

**NORTHAM PLATINUM LTD**

**NORTHAM ZONDEREINDE, RAISEBORE SURFACE  
INFRASTRUCTURE  
GEOTECHNICAL INVESTIGATION  
FACTUAL REPORT**

Report No.: JW105/19/H806-00 – Rev 0

May 2019



**Jones & Wagener**

Engineering & Environmental Consultants  
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## **NORTHAM PLATINUM LTD**

### **NORTHAM ZONDEREINDE, RAISEBORE SURFACE INFRASTRUCTURE GEOTECHNICAL INVESTIGATION FACTUAL REPORT**

**REPORT NO: JW105/19/H806-00 – Rev 0**

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### NORTHAM ZONDEREINDE, RAISEBORE SURFACE INFRASTRUCTURE GEOTECHNICAL INVESTIGATION FACTUAL REPORT

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## 1. INTRODUCTION

This report details the results of a geotechnical site investigation conducted by Jones and Wagener (J&W) for the proposed raisebore surface infrastructure to be constructed for a new vent shaft at the Northam Zondereinde Platinum Mine.

J&W was appointed to conduct the work by the client, Mr Charl van Jaarsveld of Northam Platinum Ltd.

The investigation was aimed at providing site information in terms of:-

- Description of the geological and geotechnical conditions across the site.
- Recommendations for the use of in-situ material during construction.
- Excavatability of materials on site.
- Presence of groundwater.

## 2. SITE DESCRIPTION

The site is located within the Northam Platinum Mine property to the south of the main access road, at co-ordinates 24°50'54.22"S and 27°18'42.48"E.

The site is currently undeveloped and has been cleared of all vegetation. Furthermore, it appears that the area under investigation has been levelled. This process has removed some of the blanketing material. At the time of the investigation a borehole was in the process of being drilled, to the east of the area investigated.

A locality plan is given in **Figure 1** and the general site layout is given in **Figure 2**.

## 3. METHOD OF INVESTIGATION

The investigation was conducted on the 19<sup>th</sup> of March 2019 with the excavation of seven test pits, TP1 to TP7, with a tracked excavator (Hitachi Zaxis). The positions of the test pits were determined by the chief geologist of the mine, Mpumelelo Thabethe, the on the day of the investigation.

In addition to the test pits, a 50m deep rotary cored borehole was drilled prior to the investigation. The core was logged the day after the test pits were completed.

The test pits and borehole core were logged by an engineering geologist according to the Guidelines for Soil and Rock Logging in South Africa (Brink and Bruin, 2002)

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Figure 1: LOCALITY PLAN



Figure 2: SITE LAYOUT

Representative soil samples were submitted to a commercial laboratory for the determination of indicator properties, CBR, modified density and omc values. A schematic layout showing the positions of the test pits and borehole are presented on drawing number H806-00-01 and is provided in **Appendix E**.

#### 4. REGIONAL GEOLOGY

According to the published 1:250 000 geological map, sheet 2426 THABAZIMBI, the site is underlain by gabbro, noritic at base and locally anorthositic, belonging to the Bushveld Igneous Complex.

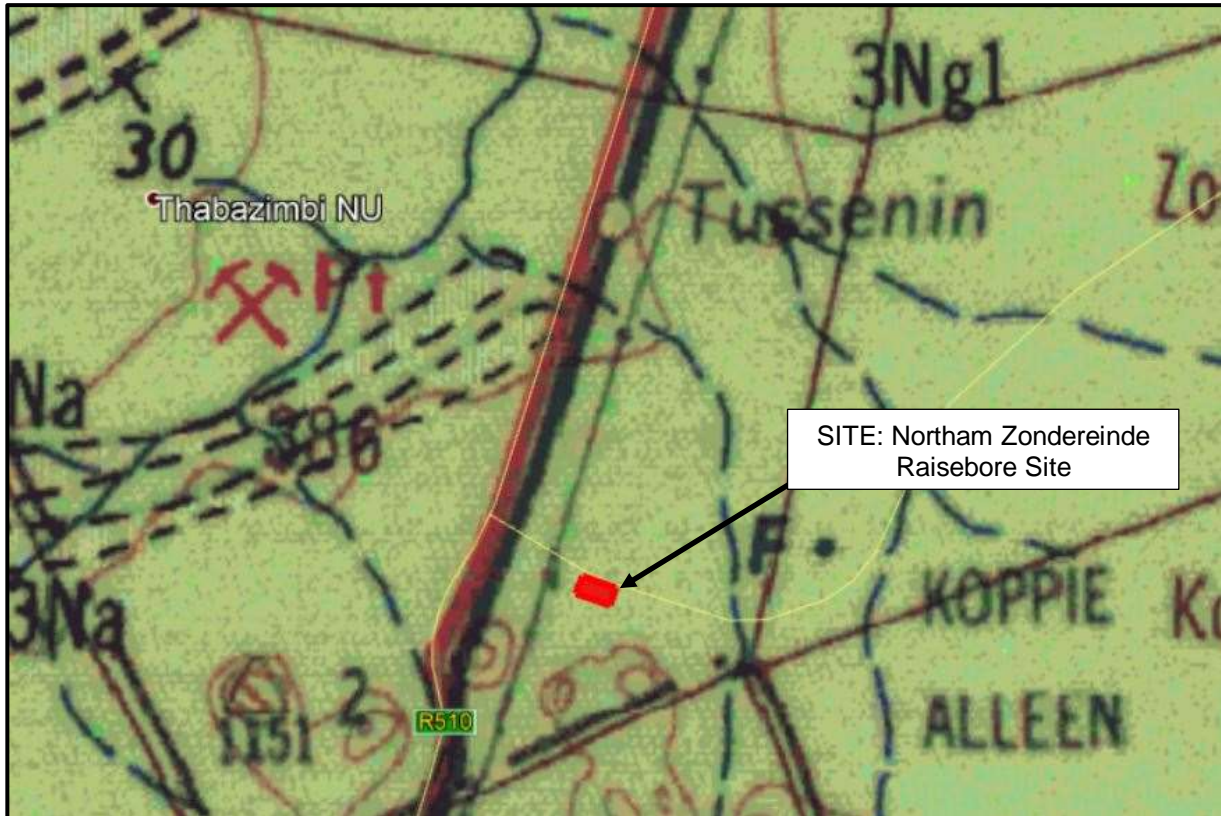


Figure 3: REGIONAL GEOLOGY

#### 5. RESULTS OF THE INVESTIGATION

##### 5.1 Test Pit and Borehole Profiles

A summary of the profile, as encountered in the test pits and borehole is provided in **Table 1** and the detailed test pit profiles are provided in **Appendix A** and the detailed borehole profile provided in **Appendix B**. Photographs of the borehole core and the test pits are included in **Appendix C**.

The profile, as encountered below the current ground level, comprises an upper layer of firm becoming stiff, shattered and slickensided, silty clay residual norite that contains occasional hard rock norite corestones up to 1.2m in diameter. The residual norite extends to a depth of between 1.6m and 2.2m.



**Table 1: Materials & Layer Thicknesses Encountered in Test Pits and Boreholes**

TP No.	Residual Norite Silty Clay	Very soft rock norite	Soft rock norite	Very hard Rock norite	Very hard rock Anorthosite	Excavation depth	Groundwater
TP1	0.0 – 1.8m	-	1.8 – 2.0m	-	-	Refusal at 2.0m on medium hard rock norite	None encountered
TP2	0.0 – 1.9m	-	1.9 – 2.0m	-	-	Refusal at 2.0m on medium hard rock norite	
TP3	0.0 – 2.0m	-	2.0 – 2.1	-	-	Refusal at 2.1m on medium hard rock norite	
TP4	0.0 – 2.2m	-	2.2 – 2.5m	-	-	Refusal at 2.5m on medium hard rock norite	
TP5	0.0 – 1.6m (with occasional norite corestones)	-	1.6 – 1.8m	-	-	Refusal at 1.8m on medium hard rock norite	
TP6	0.0 – 1.7m (with occasional norite corestones)	-	1.7 – 1.8m	-	-	Refusal at 1.8m on medium hard rock norite	
TP7	0.0 – 1.8m (with scattered norite corestones)	1.8 – 2.5m	2.5 – 2.7m	-	-	Refusal at 2.7m on medium hard rock norite	
BH1	0.0 – 1.85m	-	1.85 – 4.37m Soft to medium hard rock	4.37 – 23.96m 24.56 – 51.82m	23.96 – 24.56m	Borehole terminated at 51.82m in very hard rock norite	Not recorded during drilling.



Very soft to soft rock norite is present across the site from a depth of between 1.6m and 2.2m.

Refusal of the tracked excavator occurred in all of the test pits at a depth of between 1.8m and 2.7m on medium hard rock norite. The sidewalls appeared stable in all the test pits and in-situ profiling was conducted.

The profile as encountered in the borehole indicates that soft to medium hard rock norite extends to a depth of 4.37m. This is underlain by very hard rock norite that extends to a depth of at least 51.82m. A layer of very hard rock anorthosite is present from a depth of 23.96m to 24.56m.

Groundwater seepage was not encountered in any of the test pits excavated during the investigation. The standing groundwater level in the borehole could not be determined at the time of the investigation.

The borehole was terminated at a depth of 51.82m in very hard rock norite.

## 5.2 Laboratory Test Results

The laboratory test results are summarised in **Table 2** with the detailed results provided in **Appendix D**.

### Residual Norite

According to the Unified Soil Classification (USC) the residual norite is classified CH, indicating that the material is a clay with high plasticity.

The tested material has a Plasticity Index (PI) ranging between 45 to 49 and has a very high potential expansiveness rating.

The silty clay, residual norite, is not classifiable as per the COLTO specifications and the material is considered as worse than G9 quality material.

The residual norite has a PRA classification of A-7-5 which indicates that the material is a highly compressible silty clay, with a fair to poor subgrade rating.

The specific gravity of the silty clay residual norite ranges between 2.727 and 2.762.

### Crushed soft rock norite

According to the USC, the crushed soft rock norite is classified SC-SM, indicating that the crushed rock material is a clayey sand or silty sand.

The tested material has a Plasticity Index of 8 and a low potential expansiveness rating.

The crushed soft rock norite is classified as G6 quality material according to COLTO specifications.

The crushed soft rock norite has a PRA classification of A-2-4 which indicates that the material is a sand and gravel with low plasticity silty fines and has an excellent to good subgrade rating.

The specific gravity of the crushed soft rock norite is 2.814.

The results of the Uniaxial Compressive Strength (UCS) test are summarised in **Table 3** and the detailed results are provided in **Appendix D**.

It must be noted that the testing was carried out on intact sections of rock taken from the core box. The results, therefore, reflect the strength of the more competent and harder sections of the rock material and do not reflect the strength of the rock mass. The rock mass strength is influenced by the rock mass properties such as the presence of discontinuities and weaker layers.





**Table 2: Summary of laboratory test results**

Hole No.	Depth (m)	Field Description	Clay %	Silt %	Sand %	Gravel %	% Passing 0.425	LL	PI	LS	GM	USC	PRA	Expansiveness Rating	MDD (kg/m <sup>3</sup> )	omc (%)	CBR Values at % MOD AASHTO			COLTO	SG
																	93%	95%	98%		
TP1	1.5	Silty Clay Residual Norite	71	10	17	2	94	88	49	33.5	0.24	CH	A-7-5	Very high	-	-	-	-	-	-	2.727
TP3	2.2-2.4	Crushed soft rock norite	6	9	52	33	43	25	8	4.0	1.72	SC-SM	A-2-4	Low	2119	8.6	37	40	42	G6	2.814
TP5	1.0-1.2	Silty Clay Residual norite	71	11	16	2	95	84	45	33.5	0.22	CH	A-7-5	Very high	1455	27.3	No readings			NC	2.762

**NOTES:**

PI: Plasticity Index  
 LL: % Liquid Limit  
 LS: % Linear Shrinkage  
 NC: Not Classifiable

GM: Grading Modulus  
 COLTO: Committee of Land Transport Officials  
 MDD: Maximum Dry Density  
 SG: Specific Gravity

omc: Optimum Moisture Content  
 USC: Unified Soil Classification  
 PRA: Public Roads Administration

**Table 3: UCS test results**

Sample No.	Sample depth (m)	Rock hardness recorded during logging	UCS (MPa)	Rock hardness	Mode of failure
BH1/1	2.02	Soft to medium hard rock	24.9	Medium hard rock	Sliding shear failure
BH1/2	4.37	Very hard rock	226.3	Extremely hard rock	Splitting
BH1/3	11.52	Very hard rock	223.0	Extremely hard rock	Complete cone development
BH1/4	24.1	Very hard rock	170.9	Very hard rock	
BH1/5	23.96	Very hard rock	237.6	Extremely hard rock	
BH1/6	34.74	Very hard rock	190.2	Very hard rock	
BH1/7	40.88	Very hard rock	194.9	Very hard rock	
BH1/8	44.15	Very hard rock	194.5	Very hard rock	
BH1/9	49.93	Very hard rock	189.6	Very hard rock	
BH1/10	51.61	Very hard rock	192.0	Very hard rock	



## **6. GEOTECHNICAL EVALUATION**

### **6.1 Founding Conditions**

The general profile across the site comprises firm becoming stiff, shattered and slickensided, silty clay residual norite that contains occasional hard rock norite corestones up to 1.2m in diameter. The residual norite extends to a depth of between 1.6m and 2.2m.

The laboratory test results indicate that the silty clay, residual norite is highly expansive. Assuming a scenario with a 2.2m thick layer of highly expansive residual norite, the estimated heave is calculated as approximately **120mm**, using the method suggested by Van der Merwe (1964).

The residual norite is therefore not considered a suitable founding medium due to the high clay content and the highly expansive nature of the material. Furthermore, consolidation settlement is also expected in the silty clay, residual norite.

Very soft to soft rock norite is present across the site from a depth of between 1.6m and 2.2m. Medium hard rock norite was generally encountered from a depth of between 1.8m and 2.7m. The following allowable bearing pressures can be assigned to the different rock hardnesses:

- Very soft rock norite – 500kPa
- Soft rock norite – 1MPa
- Medium hard rock norite – 5MPa

Refusal of the tracked excavator occurred in all of the test pits at a depth of between 1.8m and 2.7m on medium hard rock norite. The norite rock is considered a competent founding medium.

### **6.2 Groundwater**

Groundwater seepage was not encountered in any of the test pits excavated during the investigation. The standing groundwater level in the borehole was not recorded on completion of drilling.

The sidewalls appeared stable in all of the test pits and in-situ profiling was conducted.

### **6.3 Excavation Conditions**

Based on the SABS 1200 excavation classifications, 'soft' excavation conditions can generally be expected across the site in the residual norite and very soft to soft rock norite to a depth of between 1.8m and 2.7m.

'Hard' excavation conditions can be expected beyond these depths within the medium hard rock to very hard rock norite.

'Soft' excavation is that in which material can be easily removed by conventional excavation plant. 'Hard' excavation is that in which material is removed with heavy ripping, use of power tools and/or blasting being necessary.

### **6.4 Stability of Sidewalls for Deep Excavations**

No deep excavations are expected for this project. However, for any excavation up to a depth of 3.0m, a batter of 1:1 (V:H) is recommended in soil for temporary slopes. For permanent slopes in soil, a batter of 1:1.5 (V:H) is recommended. Should seepage be encountered, slopes are to be flattened to 1:2 (V:H) or flatter.

### **6.5 Material Usage**

Structural fill material should conform to at least G7 quality as per the COLTO specifications.



The laboratory test results indicate that the silty clay, residual norite, is not classifiable as per the COLTO specifications and is considered as worse than G9 quality material. Therefore, the residual norite is not suitable for use as either structural or general fill due to the high clay content.

The crushed soft rock norite classifies as G6 quality material according to COLTO specifications and the material is suitable for use as both general and structural fill.

## **7. GENERAL/CONCLUDING REMARKS**

It is recommended that all foundation excavations are inspected by a suitably qualified and experienced geotechnical engineer/engineering geologist to ensure that the in-situ geotechnical conditions are not at variance to those described herein.

## **8. REFERENCES**

Brink A.B.A and Bruin R.M.H (2001) Guidelines for Soil and Rock Logging in South Africa, 2nd Impression 2001, eds. A.B.A. Brink and R.M.H. Bruin, Proceedings, Geoterminology Workshop organised by AEG, SAICE and SAIEG, 1990.

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COLTO (1998 Edition) Standard Specifications for Road and Bridge works for State Road Authorities.

Jennings JE & Knight K (1975) A guide to construction on or with materials exhibiting additional settlement due to 'collapse' of grain structure – 6th Reg. Conf. for Africa on Soil Mech. and Foun. Eng. Durban, South Africa, vol. 1 pp 99-105.

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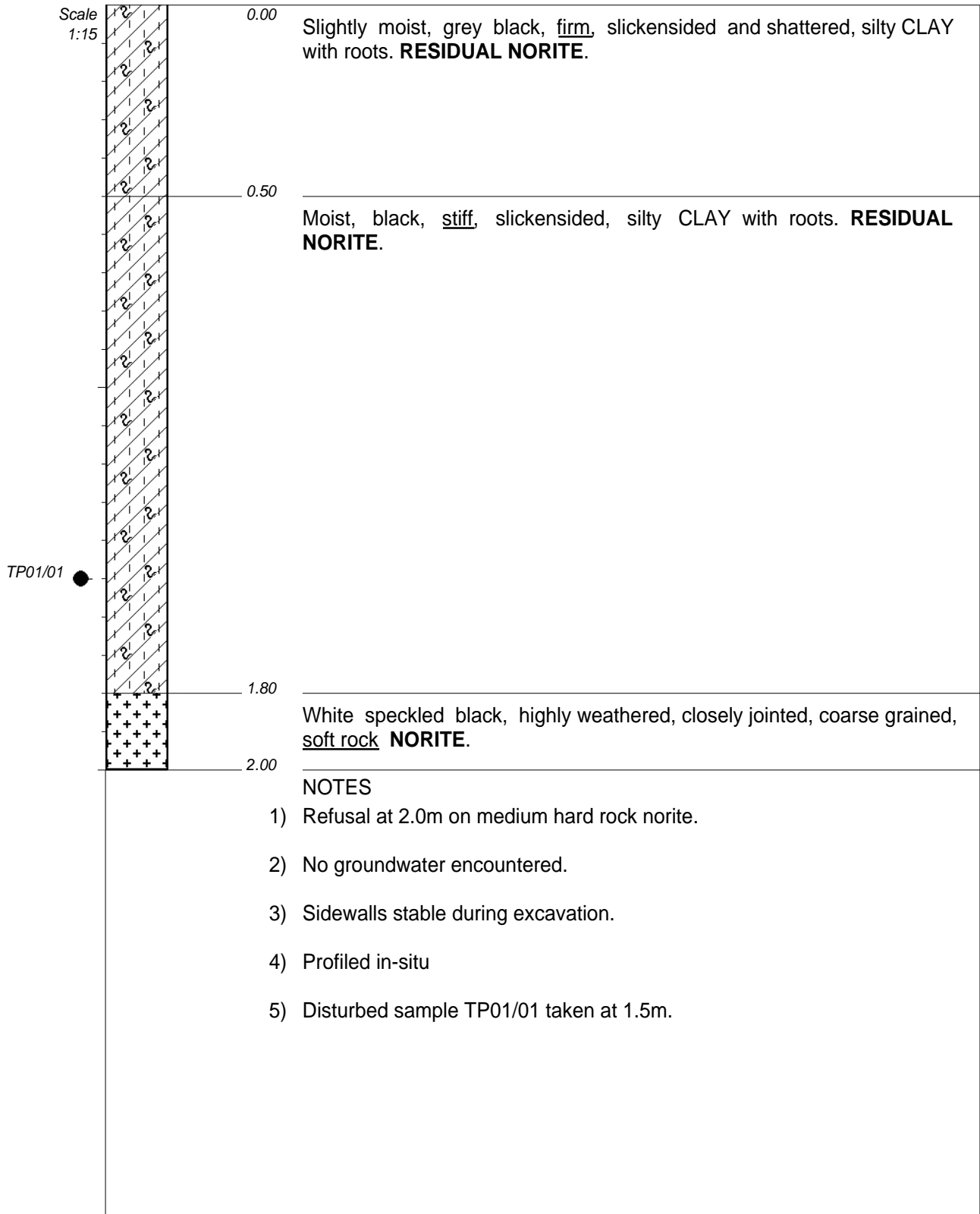
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## **APPENDIX A**

### **TEST PIT PROFILES**





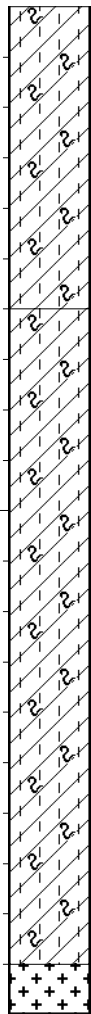
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Y-COORD : -031533



Scale  
1:15



0.00

Slightly moist, grey black, firm, slickensided and shattered, silty CLAY with roots. **RESIDUAL NORITE.**

0.60

Moist, black, stiff, slickensided, silty CLAY with roots. **RESIDUAL NORITE.**

1.90

White speckled black, highly weathered, closely jointed, coarse grained, soft rock **NORITE.**

2.00

**NOTES**

- 1) Refusal at 2.0m on medium hard rock norite.
- 2) No groundwater encountered.
- 3) Sidewalls stable during excavation.
- 4) Profiled in-situ
- 5) No samples taken.

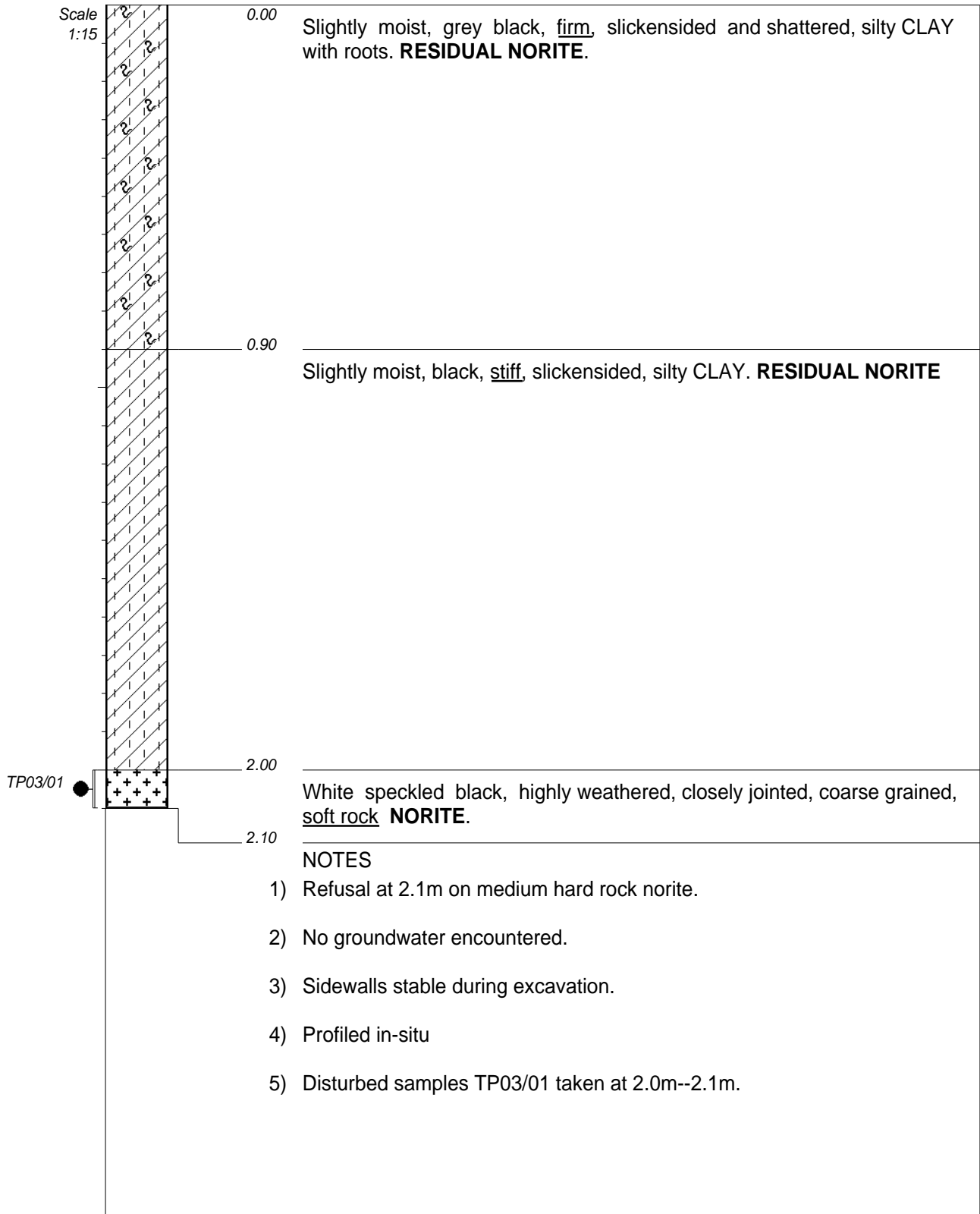
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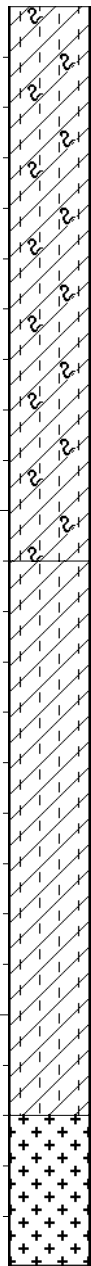
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Scale  
1:15



0.00

Slightly moist, grey black, firm with soft zones, slickensided and shattered, silty CLAY with roots. **RESIDUAL NORITE.**

1.10

Slightly moist, black, stiff, slickensided, silty CLAY. **RESIDUAL NORITE.**

2.20

White speckled black, highly weathered, closely jointed, coarse grained, soft rock **NORITE.**

2.50

**NOTES**

- 1) Refusal at 2.5m on medium hard rock norite.
- 2) No groundwater encountered.
- 3) Sidewalls stable during excavation.
- 4) Profiled in-situ
- 5) No samples taken

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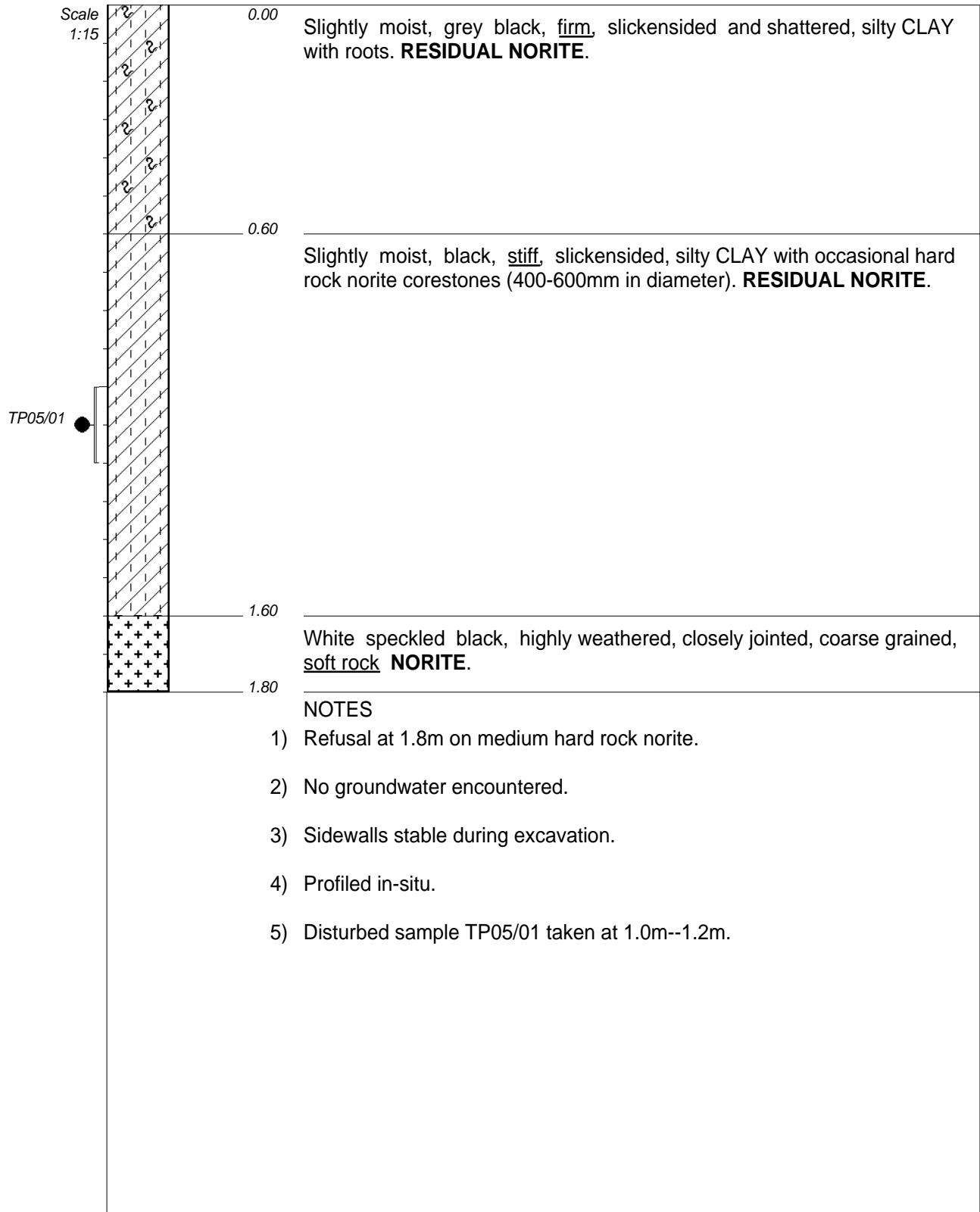
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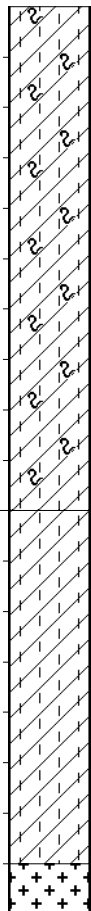
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Scale  
1:15



0.00

Slightly moist, grey black, firm, slickensided and shattered, silty CLAY with roots. **RESIDUAL NORITE.**

1.00

Slightly moist, black, stiff, slickensided, silty CLAY with occasional hard rock norite corestones up to 1.2m in diameter. **RESIDUAL NORITE.**

1.70

White speckled black, highly weathered, closely jointed, coarse grained, soft rock **NORITE.**

1.80

**NOTES**

- 1) Refusal at 1.8m on medium hard rock norite.
- 2) No groundwater encountered.
- 3) Sidewalls stable during excavation.
- 4) Profiled in-situ
- 5) No samples taken.

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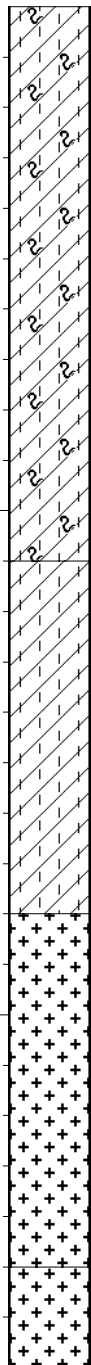
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Scale  
1:15



0.00

Slightly moist, grey black, firm, slickensided and shattered, silty CLAY with roots. **RESIDUAL NORITE.**

1.10

Moist, black, stiff, slickensided, silty CLAY with scattered hard rock norite corestones. **RESIDUAL NORITE.**

1.80

White speckled black, highly weathered, closely jointed, coarse grained, very soft rock **NORITE.**

2.50

White speckled black, highly weathered, closely jointed, coarse grained, soft rock **NORITE.**

2.70

**NOTES**

- 1) Refusal at 2.7m on medium hard rock norite.
- 2) No groundwater encountered.
- 3) Sidewalls stable during excavation.
- 4) Profiled in-situ
- 5) No samples taken.

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## **APPENDIX B**

### **ROTARY CORED BOREHOLE PROFILES**



HOLE No: BH01  
Sheet 1 of 4

JOB NUMBER: H806-00

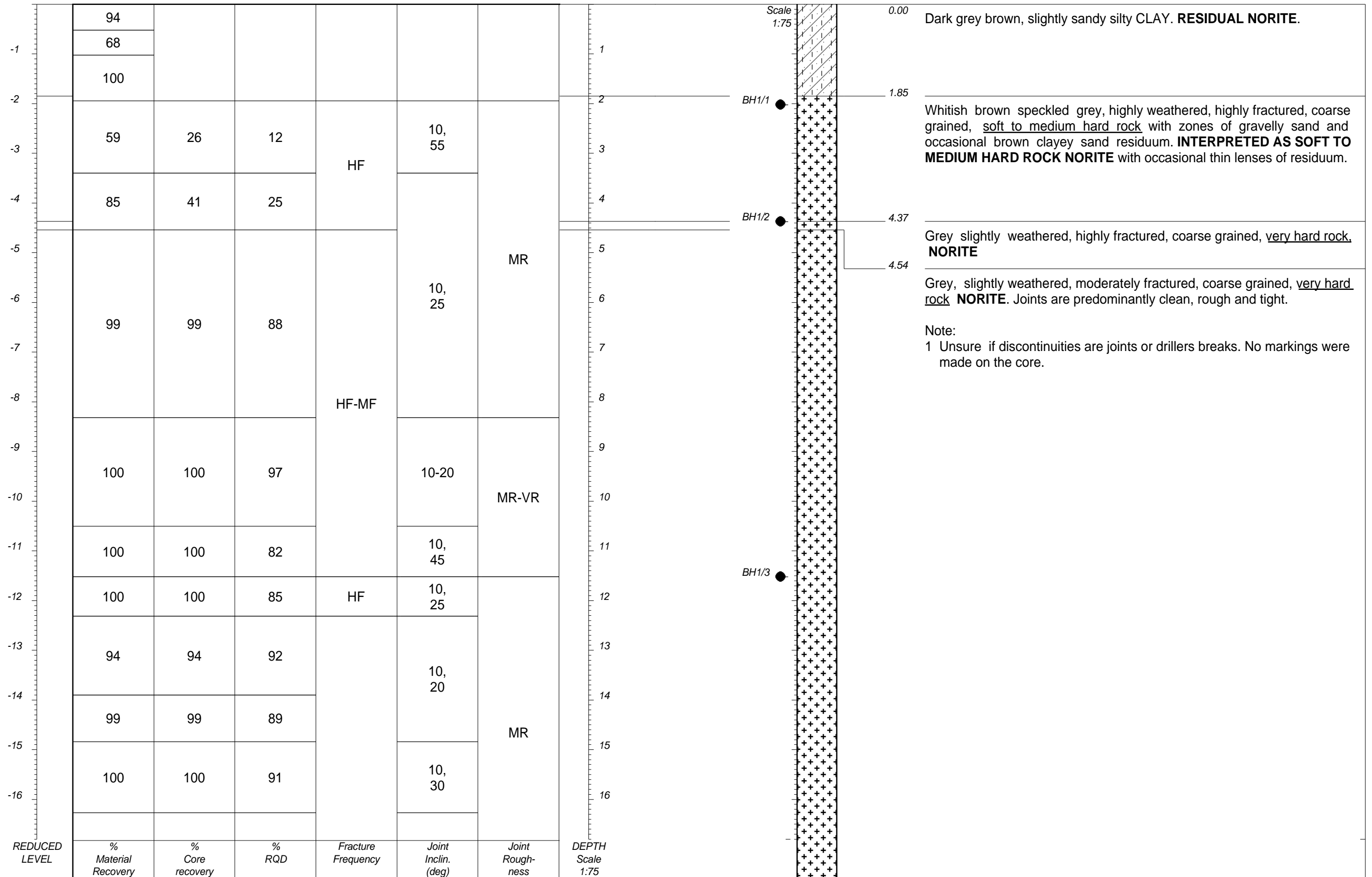
<b>ROCK FABRIC</b> MF -massive BF -bedded FF -foliated CF -cleaved SF -schistose GF -gneissose LF -laminated	<b>GRAIN SIZE</b> FG -fine grained MG -medium grain CG -coarse grain	<b>JOINT ROUGHNESS</b> SLJ-slickensided SJ -smooth RJ -rough	<b>ROCK HARDNESS</b> EHR-extremely hard rock VHR-very hard rock HR-hard rock MHR-medium hard rock SR-soft rock VSR-very soft rock
<b>JOINT SPACING</b> VCJ-very close spacg CJ -close spacing MJ -medium spacing WJ -wide spacing VWJ-very wide spacng	<b>JOINT SHAPE</b> CUR-curvilinear PLA-planar UND-undulating STE-stepped IRR-irregular		



**Northam Platinum Ltd**  
Northam Zondereinde  
Raisebore Surface Infrastructure

HOLE No: BH01  
Sheet 1 of 4

JOB NUMBER: H806-00



HOLE No: BH01  
Sheet 2 of 4

JOB NUMBER: H806-00

ROCK FABRIC  
MF -massive  
BF -bedded  
FF -foliated  
CF -cleaved  
SF -schistose  
GF -gneissose  
LF -laminated

GRAIN SIZE  
FG -fine grained  
MG -medium grain  
CG -coarse grain

JOINT SPACING  
VCJ-very close spacg  
CJ -close spacing  
MJ -medium spacing  
WJ -wide spacing  
VWJ-very wide spacng

JOINT ROUGHNESS  
SLJ-slickensided  
SJ -smooth  
RJ -rough

JOINT SHAPE  
CUR-curvilinear  
PLA-planar  
UND-undulating  
STE-stepped  
IRR-irregular

ROCK HARDNESS  
EHR-extremely hard rock  
VHR-very hard rock  
HR-hard rock  
MHR-medium hard rock  
SR-soft rock  
VSR-very soft rock



Northam Platinum Ltd  
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Raisebore Surface Infrastructure

HOLE No: BH01  
Sheet 2 of 4

JOB NUMBER: H806-00

REDUCED LEVEL	% Material Recovery	% Core recovery	% RQD	Fracture Frequency	Joint Incln. (deg)	Joint Roughness	DEPTH Scale 1:75
-17	100	100	93				17
-18					10, 25		18
-19	100	100	97			R	19
-20				MF			20
-21	100	100	91		5, 10, 25, 80		21
-22							22
-23							23
-24						MR-R	24
-25	100	100	87		0, 10-25		25
-26							26
-27							27
-28							28
-29	100	100	95		5-20		29
-30				MF-SF			30
-31							31
-32	100	100	95		0-10		32
-33						MR	33

BH1/5  
BH1/4

23.96

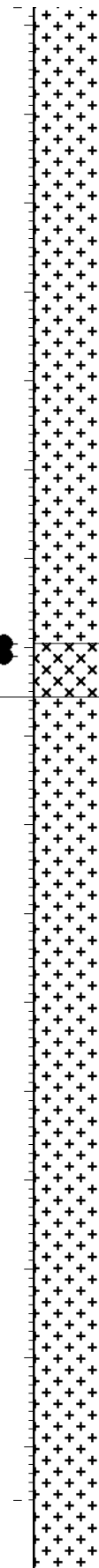
24.56

Whitish grey mottled dark grey, slightly weathered, coarse to very coarse grained, very hard rock **ANORTHOSITE**.

Grey, unweathered, slightly fractured, coarse grained, very hard rock **NORITE**. Joints are predominantly clean, rough and tight.

Note:

1 Slightly weathered joints at 25.36m dipping at 25deg and at 35.3m dipping at 80deg.



HOLE No: BH01  
Sheet 3 of 4

JOB NUMBER: H806-00

<b>ROCK FABRIC</b> MF -massive BF -bedded FF -foliated CF -cleaved SF -schistose GF -gneissose LF -laminated	<b>GRAIN SIZE</b> FG -fine grained MG -medium grain CG -coarse grain	<b>JOINT ROUGHNESS</b> SLJ-slickensided SJ -smooth RJ -rough	<b>ROCK HARDNESS</b> EHR-extremely hard rock VHR-very hard rock HR-hard rock MHR-medium hard rock SR-soft rock VSR-very soft rock
<b>JOINT SPACING</b> VCJ-very close spacg CJ -close spacing MJ -medium spacing WJ -wide spacing VWJ-very wide spacng	<b>JOINT SHAPE</b> CUR-curvilinear PLA-planar UND-undulating STE-stepped IRR-irregular		

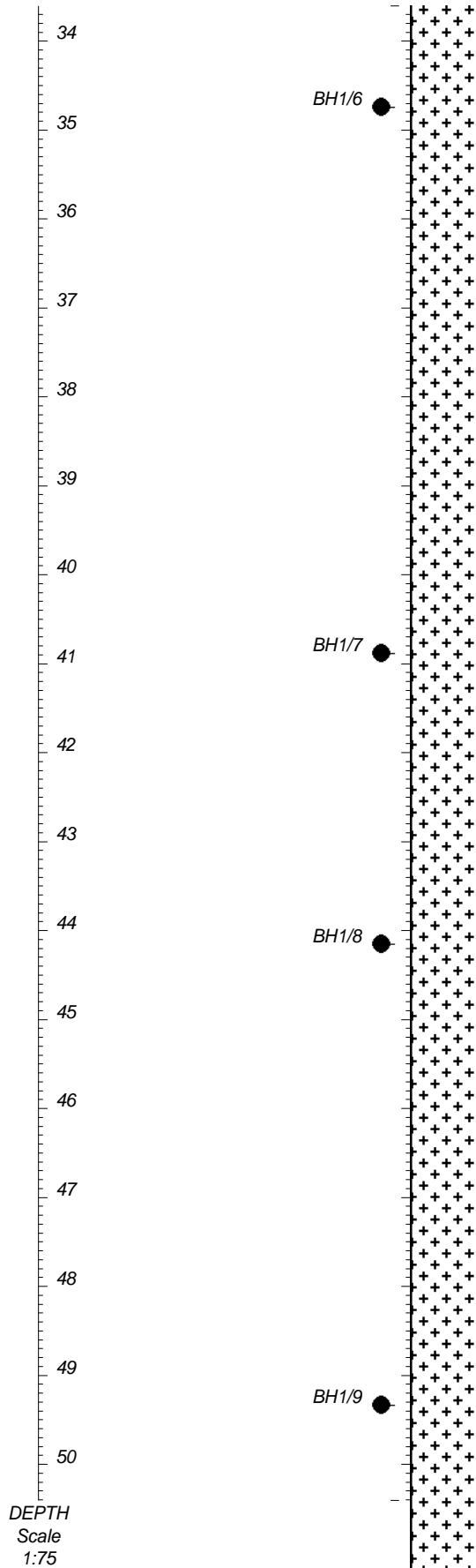


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Northam Zondereinde  
Raisebore Surface Infrastructure

HOLE No: BH01  
Sheet 3 of 4

JOB NUMBER: H806-00

REDUCED LEVEL	% Material Recovery	% Core recovery	% RQD	Fracture Frequency	Joint Incl. (deg)	Joint Roughness	DEPTH Scale 1:75
-34	100	100	92	MF	0, 10, 20		
-37	100	100	89	MF-SF	10-20	MR-R	
-42	100	100	96		0, 10, 15		
-44	100	100	90	MF	0, 15, 45	MR	
-49	100	100	96	MF-SF	0-10		



HOLE No: BH01  
Sheet 4 of 4

JOB NUMBER: H806-00

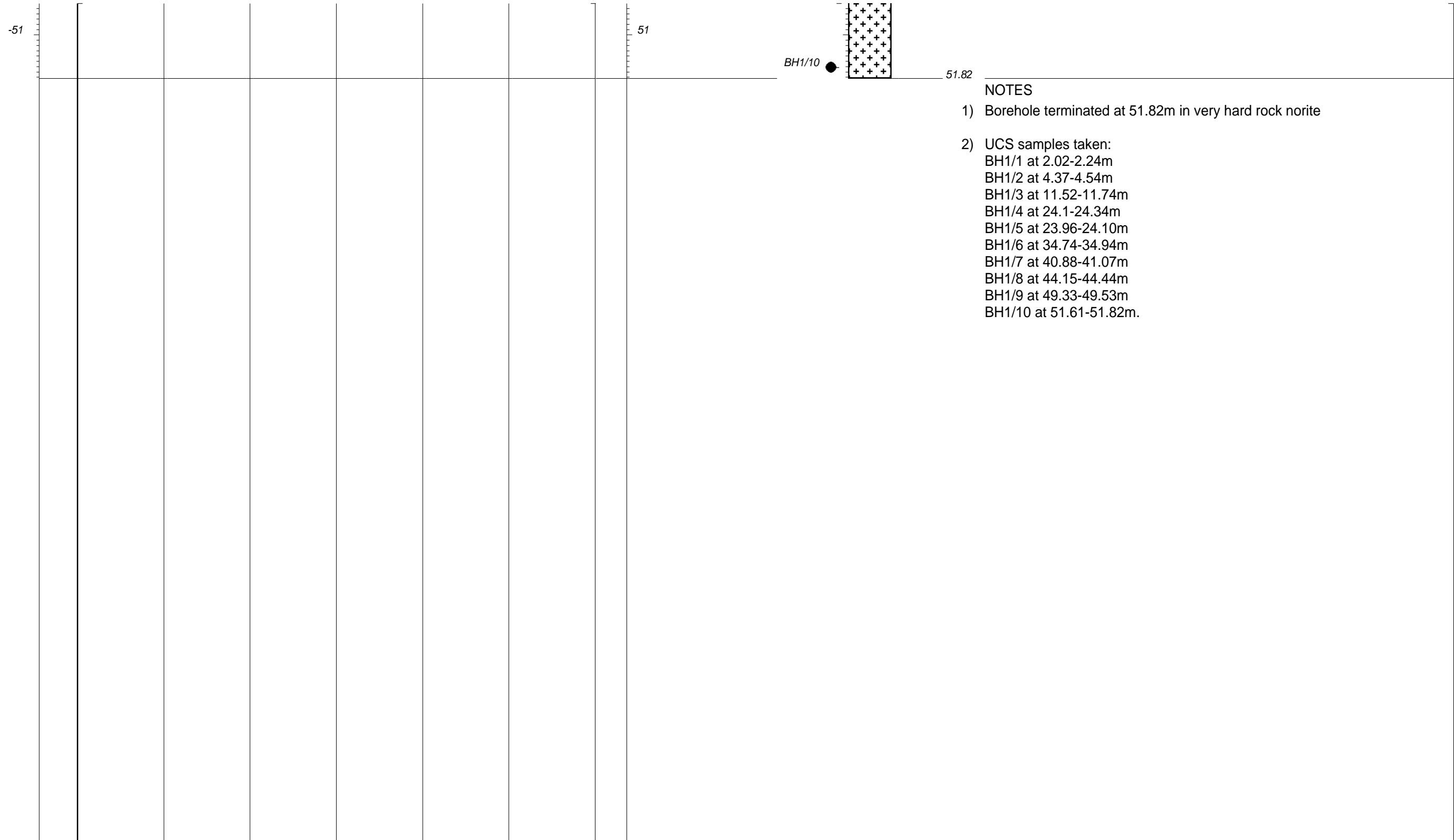
<b>ROCK FABRIC</b> MF -massive BF -bedded FF -foliated CF -cleaved SF -schistose GF -gneissose LF -laminated	<b>GRAIN SIZE</b> FG -fine grained MG -medium grain CG -coarse grain	<b>JOINT ROUGHNESS</b> SLJ-slickensided SJ -smooth RJ -rough	<b>ROCK HARDNESS</b> EHR-extremely hard rock VHR-very hard rock HR-hard rock MHR-medium hard rock SR-soft rock VSR-very soft rock
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Raisebore Surface Infrastructure

HOLE No: BH01  
Sheet 4 of 4

JOB NUMBER: H806-00



- NOTES**
- 1) Borehole terminated at 51.82m in very hard rock norite
  - 2) UCS samples taken:  
 BH1/1 at 2.02-2.24m  
 BH1/2 at 4.37-4.54m  
 BH1/3 at 11.52-11.74m  
 BH1/4 at 24.1-24.34m  
 BH1/5 at 23.96-24.10m  
 BH1/6 at 34.74-34.94m  
 BH1/7 at 40.88-41.07m  
 BH1/8 at 44.15-44.44m  
 BH1/9 at 49.33-49.53m  
 BH1/10 at 51.61-51.82m.

REDUCED LEVEL	% Material Recovery	% Core recovery	% RQD	Fracture Frequency	Joint Incl. (deg)	Joint Roughness	DEPTH Scale 1:75	CONTRACTOR : MACHINE : DRILLED BY : PROFILED BY : R Jooste	INCLINATION : Vertical DIAM : DATE : DATE : 05/02/2019	ELEVATION : X-COORD : Y-COORD :
								TYPE SET BY : R Jooste SETUP FILE : STANDARD.SET	DATE : 02/05/2019 10:16 TEXT : ..Profiles\H80600BH001.doc	HOLE No: BH01



**NORTHAM PLATINUM LTD**  
NORTHAM ZONDEREINDE, RAISEBORE SURFACE INFRASTRUCTURE  
GEOTECHNICAL INVESTIGATION  
FACTUAL REPORT

Report: JW105/19/H806-00 – Rev 0

**APPENDIX C**

**PHOTOGRAPHS**



**BH01**  
**Box 1 to 3 of 10**



# Box 4 to 6 of 10



# Box 7 to 9 of 10



## Box 10 of 10



## Test Pit Photographs



TP1



TP2



**Jones & Wagener**  
Engineering & Environmental Consultants  
59 Bevan Road PO Box 1434 Kivonia 2128 South Africa  
tel: 00 27 11 519 0200 www.jaww.co.za email: post@jaww.co.za

Northam Platinum  
Northam Zondereinde Mine Raisebore Surface Infrastructure: Geotechnical Investigation  
**TEST PIT PHOTOGRAPHS**

**H806-00**



**TP3**



**TP4**



**Jones & Wagener**  
Engineering & Environmental Consultants  
59 Bevan Road PO Box 1434 Rivonia 2128 South Africa  
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**TEST PIT PHOTOGRAPHS**

**H806-00**



**TP5**



**TP6**



**TP7**



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Report: JW105/19/H806-00 – Rev 0

**APPENDIX D**

**LABORATORY TEST RESULTS**





Unit 1, 13 Bloubokkie Street, Koedoespoort 0186

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Gerrie | 082 309 4448 | gerrie@stlab.co.za

www.stlab.co.za

*Quality | Excellence | On Time*

**Client Name:** Jones & Wagener  
**Project Name:** H806: Northam  
**Job Number:** J&W-110  
**Date:** 30-Apr-19  
**Method:** SANS 3001 GR1, GR3, GR10, GR12 GR20, GR30, GR31, GR40, GR50, GR53, GR54 & BS 1377 (where applicable)

**SUMMARY OF TEST DATA**

**Grading & Hydrometer Analysis (% Passing)**

Sample Depth (m)	TP 1	TP 3	TP 5				
Lab No	J&W-110-665	J&W-110-666	J&W-110-667				
53.0	100	96	100				
37.5	100	90	100				
26.5	100	86	100				
19.0	100	81	100				
13.2	100	81	100				
9.5	100	81	100				
6.7	100	81	100				
4.75	100	79	100				
2.00	98	67	98				
1.00	96	55	96				
0.425	94	43	95				
0.250	92	34	93				
0.150	89	25	90				
0.075	84	18	85				
0.060	81	15	82				
0.050	80	14	80				
0.035	77	12	77				
0.020	74	10	74				
0.006	72	8	73				
0.002	71	6	71				
GM	0.24	1.72	0.22				

**Atterberg Limits**

LL (%)	88	25	84				
PI (%)	49	8	45				
LS (%)	33.5	4.0	33.5				

**pH & Conductivity**

pH							
EC (S/m)							

0.029

MDD (kg/m <sup>3</sup> )		2119	1455				
OMC (%)		8.6	27.3				

**CBR**

100%		44	No Readings				
98%		42					
97%		41					
95%		40					
93%		37					
90%		33					
Swell (%)		0.9	11.6				

**UCS (MPa)**

100%							
97%							
90%							

**COLTO Classification**

		G6	*				
--	--	----	---	--	--	--	--

Remarks: \* = Not Classifiable

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.



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**Client Name:** Jones & Wagener  
**Project Name:** H806: Northam  
**Job Number:** J&W-110  
**Date:** 2019-04-30  
**Method:** SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

## FOUNDATION INDICATOR

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TP 1	TP 3	TP 5	Sample	TP 1	TP 3	TP 5
Depth (m)	1.5	2.2 - 2.4	1.0 - 1.2	Depth (m)	1.5	2.2 - 2.4	1.0 - 1.2
Lab No	J&W-110-665	J&W-110-666	J&W-110-667	Lab No	J&W-110-665	J&W-110-666	J&W-110-667
53.0	100	96	100	Liquid Limit (%)	88	25	84
37.5	100	90	100	Plastic Limit (%)	39	17	39
26.5	100	86	100	Plasticity Index (%)	49	8	45
19.0	100	81	100	Linear Shrinkage (%)	33.5	4.0	33.5
13.2	100	81	100	PI of whole sample	46	3	43
9.5	100	81	100				
6.7	100	81	100	% Gravel	2	33	2
4.75	100	79	100	% Sand	17	52	16
2.00	98	67	98	% Silt	10	9	11
1.00	96	55	96	% Clay	71	6	71
0.425	94	43	95	Activity	0.7	1.3	0.6
0.250	92	34	93				
0.150	89	25	90	% Soil Mortar	98	67	98
0.075	84	18	85				
0.060	81	15	82	Grading Modulus	0.24	1.72	0.22
0.050	80	14	80	Moisture Content (%)	N / T	N / T	N / T
0.035	77	12	77	Relative Density (SG)*	2.727	2.814	2.762
0.020	74	10	74				
0.006	72	8	73	Unified (ASTM D2487)	CH	SC-SM	CH
0.002	71	6	71	AASHTO (M145-91)	A - 7 - 5	A - 2 - 4	A - 7 - 5

Remarks: \*: Determined  
N / T: Not Tested

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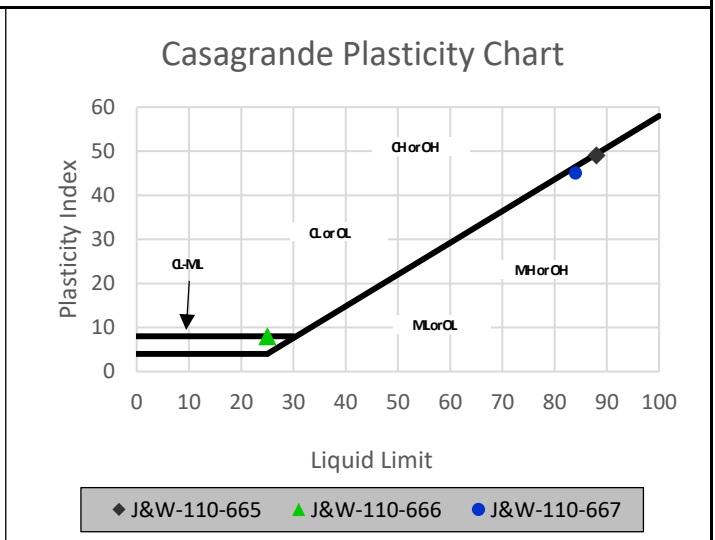
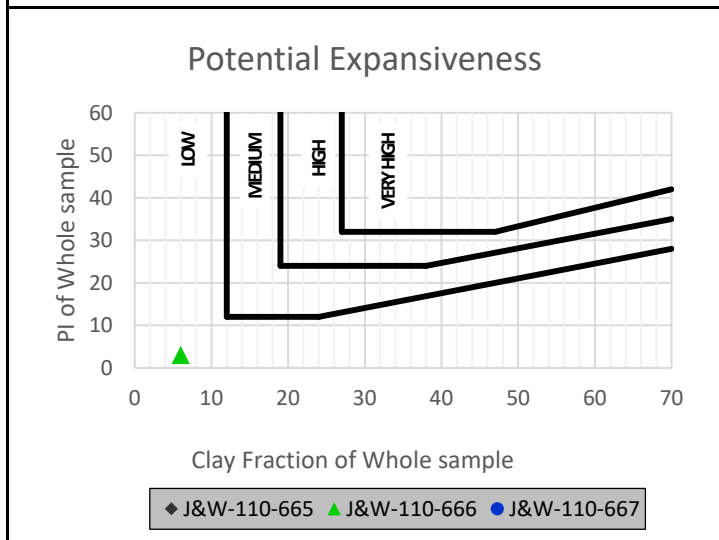
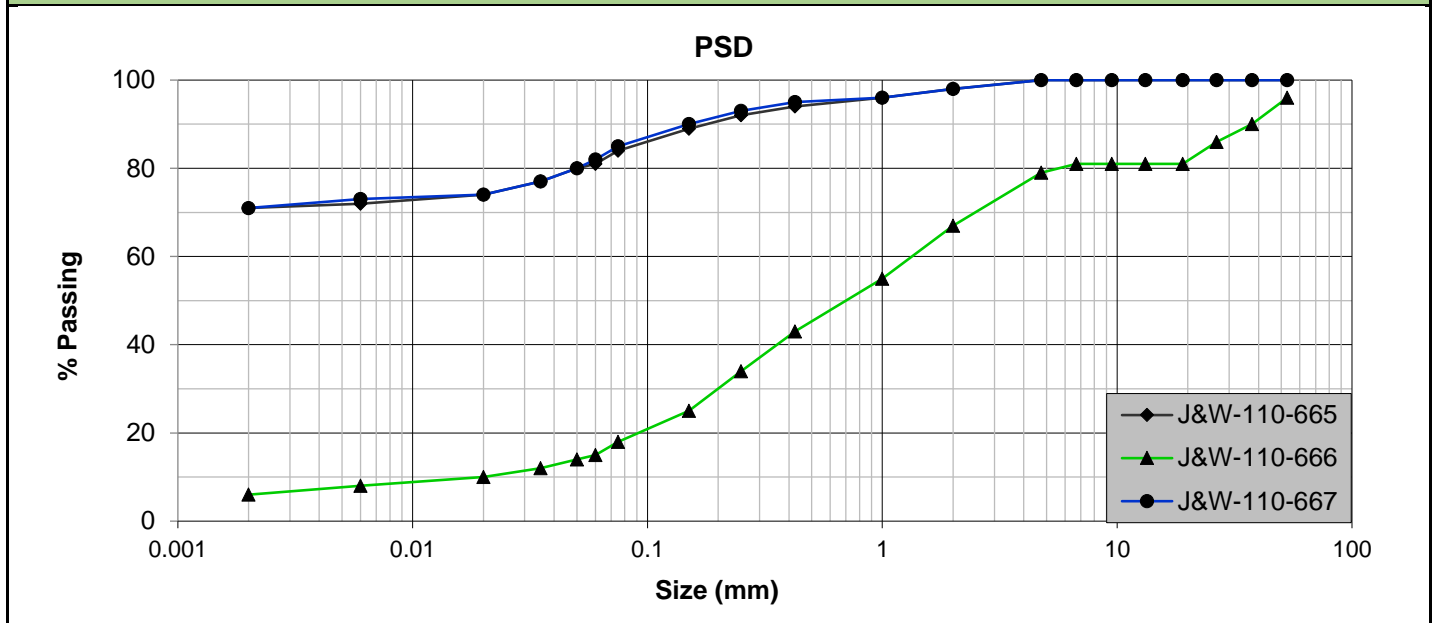
Gerle | 082 309 4448 | gerle@stlab.co.za

www.stlab.co.za

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**Client Name:** Jones & Wagener  
**Project Name:** H806: Northam  
**Job Number:** J&W-110  
**Date:** 2019-04-30  
**Method:** SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

### FOUNDATION INDICATOR



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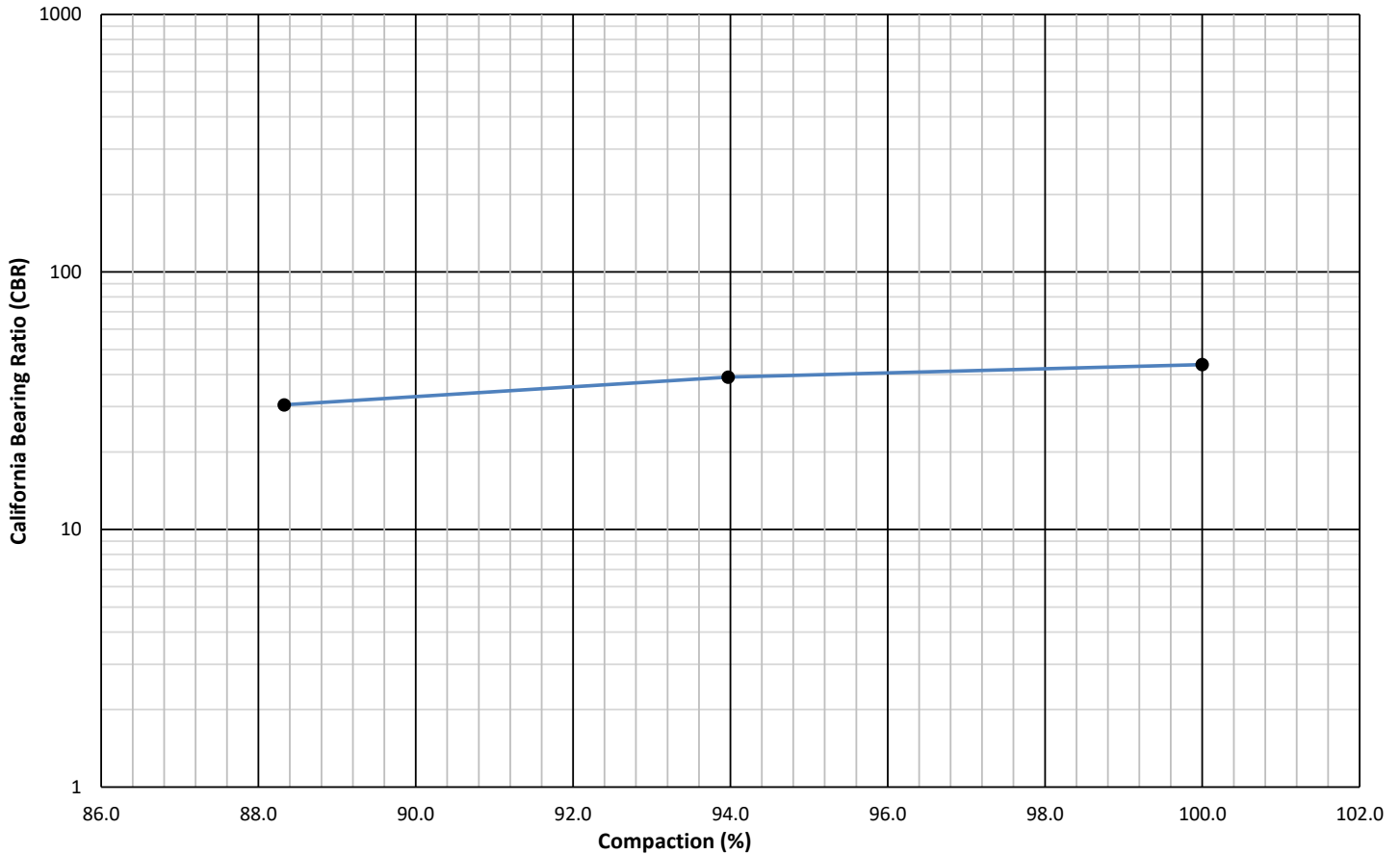
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**Client Name:** Jones & Wagener  
**Project Name:** H806: Northam  
**Sample:** TP 3  
**Depth: (m)** 2.2 - 2.4

**Job Number:** J&W-110  
**Lab Number:** J&W-110-666  
**Method:** SANS 3001 GR40  
**Date:** 30-Apr-19

### CALIFORNIA BEARING RATIO

Mod. AASHTO Values		Compaction Data: CBR			Swell	CBR at (mm)			CBR Values	
MDD	OMC	Dry Dens.	MC	Comp.		2.5	5.0	7.5	Compaction (%)	CBR
(kg/m <sup>3</sup> )	(%)	(kg/m <sup>3</sup> )	(%)	(%)	(%)					
2119	8.6	2090	9.4	100.0	0.9	44	54	58	100	44
2119	8.6	1964	9.4	94.0	0.9	39	52	60	98	42
2119	8.6	1846	9.4	88.3	1.0	31	40	44	97	41
									95	40
									93	37
									90	33



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**Client Name:** Jones & Wagener  
**Project Name:** H806: Northam  
**Sample:** TP 3  
**Depth: (m)** 2.2 - 2.4

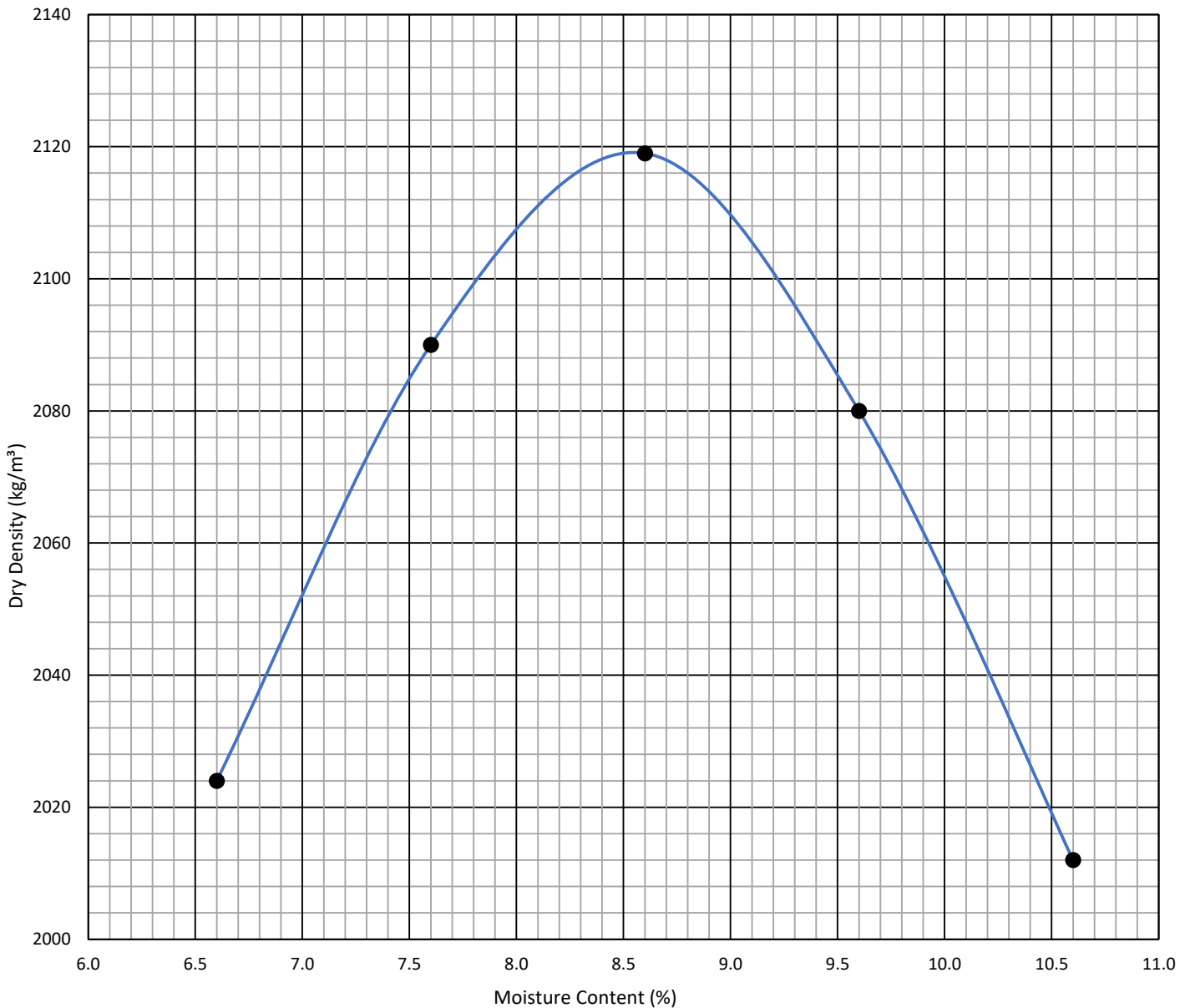
**Job Number:** J&W-110  
**Lab Number:** J&W-110-666  
**Method:** SANS 3001 GR30  
**Date:** 30-Apr-19

### MDD & OMC DETERMINATION (Mod. AASHTO)

Maximum Dry Density: **2119** kg/m<sup>3</sup>

Optimum Moisture Content: **8.6** %

Moisture Content (%):	6.6	7.6	8.6	9.6	10.6		
Dry Density (kg/m <sup>3</sup> )	2024	2090	2119	2080	2012		



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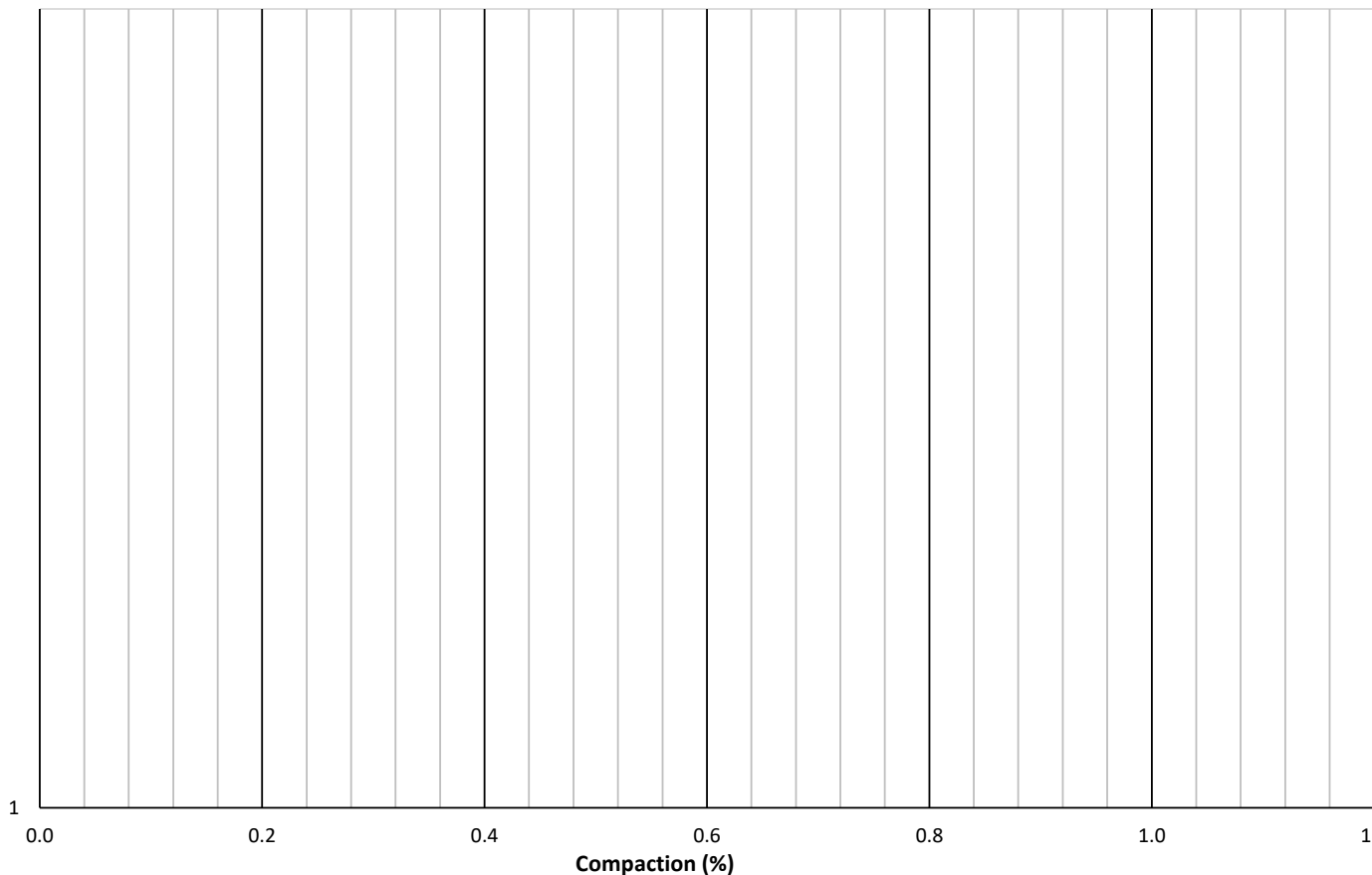
**Client Name:** Jones & Wagener  
**Project Name:** H806: Northam  
**Sample:** TP 5  
**Depth: (m)** 1.0 - 1.2

**Job Number:** J&W-110  
**Lab Number:** J&W-110-667  
**Method:** SANS 3001 GR40  
**Date:** 30-Apr-19

### CALIFORNIA BEARING RATIO

Mod. AASHTO Values		Compaction Data: CBR			Swell	CBR at (mm)			CBR Values	
MDD	OMC	Dry Dens.	MC	Comp.		2.5	5.0	7.5	Compaction (%)	CBR
(kg/m <sup>3</sup> )	(%)	(kg/m <sup>3</sup> )	(%)	(%)	(%)					
1455	27.3	1447	27.2	100.0	11.6	1	1	1	100	No Readings
									98	
									97	
1455	27.3	1263	27.2	87.3	12.1	1	1	1	95	
									93	
1455	27.3	1165	27.2	80.5	7.9	1	1	1	90	

California Bearing Ratio (CBR)



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**Client Name:** Jones & Wagener  
**Project Name:** H806: Northam  
**Sample:** TP 5  
**Depth: (m)** 1.0 - 1.2

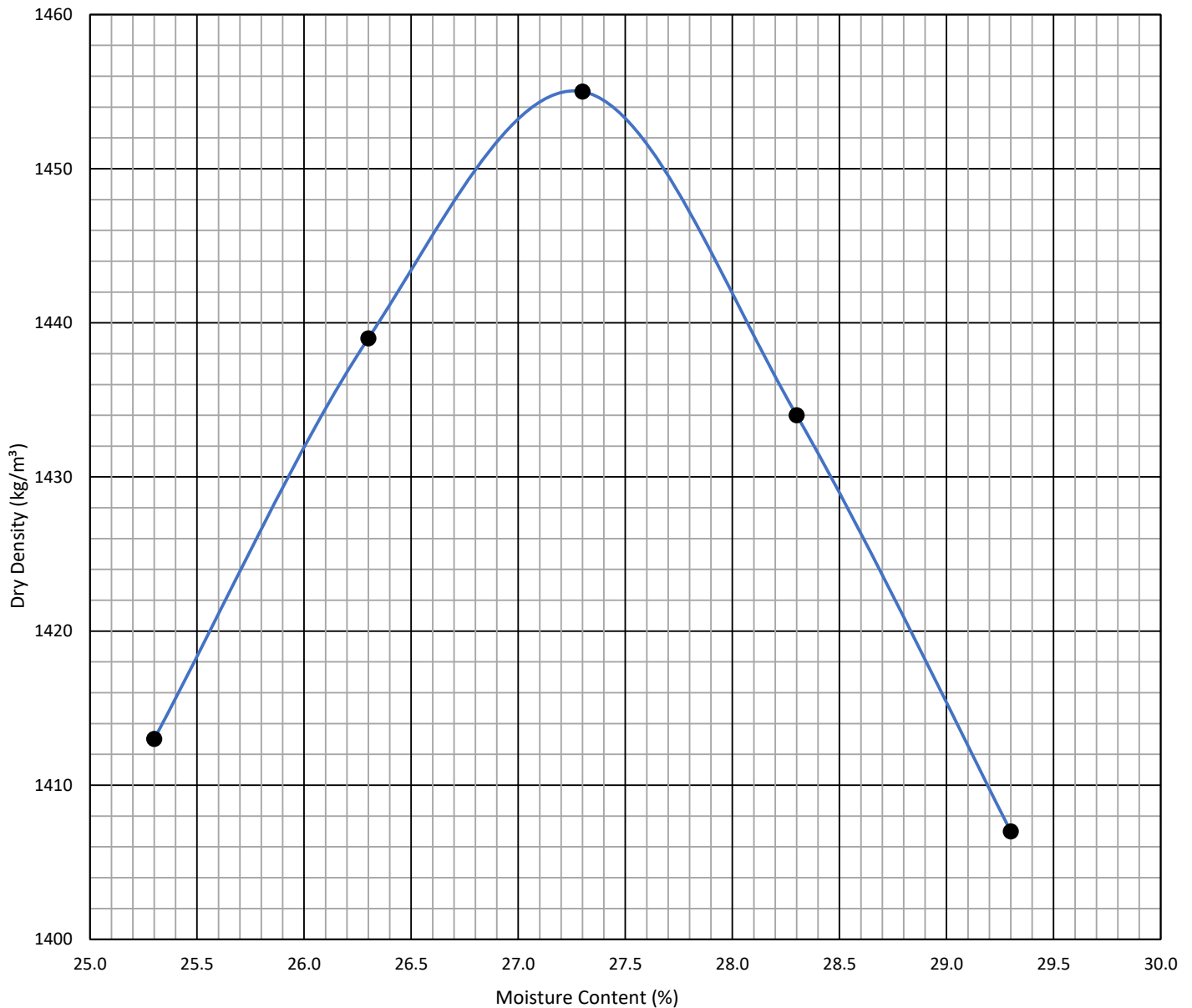
**Job Number:** J&W-110  
**Lab Number:** J&W-110-667  
**Method:** SANS 3001 GR30  
**Date:** 30-Apr-19

### MDD & OMC DETERMINATION (Mod. AASHTO)

Maximum Dry Density: **1455** kg/m<sup>3</sup>

Optimum Moisture Content: **27.3** %

Moisture Content (%):	25.3	26.3	27.3	28.3	29.3		
Dry Density (kg/m <sup>3</sup> )	1413	1439	1455	1434	1407		





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**APPENDIX E**

**DRAWING**





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INFORMATION

