brown mottled orange & yellow dense **pinholed** silty fine to coarse SAND with Fe & Mn concretions. Honeycomb ferricrete. Few roots.

0.40

NOTES

1) Refusal.

2) No seepage.

3) No sample.

CONTRACTOR : Paul Heslop Plant Hire
MACHINE : BELL 315 SG
DRILLED BY :
PROFILED BY : JL van Rooy
TYPE SET BY :
SETUP FILE : LOUIS.SET

INCLINATION :
DIAM :
DATE :
DATE : 16/11/2010
DATE : 16/12/10 17:43
TEXT : ..C:\DOT5000\1040DP.TXT

ELEVATION : 1408m
X-COORD : S25 58.001
Y-COORD : E28 00.908

HOLE No: TP10

APPENDIX C: SOIL PROFILE PHOTOGRAPHS

Soil profile TP01

Soil Profile TP02

Soil profile TP03

Soil profile TP04

Soil profile TP05

Soil Profile TP06

Soil profile TP07

Soil profile TP08

Soil profile TP09

Soil Profile TP10

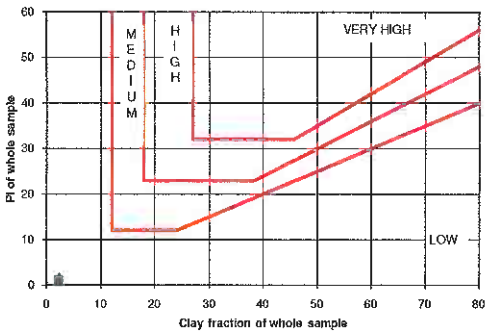
APPENDIX D: LABORATORY TEST RESULTS

PARTICLE SIZE ANALYSIS

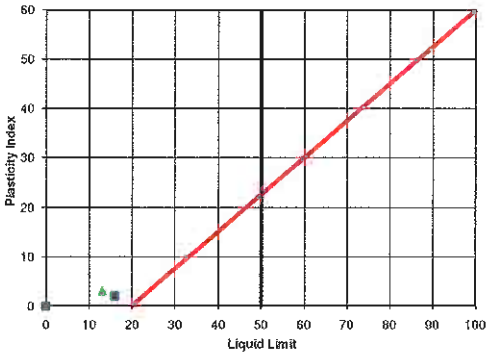
Sample No.	46960	46961
Soillab sample no.	S10-1297-01	S10-1297-02
Depth (m)	0.45	0.4
Position	TP3	TP5
Material Description	DARK GREY QUARTZ GRAVELLY SAND	LIGHT OLIVE FERRICRETE SILTY SAND
Moisture (%)		
SG		
SCREEN ANALYSIS (% PASSING) (TMH 1 A1(a) & A5)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	100
4.75 mm	92	97
2.00 mm	83	92
0.425 mm	56	58
0.075 mm	19	25
HYDROMETER ANALYSIS (% PASSING) (TMH 1 A6) *		
0.040 mm	13	17
0.027 mm	11	14
0.013 mm	7	10
0.005 mm	4	9
0.002 mm	2	2
% Clay	2	2
% Silt	14	19
% Sand	66	70
% Gravel	17	8
ATTERBERG LIMITS (TMH 1 A2 - A4)		
Liquid Limit	16	13
Plasticity Index	2	3
Linear Shrinkage (%)	1.0	0.5
Grading Modulus	1.42	1.25
Classification	A-2-4 (0)	A-2-4 (0)
Unified Classification	SM	SM
Chart Reference		

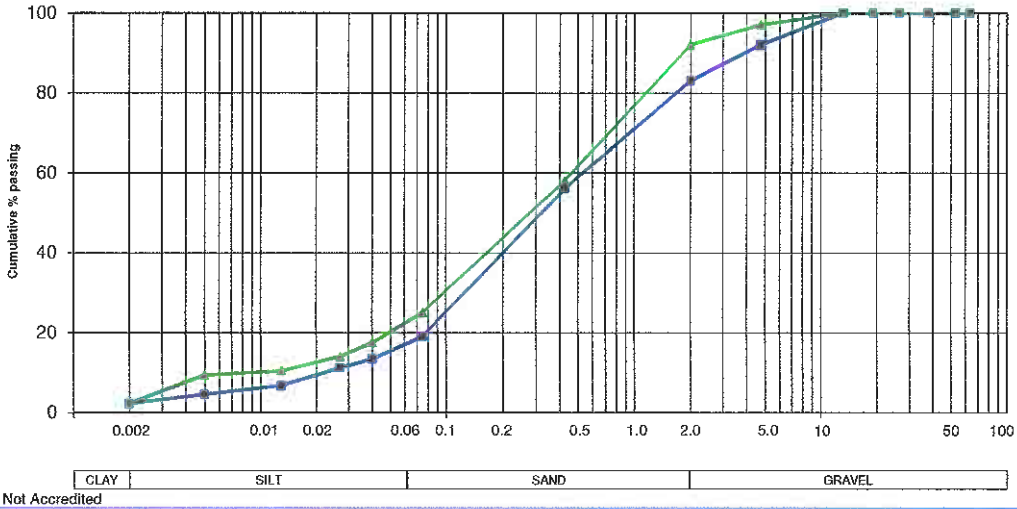
PROJECT : DIEPSLOOT 185
JOB No. : S10-1297
DATE : 2010-11-22

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





* Not Accredited

SOILLAB (PTY) LTD
Reg No 1971/000112/07
230 Albertus Street
La Montagne 0184
Tel (012) 481-3999
P O Box 72928
Lynnwood Ridge 0040
Fax (012) 481-3812

CLIENT : LOUIS VAN ROOY

PROJECT : DIEPSLOOT 185

PROJECT NO. : S10-1297

DATE : 2010-11-25

pH & CONDUCTIVITY - TMH 1 A20 & A21T

Soillab No	Sample Position	Sample Depth (m)	pH	Electrical Conductivity S/m
S10-1297-01	TP3	0.45	8.10	0.0227

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La Montagne 0184
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