NINHAM SHAND CONSULTING SERVICES

GEOTECHNICAL INVESTIGATION: ETHANOL AFRICA'S GRAIN ALCOHOL PLANT, BOTHAVILLE

Report No.: JW121/06/A872

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SYNOPSIS

This report presents the findings of a geotechnical investigation for the proposed Grain-Alcohol Plant at Bothaville in the north-western Free State. The investigation included fourteen large diameter auger holes, eleven test pits and laboratory testing of the soil samples.

The site is underlain by fine grained sandstones of the Vryheid Formation, Karoo Sequence. The average depth to the rockhead is 2,8m varying from 1,8m to 4,1m across the site. The soil profile above the sandstone consists of fine sandy hillwash, a poorly developed pedogenic horizon and fine sandy residual soils. The hillwash has a collapsible grain structure. No heaving soils were encountered on site.

Due to the collapsible nature of the hillwash, light structures should be founded on stiffened raft foundations or on a soil raft. Medium and heavy structures may be founded on spread footings extending to the residual sandstone below the hillwash and to the very soft rock weathered sandstone respectively. Piled foundations may also be considered for heavier structures.

The area is situated in a zone of mining induced seismicity and design precautions are required.

Both the hillwash and the residual sandstone classify as fine silty sands with poor to moderate compaction characteristics. The upper hillwash layer is suitable for use in lower subgrade layers below roads and construction of lightly loaded soil rafts. Selected layers, including the terrace wearing course will have to be imported.

The surface sands will soften on wetting and will not form a suitable construction platform. Impact rolling of critical areas of the site should be considered and an imported gravel wearing course should be provided to improve the traffickability of the site during construction.

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1. INTRODUCTION

Ethanol Africa are planning to construct a grain alcohol plant in the maize producing area of Bothaville in the north-western Free State. The consulting engineers on the project, Ninham Shand Consulting Services, requested Jones & Wagener to carry out a detailed geotechnical investigation for the proposed plant to supplement the preliminary investigation carried out by themselves earlier.

This report describes the investigation fieldwork which was carried out from 10th to 12th July 2006 and presents the results of the subsequent laboratory testing. The report provides recommendations for the preparation of the site and for founding of the major structures.

2. TERMS OF REFERENCE

2.1 Appointment

Following an initial meeting with Mr. Jean Louw of Ninham Shand on 3rd July, Jones & Wagener provided a proposal and cost estimate for the geotechnical investigation (our reference A872pd01_let_Proposal.doc, dated 3 July 2006). In a letter from Ninham Shand dated 6 July 2006 (Ref: 401364/LO/981), Jones & Wagener were requested to proceed with the investigation in terms of this proposal.

2.2 Information supplied

Jones & Wagener were supplied with the following drawings and reports:

- Preliminary layout drawing: "Grain Alcohol Plant, Site Layout". Lampets drawing no. UGH001-GA-00-01-L.
- Revised layout drawing: Electronic copy
- Plant layout drawings (reduced scale photocopies): various.

- Report 401364/BN/R/1: Geotechnical Report for Proposed New Ethanol Plant in Bothaville. Report to Ethanol Africa on preliminary investigation by Ninham Shand, April 2006.

2.3 Abbreviations and symbols

Commercial

J & W	**J**ones **&** **W**agener
NSCS	**N**inham **S**hand **C**onsulting **S**ervices
NHBRC	**N**ational **H**ome **B**uilders **R**egistration **C**ouncil

Technical

^{o}C	Degrees **C**elsius (Temperature)
CBR	**C**alifornian **B**earing **R**atio (compacted soils)
LDH80	Truck mounted auger with 80 foot reach
LL	**L**iquid **L**imit
LS	**L**inear **S**hrinkage
MF60	Truck mounted auger with 60 foot reach
MDD	**M**aximum **D**ry **D**ensity (compacted soils)
Mod. AASHTO	**Mod**ified **AASHTO** MDD (compacted soils)
PI	**P**lasticity **I**ndex
SG	**S**pecific **G**ravity
TLB	**T**ractor-mounted **L**oader/**B**ackhoe

3. PROPOSED DEVELOPMENT

The plant will be used to produce ethanol from maize. It comprises the following major components:

- Grain offloading station with a 8m deep basement
- Seven 35m diameter grain silos, 45m high
- A 36m high milling and mashing plant, approximately 16m x 20m in plan
- A 465 kilolitre per day ethanol plant consisting of fermentation, evaporation, liquefaction, cooling, yeast propagation and distillation modules; up to 45m high
- Product storage tanks and road loading station
- Ancillary structures (boiler house, waste water treatment plant, cooling towers, workshops, laboratory, control room, offices, stores etc).

The layout of the plant as provided electronically by NSCS is shown on J&W's drawing A872-00-001 at the back of this report.

4. LOCATION AND DESCRIPTION OF SITE

4.1 Location

The site is situated on a 40 hectare site on the western side of the Bothaville Industrial area. The Industrial Area is situated on the western side of the R30 Provincial Road from Orkney to Bothaville on the northern side of the town as shown in Figure 1.

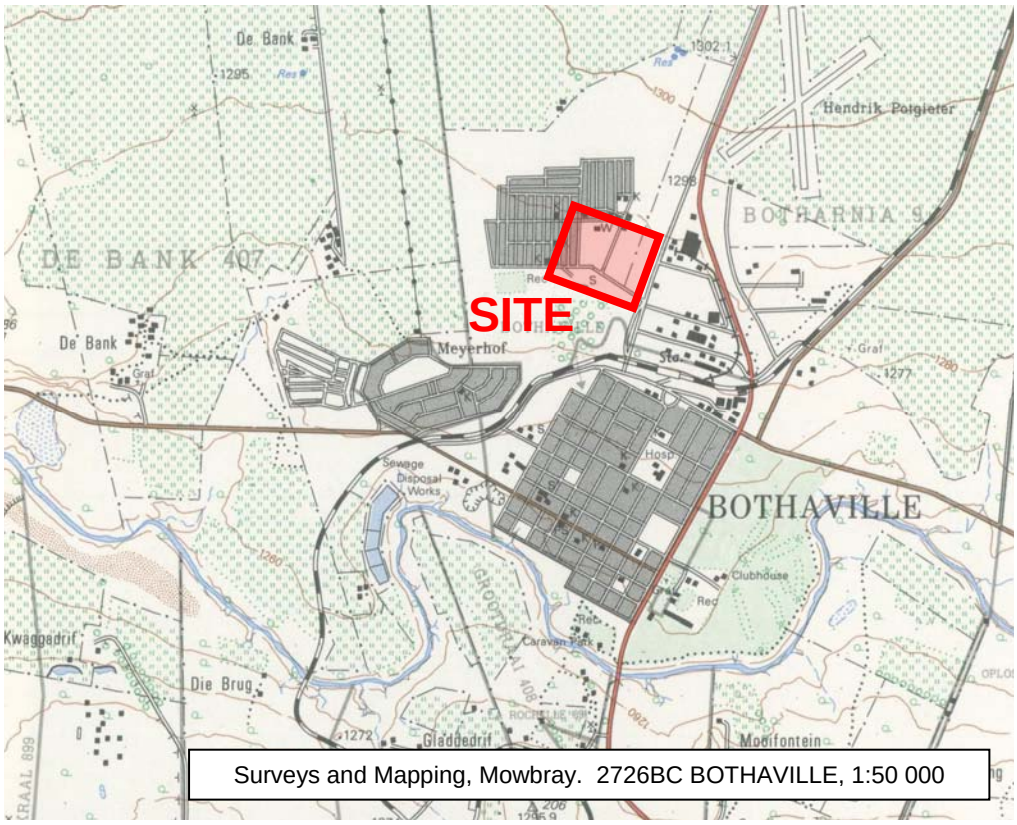

Figure 1: Location of site

4.2 Description

From the 1:50 000 topographical map (see Figure 1), the western parts of the site were previously occupied by a residential development which has since been demolished.

The site, which is relatively flat, is crisscrossed with a number of tracks and footpaths. The eastern half of the site is covered with indigenous grass, scattered thorny shrubs and isolated indigenous trees (Photo 1). The western portion of the site is covered with the remains of the residential development with numerous broken bricks, cracked concrete floor slabs, shallow excavations, heaps of ash and other foreign material (Photo 1 and Photo 2). Only one concrete walled room (cold room or strong room) has escaped demolition. Vegetation over this area of the site is patchy comprising mainly burnt indigenous grasses, weeds and occasional shrubs and trees.

Photo 1: Looking east from centre of site. Bothaville Industrial Area in background.

Photo 2: Looking west from centre of site. Demolished structures in background.

The only visible service on the site is an overhead power line which cuts across the north west corner. There are, however, a number of linear depressions visible on the eastern side of the site which could correspond to backfilled service trenches. These features were avoided during positioning of test pits.

4.3 Regional geology

The Bothaville area is situated on the Vryheid Formation of the Karoo Sequence comprising sedimentary strata including sandstones, siltstones and shales. One or more dolerite sills are present in the area and numerous dolerite outcrops are shown on the 1:250 000 geological map[1] along the course of the Valsrivier mainly to the south of the site but also to the east and west (See Figure 2).

The site itself is underlain by fine grained sandstone of the Vryheid Formation which is covered by a thin mantle of recent aeolian sand.

[1] Council for Geoscience (2000). **1:250 000 Geological Map - 2726 Kroonstad**.

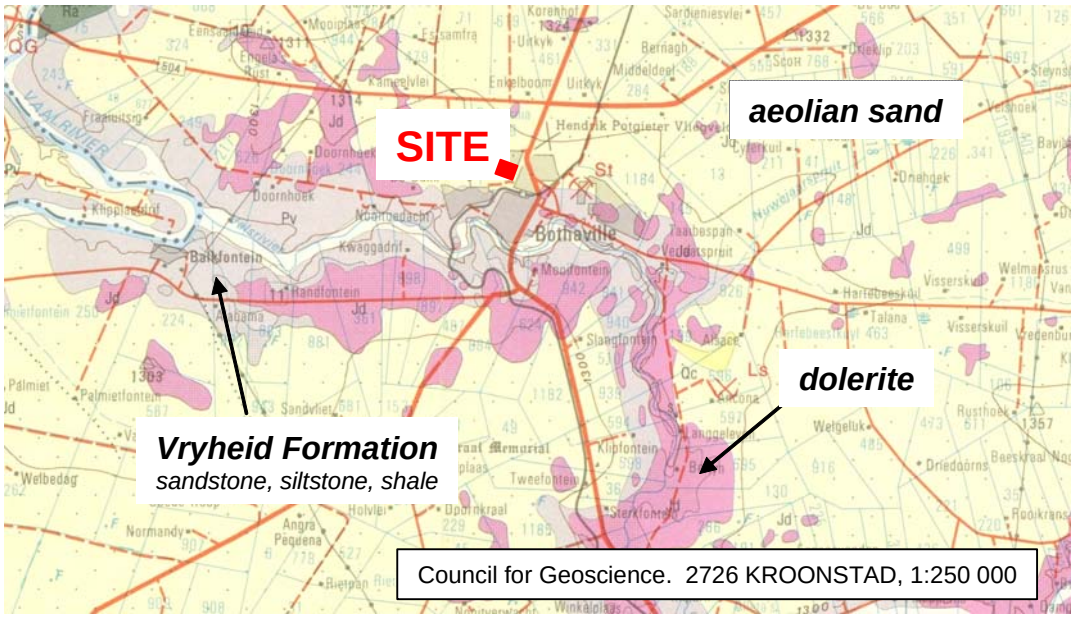

Figure 2: Geological map: 1:250 000 (Council for Geoscience)

4.4 Climate

Bothaville lies near the western edge of the Highveld Climatic Region[2]. Rainfall is in the form of showers and thundershowers sometimes accompanied by hail, mainly in the summer months (October – March). The average precipitation in the region is approximately 570mm per annum[3]. The summers are warm with an average daily maximum temperature on approximately 31°C in January. Winter nights are cold with an average daily minimum temperature of 0° - 1°C in June and July with frequent frost in low lying areas. Sunshine duration in Summer is approximately 60% rising to 80% (of the possible) in Winter. Surface winds are generally light but very occasional tornados occur.

4.5 Seismicity

In this area of South Africa, mining induced seismicity (earth tremors) are more prevalent than natural seismic events. According to SABS 0160[4], Bothaville falls within Zone 2 where account needs to be taken of mining induced seismic events. The maximum seismic event with a 10% probability of being exceeded in a 50 year period is 200cm/sec. This value agrees with more recent data produced by the Council for Geoscience[5] indicates a value of 0,20g.

Seismic design precautions are required.

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2 Weather Bureau, Republic of South Africa. **Climate of South Africa. Part 8 – General Survey. Publication WB28**. Department of Environmental Affairs, RSA.

3 Weather Bureau, Republic of South Africa. **Climate of South Africa. Climate statistics from 1961 – 1990. Publication WB42**. Department of Environmental Affairs, RSA.

4 SABS 0160 – 1989 (as amended 1990) **Code of practice for the general procedures and loadings to be adopted in the design of buildings**. S.A. Bureau of Standards, Pretoria.

5 Kijko A., Graham G., Bejaichund M., Roblin D.L. and Brandt M.B.C. (2003) **Probabilistic Seismic-Hazard Maps for South Africa**. Council for Geoscience, Pretoria.

5. INVESTIGATION

5.1 Field work

Fourteen large diameter auger holes and eleven test pits were excavated on the site between 10th and 12th July 2006.

The test pits (TP1 to TP11), were excavated using a JCB Site Master TLB equipped with a standard 600mm wide bucket. The test pits were excavated to a depth of between 3,0 and 4,0m and were generally terminated in very stiff to very soft rock material where the rate of excavation was slow. The sidewalls of all test pits were stable and the holes could be safely profiled in situ.

Most of the large diameter auger holes (AH1 to AH11) were drilled using an LDH 80 auger rig equipped with an 800mm diameter, double start flight auger. After this machine broke down during drilling of AH11, an MF 60 auger rig was brought to site and the remainder of the holes were completed using this rig with the same auger flight as before. The auger holes were drilled to depths varying from 3,8m – 7,2m, generally terminating on very soft rock to soft rock sandstone. The rate of penetration of the drilling rig in the stiff residual soils and the very soft rock sandstone was slow and the average drilling time was of the order of 60 minutes per hole. With the exception of some minor sloughing of the loose sands between 0,1 and 0,8m below ground level, the holes were stable and could be safely profiled in situ. All test pits and auger holes were profiled in accordance with standard practice[6,7]. The profiles of the auger holes are given in Appendix A and the profiles of the test pits in Appendix B.

The positions of all test pits and auger holes are indicated on drawing A872-00-001 at the back of this report.

5.2 Laboratory testing

During profiling, disturbed, undisturbed and bulk samples were taken for laboratory testing. Table 1 provides details of the sample locations and the tests undertaken.

During the consolidometer testing, the samples were loaded initially at natural moisture content to an applied pressure of 125kPa. The samples were then saturated at that load and the resulting heave / settlement observed. Further loading and unloading of the sample then continued in the normal manner.

The results of the laboratory tests are summarised in Appendix C.

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6 Brink A.B.A. and Bruin R.M.H. (eds) (1990) **Guidelines for Soil and Rock Logging in South Africa,** 2nd Impression 2002. Proc. Geoterminology Workshop. SAIEG - AEG - SAICE 1990.

7 Jennings J.E., Brink A.B.A. and Williams A.A.B. (1973) **Revised Guide to Soil Profiling for Civil Engineering Purposes in South Africa**. The Civil Engineer in South Africa, January 1973.

Table 1: Summary of soil samples submitted for laboratory testing

Sample	Depth (m)	Sample Description	Grading & Indicator	Moisture Content	Mod & CBR	Consoli-dometer	Density & SG
AH1/1	2,5	Disturbed	X				X
AH1/2	0,9	Disturbed	X	X			
AH2/1	1,1	Disturbed	X	X			
AH3/1	1,7	Disturbed	X				
AH5/1	1,7	Disturbed	X	X			
AH5/2	1,0	Disturbed	X	X			
AH6/1	1,0	Disturbed	X				
AH8/1	2,3	Block	X			X	
AH11/1	3,3	Disturbed	X				
TP1/1	0,6	Block	X			X	
TP1/2	0,2 - 0,6	Bulk x 2	X	X	X		
TP3/1	1,5	Disturbed	X				
TP3/2	0,9	Block	X			X	
TP4/1	4,1	Disturbed	X				
TP4/2	1,2	Disturbed	X	X			
TP4/3	0,9	Disturbed	X	X			
TP4/4	0,4	Disturbed	X	X			X
TP5/1	0,1 – 0,5	Bulk x 2	X	X	X		
TP5/2	1,3	Block	X			X	
TP5/3	3,0	Disturbed	X				
TP6/1	0,7 – 1,4	Bulk x 2	X	X	X		
TP6/2	3,0	Block	X			X	
TP6/3	3,4	Disturbed	X				
TP7/1	2,6	Block	X			X	
TP8/2	8,2	Disturbed	X	X			
TP8/3	1,0	Disturbed	X	X			
TP9/1	2,1	Disturbed	X				X
TP11/1	0,1 – 0,8	Bulk x 2	X	X	X		
TP11/2	0,8 – 1,4	Bulk x 2	X	X	X		

5.3 Information from NSCS reports

During the course of the preliminary investigation carried out by Ninham Shand Consulting Services, eight test pits, two boreholes and six hand held drop weight penetrometer tests were undertaken on the site. The positions of these tests are shown on drawing A872-00-001. The factual data from these tests is given in Appendix D.

6. SOIL PROFILE AND MATERIAL PROPERTIES

6.1 Soil profile

The soil profile is reasonably uniform across the entire site and may be subdivided into the following horizons.

Table 2: General description of soil horizons with depths to base of horizon

HORIZON	DEPTH*	DESCRIPTION
Hillwash	1,9m avg. (1,2m – 2,7m)	Moist, brown and orange-brown, loose, slightly porous, silty fine sand. Upper 100mm generally desiccated and dense. The profile is illuviated (fines leached downwards) and the lower half of the layer generally has a slightly higher clay content and a higher consistency. Varying degrees of ferruginisation occur near the transition with the underlying residual soils.
Residual sandstone	2,8m avg. (1,8m – 4,1m)	Slightly moist, light brown mottled orange and light grey, firm to very stiff, slightly ferruginised, silty fine sand.
Weathered sandstone	7,2m+ (Depth of auger refusal varies from 3,8m to 7,2m)	Light grey to off-white, highly weathered, very soft rock becoming soft rock, indistinctly bedded and jointed, fine grained sandstone.

* Depth given to base of horizon from present ground level. Figures in brackets denote range.

No seepage or water table was encountered in any of the boreholes and test pits excavated on this site.

6.2 Material properties

Table 3 below summarises the material properties for each of the material types encountered on this site.

Table 3: Summary of laboratory test results

Horizon: / Property	Hillwash	Illuviated Hillwash	Residual sandstone
Material Type:			
Description	Sand or silty sand	Silty sand	Silty sand
Unified classification	Generally SM	Generally SC	Generally SC
AASHTO Classification	A-2-4[0]	A6[1] to A-2-4[0]	A6[2] to A-2-4[0]
TRH14	G9 – G7	SPOIL	Not tested
Grading:			
% Coarse sand and gravel	23 (20 – 26)*	20 (17 – 23)	14 (2 – 26)
% Fine sand	55 (51 – 59)	45 (34 – 50)	48 (41 – 61)
% Silt	19 (14 – 22)	28 (24 – 37)	29 (22 – 33)
% Clay	4 (1 – 6)	8 (4 – 12)	9 (7 – 12)
Grading Modulus	0,84 (0,79 – 0,95)	0.73 (0,68 – 0,87)	0,68 (0,59 – 0,91)
Atterberg Limits:			
Liquid Limit	19 (16 – 23)	26 (22 – 35)	27 (20 – 30)
Plasticity Index	5 (0 – 10)	9 (5 – 16)	9 (6 – 11)
Linear Shrinkage	2,1 (0 – 3,3)	4,4 (3,3 – 6,0)	4,7 (3,3 – 6,0)
Field Density and SG:			
Density (kg/m^3)	1707 (1583-1950)	1465 (1 test)	1781 (1671- 906)
Moisture Content (%)	8 (5 – 11)	11 (7 – 14)	12 (9 – 14)
S.G.	2,65 (2,64 – 2,65)	2,65 (1 test)	2,63 (2,51–2,71)
% Collapse @ 125kPa	2,9 (2,6 – 3,2)	8,6 (1 test)	0,8 (0 – 2,2)
Compaction Characteristics:			
Mod AASHTO MDD (kg/m^3)	1958 (1940-1991)	1879 (1846-1911)	Not tested
OMC (%)	10,2 (9,6 – 10,6)	12,2 (11,2-13,2)	
CBR @ 90% Mod AASHTO	11 (7 – 18)	1,6 (1,6-2,1)	
CBR @ 95% Mod AASHTO	16 (10 – 24)	2,4 (1,8 – 2,9)	

* Average and (range)

The salient points from the above summary are:

- The hillwash soils, including the illuviated material, have a collapsible grain structure. Collapse settlements of 3% - 9% were measured at 125kPa which, when extrapolated to 200kPa gives a collapse potential of 5% -11%. This indicates that moderate to severe trouble can be expected with performance of foundations for light structures placed in this material (Schwartz, 1985) [8].
- No potentially expansive material was encountered on the site.
- Although the effect of illuviation of the hillwash (accumulation of fines at the base of the layer) is clearly evident in profile, there are only minor differences in grading and plasticity index from the laboratory tests. In fact all the materials on site, transported and residual, grade as a silty fine sand of low to moderate plasticity (SC and SM according to the unified classification).
- The compacted strength of the hillwash soils as measured by the CBR varies quite considerably. CBRs at 90% Mod. AASHTO vary from 1 to 18 and the TRH classification from spoil to G7. The marked difference between the CBR of the

[8] Schwartz K. (1985) **Collapsible Soils; State of the Art**. Civil Engineering in South Africa, July 1985, p379-393.

upper hillwash and the lower illuviated hillwash from the test results is very unexpectedly pronounced. On site, a lesser distinction between the two materials is expected.

6.3 Excavatability

All transported and residual soils classify as soft excavation in terms of the definitions contained in SABS1200D[9]. The very soft rock or better weathered sandstone will generally classify as intermediate excavation, i.e. material that can be excavated by heavy ripping or using a large excavator.

The only area of the site where hard rock excavation may be required is at the grain off loading area (AH 6) where the depth of the reclaim tunnel below the offloading bins is expected to be about 8m whereas near-refusal was encountered in auger hole AH6 at 4,5m. It would be prudent to allow for hard rock excavation below 4,5m for this structure.

7. FOUNDING OPTIONS

7.1 Shallow spread footings

As indicated above, the hillwash sands have a potentially collapsible grain structure. In accordance with the NHBRC classification[10], portions of the site would classify as C2 with estimated collapse settlements in excess of 10mm. As such, conventional strip footings founded directly on the hillwash sands are not recommended.

Practical founding solutions for light structures such as offices, laboratories etc include stiffened raft foundations, deep strip footings on the underlying ferruginised soil / residual sandstone or a soil raft. Although the NHBRC permit the over-excavation and re-compaction of material within the foundation trenches, our experience is that this operation is difficult and often unreliable.

7.2 Deeper foundations on residual sandstone

Over much of the site, the top of the residual sandstone is within 3m of the ground surface. This material generally has a stiff or better consistency and will form a suitable founding stratum for moderately loaded structures on spread footings or foundation rafts.

Due to the depth of founding, the bearing capacity of these soils should be adequate. Nevertheless, a maximum bearing pressure of 200kPa is recommended in order to ensure practical footing sizes and to control settlements.

The expected settlement of spread footings placed on the residual sandstone is estimated to be of the order of 1,5mm per metre width of foundation per 100 kPa of net bearing pressure for a square footing increasing to 2,5mm per metre width per 100kPa for a strip footing. For example, a 1,5m wide square footing carrying a nett bearing pressure of 200kPa would be expected to settle by 4,5mm (say 5mm) i.e. 1,5mm x 1,5 x 200/100. These values are based on an estimated elastic modulus of the residual soils of 50MPa

[9] SABS 1200D:1988. **Standardised specification for civil engineering construction. D: Earthworks.** S.A. Bureau of Standards, Pretoria.

[10] National Home Builders Registration Council. (1999) **Home Building Manual, Parts 1, 2 and 3.**

over the full depth of influence of the foundation. As the stiffness of the soil profile improves with depth, the above prediction will become increasingly conservative as the width of the footing increases.

7.3 Spread footings on rock

Over most of the site, the rockhead is present at a depth of between 2,5m and 4,1m. The rock is generally a very soft rock, fine grained sandstone improving gradually in consistency with depth. Spread footings or raft foundations for heavy structures may be placed on the rockhead using a maximum allowable bearing pressure of 600kPa. Higher bearing pressures are possible but will require further investigation or detailed inspection of the foundations during construction.

7.4 Piled foundations

Piled foundations may be considered below heavy structures in areas where the depth to rockhead makes the use of spread footings unattractive.

The stable soil profile and deep water table on the site are ideally suited to the installation of large diameter bored piles. Pile founding depths of between 6 and 8m are expected over most of the site. Note that a more powerful auger rig than was used during the investigation will be capable of drilling to depths in excess of those achieved during the investigation and it will probably not be necessary to drill the pile holes to refusal of such rigs except in the case of very heavily loaded piles.

On the assumption that the piles will be founded on soft rock sandstone (UCS approximately 6MPa), an allowable end bearing stress of 3MPa may be assumed for hand cleaned pile holes. Note that hand cleaning is not possible in holes smaller than 750mm diameter. In such cases, the end bearing capacity of the pile should be ignored and the pile designed as a friction pile. The allowable socket friction in very soft rock sandstone may be taken as 150kPa increasing to 200kPa in very soft rock to soft rock sandstone.

Assuming a socket length of 2m and founding of the pile on soft rock or better sandstone gives the following capacities for piles of various diameters:

Table 4: Capacity of hand cleaned bored cast in situ piles of various diameters

Pile Diameter	Shaft Friction	Base Capacity	Total Working Load
450mm	420kN	-	420kN
600mm	570kN	-	570kN
750mm	700kN	1 300kN	2 100kN
900mm	850kN	1 900kN	2 750kN
1 050mm	1 000kN	2 600kN	3 600kN

Based on: 2m socket in very soft rock (150kPa shaft friction)
End bearing on soft rock (3MPa end bearing)

Higher pile capacities may be achieved by increasing the socket length or augering to medium hard rock sandstone at greater depth.

Predrilled driven cast in situ piles may be considered as an alternative to bored piles. In view of the relatively shallow rockhead (and hence the short shaft length) it is recommended that predrilling should be undertaken to the top of the very soft rock sandstone and the pile based out at this level. Under these circumstances, the following pile capacities may be assumed for driven cast in situ piles.

Table 5: Capacity of driven cast in situ piles of various diameters[11]

Pile Diameter	Total Working Load
355mm	500kN
410mm	750kN
530mm	1 200kN
600mm	1 600kN

Single piles below columns should be designed to take account of moments induced by construction tolerances and lateral loading during seismic events. Short piles with nominal socket lengths are particularly susceptible failure under lateral loading.

8. RECOMMENDATIONS

8.1 Site preparation

Although the topography of the site is relatively flat, the surface of the site undulates due mainly to human activity. Existing roads, tracks and footpaths tend to be lower than the overall level of the site. In other areas, the site has been elevated by the placement of fill material (e.g. the area to the east of AH12 and TP10). Localised zones of disturbed soil are also likely to be present in the area previously occupied by residential development. Terracing of the site will therefore be required.

Prior to commencement of site preparation works, all remaining rubble and surface vegetation should be removed to spoil. Topsoil with roots (generally to 150mm depth) should be stripped and stockpiled for landscaping and rehabilitation purposes.

The minimum requirements for terracing of the site involve cutting the in situ sands to fill. Prior to placement of fill, a “road bed” preparation should be carried out in which the exposed surface sands are scarified to a depth of 150mm, the moisture content adjusted to OMC ±2% and the upper 150mm of material compacted to 90% Mod. AASHTO Maximum Dry Density. Fill material should be placed and compacted to 93% Mod. AASHTO Maximum Dry Density at OMC ±2%. Due to the fine grained nature of the material, the maximum (compacted) layer thicknesses should not exceed 200mm unless it can be shown that uniform compaction can be obtained throughout the full thickness of the thicker layer with the compaction equipment to be used on the site.

Note that the above site preparation will not ensure traffickability of the site in areas of cut and thin fill. Such a terrace will also not provide a suitable working platform for cranes with heavily loaded outriggers.

[11] Frankipile South Africa (Pty) Ltd (1995) **A guide to practical geotechnical engineering in Southern Africa**. Third edition. Franki Africa, Johannesburg.

As an alternative to the above minimum recommendations, consideration may be given to the use of impact rolling to improve the consistency of the transported sands to a depth of between 1,2m and 1,5m and reduce the collapse potential of this material. If this solution is adopted, care should be taken to preserve the in situ moisture content of the material to be compacted as the sands will not compact adequately when dry. Compaction should first be undertaken on the side of the terrace where fill is to be placed. On completion of impact rolling, the disturbed upper layer of the compacted material should be scarified, moistened to OMC ±2% and compacted with a conventional roller. A conventional cut to fill operation, as described above, may then take place followed by further impact rolling of the cut side of the terrace. Note that impact rolling could result in a drop in ground level of between 100mm and 200mm due to densification of the soils at depth.

Terraces compacted as described above should be capable of supporting applied bearing pressures of up to 150kPa provided settlements are checked and found to be acceptable. Where the specified depth of excavation results in hillwash remaining below the compacted terrace, bearing pressures should not exceed 100kPa.

A wearing course of G7 or better material will be required to improve traffickability of the site particularly in the rainy season. It is also recommended that falls of at least 1:200 be provided on all terraces to encourage surface drainage.

8.2 Roads

The hand held drop weight penetrometer tests given in Appendix D indicate that the CBR of the in situ soils to a depth of approximately 1,3m may be as low as 2 (generally ranging from 2 to 8). This is consistent with the profile descriptions and laboratory test results.

Under these circumstances, it is recommended that the road design be based on a CBR of <3 for the in situ material and a CBR of 3 to 7 after in situ compaction. As the illuviated hillwash below an average depth of 1,0m may have a CBR of less than 3, the CBR of the in situ material should be checked by penetrometer testing of the roadbed or laboratory testing during construction. Where there is any doubt about the quality of the in situ material, a further layer of G9 material (lower subgrade) should be provided.

If the roadbed is kept dry, no pioneer layer will be required. However, any flooding of the roadbed due to rain will soften the in situ materials and make them both untraffickable and unworkable.

As indicated in Section 6.2, the upper hillwash sands generally classify as G7 to G9 materials according to TRH14. Accordingly, these may be used in the lower subgrade layers in road construction. All selected material (G7 and above) will have to be imported. Dolerite borrow pits in the area will probably yield the most convenient source of such material.

8.3 Light Structures

Light structures include single storey buildings such as administration buildings (offices, gate house, etc.), laboratories, MCC, control rooms, etc.

Due to the collapsible nature of the hillwash sands, light structures should be founded on stiffened raft foundations or on a mattress of compacted soil (soil raft) as prescribed for C2 sites by the NHBRC[12]. The NHBRC recommendations regarding articulation of the superstructure and site drainage should also be followed.

[12] National Home Builders Registration Council. (1999) **Home Building Manual, Parts 1, 2 and 3.**

Where a mattress of compacted soil (soil raft) is to be formed on which light structures are to be founded, it is recommended that the following procedure be followed.

- Excavate all hillwash sands to the top of well ferruginised or residual soils. If a lesser depth is specified by the designer, this should not be at less than 1,5 times the breadth of the foundation below founding level.
- Scarify the material at the base of the excavation to a depth of 150mm, adjust the moisture content to OMC ±2% and compact the upper 150mm to a density of 90% Mod. AASHTO Maximum Dry Density.
- Replace the excavated sands in layers not exceeding 200mm thick compacting each layer to 95% Mod. AASHTO Maximum Dry Density at OMC ±2%. Note that, if it is not possible to obtain a compaction density of 95% on the first layer, the required density for this layer only may be reduced to 93% Mod. AASHTO.
- Continue terrace construction to the underside of floor level whereafter foundation trenches should be excavated into the compacted terrace. This is preferable to placing fill material between completed foundations.

8.4 Steel Framed Structures

Steel framed structures include structures such as workshops, stores and certain of the plant structures. These are likely to vary from light, flexible, sheeting clad structures to heavy, settlement sensitive processing plant structures subject to dynamic loading. The common factor is that loads are concentrated at column positions.

Light, flexible structures may be founded on spread footings extending to the top of the residual sandstone as described in Section 7.2.

Heavy and settlement sensitive plant should be founded on spread footings extending to the very soft rock sandstone or on piled foundations as described in sections 7.3 and 7.4. Note that large spread footings with heavy plinths or shear walls below ground level will provide better resistance to horizontal dynamic loading than vertical piles. If piled foundations are required to resist dynamic loads, the horizontal component of the load should be taken by raking piles rather than relying on subgrade reaction on vertical piles.

The soil preparation below the floors should be consistent with the loads to be imposed on the floors. Where floors are to be trafficked by heavy vehicles or forklifts, a full road preparation (or soil raft) should be provided as described in Sections 8.2 and 8.3.

8.5 Heavy Vessels and Distillation Columns

These are generally tall, heavy and settlement sensitive structures.

Such structures should be founded on raft foundations placed on the sandstone rock (Section 7.3) or on a group of piles (Section 7.4) with an appropriately designed pile cap. The design should take account of horizontal seismic loading particularly where the piles are founded on top of the rock or only socketed a short distance into rock.

8.6 Tanks and Cooling Towers

Steel tanks are generally capable of tolerating moderate differential settlements across the floor of the tank but require the perimeter of the tank to remain plane. Concrete ponds below cooling towers are less tolerant to settlement but are generally more lightly loaded.

It is recommended that tanks and cooling towers be founded on a soil raft as described in Section 8.3 with two additional provisions. Firstly, the soil raft should extend to the top of the residual sandstone in the case of small tanks and cooling towers and to the top of the weathered sandstone below large tanks (>150kPa bearing pressure). Secondly, the soil raft should be constructed using G7 or better material. Such material will probably have to be imported.

Allowance should be made for settlements of between 10mm and 15mm per 100kPa of applied load near the centre of the tank. A concrete ring beam should be provided if the walls of the tank are incapable of tolerating differential settlements of half the above magnitude.

Concrete ponds below cooling towers should be designed as rigid units in the case of small ponds or be provided with sealed movement joint in the case of larger ponds at the designer's discretion. Movement joints should be provided between adjacent ponds.

Bunded areas around tanks should be placed on a soil raft (say) 1,0m thick constructed as described in Section 8.3 using hillwash sands as a fill material. Sealed movement joints should be provided.

8.7 Silos

We understand that the silos are steel "tanks" with a conical concrete floor at the bottom of the tank section, supported on columns.

In view of the modest depth to rock in the vicinity of the silos (2,3m – 4,2m), it is recommended that the silos be founded on spread footings bearing on very soft rock or better as described in Section 7.3. Piled foundations may be considered but are unlikely to be effective due to the shallow depth of the rock. Short single piles will also be vulnerable to lateral loading during seismic events.

8.8 Grain Off-Loading Bins and Reclaim Tunnel

The grain off-loading bins and the reclaim tunnel extend to a depth of 8m below terrace level and are the deepest structures on site.

According to AH6, the top of the residual sandstone is at 1,5m and the rockhead at 2,1m. The excavation should be battered to 1:1,5 (V:H) in the hillwash and 1:1 in the residual soils. A 2m wide bench should be provided at the level of the rockhead. Excavation in the rock may be battered at 70^{o} to the horizontal or stepped to achieve the equivalent overall slope or flatter.

If it is considered preferable to cut the sides of the excavation vertical, soil nailing may be considered over the upper 3m of the profile followed by rock bolts, mesh and a nominal gunite skin in the rock below.

Allowance should be made in the Schedule of Quantities for hard rock excavation below 4,5m but the quality of the material and the need for blasting should be assessed on site.

Backfill around the structure should be carefully controlled in order to prevent settlement below the approach roads. Layer thicknesses should be reduced commensurate with the type of compaction equipment to be used. Consideration should be given to the use of cement stabilised backfill below the approach roads and jockey slabs.

Where the conveyor tunnel comes up to ground level, appropriate measures should be taken to minimise or accommodate differential settlements caused by founding on in situ

hillwash. The use of a soil raft or the founding of supports on the residual sandstone may be considered.

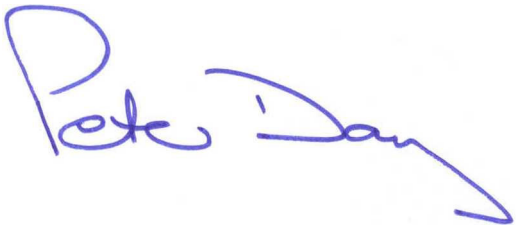
8.9 Pipe and Cable Racks

Pipe and cable racks should be founded on spread footings on the residual sandstone (see Section 7.2) or small diameter piles (Section 7.4).

9. CONCLUSIONS

The site is considered suitable for the construction of the proposed Grain-Alcohol Plant. Adequate founding for heavy structures is available on very soft rock sandstone which underlies the site at a depth of 3m to 4m. Lighter structures may be founded on the residual sandstone, stiffened rafts or soil rafts.

The two main geotechnical challenges on this site are the collapsible nature of the hillwash sand that blankets the site to a depth of approximately 2m and the poor compaction characteristics of the soils on the site. All selected fill material will have to be imported. Traffickability of the site during construction can be improved by impact rolling and provision of a gravel wearing course.



PETER DAY PrEng
for Jones & Wagener

RICHARD PUCHNER PrSciNat
for Jones & Wagener

25 August 2006

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APPENDIX A

AUGER HOLE PROFILES

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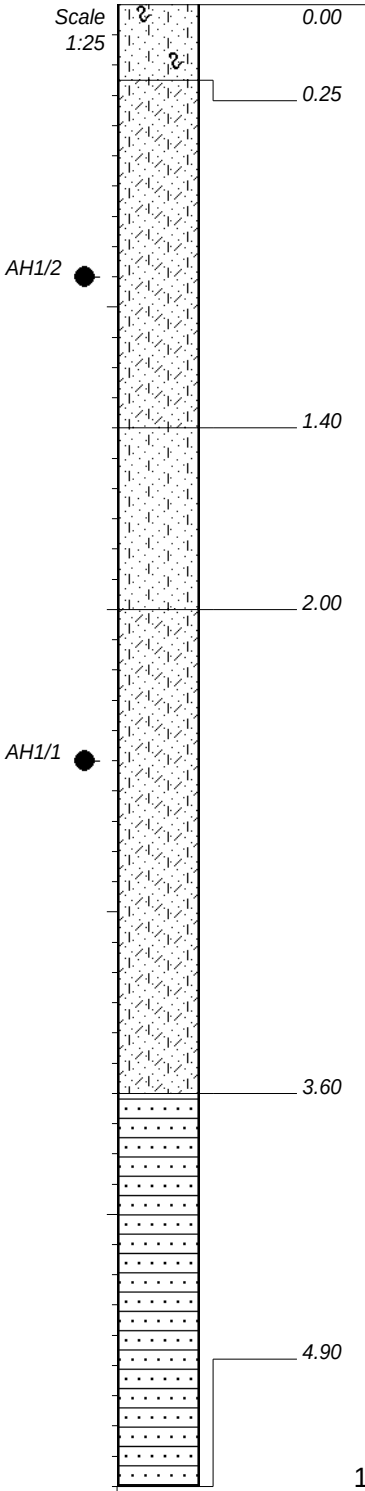
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 01
Sheet 1 of 1

JOB NUMBER: A 872



0.00

Slightly moist, red-brown occasionally mottled light brown, loose, friable, silty fine and medium SAND with numerous roots; **HILLWASH**.

0.25

Slightly moist becoming moist, light yellowish brown, silty becoming clayey fine SAND with occasional fine roots; **HILLWASH**. Isolated orange-brown, poorly formed ferricrete nodules at base of layer.

1.40

Slightly moist, light greyish brown mottled orange-brown, dense, ferruginised, silty fine SAND; **TRANSPORTED / PEDOGENIC**. Isolated hard fine ferricrete nodules at top of layer. Elsewhere in layer nodules are large and poorly formed.

2.00

Slightly moist, light greyish brown mottled light orange-brown, stiff, ferruginised, slightly micaceous, slightly clayey, silty fine SAND; **RESIDUAL SANDSTONE**. Below 3m, material predominantly light grey-brown in colour and very stiff.

3.60

Light brown banded light greyish brown, highly weathered, very dense to very soft rock becoming very soft rock below 4,2m, indistinctly bedded and jointed, very fine grained SANDSTONE; **VRYHEID FORMATION**.

4.90

NOTES

1) Auger refused at 4,9m on very soft rock to soft rock fine grained sandstone as above.

2) No seepage or water table.

3) Disturbed sample AH1/1 taken at 2,5m and AH1/2 at 0,9m.

CONTRACTOR : GAUTENG PILING
MACHINE : LDH 80
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 349.85
Y-COORD : 38 180.85

HOLE No: AH 01

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

Jones & Wagener
Consulting Civil Engineers
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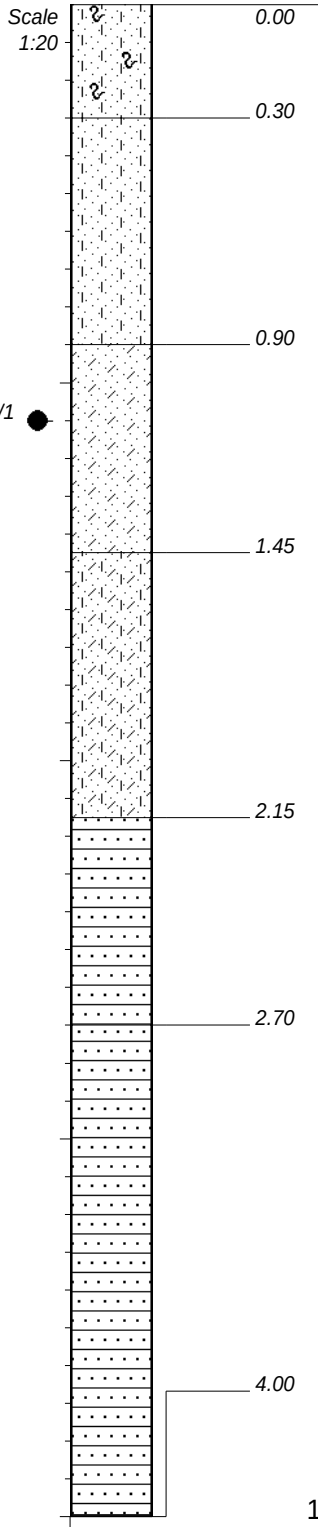
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 02
Sheet 1 of 1

JOB NUMBER: A 872



0.00

Slightly moist, brown, loose, friable, intact, silty fine SAND with fine roots; **HILLWASH**.

0.30

Moist, slightly yellowish brown, loose, intact, silty fine SAND with occasional fine roots; **HILLWASH**.

0.90

Moist, brown, occasionally mottled orange-brown, firm, slightly ferruginised, clayey fine SAND with isolated fine nodular ferricrete towards base of layer; **ILLUVIATED TRANSPORTED MATERIAL / PEDOGENIC**.

1.45

Slightly moist, light brown mottled light grey-brown and orange-brown, stiff to very stiff, slightly ferruginised, slightly clayey, silty fine SAND; **DECOMPOSED RESIDUAL SANDSTONE**. Material contains runnels of light grey speckled black clayey silt.

2.15

Dry to slightly moist, light grey mottled light orange-brown, very stiff to very soft rock, slightly micaceous, fine grained SANDSTONE; **VRYHEID FORMATION**.

2.70

Light grey to off-white, highly weathered, very soft rock becoming very soft rock to soft rock below 3,2m and soft rock at base of hole indistinctly bedded and jointed, slightly micaceous fine grained SANDSTONE; **VRYHEID FORMATION**.

4.00

NOTES

1) Auger refused at 4,0m on soft rock fine grained sandstone.

2) No seepage or water table.

3) Disturbed sample AH2/1 at 1,1m.

CONTRACTOR : GAUTENG PILING
MACHINE : LDH 80
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 322.85
Y-COORD : 38 128.85

HOLE No: AH 02

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

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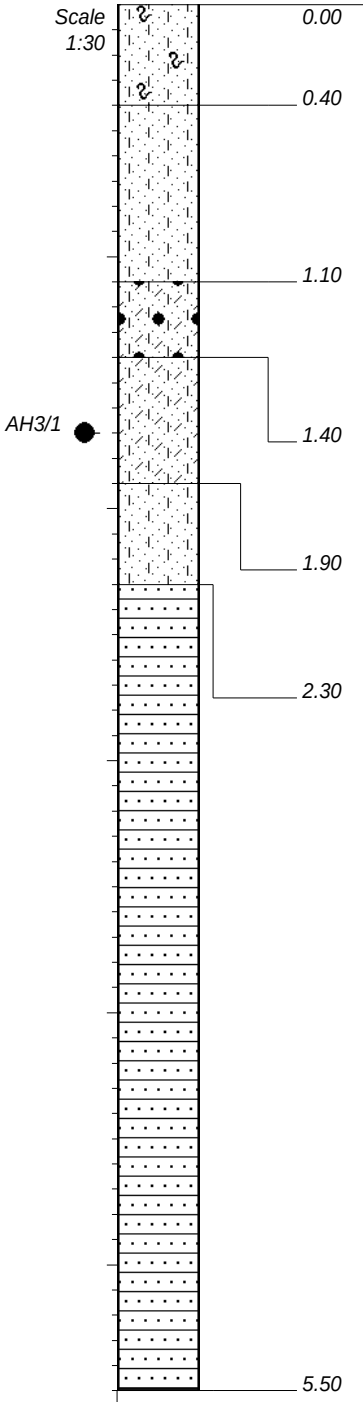
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 03
Sheet 1 of 1

JOB NUMBER: A 872



Slightly moist to moist, brown mottled light brown, loose, friable, silty fine SAND with fine roots; **HILLWASH**.

Moist, light brown, loose, slightly friable, silty fine and medium SAND; **HILLWASH**. Isolated fine roots.

Moist, light brown mottled orange-brown, medium dense, slightly clayey, silty fine SAND as matrix to scattered, fine, hard ferricrete nodules and poorly formed, orange-brown, large concretions; **HILLWASH / PEDOGENIC**.

Moist, light brown mottled orange-brown and light grey-brown, stiff, ferruginised, clayey / silty fine SAND; **DECOMPOSED RESIDUAL SANDSTONE**.

Slightly moist, light orange-brown mottled light grey and pale red-brown, very dense, slightly ferruginised, silty fine SAND with occasional runnels of light grey clayey silt; **DECOMPOSED RESIDUAL SANDSTONE**.

Light grey-brown occasionally banded light orange-brown, highly weathered, very soft rock, indistinctly bedded and jointed, fine grained SANDSTONE; **VRYHEID FORMATION**. Material becomes soft rock with depth.

NOTES

1) No seepage or water table.

2) Auger refused on soft rock fine grained sandstone at 5,5m.

3) Disturbed sample AH3/1 at 1,7m.

CONTRACTOR : GAUTENG PILING
MACHINE : LDH 80
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 375.85
Y-COORD : 38 092.85

HOLE No: AH 03

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

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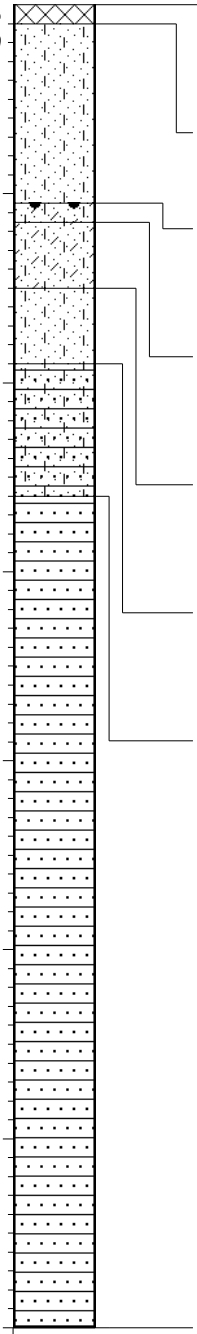
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 04
Sheet 1 of 1

JOB NUMBER: A 872



0.00 – 0.10	Dry to slightly moist, light brown banded dark brown, loose, friable, silty fine SAND with layers of ash and foreign material (plastic, glass) etc; **FILL**.
0.10 – 1.05	Moist, brown, loose, slightly friable, intact, silty fine SAND with occasional roots; **HILLWASH**. Material becomes light orange-brown with depth.
1.05 – 1.15	Relatively closely packed, fine, well developed nodular ferricrete and large orange-brown, poorly cemented, concretions in a matrix of moist, light orange brown, slightly clayey, silty fine SAND; **PEDOGENIC**.
1.15 – 1.50	Moist, light orange-brown mottled orange, stiff, ferruginised, clayey / silty fine SAND / sandy SILT with poorly formed, orange, ferruginous concretions; **FERRUGINISED RESIDUAL SANDSTONE**.
1.50 – 1.90	Slightly moist, light orange-brown mottled orange and grey-brown, very stiff, silty fine SAND with runnels of light grey, sandy silt / clayey silt; **HIGHLY WEATHERED TO DECOMPOSED RESIDUAL SANDSTONE**.
1.90 – 2.60	Light brown mottled light orange-brown, highly weathered, very soft rock, fine grained SANDSTONE with occasional runnels of light grey clayey silt as above; **VRYHEID FORMATION**.
2.60 – 7.00	Light grey occasionally mottled light orange, highly weathered, very soft rock, indistinctly jointed, fine grained SANDSTONE; **VRYHEID FORMATION**. Below 3,5m very soft rock to soft rock becoming soft rock at bottom of hole. Material becomes a uniform light greyish brown to light olive-brown with depth.

NOTES

1) No seepage or water table.

2) Auger did not refuse but making very slow progress.

3) No samples taken.

CONTRACTOR : GAUTENG PILING
MACHINE : LDH 80
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 350.00
Y-COORD : 38 050.00

HOLE No: AH 04

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

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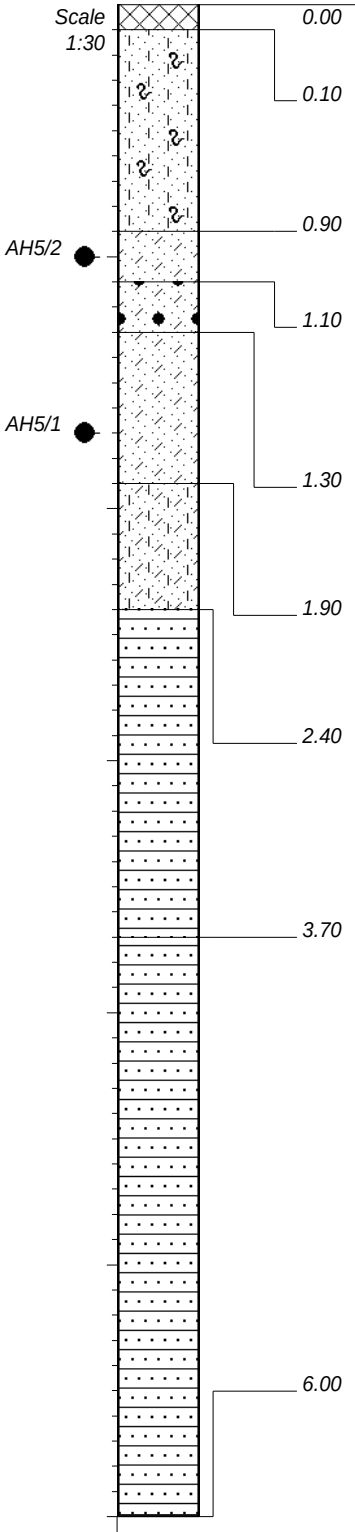
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 05
Sheet 1 of 1

JOB NUMBER: A 872



0.00 – 0.10	Dry to slightly moist, dark brown, silty fine SAND as matrix to scattered rubble; **FILL**. Numerous roots.
0.10 – 0.90	Moist, brown becoming slightly orange-brown, loose, friable becoming slightly cohesive, slightly porous, silty fine SAND becoming slightly clayey (illuviated) with depth; **HILLWASH**. Scattered roots.
0.90 – 1.10	Moist, orange-brown mottled orange and light brown, firm, ferruginised, clayey SAND; **FERRUGINISED, ILLUVIATED HILLWASH**.
1.10 – 1.30	Relatively closely packed, fine, well developed, nodular ferricrete and larger orange-brown, poorly cemented concretions in a matrix of moist, brown mottled light grey and orange, clayey fine SAND; **PEDOGENIC / TRANSPORTED**. Overall consistency medium dense.
1.30 – 1.90	Moist, light orange-brown mottled light grey and orange, firm to stiff, ferruginised, clayey fine SAND; **FERRUGINISED RESIDUAL SANDSTONE**.
1.90 – 2.40	Slightly moist, light grey mottled orange and orange-brown, very stiff, ferruginised clayey / silty fine SAND; **DECOMPOSED RESIDUAL SANDSTONE**.
2.40 – 3.70	Light orange-brown mottled orange and light grey, highly weathered, very soft rock, fine grained SANDSTONE; **VRYHEID FORMATION**.
3.70 – 6.00	Light grey-brown, occasionally mottled orange-brown, highly weathered, very soft rock to soft rock, indistinctly jointed, fine grained RESIDUAL SANDSTONE; **VRYHEID FORMATION**. Consistency improves to soft rock with depth.

NOTES

1) No seepage or water table.

2) Auger close to refusal and making slow progress.

3) Disturbed sample AH5/1 at 1,7m and AH5/2 at 1,0m.

CONTRACTOR : GAUTENG PILING
MACHINE : LDH 80
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 385.00
Y-COORD : 38 030.00

HOLE No: AH 05

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

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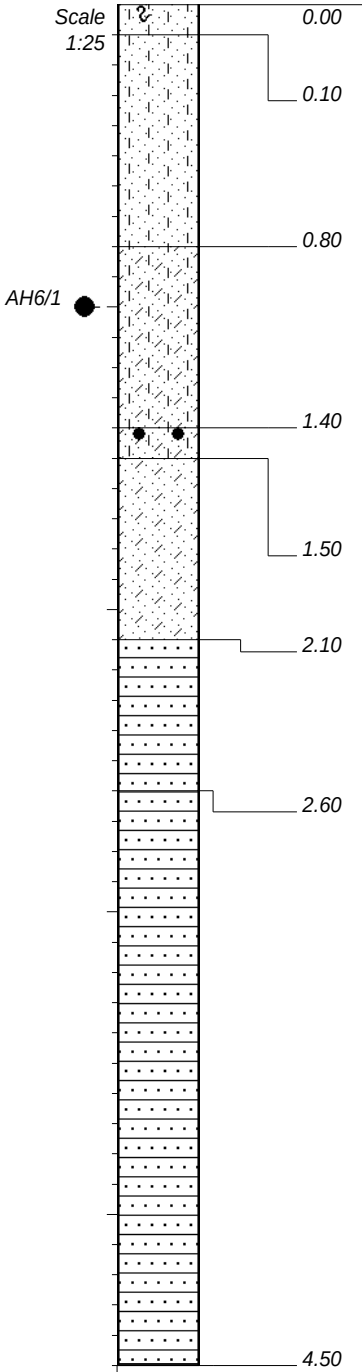
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 06
Sheet 1 of 1

JOB NUMBER: A 872



0.00 – 0.10: Dry to slightly moist, dark brown, loose, slightly organic, silty fine SAND with numerous roots. **HILLWASH**.

0.10 – 0.80: Moist, brown, very loose, slightly porous, slightly friable, silty fine SAND; **HILLWASH**. Isolated fine roots.

0.80 – 1.40: Moist, orange-brown mottled orange, loose to medium dense, slightly ferruginised, clayey / silty fine SAND; **FERRUGINISED, ILLUVIATED HILLWASH**. Isolated poorly formed large orange ferricrete nodules at base of layer.

1.40 – 1.50: Closely packed, well developed, hard ferricrete nodules and isolated fine gravel in a matrix of moist, light orange-brown, clayey / silty fine SAND; **PEDOGENIC / PEBBLE MARKER**. Overall consistency dense.

1.50 – 2.10: Slightly moist, light brown mottled orange-brown, very stiff, slightly ferruginised, clayey SAND; **DECOMPOSED RESIDUAL SANDSTONE**.

2.10 – 2.60: Light orange-brown mottled orange-brown and occasionally light grey, highly weathered, very dense to very soft rock, fine grained SANDSTONE; **VRYHEID FORMATION**. Occasional runnels of light grey clayey silt with roots on joint planes.

2.60 – 4.50: Light greyish brown, highly weathered, very soft rock, very fine grained SANDSTONE; **VRYHEID FORMATION**. Occasional orange ferruginised zones. Description of material becomes very soft rock to soft rock below 3,3m and soft rock below 3,8m.

NOTES

1) No seepage or water table.

2) Auger drilling with difficulty - near refusal.

3) Disturbed sample AH6/1 at 1,0m.

CONTRACTOR : GAUTENG PILING
MACHINE : LDH 80
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 308.85
Y-COORD : 38 011.85

HOLE No: AH 06

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

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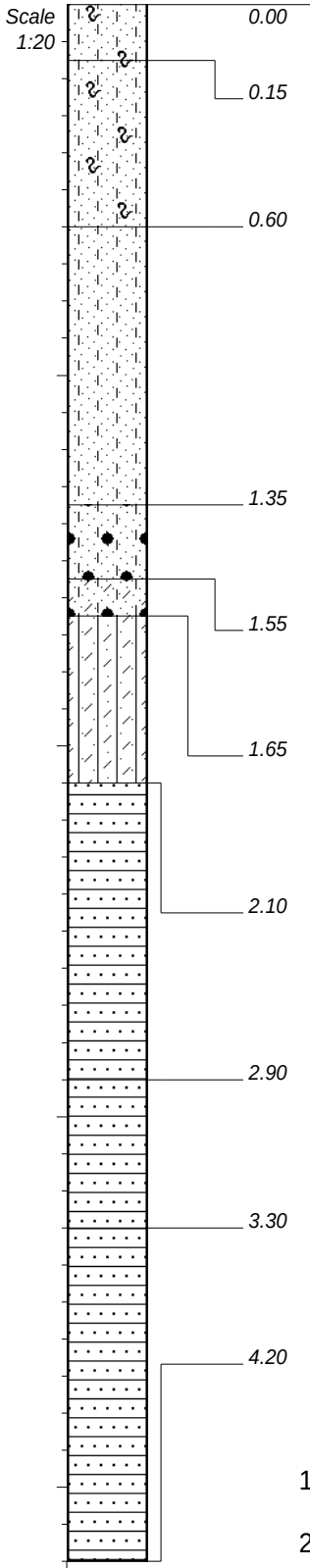
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 07
Sheet 1 of 1

JOB NUMBER: A 872



0.00 – 0.15: Dry to slightly moist, dark brown, <u>very loose</u>, organic silty fine SAND with numerous roots; **HILLWASH**.

0.15 – 0.60: Moist, light brown, <u>loose</u>, silty fine SAND with numerous roots; **HILLWASH**.

0.60 – 1.35: Moist, llight orange-brown, <u>loose</u>, friable, silty fine SAND; **HILLWASH**. Occasional roots. Upper portion of layer unstable and collapsing back 250mm from sidewall of hole.

1.35 – 1.55: Large, orange, poorly formed ferricrete concretions relatively closely packed in a matrix of moist, greyish brown, silty fine SAND; **PEDOGENIC / TRANSPORTED**. Isolated roots. Overall consistency <u>medium dense.</u>

1.55 – 1.65: Closely packed nodular ferricrete in a matrix of moist, light brown mottled grey-brown and orange, clayey / silty fine SAND; **PEDOGENIC**. Overall consistency <u>dense</u>.

1.65 – 2.10: Moist, orange-brown mottled light grey-brown and orange, <u>firm to stiff</u>, ferruginised sandy / clayey SILT / clayey SAND; **DECOMPOSED RESIDUAL SANDSTONE**. Material becomes <u>very stiff</u> towards base of layer.

2.10 – 2.90: Light orange mottled orange and occasionally light grey, <u>very dense</u> to <u>very soft rock</u>, decomposed fine grained RESIDUAL SANDSTONE; **VRYHEID FORMATION**.

2.90 – 3.30: Moist, <u>very stiff</u> to <u>very soft rock</u>, light grey-brown / orange-brown, decomposed, slightly clayey fine grained SANDSTONE; **VRYHEID FORMATION**.

3.30 – 4.20: Light grey, highly weathered, <u>very soft rock</u> becoming <u>very soft rock</u> to <u>soft rock</u>, fine grained SANDSTONE; **VRYHEID FORMATION**.

4.20

NOTES

1) No seepage or water table.

2) Auger did not refuse but making slow progress.

3) No samples taken.

CONTRACTOR : GAUTENG PILING
MACHINE : LDH 80
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 385.00
Y-COORD : 37 975.00

HOLE No: AH 07

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

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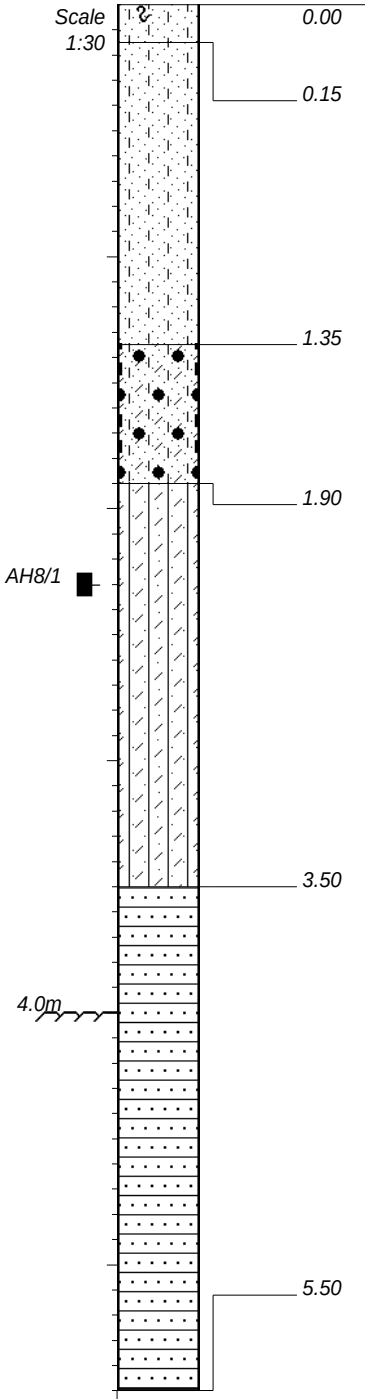
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 08
Sheet 1 of 1

JOB NUMBER: A 872



Dry to slightly moist, brown, medium dense, slightly fissured, silty fine SAND with numerous roots; **HILLWASH**.

Moist, brown becoming light orange-brown, loose, intact to slightly porous, silty fine SAND; **HILLWASH**. Isolated roots.

Relatively closely packed, poorly formed, large, orange, nodular ferricrete in a matrix of moist, light orange-brown mottled orange, slightly clayey silty SAND; **PEDOGENIC**. Occasional fine roots. Overall consistency medium dense becoming dense and partially cemented at base of layer.

Moist, light orange-brown mottled orange and light grey, firm, ferruginised, slightly micaceous, sandy / clayey SILT; **DECOMPOSED RESIDUAL SANDSTONE**. Material more cohesive than elsewhere on site. Runnel of material as above extends to 3,1m around part of perimeter of hole.

Light grey, highly weathered, very dense to very soft rock, slightly friable, fine grained SANDSTONE; **VRYHEID FORMATION**. Material becomes a very soft rock below 4,0m and very soft rock to soft rock below 4,5m.

NOTES

1) No seepage or water table.

2) Auger near refusal on soft rock sandstone at 5,5m.

3) Rockhead uneven with pockets of decomposed sandstone (sandy / clayey silt) extending to 4,0m in places.

4) Undisturbed sample AH8/1 at 2,3m in residual sandstone.

CONTRACTOR : GAUTENG PILING
MACHINE : LDH 80
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 11 July 2006
DATE : 11 July 2006

ELEVATION :
X-COORD : 29 430.85
Y-COORD : 37 938.85

HOLE No: AH 08

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

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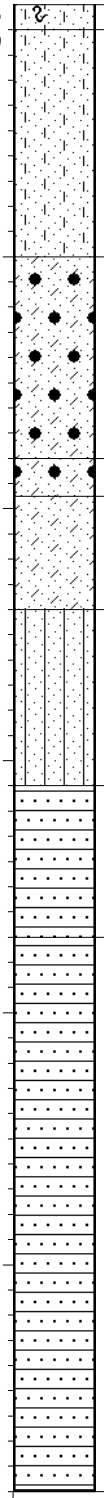
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 09
Sheet 1 of 1

JOB NUMBER: A 872

Scale 1:30



0.00	Dry to slightly moist, dark brown, <u>dense</u>, fissured, silty fine SAND with numerous roots; **HILLWASH**.
0.10	Moist, brown becoming orange-brown, <u>medium dense</u>, intact, silty fine SAND; **HILLWASH**. Isolated fine roots.
1.00	Moist, orange-brown, <u>medium dense</u>, lightly ferruginised, clayey fine SAND as matrix to scattered, large, poorly formed ferricrete nodules; **HILLWASH / PEDOGENIC**. Isolated fine roots.
1.80	Closely packed nodular ferricrete in a matrix of material as above; **PEDOGENIC**. Overall consistency <u>dense</u>.
1.95	Moist, orange-brown, <u>medium dense</u>, slightly ferruginised, clayey fine SAND; **HILLWASH?** Could be residual sandstone.
2.40	Slightly moist, light brown banded orange-brown and light grey, <u>very dense</u>, indistinctly horizontally bedded, silty fine SAND / sandy SILT; **DECOMPOSED RESIDUAL SANDSTONE**. Occasional runnels of orange-brown mottled light grey, clayey / sandy silt to 3,1m. Elsewhere around perimeter of hole, material as described below.
3.10	Light grey banded light orange-brown, highly weathered, <u>very soft rock</u>, indistinctly bedded fine grained SANDSTONE; **VRYHEID FORMATION**.
3.70	Light grey to pale brown, highly weathered, <u>very soft rock</u> to <u>soft rock</u>, indistinctly bedded and jointed, fine grained SANDSTONE; **VRYHEID FORMATION**.
5.90	

NOTES

1) No seepage or water table.

2) Auger did not refuse but penetrating very slowly.

3) Minimal smear to a depth of 5m but smear to 50mm below this depth.

CONTRACTOR : GAUTENG PILING
MACHINE : LDH 80
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 11 July 2006
DATE : 11 July 2006

ELEVATION :
X-COORD : 29 414.85
Y-COORD : 37 904.85

HOLE No: AH 09

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

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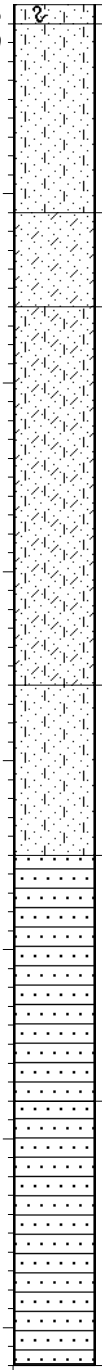
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 10
Sheet 1 of 1

JOB NUMBER: A 872

Scale 1:40



0.00	Dry to slightly moist, brown, <u>medium dense</u>, silty fine SAND with numerous roots; **HILLWASH**.
0.10	Moist, brown, <u>loose</u> becoming <u>loose</u> to <u>medium dense</u>, silty fine SAND with occasional fine roots; **HILLWASH**.
1.10	Moist, light orange-brown mottled orange, <u>medium dense</u> (<u>firm</u>), intact, slightly ferruginised, clayey fine SAND; **ILLUVIATED HILLWASH**.
1.60	Slightly moist, light orange-brown mottled orange, <u>stiff</u>, ferruginised, clayey / silty fine SAND with scattered, poorly formed, ferricrete nodules; **DECOMPOSED FERRUGINISED RESIDUAL SANDSTONE?**(No pebble marker in evidence). Material considerably drier and stiffer than overlying material but appears to be a similar grading. Isolated highly weathered sandstone clasts towards base of layer.
3.60	Slightly moist, orange-brown mottled orange and light grey, <u>very dense</u> to <u>very soft rock</u>, silty fine SAND from highly weathered sandstone with pockets of red-brown clayey sand of more decomposed material; **VRYHEID FORMATION**.
4.50	Light grey occasionally mottled orange-brown, highly weathered, <u>very soft rock</u> with occasional very dense patches, indistinctly jointed, fine grained SANDSTONE; **VRYHEID FORMATION**.
5.80	Light grey occasionally banded light orange-brown, <u>very soft rock</u> to <u>soft rock</u>, indistinctly bedded and jointed, fine grained SANDSTONE; **VRYHEID FORMATION**.
7.20	

NOTES

1) No seepage or water table.

2) Auger near refusal on soft rock fine grained sandstone at 7,2m.

3) Smear up to 25mm over most of socket.

CONTRACTOR : GAUTENG PILING
MACHINE : LDH 80
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 11 July 2006
DATE : 11 July 2006

ELEVATION :
X-COORD : 29 474.85
Y-COORD : 37 854.85

HOLE No: AH 10

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

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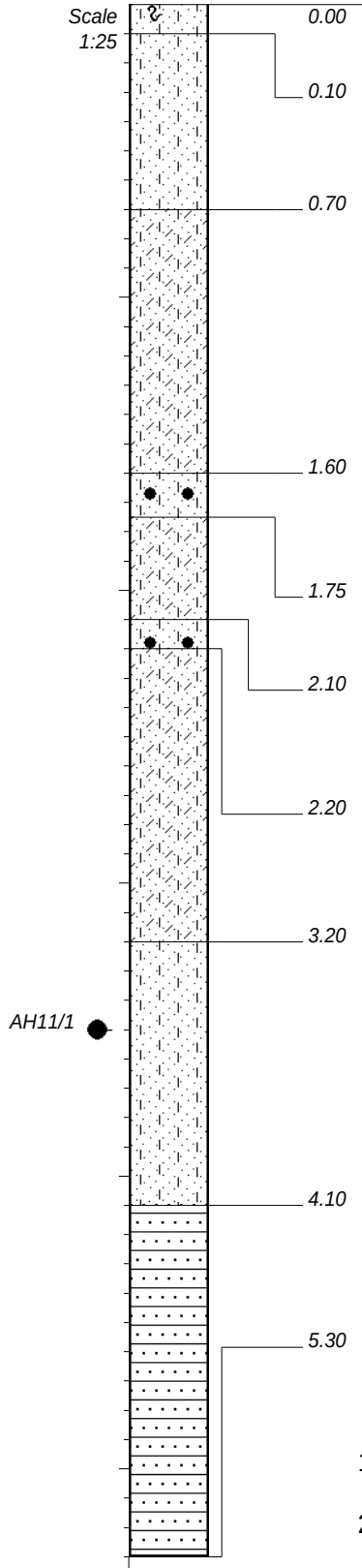
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 11
Sheet 1 of 1

JOB NUMBER: A 872



0.00	Dry to slightly moist, brown, dense, fissured, silty SAND; **HILLWASH**. Numerous roots.
0.10	Moist, brown, loose, intact, silty fine SAND with scattered fine roots; **HILLWASH**.
0.70	Moist, light orange-brown mottled brown, medium dense, slightly clayey, silty fine SAND; **ILLUVIATED HILLWASH**. Occasional fine roots. Isolated poorly formed ferricrete nodules towards base of layer. Below 1,3m, material becomes slightly moist and stiff.
1.60	Relatively closely packed, dark brown, hard ferricrete nodules in a matrix of orange-brown, ferruginised, silty fine SAND; **PEDOGENIC**. Overall consistency dense (very stiff).
1.75	Slightly moist, orange-brown, very stiff, ferruginised clayey / silty fine SAND as matrix to isolated nodular ferricrete; **ILLUVIATED HILLWASH?**
2.10	Closely packed, hard, dark brown ferricrete nodules in a matrix of slightly moist, orange-brown, partially cemented, silty fine SAND; **PEDOGENIC / PEBBLE MARKER**.
2.20	Slightly moist, orange-brown mottled brown, very stiff, ferruginised, clayey / silty fine SAND; **DECOMPOSED RESIDUAL SANDSTONE**.
3.20	Slightly moist, pale brown, very dense, intact, silty fine SAND / fine sandy SILT; **DECOMPOSED RESIDUAL SANDSTONE**. Occasional orange-brown ferruginised patches.
4.10	Pale brown occasionally mottled orange-brown, highly weathered, very soft rock SANDSTONE with occasional very dense decomposed bands to 100mm thick above 4,5m.
5.30	

NOTES

1) No seepage or water table.

2) Auger did not refuse, rotation gearbox breakdown.

3) Disturbed sample AH11/1 at 3,5m to check grading of sandstone.

CONTRACTOR : GAUTENG PILING
MACHINE : LDH 80
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 11 July 2006
DATE : 11 July 2006

ELEVATION :
X-COORD : 29 422.85
Y-COORD : 37 811.85

HOLE No: AH 11

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

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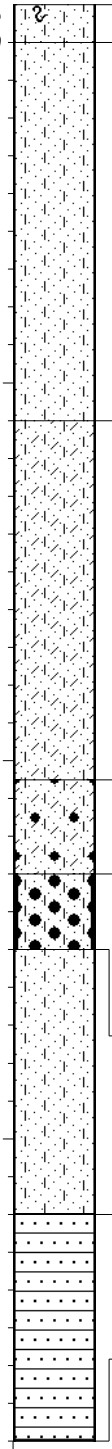
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 12
Sheet 1 of 1

JOB NUMBER: A 872

Scale 1:20



0.00	Dry to slightly moist, dark brown, medium dense, silty fine SAND with numerous roots; **HILLWASH**.
0.10	Moist, brown becoming light brown, loose, slightly friable, slightly porous, silty fine SAND with occasional fine roots; **HILWLASH**.
1.10	Moist, light orange-brown, dense, slightly ferruginised, slightly clayey, silty fine SAND; **ILLUVIATED HILLWASH**.
2.05	Slightly moist, orange-brown mottled orange, very dense, ferruginised, silty / clayey fine SAND as matrix to scattered, large, poorly developed nodular ferricrete; **PEDOGENIC / TRANSPORTED**.
2.30	Very dense to very soft rock, well cemented, HARDPAN FERRICRETE consisting of large maroon and black ferricrete nodules in a cemented, orange-brown, silty SAND matrix; **PEDOGENIC**.
2.50	Slightly moist, orange-brown mottled orange, very dense, ferruginised, silty fine SAND; **DECOMPOSED RESIDUAL SANDSTONE**. Material becomes very dense to very soft rock towards base of layer.
3.20	Pale grey-brown banded orange-brown, highly weathered, very soft rock, indistinctly bedded, fine grained SANDSTONE; **VRYHEID FORMATION**.
3.80	

NOTES

1) No seepage or water table.

2) Auger (now an NF60 due to breakdown of the LDH 80) penetrating very slowly in very soft rock to soft rock sandstone.

3) No samples taken.

CONTRACTOR : GAUTENG PILING
MACHINE : NF 60
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 11 July 2006
DATE : 11 July 2006

ELEVATION :
X-COORD : 29 489.85
Y-COORD : 37 928.85

HOLE No: AH 12

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

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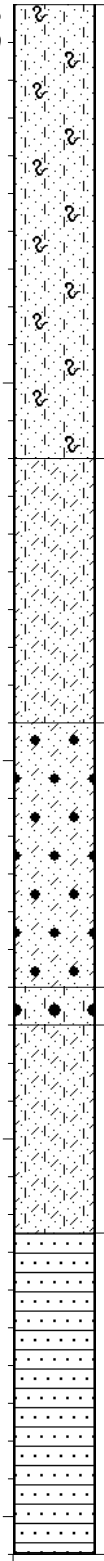
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 13
Sheet 1 of 1

JOB NUMBER: A 872

Scale 1:20



0.00 Moist, brown becoming yellow-brown, loose, intact, slightly porous, silty fine SAND with occasional fine roots. Upper 100mm desiccated with numerous roots.

1.20 Moist, light orange-brown, occasionally mottled orange, loose to medium dense, intact, slightly ferruginised, clayey / silty fine SAND; **ILLUVIATED HILLWASH**.

1.90 Slightly moist, orange-brown, stiff, slightly porous, ferruginised clayey fine SAND with isolated fine roots and scattered nodular ferricrete; **ILLUVIATED HILLWASH**.

2.60 Closely packed, hard, black, fine nodular ferricrete in a matrix of slightly moist, orange-brown, partially cemented, silty fine SAND; **PEDOGENIC**. Overall consistency very dense.

2.70 Slightly moist, orange-brown, very dense, ferruginised, silty / clayey fine SAND; **DECOMPOSED RESIDUAL SANDSTONE**.

3.25 Light grey mottled light purple and light orange-brown, highly weathered, very soft rock, fine grained SANDSTONE; **VRYHEID FORMATION**. Bedding or jointing visible.

4.10

NOTES

1) No seepage or water table.

2) NF 60 refused at 4,1m on very soft rock to soft rock fine grained sandstone as above.

CONTRACTOR : GAUTENG PILING
MACHINE : NF 60
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 12 July 2006
DATE : 12 July 2006

ELEVATION :
X-COORD : 29 544.85
Y-COORD : 37 843.85

HOLE No: AH 13

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

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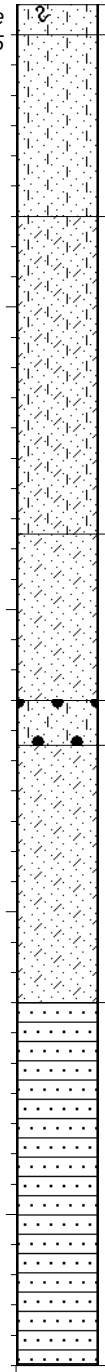
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: AH 14
Sheet 1 of 1

JOB NUMBER: A 872

Scale 1:25



0.00	Dry to slightly moist, brown, <u>medium dense</u>, silty fine SAND with numerous roots; **DESICCATED HILLWASH**.
0.10	Moist, brown, <u>loose</u>, intact, silty fine SAND with isolated fine roots; **HILLWASH**.
0.70	Moist, light orange-brown, <u>loose</u> becoming <u>medium dense</u>, slightly ferruginised, clayey / silty fine SAND with isolated fine roots; **FERRUGINISED ILLUVIATED HILLWASH**.
1.75	Slightly moist, orange-brown mottled orange, <u>stiff</u>, ferruginised clayey fine SAND; **ILLUVIATED HILLWASH**. Isolated, poorly developed, large orange ferricrete nodules.
2.30	Closely packed, well formed, fine nodular ferricrete in a matrix of slightly moist, orange-brown mottled orange, partially cemented, silty SAND; **PEDOGENIC**. Overall consistency <u>very dense</u>.
2.45	Slightly moist, orange-brown mottled orange and occasionally light grey towards base of layer, <u>very stiff</u>, ferruginised, clayey fine SAND; **DECOMPOSED RESIDUAL SANDSTONE**.
3.30	Light grey banded light purple-brown, highly weathered, <u>very soft rock</u>, indistinctly bedded and jointed, fine grained SANDSTONE; **VRYHEID FORMATION**. Occasional runnels of orange-brown material as above to a depth of 4,1m.
4.50	

NOTES

1) No seepage or water table.

2) NF 60 refused on very soft rock to soft rock fine grained sandstone at 4,5m.

3) No samples taken.

CONTRACTOR : GAUTENG PILING
MACHINE : NF 60
DRILLED BY : PAULUS
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 900mm
DATE : 12 July 2006
DATE : 12 July 2006

ELEVATION :
X-COORD : 29 570.85
Y-COORD : 37 769.85

HOLE No: AH 14

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:18
TEXT : ..\A872_B~1\A872PD~1.DOC

APPENDIX B

TEST PIT PROFILES

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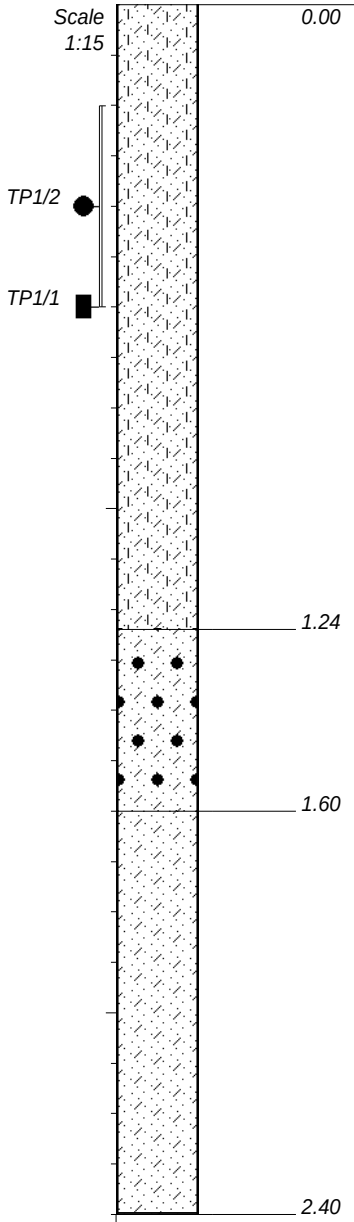
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: TP 01
Sheet 1 of 1

JOB NUMBER: A 872



0.00

Slightly moist becoming moist, light brown becoming pale orange-brown, loose, friable becoming slightly ferruginised, silty fine SAND becoming clayey fine SAND with depth; **ILLUVIATED HILLWASH**. Occasional fine roots.

1.24

Closely packed, hard, large, dark orange ferricrete nodules in a matrix of moist, light orange-brown, clayey fine SAND; **PEDOGENIC / TRANSPORTED**. Overall consistency medium dense.

1.60

Slightly moist, light brown mottled orange-brown and light grey, very stiff, ferruginised, slightly clayey fine SAND; **FERRUGINISED RESIDUAL SANDSTONE**.

2.40

NOTES

1) No seepage or water table.

2) Backhoe near refusal on very stiff to very soft rock sandstone.

3) Undisturbed sample TP1/1 at 0,6m.

4) Bulk sample TP1/2 at 0,2m--0,6m.

CONTRACTOR : PHEZULU PLANT
MACHINE : JCB SITE MASTER
DRILLED BY : ABRAHAM
PROFILED BY : PWD

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : 600mm trench
DATE : 10 July 2006
DATE : 10 July 2006

DATE : 23/08/06 11:20
TEXT : ..\A872_B~1\A872PD~2.DOC

ELEVATION :
X-COORD : 29 262.85
Y-COORD : 38 161.85

HOLE No: TP 01

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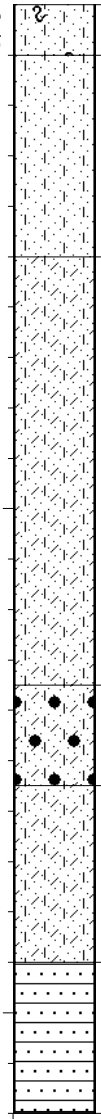
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: TP 02
Sheet 1 of 1

JOB NUMBER: A 872

Scale 1:15



0.00	Slightly moist, light brown, friable, very loose, silty fine SAND; **REWORKED HILLWASH**. Numerous roots.
0.10	Moist, light brown banded brown and occasionally dark brown, loose, silty fine SAND with isolated fine roots.
0.50	Moist, brown, occasionally banded light brown, loose, friable becoming slightly cohesive, silty becoming clayey fine SAND; **HILLWASH**.
1.35	Relatively closely packed, fine, hard nodular ferricrete and orange-brown, poorly cemented concretions in a matrix of moist, light brown, silty / clayey fine and medium SAND; **PEDOGENIC / TRANSPORTED**. Overall consistency medium dense.
1.55	Moist, orange-brown and light grey-brown mottled orange, dense, slightly clayey, silty fine SAND with inclusions of highly weathered very soft rock sandstone; **RESIDUAL SANDSTONE**. Overall consistency very dense.
1.90	Pale grey-brown to off-white banded orange-brown, highly weathered, very soft rock becoming very soft rock to soft rock, medium bedded and medium to widely jointed, fine grained SANDSTONE; **VRYHEID FORMATION**.
2.20	

NOTES

1) No seepage or water table.

2) Backhoe refused on very soft rock to soft rock fine grained sandstone at 2,2m. Could dig further but not productively.

3) No samples taken.

CONTRACTOR : PHEZULU PLANT
MACHINE : JCB SITE MASTER
DRILLED BY : ABRAHAM
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 600mm trench
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 452.85
Y-COORD : 38 002.85

HOLE No: TP 02

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:20
TEXT : ..\A872_B~1\A872PD~2.DOC

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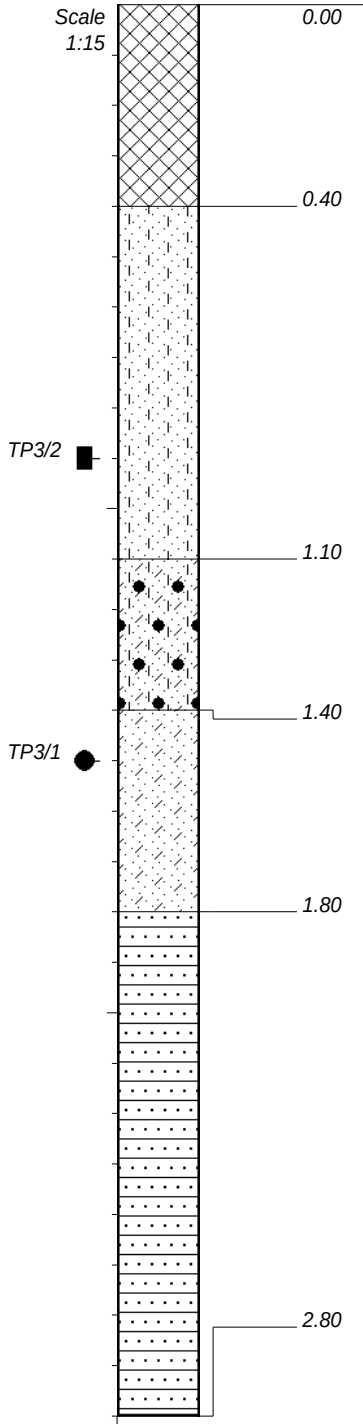
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: TP 03
Sheet 1 of 1

JOB NUMBER: A 872



0.00 – 0.40: Moist, light brown, silty fine SAND with occasional thin layers of ash and foreign inclusions (plastic, broken tiles); **FILL**. Overall consistency loose.

0.40 – 1.10: Moist, light brown becoming light yellow-brown, indistinctly mottled orange, very loose, friable, silty fine SAND becoming slightly clayey with depth; **HILLWASH**.

1.10 – 1.40: Scattered, becoming relatively closely packed, fine hard nodular ferricrete and large, poorly cemented, ferruginous concretions in a matrix of slightly clayey, silty fine SAND as above; **PEDOGENIC**. Overall consistency medium dense.

1.40 – 1.80: Slightly moist to moist, light grey-brown mottled orange and orange-brown, firm to stiff, slightly ferruginised, clayey fine SAND; **DECOMPOSED RESIDUAL SANDSTONE**.

1.80 – 2.80: Pale brown to off-white and mottled pale red-brown, very dense to very soft rock becoming very soft rock with depth, widely jointed, indistinctly bedded, very fine grained SANDSTONE; **VRYHEID FORMATION**.

NOTES

1) No seepage or water table.

2) TLB near refusal on very soft rock sandstone at 2,8m.

3) Disturbed sample TP3/1 at 1,5m.

4) Undisturbed sample TP3/2 at 0,9m.

CONTRACTOR : PHEZULU PLANT
MACHINE : JCB SITE MASTER
DRILLED BY : ABRAHAM
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 600mm trench
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 361.85
Y-COORD : 37 951.85

HOLE No: TP 03

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:20
TEXT : ..\A872_B~1\A872PD~2.DOC

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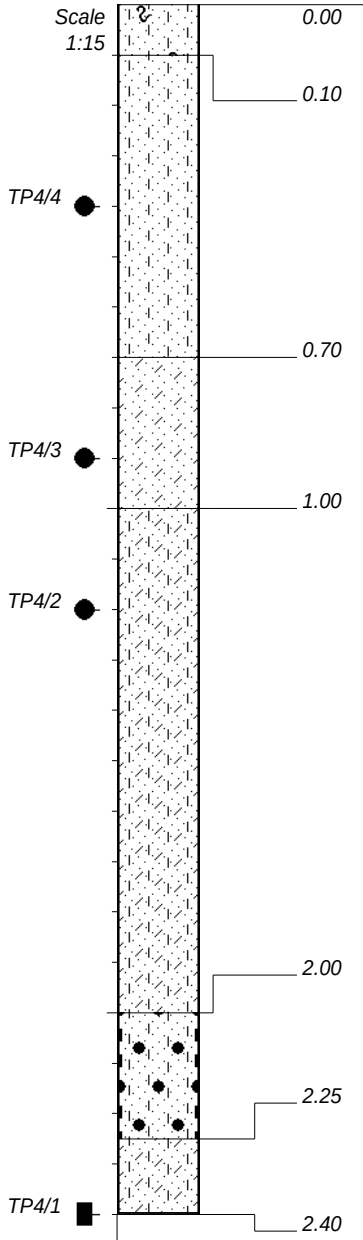
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: TP 04
Sheet 1 of 1

JOB NUMBER: A 872



0.00 – 0.10: Dry to slightly moist, dark brown, dense (desiccated), slightly fissured, silty fine SAND; **HILLWASH**. Numerous roots.

0.10 – 0.70: Moist, brown, loose, slightly porous, silty fine SAND; **HILLWASH**. Isolated fine roots.

0.70 – 1.00: Moist, slightly orange-brown, firm to stiff, slightly porous, clayey fine SAND; **ILLUVIATED, SLIGHTLY FERRUGINISED HILLWASH**.

1.00 – 2.00: Slightly moist, orange-brown mottled brown and occasionally orange, dense to very dense, slightly porous, ferruginised, clayey / silty fine SAND; **TRANSPORTED / PEDOGENIC**.

2.00 – 2.25: Closely packed, well developed, nodular ferricrete in a matrix of slightly moist, orange-brown and orange, very dense, partially cemented, silty fine SAND; **PEDOGENIC**.

2.25 – 2.40: Slightly moist to moist, light grey-brown mottled orange, very stiff, ferruginised, slightly porous, clayey / silty fine SAND; **FERRUGINISED RESIDUAL SANDSTONE**.

NOTES

1) No seepage or water table.

2) TLB did not refuse but digging with difficulty.

3) Disturbed sample TP4/1 at 2,4m. Sample cut from between tooth marks at bottom of trench. Too stiff to sample otherwise. Only small undisturbed portion retrieved.

4) Disturbed samples TP4/2 at 1,2m; TP4/3 at 0,9m and TP4/4 at 0,4m (to determine change in grading and moisture content with depth).

CONTRACTOR : PHEZULU PLANT
MACHINE : JCB SITE MASTER
DRILLED BY : ABRAHAM
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 600mm trench
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 350.00
Y-COORD : 37 875.00

HOLE No: TP 04

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:20
TEXT : ..\A872_B~1\A872PD~2.DOC

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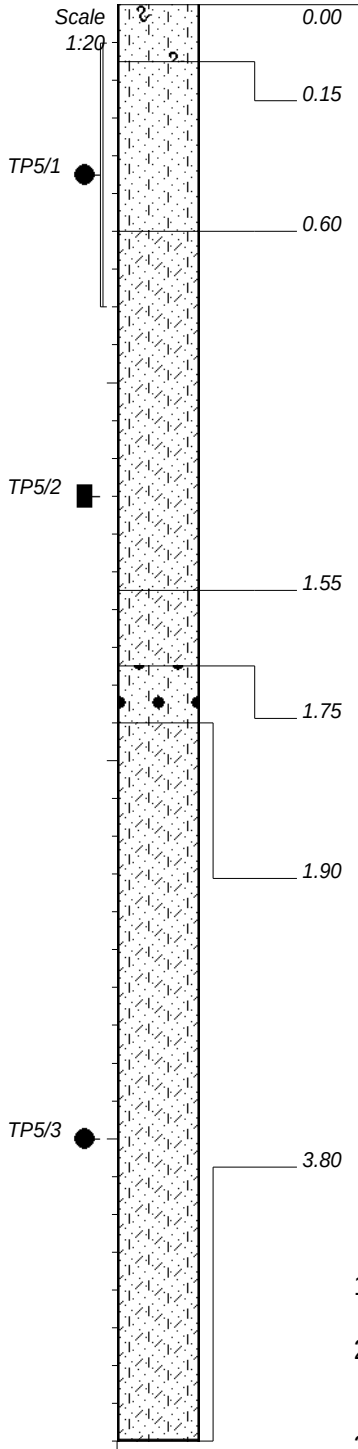
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: TP 05
Sheet 1 of 1

JOB NUMBER: A 872



0.00 – 0.15: Dry to slightly moist, brown, dense, fissured, silty fine SAND; **HILLWASH**. Numerous roots.

0.15 – 0.60: Moist, brown, loose, intact to slightly porous, silty fine SAND with isolated roots; **HILLWASH**.

0.60 – 1.55: Moist, light orange-brown banded brown, loose to medium dense (firm), slightly porous, slightly clayey, silty SAND; **ILLUVIATED HILLWASH**. Isolated fine roots.

1.55 – 1.75: Slightly moist, orange-brown mottled dark brown, dense, ferruginised, clayey / silty fine SAND with isolated, poorly formed, nodular ferricrete; **TRANSPORTED / PEDOGENIC**.

1.75 – 1.90: Closely packed, well developed, dark orange, ferricrete nodules in a matrix of slightly moist, orange-brown, cemented, silty fine SAND; **PEDOGENIC**. Overall consistency very dense bordering on very soft rock hardpan in places.

1.90 – 3.80: Slightly moist, orange-brown becoming grey-brown mottled orange-brown, very stiff, slightly ferruginised, intact, clayey, silty fine SAND / sandy SILT; **DECOMPOSED RESIDUAL SANDSTONE**.

NOTES

1) No seepage or water table.

2) Ferricrete more cemented than elsewhere on site and underlying residual sandstone stiffer and more cohesive.

3) Backhoe did not refuse but digging with difficulty.

4) Bulk sample TP5/1 at 0,1m--0,8m.

5) Undisturbed sample TP5/2 at 1,3m.

6) Disturbed sample TP5/3 taken from spoil at approximately 3,0m.

CONTRACTOR : PHEZULU PLANT
MACHINE : JCB SITE MASTER
DRILLED BY : ABRAHAM
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 600mm trench
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 388.85
Y-COORD : 37 804.85

HOLE No: TP 05

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:20
TEXT : ..\A872_B~1\A872PD~2.DOC

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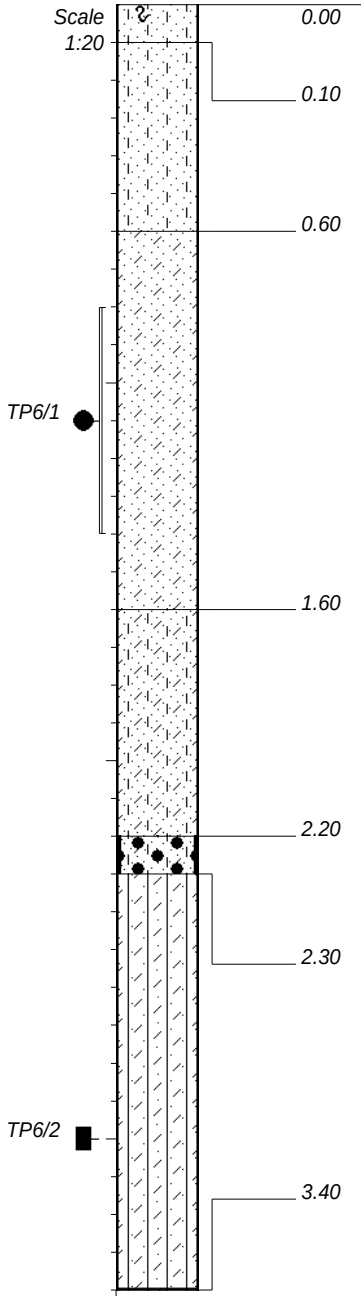
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: TP 06
Sheet 1 of 1

JOB NUMBER: A 872



0.00	Dry to slightly moist, brown, medium dense, fissured, silty fine SAND with numerous roots; **HILLWASH**.
0.10	Moist, brown, loose, intact to slightly porous, silty fine SAND; **HILLWASH**.
0.60	Moist, orange-brown becoming yellow-brown and occasionally mottled orange, medium dense (firm), clayey fine SAND; **ILLUVIATED HILLWASH**.
1.60	Slightly moist, orange-brown mottled brown, very stiff, slightly ferruginised, clayey / silty fine SAND; **TRANSPORTED / PEDOGENIC**. Material probably has a higher clay and silt content than overlying layer but may just be less moist.
2.20	Very dense, moderately cemented hardpan ferricrete consisting of closely packed, well developed, ferricrete nodules in a matrix of partially cemented, clayey / silty fine SAND; **PEDOGENIC**.
2.30	Slightly moist, orange-brown occasionally mottled brown and light grey, very stiff, slightly ferruginised, sandy / clayey SILT; **DECOMPOSED RESIDUAL SANDSTONE**.
3.40	

NOTES

1) No seepage or water table.

2) TLB did not refuse but digging with difficulty.

3) Bulk sample TP6/1 from 0,8m--1,4m.

4) Undisturbed sample TP6/2 taken from spoil during excavation at 3,0m. Material too hard to cut block samples by hand.

5) Differences in grading difficult to ascertain in the field as material remains predominantly sandy but with varying proportions of silt and clay.

CONTRACTOR : PHEZULU PLANT
MACHINE : JCB SITE MASTER
DRILLED BY : ABRAHAM
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 600mm trench
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 440.85
Y-COORD : 37 744.85

HOLE No: TP 06

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:20
TEXT : ..\A872_B~1\A872PD~2.DOC

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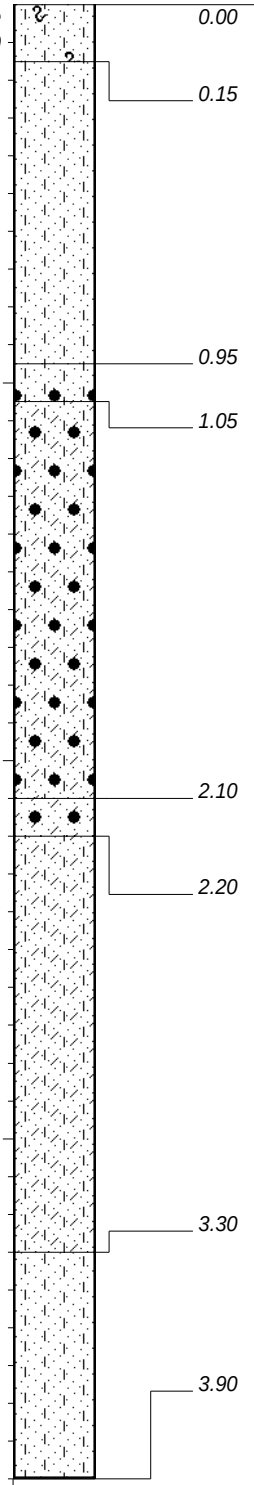
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: TP 07
Sheet 1 of 1

JOB NUMBER: A 872



0.00	Dry to slightly moist, brown, <u>dense</u>, fissured, silty fine SAND with numerous roots; **HILLWASH**.
0.15	Moist, brown becoming light orange-brown, <u>loose</u>, intact, silty fine SAND becoming slightly more clayey with depth; **HILLWASH**.
0.95	As above but with relatively closely packed nodular ferricrete.
1.05	Moist, light orange-brown mottled brown, <u>medium dense</u>, slightly ferruginised, clayey and silty fine SAND / sandy SILT with scattered nodular ferricrete; **FERRUGINISED ILLUVIATED HILLWASH**.
2.10	Closely packed nodular ferricrete in a matrix of moist, orange-brown, <u>clayey</u> fine SAND; **PEDOGENIC**. Overall consistency <u>dense.</u>
2.20	Moist, light brown mottled orange-brown and occasionally light grey, <u>firm</u>, ferruginised, clayey / silty fine SAND / sandy SILT; **DECOMPOSED RESIDUAL SANDSTONE**. Isolated nodular ferricrete.
3.30	Moist, pale grey-brown banded light orange-brown, <u>dense</u> becoming <u>very dense</u>, horizontally bedded, slightly micaceous, silty fine SAND; **DECOMPOSED RESIDUAL SANDSTONE**. Material breaks down to a sandy silt between fingers.
3.90	

NOTES

1) No seepage or water table.

2) Backhoe did not refuse.

3) Undisturbed sample TP7/1 at 2,6m.

CONTRACTOR : PHEZULU PLANT
MACHINE : JCB SITE MASTER
DRILLED BY : ABRAHAM
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 600mm trench
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 490.00
Y-COORD : 37 785.00

HOLE No: TP 07

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:20
TEXT : ..\A872_B~1\A872PD~2.DOC

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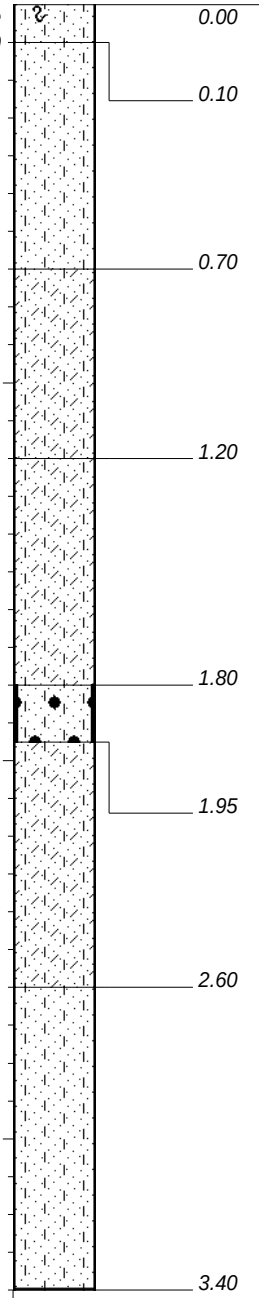
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: TP 08
Sheet 1 of 1

JOB NUMBER: A 872

Scale 1:20



0.00	Dry to slightly moist, brown, medium dense, slightly fissured, silty fine SAND with numerous roots; **HILLWASH**.
0.10	Moist, brown becoming light orange-brown, loose, friable, silty fine SAND with occasional fine roots; **HILLWASH**.
0.70	Moist, light orange-brown, medium dense, clayey / silty fine SAND; **ILLUVIATED HILLWASH**.
1.20	Slightly moist, orange-brown mottled brown, very stiff, slightly ferruginised, clayey / silty fine SAND; **ILLUVIATED HILLWASH**. Isolated large, poorly cemented, nodular ferricrete.
1.80	Closely packed, well cemented, hard, ferricrete nodules in a matrix of orange-brown, partially cemented, silty SAND; **PEDOGENIC**. Overall consistency very dense tending to very soft rock hardpan in places.
1.95	Slightly moist, light brown mottled grey and orange-brown, very stiff, ferruginised, clayey / silty fine SAND or sandy SILT; **DECOMPOSED RESIDUAL SANDSTONE**.
2.60	Slightly moist becoming moist, pale greyish brown mottled orange-brown and grey, very dense, silty fine SAND with runnels of light grey, sandy / clayey silt; **DECOMPOSED RESIDUAL SANDSTONE**.
3.40	

NOTES

1) No seepage or water table.

2) Backhoe did not refuse but digging with difficulty.

3) Disturbed samples TP8/1 at 2,3m; TP8/2 at 1,4m and TP8/3 at 1,0m.

CONTRACTOR : PHEZULU PLANT
MACHINE : JCB SITE MASTER
DRILLED BY : ABRAHAM
PROFILED BY : PWD

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

INCLINATION : VERTICAL
DIAM : 600mm trench
DATE : 10 July 2006
DATE : 10 July 2006

DATE : 23/08/06 11:20
TEXT : ..\A872_B~1\A872PD~2.DOC

ELEVATION :
X-COORD : 29 256.85
Y-COORD : 37 681.85

HOLE No: TP 08

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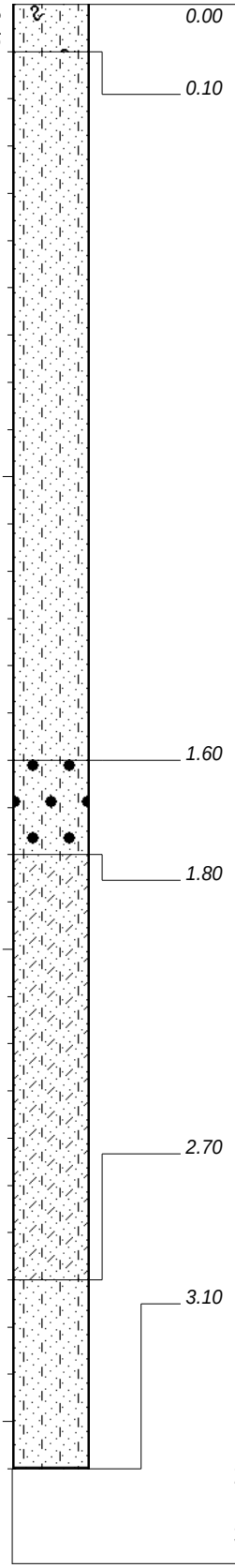
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: TP 09
Sheet 1 of 1

JOB NUMBER: A 872



0.00 – 0.10: Dry to slightly moist, brown, medium dense, silty fine SAND with numerous roots; **HILLWASH**.

0.10 – 1.60: Moist, brown becoming orange-brown, loose, silty fine SAND becoming slightly clayey with depth; **HILLWASH**.

1.60 – 1.80: Densely packed, well developed, hard, black ferricrete nodules in a matrix of very moist, brown to grey-brown, silty, fine and medium SAND; **PEDOGENIC**. Overall consistency very dense.

1.80 – 2.70: Slightly moist, light grey mottled orange-brown, very stiff, slightly ferruginised, clayey and silty SAND / sandy SILT with occasional clasts of highly weathered sandstone towards base of layer; **DECOMPOSED RESIDUAL SANDSTONE**.

TP9/1 @ 2,1m

2.70 – 3.10: Moist, pale brown with pale orange-brown bands and grey stained root channels, dense to very dense, slightly friable, slightly micaceous, silty fine SAND; **HIGHLY WEATHERED RESIDUAL SANDSTONE**. Material breaks down to a sandy silt between fingers.

3.10

NOTES

1) No seepage or water table.

2) TLB did not refuse.

3) Disturbed sample TP9/1 at 2,1m.

CONTRACTOR : PHEZULU PLANT
MACHINE : JCB SITE MASTER
DRILLED BY : ABRAHAM
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 600mm trench
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 326.85
Y-COORD : 37 671.85

HOLE No: TP 09

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:20
TEXT : ..\A872_B~1\A872PD~2.DOC

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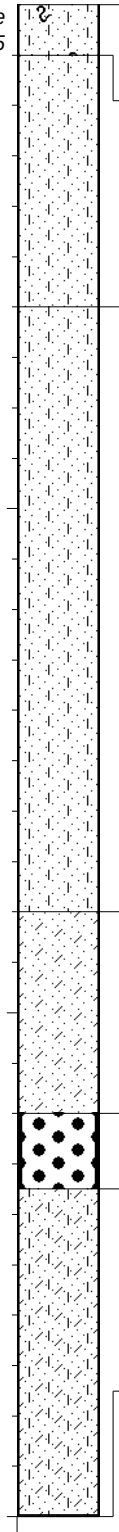
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: TP 10
Sheet 1 of 1

JOB NUMBER: A 872

Scale 1:15



0.00

Dry to slightly moist, brown, medium dense, silty fine SAND with numerous roots; **HILLWASH**.

0.10

Moist, brown, loose, slightly porous, silty fine SAND; **HILLWASH**.

0.60

Moist, light orange-brown mottled brown, loose becoming medium dense, silty fine SAND becoming slightly more clayey with depth; **ILLUVIATED HILLWASH**. Occasional fine roots.

1.80

Slightly moist, light orange-brown indistinctly mottled orange, very stiff, slightly ferruginised, clayey fine SAND; **ILLUVIATED HILLWASH**.

2.20

Very dense to very soft rock, HARDPAN FERRICRETE; **PEDOGENIC**.

2.35

Slightly moist, light orange-brown mottled light grey and orange, very stiff, silty / clayey fine SAND; **DECOMPOSED RESIDUAL SANDSTONE**.

3.00

NOTES

1) No seepage or water table.

2) TLB did not refuse but digging with difficulty.

3) No samples taken.

CONTRACTOR : PHEZULU PLANT
MACHINE : JCB SITE MASTER
DRILLED BY : ABRAHAM
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 600mm trench
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 544.85
Y-COORD : 37 940.85

HOLE No: TP 10

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:20
TEXT : ..\A872_B~1\A872PD~2.DOC

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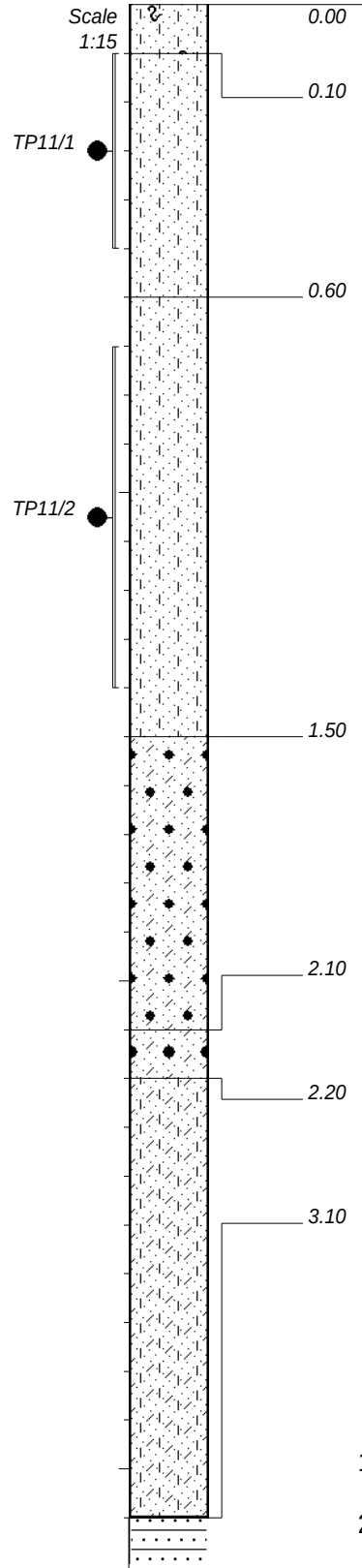
NINHAM SHAND
BOTHAVILLE ETHANOL PROJECT

HOLE No: TP 11
Sheet 1 of 1

JOB NUMBER: A 872



Dry to slightly moist, brown, medium dense, silty fine SAND; **HILLWASH**. Numerous roots.

Moist, brown, loose, intact, slightly porous, silty fine SAND with isolated fine roots; **HILLWASH**.

Moist, brown becoming orange-brown, loose becoming medium dense, intact to slightly porous, silty fine SAND becoming more clayey with depth; **ILLUVIATED HILLWASH**.

Moist, orange-brown, stiff to very stiff, ferruginised, clayey fine SAND with scattered large nodular ferricrete; **PEDOGENIC / HILLWASH**.

Closely packed, fine, hard, nodular ferricrete in a matrix of slightly moist, orange-brown, ferruginised, clayey SAND; **PEDOGENIC**. Overall consistency very dense.

Slightly moist, orange-brown mottled grey, very stiff, slightly ferruginised, intact, clayey, silty fine SAND / sandy SILT; **DECOMPOSED RESIDUAL SANDSTONE**.

Near refusal of excavator on light brown, thinly banded pale red and orange, highly weathered, very soft rock, fine grained SANDSTONE; **VRYHEID FORMATION**.

NOTES

1) No seepage or water table.

2) Backactor near refusal at 3,1m.

3) Bulk samples TP11/1 at 0,1m--0,5m and TP11/2 at 0,7m--1,4m.

CONTRACTOR : PHEZULU PLANT
MACHINE : JCB SITE MASTER
DRILLED BY : ABRAHAM
PROFILED BY : PWD

INCLINATION : VERTICAL
DIAM : 600mm trench
DATE : 10 July 2006
DATE : 10 July 2006

ELEVATION :
X-COORD : 29 628.85
Y-COORD : 37 836.85

HOLE No: TP 11

TYPE SET BY : BETH
SETUP FILE : STANDARD.SET

DATE : 23/08/06 11:20
TEXT : ..\A872_B~1\A872PD~2.DOC

APPENDIX C

SUMMARY OF SOIL TEST RESULTS

SUMMARY OF SOIL TEST RESULTS

CLIENT	Ninham Shand Consulting Services	JOB NO	A872
PROJECT	Bothaville Ethanol Plant	NAME	PW DAY
DATAFILE	C:\SOIL\DATA\A872PD01.SUM	DATE	23-08-06
LABORATORY	SOILTECH	TIME	11:28:25

SAMPLE NAME	AH1/1	A1/2	AH2/1	AH3/1	AH5/1	AH6/1	
HOLE NO	AH1	AH1	AH2	AH3	AH5	AH6	
DEPTH	2.5	0.9	1.1	1.7	1.7	1.0	m
COLOUR OF MATERIAL	Residual S/stone	Hillwash	Illuviatd Hillwash	Residual S/stone	Illuviatd Hillwash	Illuviatd Hillwash	
TYPE OF MATERIAL	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND	
AASHO CLASS	A-6[2]	A-2-4[0]	A-2-4[0]	A-6[1]	A-6[1]	A-2-4[0]	
UNIFIED CLASS	SC	SM	SC/SM	SC	SC	SC/SM	
S.A.R Index	91	55	69	89	77	70	
S.A.T.S.Class	-	-	-	-	-	-	
TRH 14 CLASS	-	-	-	-	-	-	
SABS 1200 (MF)	-	-	-	-	-	-	BASE
SABS 1200 (ME)	-	-	-	-	-	-	SUBB
SABS 1200 (DM)	-	-	-	-	-	-	SUBG

GRADING ANALYSIS - PERCENTAGE PASSING BY MASS

Sieve 37.5 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
size 26.5 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
19.0 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
13.2 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
4.750 mm	100.0	100.0	100.0	100.0	100.0	99.0	%
2.000 mm	100.0	100.0	100.0	100.0	99.0	99.0	%
0.425 mm	99.0	97.0	95.0	98.0	95.0	94.0	%
0.250 mm	93.0	80.0	81.0	92.0	83.0	81.0	%
0.150 mm	72.0	44.0	57.0	70.0	60.0	55.0	%
0.075 mm	42.0	21.0	31.0	42.0	38.0	32.0	%
0.050 mm	32.0	14.0	25.0	31.0	32.0	24.0	%
0.005 mm	13.0	3.0	6.0	14.0	16.0	7.0	%
0.002 mm	9.0	1.0	4.0	9.0	12.0	6.0	%

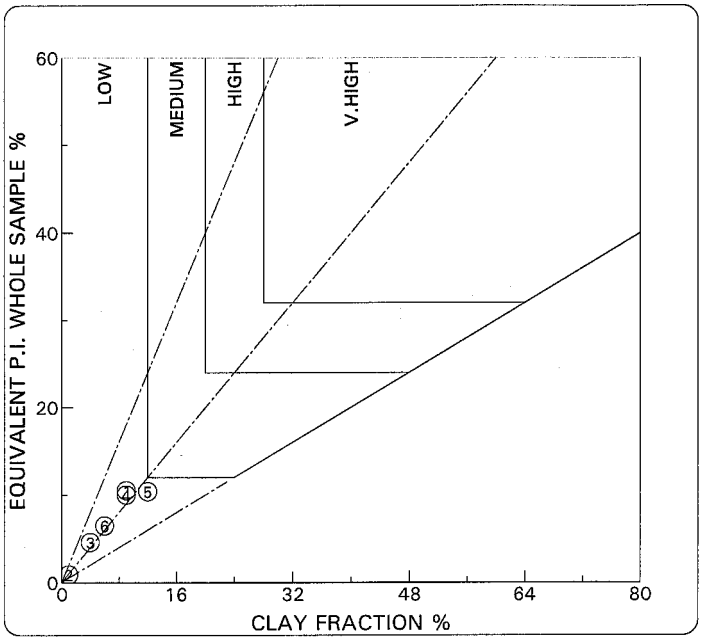
Gravel> 2.40 mm	0.0	0.0	0.0	0.0	.9	1.0	%
C Sand> 0.250 mm	7.0	20.0	19.0	8.0	16.1	18.0	%
F Sand> 0.075 mm	51.0	59.0	50.0	50.0	45.0	49.0	%
Silt> 0.002 mm	33.0	20.0	27.0	33.0	26.0	26.0	%
Clay< 0.002 mm	9.0	1.0	4.0	9.0	12.0	6.0	%
GRADING MODULUS	0.59	0.82	0.74	0.60	0.68	0.75	No

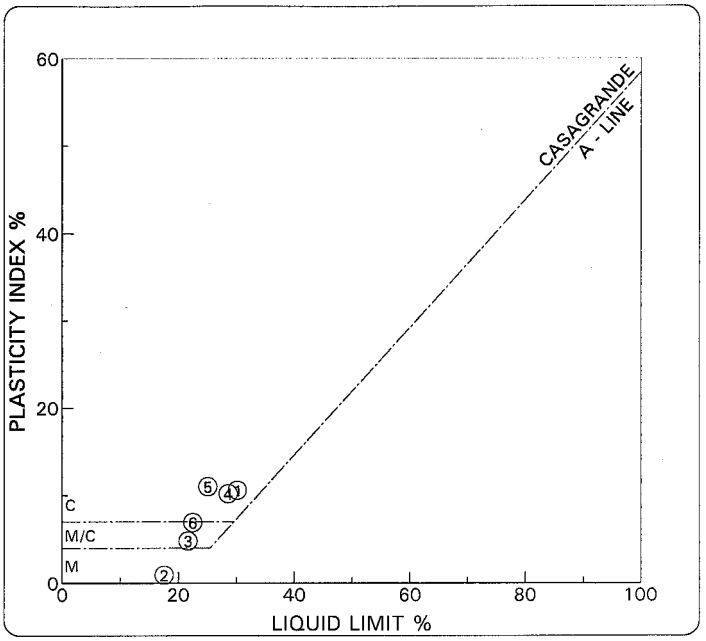
Liquid Limit	30.2	17.6	21.7	28.6	25.1	22.5	%
Plasticity Index	10.6	.9	4.8	10.2	11.0	6.9	%
Linear shrinkage	6.0	0.0	3.3	6.0	5.3	3.3	%
P.I whole sample	10.5	.9	4.6	10.0	10.4	6.5	%
Dry Density	1906.0						kg/m3
N.M.C.	9.2	8.2	11.7		11.2		%
Saturation	59.1						%
Specific Gravity	2.71						No
Brackley @ Po	P 0.00						%
Swell @ 125kPa	P 0.00						%
@ 250kPa	P 0.00						%
Heave - vd Merwe	LOW	LOW	LOW	LOW	LOW	LOW	
Parent Rock	-	-	-	-	-	-	
Regional Factor							No.
Cover to layer							mm
Stabilisation %							%
Agent	NONE	NONE	NONE	NONE	NONE	NONE	Matr

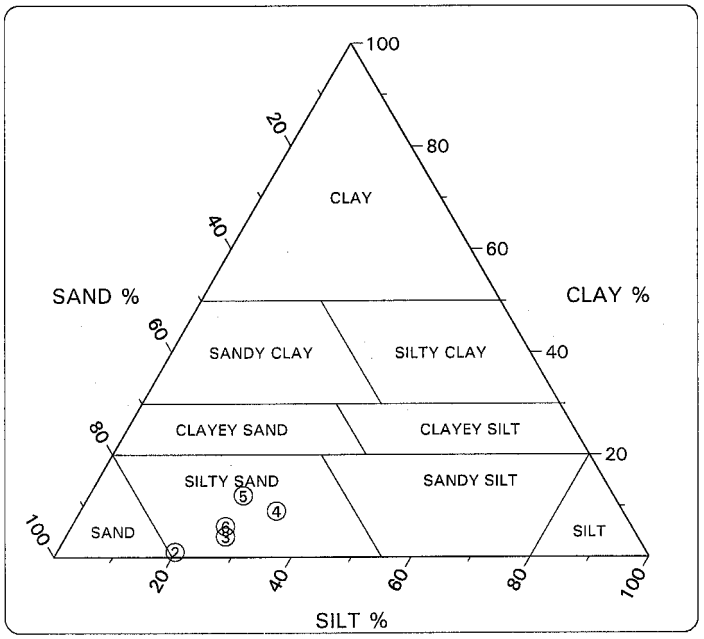
MOD AASH DENSITY							kg/m3
O.M.C.							%
C.B.R.@ 90% MOD							%
@ 95% MOD							%
@ 100% MOD							%
SWELL @ 90% MOD							%
@ 95% MOD							%
@ 100% MOD							%

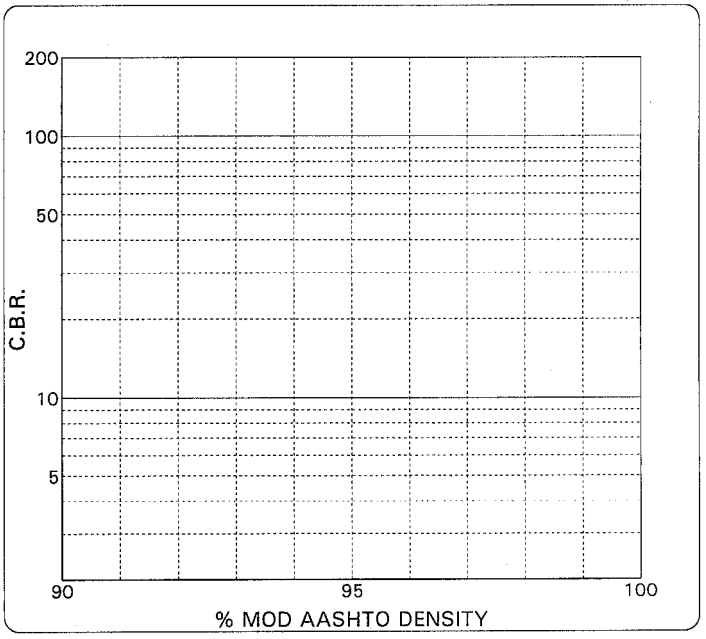
P - Pressure applied exceeds swell pressure

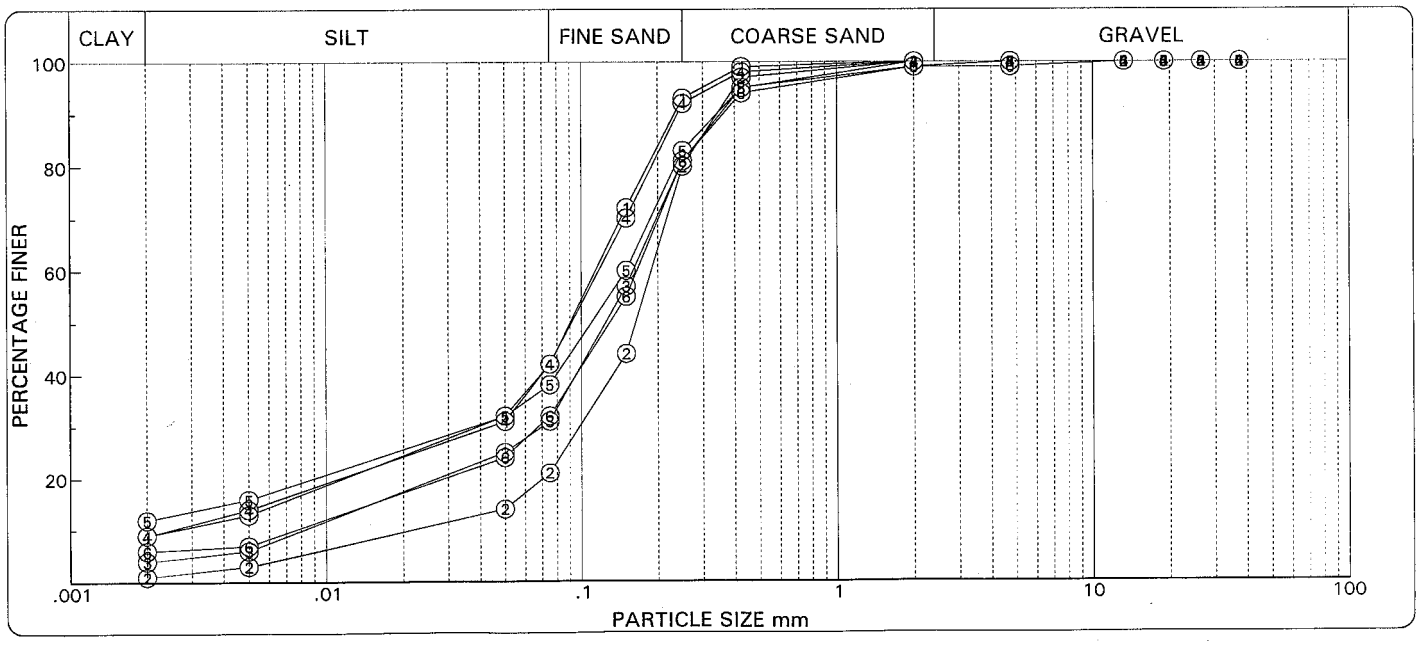
SAMPLE NUMBER	①	②	③	④	⑤	⑥
SAMPLE NAME	AH1/1	A1/2	AH2/1	AH3/1	AH5/1	AH6/1
HOLE NUMBER	AH1	AH1	AH2	AH3	AH5	AH6
DEPTH	2.5	0.9	1.1	1.7	1.7	1.0











SUMMARY OF SOIL TEST RESULTS

CLIENT	Ninham Shand Consulting Services	JOB NO	A872
PROJECT	Bothaville Ethanol Plant	NAME	PWD
DATAFILE	C:\SOIL\DATA\A872PD02.SUM	DATE	23-08-06
LABORATORY	SOILTECH	TIME	11:29:30

SAMPLE NAME	AH8/1	AH11/1	TP1/1	TP1/2	TP3/1	TP3/2	
HOLE NO	AH8	AH11	TP1	TP1	TP3	TP3	
DEPTH	2.3	3.3	0.6	0.2-0.6	1.5	0.9	m
COLOUR OF MATERIAL	Residual S/stone	Residual S/stone	Hillwash	Hillwash	Residual S/stone	Hillwash	
TYPE OF MATERIAL	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND	
AASHO CLASS	A-6[1]	A-4[0]	A-2-4[0]	A-2-4[0]	A-2-4[0]	A-2-4[0]	
UNIFIED CLASS	SC	SC/SM	SC/SM	SC/SM	SC	SC	
S.A.R Index	83	85	52	64	75	46	
S.A.T.S.Class	-	-	-	B LAYER	-	-	
TRH 14 CLASS	-	-	-	SSG: G7	-	-	
SABS 1200 (MF)	-	-	-		-	-	BASE
SABS 1200 (ME)	-	-	-		-	-	SUBB
SABS 1200 (DM)	-	-	-	SELECT	-	-	SUBG

GRADING ANALYSIS - PERCENTAGE PASSING BY MASS

Sieve 37.5 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
size 26.5 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
19.0 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
13.2 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
4.750 mm	100.0	100.0	100.0	100.0	96.0	100.0	%
2.000 mm	100.0	100.0	100.0	100.0	93.0	99.0	%
0.425 mm	97.0	99.0	95.0	95.0	87.0	93.0	%
0.250 mm	84.0	98.0	76.0	79.0	74.0	76.0	%
0.150 mm	58.0	78.0	45.0	51.0	50.0	44.0	%
0.075 mm	40.0	37.0	22.0	25.0	29.0	20.0	%
0.050 mm	32.0	29.0	17.0	17.0	23.0	14.0	%
0.005 mm	17.0	13.0	3.0	6.0	9.0	7.0	%
0.002 mm	12.0	9.0	2.0	5.0	7.0	6.0	%

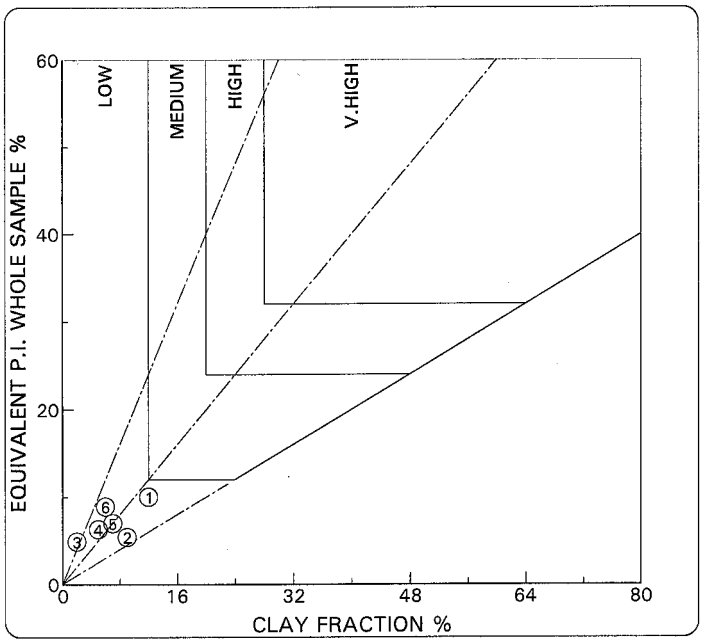
Gravel> 2.40 mm	0.0	0.0	0.0	0.0	6.6	.9	%
C Sand> 0.250 mm	16.0	2.0	24.0	21.0	19.4	23.1	%
F Sand> 0.075 mm	44.0	61.0	54.0	54.0	45.0	56.0	%
Silt> 0.002 mm	28.0	28.0	20.0	20.0	22.0	14.0	%
Clay< 0.002 mm	12.0	9.0	2.0	5.0	7.0	6.0	%
GRADING MODULUS	0.63	0.64	0.83	0.80	0.91	0.88	No

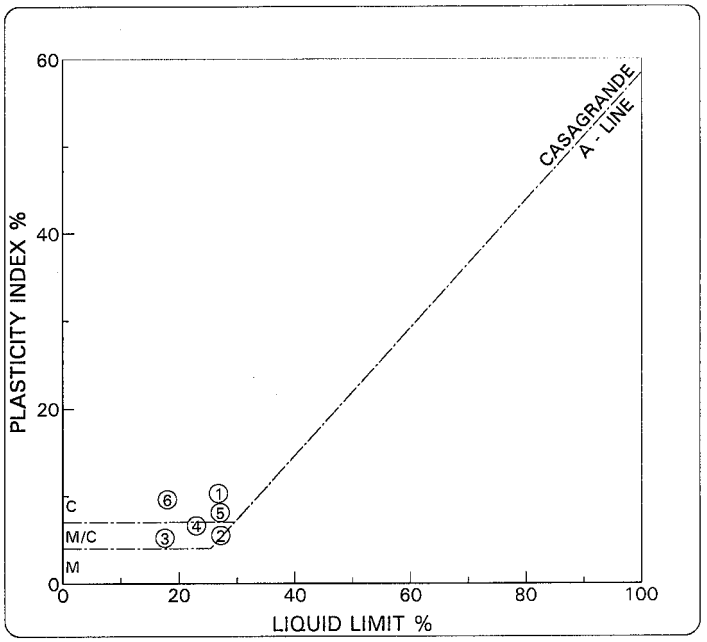
Liquid Limit	26.8	27.2	17.6	23.0	27.1	18.0	%
Plasticity Index	10.3	5.5	5.2	6.6	8.1	9.6	%
Linear shrinkage	5.3	2.7	2.7	3.3	4.0	2.7	%
P.I whole sample	10.0	5.4	4.9	6.3	7.0	8.9	%
Dry Density	1845.0		1583.0			1590.0	kg/m3
N.M.C.	14.2		7.4	8.5		9.2	%
Saturation	87.0		29.1			36.8	%
Specific Gravity	2.64		2.65			2.64	No
Brackley @ Po	PM 0.00		P 0.00			P 0.00	%
Swell @ 125kPa	PM 0.00		P 0.00			P 0.00	%
@ 250kPa	PM 0.00		P 0.00			P 0.00	%
Heave - vd Merwe	LOW	LOW	LOW	LOW	LOW	LOW	
Parent Rock	-	-	-	-	-	-	
Regional Factor				▸ 0.75			No.
Cover to layer							mm
Stabilisation %							%
Agent	NONE	NONE	NONE	NONE	NONE	NONE	Matr

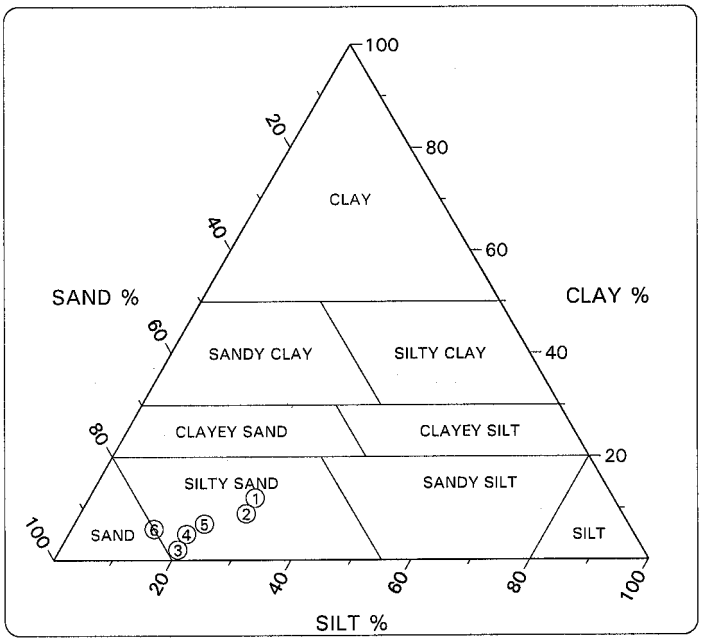
MOD AASH DENSITY				1943.0			kg/m3
O.M.C.				10.6			%
C.B.R.@ 90% MOD				18.2			%
@ 95% MOD				24.2			%
@ 100% MOD				32.3			%
SWELL @ 90% MOD				.000			%
@ 95% MOD				.000			%
@ 100% MOD				.000			%

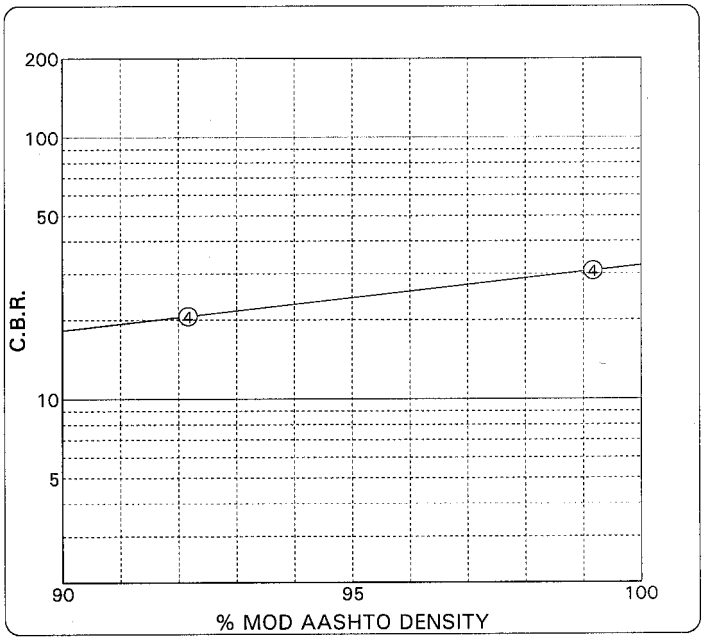
▸ - Assumed value
P - Pressure applied exceeds swell pressure
M - Moisture content too high for swell to occur

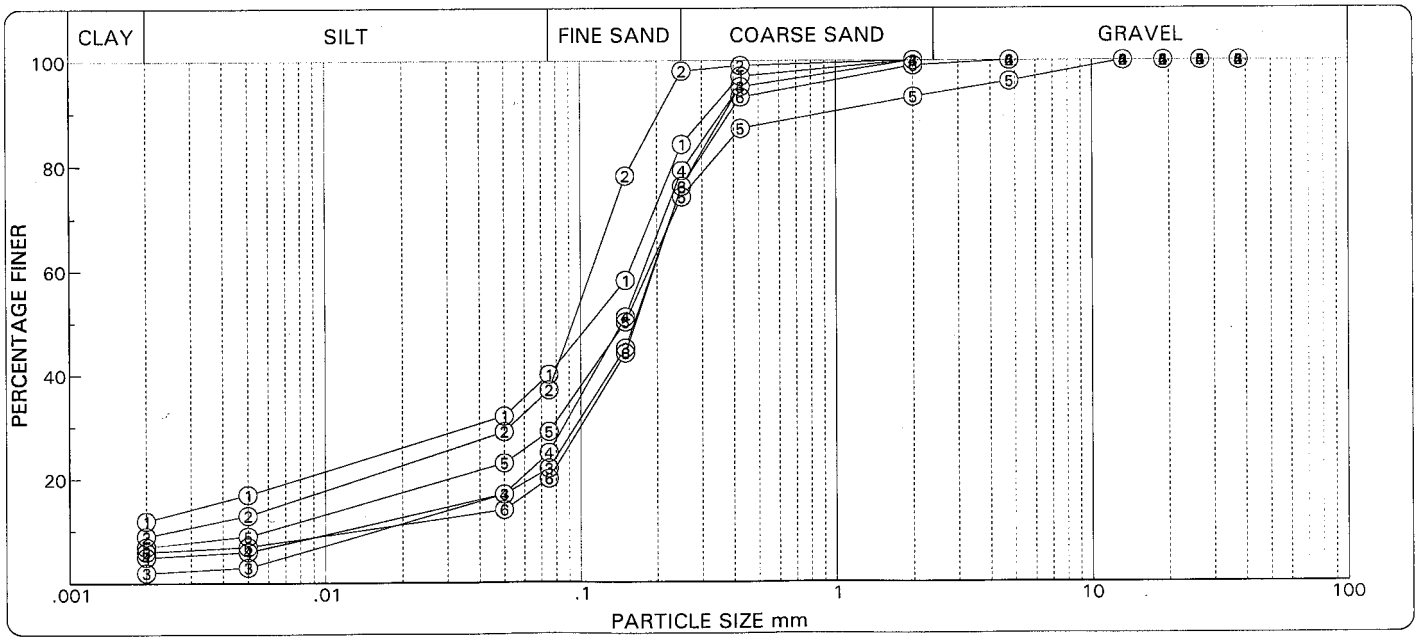
SAMPLE NUMBER	①	②	③	④	⑤	⑥
SAMPLE NAME	AH8/1	AH11/1	TP1/1	TP1/2	TP3/1	TP3/2
HOLE NUMBER	AH8	AH11	TP1	TP1	TP3	TP3
DEPTH	2.3	3.3	0.6	0.2-0.6	1.5	0.9











SUMMARY OF SOIL TEST RESULTS

CLIENT	Ninham Shand Consulting Services	JOB NO	A872
PROJECT	Bothaville Ethanol Plant	NAME	PW DAY
DATAFILE	C:\SOIL\DATA\A872PD03.SUM	DATE	23-08-06
LABORATORY	SOILTECH	TIME	11:28:54

	TP4/1	TP4/2	TP4/3	TP4/4	TP5/1	TP5/2	
SAMPLE NAME	TP4	TP4	TP4	TP4	TP5	TP5	
HOLE NO	2.4	1.2	0.9	0.4	0.1-0.5	1.3	m
DEPTH	Residual	Hillwash/	Illuviatd	Hillwash	Hillwash	Illuviatd	
COLOUR OF	S/stone	Pedogenic	Hillwash			Hillwash	
MATERIAL	SILTY	SILTY	SILTY	SAND	SILTY	SILTY	
TYPE OF	SAND	SAND	SAND		SAND	SAND	
MATERIAL	A-2-4[0]	A-2-4[0]	A-4[0]	A-2-4[0]	A-2-4[0]	A-2-4[0]	
AASHO CLASS	SC/SM	SC	SC	SM	SC	SC	
UNIFIED CLASS	77	75	77	49	53	66	
S.A.R Index	-	-	-	-	B LAYER	-	
S.A.T.S.Class	-	-	-	-	LSG: G9	-	
TRH 14 CLASS	-	-	-	-		-	BASE
SABS 1200 (MF)	-	-	-	-		-	SUBB
SABS 1200 (ME)	-	-	-	-	§ SELECT	-	SUBG
SABS 1200 (DM)							

GRADING ANALYSIS - PERCENTAGE PASSING BY MASS

Sieve 37.5 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
size 26.5 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
19.0 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
13.2 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
4.750 mm	97.0	100.0	100.0	98.0	100.0	100.0	%
2.000 mm	95.0	99.0	100.0	97.0	100.0	100.0	%
0.425 mm	91.0	94.0	94.0	91.0	94.0	96.0	%
0.250 mm	79.0	79.0	80.0	74.0	76.0	80.0	%
0.150 mm	56.0	56.0	58.0	46.0	51.0	54.0	%
0.075 mm	35.0	35.0	37.0	17.0	25.0	31.0	%
0.050 mm	27.0	28.0	29.0	9.0	17.0	25.0	%
0.005 mm	12.0	13.0	10.0	3.0	7.0	6.0	%
0.002 mm	8.0	9.0	6.0	2.0	5.0	4.0	%

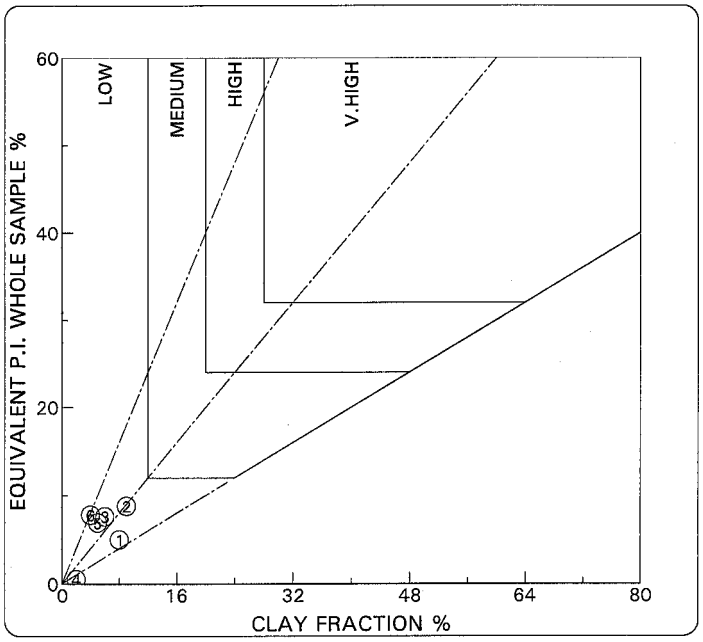
Gravel> 2.40 mm	4.7	.9	0.0	2.9	0.0	0.0	%
C Sand> 0.250 mm	16.3	20.1	20.0	23.1	24.0	20.0	%
F Sand> 0.075 mm	44.0	44.0	43.0	57.0	51.0	49.0	%
Silt> 0.002 mm	27.0	26.0	31.0	15.0	20.0	27.0	%
Clay< 0.002 mm	8.0	9.0	6.0	2.0	5.0	4.0	%
GRADING MODULUS	0.79	0.72	0.69	0.95	0.81	0.73	No

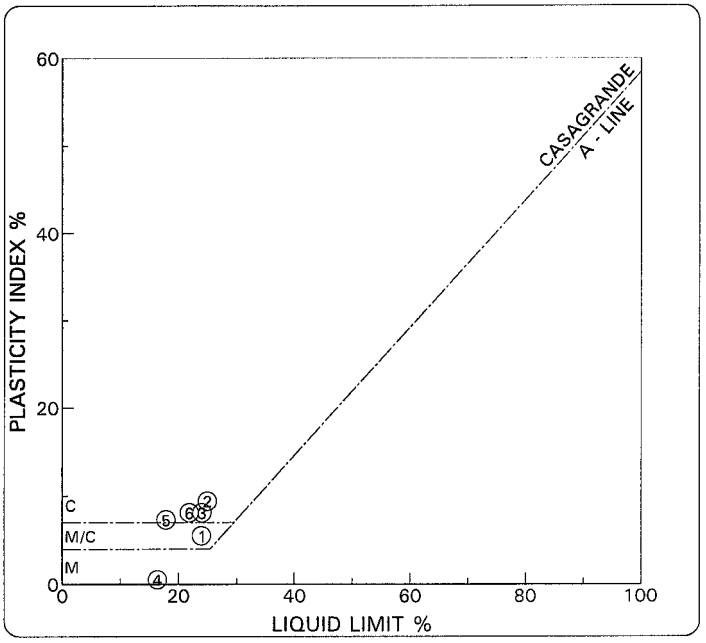
Liquid Limit	24.0	25.0	24.1	16.4	17.9	21.9	%
Plasticity Index	5.5	9.4	8.1	.5	7.3	8.1	%
Linear shrinkage	3.3	4.7	4.0	0.0	2.7	4.0	%
P.I whole sample	5.0	8.8	7.6	.5	6.9	7.8	%
Dry Density				1950.0		1465.0	kg/m3
N.M.C.		8.7	12.5	5.5	11.2	9.7	%
Saturation				40.6		31.8	%
Specific Gravity				2.65		2.65	No
Brackley @ Po				PM 0.00		PM 0.00	%
Swell @ 125kPa				PM 0.00		PM 0.00	%
@ 250kPa				PM 0.00		PM 0.00	%
Heave - vd Merwe	LOW	LOW	LOW	LOW	LOW	LOW	
Parent Rock	-	-	-	-	-	-	
Regional Factor					▸ 0.75		No.
Cover to layer							mm
Stabilisation %							%
Agent	NONE	NONE	NONE	NONE	NONE	NONE	Matr

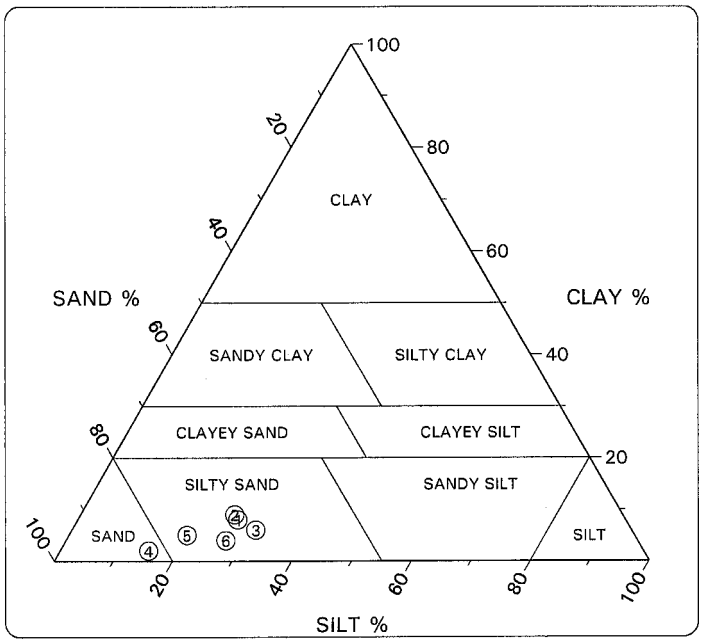
MOD AASH DENSITY					1991.0		kg/m3
O.M.C.					9.6		%
C.B.R.@ 90% MOD					8.1		%
@ 95% MOD					12.8		%
@ 100% MOD					20.2		%
SWELL @ 90% MOD					.000		%
@ 95% MOD					.000		%
@ 100% MOD					.000		%

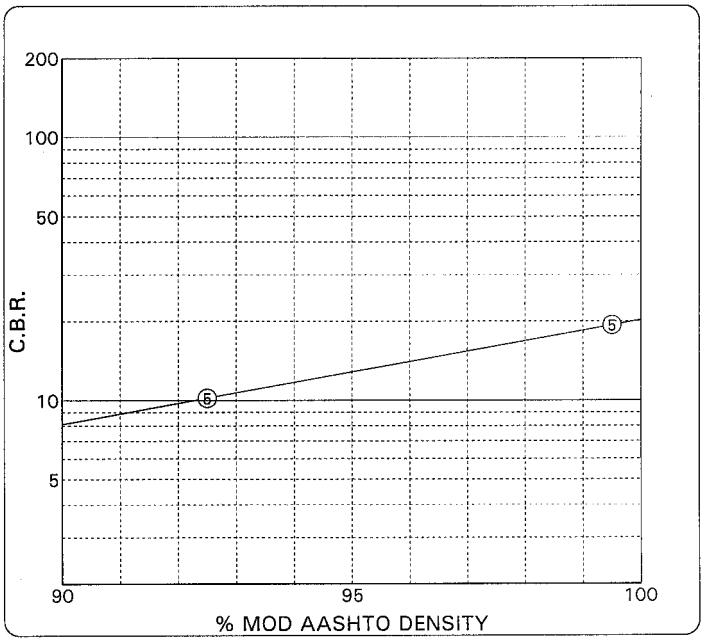
▸ - Assumed value
§ - Unsuitable for material shallower than 150 mm in layer.
P - Pressure applied exceeds swell pressure
M - Moisture content too high for swell to occur

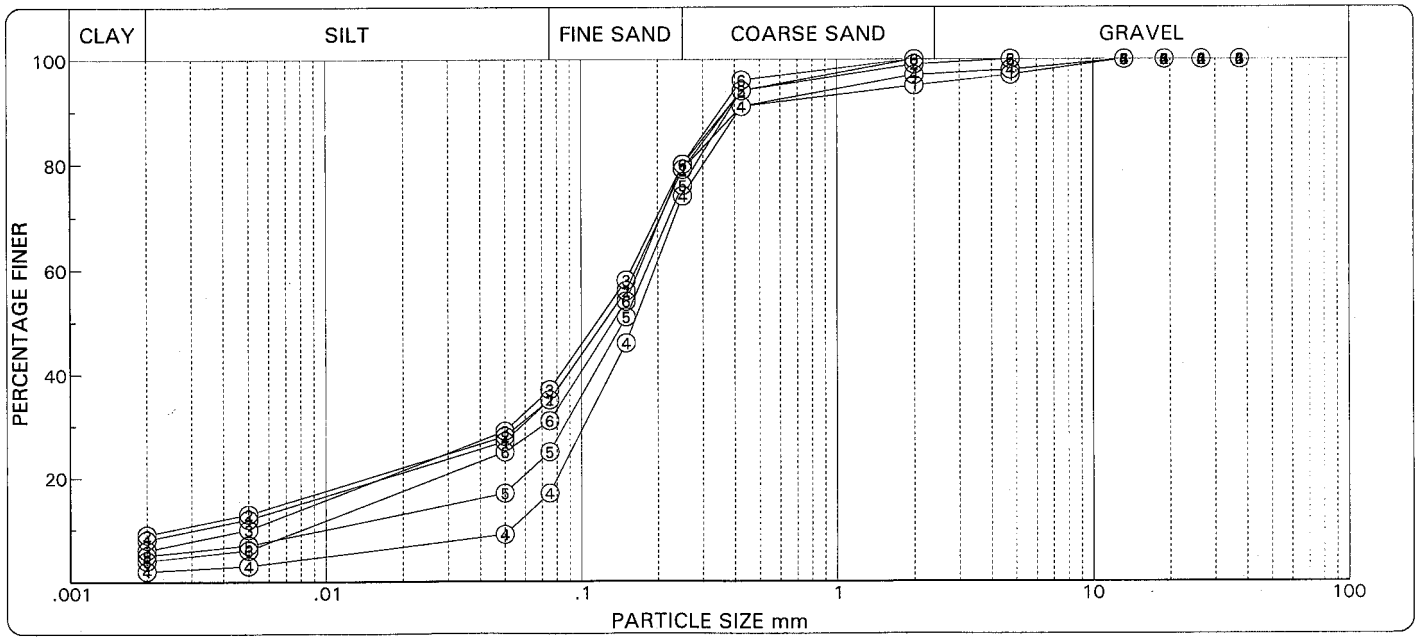
SAMPLE NUMBER	①	②	③	④	⑤	⑥
SAMPLE NAME	TP4/1	TP4/2	TP4/3	TP4/4	TP5/1	TP5/2
HOLE NUMBER	TP4	TP4	TP4	TP4	TP5	TP5
DEPTH	2.4	1.2	0.9	0.4	0.1-0.5	1.3











SUMMARY OF SOIL TEST RESULTS

CLIENT	Ninham Shand Consulting Services	JOB NO	A872
PROJECT	Bothaville Ethanol Plant	NAME	PW DAY
DATAFILE	C:\SOIL\DATA\A872PD04.SUM	DATE	23-08-06
LABORATORY	SOILTECH	TIME	11:29:59

SAMPLE NAME	TP5/3	TP6/1	TP6/2	TP6/3	TP7/1	TP8/2	
HOLE NO	TP5	TP6	TP6	TP6	TP7	TP8	
DEPTH	3.0	0.7-1.4	3.0	3.4	2.6	1.4	m
COLOUR OF MATERIAL	Residual S/stone	Illuviatd Huillwash	Residual S/stone	Residual S/stone	Residual S/stone	Illuviatd Hillwash	
TYPE OF MATERIAL	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND	
AASHO CLASS	A-4[0]	A-2-4[0]	A-6[1]	A-4[1]	A-4[0]	A-2-6[1]	
UNIFIED CLASS	SC	SC	SC	SC	SC	SC	
S.A.R Index	81	74	84	87	76	57	
S.A.T.S.Class	-	SPOIL	-	-	-	-	
TRH 14 CLASS	-	SPOIL	-	-	-	-	
SABS 1200 (MF)	-		-	-	-	-	BASE
SABS 1200 (ME)	-		-	-	-	-	SUBB
SABS 1200 (DM)	-	FILL	-	-	-	-	SUBG

GRADING ANALYSIS - PERCENTAGE PASSING BY MASS

Sieve 37.5 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
size 26.5 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
19.0 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
13.2 mm	100.0	100.0	100.0	100.0	100.0	100.0	%
4.750 mm	100.0	100.0	100.0	99.0	100.0	96.0	%
2.000 mm	100.0	100.0	99.0	99.0	99.0	94.0	%
0.425 mm	96.0	94.0	95.0	96.0	95.0	89.0	%
0.250 mm	86.0	77.0	84.0	90.0	77.0	77.0	%
0.150 mm	69.0	53.0	64.0	71.0	56.0	53.0	%
0.075 mm	37.0	33.0	41.0	40.0	36.0	30.0	%
0.050 mm	31.0	27.0	36.0	31.0	28.0	24.0	%
0.005 mm	14.0	14.0	17.0	14.0	10.0	9.0	%
0.002 mm	9.0	9.0	12.0	9.0	8.0	5.0	%

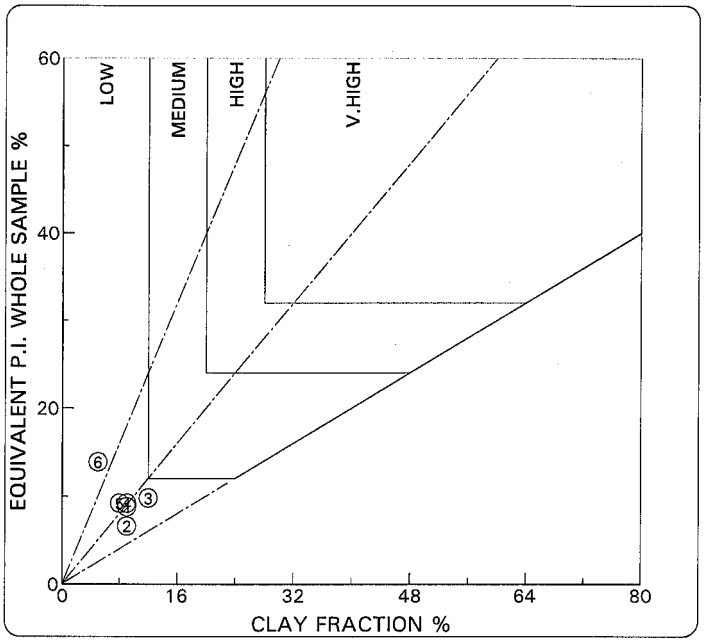
Gravel> 2.40 mm	0.0	0.0	.9	1.0	.9	5.7	%
C Sand> 0.250 mm	14.0	23.0	15.1	9.0	22.1	17.3	%
F Sand> 0.075 mm	49.0	44.0	43.0	50.0	41.0	47.0	%
Silt> 0.002 mm	28.0	24.0	29.0	31.0	28.0	25.0	%
Clay< 0.002 mm	9.0	9.0	12.0	9.0	8.0	5.0	%
GRADING MODULUS	0.67	0.73	0.65	0.65	0.70	0.87	No

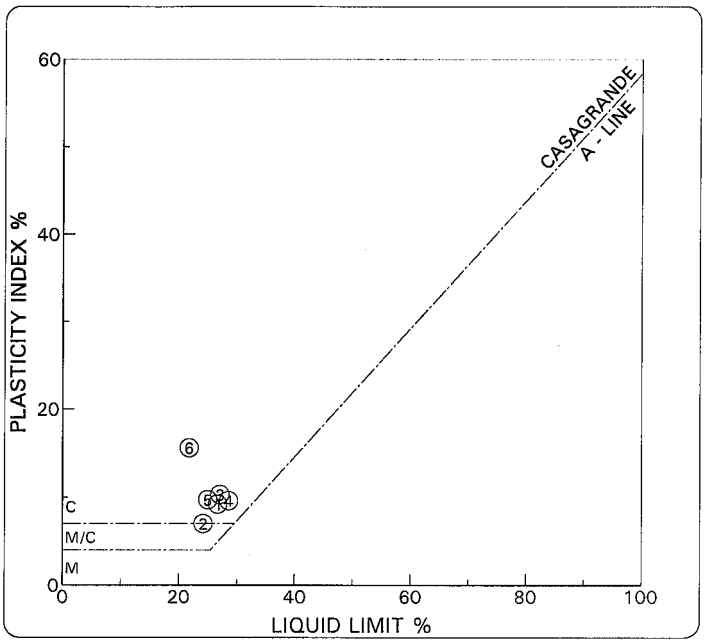
Liquid Limit	26.7	24.2	27.1	28.6	25.0	21.8	%
Plasticity Index	9.2	7.0	10.3	9.6	9.7	15.6	%
Linear shrinkage	4.7	3.3	6.0	4.7	4.7	3.3	%
P.I whole sample	8.8	6.6	9.8	9.2	9.2	13.9	%
Dry Density			1757.0		1671.0		kg/m3
N.M.C.		11.3	10.7		13.1	7.1	%
Saturation			56.2		60.0		%
Specific Gravity			2.64		2.63		No
Brackley @ Po			P 0.00		PM 0.00		%
Swell @ 125kPa			P 0.00		PM 0.00		%
@ 250kPa			P 0.00		PM 0.00		%
Heave - vd Merwe	LOW	LOW	LOW	LOW	LOW	LOW	
Parent Rock	-	-	-	-	-	-	
Regional Factor		► 0.75					No.
Cover to layer							mm
Stabilisation %							%
Agent	NONE	NONE	NONE	NONE	NONE	NONE	Matr

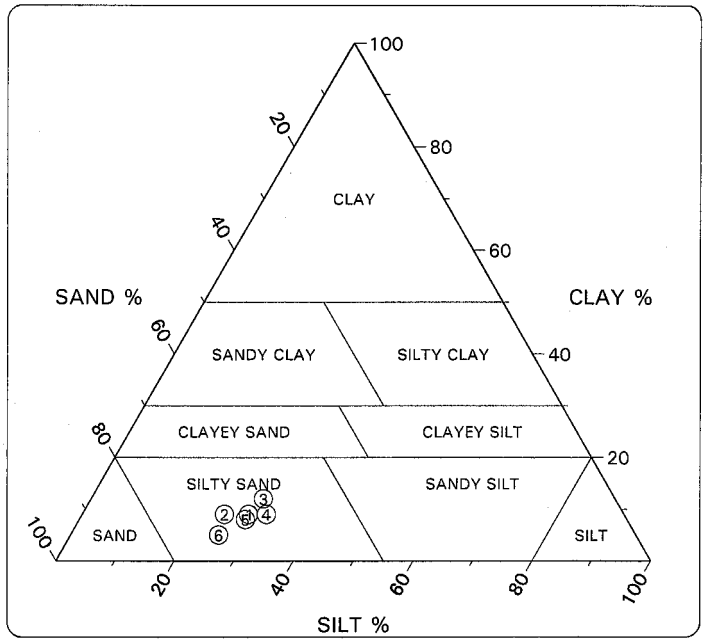
MOD AASH DENSITY		1911.0					kg/m3
O.M.C.		11.2					%
C.B.R.@ 90% MOD		1.0					%
@ 95% MOD		1.8					%
@ 100% MOD		3.1					%
SWELL @ 90% MOD		.000					%
@ 95% MOD		.000					%
@ 100% MOD		.000					%

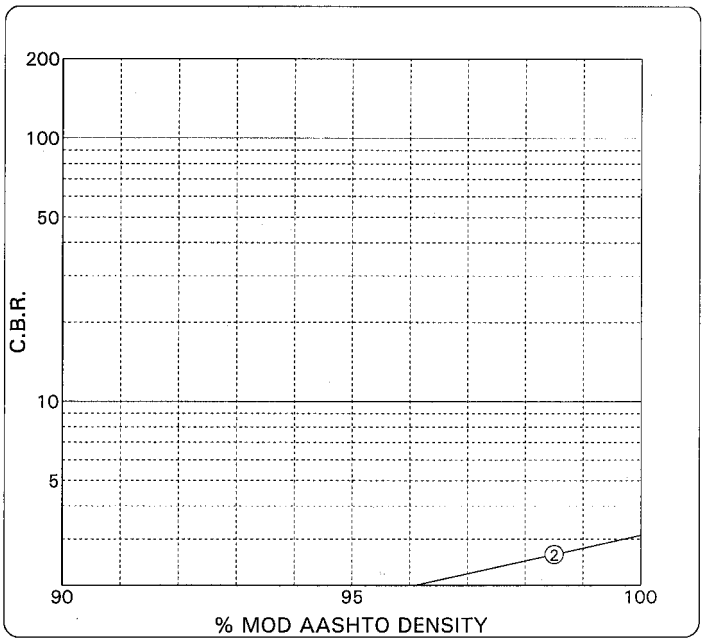
► - Assumed value
P - Pressure applied exceeds swell pressure
M - Moisture content too high for swell to occur

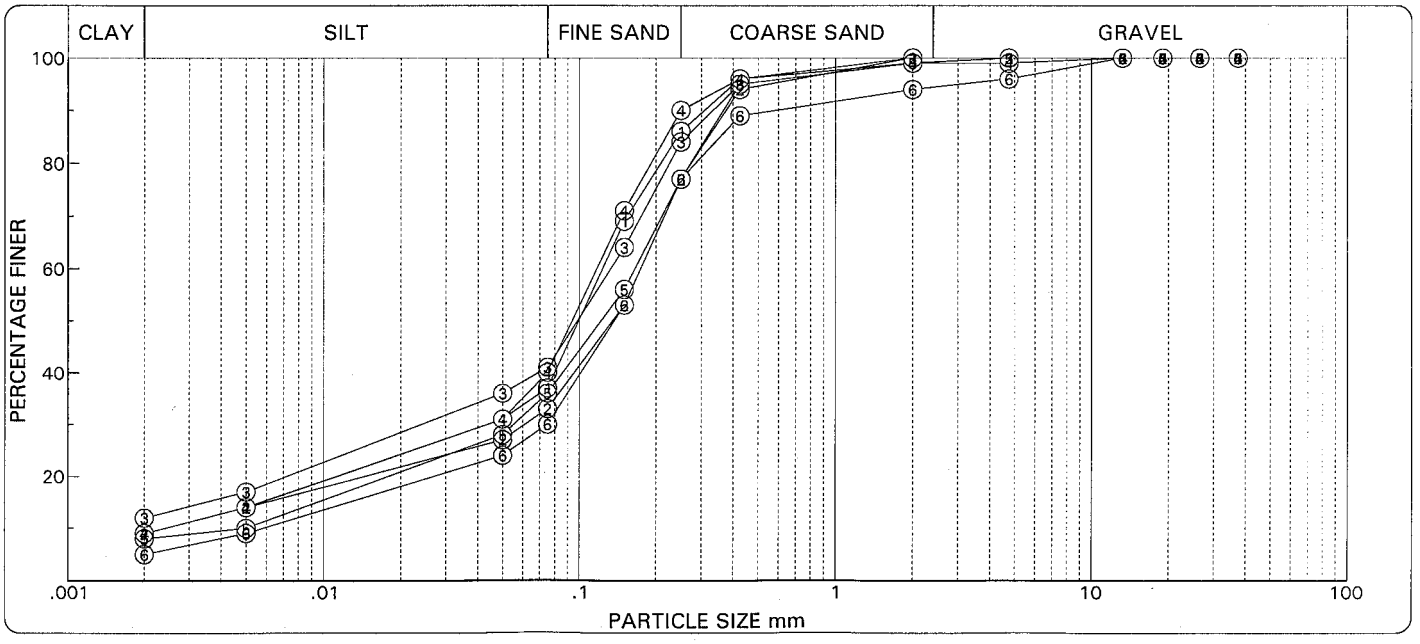
SAMPLE NUMBER	①	②	③	④	⑤	⑥
SAMPLE NAME	TP5/3	TP6/1	TP6/2	TP6/3	TP7/1	TP8/2
HOLE NUMBER	TP5	TP6	TP6	TP6	TP7	TP8
DEPTH	3.0	0.7-1.4	3.0	3.4	2.6	1.4











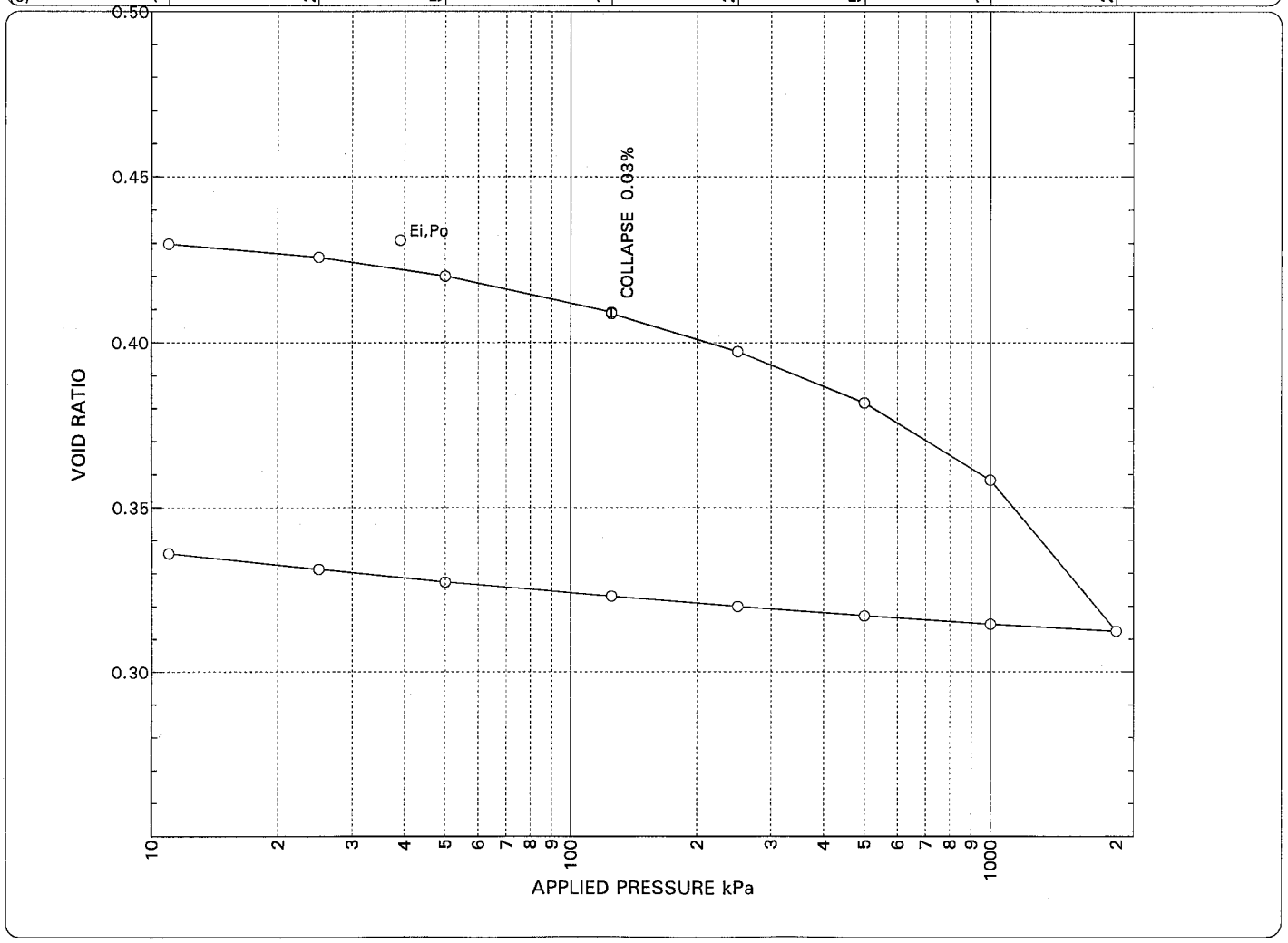
CONSOLIDOMETER TEST RESULTS CONS

CLIENT	Ninham Shand Consulting Services
PROJECT	Bothaville Ethanol Plant
DATAFILE	C:\SOIL\DATA\A872PD06.CON
LABORATORY	SOILTECH
JOB NO	A872
NAME	PW DAY
DATE	23-08-06
TIME	11:31:33

SAMPLE NAME	AH8/1	
TRIAL HOLE	AH8	
DEPTH metres	2.3	m
DESCRIPTION	Residual Sandstone	
SAMPLING DATE	11 July 2006	
TESTING DATE	21 July 2006	
REMARKS	Soaked at 125kPa	

DRY DENSITY	1845	kg/m3
INITIAL MOISTURE CONTENT	14.21	%
FINAL MOISTURE CONTENT	12.67	%
INITIAL SATURATION	87.06	%
FINAL SATURATION	99.54	%
SPECIFIC GRAVITY	2.64	No

13.7	5.0	6.2	9.8	15.4	22.4	29.4	29.7	1/Mv
	3.9	8.6	23.1	52.4	115.1	255.2	611.5	MPa
.431	.430	.426	.420	.409				VOID RATIO
				.409	.397	.382	.358	.312
.336	.331	.327	.323	.320	.317	.315	.312	
(0) 11	25	50	125	250	500	1000	2000	APPLIED PRESS. kPa



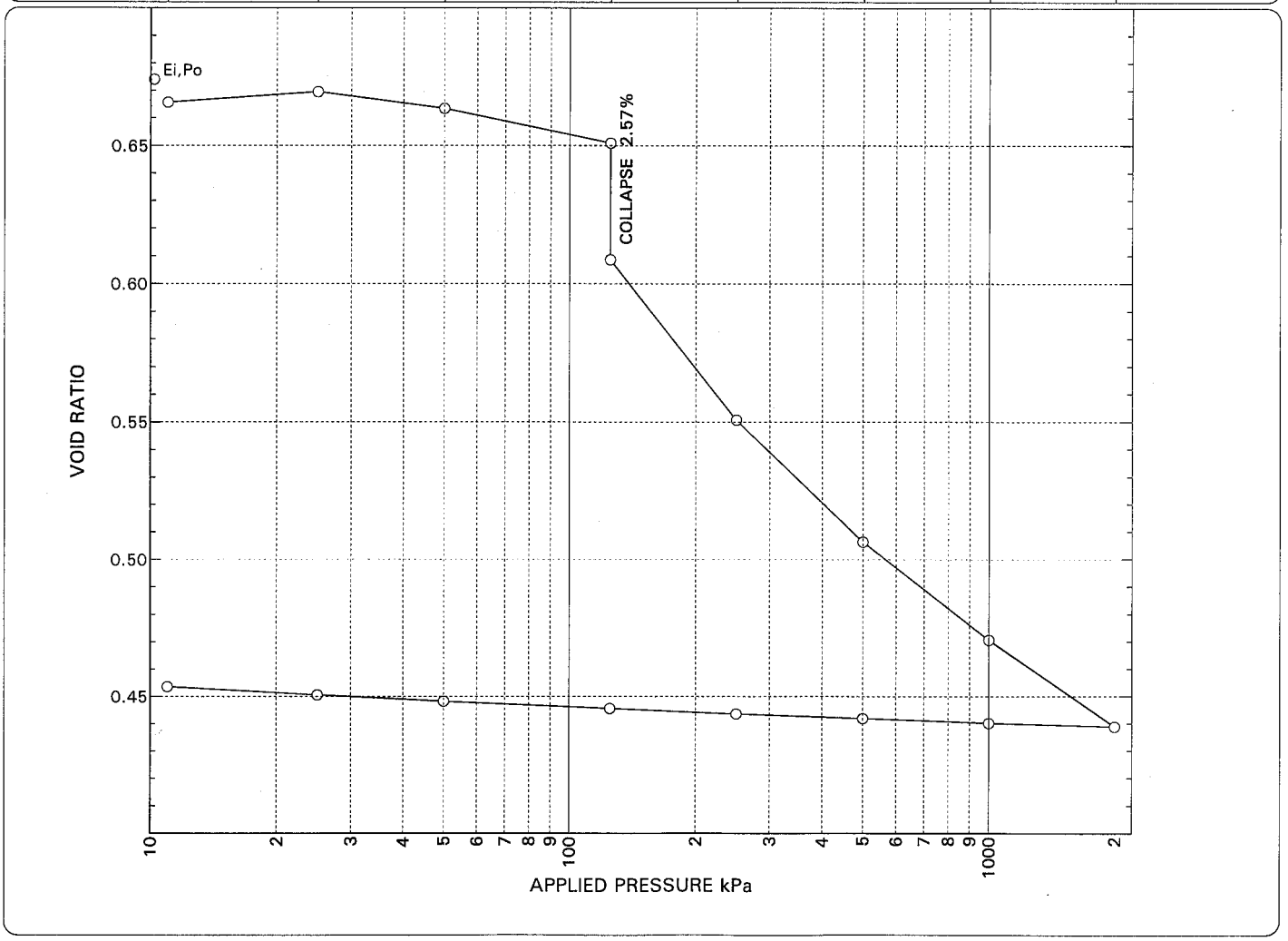
CONSOLIDOMETER TEST RESULTS CONS

CLIENT	Ninham Shand Consulting Services
PROJECT	Bothaville Ethanol Plant
DATAFILE	C:\SOIL\DATA\A872PD07.CON
LABORATORY	SOILTECH
JOB NO	A872
NAME	PW DAY
DATE	23-08-06
TIME	11:32:01

SAMPLE NAME	TP1/1	
TRIAL HOLE	TP1	
DEPTH metres	0.6	m
DESCRIPTION	Hillwash	
SAMPLING DATE	10 July 2006	
TESTING DATE	21 July 2006	
REMARKS	Soaked at 125kPa	

DRY DENSITY	1583	kg/m3
INITIAL MOISTURE CONTENT	7.38	%
FINAL MOISTURE CONTENT	17.04	%
INITIAL SATURATION	29.01	%
FINAL SATURATION	99.56	%
SPECIFIC GRAVITY	2.65	No

2.2	6.9		9.9	3.5	8.7	21.1	46.2	1/Mv
	6.7	15.4	40.5	89.8	215.3	430.2	1074.4	MPa
.674	.666	.670	.663	.651				VOID RATIO
				.609	.551	.506	.471	.439
.454	.451	.448	.446	.444	.442	.440	.439	
(0) 11	25	50	125	250	500	1000	2000	APPLIED PRESS. kPa



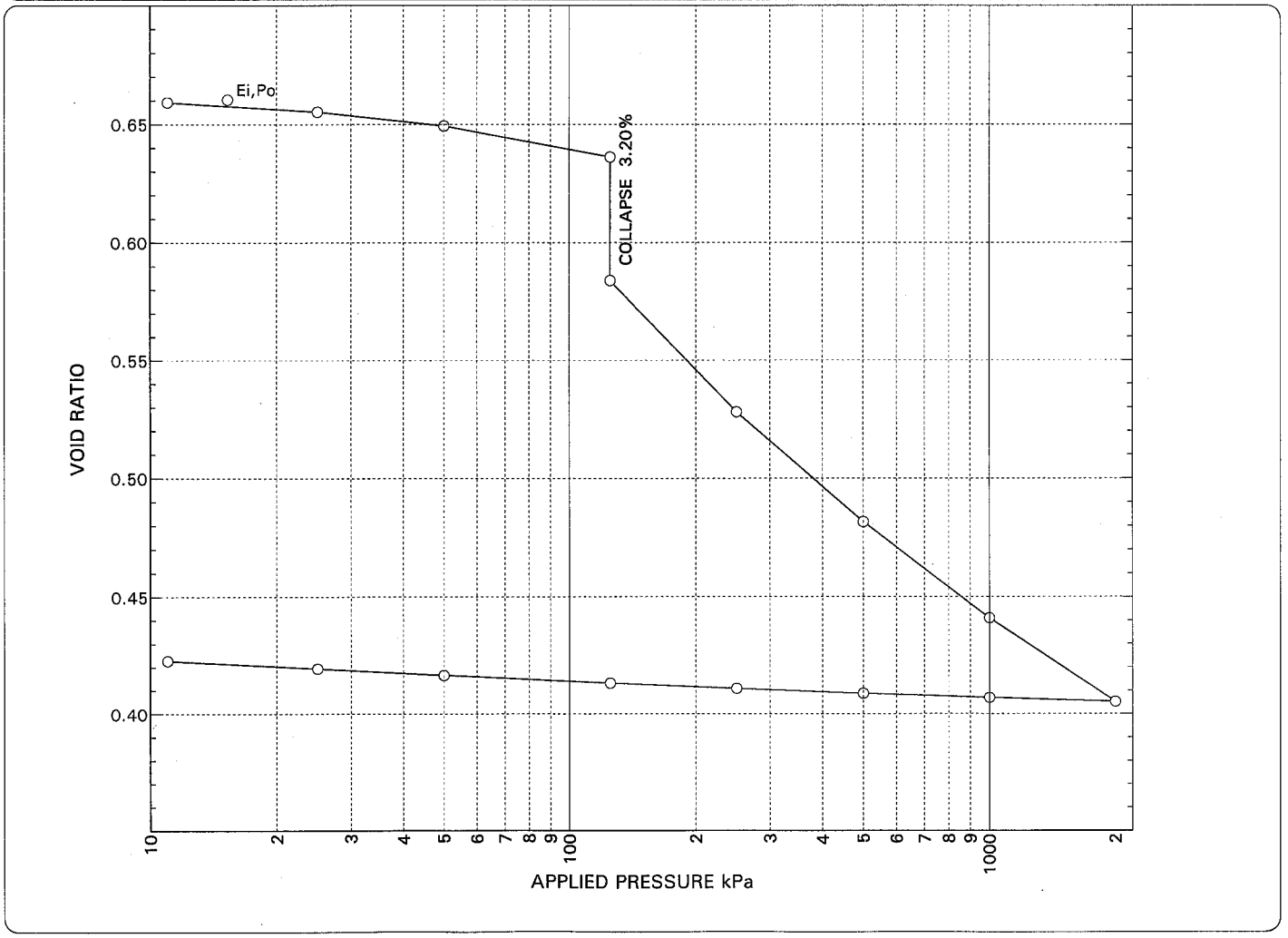
CONSOLIDOMETER TEST RESULTS CONS

CLIENT	Ninham Shand Consulting Services
PROJECT	Bothaville Ethanol Plant
DATAFILE	C:\SOIL\DATA\A872PD08.CON
LABORATORY	SOILTECH
JOB NO	A872
NAME	PW DAY
DATE	23-08-06
TIME	11:32:18

SAMPLE NAME	TP3/2	
TRIAL HOLE	TP3	
DEPTH metres	0.9	m
DESCRIPTION	Hillwash	
SAMPLING DATE	10 July 2006	
TESTING DATE	21 July 2006	
REMARKS	Soaked at 125kPa	

DRY DENSITY	1590	kg/m3
INITIAL MOISTURE CONTENT	9.19	%
FINAL MOISTURE CONTENT	15.92	%
INITIAL SATURATION	36.74	%
FINAL SATURATION	99.41	%
SPECIFIC GRAVITY	2.64	No

15.7	5.8	6.9	9.4	3.5	8.2	18.2	40.4	1/Mv
	5.7	12.5	31.9	75.9	163.2	385.1	846.3	MPa
.660	.659	.655	.649	.636				VOID RATIO
				.584	.528	.482	.441	.405
.423	.419	.416	.413	.411	.409	.407	.405	
(0) 11	25	50	125	250	500	1000	2000	APPLIED PRESS. kPa



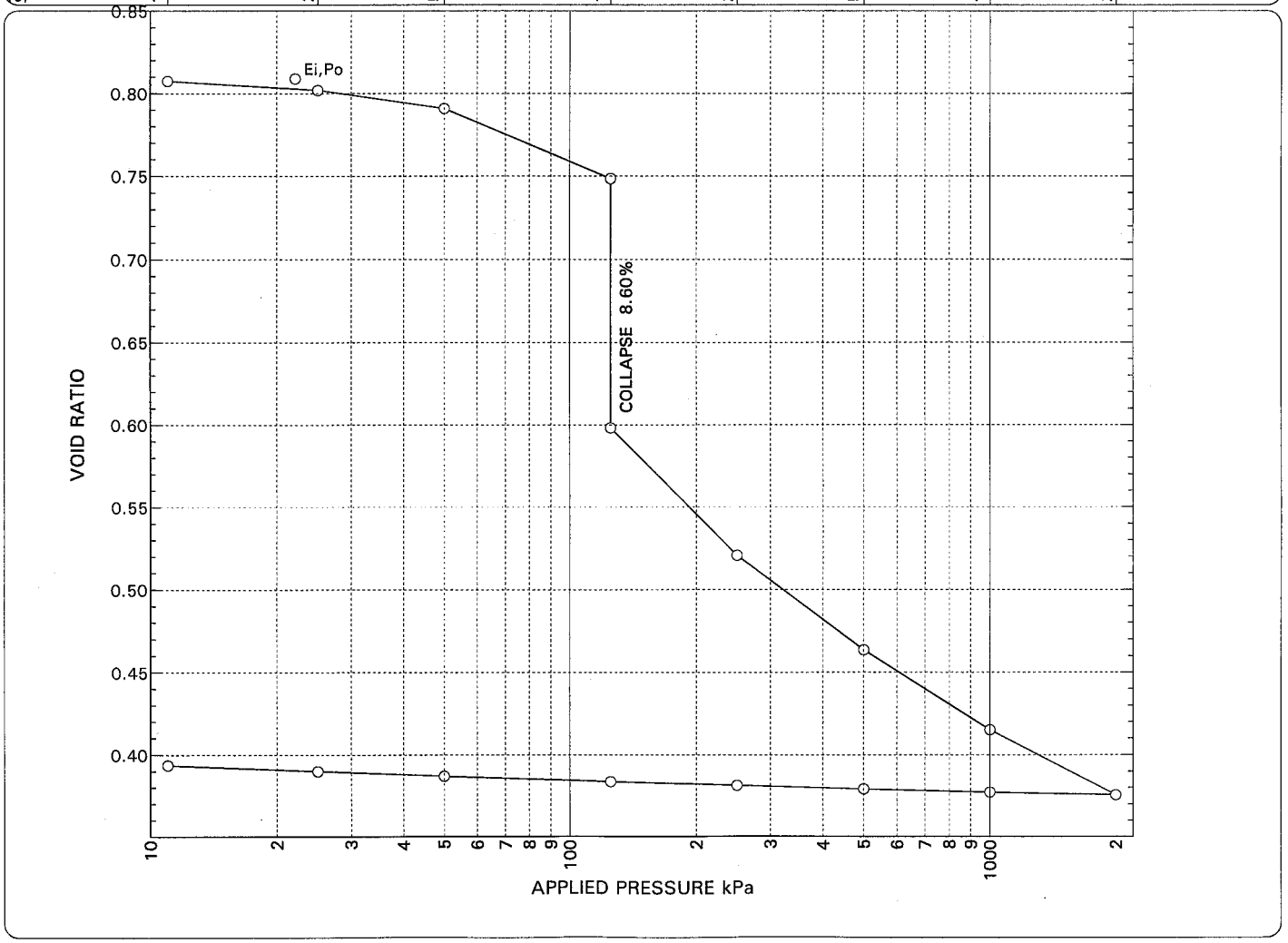
CONSOLIDOMETER TEST RESULTS CONS

CLIENT	Ninham Shand Consulting Services
PROJECT	Bothaville Ethanol Plant
DATAFILE	C:\SOIL\DATA\A872PD09.CON
LABORATORY	SOILTECH
JOB NO	A872
NAME	PW DAY
DATE	23-08-06
TIME	11:32:39

SAMPLE NAME	TP5/2	
TRIAL HOLE	TP5	
DEPTH metres	1.3	m
DESCRIPTION	Illuviated Hillwash	
SAMPLING DATE	10 July 2006	
TESTING DATE	21 July 2006	
REMARKS	Soaked at 125kPa	

DRY DENSITY	1465	kg/m3
INITIAL MOISTURE CONTENT	9.67	%
FINAL MOISTURE CONTENT	14.82	%
INITIAL SATURATION	31.68	%
FINAL SATURATION	99.79	%
SPECIFIC GRAVITY	2.65	No

13.7	4.5	4.1	3.2	2.6	6.7	15.1	35.7	1/Mv
	5.4	12.0	30.2	73.4	158.8	346.0	844.9	MPa
.809	.807	.802	.791	.748				VOID RATIO
				.598	.521	.464	.415	.375
.394	.390	.387	.384	.381	.379	.377	.375	
(0) 11	25	50	125	250	500	1000	2000	APPLIED PRESS. kPa



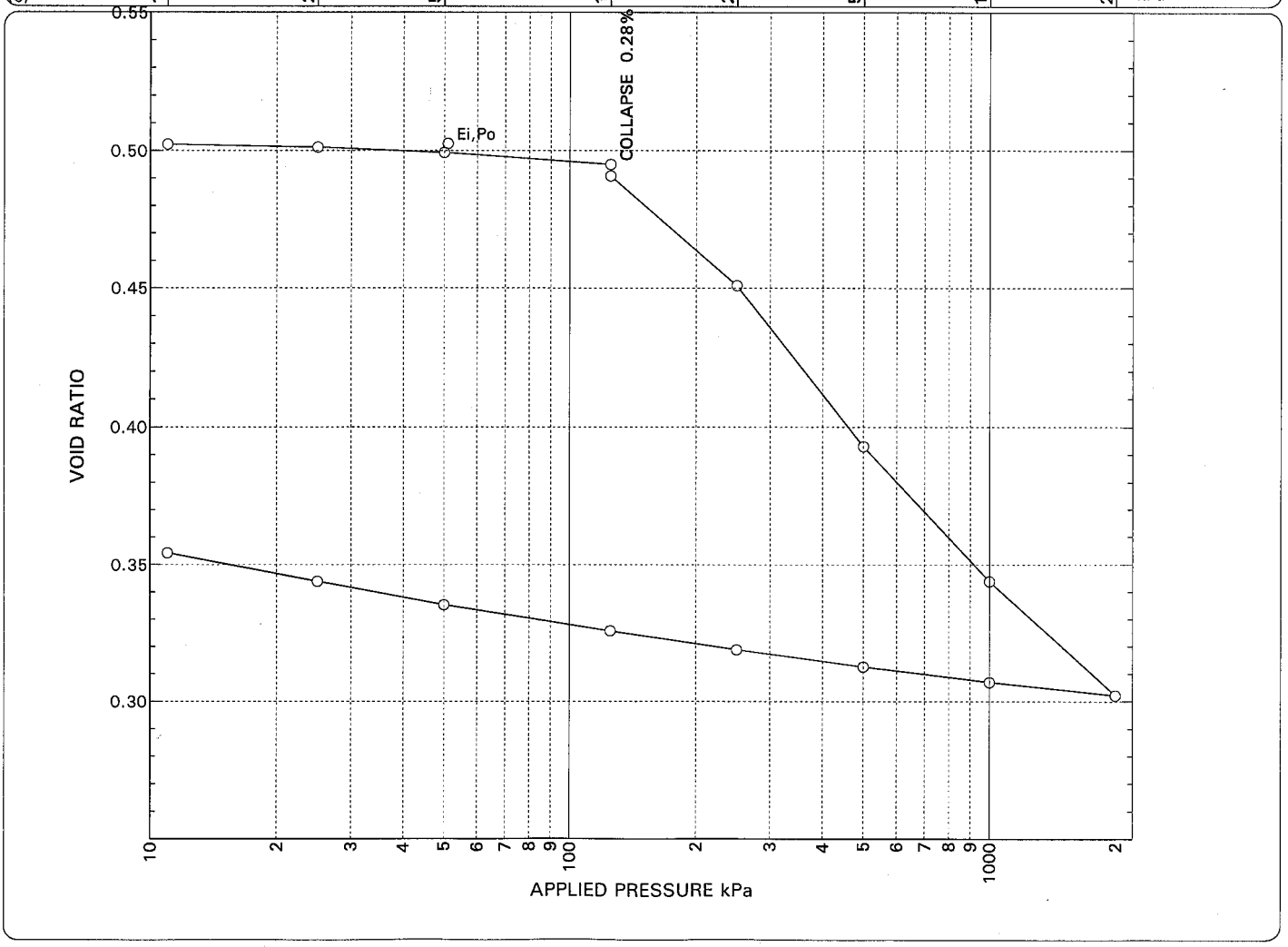
CONSOLIDOMETER TEST RESULTS CONS

CLIENT	Ninham Shand Consulting Services
PROJECT	Bothaville Ethanol Plant
DATAFILE	C:\SOIL\DATA\A872PD10.CON
LABORATORY	SOILTECH
JOB NO	A872
NAME	PW DAY
DATE	23-08-06
TIME	11:33:04

SAMPLE NAME	TP6/2	
TRIAL HOLE	TP6	
DEPTH metres	3.0	m
DESCRIPTION	Residual Sandstone	
SAMPLING DATE	10 July 2006	
TESTING DATE	21 July 2006	
REMARKS	Soaked at 125kPa	

DRY DENSITY	1757	kg/m3
INITIAL MOISTURE CONTENT	10.68	%
FINAL MOISTURE CONTENT	13.34	%
INITIAL SATURATION	56.10	%
FINAL SATURATION	99.41	%
SPECIFIC GRAVITY	2.64	No

55.0	20.0	19.2	26.7	4.7	6.3	14.2	32.2	1/Mv
	1.8	3.9	10.3	23.9	52.0	117.5	270.8	MPa
.503	.502	.501	.499	.495				VOID RATIO
.354	.344	.335	.326	.491 .319	.451 .312	.393 .307	.344 .302	.302
(0) 11	25	50	125	250	500	1000	2000	APPLIED PRESS. kPa



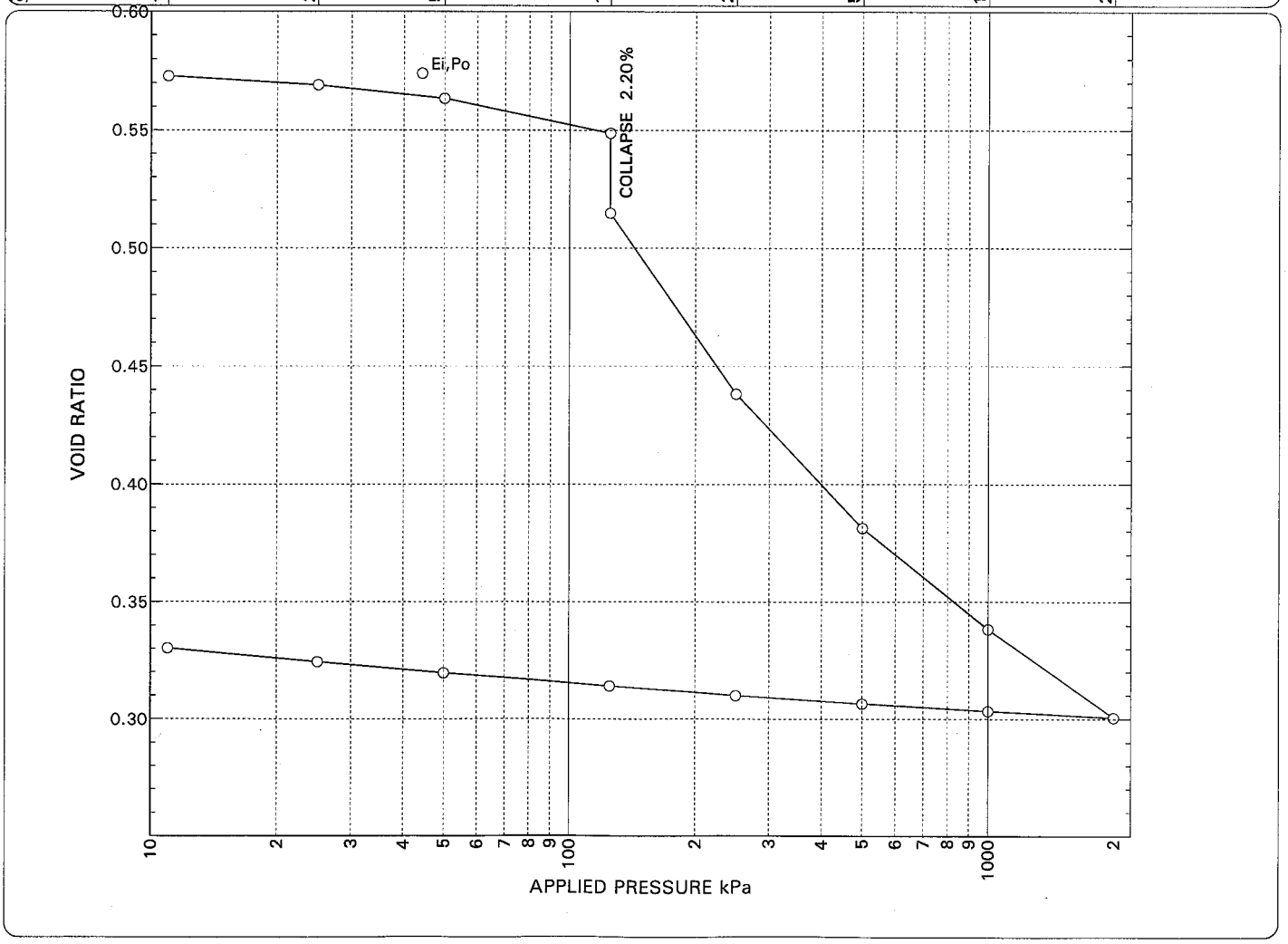
CONSOLIDOMETER TEST RESULTS CONS

CLIENT	Ninham Shand Consulting Services
PROJECT	Bothaville Ethanol Plant
DATAFILE	C:\SOIL\DATA\A872PD11.CON
LABORATORY	SOILTECH
JOB NO	A872
NAME	PW DAY
DATE	23-08-06
TIME	11:33:21

SAMPLE NAME	TP7/1	
TRIAL HOLE	TP7	
DEPTH metres	2.6	m
DESCRIPTION	Residual Sandstone	
SAMPLING DATE	11 July 2006	
TESTING DATE	21 July 2006	
REMARKS	Soaked at 125kPa	

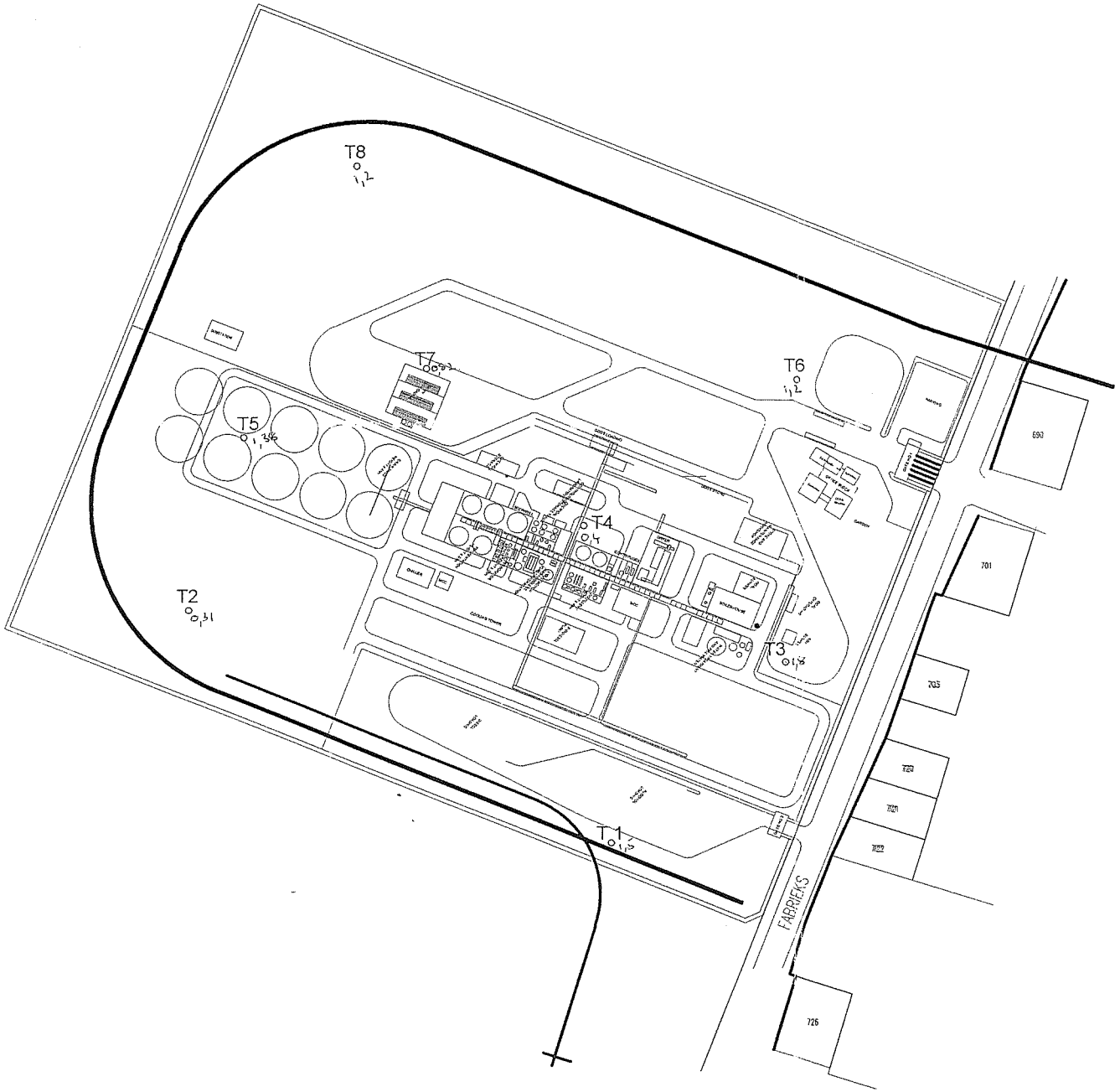
DRY DENSITY	1671	kg/m3
INITIAL MOISTURE CONTENT	13.10	%
FINAL MOISTURE CONTENT	12.53	%
INITIAL SATURATION	60.03	%
FINAL SATURATION	99.78	%
SPECIFIC GRAVITY	2.63	No

15.7	5.8	6.9	8.0	2.5	6.3	16.1	35.4	1/Mv
	3.1	7.0	17.9	40.0	94.3	207.0	459.1	MPa
.574	.573	.569	.563	.549				VOID RATIO
				.515	.438	.381	.338	.301
.330	.324	.320	.314	.310	.307	.303	.301	
(0) 11	25	50	125	250	500	1000	2000	APPLIED PRESS. kPa



APPENDIX D

DATA FROM PRELIMINARY INVESTIGATION



No.	AMENDMENTS	APPR.	DATE

SURVEYED	-
SURVEY PLOTTED	-
DRAWN	LC
DRAWING CHECKED	HJB

PROJECT MANAGER

DATE:

PROJECT DIRECTOR

DATE:

FOUNDED IN 1932

NINHAM SHAND

CONSULTING SERVICES

WELKOM

ETHANOL AFRICA

GEOTECHNICAL REPORT

LAYOUT OF TEST HOLES

SCALE	
NTS	SHEET 1 OF 1 SHEET

DRAWING No

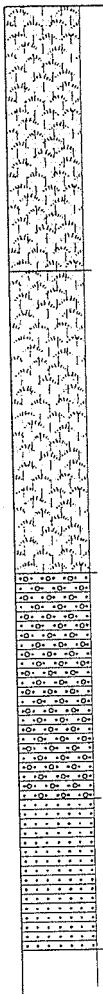
401364 W 140

TESTHOLE No : 1

GEOTECHNICAL INVESTIGATION
BOTHAVILLE

NINHAM SHAND
CONSULTING SERVICES
BLOEMFONTEIN

SCALE 1:20



0.00

MOIST LIGHT / YELLOW DENSE INTACT SILTY SAND + VEGETATION

0.700

MOIST DARK YELLOWISH / ORANGE DENSE INTACT SILTY SAND + VEGETATION

1.500

MOIST DARK YELLOWISH / ORANGE DENSE INTACT SOFT SANDSTONE GRAVEL

2.100

MOIST DARK YELLOWISH DENSE INTACT SANDSTONE

2.500

(STOP) MACHINE REFUSAL

GROUND LEVEL :		DIAM :	± 2m x 1m
MACHINE TYPE :	TLB	DATE :	21/04/2006
PROFILED BY :	H.R. CORNELLISSEN	DATE :	21/04/2006
JOB NUMBER :	401364	FILE :	401364

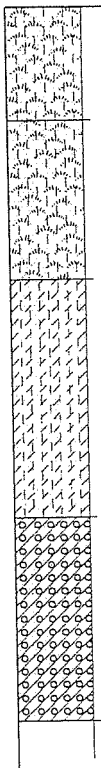
TESTHOLE No : 1

TESTHOLE No : 2

GEOTECHNICAL INVESTIGATION
BOTHAVILLE

NINHAM SHAND
CONSULTING SERVICES

SCALE 1:20



0.00 SLIGHTLY WET DARK BROWN DENSE INTACT SILTY SAND + VEGETATION

0.310 WET DARK REDDISH / BROWN DENSE INTACT SILTY SAND

0.720 WET DARK REDDISH / YELLOW VERY DENSE INTACT SILTY CLAYEY SAND CLOTS

1.350 DRY DARK YELLOWISH / RED VERY DENSE SANDY CLAY GRAVEL

1.890 (STOP) MACHINE REFUSAL

GROUND LEVEL :		DIAM :	± 2m x 1m
MACHINE TYPE :	TLB	DATE :	21/04/2006
PROFILED BY :	H.R. CORNELLISSEN	DATE :	21/04/2006
JOB NUMBER :	401364	FILE :	401364

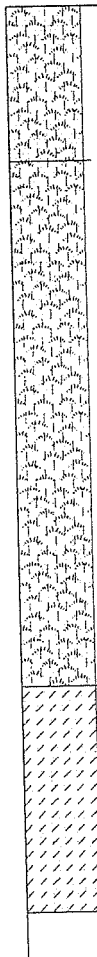
TESTHOLE No : 2

TESTHOLE No : 3

GEOTECHNICAL INVESTIGATION
BOTHAVILLE

NINHAM SHAND
CONSULTING SERVICES
BLOEMFONTEIN

SCALE 1:20



0.00

MOIST DARK BROWN DENSE LOOSE SILTY SAND + VEGETATION

0.410

WET YELLOW / ORANGE DENSE LOOSE SILTY SAND + VEGETATION

1.800

WET DARK YELLOW DENSE LOOSE SILTY CLAYEY SAND

2.400

(STOP) MACHINE REFUSAL

GROUND LEVEL :		DIAM :	± 2m x 1m
MACHINE TYPE :	TLB	DATE :	21/04/2006
PROFILED BY :	H.R. CORNELLISSEN	DATE :	21/04/2006
JOB NUMBER :	401364	FILE :	401364

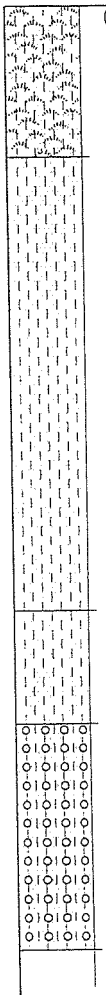
TESTHOLE No : 3

TESTHOLE No : 4

GEOTECHNICAL INVESTIGATION
BOTHAVILLE

NINHAM SHAND
CONSULTING SERVICES
BLOEMFONTEIN

SCALE 1:20



0.00 SLIGHTLY WET DARK BROWN DENSE INTACT SILTY SAND + VEGETATION

0.400 WET YELLOW / ORANGE DENSE INTACT SILTY SAND

1.600 MOIST DARK YELLOW / ORANGE DENSE INTACT SILTY SAND

1.900 MOIST DARK YELLOW / KHAKI DENSE INTACT SILTY SAND + FINE GRAVEL

2.500 (STOP) MACHINE REFUSAL

GROUND LEVEL :		DIAM :	± 2m x 1m
MACHINE TYPE :	TLB	DATE :	21/04/2006
PROFILED BY :	H.R. CORNELLISSEN	DATE :	21/04/2006
JOB NUMBER :	401364	FILE :	401364

TESTHOLE No : 4

TESTHOLE No : 5

GEOTECHNICAL INVESTIGATION
BOTHAVILLE

NINHAM SHAND
CONSULTING SERVICES
BLOEMFONTEIN

SCALE 1:20

0.00 SLIGHTLY WET DARK BROWN DENSE INTACT SILTY SAND + VEGETATION

0.270 SLIGHTLY WET DARK YELLOWISH / BROWN DENSE INTACT SILTY SAND + VEG.

0.800 WET DARK YELLOW DENSE INTACT SILTY SAND + VEG.

1.380 WET DARK YELLOWISH DENSE INTACT SANDY SILT

2.000 WET YELLOW KHAKI SPECKLED ORANGE DENSE INTACT SANDY CLAYEY SILT

2.300 (STOP) MACHINE REFUSAL

GROUND LEVEL :		DIAM :	± 2m x 1m
MACHINE TYPE :	TLB	DATE :	21/04/2006
PROFILED BY :	H.R. CORNELLISSEN	DATE :	21/04/2006
JOB NUMBER :	401364	FILE :	401364

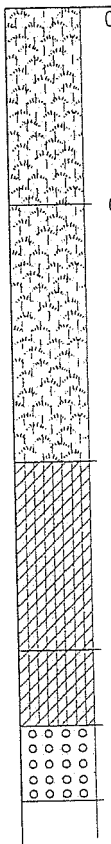
TESTHOLE No : 5

TESTHOLE No : 6

GEOTECHNICAL INVESTIGATION
BOTHAVILLE

NINHAM SHAND
CONSULTING SERVICES
BLOEMFONTEIN

SCALE 1:20



0.00 MOIST DARK BROWN DENSE LOOSE SILTY SAND + VEGETATION

0.520 WET YELLOW ORANGE DENSE LOOSE SILTY SAND + VEG.

1.200 WET KHAKI YELLOW VERY DENSE CLAY SANDY SILT

1.700 MOIST KHAKI YELLOW VERY DENSE CLAY SANDY SILT

1.900 MOIST KHAKI BROWN VERY DENSE SILTY SAND + GRAVEL

2.000 (STOP) MACHINE REFUSAL

GROUND LEVEL :		DIAM :	± 2m x 1m
MACHINE TYPE :	TLB	DATE :	21/04/2006
PROFILED BY :	H.R. CORNELLISSEN	DATE :	21/04/2006
JOB NUMBER :	401364	FILE :	401364

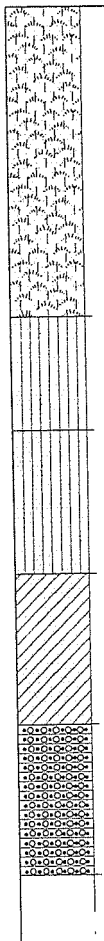
TESTHOLE No : 6

TESTHOLE No : 7

GEOTECHNICAL INVESTIGATION
BOTHAVILLE

NINHAM SHAND
CONSULTING SERVICES
BLOEMFONTEIN

SCALE 1:20



0.00 MOIST YELLOW LOOSE INTACT SILTY SAND + VEGETATION

0.820 WET DARK YELLOW LOOSE INTACT SANDY SILT

1.120 WET YELLOW / ORANGE,DENSE INTACT SANDY SILT

1.500 WET YELLOW / ORANGE VERY DENSE INTACT CLAY SAND

1.900 MOIST DARK YELLOW VERY DENSE INTACT SOFT SANDSTONE + GRAVEL

2.300 (STOP) MACHINE REFUSAL

GROUND LEVEL :		DIAM :	± 2m x 1m
MACHINE TYPE :	TLB	DATE :	21/04/2006
PROFILED BY :	H.R. CORNELLISSEN	DATE :	21/04/2006
JOB NUMBER :	401364	FILE :	401364

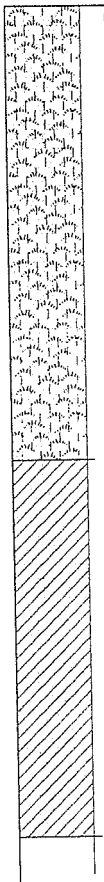
TESTHOLE No : 7

TESTHOLE No : 8

GEOTECHNICAL INVESTIGATION
BOTHAVILLE

NINHAM SHAND
CONSULTING SERVICES
BLOEMFONTEIN

SCALE 1:20



0.00

SLIGHTLY WET YELLOW LOOSE INTACT SILTY SAND + VEGETATION

1.200

SLIGHTLY WET KHAKI YELLOW / ORANGE DENSE INTACT SANDY CLAY

2.200

(STOP) MACHINE REFUSAL

GROUND LEVEL :		DIAM :	± 2m x 1m
MACHINE TYPE :	TLB	DATE :	21/04/2006
PROFILED BY :	H.R. CORNELLISSEN	DATE :	21/04/2006
JOB NUMBER :	401364	FILE :	401364

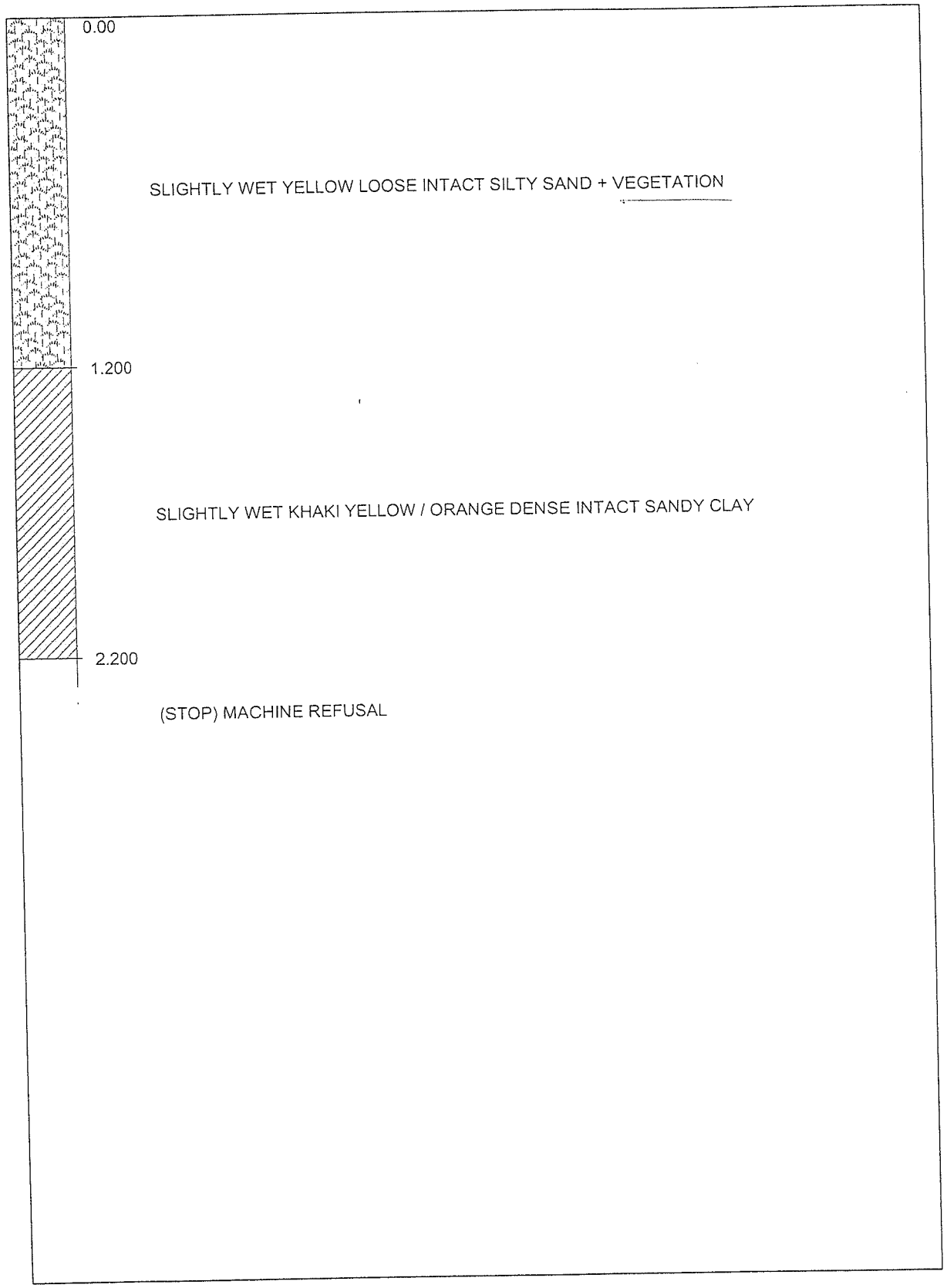
TESTHOLE No : 8

TESTHOLE No : 8

GEOTECHNICAL INVESTIGATION
BOTHAVILLE

NINHAM SHAND
CONSULTING SERVICES
BLOEMFONTEIN

SCALE 1:20



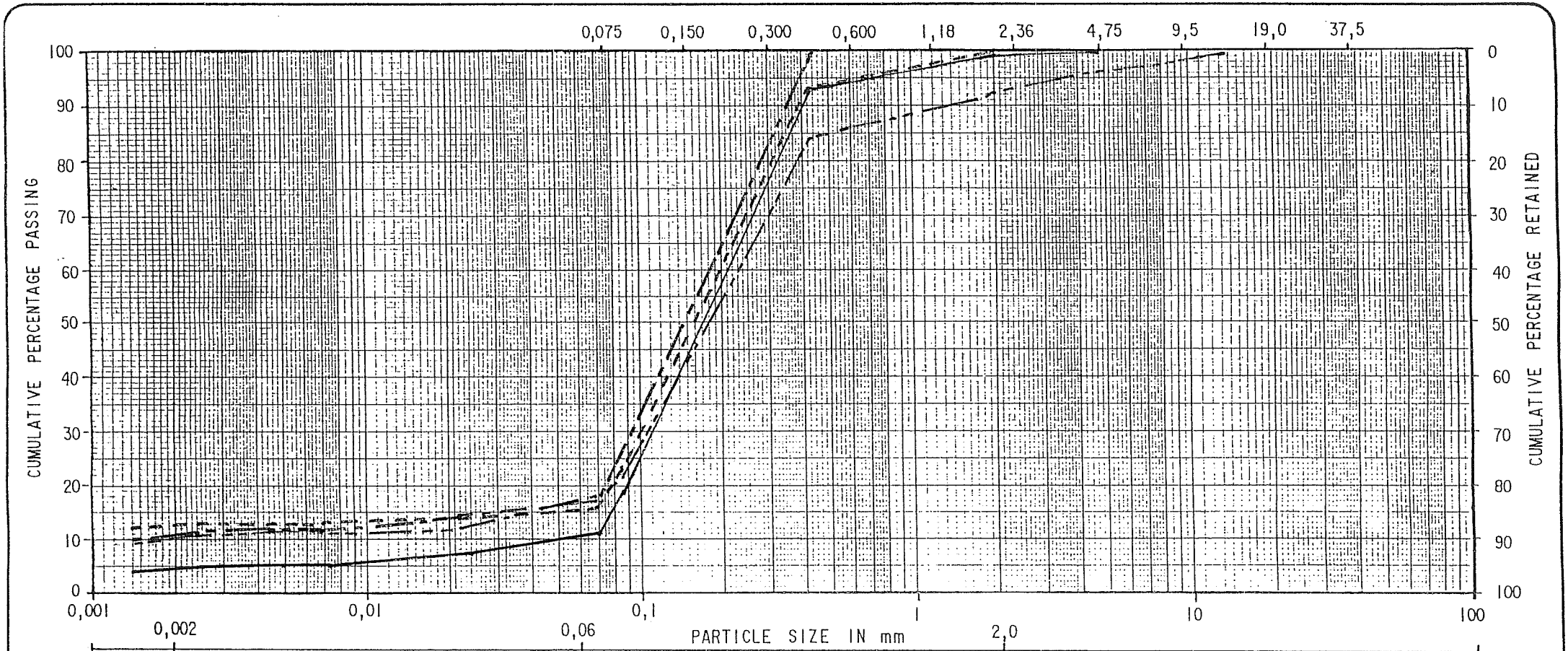
GROUND LEVEL :		DIAM :	± 2m x 1m
MACHINE TYPE :	TLB	DATE :	21/04/2006
PROFILED BY :	H.R. CORNELLISSEN	DATE :	21/04/2006
JOB NUMBER :	401364	FILE :	401364

TESTHOLE No : 8

Mr H. Beiter
N.S
Weckom

NINHAM SHAND
CONSULTING ENGINEERS

FOUNDATION INDICATOR



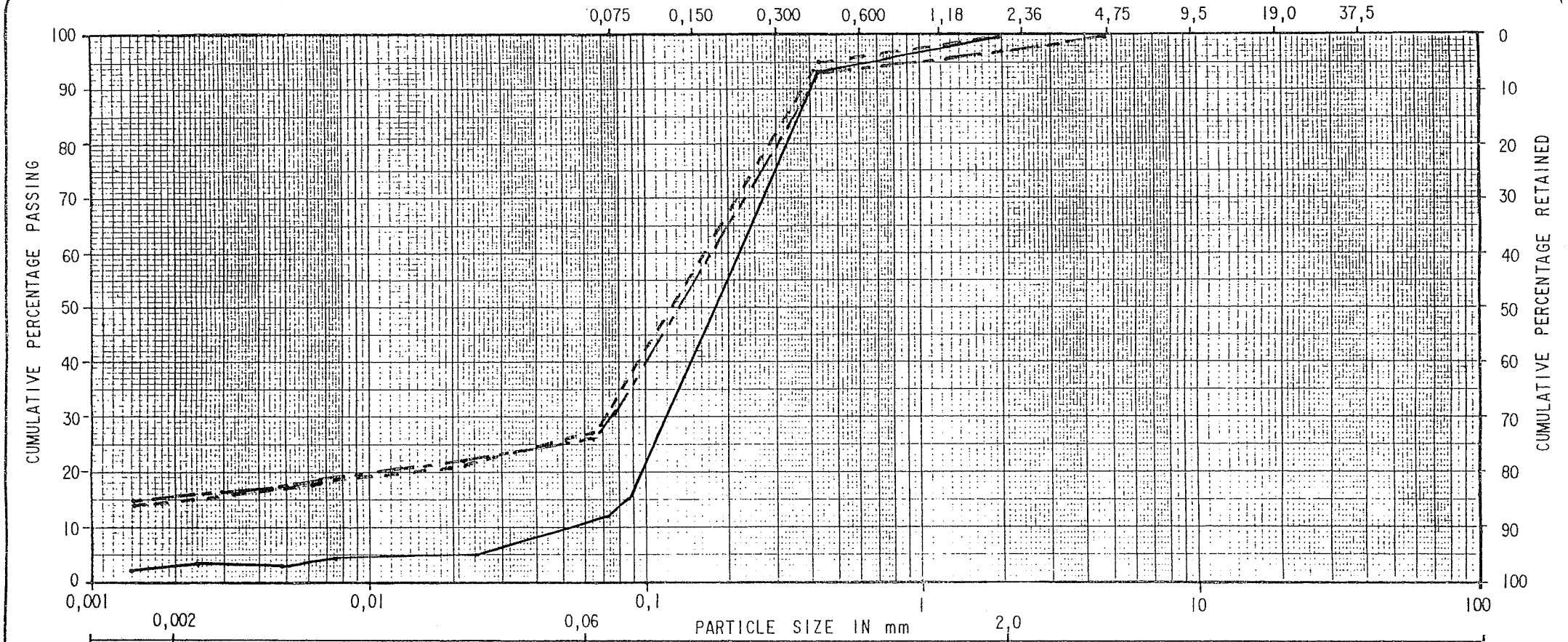
SAMPLE NUMBER	LOCATION	DEPTH mm	ATTERBERG LIMITS LL	PI	LS	CLAY %	SILT %	SAND %	GRAVEL %	SCS DSP %	LABORATORY DESCRIPTION	CHECKED BY
470	HOLE 1	0-700		SP	0·1						DARK BROWN SILTY SAND + VEG.	REFERENCE
471	"	700-1500	21	10·0	4·0						REDDISH BROWN SILTY SLIGHTLY CLAYEY SAND	
472	"	1500-2100	20	7·0	3·0						LIGHT YELLOW SILTY SAND	
473	"	2100-2500	22	9·0	4·0						DARK YELLOWISH ORANGE SOFT SANDSTONE GRAVEL	
NS	"	2500									DITTO	

PROJ NO 401364 | PROJECT BOTHAVILLE | TEST METHOD | 20.04.06

MR H. BESTER
NS
WELKOM

NINHAM SHAND
CONSULTING ENGINEERS

FOUNDATION INDICATOR



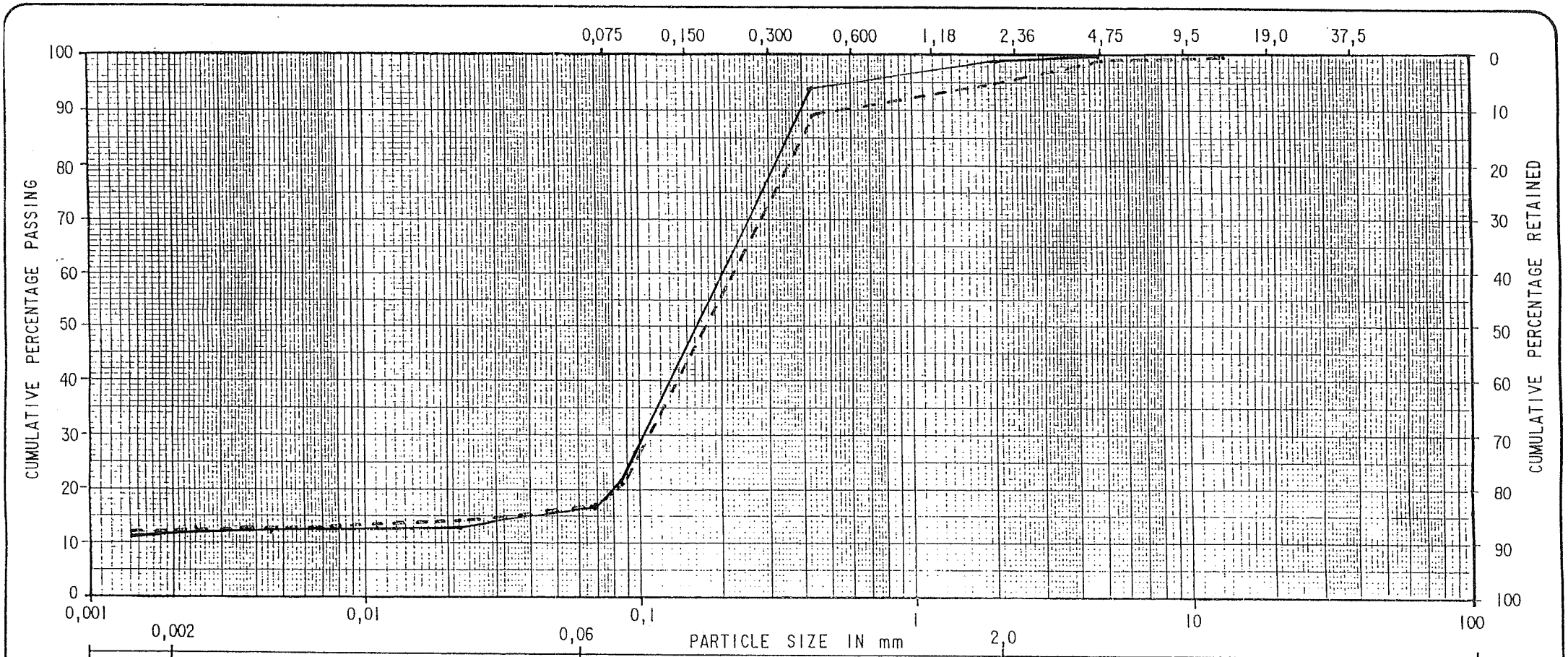
SAMPLE NUMBER	LOCATION	DEPTH mm	ATTERBERG LIMITS LL	PI	LS	CLAY %	SILT %	SAND %	GRAVEL %	SCS DSP %	LABORATORY DESCRIPTION	CHECKED BY
NS	HOLE 2	0-310							DARK BROWN		SILTY SAND + VEG	REFERENCE
474	"	310-720		SP	0.1				LT YELLOWISH		SILTY SAND	
475	"	720-1350	28	12.0	5.0				DARK YELLOWISH	ORANGE	SILTY CLAYEY SAND	D
476	"	1350-1890	31	13.0	5.5				DARK REDDISH	YELLOW	SILTY CLAYEY SAND	D
NS	"	1890								DITTO	(STOP MACHINE REFUSAL).	

PROJ NO 401364 | PROJECT BOTHAVILLE | TEST METHOD

MR H BESTER
NS
WELKOM

NINHAM SHAND
CONSULTING ENGINEERS

FOUNDATION INDICATOR



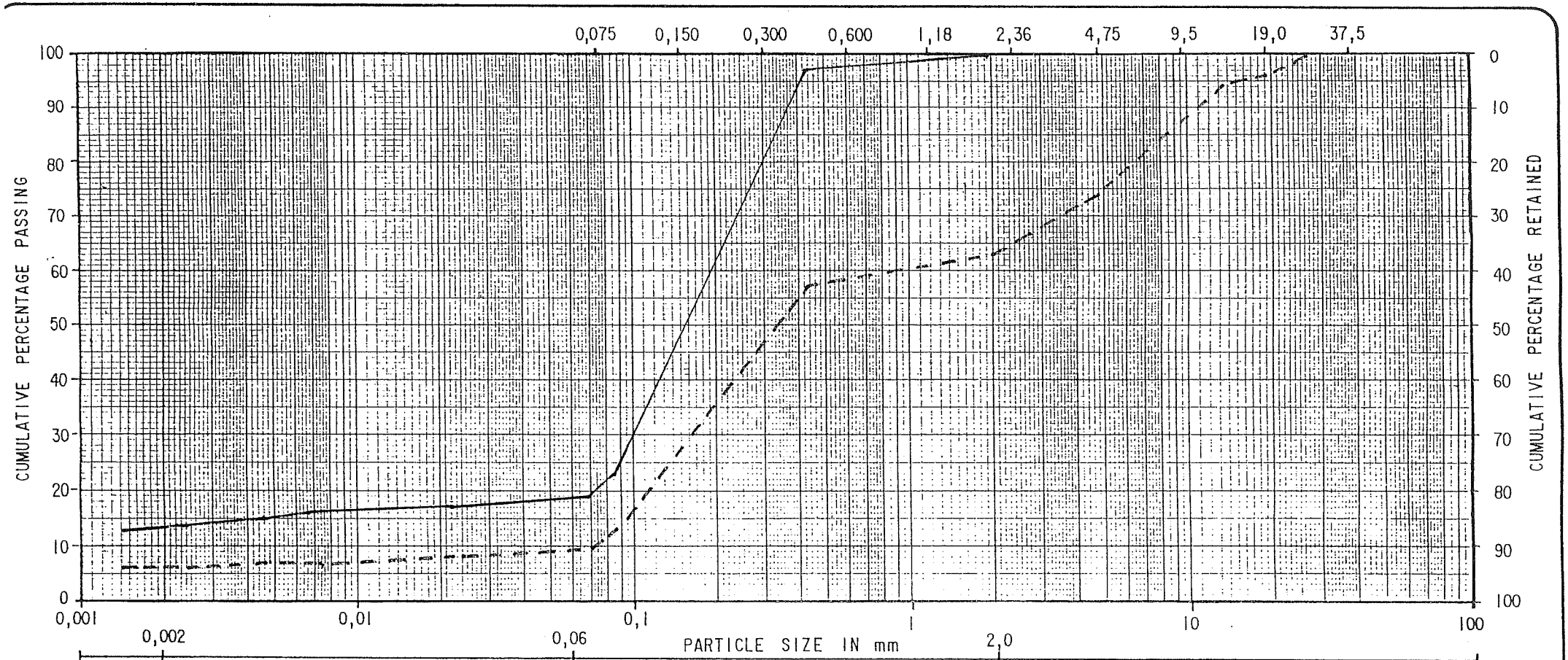
SAMPLE NUMBER	LOCATION	DEPTH mm	ATTERBERG LIMITS LL	PI	LS	CLAY %	SILT %	SAND %	GRAVEL %	SCS DSP %	LABORATORY DESCRIPTION	CHECKED BY
NS	HOLE 3	0-410									DARK/BROWN SILTY SAND + VEG	REFERENCE
477	"	410-1800	20	7.0	3.1						REDDISH/BROWN SILTY SLIGHTLY CLAYEY SAND.	
478	"	1800-2400	23	9.0	3.5						DARK/YELLOWISH/ORANGE SILTY SLIGHTLY CLAYEY SAND	
NS	"	2400									DITTO (STOP MACHINE REFUSAL).	

PROJ NO 401364 | PROJECT BOTHAVILLE | TEST METHOD | 20.04.06

Mr Hans Bester
NS
Bloemfontein

NINHAM SHAND
CONSULTING ENGINEERS

FOUNDATION INDICATOR



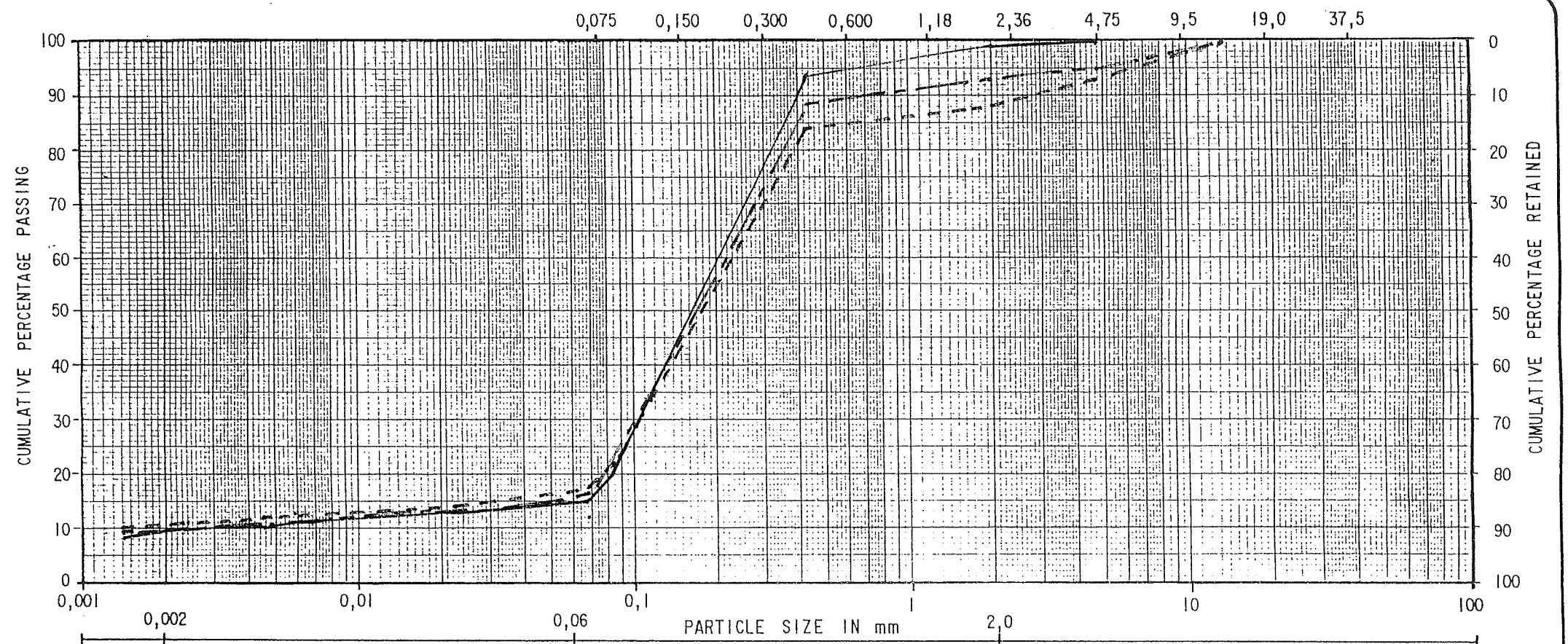
SAMPLE NUMBER	LOCATION	DEPTH mm	ATTERBERG LIMITS LL	PI	LS	CLAY %	SILT %	SAND %	GRAVEL %	SCS DSP %	LABORATORY DESCRIPTION	CHECKED BY
NS	HOLE 4	0-400									DARK BROWN SILTY SAND + VEG	REFERENCE
479	"	400-1600	21	9.0	3.5						YELLOWISH ORANGE SILTY SLIGHTLY CLAYEY SAND	
NS	"	1600-1900									DARK YELLOWISH ORANGE SILTY SLIGHTLY CLAYEY SAND	
480	"	1900-2800	26	12.0	5.7						DARK YELLOWISH ORANGE SILTY CLAYEY SAND + S/STONE GRAVEL	
NS	"	2800									DITTO	

PROJ NO [illegible] | PROJECT [illegible] | TEST [illegible]

1R Hans Beiter
NS
Bloemfontein

NINHAM SHAND
CONSULTING ENGINEERS

FOUNDATION INDICATOR



SAMPLE NUMBER	LOCATION	DEPTH mm	ATTERBERG LIMITS LL	PI	LS	CLAY %	SILT %	SAND %	GRAVEL %	SCS DSP %	LABORATORY DESCRIPTION	CHECKED BY
NS	HOLE 5	0-270									DARK BROWN SILTY SAND + VEG	REFERENCE
NS	"	270-800									DARK YELLOWISH BROWN SILTY SAND	
981	"	800-1380	19	6.0	2.6						DARK YELLOW SILTY SAND	
982	"	1380-2000	25	10.0	4.2						DARK YELLOWISH ORANGE SILTY SLIGHTLY CLAYEY SAND	
1~~983~~ NS	"	2000-2300	23	9.0	3.6						YELLOW/GREY/ORANGE SILTY SLIGHTLY CLAYEY SAND	
NS	"	2300									DITTO SOFT SANDSTONE.	

PROJ NO 00136 | PROJECT [illegible] | TEST

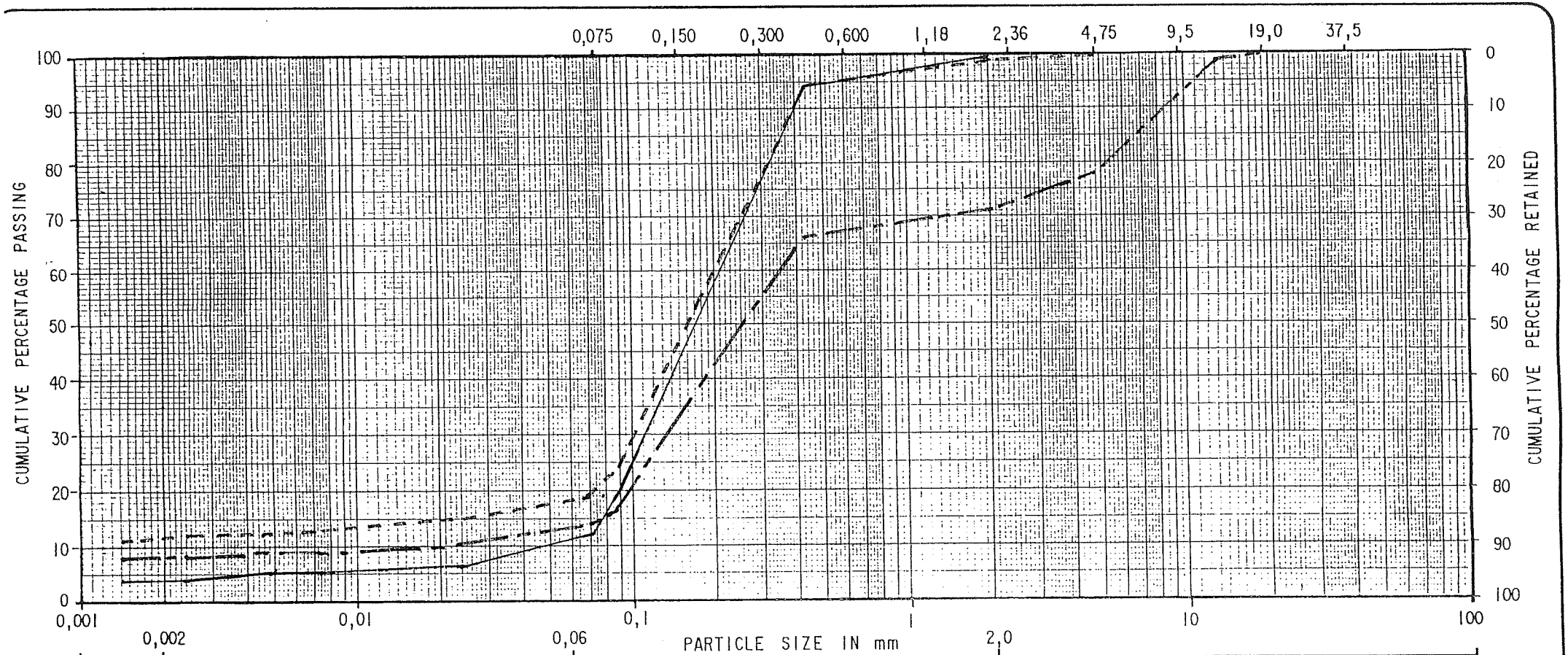
Re HANS BESTER

NS

BLOEMFONTEIN

NINHAM SHAND
CONSULTING ENGINEERS

FOUNDATION INDICATOR



SAMPLE NUMBER	LOCATION	DEPTH mm	ATTERBERG LIMITS LL	PI	LS	CLAY %	SILT %	SAND %	GRAVEL %	SCS DSP %	LABORATORY DESCRIPTION	CHECKED BY
483	HOLE 6	0-520		SP	0·1						DARK/BROWN SILTY SAND × VEG	REFERENCE
NS	"	520-1200									YELLOWISH/ORANGE SILTY SAND	
484	"	1200-1700	20	7·0	3·4						DARK/BROWN ORANGE SILTY SLIGHTLY CLAYEY SAND	
485	"	1700-2100	22	9·0	4·0						YELLOWISH/GREYEY SILTY SLIGHTLY CLAYEY SAND+S/STONE	
NS	"	2100									DITTO (STOP MACHINE REFUSAL	

PROJ NO [illegible]

PROJECT [illegible]

TEST

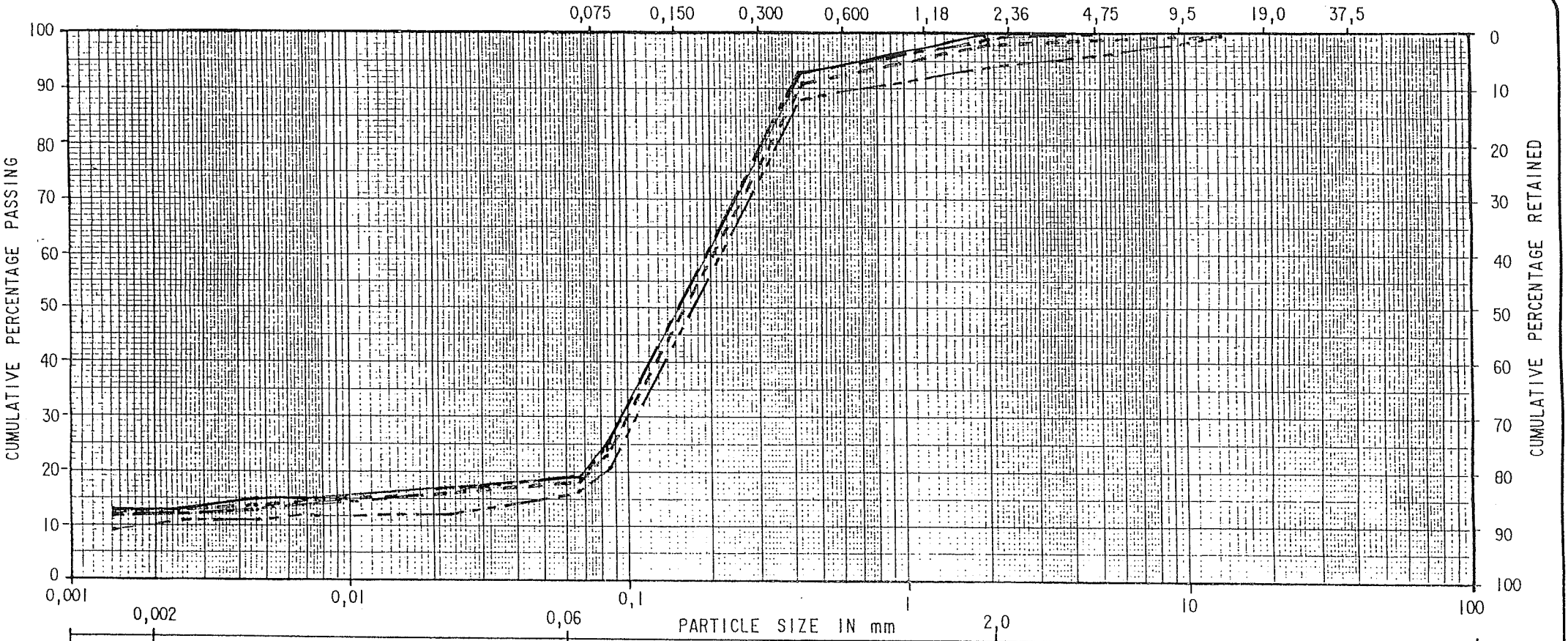
Mr H Bester

NS

Welkom

NINHAM SHAND
CONSULTING ENGINEERS

FOUNDATION INDICATOR



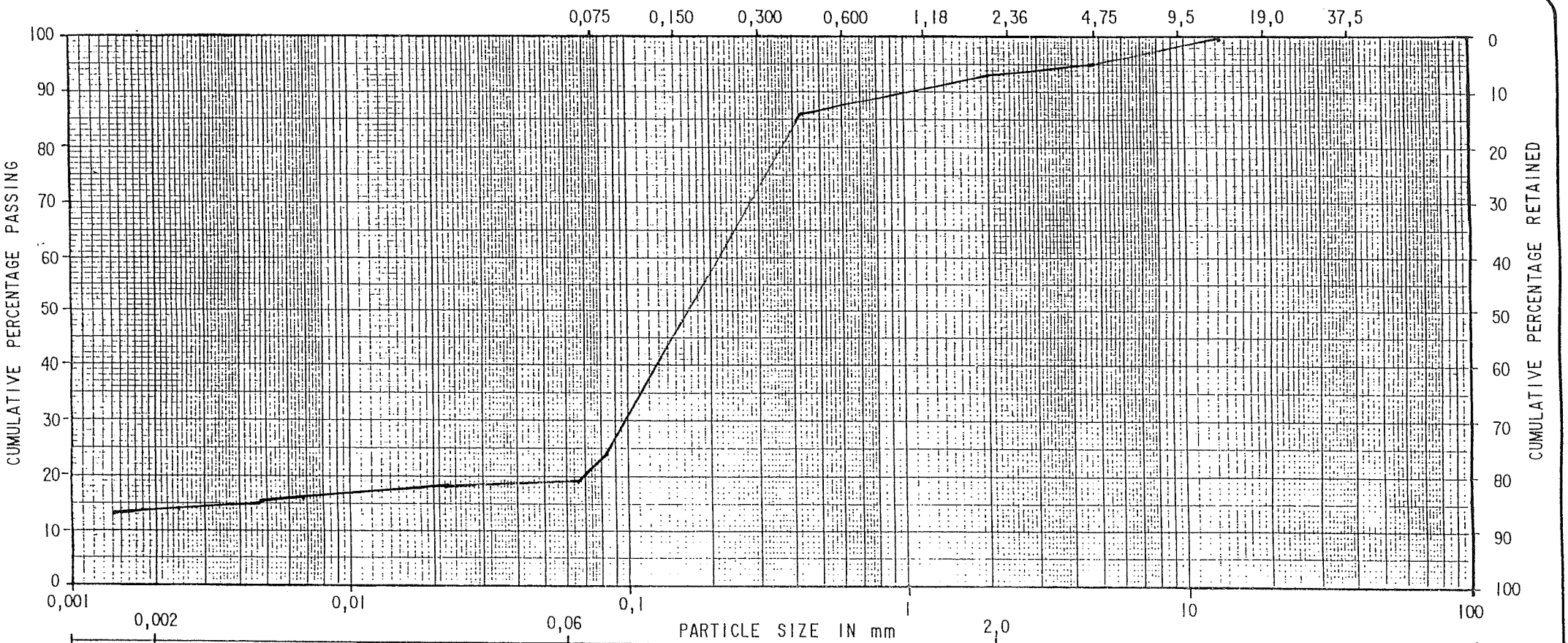
SAMPLE NUMBER	LOCATION	DEPTH m.n	ATTERBERG LIMITS LL	PI	LS	CLAY %	SILT %	SAND %	GRAVEL %	SCS DSP %	LABORATORY DESCRIPTION	CHECKED BY
NS	HOLE 7	0 - 820								Yellow	SILTY SAND + REC	REFERENCE
486	"	820 - 1120	23	9.0	4.2				REDDISH	BROWN	SILTY SLIGHTLY CLAYEY SAND	
487	"	1120 - 1500	26	12.0	5.4				DARK REDDISH	ORANGE	SILTY SLIGHTLY CLAYEY	SAND
488	"	1500 - 1900	22	9.0	4.3				ORANGE	REDDISH	SILTY SLIGHTLY CLAYEY	SAND
489	"	1900 - 2300	23	11.0	4.6				DARK	YELLOW	ORANGE SILTY SLIGHTLY CLAYEY SAND	
NS	"	2300									DITTO (TOP MACHINE REFUSAL).	

PROJ NO 901364 | PROJECT BOTHAVILLE | TEST METHOD | 21.04.06

Mr H. Bester
NS
Welkom

NINHAM SHAND
CONSULTING ENGINEERS

FOUNDATION INDICATOR



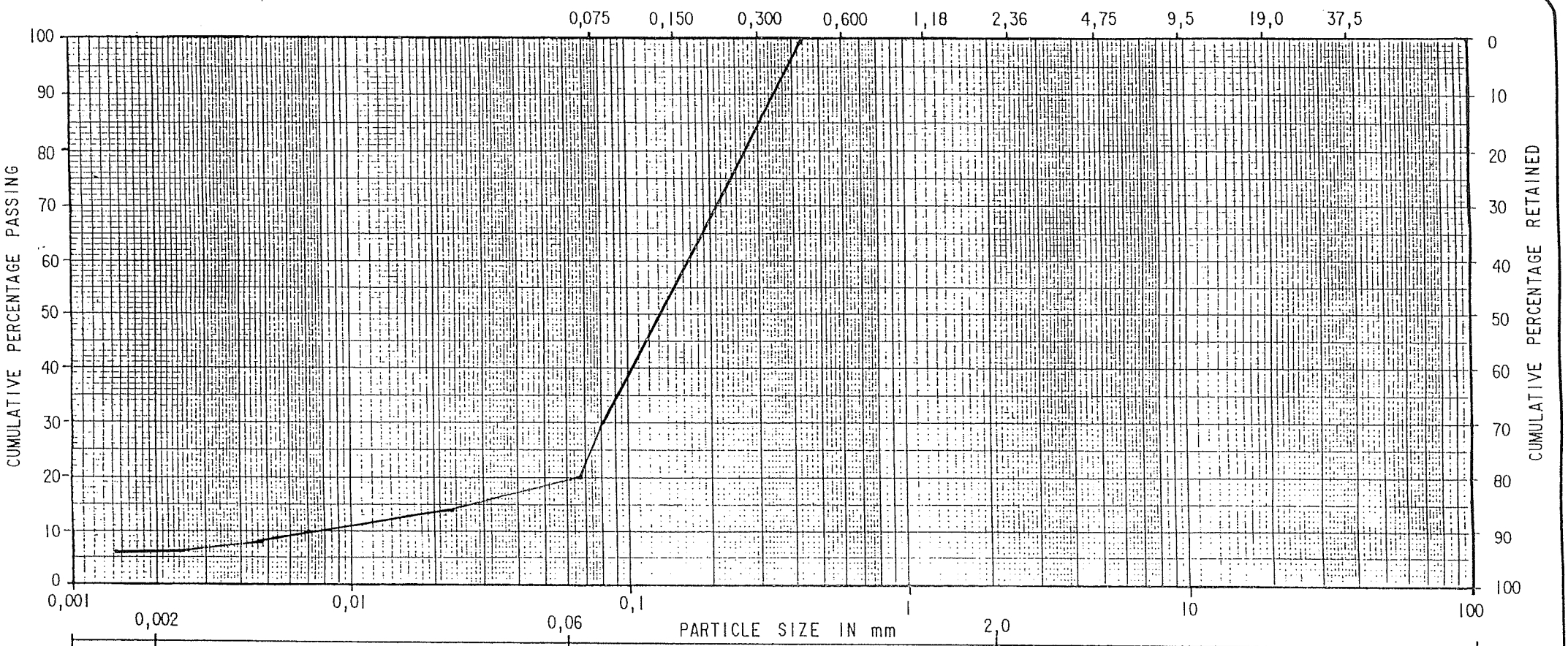
SAMPLE NUMBER	LOCATION	DEPTH mm	ATTERBERG LIMITS LL	PI	LS	CLAY %	SILT %	SAND %	GRAVEL %	SCS DSP %	LABORATORY DESCRIPTION	CHECKED BY
NS	HOLE 8	0-1200									YELLOW SILTY SAND + VEG	REFERENCE
490	"	1200-2200	31	14.0	6.5						L/GREY/ORANGE SILTY SLIGHTLY CLAYEY SAND	
NS	"	2200									DITTO (TOP MACHINE REGRAE).	

PROJ NO 401364 | PROJECT BOTHAVILLE | TEST METHOD | 21-04-06

Mr H Beyer
NS
Welkom

NINHAM SHAND
CONSULTING ENGINEERS

FOUNDATION INDICATOR



SAMPLE NUMBER	LOCATION	DEPTH mm	ATTERBERG LIMITS LL	PI	LS	CLAY %	SILT %	SAND %	GRAVEL %	SCS DSP %	LABORATORY DESCRIPTION	CHECKED BY
491a	BH 2	3900-5500	24	7.0	2.8						LIGHTLY GREYEY SILTY SLIGHTLY CLAYEY SAND	REFERENCE

PROJ NO 401364 | PROJECT BOTHAVILLE | TEST METHOD | 21-04-06

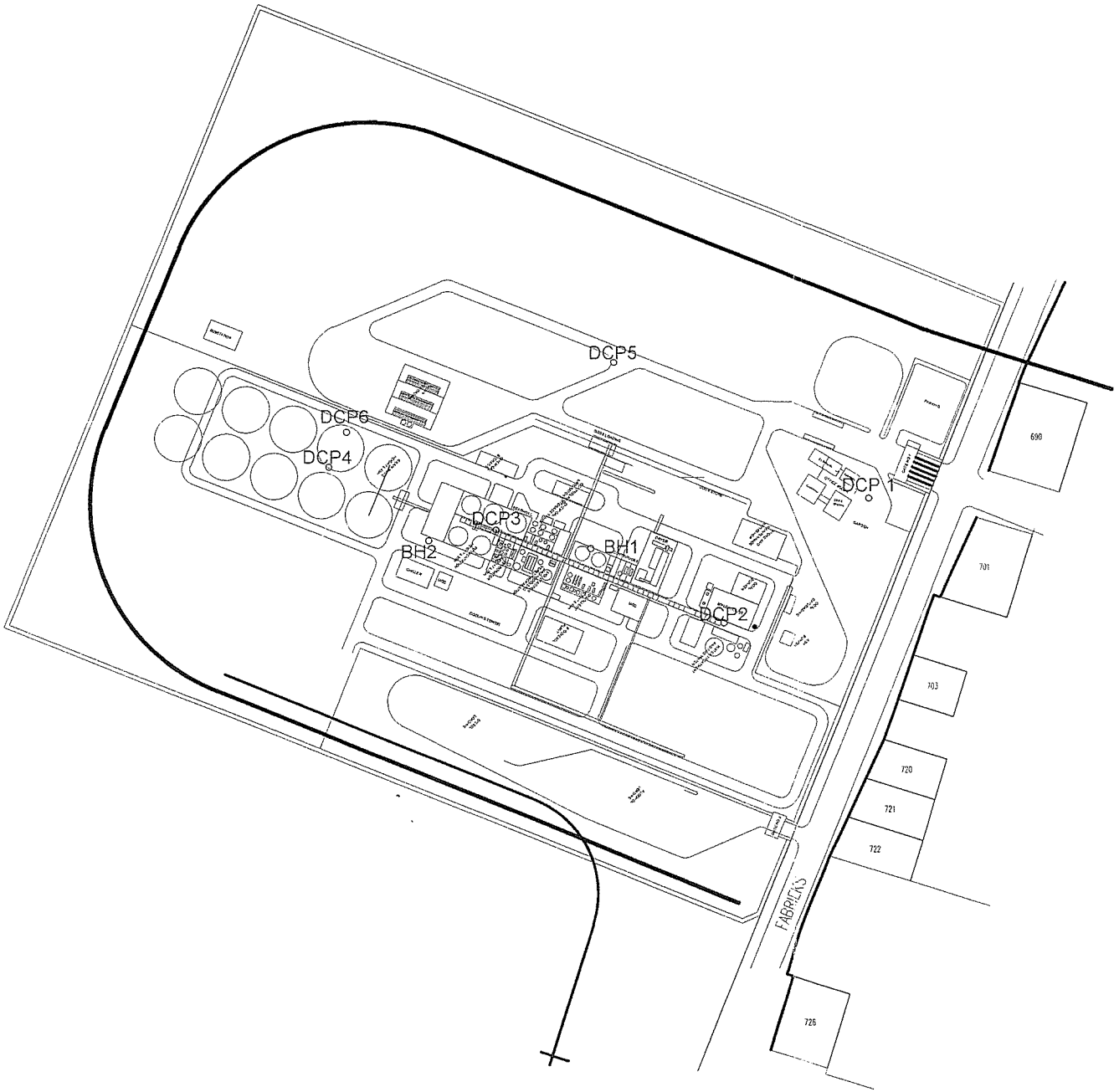
Project: BOTHAVILLE
Proj no: 401364

PREDICTION OF HEAVE

Van der Merwe Method: Construction of Road Embankments, TRH9

Layer	Depth (mm)	A Layer thickness (m)	1 PI (Atterberg)	2 Cum % passing < 425 sieve	B 1 x 2 PI (Whole sample)	3 Cum % passing < 0.002 sieve	C 2 x 3 Clay fraction	Fig 9 Relationship (B & C)	D Table III Heave mm/m of profile	E Table IV Depth factor	A x D x E Heave (mm)
1	***Testhole 1*** 0 700	0.7	SP	93		4	3.72	Low	0	0.85	0
2	700 1000 1000 1500	0.3 0.5	10 10	93 93	9.3 9.3	13 13	12.09 12.09	Low Low	0 0	0.85 0.6	0 0
3	1500 2000 2000 2100	0.5 0.1	7 7	100 100	7 7	11 11	11 11	Low Low	0 0	0.6 0.4	0 0
4	2100 2500	0.4	9	84	7.56	10	8.4	Low	0	0.4	0
									Total heave =		0
1	***Testhole 2*** 0 310										
2	310 720	0.41	SP	93		3	2.79	Low	0	0.85	0
3	720 1000 1000 1350	0.28 0.35	12 12	95 95	11.4 11.4	14 14	13.3 13.3	Low Low	0 0	0.85 0.6	0 0
4	1350 1890	0.54	13	93	12.09	16	14.88	Medium	20	0.6	6.48
									Total heave =		6.48
1	***Testhole 3*** 0 410										
2	410 1000 1000 1800	0.59 0.8	7 7	94 94	6.58 6.58	12 12	11.28 11.28	Low Low	0 0	0.85 0.6	0 0
3	1800 2000 2000 2400	0.2 0.4	9 9	89 89	8.01 8.01	12 12	10.68 10.68	Low Low	0 0	0.6 0.4	0 0
									Total heave =		0
1	***Testhole 4*** 0 400										
2	400 1000 1000 1600	0.6 0.6	9 9	97 97	8.73 8.73	13 13	12.61 12.61	Low Low	0 0	0.85 0.6	0 0
3	1600 1900										
4	1900 2000 2000 2500	0.1 0.5	12 12	57 57	6.84 6.84	6 6	3.42 3.42	Low Low	0 0	0.6 0.4	0 0
									Total heave =		0
1	***Testhole 5*** 0 270										
2	270 800										
3	800 1000 1000 1380	0.2 0.38	16 16	94 94	15.04 15.04	10 10	9.4 9.4	Low Low	0 0	0.85 0.6	0 0
4	1380 2000	0.62	8	88	7.04	11	9.68	Low	0	0.6	0
5	2000 2300	0.3	8	84	6.72	10	8.4	Low	0	0.4	0
									Total heave =		0
1	***Testhole 6*** 0 520	0.52		94		4					
2	520 1000 1000 1200	0.48 0.2									
3	1200 1700	0.5	7	94	6.58	12	11.28	Low	0	0.6	0
4	1700 2000 2000 2100	0.3 0.1	9 9	66 66	5.94 5.94	8 8	5.28 5.28	Low Low	0 0	0.6 0.4	0 0
									Total heave =		0

1	*Testhole 7* 0 820										
2	820 1000 1000 1120	0.18 0.12	9 9	93 93	8.37 8.37	13 13	12.09 12.09	Low Low	0 0	0.6 0.85	0 0
3	1120 1500	0.38	12	91	10.92	13	11.83	Low	0	0.85	0
4	1500 1900	0.4	9	88	7.92	12	10.56	Low	0	0.85	0
5	1900 2000 2000 2300	0.1 0.3	11 11	98 98	10.78 10.78	10 10	9.8 9.8	Low Low	0 0 Total heave =	0.85 0.4	0 0 0
1	*Testhole 8* 0 1000 1000 1200										
2	1200 2000 2000 2200	0.8 0.2	14 14	81 81	11.34 11.34	14 14	11.34 11.34	Low Low	0 0 Total heave =	0.6 0.4	0 0 0



No.	AMENDMENTS	APPR.	DATE

SURVEYED	-
SURVEY PLOTTED	-
DRAWN	LC
DRAWING CHECKED	HJB

PROJECT MANAGER

DATE:

PROJECT DIRECTOR

DATE:

FOUNDED IN 1932

NINHAM SHAND

CONSULTING SERVICES

WELKOM

ETHANOL AFRICA

DCP AND BOREHOLE REPORT

LAYOUT OF DCP TESTS AND DRILL HOLES

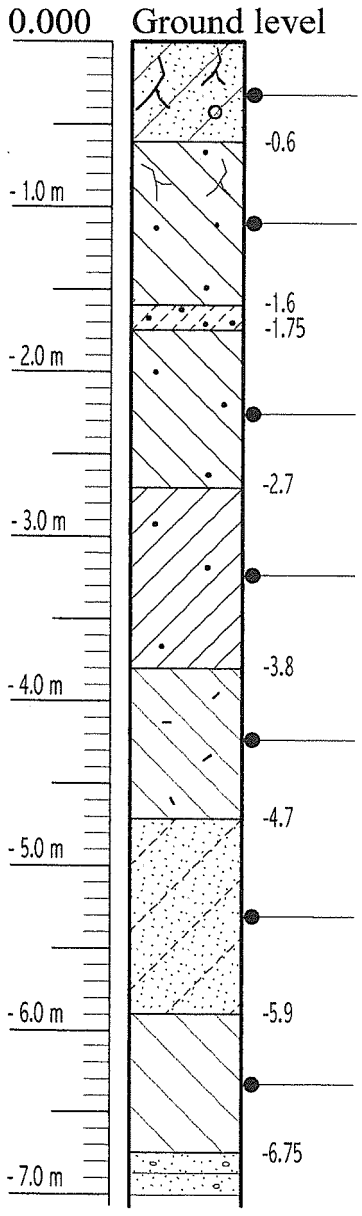
SCALE	
NTS	SHEET 1 OF 1 SHEET

DRAWING No

401364 W 141

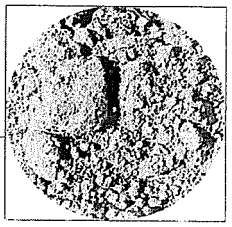
GRONDPROFIEL
SOIL PROFILE

PROJEK / PROJECT	BOTHAVILLE: PROPOSED NEW ETHANOL PLANT	TOETSGAT Nr.	BH1
DATUM / DATE	4 April 2006	TEST HOLE No.	



Brown loose damp loose sandy topsoil with grass and tree roots

Light yellow orange khaki and gray mottled firm damp clay with Fe concretions and fine root intrusions.

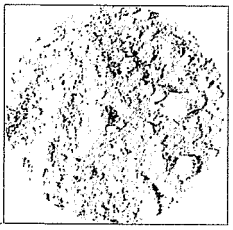


Pebble marker

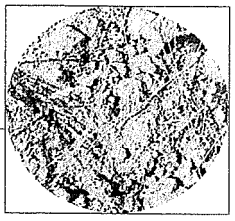
Brown orange and khaki mottled slightly damp stiff clay with Fe concretions

Light olive brown and khaki mottled slightly damp stiff clay with Fe concretions

Brown orange and khaki mottled slightly damp stiff clay with Fe staining

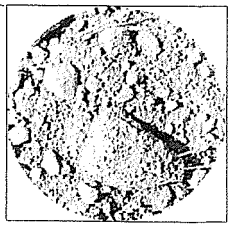


Light gray slightly damp weathered fine grained sandy clay with mica flakes and black speckles



Dark yellow khaki and brown damp soft clay

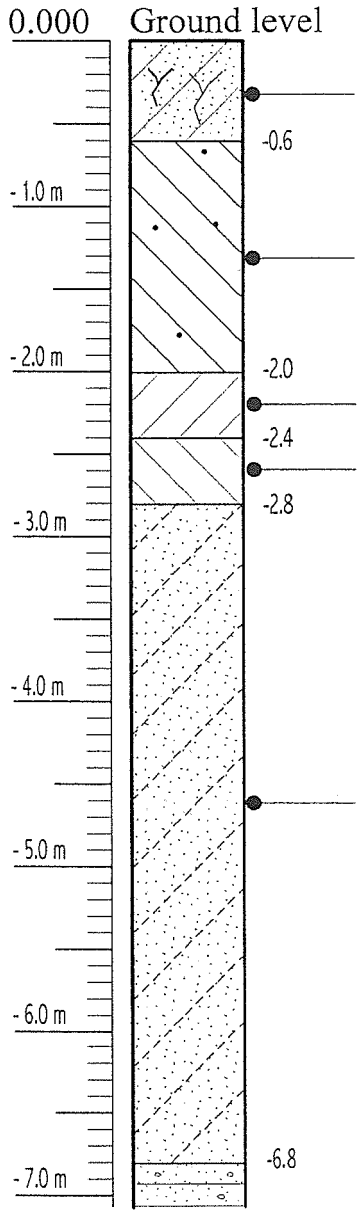
Refusal of rig on light gray slightly damp weathered soft fine grained sandstone with mica flakes at -6.75 m.



Drill rig: MF-50

GRONDPROFIEL
SOIL PROFILE

PROJEK / PROJECT	BOTHAVILLE: PROPOSE NEW ETHANOL PLANT	TOETSGAT Nr.	BH2
DATUM / DATE	4 April 2006	TEST HOLE No.	



Brown loose damp loose sandy topsoil with grass roots

Light yellow orange khaki and gray mottled firm damp clay with Fe concretions

Light gray orange and brown mottled damp soft clay

Light gray and orange mottled damp soft clay with mica flakes

Light gray slightly damp weathered fine grained soft sandy clay with mica flakes Colour becomes yellowish with increase in depth

Refusal of rig on light gray slightly damp weathered soft fine grained sandstone with mica flakes and black stains at -6.8 m.

Drill rig: MF-50

DKP / DCP

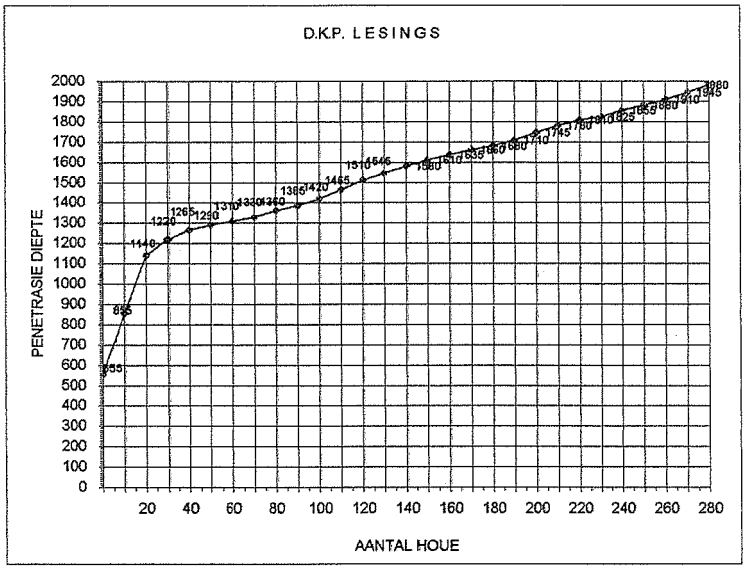
PROJEK.... ETHANOL AFRICA

DATUM.....: 99999999

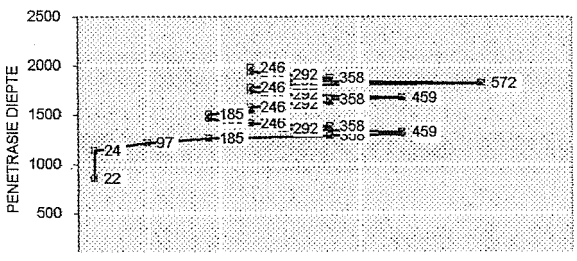
CBR

B E R E K E N I N G E

DIEPTE (mm) (A1)	SLAE	DKP GETAL (mm/slag) (X1)	DKP FAKTOR	SOM VAN HOUE (X2)	KDV	EDS kPa	EDS X 1/3 kPa	DIEPTE VIR GRAFIEK (A2)	mm/slag VIR GRAFIEK (X3)	FAKTOR VIR GRAFIEK (X4)
555			0.00							
855	10	30	0.28	10	5	67	22	555	30	0.28
1140	10	29	0.46	20	6	71	24	855	30	0.28
1220	10	8	0.49	30	29	292	97	855	28.5	0.46
1265	10	5	0.50	40	61	556	185	1140	8	0.49
1290	10	3	0.50	50	128	1073	358	1220	4.5	0.50
1310	10	2	0.50	60	170	1377	459	1265	2.5	0.50
1330	10	2	0.50	70	170	1377	459	1290	2	0.50
1360	10	3	0.51	80	102	875	292	1310	2	0.50
1385	10	3	0.51	90	128	1073	358	1330	3	0.51
1420	10	4	0.52	100	84	737	246	1360	2.5	0.51
1465	10	5	0.53	110	61	556	185	1385	3.5	0.52
1510	10	5	0.53	120	61	556	185	1420	4.5	0.53
1545	10	4	0.54	130	84	737	246	1465	4.5	0.53
1580	10	4	0.55	140	84	737	246	1510	3.5	0.54
1610	10	3	0.55	150	102	875	292	1545	3.5	0.55
1635	10	3	0.55	160	128	1073	358	1580	3	0.55
1660	10	3	0.55	170	128	1073	358	1610	2.5	0.55
1680	10	2	0.56	180	170	1377	459	1635	2.5	0.55
1710	10	3	0.56	190	102	875	292	1660	2	0.56
1745	10	4	0.56	200	84	737	246	1680	3	0.56
1780	10	4	0.57	210	84	737	246	1710	3.5	0.56
1810	10	3	0.57	220	102	875	292	1745	3.5	0.57
1825	10	2	0.57	230	218	1716	572	1780	3	0.57
1855	10	3	0.58	240	102	875	292	1810	1.5	0.57
1880	10	3	0.58	250	128	1073	358	1825	3	0.58
1910	10	3	0.58	260	102	875	292	1855	2.5	0.58
1945	10	4	0.59	270	84	737	246	1880	3	0.58
1980	10	4	0.59	280	84	737	246	1910	3.5	0.59



VEILIGE DRAVERMOë (EDS/3) kPa



DKP / DCP

2

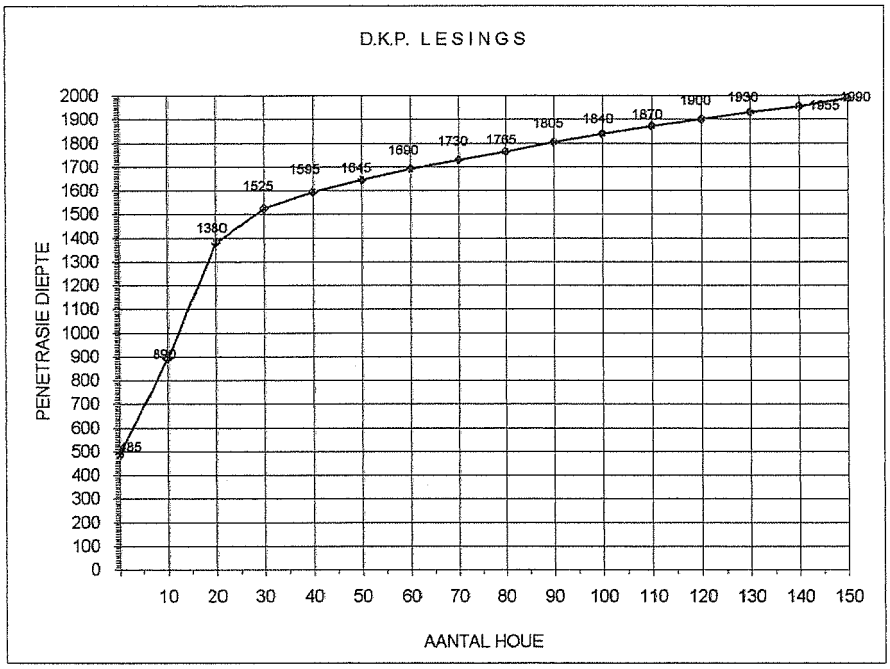
PROJEK...: ***ETHANOL AFRICA***

DATUM....: ***06-Apr-06***

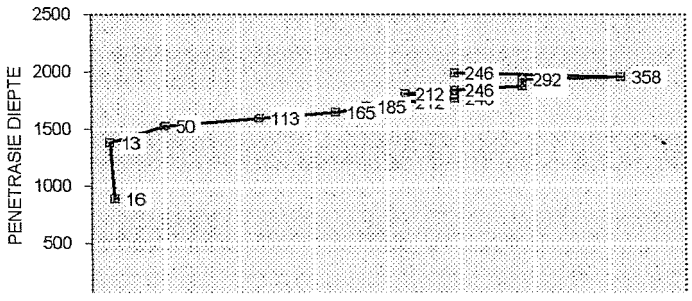
POSISIE..:

B E R E K E N I N G E

DIEPTE (mm) (A1)	SLAE	DKP GETAL (mm/slag) (X1)	DKP FAKTOR	SOM VAN HOUE (X2)	KDV	EDS kPa	EDS X 1/3 kPa	DIEPTE VIR GRAFIEK (A2)	mm/slag VIR GRAFIEK (X3)	FAKTOR VIR GRAFIEK (X4)
485			0.00							
890	10	41	0.42	10	4	48	16	485	40.5	0.42
1380	10	49	0.75	20	3	39	13	890	40.5	0.42
1525	10	15	0.80	30	14	150	50	890	49	0.75
1595	10	7	0.81	40	35	340	113	1380	14.5	0.80
1645	10	5	0.82	50	53	495	165	1525	7	0.81
1690	10	5	0.83	60	61	556	185	1595	5	0.82
1730	10	4	0.84	70	70	635	212	1645	4.5	0.83
1765	10	4	0.84	80	84	737	246	1690	4	0.84
1805	10	4	0.85	90	70	635	212	1730	3.5	0.84
1840	10	4	0.85	100	84	737	246	1765	4	0.85
1870	10	3	0.85	110	102	875	292	1805	3.5	0.85
1900	10	3	0.86	120	102	875	292	1840	3	0.85
1930	10	3	0.86	130	102	875	292	1870	3	0.86
1955	10	3	0.86	140	128	1073	358	1900	3	0.86
1990	10	4	0.87	150	84	737	246	1930	2.5	0.86



VEILIGE DRAVERMOë (EDS/3)



DKP / DCP

3

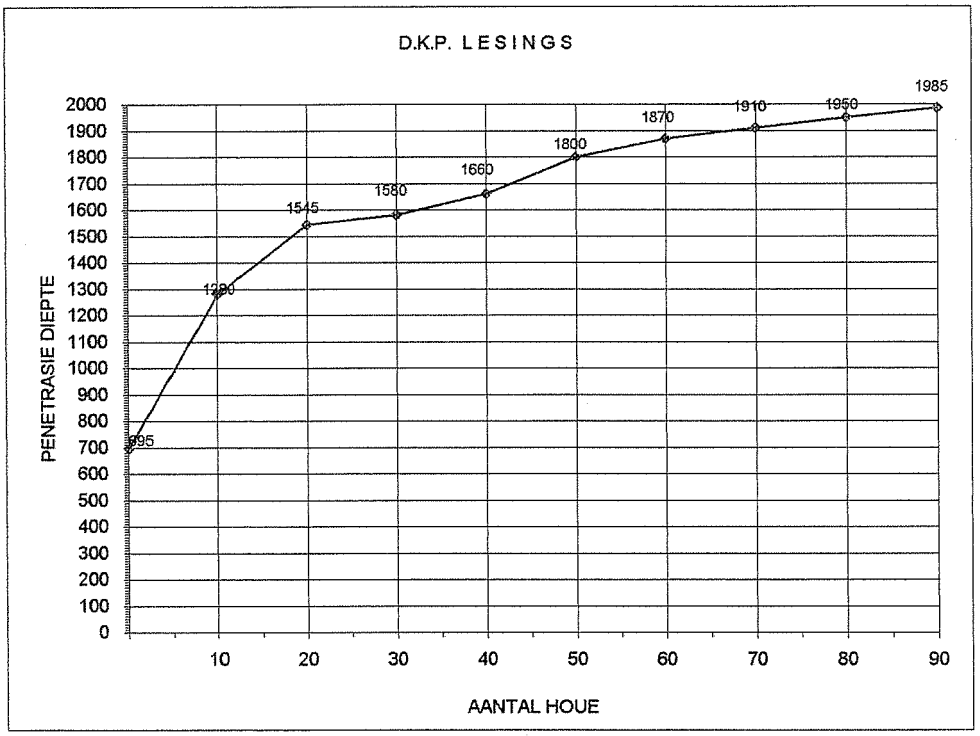
PROJEK....: ***ETHANOL AFRICA***

DATUM.....: ***06-Apr-06***

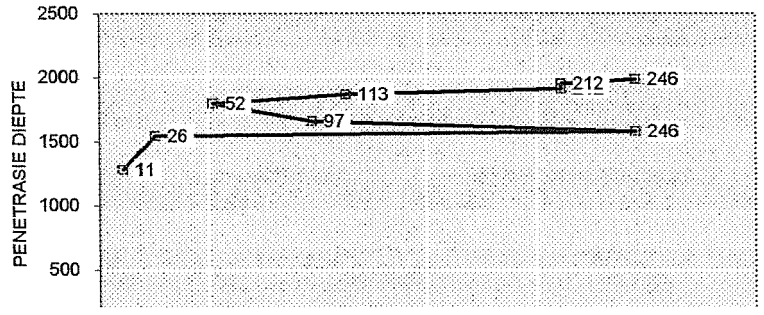
POSISIE..:

B E R E K E N I N G E

DIEPTE (mm) (A1)	SLAE	DKP GETAL (mm/slag) (X1)	DKP FAKTOR	SOM VAN HOUE (X2)	KDV	EDS kPa	EDS X 1/3 kPa	DIEPTE VIR GRAFIEK (A2)	mm/slag VIR GRAFIEK (X3)	FAKTOR VIR GRAFIEK (X4)
695			0.00							
1280	10	59	0.47	10	2	32	11	695	58.5	0.47
1545	10	27	0.58	20	6	77	26	1280	58.5	0.47
1580	10	4	0.59	30	84	737	246	1280	26.5	0.58
1660	10	8	0.61	40	29	292	97	1545	3.5	0.59
1800	10	14	0.65	50	14	156	52	1580	8	0.61
1870	10	7	0.66	60	35	340	113	1660	14	0.65
1910	10	4	0.67	70	70	635	212	1800	7	0.66
1950	10	4	0.67	80	70	635	212	1870	4	0.67
1985	10	4	0.68	90	84	737	246	1910	4	0.67



VEILIGE DRAVERMOë (EDS/3)

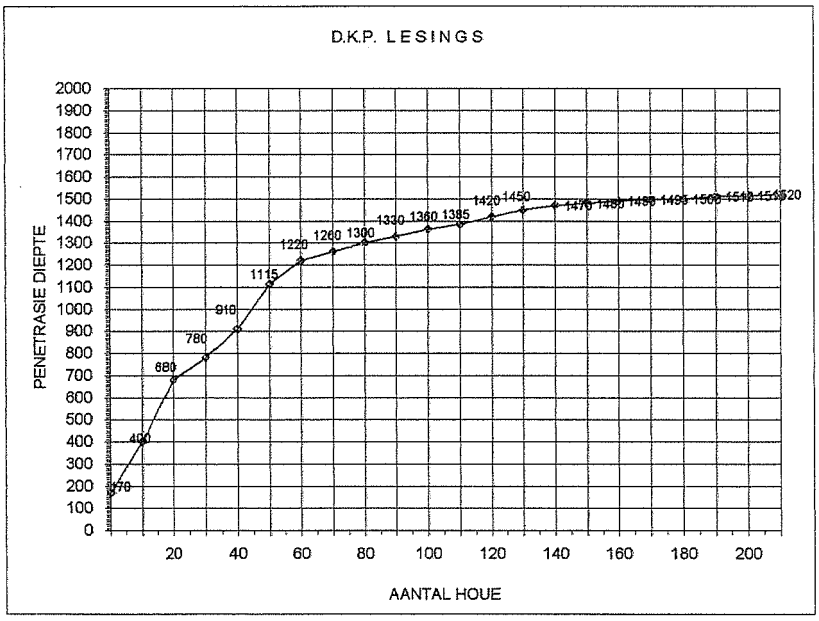


DKP / DCP

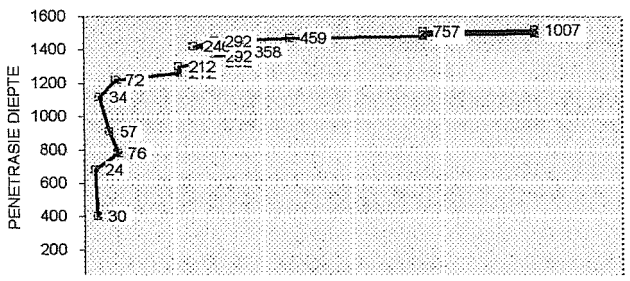
PROJEK... ***ETHANOL AFRICA***
DATUM.....: ***#######***

B E R E K E N I N G E

DIEPTE (mm) (A1)	SLAE	DKP GETAL (mm/slag) (X1)	DKP FAKTOR	SOM VAN HOUE (X2)	KDV	EDS kPa	EDS X 1/3 kPa	DIEPTE VIR GRAFIEK (A2)	mm/slag VIR GRAFIEK (X3)	FAKTOR VIR GRAFIEK (X4)
170			0.00							
400	10	23	0.51	10	8	90	30	170	23	0.51
680	10	28	0.84	20	6	72	24	400	23	0.51
780	10	10	0.90	30	22	228	76	400	28	0.84
910	10	13	0.97	40	16	170	57	680	10	0.90
1115	10	21	1.09	50	9	102	34	780	13	0.97
1220	10	11	1.13	60	21	216	72	910	20.5	1.09
1260	10	4	1.14	70	70	635	212	1115	10.5	1.13
1300	10	4	1.15	80	70	635	212	1220	4	1.14
1330	10	3	1.15	90	102	875	292	1260	4	1.15
1360	10	3	1.16	100	102	875	292	1300	3	1.15
1385	10	3	1.16	110	128	1073	358	1330	3	1.16
1420	10	4	1.16	120	84	737	246	1360	2.5	1.16
1450	10	3	1.17	130	102	875	292	1385	3.5	1.16
1470	10	2	1.17	140	170	1377	459	1420	3	1.17
1480	10	1	1.17	150	300	2270	757	1450	2	1.17
1490	10	1	1.17	160	300	2270	757	1470	1	1.17
1495	10	1	1.17	170	415	3020	1007	1480	1	1.17
1500	10	1	1.17	180	415	3020	1007	1490	0.5	1.17
1510	10	1	1.17	190	300	2270	757	1495	0.5	1.17
1515	10	1	1.17	200	415	3020	1007	1500	1	1.17
1520	10	1	1.17	210	415	3020	1007	1510	0.5	1.17



VEILIGE DRAVERMOë (EDS/3)



DKP / DCP

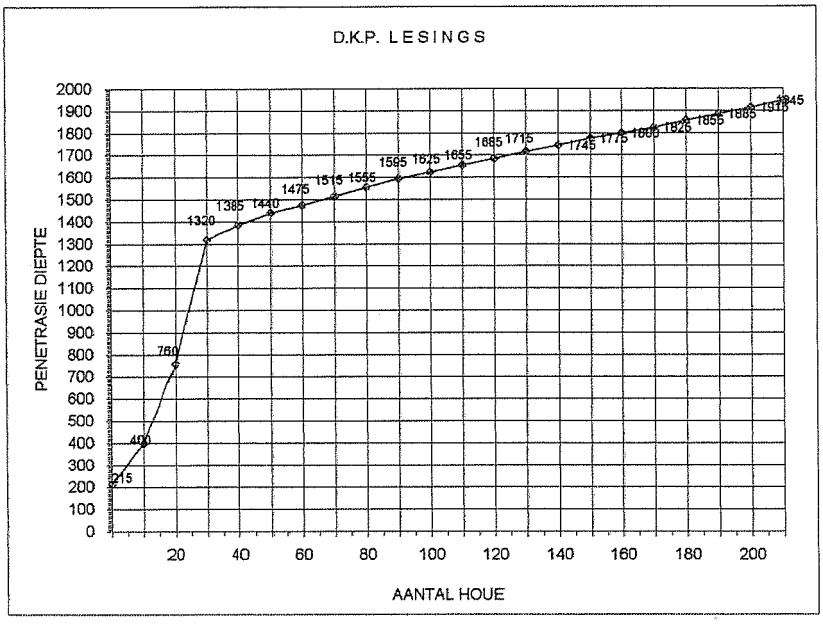
5

*PROJEK... **ETHANOL AFRICA***
DATUM.....: ########

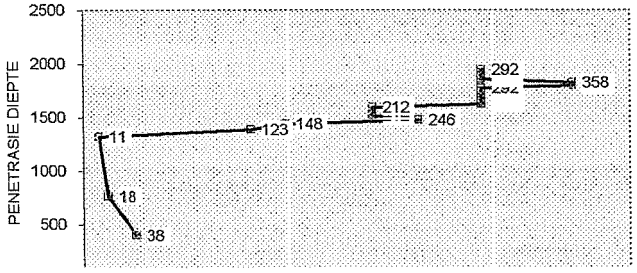
B E R E K E N I N G E

DIEPTE (mm) (A1)	SLAE	DKP GETAL (mm/slag) (X1)	DKP FAKTOR	SOM VAN HOUE (X2)	KDV	EDS kPa	EDS X 1/3 kPa	DIEPTE VIR GRAFIEK (A2)	mm/slag VIR GRAFIEK (X3)	FAKTOR VIR GRAFIEK (X4)
215			0.00							
400	10	19	0.34	10	10	115	38	215	18.5	0.34
760	10	36	0.78	20	4	54	18	400	18.5	0.34
1320	10	56	1.19	30	2	33	11	400	36	0.78
1385	10	7	1.21	40	38	369	123	760	56	1.19
1440	10	6	1.22	50	47	445	148	1320	6.5	1.21
1475	10	4	1.23	60	84	737	246	1385	5.5	1.22
1515	10	4	1.24	70	70	635	212	1440	3.5	1.23
1555	10	4	1.24	80	70	635	212	1475	4	1.24
1595	10	4	1.25	90	70	635	212	1515	4	1.24
1625	10	3	1.25	100	102	875	292	1555	4	1.25
1655	10	3	1.26	110	102	875	292	1595	3	1.25
1685	10	3	1.26	120	102	875	292	1625	3	1.26
1715	10	3	1.27	130	102	875	292	1655	3	1.26
1745	10	3	1.27	140	102	875	292	1685	3	1.27
1775	10	3	1.27	150	102	875	292	1715	3	1.27
1800	10	3	1.27	160	128	1073	358	1745	3	1.27
1825	10	3	1.28	170	128	1073	358	1775	2.5	1.27
1855	10	3	1.28	180	102	875	292	1800	2.5	1.28
1885	10	3	1.28	190	102	875	292	1825	3	1.28
1915	10	3	1.29	200	102	875	292	1855	3	1.28
1945	10	3	1.29	210	102	875	292	1885	3	1.29

4784



VEILIGE DRAVERMOë (EDS/3)

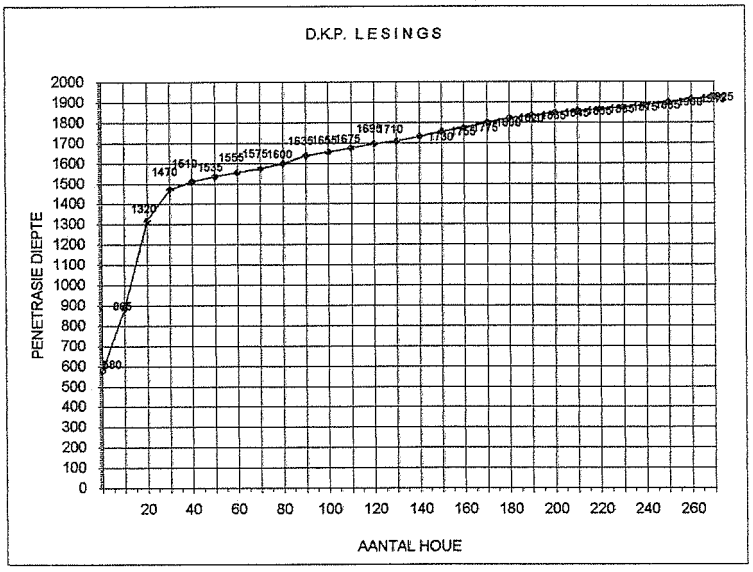


DKP / DCP

PROJEK.... ETHANOL AFRICA
DATUM....: ##########
POSISIE..:

B E R E K E N I N G E

DIEPTE (mm) (A1)	SLAE	DKP GETAL (mm/slag) (X1)	DKP FAKTOR	SOM VAN HOUE (X2)	KDV	EDS kPa	EDS X 1/3 kPa	DIEPTE VIR GRAFIEK (A2)	mm/slag VIR GRAFIEK (X3)	FAKTOR VIR GRAFIEK (X4)
580			0.00							
885	10	31	0.27	10	5	66	22	580	30.5	0.27
1320	10	44	0.56	20	3	44	15	885	30.5	0.27
1470	10	15	0.61	30	13	145	48	885	43.5	0.56
1510	10	4	0.62	40	70	635	212	1320	15	0.61
1535	10	3	0.62	50	128	1073	358	1470	4	0.62
1555	10	2	0.62	60	170	1377	459	1510	2.5	0.62
1575	10	2	0.63	70	170	1377	459	1535	2	0.62
1600	10	3	0.63	80	128	1073	358	1555	2	0.63
1635	10	4	0.63	90	84	737	246	1575	2.5	0.63
1655	10	2	0.63	100	170	1377	459	1600	3.5	0.63
1675	10	2	0.64	110	170	1377	459	1635	2	0.63
1695	10	2	0.64	120	170	1377	459	1655	2	0.64
1710	10	2	0.64	130	218	1716	572	1675	2	0.64
1730	10	2	0.64	140	170	1377	459	1695	1.5	0.64
1755	10	3	0.64	150	128	1073	358	1710	2	0.64
1775	10	2	0.64	160	170	1377	459	1730	2.5	0.64
1800	10	3	0.65	170	128	1073	358	1755	2	0.64
1820	10	2	0.65	180	170	1377	459	1775	2.5	0.65
1835	10	2	0.65	190	218	1716	572	1800	2	0.65
1845	10	1	0.65	200	300	2270	757	1820	1.5	0.65
1855	10	1	0.65	210	300	2270	757	1835	1	0.65
1865	10	1	0.65	220	300	2270	757	1845	1	0.65
1875	10	1	0.65	230	300	2270	757	1855	1	0.65
1885	10	1	0.65	240	300	2270	757	1865	1	0.65
1900	10	2	0.65	250	218	1716	572	1875	1	0.65
1915	10	2	0.65	260	218	1716	572	1885	1.5	0.65
1925	10	1	0.65	270	300	2270	757	1900	1.5	0.65



VEILIGE DRAVERMOë (EDS/3)