G E O T E C H N I C S

STATUS HOMES PROPERTY DEVELOPERS (PTY) LTD

PROPOSED SUBDIVISION & REZONING OF PORTION 9 OF FARM 432, KRANSHOEK, PLETTENBERG BAY

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J1036

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1.0 INTRODUCTION

Geotechnics Africa Western Cape (GAWC) was requested by Mr Alphons Lamour of Status Homes Property Developers (Pty) Ltd (SHPD), to undertake a limited Phase 1 Geotechnical Investigation on Portion 9 of the Farm 432 Kranshoek to the west of Plettenberg Bay. The investigation was to be based on the excavation of a series of test pits that was preceded by a preliminary desk study of the Google Earth imagery and available geological and geotechnical information on the identified land parcel to determine whether:-

(i) It is fit for human settlement.
(ii) It will be suitable for a project-linked Greenfield development.

The information gathered was presented in a Preliminary Report, which also contained the proposals and related cost structure for a Phase 1 Geotechnical Investigation.

GAWC was subsequently appointed by Mr Lamour to proceed with the limited Phase 1 Investigation that would provide the financiers of the project with sufficient information to assure them that the geotechnical conditions are acceptable for the development to proceed and the requisite finances to be released.

The main purpose of a Phase 1 Investigation is to:-

(i) Identify potential hazards.
(ii) Provide the geotechnical basis for safe and appropriate land use planning, infrastructure design, housing unit design and the formation of precautionary measures and risk management procedures.
(iii) Determine the founding characteristics of the near surface soils.
(iv) Classify the site in accordance with the NHBRC Site Class Categories.
(v) Enable the Provincial Goverment to grant conditional approval of housing subsidies.

This report presents the findings of the test pit investigation, interpretation and evaluation of the field and laboratory test results, and makes recommendations in regard to the following:-

(i) Founding conditions for the proposed residential dwellings and, where relevant, light to medium commercial and industrial buildings.
(ii) Classification of the site.
(iii) Potential groundwater problems.
(iv) Excavatability of the subsoils and, if applicable, bedrock conditions for the installation of township services and suitability of the spoil for backfilling purposes.
(v) Suitability of the near surface soils as a subgrade for the construction of township roads, driveways and parking areas.
(vi) Any other geotechnical constraints that would need to be taken into account during the planning, design and construction stages of the development.

2.0 INFORMATION USED

2.1 Information Supplied by SHPD:

Provision of the following information was arranged by Mr Lamour to enable a preliminary evaluation of the property and planning of the fieldwork for the Phase 1 Investigation to be undertaken in accordance with the National Housing Code:

(i) Google Earth image showing the layout of the existing properties surrounding the site, including their respective erf numbers and neighbouring farm portions, see Figure 1b.
(ii) Vegetation Status for the Proposed Subdivision of Portion 9 of Farm 432, Kranshoek, as compiled by MetroPlan Town & Regional Planners, Drawing No. 17008_Kra. – see Figure 6.
(iii) Proposed Framework (‘Phasing’) Plan of Portions 7, 8 & 9 of the Farm 432 Kranshoek, Drawing No. 17008_Kra. 12, Rev 1, compiled by MetroPlan, see Figure 5a.

(iv) National Department of Housing: Geotechnical Site Investigations for Housing Developments, Project Linked Greenfield Subsidy Project Developments – Generic Specification GFSH-2, dated September 2002.

The following information and revised plans were subsequently received from Messrs. Farrel Josephs of Bau-Afrika Consulting Engineers and Project Managers, and John Sharples of SES:

- Proposed Subdivision & Rezoning of Portion 9 of the Farm Kranshoek No. 483, Knysna Road, Drawing No. 17008_Kra 12 Rev.3, see Figure 5b.
- Northern Business Zone I (Shopping Centre) and Residential Zone IV (Social Housing) Properties - Revised Option 3, showing No-go Wetlands & 42m Buffer Zones, see Figure 5c.

The wetland and related no-go zones along the drainage lines that cross the northern part of the site are delineated on both these plans as depicted on the Google Earth Overlays on Figures 5b and 5c.

2.2 Information Sourced by GAWC

The following published maps and information sources were consulted by GAWC:

(i) 1:250 000 geological map, Sheet 3322 Oudtshoorn.

(ii) 1:100 000 geological map of the Republic of South Africa.

(iii) Google Earth imagery dated 20 October 2017.

(iv) Council for Geoscience's Data Bank – Mr. Stapelberg of the Council reported that they had no records of the developments in the immediate vicinity of the site but only of developments further afield. In spite of them falling on the same topocadastral map, Sheet 3423Ab, they occur in a completely different geological setting.

(v) The National Home Builders Registration Council (NHBRC) was also contacted regarding the two, evidently relatively recent affordable housing developments on the north and south sides of the existing Krantshoek residential township. However, the NHBRC also reported that they had no information on any of the developments in the general area of the site.

(vi) Plettenberg Bay Information Centre – The Info Centre confirmed that the Robberd Quarry Brickworks, is the only 'mine' in the vicinity of the site. The quarry is located approximately 1,8km west of the turn-off to Krantshoek, referred to as Trekker road off Robberg Road, see Figure 1a.

(vii) Bitou Municipality-Groundwater Management and Artificial Recharge Feasibility Study Report – compiled by Groundwater Africa in September 2007.

(viii) Breede-Gouritz Catchment Management Agency (CMA) was contacted to obtain a list of registered boreholes in the Krantshoek area; however, GAWC was unable to get in touch with their local representative.

2.0 PROPOSED DEVELOPMENT

In terms of the Proposed Framework Plan of Portions 7, 8 and 9 of Farm 432, Kranshoek, the property will be zoned as set out in the table below and developed in three phases:-

Zoning	Land Use	Portion No.	No. of Units
Residential Zone I	Dwelling Houses	1 - 559	559
Residential Zone IV	Flats	560	316
Business Zone I	Shops and shopping centre	561 & 562	2
Institutional Zone I	School & crèche	563 & 564	2
Institutional Zone II	Place of Worship	565 & 566	2
Institutional Zone III	Health clinic	567	1
Open Space Zone I	Public Parks	568 - 570	3
Transport Zone I	Roads	-	-

The layout of the above development option is shown in Figure 5a. However, rezoning of the site to accommodate the wetland and public open space flanking it, resulted in a considerable reduction in residential units and areas allocated for Business Zone 1, Residential Zone IV and Institutional Zone 1, see Figure 5b.

An additional reduction in the developable areas on the site resulted from a further extention of the wetland strips along the two drainage features and buffer zones that cross the northen part of the site, see Figure 5c.

4.0 THE SITE

4.1 Site Location

The location of the site in relation to the existing Krantshoek residential township, the N2 Highway and Trekker Road that provides access to Kranshoek from Robberg Road, including the coastline and residential areas further afield, is indicated on the Google Earth image in Figure 1a and 3.

4.2 Site Features

The two crèches on the southern part of the site, are run by Mr Brown. The property occupied by these crèches, is labelled, BC, on the Google Earth image covering the southern part of the site in Figures 4a and b. There are two partially demolished building (ruins) to the south and south east of the property occupied by the crèches.

The existing houses and related buildings that occur within the central and north parts of the site now belong to the children of the original owner, the late Mr Johnny Olivier. These properties and their reference labels indicated in Figures 4b and 4c, are tabulated below:-

Reference on Figures 4a to 4c	Owners / Occupants
QO	Quinton Olivier and family
SO	Stella Olivier and family
MP	Marita Prins, step daughter of QO's deceased uncle
OS	Old Shop
SC	Shirna Cunningham, QO's cousin

The property on the south-eastern corner, referred to as LF/GT in Figures 4a and 4b, belongs to the Griekwa Trust and is utilised by the Le Feur Tea Nursery.

The chicken farm on the north side of the site belongs to the 'Van der Schyff and Seun Boerdery'.

It is understood that the original Kranshoek residential township was developed more than 20 years ago. The RDP housing scheme to the north of it, apparently, was subsequently developed in three phases, namely:-

(i) Phase 1 ± 15 years ago.
(ii) Phase 2 ± 13 years ago.
(iii) Phase 3 ± 8 years ago.

The remainder of the site is crossed by several footpaths, vehicle tracks and access roads to the various dwellings belonging to the Olivier family.

Panoramic photographs of the surface conditions around most of the test pits are presented on Plates 1 to 21 in Appendix A.

4.3 Topography

The ancient wave-cut marine terrace on which Krantshoek and surrounding territories are located, falls gently towards the coastline and is crossed by a series of south-draining water courses, see Figures 1a and 3.

The cliffs along the coastline are near vertical in most places with caves and overhangs carved into the face by wave action, hence the name 'Neusgate' describing one of the embayments to the south-east of the site, see Figures 2 and 3.

The site itself falls gently towards the east and south-east by 4m to 5m at gradients ranging from 1:40 to 1:90.

4.4 Vegetation

Most of the site is covered by relatively tall tufted grass with scattered young pine, gum, black wattle and Port Jackson saplings, shrubs and trees.

The eastern perimeter of the site is occupied by denser vegetation ranging from mixed fynbos, invaded by alien Port Jackson saplings and shrubs with scattered larger pine and more mature blue gum trees, see Plates 1 to 21 in Appendix A.

The two drainage features that cross the northern part of the site are occupied by dense, almost thicket-forming black wattle and Port Jackson shrubs and small trees, see Plates 18 to 21 in Appendix A.

Large patches of kikuyu grass surround the derelict and abandoned buildings, see Plates 3, 9 and 22; however, the lawns and gardens surrounding Mr Quinton and Ms Stella Oliviers residences, are well maintained, see Plates 10, 23 and 24.

5.0 FIELD INVESTIGATION

The fieldwork, which was undertaken from 3 to 6 February 2020, comprised the following:-

(i) Reconnaissance site walk-over to assess, record and photograph the general surface conditions.
(ii) Meeting the various occupants of the houses on the site to inform them of the intended test pit investigation and gathering of general information.
(iii) Setting out of thirty test pits using a portable GPS.
(iv) Performance of Dynamic Probe Light (DPL) tests at each test pit position.
(v) Excavation of the test pits by a JCB supplied Bitou Civils cc.
(vi) Taking of panoramic photographs of the surface conditions around most of the test pits.
(vii) Soil profiling and sampling of dominant soil horizons, and photographing of test pit exposures.
(viii) Supervision of backfilling of test pits.

(ix) Inspection of existing dwellings on the property and to record and photograph cracks, as well as those observed on the exterior walls of the RDP houses on the eastern perimeter of the existing Kranshoek Residential Township along Trekker Road.

The surface conditions around the test pit locations are depicted on Plates 1 to 21, in Appendix A, and the photographs of the cracks observed on the exterior walls of existing houses, are illustrated on Plates 22 to 27 in Appendix B2. Those observed in the RDP houses on Trekker Street on the west side of the site, are presented on Plates 28 to 38 in Appendix B2.

The soil profiles that were described in accordance with standard procedures recommended by Jennings *et al* (Ref 1), are contained in Appendix C. The graphical representation of the DPL test results, are contained in Appendix D and the detailed laboratory test results in Appendix E.

6.0 GEOLOGY, STRATA ENCOUNTERED AND GROUNDWATER

6.1 General

An extract from the 1:250 000 geological series, Sheet 3322 Outshoorn, which includes Plettenberg Bay, shows the Kranshoek area to be underlain by quartztic sandstone of the Peninsula Formation that belongs to the Table Mountain Group (TMG), see Figure 2. However, the investigation revealed that the site is underlain by deeply weathered siltstone.

More recent and updated geological information obtained from the Council for Geosciences indicate that the site falls into an area underlain by rocks of the Nardouw Subgroup also of the TMG, which includes siltstone. The possibility that the residual siltstone could be a completely weathered relic of the Cederberg Shale Formation, also of the TMG, cannot be discounted.

6.2 Strata Encountered

The following generalised soil profiles, which should be read in conjunction with the summary in Table 1, has been compiled from the detailed descriptions of the strata recorded in the thirty test pit exposures:

Fill:- Fill was only encountered in the top 0,2m to 0,25m thick layer in test pits, TP2 and TP22. The material comprised medium dense intact silty SAND with scattered pieces of sandstone and quartz gravel in TP22.

Humified Sheetwash:- This generally 0,15m to 0,3m thick organic layer comprises dark grey-brown through grey-brown to light grey-brown predominantly loose to medium dense intact to slightly voided and voided clayey silty fine and medium SAND, or firm to stiff weakly shattered slightly organic sandy clayey SILT. It contains fine roots in the top 100mm to 200mm layer.

Sheetwash: A 0,4m to 1,4m thick light brown to yellow- or orange-brown blotched red- or yellow-brown firm through stiff to very stiff intact to slightly shattered and shattered clayey SAND-SILT to sandy clayey SILT and sandy SILT-CLAY was encountered in all the test pits.

Nodular Pedocrete/ Pebble Marker:- A predominantly 0,15m to 0,5m thick layer of scattered or numerous to abundant ferricrete and/or calcrete NODULES & CONCRETIONS contained in a stiff to very stiff indistinctly to weakly shattered sandy CLAY-SILT matrix. It is very poorly developed in places, e.g. in TP3, TP4, TP11, TP13, TP15 and TP19, where only traces to scattered ferricrete concretions occur at the base of the sheetwash horizon, i.e. at depths of between 1,0m

and 1,6m below ground level. It could not be detected at the base of the sheetwash horizon in TP10 and TP18.

Reworked Residual Siltstone:- This 0,15m to 1,2m thick biotically reworked horizon occurs from depths ranging between approximately 1,0m and 1,5m below ground level; it comprises a predominantly red-brown blotched orange-brown and light to pale grey firm through stiff to very stiff shattered to indistinctly or weakly shattered sandy CLAY-SILT to slightly sandy clayey SILT or sandy CLAY-SILT. It often contains scattered or some ferricrete concretions and nodules, in which case it is described as being ferruginous.

Partially Reworked Residual Siltstone:- The reworked residual siltstone becomes partially reworked and less ferruginous from depths ranging between 1,1m and 2,5m below ground level. It is generally pale to light grey blotched pale red- and/or orange-brown to pale pinkish-brown stiff to very stiff weakly shattered to intact silty sandy CLAY to sandy clayey SILT or sandy CLAY-SILT/ sandy SILT-CLAY.

The bedrock was not encountered in any of the test pits.

6.3 **Groundwater**

All the test pits remained dry for the duration of the field investigation, except for TP10, which was excavated in an old fenced-off abandoned cultivated field, evidently that was irrigated by a sprinkler system. It would appear that the very slight seepages encountered derive from a leak in the irrigation system.

Groundwater is also expected to be encountered in wetland zones along the two drainage features that cross the top third of the site.

It is understood that there are no boreholes on the property and that a municipal pipeline on the northern boundary supplies potable water that is being used for both domestic and irrigation purposes.

7.0 TESTING

7.1 Field Penetrometer Testing

The field data obtained from the Dynamic Probe Light (DPL) tests, also known as Drop-weight Cone Penetrometer (DCP) tests, undertaken from the surface next to the test pits, have been plotted graphically on the DPL-Sheets in Appendix C. This graphical representation of the results enables a correlation to be made between penetration rate (measured in mm/blow) and material consistency with depth.

The results obtained from these probes confirm most of the consistencies described in the field during profiling. Slight variations in the penetration rates are ascribed to localised changes in moisture content and/or the presence of random zones of ferricrete concretions that tend to partially obstruct the penetrometer and decrease the penetration rates..

For ease of reference, brief descriptions of the respective horizons have been added to the DPL graphs in Appendix D.

The general trends in consistencies are briefly summarised below:-

(i) Humified Sheetwash – Loose to medium dense.
(ii) Sheetwash – Firm to stiff and very stiff in places.
(iii) Pebble Marker / Nodular Pedocrete – Stiff and very stiff.
(iii) Reworked Residual Siltstone – Predominantly very stiff.

7.2 **Laboratory Testing**

7.2.1 General

Representative disturbed samples of the sheetwash, nodular pedocrete/pebble marker, reworked residual and partially reworked residual siltstone horizons were submitted to Control Geosciences (Pty) Ltd for foundation indicator and natural moisture content (nmc) testing.

The indicator tests entail the determination of the particle size distribution and Atterberg limits, which are summarised in Table 2, and are briefly described in Sections 7.2.2 below.

Bulk samples have also been taken for compaction testing, which will be undertaken at a later stage to confirm the compaction characteristics of the strata encountered.

A water sample and two indicator soil samples were also submitted to Control Geoscience laboratory for chemical analyses to determine the pH and Conductivity of these soils and water sample.

7.2.2 Indicator Tests and Classification

7.2.2.1 Sheetwash

This material was sampled between 0,5m and 0,8m in TP1, between 0,3m and 1,1m in TP16 and 0,3m to 0,9m in TP22. The grading analyses show the material to be composed of 14% - 30% sand, 30% - 59% silt and 17% - 52% clay with very little or no gravel. The liquid limits (LL), plasticity indices (PI), linear shrinkages (LS) and grading moduli (GM) range from 15 – 40, 7 – 16, 3,0 – 7,0 and 0,19 – 0,39, respectively. The natural moisture content (nmc) at the time of the investigation range from 8% to 24%.

7.2.2.2 Nodular Pedocrete / Pebble Marker

The index tests performed on a sample taken between 1,0m and 1,2m in TP22 shows it consist of 59% clay, 14% silt, 18% sand and 9% gravel; it also has a LL = 46, PI = 16, LS = 7,0 and GM = 0,56, which is the highest due to the increase in the coarse fraction.

7.2.2.3 Reworked Residual Siltstone

The sample taken at 2,1in TP1 and 1,4m to 1,8m in TP16 shows it to be composed of 56% and 52% clay, 15% and 18% silt, 28% sand and 1% and 2% gravel, respectively; the LL's = 38 and 45, PI's = 15 and 21, LS's = 8,0 and 10,0 and GM = 0,37 and 0,38, respectively. The natural moisture contents at the time when the two samples were tested, were 30% and 24%.

7.2.2.4 Partially Reworked Residual Siltstone

The samples taken at 3,0 in TP1 and approximately 2,0m in TP22 consist of 52% and 49% clay, 14% and 23% silt and 34% and 27% sand, respectively; the LL's = 41 and 31, PI's = 17 and 14, LS's = 8,0 and 7,0, and GM = 0,34 and 0,35, respectively.

7.2.3 Potential Expansiveness

The plastic properties of all the samples tested, were plotted on Van der Merwe's Actively Chart in Figure 7, which showed them to fall into the low potential expansive category, see Figure 7.

7.2.4 Classification

7.2.4.1 Unified Classification System

Most of the samples tested fall into the inorganic clay of low plasticity CL, category. The pebble marker in TP22 falls into the inorganic silt of low plasticity category, ML,

and the sheetwash sampled at 0,5m in TP16 receives a double classification, ML and CL, which is also referred to as MCL.

7.2.4.2 United States Public Roads Administration (USPRA) System

All the sheetwash samples fall into the A-4 group of this system and the reworked residual and partially reworked residual siltstone, including the nodular pedocrete / pebble marker, fall into either into the A-6, A-7-5 and/or A-7-6 groups of this system.

7.2.4.3 TRH 14 Classification System

Classification of the samples in this system will only be possible once the compaction tests have been completed.

7.3 **Chemical Analyses**

Conductivity and pH tests were performed on the water sample taken at the base of TP10 and on the foundation indicator samples taken between 0,3 and 0,6m, and between 1,6m and 2,1m in TP16.

The conductivity test provides a rapid indication of soluble (and most deleterious) salts present in soil and groundwater samples; it entails mixing approximately 100g of the minus 0,425mm material with distilled water and then measuring the electrical conductivity of the resultant suspension.

Acidity and electrical conductivity of a suspension also provide a quick indication of a soil's aggressive and corrosive tendencies. Low pH's, in combination with high electrical conductivity, are indicative of aggressiveness.

The acidity of the water and soil samples tested are categorised in accordance with McVicar's pH Classes (Ref 6) in the table below:-

Test Pit No	Sample Depth (m)	Soil Horizon	pH	Degree of Acidity
TP10	2,0	Water sample	5,2	Acidic
TP16	0,6	Sheetwash	6,47	Slightly acidic
TP16	1,6 – 2,1	Partially Rew Res Siltstone	6.79	Very slightly acidic

McVicar considers electrically conductive soils with values in excess of 75mS/m to have a high salt content, while those with values of less than 25mS/m are low in salt content.

The conductivity of the water sample in TP10 is 76,8mS/m, which places it just in the high salt content range, while the conductivity of the soil sample at 0,3m to 0,6m in TP16 is 20,8mS/m, which falls in the low salt content range. The conductivity of the partially reworked residual siltstone sample between 1,6m and 2,1m in TP16 is 293mS/m, which places it in the high salt content range.

The correlation between electrical conductivity and corrosivity used by Waterlab (Pty) Ltd, is set out below:-

Electrical Conductivity (mS/m)	Corrosivity
0 – 10	Non-corrosive
10 – 40	Mildly corrosive
40 – 80	Corrosive
> 80	Highly corrosive

The water sample is therefore likely to be corrosive and the sheetwash sample to be mildly corrosive; however, leachates from the partially reworked residual siltstone appears to be highly corrosive.

8.0 EVALUATION & RECOMMENDATION

8.1 Site Clearing

8.1.1 Existing Buildings

As a first requirement, the owners/occupants of the existing houses would have to be relocated before any of the structures can be demolished. It is uncertain whether the nursery school is excluded from the development and whether it will be demolished. All foundations and buried parts of these structures would have to be grubbed out and water-borne services, including electricity supply cables, should first be disconnected at the site boundaries.

8.1.2 Vegetation

The ‘Vegetation Status’ presented on the MetroPlan map in Figure 6 places the vegetation around the Kranshoek developments, including the site, in the ‘Vulnerable’ category. The botanical study undertaken on the property has presumably identified rare plant species that need to be rescued and relocated.

The alien vegetation that has invaded large parts of the site, in particular the drainage features, must be eradicated.

8.2 Drainage

8.2.1 Surface Water

The only natural occurrences of surface water were two small ponds located on the drainage features that cross the northern part of the site.

There were no apparent signs of surface water, both present and past (historical), within the buffer zones indicated on either side of the strips described as ‘wetland’ areas in Figures 5b and 5c. It is assumed that the buffer zones are based on either 1:50 or 1:100 year flood level calculations. Groundwater seepages are expected to be

encountered only in the wetland areas. Information would have to be obtained from the occupants/owners of the properties on either side of the drainage features to determine whether waterlogging occurs during exceptionally wet weather conditions and whether flooding of these features has occurred since the family acquired the property.

8.2.2 Groundwater

Practically all the materials encountered on the site are high in plastic fines and contain between 67% and 83% clay and silt. These soils therefore have low permeabilities and are therefore unable to contain significant volumes of groundwater within the top decomposed siltstone horizons that extend to depths of more than 3,0m below ground level.

Slight seapage was only intersected in TP10, which is considered to derive from a leak in the irrigation system observed on the surface in places. It was evident that this system has been out of commission for many years and must have been leaking for some time; it would therefore have to be removed and the source of water terminated to prevent waterlogging of the subsoils.

The permanent water table is expected to occur deeper down in the sedimentary succession and presumably in the underlying fractured TMG sandstone, the depth to which would need to be determined either through geophysical methods, e.g. Electric Resistivity Tomography (ERT) technology, or alternatively, by drilling boreholes into the sandstone at depth.

8.3 **Excavatability and Workability of Subsoils**

All the strata encountered in the test pits can be readily excavated with conventional earthmoving plant to depths of at least 3m below ground level.

The strata are also cohesive and predominantly stiff to very stiff below 1,5m. Unsupported temporary trenches should therefore be stable provided they are not

subjected to standing water or persistent wet weather conditions, in which case the sidewalls would either have to be shored or battered back.

Since the soils are high in plastic fines, workability will be difficult. The clayey soils will tend to stick to the compaction plant in the wet, and their optimum moisture content will be very difficult to control to achieve any satisfactory compaction.

8.4 **Potentially Expansive Soils**

8.4.1 General

A potentially expansive soil is one which is likely to experience volumetric change with variations in moisture content; these clay-dominated soils tend to swell upon saturation, which is reflected as heave at the surface and shrink when they dry out again, which reflects as ‘settlement’ around the perimeters of buildings. These movements and related damage tend to continue with seasonal moisture fluctuations.

8.4.2 Observed Damage Related to Heave

In spite of the fact that all the samples tested plot in the low category of Van der Merwe’s Activity Chart in Figure 7, the dwellings on the site display typical heave-related cracks. Cracks have also developed along movement joints formed in Mr Quinton Olivier’s double storey house. These cracks are illustrated on Plates 22 to 27 in Appendix B1. The cracks are unlikely to have been caused by differential settlement since the soils possess sufficient bearing capacity to support conventional single and double storey house foundations.

Typical heave-related cracks were also observed in some of the RDP houses on the west side of Trekker Road, see Plates 28 to 38 in Appendix B2. These houses appear to be supported either on stiffened raft or reinforced slab-on-grade foundations, which still needs to be confirmed.

8.4.3 Heave Prediction

The following method of heave prediction have been employed to establish the extent to which the soils on site are likely to swell upon saturation:-

(i) Van der Merwe Method (Ref 2), which is based on the clay fraction, plasticity index of the soil and overburden pressure.
(ii) Weston Method (Ref 3), which is used in pavement design, based on liquid limit, natural moisture content and applied load.

The heave determined from the Van der Merwe method is based on a desiccated clay-soil that swells upon saturation, whereas the Weston Method takes into account the natural moisture content, i.e. heave under the moisture conditions that prevailed at the time of the investigation.

Since the samples tested fall into the low potential expansive category on the Van der Merwe Activity Chart, heave at the surface is expected to be negligible.

Calculations show that surface heave determined from the Weston Method at the current moisture levels is also low, i.e. <7,5mm. Of note, however, is that Weston predicts an appreciable increase in heave under dryer conditions, i.e. if the current moisture contents of between 18% and 37% are reduced to between 10% and 15%, and the profile subsequently becomes saturated again. Total heave at the surface in such a case is estimated to increase to between 10mm and 30mm, or more, if the profile dries out to depths of more than 2,0m below ground level.

8.4.4 Site Class Categories

The Site Class Categories for heaving soil conditions, as set out in the Code of Practice entitled, “Foundation and Superstructures for Single Storey Residential Buildings of Masonry Construction, Ref 4, are listed in Table 3.

Total heave at the surface based on Van der Merwe’s Method of prediction under desiccated conditions is expected to be less than 7,5mm, upon saturation. This places

the entire site in an ‘H’ site class category, in which case ‘normal’ construction procedures will apply.

Total surface heave based on Weston’s method under the current moisture regime also places the site in the ‘H’ Category, which explains neither the damage observed in the buildings on the site nor the ones observed in the RDP houses on the west side of the site.

However, under much dryer conditions, such as those experienced during the recent drought, desiccation and subsequent wetting up of the soil profile may well have resulted in soil movements that could have caused the cracks observed in these structures. Weston indicates that total heave movements of up to 30mm or more may occur following a severe drought, in which case an ‘H2’ category would apply.

8.5 F**oundation Considerations**

8.5.1 House Foundations

The soils underlying the top humified sheetwash horizon are firm through stiff to very stiff. They therefore possess sufficient bearing capacity to support the anticipated light-weight house foundations. However, preparation of the surface, once the humified sheetwash horizon has been removed would require some compaction to densify any disturbed material. The placement of a limited thickness of an imported granular material, compacted to say 93% mod AASHTO, especially in wet weather conditions, would improve the working conditions.

In light of the damage observed in the existing buildings on the site and the cracks noted in the neighbouring RDP houses, it is essential that the NHBRC (Ref 7) and C.O.P (Ref 4) guidelines for at least an ‘H1’, but preferably an ‘H2’ site class category be adopted throughout the residential component of the proposed development.

An ‘H1’ category should only be considered, if a static moisture regime can be maintained beneath the individual houses. This can be achieved by placing a vertical plastic membrane in an approximately 1,5m deep trench around the dwellings to

encapsulated the underlying soils so that the effects of seasonal moisture fluctuations within the critical zone around the houses, can be minimised.

In the case of an ‘H2’ category, a stiffened or cellular raft foundation system, in conjunction with an articulated and lightly reinforced masonry super-structure is recommended.

It must be stressed that some of the movement joints observed in the neighbouring RDP houses were defective and cracks were seen to extend into the brickwork on either side. Cracks are also seen to be developed in structurally week parts of these buildings, in spite of the presence of nearby movement joints.

The structural engineers that designed these structures should be contacted to confirm whether the houses are supported on stiffened or cellular raft foundations and what site class categories were adopted.

It is essential that positive drainage always be maintained around the dwellings. The foundations should also be protected against the ingress of surface water by constructing impervious aprons with dish-drains at their perimeters to intercept and discharge surface water well away from the houses.

Any abnormal soil conditions encountered during the inspection of foundation and services trenches when the Phase 2 Geotechnical Investigation is undertaken, must be reported to the Professional Team/Engineer.

8.5.2 Business, Social Housing & Institutional Buildings

More heavily loaded single and double storey buildings should be founded on spread foundations placed on at least stiff sheetwash and/or the nodular pedocrete horizons. The foundations should be proportioned to impose contact stresses of less than 200kPa. Contact stresses should also be kept as uniformly as possible to minimise the risk of minor differential settlements occuring where the consistencies of the sheetwash varies locally and soft to firm pockets are identified.

It is essential that site specific foundation investigations be undertaken wherever heavier and more extensive structures are to be erected. These structures should also be designed to accommodate or resist total soil movements related to either ‘H1’ or ‘H2’ Site Class Categories, i.e. 7,5mm to 15mm for an ‘H1’ category, or 15mm to 30mm for an ‘H2’ category.

8.5.3 Precautionary Measures

The following additional precautionary measures are considered essential to further reduce the risk of heave-related damage occurring in movement sensitive parts of the heavier and more extensive buildings.

(i) Reinforcing of the foundations, which must be designed by a structural engineer based on engineering parameters obtained through a more detailed geotechnical investigation.

(ii) Stiffen the foundation brickwork by placing brick-force in every course up to damp proof course (DPC) level and providing a cavity between the inner and outer skins of brickwork. The cavity should then be filled with a well compacted 20 MPa concrete.

(iii) Construct full-depth movement joints where differentially-loaded double and single storey structures will be jointed, and in areas where both single and double storey buildings are likely to be affected by differential movements related to ‘H1’ and/or ‘H2’ Site Class Categories. These joints should be taken through the suspended floor slabs of double storey buildings.

(iv) The perimeters around the buildings must be protected by apron slabs with dish-drains at their edges to intercept run-off from rain driven onto the exterior walls and diverting this water well away from the foundations. Water should not be permitted to pond at the surface within 3m from the perimeter walls of any structure.

(v) The trenches of services that will be installed near the buildings must be property backfilled in well compacted layers to prevent loosely backfilled trenches from acting as conduits for surface water to be attracted to the founding stratum.

(vi) It is recommended that all beds be cast free from the walls to accommodated possible minor differential movements. Non load bearing walls should not be supported on thickenings in the surface beds. These walls should preferably be placed on their own foundations, taken to the same depth as the load bearing perimeter walls.

8.6 Suitability of Materials

The indicator tests have shown that both the transported and residual soils are fine-grained and consist of more than 67% clay and silt. These soils are therefore unsuitable to be used as general backfill materials. In fact the compaction tests that still need to be undertaken would more than likely prove them to be either of G10 or worse than G10 quality, in terms of the TRH 14 Classification (Ref 5).

The sheetwash and reworked residual siltstone materials will also be poor to very poor subgrade materials beneath the proposed township roads, driveways and paved parking areas on the premises of the business and institutional sites.

The more granular nodular pedocrete / pebble marker horizons are considered to be too inconsistent and variable to provide a reliable source of a gravel material.

In light of the poor-quality soils on the site, provision would need to be made for the importation of a granular material for the following purposes:-

(i) Backfilling beneath surface beds.
(ii) Placement of limited soil rafts beneath stiffened or cellular concrete raft foundations.
(iii) Replacing the in-situ sub-grade beneath roads and paved surfaces to the engineers design requirements.
(iv) Backfilling services trenches to achieve the requisite compaction densities.

It is recommended that the material should satisfy at least the requirements of a G7 material in terms of the TRH 14 Classification, or preferably to comply with the following specification:-

Liquid limit	<30
Plasticity index	<10
Linear shrinkage	<5
Maximum particle size	<100mm
Grading modulus	>1

Minimum CBR 15 at 95% Mod. AASHTO

8.7 Chemical Stabilisation

In order to reduce or prevent the cost of importing a granular material to replace the poor-quality in-situ subgrade soils, consideration could be given to improving their engineering characteristics through chemical stabilisation.

Bulk samples of the near-surface sheetwash horizon have been submitted to the laboratory for stabilisation testing to determine the dosage of a commercially available natural soil stabiliser to achieve the requisite material strengths.

8.8 Aggressive Ground Conditions

The electrical conductivity of the samples tested show the water sample taken from the base of TP10 to be corrosive and leachate the sheetwash sampled in TP16 to be mildly corrosive, while that from the partially reworked residual siltstone at 1,6m to 2,1m in the same test pit, appears to be highly corrosive.

In order to reduce the risk of corrosion of the steel in buried reinforced concrete, it is recommended that, as a first requirement, the concrete must be dense and not exposed to persistent groundwater conditions or ponding surface water. Repeated cycles of wetting and drying would also have an adverse effect on the durability of concrete when exposed to soluble salts. Dissolution of the cementitious binder and crystallisation of the salts, could cause disintegration of the concrete over time, mainly at or near its surface. Adequate cover over steel reinforcement is therefore essential.

9.0 CONCLUSIONS

The site is considered suitable for the envisaged mixed residential, business and institutional components of the propose development, provided that the recommendations and precautionary measures outlined in this document and the published guidelines set out in the Code of Practice (Ref 4), are strictly adhered to and implemented.

The soil conditions must be carefully assessed and confirmed by a suitably qualified 'competent person' in accordance with the NHBRC stipulations (Ref 7), during the Phase 2 Geotechnical Investigation inspections.

10.0 REFERENCES

1. Jennings JE *et al* (1973). Revised Guide to Soil Profiling for Civil Engineering Purposes in Southern Africa. The Civil Engineer in South Africa, January 1973.
2. Van der Merwe DH (1964). The prediction of heave from the Plasticity Index and percentage clay fraction of soils. The Civil Engineer in South Africa Vol. 6 1964 pp 103 – 107.
3. Weston DJ (1980). Expansive roadbed treatment for Southern Africa, 4th International Conference on Expansive Soils Denver 1980.
4. Joint Structural Division of SAICE and IStructE: Code of Practice: Foundations and Superstructures for Single Storey Residential Buildings of Masonry Construction: 1995.
5. TRH14: Guidelines for Road Construction Materials - Technical Recommendations for Highways. ISBN 0 7988 3311 4, Pretoria, 1985.

6. Mac Vicar, C.N. *et al* (1991) Soil Classification. A Taxonomic System for South Africa, NIGB, Dept. ATS, Pretoria.
7. NHBRC Home Building Manual, Parts 1, 2 & 3, Revision 1, Feb 1999.

GEOTECHNICS AFRICA WESTERN CAPE

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TABLE 1: SUMMARY OF TEST PIT PROFILES

Test Pit	Fill	Humified Sheetwash	Sheetwash	Nodular Pedocrete / Pebble Marker	Reworked Residual Siltstone	Partially Reworked Residual Siltstone
TP1	-	0,0 – 0,1 / 0,2: (0,1/0,2) Loose intact organic clayey silty SAND.	0,1/0,2 – 1,1 (0,9/1,0) Firm to stiff (very stiff to stiff from 0,5m) sandy clayey SILT to sandy SILT-CLAY.	1,1 – 1,5 (0,4): Very stiff weakly shattered sandy CLAY-SILT with ferricrete nodules and scattered gravel.	1,5 – 2,3 (0,8) Firm to stiff indistinctly shattered silty sandy CLAY.	2,3 – 3,0 +(>0,7) Stiff to very stiff weakly shattered silty sandy CLAY.
TP2	0,0 – 0,2 (0,2) Medium dense intact silty fine and medium SAND	0,2 – 0,75 (0,55) Firm to stiff intact to weakly shattered slightly organic sandy clayey SILT to sandy CLAY-SILT.	0,75 – 1,55 (0,8) Stiff weakly shattered sandy CLAY-SILT.	1,55 – 1,85 (03) Ferricrete NODULES very stiff weakly shattered sandy CLAY-SILT matrix.	1,85 – 2,0 (0,15) Very stiff weakly shattered sandy SILT-CLAY with less ferricrete nodules.	2,0 – 3,1 (1,1) Very stiff weakly shattered sandy clayey SILT.
TP3	-	0,0 – 0,2 (0,2) Loose voided slightly organic clayey silty SAND with abundant grass roots.	0,2 – 1,6 (1,4) Firm becoming very stiff from 0,7m intact to weakly shattered sandy clayey SILT.	At 1,6m: Poorly developed basal pebble marker.	1,6 – 2,2 (0,6) Very stiff weakly shattered sandy CLAY-SILT with some dark red-brown locally concentrated ferruginous nodules.	2,2 – 3,2 +(>1,0) Stiff to very stiff weakly shattered to intact sandy clayey SILT to sandy SILT-CLAY.
TP4	-	0,0 – 0,3 (0,3) Loose voided slightly organic silty SAND with fine roots concentrated in top 100mm layer.	0,3 – 1,6 (1,3) Firm to stiff becoming very stiff from 0,75 slightly voided to intact sandy clayey SILT.	At 1,6m: Poorly developed pebble marker at 1,6m.	1,6 – 2,1 (0,5) Very stiff slightly shattered sandy clayey SILT to sandy SILT-CLAY with fine and medium ferricrete nodules.	2,1 – 2,6 +(>0,5) Very stiff weakly shattered sandy clayey SILT to sandy SILT-CLAY.
TP5	-	0,0 – 0,15 (0,15) Medium dense slightly voided slightly organic clayey silty SAND.	0,15 – 1,0 (0,85) Firm slightly voided sandy clayey SILT to 0,45m below which it changes to stiff to very stiff weakly shattered to shattered sandy CLAY-SILT.	1,0 – 1,3 (0,3) Very stiff to stiff intact clayey SAND-SILT matrix with abundant GRAVEL and ferricrete CONCRETIONS.	1,3 – 2,0 (0,7) Very stiff weakly shattered ferruginised slightly sandy CLAY-SILT with ferricrete concretions.	2,0 – 2,9+ (>0,9) Very stiff weakly shattered sandy CLAY-SILT.
TP6	-	0,0 – 0,25 (0,25) Medium dense slightly voided to intact slightly organic clayey silty SAND.	0,25 – 0,7 (0,45) Firm to stiff intact to slightly shattered with depth clayey fine and medium SAND-SILT becoming more clayey with depth.	0,7 – 1,3 (0,6) Very stiff weakly shattered sandy CLAY-SILT matrix.	1,3 – 2, (0,7) Very stiff weakly shattered sandy SILT-CLAY.	2,0 Very stiff intact to indistinctly shattered, slightly sandy clayey SILT.
TP7	-	0,0 – 0,2 (0,2) Medium dense slightly voided slightly organic silty SAND.	0,3 – 1,2 (0,9) Medium dense intact sandy clayey SILT becoming stiff to very stiff and weakly shattered between 0,5 and 1,2m.	1,2 – 1,5 (0,3) Very stiff indistinctly shattered sandy CLAY-SILT with ferricrete NODULES and scattered gravel.	1,5 – 2,1 (0,6) Very stiff indistinctly shattered slightly sandy CLAY-SILT to slightly sandy clayey SILT.	2,1 – 2,5 +(>0,4) Very stiff weakly shattered to intact slightly sandy clayey SILT.
TP8	-	0,0 – 0,25 (0,25) Medium dense slightly voided organic clayey silty SAND.	0,25 – 1,35 (1,1) Medium dense slightly shattered to intact clayey SAND-SILT becoming stiff weakly shattered sandy and gravelly SILT from 0,5m and more clayey.	1,35 – 1,7 (0,35) Ferricrete NODULES in a very stiff indistinctly shattered sandy CLAY-SILT matrix.	1,7 – 2,0 (0,3) Stiff to very stiff shattered sandy SILT-CLAY.	2,0 – 2,4 +(>0,4) Very stiff weakly shattered sandy CLAY-SILT.

Test Pit	Fill	Humified Sheetwash	Sheetwash	Nodular Pedocrete / Pebble Marker	Reworked Residual Siltstone	Partially Reworked Residual Siltstone
TP9	-	0,0 – 0,15 (0,15) Medium dense voided slightly organic and clayey silty SAND.	0,15 – 0,85 (0,7) Firm through stiff to very stiff weakly shattered clayey silty SAND to clayey SILT-SAND and sandy CLAY-SILT.	0,85 – 1,3 (0,45) Very stiff shattered sandy CLAY-SILT with some ferricrete NODULES and scattered gravel.	1,3 – 2,5 (1,2) Stiff to very stiff shattered sandy CLAY-SILT.	2,5 – 2,8 +(>0,3) Very stiff weakly shattered sandy clayey SILT to sandy CLAY-SILT.
TP10	-	0,0 – 0,4 (0,4) Very loose to loose voided organic clayey SILT-SAND.	0,4 – 1,1 (0,7) Firm weakly shattered to shattered sandy CLAY-SILT.	-	1,1 – 1,6 (0,5) Firm to stiff shattered silty sandy CLAY.	1,6 – 2,4 +(>0,8) Stiff to very stiff weakly shattered silty sandy CLAY (less clayey and more silty with depth).
TP11	-	0,0 – 0,2 (0,2) Medium dense voided slightly organic clayey silty SAND.	0,2 – 1,5 (1,3) Firm weakly shattered clayey sandy SILT becoming very stiff shattered sandy CLAY-SILT.	At 1,5m: Poorly developed basal pebble marker.	1,5 – 1,9 (0,4) Very stiff weakly shattered silty sandy CLAY.	1,9 – 2,5 +(>0,6) Very stiff weakly shattered silty sandy CLAY.
TP12	-	0,0 – 0,3 (0,3) Medium dense voided slightly organic clayey silty SAND.	0,3 – 0,9 (0,6) Very stiff intact sandy clayey SILT.	0,9 – 1,35 (0,45) Abundant ferricrete NODULES and scattered gravel in very dense clayey SILT-SAND matrix.	1,35 – 1,65 (0,3) Very stiff shattered sandy silty CLAY.	1,65 – 2,6 +(>0,95) Very stiff weakly shattered silty sandy CLAY.
TP13	-	0,0 – 0,35 (0,35) Loose voided slightly organic clayey sandy SILT.	0,35 – 1,5 (1,15) Stiff to very stiff weakly shattered to shattered from 0,8m sandy CLAY-SILY to sandy silty CLAY with depth.	At 1,5m: Traces of fine ferricrete nodules at base of sheetwash horion. (Poorly developed basal pebble marker)	1,5 – 2,2 (0,7) Very stiff shattered to weakly shattered with depth silty sandy CLAY.	2,2 – 2,4 +(>0,2) Very stiff slightly shattered sandy silty CLAY
TP14	-	0,0 – 0,2 (0,2) Medium dense voided slightly organic clayey silty SAND.	0,2 – 0,8 (0,6) Stiff to very stiff weakly shattered clayey sandy SILT with calcareous inclusions from 0,4m (Partially calcretised)	0,8 – 1,5 (0,7) Ferricrete and calcrete NODULES and scattered gravel in a very stiff sandy silty CLAY matrix.	1,5 – 2,4 (0,9) Very stiff shattered silty sandy CLAY.	2,4 – 2,5 +(>0,1) Very stiff intact sandy CLAY-SILT.
TP15	-	0,0 – 0,2 (0,2) Medium dense intact slightly organic clayey silty SAND.	0,2 – 1,1 (0,9) Very stiff intact to indistinctly shattered from 0,6m sandy CLAY-SILT to sandy from 0,6m clayey SILT.	At 1,0/1,1m: Poorly developed basal pebble marker.	1,1 – 1,4 (0,3) Predominantly stiff weakly shattered slightly sandy CLAY-SILT.	1,4 – 2,3 +(>0,9) Very stiff weakly shattered ferruginous silty sandy CLAY.
TP16	-	0,0 - 0,15(0,15) Loose slightly voided organic clayey silty SAND.	0,15 – 1,1 (0,95) Very stiff weakly shattered clayey sandy SILT becoming very stiff to stiff shattered sandy SILT-CLAY from 0,8m.	1,1 – 1,4 (0,3) Very stiff weakly shattered sandy CLAY-SILT with ferricrete nodules and scattered gravel.	1,4 – 1,8 (0,4) Very stiff to stiff shattered sandy silty CLAY with some ferricrete nodules.	1,8 – 2,5 +(>0,7) Stiff weakly shattered silty sandy CLAY to sandy CLAY-SILT
TP18	-	0,0 – 0,3 (0,3) Loose voided organic clayey silty SAND	0,3 – 0,95 (0,65) Firm to stiff slightly voided sandy CLAY-SILT to sandy clayey SILT; becomes stiff to very stiff more clayey with slight increase in organic content sandy clayey SILT from 0,75m.	Could not be detected.	0,95 – 1,5 (0,55) Very stiff shattered sandy CLAY-SILT with traces of ferricrete nodules.	1,5 – 2,3 + (>0,8) Very stiff shattered sandy silty CLAY.

Test Pit	Fill	Humified Sheetwash	Sheetwash	Nodular Pedocrete / Pebble Marker	Reworked Residual Siltstone	Partially Reworked Residual Siltstone
TP19	-	0,0 – 0,3 (0,3) Loose voided organic clayey silty SAND	0,3 – 1,0 (0,7) Stiff and very stiff weakly shattered sandy clayey SILT. Note: Brown humified relics from earlier topsoil horizon below 0,6m	At 1,0: Very poorly developed basal pebble marker. Note: Only traces of ferricrete nodules and isolated gravel.	1,0 – 1,65 (0,65) Stiff to very stiff shattered sandy CLAY-SILT with numerous ferricrete nodules from 1,35m.	1,65 – 2,35 (0,7) Stiff to very stiff weakly shattered silty sandy CLAY with zones containing some ferricrete nodules.
TP20	-	0,0 – 0,2 (0,2) Medium dense slightly voided and organic clayey silty SAND	0,2 – 0,85 (0,65) Firm to stiff intact sandy clayey SILT becoming very stiff and weakly shattered silty SAND-CLAY from 0,55m.	O,85 – 1,05 (0,2) Ferricrete NODULES and CONCRETIONS in a very stiff intact sandy clayey SILT matrix.	1,05 – 1,25 (0,2) Very stiff intact sandy clayey SILT with scattered ferricrete nodules.	1,25 – 2,2 (1,05) Very stiff weakly shattered sandy CLAY-SILT; isolated zones with ferricrete nodules.
TP21	-	0,0 – 0,3 (0,3)	0,3 – 0,75 (0,45) Very stiff intact sandy clayey SILT becoming more clayey with depth.	0,75 – 1,1 (0,35) Very stiff intact sandy CLAY-STIFF with some ferricrete and calcrete nodules.	1,1 – 1,6 (0,5) Stiff to very stiff weakly shattered ferruginous sandy silty CLAY with some ferricrete nodules.	1,6 – 2,5 +(>0,9) Very stiff weakly shattered sandy silty CLAY.
TP22	0,0 – 0,25 (0,25) Medium dense intact slightly silty SAND with scattered pices of completely weathered sandstone & quartz gravel.	- (Presumably stripped)	0,25 – 0,95 (0,7) Firm to stiff intact sandy clayey SILT; becomes very stiff to stiff weakly shattered sandy CLAY-SILT from 0,55m.	0,95 – 1,3 (0,35) Stiff to very stiff weakly shattered sandy silty CLAY with schattered ferricrete and calcrete nodules.	1,3 – 1,8 (0,5) Very stiff weakly shattered sandy silty CLAY. Note: Ferruginous.	1,8 – 2,3 +(>0,5) Very stiff indistinctly shattered sandy silty CLAY. At 2,3m: weakly shattered to intact sandy CLAY-SILT.
TP23	-	0,0 – 0,3 (0,3) Loose to medium dense slightly voided slightly organic clayey silty SAND.	0,3 – 0,8 (0,5) Stiff to very stiff intact clayey sandy SILT; weakly shattered very stiff and more clayey from 0,5m.	0,8 – 1,25 (0,45) Stiff to very stiff shattered sandy silty CLAY with scattered to numerous ferricrete nodules and scattered gravel.	1,25 – 1,8 (0,55) Very stiff weakly shattered slightly silty sandy CLAY with some ferricrete concretions. Note: Partially Ferruginised.	1,8 – 2,6 (0,8) Very stiff weakly shattered to intact sandy silty CLAY.
TP24	-	0,0 – 0,2 (0,2) Very loose voided slightly organic clayey silty SAND.	0,0 – 0,85 (0,65) Soft to firm slightly shttered to intact sandy clayey SILT.	0,85 – 1,0 (0,15) Stiff to very stiff weakly shattered sandy silty Clay with some ferricrete NODULES and gravel.	1,0 – 1,7 (07) Very stiff shattered sandy silty CLAY. Note: Ferruginous.	1,7 – 2,5 +(>0,8) Very stiff weakly shattered sandy SILT-CLAY.
TP25	-	0,0 – 0,2 (0,2) Very loose voided slightly organic clayey silty SAND.	0,2 – 0,7 (0,5) Firm (stiff near base) slightly shattered sandy clayey SILT to sandy silty CLAY.	0,7 – 0,95 (0,15) Calcrete and ferricrete NODULES and CONCRETIONS with scattered gravel in a very stiff clayey silty SAND and/or sandy clayey SILT matrix.	0,95 – 1,5 (0,55) Very stiff weakly shattered sandy silty CLAY to sandy CLAY-SILT to sandy CLAY-SILT. Note: Ferruginous.	1,5 – 2,5 +(>1,0) Very stiff weakly shattered sandy SILT-CLAY.
TP26	-	0,0 – 0,2 (0,2) Loose slightly voided slightly organic clayey silty SAND.	0,2 – 1,1 (0,9) Firm to stiff slightly shattered sandy CLAY-SILT; becomes stiff to very stiff and weakly shattered sandy clayey SILT to sandy SILT-CLAY from 0.7m.	1,1 – 1,4 (0,3) Very stiff weakly shattered sandy CLAY-SILT with scattered to numerous ferricrete nodules.	1,4 – 1,75 (0,43) Very stiff weakly shattered slightly sandy clayey SILT to sandy SILT-CLAY. Note: Ferruginous.	1,75 – 2,3 +(>0,55) Very stiff weakly shattered slightly sandy clayey SILT.

Test Pit	Fill	Humified Sheetwash	Sheetwash	Nodular Pedocrete / Pebble Marker	Reworked Residual Siltstone	Partially Reworked Residual Siltstone
TP27	-	0,0 – 0,25 (0,25) Loose slightly voided organic silty fine and medium SAND.	0,25 – 0,9 (0,65) Stiff to very stiff intact to weakly shattered sandy CLAY-SILT. Note: Blotched light brown and off-white and very stiff below 0,65m.	0,9 – 1,35 (0,45) Abundant calcrete and scattered ferricrete NODULES in very stiff sandy clayey SILT matrix.	1,35 – 1,9 (0,55) Very stiff shattered to weakly shattered sandy CLAY-SILT.	1,9 – 2,3 +(>0,4) Very stiff intact slightly sandy clayey SILT.
TP28	-	0,0 – 0,3 (0,3) Loose to medium dense slightly voided organic clayey silty SAND.	0,3 – 0,7 (0,4) Stiff slightly shattered to intact sandy clayey SILT.	0,7 – 1,1 (0,4) Calcrete and ferricrete NODULES in a very stiff sandy clayey SILT matrix.	1,1 – 1,5 (0,4) Very stiff weakly shattered sandy clayey SILT. Note: Ferruginous.	1,5 – 2,4 (0,9) Very stiff weakly shattered slightly sandy clayey SILT to sandy SILT-CLAY.
TP29	-	0,0 – 0,15 (0,15) Medium dense slightly voided organic clayey silty SAND.	0,15 – 0,8 (0,65) Stiff to very stiff intact to weakly shattered sandy clayey SILT. Note: Light yellow-brown and off-white calcareous inclusions below 0,4m.	0,8 – 1,1 (0,3) Calcrete and ferricrete NODULES in a very stiff intact sandy clayey SILT matrix.	1,1 – 1,5 (0,4) Very stiff weakly shattered sandy CLAY-SILT. Note: Slightly Ferruginous.	1,5 – 2,1 +(>0,6) Very stiff weakly shattered slightly sandy CLAY-SILT.
TP30	-	0,0 – 0,2 (0,2) Very loose to loose voided organic clayey silty SAND.	0,2 – 0,6 (0,4) Soft to firm voided (becomes very stiff and weakly shattered towards base) clayey SAND-SILT.	0,6 – 0,85 (0,25) Ferricrete NODULES and some gravel in a very stiff intact sandy clayey SILT matrix.	0,85 – 1,1 (0,25) Very stiff weakly to indistinctly shattered sandy clayey SILT to sandy SILT-CLAY. Note Ferruginous.	1,1 – 2,2 +(>1,1) Very stiff weakly shattered to intact sandy clayey SILT.

TABLE 2 : SUMMARY OF LABORATORY TEST RESULTS

LOCATION	DEPTH (m)	MATERIAL DESCRIPTION	ATTERBERG LIMITS LL	PI (*)	LS	GRADING CLAY (%)	SILT (%)	SAND (%)	GRAVEL (%)	PERCENTAGE FINER THAN (mm) 0.075	0.425	2.0	GM	CBR AT % MOD AASHTO 86	93	95	98	MDD (+) kg/m³	OMC (+) (%)	AX SWELL 100% Mod AASHTO	NMC (%)	CLASSIFICATION USPRA	UNIFIED	TRH14
TP1	0,5m	Sheetwash	22	10(10)	5,0	31	48	21	0	79	99	100	0,22	-	-	-	-	-	-	-	18	A-4	CL	-
TP1	0,8m	Sheetwash	26	10(10)	5,0	37	46	17	0	83	99	99	0,19	-	-	-	-	-	-	-	19	A-4	CL	-
TP1	2,1m	Reworked Residual Siltstone	38	15(14)	8,0	56	15	28	1	71	95	97	0,37	-	-	-	-	-	-	-	30	A-6	CL	-
TP1	3,0m	Partially Reworked Residual Siltstone	41	17(17)	8,0	52	14	34	0	66	100	100	0,34	-	-	-	-	-	-	-	25	A-7-6	CL	-
TP16	0,3 - 0,6m	Sheetwash	15	7(7)	3,0	17	59	24	0	76	99	100	0,25	-	-	-	-	-	-	-	8	A-4	MCL	-
TP16	0,7 - 1,1m	Sheetwash	40	16(15)	7,0	52	30	14	4	82	94	94	0,30	-	-	-	-	-	-	-	24	A-4	CL	-
TP16	1,4 - 1,8m	Reworked Residual Siltstone	45	21(20)	10,0	52	18	28	2	70	96	96	0,38	-	-	-	-	-	-	-	24	A-7-6	CL	-
TP22	0,3 - 0,5m	Sheetwash	15	8(8)	3,0	18	52	30	0	70	99	100	0,31	-	-	-	-	-	-	-	12	A-4	CL	-
TP22	0,6 - 0,9m	Sheetwash	31	13(11)	7,0	43	31	25	1	74	88	99	0,39	-	-	-	-	-	-	-	22	A-4	CL	-
TP22	1,0 - 1,2m	Pebble Marker	46	16(13)	7,0	59	14	18	9	73	85	86	0,56	-	-	-	-	-	-	-	37	A-7-5	ML	-
TP22	1,9 - 2,2m	Partially Reworked Residual Siltstone	31	14(13)	7,0	49	23	27	1	72	96	97	0,35	-	-	-	-	-	-	-	24	A-6	CL	-

NOTE:

LL - LIQUID LIMIT
PI (*)- PLASTICITY INDEX (PI OF WHOLE SAMPLE)
LS - LINEAR SHRINKAGE
GM - GRADING MODULUS

OMC - OPTIMUM MOISTURE CONTENT
USPRA- UNITED STATES PUBLIC ROAD ADMINISTRATION
NMC - NATURAL MOISTURE CONTENT
MDD- MAXIMUM DRY DENSITY

SP - SLIGHTLY PLASTIC
NP - NON-PLASTIC

TABLE 3: Foundation Design, Building Procedures and Precautionary Measures for Single-Storey Residential Buildings Founded on Expansive Clay Horizons

Site Class	Estimated Total Heave (mm)	Construction Type	Foundation Design and Building Procedures (Expected damage limited to Category 1)
H	< 7,5	Normal	• Normal construction (strip footing or slab-on-the-ground foundations). • Site drainage and service/plumbing precautions recommended.
H1	7,5 - 15	Modified normal	• Lightly reinforced strip footings. • Articulation joints at all internal/external doors and openings • Light reinforcement in masonry. • Site drainage and plumbing/service precautions
		Soil raft	• Remove all or part of expansive horizon to 1,0m beyond the perimeter of the structure and replace with inert backfill to 93% Mod. AASHTO density at - 1% to + 2% of optimum moisture content. • Normal construction with lightly reinforced strip footings and light reinforcement in masonry if residual movements are < 7,5mm, or construction type appropriate to residual movements. • Site drainage and plumbing/service precautions.
H2	15 - 30	Stiffened or cellular raft	• Stiffened or cellular raft with articulation joints or solid lightly reinforced masonry. • Site drainage and plumbing/service precautions.
		Piled construction	• Piled foundations with suspended floor slabs with or without ground beams. • Site drainage and plumbing/service precautions.
		Split construction	• Combination of reinforced brickwork/blockwork and full movement joints. • Suspended floors or fabric reinforced ground slabs acting independently from the structure. • Site drainage and plumbing/service precautions.
		Soil raft	• As for H1.
H3	> 30	Stiffened or cellular raft	• As for H2.
		Piled construction	• As for H2.
		Soil raft	• As for H1.

NOTE:

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

PROPOSED DEVELOPMENT ON PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERGBAAI
GOOGLE EARTH IMAGE SHOWING SITE LOCATION & DIRECTIONS FROM N2

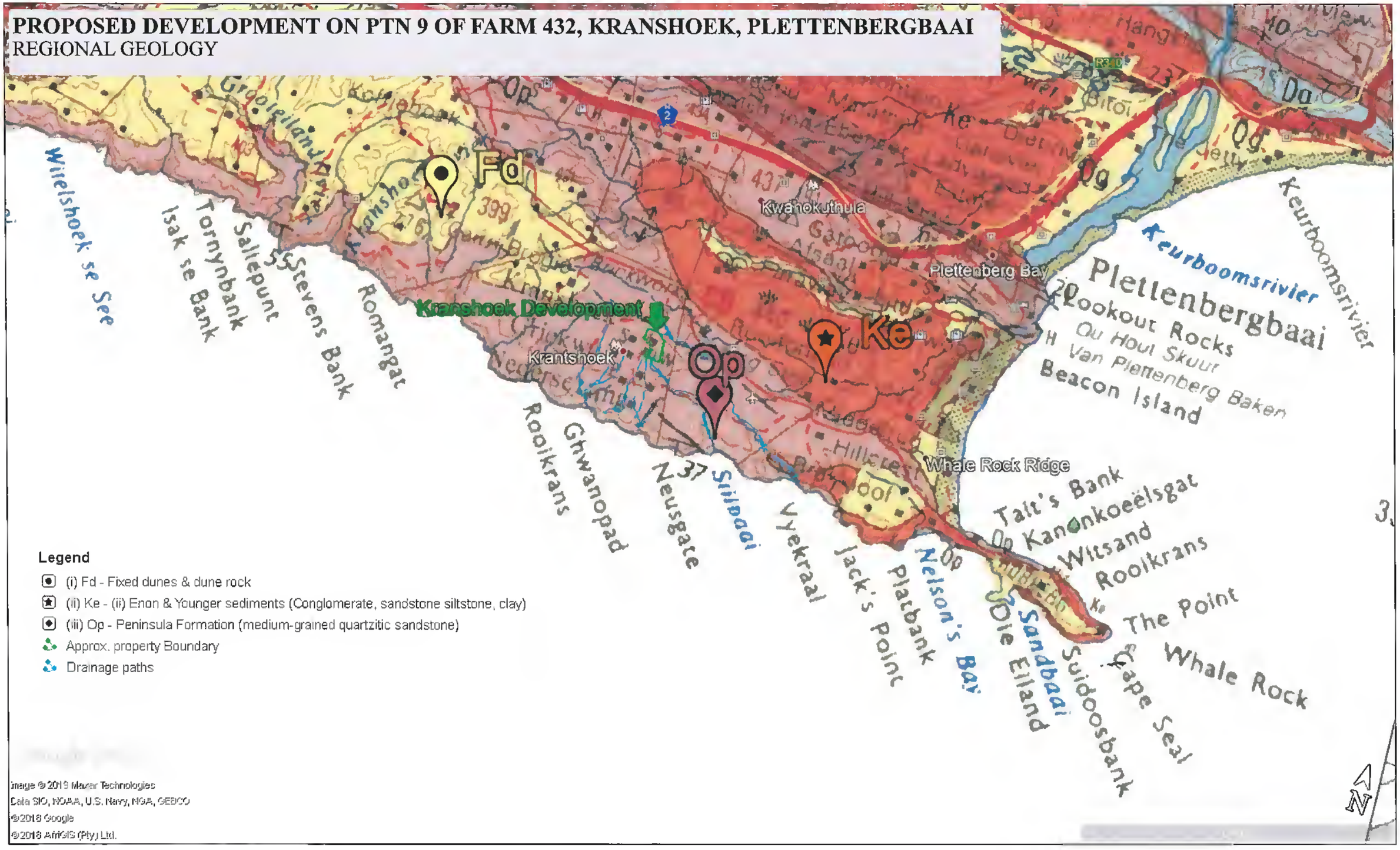
PROPOSED DEVELOPMENT ON PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERG BAY
GOOGLE EARTH IMAGE SHOWING SITE LOCATION & DIRECTIONS FROM N2
J1036 **FIGURE 1a**

PROPOSED DEVELOPMENT OF PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERG BAY

LOCATION & NUMBERS OF ERVEN & FARM PORTIONS

J1036 **FIGURE 1b**

PROPOSED DEVELOPMENT ON PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERGBAAI
REGIONAL GEOLOGY

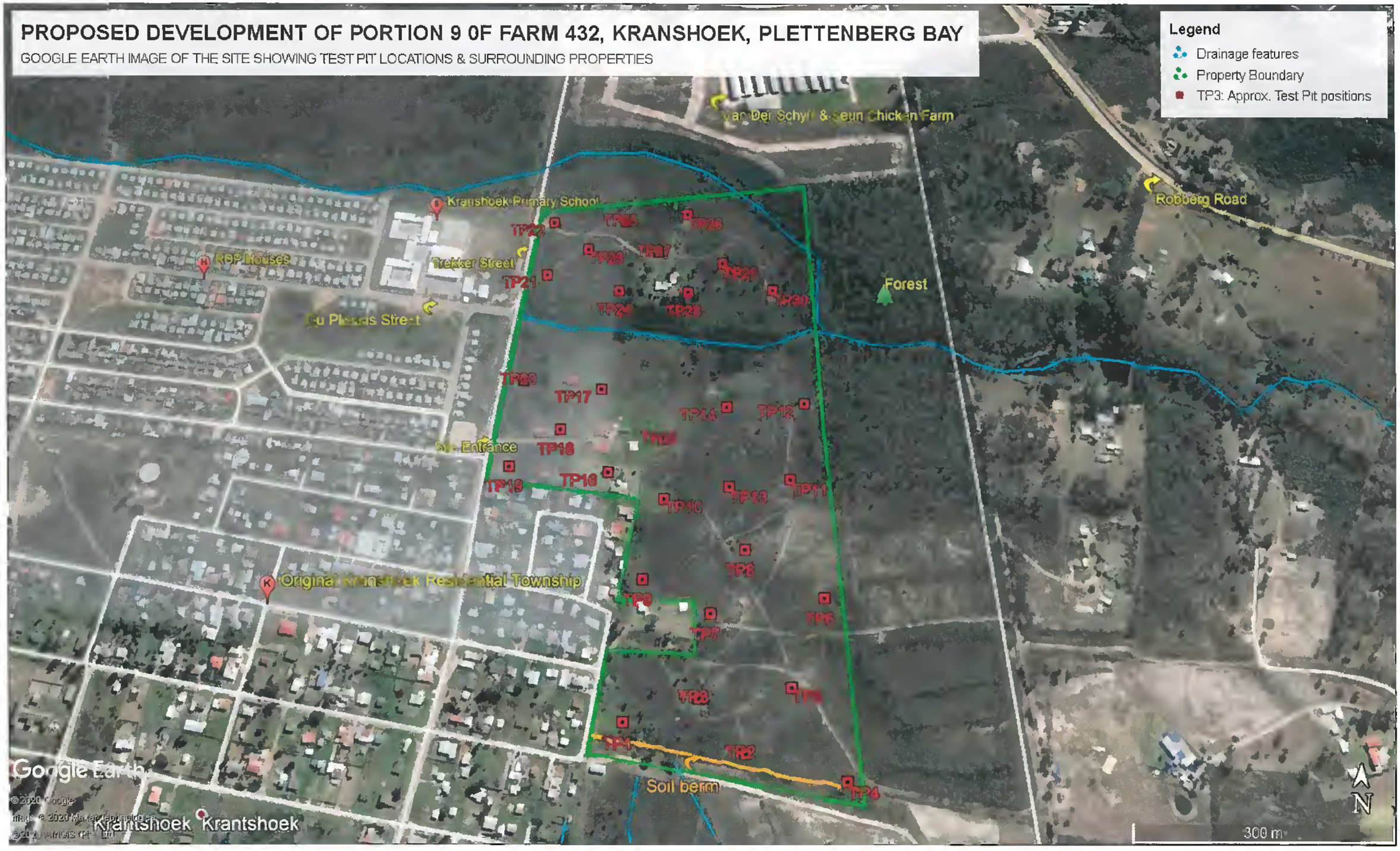


PROPOSED DEVELOPMENT ON PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERG BAY
REGIONAL GEOLOGY

J1036 **FIGURE 2**

PROPOSED DEVELOPMENT ON PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERGBAAI
OBLIQUE PERSPECTIVE OF THE SITE OCCUPYING WAVE-CUT PLATFORM FRINGED BY COASTAL CLIFFS

PROPOSED DEVELOPMENT ON PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERG BAY
GOOGLE EARTH IMAGE GIVING AN OBLIQUE PERSPECTIVE OF THE SITE ON THE COASTAL WAVE-CUT PLATFORM
J1036 **FIGURE 3**



PROPOSED DEVELOPMENT ON PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERG BAY

GOOGLE EARTH IMAGE OF THE SITE SHOWING TEST PIT LOCATIONS & SURROUNDING PROPERTIES

J1036 **FIGURE 4a**

PROPOSED DEVELOPMENT OF PORTION 9 0F FARM 432, KRANSHOEK, PLETTENBERG BAY

GOOGLE EARTH IMAGE SHOWING LOCATIONS OF EXISTING BUILDINGS & PLATE & PHOTO POSITIONS ON SOUTHERN PART OF SITE

Reference Code	Owners Tea Nursery /
LF/GT	Le Fleur / Grieksa Trust
BC	Mr Brown's Creches
R	Ruins

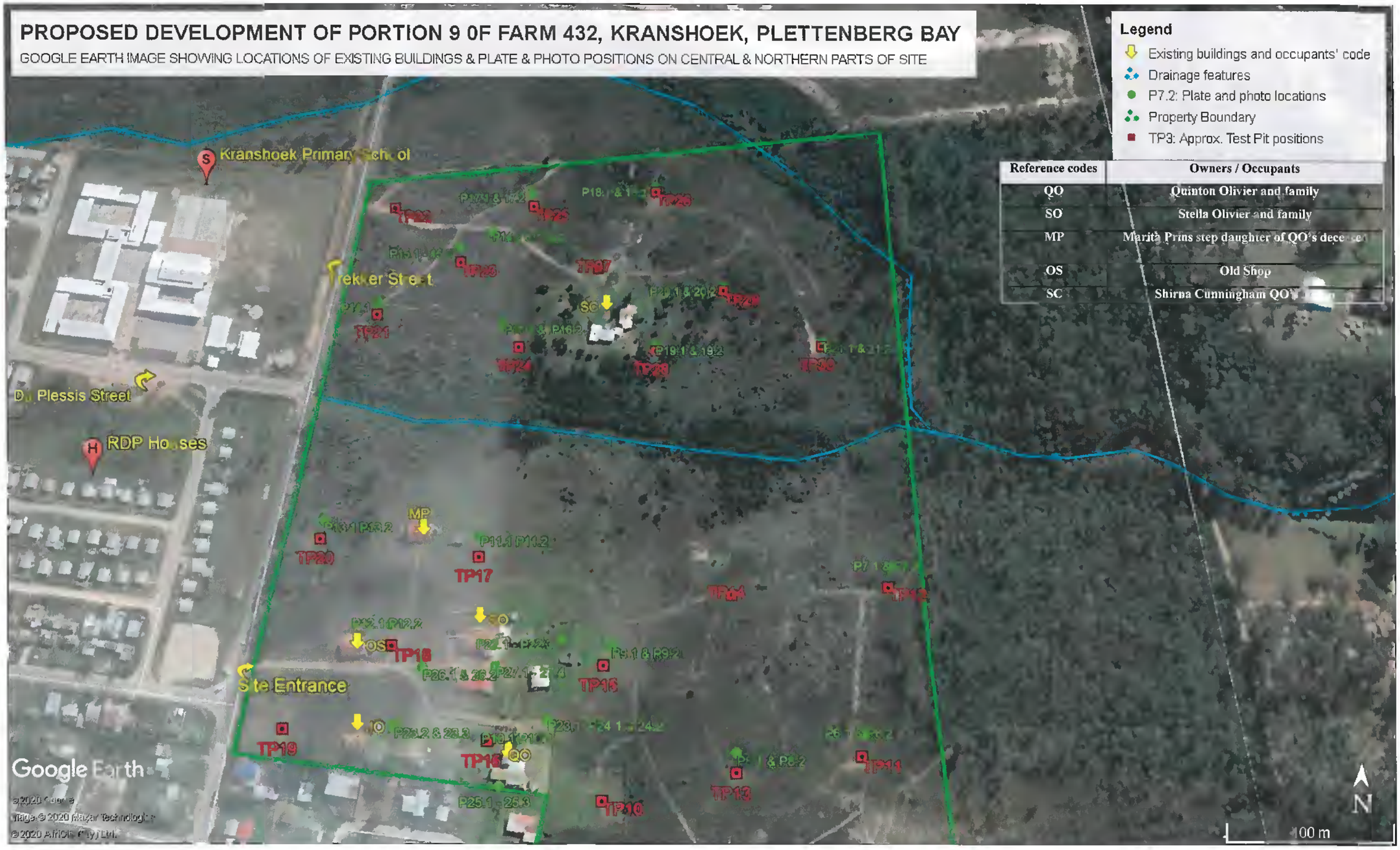
Legend

- Existing drainage features
- Existing buildings and occupants' code
- P7.2: Plate and photo locations
- Property Boundary
- Ruins
- Soil berm
- TP3: Approx. Test Pit positions

PROPOSED DEVELOPMENT ON PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERG BAY

GOOGLE EARTH IMAGE SHOWING LOCATIONS OF EXISTING BUILDINGS & PLATE & PHOTO POSITIONS ON SOUTHERN PART OF SITE

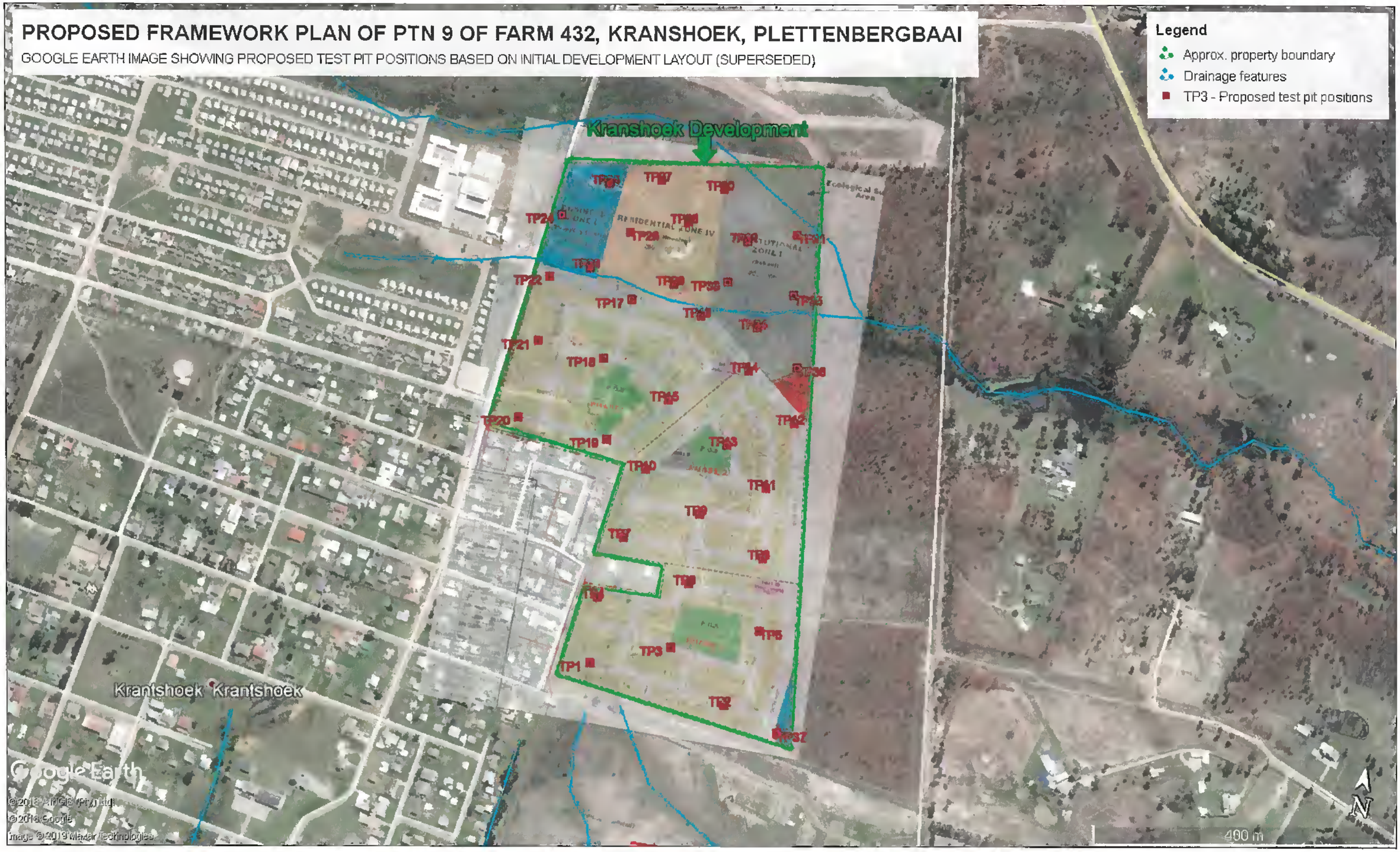
J1036 **FIGURE 4b**



PROPOSED DEVELOPMENT ON PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERG BAY

GOOGLE EARTH IMAGE SHOWING LOCATIONS OF EXISTING BUILDINGS, PHOTOS & PLATES POSITIONS ON NORTHERN PARTS OF SITE

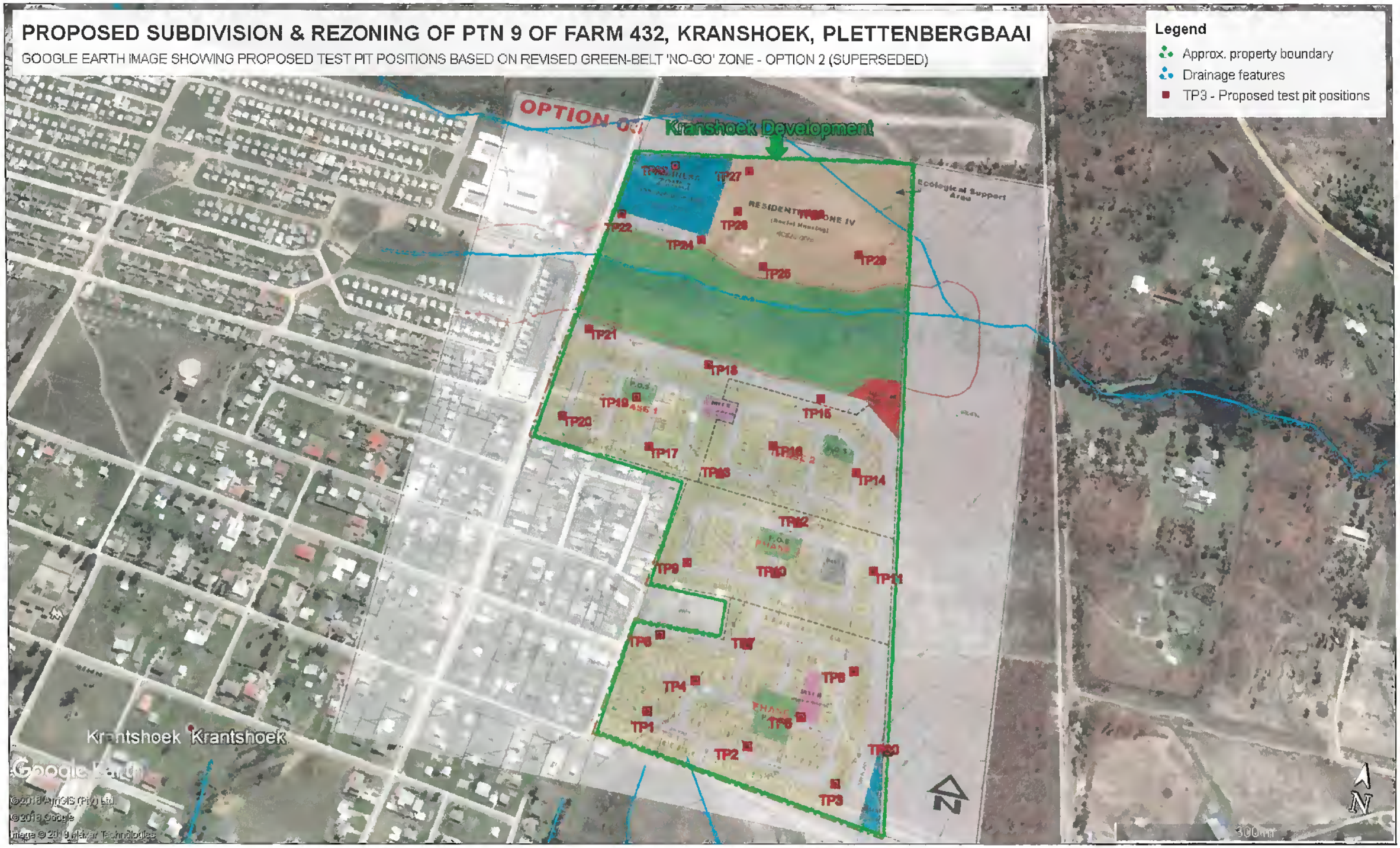
J1036 **FIGURE 4c**



PROPOSED FRAMEWORK PLAN OF PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERG BAY

GOOGLE EARTH IMAGE SHOWING PROPOSED TEST PIT POSITIONS BASED ON INITIAL DEVELOPMENT LAYOUT (SUPERSEDED)

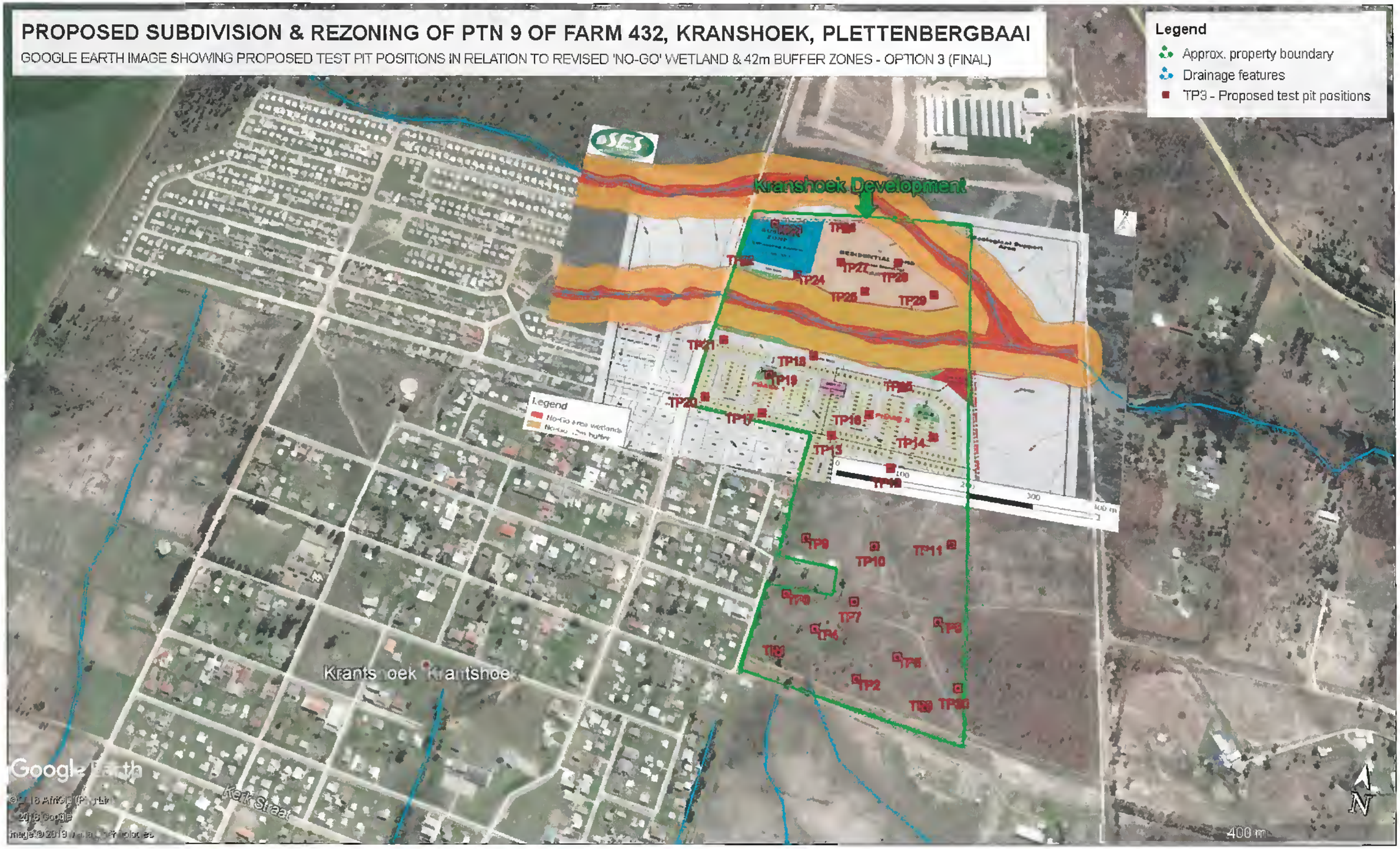
J1036 **FIGURE 5a**



PROPOSED SUBDIVISION & REZONING OF PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERG BAY

GOOGLE EARTH IMAGE SHOWING PROPOSED TEST PIT POSITIONS BASED ON REVISED GREEN-BELT 'NO-GO' ZONE - OPTION 2 (SUPERSEDED)

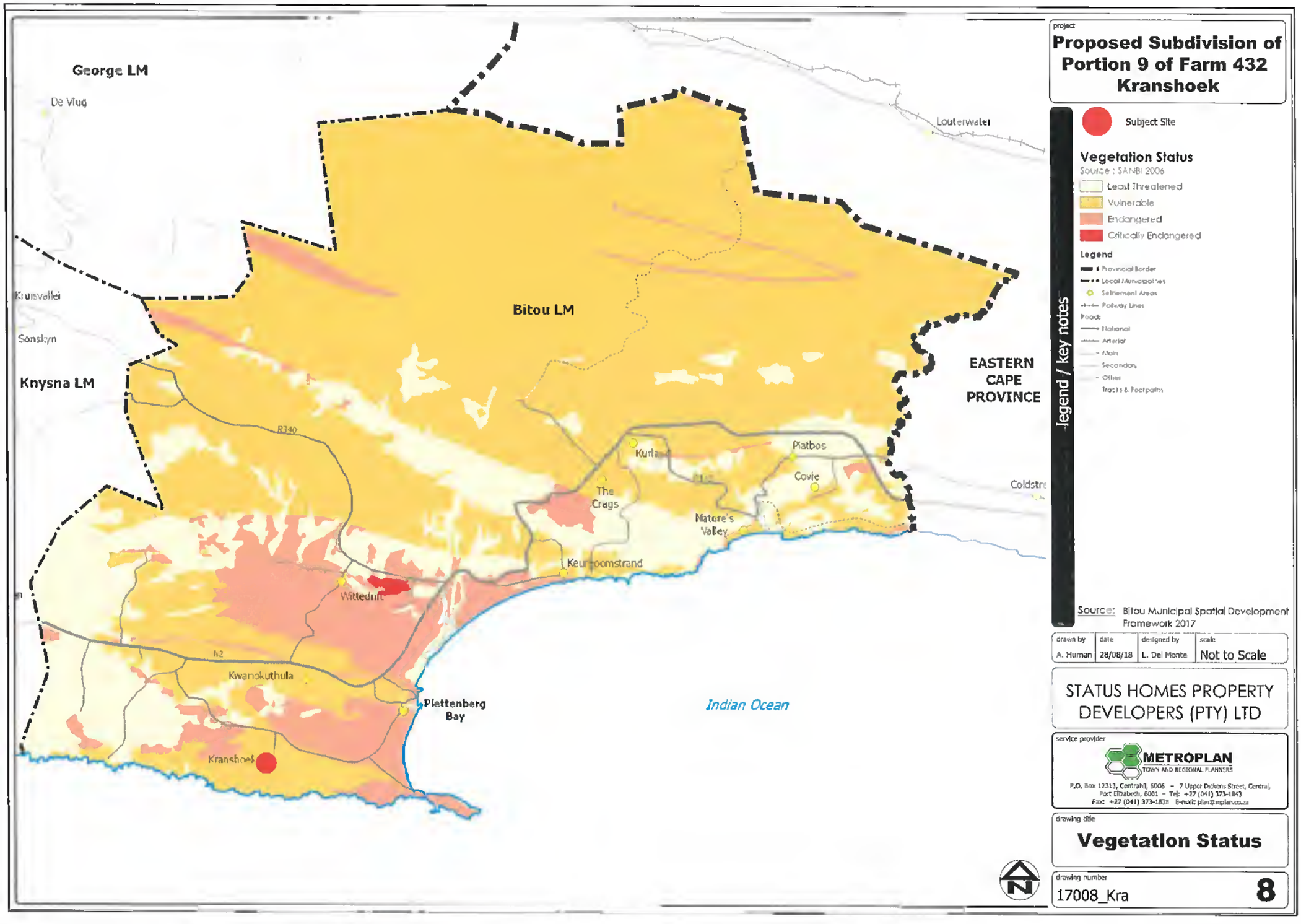
J1036 **FIGURE 5b**



PROPOSED SUBDIVISION & REZONING OF PTN 9 OF FARM 432, KRANSHOEK, PLETTENBERG BAY

GOOGLE EARTH IMAGE SHOWING TEST PIT POSITIONS IN RELATION TO REVISED 'NO-GO' WETLAND & 42m BUFFER ZONES - OPTION 3

J1036 **FIGURE 5c**



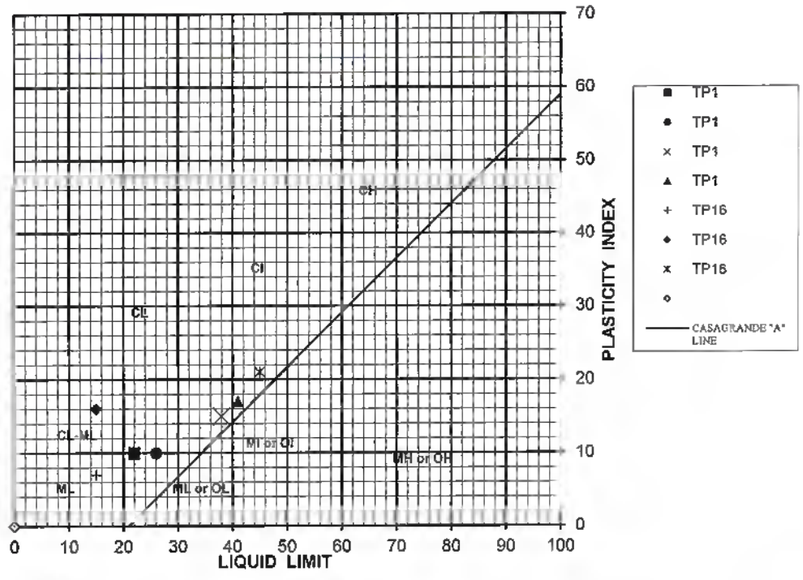
PROPOSED DEVELOPMENT OF PRT 9 OF FARM 432, KRANSHOEK, PLETTENBERG BAY

VEGETATION STATUS

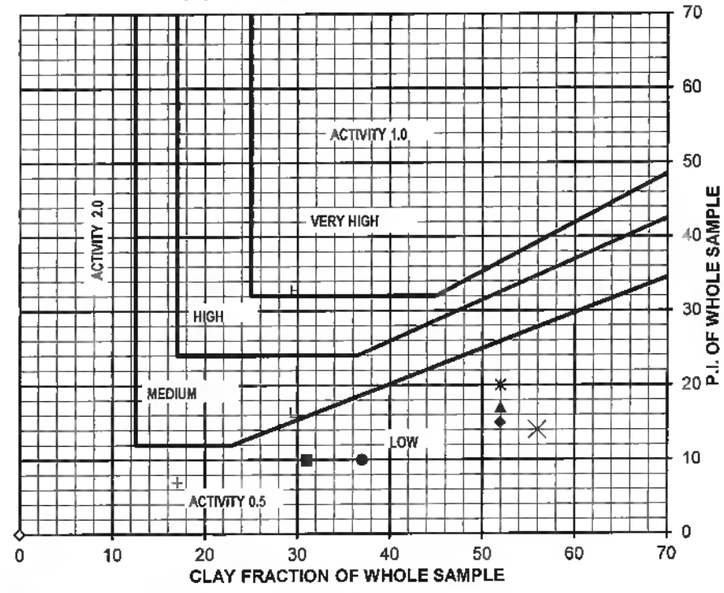
J1036

FIGURE 6

PLASTICITY CHART



POTENTIAL EXPANSIVENESS



	Location of Sample	Depth (m)	Horizon	Liquid Limit %	Plasticity Index %	P.I. of Whole Sample	Linear Shrinkage %	Clay Fraction %	Weighted Liquid Limit (%)	Natural Moisture Content (%)	Weston % Swell At 1kPa	Potential Expansiveness
0.99	TP1	0,5	Sheetwash	22	10	10	5	31	21.78	18	0.2	Low
0.99	TP1	0,8	Sheetwash	26	10	10	5	37	25.74	19	0.3	Low
0.95	TP1	2,1	Rew Res Siltstone	38	15	14	8	56	36.1	30	0.5	Low
1	TP1	3,0	Part Rew Res Siltstone	41	17	17	8	52	41	25	1.2	Low
0.99	TP16	0,3-0,6	Sheetwash	15	7	7	3	17	14.85	8	0.3	Low
0.94	TP16	0,7-1,4	Sheetwash	40	16	15	7	52	37.6	24	0.9	Low
0.96	TP16	1,6-2,1	Rew Res Siltstone	45	21	20	10	52	43.2	24	1.7	Low

Job Name:	Kranshoek		
Drawn			Date 2020/05/27

ACTIVITY AND PLASTICITY CHART

GEOTECHNICS AFRICA WESTERN CAPE

Job. No. J1036

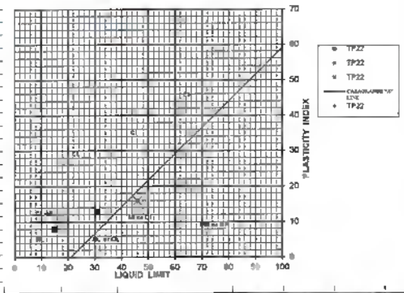
FIGURE 3

NOTE:
GO TO THE TABLE UNDER THE GRAPHS AND FILL IN ALL THE RELEVANT INFO. THERE - THANKS SGG.

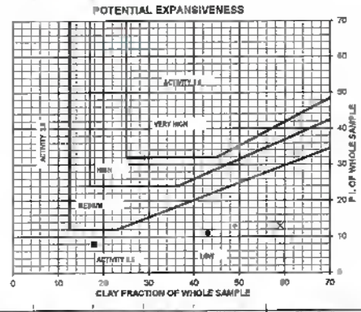
21 0
100 58

0.00041

PLASTICITY CHART



POTENTIAL EXPANSIVENESS



	Location of Sample	Depth (m)	Material	Liquid Limit %	Plasticity Index %	P.I. of Whole Sample %	Linear Shrinkage %	Clay Fraction %	Weighted Liquid Limit (%)	Natural Moisture Content (%)	Weston % Swell At 1kPa	Classification
88	TP22	0.3 - 0.5	Sheetwash	15	6	6	3	18	14.0	12	0.1	Low
85	TP22	0.6 - 0.9	Sheetwash	31	13	11	7.0	43	27.3	22	0.3	Low
85	TP22	1.0 - 1.2	Pebble Marker	46	16	13	7.0	59	39.1	37	0.4	Low
0.89	TP22	1.9 - 2.2	Part Rew Res Siltstone	31	14	13	7.0	49	29.6	24	0.4	Low

PS3M	4-0	Ruvid	20	6.5	6	3.0	23	18	7.4	-	LOW
PS2	0-0.5	Ruvid	30	12	11	6.0	21	26	12	-	LOW
PS2	5-3	Ruvid	23	8.1	5	4.0	7.6	13	16	-	LOW
PS1	1.0	Ruvid	40	18	17	8.5	42	37	13	-	LOW
PS1	2	Ruvid	25	8.5	8	4.4	24	22	-	-	LOW
PS9	0.5	Ruvid	32	14	13	7.0	40	30	14	-	LOW

Job Name	Kranshoek	ACTIVITY AND PLASTICITY CHART	GEOTECHNICS AFRICA WESTERN CAPE	
Drawn	Date 2010/05/27		Job. No. J1036	FIGURE 3

x	y
12.5	70
12.5	12
12.5	12
23	12
23	12
70	34.5
17	70
17	24
17	24
36.5	24
36.5	24
70	42.5
25	70
25	32
25	32
45	32
45	32
70	48.5

APPENDIX A

PLATES 1 to 21

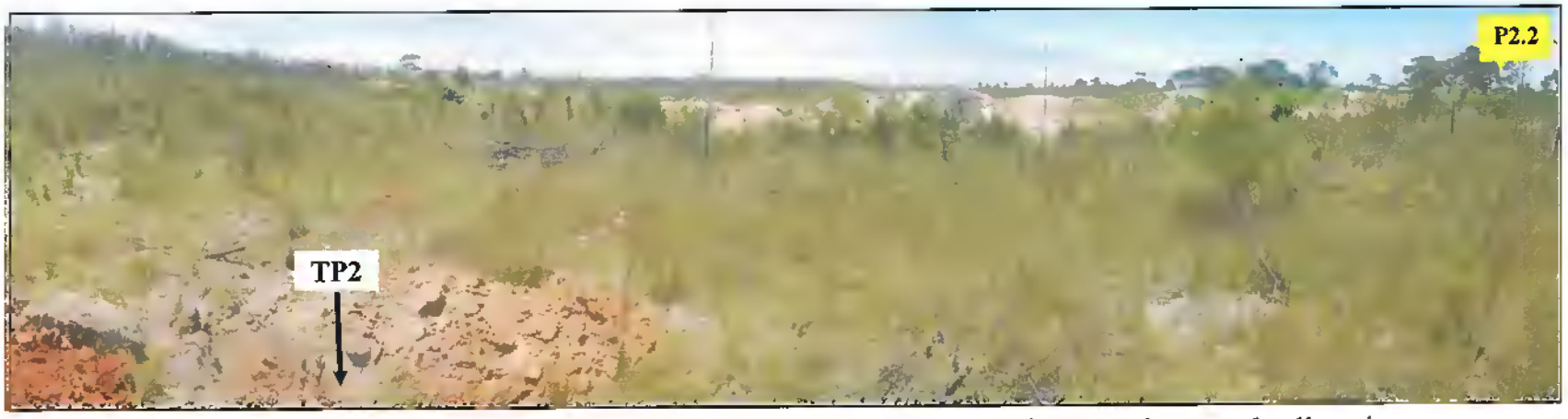
Panoramic Perspectives & Related Photos

Test pit, TP1, viewed towards the south-west corner of the site. Note the soil berm in the background that runs along the southern boundary of the property.

Terrain covered by thick kikuyu grass; viewed from test pit, TP1, in a northerly direction.

PLATE 1

Terrain north of TP2, covered by tufted veld grass with scattered dead young pine trees.



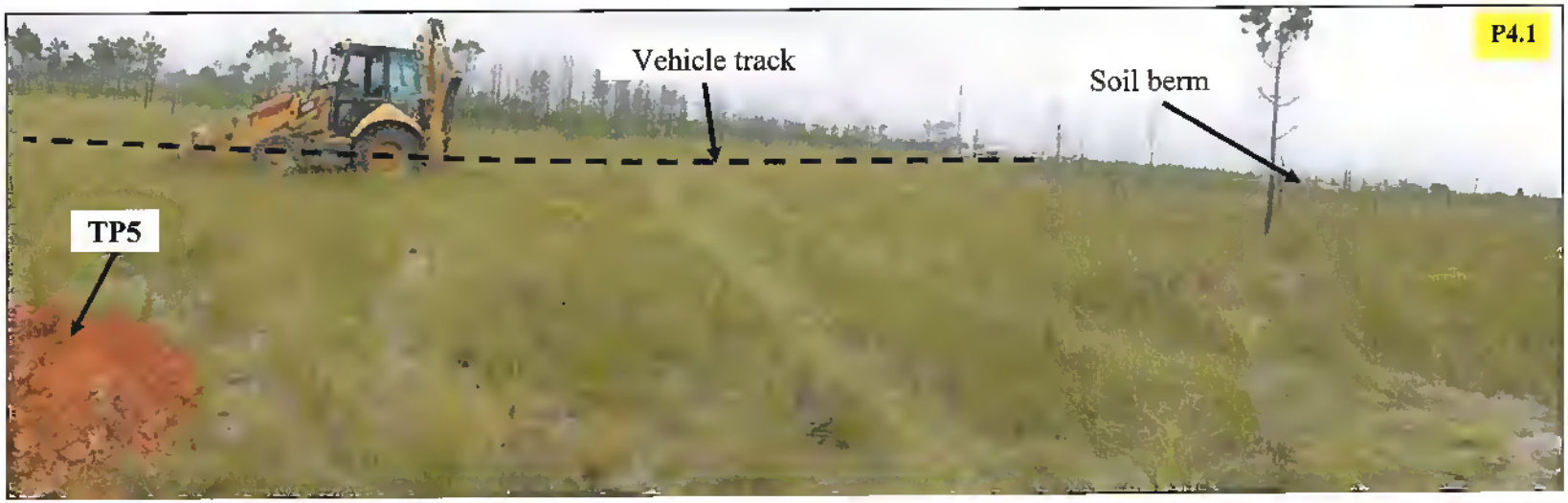
Soil berm along southern boundary of the site viewed from TP2 in a south-easterly direction .

PLATE 2

Terrain to the west of TP3 and south of partially demolished house; green patch around house clearly discernable on the Google Earth image in Figure 4b, comprises mainly kikuyu grass.

Terrain to the north-east of TP3 partially covered by kikuyu grass with scattered young pine trees.

PLATE 3



Natural grass-covered veld south of TP5; viewed towards the south-east, i.e. towards the soil berm on the southern boundary, as indicated.

TLB track heading north-west past TP5 and then turns right into the old vehicle track that continues in a northerly direction. Mainly open veld with practically no obstructions, only the stripping of the veld grass.

PLATE 4

Terrain viewed in a southerly direction from TP6; vegetation comprises tall tufted grass and mixed fynbos with saplings of alien Port Jackson invading the area from the east, see Figures 4a to 4c.

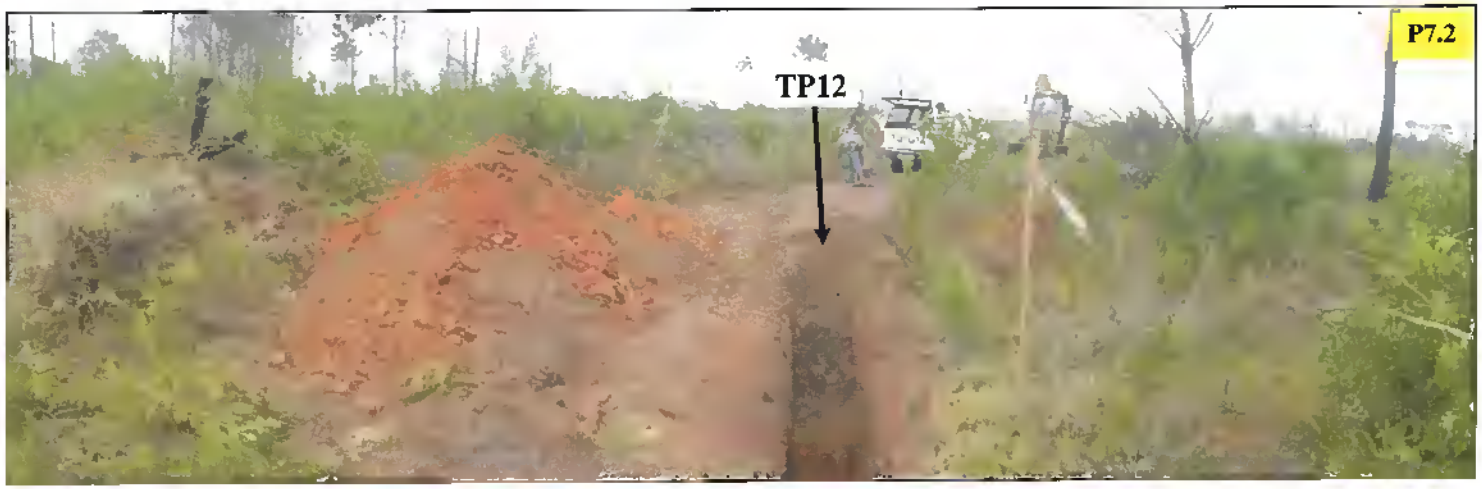
Terrain on the east side of TP6 where the Port Jackson saplings become progressively more concentrated.

PLATE 5

Area south of backfilled TP11; pine trees become progressively denser towards the east and north.

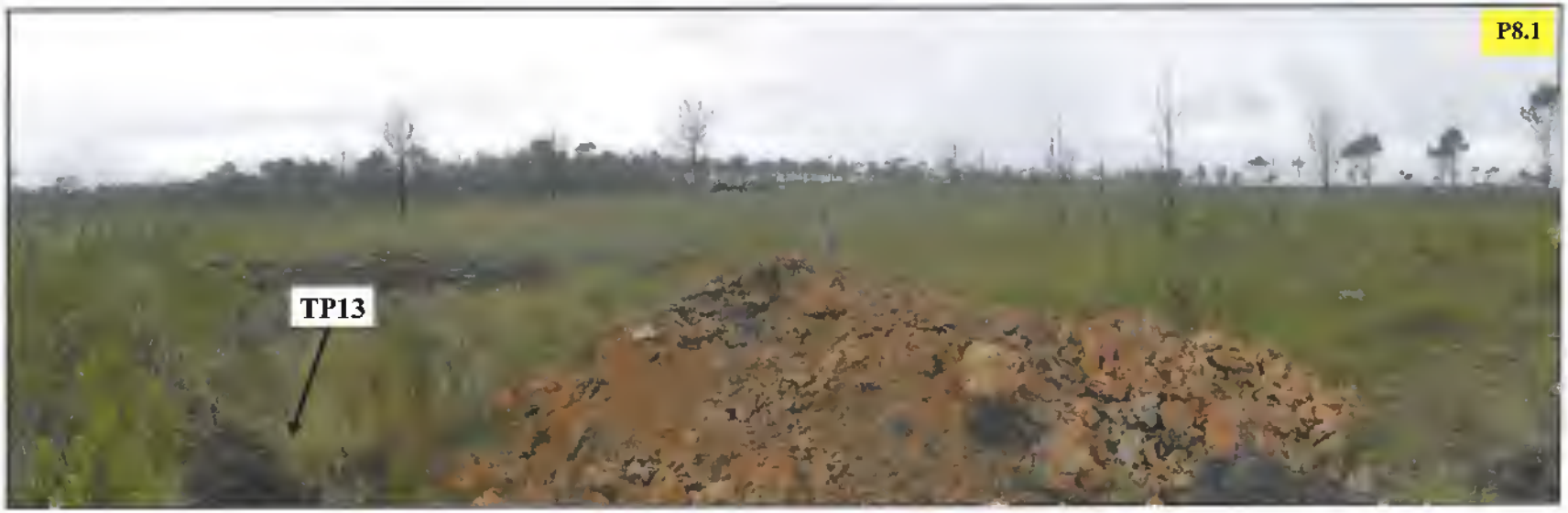
Area towards the north and east of backfilled TP11 where pine trees become denser, TLB *en route* to dig TP12.

TP12 viewed in a north-easterly direction; located in area occupied by dense Port Jackson saplings and larger shrubs with scattered pine and young blue gums trees .



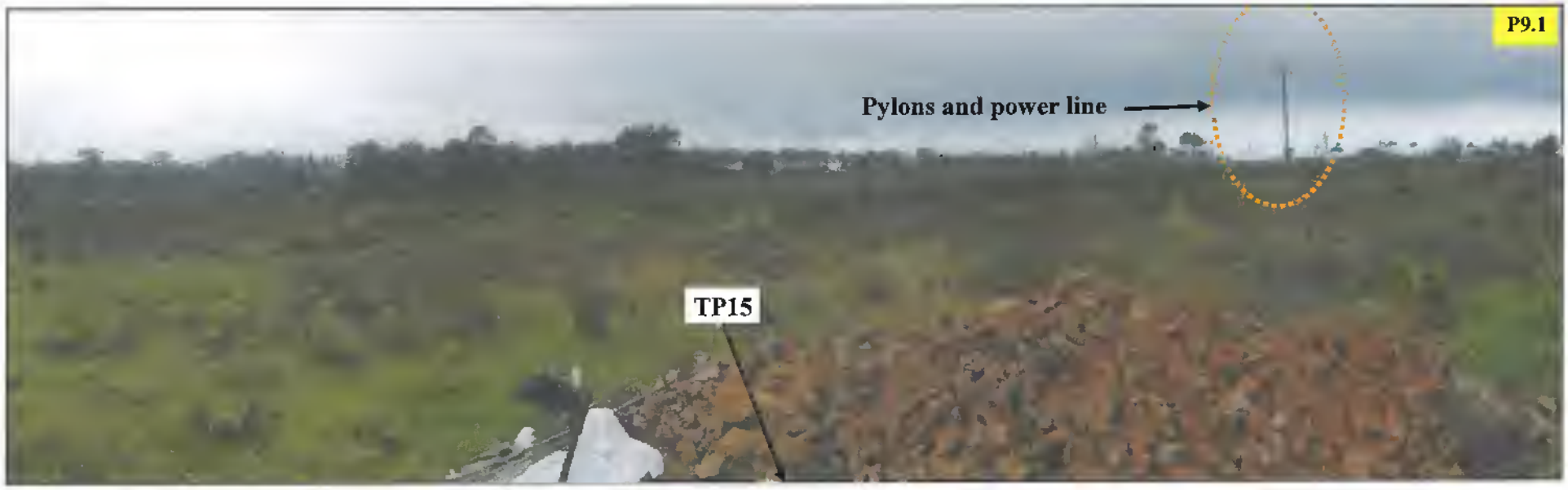
Vegetation becomes less dense in the opposite, south-west direction.

PLATE 7



Mostly open grass veld to the north of TP13.

Similar conditions to the west of TP13, i.e. towards the houses along the western boundary. Power line and pylons that cross the site, as illustrated



Terrain to the south and south-east of TP15.

Thick kikuyu grass cover around TP15 and area around old cottage, outbuilding and water tank on the west side of TP15.

PI ATE 9

Driveway to front (east) side of House Olivier; note panoramic distortion.

TLB in process of digging TP16 in back garden of House Olivier.

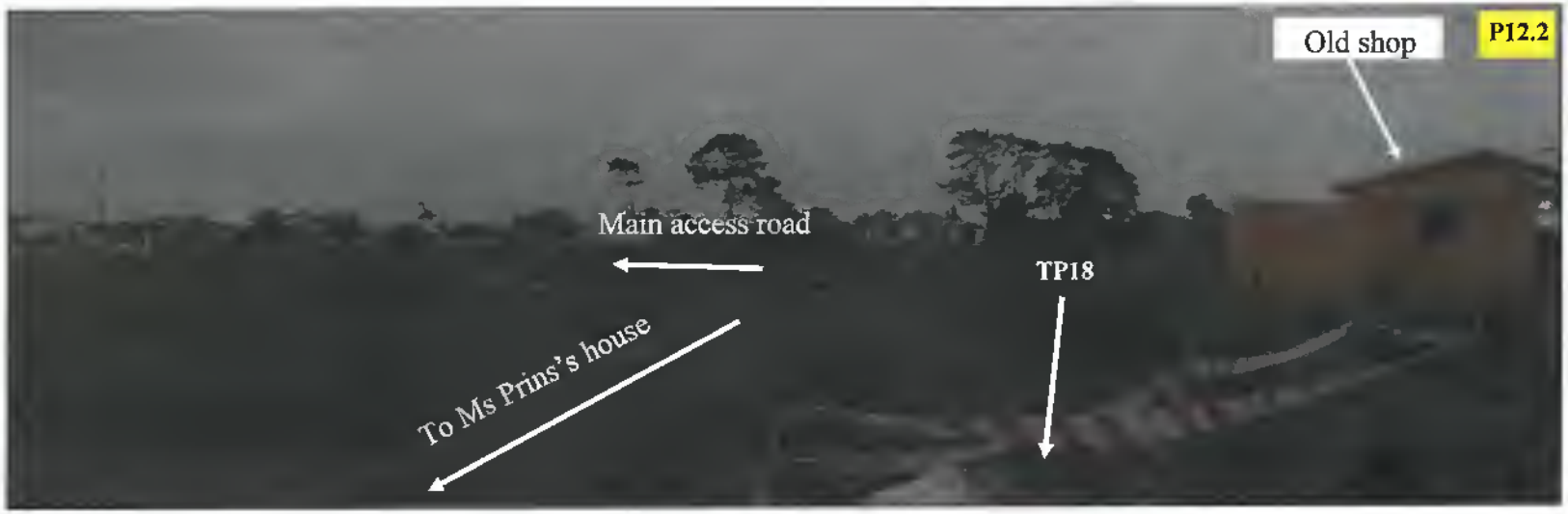
PLATE 10

Grass-covered terrain around test pit, TP17, and south-east of outbuilding on Ms. Marita Prins's property.

East end of Ms. Marita Prins's property viewed from TP17 in a westerly direction.

PLATE 11

Mowed strip to Ms Marita Prins's house viewed from TP18 in a northerly direction.

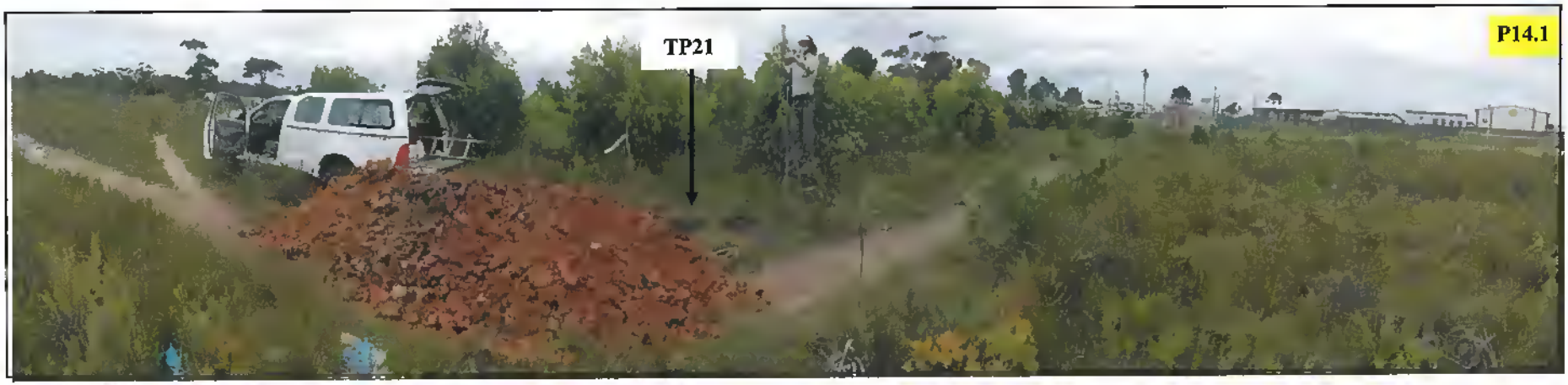


View from Test pit TP18 in a southerly direction.

Terrain around test pit, TP20, viewed in a south-westerly direction. Gum trees fringe the eastern perimeter of the Kranshoek road that separates the site from the existing residential development.

Area to the north-west of TP20; i.e. in the direction of the tar road separating the site from the existing Kranshoek Residential Township and the main entrance to the existing houses on the property.

PI ATE 13



Terrain around TP21 viewed in a westerly direction, i.e. towards the Kranzhoek School; DPL21 in process of being undertaken. Area lies to the north of drainage feature crossing this part of the terrain.

Access road to House Cunningham.

PLATE 14

Grass and scrub-covered terrain on north side of TP23.

Test pit, TP23.

Area west of TP23. Note Kranzhoek Primary School on the west side of tar road between this test pit and the school.

PI ATF 15

Terrain between TP24 and the Cunningham farmstead.

Terrain to the south of TP24; i.e. taken in the direction of the drainage feature.

Terrain on the north-west side of TP25 where a small pond occurs between a footpath and northern property boundary.

Terrain viewed from TP25 in an easterly direction; Cunningham's farmstead visible on the far right-hand side of photo.

PLATE 17

Terrain around TP26 viewed in a southerly direction, i.e. towards the Cunningham's Farmstead seen in the distance.

Terrain to the north-west of TP26; viewed towards a pond concealed by the dense bush.

PI ATF 18

Terrain around TP28 viewed in a north-westerly direction, i.e. towards the Cunningham's Farmstead with one of the outbuildings seen in the background.

Terrain around TP28 viewed in a south-easterly direction. Dense vegetation in the distance fringing the drainage feature and stand of young trees in foreground are mainly black wattle.

PLATE 10

TP29: Dense young Port Jackson shrubs on east side of test pit form an almost impenetrable thicket.

TP29: Opposite end of test pit where vegetation comprises a mixture of Port Jackson shrubs and scattered pine trees.

TP30: Viewed in a south-easterly direction towards dense pine and blue gum bush.

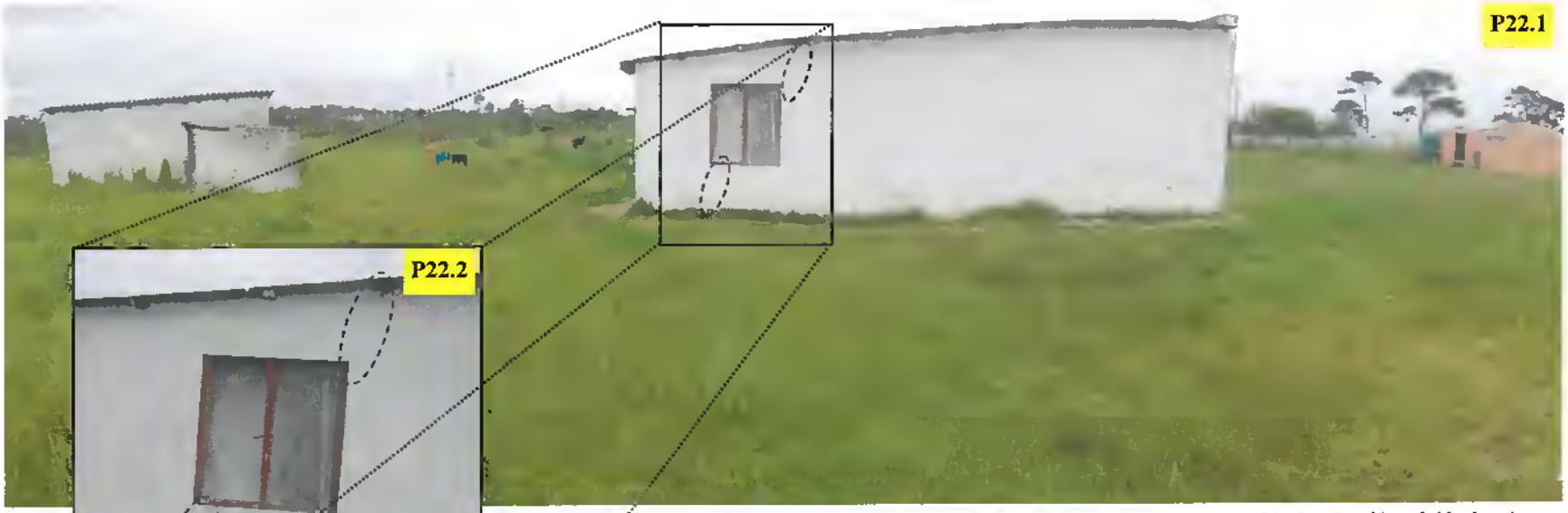
TP30: Viewed in a north-westerly direction where the vegetation is relatively sparse and consists mainly of Port Jackson saplings with scattered pine and gum trees.

PLATE 21

APPENDIX B1

PLATES 22 to 27

Foundation-Related Cracks Observed in Dwellings on the Site



Outbuilding on south-eastern part of Ms Stella Olivier's property. Close-up of outbuilding and crack extending diagonally across side window; note thick kikuyu grass covering surrounding area.

Above building viewed from the south.

PLATE 22

Mr Quintin Olivier's house viewed from the west side.

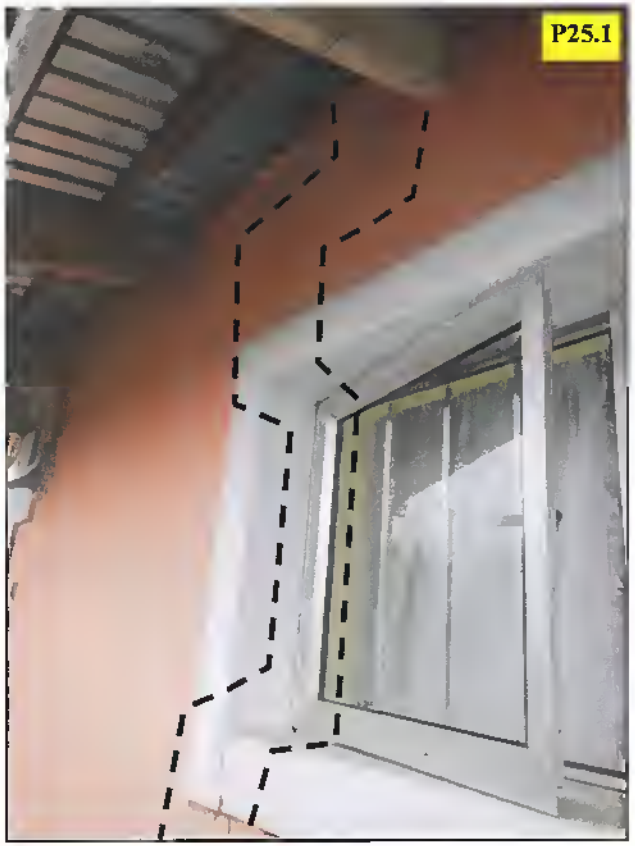
The late Mr Johnny Olivier's house and shed on the disused piece of land west of Mr Quinton Olivier's property.

Closer view of vertical crack in north wall of shed shown on P23.2.

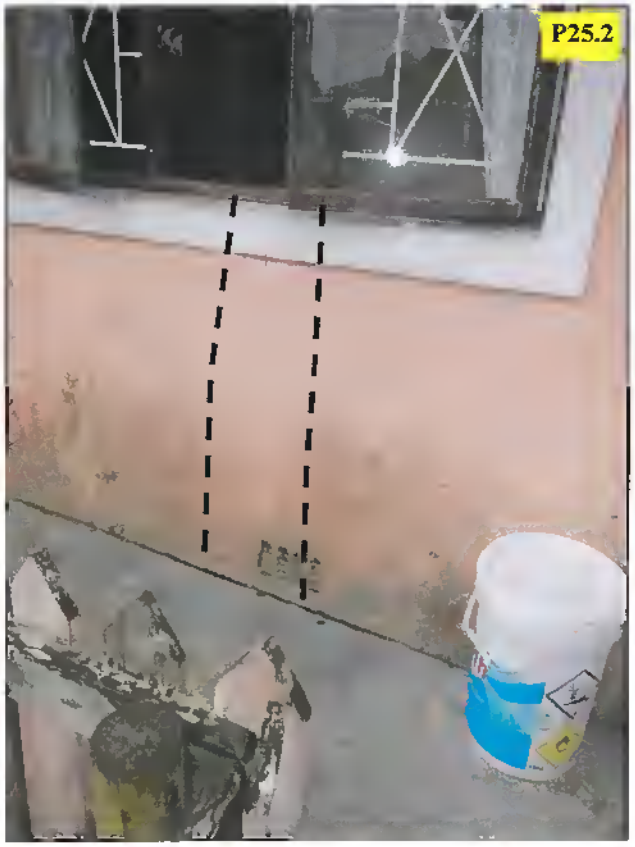
PLATE 23

Vertical crack along movement joint, evidently, that runs through the north side of Mr Quintin Olivier's house.

PLATE 24



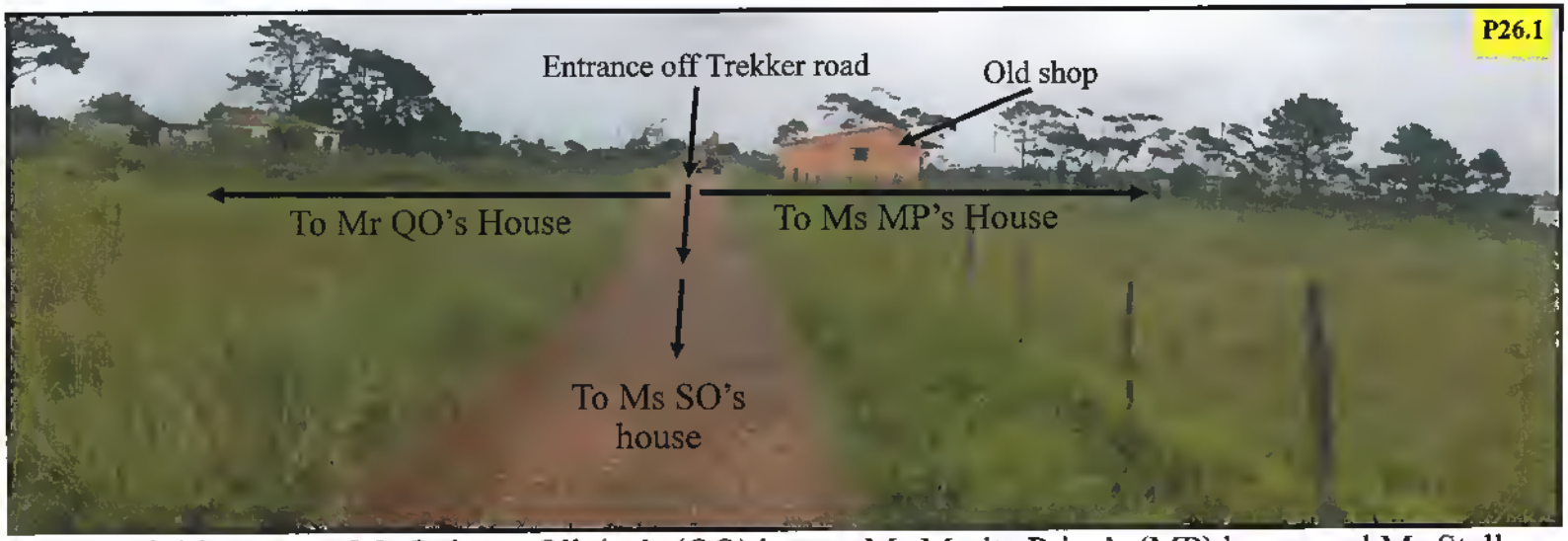
Vertical crack approximately following the movement joint shown on photo, P25.3.



Vertical crack extending from the still to the apron slab beneath window on south -west corner of Mr. Olivier's house.

Continuation of crack beneath window shown on photo P25.1.

PLATE 25

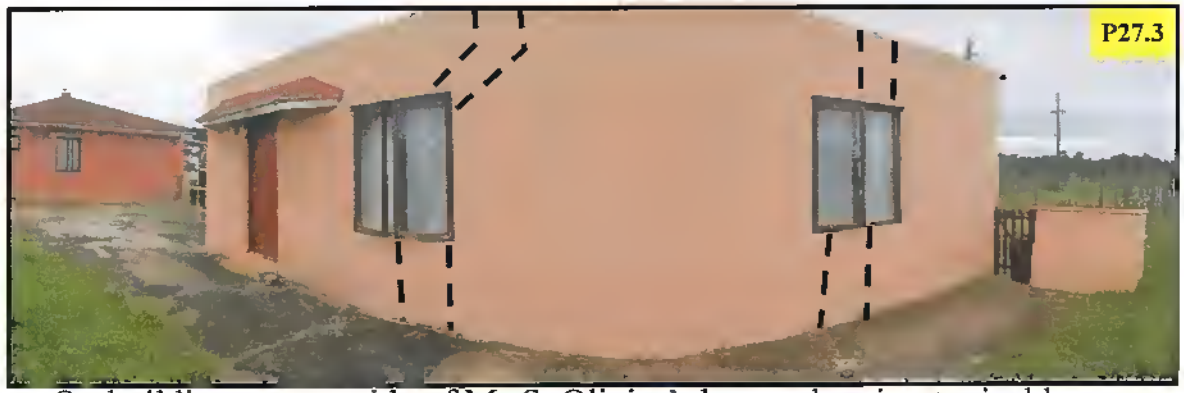


Gravel driveway to Mr Quinton Olivier's (QO) house, Ms Marita Prins's (MP) house and Ms Stella Olivier's (SO)) house

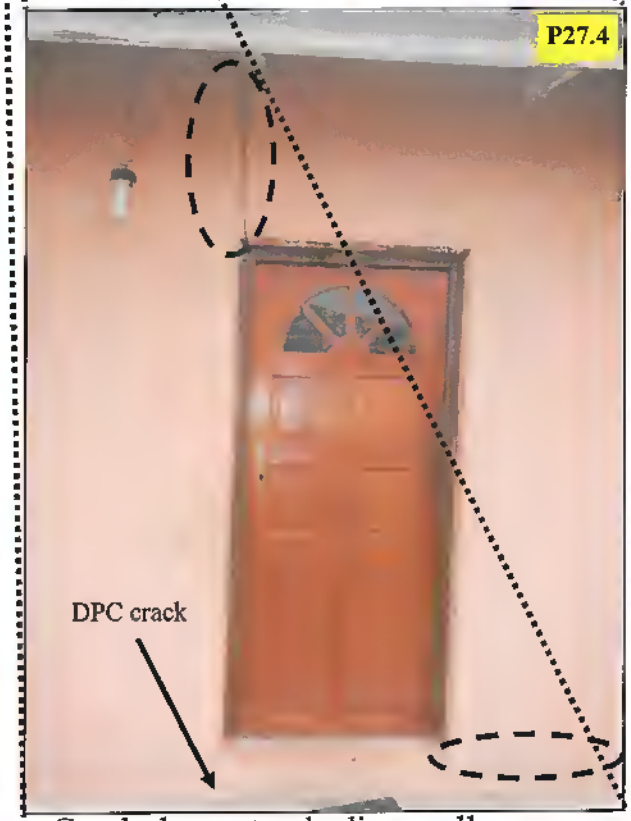
Entrance to Ms Stella Olivier's property viewed in an easterly direction.

Ms Stella Olivier's property viewed from the entrance gate.

Above property viewed from the south-east side.



Outbuilding on east side of Ms S. Olivier's house showing typical heave related cracks below and above window's.



Crack that extends diagonally across front door of dwelling on south side of driveway, as illustrated above.

PLATE 27

APPENDIX B2

PLATES 28 to 38

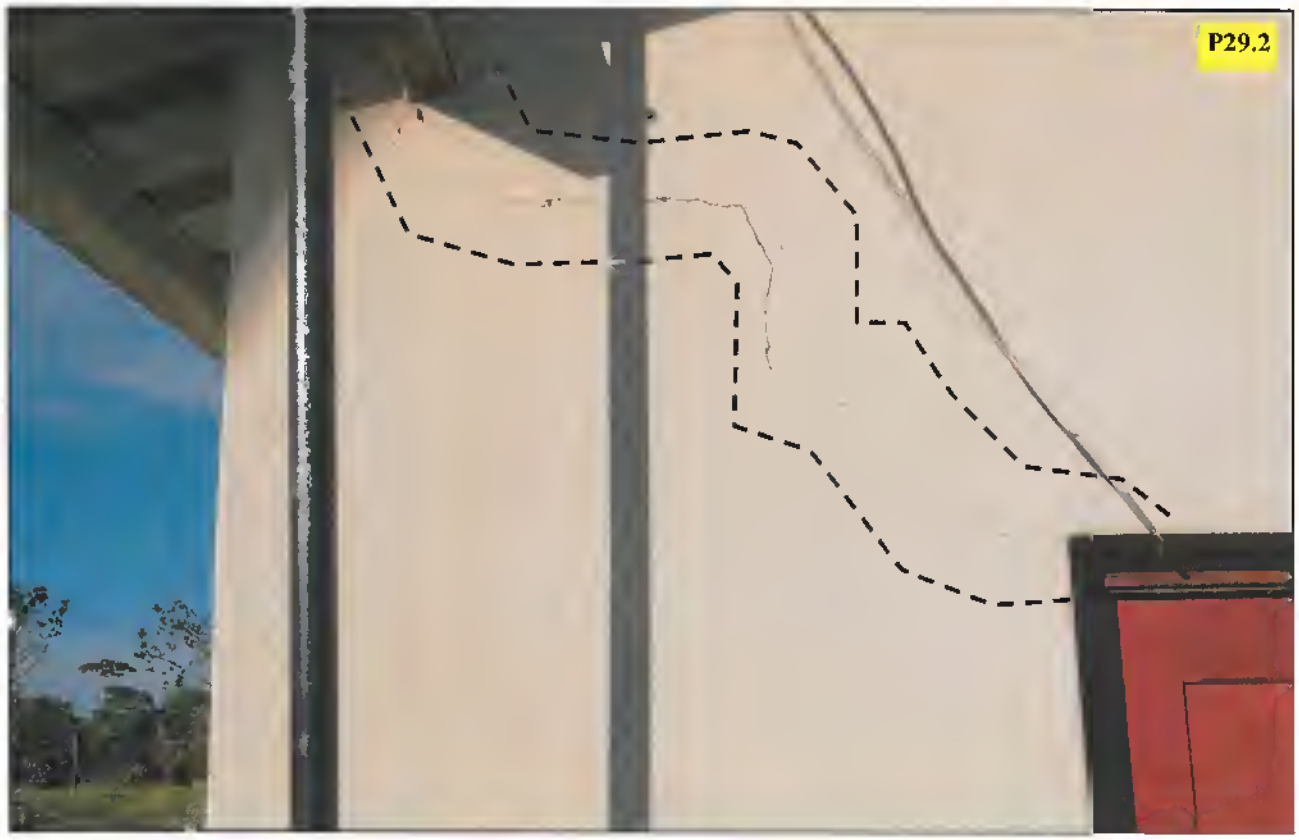
Foundation-Related Cracks Observed in Neighbouring RDP Houses of Existing Kranshoek Township

Kranshoek RDP Housing Development that was inspected to establish whether foundation related damage could be detected.

Geotechnical information regarding the above project was sought from the Bitou Municipality; however, without success.

PLATE 28

Typical RDP house on the corner of Du Plessis Street and Trekker Road on the north-east corner of the existing housing development. Only southern perimeter of house provided with concrete apron.

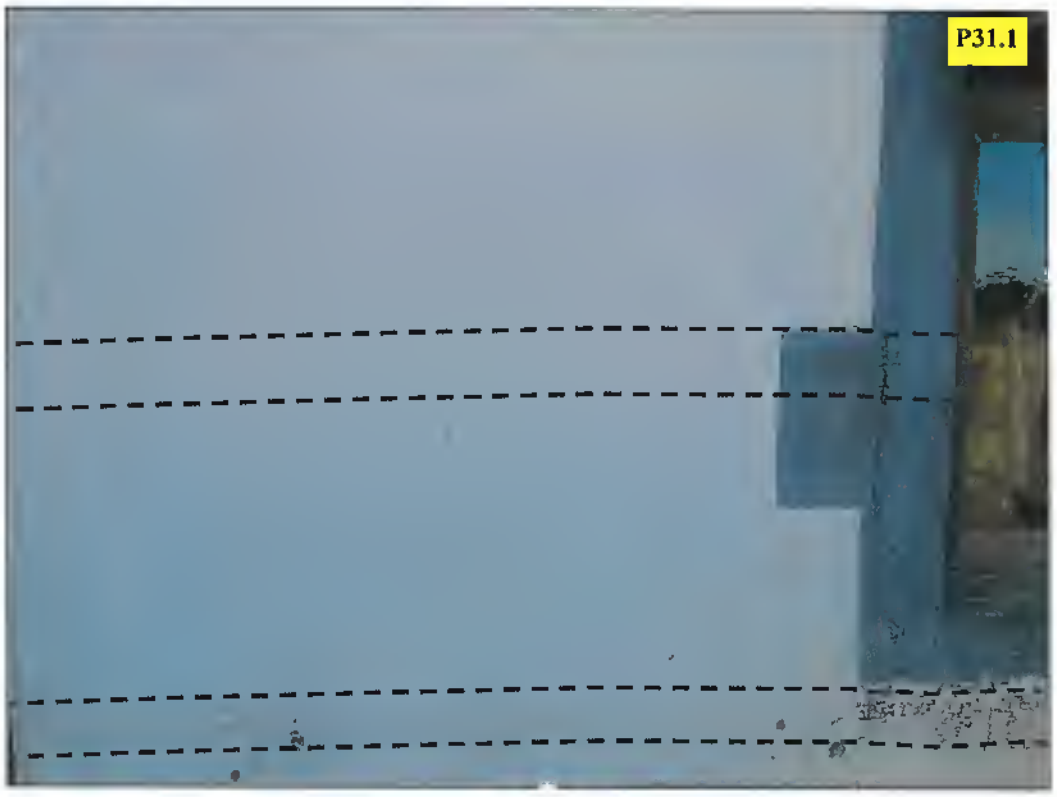


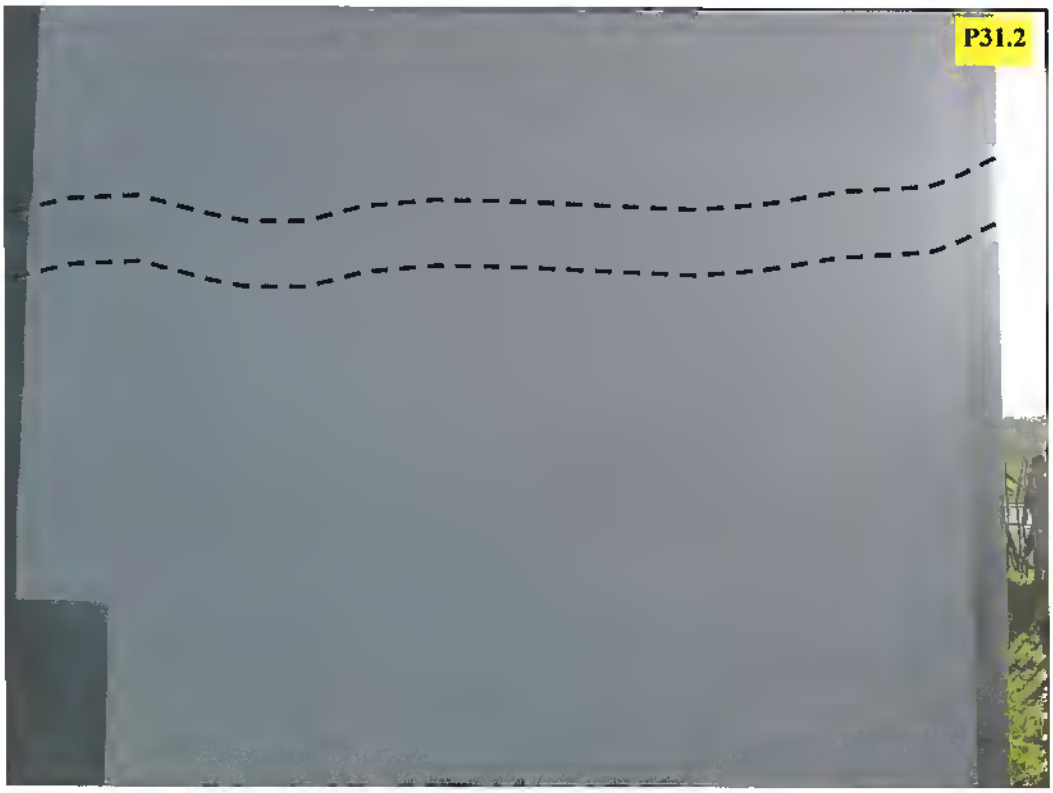
Typical heave-related diagonal crack in top corner of front door.

Typical foundation-related cracking occurring mainly in the central parts of the gable ends of the houses.

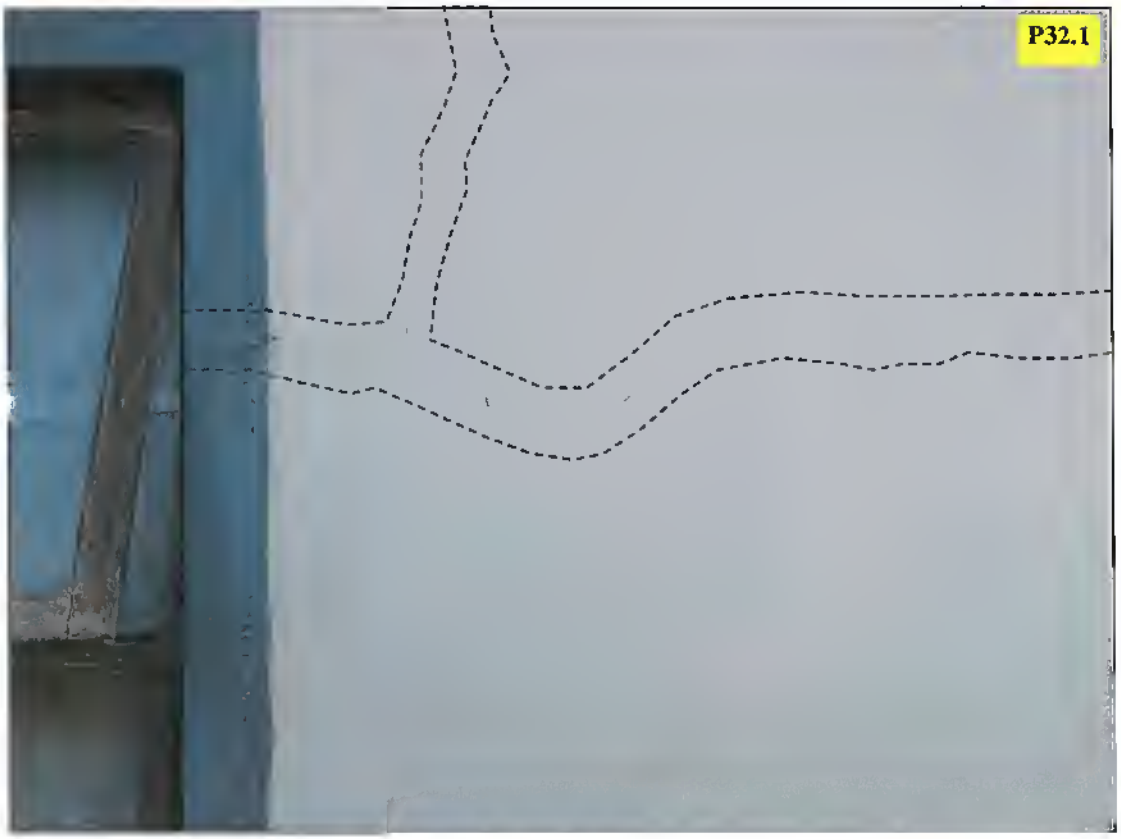
Retangular cracks, the horizontal portions of which appear to follow mortar joints containing brick-frorce. The pattern of cracking suggests that the walls have been constructed with of cement blocks.

PLATE 30





Horizontal cracks that appear to align with mortar joints containing brick-force.



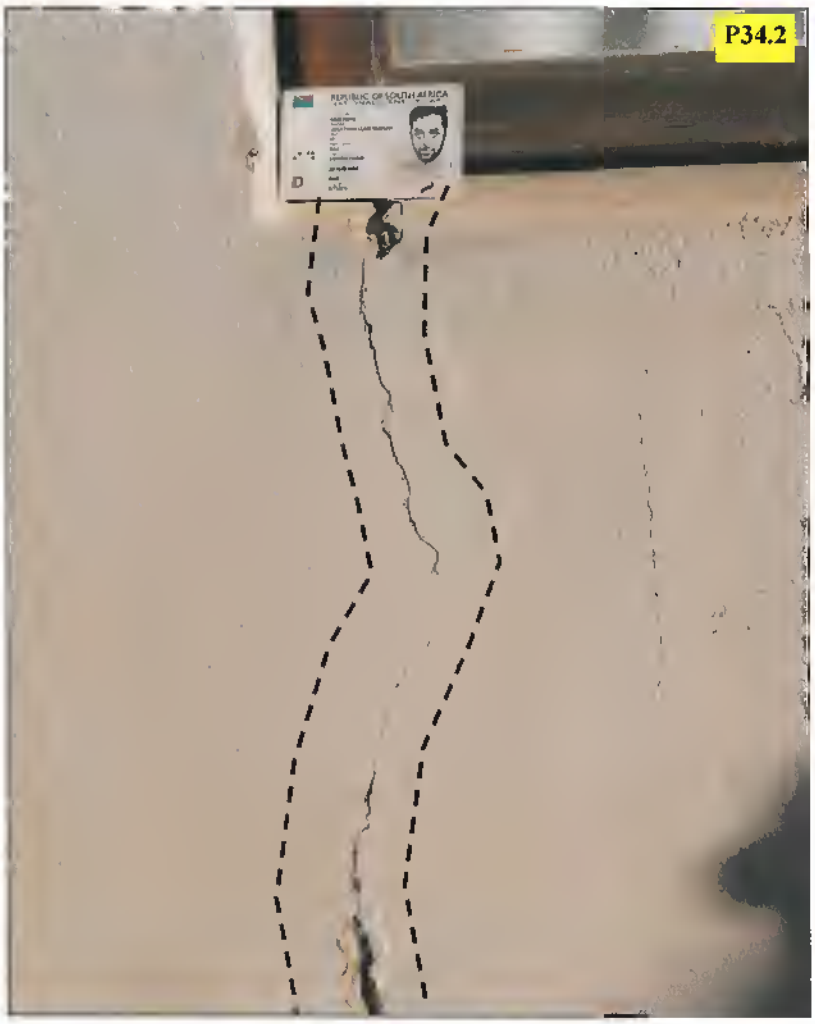
Continuation of horizontal crack, evidently along mortar joint containing brick-force.

Typical heave-related diagonal crack extending from top corner of front door to the roof.

PLATE 32

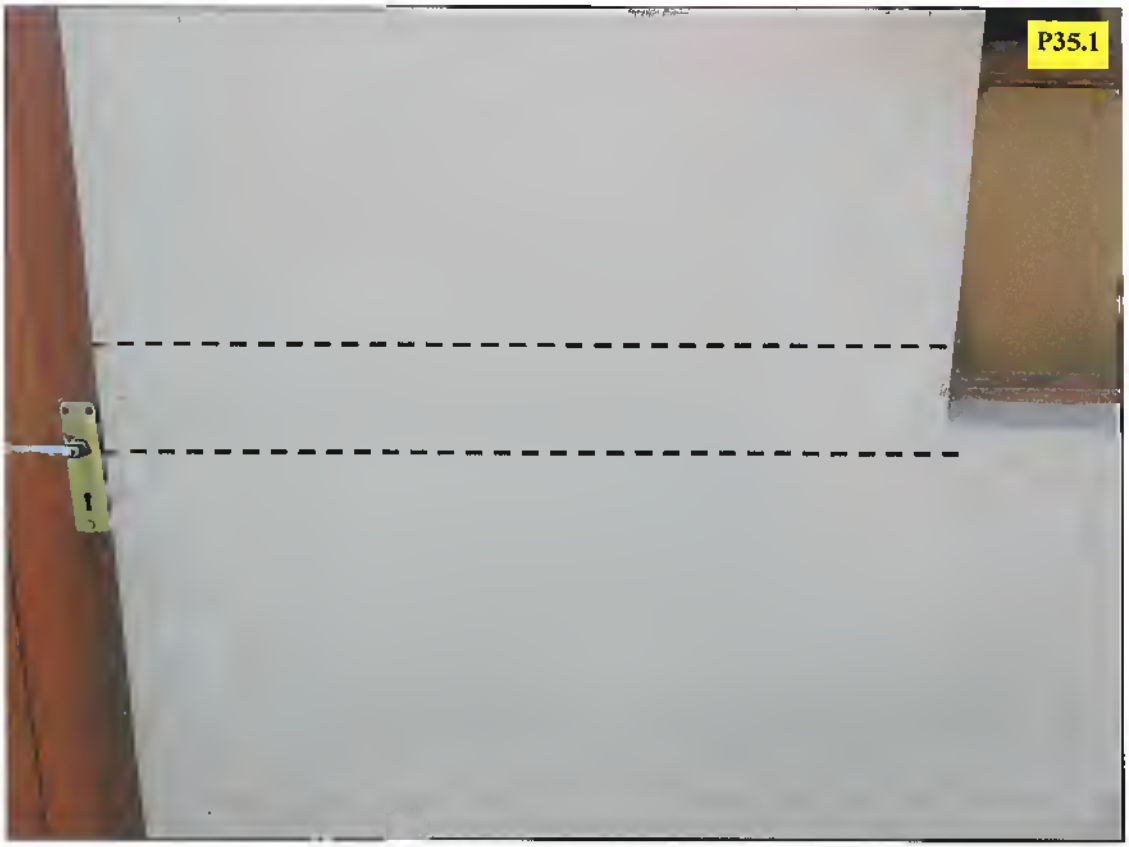
Vertical crack extending from the, apparently raft foundation to the window sill.

Close-up of above crack extending through window sill.



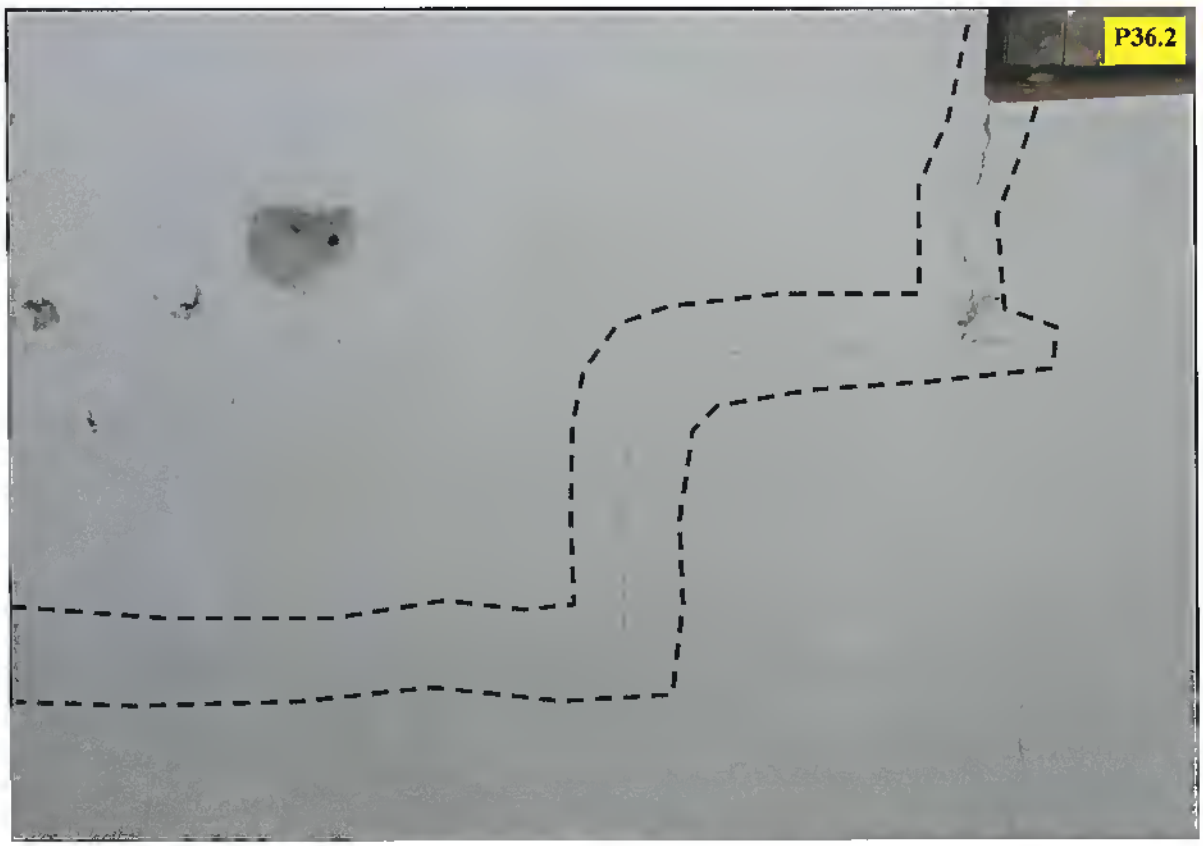
Similar crack as the one shown on Plate 33

PLATE 34



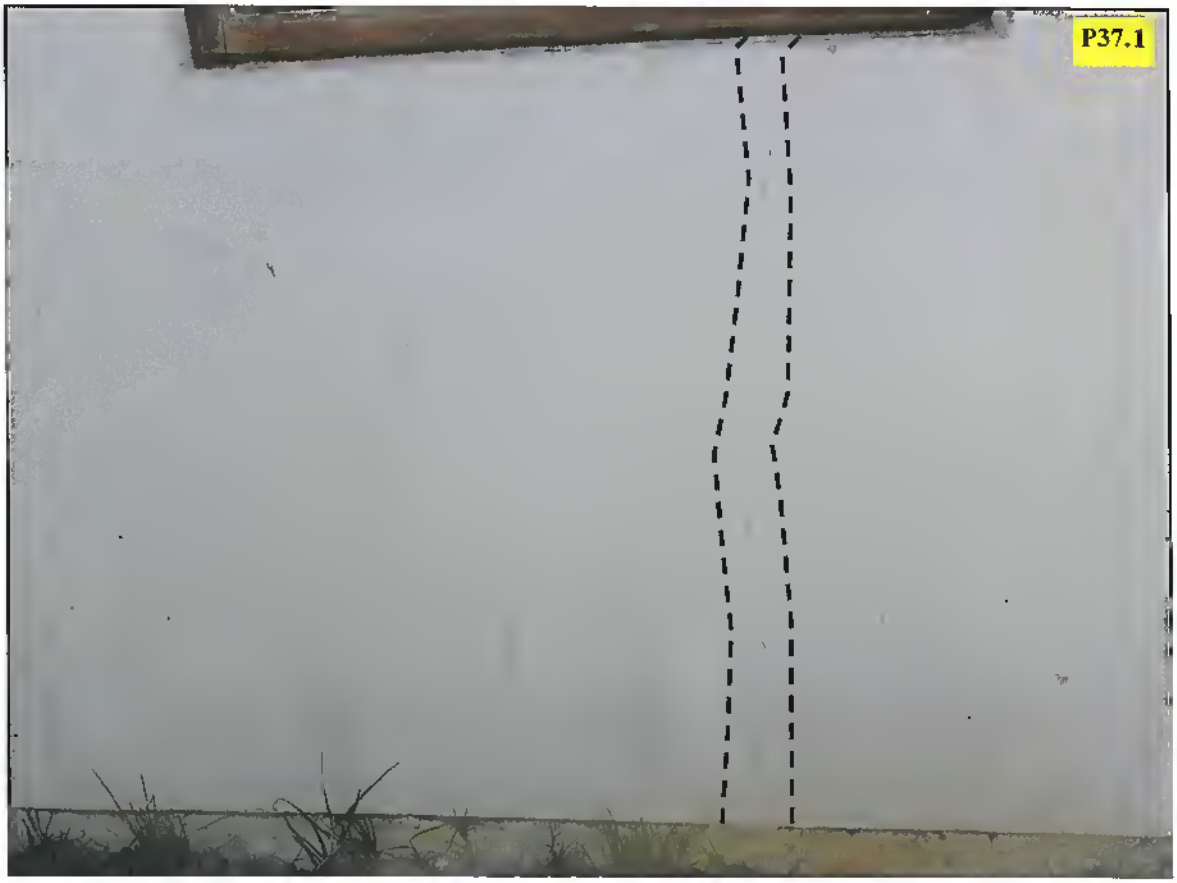
Horizontal crack extending from front door to window sill along mortar joint containing brick-force.

Cracked apron slab at front door.



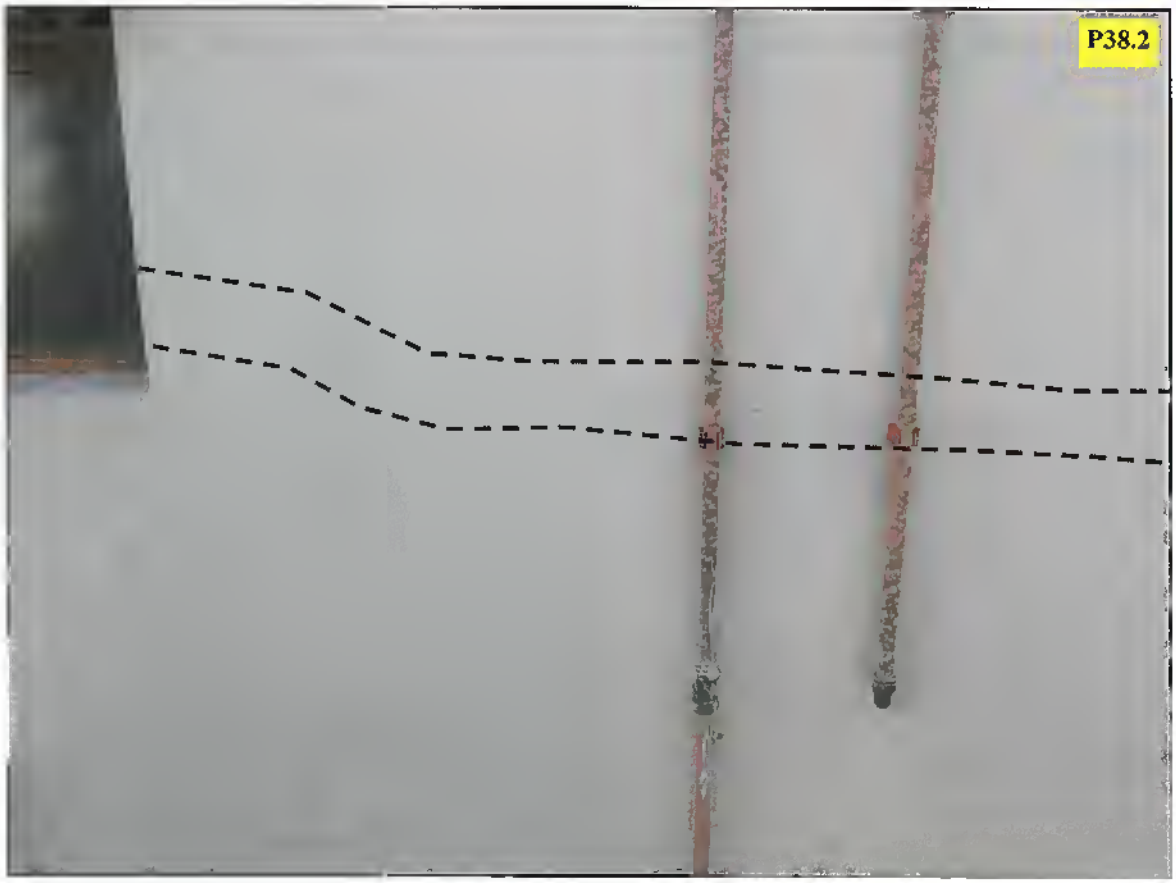
Typical stepped cracks following mortar joints below window on side wall of house; cracks occur fairly consistently in same location in surrounding houses.

PLATE 36



Near vertical cracks and diagonal crack extending from raft foundation to window sill.

PLATE 37



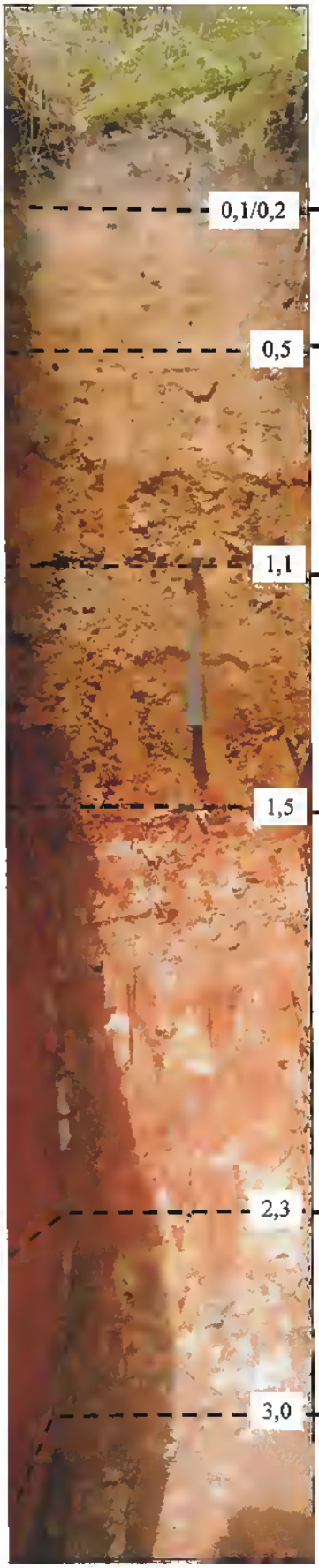
Predominantly horizontal cracks extending from bottom corners of windows to corner of house; present in a number of houses.

PLATE 38

APPENDIX C

TP1 to TP30

Soil Profiles & Related Photos



Soil profile recorded in TP1

Moist grey-brown loose intact organic clayey silty fine and medium SAND. Humified Sheetwash(Topsoil).

Moist light brown indistinctly mottled orange-brown firm to stiff intact sandy clayey SILT.
Sheetwash.

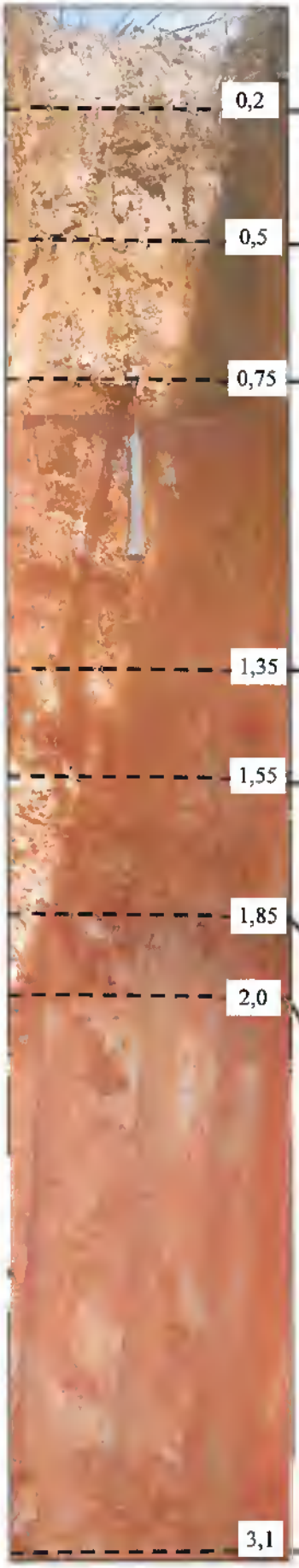
Moist light grey-brown indistinctly blotched orange-brown becoming light orange-brown very stiff to stiff shattered sandy SILT-CLAY
Sheetwash (transition layer).
Note: Samples taken at 0,5m and 0,8m.

Moist pale brown to orange-brown very stiff weakly shattered sandy CLAY-SILT with predominantly fine and medium ferricrete nodules and scattered gravel.
Pebble Marker / Nodular Ferricrete.
Note: Starts grading into stiff reworked residual sillstone from approximately1,3m.

Moist light to pale red-brown blotched light and pale grey firm to stiff indistinctly shattered slightly silty sandy CLAY. Reworked Residual Siltstone.
Note: Sample taken at 2,1m.

Moist pale to light grey blotched pale pinkish-red stiff to very stiff weakly shattered silty sandy CLAY.
Partially Reworked Residual Siltstone.
Note: Sample taken at 3,0m

At 3,0m: Excavation stopped in predominantly pale grey very stiff partially reworked residual siltstone as above.



Moist pale grey-brown medium dense intact silty fine and medium SAND; fine roots throughout layer. Fill.

Moist grey-brown to light grey-brown firm to stiff intact slightly organic sandy clayey SILT. Humified Sheetwash (Transported Horizon).

Moist light brown indistinctly blotched orange-brown stiff weakly shattered sandy CLAY-SILT. Sheetwash (Transported).

Moist red-brown becoming orange-brown blotched red-brown stiff to very stiff weakly shattered sandy silty CLAY with some fine and medium ferricrete nodules. Partially Ferruginised Transported Horizon.

As above but more clayey and very stiff with less ferricrete nodules. Reworked Residual Siltstone.

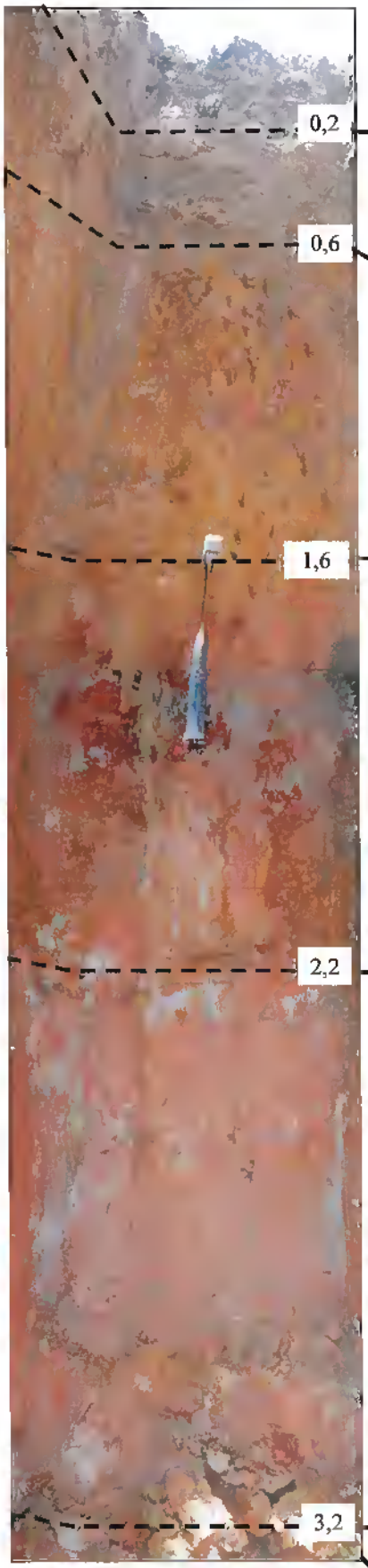
Fine medium and some coarse red-brown ferruginous NODULES in a moist orange-brown very stiff weakly shattered sandy CLAY-SILT matrix. Slightly Ferruginised Pebble Marker / Nodular Pedocrete.

Moist red-brown blotched pale grey very stiff weakly shattered sandy SILT-CLAY with scattered ferricrete nodules. Partially Reworked Residual Siltstone.

Moist light to pale orange-brown blotched light grey and pale red-brown very stiff intact to weakly shattered sandy clayey SILT.
Slightly Reworked Residual Siltstone.

Soil profile recorded in TP2

At 3,1m: Excavation stopped in very stiff slightly reworked residual siltstone as above.



Soil profile recorded in TP3

Moist grey-brown loose voided slightly organic clayey silty fine and medium SAND with abundant grass roots. Humified Sheetwash (Transported). (Note: Exposed a termite nest).

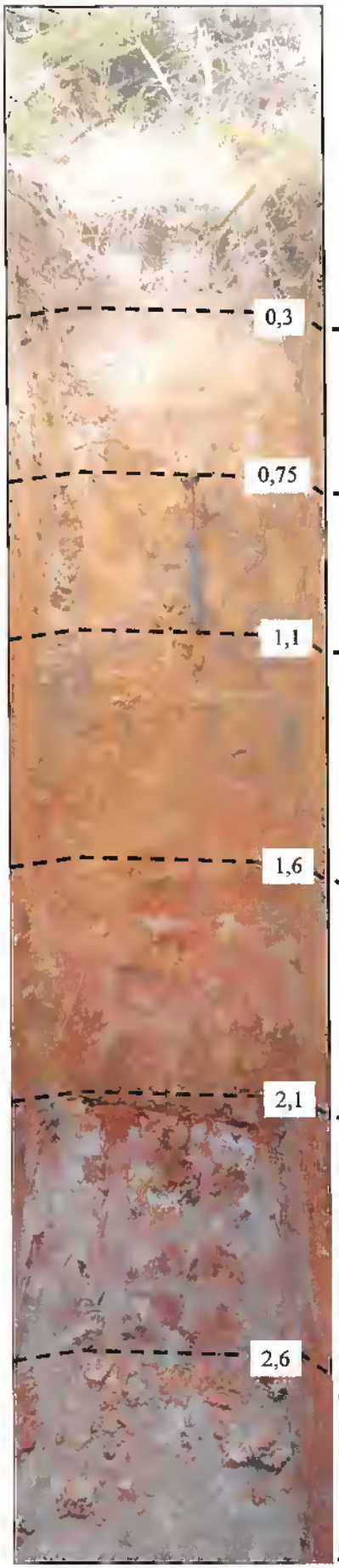
Moist light brown firm intact sandy (fine and medium) clayey SILT. Sheetwash (Transported Horizon).

Moist orange-brown blotched light brown predominantly very stiff weakly shattered clayey silty SAND to sandy clayey SILT. Sheetwash Transported).
Note: Scattered ferricrete nodules and gravel at 1,6m represent basal pebble marker.

Moist red-brown blotched light to pale grey– and pale orange-brown very stiff weakly shattered sandy CLAY-SILT with some dark red-brown locally concentrated ferruginous nodules that are partially coalesced and cemented in places.
Ferruginised Reworked Residual Siltstone.
Note: Slight localised seepages at base of nodular ferricrete pockets exposed on sidewalls.

Moist to very moist light to pale grey blotched light to pale pinkish- and red-brown (light orange-brown in places) stiff to very stiff weakly shattered to intact sandy clayey SILT to sandy SILT-CLAY.
Partially Reworked Residual Siltstone.
Note: Becomes less sandy with depth.

At 3,2m: Excavation stopped on very stiff partially reworked residual siltstone as above.



Soil profile recorded in TP4

Moist grey– to light grey-brown loose voided slightly organic silty fine and medium SAND with fine roots concentrated in top 100mm layer. Humified Sheetwash (Topsoil).

Moist pale yellowish-brown firm to stiff slightly voided to intact sandy clayey SILT. Sheetwash (Transported Horizon).

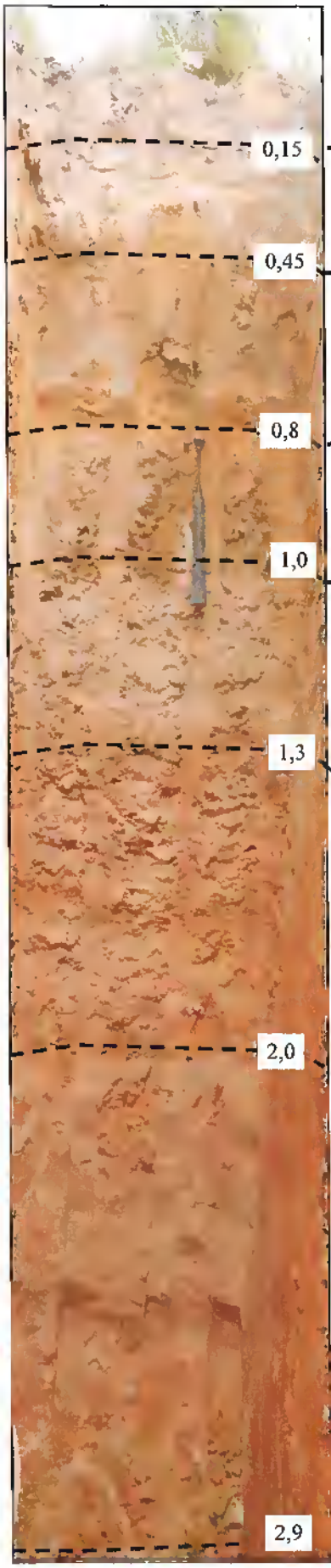
Moist light yellowish-brown blotched orange-brown very stiff weakly shattered sandy clayey SILT to sandy CLAY-SILT. Sheetwash (Transported Horizon).

Moist orange-brown blotched yellow-brown becoming red-brown and containing scattered ferricrete nodules with depth very stiff weakly shattered sandy SILT-CLAY. Sheetwash (Transported).
Note: Ferricrete nodules and scattered gravel becoming more concentrated at 1,6m.

Moist red-brown blotched orange-brown and light grey sparse very stiff slightly shattered sandy clayey SILT to sandy SILT-CLAY with fine and medium ferricrete nodules. Ferruginous Reworked Residual Siltstone (Pedogenic).

Moist pale grey blotched red-brown to pale yellowish-brown very stiff weakly shattered sandy clayey SILT to sandy SILT-CLAY. Partially Reworked Residual Siltstone.

At 2,6m: Excavation stopped on very stiff partially reworked residual siltstone as above.



Soil profile recorded in TP5

Slightly moist to moist light grey-brown medium dense slightly voided slightly organic clayey silty fine and medium SAND; scattered fine roots. Slightly Humified Sheetwash.

Moist light yellow-brown firm slightly voided sandy clayey SILT. Sheetwash(Transported Horizon.)

Moist orange-brown blotched brown stiff to very stiff weakly shattered sandy CLAY-SILT. Sheetwash (Transported Horizon.)

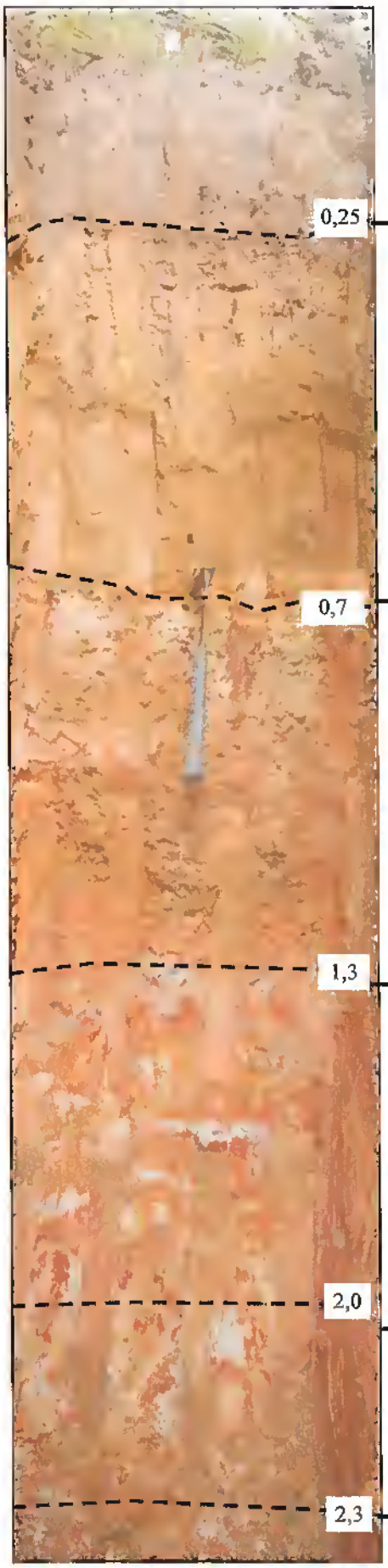
Slightly moist to moist orange–brown blotched light brown and orange-brown very stiff shattered sandy CLAY-SILT with occasional ferruginous nodules. Sheetwash

Abundant fine medium and coarse GRAVEL and scattered red-brown ferricrete concretions tightly packed in a slightly moist pale brown very stiff to stiff intact clayey SAND-SILT matrix. Pebble Marker/Nodular Ferricrete. (Pedogenic).
Note: Very tightly packed and leached in top 0,3m layer.

Predominantly fine and medium with some coarse red-brown ferricrete CONCRETIONS in a brown to red-brown very stiff weakly shattered sandy CLAY-SILT matrix. Nodular Ferricrete/ Ferruginised Reworked Residual Siltstone.

Moist red-brown blotched pale grey to light yellowish-brown very stiff weakly shattered slightly sandy CLAY-SILT. Partially Reworked Residual Siltstone.

At 2,6m: Excavation stopped on very stiff partially reworked residual siltstone as above.



Soil profile recorded in TP6

Slightly moist to moist grey brown medium dense slightly voided to intact slightly organic clayey silty fine and medium SAND; scattered fine grass roots concentrated in upper 100mm layer.
Humified Sheetwash.

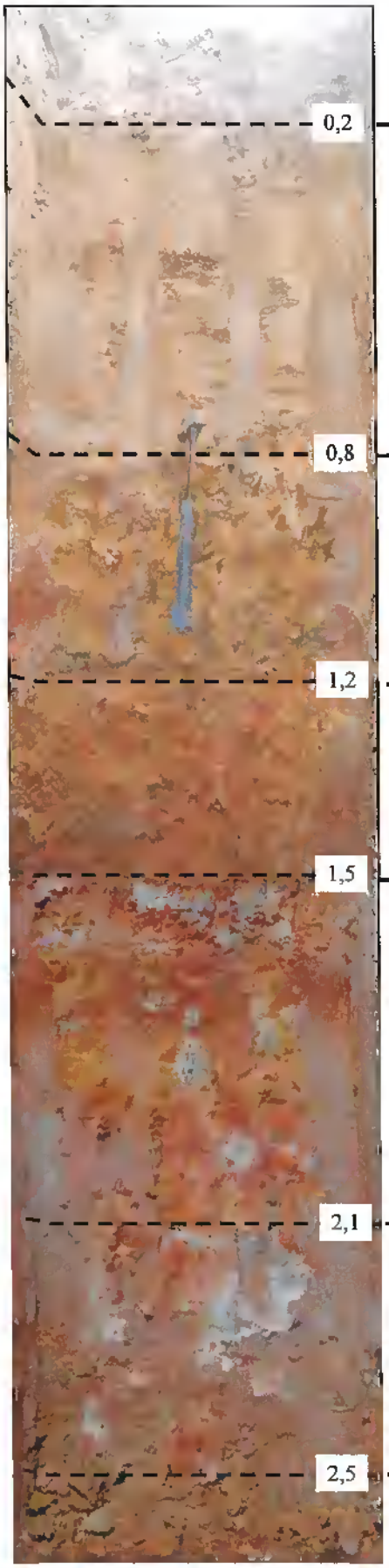
Moist light yellowish-brown firm to stiff intact to slightly shattered with depth clayey fine and medium SAND-SILT becoming more clayey with depth. Sheetwash.

Predominantly fine and medium calcrete and ferricrete NODULES with a little gravel becoming coarser with depth, contained in a moist orange-brown sparsely blotched and mottled brown to red-brown (more mottled with depth) very stiff weakly shattered sandy CLAY-SILT matrix.
Nodular Ferricrete/Pebble Marker. (Pedogenic).
Note: Upper layer leached and nodules tightly packed in a partially cemented matrix.

Moist orange-brown blotched red- and yellowish-brown to pale grey very stiff weakly shattered sandy SILT-CLAY. Reworked Residual Siltstone.

Pale yellow-brown to pale grey blotched red-brown very stiff intact to indistinctly shattered, slightly sandy clayey SILT. Partially Reworked Residual Siltstone.
Note: More silty with depth.

At 2,3m: Excavation stopped on very stiff partially reworked residual siltstone as above.



Slightly moist to moist light grey-brown medium dense slightly voided slightly organic silty fine and medium SAND; scattered fine grass roots. Sheetwash

Moist light yellowish-brown medium dense intact sandy clayey SILT. Sheetwash (Transported.)
Note: More claying and stiff to very stiff between 0,5m and 0,8m.

Moist orange-brown indistinctly blotched yellow-brown stiff to very stiff weakly shattered sandy CLAY-SILT. Ferruginous Sheetwash. (Transported.)

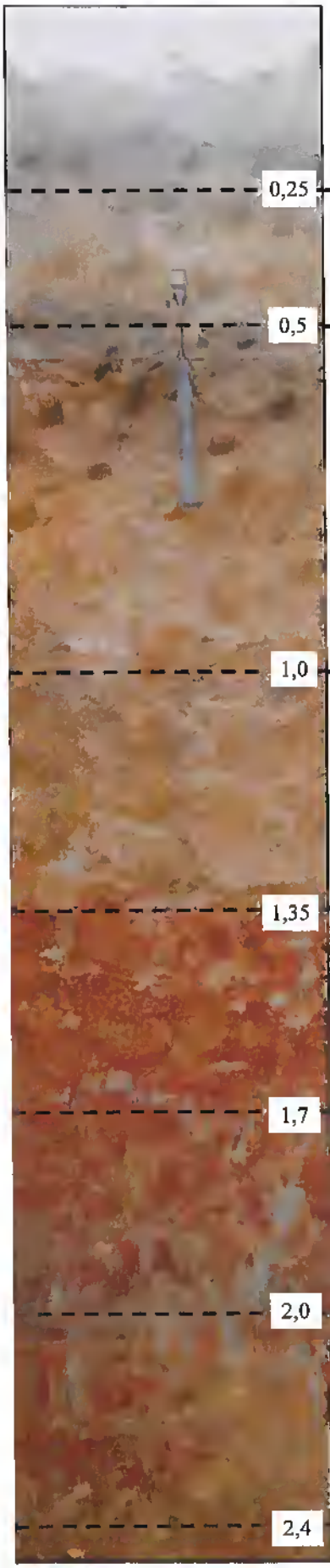
Predominantly fine and medium ferricrete NODULES and scattered gravel in a moist orange-brown blotched red-brown very stiff indistinctly shattered sandy CLAY-SILT. Nodular Ferricrete. (Pedogenic)/Pebble Marker.

Moist red- and orange-brown sparsely blotched pale grey very stiff indistinctly shattered slightly sandy CLAY-SILT to slightly sandy clayey SILT. Reworked Residual Siltstone.

Moist predominantly pale grey to off-white blotched red- and orange-brown very stiff weakly shattered to intact slightly sandy clayey SILT. Partially Reworked Residual Siltstone.

At 2,5m: Excavation stopped on very stiff partially reworked residual siltstone as above.

Soil profile recorded in TP7



Soil profile recorded in TP8

Slightly moist to moist light grey-brown medium dense slightly voided and organic clayey silty fine and medium SAND, with traces of fine roots. Humified Sheetwash (Topsoil).

Slightly moist to moist light yellowish-brown medium dense slightly shattered to intact clayey silty SAND-SILT. Sheetwash (Transported).

Slightly moist to moist grey-brown becoming light yellow-brown blotched orange-brown with depth predominantly stiff weakly shattered sandy and gravelly clayey SILT. Sheetwash (Transported).

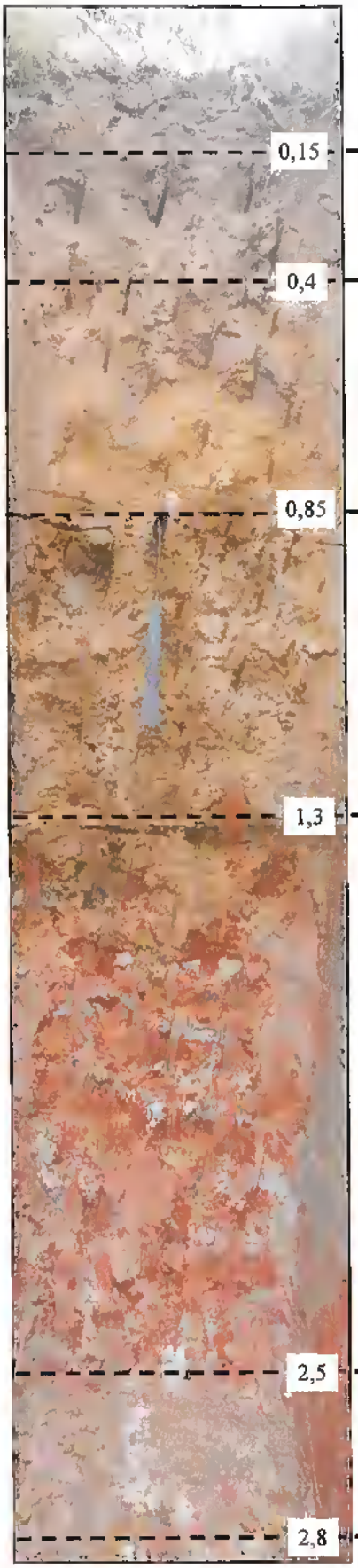
As above but more clayey.

Abundant red-brown predominantly fine and medium ferricrete NODULES in an orange-brown sparsely blotched pale grey very stiff indistinctly shattered sandy CLAY-SILT matrix. Nodular Ferricrete (Pedogenic)/Pebble Marker.

Moist red-brown blotched pale grey stiff to very stiff shattered sandy SILT-CLAY. Reworked Residual Siltstone.

Moist predominantly red-brown sparsely blotched light to pale grey and light yellow- to orange-brown very stiff weakly shattered sandy CLAY-SILT. Partially Ferruginised Reworked Residual Siltstone.

At 2,4m: Excavation stopped on very stiff partially reworked residual siltstone as above.



Soil profile recorded in TP9

Slightly moist grey-brown medium dense voided slightly organic and clayey silty fine and medium SAND with some fine roots. Humified Sheetwash.

Slightly moist to moist light grey-brown FIRM slightly clayey silty fine and medium SAND. Sheetwash.

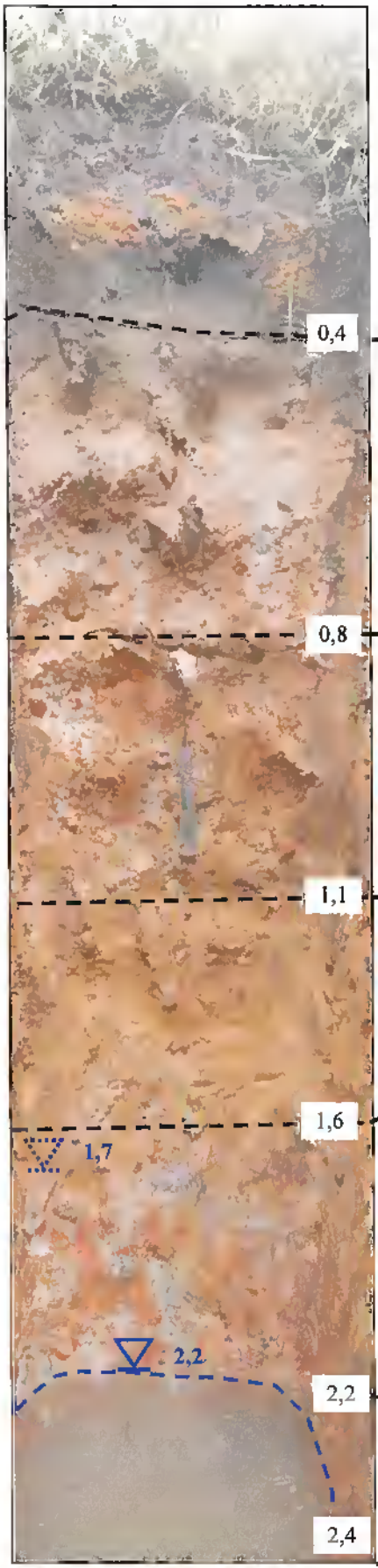
Moist light grey-brown blotched light yellow- and orange-brown stiff to very stiff weakly shattered clayey SILT-SAND to sandy CLAY-SILT. Sheet-wash (Transported).

Moist orange-brown blotched light yellow– and pale grey-brown stiff to very stiff shattered sandy CLAY-SILT with some fine and medium ferricrete nodules and scattered fine gravel. Pebble Marker/Nodular Ferricrete. (Pedogenic).

Moist red- and orange-brown blotched pale grey stiff to very stiff shattered sandy CLAY-SILT. Reworked Residual Siltstone.

Moist pale grey sparsely blotched red- and orange-brown very stiff weakly shattered sandy clayey SILT to sandy CLAY-SILT. Partially Reworked Residual

At 2,8m: Excavation stopped on very stiff partially reworked residual siltstone as above.



Soil profile recorded in TP10

Moist dark grey-brown very loose to loose voided organic clayey SILT and medium SAND. Humified Sheetwash.
Note: Kikuyu grass roots concentrated in top 100 mm zone.

Moist light yellow– to grey-brown faintly blotched light orange brown firm weakly shattered sandy CLAY-SILT. Sheetwash (Transported).

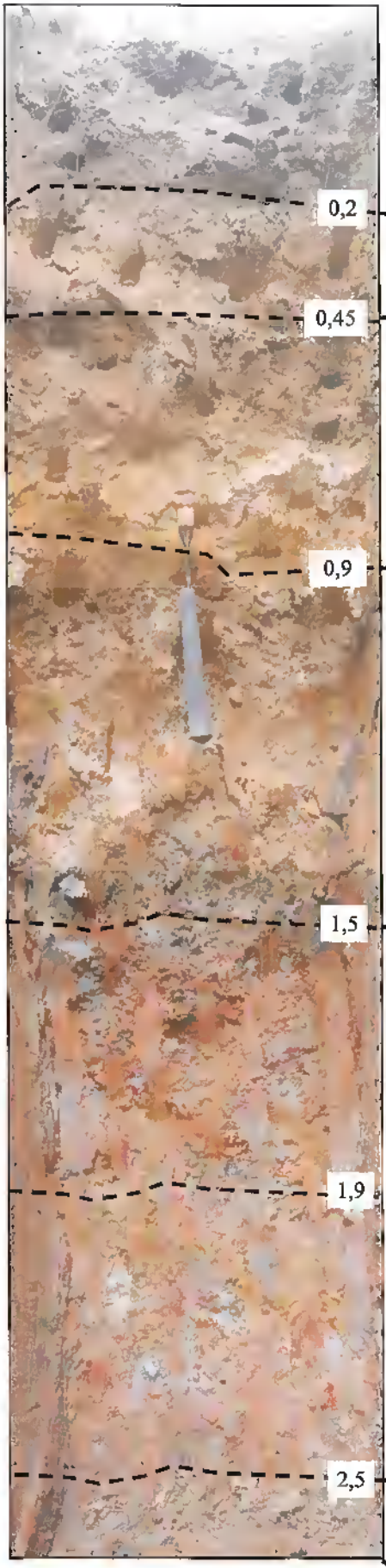
Moist pale grey-brown blotched orange-brown and sparsley red-brown firm shattered sandy CLAY-SILT with a little fine ferricrete nodules. Sheetwash (Transported).

Moist to very moist orange-brown indistinctly blotched light grey-brown firm to stiff shattered silty sandy CLAY. Reworked Residual Siltstone.

Very moist to wet light to pale yellow-brown blotched pale grey and pale red– to light orange-brown stiff weakly shattered silty sandy CLAY. Partially Reworked Residual Siltstone.
Note: (i) Very slight seepages below 1,8m.
(ii) If sufficient time was allowed the water table would most likely have stabilised at 1,7m below ground level.

As above but wet and stiff to very stiff slightly less clayey and more silty. Partially Reworked Residual Siltstone.

At 2,4m: Excavation stopped in very stiff partially reworked residual siltstone as above.



Soil profile recorded in TP11

Moist grey-brown medium dense voided slightly organic clayey silty fine and medium SAND; scattered fine roots concentrated in top 100mm. Humified Sheetwash (topsoil).

As above but light grey-brown and loose (firm) clayey sandy SILT. Sheetwash.

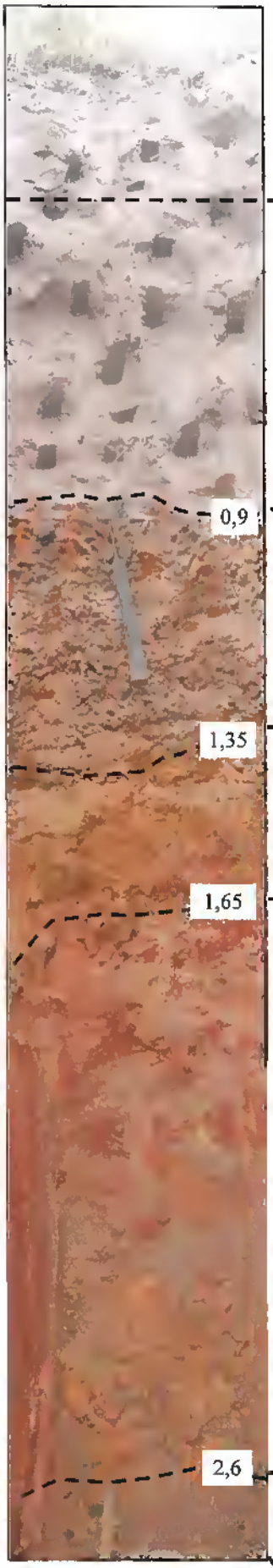
Moist light brown indistinctly blotched light orange-brown stiff weakly shattered sandy CLAY-SILT with traces of fine roots. Sheetwash (Transported).

Moist light brown blotched orange-brown and light grey-brown with depth, very stiff shattered sandy CLAY-SILT with traces of fine ferricrete nodules and scattered gravel near base. Sheetwash (Transported).
Note: Poorly developed basal pebble marker.

Moist orange-brown blotched red-brown and pale grey very stiff weakly shattered silty sandy CLAY. Partially Ferruginised Reworked Residual Siltstone

Moist light yellow-brown blotched pale grey and orange-brown (sparse light red-brown blotches) very stiff weakly shattered silty sandy CLAY. Partially Reworked Residual Siltstone.

At 2,4m: Excavation stopped in very stiff partially reworked residual siltstone as above.



Soil profile recorded in TP12

Moist grey-brown medium dense voided slightly organic clayey silty SAND. Humified Sheetwash.
Note : Roots concentrated in top 150mm layer.

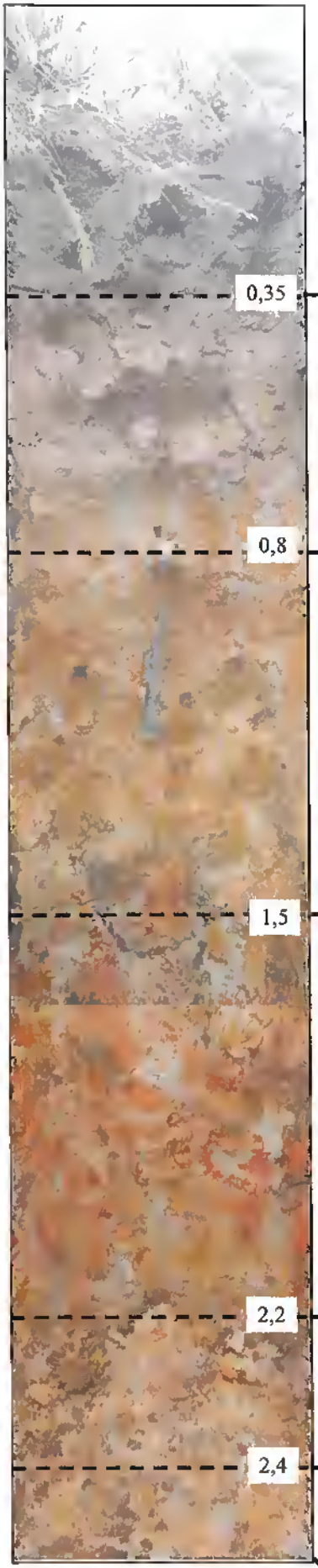
Moist light grey-brown becoming lighter with depth very stiff intact sandy clayey SILT; scattered fine roots.
Sheetwash (Transported).

Abundant orange-brown fine and medium ferricrete NODULES and scattered gravel in a moist grey-brown very dense partially cemented (ferruginised) clayey SILT-SAND matrix.
Pebble Marker / Nodular Ferricrete (Pedogenic).

Moist orange-brown very stiff shattered (shatter surfaces stained dark brown) sandy silty CLAY.
Reworked Residual Siltstone.

Moist light grey-brown blotched red-brown occasionally off-white to pale orange-brown very stiff weakly shattered silty sandy CLAY.
Partially Reworked Residual Siltstone.

At 2,6m: Excavation stopped on very stiff partially reworked residual siltstone as above.



Soil profile recorded in TP13

Moist grey-brown loose voided slightly organic (less organic with depth) clayey sandy SILT. Humified Sheetwash (Topsoil).
Note: Scattered fine roots more concentrated in top 100mm layer.

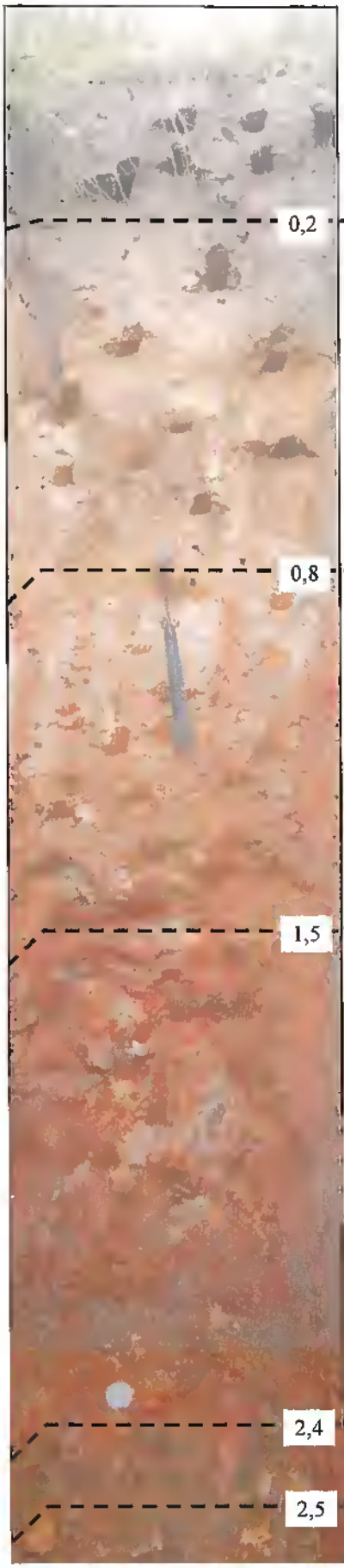
Moist light grey-brown indistinctly blotched light orange-brown (more prominent with depth) stiff to very stiff weakly shattered sandy CLAY-SILT. Sheetwash (Transported).

Moist orange-brown blotched pale grey-brown stiff to very stiff shattered sandy silty CLAY.
Sheetwash (Transported).
Note: Traces of fine ferricrete nodules at base of layer.
Pebble Marker.

Moist predominantly light orange-brown and pale grey blotched red-brown and orange-brown very stiff shattered to weakly shattered with depth (fine root penetration exposed on prominent shattered surfaces) silty sandy CLAY.
Reworked Residual Siltstone.

Moist to very moist light yellow-orange blotched pale grey to light pinkish-brown very stiff slightly shattered sandy silty CLAY. Slightly Reworked Residual Siltstone.

At 2,4m: Excavation stopped in slightly reworked residual siltstone as above.



Soil profile recorded in TP14

Moist dark grey-brown medium dense voided slightly organic clayey silty fine and medium SAND. Humified Sheetwash (Topsoil).
Note: Fine roots scattered throughout.

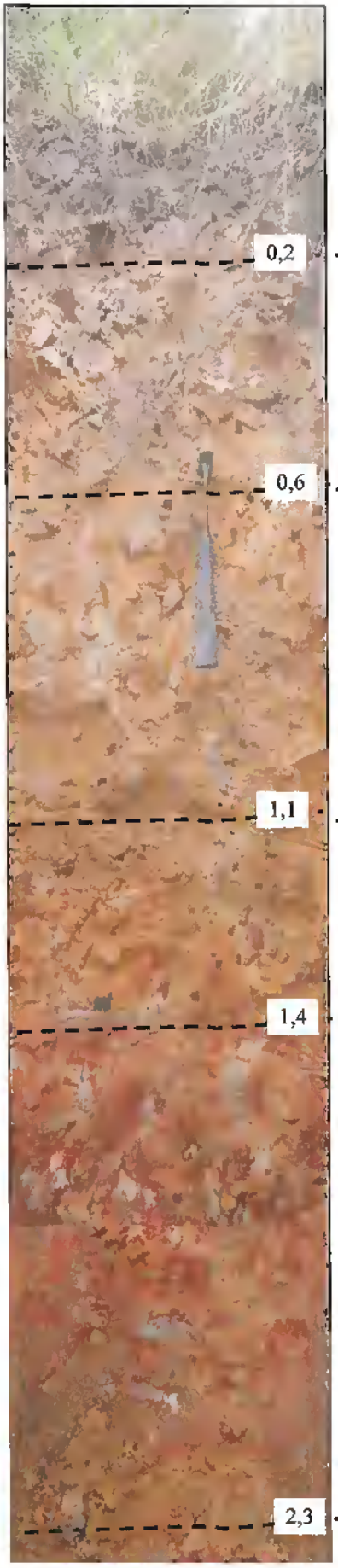
Slightly moist to moist light grey-brown becoming light yellow-brown blotched off-white (more prominent from a depth of 0,4m) stiff and very stiff from 0,35m weakly shattered clayey sandy SILT with calcareous inclusions from 0,4m and traces of fine gravel near the base. Partially Calcretised Sheetwash (Transported).

Fine and medium ferricrete and calcrete NODULES with some scattered gravel in a moist light to pale yellow-brown becoming darker yellow– to orange brown with depth very stiff sandy silty CLAY matrix. Pebble Marker / Nodular Pedocrete. (Pedogenic).

Moist predominantly orange-brown blotched pale to light grey and red-brown very stiff shattered silty sandy CLAY.
Reworked Residual Siltstone.

Moist pale pinkish to light red-brown very stiff intact sandy CLAY-SILT. Partially Reworked Residual Siltstone.

At 2,5m: Excavation stopped in very stiff partially reworked residual siltstone as above.



Soil profile recorded in TP15

Moist dark grey- to grey-brown medium dense intact slightly organic clayey silty fine and medium SAND; fine roots concentrated in upper 100mm layer and to 0,4m. Humified Sheetwash.

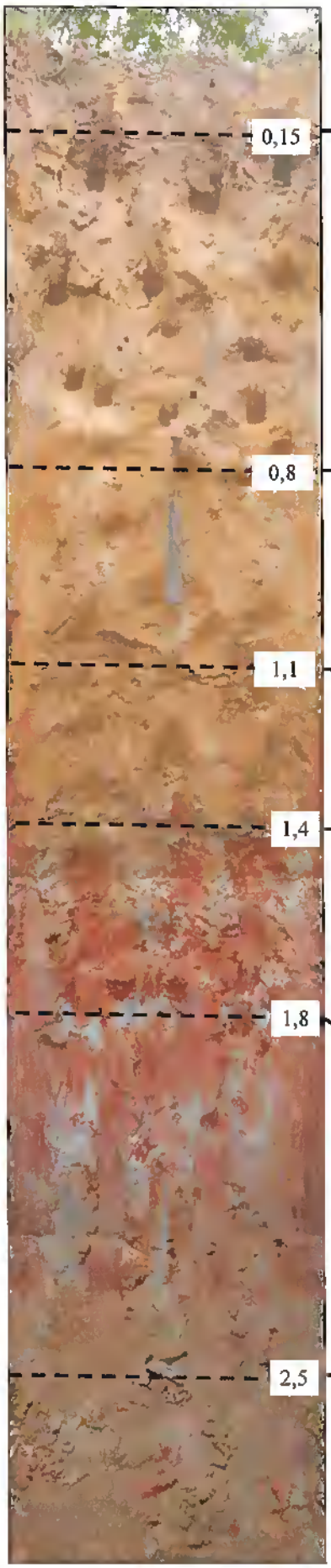
Moist light yellow-brown indistinctly blotched darker yellow-brown very stiff intact sandy CLAY-SILT. Sheetwash (Transported).
Note: Clay fraction increases with depth.

Moist orange-brown blotches / mottled pale grey very stiff to stiff indistinctly shattered, more apparent with depth, sandy (fine and medium) clayey SILT. Sheetwash (Transported).
Note: Scattered ferricrete nodules and occasional gravel between 1,0m and 1,1m. Poorly developed Basal Pebble Marker.

Moist light orange-brown blotched pale yellow– and light grey-brown (sparsely red-brown with depth) predominantly stiff weakly shattered slightly sandy CLAY-SILT with some fine and medium ferricrete nodules. Reworked Residual Siltstone.

Moist predominantly orange-brown blotched light grey and yellow-brown with some red-brown blotches very stiff weakly shattered ferruginous silty sandy CLAY.
Ferruginised Reworked Residual Siltstone (pedogenic).
Note: Isolated pockets of nodular ferricrete.

At 2,3m: Excavation stopped in stratum as above.



Soil profile recorded in TP16

Moist dark grey-brown loose slightly voided organic clayey silty SAND. Humified Sheetwash (Topsoil).

Moist yellow-brown grading into light yellow-brown very stiff weakly shattered clayey sandy SILT to sandy SILT-CLAY (becomes more silty with depth).
Sheetwash (Transported).
Note: Indicator and nmc sample.

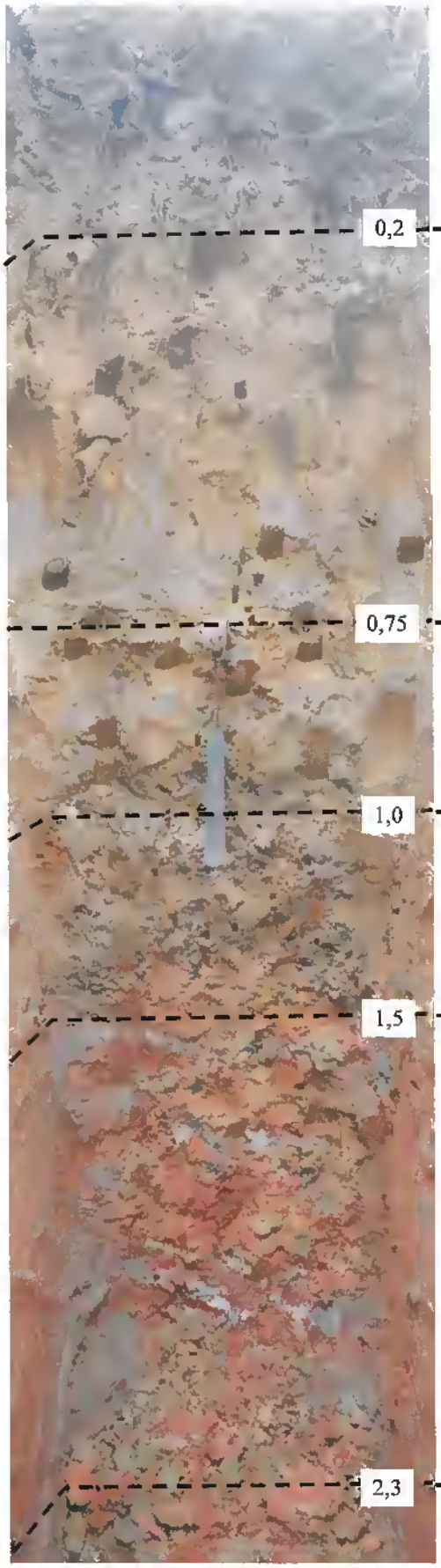
Moist orange-brown indistinctly blotched pale grey-brown very stiff to stiff shattered sandy SILT-CLAY
Sheetwash (Transported).
Note: Indicator and nmc sample.

As above but with some fine and medium ferricrete nodules and concretions, and scattered gravel.
Pebble Marker (Pedogenic).
Note: Indicator and nmc sample taken at 1,1m.

Moist light red-brown blotched light orange-brown and pale grey very stiff to stiff shattered sandy silty CLAY with some to abundant (locally concentrated) ferricrete nodules. Reworked Residual Siltstone.
Note: Indicator and NMC sample.

Moist light orange-brown and red-brown blotched pale grey and light yellow-brown stiff weakly shattered silty sandy CLAY-SILT. Partially Reworked Residual Siltstone.
Note: Indicator and nmc sample.

At 2,5m: Excavation stopped in very stiff stratum as above.



Soil profile recorded in TP17

Moist dark grey-brown loose voided organic clayey silty fine and medium SAND; fine roots concentrated in upper 100mm layer. Humified Sheetwash (Topsoil).

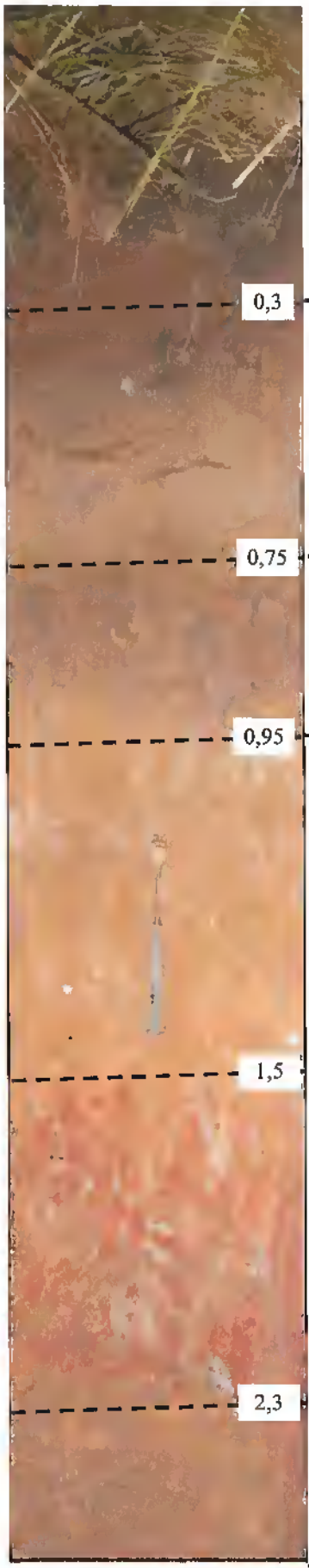
Moist light grey-brown to light yellow-brown becoming yellow-brown with depth firm to stiff weakly shattered sandy CLAY-SILT; becomes more clayey and weakly shattered with depth. Sheetwash (Transported).
Note: Isolated shrub roots to 0,6m.

Moist light yellow-brown indistinctly mottled and blotched light orange-brown stiff to very stiff shattered (roots on shatter surfaces) sandy SILT-CLAY. Sheetwash.

Fine and medium ferricrete NODULES and scattered gravel in a very stiff matrix as above. Pebble Marker / Nodular Ferricrete (Pedogenic).

Moist yellow– and orange-brown blotched pale grey and red-brown very stiff shattered sandy silty CLAY with localised pockets of fine and medium ferricrete nodules.
Slightly Ferruginised Reworked Residual Siltstone.

At 2,3m: Excavation stopped in stratum as above but with less blotches and predominantly light orange-brown silty sandy CLAY.
Partially Reworked Residual Siltstone.



Soil profile recorded in TP18

Moist dark brown loose voided organic clayey silty fine and medium SAND. Humified Sheetwash (Topsoil).
Note: Roots concentrated in top 150mm strongly humified layer.

Moist brown to light yellowish-brown firm to stiff slightly voided sandy CLAY-SILT to sandy clayey SILT. Sheetwash.

As above but grey-brown with indistinct light yellow-brown blotches, stiff to very stiff shattered and more clayey. Earlier Topsoil Horizon (Humified Sheetwash).

Moist orange-brown indistinctly blotched light yellow-brown very stiff shattered sandy CLAY-SILT with traces of fine and medium ferricrete nodules towards base.
Reworked Residual Siltstone.

Moist red-brown blotched orange-brown and pale grey very stiff shattered sandy silty CLAY.
Slightly Ferruginous Reworked Residual Siltstone.

At 2,3m: Excavation stopped in stratum as above.

Soil profile recorded in TP19

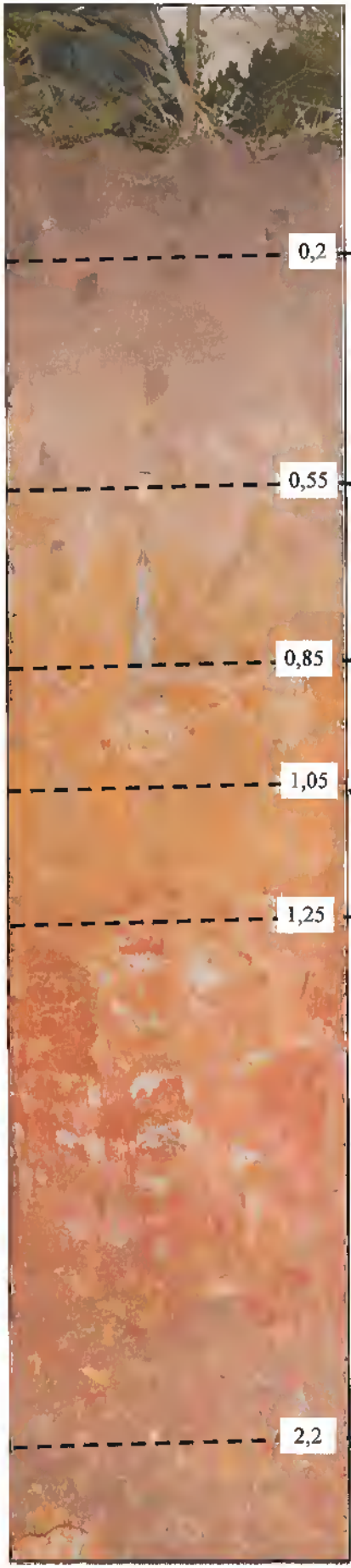
Moist dark grey-brown loose voided organic clayey silty fine and medium SAND.
Humified Sheetwash (Topsoil).

Moist light yellow-brown stiff and very stiff weakly shattered sandy clayey SILT. Sheetwash (Transported).
Note: (i) Brown blotches below 0,6m presumably relics of an earlier humified topsoil horizon.
(ii) Traces of ferricrete nodules and occasional gravel possibly representing a very poorly developed basal pebble marker

Moist orange-brown indistinctly blotched light yellow-brown stiff to very stiff shattered sandy CLAY-SILT with numerous ferricrete nodules from 1,35m.
Reworked Residual Siltstone.

Most red-brown blotched light orange-brown to pale grey stiff to very stiff weakly shattered silty sandy CLAY with isolated zones containing some ferricrete nodules. Partially Reworked Residual Siltstone.

At 2,35m: Excavation stopped in stratum as above.



Soil profile recorded in TP20

Most dark grey-brown medium dense slightly voided and organic clayey silty fine and medium SAND; some fine roots. Humified Sheetwash (Topsoil).

Moist light grey-brown loose to medium dense intact sandy clayey SILT.
Sheetwash (Transported).

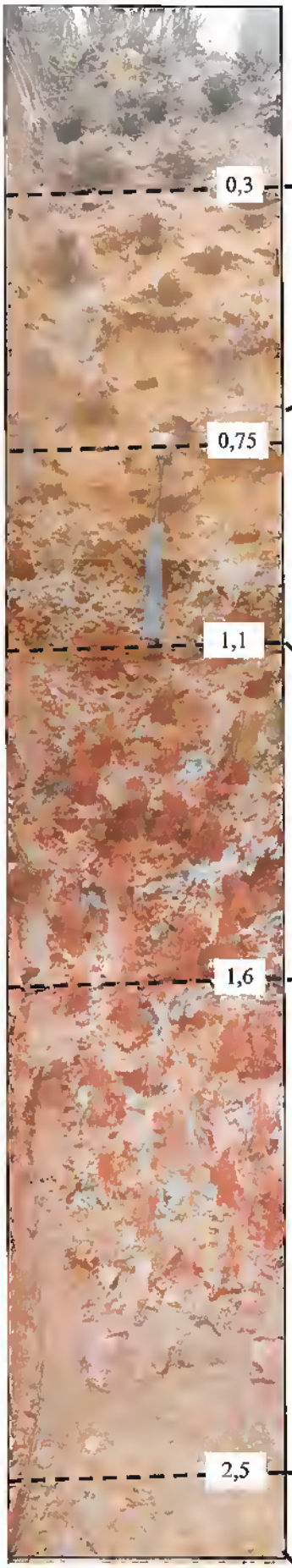
Moist light grey-brown indistinctly blotched orange-brown very stiff weakly shattered silty SAND-CLAY.
Sheetwash (Transported).

Orange-brown fine and medium ferricrete NODULES and CONCRETIONS in moist pale grey-brown very stiff intact sandy clayey SILT matrix.
Nodular Ferricrete Pedocrete/Pebble Marker.

As above but with substantially less ferricrete nodules.
Reworked Residual Siltstone.

Moist light orangey-brown blotched red-brown with sparse pale grey to red-brown blotches very stiff weakly shattered sandy CLAY-SILT with isolated zones containing ferricrete nodules. Slightly Ferruginised Reworked Residual Siltstone.

At 2,2m: Excavation stopped on very stiff slightly ferruginised reworked residual siltstone as above.



Soil profile recorded in TP21

Moist grey-brown dense intact slightly organic clayey silty fine and medium SAND.
Humified Sheetwash (Topsoil).
Note: Roots concentrated in top 100mm strongly humified layer.

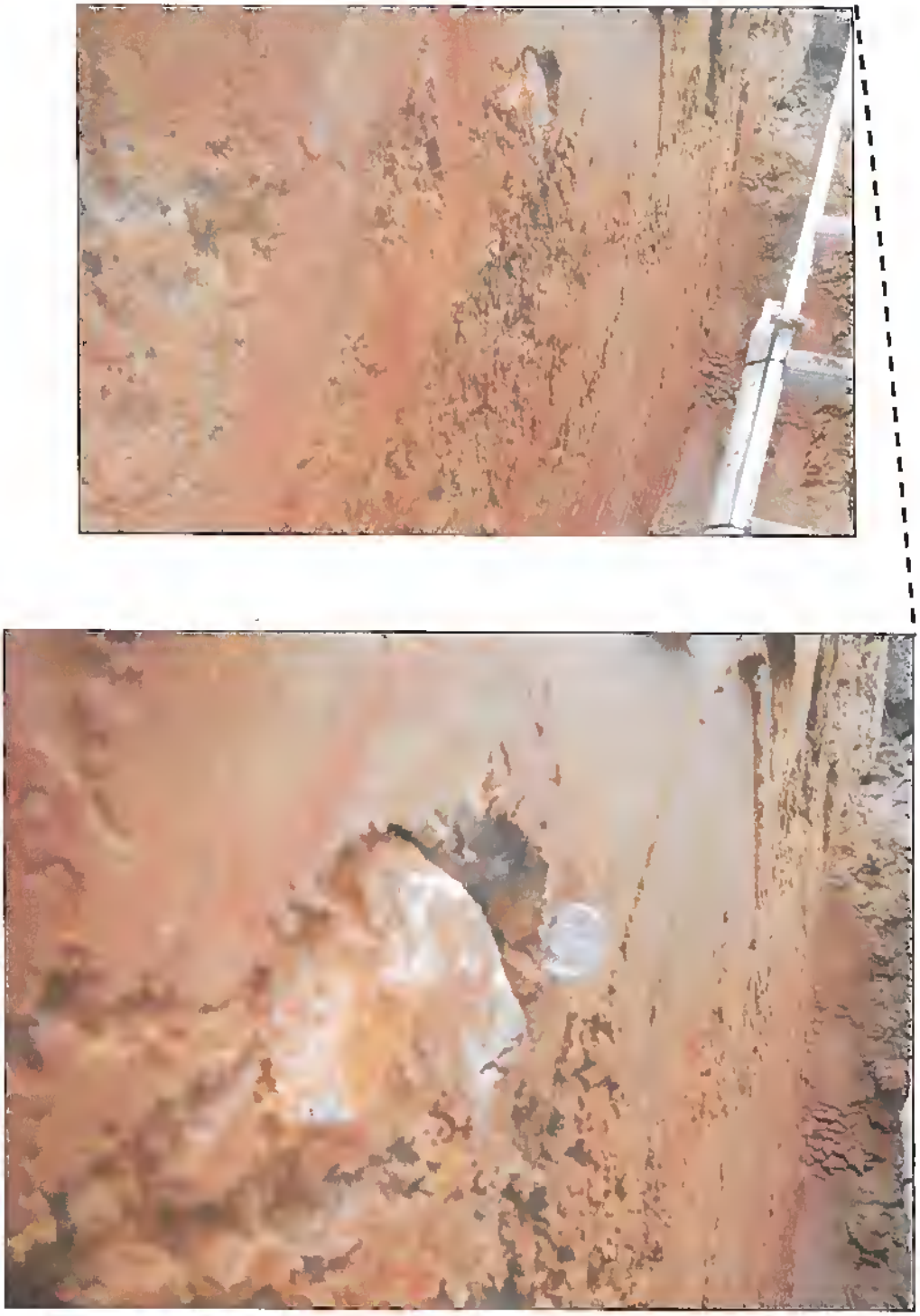
Moist yellow-brown very stiff intact sandy clayey SILT to sandy silty CLAY with depth.
Sheetwash.

Predominantly fine and medium ferricrete NODULES and some off-white calcrete nodules in an orange-brown predominantly very stiff intact sandy CLAY-SILT matrix. Nodular Pebble Marker / Ferricrete (Pedogenic).
Note: (i) Occasional clasts (one up to 75mm in diameter at 0,7m, see Plate .....
(ii) Calcareous nodules concentrated in top half and red-brown ferricrete nodules in lower half.

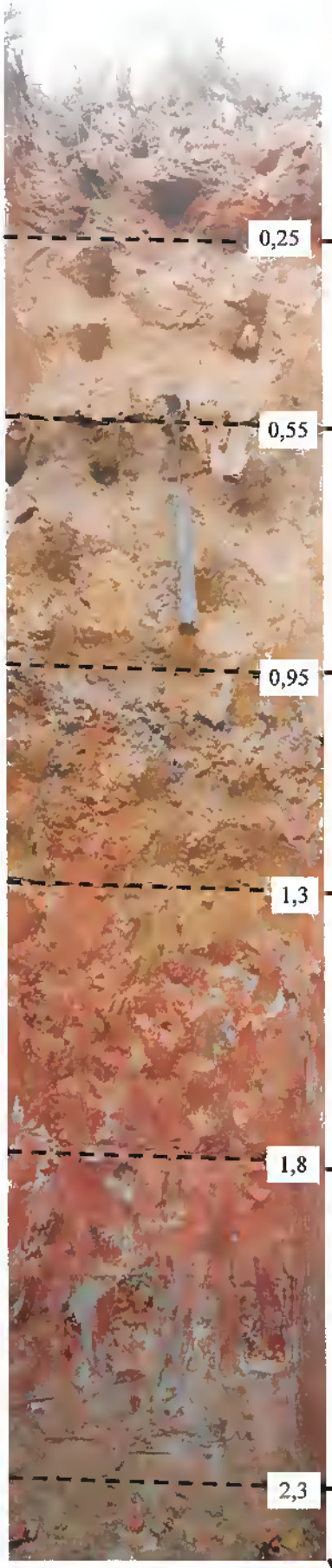
Moist red-brown blotched light orange-brown and pale grey (lenticular inclusions) stiff to very stiff weakly shattered ferruginous sandy silty CLAY with some red-brown ferricrete nodules locally concentrated in pockets and lenses. Ferruginious Reworked Residual Siltstone.

Moist red-brown blotched light orangey-brown and pale grey (pale grey clay coatings on shatter surfaces) very stiff weakly shattered sandy silty CLAY.
Slightly Ferruginised Partially Reworked Residual Siltstone.

At 2,5m: Excavation stopped on very stiff partially reworked residual siltstone as above.



TP21: Atypical clast above discontinuous Nodular Pedocrete/ Pebble Marker horizon between 0,75m and 1,1m.



Soil profile recorded in TP22

Moist brown medium dense intact slightly silty SAND with scattered pieces of orange-brown completely weathered sandstone and fine quartz gravel. Fill.

Moist light to pale yellowish-brown firm to stiff intact sandy clayey SILT. Sheetwash (Transported).
Note: Indicator and nmc sample.

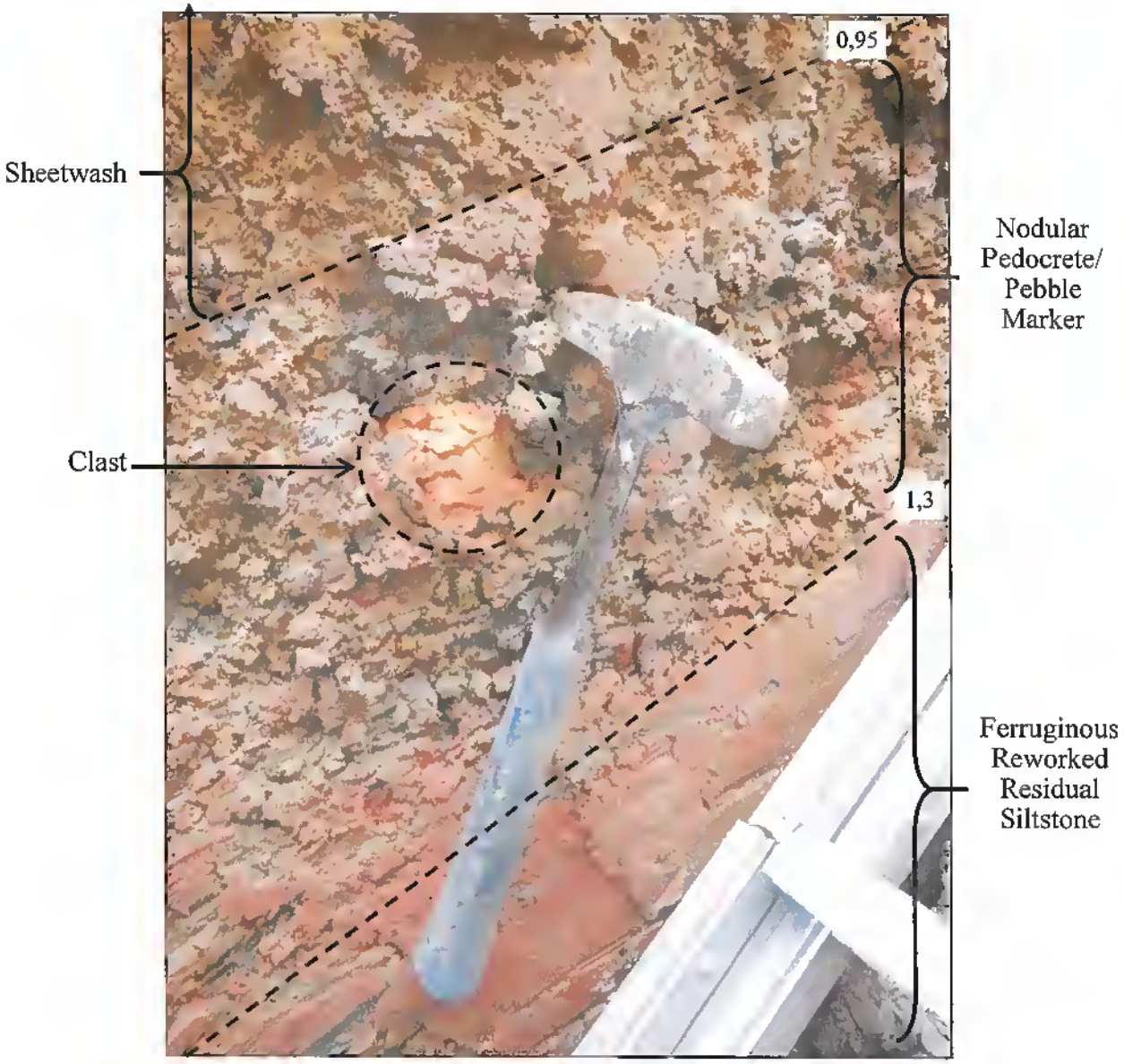
Moist light to pale brown blotched light yellowish-brown becoming light orange-brown with depth very stiff to stiff weakly shattered sandy SILT-CLAY. Sheetwash.
Note: Indicator and nmc sample.

Moist orange-brown stiff and very stiff weakly shattered sandy silty CLAY with scattered ferricrete and calcrete nodules. Pebble Marker / Nodular Pedocrete,
Note: Indicator and nmc sample.

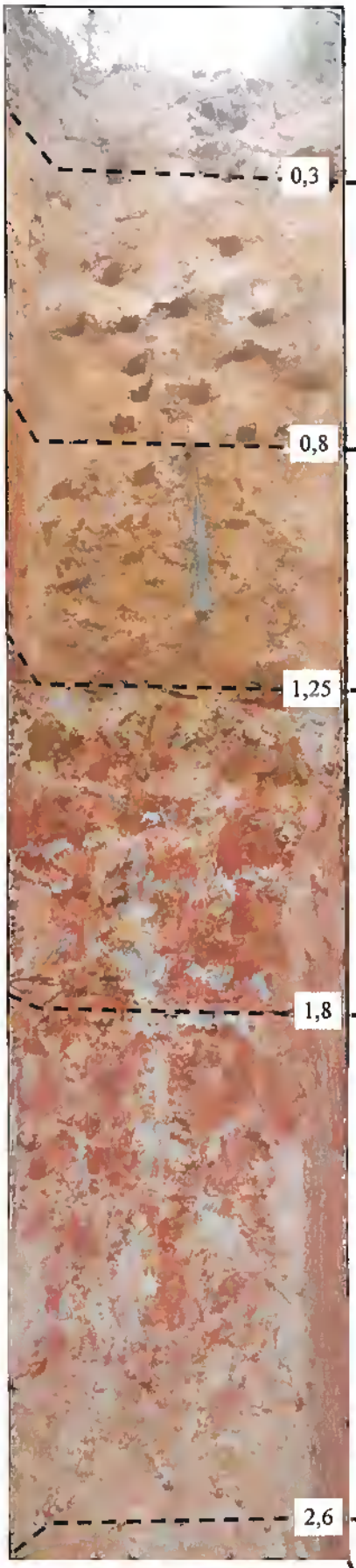
Moist red-brown blotched light orange-brown and pale grey (sparse) very stiff weakly shattered sandy silty CLAY. Ferruginous Reworked Residual Siltstone.

Moist red-brown to orange-brown blotched pale grey very stiff indistinctly shattered sandy silty CLAY. Partially Reworked Residual Siltstone.
Note: (i) Predominantly pale grey to off-white with depth.
(ii) Indicator and nmc sample.

At 2,3: Excavation stopped on pale grey to off-white sparsely blotched light red-brown very stiff weakly shattered to intact sandy CLAY-SILT as above. Slightly Reworked Residual Siltstone.



TP22: Highly to completely weathered quartzitic sandstone clast near top of Nodular Pedocrete/Pebble Marker horizon at approximately 1,0m below ground level.



Soil profile recorded in TP23

Moist light brown loose to medium dense slightly voided slightly organic clayey silty fine to medium SAND; fine roots concentrated in top 100mm more humified

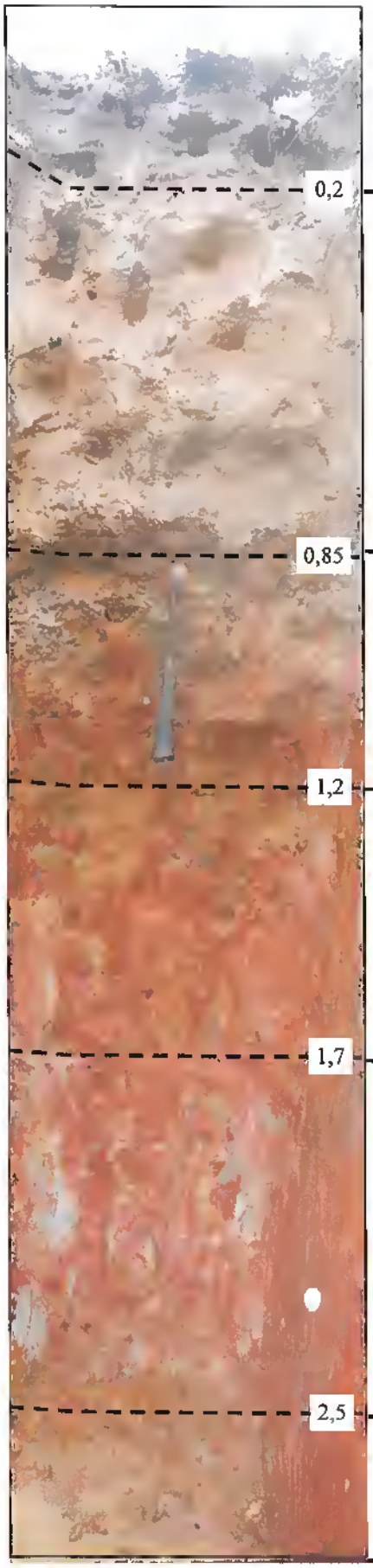
Moist light yellowish-brown stiff to very stiff intact clayey sandy SILT. Sheetwash (Transported).
Note: Blotched brown and very stiff weakly shattered and more clayey from a depth of 0,5m.

Moist orange-brown indistinctly blotched light grey-brown sparsely mottled red-brown stiff to very stiff shattered sandy silty CLAY; contains scattered to numerous fine to medium ferricrete nodules and scattered gravel. Pebble Marker / Nodular Pedocrete.

Moist red-brown blotched orange-brown to pale grey very stiff weakly shattered slightly silty sandy CLAY with some ferruginous concretions in localized pockets and lenses. Partially Ferruginised Reworked Residual Siltctone.

As above but predominantly pale grey weakly shattered to intact and substantially less ferruginised.

At 2,6m: Excavation stopped in moist pale grey sparsely blotched pale pinkish-red very stiff intact sandy silty CLAY. Partially to Slightly Reworked Residual Siltstone.



Soil profile recorded in TP24

Moist light brown very loose voided slightly organic clayey silty fine and medium SAND; roots concentrated in top 100mm more humified layer. Humified Sheetwash (Topsoil).

Moist light yellowish-brown soft to firm slightly shattered to intact sandy clayey SILT. Sheetwash (Transported).
Note: Contains some gravel towards base.

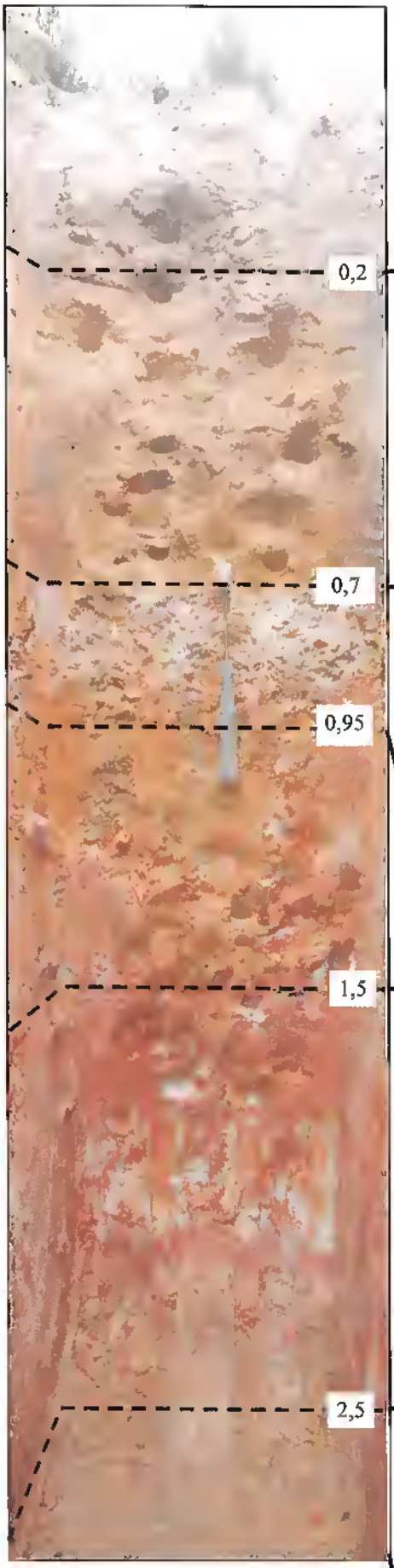
Moist orange-brown blotched light grey- to red-brown stiff to very stiff weakly shattered sandy silty CLAY with some fine and medium ferricrete NODULES and gravel. Pebble Marker / NODULAR Pedocrete (Pedogenic).

Moist red-brown blotched light yellow– to orange-brown (sparse pale grey blotches) very stiff shattered sandy silty CLAY. Ferruginious Reworked Residual Siltstone.

As above but mainly pale grey with less red-brown blotches and weakly shattered sandy SILT-CLAY. Partially Reworked Residual Siltstone.

At 2,5m: Excavation stopped in stiff to very stiff weakly shattered stratum as above.

Note: Profiled during rain; water covering test pit floor was from the rain.



Soil profile recorded in TP25

Moist light brown very loose voided slightly organic clayey silty fine and medium SAND. Humified Sheetwash (Topsoil).

Moist light yellowish-brown firm (stiff near base) slightly shattered sandy clayey SILT to sandy silty CLAY. Sheetwash (Transported).
Note: Indistinctly blotched brown from approx. 0,35m.

Fine and medium calcrete and some ferricrete NODULES and CONCRETIONS with scattered gravel in a moist off-white becoming orange-brown very stiff clayey silty SAND and/or sandy clayey SILT matrix. Pebble Marker / Nodular Pedocrete.

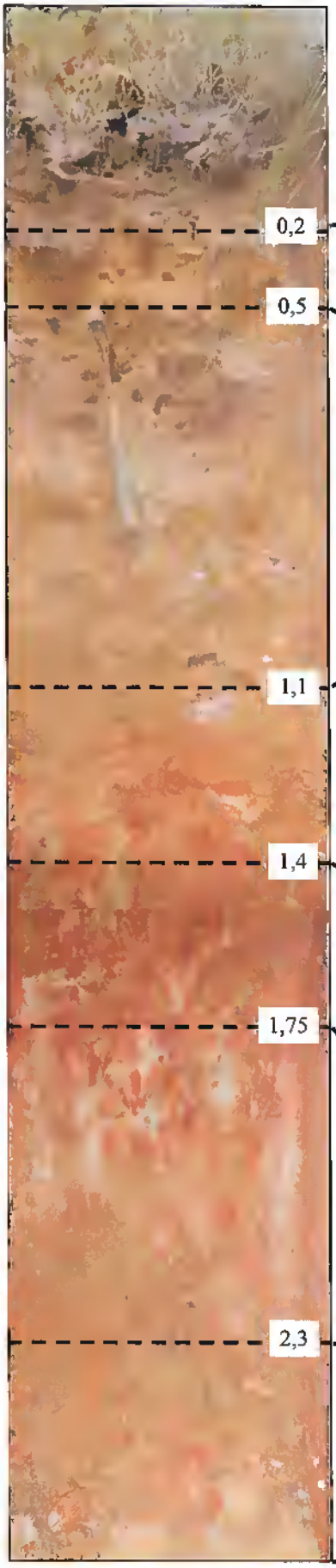
Moist light orange-brown blotched red-brown with occasional pale grey blotches very stiff weakly shattered sandy silty CLAY to sandy CLAY-SILT. Ferruginious Reworked Residual Siltstone.

Moist red-brown blotched pale grey becoming pale grey blotched red-brown with depth very stiff weakly shattered sandy SILT-CLAY.
Partially Reworked Residual Siltstone.

At 2,5m: Excavation stopped in moist pale yellow-brown and pale grey sparcely blotched pale red-brown very stiff weakly shattered to intact slightly sandy clayey SILT.
Slightly Reworked Residual Siltsone.

TP25: Sharp edged clast exposed immediately above Nodular Pedecrete/ Pebble Marker, which was considered unusual.

TP25: Removal of clast revealed it to be a stone-age artifact (hand axe).



Soil profile recorded in TP26

Moist light brown loose slightly voided slightly organic clayey silty fine and medium SAND. Humified Sheetwash.
Note: Roots concentrated in the upper 100mm layer.

Moist light yellowish-brown firm to stiff slightly shattered sandy CLAY-SILT with scattered roots. Sheetwash (Transported).
NOTE: Becomes slightly darker brown with depth.

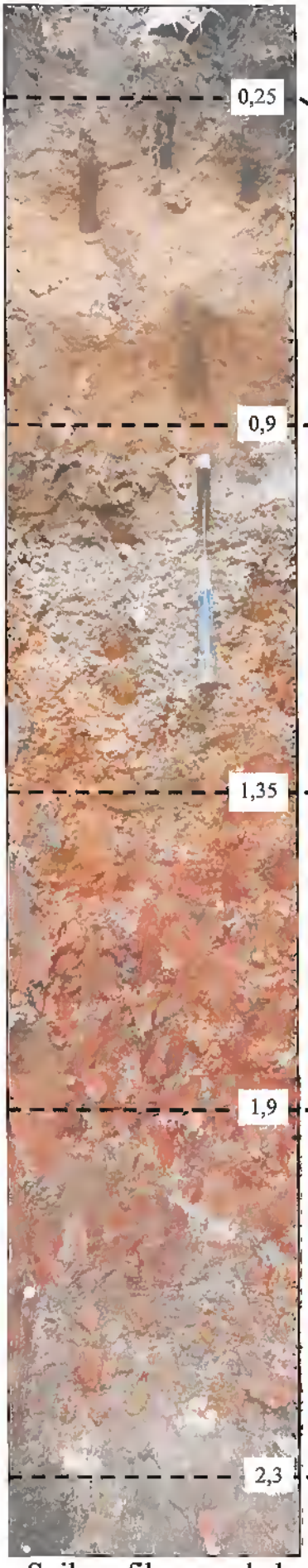
Moist grey-brown in top 200mm layer grading into yellow-brown indistinctly blotched orange-brown stiff to very stiff with depth weakly shattered sandy clayey SILT to sandy SILT-CLAY. Sheetwash.
Note: Original topsoil horizon between 0,5m and 0,7m.

Moist orange-brown indistinctly blotched red– and light yellow-brown very stiff weakly shattered sandy CLAY-SILT with scattered to numerous ferricrete nodules. Pebble Marker / Nodular Pedocrete.
Note: Becomes more nodular and mottled red-brown with some ferruginous nodules near base.

Moist red-brown blotched light orange– and pale grey-brown very stiff weakly shattered slightly sandy clayey SILT to sandy SILT-CLAY. Ferruginous Reworked Residual Siltstone.

Moist predominantly pale grey blotched red-brown with sparse less distinct orange-brown blotches very stiff weakly shattered slightly sandy clayey SILT. Partially Reworked Residual Siltstone.

At 2,3m: Excavation stopped on very stiff slightly reworked residual siltstone as above.



Soil profile recorded in TP27

Moist dark grey-brown to grey-brown loose slightly voided organic silty fine and medium SAND. Humified Sheetwash (Transported).

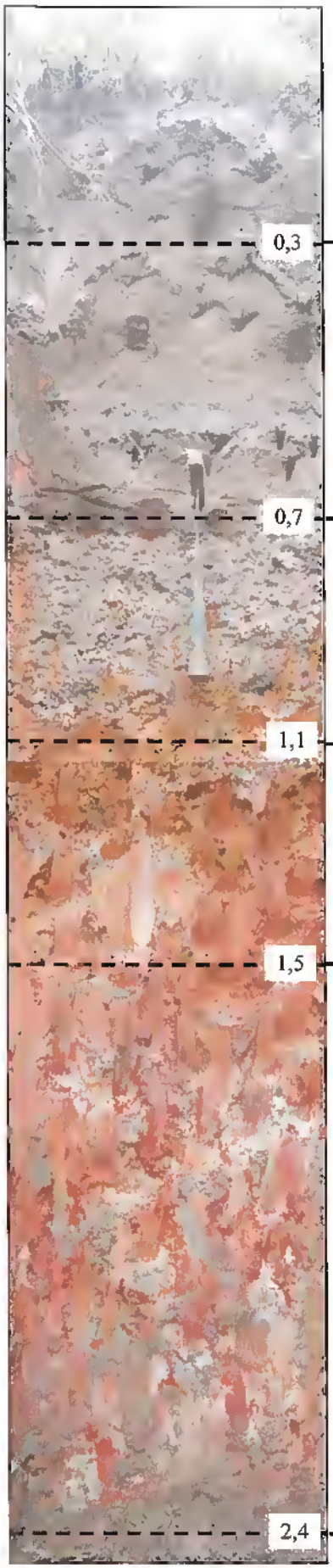
Moist light yellow-brown stiff to very stiff intact to weakly shattered sandy CLAY-SILT. Sheetwash (Transported).
Note: Becomes yellow-brown blotched light brown and off-white very stiff intact calcareous sandy clayey SILT from a depth of 0,65m.

Abundant off-white fine medium and coarse calcrete NODULES and scattered ferricrete concretions contained in an off-white to pale orange-brown and light grey-brown very stiff sandy clayey SILT matrix. Pebble Marker / Nodular Pedocrete (Pedogenic).

Moist red-brown blotched orange-brown and light grey very stiff shattered to weakly shattered sandy CLAY-SILT. Ferruginious Reworked Residual Siltstone.

As above but grades into pale pinkish-purple to light grey sparsely blotched and streaked off-white and orange-brown very stiff intact slightly sandy clayey SILT. Partially Reworked Residual Siltstone.

At 2,3m: Excavation stopped in very stiff slightly reworked residual siltstone as above.



Soil profile recorded in TP28

Moist grey-brown loose to medium dense slightly voided slightly organic clayey silty fine and medium SAND; roots concentrated in upper more humified layer. Humified Sheetwash (Topsoil).

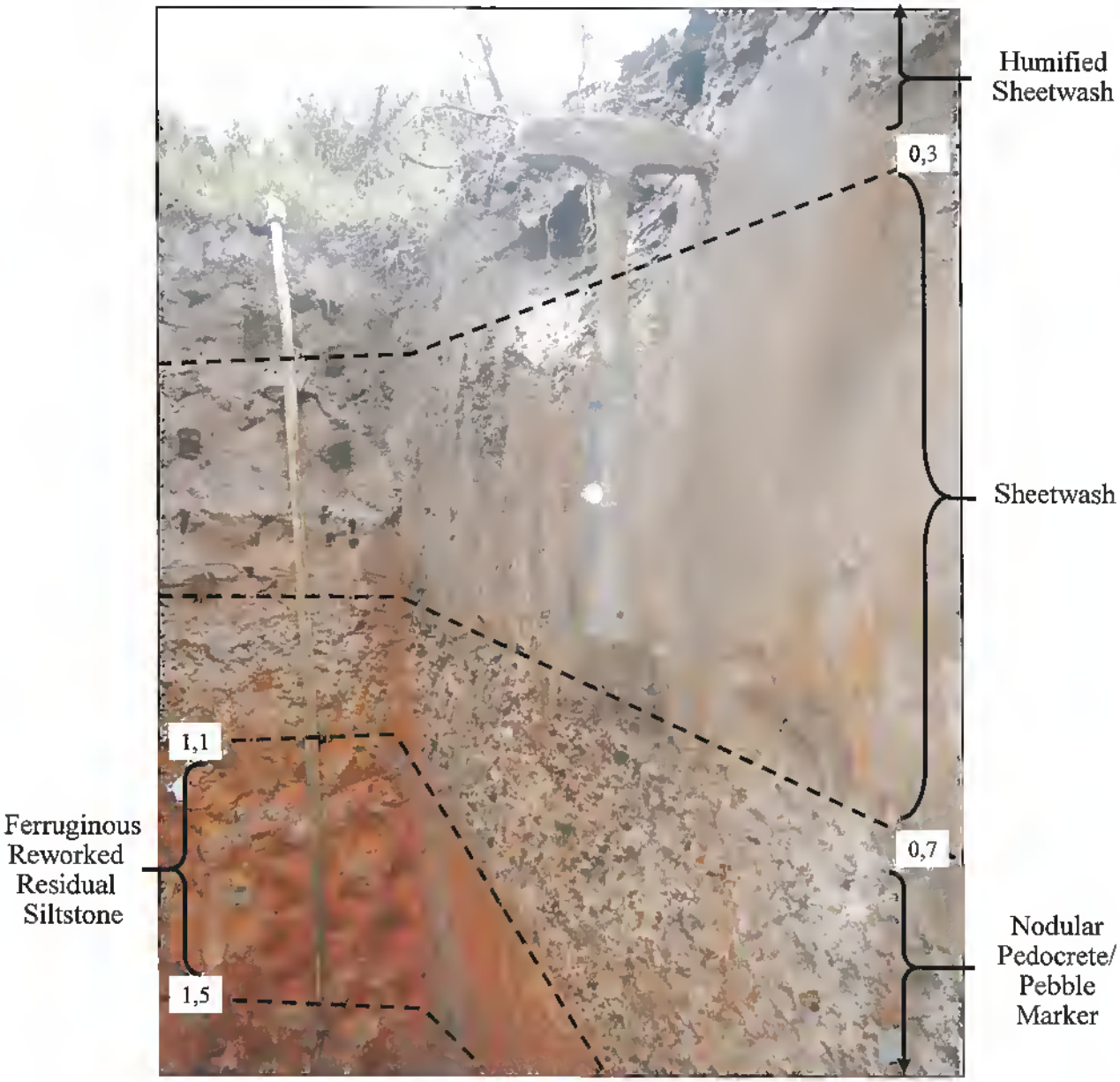
Moist light grey-brown (to grey-brown) stiff slightly shattered to intact sandy clayey SILT.
Sheetwash (Transported).

Fine medium and coarse off-white calcrete and light red-brown ferricrete NODULES in a light to pale grey-brown very stiff sandy clayey SILT matrix.
Nodular Pedocrete (Pedogenic) / Pebble Marker.
NOTE: Ferricrete and calcrete nodules exposed on side walls crushed by the machine bucket.

Moist orange-brown blotched light grey-brown very stiff weakly shattered sandy clayey SILT.
Ferruginous Reworked Residual Siltstone.

Moist predominantly pale grey blotched red-brown and orange-brown (blotches sparse) very stiff weakly shattered slightly sandy clayey SILT to sandy SILT-CLAY.
Partially Reworked Residual Siltstone.
Note: Predominantly light and pale grey blotched red– and orange-brown towards base of test pit.

At 2,4m: Excavation stopped on very stiff slightly reworked residual siltstone as above.



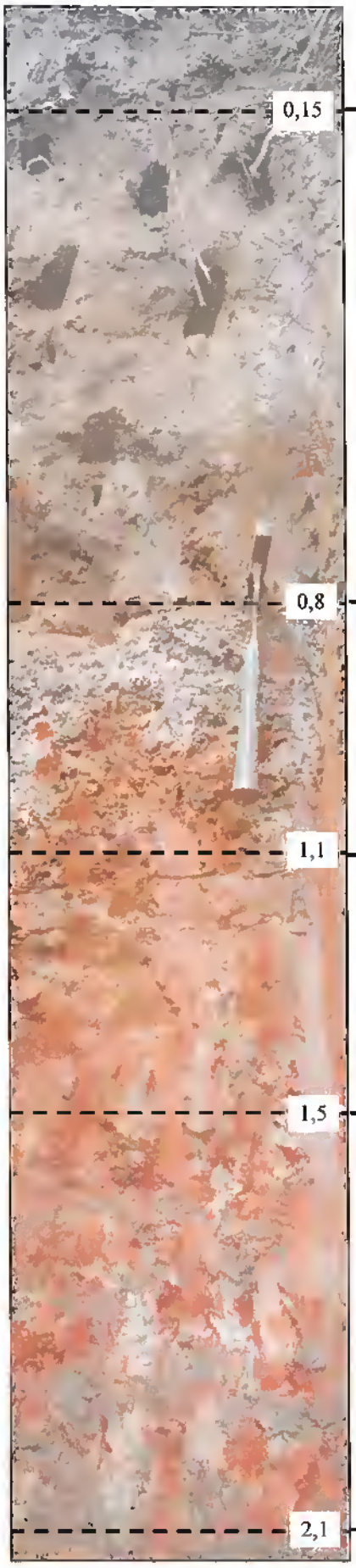
Strata exposed on sidewall in TP28.

TP28: Recording of profile within top transported (Sheetwash) horizon.

TP28: Spoil from Nodular Pedocrete/Pebble Marker excavated between 0,7 and 1,1m.

TP28: Spoil excavated from Ferruginous Reworked Residual Siltstone horizon between 1,1 and 1,5m.

TP28: Spoil from Partially Reworked Residual Siltstone between 1,5m and 2,4m.



Soil profile recorded in TP29

Moist grey-brown medium dense slightly voided slightly orangic clayey silty fine and medium SAND. Humified Sheetwash (Topsoil).

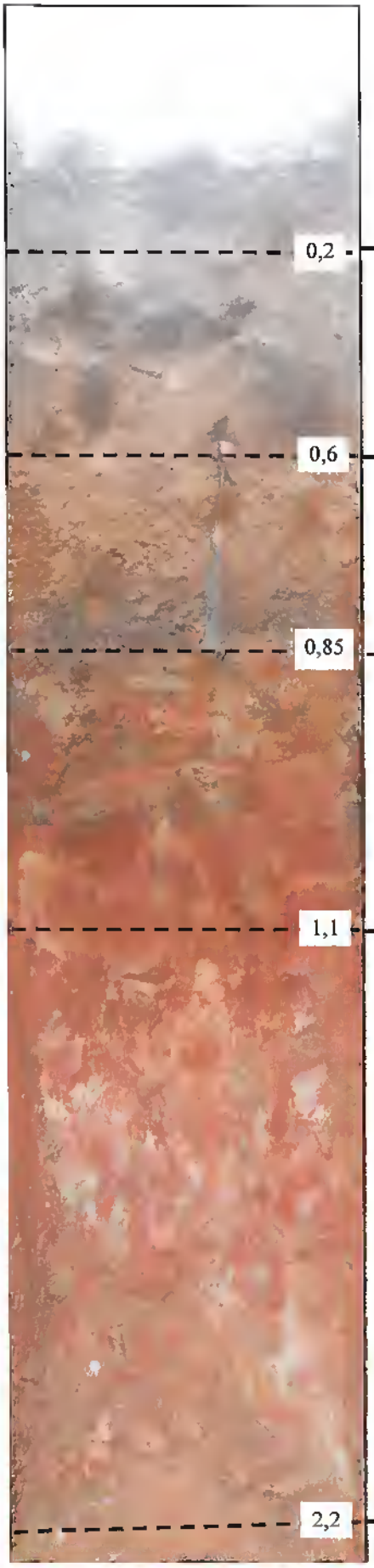
Moist light grey-brown, blotched yellow-brown with depth stiff to very stiff intact to weakly shattered sandy clayey SILT. Sheetwash Transported.
Note: Contains indistinct light yellow-brown and off -white blotches below 0,4m and partially calcareous-cemented inclusions.

Mixture of off-white calcrete and orange-brown ferricrete NODULES in an off-white light grey-brown to orange-brown very stiff intact sandy clayey SILT matrix. Pebble Marker / Nodular Pedocrete.

Moist orange-brown indistinctly blotched pale grey– and yellow-brown very stiff weakly shattered sandy CLAY-SILT.
Slightly Ferruginous Reworked Residual Siltstone.

Moist red-brown blotched light grey- and orange-brown very stiff weakly shattered slightly sandy CLAY-SILT. Partially Reworked Residual Siltstone.

At 2,1m: Excavation stopped on very stiff partially reworked residual siltstone as above.



Soil profile recorded in TP30

Moist grey-brown very loose to loose voided organic (strongly humified at the top) clayey silty fine and medium SAND. Humified Sheetwash.

Moist light grey-brown blotched brown and dark brown soft to firm voided (becomes very stiff to weakly shattered at base) clayey SAND-SILT. Sheetwash.

Fine medium and some coarse light brown and dark brown ferricrete NODULES and some gravel in a grey-brown very stiff intact sandy clayey SILT matrix. Pebble Marker / Nodular Pedocrete.

Moist red-brown blotched orange-brown and light-grey-brown very stiff weakly to indistinctly shattered sandy clayey SILT to sandy SILT-CLAY. Slightly Ferruginous Reworked Residual Siltstone.

Moist red-brown blotched off-white and pale pinkish -purple with depth very stiff weakly shattered to intact sandy clayey SILT.
Slightly to Partially Reworked Residual Siltstone.

At 2,2m: Excavation stopped on very stiff partially reworked residual siltstone as above.

TP30: Spoil from Nodular Pedocrete/ Pebble Marker between 0,6m and 0,85m.

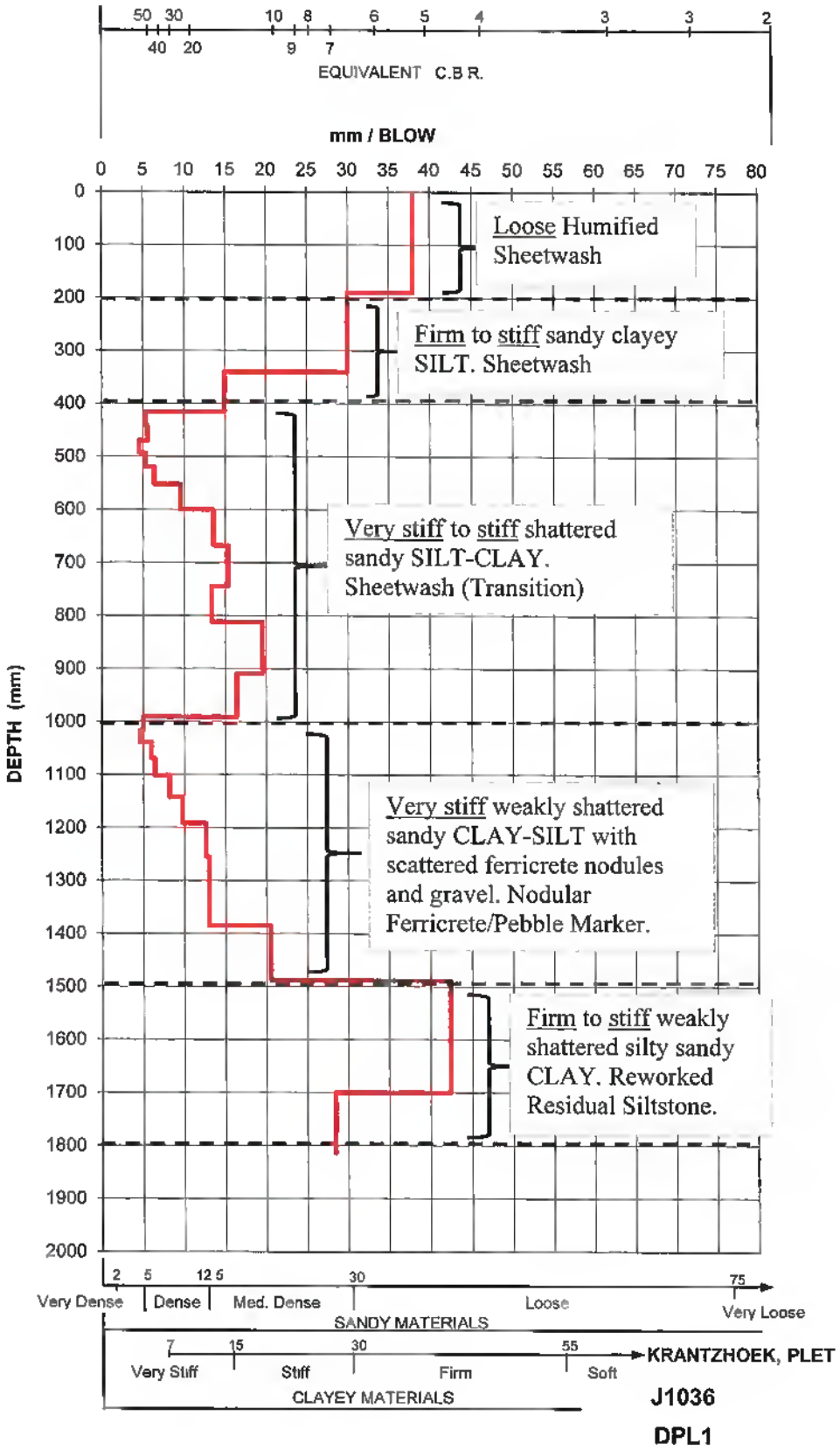
TP30: Spoil from Ferruginous Reworked Residual Siltstone between 0,85 and 1,1m

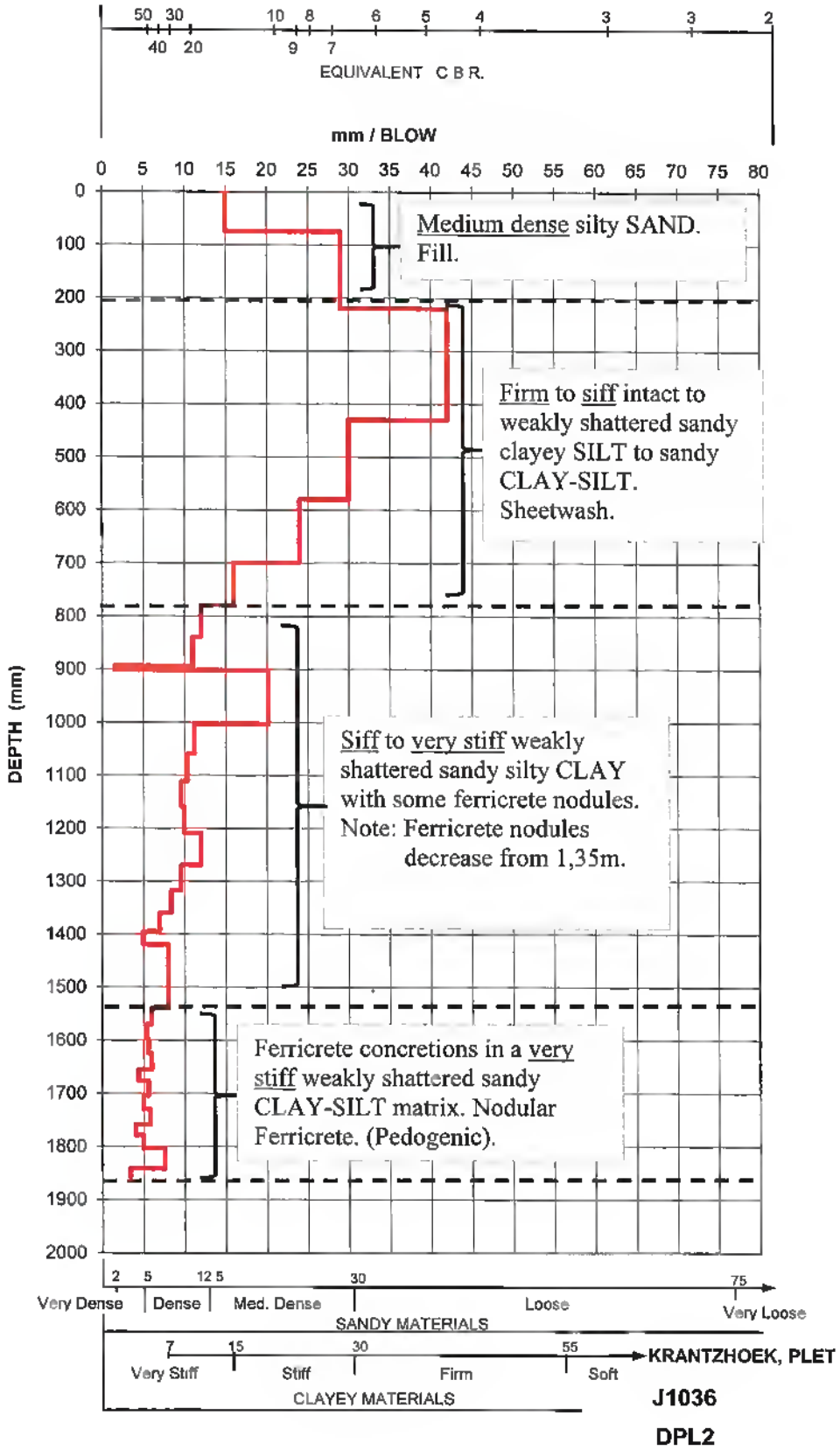
TP30: Spoil from Partially Reworked Residual Siltstone between 1,1m and 2,2m.

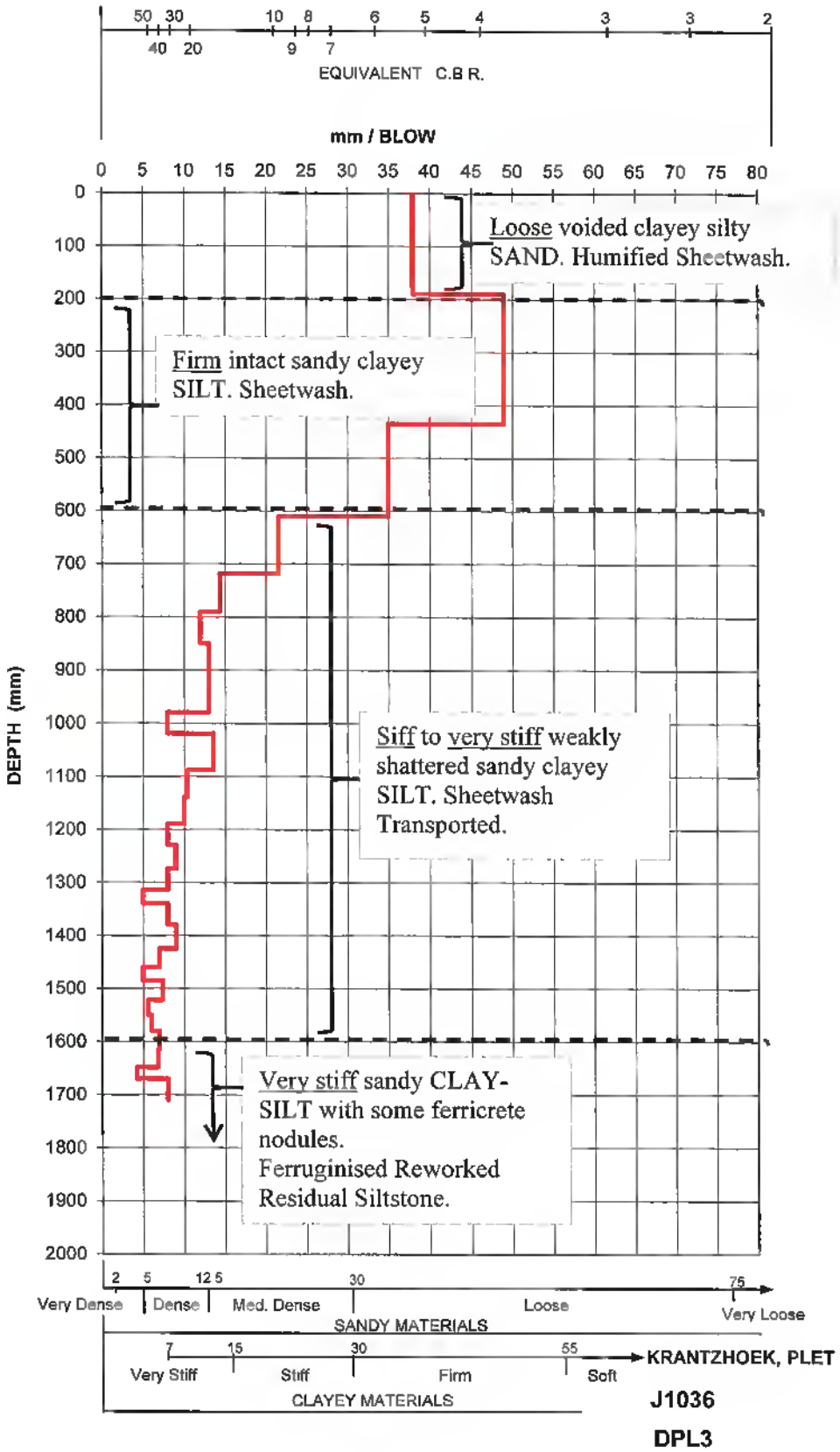
APPENDIX D

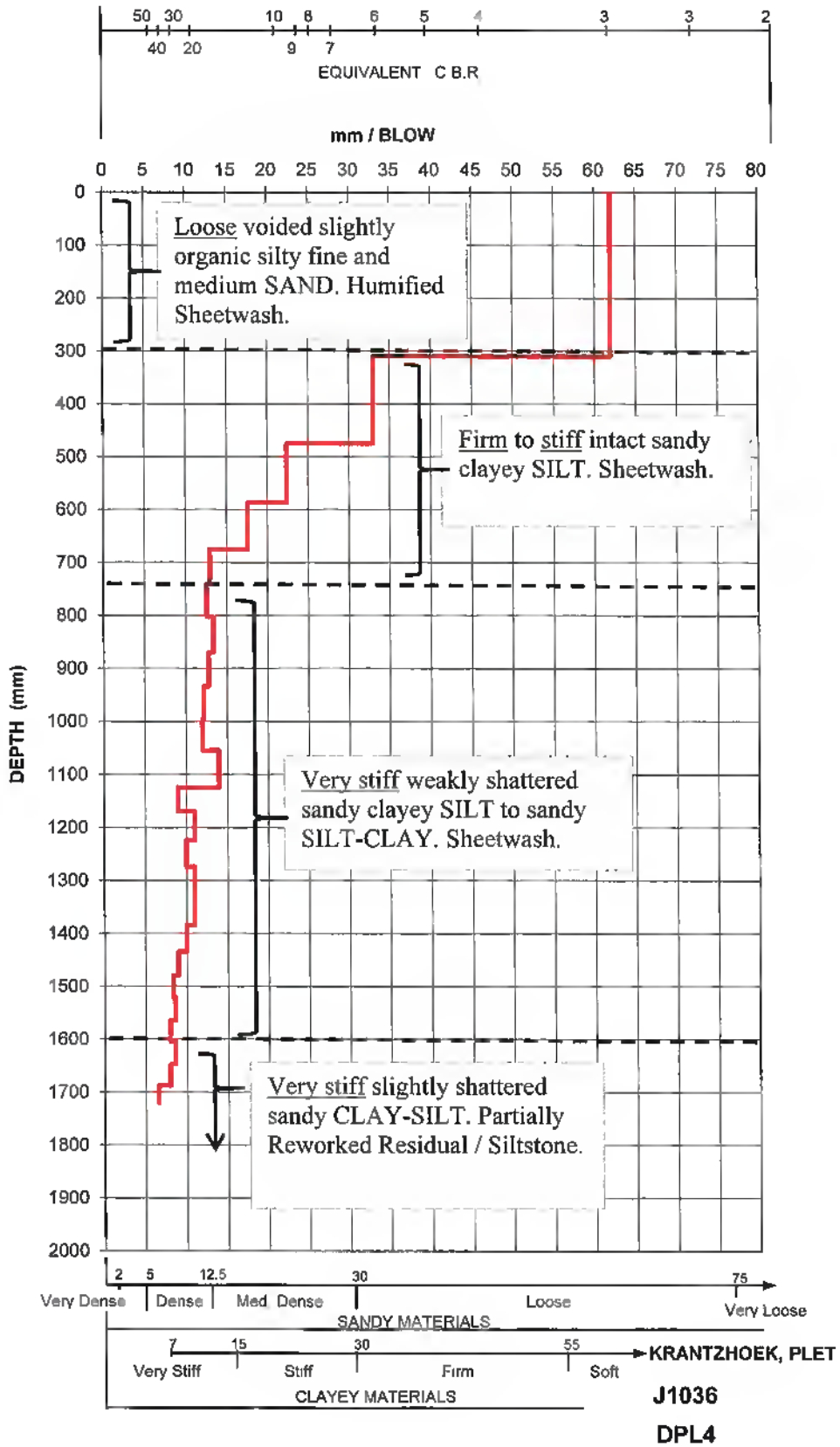
DPL1 to DPL30

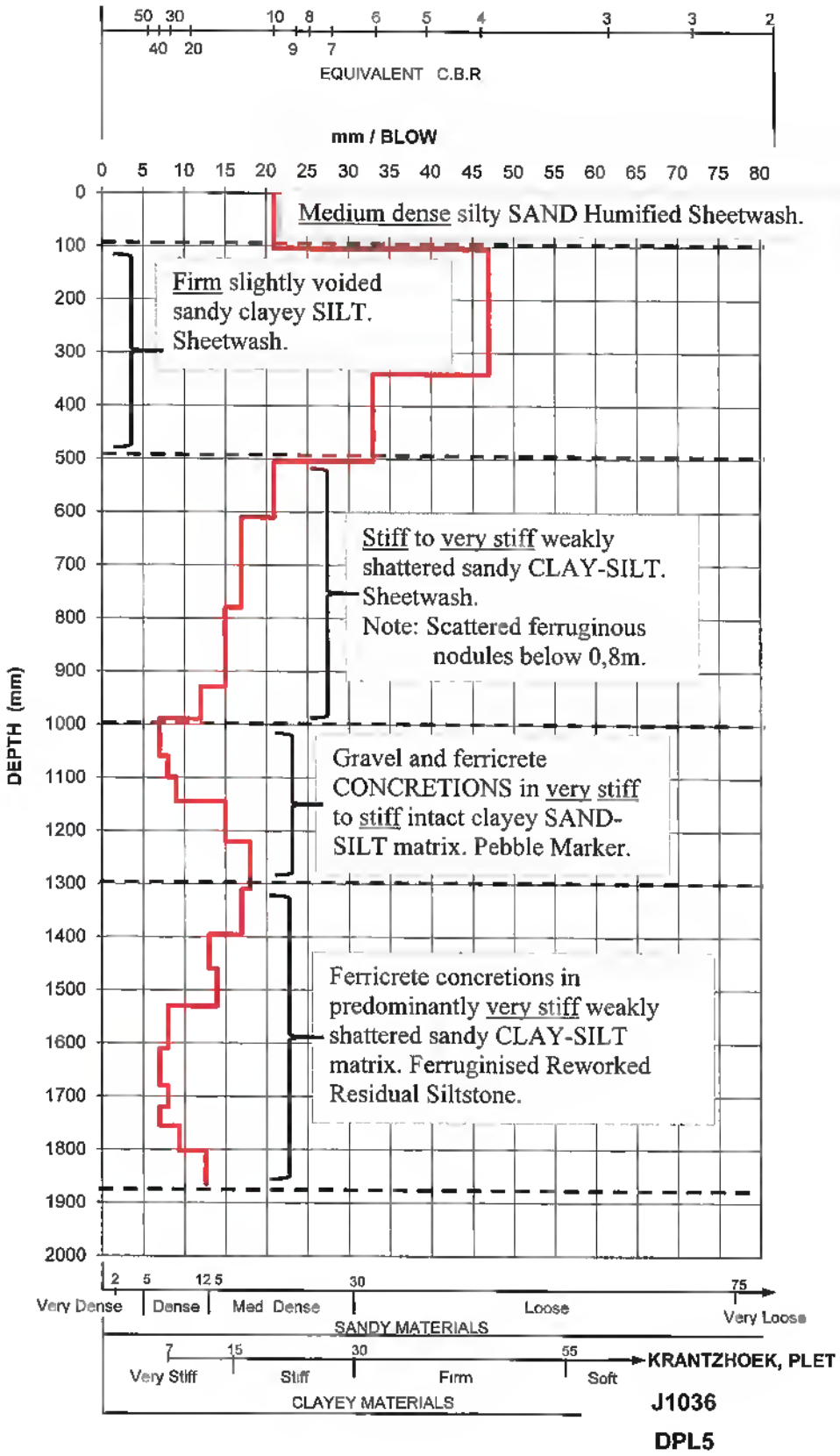
Graphs

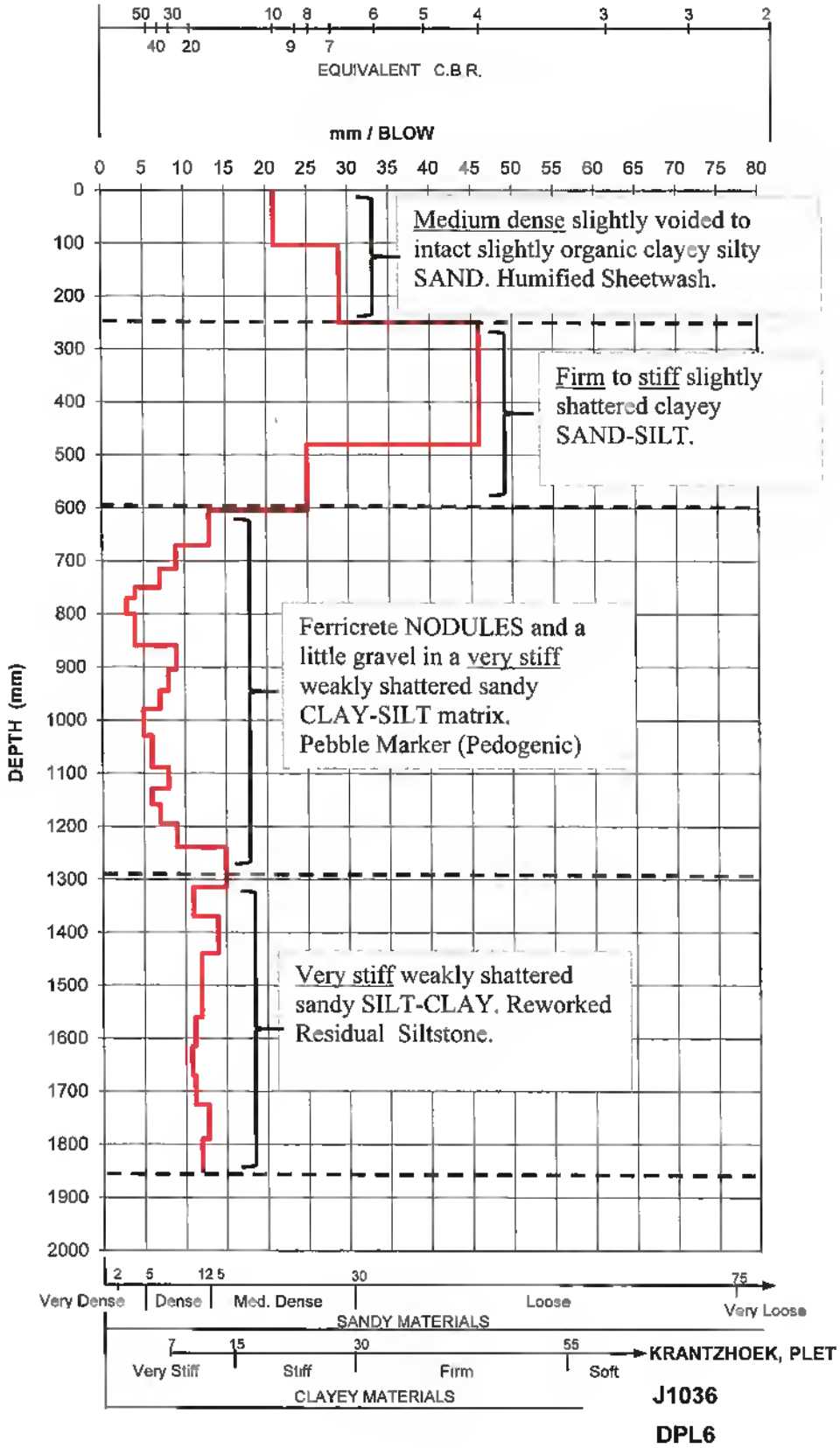

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose Humified Sheetwash
Firm to stiff sandy clayey SILT. Sheetwash
Very stiff to stiff shattered sandy SILT-CLAY. Sheetwash (Transition)
Very stiff weakly shattered sandy CLAY-SILT with scattered ferricrete nodules and gravel. Nodular Ferricrete/Pebble Marker.
Firm to stiff weakly shattered silty sandy CLAY. Reworked Residual Siltstone.
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL1

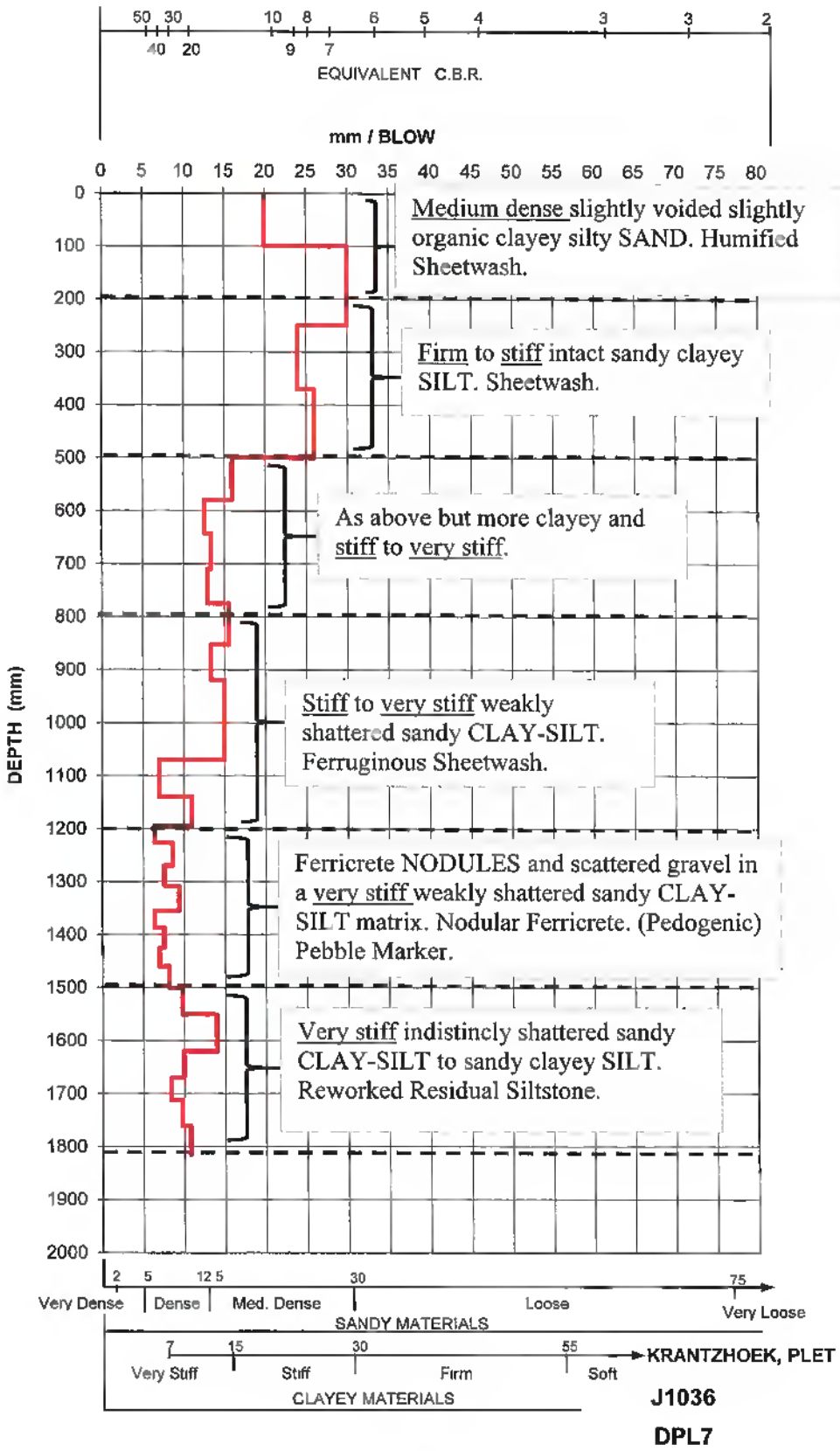

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C B R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense silty SAND. Fill.
Firm to siff intact to weakly shattered sandy clayey SILT to sandy CLAY-SILT. Sheetwash.
Siff to very stiff weakly shattered sandy silty CLAY with some ferricrete nodules. Note: Ferricrete nodules decrease from 1,35m.
Ferricrete concretions in a very stiff weakly shattered sandy CLAY-SILT matrix. Nodular Ferricrete. (Pedogenic).
2 5 12 5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL2

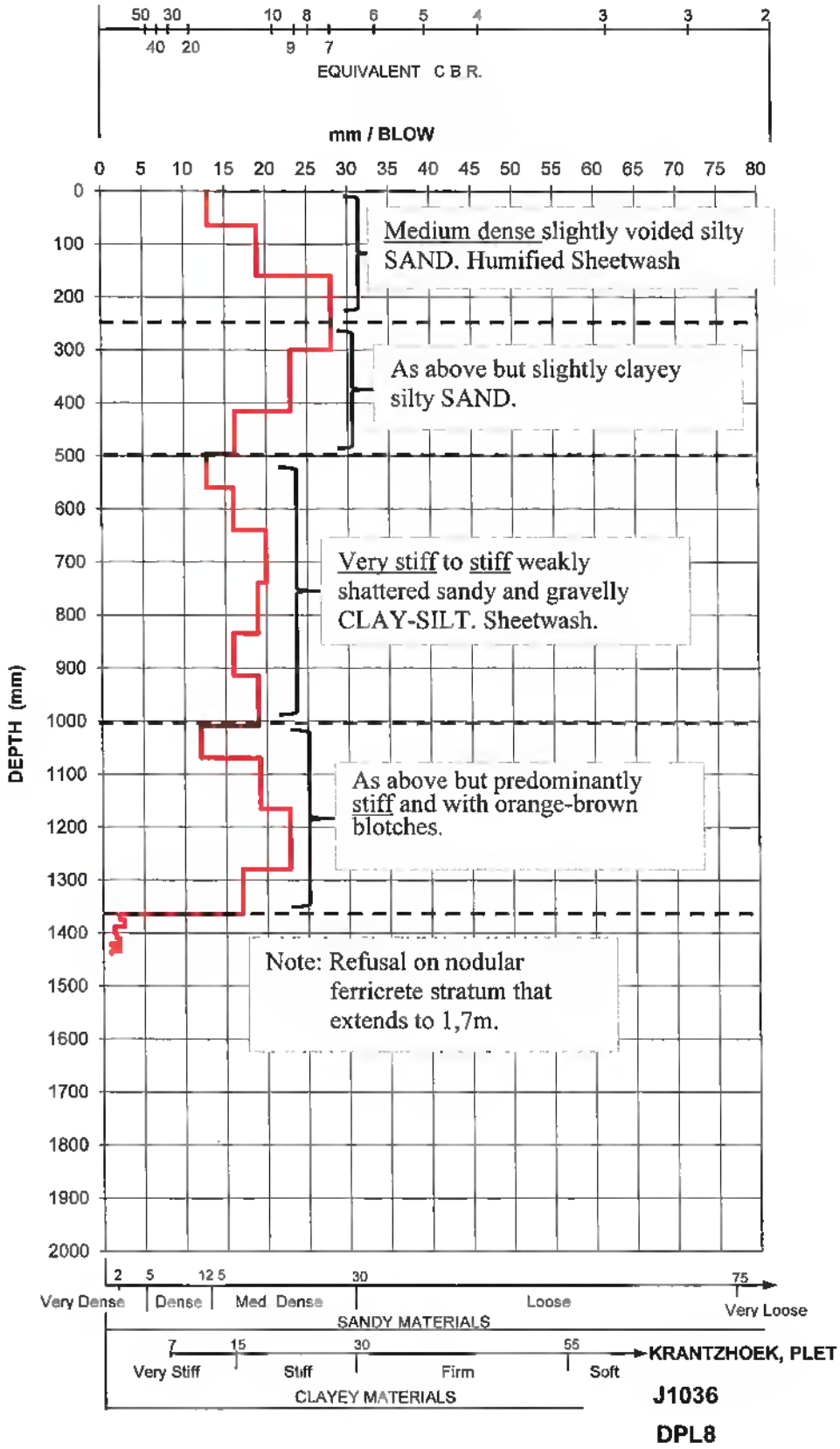

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose voided clayey silty SAND. Humified Sheetwash.
Firm intact sandy clayey SILT. Sheetwash.
Siff to very stiff weakly shattered sandy clayey SILT. Sheetwash Transported.
Very stiff sandy CLAY-SILT with some ferricrete nodules. Ferruginised Reworked Residual Siltstone.
2 5 12 5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL3

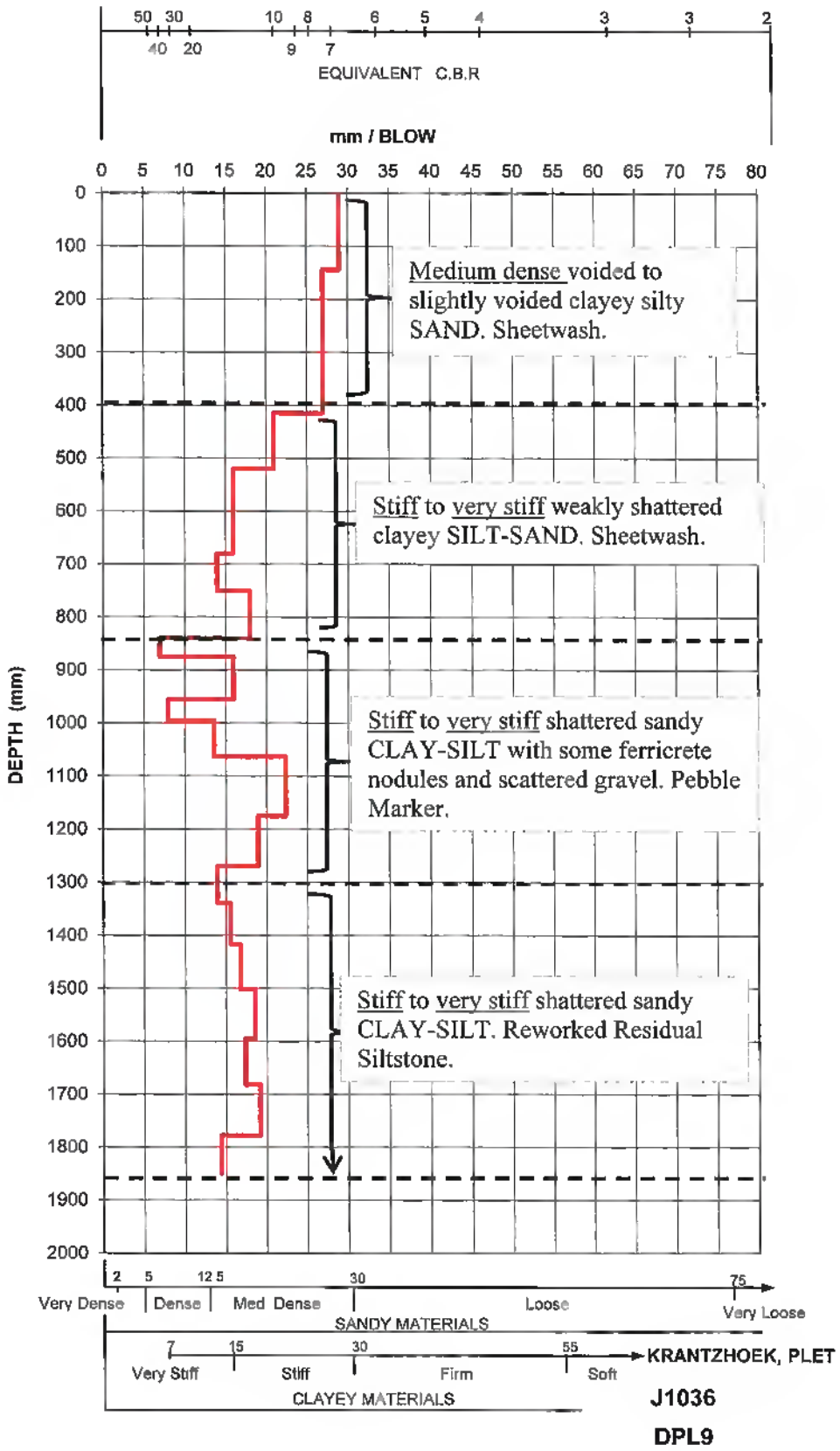

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C B.R
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose voided slightly organic silty fine and medium SAND. Humified Sheetwash.
Firm to stiff intact sandy clayey SILT. Sheetwash.
Very stiff weakly shattered sandy clayey SILT to sandy SILT-CLAY. Sheetwash.
Very stiff slightly shattered sandy CLAY-SILT. Partially Reworked Residual / Siltstone.
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL4

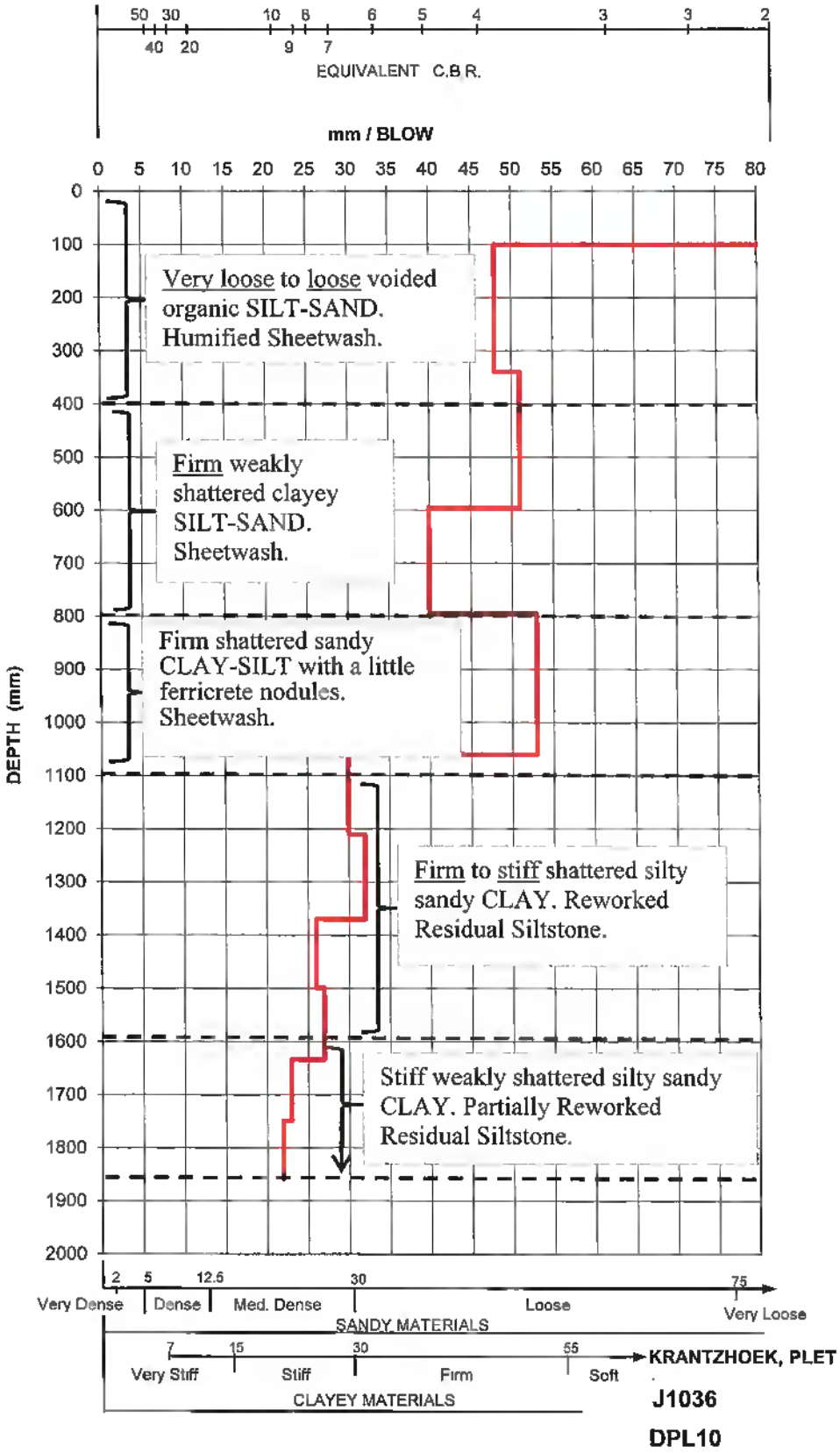

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense silty SAND Humified Sheetwash.
Firm slightly voided sandy clayey SILT. Sheetwash.
Stiff to very stiff weakly shattered sandy CLAY-SILT. Sheetwash.
Note: Scattered ferruginous nodules below 0,8m.
Gravel and ferricrete CONCRETIONS in very stiff to stiff intact clayey SAND-SILT matrix. Pebble Marker.
Ferricrete concretions in predominantly very stiff weakly shattered sandy CLAY-SILT matrix. Ferruginised Reworked Residual Siltstone.
2 5 12 5 30 75
Very Dense Dense Med Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL5

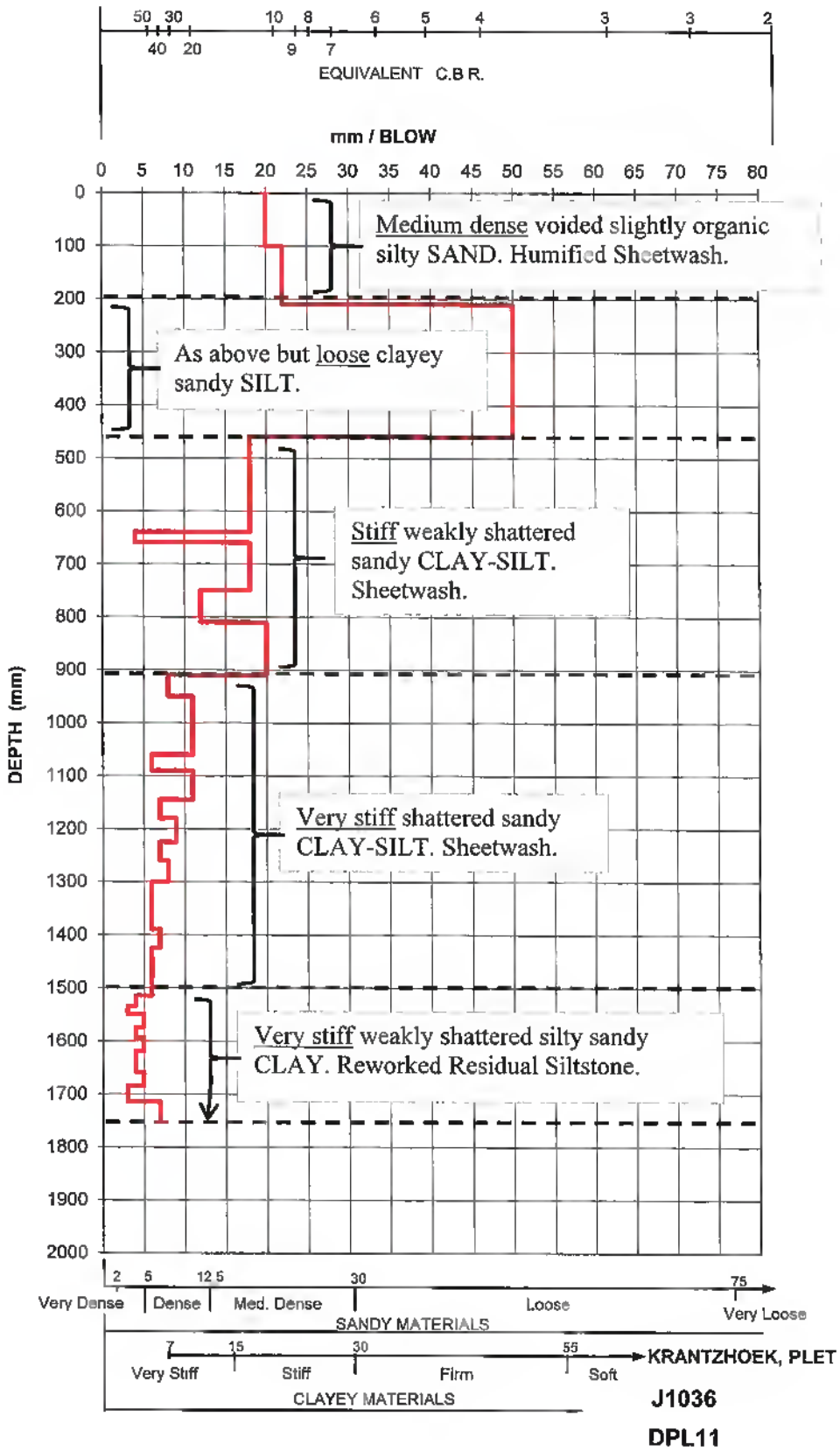

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense slightly voided to intact slightly organic clayey silty SAND. Humified Sheetwash.
Firm to stiff slightly shattered clayey SAND-SILT.
Ferricrete NODULES and a little gravel in a very stiff weakly shattered sandy CLAY-SILT matrix. Pebble Marker (Pedogenic)
Very stiff weakly shattered sandy SILT-CLAY. Reworked Residual Siltstone.
2 5 12 5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL6

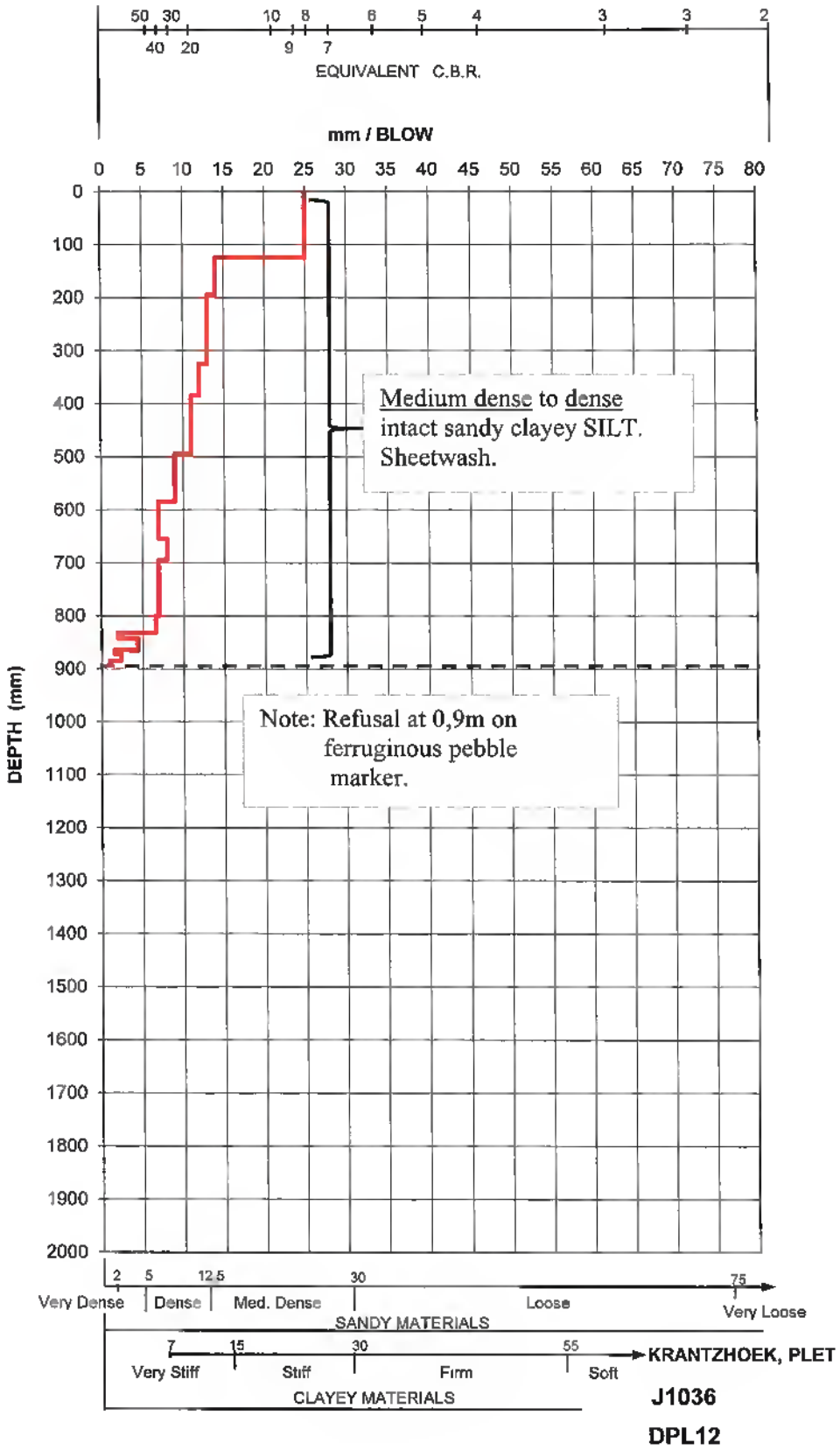

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense slightly voided slightly organic clayey silty SAND. Humified Sheetwash.
Firm to stiff intact sandy clayey SILT. Sheetwash.
As above but more clayey and stiff to very stiff.
Stiff to very stiff weakly shattered sandy CLAY-SILT. Ferruginous Sheetwash.
Ferricrete NODULES and scattered gravel in a very stiff weakly shattered sandy CLAY-SILT matrix. Nodular Ferricrete. (Pedogenic) Pebble Marker.
Very stiff indistincly shattered sandy CLAY-SILT to sandy clayey SILT. Reworked Residual Siltstone.
2 5 12 5 30 75
Very Dense
Dense
Med. Dense
Loose
Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff
Stiff
Firm
Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL7

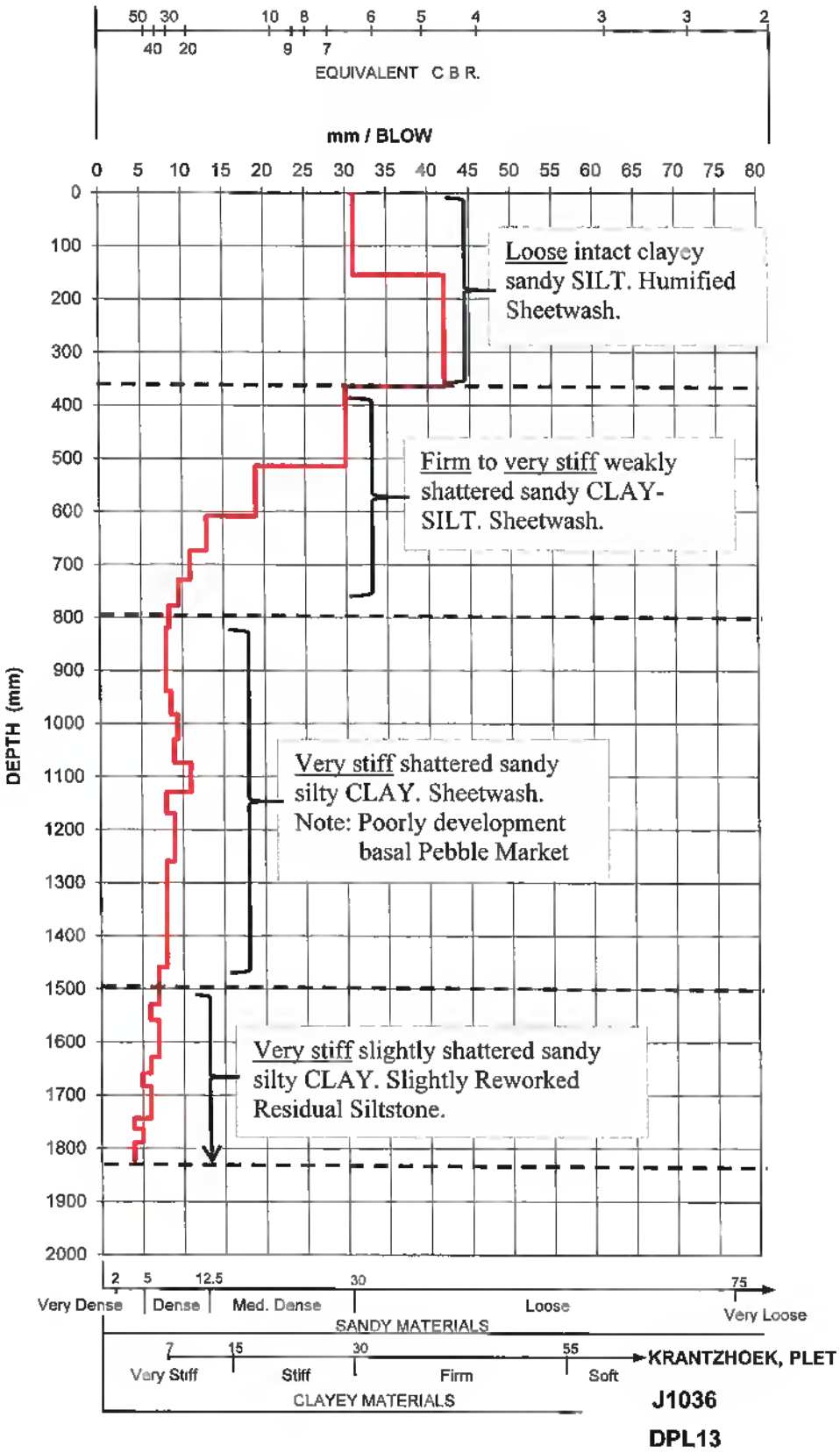

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C B R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense slightly voided silty SAND. Humified Sheetwash
As above but slightly clayey silty SAND.
Very stiff to stiff weakly shattered sandy and gravelly CLAY-SILT. Sheetwash.
As above but predominantly stiff and with orange-brown blotches.
Note: Refusal on nodular ferricrete stratum that extends to 1,7m.
2 5 12 5 30 75
Very Dense Dense Med Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL8

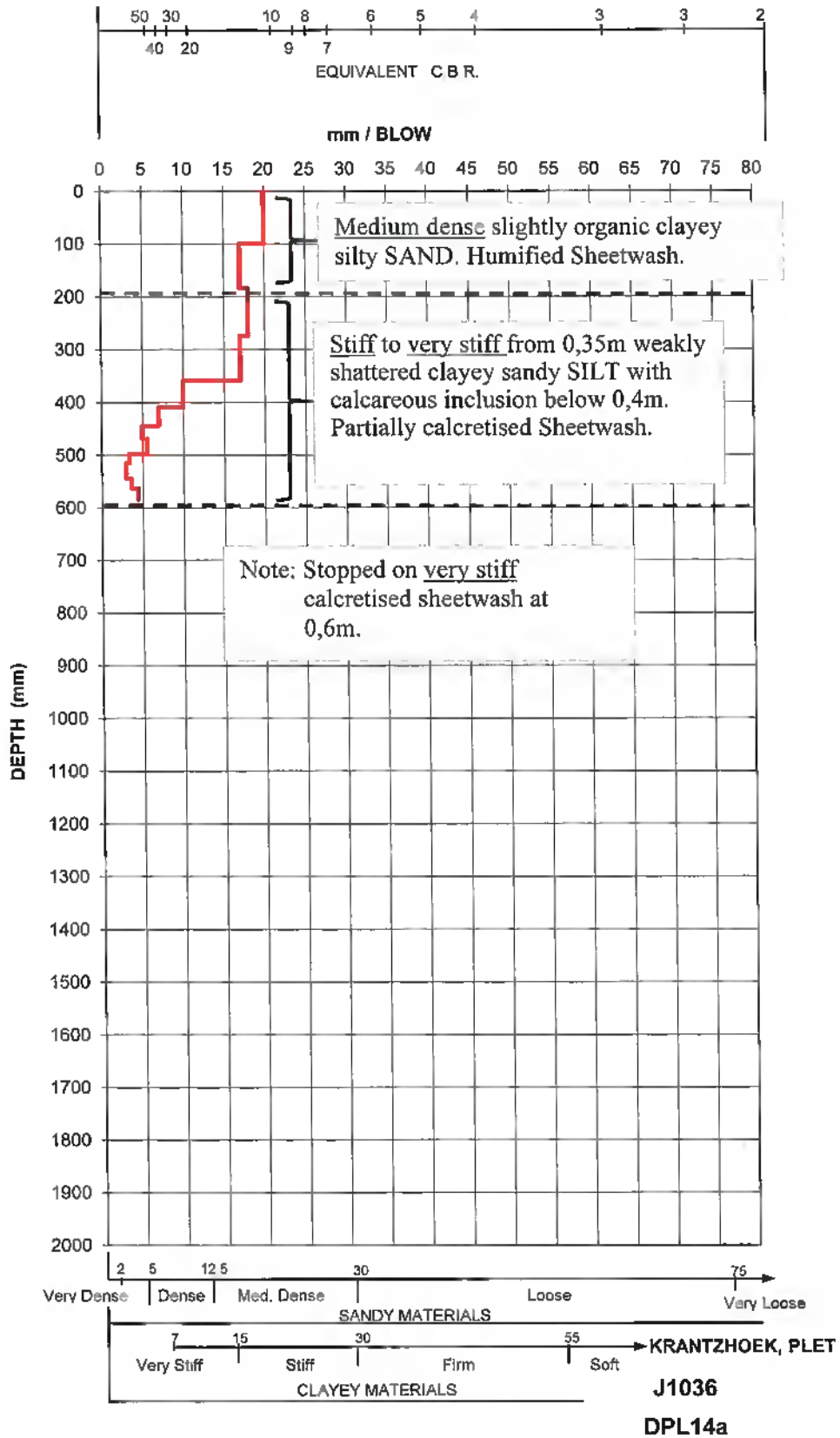

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense voided to slightly voided clayey silty SAND. Sheetwash.
Stiff to very stiff weakly shattered clayey SILT-SAND. Sheetwash.
Stiff to very stiff shattered sandy CLAY-SILT with some ferricrete nodules and scattered gravel. Pebble Marker.
Stiff to very stiff shattered sandy CLAY-SILT. Reworked Residual Siltstone.
2 5 12 5 30 75
Very Dense
Dense
Med Dense
Loose
Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff
Stiff
Firm
Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL9

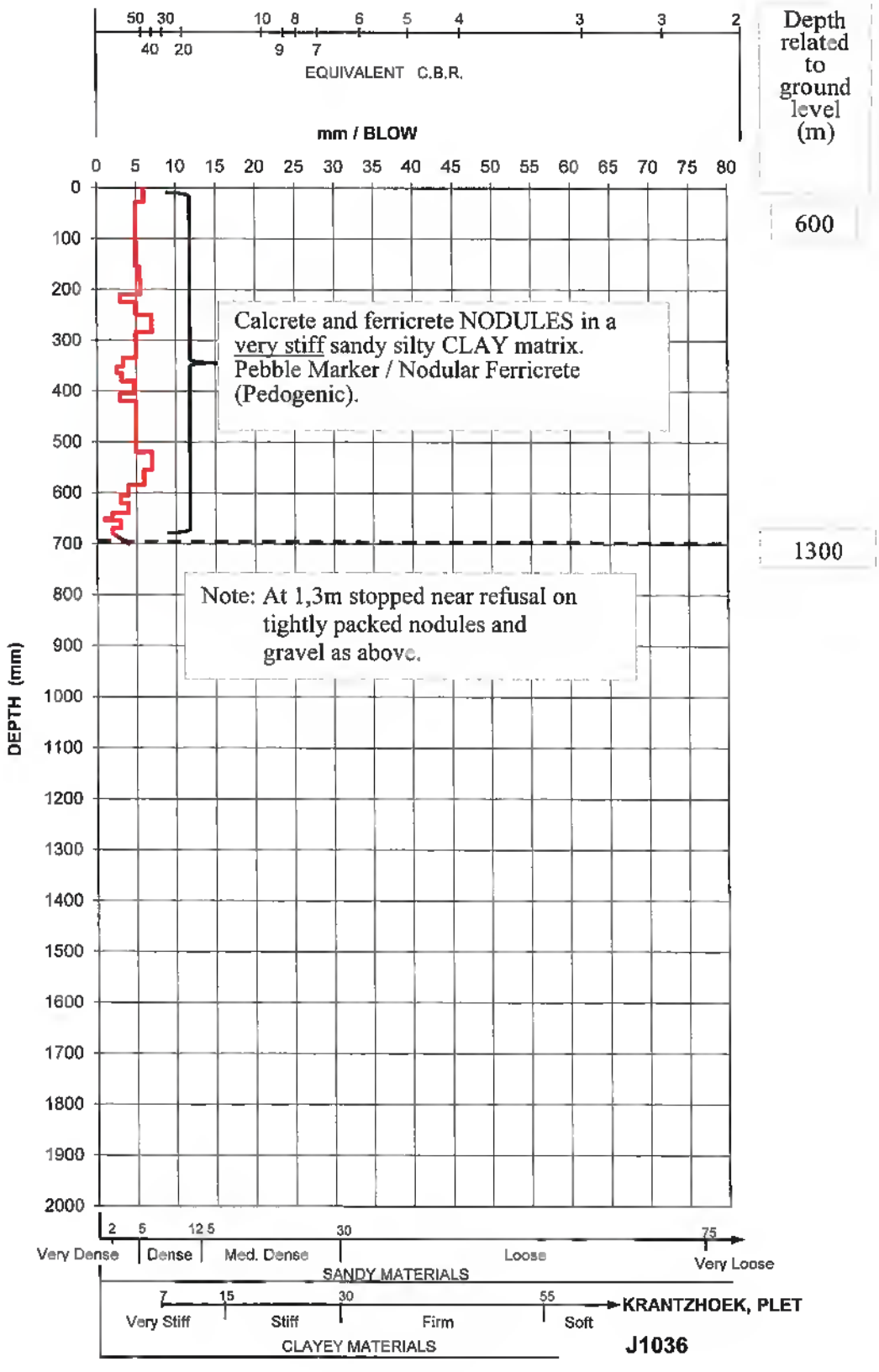

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Very loose to loose voided organic SILT-SAND. Humified Sheetwash.
Firm weakly shattered clayey SILT-SAND. Sheetwash.
Firm shattered sandy CLAY-SILT with a little ferricrete nodules. Sheetwash.
Firm to stiff shattered silty sandy CLAY. Reworked Residual Siltstone.
Stiff weakly shattered silty sandy CLAY. Partially Reworked Residual Siltstone.
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL10

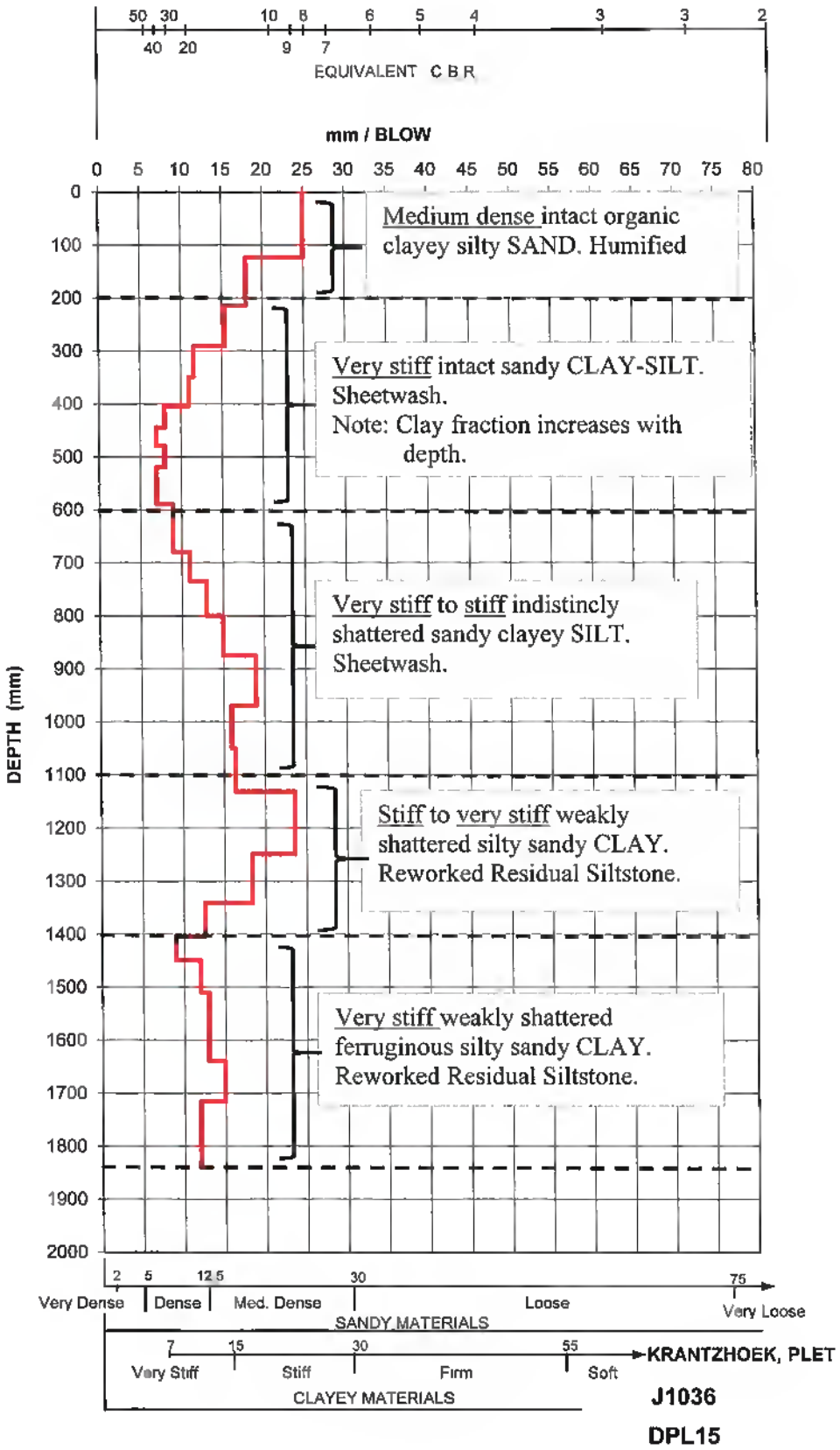

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense voided slightly organic silty SAND. Humified Sheetwash.
As above but loose clayey sandy SILT.
Stiff weakly shattered sandy CLAY-SILT. Sheetwash.
Very stiff shattered sandy CLAY-SILT. Sheetwash.
Very stiff weakly shattered silty sandy CLAY. Reworked Residual Siltstone.
2 5 12.5 30 75
Very Dense
Dense
Med. Dense
Loose
Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff
Stiff
Firm
Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL11

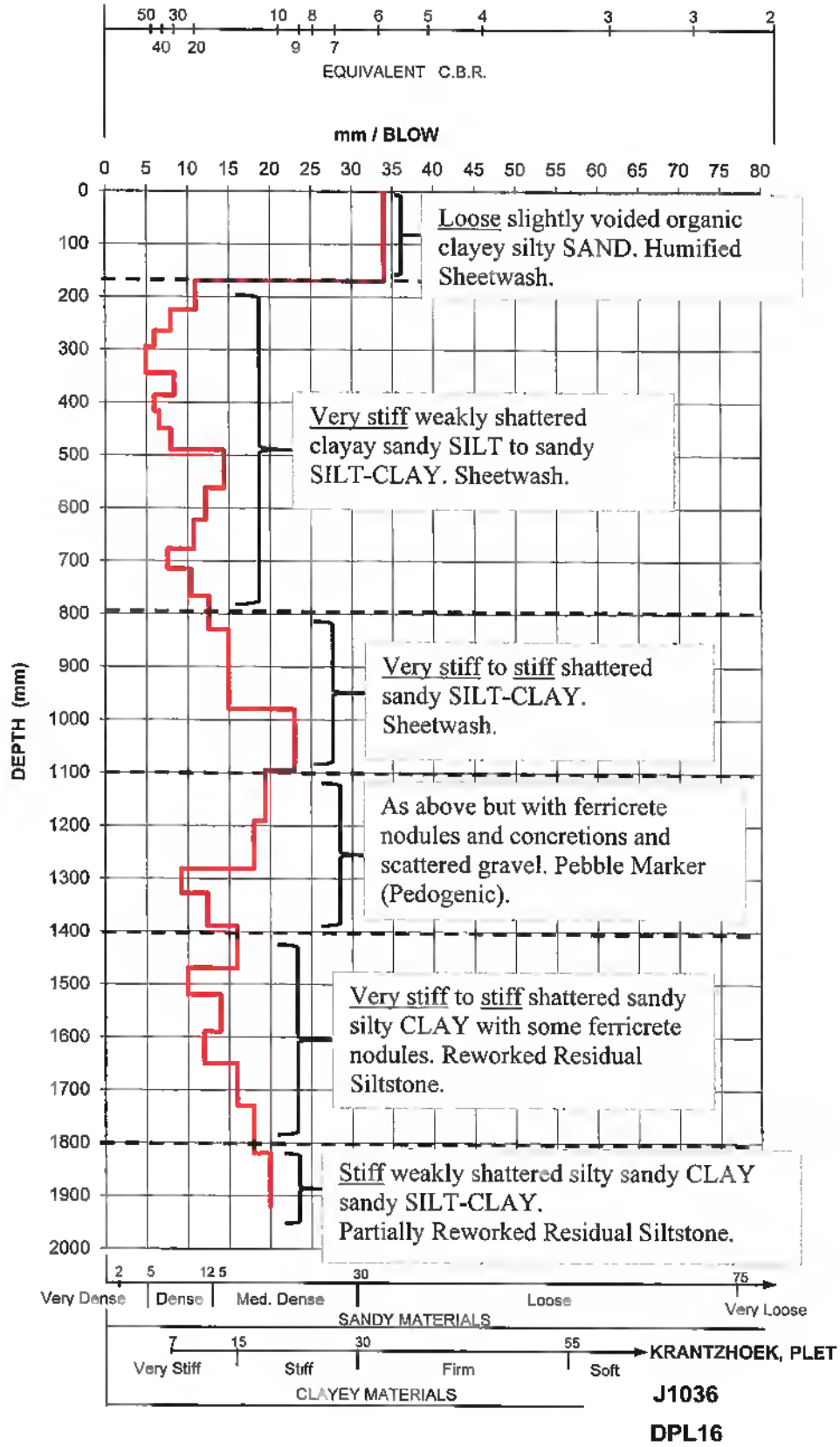

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense to dense intact sandy clayey SILT. Sheetwash.
Note: Refusal at 0,9m on ferruginous pebble marker.
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL12

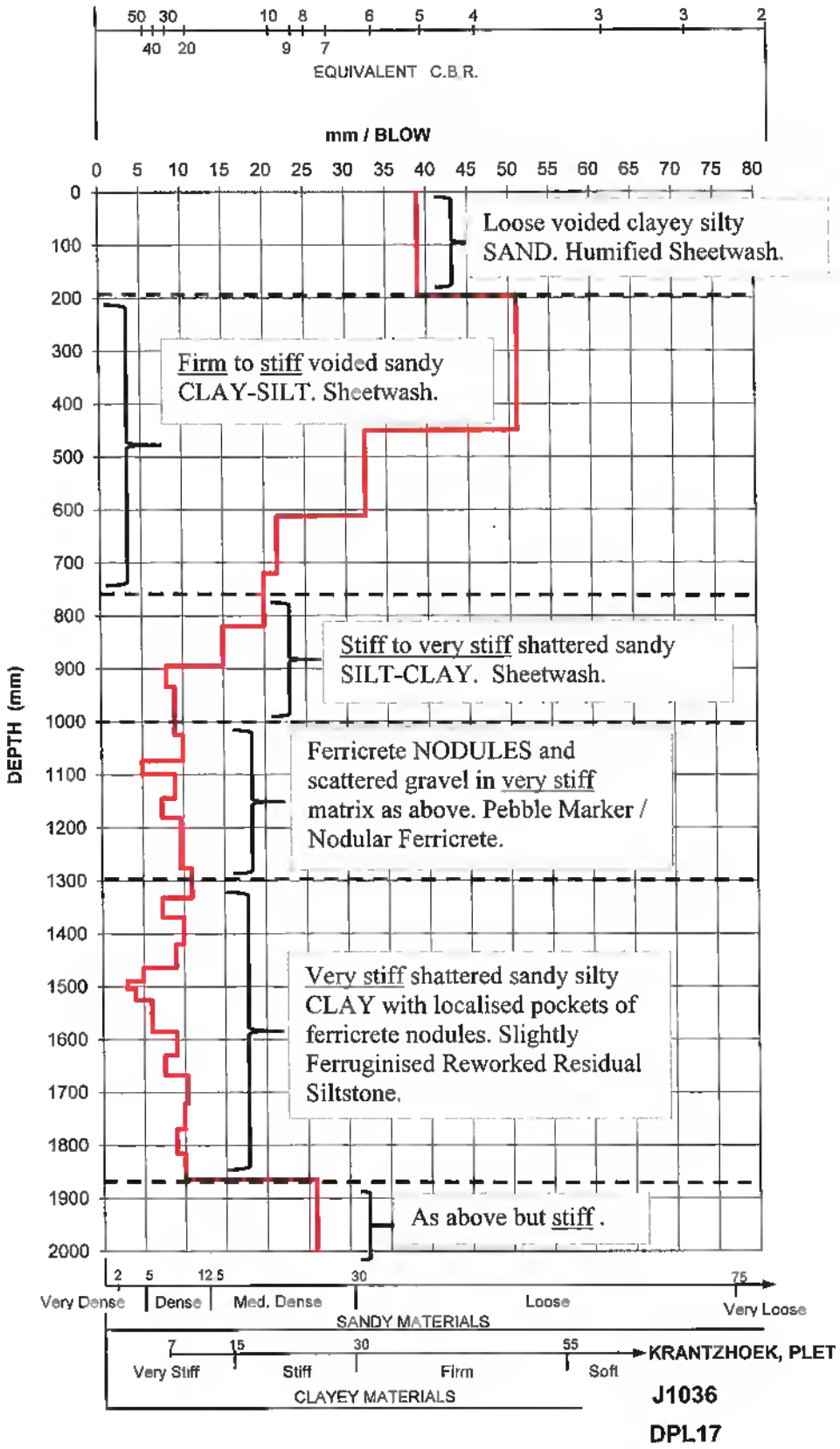

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C B R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose intact clayey sandy SILT. Humified Sheetwash.
Firm to very stiff weakly shattered sandy CLAY-SILT. Sheetwash.
Very stiff shattered sandy silty CLAY. Sheetwash.
Note: Poorly development basal Pebble Market
Very stiff slightly shattered sandy silty CLAY. Slightly Reworked Residual Siltstone.
2 5 12.5 30 75
Very Dense
Dense
Med. Dense
Loose
Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff
Stiff
Firm
Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL13

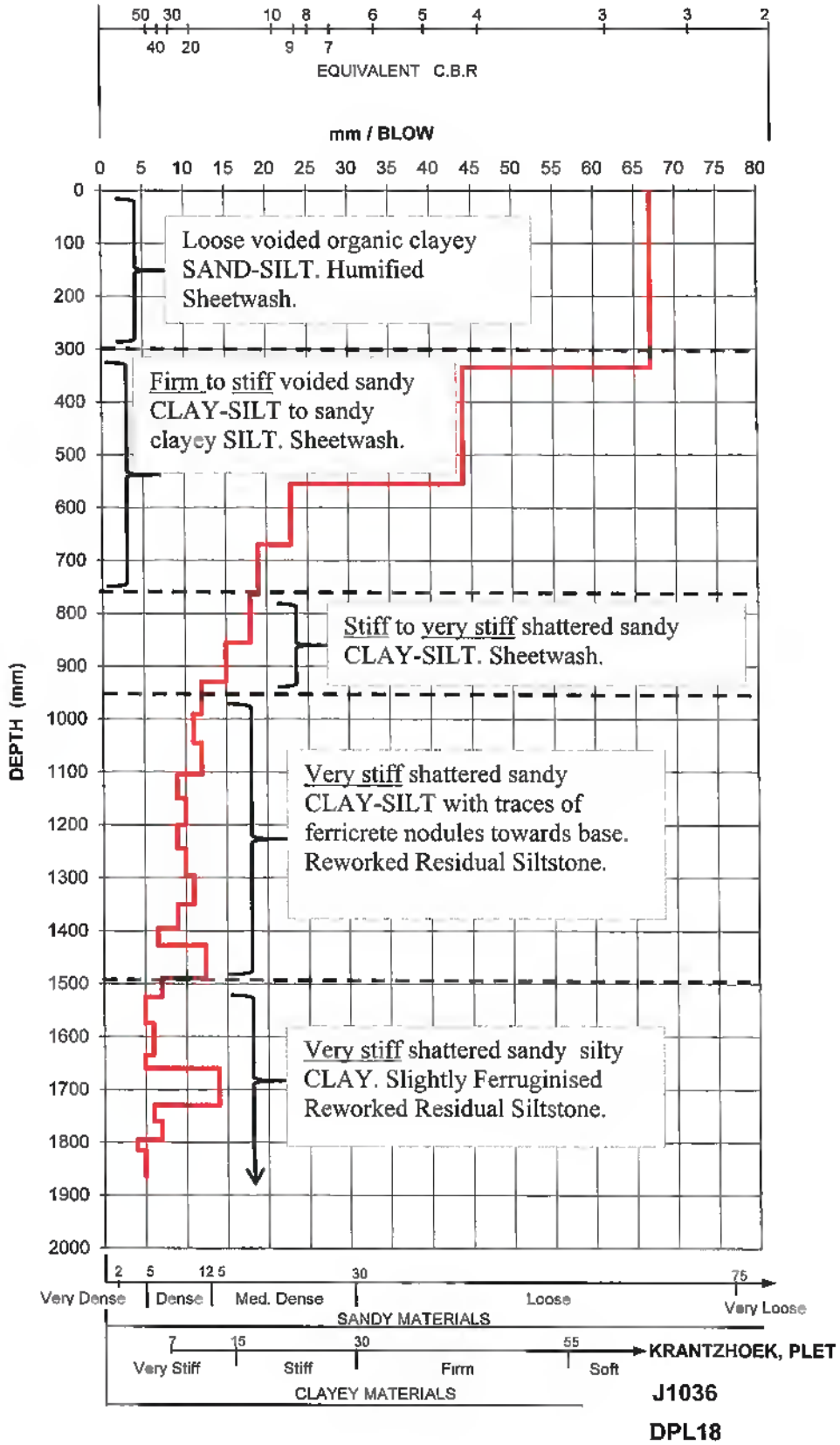

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C B R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense slightly organic clayey silty SAND. Humified Sheetwash.
Stiff to very stiff from 0,35m weakly shattered clayey sandy SILT with calcareous inclusion below 0,4m. Partially calcretised Sheetwash.
Note: Stopped on very stiff calcretised sheetwash at 0,6m.
2 5 12 5 30 75
Very Dense
Dense
Med. Dense
Loose
Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff
Stiff
Firm
Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL14a

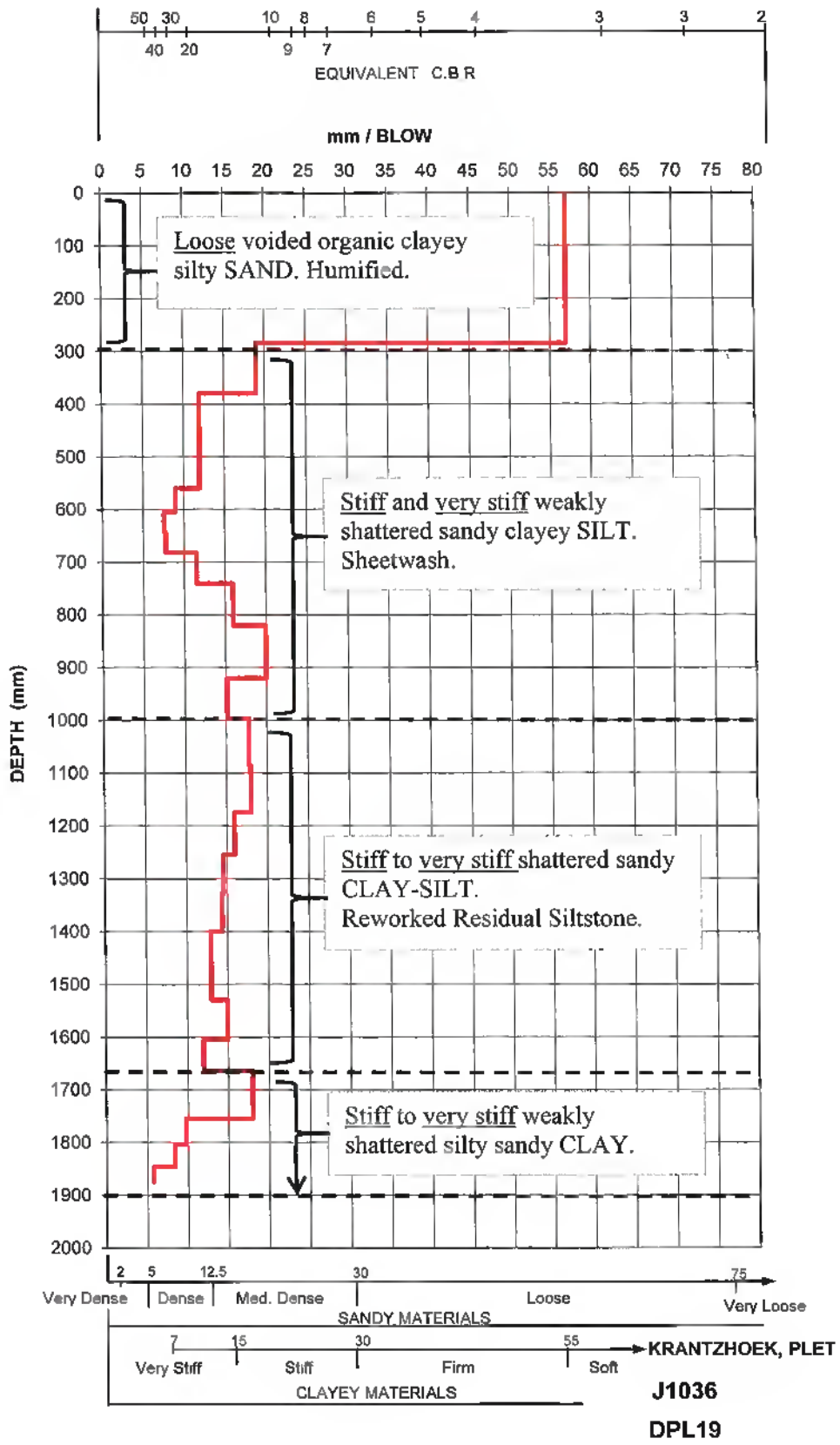

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Depth related to ground level (m)
600
1300
Calcrete and ferricrete NODULES in a very stiff sandy silty CLAY matrix. Pebble Marker / Nodular Ferricrete (Pedogenic).
Note: At 1,3m stopped near refusal on tightly packed nodules and gravel as above.
2 5 12 5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL14b from 0.6m

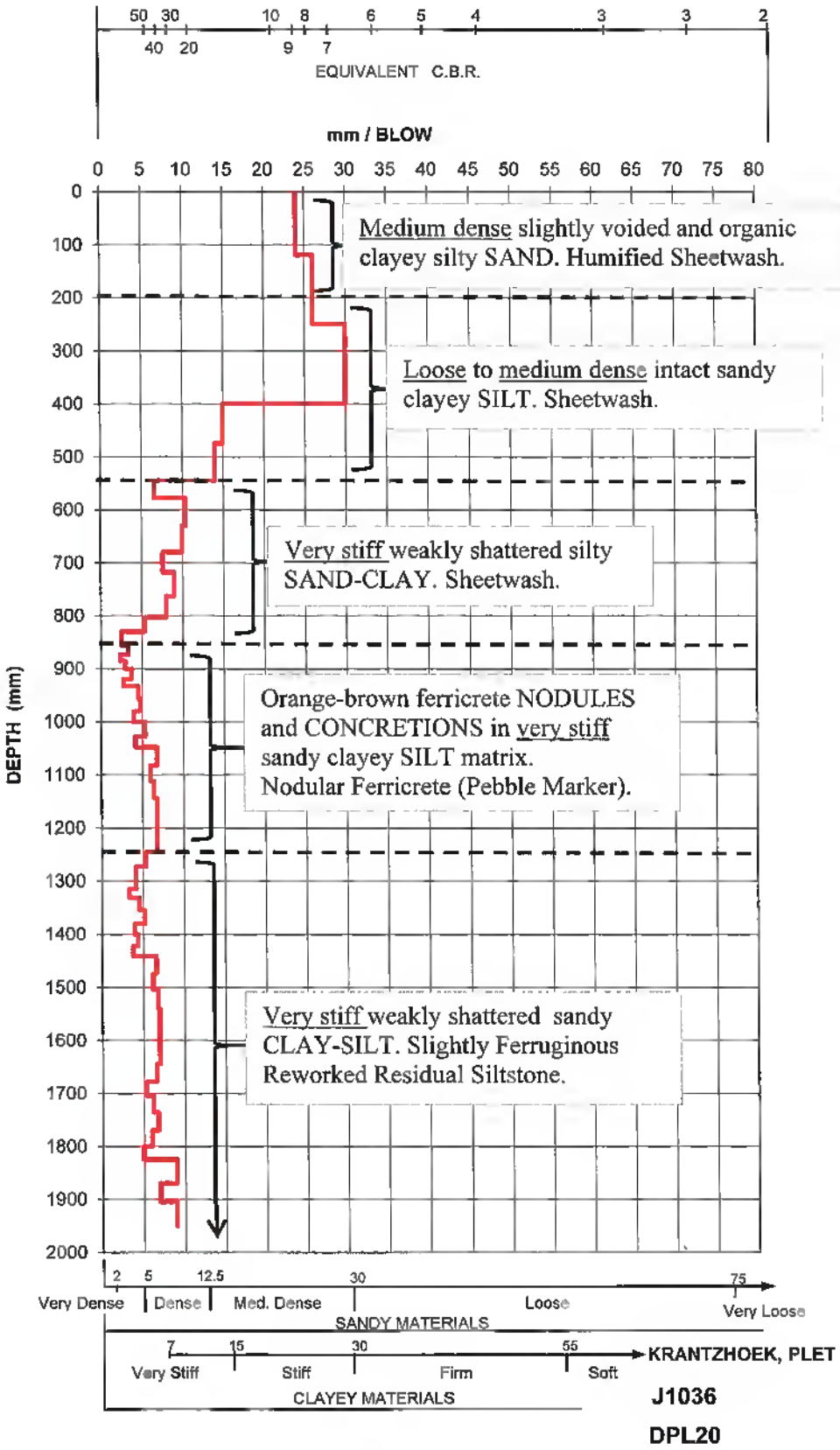

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C B R
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense intact organic clayey silty SAND. Humified
Very stiff intact sandy CLAY-SILT. Sheetwash.
Note: Clay fraction increases with depth.
Very stiff to stiff indistinctly shattered sandy clayey SILT. Sheetwash.
Stiff to very stiff weakly shattered silty sandy CLAY. Reworked Residual Siltstone.
Very stiff weakly shattered ferruginous silty sandy CLAY. Reworked Residual Siltstone.
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL15

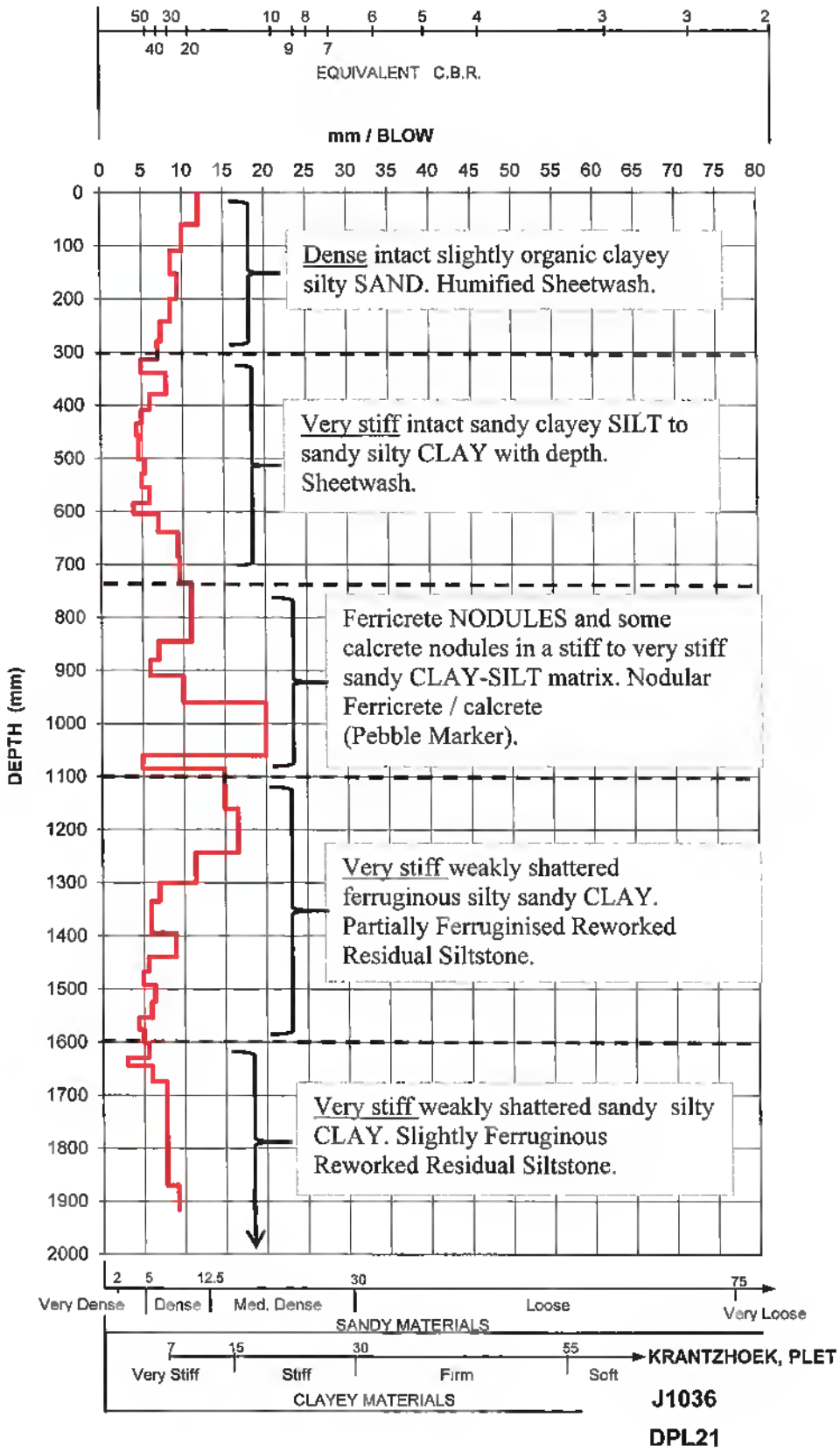

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose slightly voided organic clayey silty SAND. Humified Sheetwash.
Very stiff weakly shattered clayay sandy SILT to sandy SILT-CLAY. Sheetwash.
Very stiff to stiff shattered sandy SILT-CLAY. Sheetwash.
As above but with ferricrete nodules and concretions and scattered gravel. Pebble Marker (Pedogenic).
Very stiff to stiff shattered sandy silty CLAY with some ferricrete nodules. Reworked Residual Siltstone.
Stiff weakly shattered silty sandy CLAY sandy SILT-CLAY. Partially Reworked Residual Siltstone.
2 5 12 5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL16

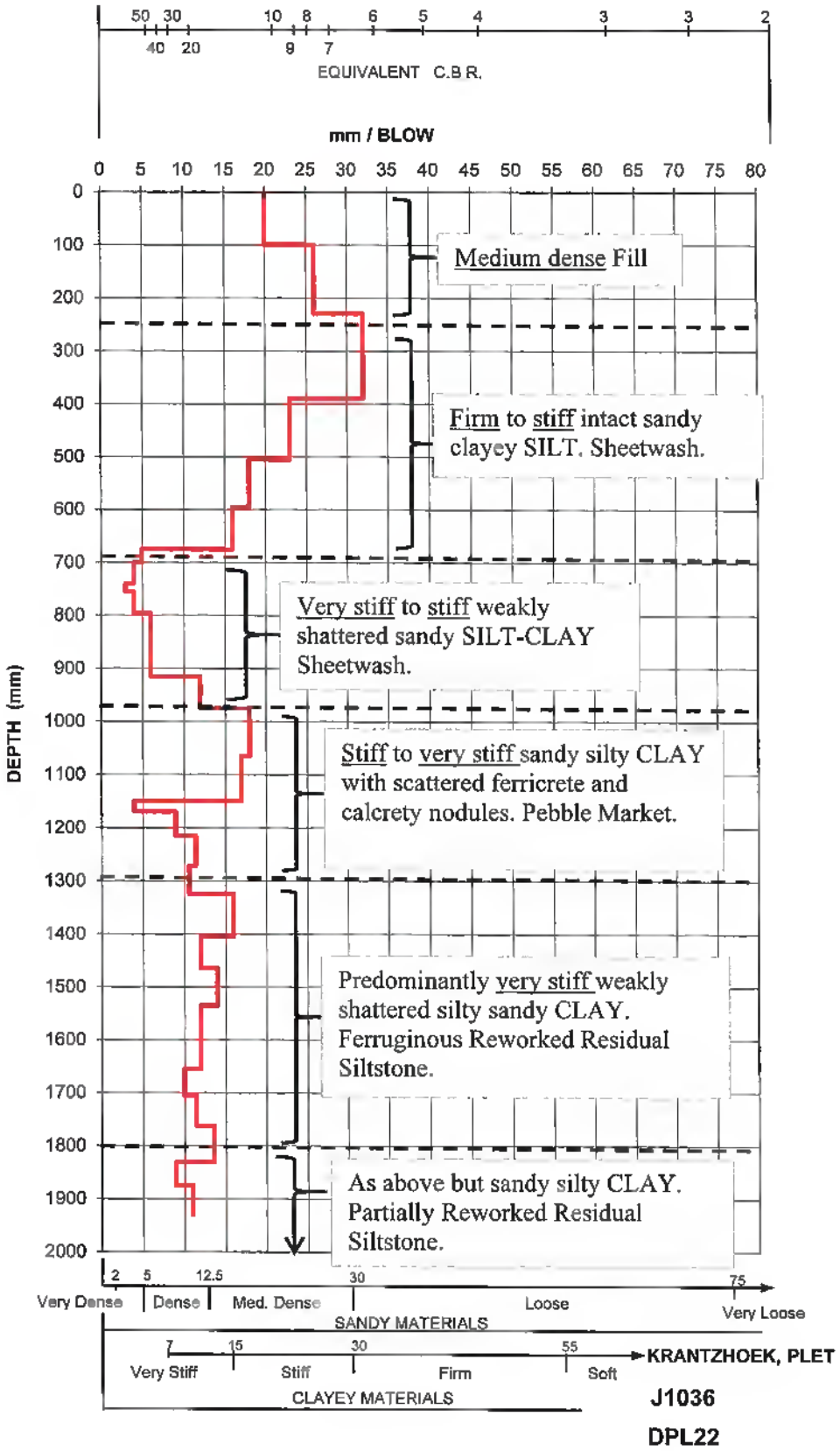

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose voided clayey silty SAND. Humified Sheetwash.
Firm to stiff voided sandy CLAY-SILT. Sheetwash.
Stiff to very stiff shattered sandy SILT-CLAY. Sheetwash.
Ferricrete NODULES and scattered gravel in very stiff matrix as above. Pebble Marker / Nodular Ferricrete.
Very stiff shattered sandy silty CLAY with localised pockets of ferricrete nodules. Slightly Ferruginised Reworked Residual Siltstone.
As above but stiff .
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL17

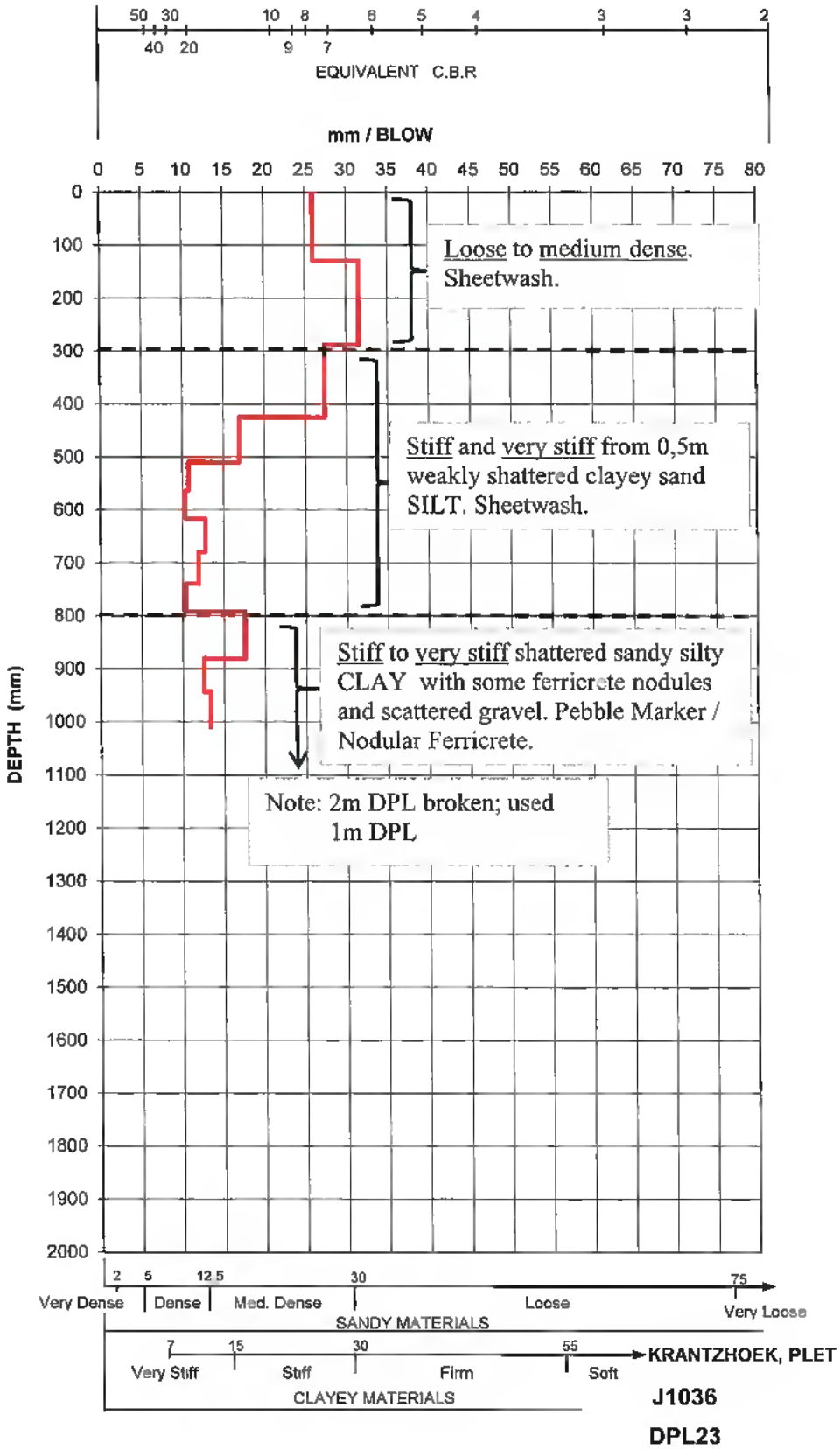

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose voided organic clayey SAND-SILT. Humified Sheetwash.
Firm to stiff voided sandy CLAY-SILT to sandy clayey SILT. Sheetwash.
Stiff to very stiff shattered sandy CLAY-SILT. Sheetwash.
Very stiff shattered sandy CLAY-SILT with traces of ferricrete nodules towards base. Reworked Residual Siltstone.
Very stiff shattered sandy silty CLAY. Slightly Ferruginised Reworked Residual Siltstone.
2 5 12.5 30 75
Very Dense
Dense
Med. Dense
Loose
Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff
Stiff
Firm
Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL18

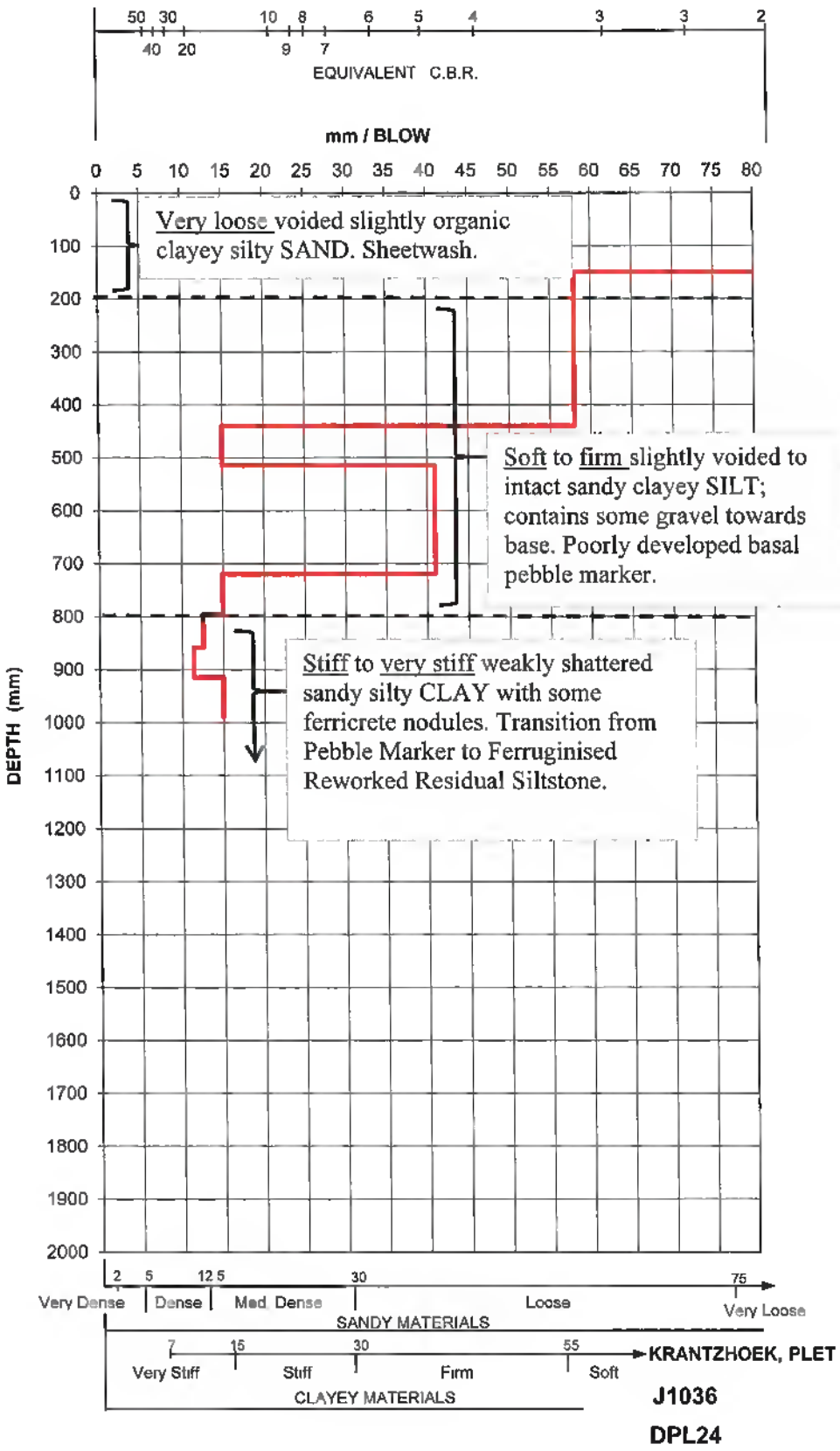

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose voided organic clayey silty SAND. Humified.
Stiff and very stiff weakly shattered sandy clayey SILT. Sheetwash.
Stiff to very stiff shattered sandy CLAY-SILT. Reworked Residual Siltstone.
Stiff to very stiff weakly shattered silty sandy CLAY.
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL19

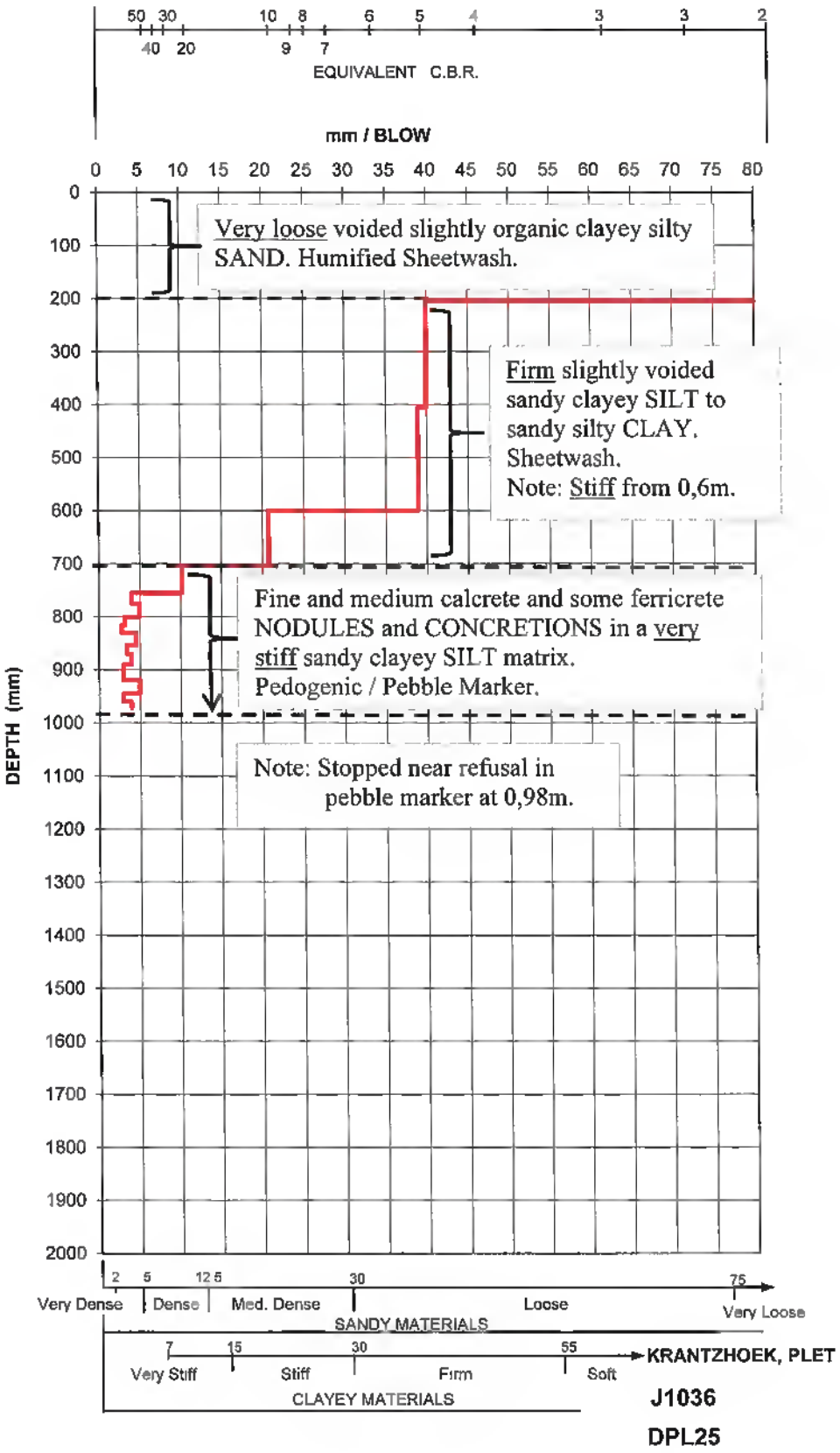

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense slightly voided and organic clayey silty SAND. Humified Sheetwash.
Loose to medium dense intact sandy clayey SILT. Sheetwash.
Very stiff weakly shattered silty SAND-CLAY. Sheetwash.
Orange-brown ferricrete NODULES and CONCRETIONS in very stiff sandy clayey SILT matrix. Nodular Ferricrete (Pebble Marker).
Very stiff weakly shattered sandy CLAY-SILT. Slightly Ferruginous Reworked Residual Siltstone.
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL20

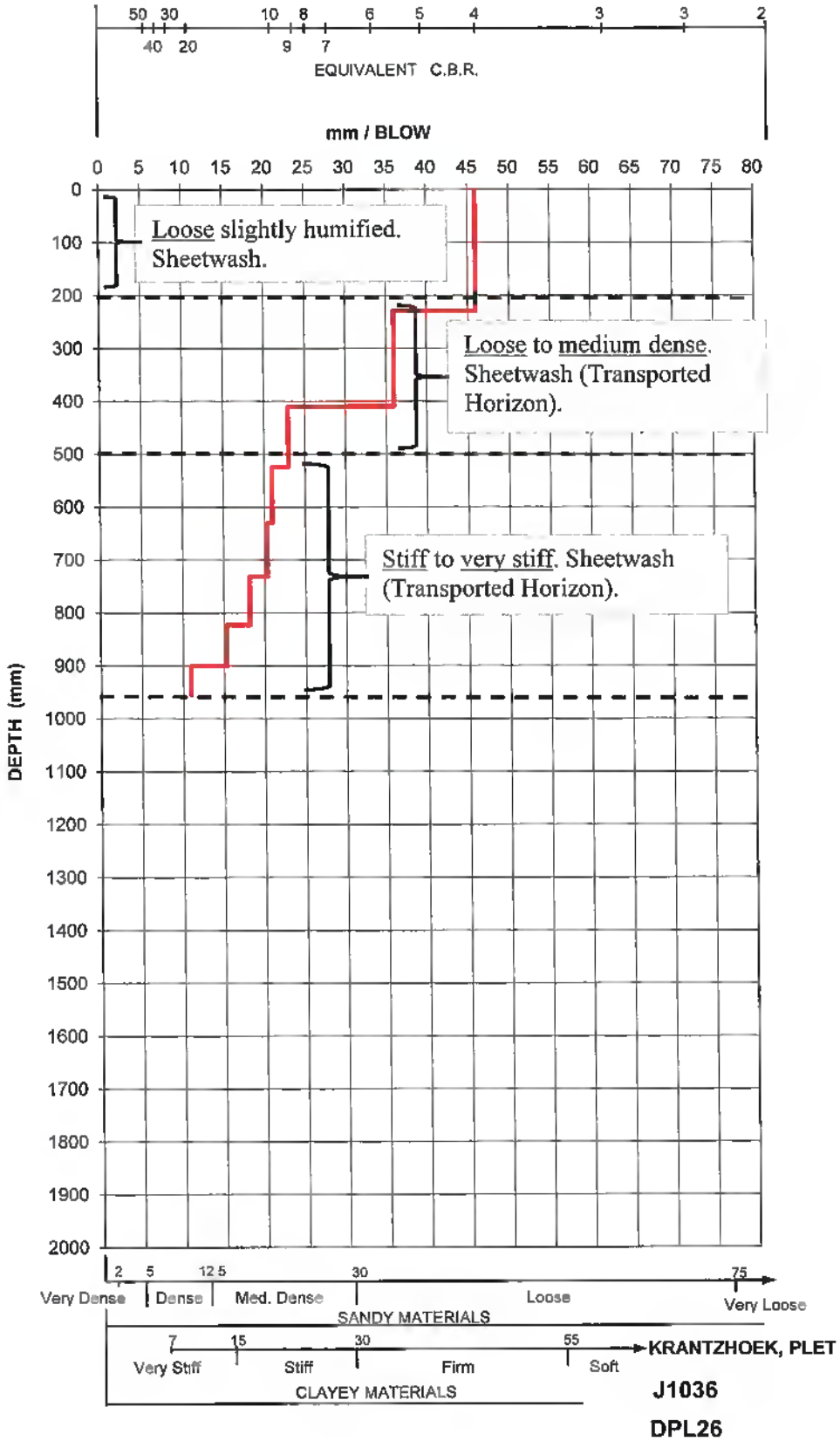

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Dense intact slightly organic clayey silty SAND. Humified Sheetwash.
Very stiff intact sandy clayey SILT to sandy silty CLAY with depth. Sheetwash.
Ferricrete NODULES and some calcrete nodules in a stiff to very stiff sandy CLAY-SILT matrix. Nodular Ferricrete / calcrete (Pebble Marker).
Very stiff weakly shattered ferruginous silty sandy CLAY. Partially Ferruginised Reworked Residual Siltstone.
Very stiff weakly shattered sandy silty CLAY. Slightly Ferruginous Reworked Residual Siltstone.
2 5 12.5 30 75
Very Dense
Dense
Med. Dense
Loose
Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff
Stiff
Firm
Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL21

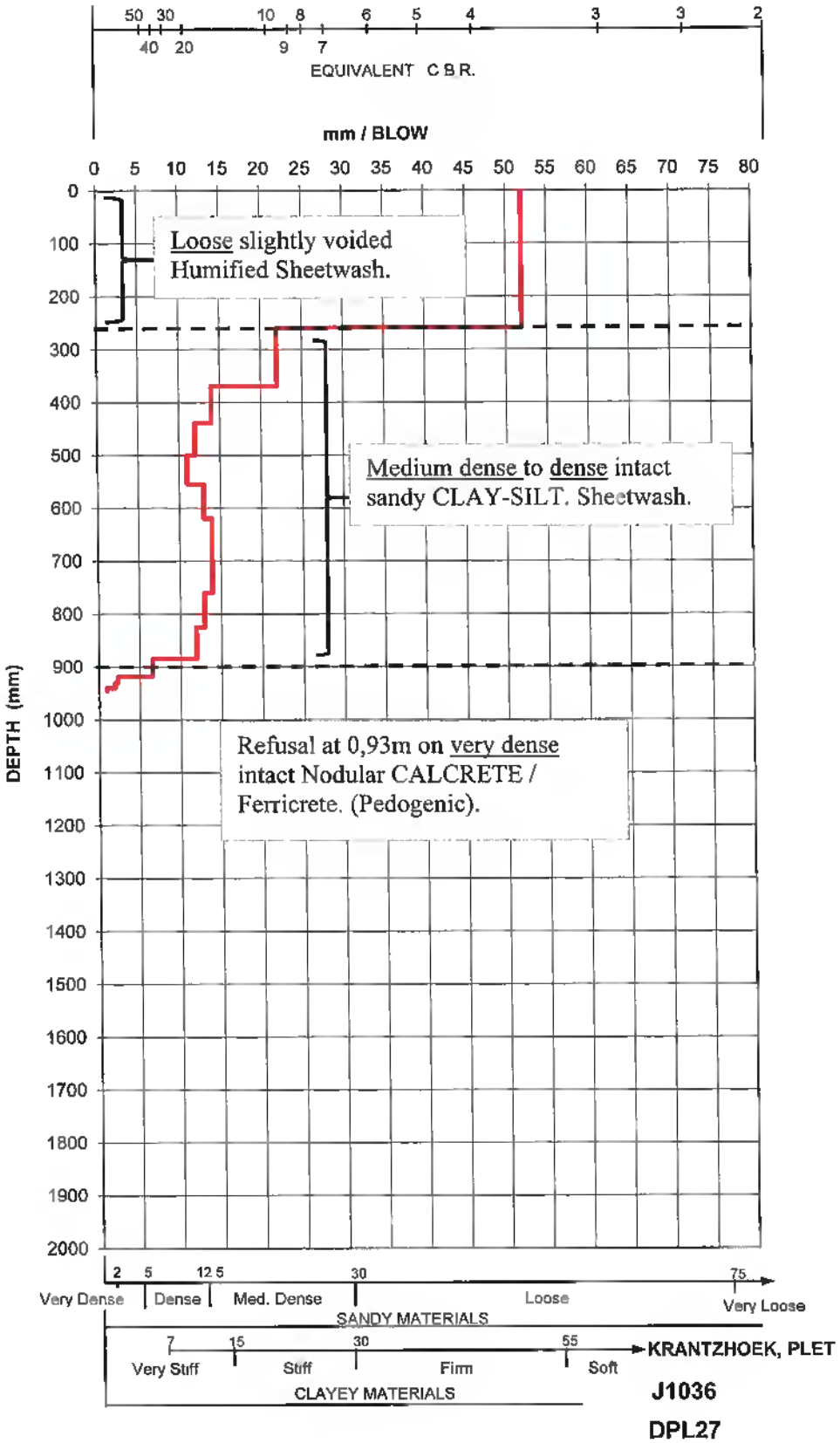

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense Fill
Firm to stiff intact sandy clayey SILT. Sheetwash.
Very stiff to stiff weakly shattered sandy SILT-CLAY Sheetwash.
Stiff to very stiff sandy silty CLAY with scattered ferricrete and calcrety nodules. Pebble Market.
Predominantly very stiff weakly shattered silty sandy CLAY. Ferruginous Reworked Residual Siltstone.
As above but sandy silty CLAY. Partially Reworked Residual Siltstone.
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL22

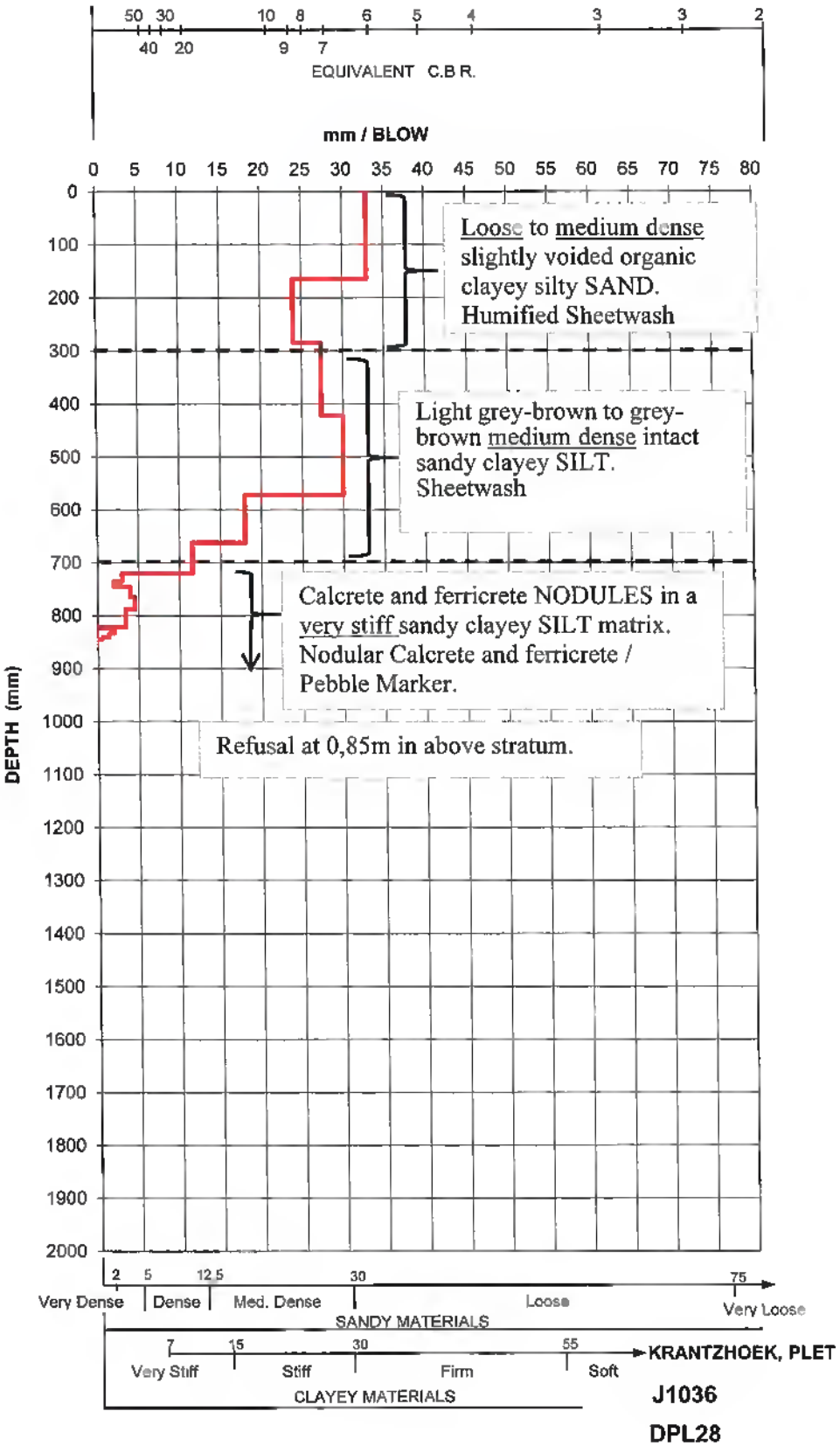

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose to medium dense. Sheetwash.
Stiff and very stiff from 0,5m weakly shattered clayey sand SILT. Sheetwash.
Stiff to very stiff shattered sandy silty CLAY with some ferricrete nodules and scattered gravel. Pebble Marker / Nodular Ferricrete.
Note: 2m DPL broken; used 1m DPL
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL23

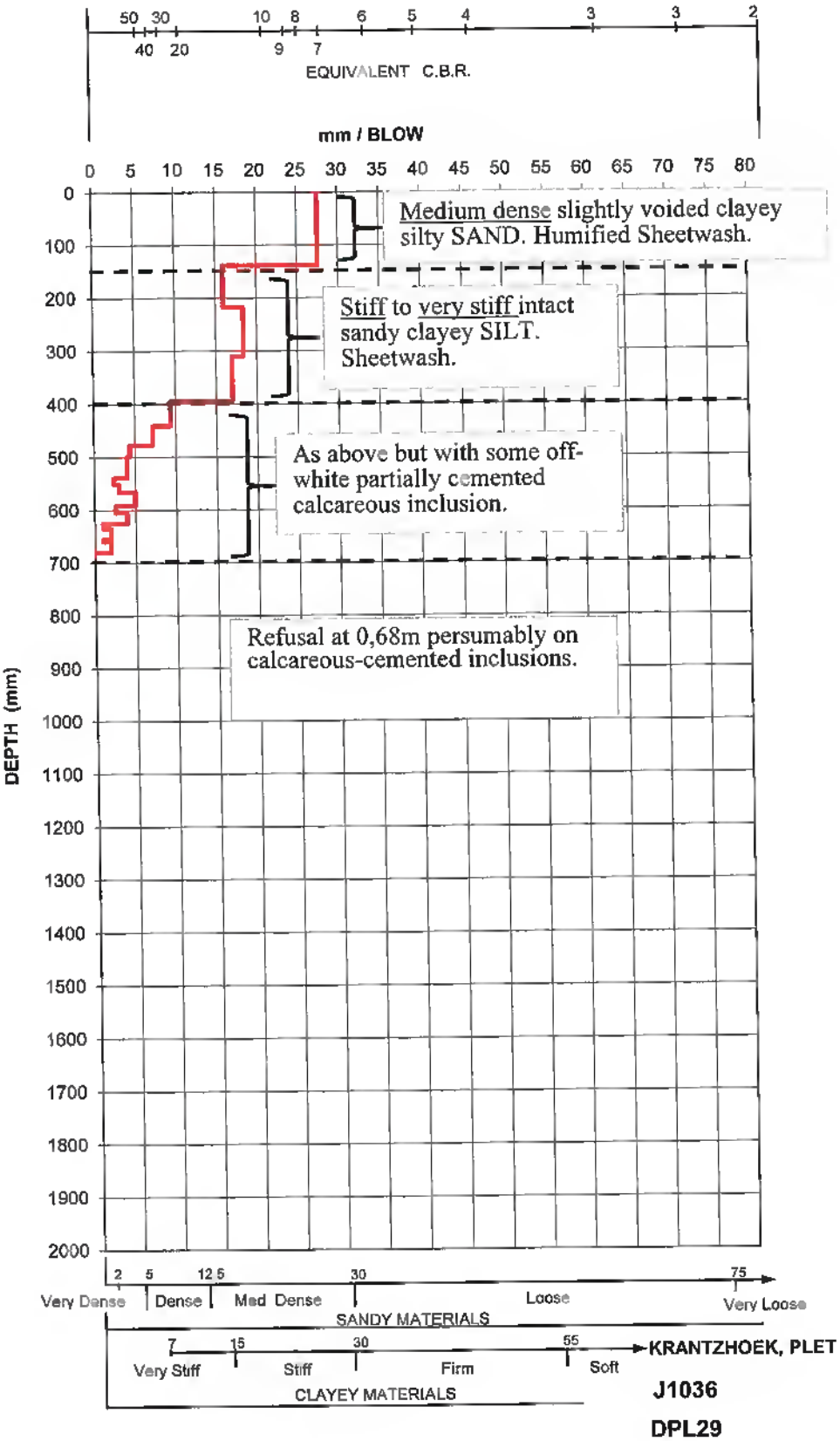

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Very loose voided slightly organic clayey silty SAND. Sheetwash.
Soft to firm slightly voided to intact sandy clayey SILT; contains some gravel towards base. Poorly developed basal pebble marker.
Stiff to very stiff weakly shattered sandy silty CLAY with some ferricrete nodules. Transition from Pebble Marker to Ferruginised Reworked Residual Siltstone.
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL24

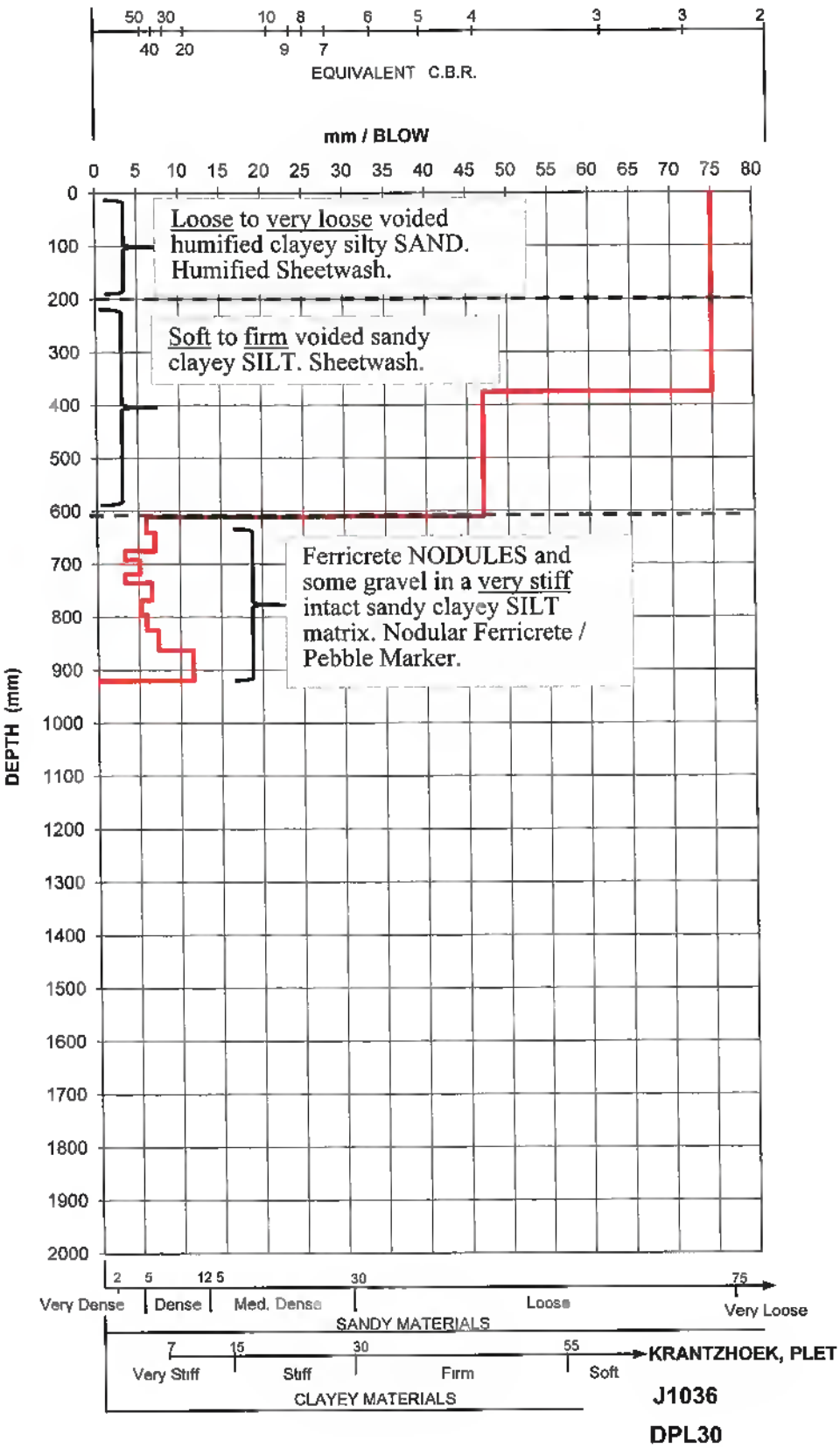

50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Very loose voided slightly organic clayey silty SAND. Humified Sheetwash.
Firm slightly voided sandy clayey SILT to sandy silty CLAY. Sheetwash.
Note: Stiff from 0,6m.
Fine and medium calcrete and some ferricrete NODULES and CONCRETIONS in a very stiff sandy clayey SILT matrix.
Pedogenic / Pebble Marker.
Note: Stopped near refusal in pebble marker at 0,98m.
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL25


50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose slightly humified. Sheetwash.
Loose to medium dense. Sheetwash (Transported Horizon).
Stiff to very stiff. Sheetwash (Transported Horizon).
2 5 12 5 30 75
Very Dense
Dense
Med. Dense
Loose
Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff
Stiff
Firm
Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL26


50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C B R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose slightly voided Humified Sheetwash.
Medium dense to dense intact sandy CLAY-SILT. Sheetwash.
Refusal at 0,93m on very dense intact Nodular CALCRETE / Ferricrete. (Pedogenic).
2 5 12.5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL27


50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose to medium dense slightly voided organic clayey silty SAND. Humified Sheetwash
Light grey-brown to grey-brown medium dense intact sandy clayey SILT. Sheetwash
Calcrete and ferricrete NODULES in a very stiff sandy clayey SILT matrix. Nodular Calcrete and ferricrete / Pebble Marker.
Refusal at 0,85m in above stratum.
2 5 12.5 30 75
Very Dense
Dense
Med. Dense
Loose
Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff
Stiff
Firm
Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL28


50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Medium dense slightly voided clayey silty SAND. Humified Sheetwash.
Stiff to very stiff intact sandy clayey SILT. Sheetwash.
As above but with some off-white partially cemented calcareous inclusion.
Refusal at 0,68m persumably on calcareous-cemented inclusions.
2 5 12.5 30 75
Very Dense Dense Med Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL29


50 30 10 8 6 5 4 3 3 2
40 20 9 7
EQUIVALENT C.B.R.
mm / BLOW
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
DEPTH (mm)
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Loose to very loose voided humified clayey silty SAND. Humified Sheetwash.
Soft to firm voided sandy clayey SILT. Sheetwash.
Ferricrete NODULES and some gravel in a very stiff intact sandy clayey SILT matrix. Nodular Ferricrete / Pebble Marker.
2 5 12 5 30 75
Very Dense Dense Med. Dense Loose Very Loose
SANDY MATERIALS
7 15 30 55
Very Stiff Stiff Firm Soft
CLAYEY MATERIALS
KRANTZHOEK, PLET
J1036
DPL30

APPENDIX E

Laboratory Test Results

CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

CLIENT:	Geotechnics Africa PO Box 1321 Hermanus 7200	**PROJECT:**	Plett Kranzhoek
		DATE:	03-03-2020
ATT:	Dirk van Rooyen	**REF:**	L200225

ASTM D422 SIEVE ANALYSIS

DESCRIPTION : yellow brown sandy silty clay
POSITION : TP 1 @ 0.5m

SAMPLE NO. : 32494
CLIENT SAMPLE NO. :

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	
	13,20	
	9,50	
	6,70	
	4,75	
	2,36	
	2,00	
	1,18	
	0,600	100
	0,425	99
	0,300	96
	0,150	87
	0,0750	79

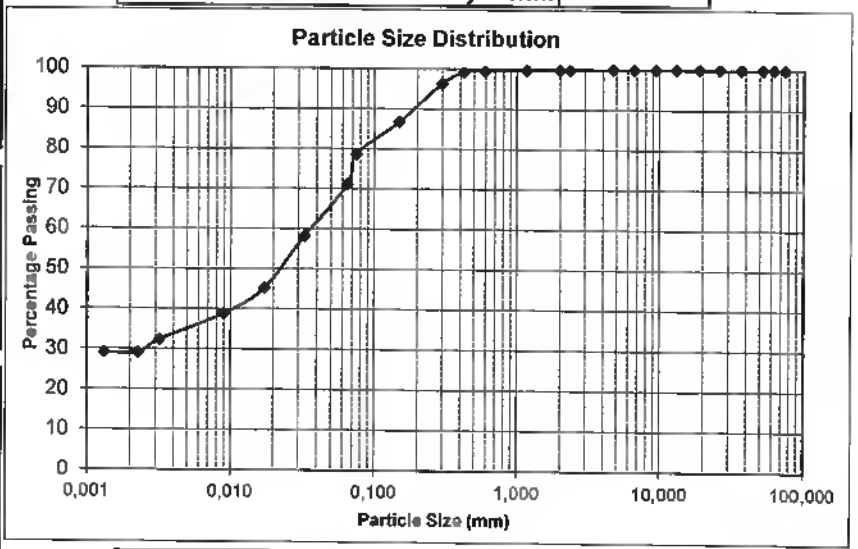
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0648	71
0,0331	58
0,0173	45
0,0090	39
0,0032	32
0,0023	29
0,0013	29

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	17,8
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	22
Plastic Index	10
Linear Shrinkage	5,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	0
Sand : Percentage - 4.75mm and + 0.075mm	21
Silt : Percentage - 0.075mm and + 0.002mm	48
Clay : Percentage - 0.002mm	31

The above test results are pertinent to the samples received and tested only

CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

CLIENT: Geotechnics Africa
PO Box 1321
Hermanus
7200

ATT: Dirk van Rooyen

PROJECT: Plett Kranzhoek

DATE: 03-03-2020

REF: L200225

ASTM D422 SIEVE ANALYSIS

DESCRIPTION : yellow brown silty clay
POSITION : TP 1 @ 0.8m

SAMPLE NO. : 32495
CLIENT SAMPLE NO. :

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	
	13,20	
	9,50	
	6,70	
	4,75	100
	2,36	99
	2,00	99
	1,18	99
	0,600	99
	0,425	99
	0,300	99
	0,150	90
	0,0750	83

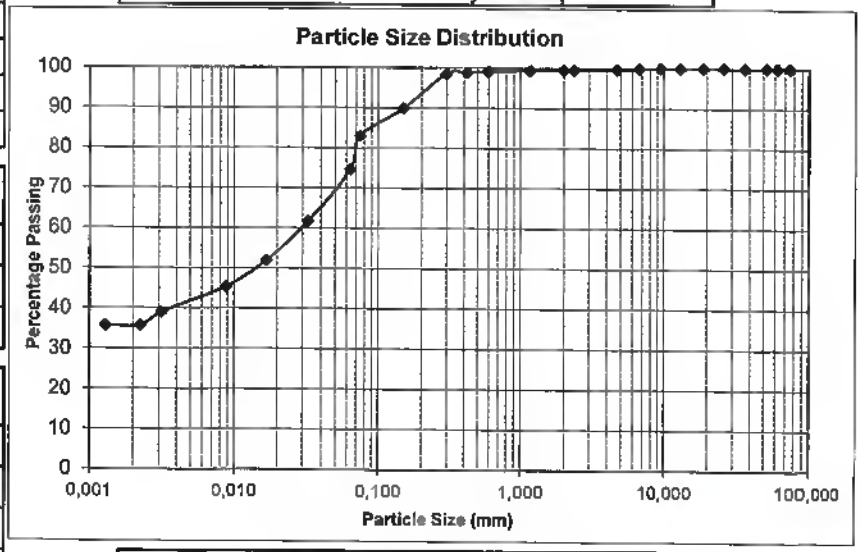
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0639	75
0,0328	62
0,0170	52
0,0088	45
0,0031	39
0,0022	36
0,0013	36

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	18,9
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	26
Plastic Index	10
Linear Shrinkage	5,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	0
Sand : Percentage - 4.75mm and + 0.075mm	17
Silt : Percentage - 0.075mm and + 0.002mm	46
Clay : Percentage - 0.002mm	37

The above test results are pertinent to the samples received and tested only

Technical Signatory: M Hofman

CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

CLIENT:	Geotechnics Africa PO Box 1321 Hermanus 7200	**PROJECT:**	Plett Kranzhoek
		DATE:	03-03-2020
ATT:	Dirk van Rooyen	**REF:**	L200225

ASTM D422 SIEVE ANALYSIS

DESCRIPTION : red clay
POSITION : TP 1 @ 2.1m
SAMPLE NO. : 32496
CLIENT SAMPLE NO. :

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	
	13,20	
	9,50	100
	6,70	99
	4,75	99
	2,36	97
	2,00	97
	1,18	96
	0,600	96
	0,425	95
	0,300	89
	0,150	77
	0,0750	71

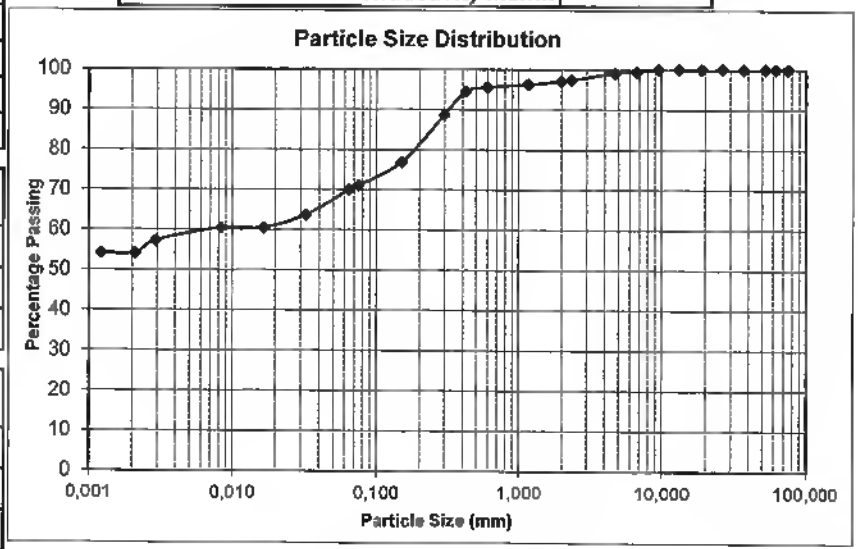
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0648	70
0,0324	64
0,0164	60
0,0084	60
0,0029	57
0,0021	54
0,0012	54

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	30,3
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	38
Plastic Index	15
Linear Shrinkage	8,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	1
Sand : Percentage - 4.75mm and + 0.075mm	28
Silt : Percentage - 0.075mm and + 0.002mm	15
Clay : Percentage - 0.002mm	56

The above test results are pertinent to the samples received and tested only

Technical Signatory: M Hofman

CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

CLIENT:	Geotechnics Africa PO Box 1321 Hermanus 7200	**PROJECT:**	Plett Kranzhoek
		DATE:	03-03-2020
ATT:	Dirk van Rooyen	**REF:**	L200225

ASTM D422 SIEVE ANALYSIS

DESCRIPTION :	lt grey & olive clay	**SAMPLE NO. :**	32497
POSITION :	TP 1 @ 3.0m	**CLIENT SAMPLE NO. :**	

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	
	13,20	
	9,50	
	6,70	
	4,75	
	2,36	
	2,00	
	1,18	
	0,600	
	0,425	100
	0,300	91
	0,150	73
	0,0750	66

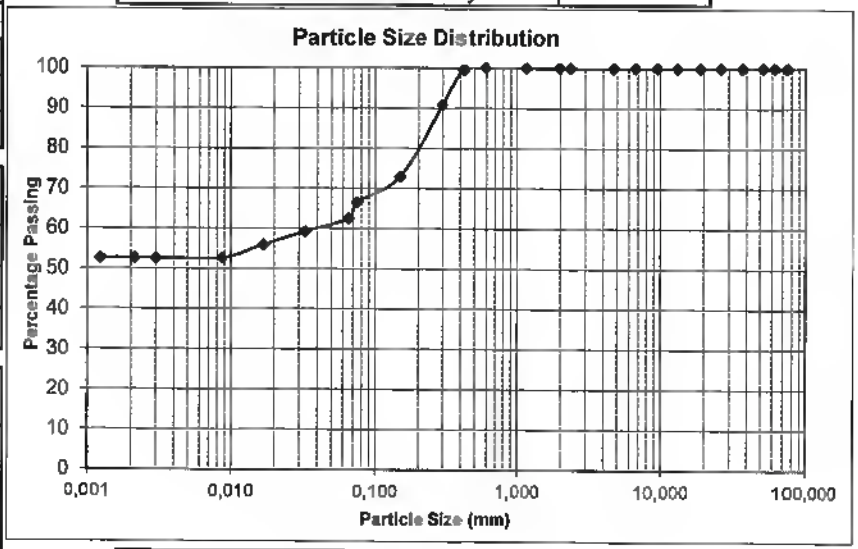
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0657	63
0,0331	59
0,0168	56
0,0087	53
0,0030	53
0,0021	53
0,0012	53

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	24,9
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	41
Plastic Index	17
Linear Shrinkage	8,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	0
Sand : Percentage - 4.75mm and + 0.075mm	34
Silt : Percentage - 0.075mm and + 0.002mm	14
Clay : Percentage - 0.002mm	52

The above test results are pertinent to the samples received and tested only

CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

CLIENT:	Geotechnics Africa PO Box 1321 Hermanus 7200	**PROJECT:**	Plett Kranzhoek
		DATE:	03-03-2020
ATT:	Dirk van Rooyen	**REF:**	L200225

ASTM D422 SIEVE ANALYSIS

DESCRIPTION : yellow brown sandy silt
POSITION : TP 16 @ 0.3-0.6m

SAMPLE NO. : 32499
CLIENT SAMPLE NO. :

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	
	13,20	
	9,50	
	6,70	
	4,75	
	2,36	
	2,00	
	1,18	
	0,600	100
	0,425	99
	0,300	96
	0,150	86
	0,0750	76

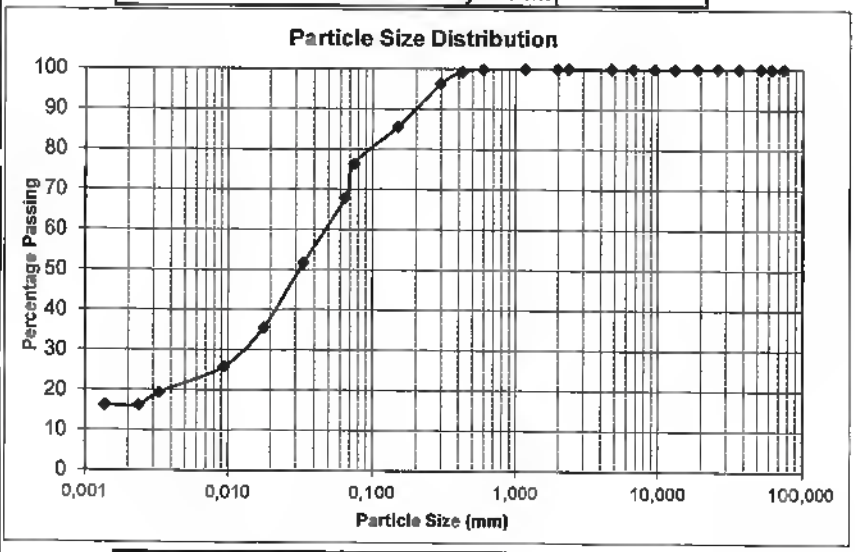
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0648	68
0,0340	52
0,0179	36
0,0094	26
0,0033	19
0,0024	16
0,0014	16

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	7,8
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	15
Plastic Index	7
Linear Shrinkage	3,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	0
Sand : Percentage - 4.75mm and + 0.075mm	24
Silt : Percentage - 0.075mm and + 0.002mm	59
Clay : Percentage - 0.002mm	17

The above test results are pertinent to the samples received and tested only

Technical Signatory: M Hofmeyr

CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

CLIENT:	Geotechnics Africa PO Box 1321 Hermanus 7200	**PROJECT:**	Plett Kranzhoek
		DATE:	03-03-2020
ATT:	Dirk van Rooyen	**REF:**	L200225

ASTM D422 SIEVE ANALYSIS

DESCRIPTION : olive silty clay
POSITION : TP 16 @ 0.7-1.4m
SAMPLE NO. : 32500
CLIENT SAMPLE NO. :

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	
	13,20	100
	9,50	99
	6,70	98
	4,75	96
	2,36	94
	2,00	94
	1,18	94
	0,600	94
	0,425	94
	0,300	93
	0,150	87
	0,0750	82

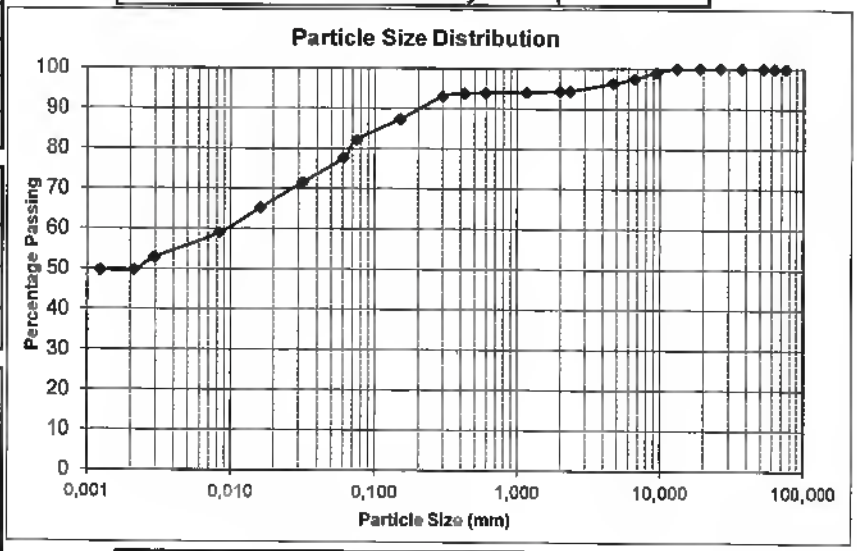
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0609	78
0,0320	71
0,0162	65
0,0084	59
0,0030	53
0,0021	50
0,0012	50

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	23,7
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	40
Plastic Index	16
Linear Shrinkage	7,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	
O.M.C (%)	
C.B.R. @ 100% Comp.	
C B R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	4
Sand : Percentage - 4.75mm and + 0.075mm	14
Silt : Percentage - 0.075mm and + 0.002mm	30
Clay : Percentage - 0.002mm	52

The above test results are pertinent to the samples received and tested only.

CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

CLIENT:	Geotechnics Africa PO Box 1321 Hermanus 7200	**PROJECT:**	Plett Kranzhoek
		DATE:	03-03-2020
ATT:	Dirk van Rooyen	**REF:**	L200225

ASTM D422 SIEVE ANALYSIS

DESCRIPTION : grey & red clay
POSITION : TP 16 @ 1.6-2.1m
SAMPLE NO. : 32501
CLIENT SAMPLE NO. :

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	
	13,20	
	9,50	
	6,70	100
	4,75	98
	2,36	97
	2,00	96
	1,18	96
	0,600	96
	0,425	96
	0,300	92
	0,150	78
	0,0750	70

Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0648	67
0,0328	60
0,0166	57
0,0085	57
0,0030	51
0,0021	51
0,0012	51

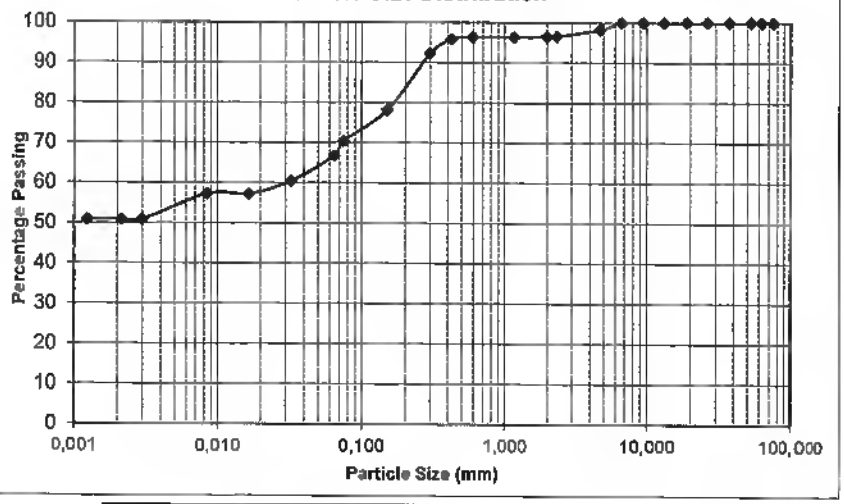
SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	24,1
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	45
Plastic Index	21
Linear Shrinkage	10,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	

Particle Size Distribution



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	2
Sand : Percentage - 4.75mm and + 0.075mm	28
Silt : Percentage - 0.075mm and + 0.002mm	18
Clay : Percentage - 0.002mm	52

CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

CLIENT:	Geotechnics Africa PO Box 1321 Hermanus 7200	**PROJECT:**	Plett Kranzhoek
		DATE:	03-03-2020
ATT:	Dirk van Rooyen	**REF:**	L200225

ASTM D422 SIEVE ANALYSIS

DESCRIPTION : yellow olive silt
POSITION : TP 22 @ 0.3-0.5m
SAMPLE NO. : 32502
CLIENT SAMPLE NO. :

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	
	13,20	
	9,50	
	6,70	
	4,75	
	2,36	
	2,00	
	1,18	
	0,600	100
	0,425	99
	0,300	96
	0,150	80
	0,0750	70

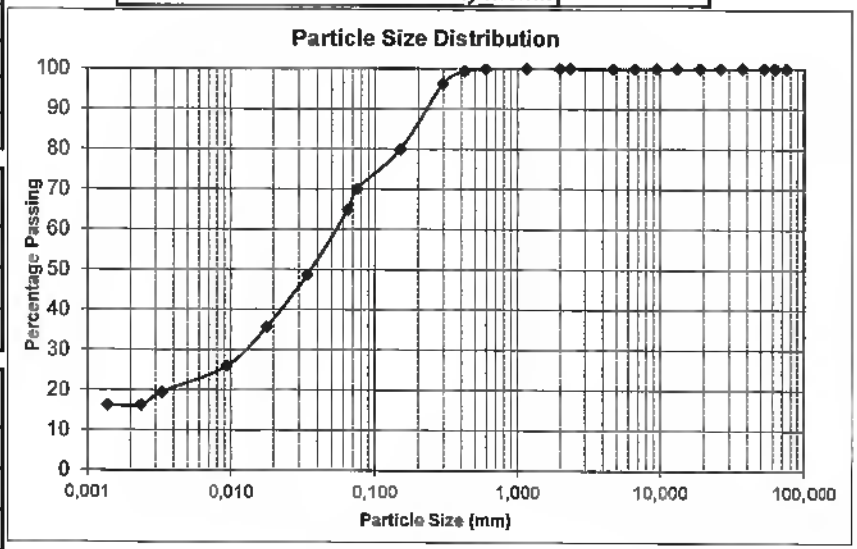
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0648	65
0,0343	49
0,0179	36
0,0094	26
0,0033	19
0,0024	16
0,0014	16

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	11,6
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	15
Plastic Index	8
Linear Shrinkage	3,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	0
Sand : Percentage - 4.75mm and + 0.075mm	30
Silt : Percentage - 0.075mm and + 0.002mm	52
Clay : Percentage - 0.002mm	18

Technical Signatory: M Hofman

CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

CLIENT:	Geotechnics Africa PO Box 1321 Hermanus 7200	**PROJECT:**	Plett Kranzhoek
		DATE:	03-03-2020
ATT:	Dirk van Rooyen	**REF:**	L200225

ASTM D422 SIEVE ANALYSIS

DESCRIPTION : yellow brown & red silty clay
POSITION : TP 22 @ 0,6-0,9m
SAMPLE NO. : 32503
CLIENT SAMPLE NO. :

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	
	13,20	
	9,50	100
	6,70	99
	4,75	99
	2,36	99
	2,00	99
	1,18	88
	0,600	88
	0,425	88
	0,300	87
	0,150	80
	0,0750	74

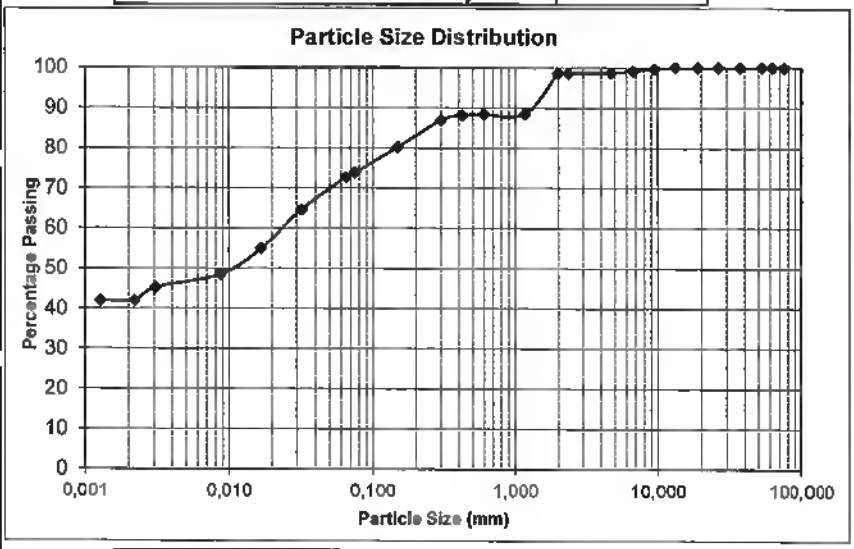
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0648	73
0,0324	65
0,0168	55
0,0087	48
0,0031	45
0,0022	42
0,0013	42

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	21,8
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	31
Plastic Index	13
Linear Shrinkage	7,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	1
Sand : Percentage - 4.75mm and + 0.075mm	25
Silt : Percentage - 0.075mm and + 0.002mm	31
Clay : Percentage - 0.002mm	43

Technical Signatory: M Hofman

CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

CLIENT:	Geotechnics Africa PO Box 1321 Hermanus 7200	**PROJECT:**	Plett Kranzhoek
		DATE:	03-03-2020
ATT:	Dirk van Rooyen	**REF:**	L200225

ASTM D422 SIEVE ANALYSIS

DESCRIPTION : red & grey clay
POSITION : TP 22 @ 1.0-1.2m
SAMPLE NO. : 32504
CLIENT SAMPLE NO. :

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	100
	13,20	98
	9,50	97
	6,70	96
	4,75	91
	2,36	87
	2,00	86
	1,18	86
	0,600	86
	0,425	85
	0,300	84
	0,150	77
	0,0750	73

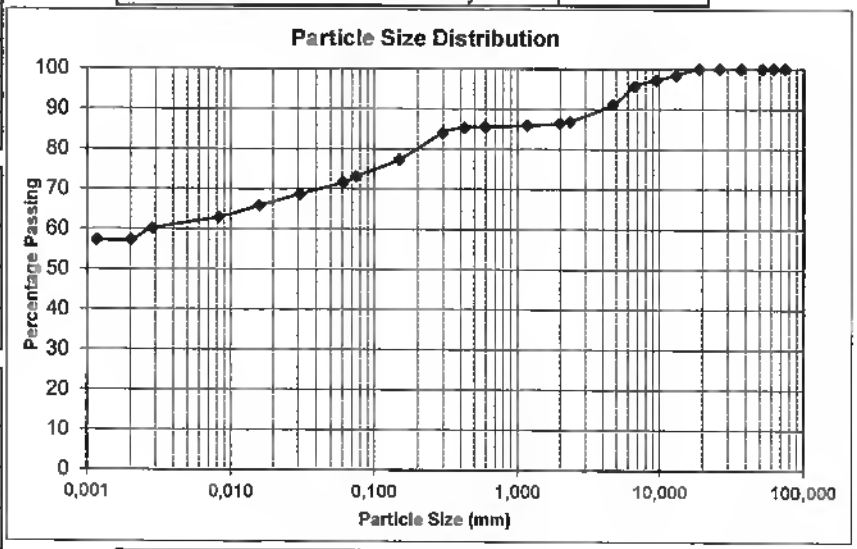
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0609	72
0,0309	69
0,0160	66
0,0083	63
0,0029	60
0,0020	57
0,0012	57

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	37,2
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	46
Plastic Index	16
Linear Shrinkage	7,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	9
Sand : Percentage - 4.75mm and + 0.075mm	18
Silt : Percentage - 0.075mm and + 0.002mm	14
Clay : Percentage - 0.002mm	59

The above test results are pertinent to the samples received and tested only.

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CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

CLIENT:	Geotechnics Africa PO Box 1321 Hermanus 7200	**PROJECT:**	Plett Kranzhoek
		DATE:	03-03-2020
ATT:	Dirk van Rooyen	**REF:**	L200225

ASTM D422 SIEVE ANALYSIS

DESCRIPTION :	red & grey silty clay	**SAMPLE NO. :**	32505
POSITION :	TP 22 @ 1.9-2.2m	**CLIENT SAMPLE NO. :**	

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	
	26,50	
	19,00	
	13,20	
	9,50	
	6,70	100
	4,75	99
	2,36	97
	2,00	97
	1,18	97
	0,600	96
	0,425	96
	0,300	93
	0,150	80
	0,0750	72

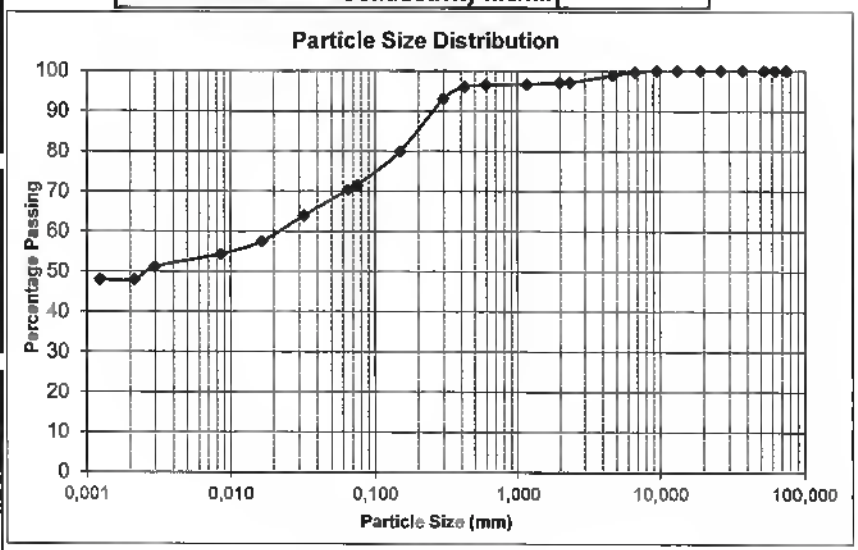
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0648	70
0,0324	64
0,0166	58
0,0086	54
0,0030	51
0,0021	48
0,0012	48

SCS Dispersion Test	
Diameter of particle (mm)	Percentage of soil suspension (%)

% SCS Dispersion:	
Initial Moisture Content (%) :	24,1
pH:	
Conductivity mS/m:	

Atterberg Limits :	
Liquid Limit	31
Plastic Index	14
Linear Shrinkage	7,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m³)	
O.M.C. (%)	
C.B.R. @ 100% Comp.	
C.B.R. @ 98 % Comp.	
C.B.R. @ 95 % Comp.	
C.B.R. @ 93 % Comp.	
C.B.R. @ 90 % Comp.	
Swell (max) %	



Tabulated Summary	Percentage
Gravel : Percentage - 4.75 mm	1
Sand : Percentage - 4.75mm and + 0.075mm	27
Silt : Percentage - 0.075mm and + 0.002mm	23
Clay : Percentage - 0.002mm	49

The above test results are pertinent to the samples received and tested only.

CONTROL GEOSCIENCES (PTY) LTD

CIVIL ENGINEERING MATERIAL AND GEOTECHNICAL LABORATORY,
GEOTECHNICAL AND ENVIRONMENTAL SERVICES

CLIENT: Geotechnics Africa **PROJECT:** Plett Kranzhoek

ATT: Dirk van Rooyen **REF:** L200225

CHEMICAL ANALYSIS RESULT SUMMARY

SAMPLE NO:	32498	32499	32501		
POSITION:	Water	TP 16	TP 16		
DEPTH:		0,3-0,6m	1,6-2,1m		

pH	5,20	6,47	6,79		
CONDUCTIVITY mS/m	76,8	20,8	293,0		

SAMPLE NO:					
POSITION:					
DEPTH:					

pH					
CONDUCTIVITY mS/m					

REMARKS: Tested by Bemlab