

**GEOTECHNICAL INVESTIGATIONS  
OF SITE 1: BOKSBURG MINING BELT.**

**IR823 addendum**

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OF SITE 1: BOKSBURG MINING BELT.**

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**INTRACONSULT ASSOCIATES  
P.O. BOX 604  
FOURWAYS  
2055  
TEL: (011) 469 0854  
FAX: (011) 469 0961**

**IR823 ad  
MAY 2007**

URBAN DYNAMICS  
P.O. BOX 291803  
MELVILLE  
2109

P.O. Box 604,  
Fourways 2055  
Johannesburg

Telephone :  
Direct : (011) 469 0854

ATTENTION: MR H. POTGIETER

Fax : (011) 469 0961  
Email: [intrac@mweb.co.za](mailto:intrac@mweb.co.za)

Your reference

Our reference  
IR823 ad

Date  
21 May 2007

## GEOTECHNICAL INVESTIGATIONS OF SITE 1: BOKSBURG MINING BELT : ADDENDUM

### 1. INTRODUCTION

During the initial GFSH-1 geotechnical investigation in January 2007, the project site was divided into four geotechnical zones, as defined and graphically presented on Figure 3, Revision 0 of report IR823R. Zones 1 to 3 classified the site into areas with common engineering and founding conditions, while Zone 4 was demarcated as an area inaccessible to test pitting, due to essentially waterlogged ground conditions, which could not be formally evaluated and classified.

### 2. ADDITIONAL FIELDWORK

Following the completion of the initial fieldwork, this portion of the project site was largely drained and stripped of all fluvial and vlei vegetation, permitting vehicular access and, consequently, the excavation and profiling of an additional 11 additional test pits in the previously unexplored regions of the site (Figure 2, Revision 1).

The profiles of these test pits (Appendix A2) confirm the soil/rock conditions occurring on the fringes of the previously unexplored waterlogged Zone 4, i.e., two fairly uniform horizons of firm through stiff, slickensided (moderately to highly expansive) lacustrine deposits, which become progressively ferruginised and/or calcretised with depth, beneath the uppermost horizon comprising mine tailings and/or mixed, organic-rich fill.

The competent ferricrete horizon previously encountered in Zone 2, was found to persist around the southern and eastern periphery of the Zone 4, buried beneath a thin, unconsolidated hillwash horizon.

The underlying residual soils and rock were, in all test pits, once again, not proven.

Table 1 below presents the profile summary of all horizon data encountered in the test pits, and supercedes Table 1 of the former report.

Although essentially drained of surface water at the time of this investigation, the low permeability soil profile is such that general waterlogged conditions may easily reoccur during the wet season unless the surface runoff is appropriately canalized through the site. The general site drainage precautions presented in the former report are considered essential for the development of this site.

### 3. REVISED GEOTECHNICAL ZONATION

On the basis of the additional test pit information, the Geotechnical Zonation previously presented has been revised as follows:

- Zone 4 (the inaccessible waterlogged area) is now largely absorbed into Zone 1 and partly into Zone 2.
- Zone 2 is slightly enlarged on the eastern periphery of the site.

In summary, the site is condensed into the following three geotechnical zones, the inferred boundaries of which are presented in Figure 3, Revision 1 (cf Figure 3, Revision 0):

Zone 1:        **2 / H1-H2 / S1 / P (contaminated soils)** comprising the central and northern portions of the site in which *potentially moderately to highly expansive* clay horizons underlie, a horizon of moist, compressible mine tailings and / or transported soils.

Zone 2:        **2 / C-C1 / R (hardpan ferricrete sub-outcrop) / P (contaminated soils)** comprising the southern and eastern fringe of the site around the perimeter of Zone 1, in which very competent ferricrete underlies the site, intermittently buried beneath shallow *potentially collapsible* and/or compressible transported soils.

Zone 3:        **2 / C2 / P (contaminated soils)** which comprises the south-western extremity of the site in which thick, *potentially highly collapsible* transported soils overlie hardpan ferricrete at depth.

Table 1: Depth and Inferred Thicknesses of the Soils / Rocks Underlying the Site

Hole Number	Depth of Hole (m)	Depth (m) to Base of Horizon						Depth to Rock (m)	Depth to Ground Water (m)
		Mine Silimes	Lacustrine	Hillwash	Ferricrete	Alluvium	Residual Sandstone		
TP01	2.4	0.3	2.4 <sup>1+</sup>					NP	1.8
TP02	2.5	0.1	0.4		2.5+			NP	0.4
TP03	2.5		2.0				2.5+	NP	-
TP04	2.4	0.4	2.0		2.4+			NP	0.4
TP05	2.6	0.2		0.5	2.6+			NP	
TP06	2.4			2.4 <sup>1+</sup>				NP	1.2
TP07	2.5	0.4	2.0				2.5+	NP	-
TP08	2.6		2.6+					NP	-
TP09	2.7		2.7+					NP	-
TP10	2.4	0.15		1.25	2.4+			NP	-
TP11	2.4			1.2	2.4+			NP	1.2
TP12	2.2			1.2	2.2+			NP	1.8
TP13	2.7			0.1 <sup>1+</sup>				NP	0.9
TP14	1.0	0.25		0.4	1.0+			NP	-
TP15	2.4		2.4+	0.35				NP	-
TP16	0.7			0.5	0.7+			NP	-
TP17	2.1			1.5 <sup>1</sup>				NP	1.5
TP18	2.7	0.6	2.7 <sup>1+</sup>					NP	-
TP19	2.4	0.3	2.4 <sup>1+</sup>					NP	-
TP20	1.65			0.50	1.65+			NP	-
TP21	2.55	0.3	0.85			2.55 <sup>1+</sup>		NP	-
TP22	2.5		2.5 <sup>1+</sup>					NP	-
TP23	2.2		2.0			2.2 <sup>1,2+</sup>		NP	-
TP24	2.5		2.5 <sup>1+</sup>	0.35				NP	-
TP25	2.5	0.5	2.01+			2.5 <sup>2+</sup>		NP	-
TP26	2.65	0.5	2.65+					NP	-
TP27	1.2	0.3	1.2 <sup>1+</sup>					NP	-
TP28	2.2	0.5	2.2 <sup>1+</sup>					NP	-

NP: Not Proven  
<sup>1</sup> Ferruginised  
<sup>2</sup> Includes an alluvial boulder bed

Consulting Engineering Geologists & Engineers

# Intraconsult

Intraconsult Associates

URBAN DYNAMICS  
P.O. BOX 291803  
MELVILLE  
2109

P.O. Box 604,  
Fourways 2055  
Johannesburg

ATTENTION: MR H. POTGIETER

Telephone :  
Direct : (011) 469 0854  
Fax : (011) 469 0961  
Email: [intrac@mweb.co.za](mailto:intrac@mweb.co.za)

Your reference

Our reference  
IR823

Date  
16 MARCH 2007

## GEOTECHNICAL INVESTIGATIONS OF SITE 1: BOKSBURG MINING BELT

This report presents the results of geotechnical investigations carried out on the area designated by Urban Dynamics as Site 1 in the Mining Belt in Boksburg.

The site is partially located on reclaimed ground in the Boksburg Mining Belt. The area is underlain by a thin cover of Karoo rocks that in turn blankets quartzite and conglomerate of the Johannesburg Sub Group, Central Rand Group, Witwatersrand Supergroup.

This investigation has involved reviewing the findings of a feasibility risk report by Jones and Wagner, undertaking a drilling programme, excavating test pits, profiling, sampling and laboratory testing. Based on the results of the investigations the site is subdivided into Geotechnical Zones. Appropriate planning and precautionary measures are outlined in the report.

# **GEOTECHNICAL INVESTIGATIONS OF SITE 1: BOKSBURG MINING BELT.**

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## 1. INTRODUCTION

This report documents the results and observations of geotechnical investigations carried out for township establishment on portions of the farm Driefontein 851R in the Boksburg area. The site is to be planned for both commercial and residential purposes. This report outlines the terms of reference, procedures used in the investigation, available data used, drilling work undertaken, test pitting, testing, geology, geohydrology, geotechnical zoning, conclusions and recommendations.

## 2. TERMS OF REFERENCE AND SCOPE OF WORK

At the request of Urban Dynamics, Intraconsult were appointed to carry out a phased geotechnical investigation of approximately 28ha of available land in the Boksburg Mining Belt, designated Site 1 (portion 406 of the Farm Driefontein 85-IR).

The terms of reference of the investigation allow for:

- A GFSH-2 Phase 1 geotechnical investigation to meet NHBRC requirements, taking into account that the site is partially undermined,
- Verification that the undermining will not negatively impact on future development.

The current proposed land utilisation includes the following development types:

- Industrial stand of approximately 22,57ha
- Commercial stands of approximately 3ha.
- Residential 3 stands of approximately 2,5ha.

The intention of this Phase 1 geotechnical investigation is to provide sufficient information for township planning and proclamation purposes. This investigation has been carried out in accordance with the requirements set out in the *Geotechnical Site Investigations for Housing Developments* as published by the National Department of Housing (GFSH-2), with provision for site coverage and classification made in terms of NHBRC (National Home Builders Registration Council) guidelines.

The scope of work includes the following:

- < to determine, in broad terms, the nature, distribution and engineering properties of the near surface soils and rocks as they affect the proposed development;
- < to classify the site into zones according to the guidelines referred to above;
- < to give general foundation recommendations for the proposed development;
- < to determine the suitability of the upper soils for use as road building materials;
- < to comment on excavation characteristics and classification for the installation of services;
- < to appraise groundwater conditions particularly pertaining to shallow groundwater or seepage.
- < to review the findings of the feasibility study into mining activities.



### 3. EXISTING INFORMATION

The following information has been used in this study:

- 1:250 000 Geological Map: 2628 East Rand, 1986.
- Aerial photographic coverage provided by Urban Dynamics.
- Jones & Wagener report number JW38/06/A569, February 2006, Feasibility Risk Evaluation of Areas Located on or Adjacent to Undermined Areas - East Rand Region, Witwatersrand Gold Mining Realization Trust.
- Generic specification GFSH-2, National Department of housing Specification, "Geotechnical site investigations for housing development."
- National Home Builders Registration Council: Home Builders Manual: Parts 1 and 2, Revision 1, February 1999.

### 4. GENERAL LOCATION AND DESCRIPTION OF THE SITE

The site is situated due south of the East Rand Mall, north of Plantation and immediately west of Rondebult Road, adjacent to East Rand Proprietary Mines (ERPM). The area is located in a low-lying basin characterized by poor drainage. The bulk of the site is open land due west of a mine dump. A large proportion of the site appears to be reclaimed mining land (Figure 1).

A small, waterlogged pan dominates the central northern sector of the site, which is substantially colonized by reeds and other vlei vegetation.

The southern sector of the site, on the border of an existing low-income residential development, is dominated by large invasive trees and dense kikuyu grass that are indicative of abundant free surface water. The available topographical maps indicate a natural drainage path in this area, although this feature was not clearly visible at the time of the investigation (Figure 2).

### 5. PROCEDURES USED IN THIS INVESTIGATION

In order to establish the general geotechnical characteristics of the near surface soils, a series of test pits have been excavated across the site. Percussion boreholes have been drilled on site to depths of 120m to confirm the findings on undermining given in a previous study carried out by others (Section 2).

#### 5.1 Trial Holes

The focus of this particular investigation is the identification and assessment of the shallow surface soils and rocks, which have a bearing on the founding of structures and earth terraces, and the installation of services trenches.

The investigation comprised a series of 17 number shallow test pits excavated to depth limit or refusal of a Bell 315.SG TLB, and profiled in situ by a geotechnician / geotechnical engineer. The test pits, the GPS location of which is indicated on Figure 2, provide reasonable, if not optimal, coverage of the site, in terms of the profile observed, but are unlikely to have exposed the full variation of the geotechnical conditions which may exist. Soil profiles, which graphically represent the soil conditions observed in the test pits, are included in Appendix A.

A fairly large waterlogged sump dominates the central northern sector of the site (which was probably formed during mine-dump reclamation), which rendered this portion of the site inaccessible to vehicular traffic and, therefore, in situ test pitting and profiling. As such, the soil conditions within this area remain unexplored.

## 5.2 Percussion Boreholes

According to the Jones and Wagner report, mine records indicate that the depth of undermining below the project site ranges from 120m along the northern perimeter, dipping rapidly to in excess of 400m along the southern boundary. Consequently ten rotary percussion boreholes have been drilled for the purpose of a stability risk assessment in order to audit these records and confirm that no shallow undermining exists beneath the project site. As the strata dips towards the north, drilling work was undertaken on the hanging wall to ensure that no voids, cavities or openings occurred at shallower depth. This drilling work was undertaken on traverses set out at right angles to the dip of the strata beneath the site.

The GPS positions of these percussion boreholes are, similarly, presented on Figure 2. The percussion borehole profiles are included in Appendix B.

The drilling programme was undertaken using a down-the-hole rotary percussion rig and a 950 c.f.m. (21 Bar) compressor delivering 308 psi to a 165 mm diameter button bit. Chip samples were retrieved from the return air stream through each metre drilled, while the penetration times per metre were recorded with an electronic stopwatch. The retrieved samples are described according to current practice.

The X- and Y-coordinates (values) for the boreholes, conform to the South African Coordinate System as set in the national control survey network maintained by the Chief Directorate: Surveys and Mapping of the Department of Land Affairs. The X- and Y-values are given in metres latitude (7 digit value) and longitude (5 or 6 digit value). These coordinates are projected using the Gauss Conform Projection which is the Transverse aspect of the Mercator projection. The reference ellipsoid is the WGS84 (Hartebeeshoek 1994) ellipsoid. The Central Meridian (longitude of origin or  $L_0$ ) for this site is 29°E, with the site as a whole located **west of the Central Meridian**. In the South African coordinate system the X coordinates are measured **southwards from the equator** (where  $x = 0$ ) towards the south pole which is **positive**. Y coordinates are measured from the Central Meridian (CM), increasing from the CM in a westerly direction so that Y is **positive west of the CM** and negative east of the CM.

All the drawings in this report have been produced using a Global Information System (GIS). The method used to define X- and Y-values differ from that of the South African Coordinate System. The borehole positions will project in the correct location in the GIS with the Gauss Conform Projection and WGS84 datum (reference ellipsoid) provided:

- a) the coordinate values are interchanged, i.e. the X coordinate and Y coordinate reported in the logs of Appendix 1 becomes Y coordinate and X coordinate, and
- b) the X coordinate (defining line of latitude) is made negative;
- c) the Y coordinate (defining line of longitude) is made negative;

before being placed in the GIS or plotted on any of the drawings produced in this report.

## 5.3 Laboratory Testing

Laboratory tests for foundation engineering purposes were conducted on selected soil samples taken from the soil horizons encountered in the test pits. These tests include the following:

- Grading and Atterberg limit tests to determine the basic engineering properties of the in situ soils and for classification purposes.

- Natural moisture content tests to determine the in situ moisture regime.
- Collapse potential tests to determine the collapse settlement characteristics of the soil under load and saturation, for purposes of determining the site classification and estimating foundation movements.
- One dimensional consolidation tests (oedometer) to determine the stiffness modulus for the soil under load and moisture ingress;
- Basic chemistry (pH and conductivity) tests to assess the corrosive potential of the soils and associated groundwater towards buried ferrous services.

## 6. GEOLOGY AND SOILS

### 6.1 Lithology

Available surface geological mapping indicates that the site is underlain at surface by rocks of the Vryheid and Dwyka Formations of the Karoo Sequence, principally comprising sandstone, shale and diamictite. These relatively juvenile Karoo rocks may, however, be relatively superficial and underlain at modest depth by quartzite and conglomerate of the Central Rand Group which dips between 70° and 35° southwards.

The profile observed in the test pits did not, in general, expose the underlying parent rock, with the exception of two boreholes that intercepted residual sandstone of the Karoo Sequence. In contrast with the test pits, thick and competent quartzitic bedrock was encountered in the percussion holes to the full depth of the hole (120m), confirming the findings of Jones & Wagener, which stated that the site is underlain by Central Rand Group Rocks (Johannesburg Sub-Group).

Given this, it is evident that the Karoo bedrock, which forms the upper crust of this site, is relatively superficial and possibly highly weathered, below which fairly competent quartzite bedrock occurs, typically from depths in the order of 5m-16m below NGL. In conformance with the regional geological mapping of the site, there is no evidence of Transvaal Sequence rocks (specifically dolomite) in the profile.

### 6.2 Soil Profile

Table 1 below provides a summary of the soil/ rock profile encountered in the exploratory holes on this site.

Table 1: Depth and Inferred Thicknesses of the Soils / Rocks Underlying the Site								
Hole Number	Depth of Hole (m)	Depth (m) to Base of Horizon					Depth to Rock	Depth to Ground Water
		Mine Slimes	Lacustrine	Hillwash	Ferricrete	Residual Sandstone		
<b>TEST PITS</b>								
TP1	2.4	0.3	2.4 <sup>1+</sup>				NP	1.8
TP2	2.5	0.1	0.4		2.5+		NP	0.4
TP3	2.5		2.0			2.5+	NP	-
TP4	2.4	0.4	2.0		2.4+		NP	0.4
TP5	2.6	0.2		0.5	2.6+		NP	-
TP6	2.4			2.4 <sup>1+</sup>			NP	1.2

Hole Number	Depth of Hole (m)	Depth (m) to Base of Horizon					Depth to Rock	Depth to Ground Water
		Mine Slimes	Lacustrine	Hillwash	Ferricrete	Residual Sandstone		
<b>TEST PITS</b>								
TP7	2.5	0.4	2.0			2.5+	NP	-
TP8	2.6		2.6+				NP	-
TP9	2.7		2.7+				NP	-
TP10	2.4	0.15		1.25	2.4+		NP	-
TP11	2.4			1.2	2.4+		NP	1.2
TP12	2.2			1.2	2.2+		NP	1.8
TP13	2.7			0.1 <sup>1</sup> +			NP	0.9
TP14	1.0	0.25		0.4	1.0+		NP	-
TP15	2.4		2.4+	0.35			NP	-
TP16	0.7			0.5	0.7+		NP	-
TP17	2.1			1.5 <sup>1</sup>			NP	1.5

<b>PERCUSSION BOREHOLES</b>								
MB1	120			0.2		8.0	8.0	
MB2	120		9.0				9.0	
MB3	120		5.0				5.0	
MB4	120		6.0				6.0	
MB5	120			3.0		5.0	5.0	
MB6	120				9.0 <sup>2</sup>	11.0	11.0	
MB7	120	1.0		6.0			6.0	
MB8	120	1.0				6.0	6.0	2.0
MB9	120		4.0			16.0	16.0	
MB10	120		5.0				5.0	31.0

NE: Not Encountered  
NP: Not Proven

<sup>1</sup> Ferruginised  
<sup>2</sup> Including a boulder bed

\* Evidence of perched water table

The superficial unconsolidated deposits making up the soil profile typically comprise the following sequence:

- Mine tailings / lacustrine deposits dominating the low-lying pan in the central northern portion of the site,
- Overlying partially ferruginised aeolian / hillwash deposits particularly evident in the southern sector,
- Grading into well-developed ferricrete,
- Overlying residual sandstone

## 7. GREGHYDROLOGY

A large portion of the central northern sector of the site is currently waterlogged, preventing vehicular access (Figure 2). In view of the restricted access it is probable that a relatively shallow perched groundwater table exists in this area of the site.

For the remainder of the site, the well-developed ferricrete horizon is indicative of a seasonal shallow perched groundwater tables. In terms of groundwater conditions, it is apparent from observations that these shallow perched water conditions persist throughout the site.

## 8. GEOTECHNICAL ASSESSMENT

Background information for this site was provided by way of a preliminary engineering geology report, prepared by Jones and Wagener in February 2006<sup>1</sup>, and a rudimentary CAD drawing showing the cadastral boundary of the site.

The Jones and Wagener report, which deals primarily with the risk evaluation aspects of the site, has identified an area of shallow undermining (around 120m below surface) along the northern boundary, which dips southwards to in excess of 400m. In line with the Mines Health and Safety Regulations, the areas in excess of 240m (comprising the bulk of the site) require no undue concern. Building restrictions and risk assessment issues will, however, be applicable in the areas of shallow undermining.

### 8.1 Site Class Zonation

On the basis of the test pit profiles, the site is classified into four geotechnical zones that will exhibit similar behaviour under load and changes in the moisture regime (Figure 3). The severity of problematic soil conditions encountered is made on the basis of both laboratory test results and engineering judgment on site. The zonation is defined according to the tables below:

<b>Sub-Area</b>	<b>Development Potential</b>	<b>Impact of Geotechnical Character of Area on Construction Measures</b>
1	The geotechnical conditions are such that urban development can take place without any special precautionary/remedial measures for geotechnical conditions.	- None - Normal building construction
2	Geotechnical conditions are such that the area may be developed for urban use, but appropriate remedial measures and/or precautionary measures are required in the context of the geotechnical constraints.	- Problem Soils - Special foundation and top structure requirements
3	Geotechnical conditions are such that urban development is not recommended.	- Severe Geotechnical or Environmental Constraints - Development not recommended / permitted

Site Class	Typical Founding Material	Character of Founding Material	Expected Range of Total Soil Movements (mm)	Assumed Differential Movement (% of Total)
R	Rock (excluding mud rocks which may exhibit swelling to some depth)	Stable	Negligible	-
H H1 H2 H3	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%
C C1 C2	Silty sands, sands, sandy and gravelly soils	Compressible and Potentially Collapsible Soils	<5.0 5.0 - 10 >10	75% 75% 75%
S S1 S2	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%
P	Contaminated soils; Controlled fill; Dolomitic areas; Landslip; Land fill; Marshy areas; Mine waste fill; Mining subsidence; Reclaimed areas; Very soft silt/silty clays; Uncontrolled fill	Variable	Variable	
W	Development probably controlled by floodline considerations	N/A	N/A	N/A

The following zones are delineated on the site:

- Zone 1: **2 / H1-H2 / S1 / P (mine tailings and contaminated soils)** comprising the central and northern portions of the site in which *potentially moderately to highly expansive* clay horizons underlie, a horizon of moist, compressible mine tailings and / or transported soils.
- Zone 2: **2 / C-C1 / R (hardpan ferricrete sub-outcrop) / P (contaminated soils)** comprising the southern fringe of the site, in which very competent ferricrete underlies the site, intermittently buried beneath shallow *potentially collapsible* and/or compressible transported soils.
- Zone 3: **2 / C2 / P (contaminated soils)** comprising the south-western extremity of the site in which thick, potentially *highly collapsible* transported soils overlie hardpan ferricrete at depth.
- Zone 4: **2-3 / W (waterlogged conditions) / P (contaminated soils)** comprising a large, low-lying enclave in the centre of Zone 1, as well as a yet-to-be-defined zone associated with the mapped drainage line in the southern sector.

In view of the low-lying nature of the project site, large portions are characterised by relatively shallow perched groundwater conditions. This will have a significant influence on drainage issues (particularly in the vicinity of the existing water body), water-proofing and construction.

## 8.2 Slope stability

In view of the relatively low-lying and water-logged nature of much of this site, significant earth terracing is envisaged to elevate the site above the potential floodlines and serve as engineered soil mattresses for construction purposes.

Nominal fill slopes formed during this process should be placed at nominal angles of 2H:1V, failing which shear strength tests should be carried out to verify appropriate shear strength parameters.

It appears unlikely that cut slopes will be formed. However, deep excavations for service trenches should ideally be cut back at angles flatter than 45 degrees in the short term and 30 degrees in the long, failing which shoring or lateral support measures will be required, particularly in the low shear-strength lacustrine and mine tailing deposits.

It is recommended, in general, that all excavations in excess of 1.5m depth be inspected by the Geotechnical Engineer to assess the safety thereof. Notwithstanding this, the responsibility for excavations remains with the Contractor who is in the best position to assess the stability thereof during construction.

## 8.3 Materials

Copies of the laboratory tests are presented in Appendix C, and summarized in Table 4 below.

Sample No	Depth (m)	Origin	Soil Type	LL	PI (425)	LS	GM	NMC	PI (w)	425	075	002	pH	Con	TRH14 *
D1/1	0.2	Mine Slimes	Silty fine Sand	22	5	2	0.59	11	4	81	63	5	3.8	22.7	Sub G7
D1/3	2.0	Lacustrine	Sandy Clayey Silt	29	14	7	1.78	13	6	39	32	7			G6/G7
D2/2	2.0	Lacustrine	Clayey Silty Sand	36	18	9	0.78	17	13	71	64	25			Sub G7
D4/1	0.2	Mine Slimes	Silty fine Sand	NP	NP	1	0.52	15	NP	85	67	8	4.0	17.1	Sub g7
U4/2	1.0	Lacustrine	Clay - Silt	39	20	10	0.27	35	19	93	77	10			Sub G9
D5/1	1.5	Ferricrete	Sand	32	15	8	0.57	16	12	83	66	13	6.2	6.4	Sub G7
D6/1	1.0	Hillwash	Clayey Silty Sand	31	15	7	1.03	12	10	67	50	5			Sub G7
D7/2	2.3	Res Sandstone	Clayey Silty Sand	27	11	5	0.31	12	10	94	73	25			Sub G7
U8/1	1.5	Lacustrine	Sandy Clay - Silt	43	21	11	0.24	20	19	92	84	15			Sub G9
U11/1	0.8	Hillwash	Clayey Silty Sand	29	14	7	0.49	18	12	84	65	3	5.5	11.7	Sub G7
D11/2	2.0	Ferricrete	Clayey Silty Sand	31	16	7	0.74	12	12	74	63	18	6.1	5.1	Sub G7
U17/1	1.0	Hillwash	Sandy Clayey Silt	28	14	7	0.36	17	12	86	77	10			Sub G8

### KEY

LL: Liquid limit  
 PI (425): Plasticity index of sample fines portion  
 LS: Linear shrinkage  
 425: Percent passing 425µm sieve  
 075: Percent passing 75 µm sieve  
 002: Percent passing 2 µm sieve  
 \*: Subject to CBR testing

GM: Grading modulus  
 PI (w): Plasticity index of whole sample  
 NMC: Natural moisture content (%)  
 pH: Acidity / Alkalinity index of soil  
 Con: Electrical conductivity of soil (S/cm)  
 TRH14: Provisional Road Material Evaluation

Reference is made to the index tests (Appendix B and Table 4), on which the following comments are based:

The lacustrine deposits underlying the mine slimes are poor to very poor quality materials, judged to be sub-G7 through sub-G9 quality, which should be avoided for use in any engineered fills.

The ferricrete encountered classifies as sub-G7 in terms of the laboratory tests, but may present good quality sub-base or selected material (G6) where it is well-developed into a hardpan horizon.

The hillwash material classifies as sub-G7 through sub-G8 in view of its low grading modulus and moderately high plasticity and will be suitable for bulk fill in terrace construction.

#### 8.4 Excavation

The excavation characteristics of the site have been evaluated according to *SABS 1200D : Earthworks Specification*, on the basis of test pit excavation by means of a Bell 315.SG TLB, with a depth limitation of around 3,0m (the maximum reach of the machine). The excavation classification is presented by test pit number in the table below.

Test Pit No.	Depth (m)	Depth (m) of Groundwater [Potential Perched]	Depth (m) to base of		Hard Rock Excavation from (m)	Boulders Encountered in Profile	Material at base of Test Pit
			Soft Excavation	Intermediate Excavation			
1	2.4	1.8	1.5	-	-	-	Ferricrete
2	2.5	[0.4-0.9]	1.5	-	-	-	Ferricrete
3	2.5	[0.6-2.0]	1.5	-	-	-	Ferruginised Sandstone
4	2.4	[1.6]	1.5	-	-	-	Nodular Ferricrete
5	2.6	Nil	0.8	1.5	-	-	Ferricrete
6	2.4	[1.2]	1.5	-	-	-	Ferricrete
7	2.5	[0.4-1.5]	1.5	-	-	-	Residual Sandstone
8	2.6	[0.8]	1.5	-	-	-	Lacustrine
9	2.7	[0.4]	1.5	-	-	-	Lacustrine
10	2.4	Nil	1.5	-	-	-	Ferricrete
11	2.4	1.2	1.5	-	-	-	Ferricrete
12	2.2	1.8	1.5	-	-	-	Nodular Ferricrete
13	2.7	[0.9]	0.1	>0.1	-	-	Ferricrete
14	1.0	Nil	>1.0	-	-	-	Nodular Ferricrete
15	2.4	Nil	1.5	-	-	-	Lacustrine
16	0.7	Nil	0.5	>0.5	-	-	Ferricrete
17	2.1	[1.5]	1.5	-	-	-	Ferricrete

- **Soft excavation**, which is possible using conventional light earth-moving equipment (TLB and the like), should generally be encountered to a depth of 1.5m below surface (and probably deeper as reflected by the depths achieved with the TLB) throughout the project site, with the exception of Zone 2, where shallow dense and better ferricrete is present.



- **Intermediate excavation**, which will necessitate the use of heavier plant (excavator) and/or pneumatic ground-engaging-tools to break up material prior to excavation, should be anticipated from just below surface in Zone 2 in the perimeter around the low-lying largely water logged Zone 1.
- **Hard excavation**, requiring drill-and-blast operations, was not encountered in the upper 1.5m and appears unlikely in this profile.
- **Boulder excavation**, requiring localised drill-and-blast operations to fragment large boulders and heavy plant for the removal thereof, was similarly not encountered, and is judged to be relatively improbable.

## 8.5 Ground and surface water

In view of the topographic low-lying area in the central-northern sector of the site where waterlogged conditions proliferate, and the mapped drainage line, a floodline analysis will be required to quantify the developable area more accurately (Zone 4).

It is anticipated that these water-related problems and development constraints may be mitigated by means of stream canalisation and the construction of large fill terraces (as is the case to the north of this site) to facilitate construction above the potential flooding level.

Drainage and plumbing precautions should be applied.

## 8.6 Foundation recommendations

On the basis of the soil profile observed in the exploratory holes, several foundation options are presented in Table 6 that is applicable to single-storey masonry construction, with a nominal 50kPa bearing stress, founded at 0.4m below ground.

Available Foundation Solutions		Geotechnical Site Class Zone			
		Zone 1 <sup>1,2</sup>	Zone 2 <sup>1,2</sup>	Zone 3 <sup>1,2</sup>	Zone 4 <sup>1,2</sup>
Normal (Strip footing / slab on the ground)		E	E	E	E
Structural Solutions	Modified Normal (Reinforced Strip Footing)	E	T <sup>3,4</sup>	E	E
	Stiffened Strip Footings / Cellular Raft	T <sup>4</sup>	E	T <sup>4</sup>	E
	Piled / Pier Foundation	T	E	T	E
Geotechnical Solutions	Compaction of Soil Below Individual Footings	E	E	E	E
	Deep Strip Foundations (Excavated to, <i>but not through</i> the competent ferricrete where present)	E	T	T <sup>4</sup>	E
	Engineered Soil Raft (Soil Mattress)	T <sup>4</sup>	T <sup>4</sup>	T <sup>4</sup>	T <sup>4,5</sup>
<b>KEY</b>					
T	Foundation solution recommended ✓				
E	Foundation solution not recommended				
1	Where both yielding & unyielding materials occur (rock & soil), the foundation design should be submitted to the Geotechnical Engineer for review and approval.				
2	All foundation solutions should employ appropriate services / draining measures (Appendix D).				
3	Only when foundations are excavated to the base of the hillwash horizon and a competent ferricrete founding horizon is proven.				
4	With foundation/ masonry reinforcement and possible structure articulation.				
5	Would need further site-specific and detailed investigation.				

## 8.7 Undermining

In the context of the Jones and Wagner report that indicated potentially shallow undermining beneath this site, 10 percussion boreholes were drilled at strategic locations to a depth of 120m to test for both shallow (<120m depth) mine workings and signs of subsidence.

The results of the percussion drilling indicate that no undermining is present within the upper 120m of the ground surface (Jones and Wagner reported that undermining occurs around 120m below surface along the northern boundary of the site, increasing in depth to in excess of 400m southwards). Based on the drilling results, single-storey structures (5m high walls) with one basement are deemed safe in accordance with the building restriction guidelines for undermined ground.

In the northern part of the site, where undermining is the shallowest, limiting buildings to single-storey with single basements is, probably, appropriate for reasons other than those relating to undermining, namely the waterlogged and shallow groundwater issues pertaining to this part of the site, which will impose significant engineering impact for development.

Based on the Jones and Wagner findings, the mined reefs dip at 50° to 70° to a depth of approximately 150m, below ground, after which the dip flattens to about 35°. Given this, and the findings of limited site-specific percussion drilling to confirm the depth of undermining, the depth to undermining will rapidly deepen southwards beneath the site, thereby obviating the bulk of the site (i.e. to the south of the 240m undermined contour) of any undermining building restrictions, presenting it safe for development.

## 8.8 Soil Chemistry

The results of limited soil chemistry testing (pH and conductivity) indicate the soils exhibit low pH and relatively high conductivity (as a consequence of previous mining activity) and, as such, will be moderately to highly corrosive towards buried concrete, steel and other ferrous services.

Specialist advice should, therefore, be sought to mitigate against these corrosive forces, and any stringent precautionary measures required should be adhered to.

## 9. CONCLUSIONS

9.1 The site is subdivided into four zones defined in terms of soil site classes:

- Zone 1: **2 / H1-H2 / S1 / P (mine tailings and contaminated soils)** comprising the central and northern portions of the site.
- Zone 2: **2 / C-C1 / R (hardpan ferricrete sub-outcrop) / P (contaminated soils)** comprising the southern fringe of the site.
- Zone 3: **2 / C2 / P (contaminated soils)** that comprises the south-western extremity of the site.
- Zone 4: **2-3 / W (waterlogged conditions) / P (contaminated soils)** comprising a large, low-lying enclave in the centre of Zone 1, as well as a yet-to-be-defined zone associated with the mapped drainage line in the southern sector.

- 9.2 Based on the Jones and Wagner findings, the mined reefs dip at 50° to 70° to a depth of approximately 150m, below ground, after which the dip flattens to about 35°. Given this, and the findings of limited site-specific percussion drilling to confirm the depth of undermining, the depth to undermining will rapidly deepen southwards beneath the site, thereby obviating the bulk of the site (i.e. to the south of the 240m undermined contour) of any undermining building restrictions, presenting it safe for development.

## 10. RECOMMENDATIONS

### 10.1 General

This GFSH-2, Phase 1 geotechnical investigation has identified several classes of problem soils that underlie the project site, each of which will have significantly different behavioural characteristics influencing the development of the area. On the basis of this investigation, the project site is provisionally classified into four geotechnical site class zones, each of which is developable with precautions, with the exception of Zone 4, which is currently inaccessible and will require significant terracing, draining and stream canalisation to facilitate development.

Zone 4, which arises due to the formation of a low-lying waterlogged pan, largely contained within Zone 1, was precluded from this investigation due to vehicular access constraints. It is surmised that the soil conditions will comprise thick, highly compressible lacustrine deposits and reworked mine waste, but this needs to be verified using alternative investigation techniques.

In view of the waterlogged conditions, a floodline analysis is required to delineate the boundaries of Zone 4 more accurately, as this will impose the development constraints on both the pan area, as well as the mapped drainage line which passes east-west through the southern sector of the project site.

It is emphasized that this investigation is undertaken to permit the proclamation and planning of the proposed commercial and residential developments. The geotechnical zone boundaries are subject to verification and refinement during the Phase 2 trench inspections, which should be routinely carried once development commences.

### 10.2 The various recommendations and precautionary measures outlined in Section 8 should be applied to this development.

- 10.3 The following site drainage and service precautions as required by the National Home Builders Registration Council, Home Building Manual, Part 1 should be adhered to:

#### 10.3.1 C1 and C2 (and S1 and S2) Category Designated Sites)

##### *Site Drainage*

The site shall be drained so as to ensure that water cannot pond adjacent or near the structure. The surface of the ground immediately adjacent to the building shall fall 75mm over the first 1,5m. Any paving shall be similarly slopes.

### *Limitations of Gardens*

Flower beds, trees and shrubs should not be planted within 1,5m from buildings, and either a lawn or impermeable apron should be provided around the building so as to provide a surface which will facilitate free run-off of water.

### *Restrictions on the Planting of Trees*

The recommendations regarding the planting of trees contained in the relevant Clause C5 of the Joint Structural Division of SAICE and IStructE Code of Practice for "Foundations and Superstructures for Single Storey Residential Buildings of Masonry Construction" should be observed.

### *Repair of Leaks*

Leaks in plumbing, including stormwater, sewerage and other drainage shall be repaired promptly so as to prevent wetting up of the founding horizons in the vicinity of the foundations.

### *Services*

The following shall be observed :

- No plumbing and drainage shall be placed under floor slabs as far as is practicable.
- The fall of all trenches shall be in a direction away from buildings.
- All service trenches shall be located at least 1,5m away from structures and shall be backfilled with in situ material compacted to not less than 88% Mod AASHTO density.
- Sewer and drainage pipes and fittings shall be provided with flexible joints.

Water pipe entries into buildings shall be provided to allow for movement. Pipes through walls shall be sleeved to permit relative movement and WC pans shall be provided with a flexible connection at the junction with the pipe.

## **10.3.2 H1 Category Designated Sites**

### *Site Drainage*

The site shall be drained so as to ensure that water cannot pond adjacent or near the structure. The surface of the ground immediately adjacent to the building shall fall 75mm over the first 1,5m. Any paving shall be similarly slopes.

### *Limitations of Gardens*

Flower beds, trees and shrubs should not be planted within 1,5m from buildings, and either a lawn or impermeable apron should be provided around the building so as to provide a surface which will facilitate free run-off of water.

### *Restrictions on the Planting of Trees*

The recommendations regarding the planting of trees contained in the relevant Clause C5 of the Joint Structural Division of SAICE and IStructE Code of Practice for "Foundations

and Superstructures for Single Storey Residential Buildings of Masonry Construction” should be observed.

#### Repair of Leaks

Leaks in plumbing, including stormwater, sewerage and other drainage shall be repaired promptly so as to prevent wetting up of the founding horizons in the vicinity of the foundations.

#### Services

The following shall be observed :

- No plumbing and drainage shall be placed under floor slabs as far as is practicable.
- The fall of all trenches shall be in a direction away from buildings.
- All service trenches shall be located at least 1,5m away from structures and shall be backfilled with in situ material compacted to not less than 88% Mod AASHTO density.
- Sewer and drainage pipes and fittings shall be provided with flexible joints.

Water pipe entries into buildings shall be provided to allow for movement. Pipes through walls shall be sleeved to permit relative movement and WC pans shall be provided with a flexible connection at the junction with the pipe.

In addition, it is recommended that:

- Clay should be utilized within 1,5m of the building as backfill material in the 300mm layer nearest the ground surface.
- Sub-surface drains should not be excavated near footings as they can become water-logged when blocked.
- Excavations should be backfilled above or adjacent to footings with moist clay compacted by hand-rodging or tamping, and not with porous material such as sand or gravel.
- uPVC sewer and drain pipes should be used in preference to rigid pipe systems.
- Softboard packing should be placed between gulleys and adjacent walls.

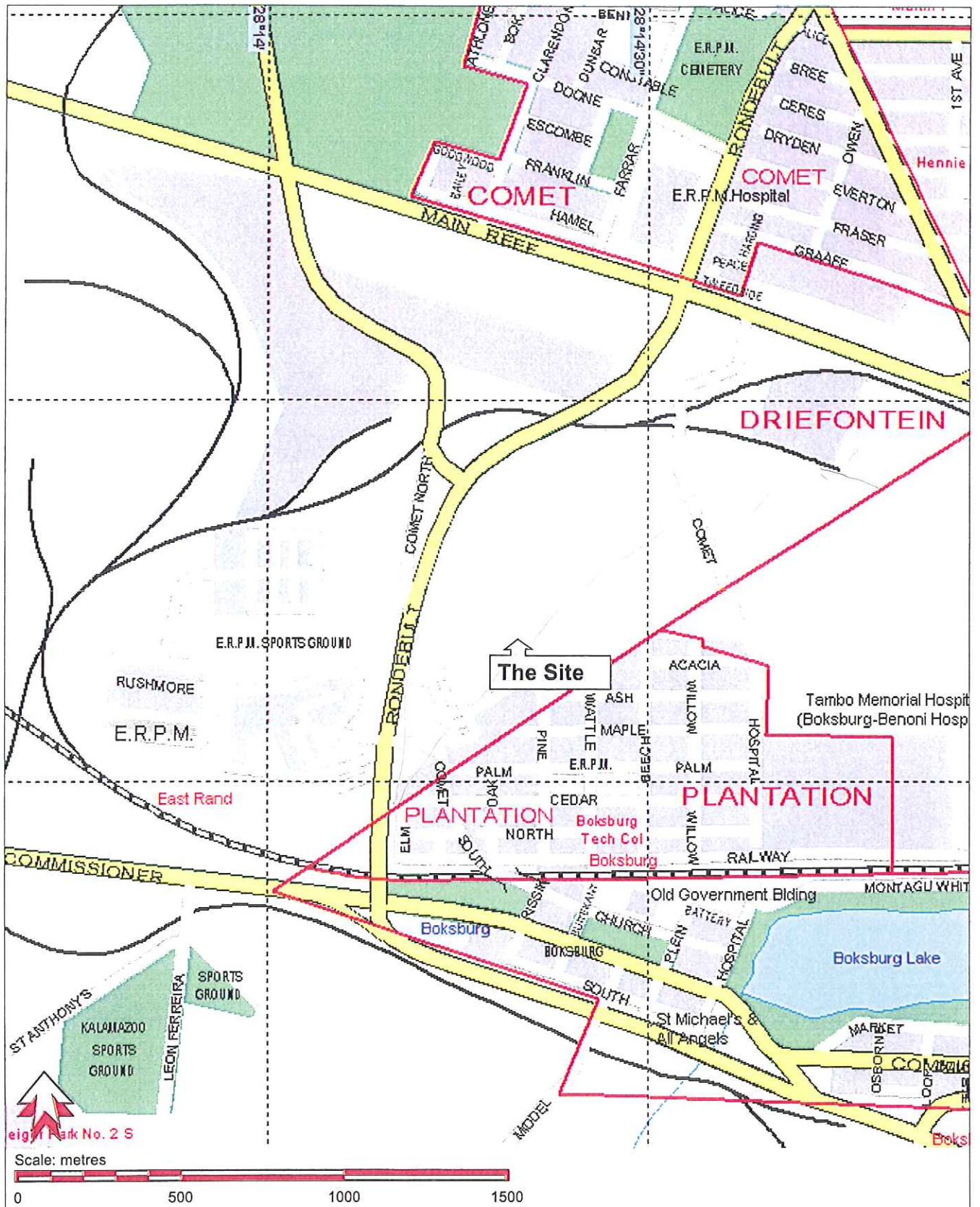
- 10.4 As mining took place on this site, old concrete foundations, pockets of waste or even unmapped shafts may be encountered.
- 10.5 Loose reworked mine slimes at surface should be removed from the site prior to construction commencing.
- 10.6 The site should be assessed for radioactive emissions. Sites on former mine land shall have specific activities of  $^{226}\text{Ra}$ ,  $^{228}\text{Ra}$ ,  $^{\text{nat}}\text{Th}$  and  $^{\text{nat}}\text{U}$  of less than 200 becquerels per kilogram.
- 10.7 The Department of Mineral and Energy Affairs (DME) must provide final comment on the mining constraints on this site.

- 10.8 The general area may be subject to ground vibrations. The design of foundations and superstructures for residential, commercial and industrial buildings must allow for seismic activity. The Council for Geoscience may be approached by the foundation/superstructure designers to obtain a perspective of the magnitude of seismicity that characterize the general site area. In addition, it is anticipated that the DME will impose a shock clause on the development. Typically the 'shock clause' is included in the title deeds of erven. The clause typically reads as follows:

"As this erf (stand, land, etc) forms part of land which is, or may be, undermined and liable to subsidence, settlement, shock and cracking due to mining operations past, present or future, the owner (applicant, grantee, as the case may be) thereof accepts all liability for any damage thereto or to any structure thereon, which may result from such subsidence, settlement, shock or cracking."

**INTRACONSULT ASSOCIATES**  
**P O BOX 604**  
**FOURWAYS**  
**2055**  
**TEL: (011) 469 0854**  
**FAX: (011) 469 0961**






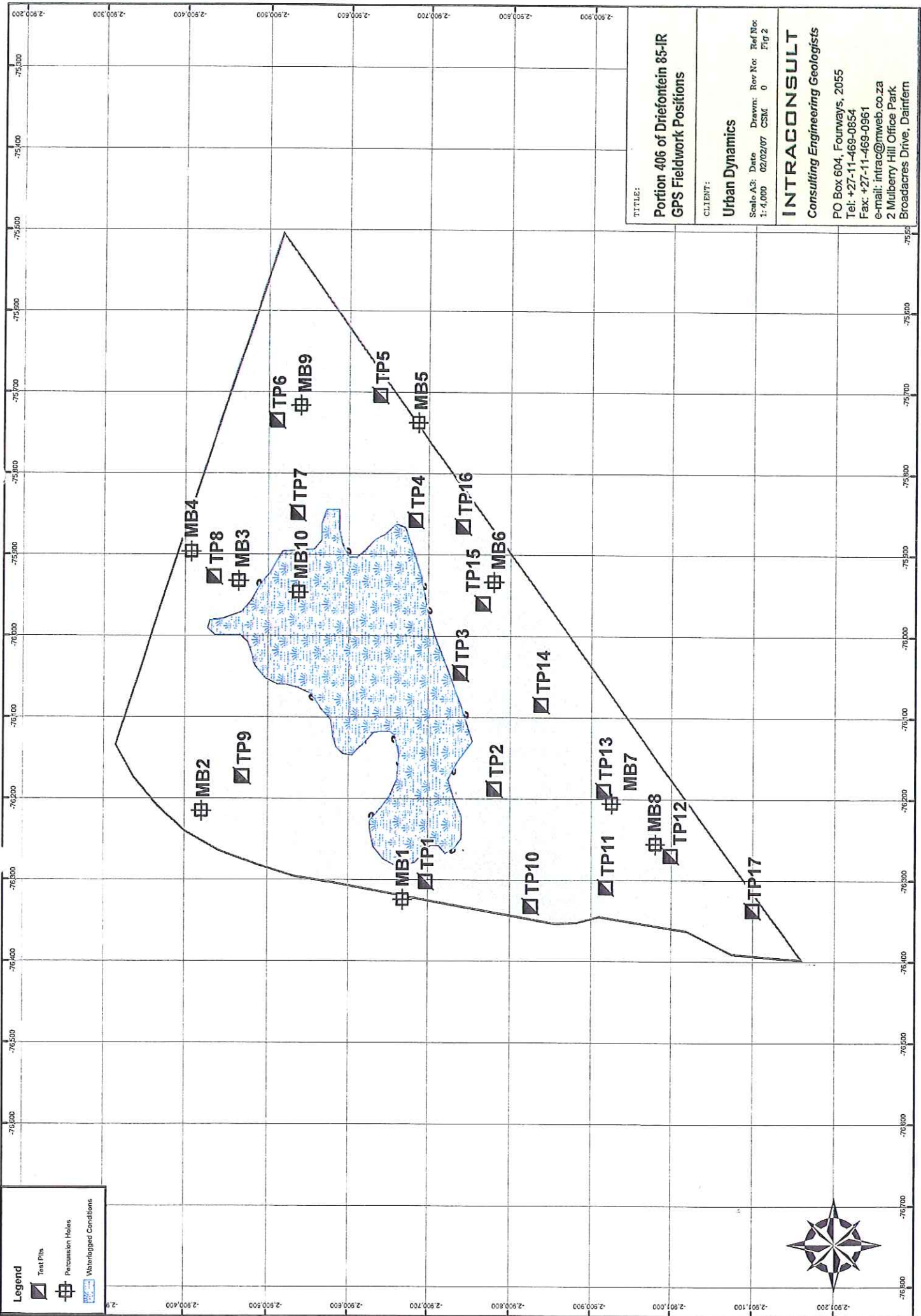


<b>T I T L E :</b> Portion 406 of Driefontein 85-IR Site Locality Plan				
<b>C L I E N T :</b> Urban Dynamics				
Scale A4: see bar	Date 02/02/07	Drawn: CSM	Rev No: 0	Ref No: Fig 1

**Intraconsult**  
 Consulting Engineering Geologists  
 PO Box 604, Fourways, 2055  
 Tel: +27-11-469-0854  
 Fax: +27-11-469-0961  
 e-mail: intrac@mweb.co.za  
 2 Mulberry Hill Office Park  
 Broadacres Drive, Dainfern

**Legend**

-  Test Pit
-  Percussion Hole
-  Waterlogged Conditions



**TITLE:**  
**Portion 406 of Driefontein 85-IR**  
**GPS Fieldwork Positions**

**CLIENT:**  
**Urban Dynamics**

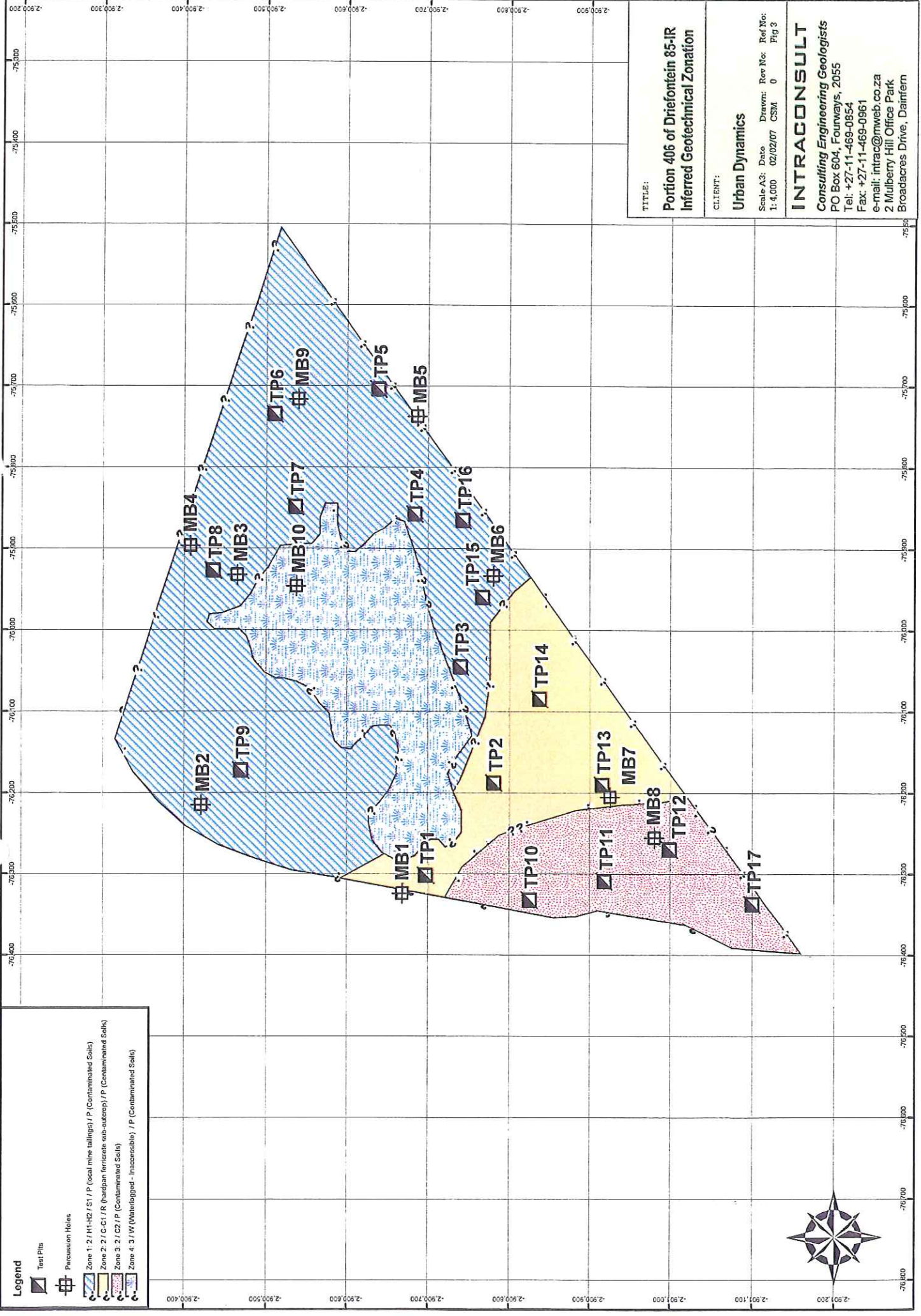
Scale A3: Date: Drawn: Rev No: Ref No:  
 1:4,000 02/02/07 CSM: 0 Fig 2

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*Consulting Engineering Geologists*

PO Box 604, Fourways, 2055  
 Tel: +27-11-469-0854  
 Fax: +27-11-469-0961  
 e-mail: intrac@intrac.co.za  
 2 Mulberry Hill Office Park  
 Broadacres Drive, Dainfern







**Legend**

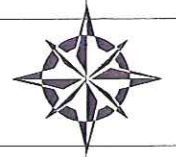
- Test Pits
- Percussion Holes
- Zone 1: 2 / H1-H2 / S1 / P (local mine tailings) / P (Contaminated Soils)
- Zone 2: 2 / C-C1 / R (hardpan ferricrete sub-outcrop) / P (Contaminated Soils)
- Zone 3: 2 / C2 / P (Contaminated Soils)
- Zone 4: 3 / W (Waterlogged - Inaccessible) / P (Contaminated Soils)

**TITLE:**  
**Portion 406 of Driefontein 85-IR**  
**Inferred Geotechnical Zonation**

**CLIENT:**  
**Urban Dynamics**

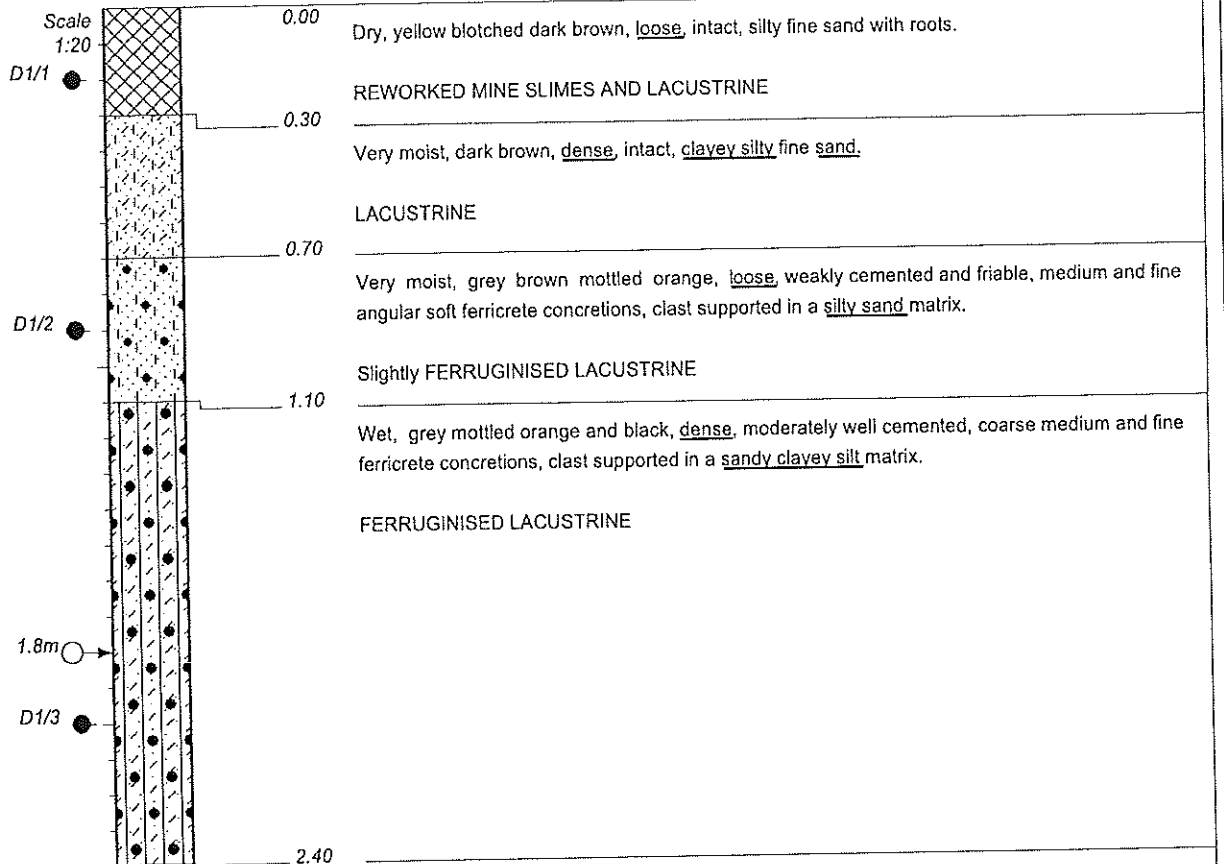
Scale A3: Date: 02/02/07 Drawn: Rev No: 0 Ref No:  
 1:4,000 02/02/07 CSM 0 Fig 3

**INTRACONSULT**  
**Consulting Engineering Geologists**  
 PO Box 604, Fourways, 2055  
 Tel: +27-11-469-0854  
 Fax: +27-11-469-0961  
 e-mail: intrac@rweb.co.za  
 2 Mulberry Hill Office Park  
 Broadacres Drive, Dainfern



**APPENDIX A**

Test Pit Soil Profiles



NOTES

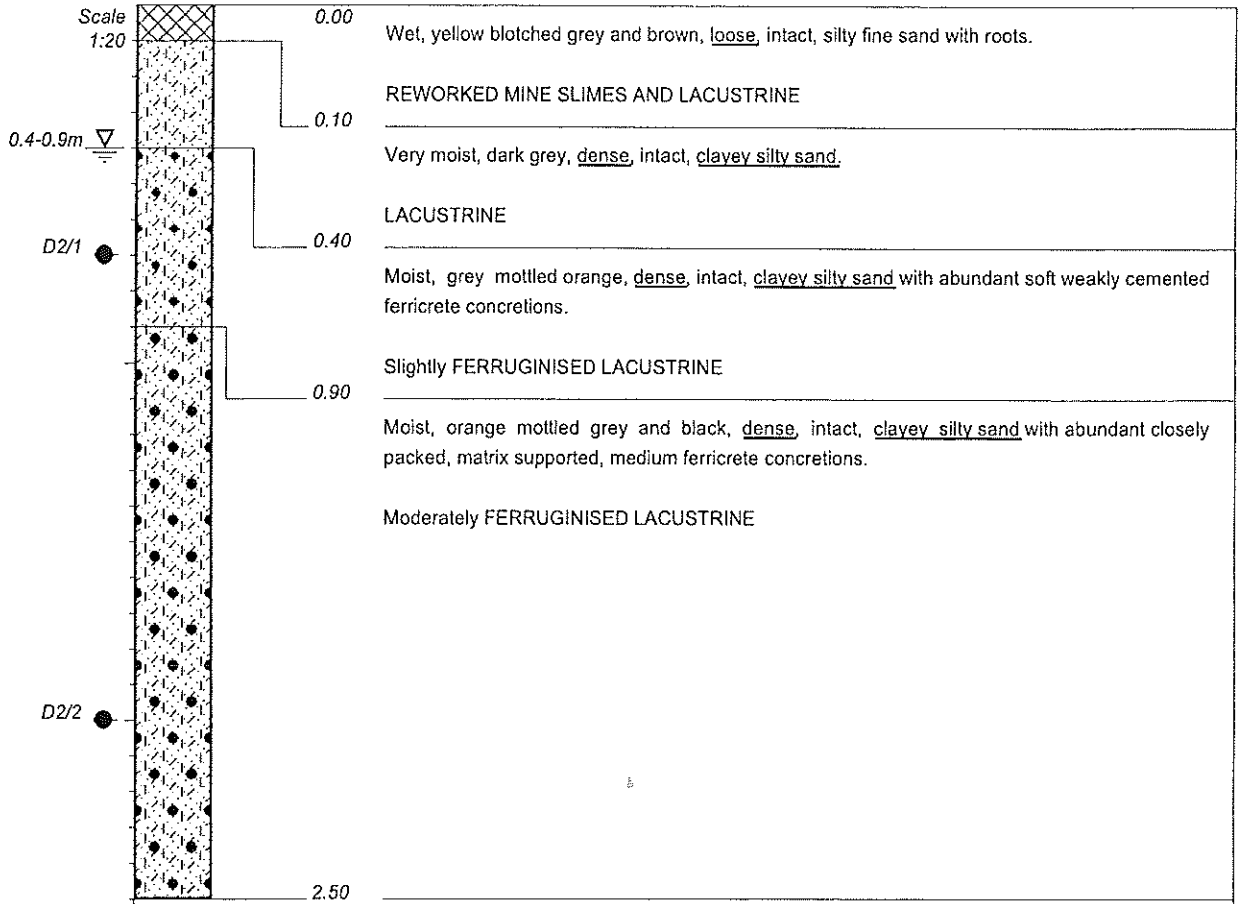
- 1) Excavated to near refusal on very dense ferricrete.
- 2) Moderate sidewall seepage below 1,8m.
- 3) Disturbed sample D1/1 taken at 0,2m.
- 4) Disturbed sample D1/2 taken at 0,9m.
- 5) Disturbed sample D1/3 taken at 2,0m.

CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho  
TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07  
DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILESVR823D-3.TXT

ELEVATION : 1632  
X-COORD : 76302  
Y-COORD : 2900697

HOLE No: TP1



NOTES

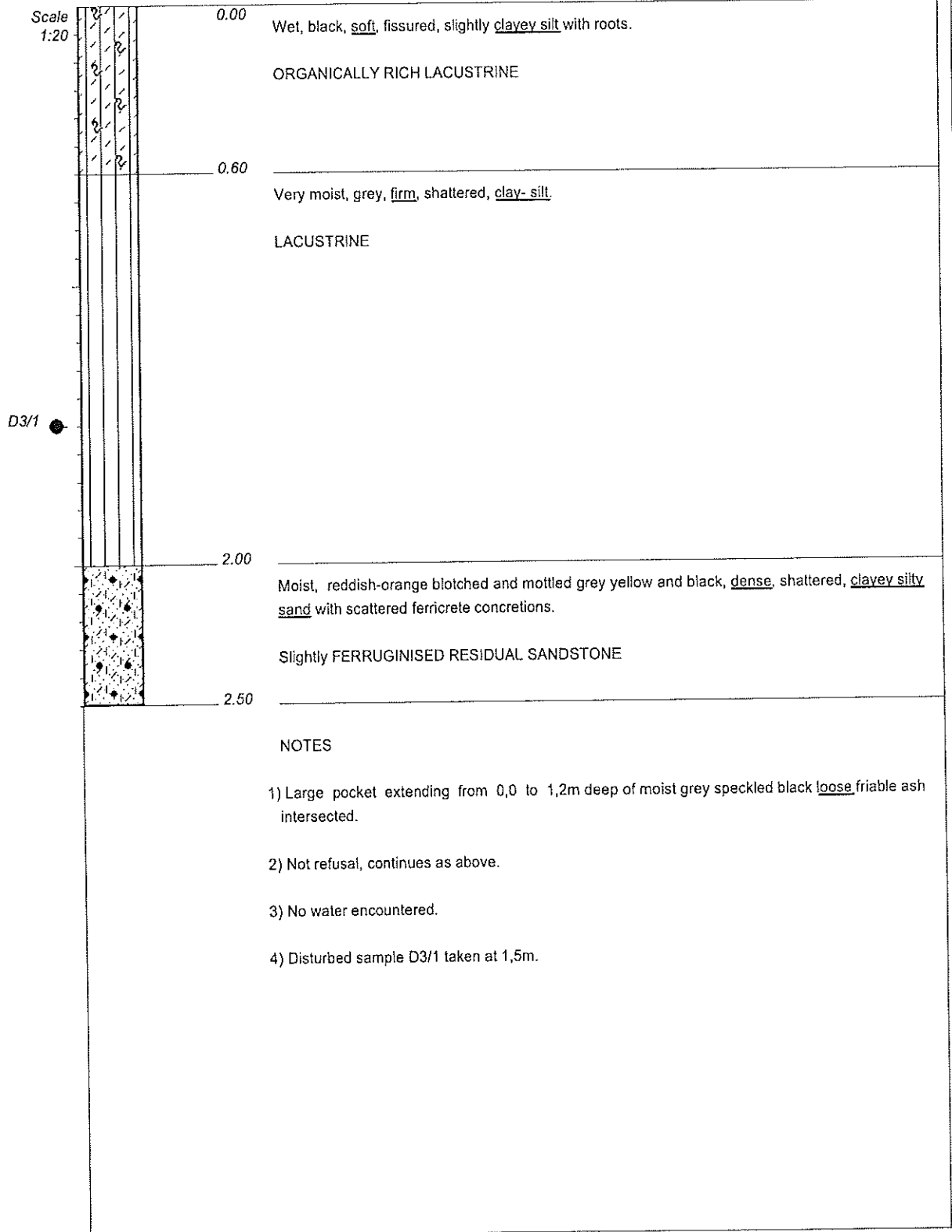
- 1) Not refusal, continues as above.
- 2) No water encountered but perched water table conditions evident from 0,4-0,9m.
- 3) Disturbed sample D2/1 taken at 0,7m.
- 4) Disturbed sample D2/2 taken at 2,0m.

CONTRACTOR : Geoid Earthworks Services  
 MACHINE : Bell 315.SG  
 DRILLED BY : Phillip  
 PROFILED BY : B. Bolitho  
 TYPE SET BY : Scott  
 SETUP FILE : INTRATP.SET

INCLINATION :  
 DIAM : 3,0 x 0,75m  
 DATE : 24/01/07  
 DATE : 24/01/07  
 DATE : 23/03/07 16:05  
 TEXT : ..C:\PROFILES\IR823D~3.TXT

ELEVATION : 1637  
 X-COORD : 76188  
 Y-COORD : 2900780

HOLE No: TP2

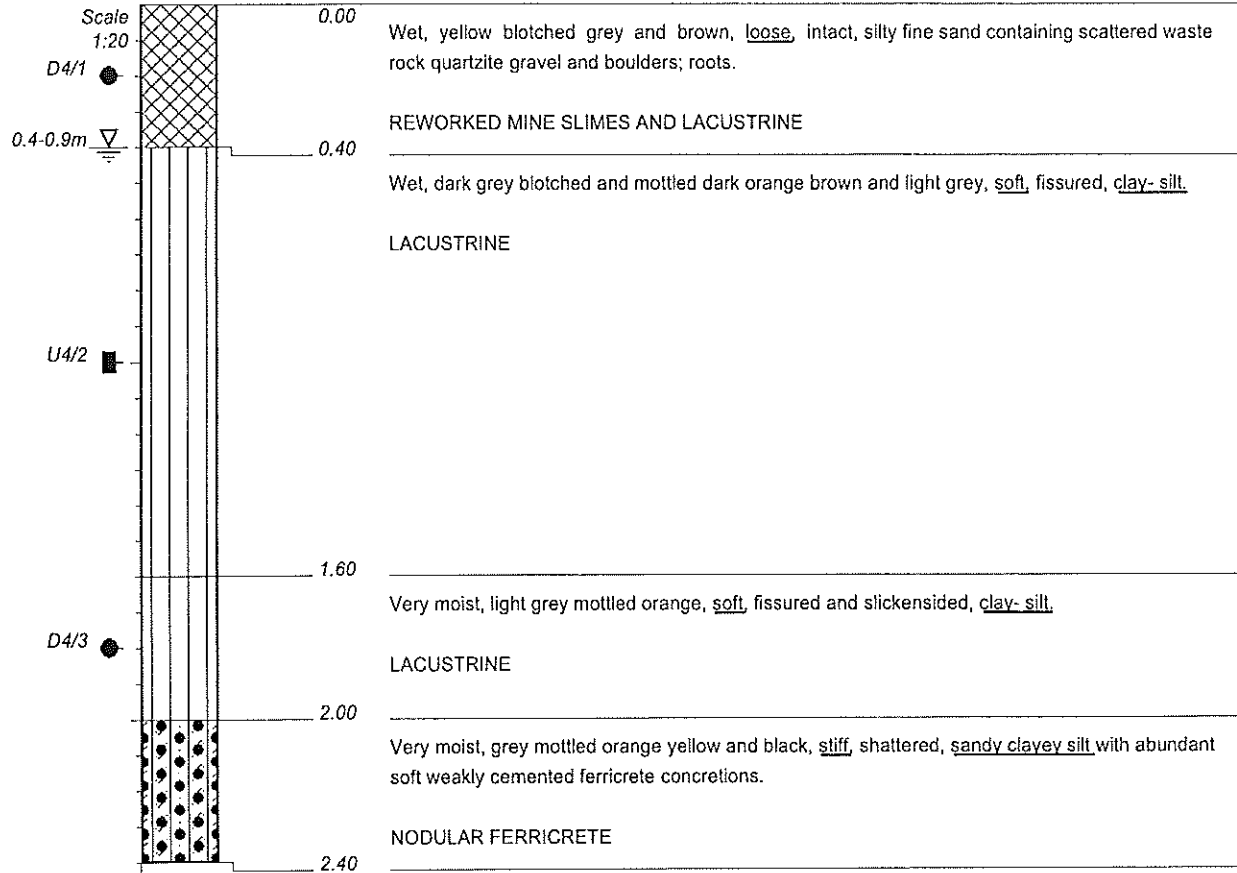


CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho  
TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07  
DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\IR823D-3.TXT

ELEVATION : 1641  
X-COORD : 76045  
Y-COORD : 2900739

HOLE No: TP3



NOTES

- 1) Not refusal, continues as above.
- 2) No water encountered but perched water table conditions evident from 0,4-0,9m.
- 3) Disturbed sample D4/1 taken at 0,2m.
- 4) Undisturbed sample U4/2 taken at 1,0m.
- 5) Disturbed sample D4/3 taken at 1,8m.

CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho  
TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07  
DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\IR823D-3.TXT

ELEVATION : 1639  
X-COORD : 75857  
Y-COORD : 2900683

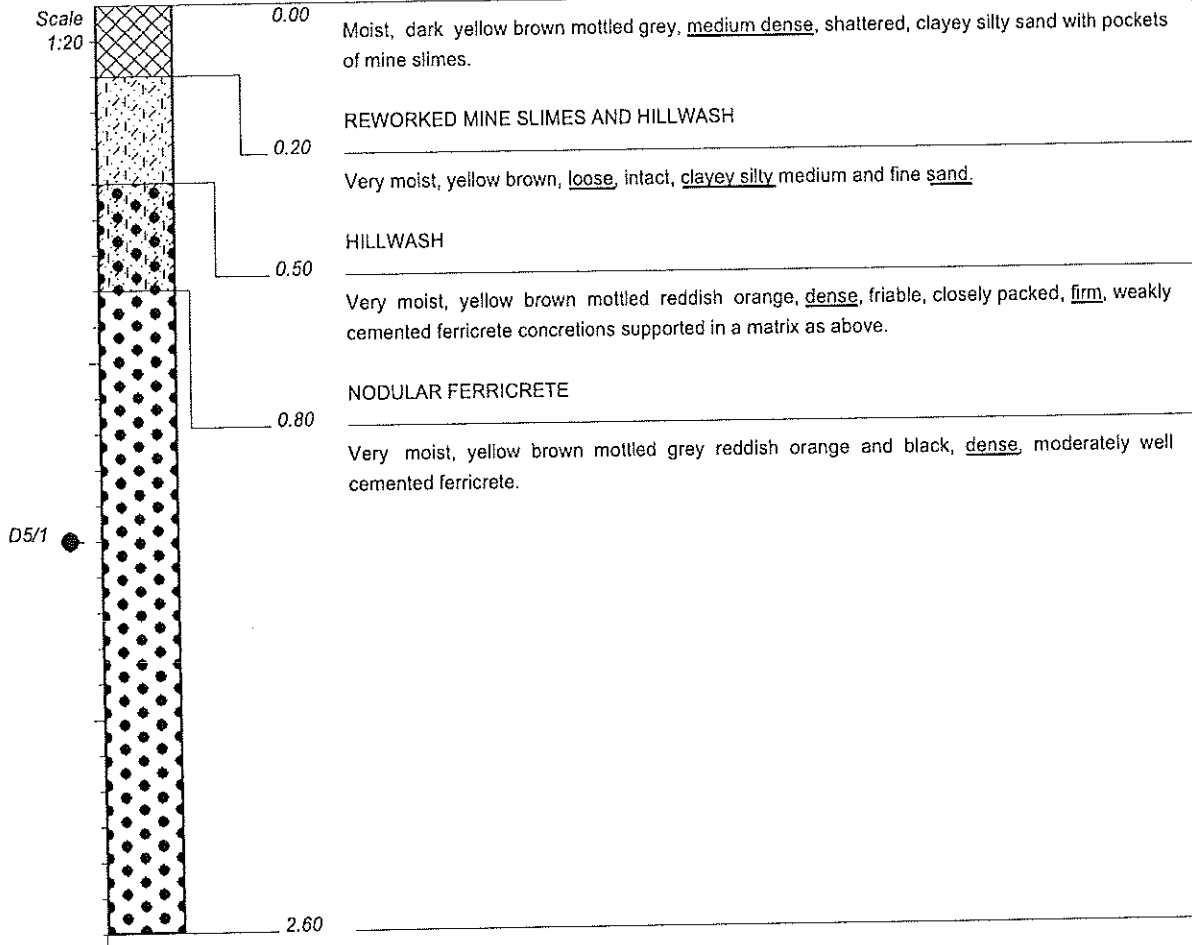
HOLE No: TP4



Portion 406 of Driefontein 85-IR  
Urban Dynamics

HOLE No: TP5  
Sheet 1 of 1

JOB NUMBER: IR 823



NOTES

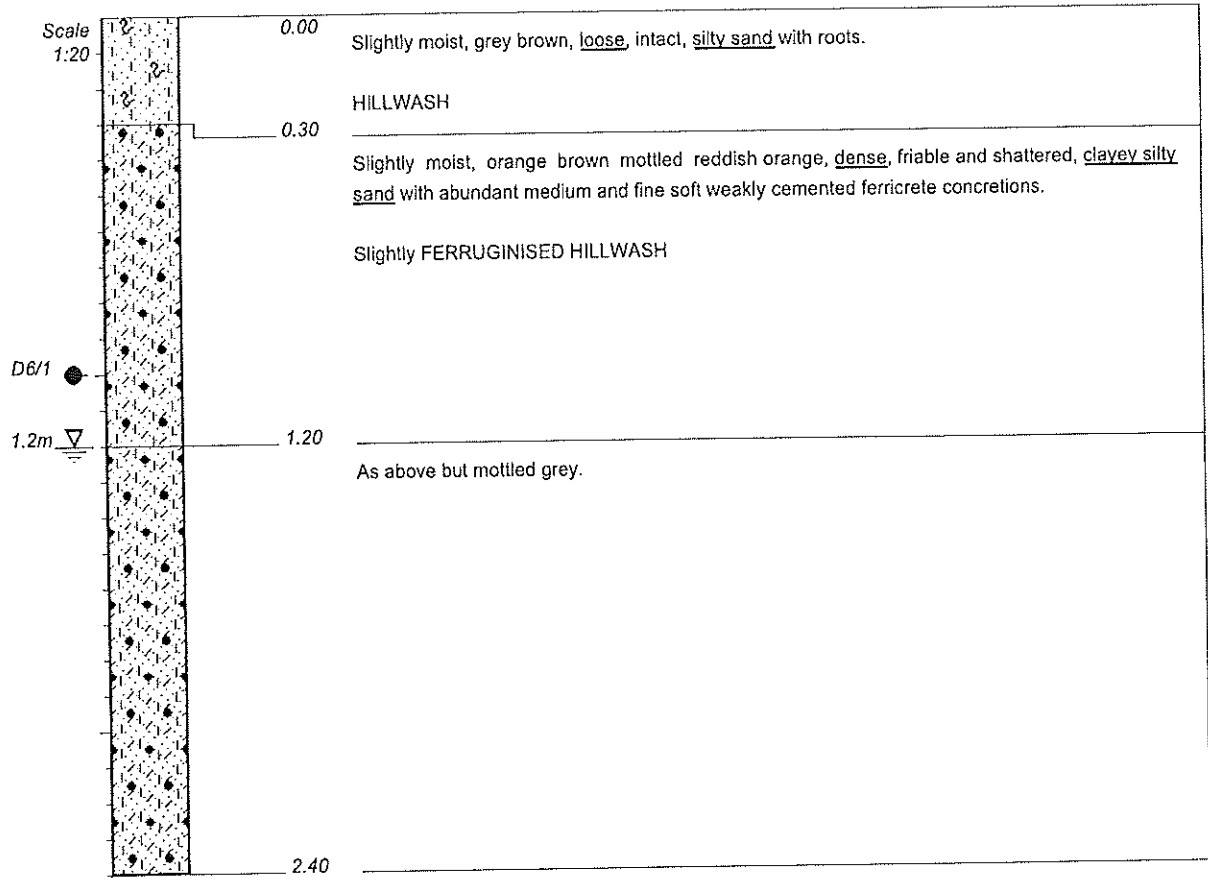
- 1) Not refusal, continues as above.
- 2) No water encountered.
- 3) Disturbed sample D5/1 taken at 1,5m.

CONTRACTOR : Geoid Earthworks Services  
 MACHINE : Bell 315.SG  
 DRILLED BY : Phillip  
 PROFILED BY : B. Bollitho  
 TYPE SET BY : Scott  
 SETUP FILE : INTRATP.SET

INCLINATION :  
 DIAM : 3,0 x 0,75m  
 DATE : 24/01/07  
 DATE : 24/01/07  
 DATE : 23/03/07 16:05  
 TEXT : ..C:\PROFILES\IR823D~3.TXT

ELEVATION : 1637  
 X-COORD : 75704  
 Y-COORD : 2900638

HOLE No: TP5



NOTES

- 1) Refusal on very dense as above.
- 2) No water encountered but perched water table conditions evident from 1,2m.
- 3) Disturbed sample D6/1 taken at 1,0m.

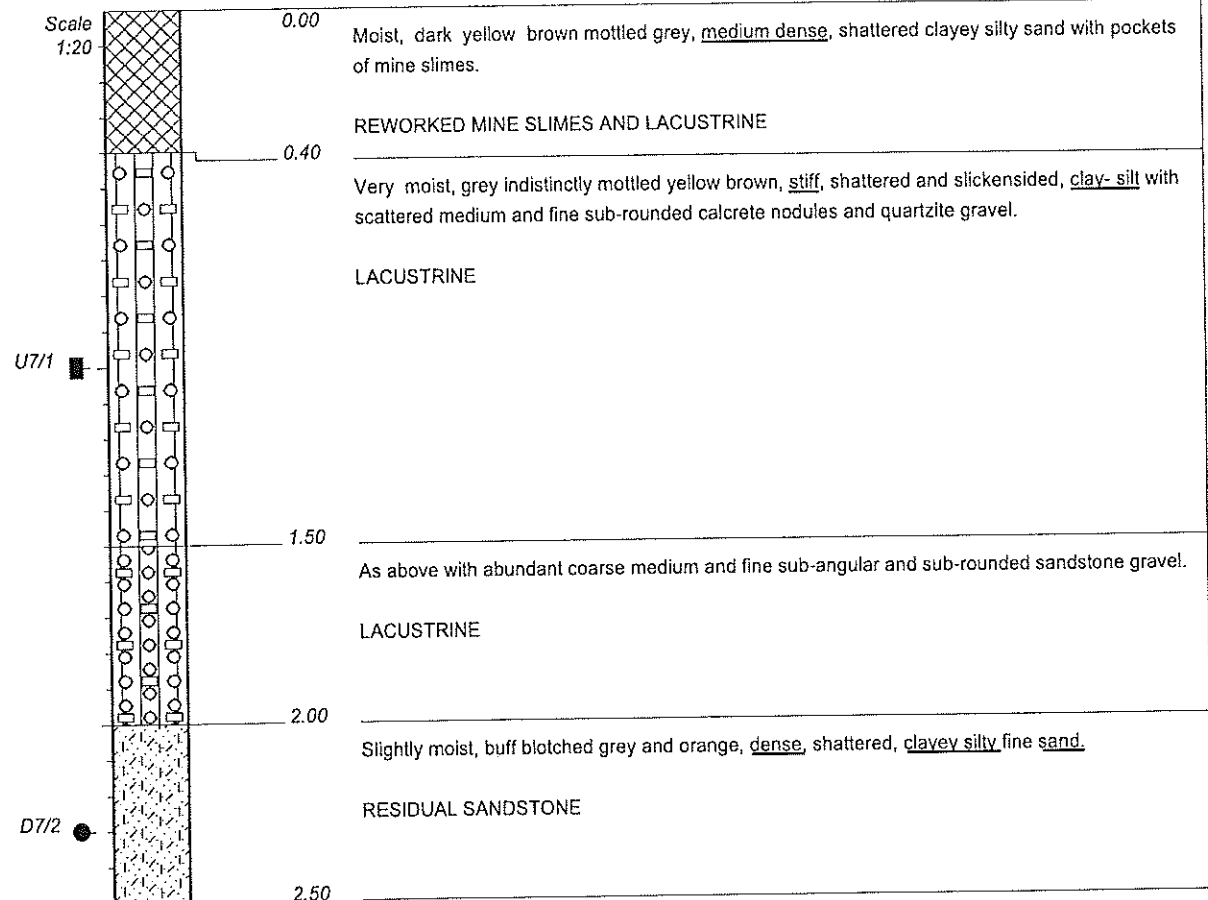
CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho  
TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07  
DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\IR823D-3.TXT

ELEVATION : 1641  
X-COORD : 75735  
Y-COORD : 2900510

HOLE No: TP6





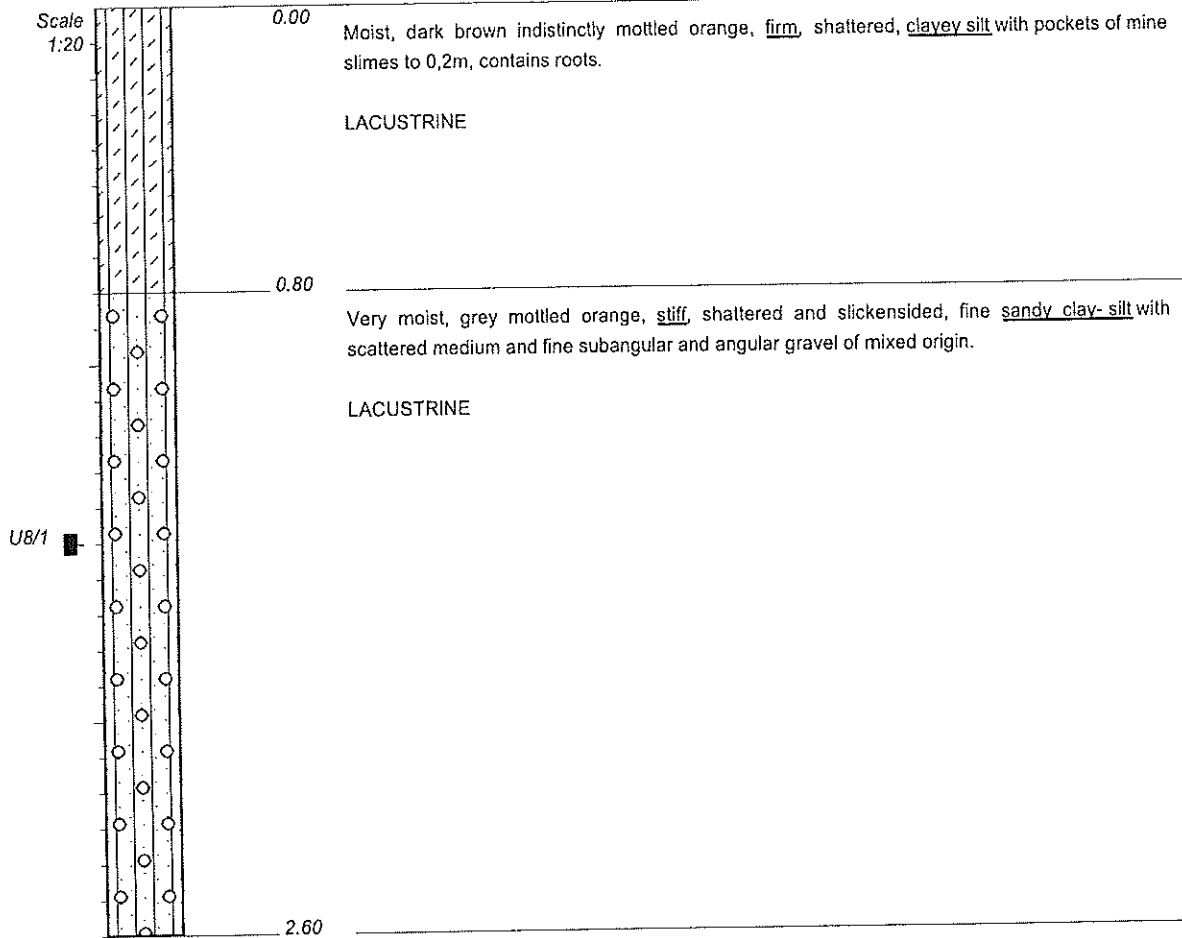
- NOTES
- 1) Refusal on very dense as above.
  - 2) No water encountered.
  - 3) Undisturbed sample U7/1 taken at 1,0m.
  - 4) Disturbed sample D7/2 taken at 2,3m.

CONTRACTOR : Geoid Earthworks Services  
 MACHINE : Bell 315.SG  
 DRILLED BY : Phillip  
 PROFILED BY : B. Bolitho  
 TYPE SET BY : Scott  
 SETUP FILE : INTRATP.SET

INCLINATION :  
 DIAM : 3,0 x 0,75m  
 DATE : 24/01/07  
 DATE : 24/01/07  
 DATE : 23/03/07 16:05  
 TEXT : ..C:\PROFILES\IR823D~3.TXT

ELEVATION : 1637  
 X-COORD : 75849  
 Y-COORD : 2900536

HOLE No: TP7



NOTES

- 1) Not refusal, continues as above.
- 2) No water encountered.
- 3) Undisturbed sample U8/1 taken at 1,5m.

CONTRACTOR : Geoid Earthworks Services

MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolfitho

TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :

DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07

DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\IR823D~3.TXT

ELEVATION : 1636  
X-COORD : 75927  
Y-COORD : 2900435

HOLE No: TP8

Scale  
1:20



0.00

Moist, dark brown, soft, fissured, sandy clay- silt with pockets of mine slimes and with roots.

LACUSTRINE

0.40

Very moist, grey blotched orange, stiff, shattered and slickensided, sandy clay- silt with scattered medium and fine sub-rounded calcrete nodules.

LACUSTRINE

2.70

NOTES

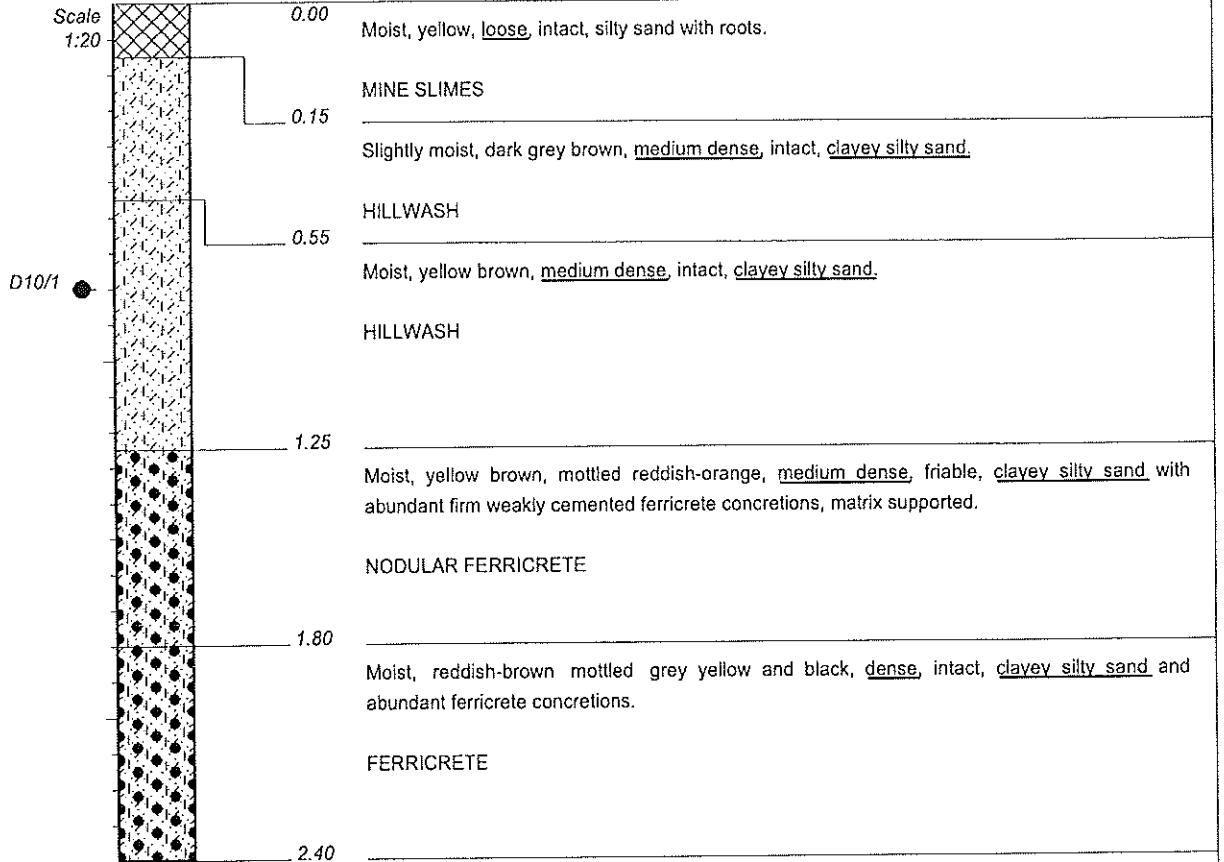
- 1) Not refusal, continues as above.
- 2) No water encountered.

CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho  
TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07  
DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\IR823D~3.TXT

ELEVATION : 1636  
X-COORD : 76173  
Y-COORD : 2900469

HOLE No: TP9



NOTES

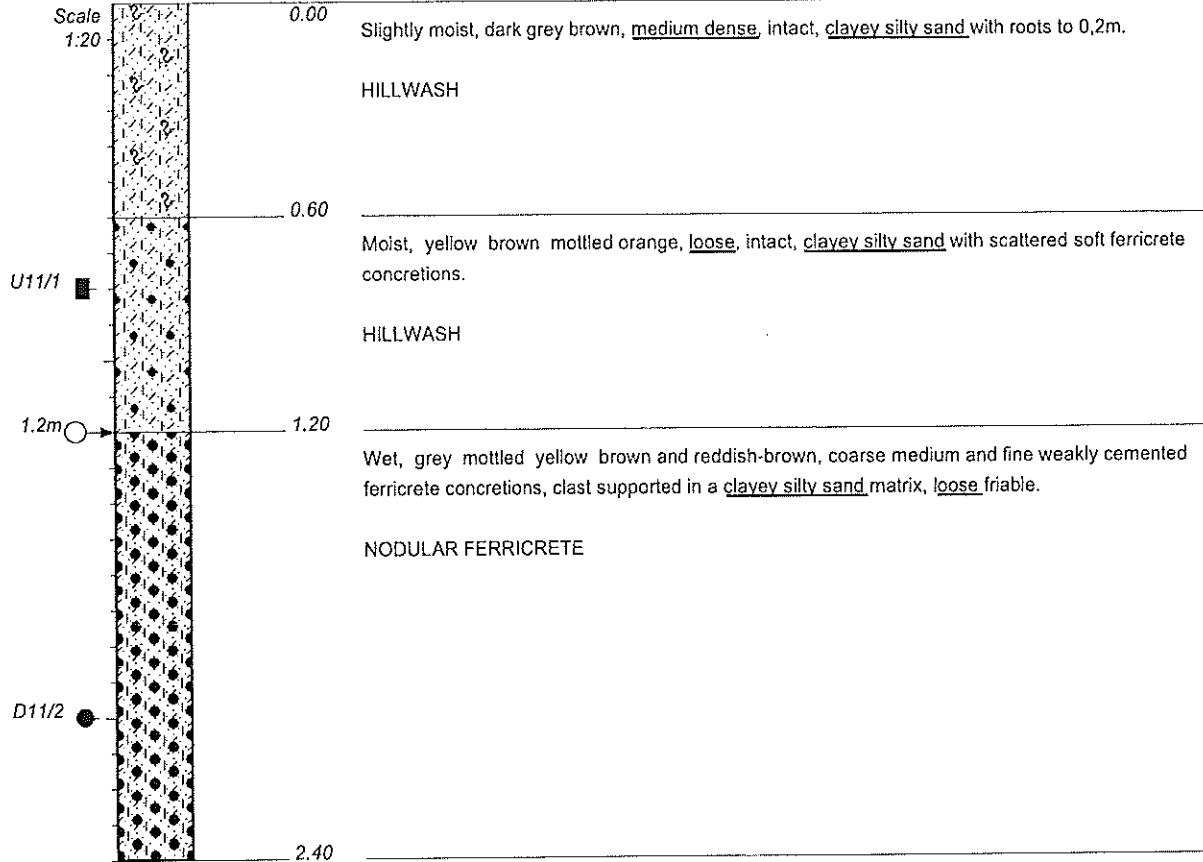
- 1) Excavated to near refusal on very dense ferricrete.
- 2) No water encountered.
- 3) Disturbed sample D10/1 taken at 0,8m.

CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho  
TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07  
DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\IR823D-3.TXT

ELEVATION : 1643  
X-COORD : 76332  
Y-COORD : 2900825

HOLE No: TP10



NOTES

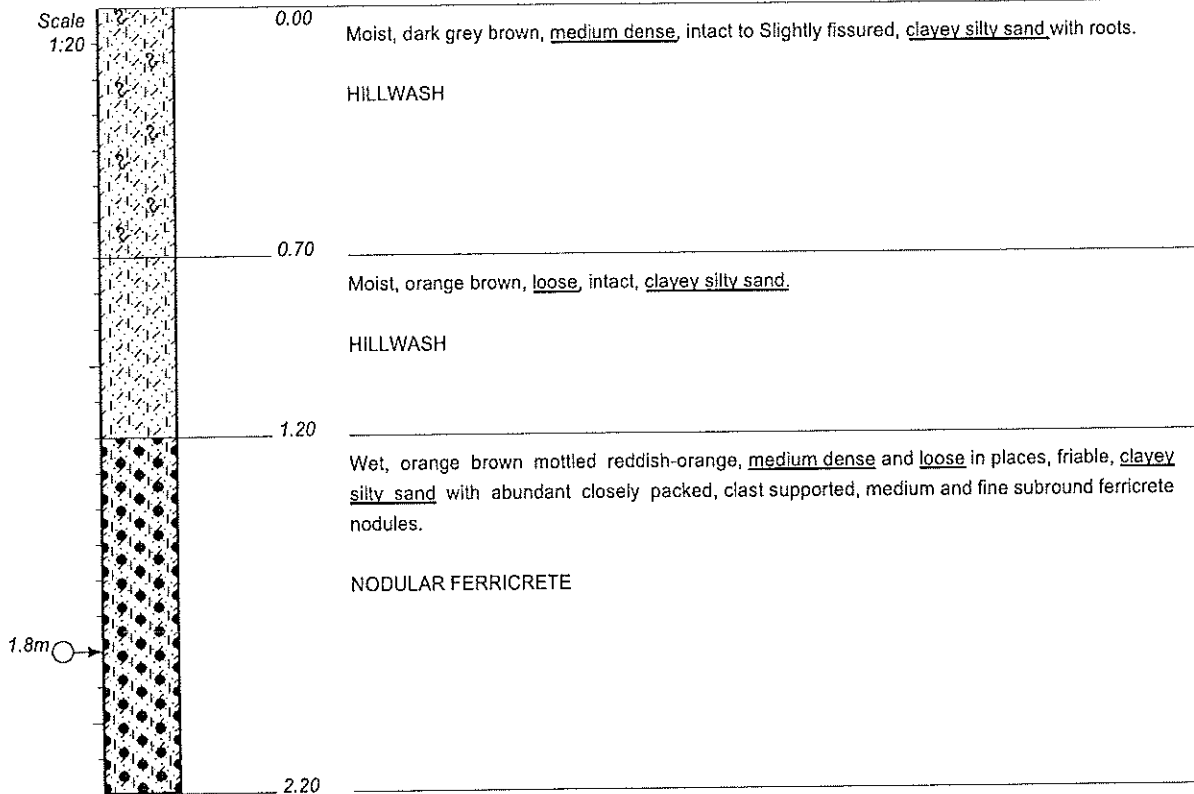
- 1) Near refusal on dense ferricrete.
- 2) Slight seepage below 1,2m with partial sidewall collapse.
- 3) Undisturbed sample U11/1 taken at 0,8m.
- 4) Disturbed sample D11/2 taken at 2,0m.

CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho  
TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07  
DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\IR823D~3.TXT

ELEVATION : 1649  
X-COORD : 76309  
Y-COORD : 2900918

HOLE No: TP11



NOTES

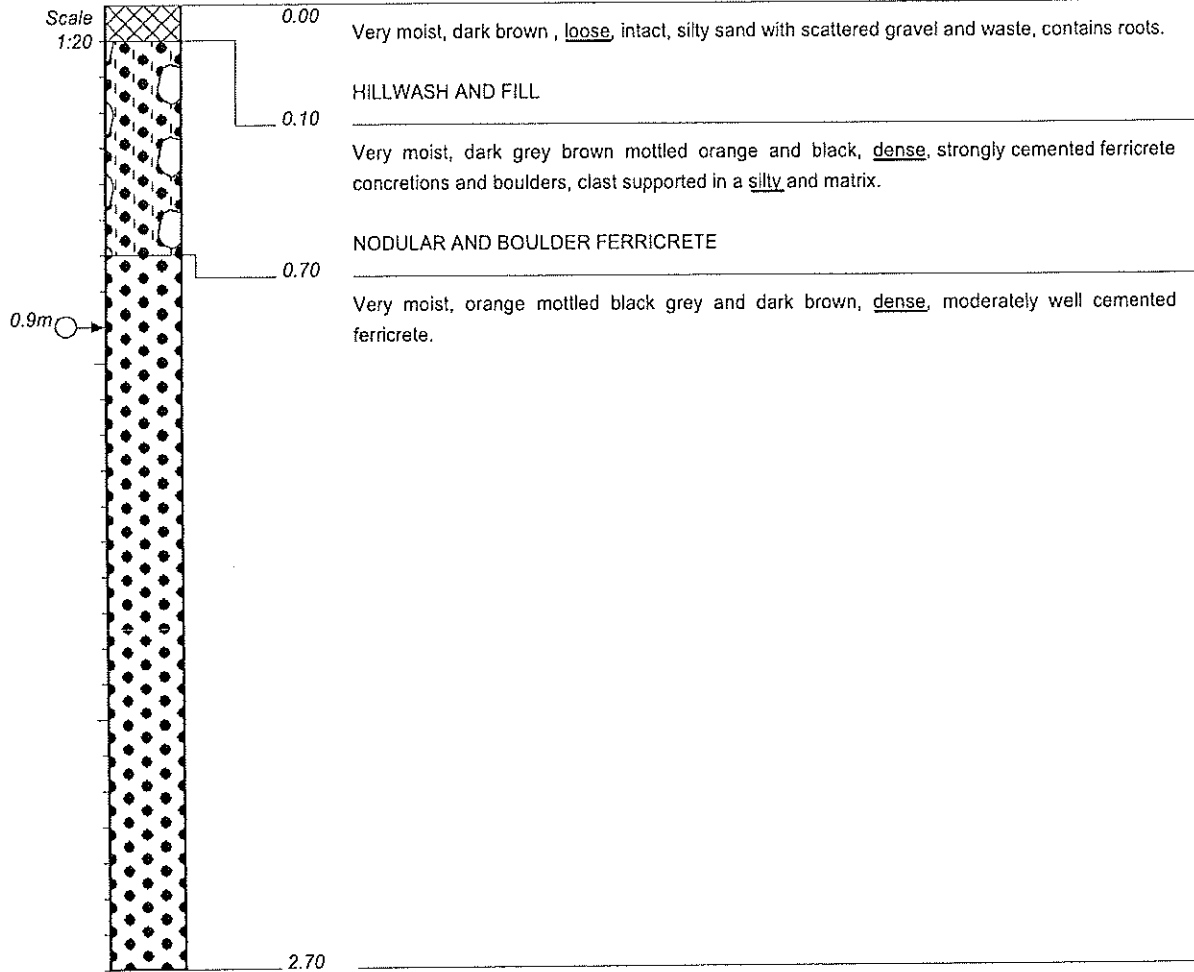
- 1) Not refusal, continues as above.
- 2) No water encountered.
- 3) Moderate seepage below 1,8m.
- 4) Water standing at 2,0m after 10 minutes.

CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho  
TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07  
DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\VR823D~3.TXT

ELEVATION : 1634  
X-COORD : 76270  
Y-COORD : 2900998

HOLE No: TP12



NOTES

- 1) Not refusal, continues as above.
- 2) Moderate seepage at 0.9m.

CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho  
TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07  
DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\IR823D~3.TXT

ELEVATION : 1635  
X-COORD : 76190  
Y-COORD : 2900915

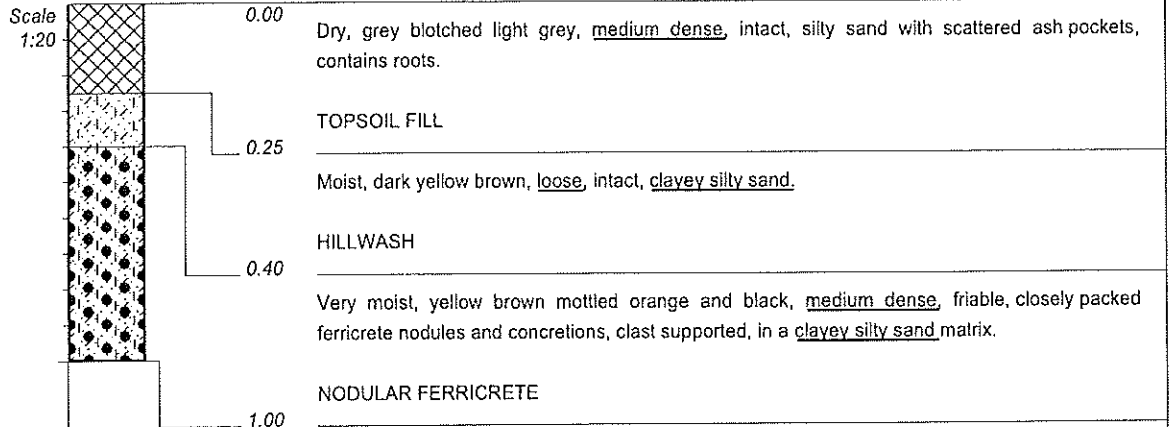
HOLE No: TP13



Portion 406 of Driefontein 85-IR  
Urban Dynamics

HOLE No: TP14  
Sheet 1 of 1

JOB NUMBER: IR 823



NOTES

- 1) Refusal on steel pipe at 1,0m.
- 2) Continues as above.
- 3) No water encountered.

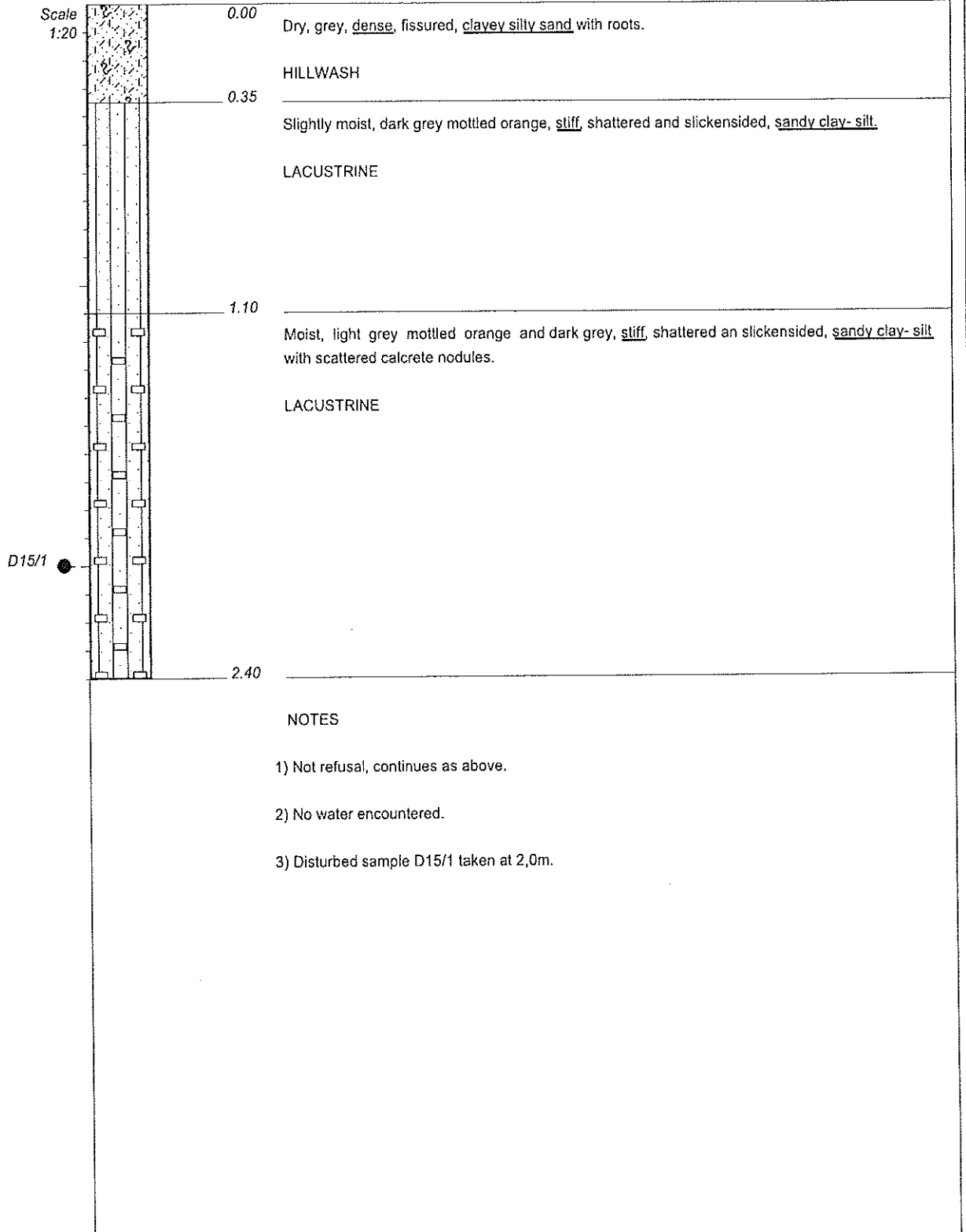
CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho  
TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07  
DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\IR823D-3.TXT

ELEVATION : 1634  
X-COORD : 76084  
Y-COORD : 2900837

HOLE No: TP14





CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho  
TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07  
DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\IR823D~3.TXT

ELEVATION : 1633  
X-COORD : 75960  
Y-COORD : 2900766

HOLE No: TP15

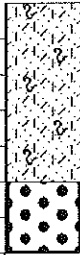


Portion 406 of Driefontein 85-IR  
Urban Dynamics

HOLE No: TP16  
Sheet 1 of 1

JOB NUMBER: IR 823

Scale  
1:20



0.00

Dry, grey, dense, fissured, clayey silty sand with roots.

HILLWASH

0.50

Dry to slightly moist, yellow mottled orange grey and black, very dense, strongly cemented hardpan ferricrete.

0.70

NOTES

- 1) Refusal on the above.
- 2) No water encountered.

CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho

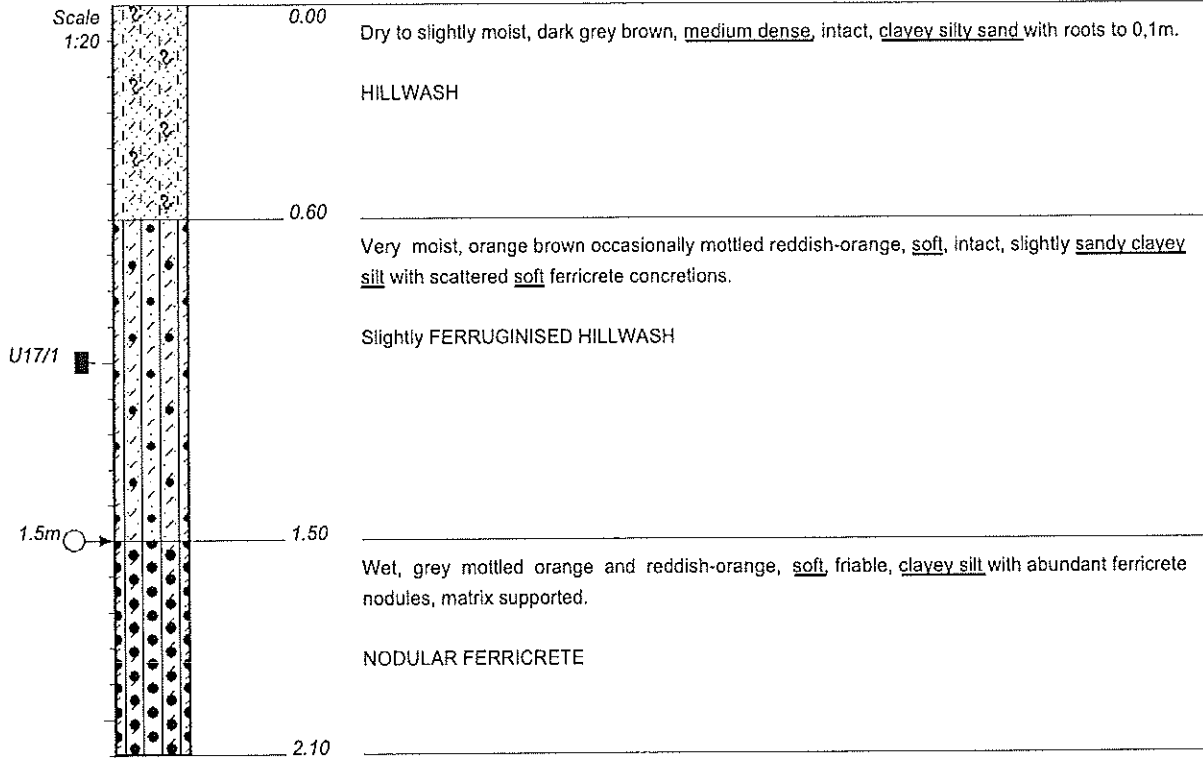
INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07

ELEVATION : 1634  
X-COORD : 75865  
Y-COORD : 2900742

TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\IR823D~3.TXT

HOLE No: TP16



NOTES

- 1) Near refusal on dense ferricrete.
- 2) Very slight seepage below 1,5m.
- 3) Undisturbed sample U17/1 taken at 1,0m.

CONTRACTOR : Geoid Earthworks Services  
MACHINE : Bell 315.SG  
DRILLED BY : Phillip  
PROFILED BY : B. Bolitho  
TYPE SET BY : Scott  
SETUP FILE : INTRATP.SET

INCLINATION :  
DIAM : 3,0 x 0,75m  
DATE : 24/01/07  
DATE : 24/01/07  
DATE : 23/03/07 16:05  
TEXT : ..C:\PROFILES\IR823D~3.TXT

ELEVATION : 1637  
X-COORD : 76337  
Y-COORD : 2901099

HOLE No: TP17

**APPENDIX B**

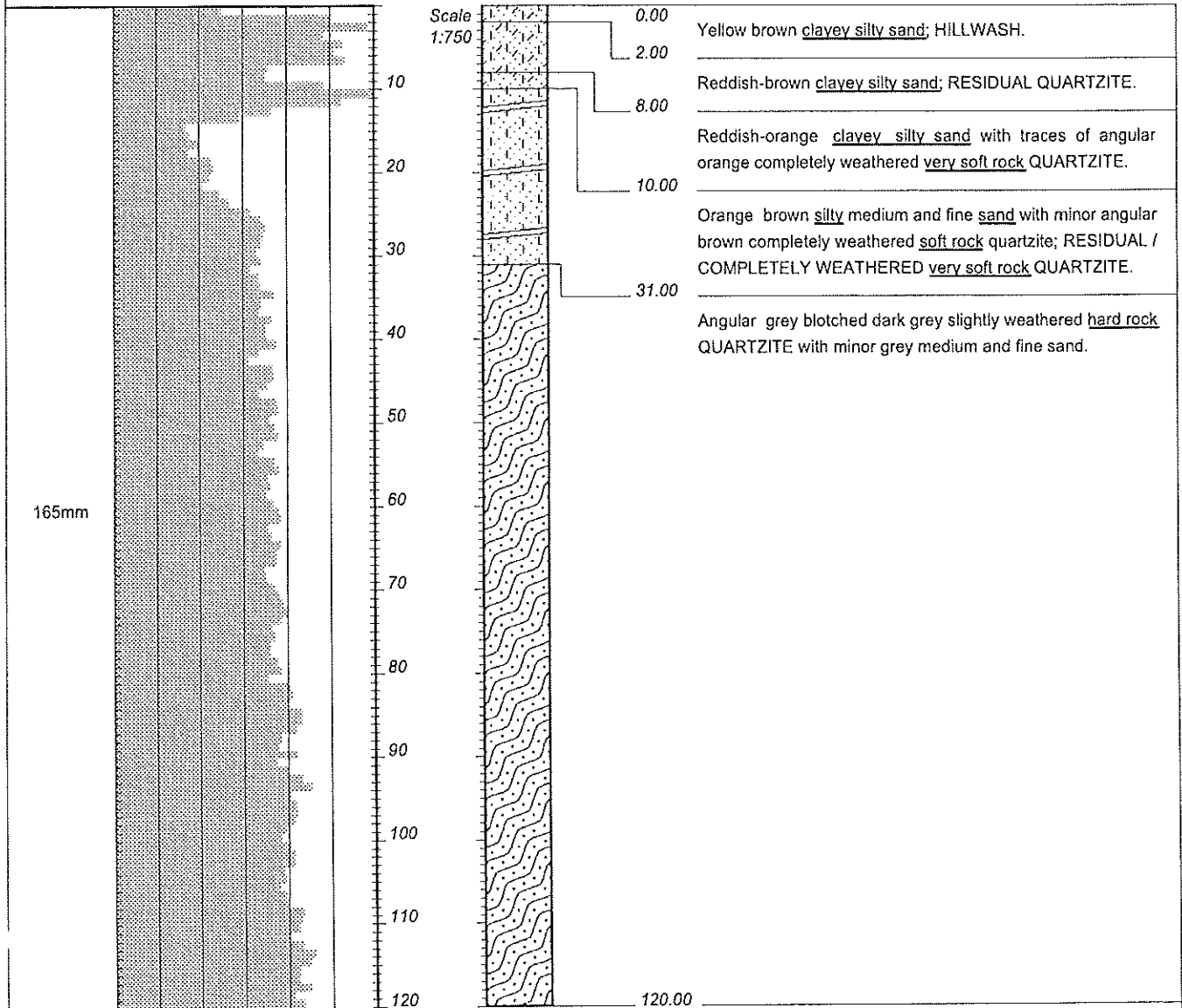
Percussion Borehole Logs



Portion 406 of Driefontein 85-IR  
Urban Dynamics

HOLE No: MB1  
Sheet 1 of 1

JOB NUMBER: IR 823



NOTES

1) No groundwater strikes encountered.

Hole Diam.	1	2	3	4	5	6
Penetration Rate min/metre						

CONTRACTOR : Johann Botha  
MACHINE : Rock Giant  
DRILLED BY : Stefan Botha  
PROFILED BY : B. Bollitho

TYPE SET BY : CSM  
SETUP FILE : INTRAPER.SET

INCLINATION : Vertical  
DIAM : 165mm  
DATE : 22 February 2007  
DATE : 7&8 March 2007

DATE : 23/03/07 15:58  
TEXT : ..C:\PROFILES\IR823D~2.TXT

ELEVATION :  
X-COORD : 76324  
Y-COORD : 2900668

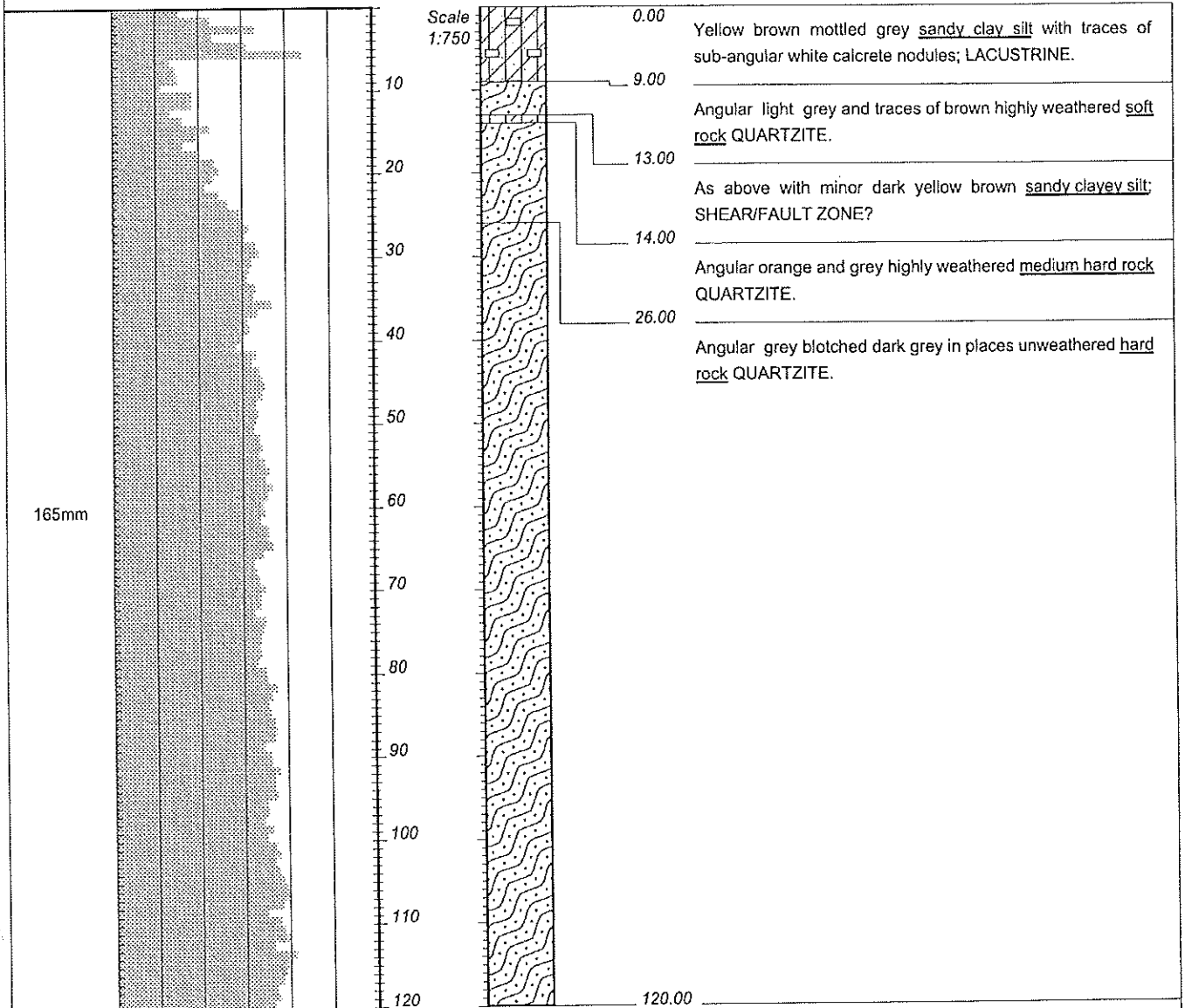
HOLE No: MB1



Portion 406 of Driefontein 85-IR  
Urban Dynamics

HOLE No: MB2  
Sheet 1 of 1

JOB NUMBER: IR 823



NOTES

1) No groundwater strikes encountered.

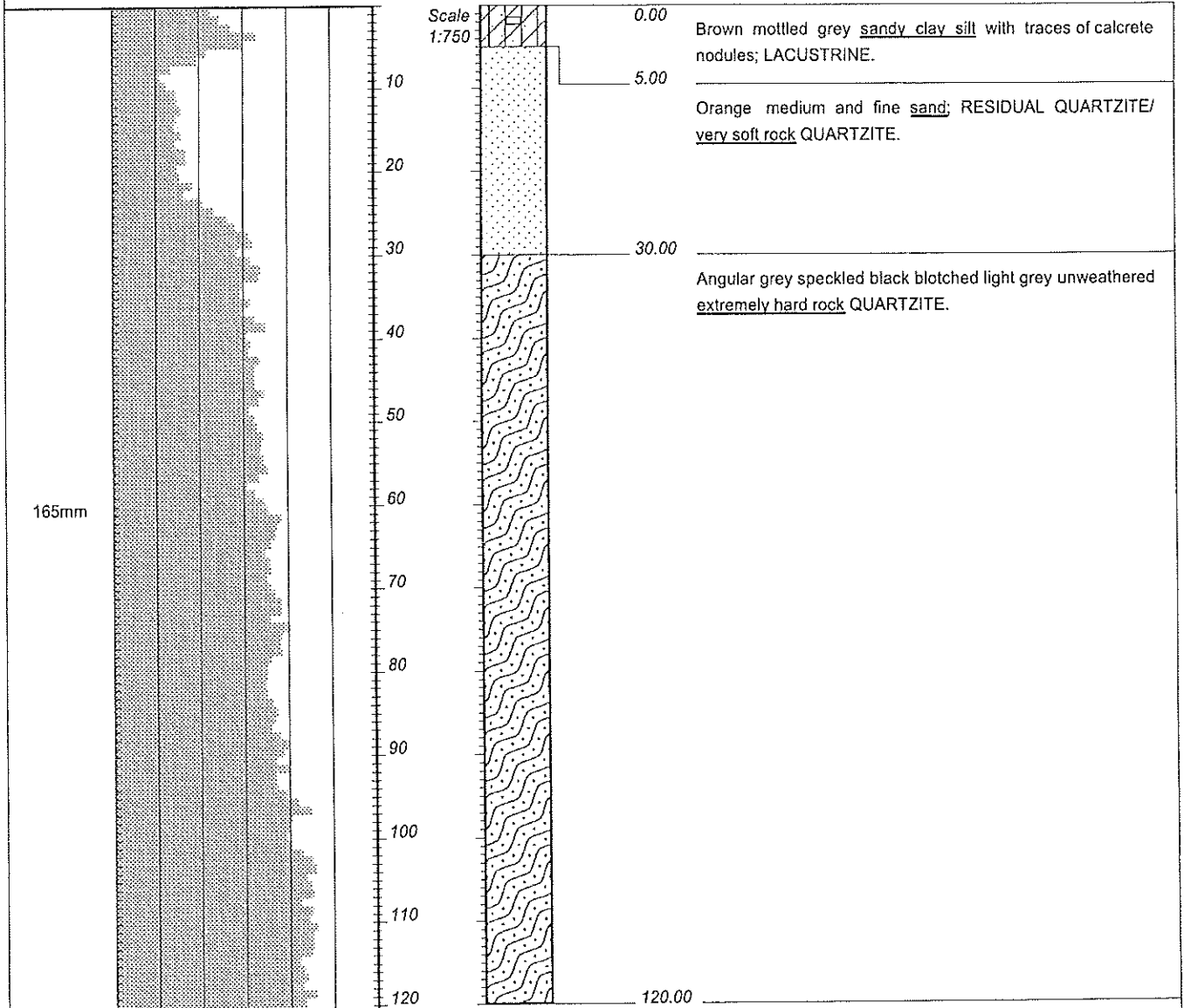
Hole Diam.	1	2	3	4	5	6

CONTRACTOR : Johann Botha  
MACHINE : Rock Giant  
DRILLED BY : Stefan Botha  
PROFILED BY : B. Bolitho  
TYPE SET BY : CSM  
SETUP FILE : INTRAPER.SET

INCLINATION :  
DIAM : 165mm  
DATE : 22 February 2007  
DATE : 7&8 March 2007  
DATE : 23/03/07 15:58  
TEXT : ..C:\PROFILES\IR823D~2.TXT

ELEVATION :  
X-COORD : 76215  
Y-COORD : 2900420

HOLE No: MB2



NOTES

1) No groundwater strikes encountered.

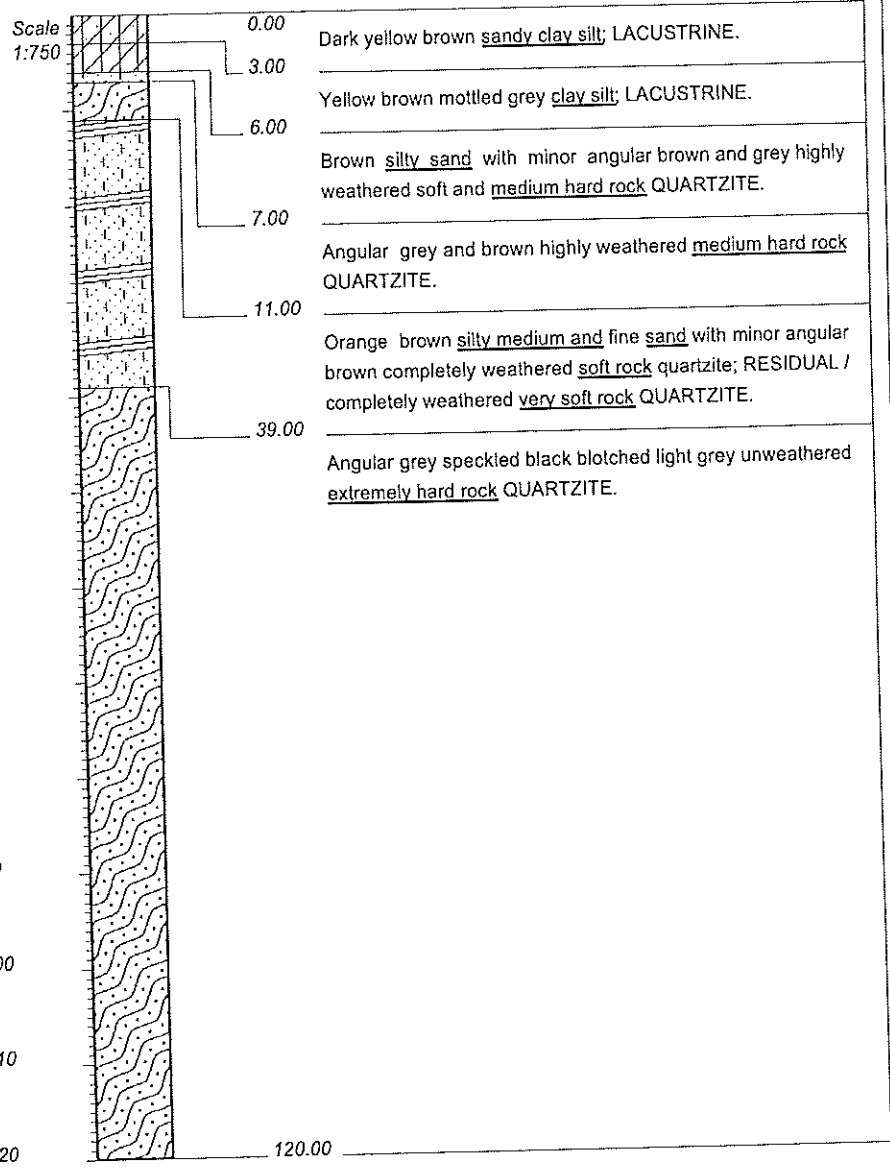
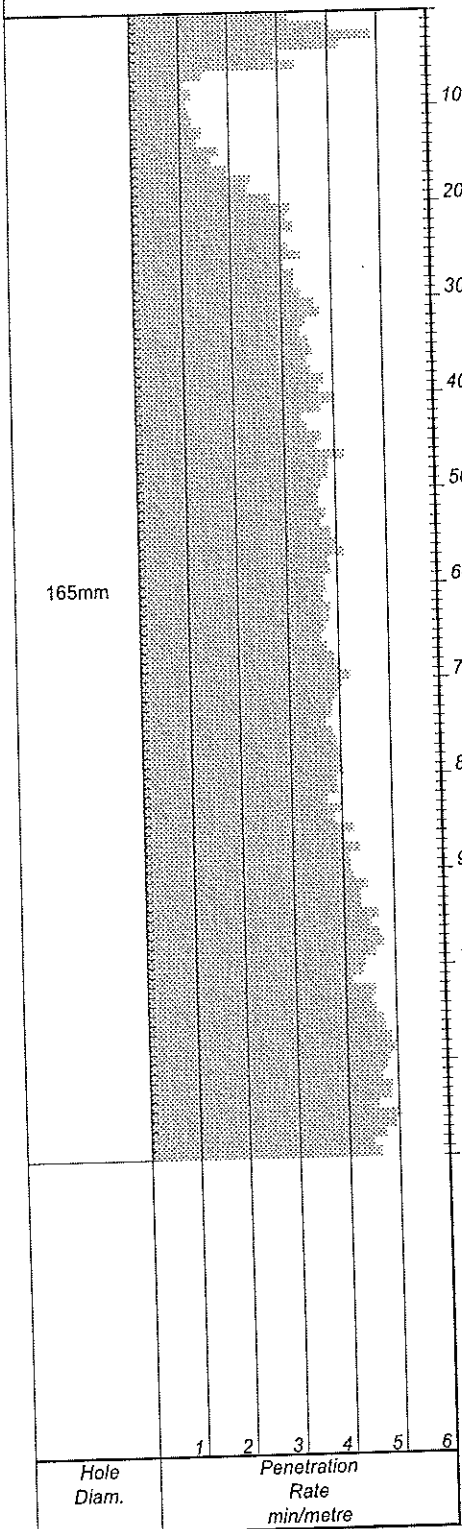
Hole Diam.	1	2	3	4	5	6
Penetration Rate min/metre						

CONTRACTOR : Johann Botha  
MACHINE : Rock Giant  
DRILLED BY : Stefan Botha  
PROFILED BY : B. Bolitho  
TYPE SET BY : CSM  
SETUP FILE : INTRAPER.SET

INCLINATION :  
DIAM : 165mm  
DATE : 22 February 2007  
DATE : 7&8 March 2007  
DATE : 23/03/07 15:58  
TEXT : ..C:\PROFILES\VR823D~2.TXT

ELEVATION :  
X-COORD : 75932  
Y-COORD : 2900464

HOLE No: MB3



NOTES

- 1) No groundwater strikes encountered.

Hole Diam.	1	2	3	4	5	6

CONTRACTOR : Johann Botha  
MACHINE : Rock Giant  
DRILLED BY : Stefan Botha  
PROFILED BY : B. Bolitho  
TYPE SET BY : GSM  
SETUP FILE : INTRAPER.SET

INCLINATION :  
DIAM : 165mm  
DATE : 22 February 2007  
DATE : 7&8 March 2007  
DATE : 23/03/07 15:58  
TEXT : ..C:\PROFILES\IR823D~2.TXT

ELEVATION :  
X-COORD : 75896  
Y-COORD : 2900407

HOLE No: MB4

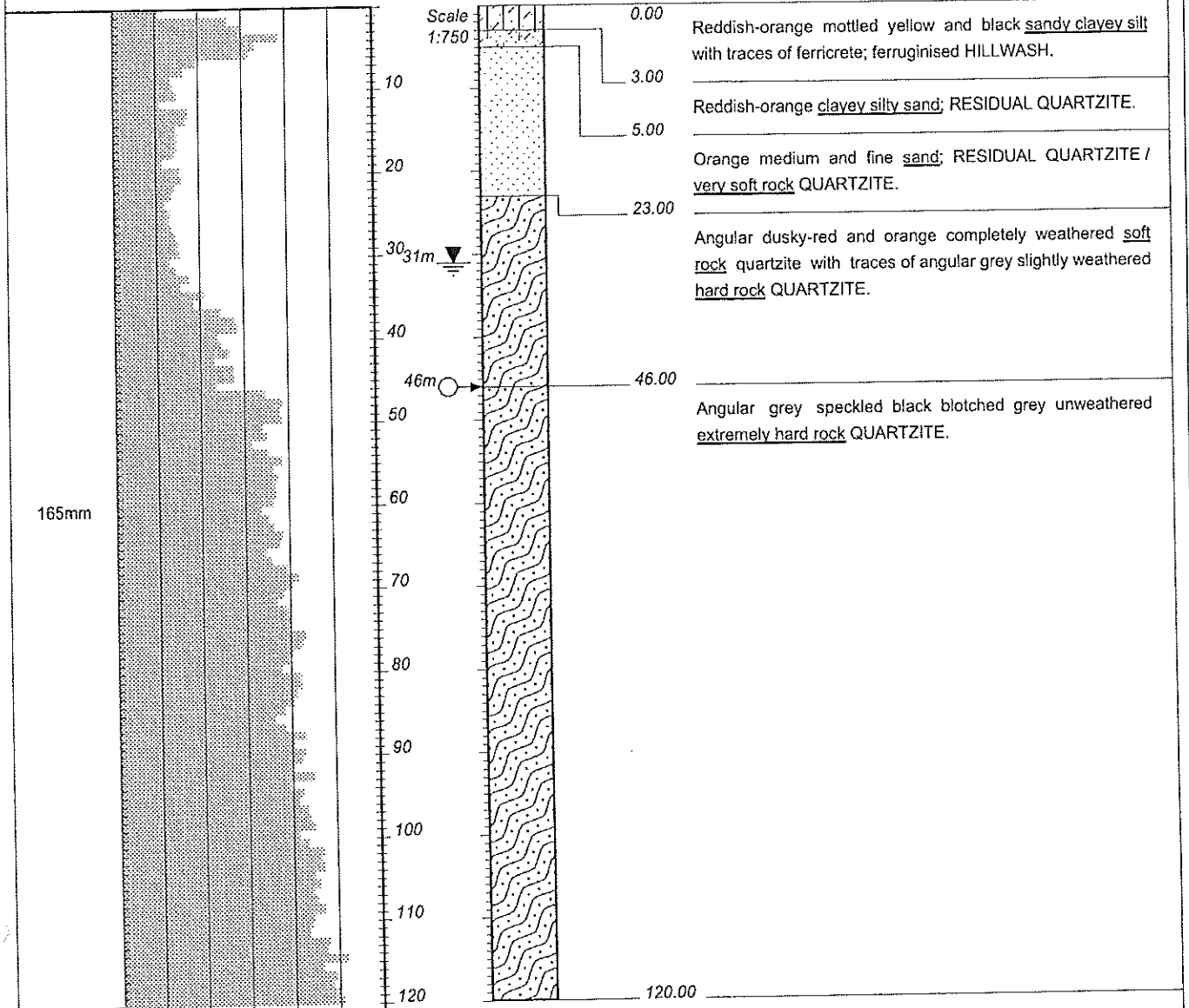




Portion 406 of Driefontein 85-IR  
Urban Dynamics

HOLE No: MB5  
Sheet 1 of 1

JOB NUMBER: IR 823



NOTES

- 1) Water strike at 46m.
- 2) Groundwater rest level 31m.

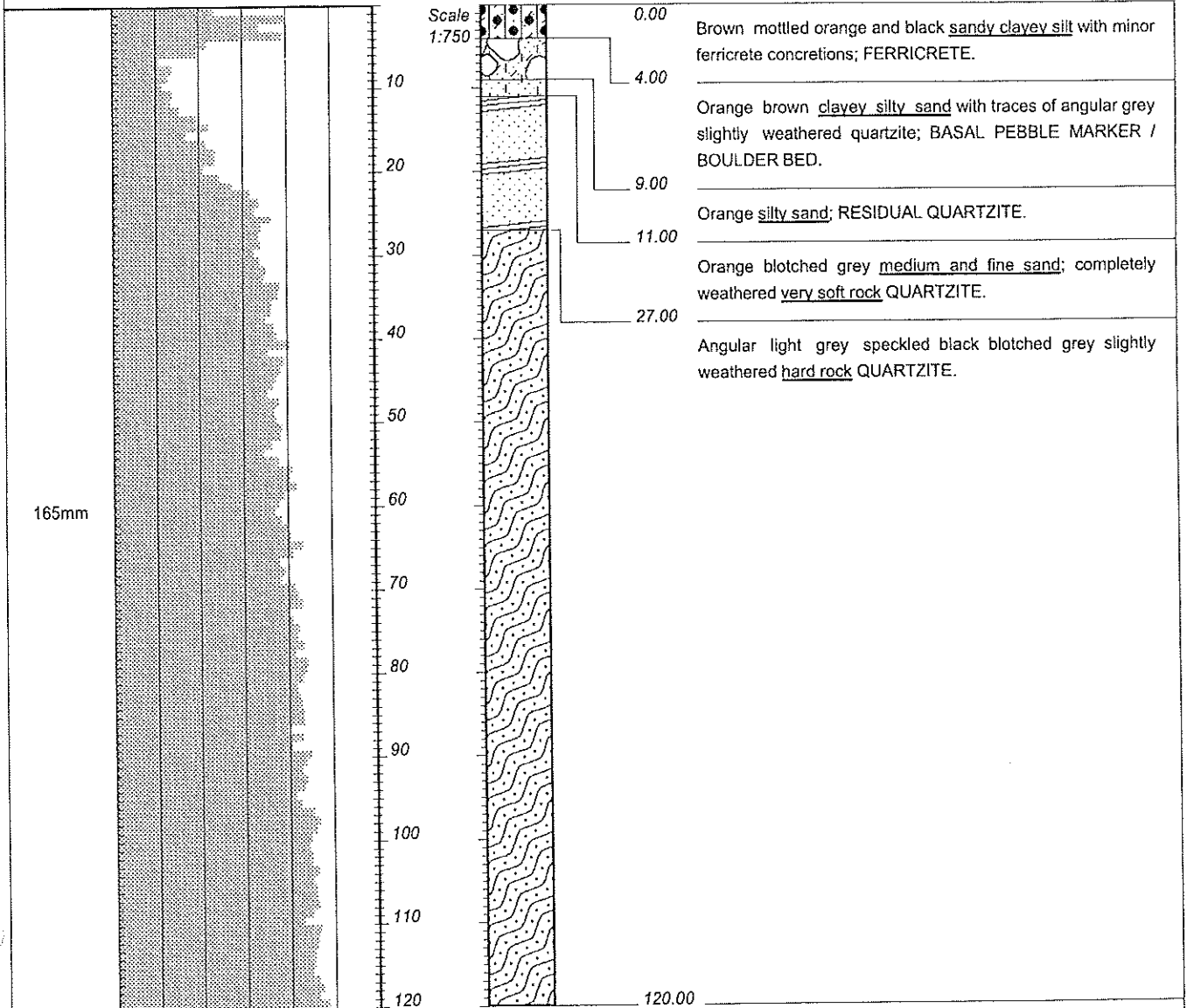
Hole Diam.	1	2	3	4	5	6
Penetration Rate min/metre						

CONTRACTOR : Johann Botha  
MACHINE : Rock Giant  
DRILLED BY : Stefan Botha  
PROFILED BY : B. Boliitho  
TYPE SET BY : CSM  
SETUP FILE : INTRAPER.SET

INCLINATION :  
DIAM : 165mm  
DATE : 22 February 2007  
DATE : 7&8 March 2007  
DATE : 23/03/07 15:58  
TEXT : ..C:\PROFILES\IR823D~2.TXT

ELEVATION :  
X-COORD : 75737  
Y-COORD : 2900686

HOLE No: MB5



NOTES

1) No groundwater strikes encountered.

Hole Diam.	Penetration Rate min/metre					
	1	2	3	4	5	6

CONTRACTOR : Johann Botha  
MACHINE : Rock Giant  
DRILLED BY : Stefan Botha  
PROFILED BY : B. Bolitho

TYPE SET BY : CSM  
SETUP FILE : INTRAPER.SET

INCLINATION :

DIAM : 165mm  
DATE : 22 February 2007  
DATE : 7&8 March 2007  
DATE : 23/03/07 15:58  
TEXT : ..C:\PROFILES\IR823D~2.TXT

ELEVATION :

X-COORD : 75933  
Y-COORD : 2900779

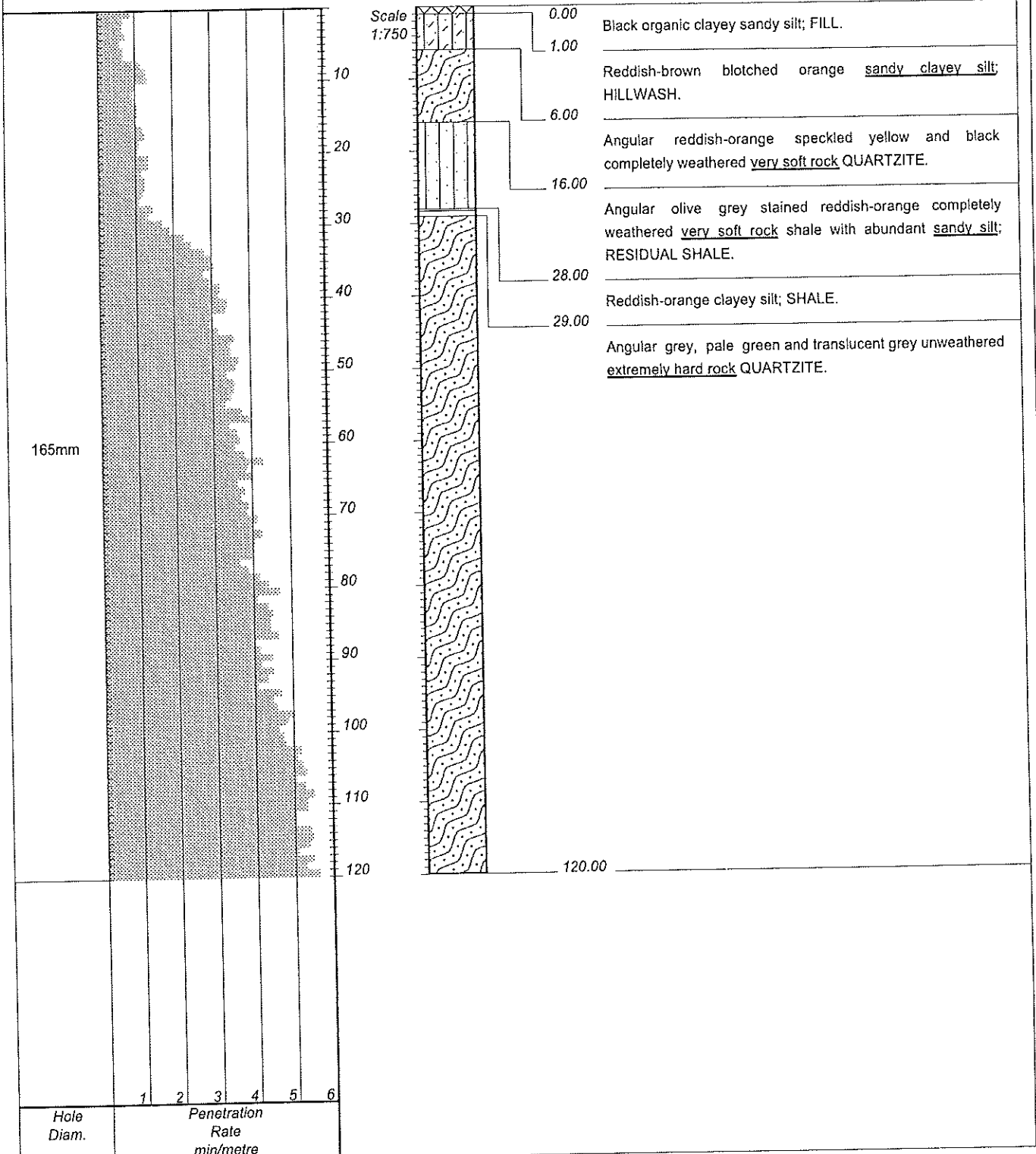
HOLE No: MB6



Portion 406 of Driefontein 85-IR  
Urban Dynamics

HOLE No: MB7  
Sheet 1 of 1

JOB NUMBER: IR 823

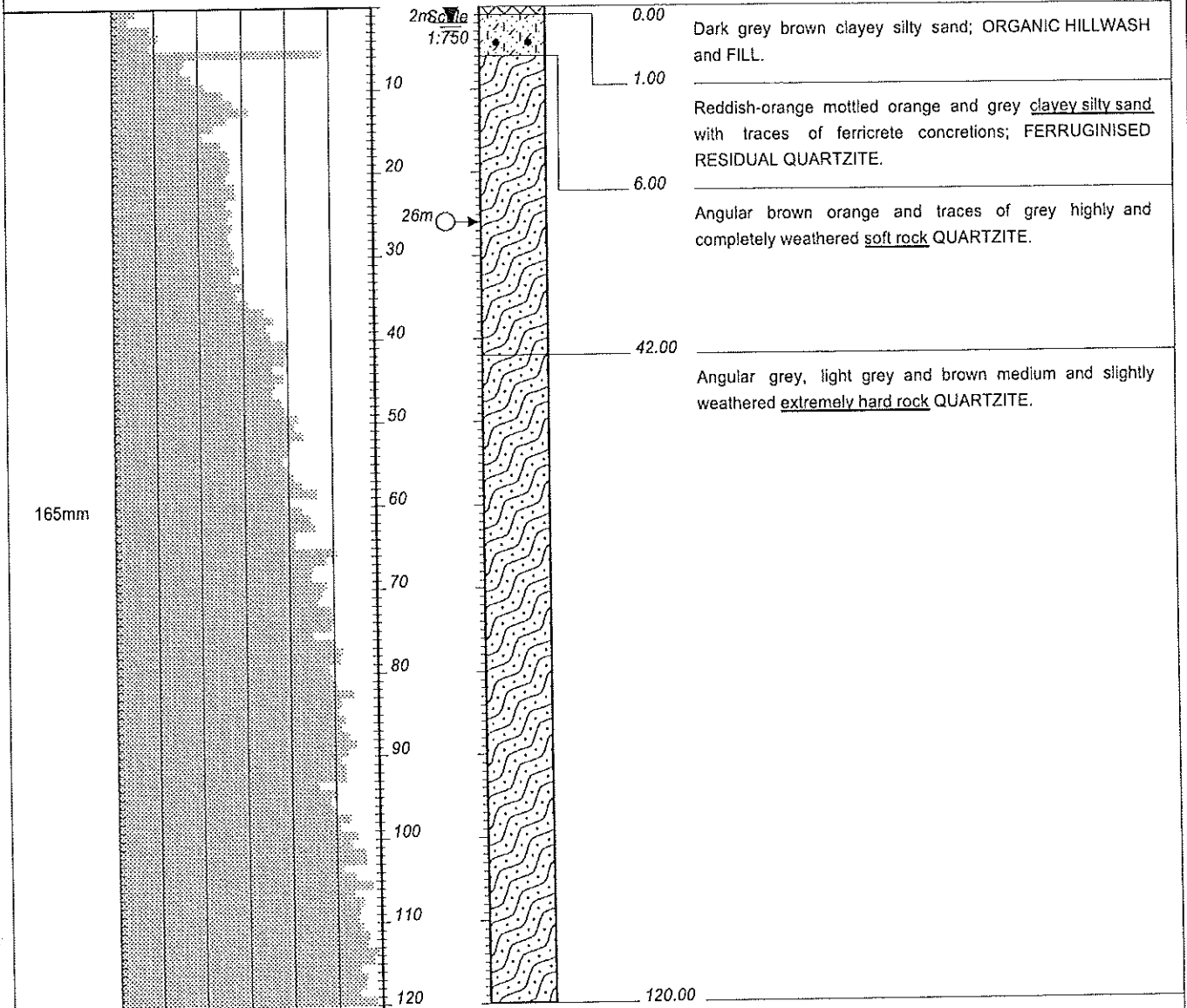


CONTRACTOR : Johann Botha  
MACHINE : Rock Giant  
DRILLED BY : Stefan Botha  
PROFILED BY : B. Bolitho  
TYPE SET BY : CSM  
SETUP FILE : INTRAPER.SET

INCLINATION :  
DIAM : 165mm  
DATE : 22 February 2007  
DATE : 7&8 March 2007  
DATE : 23/03/07 15:58  
TEXT : ..C:\PROFILES\IR823D-2.TXT

ELEVATION :  
X-COORD : 76205  
Y-COORD : 2900925

HOLE No: MB7



NOTES

- 1) Water strike at 26m.
- 2) Groundwater rest level 2m.

Hole Diam.	1	2	3	4	5	6
	Penetration Rate min/metre					

CONTRACTOR : Johann Botha  
MACHINE : Rock Giant  
DRILLED BY : Stefan Botha  
PROFILED BY : B. Bolitho  
TYPE SET BY : CSM  
SETUP FILE : INTRAPER.SET

INCLINATION :  
DIAM : 165mm  
DATE : 22 February 2007  
DATE : 7&8 March 2007  
DATE : 23/03/07 15:58  
TEXT : ..C:\PROFILES\IR823D~2.TXT

ELEVATION :  
X-COORD : 76255  
Y-COORD : 2900980

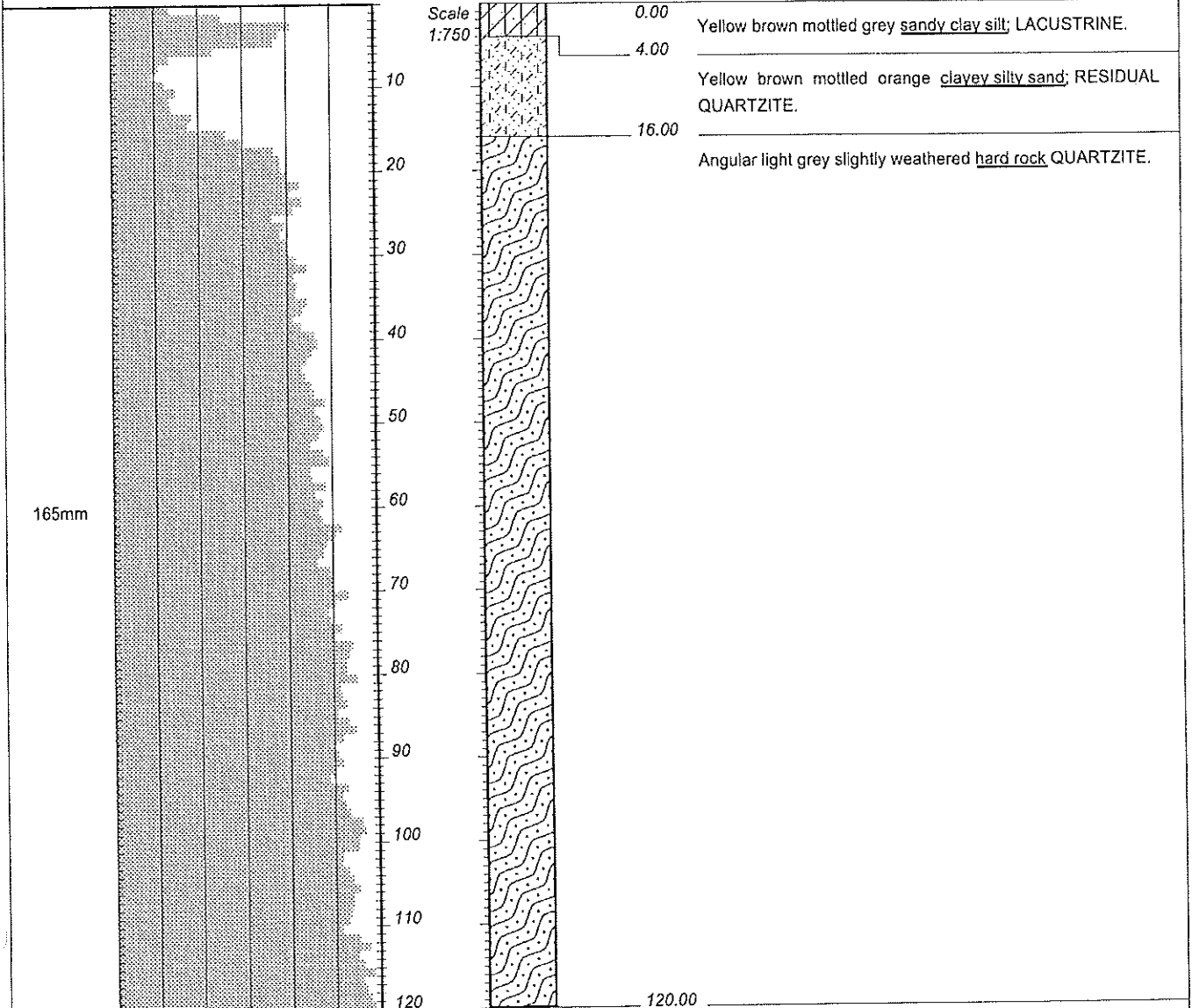
HOLE No: MB8



Portion 406 of Driefontein 85-IR  
Urban Dynamics

HOLE No: MB9  
Sheet 1 of 1

JOB NUMBER: IR 823



NOTES

1) No groundwater strikes encountered.

Hole Diam.	Penetration Rate min/metre					
	1	2	3	4	5	6

CONTRACTOR : Johann Botha  
MACHINE : Rock Giant  
DRILLED BY : Stefan Botha  
PROFILED BY : B. Bollitho

INCLINATION :

DIAM : 165mm  
DATE : 22 February 2007  
DATE : 7&8 March 2007  
DATE : 23/03/07 15:58  
TEXT : ..C:\PROFILES\IR823D~2.TXT

ELEVATION :  
X-COORD : 75716  
Y-COORD : 2900539

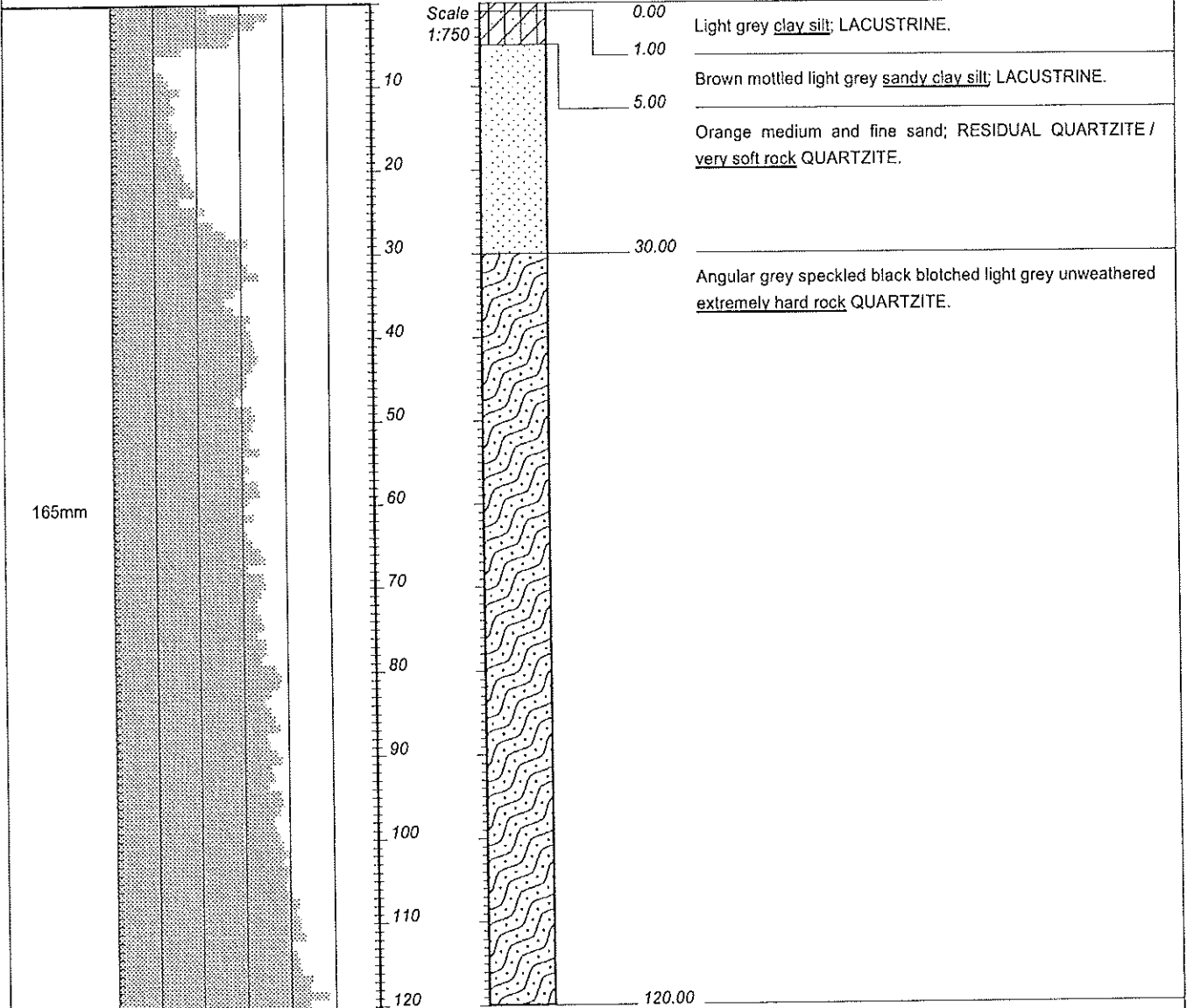
HOLE No: MB9



Portion 406 of Driefontein 85-IR  
Urban Dynamics

HOLE No: MB10  
Sheet 1 of 1

JOB NUMBER: IR 823



NOTES

- 1) No groundwater strikes encountered.

Hole Diam.	1	2	3	4	5	6
Penetration Rate min/metre						

CONTRACTOR : Johann Botha  
MACHINE : Rock Giant  
DRILLED BY : Stefan Botha  
PROFILED BY : B. Bolitho  
TYPE SET BY : CSM  
SETUP FILE : INTRAPER.SET

INCLINATION :  
DIAM : 165mm  
DATE : 22 February 2007  
DATE : 7&8 March 2007  
DATE : 23/03/07 15:58  
TEXT : ..C:\PROFILES\IR823D-2.TXT

ELEVATION :  
X-COORD : 75946  
Y-COORD : 2900537

HOLE No: MB10

**APPENDIX C**

**Laboratory Test Results**



## FOUNDATION INDICATOR

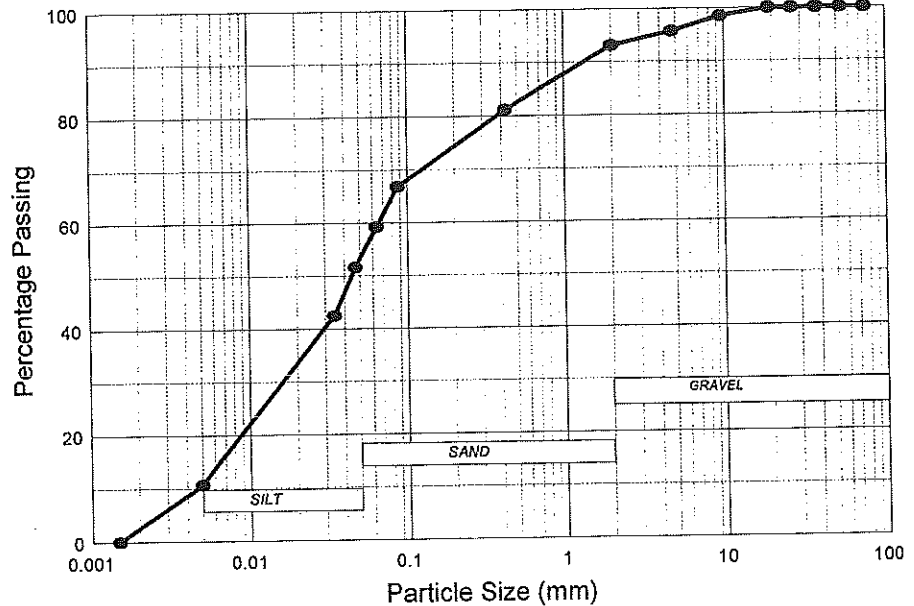
Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 1/1 @ 0,2m	
Date	20 FEBRUARY 2007	Test No	352
Job No	07085	Checked By	EB

### SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	98.49
4.75	95.75
2.00	93.12
0.425	81.15

### GRADING ANALYSIS



### HYDROMETER ANALYSIS

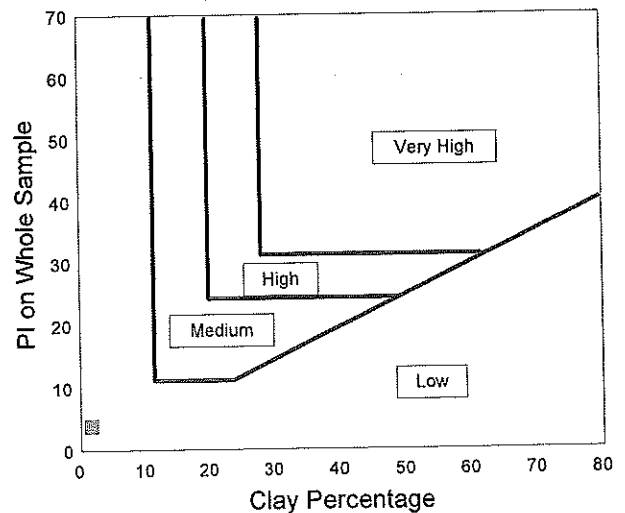
Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0867	66.87
0.0637	59.27
0.0467	51.67
0.0343	42.55
0.0050	10.64
0.0015	0.00

### ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	22
Plastic Limit	17
Plastic Index	5
Linear Shrinkage	2
Grading Modulus	0.59
Moisture Content	10.54
PI on Whole Sample	4

### ACTIVITY CHART







## FOUNDATION INDICATOR

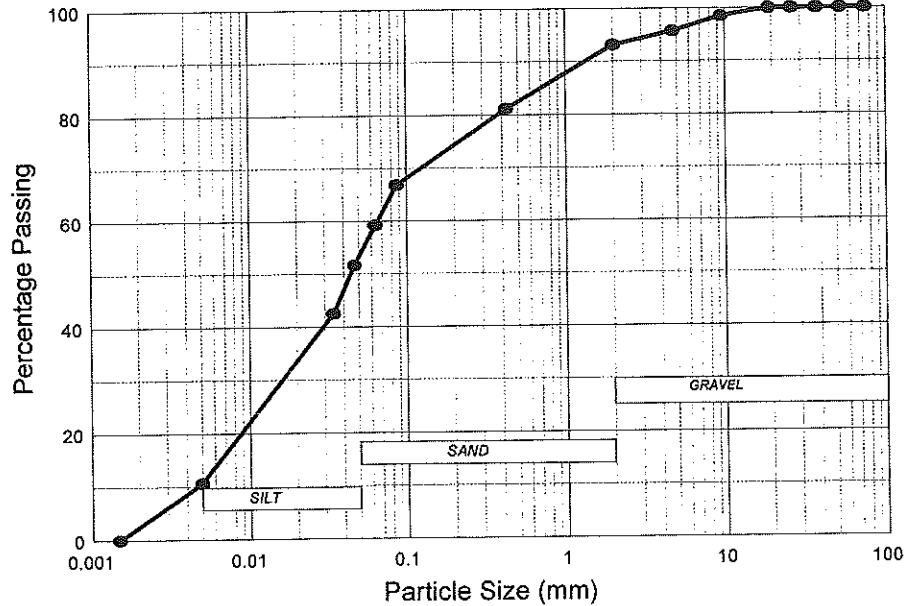
Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 1/1 @ 0,2m	
Date	20 FEBRUARY 2007	Test No	352
Job No	07085	Checked By	EB

### SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	98.49
4.75	95.75
2.00	93.12
0.425	81.15

### GRADING ANALYSIS



### HYDROMETER ANALYSIS

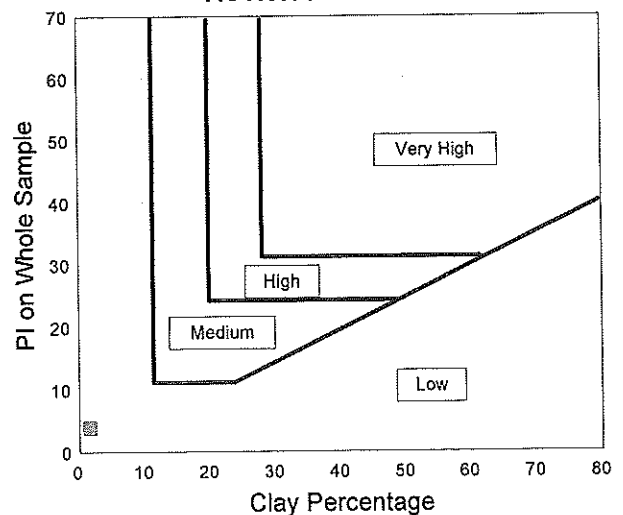
Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0867	66.87
0.0637	59.27
0.0467	51.67
0.0343	42.55
0.0050	10.64
0.0015	0.00

### ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	22
Plastic Limit	17
Plastic Index	5
Linear Shrinkage	2
Grading Modulus	0.59
Moisture Content	10.54
PI on Whole Sample	4

### ACTIVITY CHART





## FOUNDATION INDICATOR

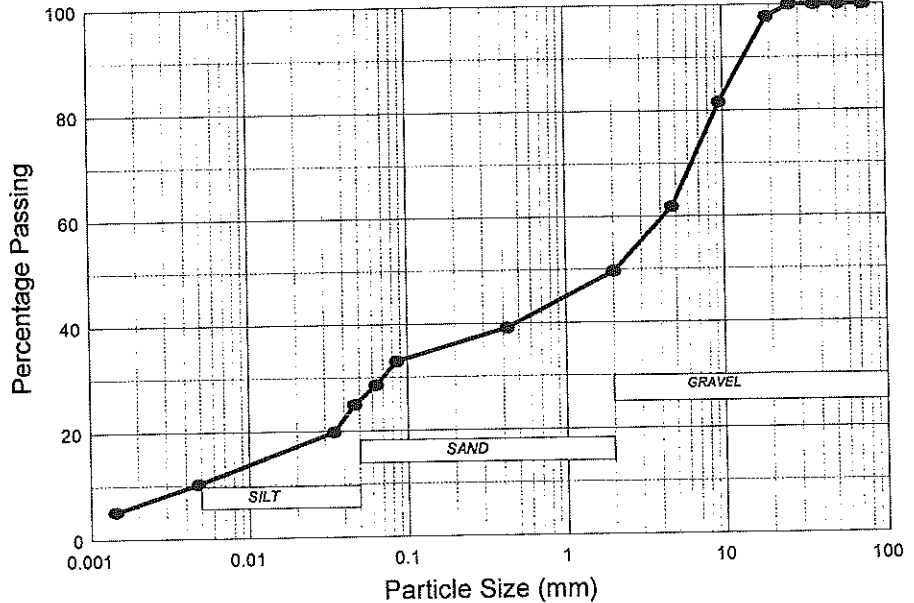
Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 1/3 @ 2,0m	
Date	20 FEBRUARY 2007	Test No	354
Job No	07085	Checked By	EB

### SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	97.75
9.50	81.58
4.75	61.89
2.00	49.72
0.425	39.21

### GRADING ANALYSIS



### HYDROMETER ANALYSIS

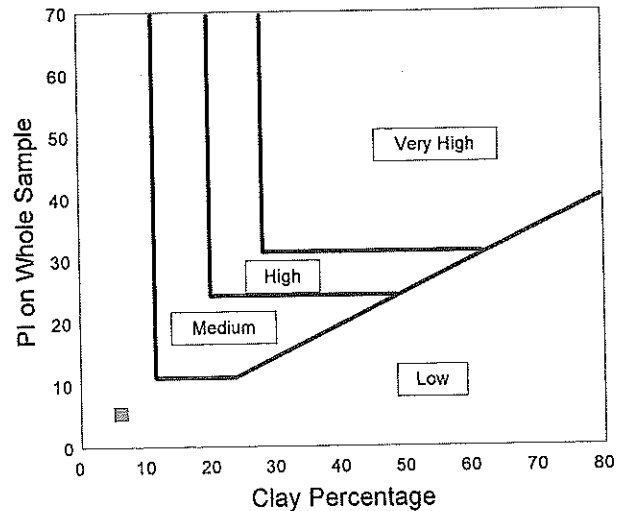
Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0861	33.04
0.0637	28.64
0.0467	24.97
0.0346	19.83
0.0048	10.28
0.0014	5.14

### ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	29
Plastic Limit	15
Plastic Index	14
Linear Shrinkage	7
Grading Modulus	1.78
Moisture Content	12.70
PI on Whole Sample	6

### ACTIVITY CHART



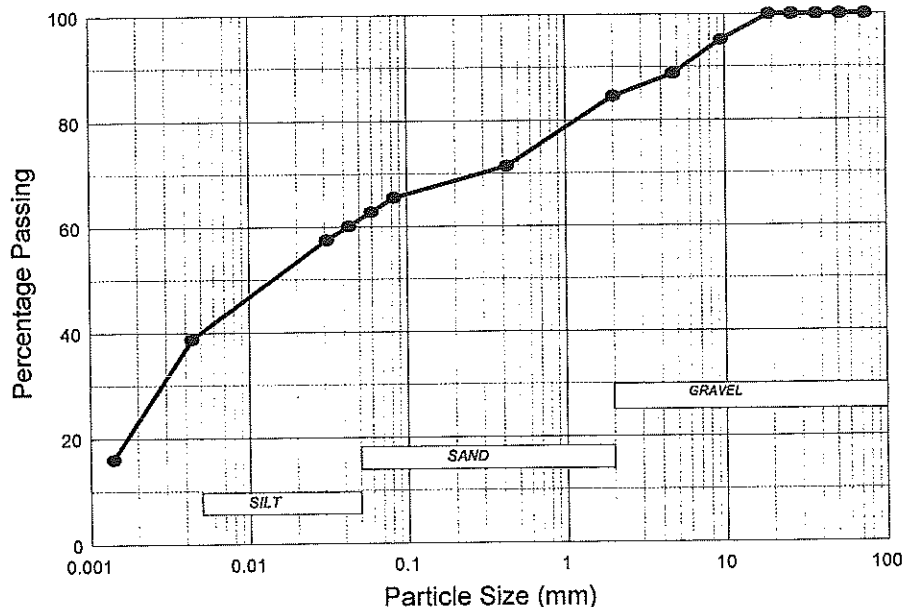
**GEO PRACTICA**SOILS & MATERIALS TESTING  
P.O. BOX 227, MARAISBURG, 1700TEL: (011) 674 1325  
FAX: (011) 674 4513  
e mail: lab@geopractica.co.za**FOUNDATION INDICATOR**

Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 2/2 @ 2,0m	
Date	20 FEBRUARY 2007	Test No	355
Job No	07085	Checked By	EB

**SIEVE ANALYSIS**

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	95.13
4.75	88.77
2.00	84.56
0.425	71.45

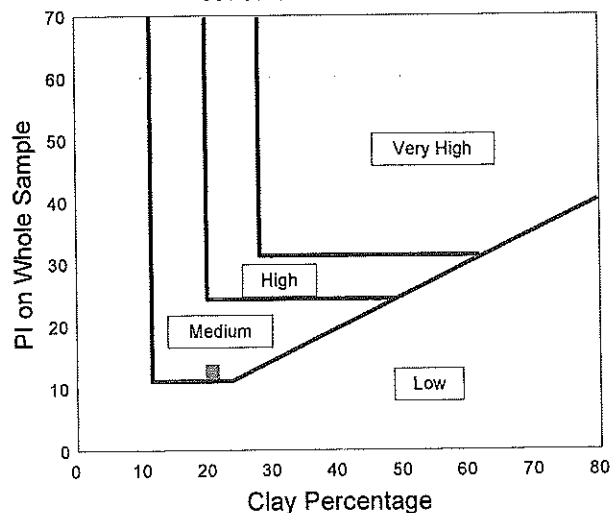
**GRADING ANALYSIS****HYDROMETER ANALYSIS**

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0832	65.57
0.0599	62.89
0.0430	60.22
0.0309	57.54
0.0044	38.81
0.0014	16.06

**ATTERBERG LIMITS & OTHER VALUES**

Liquid Limit	36
Plastic Limit	18
Plastic Index	18
Linear Shrinkage	9
Grading Modulus	0.78
Moisture Content	17.25
PI on Whole Sample	13

**ACTIVITY CHART**



# GEOPRACTICA

SOILS & MATERIALS TESTING  
P.O. BOX 227, MARAISBURG, 1700

TEL: (011) 674 1325

FAX: (011) 674 4513

e mail: lab@geopractica.co.za

## FOUNDATION INDICATOR

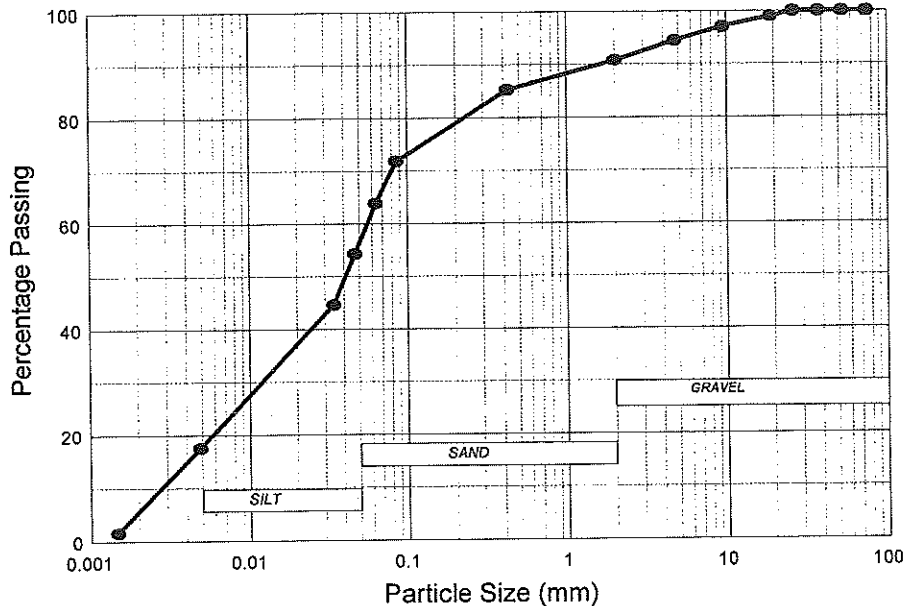
Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 4/1 @ 0,2m	
Date	20 FEBRUARY 2007	Test No	356
Job No	07085	Checked By	EB

### SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	99.02
9.50	97.09
4.75	94.50
2.00	90.79
0.425	85.31

### GRADING ANALYSIS



### HYDROMETER ANALYSIS

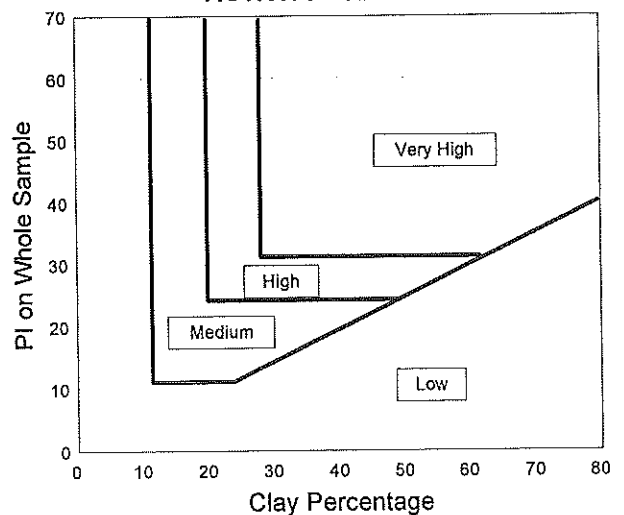
Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0861	71.89
0.0633	63.91
0.0467	54.32
0.0343	44.73
0.0049	17.57
0.0015	1.60

### ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	Non Plastic
Plastic Limit	Non Plastic
Plastic Index	Non Plastic
Linear Shrinkage	1
Grading Modulus	0.52
Moisture Content	15.01
PI on Whole Sample	Non Plastic

### ACTIVITY CHART





## FOUNDATION INDICATOR

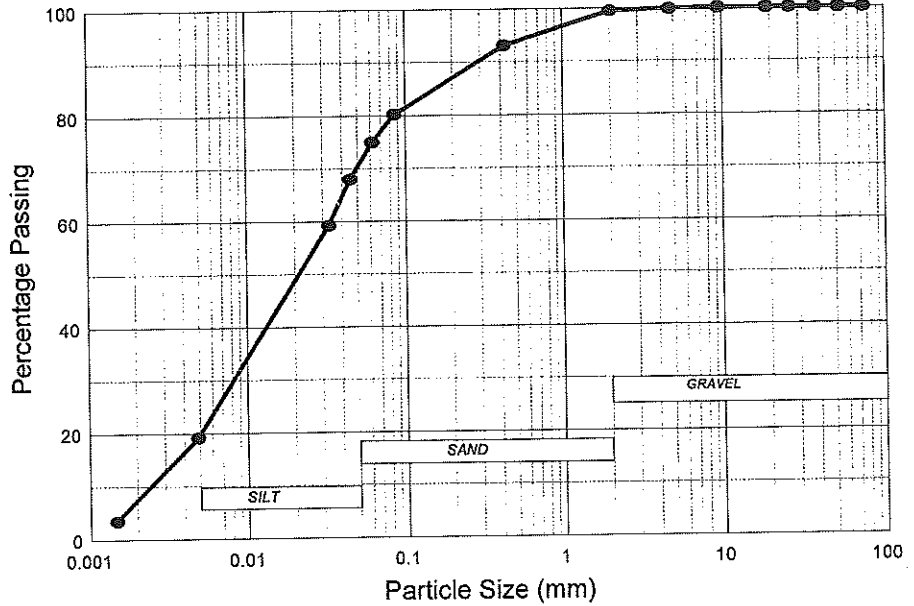
Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 4/2 @ 1,0m	
Date	20 FEBRUARY 2007	Test No	357
Job No	07085	Checked By	EB

### SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	100.00
4.75	99.92
2.00	99.51
0.425	93.14

### GRADING ANALYSIS



### HYDROMETER ANALYSIS

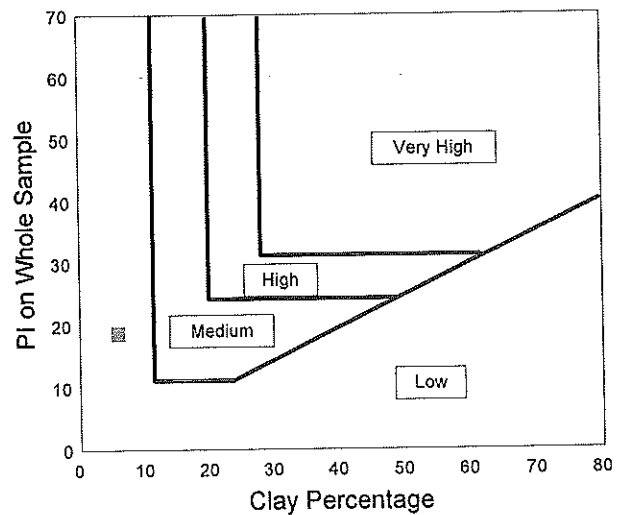
Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0854	80.24
0.0618	75.01
0.0451	68.03
0.0330	59.31
0.0049	19.19
0.0015	3.49

### ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	39
Plastic Limit	19
Plastic Index	20
Linear Shrinkage	10
Grading Modulus	0.27
Moisture Content	34.67
PI on Whole Sample	19

### ACTIVITY CHART





**SINGLE OEDOMETER CONSOLIDATION - SOAKED AT 10 kPa**

Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 4 @ 1,0m	
Date	20 FEBRUARY 2007	Test No	357
Job No	07087	Checked By	EB

Sample Height (mm)	20	Sample Diameter (mm)	64	Sample Specific Gravity	2.602
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Sample Preparation	NMC
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Effective Stress (kPa)	Time (mins)	Consolidation Reading	Voids Ratio	Strain (%)
10	60	768	1.303	0.00
10	1500	780	1.289	0.60
33	1590	821	1.242	2.65
65	1650	861	1.196	4.65
127	1740	921	1.127	7.65
251	1800	997	1.039	11.45
498	1890	1070	0.955	15.10
993	1950	1142	0.872	18.70
1868	3390	1215	0.788	22.35
743	3450	1206	0.798	21.90
118	3540	1178	0.831	20.50
10	3600	1146	0.868	18.90

**Moisture Content Calculations**

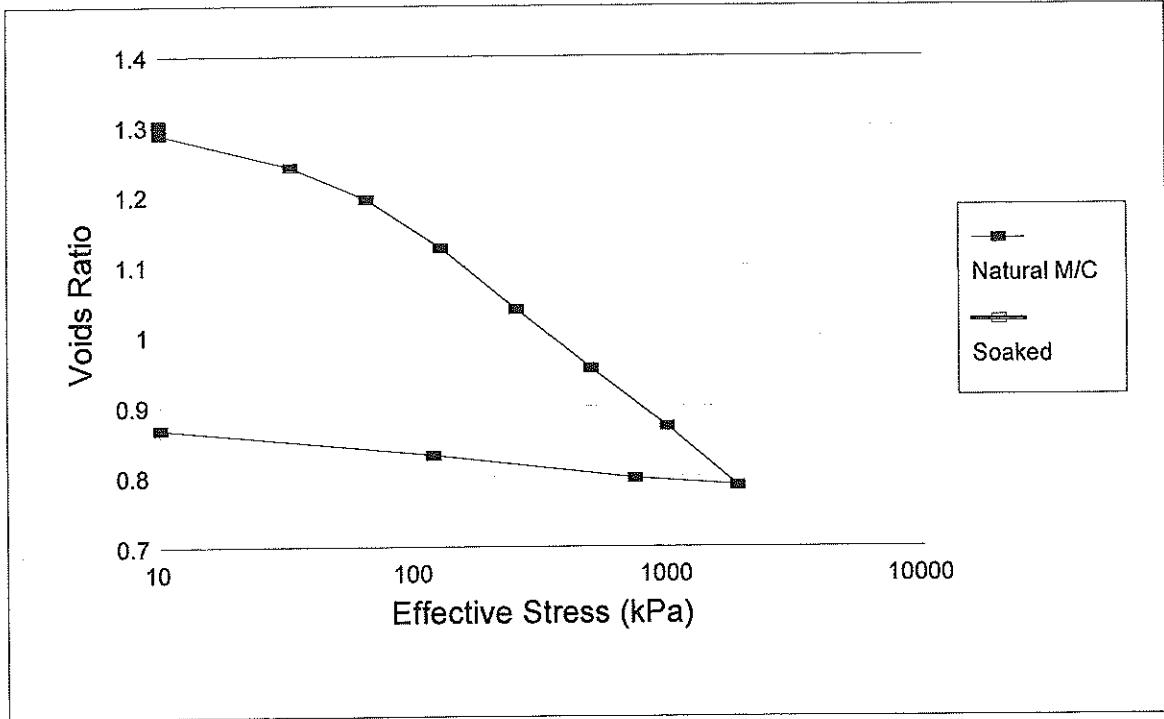
Mass wet sample plus ring before test (gms)	318.30
Mass wet sample plus ring after test (gms)	315.30
Mass dry sample plus ring (gms)	294.90
Mass ring (gms)	222.20
Moisture content before test (%)	32.19
Moisture content after test (%)	28.06

**Other Data**

Initial Dry Density (kg/m <sup>3</sup> )	1130
Initial Void Ratio	1.30

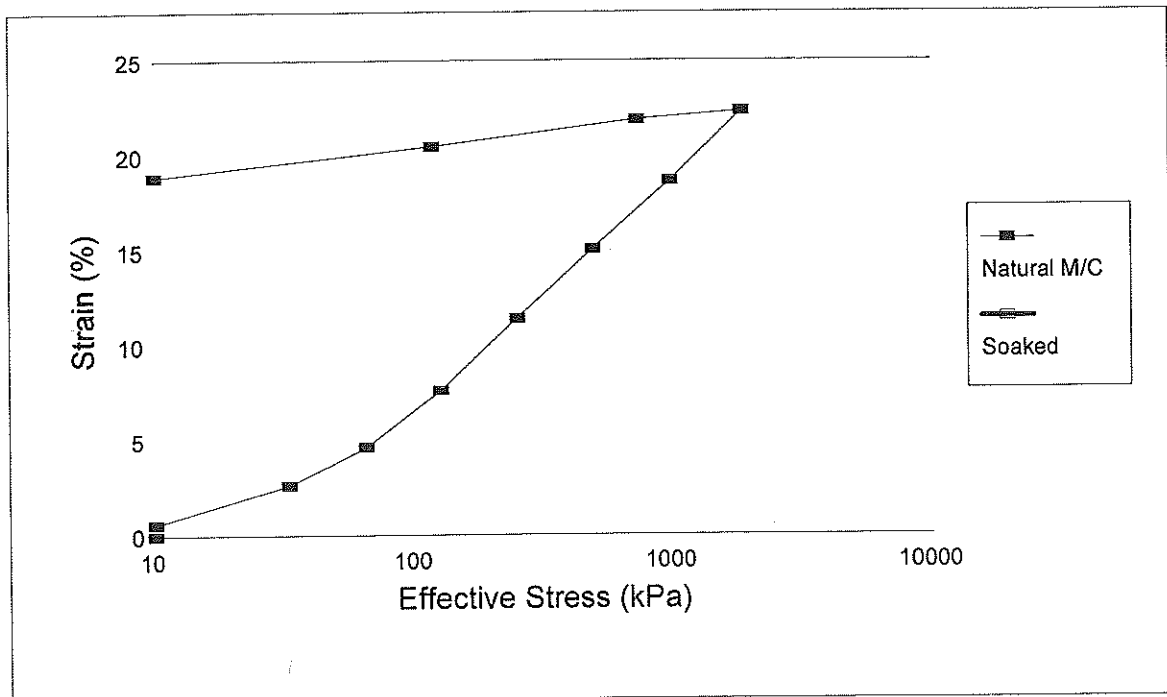
### VOIDS RATIO v EFFECTIVE STRESS

Test No: 357



### STRAIN v EFFECTIVE STRESS

Test No: 357





## FOUNDATION INDICATOR

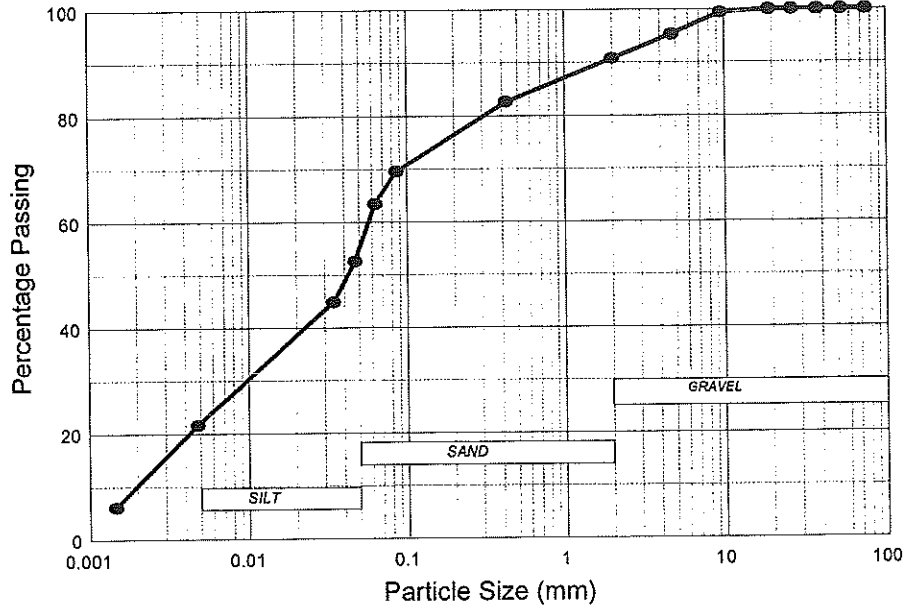
Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 5/1 @ 1,5m	
Date	20 FEBRUARY 2007	Test No	358
Job No	07085	Checked By	EB

### SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	99.37
4.75	95.32
2.00	90.77
0.425	82.68

### GRADING ANALYSIS



### HYDROMETER ANALYSIS

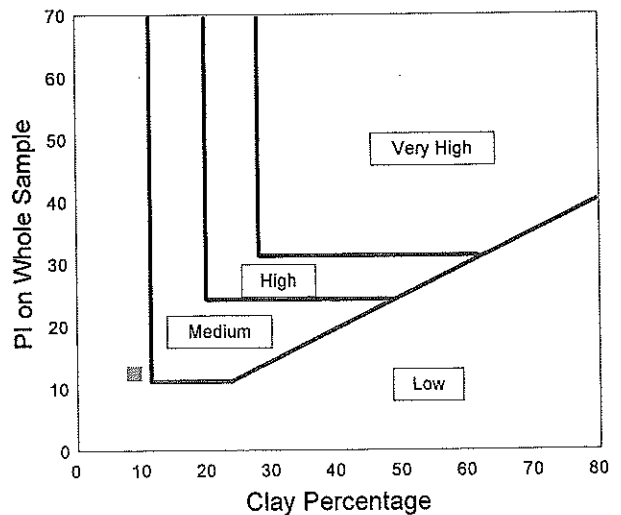
Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0861	69.67
0.0628	63.48
0.0467	52.64
0.0341	44.90
0.0048	21.68
0.0015	6.19

### ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	32
Plastic Limit	17
Plastic Index	15
Linear Shrinkage	8
Grading Modulus	0.57
Moisture Content	16.16
PI on Whole Sample	12

### ACTIVITY CHART







## FOUNDATION INDICATOR

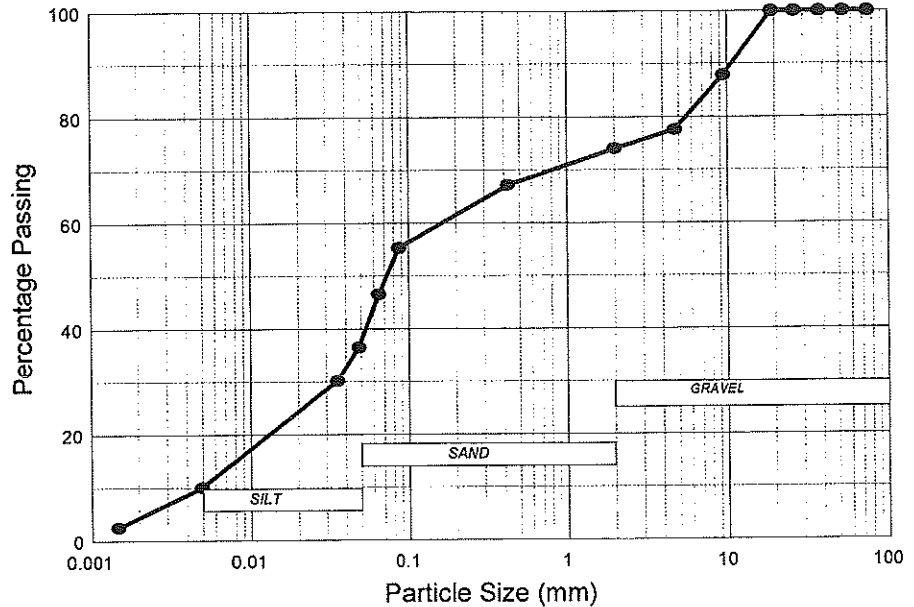
Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 6/1 @ 1,0m	
Date	20 FEBRUARY 2007	Test No	359
Job No	07085	Checked By	EB

### SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	87.90
4.75	77.60
2.00	74.09
0.425	67.27

### GRADING ANALYSIS



### HYDROMETER ANALYSIS

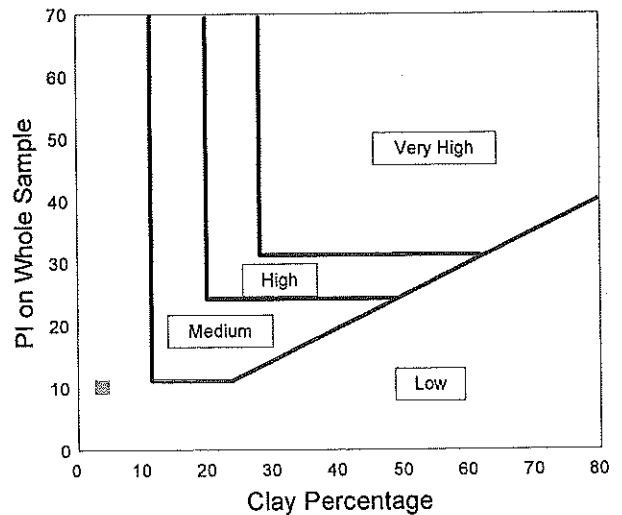
Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0867	55.43
0.0646	46.61
0.0482	36.53
0.0352	30.23
0.0050	10.08
0.0015	2.52

### ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	31
Plastic Limit	16
Plastic Index	15
Linear Shrinkage	7
Grading Modulus	1.03
Moisture Content	12.38
PI on Whole Sample	10

### ACTIVITY CHART





**SINGLE OEDOMETER CONSOLIDATION - SOAKED AT 10 kPa**

Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 7 @ 1,0m	
Date	20 FEBRUARY 2007	Test No	360
Job No	07087	Checked By	EB

Sample Height (mm)	20	Sample Diameter (mm)	64	Sample Specific Gravity	2.681
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Sample Preparation	NMC
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Effective Stress (kPa)	Time (mins)	Consolidation Reading	Voids Ratio	Strain (%)
10	60	441	0.843	0.00
10	1500	417	0.865	-1.20
33	1590	433	0.850	-0.40
65	1650	457	0.828	0.80
127	1740	490	0.798	2.45
251	1800	550	0.742	5.45
498	1890	595	0.701	7.70
993	1950	685	0.618	12.20
1868	3390	815	0.498	18.70
743	3450	800	0.512	17.95
118	3540	765	0.544	16.20
10	3600	734	0.573	14.65

**Moisture Content Calculations**

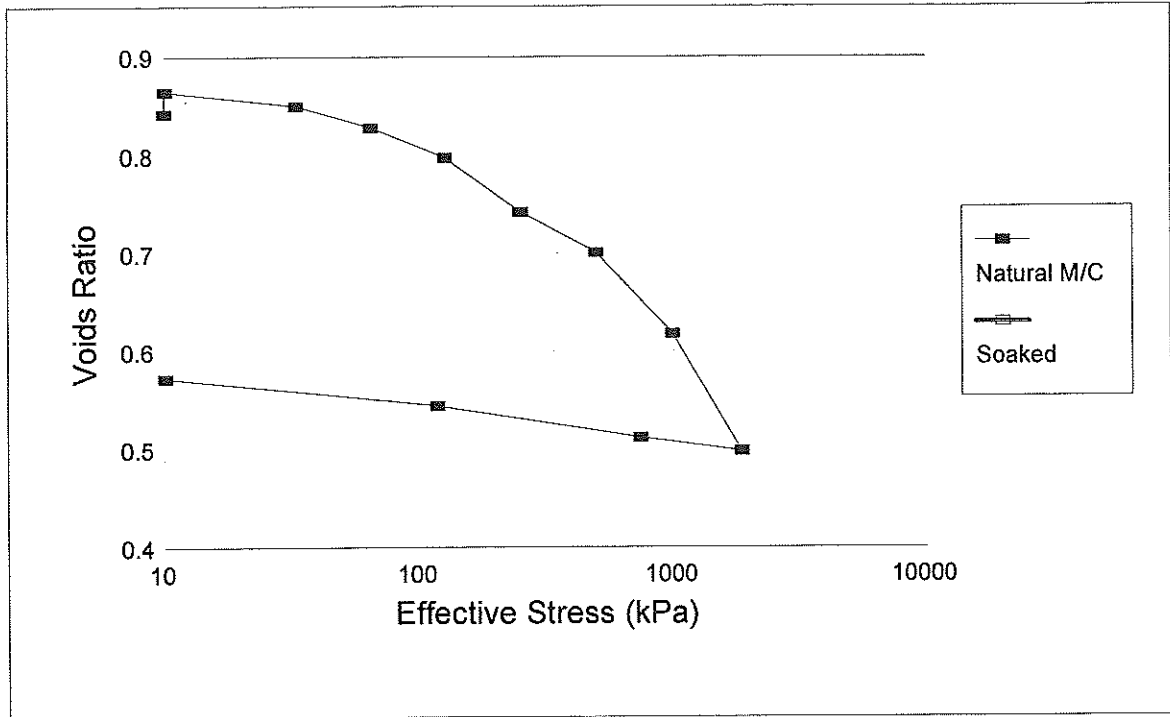
Mass wet sample plus ring before test (gms)	343.20
Mass wet sample plus ring after test (gms)	339.80
Mass dry sample plus ring (gms)	317.20
Mass ring (gms)	223.60
Moisture content before test (%)	27.78
Moisture content after test (%)	24.15

**Other Data**

Initial Dry Density (kg/m <sup>3</sup> )	1455
Initial Void Ratio	0.84

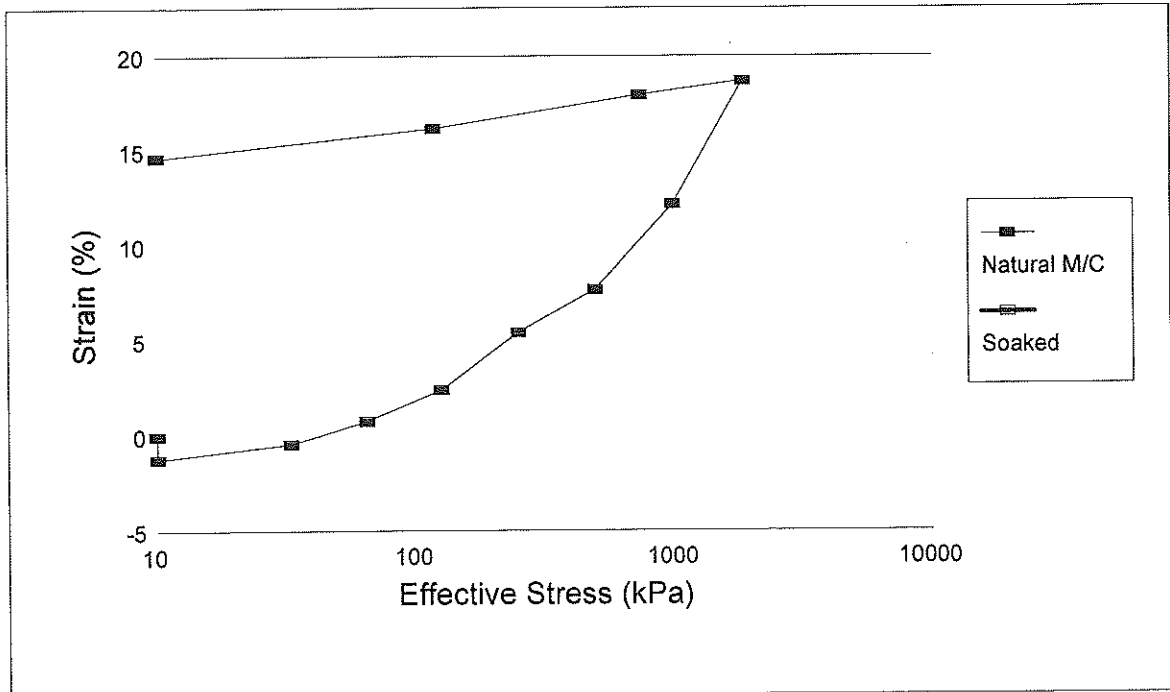
### VOIDS RATIO v EFFECTIVE STRESS

Test No: 360



### STRAIN v EFFECTIVE STRESS

Test No: 360





## FOUNDATION INDICATOR

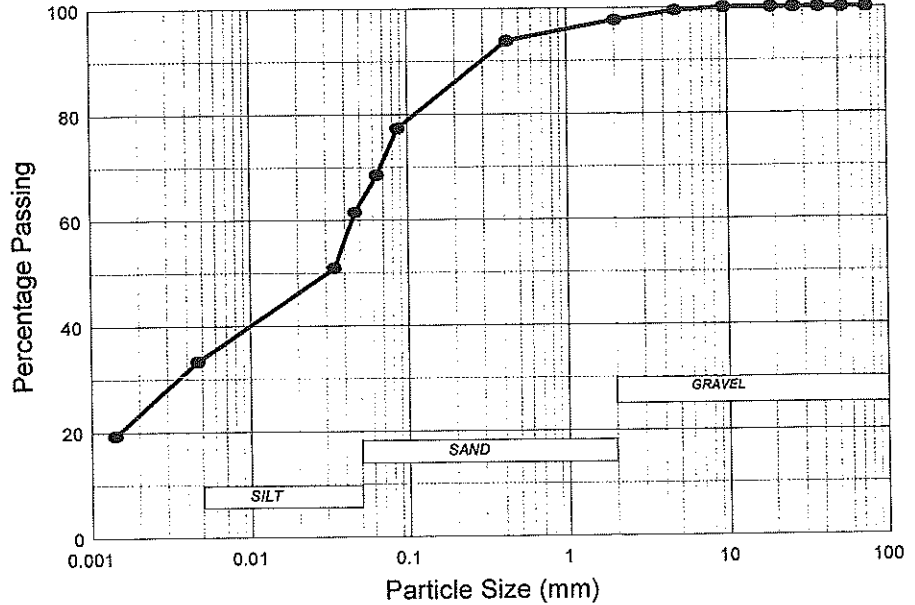
Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 7/2 @ 2,3m	
Date	20 FEBRUARY 2007	Test No	361
Job No	07085	Checked By	EB

### SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	100.00
4.75	99.46
2.00	97.71
0.425	93.89

### GRADING ANALYSIS



### HYDROMETER ANALYSIS

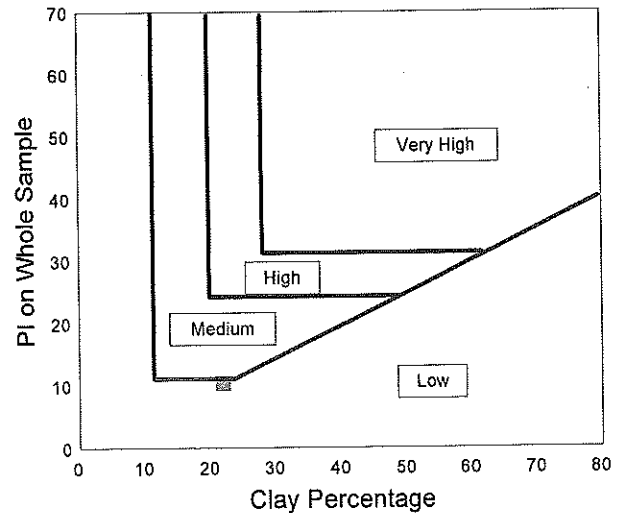
Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0867	77.37
0.0637	68.58
0.0464	61.54
0.0341	50.99
0.0047	33.41
0.0014	19.34

### ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	27
Plastic Limit	16
Plastic Index	11
Linear Shrinkage	5
Grading Modulus	0.31
Moisture Content	12.33
PI on Whole Sample	10

### ACTIVITY CHART





**SINGLE OEDOMETER CONSOLIDATION - SOAKED AT 10 kPa**

Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 8/1 @ 1,5m	
Date	20 FEBRUARY 2007	Test No	362
Job No	07087	Checked By	EB

Sample Height (mm)	20	Sample Diameter (mm)	64	Sample Specific Gravity	2.579
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Sample Preparation	NMC
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Effective Stress (kPa)	Time (mins)	Consolidation Reading	Voids Ratio	Strain (%)
10	60	810	0.758	0.00
10	1500	833	0.738	1.15
33	1590	846	0.726	1.80
65	1650	883	0.694	3.65
127	1740	926	0.656	5.80
251	1800	995	0.595	9.25
498	1890	1046	0.550	11.80
993	1950	1100	0.503	14.50
1868	3390	1178	0.434	18.40
743	3450	1160	0.450	17.50
118	3540	1100	0.503	14.50
10	3600	1048	0.549	11.90

**Moisture Content Calculations**

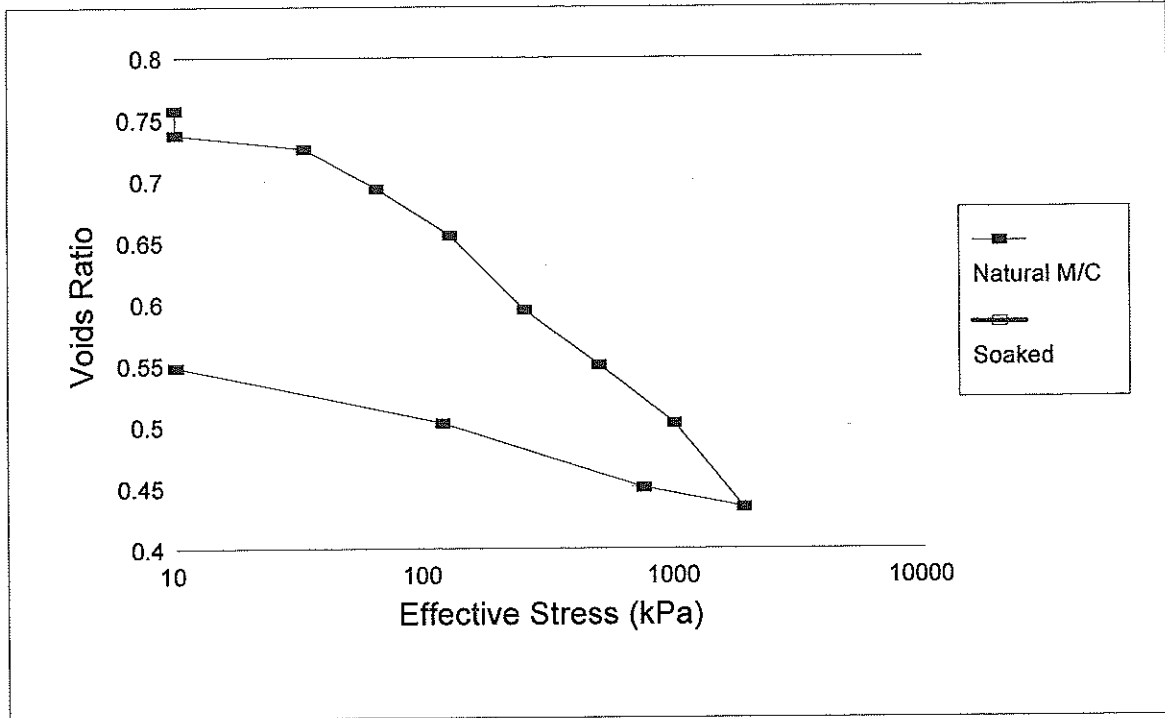
Mass wet sample plus ring before test (gms)	332.10
Mass wet sample plus ring after test (gms)	332.60
Mass dry sample plus ring (gms)	313.50
Mass ring (gms)	219.10
Moisture content before test (%)	19.70
Moisture content after test (%)	20.23

**Other Data**

Initial Dry Density (kg/m <sup>3</sup> )	1467
Initial Void Ratio	0.76

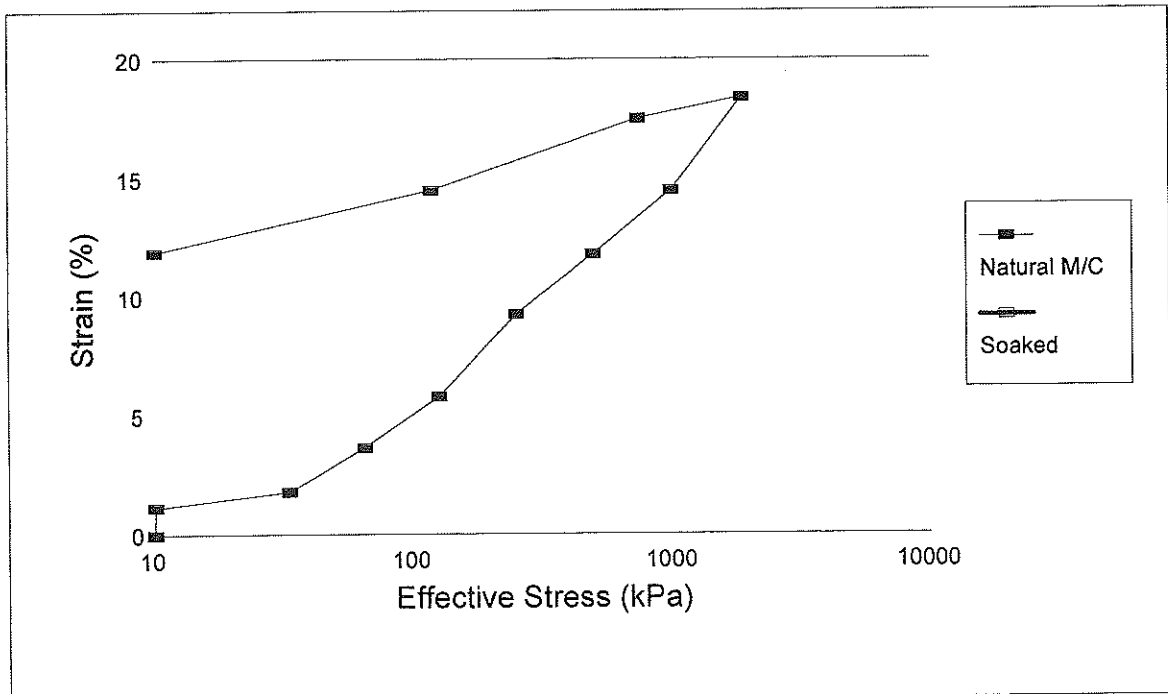
### VOIDS RATIO v EFFECTIVE STRESS

Test No: 362



### STRAIN v EFFECTIVE STRESS

Test No: 362





**FOUNDATION INDICATOR**

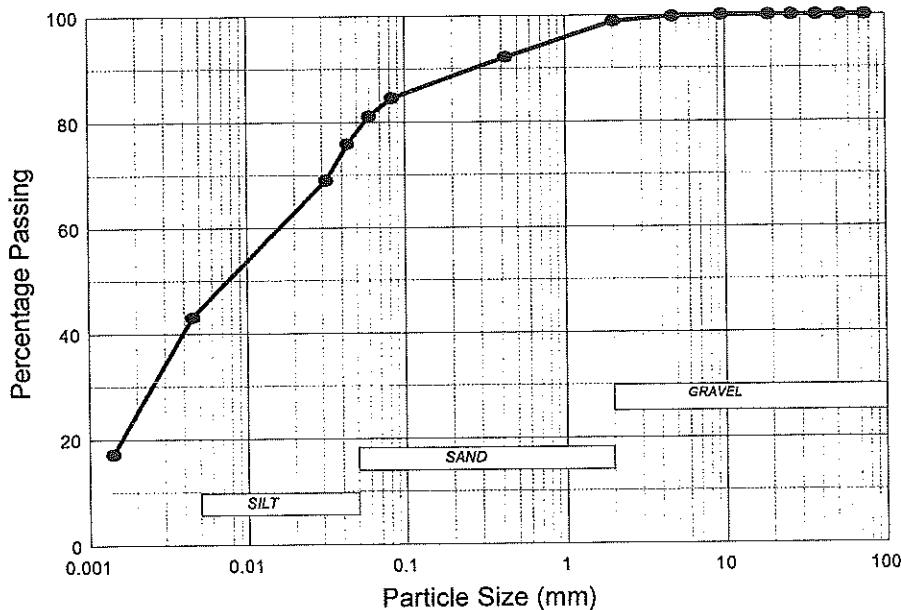
Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 8/1 @ 1,5m	
Date	20 FEBRUARY 2007	Test No	362
Job No	07085	Checked By	EB

**SIEVE ANALYSIS**

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	100.00
4.75	99.75
2.00	98.91
0.425	92.17

**GRADING ANALYSIS**



**HYDROMETER ANALYSIS**

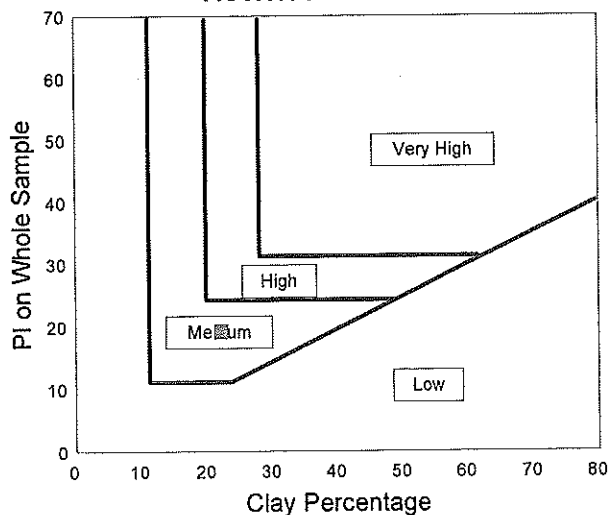
Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0832	84.58
0.0599	81.12
0.0434	75.95
0.0316	69.04
0.0045	43.15
0.0014	17.26

**ATTERBERG LIMITS & OTHER VALUES**

Liquid Limit	43
Plastic Limit	22
Plastic Index	21
Linear Shrinkage	11
Grading Modulus	0.24
Moisture Content	20.36
PI on Whole Sample	19

**ACTIVITY CHART**





## FOUNDATION INDICATOR

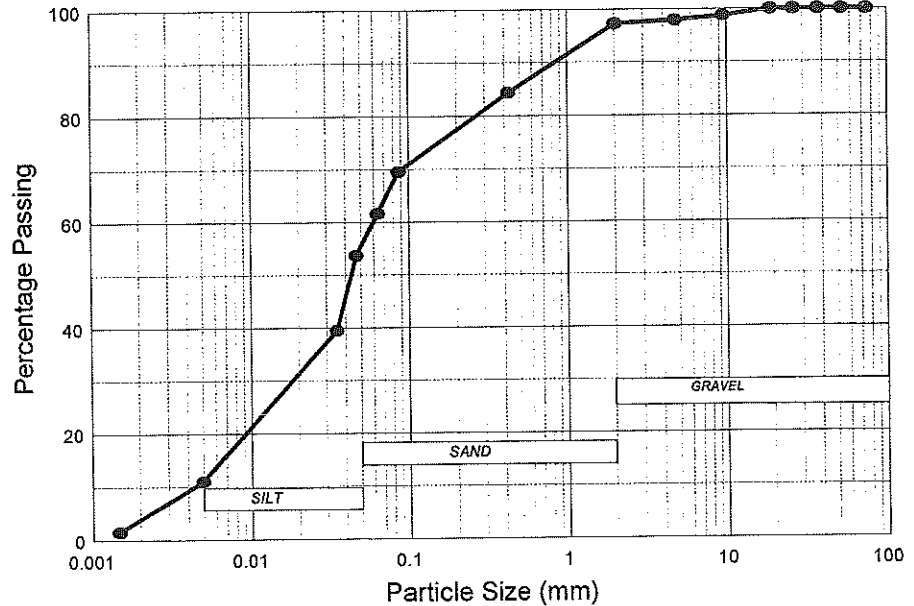
Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 11/1 @ 0,8m	
Date	20 FEBRUARY 2007	Test No	363
Job No	07085	Checked By	EB

### SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	98.75
4.75	97.96
2.00	97.34
0.425	84.42

### GRADING ANALYSIS



### HYDROMETER ANALYSIS

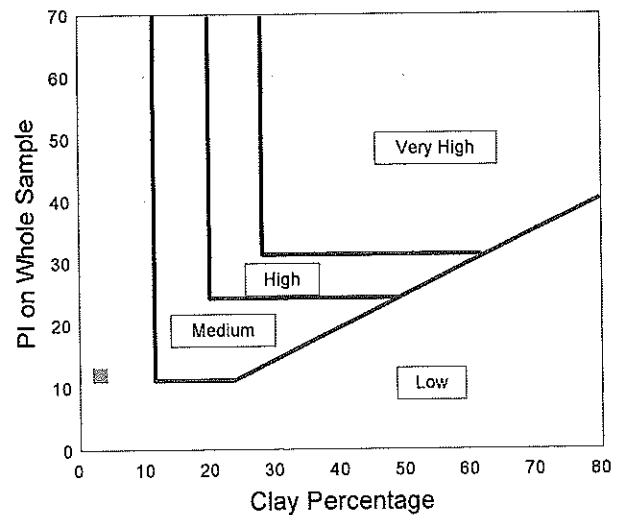
Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0867	69.57
0.0637	61.66
0.0467	53.75
0.0350	39.53
0.0050	11.07
0.0015	1.58

### ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	29
Plastic Limit	15
Plastic Index	14
Linear Shrinkage	7
Grading Modulus	0.49
Moisture Content	18.38
PI on Whole Sample	12

### ACTIVITY CHART







# GEO PRACTICA

SOILS & MATERIALS TESTING  
P.O. BOX 227, MARAISBURG, 1700

TEL: (011) 674 1325

FAX: (011) 674 4513

e mail: lab@geopractica.co.za

## FOUNDATION INDICATOR

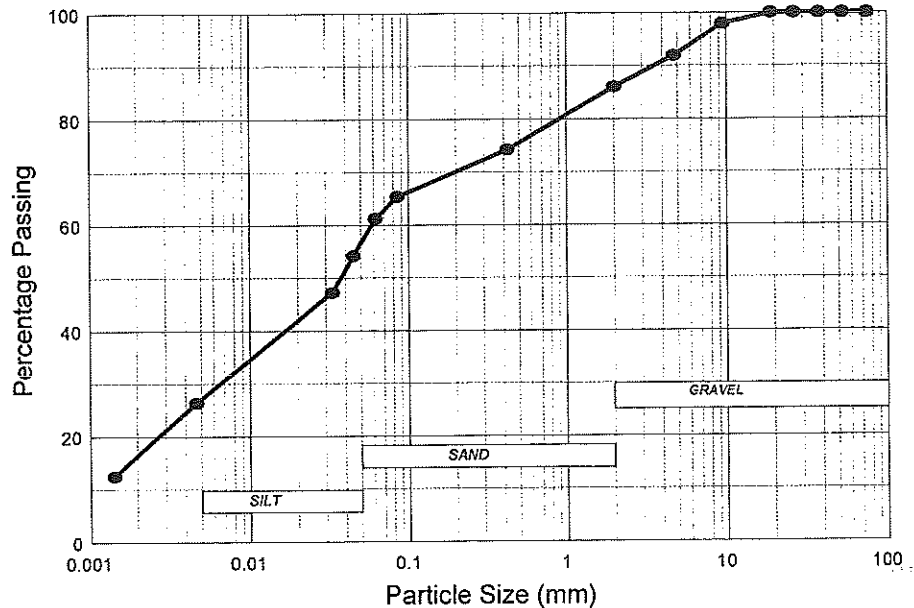
Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 11/2 @ 2,0m	
Date	20 FEBRUARY 2007	Test No	364
Job No	07085	Checked By	EB

### SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	97.94
4.75	91.95
2.00	86.08
0.425	74.30

### GRADING ANALYSIS



### HYDROMETER ANALYSIS

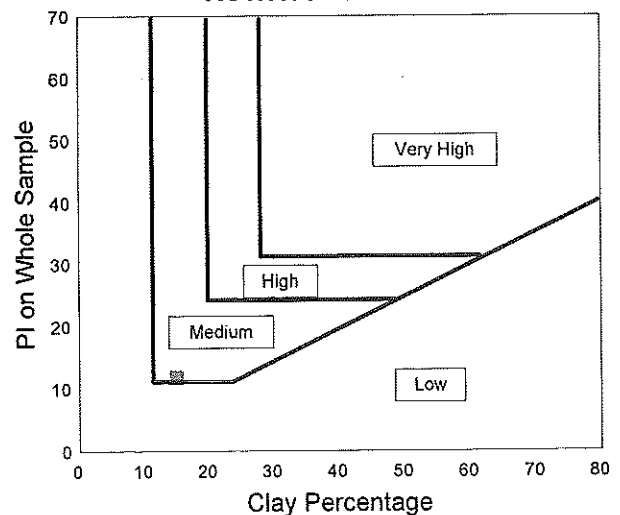
Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0847	65.40
0.0613	61.23
0.0451	54.27
0.0330	47.31
0.0047	26.44
0.0014	12.52

### ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	31
Plastic Limit	15
Plastic Index	16
Linear Shrinkage	7
Grading Modulus	0.74
Moisture Content	11.91
PI on Whole Sample	12

### ACTIVITY CHART



**GEOPRACTICA**SOILS & MATERIALS TESTING  
P.O.BOX 227, MARAISBURG, 1700TEL: (011) 674 1325  
FAX: (011) 674 4513  
e mail: lab@geopractica.co.za**COLLAPSE POTENTIAL at 200 kPa**

Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 17/1 @ 1,0m	
Date	20 FEBRUARY 2007	Test No	365
Job No	07087	Checked By	EB

Sample Height (mm)	20	Sample Diameter (mm)	64	Sample Specific Gravity	2.627
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Sample Preparation	NMC
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Effective Stress (kPa)	Time (mins)	Consolidation Reading	Voids Ratio	Strain (%)
10	10	659	1.005	0.00
10	70	660	1.004	0.05
33	130	670	0.994	0.55
65	250	710	0.954	2.55
127	340	822	0.842	8.15
200	490	878	0.785	10.95
200	1930	917	0.746	12.90
498	2170	1054	0.609	19.75
993	2410	1127	0.536	23.40
1868	3850	1190	0.473	26.55
743	3970	1188	0.475	26.45
118	4090	1185	0.478	26.30
10	4210	1174	0.489	25.75

**Moisture Content Calculations**

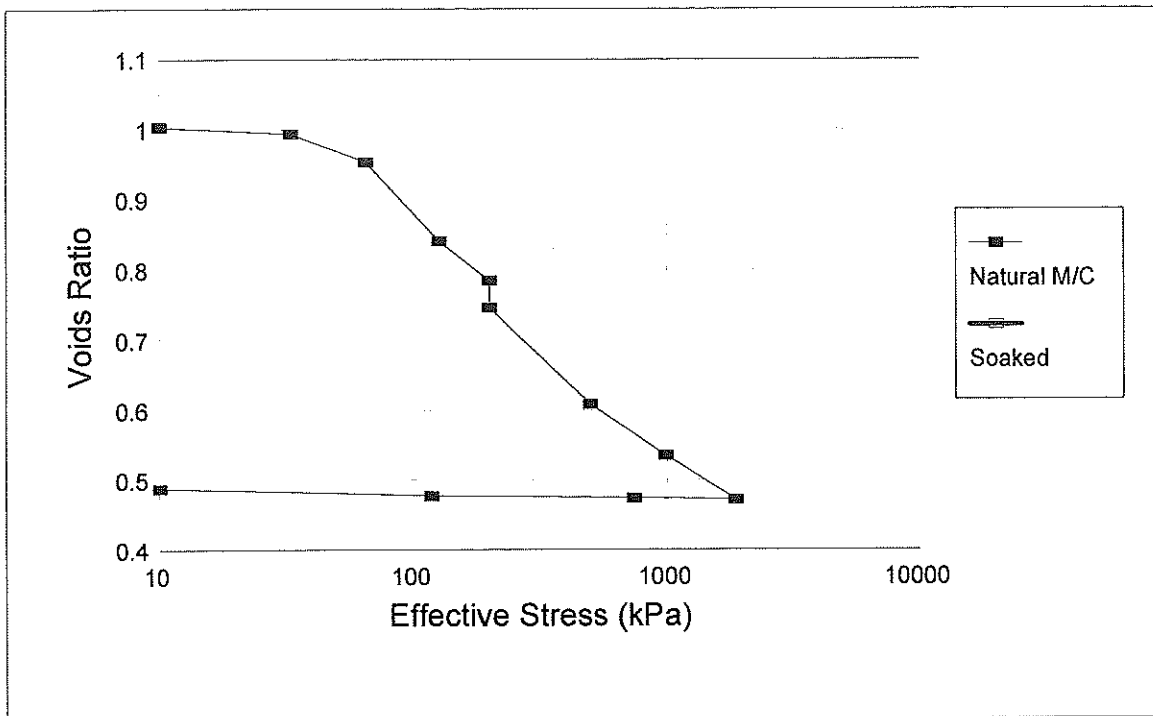
Mass wet sample plus ring before test (gms)	318.50
Mass wet sample plus ring after test (gms)	318.40
Mass dry sample plus ring (gms)	304.50
Mass ring (gms)	220.20
Moisture content before test (%)	16.61
Moisture content after test (%)	16.49

**Other Data**

Initial Dry Density (kg/m <sup>3</sup> )	1310
Initial Void Ratio	1.00

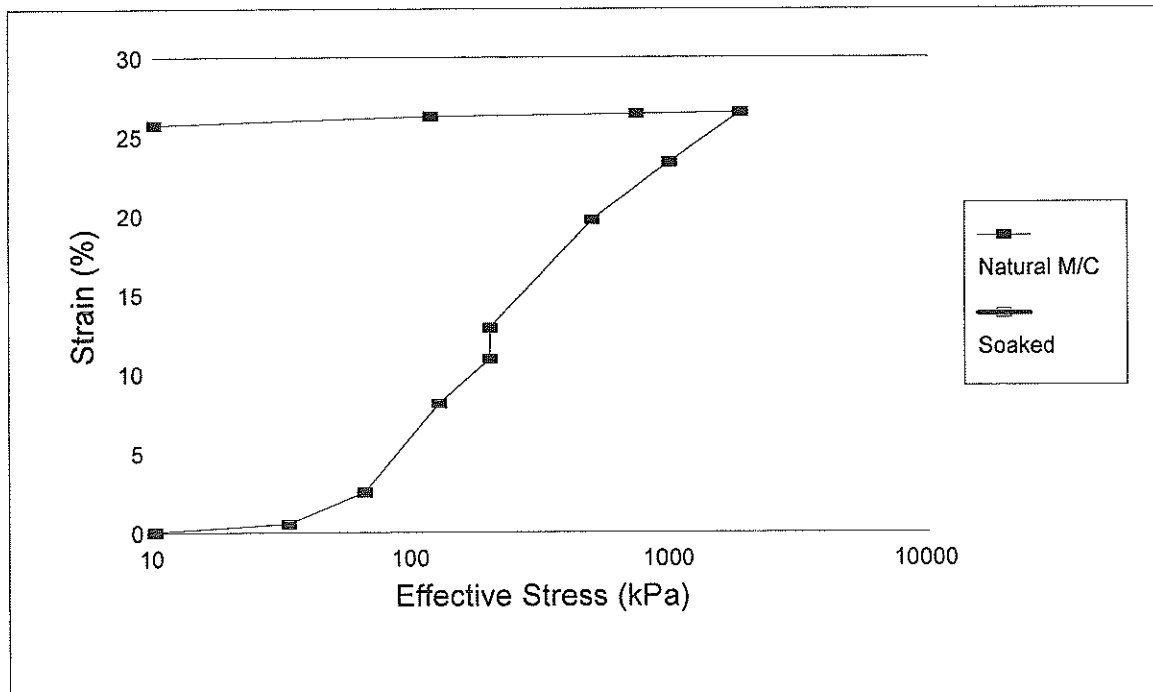
### VOIDS RATIO v EFFECTIVE STRESS

Test No: 365



### STRAIN v EFFECTIVE STRESS

Test No: 365





## FOUNDATION INDICATOR

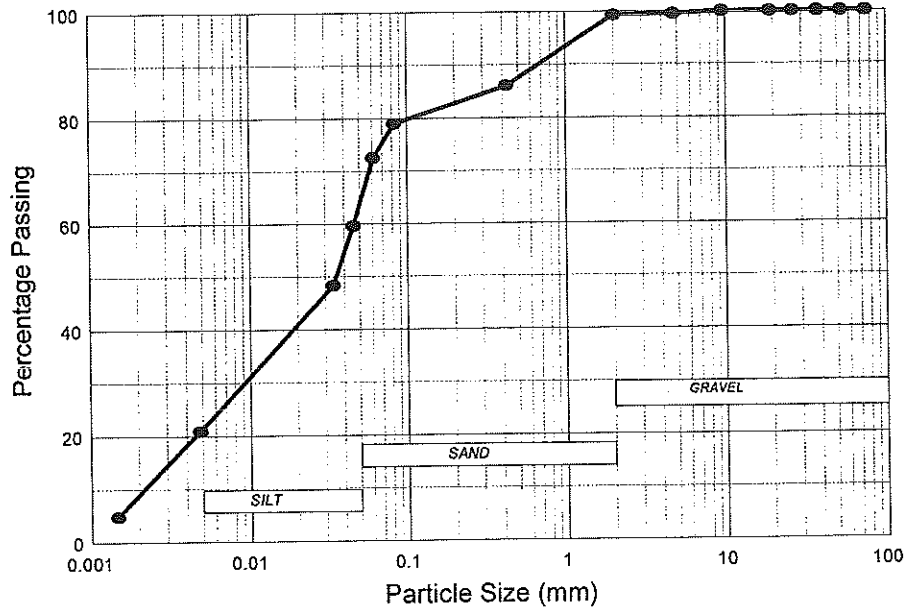
Client	INTRACONSULT		
Location	MINE SITE - BOKSBURG	TP 17/1 @ 1,0m	
Date	20 FEBRUARY 2007	Test No	365
Job No	07087	Checked By	EB

### SIEVE ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
75.00	100.00
53.00	100.00
37.50	100.00
26.50	100.00
19.00	100.00
9.50	100.00
4.75	99.59
2.00	99.35
0.425	86.08

### GRADING ANALYSIS



### HYDROMETER ANALYSIS

Values are expressed as a percentage of total sample

Sieve Size (mm)	Total Passing (%)
0.0832	78.99
0.0609	72.54
0.0457	59.65
0.0339	48.36
0.0048	20.96
0.0015	4.84

### ATTERBERG LIMITS & OTHER VALUES

Liquid Limit	28
Plastic Limit	14
Plastic Index	14
Linear Shrinkage	7
Grading Modulus	0.36
Moisture Content	16.97
PI on Whole Sample	12

### ACTIVITY CHART

