REPORT ON A PHASE I GEOTECHNICAL INVESTIGATION FOR THE PROPOSED "SOUTH HILLS" TOWNSHIP ESTABLISHMENT SITUATED ON PORTION 65 OF THE FARM KLIPRIVIERSBERG 106 IR, GAUTENG PROVINCE

Phase I Geotechnical Investigation

30 September 2009

POSTNET SUITE #8
PRIVATE BAG X9676
POLOKWANE
0700
TEL: (015) 296-1560

2 RHODESDRIFT STREET
HAMPTON COURT
POLOKWANE
0699
FAX: (015) 296-4158
ENQUIRIES: DH Wessels Pr.Sci.Nat.

REPORT ON A PHASE I GEOTECHNICAL INVESTIGATION FOR THE PROPOSED "SOUTH HILLS" TOWNSHIP ESTABLISHMENT SITUATED ON PORTION 65 OF THE FARM KLIPRIVIERSBERG 106 IR, GAUTENG PROVINCE

Phase I Geotechnical Investigation

WF09071 – SOUTH HILLS

COMPILED BY

WSM LESHIKA CONSULTING (PTY) LTD

P.O.Box 39942
MORELETA PARK
PRETORIA
0044
TEL: (012) 997-6760

623 RUBENSTEIN STREET
MORELETA PARK
PRETORIA
0044
FAX: (012) 997-6768

CONTACT PERSON : DH Wessels Pr.Sci.Nat.

REPORT ON A PHASE I GEOTECHNICAL INVESTIGATION FOR THE PROPOSED "SOUTH HILLS" TOWNSHIP ESTABLISHMENT SITUATED ON PORTION 65 OF THE FARM KLIPRIVIERSBERG 106 IR, GAUTENG PROVINCE

Page

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

PHASE I GEOTECHNICAL PROGRESS REPORT FOR THE PROPOSED "SOUTH HILLS" TOWNSHIP ESTABLISHMENT SITUATED ON PORTION 65 OF THE FARM KLIPRIVIERSBERG 106 IR, GAUTENG PROVINCE

1. INTRODUCTION AND TERMS OF REFERENCE

WSM Leshika Consulting (Pty) Ltd was appointed to conduct a Phase I Engineering Geological Investigation for the proposed "South Hills" Township Development comprising of Erf 1202 South Hills, Holding 88, Klipriviersberg Estate situated on Portion 65 of the farm Klipriviersberg 106 IR, Gauteng Province.

The aim of the investigation is to identify the underlying geological formation and to address the possible geological constraints.

The fieldwork, entailing a site walkover, trial pitting and profile descriptions, was conducted on during August 2009. This report describes the methodology of the investigation and the expected geotechnical constraints with the necessary precautionary measures and recommendations.

2. OBJECTIVE OF THE DIFFERENT GEOTECHNICAL INVESTIGATIONS

Three types of geotechnical investigations are generally conducted for housing developments namely:

- Preliminary Geotechnical Site Investigation,
- Phase I Geotechnical Site Investigation and a
- Phase II Geotechnical Site Investigation.

This investigation is a **Phase I Geotechnical Investigation**.

According to the Generic Specification GFSH-2 (September 2002) "Geotechnical Site Investigations for Housing Developments" the objectives of the different investigations are as follows:

The objective of the **Preliminary Geotechnical Site Investigation** is to make an initial determination for an Identified Land Parcel as to whether or not such land is:

a) Fit for human settlements: and
b) Suitable for project linked subsidy housing development.

Note: *The preliminary Geotechnical Site Investigation is incorporated in the project descriptions that form part of the submission to a Provincial Government for the conditional approval of housing subsidies against the selected parcel of land.*

The objective of the **Phase I Geotechnical Site Investigation** is, with respect to the identified parcel of land for which a Provincial Government has granted conditional approval of housing subsidies, to:

a) Identify any potential geotechnical Hazards;
b) Define the ground conditions and provide Site Classifications including detailed soil profile and groundwater occurrences within the zone of influence of foundation work;
c) Determine the suitability of Dolomitic Land for subsidy housing developments;
d) Provide the geotechnical basis for safe and appropriate land use planning, infrastructure design, housing unit design, and the formulation of precautionary measures and risk management procedures;
e) Broadly classify the land which is to be developed for subsidy housing in terms of the Council's residential Site Class designations;
f) Designate Dolomitic Land in accordance with the Council's dolomitic area designations and to obtain the Council's in principle acceptance of such designations;
g) Gather certain Factual Data which has a bearing on the determination of housing subsidy variations and the installation of township services; and
h) Obtain necessary information for the Council's in principle approval for the enrolment of the project in terms of the Housing Consumers Protection Measures Act (Act 95 of 1998).

Note: *The Phase I Geotechnical Site Investigation is undertaken after a Provincial Government has granted conditional approval of housing subsidies. The Report of the Phase I Geotechnical Investigation forms part of the feasibility study report which is required for the confirmation of housing subsidies.*

The objective of the **Phase II Geotechnical Site Investigation** is, with respect to the identified parcel of land for which a Provincial Government has confirmed housing subsidies, to:

a) Confirm and refine the residential Site Class designations in respect of each erf so that the necessary documentation required for the enrolment of individual houses with the Council can take place; and
b) Confirm and refine, in sites with D2 and D3 dolomitic area designations, that the mandatory precautions have been observed.

Note: *Work associated with Phase II can only be undertaken once the erven have been pegged. This phase of the Geotechnical Site Investigation must be co-ordinated with the installation of township services. The Phase II investigation in Dolomitic Areas is essentially a risk management and verification process.*

The sections regarding areas underlain by dolomitic land are not of concern for the investigated area as the site is not underlain by dolomitic rock with the potential for sinkhole and/or doline formation.

3. AVAILABLE INFORMATION

The following information was available at the time of the investigation:

- 1:250 000-scale 26728 EAST RAND Geological Sheet;
- 1:50 000-scale 2628 AA and 2628 AC Topographical Sheets;
- Site locality map;
- Contour map;
- Google satellite image.

No preliminary or urban planning geotechnical investigation was available at the time of writing this report.

4. SITE DESCRIPTION

4.1 Location and size

The site is situated between South Rand Road and Southern Klipriviersberg Road forming the southern and northern boundaries of the site and between East Road and Nephin Road forming the western and eastern boundaries respectively. The site investigated area is situated between Booysens and Alberton, south of Johannesburg, Gauteng Province.

The centre site coordinates is as follows (Datum: WGS84):
Latitude: -26.251244°
Longitude: 28.077669°

The site locality is depicted in Figure 1 and Figure 2, Appendix A.

The investigated area comprise of a total surface area of roughly 265 hectares.

4.2 Topography, Drainage, Vegetation and Installed Services

The site is situated between approximately 1 780 m and 1 677 m above sea level. The general slope direction is towards the north with an elevation difference of 103 m between the upper southern and lower northern portions of the site.

An existing south to north draining river cuts through the centre portion of the site. The western half of the site is thus sloping towards the northeast and the eastern half of the site towards the northwest towards the existing river. Surface water will naturally flow perpendicular to the contours in the direction of the drainage channels and river.

The detailed topography can be viewed on the contour map attached as Figure 3, Appendix A. A 3 dimensional perspective view of the site is attached as Figure 4, Appendix A with slope direction vectors depicted in Figure 5, Appendix A indicating the expected direction of surface water flow.

The site is currently not serviced with the usual municipal services. The surrounding area is developed and fully serviced. The services are discussed in detail in the available services report.

5. METHOD OF INVESTIGATION

The fieldwork, entailing a site walkover survey, surface mapping, excavation of test pits, soil profile logging and selected sampling was conducted in August 2009.

Twenty-eight test pits were excavated in the accessible parts of the site in order to identify the areas covered with relatively thick fill, transported or residual horizons. The test pits were excavated by means of a CASE 580 TLB (backhoe).

Shallow rock and/or outcrop were generally encountered in the remainder portions not investigated by test pits.

A suitably qualified and registered Engineering Geologist positioned the test pits, supervised the excavation of the pits, inspected the test pits and recorded the soil profiles using the standard procedures as recommended by SAIEG (1997).

A number of disturbed soil samples were selectively retrieved from representative soil layers and submitted to Soillab Pty. Ltd. for testing. Foundation indicator tests were performed on these samples to determine the particle size distribution and plasticity of the soil. The materials were tested for foundation purposes and therefore the grading was carried out to 0,002 mm. The pH and conductivity of the soil paste from selective soil samples were also measured to determine the corrosiveness of the soils. Compaction tests were also performed on selected samples.

6. GEOLOGY

6.1 General Geology

According to the 1:250 000-scale geological sheet, the site is mainly underlain by (Rt) quartzite, conglomerate and sandy shale of the Turffontein Formation, Central Rand Group, Witwatersrand Supergroup. The geology is depicted in Figure 6, Appendix A.

Conglomerate was encountered in the southern portion of the investigated area with quartzite in the centre to northern portions.

The site is not underlain by dolomite and/or chert and a dolomite stability investigation is therefore not required.

According to the geological map and accompanied explanation no specific mineral deposits are present on or in close proximity of the site.

Economic silver and gold deposits are indicated towards the north-east of the investigated areas and are indicated on Figure 6, Appendix A.

6.2 Soil Profile

The soil profile was investigated by the excavation and inspection of twenty-eight test pits. The positions of the test pits are indicated on Figure 7, Appendix A. The general soil profile is very briefly discussed below with a summary in Table 1. The detailed soil profile descriptions are attached in Appendix B with photographs of the corresponding soil profiles attached in Appendix C.

Rock outcrop is evident throughout the majority of the site. The areas where no rock outcrops are visible are generally covered with very thin topsoil, hillwash or pebble marker horizon underlain by a thin reworked residual horizon. The upper transported and reworked residuum was generally encountered down to less than 1 m below ground level from where very soft to hard rock quartzite and conglomerate were encountered.

The consistencies of the transported and highly reworked residual horizons were generally described as loose to medium dense with an open soil structure. The topsoil and reworked residuum consist mainly of sand originated from the weathering of the quarzites and finer portion of the conglomerates. The typical pebble marker and/or hillwash horizon mainly consist of abundant sub rounded to rounded quartz gravel and pebbles originated from the weathering of the conglomerate horizons with a sandy matrix.

TABLE 1 : ENCOUNTERED DEPTHS OF DIFFERENT SOIL HORIZONS (meters)

Test pit	Topsoil	Fill	Pebble marker or Hillwash	Residuum	Very soft to hard rock Quartzite or conglomerate	Depth of hole	Excavatability conditions in bottom of hole	Water encountered	Site Class designation
TP01	0.40-0.50	0.10-0.40	-	-	0.50-0.60	0.60	TLB refusal	None	S-R/3F 2E
TP02	-	0-0.60	0.60-1.00	1.00-2.40	-	2.40	Soft excavation	None	P(fill)-S2/3D 2ABE
TP03	-	0-1.30	-	-	1.30-1.40	1.40	TLB refusal	None	P(fill)-S2/3D 2ABEF
TP04	-	0-2.00	-	-	-	2.00	Soft excavation	None	P(fill)-S2/3D 2ABE
TP05	0-0.25	-	-	-	0.25-0.35	0.35	TLB refusal	None	R/3F 2E
TP06	-	0-1.60	-	-	1.60-1.70	1.70	TLB refusal	None	P(fill)-S2/3D 2ABE
TP07	-	0-0.80	-	-	0.80-0.90	0.90	TLB refusal	None	P(fill)-S2/2ABDEF
TP08	-	0-1.30	-	-	1.30-1.40	1.40	TLB refusal	None	P(fill)-S2/3D 2ABEF
TP09	0-0.20	-	Rew→	0.20-0.45	0.45-0.50	0.50	TLB refusal	None	R/3F 2E
TP10	0-0.10	-	Rew→	0.10-0.40	0.40-0.50	0.50	TLB refusal	None	R/3F 2E
TP11	0-0.10	-	Rew→	0.10-0.25	0.25-0.35	0.35	TLB refusal	None	R/3F 2E
TP12	0-0.10	-	Rew→	0.10-0.15	0.15-0.20	0.20	TLB refusal	None	R/3F 2E
TP13	0-0.05	-	Rew→	0.05-0.10	0.10-0.15	0.15	TLB refusal	None	R/3F 2E
TP14	-	0-3.00	-	-	-	3.00	Soft excavation	None	P(fill)-S2/3D 2E
TP15	-	0-3.00	-	-	-	3.00	Soft excavation	None	P(fill)-S2/3D 2E
TP16	-	0-0.70	Rew→	0.70-1.50	1.50-1.60	1.60	TLB refusal	None	P(fill)-S2/2BDE
TP17	0-0.20	-	0.20-0.85	0.85-1.35	1.35-1.40	1.40	TLB refusal	None	P(fill)-S2-S1/2BDE
TP18	-	0-0.45	0.45-1.05	1.05-1.25	1.25-1.30	1.30	TLB refusal	None	S2-S1/2BDEF
TP19	0-0.20	-	0.20-0.65	0.65-0.75	0.75-0.85	0.85	TLB refusal	None	S1-S-R/3F 2BDEF

Test pit	Topsoil	Fill	Pebble marker or Hillwash	Residuum	Very soft to hard rock Quartzite or conglomerate	Depth of hole	Excavatability conditions in bottom of hole	Water encountered	Site Class designation
TP20	0-0.20	-	0.20-0.70	0.70-1.00	1.00-1.20	1.20	TLB refusal	None	S1-S-R/2BDEF
TP21	0-0.10	-	0.10-0.60	0.60-0.90	0.90-0.95	0.95	TLB refusal	None	S1-S-R/2BDEF
TP22	0-0.10	-	0.10-0.25	0.25-0.35	0.35-0.45	0.45	TLB refusal	None	R/3F 2BE
TP23	0-0.10	-	0.10-0.25	0.25-0.35	0.35-0.45	0.45	TLB refusal	None	R/3F 2BE
TP24	-	0-1.70	1.70-2.00	-	2.00-2.30	2.30	Gradual refusal	None	P(fill)-S2/3D 2BE
TP25	0-0.15	-	0.15-0.45	0.45-0.60	0.60-0.70	0.70	TLB refusal	None	S-R/3F 2BE
TP26	0-0.10	-	0.10-0.25	0.25-0.60	0.60-0.70	0.70	TLB refusal	None	S-R/3F 2BE
TP27	0-0.10	-	0.10-0.25	-	0.25-0.35	0.35	TLB refusal	None	S-R/3F 2BE
TP28	0-0.30	-	0.30-2.00*	2.00-3.00	-	3.00	Soft excavation	None	P(flooding)-S2/3D 2ABE

***** - Sandy transported alluvial material; TLB refusal – Intermediate to hard excavation (SANS)

6.3 Shallow groundwater and/or saturated soil profile

No shallow groundwater or seepage water was encountered in any of the test pits excavated during August 2009.

Seasonal shallow seepage water (mainly on the contact between the upper transported and lower highly to unweathered rock) and saturated soil conditions is expected during and towards the end of the wet season, especially during and after heavy and/or continuous downpours. The slight ferruginisation (orange mottles and staining) is an indication of seasonal saturated conditions.

The natural expected flow direction of the shallow seepage water is depicted in Figure 5, Appendix A.

7. GEOTECHNICAL EVALUATION

The Geotechnical Evaluation is based on the visual observations, soil profile descriptions, field interpretations and laboratory test results.

7.1 General Engineering and Material Characteristics

The foundation indicator test results from the selectively retrieved samples are summarized in Table 2.

TABLE 2 : FOUNDATION INDICATOR TEST RESULTS

Test pit	Depth (m)	Description	Soil composition				Atterberg Limits		LS %	GM	Activity	AASHTO / Unified classification
			Clay %	Silt %	Sand %	Gravel %	LL %	PI %				
TP05	0-1.5	Reworked topsoil	0	15	48	37	--	NP	0.0	1.74	Low	A-1-b (0) / SC
TP16	0.7-1.5	Residual quartzite backfill	0	17	45	38	18	3	1.5	1.80	Low	A-1-b (0) / SM
TP25	0-0.15	Topsoil	0	28	68	4	22	4	2.0	1.07	Low	A-2-4 (0) / SC & SM
TP25	0.15-0.45	Pebble marker	0	6	24	69	18	4	1.5	2.42	Low	A-1-a (0) / GP & GC
TP25	0.45-0.60	Reworked residual to totally weathered quartzite	0	19	70	11	--	SP	0.5	1.40	Low	A-1-b (0) / SC
MOD (A) TP28	--	Alluvial sand	8	24	63	5	21	8	4.0	0.99	Low	A-4 (0) / SC
MOD (B)	--	Pebble marker	0	8	26	66	20	4	1.5	2.33	Low	A-1-a (0) / GW & GC
MOD (C)	--	Pebble marker	0	7	14	79	22	5	2.0	2.53	Low	A-1-a (0) / GP & GC

Rew – Reworked; Ferr – Ferruginised; Coll – Colluvium, PM – Pebble Marker; Undist – Undisturbed; LL – Liquid limit; PI – Plasticity index; LS – Linear shrinkage; GM – grading modulus; SP – slightly plastic

The test results on the soil samples indicate the following:

- The ***topsoil and reworked colluvium and residual material*** retrieved from test pits TP05, TP25 and TP28 generally grades as gravelly silty sand with a very low percentage of clay. The material is generally non-plastic to only slightly plastic, with a low linear shrinkage, low potential activity and a moderate grading modulus. The material generally classifies as "SC" and "SM" according to the Unified Soil Classification System which represents sandy materials.
- The ***pebble marker material*** retrieved from the various test pits generally grades as sandy gravel with a low percentage of silt and no clay. The material is generally non-plastic to only slightly plastic, with a low linear shrinkage, low potential activity and a high grading modulus. The material generally classifies as "GW", "GP" and "GC" according to the Unified Soil Classification System which represents gravelly material.

The general properties and characteristics for materials classifying as "GW", "GP", "GC", "SM" and "SC" are summarized in Table 11 to Table 14, Appendix F.

7.2 pH and Conductivity of the Soils

The pH and conductivity (mS/m^{-1}) of soil pastes of selective samples have been measured to determine the acidity and potential corrosiveness of the soils. The results are indicated in Table 3.

TABLE 3 : SOIL CONDUCTIVITY, PH AND CORROSIVENESS

Sample Position	Sample Depth (m)	pH	Electrical Conductivity of soil paste (mS/m)	Soil corrosiveness based on the electrical conductivity
TP05	0-1.5	5.53	12.7	Mildly corrosive
TP16	0.7-1.5	7.06	13.6	Mildly corrosive
TP25	0-0.15	4.81	20.9	Corrosive
TP25	0.15-0.45	4.38	11.9	Mildly corrosive
TP25	0.45-0.60	5.07	9.9	Not generally corrosive
MOD (A)	--	4.82	7.5	Not generally corrosive
MOD (B)	--	4.85	3.6	Not generally corrosive
MOD (C)	--	4.65	3.0	Not generally corrosive

The results indicate soils that are generally potentially mildly corrosive to ferrous metals. The results indicate that the alluvial sandy material and pebble marker material on which the compaction testing was conducted are not generally corrosive to ferrous metals. Although the results indicated that the soils are not highly corrosive to ferrous metals it will be good practice to apply the necessary corrosion protection for ferrous materials as some of the soils are potentially mildly corrosive to corrosive to ferrous metals. Alternatives such as plastic / PVC pipes rather that steel pipes can also be considered where practical.

7.3 Compaction Characteristics of the Soils

Compaction tests (Mod. AASHTO) were conducted on three of the disturbed samples retrieved from the sandy alluvial material and pebble marker horizons.

The test results are summarised in Table 4 (and Table 2 for foundation indicator results) with the laboratory results attached in Appendix D.

TABLE 4 : COMPACTION TEST RESULTS

TP no	Depth (m)	Material type	OMC (%)	MDD (kg/m^3)	Swell (%)	CBR at various compaction efforts					TRB / COLTO / Unified
						90 %	93 %	95 %	98 %	100 %	
MOD (A)	--	Silty sand	8.4	2 097	0.1	15	20	24	35	44	A-4 (0) / **G7** / SC
MOD (B)	--	Sandy gravel	6.5	2 154	0.0	16	25	35	51	66	A-1-a (0) / **G6** / GW&GC
MOD (C)	--	Sandy gravel	6.5	2 154	0.0	14	26	40	62	82	A-1-a (0) / **G6** / GP&GC

OMC = Optimum moisture content; MDD = Maximum dry density (Mod AASHTO); Swell = % Swell soaked at 100% Mod. AASHTO compaction; Coll = Colluvium; Ferr = Ferruginised

7.3.1 Sandy Alluvial Material

The results indicate that the sandy colluvial material have an optimum moisture content of 8,4 % and a maximum dry density of 2 097 kg/m^3. 0.1 % swell are expected (soaked at 100% Mod. AASHTO compaction effort). The CBR increases from 15 at 90% compaction effort to 24 and 44 at 95% and 100% compaction efforts which indicate good compaction characteristics.

The material has a Liquid Limit (LL) of 21, a Plasticity Index (PI) of 8, Linear Shrinkage (LS) of 4,0 and a Grading Modulus (GM) of 0,99. The foundation indicator testing predicts a low soil heave potential. The material grades as a gravelly (5 %), clayey (8 %), silty (24 %) sand (63 %).

This sandy alluvial material classify as **"G7"** according to the COLTO classification. Material classifying as **"G7"** is usually suitable for subgrade and selected layer in road construction. The material will not be suitable for construction of the upper road pavement.

The material classify as **"SC"** according to the Unified Soil Classification System. Materials classifying as **"SC"** are generally fair for use as subgrade material, poor for subbase material and not suitable for base material in road construction. These materials generally have "good" to "fair" compaction characteristics with a low compressibility when compacted.

7.3.2 Gravelly Pebble Marker Material

The results indicate that the gravelly pebble marker material have an optimum moisture content of 6,5 % and a maximum dry density of 2 154 kg/m^3. No swell are expected (soaked at 100% Mod. AASHTO compaction effort). The CBR increases from 14 and 16 at 90% compaction effort to 35 and 40 at 95% and 66 to 82 at 100% compaction efforts which indicate good compaction characteristics.

The materials have an average Liquid Limit (LL) of 21, a Plasticity Index (PI) of 4 to 5, Linear Shrinkage (LS) of 1,5 to 2,0 and a Grading Modulus (GM) of 2,33 to 2,53. The foundation indicator testing predicts a low soil heave potential. The material grades as silty (7 to 8 %), sandy (14 to 26 %) gravel (66 to 79 %) with no clay.

This gravel pebble marker horizon classify as **"G6"** according to the COLTO classification. Material classifying as **"G6"** is usually suitable for subgrade, selected layer and subbase in road construction.

The material classify as **"GW"**, **"GP"** and **"GC"** according to the Unified Soil Classification System. The general material properties and expected performance for use in road construction are summarized in Table 11 and Table 12, Appendix F.

7.4 Collapse potential

The upper sandy topsoil, colluvial and reworked sandy residual material is generally slightly open structured and pinholed with open root channels with localised termite activity. These horizons have a moderate to high collapse potential depending on the moisture content at time of construction.

The combined thickness of the potentially collapsible horizon is however generally relatively thin and are not considered a major concern for the proposed development. Thicker collapsible transported alluvial sandy material was encountered adjacent to the river towards the northern portion of the site. This material has a high collapse potential but are expected to be below the 1:100 year floodline and thus outside the developable area and not considered a major geotechnical constraint for the proposed development.

7.5 Settlement (Consolidation) Characteristics of the Soils

There are basically three components to settlement namely immediate settlement (also referred to as elastic settlement), primary consolidation settlement and secondary consolidation (also referred to as creep).

Immediate settlement takes place as a load is exerted on the soil mainly as a result of distortion of the soil. As poor water begins to flow out of the soil a time dependant decrease in volume occurs which is termed consolidation settlement. This settlement will continue until a conditions of constant effective stress is reached. This primary consolidation settlement takes place generally in fine grained materials (fairly high percentage of clay or silt). Secondary consolidation settlement is not considered a concern as this type of settlement usually occurs in soft organic clays where plastic flow within the soil mass results in displacement of the soil particles.

Only primary consolidation settlement are calculated for housing construction and this primary consolidation are not considered a major concern on this site as the soils generally contains low percentages of silt and very low percentages to no clay. Primary consolidation settlement is expected in the saturated alluvial sandy material adjacent to the river towards the northern portion of the site. This area is however expected to be outside the developable portion of the site.

Settlement/consolidation resulting in unwanted differential movement and damage to the proposed units will occur if founded on the low density fill areas as indicated on the zonation map.

Rehabilitation of these fill areas may include; complete removal of the fill; partially remove upper fill, compact and backfill with inert material (properly compacted in layers) together with foundation modifications.

7.6 Bearing capacity and potential differential movement

The upper transported and residual material originating from the weathering of the interlayered quartzite and conglomerate mainly consist of sand (originating from weathering of the quarzites) with varying amounts of gravel (originating from weathering of the conglomerate). The soils are non-cohesive as very low percentages of clay are present.

The in situ material consistency upper reworked topsoil, pebble marker and highly reworked residual horizons were generally described as loose to medium dense at the moisture content at the time of the investigation which can be correlated with allowable bearing pressures of between 10 to 50 kPa (for the loose material) and between 50 and 100 kPa (for the medium dense material). The soils are however open structured and have a high collapse potential depending on the moisture content at the time of construction. A decrease in allowable bearing pressure of up to 50 % can be expected on saturation of the soils. An average allowable bearing pressure of between 35 and 60 kPa is estimated for the uncompacted upper topsoil and colluvial material.

TLB refusal is generally reached in very soft quartzite and conglomerate rock with an estimated allowable bearing pressure of between 1 to more than 3 MPa depending on the degree of weathering. The moderately to slightly weathered quartzite and conglomerate can have an Uniaxial Compressive Strength (UCS) of between 25 to 50 MPa with a UCS of >150 for the unweathered rock.

7.7 Slope Stability and Erosion

Steep slopes are present next to the drainage gully's, small drainage channels and river. These areas will most probably be environmental sensitive areas or subject to flooding (localised towards the lower slopes).

The steep areas will most probably be situated outside the developable areas and are not considered to be a constraint from a stability point of view for the proposed residential units.

A detailed slope stability analysis however needs to be considered for any proposed high load bearing foundations placed on or adjacent to the steep slopes such as foundations for possible bridge, road or pipeline crossings.

The slope stability analysis is site specific and falls outside the scope of this Phase I Geotechnical investigation.

The slope angles are discussed in more detail in the Geotechnical Evaluation section of this report.

The upper sandy soils have an intermediate to high susceptibility to erosion due to the slope angles and sandy nature of the material. Erosion is expected especially after the surface vegetation has been removed and after heavy and/or continuous downpours where congress water flow are expected.

7.8 Excavatability

Shallow rock and/or rock outcrop were identified throughout the majority of the investigated area.

Rock outcrop represents roughly 50% of the surface area of the site. The remainder portions is generally covered with a thin topsoil, hillwash or pebble marker and highly reworked residual horizon with an average combined thickness of roughly < 0,5 m to 1,0 m to 1,5 m in localised areas.

Roughly 10,2 hectares of the site is covered with varying types and thickness of fill material that will be excavatable down to average depth of roughly +1,5 to 2,5 m below ground level. The concerned fill covers roughly 3,8 % of the total surface area of the investigated area.

Excavatability of materials can be classified in five different categories according to the SABS 1200 D-1988 standards. Table 5 below is a summary of the SABS standards (refer to SABS 1200D-1988 documents for detailed classification):

TABLE 5 : EXCAVATION CLASSES (Modified SABS 1200D)

Sample Position	Simplified description of typical material properties
Soft excavation	Material that can be efficiently removed or loaded, without prior ripping, by means of a bulldozer, tractor-scraper, track type front-end loader or back-acting excavator without the use of pneumatic tools such as paving breakers
Intermediate excavation	Material that can be efficiently ripped by a bulldozer fitted with a single-tine ripper or with a back-acting excavator of flywheel power exceeding 0,10 kW per mm of tined-bucket width or the use of pneumatic tools before removal by equipment equivalent to that specified above.
Hard rock excavation	Excavation in material that cannot, before removal, be efficiently ripped by a bulldozer. This is material that cannot be efficiently removed without blasting or without wedging and splitting.
Boulder excavation (Class A)	Excavation in material containing more than 40 % by volume boulders of size in the range of 0,03-20m3, in a matrix of soft material or smaller boulders.
Boulder excavation (Class B)	Excavation in material containing 40 % or less by volume boulders of size in the range of 0,03-20m3, in a matrix of soft material or smaller boulders and which require individual drilling and blasting in order to be loaded by a track type front-end loader or back-acting excavator .

Roughly + 50% “intermediate excavation” becoming “hard excavation” conditions are anticipated down to 1,50 m below ground level from where most of the materials will be intermediate to hard excavation depending on the locality and degree of weathering of the rock.

The abovementioned percentages are only rough estimations.

7.9 Permeability of the upper soils

No infiltration tests or laboratory tests were performed to determine the permeability of the soil.

The fine sandy reworked topsoil and colluvial material will probably have a hydraulic conductivity of between approximately 1 x 10^{-2} mm/s and 1 x 10^{-4} mm/s. This is typical values for fine to medium grain sandy material.

The particle size analysis can provide more accurate estimates of the permeability of soils. Hazen's formula for approximate values of permeability is widely used and is used for the purposes of this investigation.

More detailed and specific testing is required for groundwater infiltration or flow modelling purposes.

8. SITE CLASSIFICATION

The investigated area has been broadly classified into four basic Site Class Designation zones (Figure 9, Appendix A), 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 E. The zones with different slope angles as classified by Partridge, Wood and Brink, 1993 are depicted in Figure 8, Appendix A. The classification and foundation recommendations are based on the field observations, soil profile descriptions and visual interpretations.

8.1 Geotechnical Zonation and Impact of the Geotechnical Character of the Site on the Development

Table 6 summarizes the general geotechnical constraints pertaining to urban development as proposed by Partridge, Wood and Brink (1993). The "Class" column indicates the severity of the particular constraint. The complete classification table is attached as Table 10, Appendix E.

TABLE 6 : GEOTECHNICAL CLASSIFICATION FOR URBAN DEVELOPMENT (PARTRIDGE, WOOD & BRINK, 1993)

Constraint		*Site Condition*	*Class*
A	Collapsible soil.	Potentially collapsible horizons generally less than 750 mm in thickness. Low collapse expected. Very localised areas of high soil collapse will be present and needs to be identified during Phase II investigation.	1-(2)
B	Seepage.	Seasonal shallow perched seepage water and/or saturated upper soil profiles are expected, especially after heavy and/or continuous downpours.	2
C	Active soil.	Low soil heave expected.	1
D	Compressible soil.	Localised areas of medium oil compressibility will be present and needs to be identified during Phase II investigation. High compressibility in low density fill areas expected.	1-(3)
E	Erodability of soil.	Intermediate soil erodability expected due to gradient and sandy nature of the upper soil horizons soils, especially after the vegetation has been cleared and after heavy and/or continuous downpour where congress water flow are expected.	2
F	Difficulty of excavation to 1.5m depth.	Rock more than 40% of volume down to 1,5 m below ground level expected.	3
G	Undermined ground.	No undermined ground.	1
H	Instability in areas of soluble rock.	No soluble rock. Site is not underlain by chert or dolomite rock.	1
I	Steep slopes.	Areas where slope angles are between: 2 and 6º, 6 and 12º and >12º are present. (Refer to attached Figure 8, Appendix A).	1-2-3
J	Areas of unstable natural slopes.	High risk areas outside developable areas. Steep slopes needs to be evaluated if any structures are to be placed near vertical slopes.	1
K	Areas subject to seismic activity.	Less than 10% probability of an event less than 100cm/s^2 within 50 years.	1
L	Areas subject to flooding.	Localised seasonal flooding expected. Refer to floodline report for details. The zone will be incorporated into the final report.	1-(3)
Geotechnical classes:		*Most favourable (1)*	*Intermediate (2)*	*Least favourable (3)*

The main expected geotechnical constraints on this site are:

- Shallow severe excavation difficulty.
- Areas with steep slope angles present.
- Rock outcrop.
- Shallow seasonal seepage water and/or saturated conditions.
- Localised areas of uncontrolled and uncompacted fill.
- Upper thin collapsible/compressible soil horizon.

Based on the available information the site is considered four geotechnical zones (SAICE 1995 / Partridge, Wood and Brink 1993):

Zone I: **P(flooding) / 3FIL**
Zone II: **P(outcrop and steep slopes)-R / 3FI**
Zone III: **P(fill)-S2 / 3D**
Zone IV: **C1-R / 2-3F 1AB 2E**

The approximate boundaries of the zones is depicted in Figure 9, Appendix A with more detailed outlines of Zone III in Figures 10, 11, 12 and 13, Appendix A. Zone I (area situated below 1:100 year floodline) is a rough estimate and the planners and design engineers should refer to the detailed floodline report for the exact boundaries of this zone.

The zones representing different slope angles as recommended by Partridge, Wood and Brink, 1993 is depicted in Figure 8, Appendix A as:

- Zone a: < 2º,
- Zone b: 2º to 6º
- Zone c: 6º to 12º
- Zone d: >12º

9. FOUNDATION OPTIONS AND SOLUTIONS

The following are recommended for the different geotechnical zones:

Zone I: **P(flooding) / 3FIL**

- Determination of 1:100 year floodline (refer to floodline report).
- No development below the 1:100 year floodline.
- Proper drainage and risk management.

Zone II: P(Rock outcrop and steep slopes)-R / 3FI

- Exclude from development due to cost implications for construction on steep slopes and severe excavation conditions due to shallow rock. This area is also probably an environmental sensitive area. Refer to environmental impact report to be finalised.

Zone III: P(fill)-S2 / 3D

- Rehabilitate the fill areas by removal of the low density fill and replace and compact by inert material to design specifications or;
- Cover fill areas with a thin soil covering according to guideline specifications and exclude these areas from development.

Zone IV: C1-R / 2-3F 1AB 2E

- This larger portion of this zone is suitable for the proposed housing development despite the shallow rock and/or outcrop.
- ***Normal foundations*** (strip footing or slab-on-the-ground construction) will be sufficient where shallow competent material prevails (the majority of the developable area)
- Only *very localised* areas where ***modified normal foundations*** or ***compaction of in situ soils below individual footings*** will be necessary to prevent damage to the proposed units are present and needs to be identified during the Phase II Geotechnical investigation.

The above foundation recommendations are according to the NHBRC Home Builders Manual (1999) for single storey masonry structures (Table 7, Table 8 and Table 9, Appendix E).

Foundation precautionary measures also need to be implemented where foundations span composite geotechnical conditions such as shallow competent rock and collapsible or compressible soil. These composite conditions can result in unwanted differential movement and damage to the proposed structures.

It is recommended that the structural engineers calculate the best economical foundation option for the proposed units.

A competent engineer should be responsible for the final foundation design.

10. BASIC CONSTRUCTION MATERIALS

The suitability of the encountered materials for different construction materials are briefly discussed below with summaries of material specifications in Appendix F. This section is only for guideline purposes and the SANS documents needs to be consulted for the more detailed material specifications and requirements. More detailed sampling and specific testing are recommended to determine the suitability of the existing on-site materials for construction material purposes.

10.1 Pipe bedding (cradle), selected fill (blanket) and backfill (mail fill)

Below are summaries of material specifications for pipe bedding (cradle), selected fill (blanket) and backfill (mail fill). Refer to the SANS standards for more detailed specifications.

10.1.1 Pipe bedding (cradle) material

The following are simplified guideline specifications for pipe bedding (cradle) material:

- PI (Plasticity Index) of less than 18
- No organic material present
- Grading limit between 0,6 and 19 mm
- Compactability factor > 4
- CBR of at least 3% at the minimum specified density compacted at Optimum Moisture Content

The materials have a PI of between 0 and 8. The materials has a CBR of at least 3%. The materials will probably have a compactability factor >4. The materials contain relatively low percentages of organic matter mainly in the form of grass roots. The matrix of the materials encountered on site however generally has an abundant of fines originating from the weathering of the interlayered sandstone, shale and conglomerate.

An average of between roughly 30 % to 70% of the material grades < 0,6 mm. Approximately 30 % to 37 % of the material grades > 19 mm resulting in unwanted amounts of course fragments. Large volume loss will be experienced if graded to the required SABS specifications.

10.1.2 Selected fill (blanket) material

According to the SANS standards selected fill material shall be material that has a PI not exceeding 6 and that is free from vegetation and from lumps and stones of diameter exceeding 30 mm.

The colluvium and pebble marker material has a PI of < 6. The sandy colluvium and pebble marker material may used for selected fill (blanket) material if the organic matter and stones of > 30 mm are removed. Large volume losses (between 15 % and 30 %) are expected if the pebble marker material is graded to the required specifications.

10.1.3 Backfill (main fill) material

The following are simplified guideline specifications for backfill (main fill) for pipe bedding material (for backfill not subject to traffic loads):

- Excludes stones of average dimension exceeding 150 mm.
- Not more than 10% rock or hard fragments retained on a sieve of nominal aperture size 50 mm.
- Material should not contain large clay lumps that do not break up under the action of compaction equipment
- No or little organic material

The SANS 1200DB-1989 standards specifies that materials with a PI<12, CBR of >15 % at specified density be placed in the upper 150 mm of the subgrade, and a minimum CBR of 7 % if the backfill is to be placed lower in the subgrade for areas subject to loads from road traffic.

The materials encountered on site will be suitable for backfill material if the large stones are removed.

The sandy colluvial and pebble marker material can be used for upper backfill in areas subject to traffic loads (refer to SANS1200DB-1989 abovementioned specifications). The CBR values of the materials tested were 15, 16 and 14 at 90 % Mod. AASHTO compaction effort and 20, 25 and 26 at 93 % compaction effort. Refer to compaction test results.

10.2 Road construction

Compaction tests were performed on three selectively retrieved samples.

The tests were conducted on the sandy alluvial material encountered next to the existing river and on the gravelly pebble marker material encountered mainly towards the southern portion of the investigated area.

The results and expected performance of the material for road building purposes are discussed under section 7.3 Compaction Characteristics.

10.3 Fine aggregate for mortar and plaster

Modified specifications for fine aggregates for mortar and plaster are summarized in Table 18, Appendix F.

The SANS1090 document needs to be consulted for the detailed material specifications and requirements.

The sandy colluvial material may be considered for fine aggregates for mortar and plaster if graded to the specifications. According to the SANS standards natural sand should grade as follows +/- 90 % passing 4,75 mm sieve and +/- 5 % passing 0,150 mm sieve. 15 % to 50 % of the material grades passes the 0,150 mm sieve. Relatively large volume losses will however be experienced if graded to specifications.

Additional testing are however required and this needs to be investigated during the construction materials investigation.

It is recommended that fine aggregates be obtained from the nearest source.

10.4 Course aggregate for concrete

The gravel obtained from the pebble marker originating from the weathering of the conglomerate rock can be used for course aggregate for concrete depending on the specifications. It must however noted that the gravel generally have polished surfaces and has a round shape. No testing was conducted on the gravel for the use as course aggregate for concrete. ***It is recommended that suitable material be obtained from the nearest source.***

The SANS1083 needs to be consulted for the material specifications and requirements for use as course aggregates in concrete.

10.5 Soil mattresses

The soils encountered generally have good compaction characteristics with a low compressibility when compacted. Depending on the structures to be erected and the design specifications the sandy colluvial material and gravel pebble marker horizon may be used for the construction of soil mattresses (refer to lab results for maximum dry densities, optimum moisture content and grading of the materials).

11. CONCLUSIONS AND RECOMMENDATIONS

The site is **not** underlain by dolomite rock. A dolomite stability investigation is therefore **not** required.

Rock outcrop is evident throughout the majority of the site. The areas where no rock outcrops are visible are generally covered with very thin topsoil, hillwash or pebble marker horizon underlain by a thin reworked residual horizon.

The upper transported and reworked residuum was generally encountered down to less than 1 m below ground level from where very soft to hard rock quartzite and conglomerate were encountered.

The main expected geotechnical constraints on this site are:

- Shallow severe excavation difficulty.
- Areas with steep slope angles present.
- Rock outcrop.
- Shallow seasonal seepage water and/or saturated conditions.
- Localised areas of uncontrolled and uncompacted fill.
- Upper thin collapsible/compressible soil horizon.

Based on the available information the site is considered four geotechnical zones (SAICE 1995 / Partridge, Wood and Brink 1993):

Zone I: **P(flooding) / 3FIL**
Zone II: **P(outcrop and steep slopes)-R / 3FI**
Zone III: **P(fill)-S2 / 3D**
Zone IV: **C1-R / 2-3F 1AB 2E**

No construction should be allowed below the 1:100 year floodline. It is recommended that construction be excluded from the areas represented by shallow rock and steep slopes as indicated on Figure 8 and Figure 9, Appendix A. Zone II (Figure 9) and Zone c and Zone d (Figure 8).

Normal foundations will be sufficient for the majority of the site if placed on the competent residual or highly to slightly weathered rock. Foundation modifications will be necessary where foundations span composite geotechnical conditions such as competent shallow rock and compressible/collapsible soils which will result in differential movement and damage to the proposed units.

It is recommended that the fill areas be excluded from the development or that the fill areas be rehabilitated with proper foundation modifications to prevent or limit damage to the proposed units.

Damp proofing will be good practice to prevent moisture damage to the foundations and walls as seasonal saturated soil profiles and/or shallow seasonal seepage water are expected.

A phase II geotechnical investigation will be necessary for NHBRC enrolment.

12. REPORT PROVISIONS

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

For this reason, this investigation has sought to highlight areas of potential foundation, groundwater and excavation problems, as well as to provide prior warning to the Town and Regional Planners and Consulting Engineers.

A competent geotechnical engineer or engineering geologist should inspect foundation and open service trenches to determine the variance from the above assessment. NHBRC enrolment of the site can only be completed once this Phase II geotechnical site investigation has been executed.

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

DH WESSELS Pr.Sci.Nat.

ENGINEERING GEOLOGIST
SACNASP registration number: 400076/8

13. REFERENCES

Das, B. M., 1990. Principles of Geotechnical Engineering. 2nd Ed. PWS-Kent. USA.

Jennings, J.E.B., Brink, A.B.A., Williams, A.A.B., 1973. Revised guide to Soil Profiling for Civil Engineering Purposes in Southern Africa. The Civil Engineer in SA. pp 3-12. January 1973.

Partridge, T.C., Wood, C.K., Brink, A.B.A., 1993. Priorities for Urban Expansion within the PWV Metropolitan Region: The primacy of geotechnical constraints. South African Geographical Journal, Vol 75, pp 9-13.

National Home Builders Registration Council, 1995. Standards and Guidelines. HBRC.

South African Bureau of Standards, 1988. Standardized Specification for Civil Engineering Construction. DA: Earthworks (Small Works). SABS 1200 DA-1988, (As amended 1990).

South African National Standards. 2001. Drinking Water. SANS 241:2001.

SAICE. 1995. Code of Practice: Foundations and Superstructures for Single Storey Residential Buildings of Masonry Construction. Joint Structural Division, Johannesburg. First Edition.

SAIEG, 1996. Guidelines for Soil and Rock Logging. SAICE/SAIEG.

Weinert, H.H., 1980. The Natural Road Construction Materials of Southern Africa. Academica. Cape Town.

SANS 1083:2002, Aggregates from natural sources - Aggregates for concrete, Pretoria: South African Bureau of Standards, 2002.

SANS 1090:2002, Aggregates from natural sources - Fine aggregates for plaster and mortar, Pretoria: South African Bureau of Standards, 2002.

APPENDIX A

(FIGURES)

Figure 1: Locality map 1: South Hills - Klipriviersberg Estate

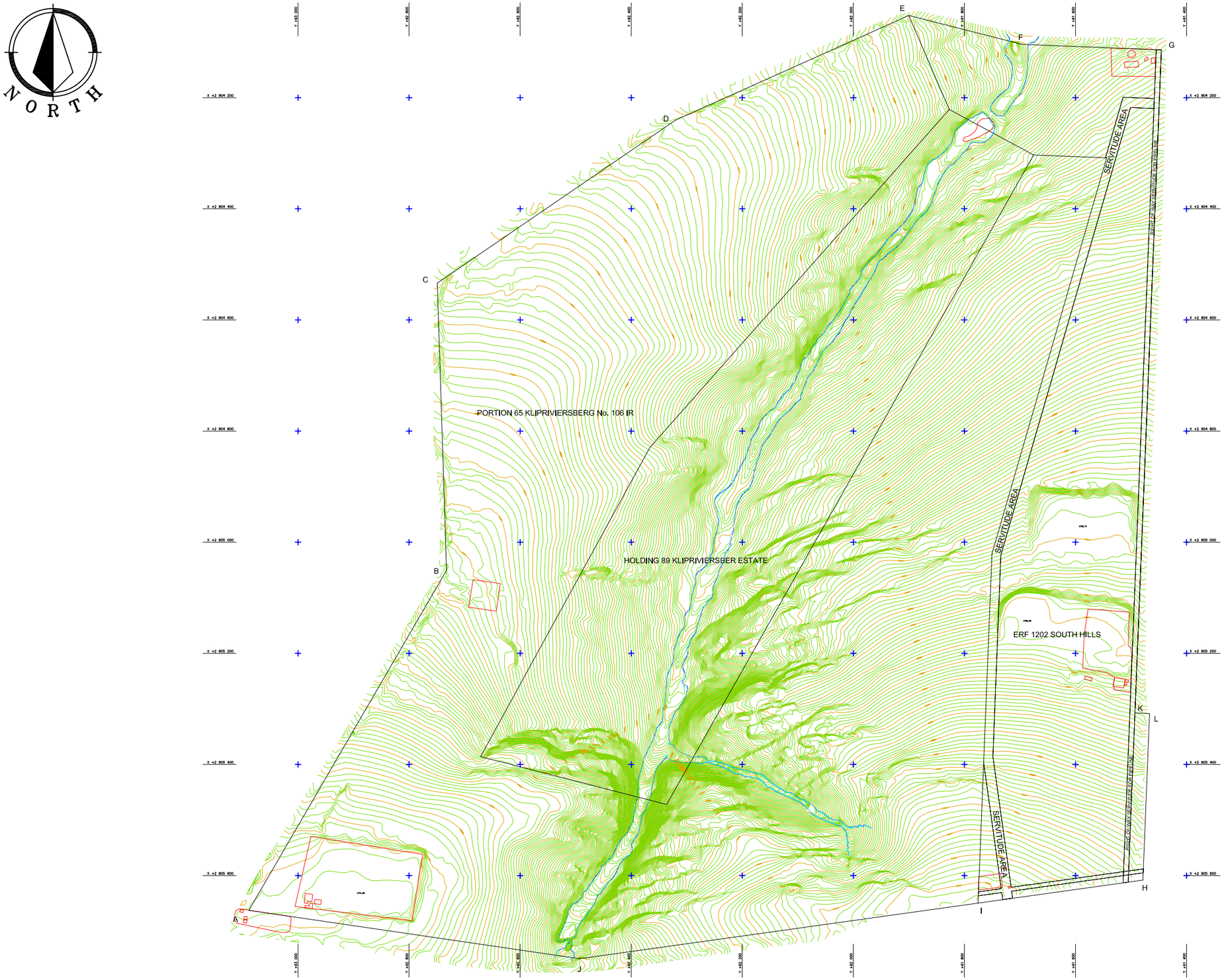
WSM LESHIKA CONSULTING (Pty) Ltd

© GoogleEarth 2007

Figure 2: Locality map 2: South Hills - Klipriviersberg Estate

WSM LESHIKA CONSULTING (Pty) Ltd

© GoogleEarth 2007



Legend:

1 : 100 year Floodline

1 : 50 year Floodline

WSM LESHIKA CONSULTING (Pty) Ltd

Engineers, Geohydrologists, ISD Practitioners & Project Managers

FLOODLINES

FIGURE 3

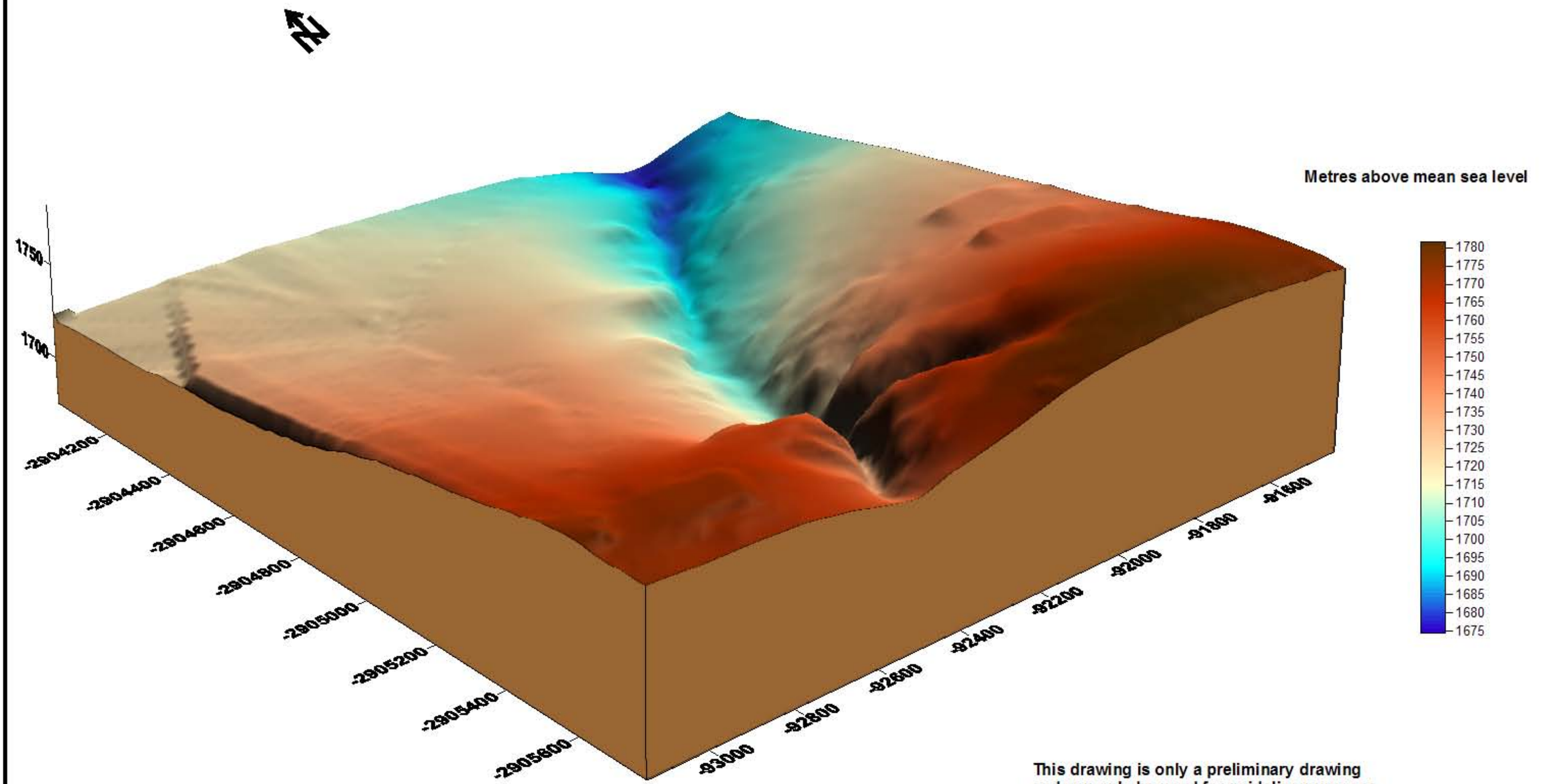
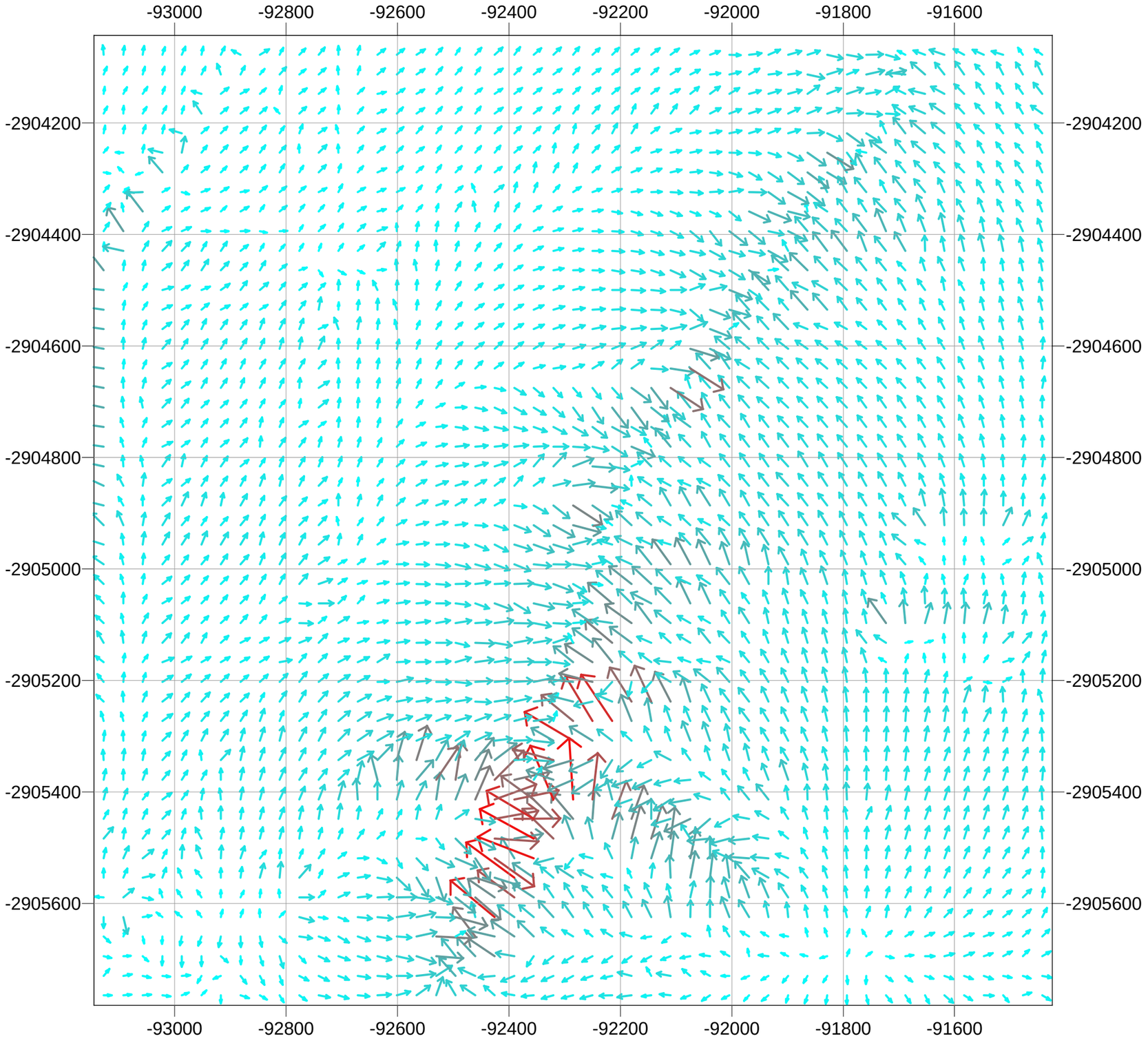
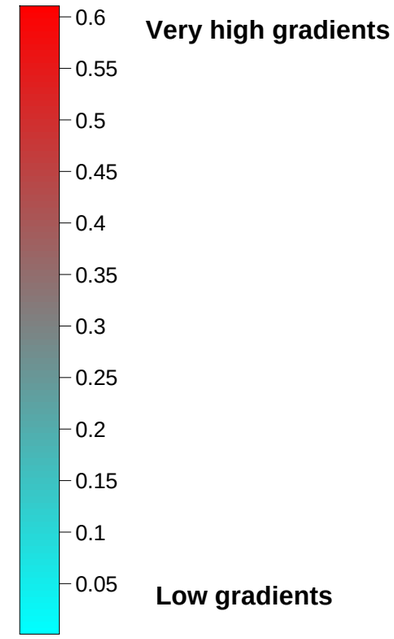


Figure 4: South Hills: 3 Dimensional Perspective view of the site contours (Brown-high, blue-low)





Very high gradients

Low gradients

This drawing is only a preliminary drawing and can only be used for guideline purposes

Figure 5: South Hills: Surface drainage vectors (Blue low gradient, rid high gradient)

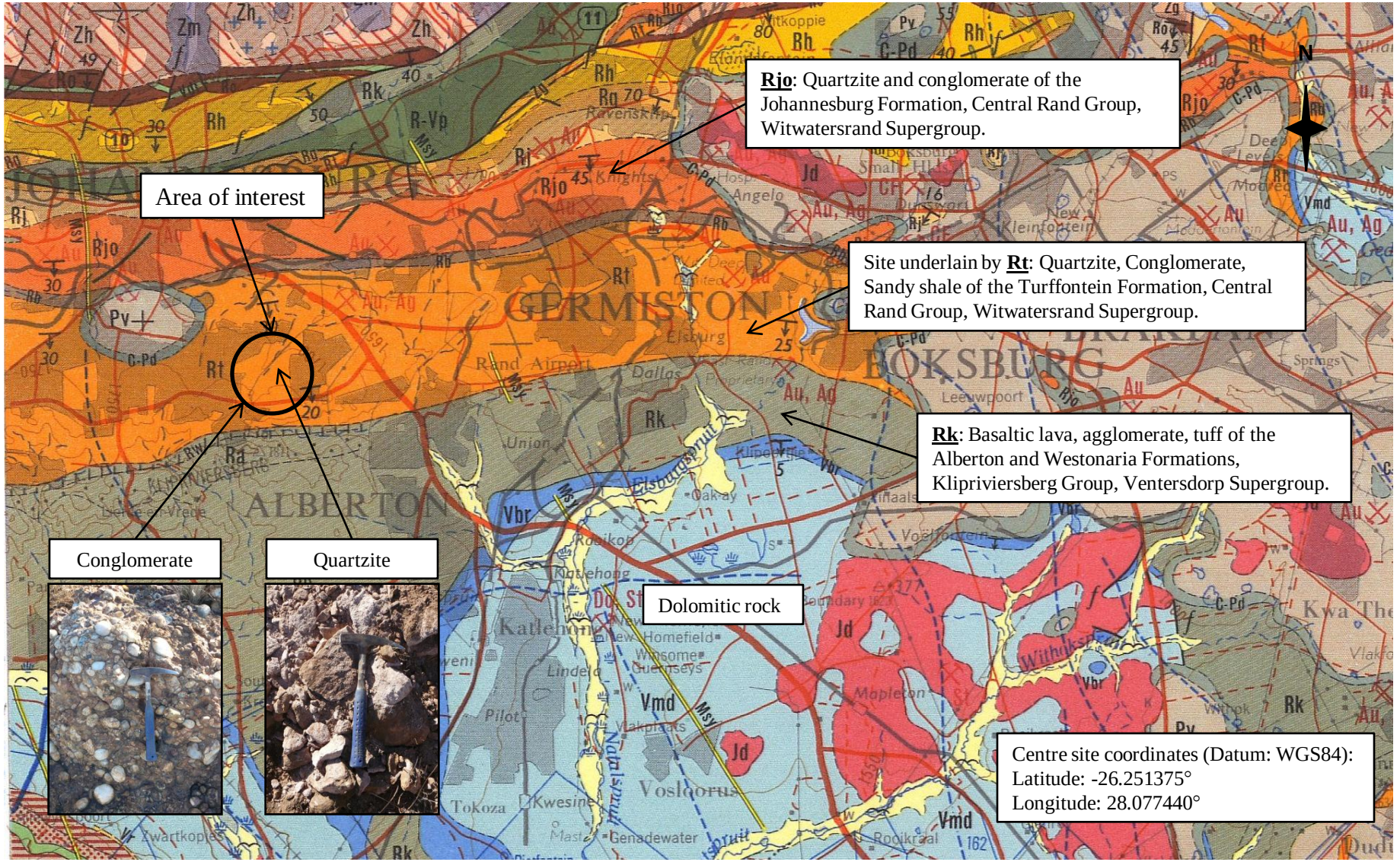
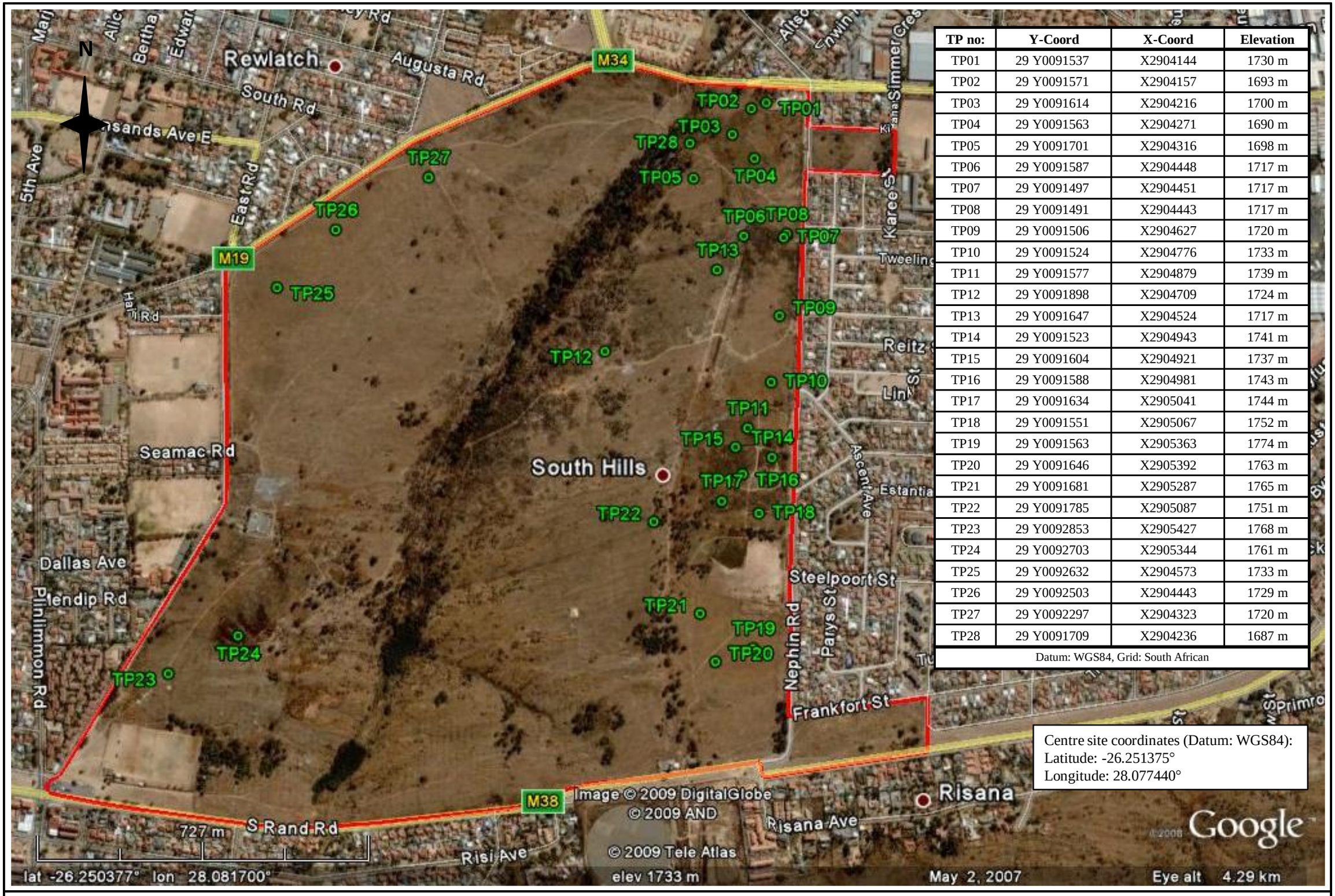


Figure 6: Geology map: South Hills - Klipriviersberg Estate

WSM LESHIKA CONSULTING (Pty) Ltd

© The Government Printer



TP no:	Y-Coord	X-Coord	Elevation
TP01	29 Y0091537	X2904144	1730 m
TP02	29 Y0091571	X2904157	1693 m
TP03	29 Y0091614	X2904216	1700 m
TP04	29 Y0091563	X2904271	1690 m
TP05	29 Y0091701	X2904316	1698 m
TP06	29 Y0091587	X2904448	1717 m
TP07	29 Y0091497	X2904451	1717 m
TP08	29 Y0091491	X2904443	1717 m
TP09	29 Y0091506	X2904627	1720 m
TP10	29 Y0091524	X2904776	1733 m
TP11	29 Y0091577	X2904879	1739 m
TP12	29 Y0091898	X2904709	1724 m
TP13	29 Y0091647	X2904524	1717 m
TP14	29 Y0091523	X2904943	1741 m
TP15	29 Y0091604	X2904921	1737 m
TP16	29 Y0091588	X2904981	1743 m
TP17	29 Y0091634	X2905041	1744 m
TP18	29 Y0091551	X2905067	1752 m
TP19	29 Y0091563	X2905363	1774 m
TP20	29 Y0091646	X2905392	1763 m
TP21	29 Y0091681	X2905287	1765 m
TP22	29 Y0091785	X2905087	1751 m
TP23	29 Y0092853	X2905427	1768 m
TP24	29 Y0092703	X2905344	1761 m
TP25	29 Y0092632	X2904573	1733 m
TP26	29 Y0092503	X2904443	1729 m
TP27	29 Y0092297	X2904323	1720 m
TP28	29 Y0091709	X2904236	1687 m
Datum: WGS84, Grid: South African			

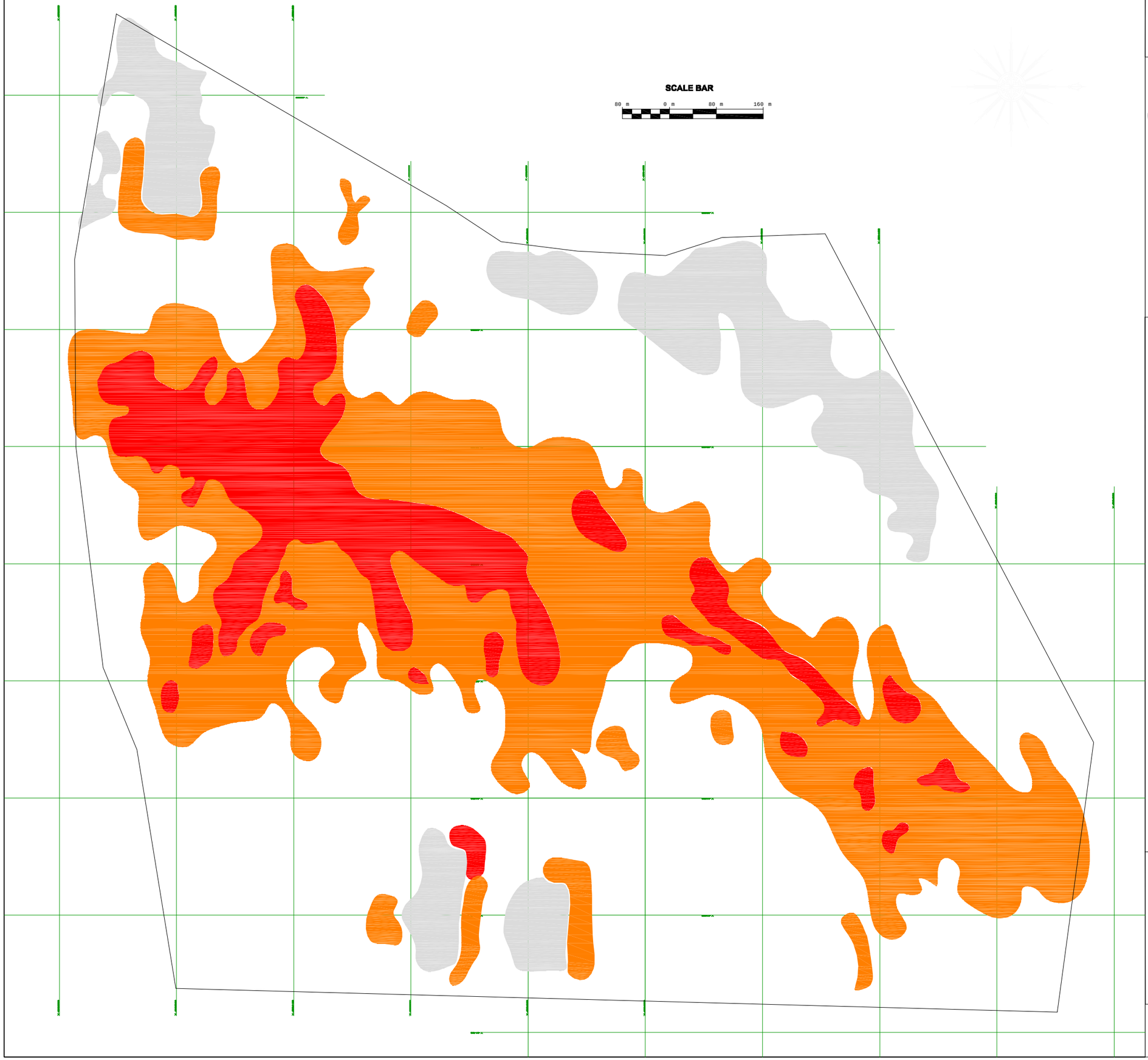
Centre site coordinates (Datum: WGS84):
Latitude: -26.251375°
Longitude: 28.077440°

Figure 7: Test pit positions: South Hills - Klipriviersberg Estate

WSM LESHIKA CONSULTING (Pty) Ltd

© GoogleEarth 2008

"South Hills"



SLOPE ANGLE ZONATION AND GENERAL LEGEND

- **Zone a - Slope angle between 0 and 2 degrees**
- **Zone b - Slope angle between 2 and 6 degrees**
- **Zone c - Slope angle between 6 and 12 degrees**
- **Zone d - Slope angles > 12 degrees**
- **Approximate site boundary**

General recommendations

Zone a: (Zone represented with light grey coloring)
Suitable for proposed development.
Slope angles of < 2 degrees.
Water ponding may occur after heavey and/or continious downpours.
Proper surface drainage must be installed due to very low slope angles.

Zone b: (Zone represented by no coloring)
Suitable for proposed development.
Slope angles of between 2 and 6 degrees.
Proper surface drainage to prevent erosion.

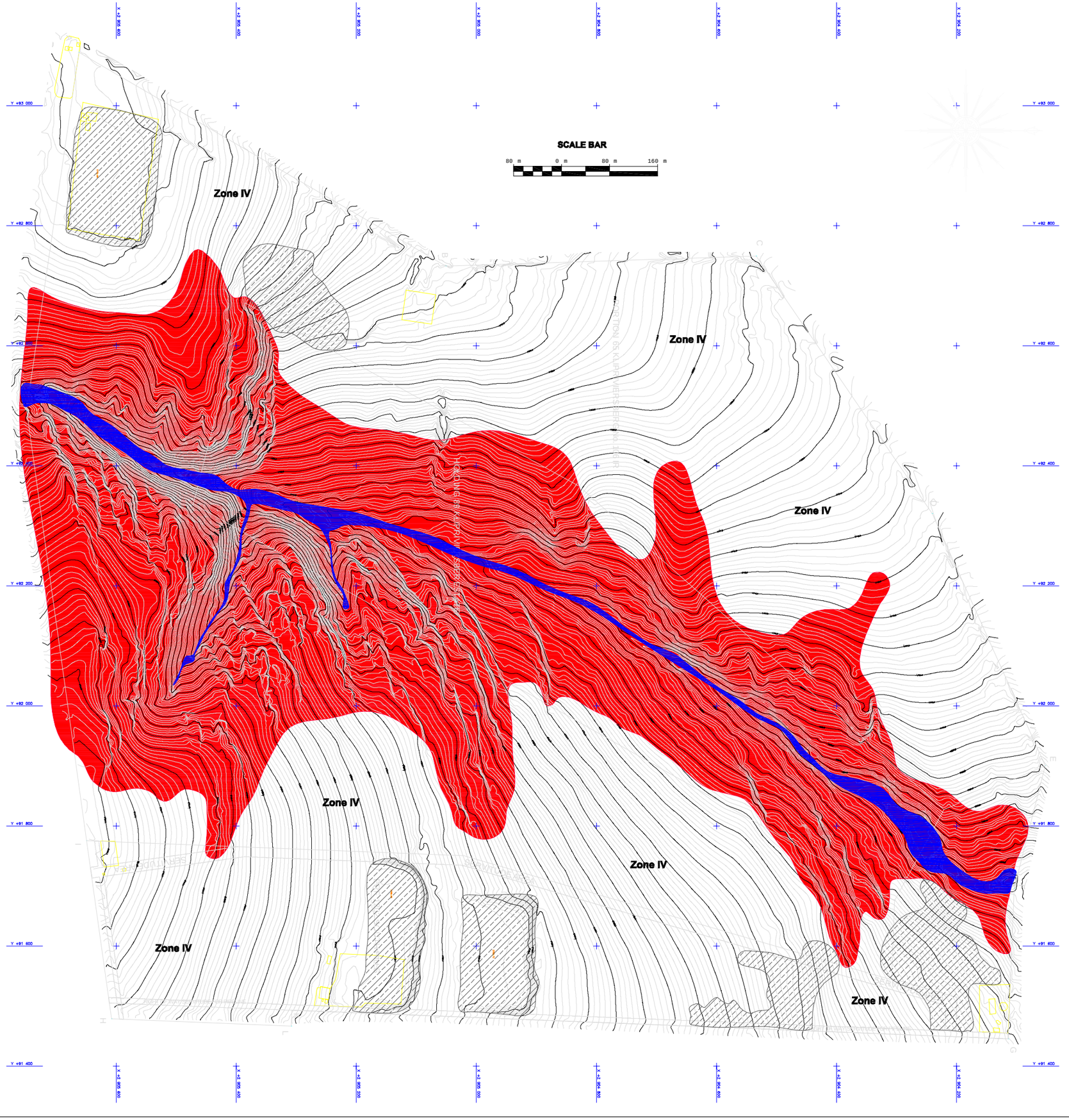
Zone c: (Zone represented by orange coloring)
Recommended to be excluded for this development.
Slope angles of between 6 and 12 degrees.
Mainly prominent rock outcrop in this zone and steep angles in fill areas.

Zone d: (Zone represented by red coloring)
Not suitable for any development.
Slope angles of > 12 degrees up to +60 degrees.
Mainly prominent rock outcrop in this zone with very steep slope angles.

Project/reference number: WF09071
Drawing date: 2009-10-05
Designed by: DH Wessels
Company: WSM LESHIKA Consulting (Pty) Ltd.
Contact person: DH Wessels
E-mail: hwessels@wsmleshika.co.za
Office no: 012 997 6760

Figure 8 : Slope Zonation Map

"South Hills"



LEGEND

- **Zone I: P(flooding) / 3FIL**
- **Zone II: P(Outcrop and steep slopes)-R / 3FI**
- **Zone III: P(fill)-S2 / 3D**
- **Zone IV: C1-R / 2-3F 1AB 2E**
- **Approximate site boundary**

BASIC RECOMMENDATIONS FOR ZONES:

Zone I: P(flooding) / 3FIL

- Determination of 1:100 year floodline (refer to floodline report).
- No development below the 1:100 year floodline.
- Proper drainage and risk management.

Zone II: P(Rock outcrop and steep slopes)-R / 3FI

- Exclude from development due to cost implications for construction on steep slopes and severe excavation conditions due to shallow rock. This area is also probably an environmental sensitive area. Refer to environmental impact report to be finalised.

Zone III: P(fill)-S2 / 3D

- Rehabilitate the fill areas by removal of the low density fill and replace and compact by inert material to design specifications or;
- Cover fill areas with a thin soil covering according to guideline specifications and exclude these areas from development.

Zone IV: C1-R / 2-3F 1AB 2E

- This larger portion of this zone is suitable for the proposed housing development despite the shallow rock and/or outcrop.
- Normal foundations (strip footing or slab-on-the-ground construction) will be sufficient where shallow competent material prevails (the majority of the developable area)
- Only very localised areas where modified normal foundations or compaction of in situ soils below individual footings will be necessary to prevent damage to the proposed units are present and needs to be identified during the Phase II Geotechnical investigation.

Project/reference number: WF09071
Drawing date: 2009-10-05
Designed by: DH Wessels
Company: WSM LESHIKA Consulting (Pty) Ltd.
Contact person: DH Wessels
E-mail: hwessels@wsmleshika.co.za
Office: **012** 997 6760

Figure 9 : Geotech Zonation Map

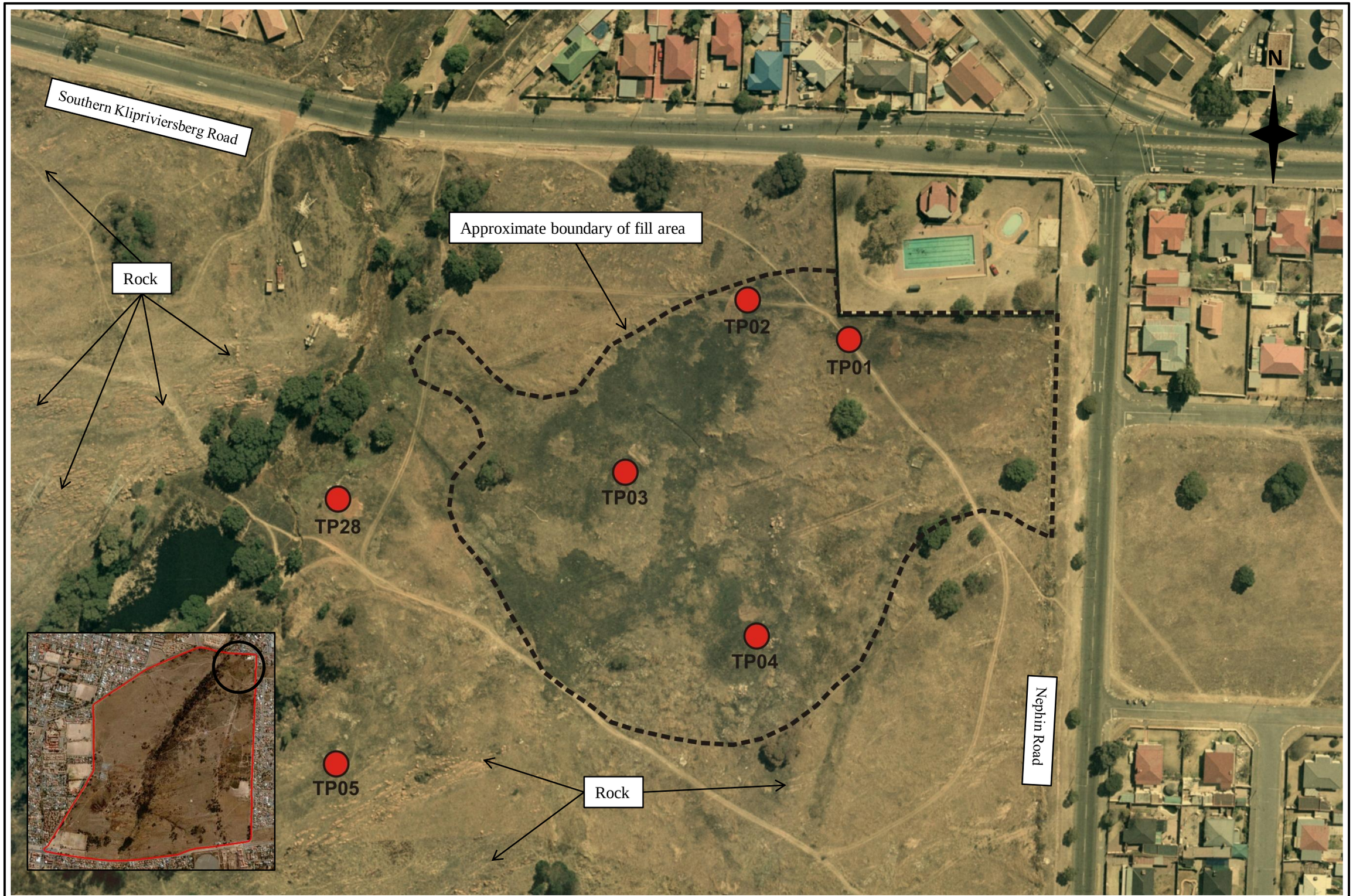


Figure 10: Fill area towards north-eastern corner: South Hills - Klipriviersberg Estate WSM LESHIKA CONSULTING (Pty) Ltd © GoogleEarth 2008

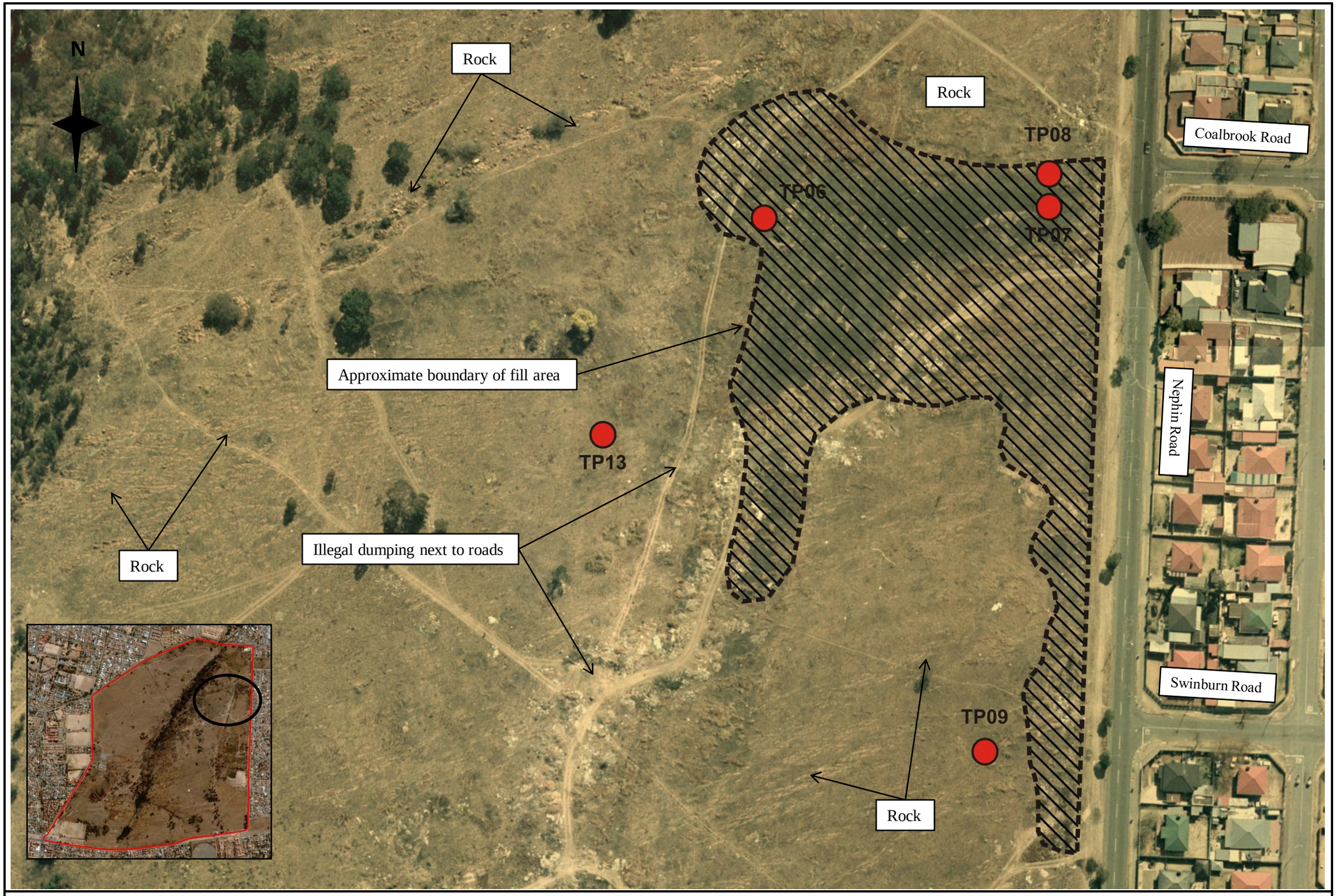


Figure 11: Fill area towards north-eastern boundary: South Hills - Klipriviersberg Estate

WSM LESHIKA CONSULTING (Pty) Ltd © GoogleEarth 2008

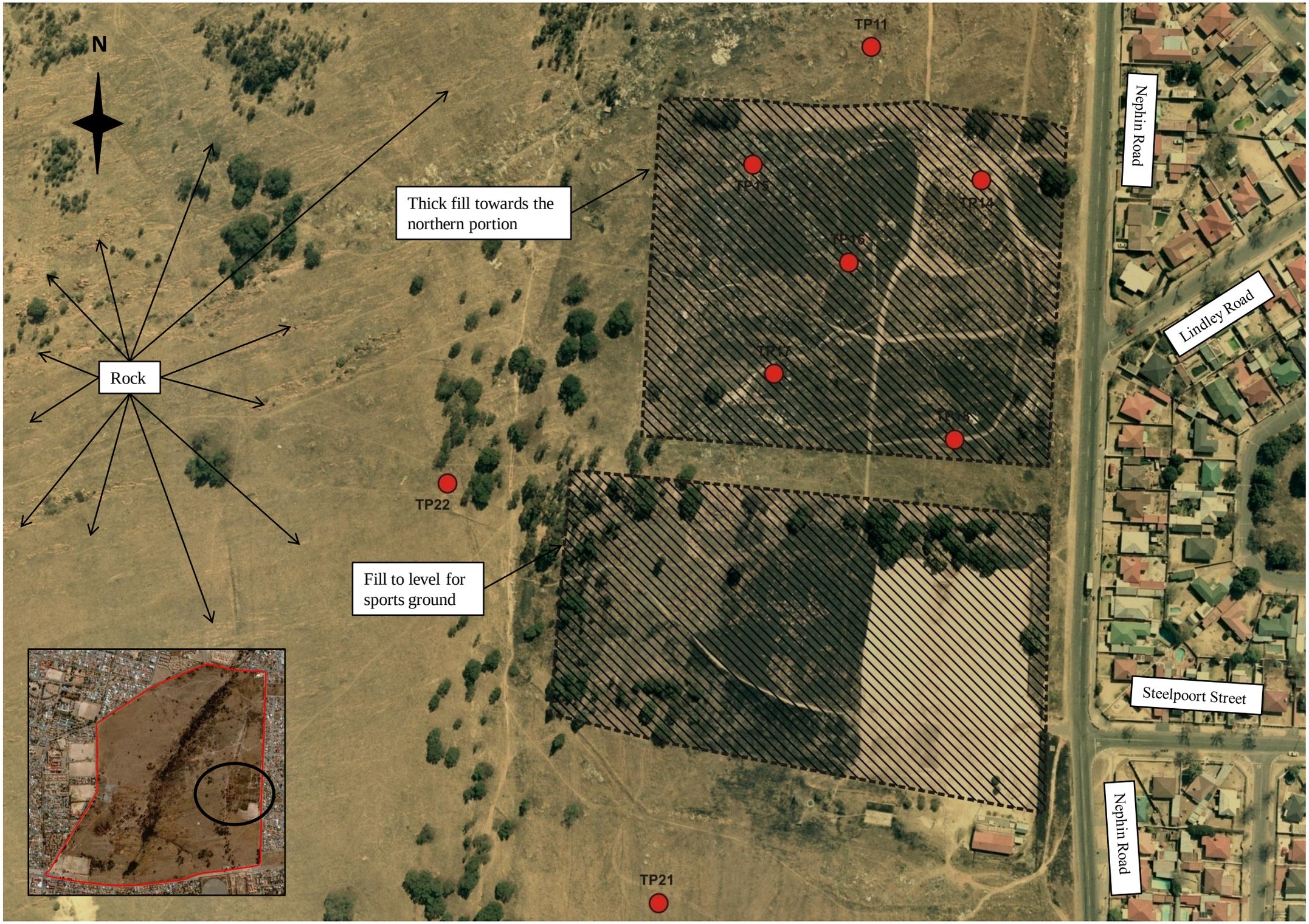


Figure 12: Fill area towards southeastern boundary: South Hills - Klipriviersberg Estate WSM LESHIKA CONSULTING (Pty) Ltd © GoogleEarth 2008

East Road

Rock

N

TP24

Approximate boundary of fill area

Rock

Figure 13: Fill area to south-western portion: South Hills - Klipriviersberg Estate

© GoogleEarth 2008

APPENDIX B:

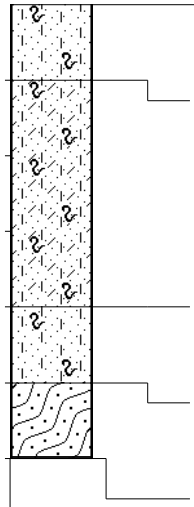
(SOIL PROFILE DESCRIPTIONS)

City of Joburg Property Company
South Hills

HOLE No: TP01
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00 Moist, greyish-brown, loose to medium dense, intact, silty SAND. Reworked topsoil and backfill. Abundant roots.

0.10 Moist, brownish-orange, medium dense, intact, clayey silty SAND. Backfill. Roots.

0.40 Slightly moist, brownish-grey, medium dense, intact, silty SAND. Topsoil. Abundant roots. Original ground level.

0.50 Very light grey, jointed, stained orange on joint surfaces, very dense, highly weathered soft rock quartzite.

0.60

NOTES

1) TLB refused on very dense quartzite rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: S-R/3F 2E.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels

TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13

DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1730
X-COORD : 2904144
Y-COORD : 0091537

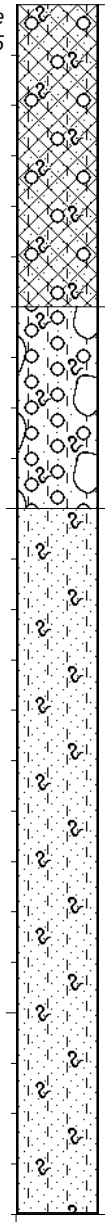
HOLE No: TP01

City of Joburg Property Company
South Hills

HOLE No: TP02
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:15



0.00

Moist, darkish-brownish-grey to greyish-brown, loose to medium dense, intact, gravelly silty SAND with minor to abundant sub angular to rounded quartz gravel and pebbles and scattered highly to totally weathered quartzite cobble, brick, wire and glass fragments. Uncontrolled and uncompacted fill. Abundant roots.

0.60

Moist, brownish-orange, medium dense, intact, silty sandy GRAVEL with abundant sub rounded light brown semi-translucent quartz gravel and pebbles and minor angular highly to moderately weathered quartzite cobbles. Seemingly natural pebble marker or hill wash horizon. Abundant roots.

1.00

Moist, brownish-orange to orange-brown, loose to medium dense, **slightly open structured**, silty fine SAND with minor to abundant sub angular quartz gravel and minor amounts of pebbles. Seemingly reworked residual quartzite. Roots.

2.40

NOTES

1) Hole stopped.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: P(fill)-S2/3D 2ABE.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1693
X-COORD : 2904157
Y-COORD : 0091571

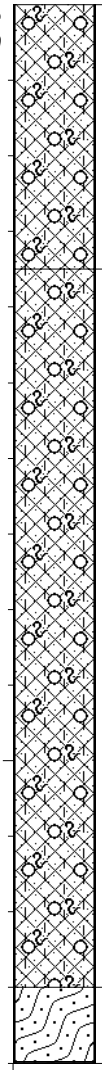
HOLE No: TP02

City of Joburg Property Company
South Hills

HOLE No: TP03
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00

Moist, darkish-brownish-grey to greyish-brown, loose to medium dense, intact, gravelly silty SAND with minor to abundant sub angular to rounded quartz gravel and pebbles and scattered highly to totally weathered quartzite cobble, brick, wire and glass fragments. Uncontrolled fill. Abundant roots.

0.35

Moist, brownish-orange, loose to medium dense, intact, gravelly silty SAND with blotches of grey loose to medium dense, gravelly silty sand and minor to abundant wire, concrete and brick rubble. Uncontrolled and uncompacted fill. Abundant becoming minor amounts of roots.

1.30

Very light grey, jointed, stained orange on joint surfaces, very dense, moderately weathered soft rock quartzite.

1.40

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: P(fill)-S2-R/3D 2ABEF.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels

TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13

DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1700
X-COORD : 2904216
Y-COORD : 0091614

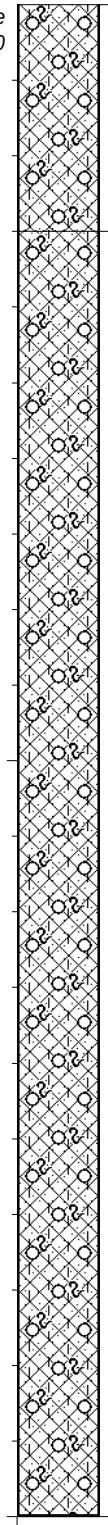
HOLE No: TP03

City of Joburg Property Company
South Hills

HOLE No: TP04
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00

Moist, brownish-grey, loose to medium dense, intact, gravelly silty SAND with abundant sub rounded light brown semi-translucent quartz gravel, pebbles and minor concrete, wire and brick rubble. Uncontrolled and uncompacted fill. Abundant roots.

0.30

Moist, brown to dark brown, loose to medium dense, intact, gravelly silty SAND with abundant sub rounded light brown semi-translucent quartz gravel, pebbles and minor concrete, wire and brick rubble. Uncontrolled and uncompacted fill. Abundant becoming minor amounts of roots.

2.00

NOTES

1) Hole stopped.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: P(fill)-S2/3D 2ABE.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels

TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13

DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

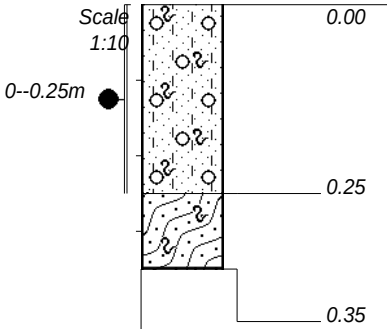
ELEVATION : 1690
X-COORD : 2904271
Y-COORD : 0091563

HOLE No: TP04

City of Joburg Property Company
South Hills

HOLE No: TP05
Sheet 1 of 1

JOB NUMBER: WF09071



0.00

Moist, greyish-brown, loose to medium dense, intact, gravelly silty SAND with minor to abundant sub rounded light brown to grey semi-translucent quartz gravel and pebbles. Reworked topsoil. Abundant roots.

0.25

Slightly moist, light pinkish-grey, jointed, stained orange on joint surfaces, dense becoming very dense, highly to moderately weathered soft becoming medium hard quartzite rock. No roots.

0.35

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) Disturbed sample taken at 0--0.25m.

4) Individual NHBRC classification: R/3F 2E.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1698
X-COORD : 2904316
Y-COORD : 0091701

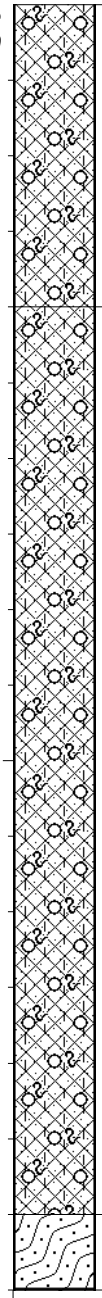
HOLE No: TP05

City of Joburg Property Company
South Hills

HOLE No: TP06
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00

Moist, grey, loose, intact, gravelly silty SAND with abundant quartzite gravel and concrete, brick and minor plastic rubble. Uncontrolled and uncompacted fill. Abundant roots.

0.40

Moist, greyish-brown, loose to medium dense, **slightly open structured**, gravelly silty SAND with minor to abundant brick, concrete and quartzite cobbles and small boulders. Uncontrolled and uncompacted fill. Roots.

1.60

Very light grey, jointed, stained orange on joint surfaces, very dense, moderately weathered soft rock quartzite. Seemingly bedrock conditions but can also be a large size boulder.

1.70

NOTES

1) TLB refusal on very dense quartzite bedrock or large size boulders.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: P(fill)-S2/3D 2ABE.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1717
X-COORD : 2904448
Y-COORD : 0091587

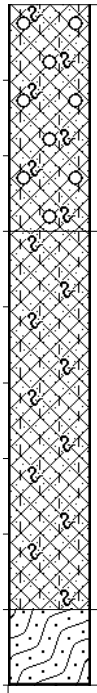
HOLE No: TP06

City of Joburg Property Company
South Hills

HOLE No: TP07
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00 Moist, grey, loose, intact, gravelly silty SAND with abundant quartzite gravel and concrete, brick and minor plastic rubble. Uncontrolled and uncompacted fill. Abundant roots.

0.30 Moist, light grey to grey, loose, intact, abundant ash gravel and silty SAND matrix with minor to abundant glass and brick rubble and fragments. Uncontrolled and uncompacted low density ash and fill. Few roots.

0.80 Very light grey, jointed, stained orange on joint surfaces, very dense, highly weathered soft rock quartzite.

0.90

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: P(fill)-S2/2ABDEF.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1717
X-COORD : 2904451
Y-COORD : 0091497

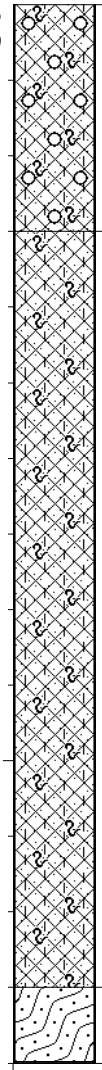
HOLE No: TP07

City of Joburg Property Company
South Hills

HOLE No: TP08
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00

Moist, grey, loose, intact, gravelly silty SAND with abundant quartzite gravel and concrete, brick and minor plastic rubble. Uncontrolled and uncompacted fill. Abundant roots.

0.30

Moist, light grey to grey, loose, intact, abundant ash gravel and silty SAND matrix with minor to abundant glass and brick rubble and fragments and minor large size quartzite cobbles with scattered boulders. Uncontrolled and uncompacted low density ash and fill. Few roots.

1.30

Very light grey, jointed, stained orange on joint surfaces, very dense, highly weathered soft rock quartzite.

1.40

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: P(fill)-S2/3D 2ABEF.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1717
X-COORD : 2904443
Y-COORD : 0091491

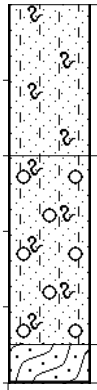
HOLE No: TP08

City of Joburg Property Company
South Hills

HOLE No: TP09
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00 Moist, greyish-brown, (gravelly) silty SAND with minor sub rounded quartz gravel. Reworked topsoil. Abundant roots.

0.20 Moist, brownish-orange, loose to medium dense, intact, gravelly silty SAND with minor quartz gravel and pebbles. Slightly reworked colluvium and residuum. Roots.

0.45 Very light grey, jointed, stained orange on joint surfaces, very dense, highly weathered soft rock quartzite.

0.50

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: R/3F 2E.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels

TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13

DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1720
X-COORD : 2904627
Y-COORD : 0091506

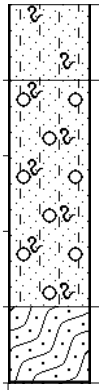
HOLE No: TP09

City of Joburg Property Company
South Hills

HOLE No: TP10
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00 Moist, greyish-brown, (gravelly) silty SAND with minor sub rounded quartz gravel. Reworked topsoil. Abundant roots.

0.10 Moist, brownish-orange, loose to medium dense, intact, gravelly silty SAND with minor quartz gravel and pebbles. Slightly reworked colluvium and residuum. Roots.

0.40 Very light grey, jointed, stained orange on joint surfaces, very dense, highly weathered soft rock quartzite.

0.50

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: R/3F 2E.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1733
X-COORD : 2904776
Y-COORD : 0091524

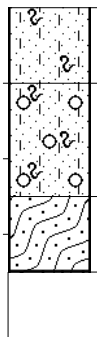
HOLE No: TP10

City of Joburg Property Company
South Hills

HOLE No: TP11
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00 Moist, greyish-brown, (gravelly) silty SAND with minor sub rounded quartz gravel. Reworked topsoil. Abundant roots.

0.10 Moist, brownish-orange, loose to medium dense, intact, gravelly silty SAND with minor quartz gravel and pebbles. Slightly reworked colluvium and residuum. Roots.

0.25 Very light grey, jointed, stained orange on joint surfaces, very dense, highly weathered soft rock quartzite.

0.35

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: R/3F 2E.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1739
X-COORD : 2904879
Y-COORD : 0091577

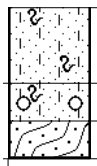
HOLE No: TP11

City of Joburg Property Company
South Hills

HOLE No: TP12
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00 Moist, greyish-brown, (gravelly) silty SAND with minor sub rounded quartz gravel. Reworked topsoil. Abundant roots.

0.10 Moist, brownish-orange, loose to medium dense, intact, gravelly silty SAND with minor quartz gravel and pebbles. Slightly reworked colluvium and residuum. Roots.

0.15 Very light grey, jointed, stained orange on joint surfaces, very dense, highly weathered soft rock quartzite.

0.20

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: R/3F 2E.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels

TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13

DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1724
X-COORD : 2904709
Y-COORD : 0091898

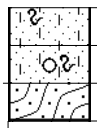
HOLE No: TP12

City of Joburg Property Company
South Hills

HOLE No: TP13
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00 Moist, greyish-brown, (gravelly) silty SAND with minor sub rounded quartz gravel. Reworked topsoil. Abundant roots.

0.05 Moist, brownish-orange, loose to medium dense, intact, gravelly silty SAND with minor quartz gravel and pebbles. Slightly reworked colluvium and residuum. Roots.

0.10 Very light grey, jointed, stained orange on joint surfaces, very dense, highly weathered soft rock quartzite.

0.15

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: R/3F 2E.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels

TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13

DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1717
X-COORD : 2904524
Y-COORD : 0091647

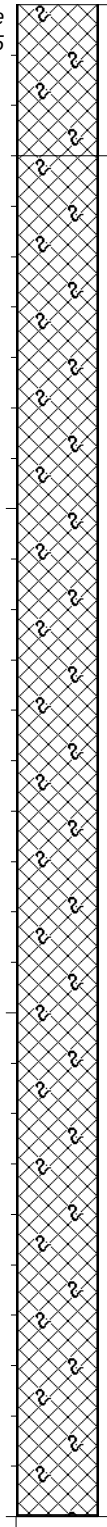
HOLE No: TP13

City of Joburg Property Company
South Hills

HOLE No: TP14
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:15



0.00 Moist, light grey with orange patches, loose to medium dense, **slightly open structured**, ash, glass, quartz gravel and rubble. Low density uncontrolled and uncompacted fill. Abundant roots.

0.30 Moist, light grey with orange patches, loose to medium dense, **slightly open structured**, ash, glass, quartz gravel and rubble. Low density uncontrolled and uncompacted fill. Roots.

3.00

NOTES

1) Reach of TLB.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: P(fill)-S2/3D 2E.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1741
X-COORD : 2904943
Y-COORD : 0091523

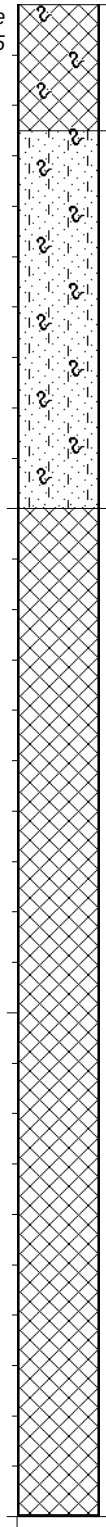
HOLE No: TP14

City of Joburg Property Company
South Hills

HOLE No: TP15
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:15



0.00

Moist, light grey with orange patches, loose to medium dense, **slightly open structured**, ash, glass, quartz gravel and rubble. Low density uncontrolled and uncompacted fill. Abundant roots.

0.25

Slightly moist to moist, brownish orange, medium dense, intact, silty SAND. Uncompacted residual quartzite fill. Few roots.

1.00

Moist, light grey with orange patches, loose to medium dense, **slightly open structured**, ash, glass, quartz gravel and rubble. Low density uncontrolled and uncompacted fill.

3.00

NOTES

1) Reach of TLB.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: P(fill)-S2/3D 2E.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels

TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13

DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

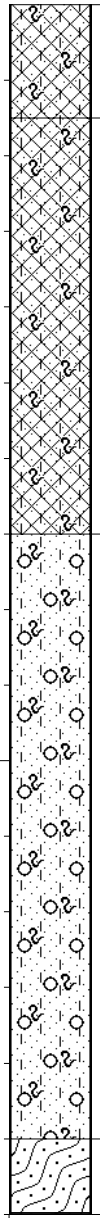
ELEVATION : 1737
X-COORD : 2904921
Y-COORD : 0091604

HOLE No: TP15

City of Joburg Property Company
South Hills

HOLE No: TP16
Sheet 1 of 1

JOB NUMBER: WF09071



0.00 – 0.15: Moist, brown, medium dense, intact, (gravelly) silty SAND with minor quartz gravel and brick and concrete rubble and fragments. Uncontrolled and uncompacted fill. Abundant roots.

0.15 – 0.70: Moist, brown, medium dense, intact, (gravelly) silty SAND with minor quartz gravel and brick and concrete rubble and fragments. Uncontrolled and uncompacted fill. Abundant becoming few roots.

0.70 – 1.50: Moist, light brownish-orange, loose to medium dense, intact, gravelly silty SAND with minor to abundant highly to totally weathered quartzite fragments. Seemingly residual quartzite backfill? Few roots.

1.50 – 1.60: Slightly moist, light orange-brown to slightly pinkish light brown, dense becoming very dense, jointed and layered, highly to moderately weathered quartzite rock. No roots.

NOTES

1) TLB refusal on quartzite rock.

2) No water seepage.

3) Disturbed sample taken at 0.70m--1.50m.

4) Individual NHBRC classification: P(fill)-S2/2BDE.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1743
X-COORD : 2904981
Y-COORD : 0091588

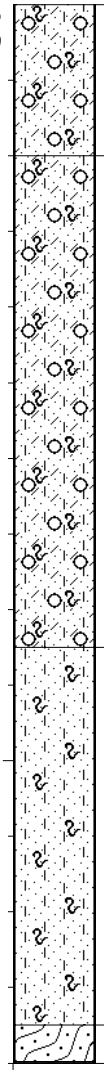
HOLE No: TP16

City of Joburg Property Company
South Hills

HOLE No: TP17
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00

Moist, grey, loose to medium dense, **open structured**, clayey silty gravelly SAND with minor light grey semi-translucent sub rounded to sub angular quartz gravel and pebbles. Seemingly reworked topsoil or backfill. Abundant roots.

0.20

Moist, grey, loose to medium dense, **open structured**, clayey silty gravelly SAND with abundant light grey semi-translucent sub rounded to sub angular quartz gravel and pebbles. Seemingly uncompacted gravel backfill or reworked pebble marker horizon. Abundant roots.

0.85

Moist, brown, dense, intact, (gravelly) silty SAND with minor quartz gravel. Seemingly reworked residual quartzite. Few roots.

1.35

Slightly moist, light orange-brown to slightly pinkish light brown, dense becoming very dense, jointed and layered, highly to moderately weathered quartzite rock. No roots.

1.40

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: P(fill)-S2-S1/2BDE.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1744
X-COORD : 2905041
Y-COORD : 0091634

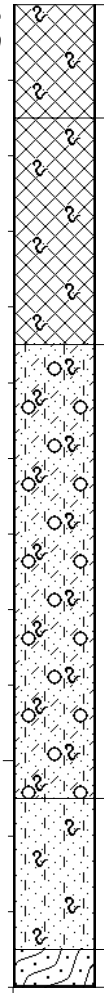
HOLE No: TP17

City of Joburg Property Company
South Hills

HOLE No: TP18
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00 Moist, light grey with orange patches, loose to medium dense, **slightly open structured**, ash, glass, quartz gravel and rubble. Low density uncontrolled and uncompacted fill. Abundant roots.

0.15 Moist, light grey with orange patches, loose to medium dense, **slightly open structured**, ash, glass, quartz gravel and rubble. Low density uncontrolled and uncompacted fill. Roots.

0.45 Moist, grey, loose to medium dense, **open structured**, clayey silty gravelly SAND with abundant light grey semi-translucent sub rounded to sub angular quartz gravel and pebbles. Seemingly uncompacted gravel backfill or reworked pebble marker horizon. Abundant roots.

1.05 Moist, brown, dense, intact, (gravelly) silty SAND with minor quartz gravel. Seemingly reworked residual quartzite. Few roots.

1.25 Slightly moist, light orange-brown to slightly pinkish light brown, dense becoming very dense, jointed and layered, highly to moderately weathered quartzite rock. No roots.

1.30

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: S2-S1/2BDEF.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

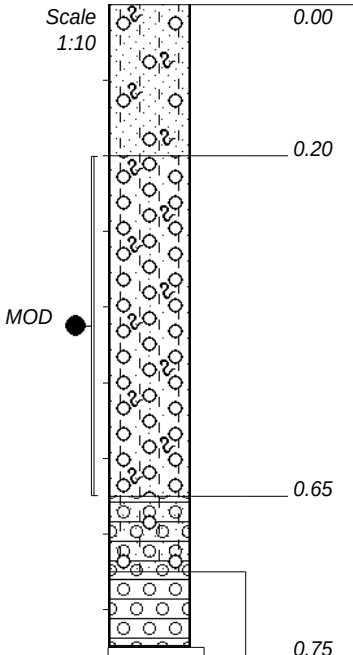
ELEVATION : 1752
X-COORD : 2905067
Y-COORD : 0091551

HOLE No: TP18

City of Joburg Property Company
South Hills

HOLE No: TP19
Sheet 1 of 1

JOB NUMBER: WF09071



0.00 Moist, brownish-grey, loose, intact, gravelly silty SAND with minor rounded quartz gravel. Reworked topsoil. Abundant roots.

0.20 Moist, orange-brown, medium dense, **slightly open structured**, silty sandy GRAVEL with abundant rounded quartz gravel and pebbles. Clast supported. Roots.

0.65 Slightly moist, light orange-brown, medium dense to dense, intact, silty gravelly SAND with minor sub rounded quartz gravel and pebbles. Reworked residual to totally weathered conglomerate. Very few to no roots.

0.75 Slightly moist, light pinkish grey, dense becoming very dense, jointed, moderately weathered conglomerate. No roots.

0.85

NOTES

1) TLB refusal on very dense conglomerate rock.

2) No water seepage.

3) MOD sample taken at 0.20m--0.65m.

4) Individual NHBRC classification: S1-S-R/3F 2BDEF.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1774
X-COORD : 2905363
Y-COORD : 0091563

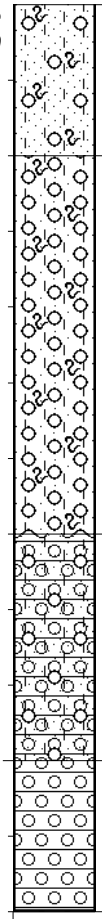
HOLE No: TP19

City of Joburg Property Company
South Hills

HOLE No: TP20
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00 Moist, brownish-grey, loose, intact, gravelly silty SAND with minor rounded quartz gravel. Reworked topsoil. Abundant roots.

0.20 Moist, orange-brown, medium dense, **slightly open structured**, silty sandy GRAVEL with abundant rounded quartz gravel and pebbles. Clast supported. Roots.

0.70 Slightly moist to moist, brownish-orange, medium dense to dense, intact, silty gravelly SAND with minor rounded quartz gravel and pebbles and minor vertical medium dense, **open structured**, weathering zones. Highly reworked totally weathered conglomerate. Roots in weathering zones.

1.00 Slightly moist, light orange-brown to slightly pinkish light brown, dense becoming very dense, highly becoming moderately weathered conglomerate rock. No roots.

1.20

NOTES

1) TLB refusal on very dense conglomerate rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: S1-S-R/2BDEF.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1763
X-COORD : 2905392
Y-COORD : 0091646

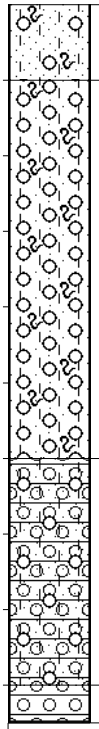
HOLE No: TP20

City of Joburg Property Company
South Hills

HOLE No: TP21
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00 Moist, brownish-grey, loose, intact, gravelly silty SAND with minor rounded quartz gravel. Reworked topsoil. Abundant roots.

0.10 Moist, orange-brown, medium dense, **slightly open structured**, silty sandy GRAVEL with abundant rounded quartz gravel and pebbles. Clast supported. Roots.

0.60 Slightly moist to moist, brownish-orange, medium dense to dense, intact, silty gravelly SAND with minor rounded quartz gravel and pebbles and minor vertical medium dense, **open structured**, weathering zones. Highly reworked totally weathered conglomerate. Roots in weathering zones.

0.90 Slightly moist, light orange-brown to slightly pinkish light brown, dense becoming very dense, highly becoming moderately weathered conglomerate rock. No roots.

0.95

NOTES

1) TLB refusal on very dense conglomerate rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: S1-S-R/2BDEF.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

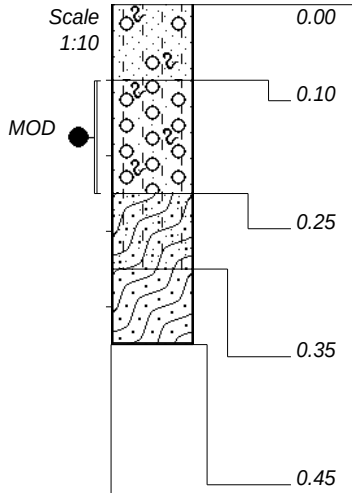
ELEVATION : 1765
X-COORD : 2905287
Y-COORD : 0091681

HOLE No: TP21

City of Joburg Property Company
South Hills

HOLE No: TP22
Sheet 1 of 1

JOB NUMBER: WF09071



Slightly moist to moist, brownish-grey, loose to medium dense, intact, gravelly silty SAND. Reworked topsoil. Abundant roots.

Slightly moist to moist, slightly greyish-brown, minor mottled orange-red, medium dense, intact, silty sandy GRAVEL with abundant rounded quartz gravel and pebbles. Pebble marker. Roots.

Slightly moist to moist, light brown, minor mottled orange-red, dense, intact, silty SAND with greyish-brown vertical weathering zones. Highly reworked highly weathered quartzite. Very few roots in weathering zones.

Slightly moist, light orange-brown to slightly pinkish light brown, dense becoming very dense, jointed and layered, highly to moderately weathered quartzite rock. No roots.

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) MOD sample taken at 0.10m--0.25m.

4) Individual NHBRC classification: R/3F 2BE.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1751
X-COORD : 2905087
Y-COORD : 0091785

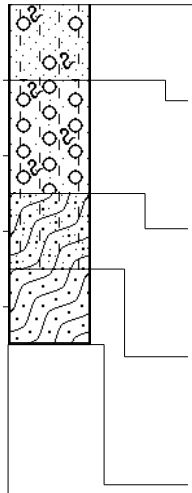
HOLE No: TP22

City of Joburg Property Company
South Hills

HOLE No: TP23
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00	Slightly moist to moist, brownish-grey, loose to medium dense, intact, gravelly silty SAND. Reworked topsoil. Abundant roots.
0.10	Slightly moist to moist, slightly greyish-brown, minor mottled orange-red, medium dense, intact, silty sandy GRAVEL with abundant rounded quartz gravel and pebbles. Pebble marker. Roots.
0.25	Slightly moist to moist, light brown, minor mottled orange-red, dense, intact, silty SAND with greyish-brown vertical weathering zones. Highly reworked highly weathered quartzite. Very few roots in weathering zones.
0.35	Slightly moist, light orange-brown to slightly pinkish light brown, dense becoming very dense, jointed and layered, highly to moderately weathered quartzite rock. No roots.
0.45	

NOTES

1) TLB refusal on very dense quartzite rock.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: R/3F 2BE.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels

TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13

DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1768
X-COORD : 2905427
Y-COORD : 0092853

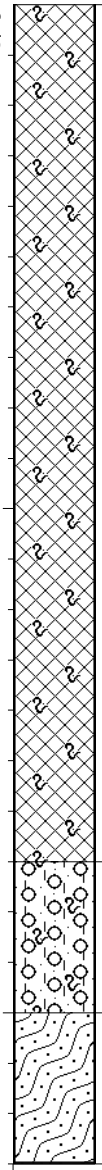
HOLE No: TP23

City of Joburg Property Company
South Hills

HOLE No: TP24
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:15



0.00 Moist, light grey to grey, very loose, abundant ash and glass. Low density uncompacted incinerated domestic refuse. Roots.

1.70 Slightly moist to moist, slightly greyish-brown, minor mottled orange-red, medium dense, intact, silty sandy GRAVEL with abundant rounded quartz gravel and pebbles. Reworked pebble marker. Roots.

2.00 Slightly moist, light orange-brown to slightly pinkish light brown, dense becoming very dense, jointed and layered, highly to moderately weathered quartzite rock. No roots.

2.30

NOTES

1) TLB gradual refusal on dense to very dense quartzite.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: P(fill)-S2/3D 2BE.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

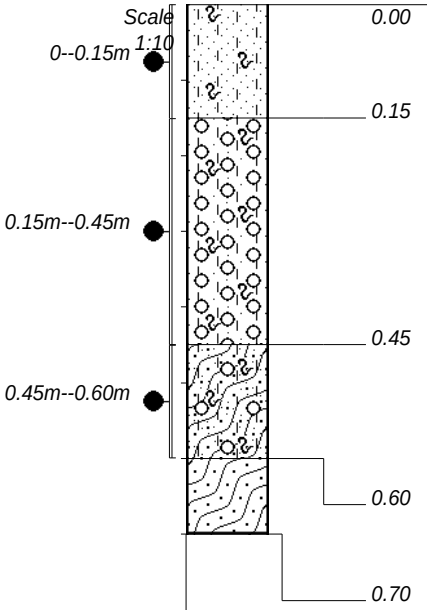
ELEVATION : 1761
X-COORD : 2905344
Y-COORD : 0092703

HOLE No: TP24

City of Joburg Property Company
South Hills

HOLE No: TP25
Sheet 1 of 1

JOB NUMBER: WF09071



Slightly moist to moist, greyish-brown, loose, intact, silty SAND with minor quartz gravel and pebbles. Topsoil. Abundant roots.

Slightly moist to moist, greyish-brown, loose to medium dense, intact, silty sandy GRAVEL to silty gravelly sand with abundant light grey to white and orange semi-translucent quartz gravel and pebbles. Pebble marker. Roots.

Slightly moist, brownish-orange, dense, intact, gravelly silty SAND with abundant highly to totally weathered quartzite fragments and medium dense vertical weathering zones. Reworked residual to totally weathered quartzite. Roots.

Slightly moist, light greyish-pink to slightly orange-pink, very dense, highly to moderately weathered quartzite rock.

NOTES

1) TLB refusal on very dense quartzite.

2) No water seepage.

3) Disturbed samples taken at 0--0.15m, 0.15m--0.45m and 0.45m--0.60m.

4) Individual NHBRC classification: S-R/3F 2BE.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1733
X-COORD : 2904573
Y-COORD : 0092632

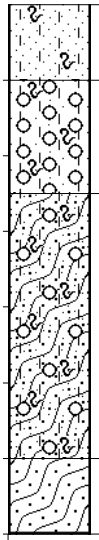
HOLE No: TP25

City of Joburg Property Company
South Hills

HOLE No: TP26
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00 Slightly moist to moist, greyish-brown, loose, intact, silty SAND with minor quartz gravel and pebbles. Topsoil. Abundant roots.

0.10 Slightly moist to moist, greyish-brown, loose to medium dense, intact, silty sandy GRAVEL to silty gravelly sand with abundant light grey to white and orange semi-translucent quartz gravel and pebbles. Pebble marker. Roots.

0.25 Slightly moist, brownish-orange, dense, intact, gravelly silty SAND with abundant highly to totally weathered quartzite fragments and medium dense vertical weathering zones. Reworked residual to totally weathered quartzite. Roots.

0.60 Slightly moist, light greyish-pink to slightly orange-pink, very dense, highly to moderately weathered quartzite rock.

0.70

NOTES

1) TLB refusal on very dense quartzite.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: S-R/3F 2BE.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels

TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13

DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1729
X-COORD : 2904443
Y-COORD : 0092503

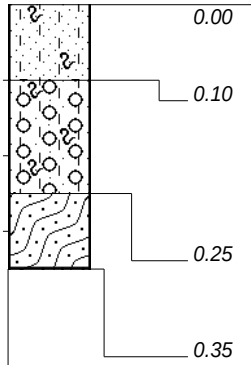
HOLE No: TP26

City of Joburg Property Company
South Hills

HOLE No: TP27
Sheet 1 of 1

JOB NUMBER: WF09071

Scale 1:10



0.00

Slightly moist to moist, greyish-brown, loose, intact, silty SAND with minor quartz gravel and pebbles. Topsoil. Abundant roots.

0.10

Slightly moist to moist, greyish-brown, loose to medium dense, intact, silty sandy GRAVEL to silty gravelly sand with abundant light grey to white and orange semi-translucent quartz gravel and pebbles. Pebble marker. Roots.

0.25

Slightly moist, light greyish-pink to slightly orange-pink, very dense, highly to moderately weathered quartzite rock.

0.35

NOTES

1) TLB refusal on very dense quartzite.

2) No water seepage.

3) No sample taken.

4) Individual NHBRC classification: S-R/3F 2BE.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels

TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13

DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

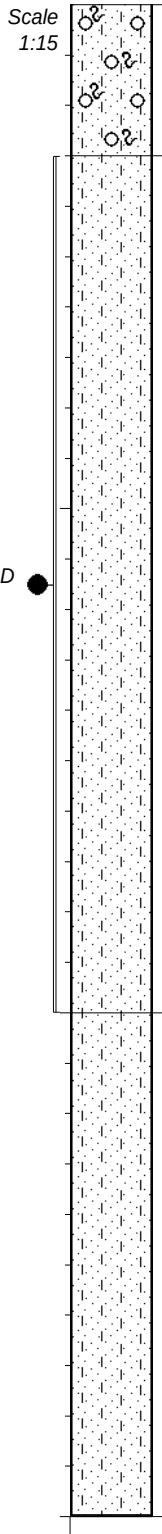
ELEVATION : 1720
X-COORD : 2904323
Y-COORD : 0092297

HOLE No: TP27

City of Joburg Property Company
South Hills

HOLE No: TP28
Sheet 1 of 1

JOB NUMBER: WF09071



0.00

Slightly moist to moist, brownish-grey, medium dense, intact, gravelly silty SAND with minor sub rounded quartz gravel and pebbles. Reworked topsoil. Abundant roots.

0.30

Moist, brownish-orange, loose to medium dense, **slightly open structured**, (clayey) silty fine SAND with scattered sub angular semi-translucent quartz gravel. Seemingly fine grained alluvial material. Very few roots.

2.00

Moist, light brownish-grey, blotched light grey, stained orange, medium dense to dense, intact, silty SAND. Seemingly slightly ferruginised residual sandstone? No roots.

3.00

NOTES

1) Reach of TLB.

2) No water seepage.

3) MOD sample taken at 0.30m--2.00m.

4) Individual NHBRC classification: P(flooding)-S2/3LD 2BE.

CONTRACTOR : TJ Plant Hire
MACHINE : CASE 580-K
DRILLED BY :
PROFILED BY : DH Wessels
TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 2009-08-13
DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

ELEVATION : 1687
X-COORD : 2904236
Y-COORD : 0091709

HOLE No: TP28

City of Joburg Property Company
South Hills

LEGEND
Sheet 1 of 1

JOB NUMBER: WF09071

	SCATTERED BOULDERS/occasional boulders	{SA48}
	GRAVEL	{SA02}
	GRAVELLY	{SA03}
	SAND	{SA04}
	SANDY	{SA05}
	SILTY	{SA07}
	CLAYEY	{SA09}
	CONGLOMERATE/agglomerate/tillite	{SA10}
	QUARTZITE	{SA15}
	FILL	{SA32}
Name ●	DISTURBED SAMPLE	{SA38}
	ROOTS	{SA40}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : DH Wessels
SETUP FILE : STANDARD.SET

DATE : 03/09/09 09:39
TEXT : ..C:\DOTFILES\09071_DP.TXT

LEGEND
SUMMARY OF SYMBOLS

APPENDIX C:

(SOIL PROFILE AND GENERAL PHOTOGRAPHS)

TP01 (a)
Photograph

Note: Refusal on quartzite at 0.60m.

TP01 (a)
Photograph

Note: Refusal on quartzite at 0.60m.

TP02 (a)
Photograph

Note: Hole stopped at 2.40m.

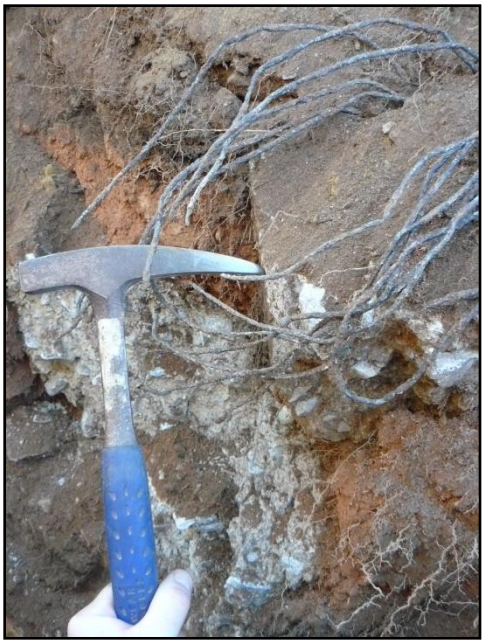
TP02 (b)
Photograph

Note: Note wire, brick and concrete fill.

TP03 (a)
Photograph

Note: Refusal on quartzite at 1.40m.

TP03 (b)
Photograph



Note: Concrete, brick and wire representing fill.

TP04 (a)
Photograph

Note: Hole stopped at 2.00m in uncompacted fill.

TP06(a)
Photograph

Note: Refusal on possibly quartzite bedrock or large size boulders at 1.70m.

TP06 (b)
Photograph

Note: Glass and ash in fill.

TP06 (c)
Photograph

Note: Glass, ash, domestic refuse.

TP07 (a)
Photograph

Note: Refusal on quartzite at 0.90m.

TP07 (b)
Photograph

Note: Ash, soil and domestic refuse.

TP08 (a)
Photograph

Note: Upper ash and boulder fill.

TP09 (a)
Photograph

Note: Refusal on quartzite at 0.50m.

TP09 (b)
Photograph

Note: Refusal on quartzite at 0.50m.

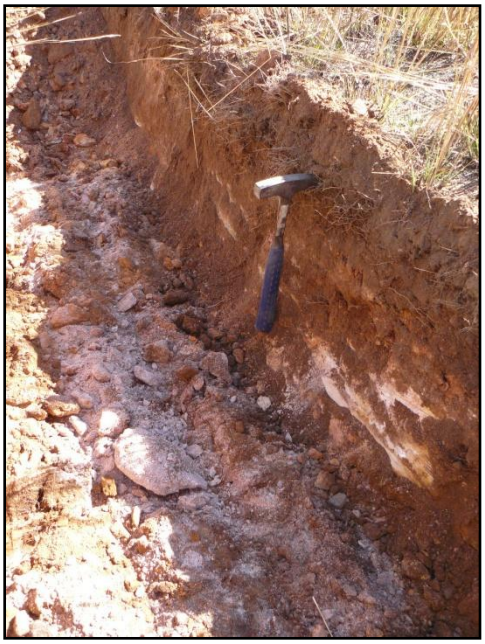
TP09 (c)
Photograph

Note: Highly weathered quartzite.

TP10 (a)
Photograph

Note: Refusal on quartzite at 0.50m.

TP11 (a)
Photograph



Note: Refusal on quartzite at 0.35m.

TP12 (a)
Photograph

Note: Refusal on quartzite at 0.20m.

TP13 (a)
Photograph

Note: Refusal on quartzite at 0.15m.

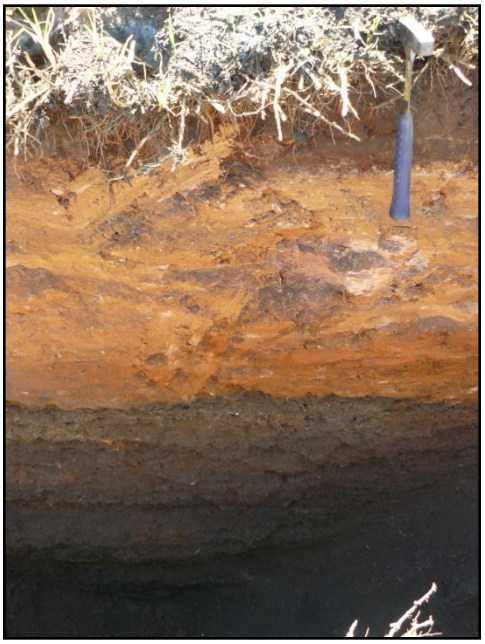
TP14 (a)
Photograph

Note: Fill down to +3.00m.

TP14 (b)
Photograph

Note: Low density ash and glass.

TP15 (a)
Photograph



Note: Upper residual sandstone backfill and domestic incinerated fill down to +3.00m.

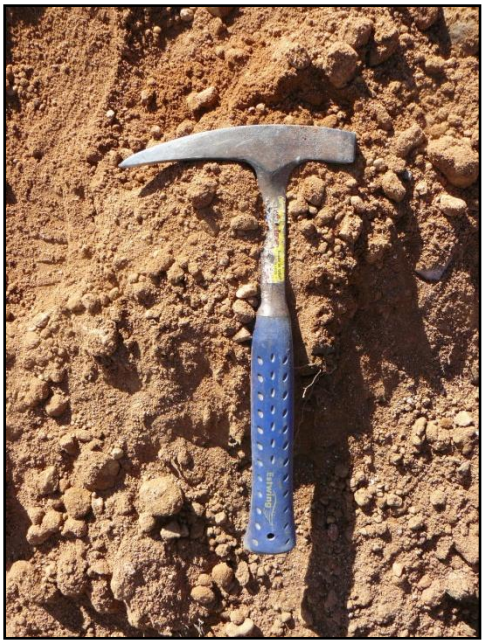
TP15 (b)
Photograph

Note: Low density ash and glass.

TP16 (a)
Photograph

Note: Refusal on quartzite at 1.60m.

TP16 (b)
Photograph



Note: Residual quartzite soil.

TP17 (a)
Photograph

Note: Refusal on quartzite at 1.40m.

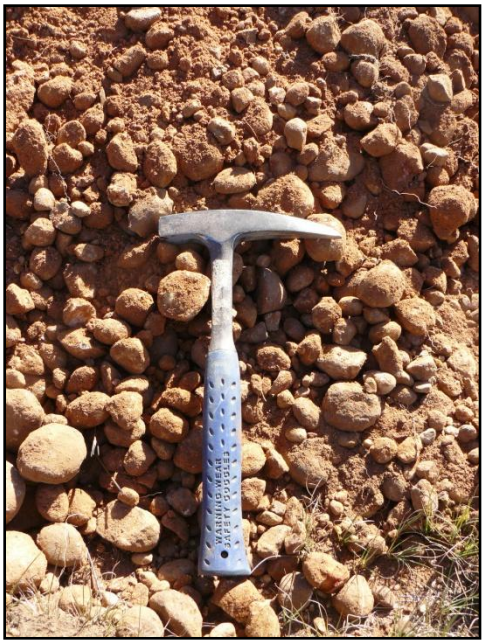
TP18 (a)
Photograph

Note: Upper fill and refusal on quartzite at 1.30m.

TP19 (a)
Photograph

Note: Refusal on conglomerate at 0.85m.

TP19 (b)
Photograph



Note: Pebble marker originating from weathered conglomerate.

TP20 (a)
Photograph

Note: Refusal on conglomerate at 1.20m.

TP20 (b)
Photograph

Note: Pebble marker originating from weathered conglomerate.

TP21 (a)
Photograph

Note: Refusal on conglomerate at 0.95m.

TP21 (b)
Photograph

Note: Pebble marker originating from weathered conglomerate.

TP21 (c)
Photograph

Note: Totally weathered sandy portion in interlayered conglomerate and quartzite.

TP22 (a)
Photograph

Note: Refusal on quartzite at 0.45m.

TP23 (a)
Photograph

Note: Refusal on sandstone at 0.45m.

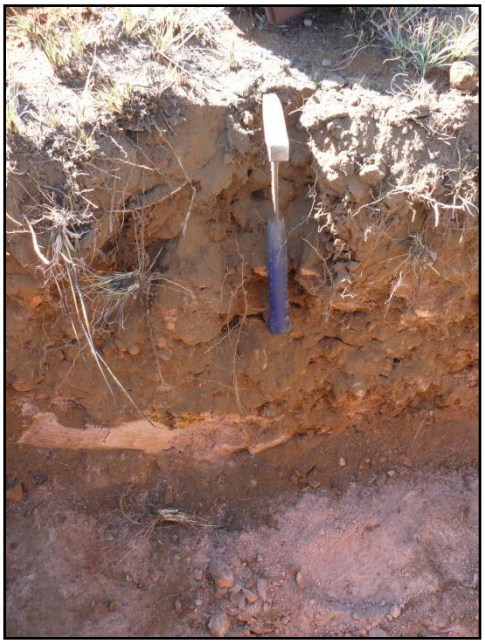
TP24 (a)
Photograph

Note: Refusal on sandstone at 2.30m. Not bottle from upper fill in bottom of test pit.

TP24 (b)
Photograph

Note: Ash and glass from domestic refuse.

TP25 (a)
Photograph



Note: Refusal on quartzite at 0.70m.

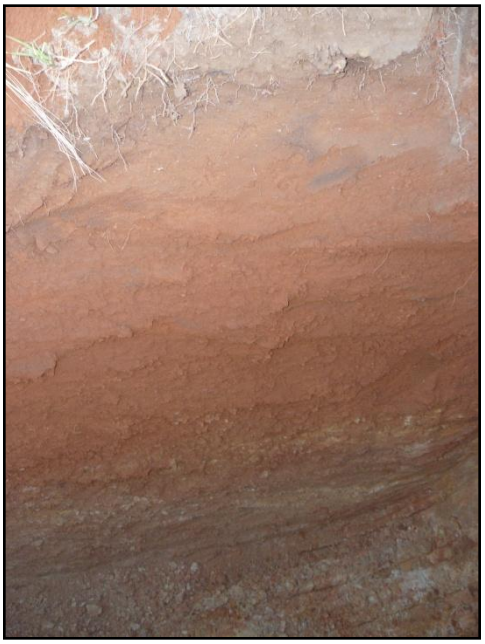
TP26 (a)
Photograph

Note: Refusal on quartzite at 0.70m.

TP27 (a)
Photograph

Note: Refusal on quartzite at 0.35m.

TP28 (a)
Photograph



Note: Reach of TLB at 3.00m.

TP28 (b) – Sample for compaction testing
Photograph

Note: Upper alluvial material.

TP28 (c)
Photograph

Note: Totally weathered quartzite.

GPS094
Photograph

Note: GPS94 – Conglomerate rock outcrop.

GPS134
Photograph

Note: GPS134 – Conglomerate rock outcrop.

Sample for compaction testing
Photograph

Note: Compaction sample of pebble marker/Hillwash originating from weathered conglomerate to southern portion of the investigated area.

APPENDIX D:

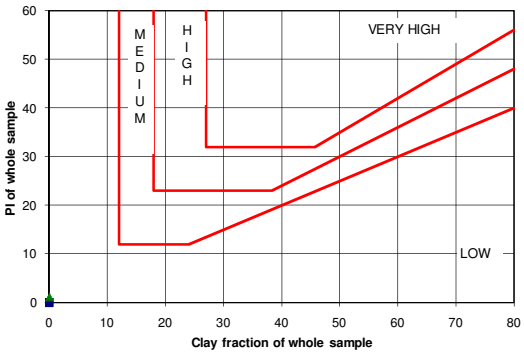
(LABORATORY TEST RESULTS)

PARTICLE SIZE ANALYSIS

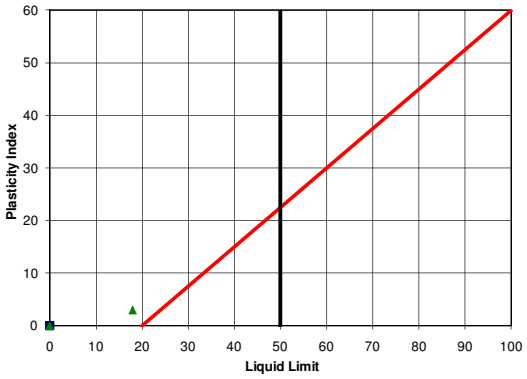
Sample No.	41998	41999
Soillab sample no.	S09-0914-01	S09-0914-02
Depth (m)	0-1.5	0.7-1.5
Position	TP05	TP17
Material Description	DARK GREY QUARTZ GRAVELLY SAND	DUSKY RED QUARTZ + SANDSTONE GRAVELLY SAND
Moisture (%)		
SG		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	96	100
37.5 mm	90	100
26.5 mm	84	100
19.0 mm	78	100
13.2 mm	76	95
4.75 mm	67	73
2.00 mm	63	62
0.425 mm	44	38
0.075 mm	19	20
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	11	13
0.027 mm	7	10
0.013 mm	2	5
0.005 mm	0	2
0.002 mm	0	0
% Clay	0	0
% Silt	15	17
% Sand	48	45
% Gravel	37	38
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit		18
Plasticity Index	NP	3
Linear Shrinkage (%)	0.0	1.5
Grading Modulus	1.74	1.80
Classification	A-1-b (0)	A-1-b (0)
Unified Classification	SC	SM
Chart Reference		

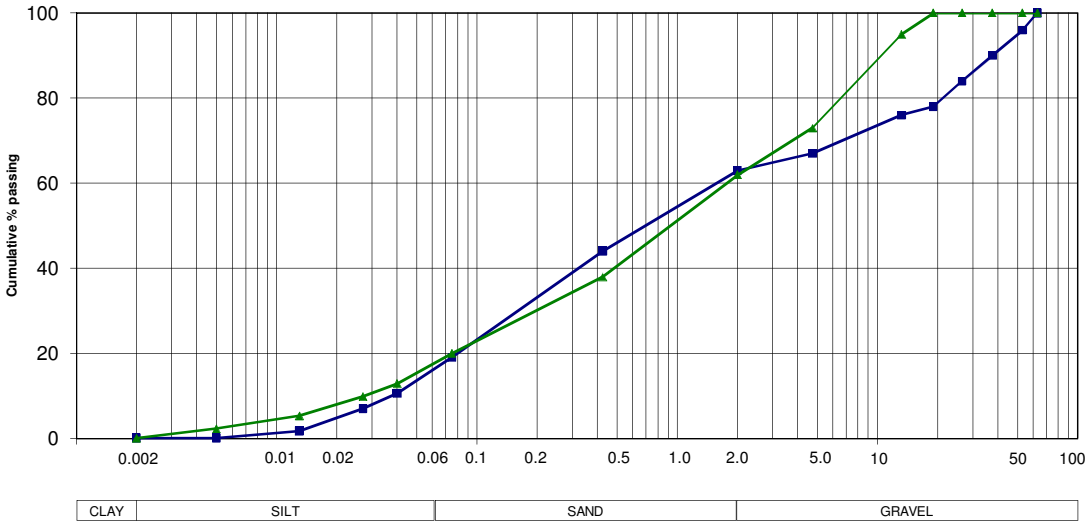
PROJECT : SOUTH HILLS
JOB No. : S09-0914
DATE : 2009-08-25

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





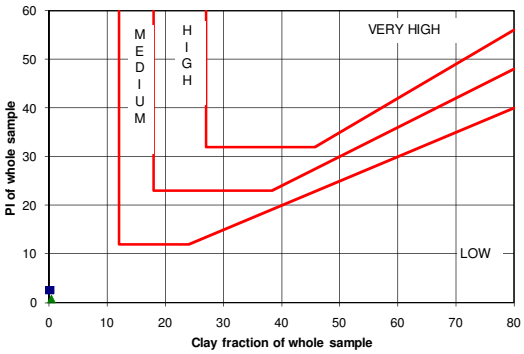
SOILLAB (PTY) LTD
Reg No 1971/000112/07
230 Albertus Street
La Montagne 0184
Tel (012) 481-3999
P O Box 72928
Lynnwood Ridge 0040
Fax (012) 481-3812

PARTICLE SIZE ANALYSIS

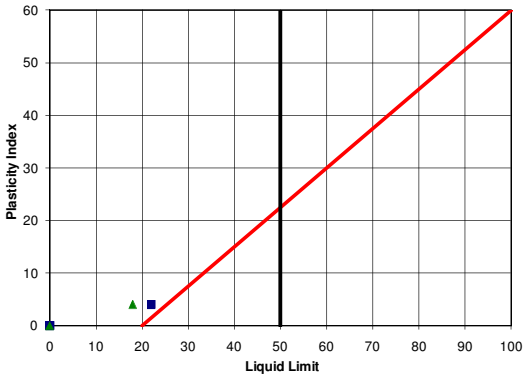
Sample No.	42000	42001
Soillab sample no.	S09-0914-03	S09-0914-04
Depth (m)	0-0.15	0.15-0.45
Position	TP25	TP25
Material Description	DARK GREY QUARTZ SILTY SAND	DARK BROWN QUARTZ SANDY GRAVEL
Moisture (%)		
SG		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	94
26.5 mm	100	77
19.0 mm	100	69
13.2 mm	99	59
4.75 mm	97	35
2.00 mm	96	31
0.425 mm	64	19
0.075 mm	33	8
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	20	5
0.027 mm	17	5
0.013 mm	10	3
0.005 mm	4	2
0.002 mm	0	0
% Clay	0	0
% Silt	28	6
% Sand	68	24
% Gravel	4	69
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit	22	18
Plasticity Index	4	4
Linear Shrinkage (%)	2.0	1.5
Grading Modulus	1.07	2.42
Classification	A-2-4 (0)	A-1-a (0)
Unified Classification	SC & SM	GP & GC
Chart Reference		

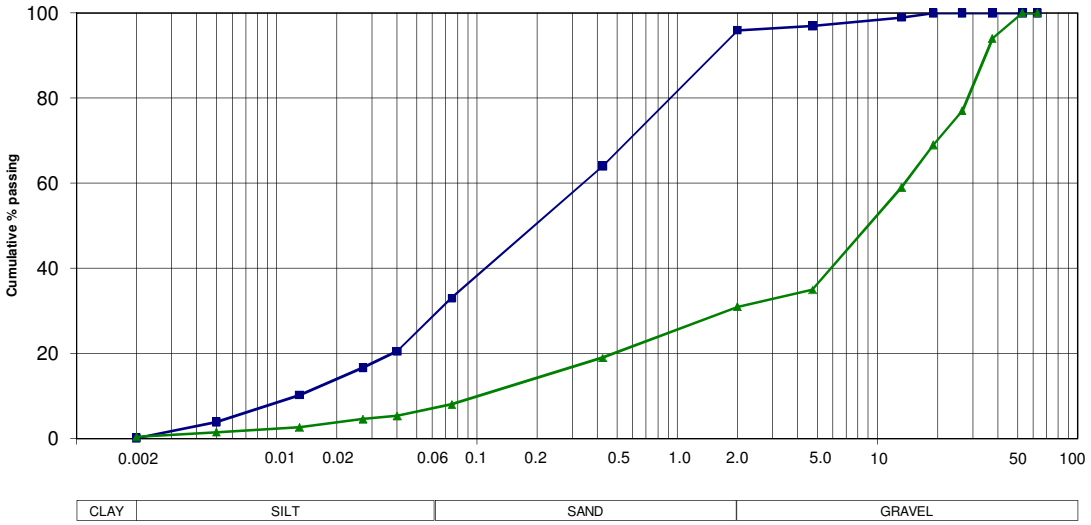
PROJECT : SOUTH HILLS
JOB No. : S09-0914
DATE : 2009-08-25

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





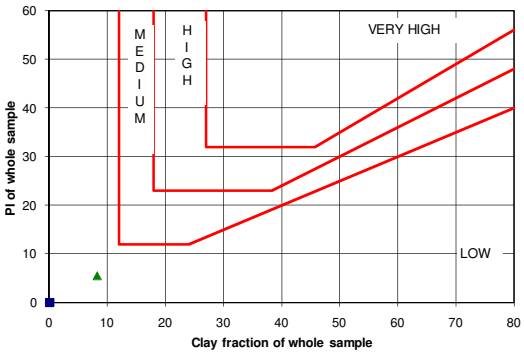
SOILLAB (PTY) LTD
Reg No 1971/000112/07
230 Albertus Street
La Montagne 0184
Tel (012) 481-3999
P O Box 72928
Lynnwood Ridge 0040
Fax (012) 481-3812

PARTICLE SIZE ANALYSIS

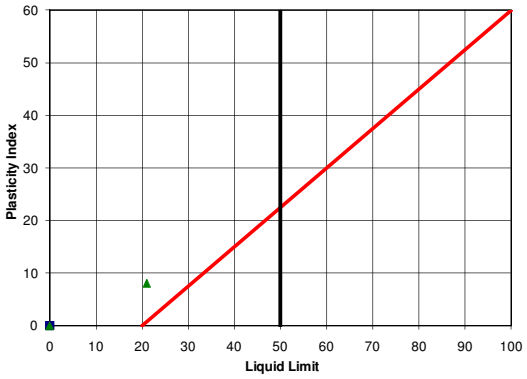
Sample No.	42002	42003
Soillab sample no.	S09-0914-05	S09-0914-06
Depth (m)	0.45-0.6	
Position	TP25	MOD A
Material Description	DARK R ORANGE QUARTZ + SANDSTONE SILTY SAND	DARK R ORANGE QUARTZ SILTY SAND
Moisture (%)		
SG		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	99	100
4.75 mm	95	99
2.00 mm	89	95
0.425 mm	48	69
0.075 mm	23	37
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	14	25
0.027 mm	12	21
0.013 mm	7	17
0.005 mm	2	12
0.002 mm	0	8
% Clay	0	8
% Silt	19	24
% Sand	70	63
% Gravel	11	5
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit		21
Plasticity Index	SP	8
Linear Shrinkage (%)	0.5	4.0
Grading Modulus	1.40	0.99
Classification	A-1-b (0)	A-4 (0)
Unified Classification	SC	SC
Chart Reference		

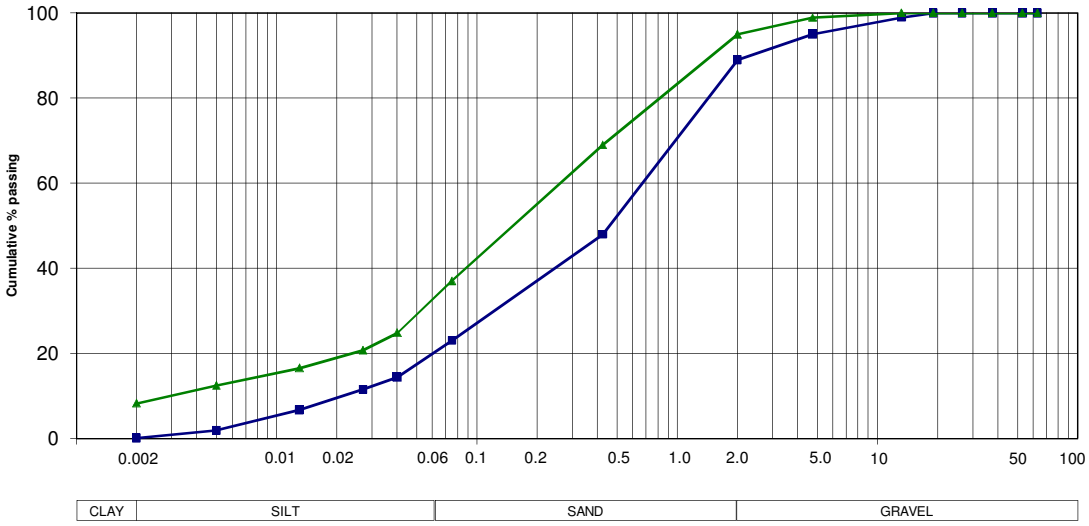
PROJECT : SOUTH HILLS
JOB No. : S09-0914
DATE : 2009-08-25

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





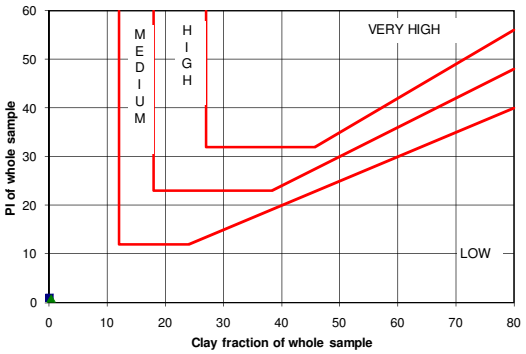
SOILLAB (PTY) LTD
Reg No 1971/000112/07
230 Albertus Street
La Montagne 0184
Tel (012) 481-3999
P O Box 72928
Lynnwood Ridge 0040
Fax (012) 481-3812

PARTICLE SIZE ANALYSIS

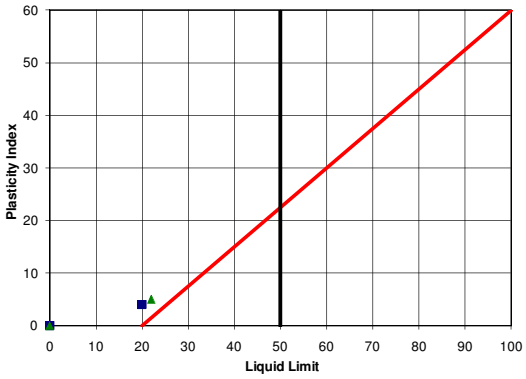
Sample No.	42004	42005
Soillab sample no.	S09-0914-07	S09-0914-08
Depth (m)		
Position	MOD B	MOD C
Material Description	DARK BROWN QUARTZ SANDY GRAVEL	DUSKY RED QUARTZ SANDY GRAVEL
Moisture (%)		
SG		
SCREEN ANALYSIS (% PASSING) **(TMH 1 A1(a) & A5)**		
63.0 mm	98	97
53.0 mm	97	94
37.5 mm	89	81
26.5 mm	75	71
19.0 mm	67	63
13.2 mm	55	50
4.75 mm	38	31
2.00 mm	34	21
0.425 mm	24	17
0.075 mm	9	9
HYDROMETER ANALYSIS (% PASSING) **(TMH 1 A6)**		
0.040 mm	6	5
0.027 mm	4	4
0.013 mm	2	2
0.005 mm	1	1
0.002 mm	0	0
% Clay	0	0
% Silt	8	7
% Sand	26	14
% Gravel	66	79
ATTERBERG LIMITS **(TMH 1 A2 - A4)**		
Liquid Limit	20	22
Plasticity Index	4	5
Linear Shrinkage (%)	1.5	2.0
Grading Modulus	2.33	2.53
Classification	A-1-a (0)	A-1-a (0)
Unified Classification	GW & GC	GP & GC
Chart Reference		

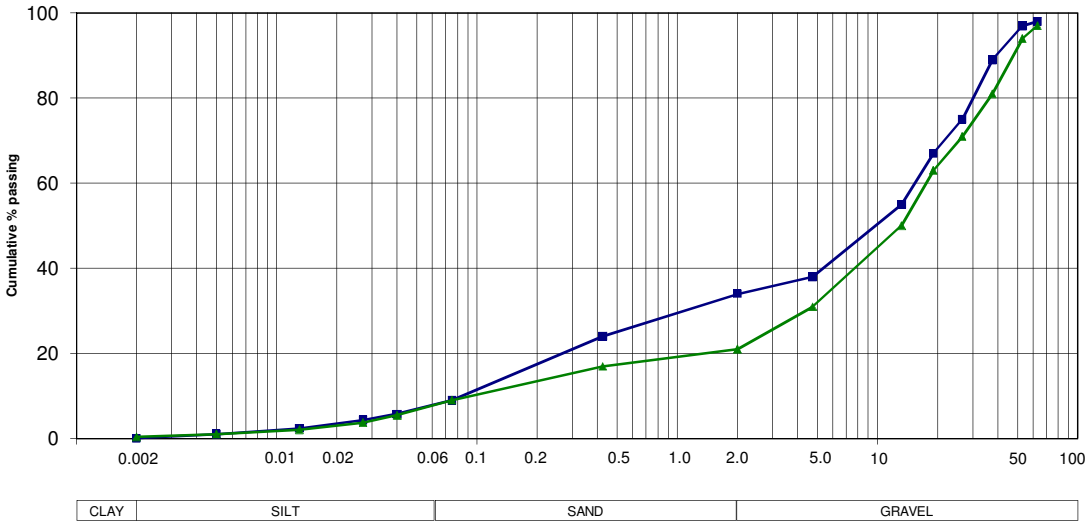
PROJECT : SOUTH HILLS
JOB No. : S09-0914
DATE : 2009-08-25

POTENTIAL EXPANSIVENESS



PLASTICITY CHART





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 : WSM LESHIKA

PROJECT : SOUTH HILLS

PROJECT NO. : S09-0914

DATE : 2009-08-26

pH & CONDUCTIVITY

Soillab Sample No	Sample Position	Sample Depth (m)	pH	Electrical Conductivity S/m
S09-0914-01	TP05	0-0.15	5.53	0.0127
S09-0914-02	TP17	0.7-1.5	7.06	0.0136
S09-0914-03	TP25	0-0.5	4.81	0.0209
S09-0914-04	TP25	0.15-0.45	4.38	0.0119
S09-0914-05	TP25	0.45-0.60	5.07	0.0099
S09-0914-06	MOD A	-	4.82	0.0075
S09-0914-07	MOD B	-	4.85	0.0036
S09-0914-08	MOD C	-	4.65	0.0030

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

Customer ..... : WSM LESHIKA
Job Description ..... : SOUTH HILLS
Road Number ..... :
Job Number ..... : S09-0914
Contract Number .... :
Date ..... : 2009-08-25

SAMPLE DESCRIPTION						
Sample Number	42003	42004	42005			
Sample Position	MOD A	MOD B	MOD C			
Sample Depth (mm)						
Material Description	DARK RED ORANGE QUARTZ SANDY SILT	DARK BROWN QUARTZ GRAVEL	DUSKY RED QUARTZ GRAVEL			
Max size of boulder (mm)	-	-	130			
SCREEN ANALYSIS (% PASS)						
75,00 mm	100	100	100			
63,00 mm	100	98	97			
53,00 mm	100	97	94			
37,50 mm	100	89	81			
26,50 mm	100	75	71			
19,00 mm	100	67	63			
13,20 mm	100	55	50			
4,750 mm	99	38	31			
2,000 mm	95	34	21			
0,425 mm	69	24	17			
0,075 mm	37	9	9			
SOIL MORTAR						
Coarse Sand 2,000-0,425	27	30	22			
Coarse Fine Sd 0,425-0,250	13	16	13			
Medium Fine Sd 0,250-0,150	11	15	10			
Fine Fine Sand 0,150-0,075	10	12	14			
Material <0,075	39	27	41			
CONSTANTS						
Grading Modulus	0.99	2.33	2.53			
Liquid Limit	21	20	22			
Plasticity Index	8	4	5			
Linear Shrinkage (%)	4.0	1.5	2.0			
Sand Equivalent						
Classification - TRB	A-4 (0)	A-1-a (0)	A-1-a (0)			
Classification - COLTO	G7	G6	G6			
CBR / UCS VALUES	CBR	CBR	CBR			
MOD. AASHTO						
Max Dry Density (kg/m³)	2097	2154	2154			
Optimum Moisture Cont (%) ...	8.4	6.5	6.5			
Moulding Moisture Cont (%) ...	8.5	6.6	6.6			
Dry Density (kg/m³)	2098	2164	2151			
% of Max Dry Density	100.0	100.5	99.9			
100% Mod CBR/UCS	44	70	80			
% Swell	0.1	0.0	0.0			
NRB						
Dry Density (kg/m³)	1997	2043	2052			
% of Max Dry Density	95.2	94.8	95.3			
100% NRB CBR/UCS	25	34	42			
% Swell	0.1	0.0	0.0			
PROCTOR						
Dry Density (kg/m³)	1891	1940	1944			
% of Max Dry Density	90.2	90.1	90.3			
100% Proc CBR/UCS	15	16	15			
% Swell	0.1	0.0	0.0			
CBR / UCS VALUES						
100% Mod AASHTO	44	66	82			
98% Mod AASHTO	35	51	62			
97% Mod AASHTO	31	45	54			
95% Mod AASHTO	24	35	40			
93% Mod AASHTO	20	25	26			
90% Mod AASHTO	15	16	14			
Soillab No.	S09-0914-06	S09-0914-07	S09-0914-08			

SOILLAB (PTY) LTD
Reg No 1971/000112/07
230 Albertus Street
La Montagne
Tel (012) 481-3801
P O Box 72928
Lynnwood Ridge 0040
Fax (012) 481-3812

APPENDIX E:

(SITE CLASS DESIGNATIONS AND FOUNDATION DESIGNS)

Table 7 : 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 are 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 8 : 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 adoption of a construction type appropriate to a more severe site class.

TABLE 9 : 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.
		Soil raft	- Good site drainage. - 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 10. GEOTECHNICAL CLASSIFICATION FOR URBAN DEVELOPMENT (after Partridge, Wood and Brink 1993)

CONSTRAINT		Most favourable (1)	Intermediate (2)	Least favourable (3)
A	Collapsible Soil	Any collapsible horizon or consecutive horizons totalling a depth of less than 750 mm in thickness.*	Any collapsible horizon or consecutive horizons with a depth of more than 750 mm in thickness.	A least favourable situation for this constraint does not occur.
B	Seepage	Permanent or perched water table more than 1,5 m below ground surface.	Permanent or perched water table less than 1,5 m below ground surface	Swamps and marshes.
C	Active soil	Low soil-heave potential predicted. *	Moderate soil heave potential predicted.	High soil-heave potential predicted.
D	Highly compressible soil	Low soil compressibility expected.*	Moderate soil compressibility expected.	High soil compressibility expected.
E	Erodability of soil	Low.	Intermediate.	High.
F	Difficulty of excavation to 1,5 m depth	Scattered or occasional boulders less than 10% of the total volume.	Rock or hardpan pedocretes between 10 and 40 % of the total volume.	Rock or hardpan pedocretes more than 40 % of the total volume.
G	Undermined ground	Undermining at a depth greater than 100 m below surface (except where total extraction mining has not occurred.)	Old undermined areas to a depth of 100m below surface where stope closure has ceased.	Mining within less than 100 m of surface or where total extraction mining has taken place.
H	Instability in areas of soluble rock	Possibly unstable.	Probably unstable.	Known sinkholes and dolines
I	Steep slopes	Between 2 and 6 degrees (all regions).	Slopes between 6 and 18 degrees and less than 2 degrees (Natal and Western Cape). Slopes between 6 and 12 degrees and less than 12 degrees (all other regions).	More than 18 degrees (Natal and Western Cape). More than 12 degrees (all other regions).
J	Areas of unstable natural slopes	Low risk.	Intermediate risk.	High risk (especially in areas subject to seismic activity).
K	Areas subject to seismic activity	10% probability of an event less than 100 cm/s^2 within 50 years	Mining-induced seismic activity more 100 cm/s^2.	Natural seismic activity more than 100 cm/s^2.
L	Areas subject to flooding	A “most favourable” situation for this constraint does not occur.	Areas adjacent to a known drainage channel or floodplain with slope less than 1%.	Areas within a known drainage channel or floodplain.

* These areas are designated as 1A, 1C, 1D, or 1F where localised occurrences of the constraint may arise.

APPENDIX F:

(GUIDELINE MATERIAL PROPERTIES AND SPECIFICATIONS)

TABLE 11 : Typical material properties (Unified Soil Classification System)

Class:	Material description	Subgrade	Subbase	Base	Drainage when compacted	Compaction characteristics	Embankment material	Compressibility when compacted
GW	Well-graded gravel	Good to Excellent	Good	Fair to good	Excellent	Good	Reasonably stable	Low
GP	Poorly grade gravel (<5% fines)	Good to Excellent	Good	Fair to good	Excellent	Good	Reasonably stable	Low
GC	Clayey gravel (>12% fines)	Good	Fair	Poor to not suitable	Poor to practically impervious	Good to fair	Reasonably stable	Low
SP	Poorly graded sand (<5% fines)	Fair to good	Fair	Poor to not suitable	Excellent	Good	Reasonably stable	Low
SM	Silty sand (sand with fines PI<4)	Fair to good	Fair to good	Poor to not suitable	Fair to practically impervious to impervious	Good	Reasonably stable	Low
SC	Clayey sand (>12% fines PI>7)	Fair	Poor	Not suitable	Poor, impervious when compacted	Good to fair	Reasonably stable	Low
CL	Silts and clays (LL<50 & PI>7)	Fair to poor	Not suitable	Not suitable	Practically impervious	Good to fair	Good stability	Medium
ML	Silts and clays (LL<50 & PI<4)	Fair to poor	Not suitable	Not suitable	Semi-pervious to impervious	Good to poor	Poor stability	Medium
CH	Silts and clays (LL>50)	Poor to fair	Not suitable	Not suitable	Practically impervious	Fair to poor	Fair stability	Medium to high
MH	Silts and clays (LL>50)	Poor	Not suitable	Not suitable	Fair to poor, semi-pervious to pervious	Fair to poor	Poor stability	Medium to high

TABLE 12 : Typical material properties after NAVFAC DM7 (1971)

Group symbol	Soil type	Max yd	Optimum moisture (%)	Typical strength characteristics			
				Cu (kPa)	C` (kPa)	ϕ` (deg.)	tan ϕ`
GW	Well-graded clean gravels, gravel-sand mixtures	19.7-21.2	11-8	0	0	>38	>0.78
GC	Clayey gravels, poorly graded gravel-sand-clay	18.1-20.5	14-9	0	0	>31	>0.60
SM	Silty sands, poorly graded sand-silt mixtures	17.3-19.7	16-11	50	5	34	0.67
SC	Clayey sands poorly graded sand-clays	16.5-19.7	19-11	75	10	31	0.60
CL	Inorganic clays of low to medium plasticity	15.0-18.9	24-12	85	12	28	0.54
ML	Inorganic silts and clayey silts	15.0-18.9	24-12	65	10	32	0.62
CH	Inorganic clays of high plasticity	11.8-16.5	36-19	100	12	19	0.35

yd – Dry density; Cu – Undrained cohesion; C` - Drained cohesion; ϕ`(deg.) – Shearing resistance

TABLE 13 : Shear strength parameters for slow draining cohesive materials

	Consistency	**Rule of thumb Field identification**	**Unconfined Compressive Strength (kN/m^2)**	**UCS (kPa) (COP4)**	**UCS (kPa) (Terz & Peck)**	**Approximate SPT (N)**
S.1	Very soft	Easily moulded by fingers. Full pick penetration	< 40	< 35	<25	<2
S.2	Soft	Easily penetrated by with thumb. Moulded with strong pressure. 30 to 40mm penetration	40 to 80	35 to 75	25 to 50	2 to 4
S.3	Firm	Indent by thumb with effort. Very difficult to mould with fingers. 10mm penetration	80 to 160	75 to 150	50 to 100	4 to 8
S.4	Stiff	Penetration by thumb nail. Cannot be moulded with fingers. Geologist pick (sharp end) makes slight indentation when pushed.	160 to 320	150 to 300	100 to 200	8 to 15
S.5	Very stiff	Indentation by thumb nail difficult. Slight indentation with blow of geologist pick. Power tools required for excavation.	320 to 1000	> 300	200 to 400	15 to 50

TABLE 14 : Shear strength parameters for quick draining non-cohesive materials

Consistency	Rule of thumb Field identification	Approx CPT (MPa)	Approx SPT (N)	Approximate ϕ`	Typical Dry Density (kg/m^3)
Very loose	Crumbles very easily when scraped with geological pick	0 to 2	0 to 5	26 to 28	< 1450
Loose	Small resistance to penetration by sharp end of geological pick	2 to 4	5 to 10	28 to 30	1 450 to 1 600
Medium dense	Considerable resistance to penetration by sharp end of geological pick	4 to 9	10 to 30	30 to 35	1 600 to 1 750
Dense	Very high resistance to penetration of sharp end of geological pick. Requires many blows of pick for excavation	9 to 12.5	30 to 50	35 to 40	1 750 to 1 950
Very dense	High resistance to repeated blows of geological pick. Requires power tools for excavation	< 12.5	> 50	40 to 50	> 1 950

TABLE 15 : Pipe bedding material and backfill (modified summary according to SABS 1200)

Pipe Bedding Material					
Grading limits	**Pipe cradle**	**CBR**	**PI**	**Compactability factor**	**Organic material**
Between 0,6 and 19 mm	< 30 mm	At least 3% at the minimum specified density compacted at **OMC***	< 18	> 0.4	No organic material
Main Fill Material					
• Excludes stones of average dimension exceeding 150mm. • Not more than 10% rock or hard fragments retained on a sieve of nominal aperture size 50mm. • Material should not contain large clay lumps that do not break up under the action of compaction equipment • No or little organic material					

***OMC** – Optimum Moisture Content

TABLE 16 : Summary of specified requirements for coarse aggregate (stone) used in the production of both readymix and site-batched concrete.

Property	**Requirements**							
Grading Limits % (m/m) passing sieve sizes	**Nominal aggregate size, mm**							
	75,5	53,0	37,5	26,5	19,0	13,2	9,5	6,7
75,0	100	100						
53,0	0-50	85-100	100					
37,5	0-25	0-50	85-100	100				
26,5	0-5	0-25	0-50	85-100	100			
19,0		0-5	0-25	0-50	85-100	100		
13,2			0-5	0-25	0-50	85-100	100	
9,5				0-5	0-25	0-55	85-100	100
6,7					0-5	0-25	0-55	85-100
4,75						0-5	0-25	0-55
2,36							0-5	0-25
1,18								0-5
Dust Content (Material passing 75 um sieve, mass percentage, max)	2,0							
Flakiness index % max	35							
10% FACT kN, min	110 for aggregates used in concrete subject to surface abrasion, and for structural elements of reinforced concrete and pre-stressed concrete							
	70 for aggregates used in concrete not subject to surface abrasion							
Aggregate crushing value, % max	29							

TABLE 17 : Summary of specified requirements for fine aggregate (sand) used in the production of both readymix and site-batched concrete.

Property	**Requirements**	
Grading limits, % (m/m) passing sieve sizes, mm	**Natural Sand**	**Crushed Sand**
4,75 0,150	90-100 5 - 25	
Methylene blue absorption value, max	0,7	
Clay content (Material of particle size smaller than 5 um, mass percentage, max)	2,0	
Dust content (Material passing 75 um sieve, mass percentage, max)	5	10
Fineness modulus	1,2 - 3,5	

TABLE 18 : Summary of specified requirements for sands used in the production of mortars and plasters.

Property	**SABS requirements**	
	Plaster	**Mortar**
Grading limits, % (m/m) passing sieve sizes, mm 4,75 2,36 1,18 0,600 0,300 0,150	 100 90-100 70-100 40-90 5-65 5-20	 100 90-100 70-100 40-100 5-85 5-35
Dust content (Material passing 75 um sieve, mass percentage, max)	7,5	12,5
Clay content (Material of particle size smaller than 5 um, mass percentage, max)	2,0	
Drying shrinkage of mix, % max	0,10	0,12