

**PHASE I**  
**GEOTECHNICAL SITE INVESTIGATION**

**FOR**

**ERVEN 513 & 1719**  
**NAPIER**

**FOR**

**ASLA DEVCO (PTY) LTD**



**CORE GEOTECHNICAL  
CONSULTANTS**

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**PHASE I GEOTECHNICAL SITE INVESTIGATION FOR  
ERVEN 513 & 1719 NAPIER**

NOVEMBER 2017

Project no: 178-17

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## PHASE I GEOTECHNICAL SITE INVESTIGATION FOR ERVEN 513 & 1719 NAPIER

for

**ASLA DEVCO (PTY) LTD**

NOVEMBER 2017

Project no: 178-17

### Executive Summary

Erven 513 and 1719 in Napier are approximately 7.8 Ha in total area, and are located on the southern side of the town's urban area. Access to the site is gained via Short Street that also forms the eastern boundary of the site. Existing housing is located to the north and east and open land adjoins the southern side of the site. The location of the site is indicated in the site locality plan (Figure 3.1).

Topographically, the broader area is fairly flat-lying, with a slight to moderate fall towards the south, north and north-west. Vegetation comprises grass, shrubs and scattered small trees. Site features are illustrated in the remote image in Figure 3.2.

The entire site is underlain by transported soils, comprising gravelly silty sand, sandy clayey silt and silty clay.

Very soft to medium hard rock shale and siltstone underlie the transported soils, and were encountered to depths in excess of 2.0 m bgl. Discontinuous pedogenic ferricrete and cemented lenses also occur within some parts of the site, directly overlying the weathered shale. These cemented layers are however inconsistent and vary in thickness and degree of cementation.

A perched water table was encountered at 2.0 m bgl in TP10. This is at the lowest part of the site, and no water was encountered in any of the other test pits. The investigation was conducted towards the end of a relatively dry winter period and it is therefore possible that the water table might rise slightly.

The following geotechnical characteristics of the site are expected to have an impact on subsidy housing development and subsidy variations:-

- a) Difficulty of servicing land due to slopes, with the average slope generally being flatter than 1:10 but exceeds 1:20.
- b) Potentially expansive clayey soils on site that may require modified construction methods to be applied.

A schedule of generic subsidy variations applicable to the site is outlined in Table 6.3.

The Residential Site Class Designation is set out in Table 7.1. The areal extent of classified areas is shown in the site plan in Appendix A. A site classification of **S/H1/R** is assigned to the entire site.

Conventional founding (strip or pad footings) at a depth of 0.5m is recommended. Structures will require modified normal construction techniques to be applied to cater for the predicted settlement and minor heave movements of up to 10 mm.

This Phase 1 geotechnical site investigation indicates that the site is broadly suitable for project linked subsidy housing development, provided that aspects of concern relating to the geotechnical character of the site are addressed.

## **1. Introduction**

At the request of Asla Devco (Pty) Ltd, we have prepared a Phase 1 geotechnical site investigation report for the proposed new housing development on erf 513 & 1719, in Napier.

The objectives of this investigation were as follows: -

- a) Identify any potential hazards
- b) Define the ground conditions and provide site classifications including detailed soil profiles and groundwater occurrences within the zone of influence of foundations
- c) Provide the geotechnical basis for safe and appropriate land use planning, infrastructure design, housing unit design and the formulation of precautionary measures and risk management procedures
- d) Broadly classify the land that is to be developed for subsidy housing in terms of the Housing Code's Residential Site Class Designations
- e) Gather factual data that has a bearing on the determination of housing subsidy variations and the installation of township services.

This report has been prepared in accordance with the standard specifications of the National Housing Code for Project Linked Greenfield Subsidy Housing Projects (Standard Specification GFSH-2).

## **2. Information used in the study**

The following information sources were used in the investigation: -

- a) Remote imagery from various years.
- b) The 1:250 000 geological map – Worcester (Council for Geoscience)
- c) The 1:500 000 geohydrological map – CT3317 (Dept, Water Affairs & Forestry).

## **3. Site description**

Erven 513 and 1719 in Napier are approximately 7.8 Ha in total area, and are located on the southern side of the town's urban area. Access to the site is gained via Short Street that also forms the eastern boundary of the site. Existing housing is located to the north and east and open land adjoins the southern side of the site. The location of the site is indicated in the site locality plan (Figure 3.1).

Topographically, the broader area is fairly flat-lying, with a slight to moderate fall towards the south, north and north-west. Vegetation comprises grass, shrubs and scattered small trees. Site features are illustrated in the remote image in Figure 3.2.

Existing houses in the surrounding area appear to be in reasonable condition from a structural point of view, with only a few instances of minor cracking evident in brickwork.

There is no evidence of past mining activity and the area is not undermined.

Site features are illustrated in the remote image in Figure 3.2.





**Figure 3.1: Locality of erven 513 & 1719**



**Figure 3.2: Physiological features of the site**

## **4. Nature of investigation**

### **4.1 Test pits**

The following field work was carried out: -

- a) Ten test pits (TP1-TP10), located across the site where access would allow, were excavated using a digger-loader to expose the soil profile. All test pits were visually profiled, with representative soil samples being taken from selected horizons for laboratory testing purposes

DPL light probe testing was not carried out due to the presence of cobbles and gravels and the dense nature of the surface soils and shallow nature of the underlying rock.

Test pit positions are shown in the site plan (see Appendix A). Copies of the recorded soil profiles are included in Appendix B.

### **4.2 Laboratory testing**

The following laboratory tests were carried out on selected soil samples: -

- a) Indicator tests in the form of moisture content, grading and Atterberg Limits analyses to determine basic soils engineering properties
- b) Compaction testing in the form of CBR and Mod AASHTO tests to determine material compaction characteristics
- c) Geochemical testing (pH and conductivity) to indicate possible deleterious effects of soils on concrete and buried services.

Copies of the full laboratory test results are included in Appendix C.

## **5. Site geology and groundwater conditions**

### **5.1 General**

Regionally the area is underlain by unconsolidated colluvial gravels and sands of Recent (transported) origin. Geological maps indicate that the Recent origin soils are underlain by shale, siltstone and poorly defined sandstone of the Bokkeveld Group.

### **5.2 Soil profile**

The entire site is underlain by transported soils, comprising gravelly silty sand, sandy clayey silt and silty clay. The thickness of the transported soils is somewhat variable and is encountered to depths of 0.20 – 1.20 m below ground level (bgl).

Very soft rock to medium hard rock shale and siltstone underlie the transported soils, and were encountered to depths in excess of 2.0 m bgl. Discontinuous pedogenic ferricrete and cemented lenses also occur within some parts of the site, directly overlying the weathered shale. These cemented layers are however inconsistent (discontinuous) and vary in thickness and degree of cementation.

Detailed descriptions of the soils underlying the site and encountered in test pits, may be found in the recorded soil profiles (see Appendix B).

### **5.3 Water table**

A perched water table was encountered at 2.0 m bgl in TP10. This is at the lowest part of the site, and no water was encountered in any of the other test pits. The investigation was conducted towards the end of a relatively dry winter period and it is therefore possible that the water table might rise slightly.

The water table relies mainly on recharge from direct infiltration of rainfall, as well as from upslope recharge of groundwater. Groundwater in this area occurs mainly within the deeper fractured rock ("secondary aquifer") of the Bokkeveld Group. This aquifer is expected to be located at considerable depth.

## **6. Geotechnical evaluation**

### **6.1 Engineering and material characteristics**

On the basis of the geotechnical investigation and the laboratory test results summarised in Table 6.1 and Table 6.2, the following points relating to site geotechnical conditions and constraints, may be made:-

- a) The transported soils found at surface are generally medium dense to very dense. These transported soils are moderately compressible and will form a competent founding horizon. Design precautions will be required to cater for expected minor heave movements.
- b) The transported soils derived from residual soils and residual weathered shale and siltstone exhibit low compressibility and low to moderate plasticity. Post-compaction strength is expected to be low. Poor workability and drainage characteristics make these soils unsuitable for use in construction. These soils have a low to moderate potential for heave, and will generally be suitable for use as a load-bearing founding horizon, provided bearing pressures are limited and cognizance is taken of potential heave movements.
- c) The underling weathered shale, siltstone and sandstone horizons exhibit low compressibility and will form competent founding horizons.
- d) The transported sandy soils are plastic and are expected to have a low post-compaction strength. They would possibly be suitable only for use as a general fill. Clay and silt content however varies across the site and this may hamper compaction efforts and require cement stabilization. The coarse cobbly gravelly transported soils has a low to moderate post compaction strength and should thus be suitable for use as a general fill and selected layer quality material (possibly G9). To achieve suitable compaction levels however, the coarser cobble and gravel fractions will need to be selected out or crushed. Material for upper pavement layer works would need to be imported from an outside source.
- e) No particular excavation problems are anticipated within the transported soils and residual/completely weathered shale and siltstone. Refusal of the digger loader was however met within areas of medium hard rock shale, encountered within some parts of the site.
- f) Soils samples tested geochemically are slightly acidic in terms of pH. The soils generally have a moderate to high conductivity. No particular problems are foreseen with regard to possible deleterious effects on buried services.
- g) No sidewall collapse occurred within test pits. Excavation deeper than 1.5m will require shoring or battering for safety reasons.
- h) A perched water table was encountered in TP10 at a depth of 2.0 m bgl. TP10 is the lowest point on the site. The water table could rise slightly during the rainy season, but is not expected to reach founding depth.



**Table 6.1 Summary of Soils Engineering Properties**

Test Pit	Depth (m)	Material Description	LL	PI	LS	MC	GM	pH	Potential for heave	Conductivity (mS/m)	CBR @95 %
TP 3	0.0-0.4	Clayey silty sandy gravel	24	9	4.0	4.4	1.81	5.70	Low	163	-
TP 6	0.2-0.7	Clayey silty gravelly sand	30	15	7.0	-	1.61	-	Medium	-	22
TP 6	0.5-1.0	Gravelly sandy silty clay	42	20	11.0	21.2	0.41	-	Medium to moderately high	-	-
TP 8	0.5-1.0	Gravelly sandy silty clay	37	18	9.0	17.2	0.62	6.60	Medium	35	-
TP 9	0.5-1.3	Gravelly silty clayey sand	33	18	9.0	-	0.99	-	Medium	-	15

Key: LL – liquid limit. PI – plasticity index. LS – linear shrinkage. MC – in-situ moisture content. GM – grading modulus. CBR – California bearing ratio.

**Table 6.2 Engineering Properties of Compacted Materials**

Material	Potential usage	Shear strength when compacted	Drainage characteristics	Workability as a construction material	Possible TRH 14 classification
Clayey sandy soils	General fill/Selected layer	Low	Good	Good	G7-G8
Sandy silty clay	General fill	Low	Very poor	Poor	Not suitable

## 6.2 Slope stability and erosion

In terms of topography the site is fairly flat lying sloping gradually and there is no risk of large scale slope failures unless large cuts are envisaged.

Slopes cut into transported soils will be unstable at gradients greater than 45° to the horizontal. Design precautions will thus be required for both temporary and permanent cut slopes.

As regards soil erosion, the transported sands immediately are susceptible to erosion under the influence of water during periods of heavy rain, especially once the vegetation covering the site is removed. Appropriate design precautions will thus be required.

## 6.3 Excavation classification with respect to services

Excavation within the transported and residual/ very soft rock shale, classifies as “soft to intermediate excavation” in terms of the SANS 1200 D Earthworks Specification. No “hard rock” excavation is expected within 4.0m of surface and in practice, these materials can be excavated and worked using conventional earthmoving equipment. Larger plant equipment such as a tracked excavator, possibly fitted with a rock bucket, may be required for pedogenic soils and deeper excavations (deeper than 3.0m from surface) within less weathered soft rock shale.



## 6.4 Impact of the geotechnical character of the site on subsidy housing developments

The following geotechnical characteristics of the site are expected to have an impact on subsidy housing development and subsidy variations:-

- c) Difficulty of servicing land due to slopes, with the average slope generally being flatter than 1:10 but exceeds 1:20.
- d) Potentially expansive clayey soils on site that might require strengthened foundations.

A schedule of generic subsidy variations applicable to the site is outlined in Table 6.3.

**Table 6.3 Factors to consider in subsidy variations**

Category of subsidy Variation	Verification Criteria	Factors Affecting Amount of Subsidy Variation
Difficulty of servicing of land due to slopes, Type 2 Site.	Average slope measured across the site in any direction from any of the boundaries of the erf exceeds 1:20 but is flatter than 1:10.	Terracing for houses / additional masonry units in foundation walls required.
Expansive soils Class H1	Site class designations classified in accordance with 2.5 of part 1 section 2 of the NHRBC Home Building Manuel	Masonry houses will require foundation design, building procedures and precautionary measures to be in accordance with Table 5, 6 and 7 of Part 1 Section 2 of the NHRBC Home Building Manuel.

## 7. Site classification

The Residential Site Class Designation (after Watermeyer & Tromp and the Joint Structural Division) is set out in Table 7.1. The areal extent of classified areas is shown in the site plan in Appendix A.

As a result of the compressible transported soils (S), overlying low to moderately compressible and potentially expansive clayey soils (H1) and deeper residual weathered shale and siltstone rock (R), a site classification of **S/H1/R** is assigned to the entire site.

**Table 7.1 Residential Site Class Designations**

Site Classification	Character of founding materials	Expected range of total soil movement (mm)	Assumed differential movement (% of total)	Maximum allowable bearing pressure (kPa)
S/H1/R	Moderately compressible transported soils overlying clayey and potentially expansive soils overlying rock	5-10	50	100 on transported soils 250 on rock

## 8. Foundation recommendations and solutions

Recommendations for foundation design applicable to the site geotechnical conditions and site classification (S/H1/R, are discussed below:-

- a) Found using conventional pad or strip footings.
  - Found within medium dense to dense transported soils at approximately 0.5 m bgl. Total movement, including settlement and heave, should be within acceptable levels (<10 mm) with a maximum allowable bearing pressure of 100 kPa.
  - Bearing pressure could be increased to 250 kPa if founded on rock. This will also limit the amount of settlement and potential heave expected for clayey soils above the rock layer.

b) Found using stiffened concrete raft foundations

- Compact from surface to at least 95 % Mod AASHTO maximum dry density, using a heavy vibratory roller, before founding.
- Bearing pressures should be limited to 70 kPa

The following should be noted with regards to the above mentioned founding options:-

- Surface beds can be founded conventionally on in-situ transported soils once this material has been compacted to at least 93% Mod. AASHTO maximum dry density. Reinforcement of the surface beds and isolating them from walls to accommodate possible movements will minimize the risk of cracking. Alternatively surface beds may be designed as suspended slabs, in which case in-situ soils can be left in place (as is) and used only as a back-shutter.
- Structures will require modified normal construction techniques to be applied to cater for some minor settlement (due to the presence of soft spots in the profile) and heave movement (totaling approximately 5-10mm). Suitable measures would include additional reinforcement in brickwork in plinth walls and above doors and windows, reinforcement of surface beds, articulation of brick panels using construction joints and effective water management as outlined in Section 9 (refer also to NHBRC Home Building Manual).

## 9. Drainage

A perched water table was only encountered in TP10 at a depth of 2.0 m bgl. Groundwater is not expected to influence the remainder of the site. Site drainage is however required to minimize ingress of water into soils below foundations and therefore minimize risks of any associated differential movements.

All drainage and storm water services should be designed in accordance with sound engineering practice.

## 10. Special precautionary measures

Apart from those outlined above, no special precautionary measures are expected to be required.

The required Phase 2 geotechnical site investigation would need to confirm site ground conditions, as described herein, and also confirm the design precautions necessary for structures and roads. Normally the Phase 2 investigation would involve the inspection of service trenches across the site as a minimum, with an Addendum report to be attached to the Phase 1 geotechnical report.

## 11. Conclusions

This Phase 1 geotechnical site investigation indicates that the site is broadly suitable for project linked subsidy housing development, provided that aspects of concern relating to the geotechnical character of the site are addressed. These aspects are highlighted in the report.



**JOHN YATES**




**JURGENS SCHOEMAN**

**APPENDIX A**

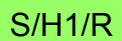
**SITE PLAN AND CLASSIFICATION**



## Key

 TP-  
Position

## Site Class Designation

 S/H1/R

Slightly  
compressible  
transported  
soils overlying  
potentially  
expansive  
clayey soils  
overlying rock



**CLIENT:** ASLA DEVCO (PTY) LTD

**PROJECT:** Napier Erven 513 & 1719

**TITLE:** SITE PLAN SHOWING TEST PIT POSITIONS

**DATE:** 11-2017

**SCALE:** NTS

**TRACED BY:** JS

**FIG.NO.** 1

**JOB NO.** 178-17



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Claremont

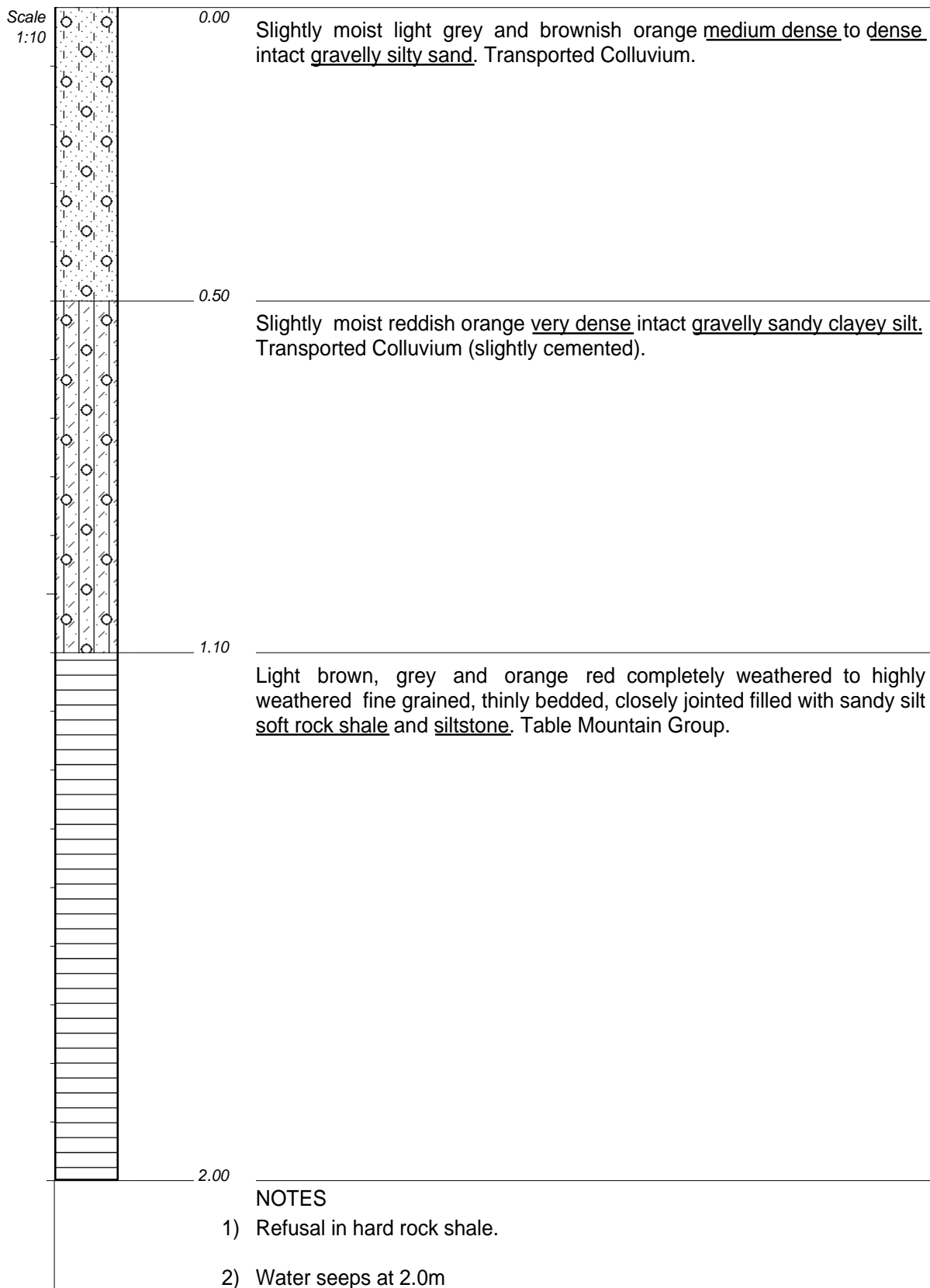
## **APPENDIX B - SOIL PROFILES**





TEST PIT SOIL PROFILE

JOB NUMBER: 178-17



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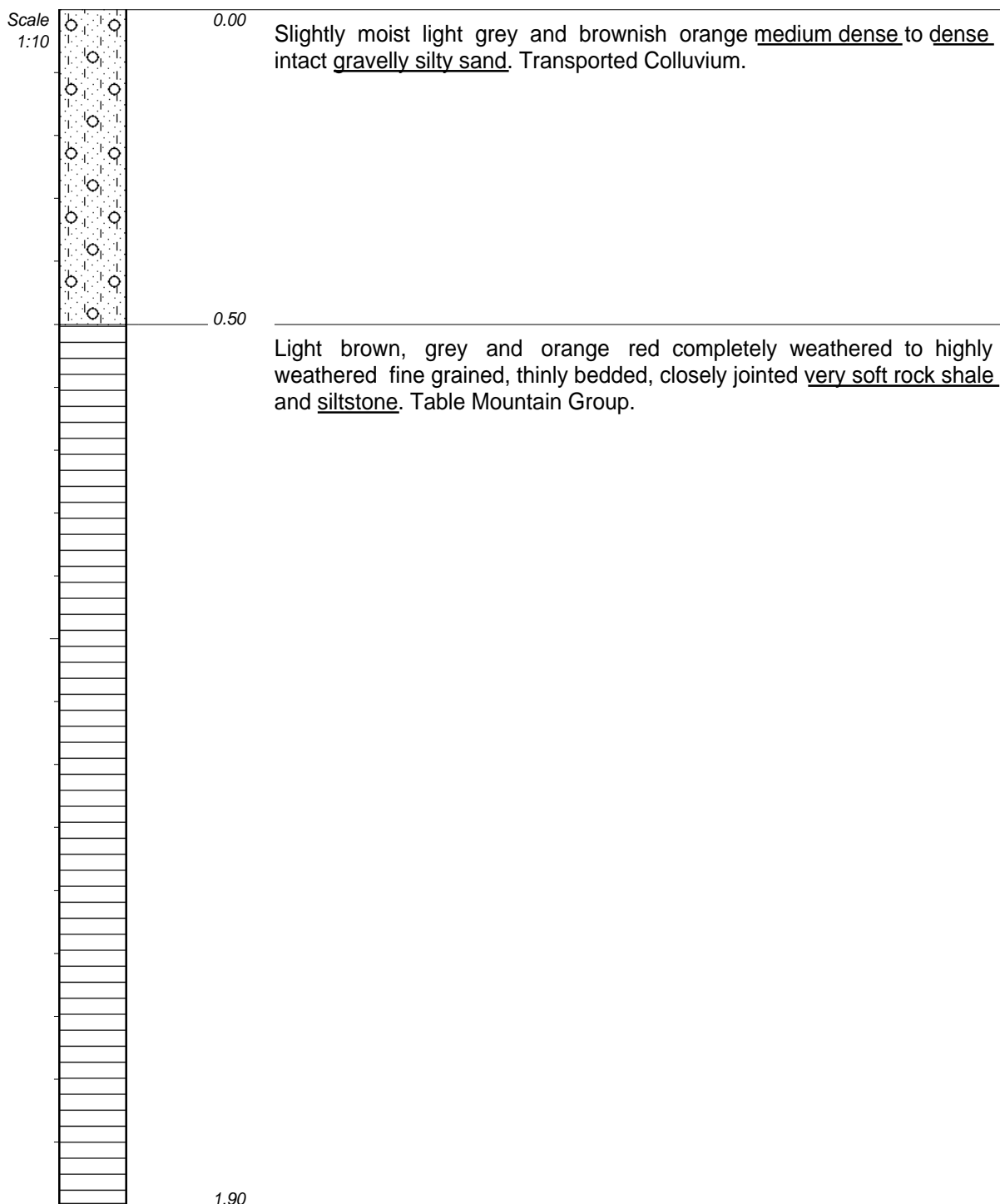
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Y COORD :

HOLE No: TP10



TEST PIT SOIL PROFILE

JOB NUMBER: 178-17



NOTES

- 1) Refusal in soft rock.

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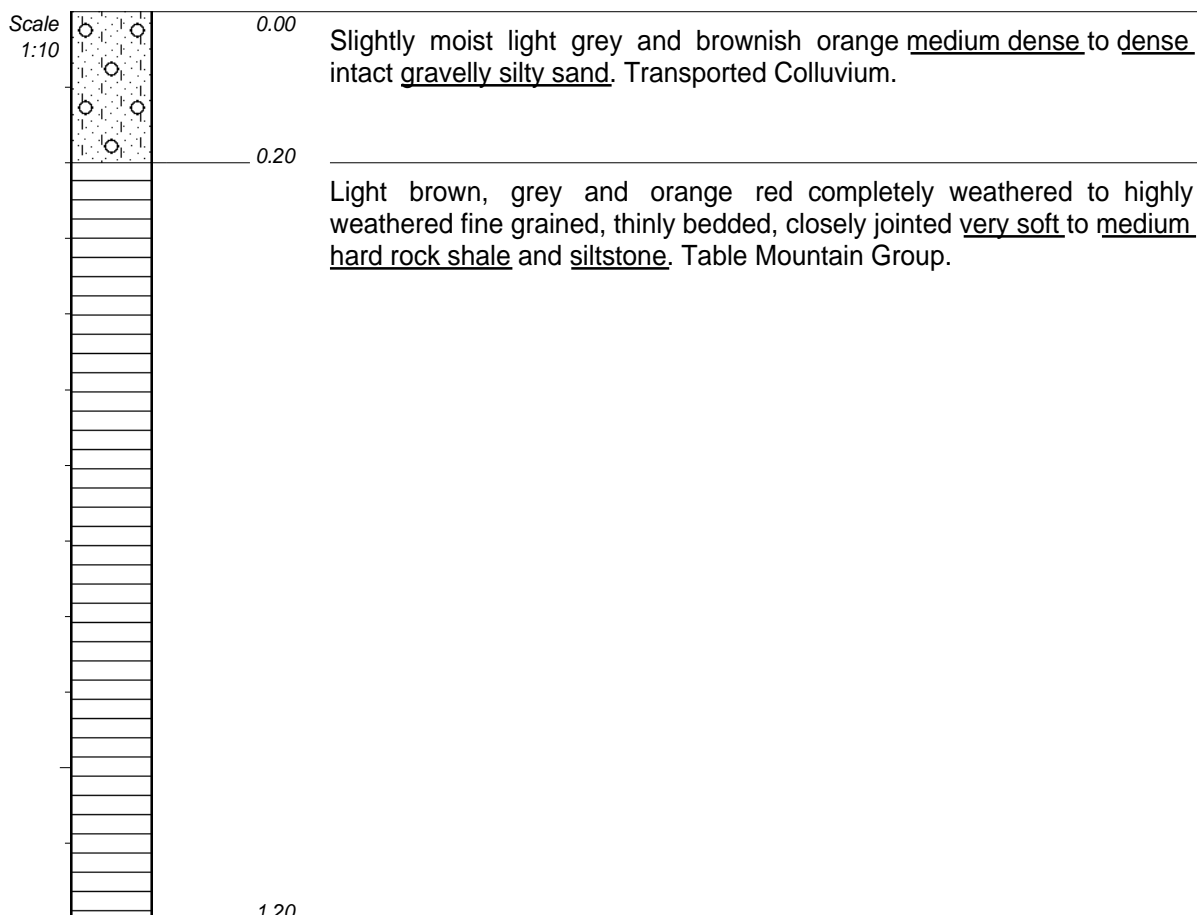
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Y COORD :

HOLE No: TP1



TEST PIT SOIL PROFILE

JOB NUMBER: 178-17



NOTES

- 1) Refusal in hard rock shale.

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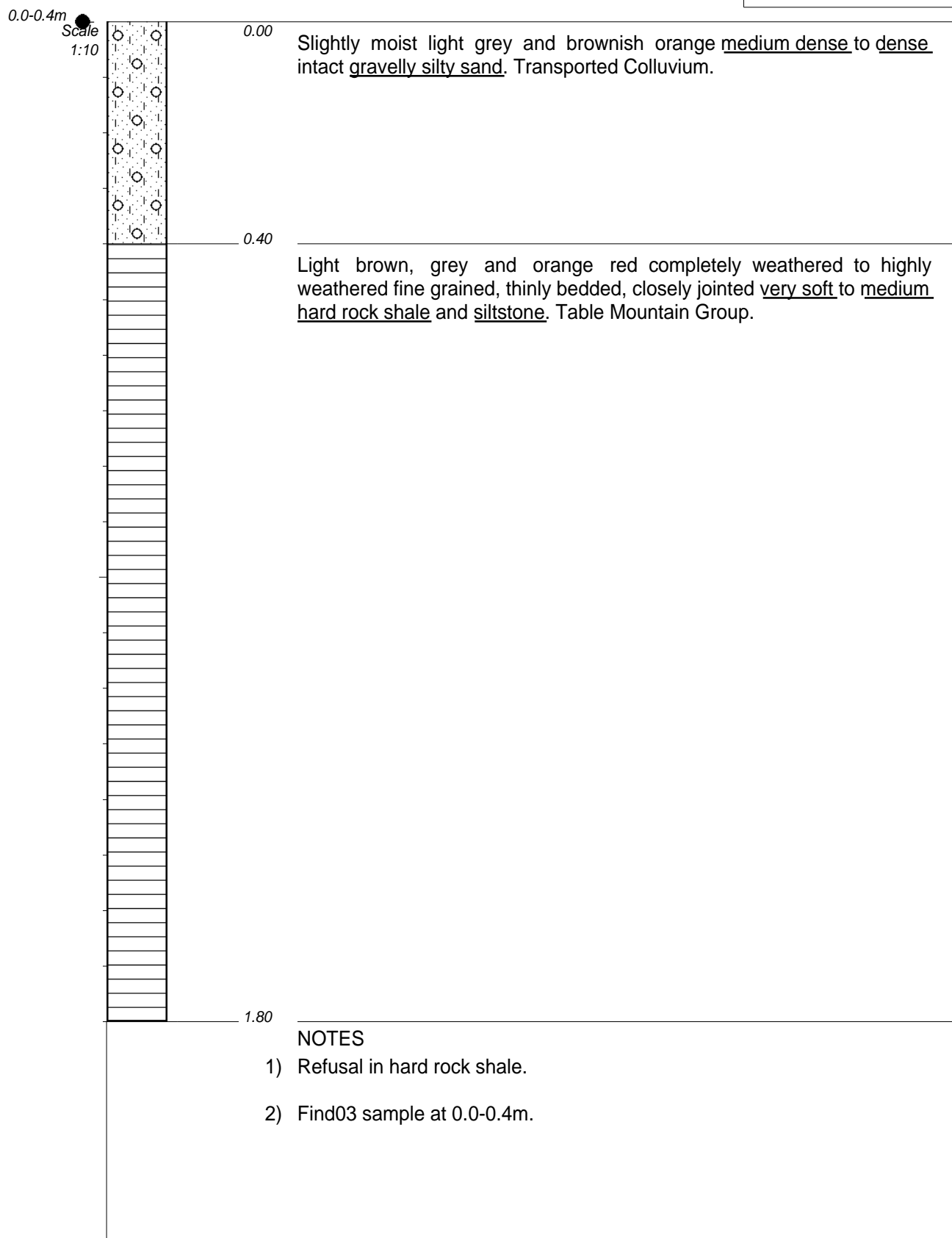
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HOLE No: TP2



TEST PIT SOIL PROFILE

JOB NUMBER: 178-17



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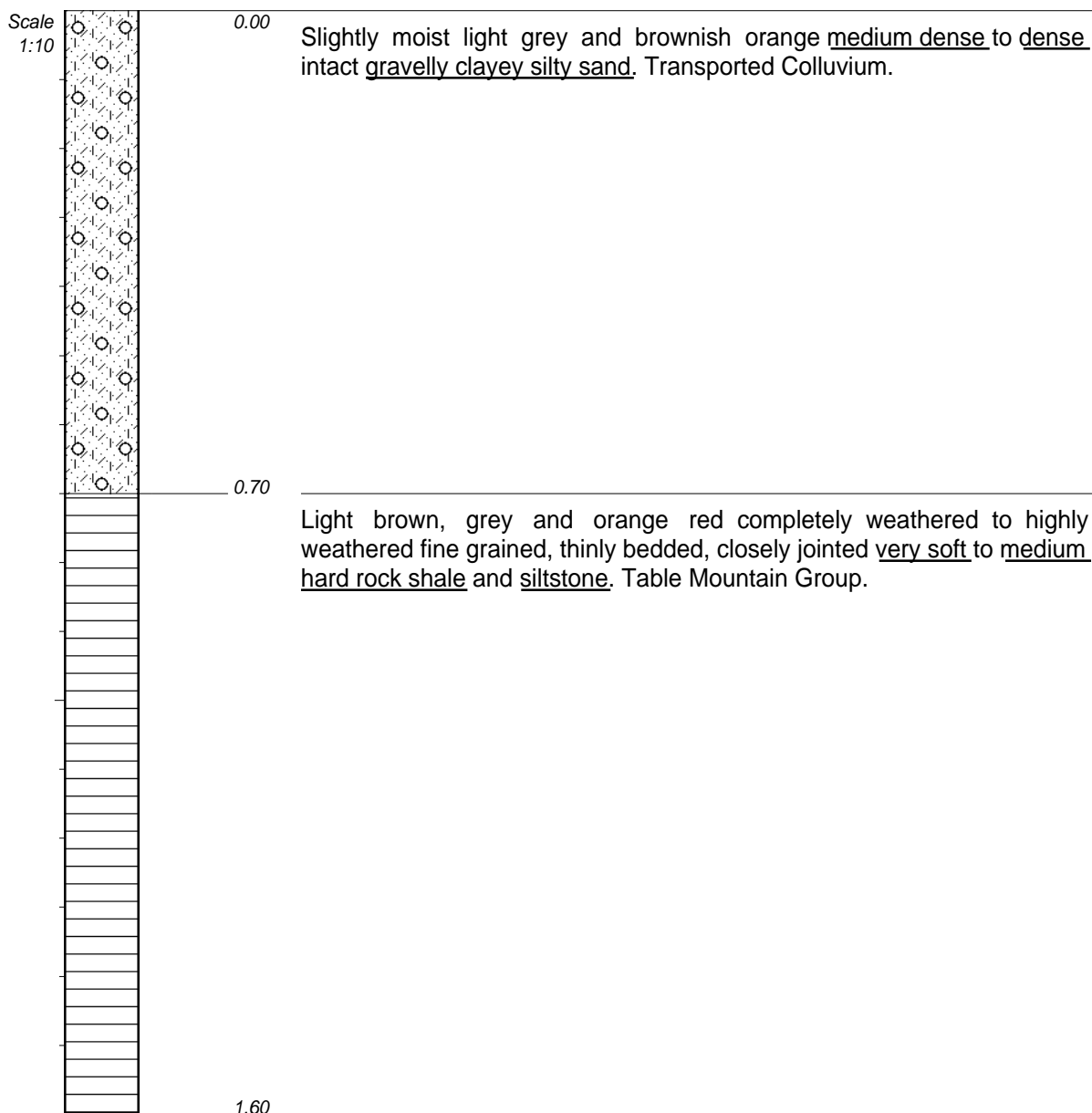
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HOLE No: TP3



TEST PIT SOIL PROFILE

JOB NUMBER: 178-17



NOTES

- 1) Refusal in hard rock shale.

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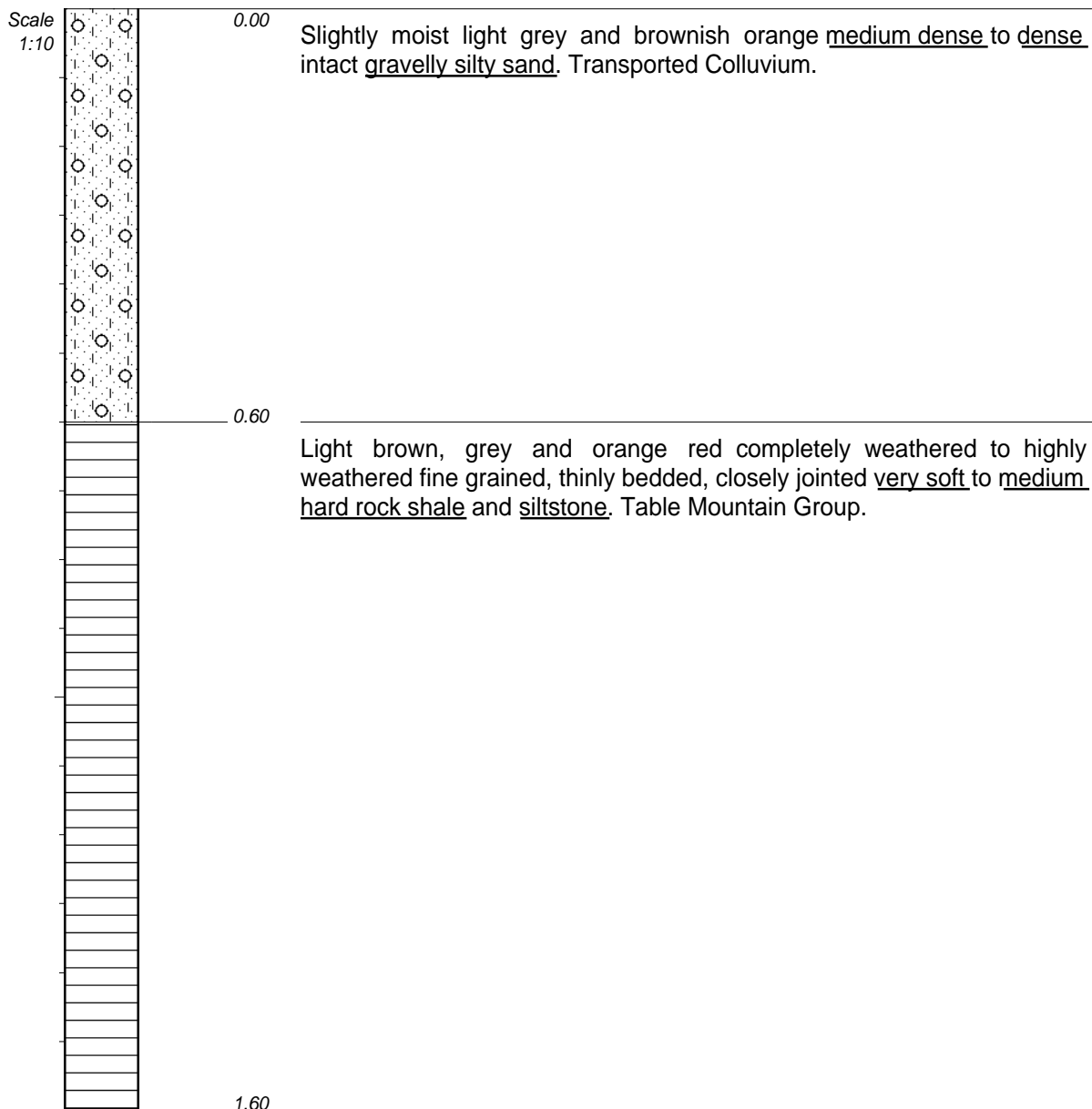
HOLE No: TP4





TEST PIT SOIL PROFILE

JOB NUMBER: 178-17



NOTES

- 1) Refusal in hard rock shale.

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TYPE SET BY : JURGENS SCHOEMAN  
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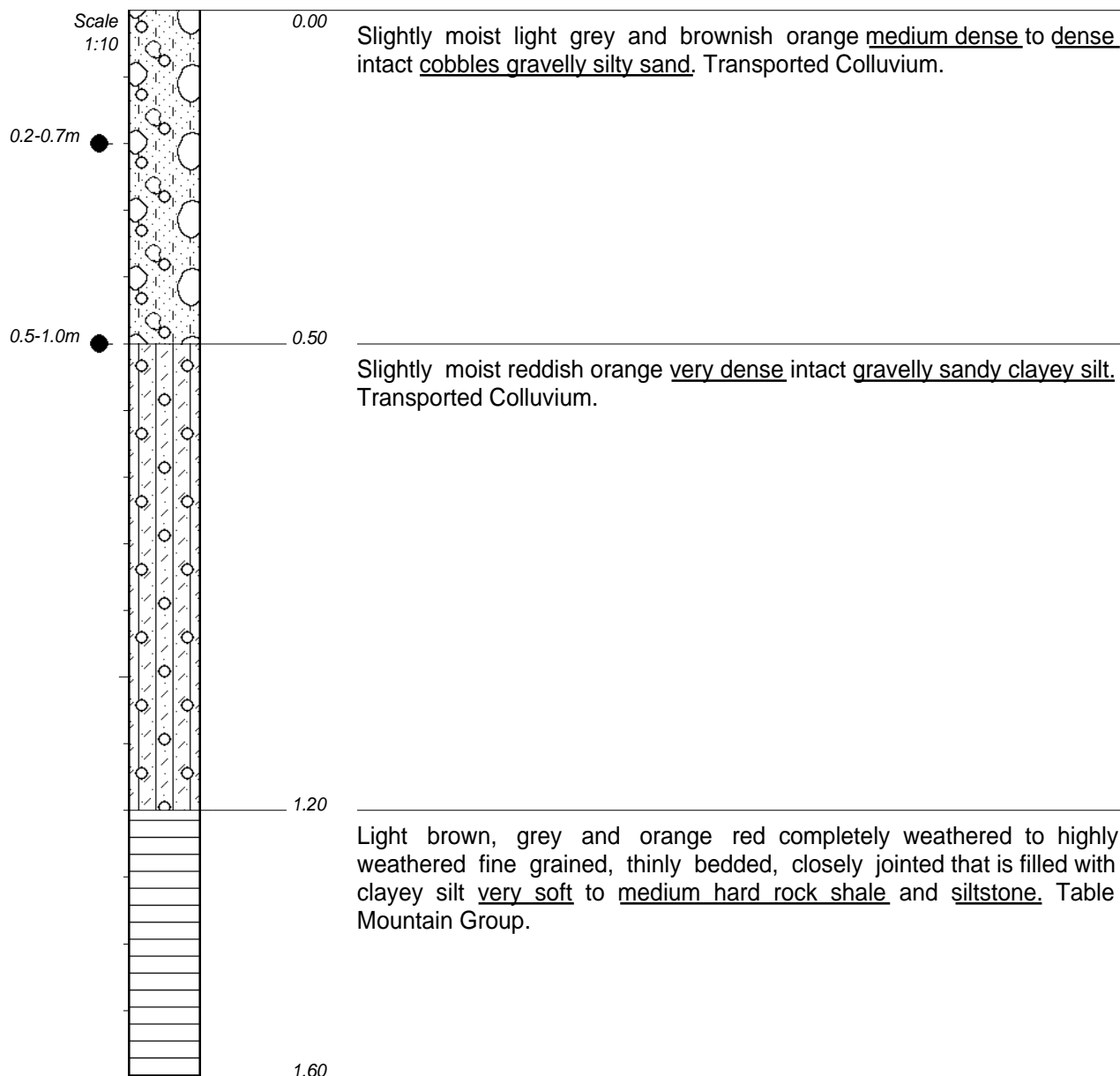
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X COORD :  
Y COORD :

HOLE No: TP5



TEST PIT SOIL PROFILE

JOB NUMBER: 178-17



NOTES

- 1) Refusal in hard rock shale.
- 2) Find06 sample 0.5-1.0m.
- 3) Bulk06 sample 0.2-0.7m.

CONTRACTOR :  
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Y COORD :

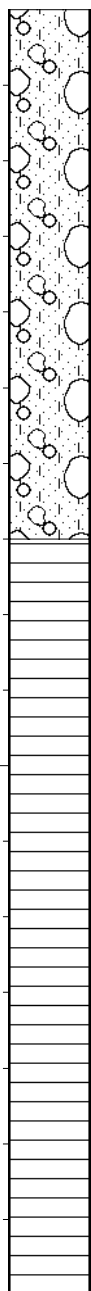
HOLE No: TP6



TEST PIT SOIL PROFILE

JOB NUMBER: 178-17

Scale  
1:10



0.00

Slightly moist light grey and brownish orange medium dense to dense intact cobbles gravelly silty sand. Transported Colluvium.

0.70

Light brown, grey and orange red completely weathered to highly weathered fine grained, thinly bedded, closely jointed that is filled with clayey silt very soft to medium hard rock shale and siltstone. Table Mountain Group.

1.70

NOTES

- 1) Refusal in hard rock shale.

CONTRACTOR :  
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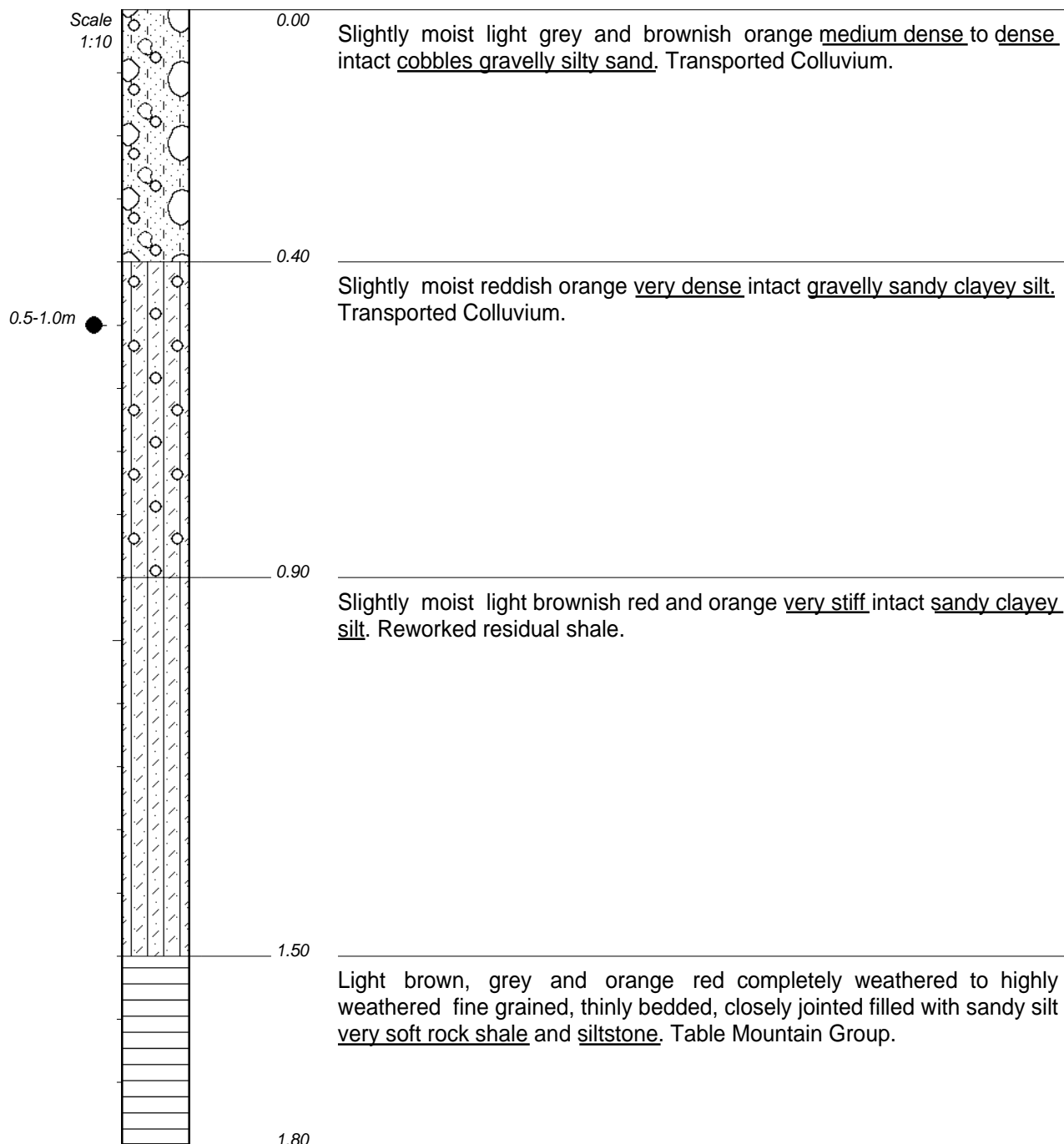
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X COORD :  
Y COORD :

HOLE No: TP7



TEST PIT SOIL PROFILE

JOB NUMBER: 178-17



NOTES

- 1) Refusal in hard rock shale.
- 2) Find08 sample 0.5-1.0m.

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TYPE SET BY : JURGENS SCHOEMAN  
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DATE : 28/11/2017 10:31  
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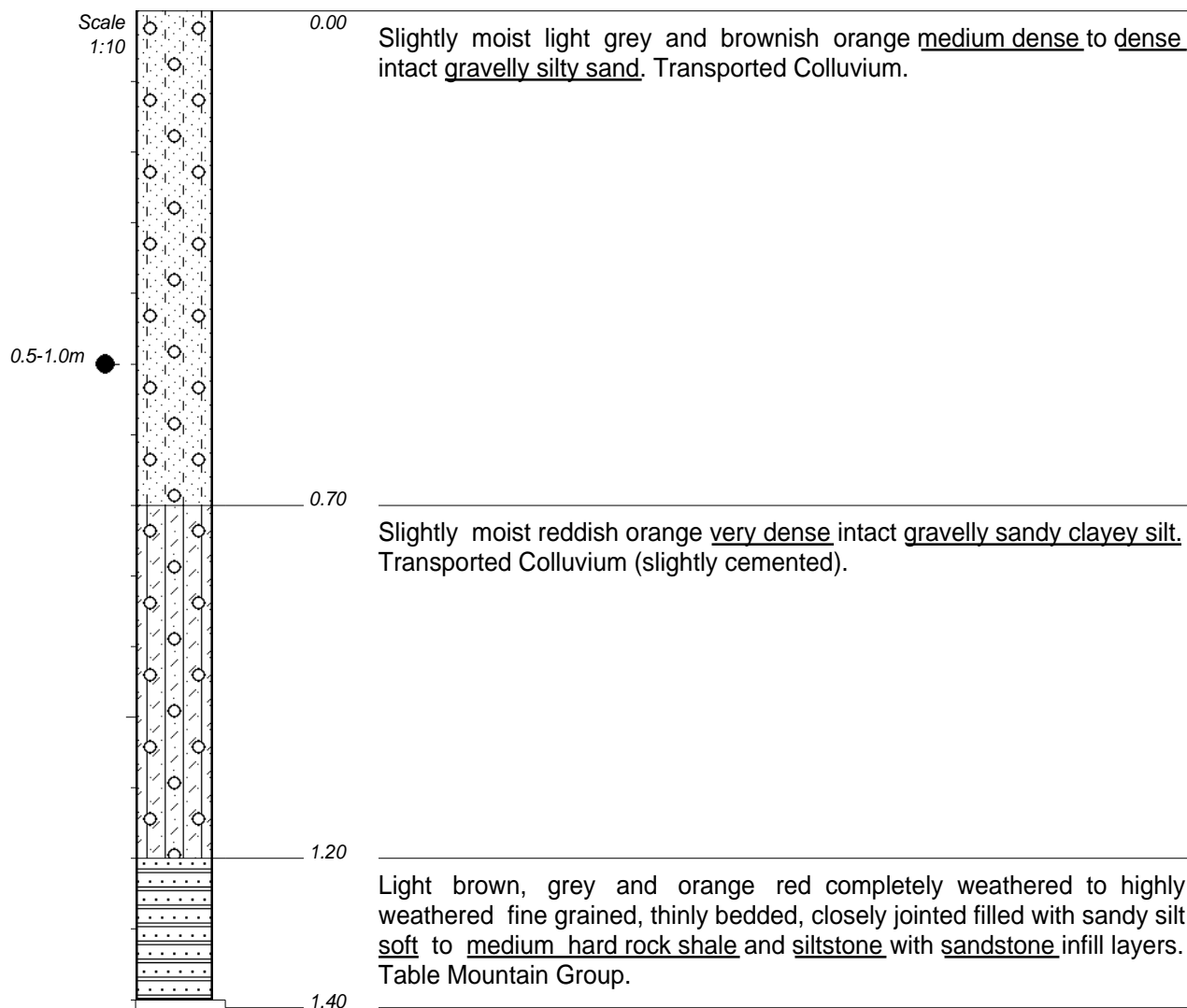
COLLAR LEVEL :  
X COORD :  
Y COORD :

HOLE No: TP8



TEST PIT SOIL PROFILE

JOB NUMBER: 178-17



NOTES

- 1) Refusal in hard rock shale.
- 2) Bulk09 sample 0.5-1.0m.

CONTRACTOR :  
MACHINE : JCB DIGGER LOADER  
DRILLED BY :  
PROFIED BY : JURGENS SCHOEMAN  
TYPE SET BY : JURGENS SCHOEMAN  
SETUP FILE : STANDARD.SET

LOCATION:  
DIAM :  
DATE :  
DATE : 30 OCTOBER 2017  
DATE : 28/11/2017 10:31  
TEXT : ..erPhase1Soilprofiles.txt

COLLAR LEVEL :  
X COORD :  
Y COORD :

HOLE No: TP9





TEST PIT SOIL PROFILE

JOB NUMBER: 178-17

	GRAVELLY	{SA03}
	SAND	{SA04}
	SANDY	{SA05}
	SILT	{SA06}
	SILTY	{SA07}
	CLAYEY	{SA09}
	SANDSTONE	{SA11}
	SHALE/siltstone	{SA12}
	DISTURBED SAMPLE	{SA38}
	COBBLES	{SA58}

Name ●

CONTRACTOR :

MACHINE :

DRILLED BY :

PROFILED BY :

TYPE SET BY : JURGENS SCHOEMAN

SETUP FILE : STANDARD.SET

LOCATION:

DIAM :

DATE :

DATE :

DATE : 28/11/2017 10:31

TEXT : ..erPhase1Soilprofiles.txt

COLLAR LEVEL :

X COORD :

Y COORD :

LEGEND  
SUMMARY OF SYMBOLS

## **APPENDIX C - LABORATORY TEST RESULTS**

**CLIENT:** Core Geotechnical  
Postnet Suite 177  
Private Bag X3  
Plumstead 7801

**PROJECT:** Napier Erven 513 & 1719

**DATE:** 09-11-2017

**ATT:** John Yates

**REF:** L171050

### ASTM D422 SIEVE ANALYSIS

**DESCRIPTION :** brown gvl silty sand

**SAMPLE NO. :** 29812

**POSITION :** TP 3 @ 0.0-0.4m

**CLIENT SAMPLE NO. :**

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	100
	37,50	97
	26,50	94
	19,00	90
	13,20	84
	9,50	75
	6,70	66
	4,75	61
	2,36	52
	2,00	51
	1,18	44
	0,600	39
	0,425	38
	0,300	37
	0,150	34
0,0750	30	

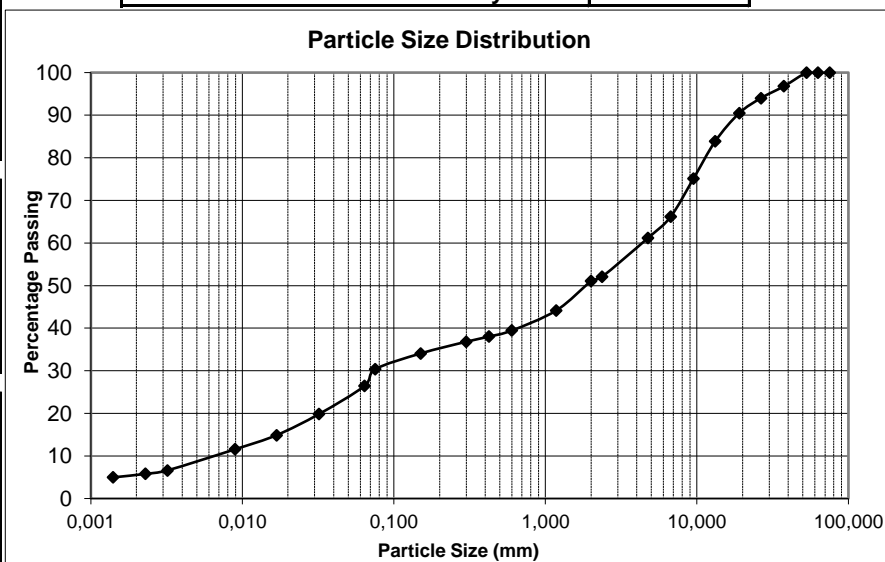
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0671	26
0,0349	20
0,0180	15
0,0095	12
0,0034	7
0,0024	6
0,0014	5

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

<b>% SCS Dispersion:</b>	
<b>Initial Moisture Content (%) :</b>	4,4
<b>pH:</b>	5,70
<b>Conductivity mS/m:</b>	163

Atterberg Limits :	
Liquid Limit	24
Plastic Index	9
Linear Shrinkage	4,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m <sup>3</sup> )	
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
<b>Gravel</b> : Percentage - 4.75 mm	39
<b>Sand</b> : Percentage - 4.75mm and + 0.075mm	31
<b>Silt</b> : Percentage - 0.075mm and + 0.002mm	24
<b>Clay</b> : Percentage - 0.002mm	6

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

For Geoscience:

While the tests are carried out according to recognized standards Geoscience shall not

be liable for erroneous testing or reporting thereof. This report may not be reproduced except in full without prior consent of Geoscience.

Remarks:

ConSR22

**CLIENT:** Core Geotechnical  
Postnet Suite 177  
Private Bag X3  
Plumstead 7801  
**ATT:** John Yates

**PROJECT:** Napier Erven 513 & 1719

**DATE:** 09-11-2017  
**REF:** L171050

### ASTM D422 SIEVE ANALYSIS

**DESCRIPTION :** dark brown gvl silty sand  
**POSITION :** TP 6 @ 0.2-0.7m

**SAMPLE NO. :** 29813  
**CLIENT SAMPLE NO. :**

Sieve Analysis	Percent Passing
75,00	
63,00	100
53,00	99
37,50	97
26,50	94
19,00	91
13,20	88
9,50	85
6,70	79
4,75	72
2,36	58
2,00	57
1,18	52
0,600	48
0,425	46
0,300	45
0,150	41
0,0750	36

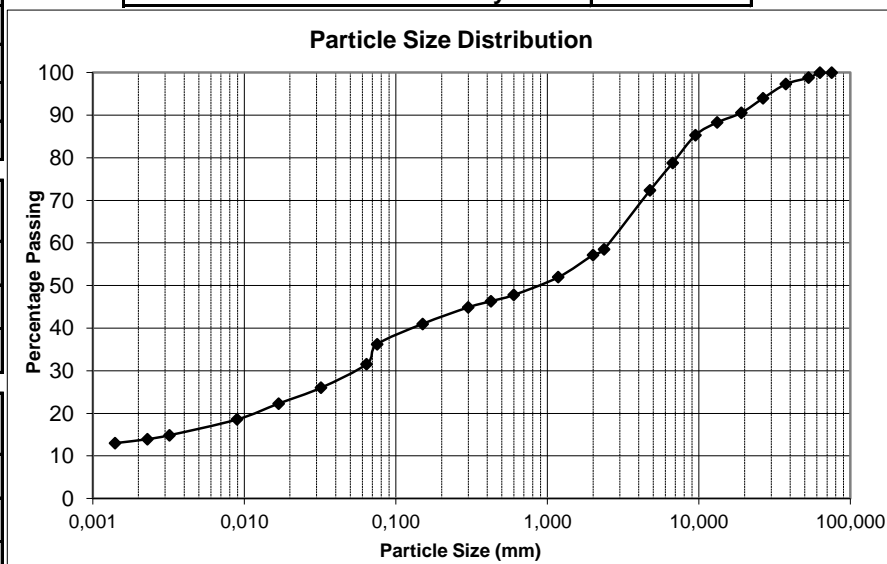
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0663	32
0,0343	26
0,0175	22
0,0092	19
0,0033	15
0,0023	14
0,0014	13

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

<b>% SCS Dispersion:</b>	
<b>Initial Moisture Content (%) :</b>	
<b>pH:</b>	
<b>Conductivity mS/m:</b>	

Atterberg Limits :	
Liquid Limit	30
Plastic Index	15
Linear Shrinkage	7,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m <sup>3</sup> )	2092
O.M.C. (%)	10,4
C.B.R. @ 100% Comp.	60
C.B.R. @ 98 % Comp.	40
C.B.R. @ 95 % Comp.	22
C.B.R. @ 93 % Comp.	16
C.B.R. @ 90 % Comp.	8
Swell ( max ) %	0,20



Tabulated Summary	Percentage
<b>Gravel</b> : Percentage - 4.75 mm	28
<b>Sand</b> : Percentage - 4.75mm and + 0.075mm	36
<b>Silt</b> : Percentage - 0.075mm and + 0.002mm	22
<b>Clay</b> : Percentage - 0.002mm	14

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

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Remarks:

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Postnet Suite 177  
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Plumstead 7801

**PROJECT:** Napier Erven 513 & 1719

**DATE:** 09-11-2017

**ATT:** John Yates

**REF:** L171050

### ASTM D422 SIEVE ANALYSIS

**DESCRIPTION :** red brown silty clay

**SAMPLE NO. :** 29814

**POSITION :** TP 6 @ 0.5-1.0m

**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	100
	6,70	98
	4,75	98
	2,36	95
	2,00	94
	1,18	91
	0,600	88
	0,425	86
	0,300	85
	0,150	82
0,0750	79	

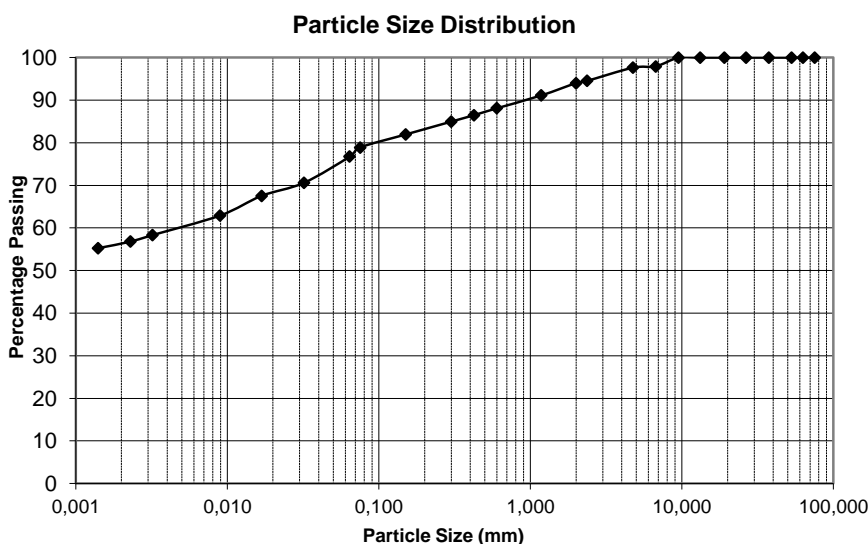
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0601	77
0,0316	71
0,0160	68
0,0083	63
0,0029	58
0,0021	57
0,0012	55

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

<b>% SCS Dispersion:</b>	
<b>Initial Moisture Content (%) :</b>	21,2
<b>pH:</b>	
<b>Conductivity mS/m:</b>	

Atterberg Limits :	
Liquid Limit	42
Plastic Index	20
Linear Shrinkage	11,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m <sup>3</sup> )	
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
<b>Gravel</b> : Percentage - 4.75 mm	2
<b>Sand</b> : Percentage - 4.75mm and + 0.075mm	19
<b>Silt</b> : Percentage - 0.075mm and + 0.002mm	21
<b>Clay</b> : Percentage - 0.002mm	58

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

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Remarks:

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**CLIENT:** Core Geotechnical  
Postnet Suite 177  
Private Bag X3  
Plumstead 7801

**PROJECT:** Napier Erven 513 & 1719

**DATE:** 09-11-2017

**ATT:** John Yates

**REF:** L171050

### ASTM D422 SIEVE ANALYSIS

**DESCRIPTION :** yellow brown gvl silty clay

**SAMPLE NO. :** 29815

**POSITION :** TP 8 @ 0.5-1.0m

**CLIENT SAMPLE NO. :**

Sieve Analysis		Percent Passing
SIEVE SIZE (mm)	75,00	
	63,00	
	53,00	
	37,50	100
	26,50	98
	19,00	98
	13,20	95
	9,50	93
	6,70	91
	4,75	90
	2,36	87
	2,00	86
	1,18	82
	0,600	80
	0,425	79
	0,300	78
0,150	75	
0,0750	73	

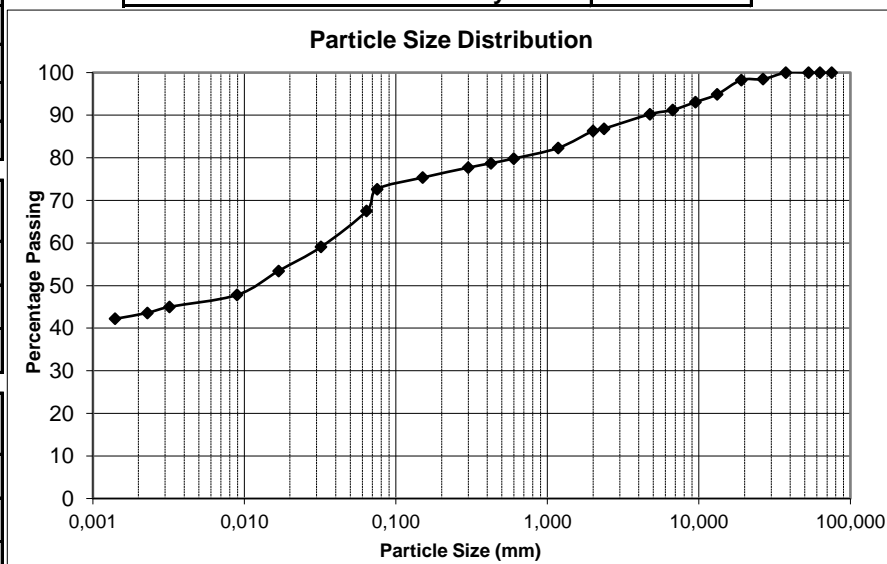
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0610	67
0,0320	59
0,0162	53
0,0086	48
0,0030	45
0,0022	44
0,0013	42

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

<b>% SCS Dispersion:</b>	
<b>Initial Moisture Content (%) :</b>	17,2
<b>pH:</b>	6,60
<b>Conductivity mS/m:</b>	35

Atterberg Limits :	
Liquid Limit	37
Plastic Index	18
Linear Shrinkage	9,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m <sup>3</sup> )	
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
<b>Gravel</b> : Percentage - 4.75 mm	10
<b>Sand</b> : Percentage - 4.75mm and + 0.075mm	18
<b>Silt</b> : Percentage - 0.075mm and + 0.002mm	29
<b>Clay</b> : Percentage - 0.002mm	44

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

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**ATT:** John Yates

**PROJECT:** Napier Erven 513 & 1719

**DATE:** 09-11-2017  
**REF:** L171050

### ASTM D422 SIEVE ANALYSIS

**DESCRIPTION :** yellow brown silty clay  
**POSITION :** TP 9 @ 0.5-1.3m

**SAMPLE NO. :** 29816  
**CLIENT SAMPLE NO. :**

Sieve Analysis	Percent Passing
75,00	
63,00	
53,00	
37,50	
26,50	
19,00	
13,20	
9,50	100
6,70	98
4,75	96
2,36	85
2,00	83
1,18	75
0,600	69
0,425	66
0,300	64
0,150	58
0,0750	52

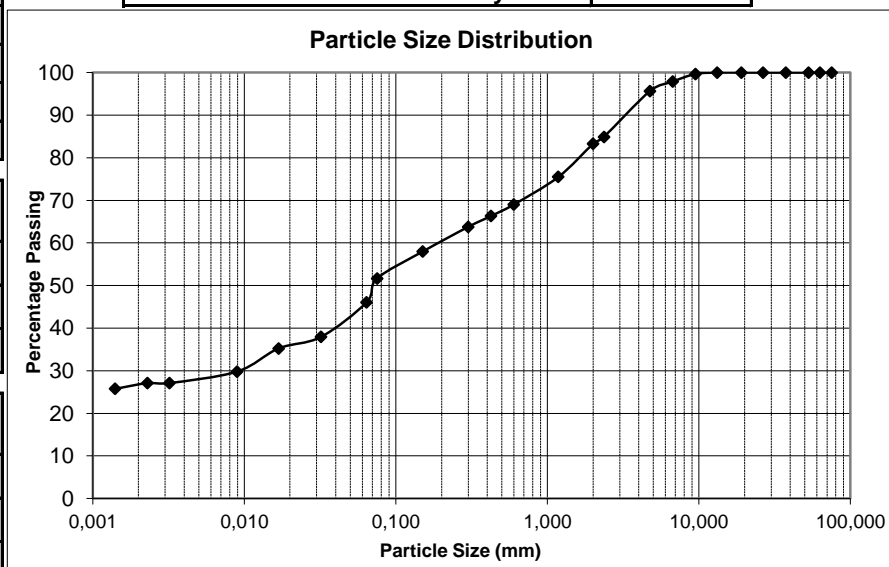
Hydrometer Analysis	
Diameter of particle (mm)	Percentage of soil suspension (%)
0,0663	46
0,0343	38
0,0173	35
0,0091	30
0,0032	27
0,0023	27
0,0014	26

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

<b>% SCS Dispersion:</b>	
<b>Initial Moisture Content (%) :</b>	
<b>pH:</b>	
<b>Conductivity mS/m:</b>	

Atterberg Limits :	
Liquid Limit	33
Plastic Index	18
Linear Shrinkage	9,0

MOD AASHTO ; C.B.R. :	
MOD AASHTO (Kg/m <sup>3</sup> )	1960
O.M.C. (%)	13,7
C.B.R. @ 100% Comp.	29
C.B.R. @ 98 % Comp.	23
C.B.R. @ 95 % Comp.	15
C.B.R. @ 93 % Comp.	10
C.B.R. @ 90 % Comp.	7
Swell ( max ) %	0,70



Tabulated Summary	Percentage
<b>Gravel</b> : Percentage - 4.75 mm	4
<b>Sand</b> : Percentage - 4.75mm and + 0.075mm	44
<b>Silt</b> : Percentage - 0.075mm and + 0.002mm	25
<b>Clay</b> : Percentage - 0.002mm	27

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

For Geoscience:

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Remarks:

ConSR22



**APPENDIX D**  
**INPUT TO THE VARIANCE CALCULATOR**

**NATIONAL HOUSING PROGRAMME:** The adjustment of the subsidy amount to cater for extraordinary development conditions.

**Questionnaire**



**Name of project:**

Napier

**Project number:**

**ERF NRS:**

Erven 513 & 1719

		Size of House	40
<b>1. GROUNDWATER</b>		<b>YOU MAY HAVE ONLY ONE "Y" IN THIS SECTION</b>	
CATEGORY 1 - Permanent or perched water table equal to or less than 1.0m below ground level.		N	
CATEGORY 2 - Permanent or perched water table more than 1.0 but less than 1.5m below ground level.		N	
<b>2. ERODIBILITY OF SOIL</b>		<b>YOU MAY HAVE ONLY ONE "Y" IN THIS SECTION</b>	
CATEGORY 1 - High risk- Erodibility index 1-8		N	
CATEGORY 2- Medium risk - Erodibility index 9-15		N	
<b>3. HARD EXCAVATION</b>		<b>YOU MAY COMPLETE ONLY CATEGORY</b>	
CATEGORY 1 - Hard rock excavation		10% - 100%	
CATEGORY 2 - Boulder excavation		10% - 100%	
<b>4. DOLOMITE (Site Class D)</b>		<b>*YOU MAY HAVE ONLY ONE "Y" IN SECTIONS 4-7*</b>	
CATEGORY 1 - Class P and anticipated inherent risk Class 1 and 2: Dolomite area Class D2		N	
CATEGORY 2 - Class P and anticipated inherent risk Class 3, 4 and 5: Dolomite area Class D3		N	
<b>5. EXPANSIVE CLAYS (Site Class H)</b>		<b>*YOU MAY HAVE ONLY ONE "Y" IN SECTIONS 4-7*</b>	
CATEGORY 1 - Medium - Class H1		Y	
CATEGORY 2 - High - Class H2		Low PE: 5 < CDS < 20 OR Medium PE: 20 < CDS < 40 N High PE: 40 < CDS < 60 OR Very High PE: CDS < 60 N	
<b>6. COLLAPSING SANDS (Site Class C)</b>		<b>*YOU MAY HAVE ONLY ONE "Y" IN SECTIONS 4-7*</b>	
CATEGORY 1 - Class C1		Modified normal foundations OR Compaction below footings N N	
CATEGORY 2 - Class C2		Compaction below footings OR Light raft OR Medium raft OR Heavy raft OR Special raft N N N N N	
<b>7. COMPRESSIBLE SOILS (Site Class S)</b>		<b>*YOU MAY HAVE ONLY ONE "Y" IN SECTIONS 4-7*</b>	
CATEGORY 1 - Class S1		Modified normal foundations OR Compaction below footings N N	
CATEGORY 2 - Class S2		Light raft OR Medium raft OR Heavy raft OR Special raft N N N N	
<b>8. MINING SUBSIDENCE</b>		<b>YOU MAY HAVE ONLY ONE "Y" IN THIS SECTION</b>	
CATEGORY 1 - Old under-mining depth 90m-240m below surface		Compaction below footings OR Medium raft N N	
CATEGORY 2 - Mining within a depth of between 90m-240m below surface		Additional earthworks OR Soil mattress N N	
<b>9. SEISMIC ACTIVITY</b>		<b>YOU MAY HAVE ONLY ONE "Y" IN THIS SECTION</b>	
CATEGORY 1 - Mining induced seismic activity >100 cm/s <sup>2</sup>		Stiffened strip footings OR Heavy raft N N	
CATEGORY 2 - Natural induced seismic activity >100 cm/s <sup>2</sup>		Stiffened strip footings OR Heavy raft N N	
<b>10. TOPOGRAPHY OF THE SITE</b>		<b>YOU MAY HAVE ONLY ONE "Y" IN THIS SECTION</b>	
CATEGORY 1 - Average ground slope flatter than 1:100		N	
CATEGORY 2 - Average ground slope of between 1:11 and 1:20		Y	
CATEGORY 3 - Average ground slope of between 1:7.5 and 1:10		N	
CATEGORY 4 - Average ground slope of between 1:5 and 1:7.5		N	
CATEGORY 5 - Average ground slope of more than 1:5		N	
<b>11. SOUTHERN CAPE COASTAL CONDENSATION AREAS</b>			
Housing in the designated area is subject to severe condensation conditions.		Y	
<b>12. LOCATION ADJUSTMENT</b>			
Major Centre		Worcester	
Distance from identified major centre (measured in ONE direction)		150.0 km	
% allowance on material cost		1%	
<b>13. PHYSICAL DISABILITIES AND SPECIAL HOUSING NEEDS</b>			
CATEGORY A- Needs walking aids			
CATEGORY B - Partial usage of wheel chair.			
CATEGORY C - Full-time usage of wheel chair.			
CATEGORY D- Partially/profoundly deaf			
CATEGORY E- Partially/totally blind.			
CATEGORY F - Partially/ total movement loss/paralysis in the upper body limbs.			

**Number of houses:**