OMEGA ZONE 8, ST HELENS

Omega St Helens Ltd / T. J. Morris Limited

Ground Investigation Report
& Remediation Strategy
Appendix D Part 4
OPP DOC. 2.8

PHOTOGRAPHS

Project Number : PN194027

Project : OMEGA DEVELOPMENT

TP8D37 Pit

TP8D37 Spoil

geotechnics

PHOTOGRAPHS

Project Number : PN194027

Project : OMEGA DEVELOPMENT

TP8D38 Pit

TP8D38 Spoil

geotechnics

PHOTOGRAPHS

Project Number : PN194027

Project : OMEGA DEVELOPMENT

TP8E01 Pit & Spoil

Project Number : PN194027

Project : OMEGA DEVELOPMENT

TP8E02 Pit

PHOTOGRAPHS

Project Number : PN194027

Project : OMEGA DEVELOPMENT

TP8E03 Pit

TP8E03 Spoil

APPENDIX 6

Dynamic Sample Borehole Records, Substitute Cable Percussion Borehole Records, SPT Results Summary Sheets & SPT Hammer Calibration Certificates

DATA SHEET - Symbols and Abbreviations used on Records

Sample Types

B	Bulk disturbed sample
BLK	Block sample
C	Core sample
D	Small disturbed sample (tub/jar)
E	Environmental test sample
ES	Environmental soil sample
EW	Environmental water sample
G	Gas sample
L	Liner sample
LB	Large bulk disturbed sample
P	Piston sample (PF - failed P sample)
TW	Thin walled push in sample
U	Open Tube - 102mm diameter with blows to take sample. (UF - failed U sample)
UT	Thin wall open drive tube sampler - 102mm diameter with blows to take sample. (UTF - failed UT sample)
V	Vial sample
W	Water sample
#	Sample Not Recovered

Insitu Testing / Properties

CBRP	CBR using TRL probe
CHP	Constant Head Permeability Test
COND	Electrical conductivity
TC	Thermal Conductivity
TR	Thermal Resistivity
HV	Strength from Hand Vane
ICBR	CBR Test
IDEN	Density Test
IRES	Resistivity Test
MEX	CBR using Mexecone Probe Test
PKR	Packer Permeability Test
PLT	Plate Load Test
PP	Strength from Pocket Penetrometer
Temp	Temperature
VHP	Variable Head Permeability Test
VN	Strength from Insitu Vane
w%	Water content

(All other strengths from undrained triaxial testing)

S	Standard Penetration Test (SPT)
C	SPT with cone
N	SPT Result
-/-	Blows/penetration (mm) after seating drive
-*/- (mm)	Total blows/penetration
( )	Extrapolated value

Groundwater

Water Strike

Depth Water Rose To

Instrumentation

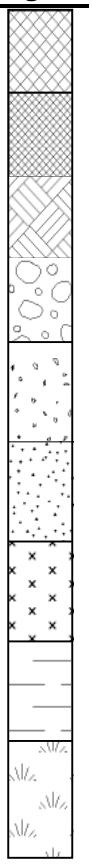
Seal

Filter

Seal

Strata

Legend



Made Ground Granular

Made Ground Cohesive

Topsoil

Cobbles and Boulders

Gravel

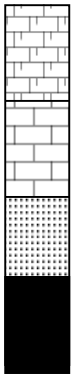
Sand

Silt

Clay

Peat

Note: Composite soil types shown by combined symbols



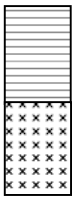
Chalk

Limestone

Sandstone

Coal

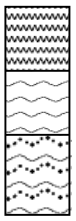
Strata, Continued



Mudstone

Siltstone

Metamorphic Rock

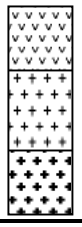


Fine Grained

Medium Grained

Coarse Grained

Igneous Rock



Fine Grained

Medium Grained

Coarse Grained

Backfill Materials

Arisings

Bentonite Seal

Concrete

Fine Gravel Filter

General Fill

Gravel Filter

Grout

Sand Filter

Tarmacadam

Rotary Core

RQD	Rock Quality Designation (% of intact core >100mm)
FRACTURE INDEX	Fractures/metre
FRACTURE SPACING (m)	Maximum Minimum
NI	Non-intact core
NR	No core recovery
AZCL	Assumed zone of core loss

(where core recovery is unknown it is assumed to be at the base of the run)

BOREHOLE RECORD – Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8A01** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **354707.6** E **390774.1** N | Ground Level **25.89** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		25.89
0.20	ES					Rough grass over TOPSOIL: Soft dark brown slightly sandy slightly gravelly clay with some rootlets. Gravel is subangular to subrounded fine to medium of various lithologies.	0.50		25.39
0.50	ES					Firm brown slightly sandy CLAY with occasional pockets (up to 15mm) of orange fine to medium sand.			
1.00- 2.00	B					Below 1.20m, stiff.			
1.00- 2.00	D								
1.00	ES								
1.20- 1.65					S16				
2.00- 3.00	B					Below 2.00m, occasional pockets (up to 15mm) of shale fragments.			
2.00- 3.00	D								
2.00- 2.45					S26				
3.00- 3.20	D								
3.00- 3.45					S21				
3.20- 4.00	B								
4.00- 4.20	D								
4.00- 4.45					S18				
4.20- 5.00	B								
5.00- 5.45					S20				
						End of Borehole	5.45		20.44

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	IH
5.45	0.10	Dynamic Sampler	IH

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			07/10/19	08:00
5.45		DRY	07/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
A 50mm gas monitoring pipe was installed to 5.45m with a geowrapped slotted section from 1.00m to 5.45m with upright lockable protective cover. Backfill details from base of hole: gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Logged by **CW**

Figure **1 of 1**

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Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8A02** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **354871.4** E **390773.7** N | Ground Level **25.23** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		25.23
0.20	ES					Rough grass over TOPSOIL: Soft dark brown slightly sandy slightly gravelly clay with some rootlets. Gravel is subangular to subrounded fine to coarse of various lithologies.			
0.50	ES						0.50		24.73
1.00	ES					Soft to firm brown mottled orange slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies.			
1.20- 2.00	B								
1.20- 1.65					S11				
						Below 1.50m, occasional pockets (up to 50mm) of greenish brown sand.			
2.00- 2.30	D					Below 2.00m, stiff.			
2.00- 2.45					S17				
2.30- 3.00	B								
3.00- 3.30	D								
3.00- 3.45					S19	Below 3.20m, occasional pockets (up to 20mm) of shale fragments.			
3.30- 4.00	B								
4.00- 4.20	D								
4.00- 4.45					S19				
4.20- 5.00	B								
5.00- 5.45					S19				
						End of Borehole	5.45		19.78

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	IH
5.45	0.10	Dynamic Sampler	IH

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			07/10/19	08:00
5.45		DRY	07/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
A 50mm gas monitoring pipe was installed to 5.45m with a geowrapped slotted section from 1.00m to 5.45m with upright lockable protective cover. Backfill details from base of hole: gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by **CW**

Figure **1 of 1**

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geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI**
Engineer **WSP**
Borehole **WS8A03**
Project No **PN194027**

Client **WSP**
National Grid Coordinates **354974.5** E **390531.1** N
Ground Level **24.91** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		24.91
0.20	B					Grass over TOPSOIL: Soft brown slightly sandy slightly gravelly clay with some rootlets. Gravel is subangular to subrounded fine to coarse of various lithologies.			
0.20	D								
0.20	ES								
0.50	ES						0.50		24.41
						Firm brown mottled orange slightly sandy slightly gravelly CLAY with a low cobble content. Gravel is subangular to subrounded fine to coarse of various lithologies.			
1.00	ES								
1.20- 1.65					S10				
						Below 1.50m, occasional pockets (up to 30mm) of shale fragments.			
2.00- 2.20	D					Below 2.00m, stiff.			
2.00- 2.45					S17				
2.20- 3.00	B								
3.00- 3.20	D								
3.00- 3.45					S21				
3.20- 4.00	B								
4.00- 4.20	D								
4.00- 4.45					S23				
4.20- 5.00	B								
5.00- 5.45					S50	Below 5.00m, very stiff.			
						End of Borehole	5.45		19.46

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	IH
5.45	0.10	Dynamic Sampler	IH

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			07/10/19	08:00
5.45		WET	07/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
4.25					Inflow.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
A 50mm gas monitoring pipe was installed to 5.45m with a geowrapped slotted section from 1.00m to 5.45m with upright lockable protective cover. Backfill details from base of hole: gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by **CW**

Figure **1 of 1**
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geotechnics

BOREHOLE RECORD - Cable Percussion

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8B01** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355313.8** E **390656.3** N | Ground Level **21.87** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		21.87
0.00- 0.50	B					Grass over TOPSOIL: Soft dark brown slightly sandy slightly gravelly clay. Gravel is subrounded fine of mudstone.			
0.25	ES						0.40		21.47
0.50- 1.20	B					POSSIBLE MADE GROUND: Dark brown slightly clayey fine to medium sand.	0.50		21.37
0.50	ES								
1.00	ES					Firm sandy slightly gravelly CLAY. Gravel is subrounded to rounded fine of mudstone. Below 1.20m, stiff.			
1.20- 1.65	B								
1.20- 1.65		(DRY)			S15				
1.80	D								
2.00- 2.45	B								
2.00- 2.45		1.70 (DRY)			S16				
2.80	D								
3.00- 3.45	B								
3.00- 3.08		1.70 (DRY)			S50/32				
						At 3.60m, obstruction - probable cobble/boulder.			
						End of Borehole	3.60		18.27

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	SL/JL
3.60	0.15	Cable Percussion	SL/JL

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			26/09/19	08:00
3.60		DRY	26/09/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
Borehole carried out by cable percussion rig in place of dynamic sampler due to access restrictions. The borehole was terminated at a depth of 3.60m on encountering an obstruction - probable cobble/boulder.
Backfill details from base of hole: bentonite seal up to ground level.
Chiselling: 3.20-3.60m for 50 minutes.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by **MM**

Figure **1 of 1**

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geotechnics

BOREHOLE RECORD - Cable Percussion

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | Borehole **WS8B02** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355263.8 E, 390628.4 N** | Ground Level **22.28** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		22.28
0.00- 0.40	B					Grass over TOPSOIL: Soft dark brown slightly sandy slightly gravelly clay with some rootlets. Gravel is fine to medium, subrounded to rounded of sandstone and mudstone.	0.40		21.88
0.25	ES								
0.40- 0.60	B					POSSIBLE MADE GROUND: Dark brown slightly clayey fine to medium sand.	0.60		21.68
0.50	ES								
0.60- 1.20	B					Firm reddish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to medium of sandstone mudstone and coal. Below 1.20m, stiff.			
1.00	ES								
1.20- 1.65	B								
1.20- 1.65		(DRY)			S15				
1.80	D								
2.00- 2.45	B								
2.00- 2.45		1.70 (DRY)			S16				
2.80	D								
3.00- 3.45		3.00 (1.90)			S19				
4.00- 4.45		4.00 (DRY)			S19				
						End of Borehole	5.00		17.28

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	SL/JL
5.00	0.15	Cable Percussion	SL/JL

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			27/09/19	08:00
3.00	1.70	DRY	27/09/19	18:00
3.00	1.70	DRY	30/09/19	08:00
5.00	4.00	DRY	30/09/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
Borehole carried out by cable percussion rig in place of dynamic sampler due to access restrictions.
A 50mm groundwater monitoring pipe was installed to 5.00m with a geowrapped slotted section from 1.00m to 5.00m with upright lockable protective cover. Backfill details from base of hole: gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Logged by **MM**

Figure **1 of 1**

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Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8B03** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355208.4** E **390484.4** N | Ground Level **21.71** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		21.71
0.10- 0.30	B					Crops over TOPSOIL: Very soft dark brown slightly sandy slightly gravelly clay with a medium cobble content and some rootlets. Gravel is angular to rounded fine to coarse including sandstone and brick fragments.			
0.20	D								
0.20	ES								
0.30- 1.00	B						0.30		21.41
0.50	D			16					
0.50	ES								
1.00- 1.40	B					MADE GROUND: Soft to firm brown mottled orange and grey slightly sandy slightly gravelly clay. Gravel is angular to rounded fine to coarse of siltstone, sandstone and brick fragments.			
1.00	ES								
1.20- 1.65		(WET)			S13				
							1.40		20.31
1.40- 2.00	B					Firm brown mottled orange and grey slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of sandstone, siltstone and mudstone. Below 2.00m, stiff.			
1.50	D								
2.00- 3.00	B								
2.00- 2.45		(DRY)			S24				
2.50	D								
3.00- 4.00	B								
3.00- 3.45		(DRY)			S26				
3.50	D								
4.00- 5.00	B								
4.00- 4.45		(DRY)			S29				
4.50	D								
5.00- 5.45		(DRY)			S27				
						End of Borehole	5.45		16.26

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	JP
5.45	0.10	Dynamic Sampler	JP

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			01/10/19	08:00
5.45		WET	01/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
0.75					Slow inflow.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
A 50mm standpipe was installed to 5.45m with a geowrapped slotted section from 0.50m to 4.50m with flush lockable protective cover. Backfill details from base of hole: bentonite seal up to 4.50m, gravel filter up to 0.50m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by **NC**

Figure **1 of 1**

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geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8B04** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355106.5** E **390776.8** N | Ground Level **22.84** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		22.84
0.10- 0.30	B					Crops over TOPSOIL: Very soft dark brown slightly gravelly sandy clay with some rootlets. Gravel is angular to subrounded fine to coarse of siltstone and quartz.			
0.20	D								
0.20	ES						0.35		22.49
0.40- 1.00	B					Firm orangish brown mottled grey slightly sandy slightly gravelly CLAY with some pockets of sand. Gravel is subangular to rounded fine to coarse of siltstone and quartz.			
0.50	D								
0.50	ES								
1.00	ES								
1.20- 2.00	B								
1.20- 1.65		(WET)			S9				
1.50	D			16					
2.00- 3.00	B					Below 2.00m, stiff.			
2.00- 2.45		(WET)			S18				
2.50	D								
3.00- 3.45		(DRY)			S25				
3.50	D								
4.00- 4.45		(DRY)			S17				
4.50	D								
5.00- 5.45		(DRY)			S15				
						End of Borehole	5.45		17.39

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	JP
5.45	0.10	Dynamic Sampler	JP

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			01/10/19	08:00
5.45		WET	01/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
0.70					Slow inflow.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
A 50mm standpipe was installed to 4.50m with a geowrapped slotted section from 0.50m to 4.50m with flush lockable protective cover. Backfill details from base of hole: bentonite seal up to 4.50m, gravel filter up to 0.50m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by **NC**

Figure **1 of 1**

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geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8B05** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355377.9** E **390911.4** N | Ground Level **21.28** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		21.28
0.10- 0.40	B					Grass over TOPSOIL: Very soft dark brown sandy slightly gravelly clay with some rootlets. Gravel is subangular to subrounded fine to medium of siltstone.			
0.20	D								
0.20	ES								
0.50- 1.00	B						0.40		20.88
0.50	D					Below 0.30m, mottled grey, grading to very clayey fine to coarse sand.			
0.50	ES								
1.00	ES					Firm to stiff fissured mottled orange brown and grey slightly sandy slightly gravelly CLAY with a low cobble content. Gravel is subangular to rounded fine to coarse of various lithologies. Some pockets (up to 30mm) of yellowish grey sand.			
1.20- 2.00	B								
1.20- 1.65		(DRY)			S7				
1.30	D								
1.50	D			17		At 1.30m, large pocket of yellowish grey fine to coarse sand.			
						Below 1.50m, stiff, brown mottled grey.			
2.00- 3.00	B								
2.00- 2.45		(WET)			S17				
2.50	D								
3.00- 4.00	B					Below 3.00m, mottling and pockets of sand absent. Rare bivalve fragments and rare pockets (up to 20mm) of grey silt.			
3.00- 3.45		(WET)			S32				
3.50	D								
4.00- 5.00	B								
4.00- 4.45		(DRY)			S22				
4.50	D			13					
5.00- 5.45		(DRY)			S19				
						End of Borehole	5.45		15.83

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	JP
5.45	0.10	Dynamic Sampler	JP

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			30/09/19	08:00
5.45		DRY	30/09/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
A 50mm groundwater monitoring pipe was installed to 4.00m with a geowrapped slotted section from 1.00m to 4.00m with upright lockable protective cover. Backfill details from base of hole: bentonite seal up to 4.00m, gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Logged by **NC**

Figure **1 of 1**

18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Cable Percussion

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8B06** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355284.0** E **390811.6** N | Ground Level **22.41** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		22.41
0.00- 0.40	B					Grass over TOPSOIL: Soft dark brown slightly sandy slightly gravelly clay with rootlets. Gravel is subrounded to rounded fine to coarse of sandstone and mudstone.	0.40		22.01
0.25	ES								
0.50- 1.00	B					Dark brown slightly clayey slightly gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to medium of sandstone.	1.00		21.41
0.50	ES								
1.00- 1.20	B								
1.00	ES								
1.20- 1.65	B					Firm reddish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone mudstone and quartz.			
1.20- 1.65		(1.00)			S11				
1.80	D								
2.00- 2.45	B								
2.00- 2.45		1.70 (DRY)			S14				
2.80	D								
3.00- 3.45	B					Below 3.00m, stiff to very stiff.			
3.00- 3.45		1.70 (DRY)			S31				
3.80	D								
4.00- 4.45	B								
4.00- 4.45		1.70 (DRY)			S19				
4.80	D								
						End of Borehole	5.00		17.41

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	SL/JL
5.00	0.15	Cable Percussion	SL/JL

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			27/09/19	08:00
5.00	1.70	DRY	27/09/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.00		0.90	20	1.70	Slow inflow.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
Borehole carried out by cable percussion rig in place of dynamic sampler due to access restrictions.
A 50mm standpipe was installed to 5.00m with a geowrapped slotted section from 1.00m to 5.00m with upright lockable protective cover. Backfill details from base of hole: gravel filter up to 0.50m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by **MM**

Figure **1 of 1**

18/12/2019

geotechnics

BOREHOLE RECORD - Cable Percussion

Project	OMEGA DEVELOPMENT GI	Engineer	WSP	Borehole	WS8B07
				Project No	PN194027
Client	WSP	National Grid Coordinates	355237.5 E 390734.1 N	Ground Level	22.17 m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		22.17
0.00- 0.50	B					Grass over TOPSOIL: Soft dark brown slightly sandy clay with some rootlets.			
0.25	ES						0.40		21.77
0.50- 1.20	B					POSSIBLE MADE GROUND: Dark brown slightly clayey fine to medium sand.	0.50		21.67
0.50	ES								
						Firm reddish brown slightly sandy slightly gravelly CLAY. Gravel is subrounded to rounded fine to medium of sandstone, mudstone and coal.			
1.00	ES								
1.20- 1.65	B								
1.80	D								
2.00- 2.45	B					Below 2.00m, stiff to very stiff.			
2.00- 2.45		1.70 (1.20)			S27				
2.80	D								
3.00- 3.45		3.00 (DRY)			S35				
3.80	D								
4.00- 4.45	B								
4.00- 4.45		3.00 (DRY)			S17				
4.80	D								
						End of Borehole	5.00		17.17

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	SL/JL
5.00	0.15	Cable Percussion	SL/JL

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			25/09/19	08:00
2.00	1.70	DRY	25/09/19	18:00
2.00	1.70	DRY	26/09/19	08:00
5.00	3.00	DRY	26/09/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
Borehole carried out by cable percussion rig in place of dynamic sampler due to access restrictions.
A 50mm gas monitoring pipe was installed to 5.00m with a geowrapped slotted section from 1.00m to 5.00m with upright lockable protective cover. Backfill details from base of hole: gravel filter up to 1.00m, bentonite grout up to 0.20m, concrete up to ground level.

Logged by MM

Figure 1 of 1

18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8C01** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355032.5** E **389954.8** N | Ground Level **19.24** m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		19.24
0.00- 0.30	B					TOPSOIL: Soft grey sandy clay with some rootlets.			
0.00- 0.30	D								
0.20	ES						0.30		18.94
0.30- 0.90	B					Brown gravelly fine to coarse SAND with a low cobble content. Gravel is subangular to rounded fine to coarse of sandstone and quartzite.			
0.30- 0.90	D								
0.50	ES						0.90		18.34
0.90- 1.20	B					Soft to firm brown sandy gravelly CLAY with occasional bands of grey fine sand. Gravel is angular to subrounded fine to coarse of sandstone, mudstone and quartzite.			
0.90- 1.20	D								
1.00	ES								
1.20- 2.00	B								
1.20- 2.00	D								
1.20- 1.65					S9				
2.00- 3.00	B						2.00		17.24
2.00- 3.00	D					Medium dense brown gravelly fine to coarse SAND. Gravel is angular to subrounded fine to coarse of sandstone.			
2.00- 2.45					S18				
2.80- 3.25					S16				
3.00- 3.60	B								
3.00- 3.60	D								
3.60- 3.80					S50/90	Very weak reddish brown fine to medium grained SANDSTONE. (Recovered as slightly gravelly sand).	3.60		15.64
							3.80		15.44
						End of Borehole			

Boring | Progress | Groundwater

Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20		Inspection Pit	IH	G.L.			10/10/19	08:00						None
3.80	0.10	Dynamic Sampler	IH	3.80		DRY	10/10/19	18:00						encountered.

Remarks **Inspection pit hand excavated to 1.20m depth and no services were found.**
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.

Logged by **FKT**

Figure **1 of 1**
18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8C02** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **354800.0** E **390014.6** N | Ground Level **20.68** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		20.68
0.00- 0.30	B					TOPSOIL: Soft grey sandy clay with some rootlets.			
0.00- 0.30	D								
0.20	ES								
0.30- 0.80	B					Firm grey and orangish brown sandy CLAY.	0.30		20.38
0.30- 0.80	D								
0.50	ES								
0.80- 1.20	B					Stiff brown mottled grey sandy CLAY.	0.80		19.88
0.80- 1.20	D								
1.00	ES								
1.20- 2.00	B								
1.20- 2.00	D								
1.20- 1.65					S10				
2.00- 3.00	B						2.00		18.68
2.00- 3.00	D					Stiff brown mottled grey slightly gravelly sandy CLAY. Gravel is subrounded to rounded fine to coarse of sandstone, mudstone, quartzite and coal.			
2.00- 2.45					S18				
3.00- 4.80	B						3.00		17.68
3.00- 4.80	D					Stiff brown slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone, mudstone, quartzite and coal.			
3.00- 3.45					S22				
4.00- 4.45					S21				
4.80- 5.43					S50/ 275	Very weak reddish brown fine to medium SANDSTONE. (Recovered as slightly gravelly clayey sand).	4.80		15.88
						End of Borehole	5.43		15.25

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	IH
5.43	0.10	Dynamic Sampler	IH

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			10/10/19	08:00
5.43		DRY	10/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.

Logged by **FKT**

Figure **1 of 1**

18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | Borehole **WS8C03** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355083.5** E **390142.4** N | Ground Level **20.50** m OD

Scale 1:50

Sampling Depth	Sample Type	Depth Cased & (to Water)	Properties Strength kPa	w %	SPT N	Strata Description	Depth	Legend	Level m OD
							G.L.		20.50
0.00- 0.30	B					TOPSOIL: Soft grey sandy gravelly clay with many rootlets. Gravel is angular to subrounded fine to coarse of sandstone and quartzite.			
0.00- 0.30	D								
0.20	ES						0.30		20.20
0.30- 0.70	B					Firm brown sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone, mudstone and quartzite.			
0.30- 0.70	D								
0.50	ES						0.70		19.80
0.70- 1.20	B					Stiff brown sandy gravelly CLAY with a low cobble content. Gravel is angular to subrounded fine to coarse of sandstone, mudstone, quartzite and coal.			
0.70- 1.20	D								
1.00	ES								
1.20- 2.00	B								
1.20- 2.00	D								
1.20- 1.65					S15				
2.00- 3.00	B								
2.00- 3.00	D								
2.00- 2.45					S18				
2.60- 3.05					S27				
3.00- 4.00	B								
3.00- 4.00	D								
3.70- 4.15					S50				
						End of Borehole	4.15		16.35

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	IH
4.15	0.10	Dynamic Sampler	IH

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			10/10/19	08:00
4.15		DRY	10/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks: Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.

Logged by **FKT**

Figure **1 of 1**

18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project	OMEGA DEVELOPMENT GI	Engineer	WSP	Borehole	WS8C04
				Project No	PN194027
Client	WSP	National Grid Coordinates	354980.4 E 390291.0 N	Ground Level	21.68 m OD

Sampling			Properties			Strata			Scale 1:50
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		21.68
0.20	B					Rough grass over TOPSOIL: Soft brown slightly gravelly sandy clay with a low cobble content and some rootlets. Gravel is subangular to subrounded fine to coarse of various lithologies.	0.45		21.23
0.20	ES								
0.50	D								
0.50	ES								
1.00	D			26		Soft orangish brown slightly gravelly sandy CLAY with occasional pockets (up to 20mm) of sand. Gravel is subangular to subrounded fine to coarse of various lithologies.			
1.00	ES								
1.20- 1.65					S11	Below 1.10m, firm. Below 1.30m, slightly sandy.			
1.50- 2.00	B								
1.50	D			19					
2.00	D			13		Below 2.00m, stiff.			
2.00- 2.45					S23				
2.10- 2.40	B								
2.50	D								
2.60- 2.90	B								
3.00	D			12					
3.00- 3.45					S22				
3.10- 3.40	B								
3.50	D								
3.60- 3.90	B								
4.00	D			10.0		Below 4.00m, very stiff.			
4.00- 4.45					S32				
4.10- 4.40	B								
4.50	D								
4.60- 4.90	B								
5.00	D								
5.00- 5.45					S38				
						End of Borehole	5.45		16.23

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20		Inspection Pit	IH	G.L.			08/10/19	08:00	1.00					Seepage.
5.45	0.10	Dynamic Sampler	IH	5.45		WET	08/10/19	18:00						

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
Backfill details from base of hole: bentonite seal up to ground level.

Logged by CW

Figure 1 of 1
18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI**
Engineer **WSP**
Borehole **WS8C04A**
Project No **PN194027**

Client **WSP**
National Grid Coordinates **354973.7** E **390283.1** N
Ground Level **21.98** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		21.98
0.10- 0.30	D					Rough grass over TOPSOIL: Brown slightly sandy slightly gravelly silt. Gravel is subangular to subrounded fine to coarse of various lithologies.			
0.20	ES								
0.30- 0.70	D								
0.50	ES								
0.70- 1.10	D			20					
1.00	ES								
1.20- 1.50	D			15					
1.20- 1.65					S7				
1.50- 2.00	D			14			1.50		20.48
						Firm reddish brown mottled grey slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies.			
2.00- 2.50	D								
2.00- 2.45					S12				
2.50- 3.00	D			13					
3.00- 3.40					S50/ 245				
						At 3.45m, obstruction - probable cobble/boulder.			
							3.45		18.53
						End of Borehole			

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	
3.45	0.10	Dynamic Sampler	

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			17/10/19	08:00
3.45		DRY	17/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
The Dynamic Sample Borehole was terminated at 3.45m depth on encountering an obstruction - probable cobble/boulder.

Logged by **MM**
Figure **1 of 1**
18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI**
Engineer **WSP**
Borehole **WS8C05**
Project No **PN194027**

Client **WSP**
National Grid Coordinates **354803.8** E **390159.5** N
Ground Level **23.16** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		23.16
0.00- 0.20	B					Grass over TOPSOIL: Soft dark brown slightly sandy clay with many rootlets.			
0.20- 0.50	B						0.40		22.76
0.20	D								
0.20	ES					Soft yellowish brown mottled orange and white slightly sandy slightly gravelly CLAY. Gravel is subrounded to rounded fine to medium of sandstone, mudstone and coal.			
0.50- 1.20	B								
0.50	D								
0.50	ES								
1.00	D								
1.00	ES								
1.20- 1.90	B								
1.20- 1.65					S6				
1.90- 2.00	D					Below 2.00m, reddish brown.			
2.00- 2.90	B								
2.00- 2.45					S13				
						Below 2.50m, firm.			
2.90- 3.00	D						3.00		20.16
3.00- 3.45					S24	No recovery - rods snapped and sampler was lost down the hole.			
						End of Borehole	4.00		19.16

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	PM
4.00	0.10	Dynamic Sampler	PM

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			08/10/19	08:00
4.00		DRY	08/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
On sample drive from 3.00m to 4.00m, rods snapped at 4.00m with sampler lost down the hole.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.

Logged by **MM**

Figure **1 of 1**
18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8C06** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **354889.5** E **390088.7** N | Ground Level **21.07** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		21.07
0.00- 0.20	B					Grass over TOPSOIL: Soft dark brown slightly sandy clay with many rootlets.			
0.20- 0.50	B								
0.20	D								
0.20	ES						0.40		20.67
0.50- 1.20	B					Firm yellowish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to medium of sandstone, mudstone and coal.			
0.50	D								
0.50	ES								
1.00	D					Below 1.00m, reddish brown.			
1.00	ES								
1.20- 1.90	B								
1.20- 1.65					S12				
1.90- 2.00	D					Below 2.00m, stiff.			
2.00- 2.90	B								
2.00- 2.45					S20				
2.90- 3.00	D								
3.00- 3.90	B								
3.00- 3.45					S25				
						At 3.90m, bands of sand.			
3.90- 4.00	D								
4.00- 4.32					S50/ 165	At 4.32m, obstruction - probable cobble/boulder.			
						End of Borehole	4.32		16.75

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	PM
4.32	0.10	Dynamic Sampler	PM

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			09/10/19	08:00
4.32		DRY	09/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
The Dynamic Sample Borehole was terminated at 4.32m depth on encountering an obstruction - probable cobble/boulder.
A 50mm gas monitoring pipe was installed to 4.00m with a geowrapped slotted section from 1.00m to 4.00m with upright lockable protective cover. Backfill details from base of hole: gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by **MM**

Figure **1 of 1**

18/12/2019

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8C07** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355147.7** E **390264.9** N | Ground Level **20.99** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		20.99
0.20	ES					Rough grass over TOPSOIL: Soft brown slightly gravelly sandy clay with a low cobble content and some rootlets. Gravel is subangular to subrounded fine to coarse of various lithologies.			
0.30	B								
0.30	D								
0.50	ES						0.45		20.54
1.00	ES					Firm orangish brown mottled grey slightly gravelly sandy CLAY with some pockets (up to 30mm) of brown sand). Gravel is subangular to subrounded fine to coarse of various lithologies.			
1.20- 2.00	B								
1.20- 1.65					S8				
2.00- 2.20	D					Below 2.00m, stiff.			
2.00- 2.45					S21				
2.20- 3.00	B								
3.00- 3.20	D								
3.00- 3.45					S23				
3.20- 4.00	B								
4.00- 4.20	D								
4.00- 4.45					S30				
4.20- 5.00	B								
5.00- 5.45					S29				
						End of Borehole	5.45		15.54

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	IH
5.45	0.10	Dynamic Sampler	IH

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			08/10/19	08:00
5.45		DRY	08/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.

Logged by **CW**

Figure **1 of 1**
18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8C08** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355066.3** E **390330.5** N | Ground Level **21.49** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		21.49
0.20	B					Rough grass over TOPSOIL: Soft brown slightly sandy slightly gravelly clay with a low cobble content and some rootlets. Gravel is subangular to subrounded fine to coarse of various lithologies.			
0.20	D								
0.20	ES						0.50		20.99
0.50	B					Firm orangish brown mottled grey slightly sandy slightly gravelly CLAY with some pockets (up to 40mm) of sand and pockets (up to 30mm) of shale fragments. Gravel is subangular to subrounded fine to coarse of various lithologies.			
0.50	D								
0.50	ES								
1.00	D								
1.00	ES								
1.20- 1.65					S12				
1.60- 2.00	B								
2.00- 2.20	D					Below 2.00m, stiff.			
2.00- 2.45					S18				
2.20- 3.00	B								
3.00- 3.20	D								
3.00- 3.45					S20				
3.20- 4.00	B								
4.00- 4.20	D					Below 4.00m, very stiff.			
4.00- 4.45					S31				
4.20- 5.00	B								
5.00- 5.45					S35				
						End of Borehole	5.45		16.04

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	IH
5.45	0.10	Dynamic Sampler	IH

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			07/10/19	08:00
5.45		DRY	07/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
A 50mm gas monitoring pipe was installed to 5.45m with a geowrapped slotted section from 1.00m to 5.45m with upright lockable protective cover. Backfill details from base of hole: gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Logged by **CW**

Figure **1 of 1**

18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8D01** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355170.9** E **390381.1** N | Ground Level **21.43** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		21.43
0.20	ES					**TOPSOIL: Soft brown slightly sandy slightly gravelly clay with some rootlets. Gravel is subangular to subrounded fine to coarse of various lithologies.**	0.40		21.03
0.40	D								
0.50	ES					**Firm brown mottled orange slightly gravelly CLAY with a low cobble content. Gravel is subangular to subrounded fine to coarse of various lithologies.**			
0.80	D								
1.00	ES								
1.20- 1.65					S12				
1.65- 2.00	B								
1.65- 2.00	D								
2.00- 2.30	D					**Below 2.00m, stiff.**			
2.00- 2.45					S20				
2.30- 3.00	B								
3.00- 3.30	D								
3.00- 3.45					S28				
3.30- 4.00	B								
4.00- 4.30	D								
4.00- 4.45					S28				
4.30- 5.00	B					**Below 4.50m, occasional pockets (up to 150mm) of brown fine to coarse sand.**			
5.00- 5.45					S27				
						End of Borehole	5.45		15.98

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	
5.45	0.10	Dynamic Sampler	

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			17/10/19	08:00
5.45		DRY	17/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks AGS **Inspection pit hand excavated to 1.20m depth and no services were found.**
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.

Logged by **MM**

Figure **1 of 1**

18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI**
Engineer **WSP**
Borehole **WS8D02**
Project No **PN194027**

Client **WSP**
National Grid Coordinates **355309.7** E **390322.0** N
Ground Level **20.69** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		20.69
0.00- 0.30	B					TOPSOIL: Dark brown clayey sand with some rootlets.			
0.00- 0.30	D								
0.20	ES						0.30		20.39
0.30- 0.80	B					Firm grey sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone, mudstone and quartzite.			
0.30- 0.80	D								
0.50	ES								
0.80- 1.20	B						0.80		19.89
0.80- 1.20	D					Firm to stiff brown sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone, mudstone, quartzite and coal.			
1.00	ES								
1.20- 2.00	B								
1.20- 2.00	D								
1.20- 1.65					S10				
2.00- 2.33					S29				
						At 2.45m, obstruction - probable cobble/boulder.			
						End of Borehole	2.45		18.24

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	IH
2.45	0.10	Dynamic Sampler	IH

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			11/10/19	08:00
2.45			11/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
Dynamic sample borehole terminated at 2.45m depth on encountering an obstruction - probable cobble/boulder. Rig moved to WS8D02A.

Logged by **FKT**
Figure **1 of 1**
18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8D02A** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355311.5** E **390321.2** N | Ground Level **20.63** m OD

Scale 1:50

Sampling Depth	Sample Type	Depth Cased & (to Water)	Properties Strength kPa	w %	SPT N	Strata Description	Depth	Legend	Level m OD
						TOPSOIL: Dark brown clayey sand with some rootlets.	**G.L.**		**20.63**
						Firm grey sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone, mudstone and quartzite.	**0.30**		**20.33**
						Firm to stiff brown sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone, mudstone, quartzite and coal.	**0.80**		**19.83**
2.00- 3.00	**B**								
2.00- 3.00	**D**								
3.00- 4.00	**B**					**Below 3.00m, stiff.**			
3.00- 4.00	**D**								
3.00- 3.45					**S18**				
4.00- 5.00	**B**								
4.00- 5.00	**D**								
4.00- 4.45					**S29**				
5.00- 5.45					**S24**				
						End of Borehole	**5.45**		**15.18**

Boring

Depth	Hole Dia	Technique	Crew
1.20		**Inspection Pit**	**IH**
5.45	**0.10**	**Dynamic Sampler**	**IH**

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			**11/10/19**	**08:00**
5.45		**DRY**	**11/10/19**	**18:00**

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks **Inspection pit hand excavated to 1.20m depth and no services were found.**

Logged by **FKT**

Figure **1 of 1**

18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI**
Engineer **WSP**
Borehole **WS8D03**
Project No **PN194027**

Client **WSP**
National Grid Coordinates **355222.4** E **389926.9** N
Ground Level **20.66** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
						Grass over TOPSOIL: Soft dark brown slightly sandy clay with some rootlets.	**G.L.**		**20.66**
							0.40		**20.26**
0.50	**B**					**Soft to firm brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse fine to coarse of sandstone and coal.**			
0.50	**ES**								
1.00	**B**								
1.00	**ES**								
1.20- 1.90	**B**								
1.20- 2.00	**D**								
1.20- 1.65					**S10**	**Below 1.50m, occasional bands of fine to coarse sand.**			
2.00- 2.90	**B**					**Below 2.00m, stiff.**			
2.00- 3.00	**D**								
2.00- 2.45					**S18**				
3.00- 3.90	**B**								
3.00- 3.45					**S16**				
3.90- 4.00	**D**								
4.00- 4.90	**B**								
4.00- 4.45					**S20**				
4.90- 5.00	**D**								
5.00- 5.45					**S28**				
						End of Borehole	**5.45**		**15.21**

Boring

Depth	Hole Dia	Technique	Crew
1.20		**Inspection Pit**	
5.45	**0.10**	**Dynamic Sampler**	

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			**17/10/19**	**08:00**
5.45		**DRY**	**17/10/19**	**18:00**

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks **Inspection pit hand excavated to 1.20m depth and no services were found.**
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.

Logged by **MM**

Figure **1 of 1**
18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI**
Engineer **WSP**
Borehole **WS8D04**
Project No **PN194027**

Client **WSP**
National Grid Coordinates **355211.0** E **390111.1** N
Ground Level **21.07** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		21.07
0.00- 0.20	B					Grass over TOPSOIL: Soft dark brown slightly sandy clay with some rootlets.			
0.20- 0.50	B								
0.20	ES						0.40		20.67
0.50- 1.20	B					Firm yellowish brown sandy CLAY.			
0.50	D						0.60		20.47
0.50	ES					Firm reddish brown slightly sandy gravelly CLAY. Gravel is subangular to rounded fine to coarse of mudstone, coal and quartz.			
1.00	ES								
1.20- 1.90	D								
1.20- 1.65					S8				
1.90- 2.00	D					Below 2.00m, stiff.			
2.00- 2.90	B								
2.00- 2.45					S20				
2.90- 3.00	D								
3.00- 3.90	B								
3.00- 3.45					S18				
3.90- 4.00	D					At 4.41m, obstruction - probable cobble/boulder.			
4.00- 4.41					S50/ 260				
						End of Borehole	4.41		16.66

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	IH
4.41	0.10	Dynamic Sampler	IH

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			11/10/19	08:00
4.41		DRY	11/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
Dynamic sample borehole terminated at 4.41m depth on encountering an obstruction - probable cobble/boulder.
A 50mm gas monitoring pipe was installed to 4.00m with a geowrapped slotted section from 1.00m to 4.00m with upright lockable protective cover. Backfill details from base of hole: gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by **MM**

Figure **1 of 1**
18/12/2019

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI**
Engineer **WSP**
Borehole **WS8D05**
Project No **PN194027**

Client **WSP**
National Grid Coordinates **355321.6** E **390147.1** N
Ground Level **20.77** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		20.77
0.00- 0.20	B					Grass over TOPSOIL: Soft dark brown slightly sandy clay with some rootlets.			
0.20- 0.50	B								
0.20	ES								
0.50- 1.20	B						0.50		20.27
0.50	D					Firm reddish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and quartz.			
0.50	ES								
1.00	ES								
1.20- 1.90	B								
1.20- 1.65					S13				
1.90- 2.00	D					Below 2.00m, stiff.			
2.00- 2.90	B								
2.00- 2.45					S23				
2.90- 3.00	D								
3.00- 3.90	B								
3.00- 3.45					S21				
3.90- 4.00	B					Below 4.00m, stiff to very stiff.			
4.00- 4.70	B								
4.00- 4.45					S30				
4.70- 4.80	D								
4.80- 5.12					S50/ 170				
							5.12		15.65
						End of Borehole			

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	IH
5.12	0.10	Dynamic Sampler	IH

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			11/10/19	08:00
5.12		DRY	11/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.
A 50mm gas monitoring pipe was installed to 4.80m with a geowrapped slotted section from 1.00m to 4.80m with upright lockable protective cover. Backfill details from base of hole: gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Logged by **MM**
Figure **1 of 1**
18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI** | Engineer **WSP** | **Borehole** **WS8D06** | Project No **PN194027**

Client **WSP** | National Grid Coordinates **355369.2** E **389959.2** N | Ground Level **20.39** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		20.39
0.25	ES					Grass over TOPSOIL: Soft dark brown slightly sandy clay with some rootlets.			
0.50	B						0.50		19.89
0.50	ES					Soft to firm brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to medium of various lithologies.			
1.00	B								
1.00	ES								
1.20- 1.90	B								
1.20- 1.65					S4				
1.90- 2.00	D					Below 2.00m, occasional bands (up to 100mm) of fine to coarse sand.			
2.00- 2.90	B								
2.00- 2.45					S11				
2.90- 3.00	D					Below 3.00m, stiff.			
3.00- 3.90	B								
3.00- 3.45					S18				
3.90- 4.00	D								
4.00- 4.90	B								
4.00- 4.45					S29				
4.90- 5.00	D					Below 5.00m, very stiff.			
5.00- 5.45					S32				
						End of Borehole	5.45		14.94

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	
5.45	0.10	Dynamic Sampler	

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			17/10/19	08:00
5.45		DRY	17/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks AGS **Inspection pit hand excavated to 1.20m depth and no services were found.**
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.

Logged by **MM**

Figure **1 of 1**
18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI**
Engineer **WSP**
Borehole **WS8D07**
Project No **PN194027**

Client **WSP**
National Grid Coordinates **355192.7** E **390215.8** N
Ground Level **20.65** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		20.65
0.00- 0.40	B					TOPSOIL: Soft dark brown sandy gravelly clay with many rootlets.			
0.00- 0.40	D								
0.20	ES								
0.40- 0.70	B					Firm grey sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone and quartzite.	0.40		20.25
0.40- 0.70	D								
0.50	ES						0.70		19.95
0.70- 1.20	B					Firm to stiff brown sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse of sandstone, mudstone, quartzite and coal.			
0.70- 1.20	D								
1.00	ES								
1.20- 2.00	B								
1.20- 2.00	D								
1.20- 1.65					S10				
2.00- 3.00	B					Below 2.00m, stiff.			
2.00- 3.00	D								
2.00- 2.45					S23				
3.00- 4.00	B								
3.00- 4.00	D								
3.00- 3.45					S26				
4.00- 5.00	B					Below 4.00m, stiff to very stiff. Between 4.10-4.30m, band of fine sand.			
4.00- 5.00	D								
4.00- 4.45					S30				
5.00- 5.45					S33				
						End of Borehole	5.45		15.20

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	IH
5.45	0.10	Dynamic Sampler	IH

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			11/10/19	08:00
5.45		DRY	11/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks AGS **Inspection pit hand excavated to 1.20m depth and no services were found.**
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.

Logged by **FKT**

Figure **1 of 1**
18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

BOREHOLE RECORD - Dynamic Sampler

Project **OMEGA DEVELOPMENT GI**
Engineer **WSP**
Borehole **WS8D08**
Project No **PN194027**

Client **WSP**
National Grid Coordinates **355270.4** E **390021.0** N
Ground Level **21.69** m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		21.69
0.20	ES					Rough grass over TOPSOIL: Soft brown slightly sandy slightly gravelly clay with some rootlets. Gravel is subangular to subrounded fine to coarse of various lithologies.			
0.50	ES						0.50		21.19
0.60	D					Brown mottled grey fine to coarse SAND.			
0.80	D						0.80		20.89
1.00	ES					Soft to firm brown mottled orange slightly sandy CLAY with a low cobble content.			
1.20- 1.50	D								
1.20- 1.65					S6				
1.50- 2.00	B								
2.00- 2.30	D					Below 2.00m, stiff, mottled grey, slightly gravelly. Gravel is subangular to subrounded fine to coarse of various lithologies.			
2.00- 2.45					S23				
2.30- 3.00	B								
3.00- 3.30	D					Below 3.00m, occasional pockets (up to 100mm) of sandy clay.			
3.00- 3.45					S18				
3.30- 4.00	B								
4.00- 4.30	D								
4.00- 4.45					S14				
4.30- 5.00	B								
5.00- 5.45					S50/ 295	Below 5.00m, very stiff.			
						End of Borehole	5.45		16.24

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	
5.45	0.10	Dynamic Sampler	

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			17/10/19	08:00
5.45		DRY	17/10/19	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars.

Logged by **MM**

Figure **1 of 1**
18/12/2019

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

geotechnics

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth	Level	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'
	m bgl	m OD			0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10 20 30 40 50
WS8A01	1.20	24.69	S	-	2	3	3	3	5	5	16	*
WS8A01	2.00	23.89	S	-	3	3	5	6	8	7	26	*
WS8A01	3.00	22.89	S	-	3	3	4	5	6	6	21	*
WS8A01	4.00	21.89	S	-	3	3	3	5	5	5	18	*
WS8A01	5.00	20.89	S	-	3	3	3	5	5	7	20	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8A02	1.20	24.03	S	-	2	1	2	3	2	4	11	*
WS8A02	2.00	23.23	S	-	2	3	3	4	5	5	17	*
WS8A02	3.00	22.23	S	-	3	4	4	4	6	5	19	*
WS8A02	4.00	21.23	S	-	3	3	3	5	5	6	19	*
WS8A02	5.00	20.23	S	-	3	4	3	4	5	7	19	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth	Level	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'
	m bgl	m OD			0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10 20 30 40 50
WS8A03	1.20	23.71	S	-	1	2	1	3	3	3	10	*
WS8A03	2.00	22.91	S	-	2	2	3	3	5	6	17	*
WS8A03	3.00	21.91	S	-	3	4	4	5	6	6	21	*
WS8A03	4.00	20.91	S	-	3	3	3	6	6	8	23	*
WS8A03	5.00	19.91	S	-	6	8	8	9	17	16	50	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8B01	1.20	20.67	S	-	1	2	3	3	4	5	15	*
WS8B01	2.00	19.87	S	-	2	2	3	4	4	5	16	*
WS8B01	3.00	18.87	S	-	12/43		50/32				50/32	>

Driller	Steve Lowery
Hammer No.	AR2636
Energy Ratio, Er (%)	71.00
Calibration Date	15/02/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8B02	1.20	21.08	S	-	2	3	3	3	4	5	15	*
WS8B02	2.00	20.28	S	-	2	3	3	3	5	5	16	*
WS8B02	3.00	19.28	S	-	1	2	3	3	5	8	19	*
WS8B02	4.00	18.28	S	-	2	3	4	4	5	6	19	*

Driller	Steve Lowery
Hammer No.	AR2636
Energy Ratio, Er (%)	71.00
Calibration Date	15/02/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8B03	1.20	20.51	S	-	2	2	3	3	4	3	13	*
WS8B03	2.00	19.71	S	-	4	3	4	7	6	7	24	*
WS8B03	3.00	18.71	S	-	4	5	7	6	6	7	26	*
WS8B03	4.00	17.71	S	-	4	4	5	8	8	8	29	*
WS8B03	5.00	16.71	S	-	6	5	6	6	8	7	27	*

Driller	John Price
Hammer No.	DART150
Energy Ratio, Er (%)	78.00
Calibration Date	12/04/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8B04	1.20	21.64	S	-	1	2	1	3	2	3	9	*
WS8B04	2.00	20.84	S	-	2	3	4	4	5	5	18	*
WS8B04	3.00	19.84	S	-	4	5	5	6	7	7	25	*
WS8B04	4.00	18.84	S	-	4	4	4	4	4	5	17	*
WS8B04	5.00	17.84	S	-	2	3	3	4	3	5	15	*

Driller	John Price
Hammer No.	DART150
Energy Ratio, Er (%)	78.00
Calibration Date	12/04/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10 20 30 40 50
WS8B05	1.20	20.08	S	-	1	2	1	2	2	2	7	*
WS8B05	2.00	19.28	S	-	2	2	2	5	5	5	17	*
WS8B05	3.00	18.28	S	-	5	6	7	8	9	8	32	*
WS8B05	4.00	17.28	S	-	3	3	5	5	6	6	22	*
WS8B05	5.00	16.28	S	-	3	4	4	5	5	5	19	*

Driller	John Price
Hammer No.	DART150
Energy Ratio, Er (%)	78.00
Calibration Date	12/04/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8B06	1.20	21.21	S	-	1	1	2	2	3	4	11	*
WS8B06	2.00	20.41	S	-	1	2	2	3	4	5	14	*
WS8B06	3.00	19.41	S	-	2	3	4	7	9	11	31	*
WS8B06	4.00	18.41	S	-	2	3	4	4	5	6	19	*

Driller	Steve Lowery
Hammer No.	AR2636
Energy Ratio, Er (%)	71.00
Calibration Date	15/02/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth	Level	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'
	m bgl	m OD			0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10 20 30 40 50
WS8B07	2.00	20.17	S	-	2	3	5	6	7	9	27	*
WS8B07	3.00	19.17	S	-	3	5	9	9	8	9	35	*
WS8B07	4.00	18.17	S	-	2	3	3	4	4	6	17	*

Driller	Steve Lowery
Hammer No.	AR2636
Energy Ratio, Er (%)	71.00
Calibration Date	15/02/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8C01	1.20	18.04	S	-	1	1	1	2	3	3	9	*
WS8C01	2.00	17.24	S	-	3	3	4	4	4	6	18	*
WS8C01	2.80	16.44	S	-	3	3	4	3	4	5	16	*
WS8C01	3.60	15.64	S	-	15	10/30	38	12/15			50/90	>

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8C02	1.20	19.48	S	-	2	2	2	2	3	3	10	*
WS8C02	2.00	18.68	S	-	3	3	3	4	6	5	18	*
WS8C02	3.00	17.68	S	-	4	4	4	4	6	8	22	*
WS8C02	4.00	16.68	S	-	3	4	3	5	6	7	21	*
WS8C02	5.00	15.68	S	-	6	6	9	12	14	15/50	50/275	>

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8C03	1.20	19.30	S	-	2	3	4	3	4	4	15	*
WS8C03	2.00	18.50	S	-	3	3	4	4	5	5	18	*
WS8C03	2.60	17.90	S	-	3	4	5	6	8	8	27	*
WS8C03	3.70	16.80	S	-	6	5	7	13	13	17	50	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8C04	1.20	20.48	S	-	2	2	2	2	3	4	11	*
WS8C04	2.00	19.68	S	-	2	3	4	5	6	8	23	*
WS8C04	3.00	18.68	S	-	3	3	4	5	5	8	22	*
WS8C04	4.00	17.68	S	-	4	5	6	7	9	10	32	*
WS8C04	5.00	16.68	S	-	6	7	7	9	10	12	38	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N'
WS8C04A	1.20	20.78	S	-	1	2	1	2	2	2	7	*
WS8C04A	2.00	19.98	S	-	2	2	2	3	3	4	12	*
WS8C04A	3.00	18.98	S	-	4	5	5	14	21	10/20	50/245	>

Uncorrected SPT 'N' scale: 10 20 30 40 50

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8C05	1.20	21.96	S	-	1	2	1	2	1	2	6	*
WS8C05	2.00	21.16	S	-	1	2	2	2	4	5	13	*
WS8C05	3.00	20.16	S	-	4	5	5	5	6	8	24	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8C06	1.20	19.87	S	-	2	3	3	3	3	3	12	*
WS8C06	2.00	19.07	S	-	3	3	3	4	6	7	20	*
WS8C06	3.00	18.07	S	-	2	4	4	6	6	9	25	*
WS8C06	4.00	17.07	S	-	11	12	18	25	7/15		50/165	>

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8C07	1.20	19.79	S	-	1	2	1	2	3	2	8	*
WS8C07	2.00	18.99	S	-	3	3	4	4	5	8	21	*
WS8C07	3.00	17.99	S	-	3	4	4	6	6	7	23	*
WS8C07	4.00	16.99	S	-	4	5	6	7	9	8	30	*
WS8C07	5.00	15.99	S	-	5	5	5	7	8	9	29	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth	Level	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'
	m bgl	m OD			0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10 20 30 40 50
WS8C08	1.20	20.29	S	-	2	2	2	3	3	4	12	*
WS8C08	2.00	19.49	S	-	2	3	3	4	5	6	18	*
WS8C08	3.00	18.49	S	-	2	3	3	4	6	7	20	*
WS8C08	4.00	17.49	S	-	4	4	6	7	9	9	31	*
WS8C08	5.00	16.49	S	-	7	6	6	8	10	11	35	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth	Level	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'
	m bgl	m OD			0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10 20 30 40 50
WS8D01	1.20	20.23	S	-	1	1	2	3	3	4	12	*
WS8D01	2.00	19.43	S	-	3	3	3	4	6	7	20	*
WS8D01	3.00	18.43	S	-	5	6	6	6	8	8	28	*
WS8D01	4.00	17.43	S	-	5	5	6	6	8	8	28	*
WS8D01	5.00	16.43	S	-	5	5	6	7	7	7	27	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8D02	1.20	19.49	S	-	1	2	2	2	3	3	10	*
WS8D02	2.00	18.69	S	-	25/30		11	6	6	6	29	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8D02A	3.00	17.63	S	-	3	3	3	4	5	6	18	*
WS8D02A	4.00	16.63	S	-	3	4	4	6	9	10	29	*
WS8D02A	5.00	15.63	S	-	4	5	5	6	6	7	24	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8D03	1.20	19.46	S	-	1	1	2	2	3	3	10	*
WS8D03	2.00	18.66	S	-	2	2	3	4	5	6	18	*
WS8D03	3.00	17.66	S	-	2	2	3	4	4	5	16	*
WS8D03	4.00	16.66	S	-	4	4	4	5	5	6	20	*
WS8D03	5.00	15.66	S	-	4	5	6	6	7	9	28	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8D04	1.20	19.87	S	-	1	1	1	2	2	3	8	*
WS8D04	2.00	19.07	S	-	3	3	3	5	5	7	20	*
WS8D04	3.00	18.07	S	-	3	2	3	4	5	6	18	*
WS8D04	4.00	17.07	S	-	6	6	15	14	13	8/35	50/260	>

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8D05	1.20	19.57	S	-	2	2	3	3	3	4	13	*
WS8D05	2.00	18.77	S	-	3	3	4	5	6	8	23	*
WS8D05	3.00	17.77	S	-	3	3	4	5	6	6	21	*
WS8D05	4.00	16.77	S	-	5	6	6	7	8	9	30	*
WS8D05	4.80	15.97	S	-	6	7	15	24	11/20		50/170	>

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8D06	1.20	19.19	S	-	1	1	1	1	1	1	4	*
WS8D06	2.00	18.39	S	-	2	2	2	3	3	3	11	*
WS8D06	3.00	17.39	S	-	3	3	3	5	5	5	18	*
WS8D06	4.00	16.39	S	-	5	6	7	7	7	8	29	*
WS8D06	5.00	15.39	S	-	6	6	7	8	8	9	32	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8D07	1.20	19.45	S	-	1	2	2	2	2	4	10	*
WS8D07	2.00	18.65	S	-	3	3	5	5	6	7	23	*
WS8D07	3.00	17.65	S	-	4	4	5	6	7	8	26	*
WS8D07	4.00	16.65	S	-	5	5	6	6	8	10	30	*
WS8D07	5.00	15.65	S	-	5	5	6	7	8	12	33	*

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - *SPT Results Summary*

Project OMEGA DEVELOPMENT GI **Project No** PN194027

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive 0-75 (mm)	Seating Drive 75-150 (mm)	Test Drive 0-75 (mm)	Test Drive 75-150 (mm)	Test Drive 150-225 (mm)	Test Drive 225-300 (mm)	SPT 'N' Value	Uncorrected SPT 'N' 10 20 30 40 50
WS8D08	1.20	20.49	S	-	1	1	1	1	2	2	6	*
WS8D08	2.00	19.69	S	-	2	2	4	4	7	8	23	*
WS8D08	3.00	18.69	S	-	4	4	4	4	5	5	18	*
WS8D08	4.00	17.69	S	-	2	3	3	3	4	4	14	*
WS8D08	5.00	16.69	S	-	8	8	10	10	15	15/70	50/295	>

Driller	Ian Hilton
Hammer No.	DART428
Energy Ratio, Er (%)	75.00
Calibration Date	01/07/2019

Remarks
Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
C - SPT with cone
L - Split Spoon with liner used

GEOTECHNICS

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

James Fisher Testing Services Ltd
40A Hardwick Grange
Ruby House
Woolston
Warrington
WA1 4RF

SPT Hammer Ref:	DART150
Test Date:	12/04/2019
Report Date:	12/04/2019
File Name:	DART150.spt
Test Operator:	OT

Instrumented Rod Data

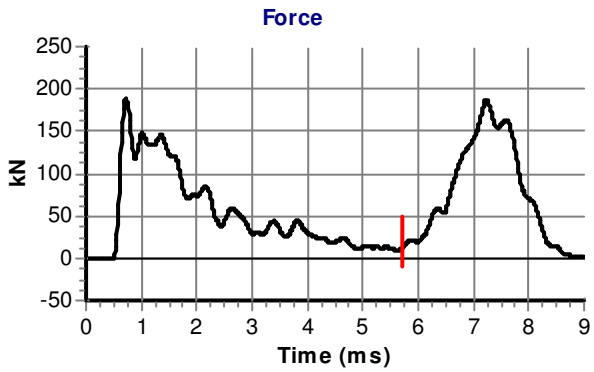
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.9
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	63175
Accelerometer No.2:	63176

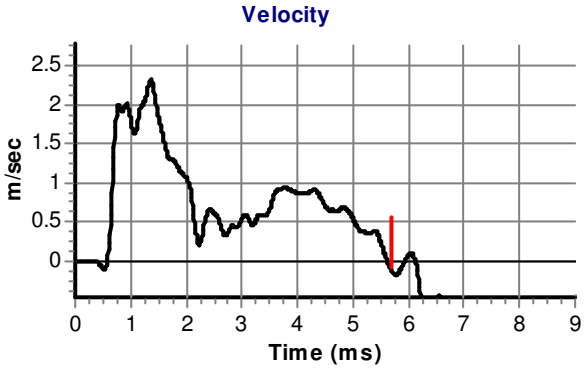
SPT Hammer Information

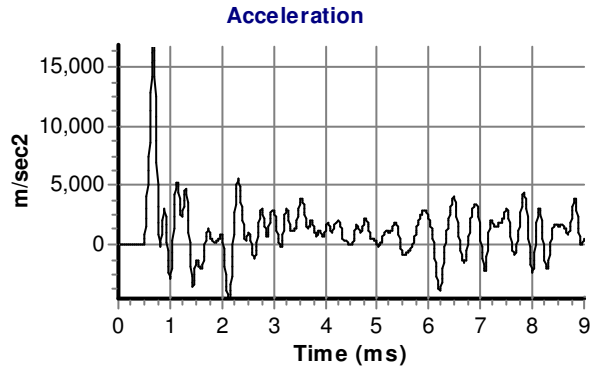
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	14.5

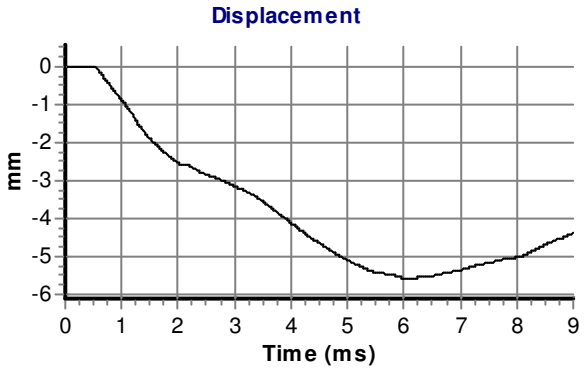
Comments / Location

Client - Strata Renewables
Location - JFTS Laboratory
Hammer Type - Window Sampler









Calculations

Area of Rod A (mm2):	1021
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	371

Energy Ratio E_r (%): **78**

[redacted]

Signed: Oliver Turpin
Title: Team Leader

ARCHWAY ENGINEERING
AINLEYS INDUSTRIAL ESTATE
ELL-AND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref: DART426
Test Date: 01/07/2019

Report Date: 01/07/2019
File Name: DART428.spt
Test Operator:

Instrumented Rod Data

Diameter dr (mm): 54
Wail Thickness tr (mm): 6.3
Assumed Modulus Ea (GPa): 200
Accelerometer No.l: 9080
Accelerometer No.2: 11609

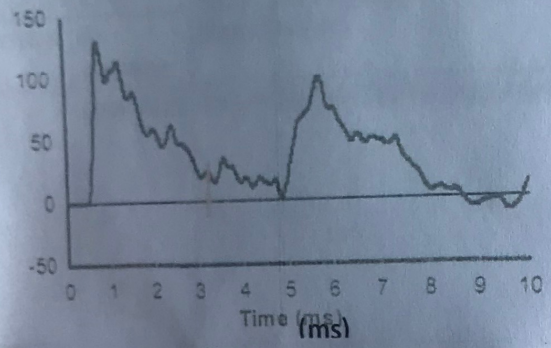
SPT Hammer Information

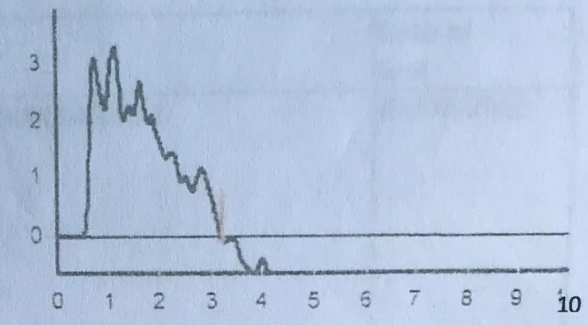
Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 10.0

Comments / Location

Ve ioc;ty

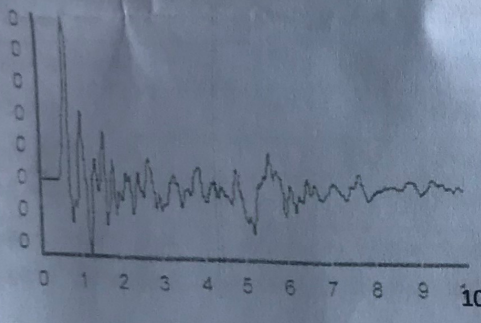
Force



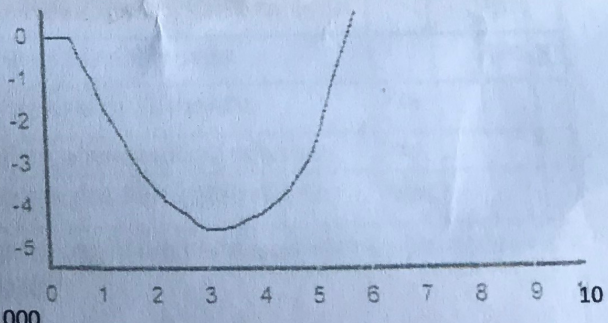


Time (ms)

Acceleration



Displacement



2C.coc
15,000 u 10.000
5. coc
-5.000
-10.000
25.000

Time (ms)

Time (ms)

Calculations

Area of Rcd A (mm2): 944
Theoretical Energy Etheor (J): 473
Measured Energy Emeas (J): 353
Signed:

[redacted]

M,GARDNER Energy Ratio E r (%): 75 Title:

The recommended calibration interval is 12 months

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING (UK) LTD
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref:	AR2636
Test Date:	15/02/2019
Report Date:	15/02/2019
File Name:	AR2636.spt
Test Operator:	CM

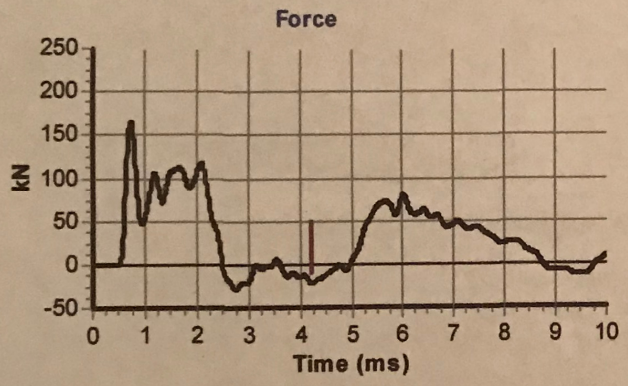
Instrumented Rod Data

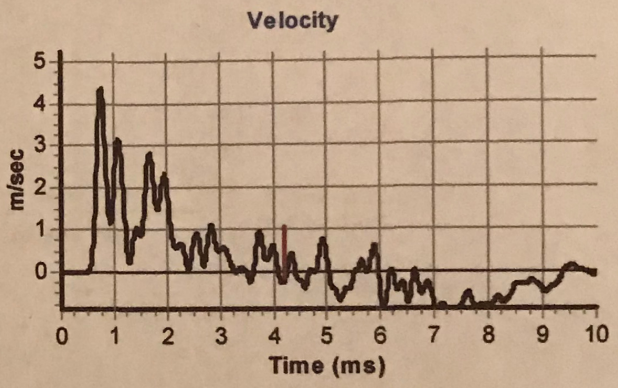
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	7080
Accelerometer No.2:	11609

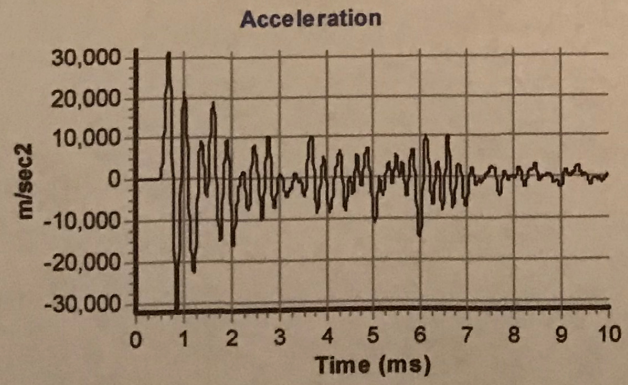
SPT Hammer Information

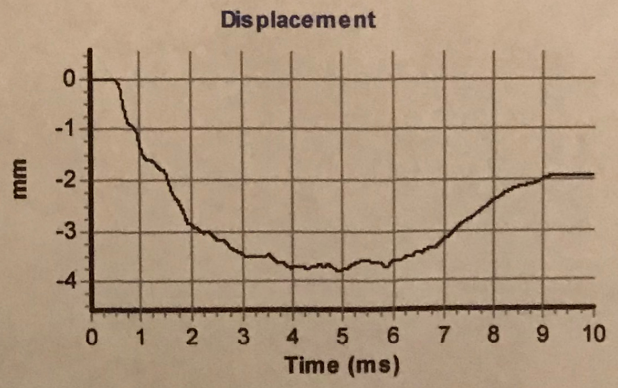
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

Comments / Location









Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	337

Energy Ratio E_r (%): **71**

[redacted]

Title: FITTER

The recommended calibration interval is 12 months

APPENDIX 7

Lankelma Limited Report - Static Cone Penetration and Pressuremeter Tests
&
CPT Inspection Pit Records

LANKELMA Limited
Cold Harbour Barn, Cold Harbour Lane, Iden
East Sussex, TN31 7UT
T: +44 (0)1797 280050
E: info@lankelma.com
www.lankelma.com

WARRINGTON

SOIL INVESTIGATION

CPT REPORT

Cone penetration test
Full displacement pressuremeter test
Geotechnical data interpretation

Project ref.: P-107284-10




PROJECT:	Warrington

CLIENT:	Geotechnics

FIELDWORK

CPT rig(s)	18.0-tonne track-truck mounted CPT unit (UK22)
Date fieldwork started	25th September 2019
Date fieldwork completed	1st October 2019
Lankelma's representative	Emma Stickland
Client's representative	Connor Southall

REPORT

Status	Revision	Action	Date	Name
Revised	00	**Completed**	09/10/19	Chris Player
		Checked	09/10/19	Emma Stickland
		Approved	09/10/19	Joseph Hobbs
Revised	01	**Completed**	21/11/19	Chris Player
		Checked	21/11/19	Emma Stickland
		Approved	21/11/19	Joseph Hobbs
Revised	02	**Completed**	20/11/19	Joseph Hobbs
		Checked	20/11/19	Emma Stickland
		Approved	20/11/19	Joseph Hobbs
Final	03	**Completed**	03/01/20	Chris Player
		Checked	03/01/20	Emma Stickland
		Approved	03/01/20	Joseph Hobbs

CONTENTS

1 INTRODUCTION

At the request of Geotechnics, a soils investigation was carried out on project *Warrington*.

Site location (in the general region of):

Omega Boulevard
Warrington
WA5 3UG

2 DISCLAIMER

The investigation information, raw data and interpretations provided in this report are for the sole benefit of the Client identified at the front of the report.

Lankelma has exercised reasonable skill, care and diligence in the fieldwork and preparation of this report. This report has been completed based on information available to Lankelma at the time of preparation. The measurement and interpreted data in this report do not constitute recommendations for design purposes. An appropriately qualified person must review and interpret the data given in this report, together with any assumptions we have made that affect the data, before using the data for design or recommendation.

Lankelma accepts no responsibility for the accuracy or appropriateness of any assumptions, derived soil parameters, soil descriptions or soil unit boundaries contained in this report.

3 COMPLETED WORKS

- 19 nr. cone penetration tests (CPTu) with piezo measurement;
- 10 nr. full displacement pressuremeter tests (FDPM); and
- Factual report plus additional geotechnical data interpretation.

The *Summary Tables* section contains tabulated summaries of the works completed together with analysis results where necessary.

4 FIELDWORK GENERAL

Fieldwork was performed with an 18.0-tonne track-truck mounted CPT unit (UK22) equipped with a 17.5-tonne capacity hydraulic ram set.

The Client was responsible for the positioning and re-survey of all investigative locations.

The target depth for the investigation was 12 m below ground level. Table 1 details the final test depths and reasons for test termination (r*efusal factor). W*here penetration refusal was

encountered the termination depth was advised to, and agreed with, the Client's on-site representative.

5 CONE PENETRATION TESTS

Cone penetration testing was carried out in general accordance with BS ISO 22476-1:2012.

Penetrometer measurements included cone tip resistance, friction sleeve resistance and dynamic pore water pressure sampled at a 10 mm resolution.

The penetrometer was calibrated in accordance with BS8422:2003 and ASTM E74-13a. The management of calibration records is in accordance with ISO 10012. Copies of all calibration certificates for the cones used are provided in Appendix B.

The piezometer filter element was in the u_2 position and was vacuum saturated. The pore pressure system was saturated with de-aired 10000 cSt silicone oil.

5.1 CPT DATA REDUCTION AND PRESENTATION

The CPT results are presented in Appendix C. The corrected cone resistance (q_t), local side friction (f_s), dynamic pore water pressure (u_2), friction ratio (R_f) and inclination are all presented against depth and elevation in accordance BS ISO 22476-1:2012. CPT data and the associated derived geotechnical parameters are included in the AGS 3.1 and 4.0 data files provided.

The cone tip resistance and sleeve force measurements were converted to pressures using the nominal dimensions of the penetrometer.

For piezocone tests the corrected tip resistance was calculated according to the formula:

$$q_t = q_c + u_2 \times (1 - a)$$

Where a is the 'area ratio' and (1- a) is the proportion of cross-sectional area between the cone tip and cone body where pore pressures (positive or negative) can act to add or subtract from the total external axial force on the tip. The difference between measured and corrected values is largest in low strength soils with large excess pore pressures. The relationship between measured resistance, excess pressure and correction difference is described by the curves in the following chart for alpha factor of 0.8:

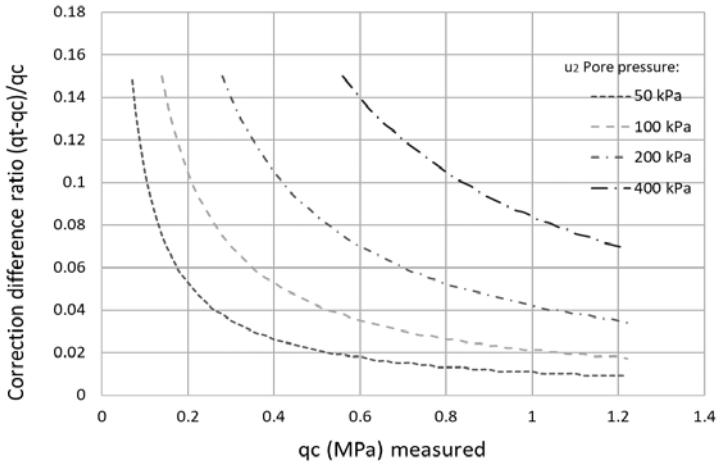


Figure 5-1 corrected tip resistance fraction with measured tip resistance

Penetration length readings were corrected for inclination and sleeve readings were depth corrected for the dimensional offset between cone tip and sleeve during post processing. An additional shift of -80 mm was applied to the sleeve to account for tip failure zone offset (see 'CPT Interpretation Notes'). 'Rod spikes', artefacts of the pause for push rod addition, were filtered from the cone tip and sleeve data.

The raw (or corrected) data are presented in Appendix C.

Geotechnical parameters appropriate for drained and undrained cone penetration conditions were derived for corresponding drained and undrained derived soil behaviour types (SBTs) respectively, however, to account for uncertainty in the SBT correlation with drainage behaviour, all parameters were derived over a range of transitional soils within the range $2.4 < Ic < 2.7$ (see section 6.3).

In general, the engineering parameters derived are intended for non-cemented predominantly silicate soils.

5.2 IN-SITU STRESS CONDITIONS

The in-situ total and effective stress state was calculated based on an assumed total unit weight of 17 kN/m^3 above the principal phreatic surface and 18 kN/m^3 below.

The depth of the principal phreatic surface, or groundwater table, was assumed at an arbitrary value of 3.0 mBGL for parameter calculations.

Note: The term phreatic surface is used here, however when it is based on piezocone measurements it is assumed that the piezometric level (under hydrostatic conditions) and groundwater table coincide. The phreatic or piezometric surface reported is intended to provide information about the assumed pore pressure distribution for calculation of relevant derived parameters from the CPT and may not represent the true position of the groundwater table or perched water bodies. Complex groundwater pressure distributions, if they are observed from the measurements, will be applied to relevant derived parameters.

5.3 SOIL BEHAVIOUR TYPE

The soil behaviour type (SBT) was interpreted using the Robertson (1990) classification system based on the normalised cone resistance (Qt) and normalised friction sleeve resistance (Fr) for silicate soils.

While the classification based on normalised parameters is considered more accurate, particularly at depths exceeding 15-20 m, the classification is often significantly in error (artificially granular/drained) at very shallow depth (< 1-3 m). The error at shallow depth is associated with the potentially large difference between the estimated vertical effective stress (applied in normalisation) and the unknown horizontal stress influencing penetration resistance.

Robertson (2010) proposed a non-normalised version of the 1990 chart which uses dimensionless cone resistance (q_c/Pa) and friction ratio, Rf. The classification according to this chart can be more reliable at shallow depth and has been plotted as an approximate SBT index (discussed below) for comparison to the normalised classification.

The SBT chart is provided in Appendix B – *General Information,* titled 'CPT Soil Behaviour Type Chart'.

It should be noted that the SBT classification provides the general soil 'type' which typically provides a similar CPT measurement range of q_c and f_s. Correspondingly, it will also show biased towards the soil fraction that dominates the mechanical behaviour. While the repeatability and behavioural bias of the SBT is usually beneficial, the classification is not always an appropriate substitute for classification based on grain-size distribution.

The results are presented on the plots of Appendix D.

5.4 SOIL BEHAVIOUR TYPE INDEX – I_C

The main trend in soil behaviour type (SBT) variation can be expressed a continuous index, I_C, proposed by Robertson and Wride (1998) based on a similar index proposed by Jefferies and Davies (1993). The index provides a continuous profile of SBT variation with depth for end-user analysis of soil units and variation within units.

The equivalent non-normalised version, as proposed by Robertson (2010), is provided for comparison.

The basis of I_c and its approximation of the original chart classification zones may be seen from Appendix B figure 'CPT Soil Behaviour Type Chart'. The method does not identify zones 1 (*sensitive fine grained)* and zones 8 & 9 (*overconsolidated or cemented*).

Normalised SBT index I_C (Robertson and Wride, 1998)*:*

$$I_c = [(3.47 - \log Q_t)^2 + (logF_r + 1.22)^2]^{0.5}$$

Non-normalised SBT index I_C (Robertson, 2010)*:*

$$I_c = \left[\left(3.47 - \log\left(\frac{q_c}{\sigma_{atm}}\right)\right)^2 + (logR_f + 1.22)^2\right]^{0.5}$$

(See glossary of terms and symbols Appendix B)

The results are presented on the plots of Appendix D.

5.5 RELATIVE DENSITY

The relative density of sands was calculated based on an empirical relationship proposed by Jamiolkowski *et al.* (2001) based on a large database of undisturbed frozen samples and calibration chamber tests. The expected accuracy may be evaluated from the figures presented below.

$$D_r = 100\left[0.268 \cdot \ln\left(\frac{q_t/\sigma_{atm}}{\sqrt{\sigma_{vo}'/\sigma_{atm}}}\right) - k\right]$$

(See glossary of terms and symbols Appendix B)

k = Compressibility dependant constant can be taken as -0.675 for medium compressibility (applied value in our interpretation), <= 1 for high compressibility and >= 2 for compressible sands.

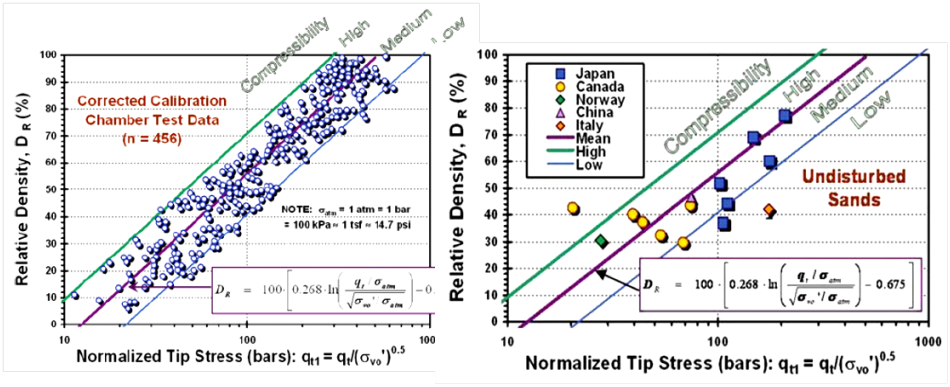


Figure 5-2 Relative density with normalised tip stress and sand compressibility from calibration chamber tests (left) and undisturbed frozen samples (right). Jamiolkowski *et al.* (2001). Reproduced from Mayne (2007).

The results are presented on the plots of Appendix E– *Standard interpretation results (set 2)*.

5.6 UNDRAINED SHEAR STRENGTH

The undrained shear strength s_u is usually estimated as a factor of net cone tip resistance (Lunne *et al*, 1981):

$$s_u = \frac{q_c - \sigma_{v0}}{N_k}$$

where N_k is an empirical cone factor which varies with soil type, stress history, structure/fabric, plasticity and the mode of shearing.

(See glossary of terms and symbols Appendix B)

Mayne and Peuchen (2018) performed and evaluation of 407 high-quality triaxial compression tests against net tip resistance and proposed N_{kt} factors with regression analysis details for five categories of clays shown in Table 1.

Table 1 Summary of CAUC s_u versus q_{net} for clays. Reproduced from Mayne and Peuchen (2018).

Clay Group	Number of sites	No. Data	Correlation Coefficient r_2	Factor N_{kt}	Mean Pore Pressure Parameter B_q
Offshore NC-LOC	17	115	0.98	12.32	0.51
Onshore NC-LOC	30	191	0.867	12	0.53
Sensitive NC-LOC	5	43	0.507	10.33	0.84
OC Intact	5	36	0.862	13.57	0.49
OC Fissured	5	22	0.393	22.47	-0.01
All clays	62	407	0.923	13.33	0.55

Alternatively, a variable N_{kt} factor can be estimated for the profile as a function of the pore pressure parameter B_q, applicable for B_q values of > -0.01. The following equation proposed by Mayne and Peuchen is based on the same database evaluation:

$$N_{kt} = 10.5 - 4.6 \cdot \ln(B_q + 0.1)$$

Where the pore pressure parameter B_q is the ratio of excess pore pressure to net tip resistance:

$$B_q = \frac{u_2 - u_0}{q_t - \sigma_{v0}}$$

The N_{kt} estimate has a standard error of 2.4 N_k and correlation coefficient of 0.645.

The estimate based on B_q is presented as 's_u5' on the parameter plots and is only suitable for tests that have a high-quality pore pressure data, often indicated by a positive, repeatable and dynamic response. For tests that have a reliable pore pressure response throughout, the evaluation on a point by point basis is warranted. For projects with variable response quality and with possible piezo desaturation (for example in the unsaturated zone or by dilation/cavitation) it is preferable to identify zones with reliable pore pressure response for representative soils and select a characteristic value of B_q for evaluation of N_{kt}. Lankelma are not always in view of the effort that has been made in preparation of the test location to maintain saturation of the piezo sensor.

Note: N_{kt} (with subscript 't') indicates a N_k factor that has been established using the corrected tip resistance q_t. N_{kt} can be applied to the uncorrected tip resistance q_c (non-piezocone tests) but results in a slightly lower estimate of s_u depending on the correction magnitude (q_c - q_t) in lower strength soils.

Undrained shear strengths corresponding to selected values of N_k are presented on the plots of Appendix D. *'s_u3'* on the logs (N_k = 15) has been included as a reference for comparison to traditional arbitrary N_k values of 15 and 20.

5.7 OVERCONSOLIDATION RATIO

The preconsolidation stress σ_p' was calculated based on the method proposed by Mayne et al (2009):

$$\sigma_p' = k \cdot (q_t - \sigma_{vo})^{m\prime}$$

$$OCR = \sigma_p'/\sigma'_{v0}'$$

(See glossary of terms and symbols Appendix B)

Mayne *et al* found that the trend with mean grain size followed a power law through the addition of exponent m' and that its value can be estimated by relation to soil behaviour type index I_c:

$$m' = 1 - \frac{0.28}{1 + \left(\frac{I_c}{2.65}\right)^{25}}$$

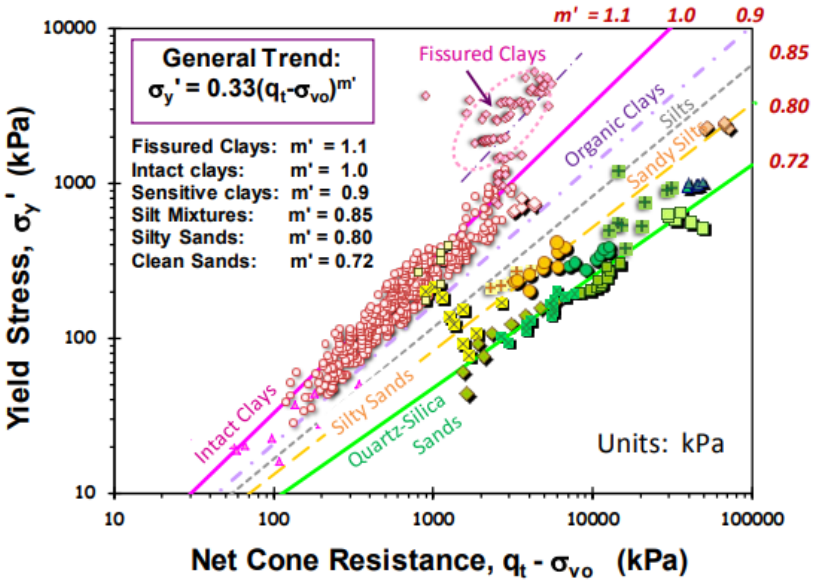


Figure 5-3 Preconsolidation stress with net cone resistance power law, reproduced from Mayne (2014).

An additional σ_p' and OCR was calculated for m' = 1.1 to reflect the upper trend for over consolidated fissured clays not captured by the soil behaviour type index I_c

5.8 SPT N60 VALUES

Equivalent SPT N60 values, defined as the non-normalised SPT blow count over a 30 cm interval, were derived for two correlations and are presented together in the results section for comparison.

Method 1 - Lunne *et al.* (1997)

$$N_{60} = \frac{q_t}{8.5 \cdot \sigma_{atm} \cdot \left(1 - \frac{I_c}{4.6}\right)}$$

Method 2 - Robertson (2012)

$$\frac{\left(\frac{q_t}{p_a}\right)}{N_{60}} = 10^{(1.268 - 0.2817 I_c)}$$

(See glossary of terms and symbols Appendix B)

The correlations are intended for clays, silts and sands and not for carbonates or cemented geo-materials.

The results are presented in Appendix D.

5.9 FRICTION ANGLE

Sands

The peak friction angle of granular materials was calculated using the Kulhawy and Mayne (1990) method and is an empirical relationship as a function of stress normalised cone tip resistance. The relationship is based on a calibration chamber database from 24 sands of varying mineralogy. The relationship has the form:

$$\phi' = 17.6 + 11.0 \cdot \log\left(q_{t1}\right)$$

Where:

ϕ' = Peak friction angle (degrees)

q_{t1} = stress normalised cone resistance =

$$\left(\frac{q_t}{\sigma_{atm}}\right) / \left(\frac{\sigma_{v0'}}{\sigma_{atm}}\right)^{0.5}$$

The presence of compressible minerals tends to reduce tip resistance resulting in lower estimate of friction angle, while very coarse (sand) or larger grain size tends to increase tip resistance resulting in higher estimate.

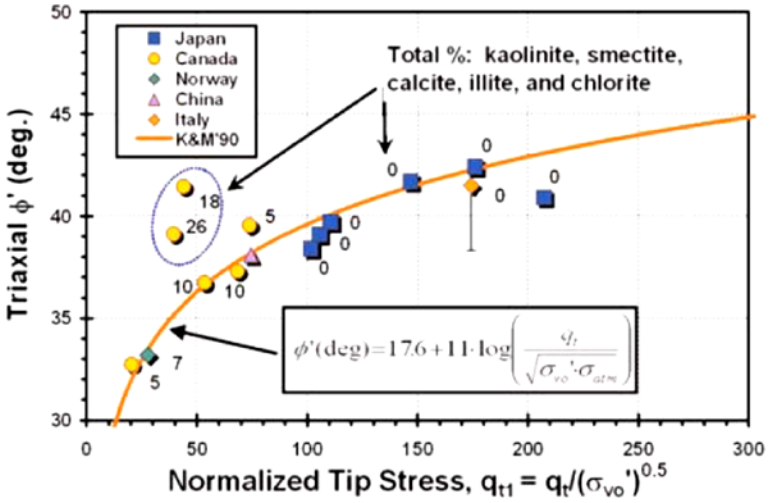


Figure 5-4 Peak triaxial friction angle from undisturbed sands with normalised cone resistance.

Fine grained soils

The effective friction angle for fine grained soils was calculated based on the Senneset *et al.* (1988, 1989) method by applying the approximate closed form solution by Mayne & Campanella (2005) as a direct function of the pore pressure parameter Bq and normalised tip resistance Q. The method is applicable where $0.1 < B_q < 1.0$ and $20° < \phi' < 45°$ and generally appropriate for non-cemented NC-LOC soils.

$$\phi' = 29.5° \, B_q^{0.121} [0.256 + 0.336 \, B_q + \log Q]$$

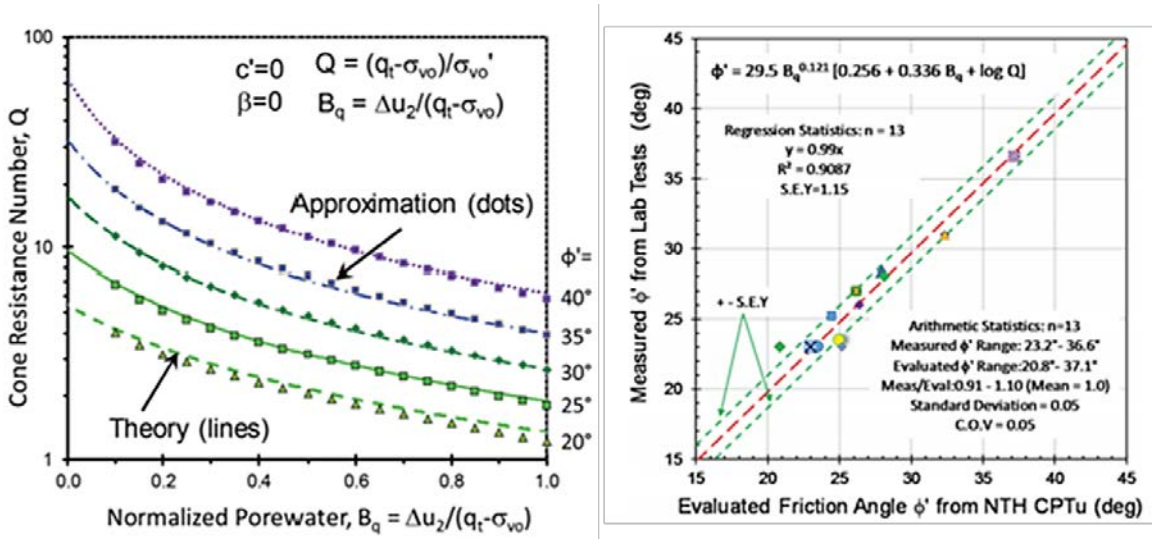


Figure 5-5 [Left] Theoretical curves with function approximation (dots) overlay [Right] calibration data from geotechnical centrifuge tests for a variety of soils. Redrawn from Ouyang & Mayne (2018).

The results are presented in Appendix E.

5.10 COEFFICIENT OF VOLUME CHANGE

Coefficient of volume change (m_v) defined as the inverse of the constrained modulus (M), is evaluated for all soil types using the constrained modulus method proposed by Mayne (2006) cited in Mayne (2007) applicable to the present state of vertical effective stress up to the pre-consolidation stress.

$$m_v = \frac{1}{M}$$

Where:

$$M = \alpha \cdot (q_t - \sigma_v)$$

$$\alpha = 5$$

An alpha factor of 8.25 reported by Kulhawy & Mayne (1990) for fine grained soils appears to provide a better fit through the data for intact non-organic clays, reducing to around 1 to 2 for organic plastic clays.

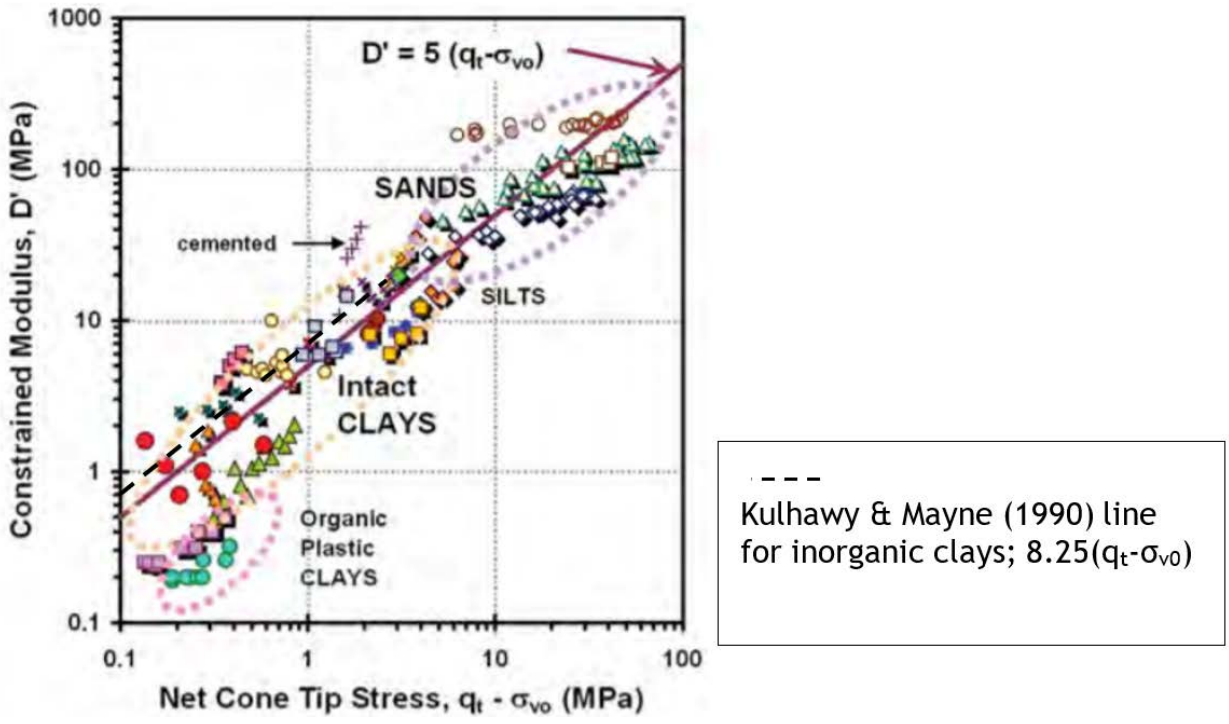


Figure 5-6 Constrained modulus of Mayne (2006). Annotated/redrawn from NCHRP Synthesis 368 (2007).

The results are presented on the plots of Appendix D.

5.11 YOUNG'S MODULUS

The Young's Modulus at 25% mobilised shear strength (FOS = 4) was calculated according to the method proposed by Robertson (2009):

$E' = \alpha(q_t - \sigma_v)$
Where:

$\alpha = 0.015(10^{0.55Ic+1.68})$

(See glossary of terms and symbols Appendix B)

The method described by Robertson may be adapted to estimate E' for loading at different percentages of yield stress.

The results are presented in Appendix E.

6 CPT INTERPRETATION NOTES

Provided below is a non-exhaustive set of notes on interpretation of the acquired CPT data with reference to examples within the dataset where appropriate.

DRAINED AND UNDRAINED SOIL BEHAVIOUR

Geotechnical parameters appropriate for drained and undrained cone penetration conditions are derived for drained and undrained soil behaviour types (SBTs) respectively, however, to help mitigate the uncertainty in the SBT correlation with drainage behaviour, all parameters are derived over the Soil Behaviour Type range $2.4 < I_c < 2.7$. For partially drained conditions, error will be introduced within derived parameters.

Piezocone dynamic pore pressure and dissipation tests may be used to identify drainage conditions. Dissipation t_{50} values exceeding 50 seconds indicate undrained penetration behaviour based on the findings of Kim *et al.* (2008).

In partially drained materials the friction sleeve resistance may rise significantly immediately following a pause in penetration due to consolidation and increased effective stress on the friction sleeve.

DYNAMIC PORE PRESSURE DATA (CPTu)

While the piezo system is saturated before use, testing through unsaturated soils may result in some degree of desaturation leading to a less accurate and more 'sluggish' pore pressure response. Desaturation can also occur during penetration due to suction during dilative shear at the cone shoulder. Dissipation tests that are undertaken following desaturation are likely to have a more pronounced initial rise and some degree of error will be present in the analysis.

If the system becomes desaturated it may or may not re-saturate at higher excess pressures later in the test. The pore pressure response in saturated contractive soils normally have a dynamic 'peaky' appearance.

The tip resistance in lower strength contractive soils without pore pressure measurement in the u_2 position is likely to be significantly lower than the equivalent corrected tip resistance depending on the magnitude of pore pressure acting in the gap between cone tip and cone body.

CONE TIP AND SLEEVE OFFSET

The accuracy of the SBT over thin layers and at layer boundaries is sensitive to offset error in the friction ratio often seen as sharp spikes or drops at boundaries. The friction ratio is often inaccurate in heavily disturbed soils with a 'blocky' macro fabric.

For this investigation a friction sleeve depth offset correction of -80mm was applied together with a 5-point moving average on the friction ratio to minimise the influence of this effect.

CONE TYPE

The reference cone type has a 10 cm^2 projected cone tip area and 150 cm^2 friction sleeve area, however it is common to use the larger 15 cm^2 cone with 225 cm^2 friction sleeve area for improved sensitivity and penetration depth potential. Use of the 15 cm^2 cone will produce more pronounced transitions zones and thin layer effects (larger zone of influence and failure zone).

TRANSITION ZONES AND THIN LAYER EFFECTS

During penetration at the boundary between soils of contrasting stiffness, a transition zone is often evident prior to mobilisation of the true soil stiffness. These should be cautiously ignored in assessment of soil behaviour type and parameter evaluation. Where the stiff layer is thin (<~0.75 m) mobilised resistance may be significantly less than that of an equivalent thick layer. The effect for thin low stiffness layers is less significant. Procedures for thin-layer effect correction are provided by Robertson and Wride (1998).

GRAVELS

The presence of gravel or larger clasts in a soil is often characterised by short peaks in the CPT tip and sleeve readings, possibly with associate inclinometer 'shake' and/or sharp reductions in pore water readings due to dilation effects. Frequent gravels in soft or loose soils may generate localised erroneous friction ratio values.

7 PRESSUREMETER TESTING

7.1 PRESSUREMETER FIELDWORK

A programme of direct-push full-displacement pressuremeter testing was performed with the objective of determining the strength and stiffness of the shallow deposits at the site. The equipment used was the Lankelma Full Displacement Pressuremeter (FDPM); full details of this equipment are included in Clarke (2005). The principal dimensions of the FDPM are given below;

Length of expanding section	320 mm
Diameter of expanding section	44 mm
Pressure capacity	3.5 MPa
Number of strain arms	2 arms located centrally
Strain range	0 - 50%
Centre of expanding section to tip	350 mm

The equipment was operated by Lankelma in general accordance with BS5930 Clause 25.7 (1999).

The pressuremeter strain arms and pressure sensor were fully calibrated prior to mobilisation to site. Membrane calibrations were performed at the start of the test program and then again, every 2nd to 3rd test. The results of all calibrations are presented in Appendix G *Pressuremeter calibrations*.

The FDPM was hydraulically push to depth using the thrust of a cone penetration truck, with the test commencing as soon as possible after reaching the required depth.

The pressure increment rate during the initial part of the test was controlled, such that an adequate number of data points are obtained to define the initial loading curve. Once the membrane had lifted off the body and expansion commenced, unload reload loops were performed at appropriate intervals during expansion. The magnitude of these loops was controlled to prevent failure of the soil around the cavity and to enable the determination of elastic properties. Prior to performing the loop cycles the pressure was held to allow creep movements to reduce to a steady low rate. The final unloading stage was also controlled to capture the plastic yielding in extension for the derivation of shear strength.

7.2 PRESSUREMETER DATA REDUCTION & PRESENTATION

The pressuremeter test results and analysis plots are presented in Appendix F.

The raw data required no treatment other than for the pressure contribution of the elastic pressuremeter membrane, which is subtracted from the measured pressure.

The following plots are provided for each test:

- Full test response curve of total pressure with cavity strain;
- Individual unload-reload loop plots of total radial stress with cavity strain;
- Preliminary analysis charts for the derivation of shear modulus using the Palmer (1972) and Bolton and Whittle (1999) methods;

- Plots of calculated and predicted shear modulus with shear strain for the reload data of each loop;
- An unloading analysis plot of total pressure against the natural log of maximum strain minus current strain i.e. $ln(\varepsilon_{max} - \varepsilon_{current})$ applying Houlsby and Withers (1988).

Results are presented in Appendix F, with instrument calibrations in Appendix G.

7.3 SHEAR STRENGTH

The undrained shear strength was determined from the final unloading stage using the Houlsby and Withers (1988) method. The analysis requires plotting the total pressure against the natural log of maximum strain minus current strain i.e. $ln(\varepsilon_{max} - \varepsilon_{current})$. A line was then plotted along the linear portion of the unloading curve, with the undrained shear strength equal to half the gradient of this curve.

7.4 SHEAR MODULUS

For measurement of the elastic response of the soil, unload-reload loops were carried out. These allow for interpretation of the response curve at a known stress/strain origin.

A summary of the test results is provided in Table 3 with the full graphical output from each test shown in Section 6 *Graphical results*. Full details of the analysis's methods used are given in Palmer (1972), Clarke (1996), Mair and Wood (1987) and Bolton and Whittle (1999). The reader is referred to these publications for a full discussion of the methodology.

7.4.1 UNLOAD-RELOAD SHEAR MODULUS

The unload-reload shear modulus (Gur) is determined from a line describing the general trend of the data between the apexes of the loop. The shear modulus is taken as half the gradient of this line assumes a linear elastic stress strain response.

$$Gur = 1/2 \ \Delta P/\Delta\varepsilon$$

$$\varepsilon = Ln(r/r_0)$$

Where Gur is the unload-reload shear modulus, P is the cavity pressure (total radial stress) and ε is the cavity strain; r is the current radius of the inflated pressuremeter and r_0 is the radius at the strain origin.

7.4.2 SECANT & TANGENT SHEAR MODULUS

Non-linear elastic shear modulus values are calculated using the Palmer (1792) and Bolton and Whittle (1999) methods. In these methods only the reload portion of the unload-reload cycle is required and has the advantage of being less influenced by creep with a clearer stain reversal origin.

Palmer (1972) subtangent analysis

The secant shear modulus can be calculated by applying the Palmer (1972) 'subtangent' method for cylindrical cavity expansion to the reloading portion of an unload-reload cycle. In this method the shear stress is taken as the local gradient of the pressure against log shear strain curve. No assumptions are made regarding the stress strain behaviour of the soil medium and consequently the non-linear stress-strain relationship can be derived.

$$\tau = \gamma \ dP/d\gamma = \ \Delta P/Ln(\Delta A/A)$$

$$Gs = \tau/(\Delta A/A) = \tau/\gamma$$

Where $\boldsymbol{\tau}$ is the shear stress; P is the radial stress (cavity pressure); and $\Delta A/A$ is the change in area over the current area and is equal to the shear strain γ at the cavity wall.

The subtangent method of calculating shear modulus is sensitive to small irregularities in strain measurement due to shear strain appearing in both the numerator and denominator term, resulting in large scatter in the measured modulus values, particularly below 0.1% shear strain. This is especially relevant at the start of the reloading curves due to small inconsistencies the strain arm measurement. To remove some of this noise a local polynomial regression has been taken through four data points to minimise the effects of outliers. In general, this is justified as the density of data is high, however, some occasions may arise where the strain range is unacceptably large to represent the local tangent. The appropriateness of the linear least squares' method may be assessed by observing the closeness of the plotted values on the shear strain axis.

Despite use of the least squared method significant scatter is observed below 0.1% shear strain. A representative value may be taken by visual examination of the general trend of shear modulus with shear strain.

Bolton and Whittle (1999) power law analysis

The Bolton and Whittle 1999 method provides a closed form solution for the undrained cylindrical cavity expansion of a non-linear/perfectly plastic soil. Shear stress is given by:

$$\tau = \alpha\gamma^{\beta}$$

Where τ is the shear stress; α is a shear stress coefficient; γ is the shear strain (=$\Delta A/A$) and β is the non-linearity exponent.

The parameters of the function are obtained from the linear relation observed in a log-log plot of change in cavity pressure against change in shear strain for the reload portion of the unload-reload cycle, where the lower apex of the cycle is taken as the new stress-strain origin.

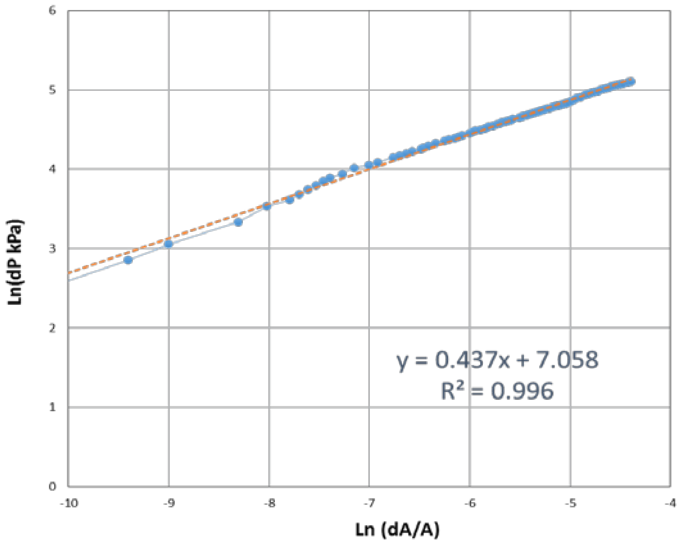


Figure 6-1 Example reload data plotted on log scales for the determination of linear regression parameters

The exponential form of the least squares line equation shown on the plot is

$\Delta P = \eta[\Delta\gamma]\hat{}\beta$

Where P is total pressure; γ is shear strain (=$\Delta A/A$); β is the gradient (0.437 – Fig. 1); and η is the intercept ($[e\hat{}7.058/1000 = 1.16\ MPa]$ – Fig.1).

The right-hand side of this equation then used to solve the Palmer (1972) differential expression

$\tau = \gamma\ dP/d\gamma = \gamma\ (\eta[\Delta\gamma]^{\beta})/d\gamma = \gamma\ (\eta\beta[\Delta\gamma]^{\beta-1})$ = $\eta\beta\gamma\hat{}\beta$

Secant shear modulus G_s is then defined by:

$G_s = \eta\beta\gamma^{\beta}/\gamma = \eta\beta\gamma^{(\beta-1)} = \alpha\gamma^{(\beta-1)}$

The secant and tangent shear modulus are related through the differential equation (Muir Wood 1990)

$Gt = Gs + \gamma\ dGs/d\gamma$

The solution to this equation in the Bolton and Whittle power law form is

$G_t = G_s + \eta\beta^2\gamma^{(\beta-1)} = \alpha\beta\gamma^{(\beta-1)}$

Note on data treatment: In the calculation of the power law parameters initial data points within the reload portion of the reload curve are sometimes filtered due to limitations in the sensitivity of the strain arms at low strain values. This is necessary to prevent spurious data points significantly affecting the regression analysis over the more accurate strain range.

Rigidity index

The rigidity index Ir is calculated as the ratio of shear modulus to shear strength:

$$I_r = \frac{G}{S_u}$$

The value of shear modulus to be used depends on the mobilised shear stress and shear strain. The shear strain value at a given mobilised shear stress is found through the Bolton and Whittle power law function by:

$$\gamma = ((Su \cdot X)/\alpha)^{1/\beta}$$

Where Su is the undrained shear strength and X is the proportion of mobilised shear strength. This method can also be used to present the decay in shear modulus against mobilised shear strength.

7.5 DISCUSSION

The pressuremeter tests were generally successful and in general the measured shear modulus fitted well with the power law analysis.

It was observed that significant creep occurred during the hold period before unload-reload (U-R) loops undertaken during the loading stage of the tests. In comparison, essentially no creep was observed prior to reload-unload (R-U) loops undertaken during the unloading stage of the test. For this reason, it was decided to perform at least one loop on both the loading and unloading stage of the test throughout the campaign.

The modulus values derived from the U-R loops had consistently higher G values than those obtained from R-U loops. The reason for this isn't precisely known but may be associated with creep during U-R loops or some degree of stress dependency. In general, the modulus values from R-U loops had higher non-linearity with β values closer to those expected in clays.

It is thought that modulus values obtained from the R-U loops should be favoured as they are not affected by creep and will be less affected by stress dependency if it exists.

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APPENDICES

APPENDIX A SUMMARY TABLES

Table 1 CPT summary

Test ID	Final depth (mBGL)	**Cone ID {C=**Cone tip; **F=**Friction Sleeve**; I=** Inclination**; P =** Piezo**; S=**Subtraction cone**; 15/10 =** cone projected area (cm2))}	CPT rig	Pre-drilled / inspection pit (m)	Refusal factor	Dissipations	Seismic cone	Easting	Northing	Elevation (m)	Date of test	Remarks
CPT8A01	11.40	S15-CFIPT.1768	UK22	0.90	Lateral support			354708.317	390661.294	25.306	01/10/2019	
CPT8A02	9.90	S15-CFIPT.1768	UK22	1.20	Sleeve load			354749.627	390698.494	25.837	01/10/2019	
CPT8A03	10.04	S15-CFIPT.1768	UK22		Lateral support			354779.753	390751.320	26.051	01/10/2019	
CPT8A04	13.48	S15-CFIPT.1768	UK22	1.20	Lateral support			354795.810	390589.233	24.965	01/10/2019	
CPT8A05	9.36	S15-CFIPT.1768	UK22		Lateral support			354841.806	390645.089	25.177	01/10/2019	
CPT8A06	9.00	S15-CFIPT.1768	UK22	1.20	Lateral support			354865.150	390675.865	25.131	01/10/2019	
CPT8A07	9.28	S15-CFIPT.1768	UK22	1.20	Lateral support			354896.233	390722.399	25.016	01/10/2019	
CPT8A08A	8.32	S15-CFIPT.1768	UK22	1.20	Lateral support			354931.435	390765.130	24.466	01/10/2019	
CPT8A09	8.92	S15-CFIPT.1768	UK22	1.20	Lateral support			354951.213	390611.664	25.109	01/10/2019	
CPT8A10	8.02	S15-CFIPT.1768	UK22	1.20	Lateral support			354985.423	390646.749	24.824	01/10/2019	
CPT8A11	8.78	S15-CFIPT.1768	UK22	1.20	Lateral support			355020.646	390689.418	23.768	01/10/2019	
CPT8B01	7.36	S15-CFIPT.1768	UK22	1.00	Lateral support			355083.729	390736.585	23.224	25/09/2019	
CPT8B02	7.68	S15-CFIPT.1768	UK22		Lateral support			355139.955	390794.903	22.930	25/09/2019	
CPT8B03	8.32	S15-CFIPT.1768	UK22	1.20	Lateral support			355143.117	390638.942	22.942	25/09/2019	
CPTP8A01	10.28	S15-CFIPT.1768	UK22	1.20	Lateral support			354747.865	390623.751	24.849	27/09/2019	
CPTP8A02	9.16	S15-CFIPT.1768	UK22	1.20	Lateral support			354823.054	390713.370	25.991	27/09/2019	
CPTP8A03	9.82	S15-CFIPT.1768	UK22	1.20	Lateral support			354899.346	390640.026	24.918	27/09/2019	
CPTP8A04A	8.90	S15-CFIPT.1768	UK22	1.20	Lateral support			354929.800	390762.800	24.660	27/09/2019	
CPTP8B01	9.24	S15-CFIPT.1768	UK22	1.20	Lateral support			355075.308	390661.689	23.704	25/09/2019	

CPT test plots are presented in Appendix C.

Pressuremeter test general

Table 2 Pressuremeter test summary

Location ID	Depth at centre (m)	Drainage state	Undrained shear strength Su (kPa)	Test duration (mins)	Comments
CPTP8A01	2.00	Undrained	111	42	
CPTP8A01	4.00	Undrained	121	77	
CPTP8A03	3.00	Undrained	126	62	
CPTP8A03	6.42	Undrained	-	18	Membrane damaged, test ended early.
CPTP8A04A	2.50	Undrained	202	92	
CPTP8A04A	4.50	Undrained	65	61	
CPTP8B01	2.75	Undrained	222	82	
CPTP8B01	3.50	Undrained	94	62	
CPTP8B01	4.20	Undrained	60	28	
CPTP8B01	5.50	Undrained	98	69	

Pressuremeter plots are presented in Appendix F

Pressuremeter reload loop results

Table 3 Unload-reload loop summary

Location ID	Depth (m)	Loop Type2	B&W1 Gradiant	B&W1 Shear Stress Constant Mpa	Strain at Yield	Gsec at 0.05% Strain	Gsec at 0.1% Strain	Gsec at 0.3% Strain	Gur MPa	Comments
CPTP8A01	2.00	R-U	0.53	1.12	0.01	41.2	29.6	17.6	20.7	
CPTP8A01	2.00	U-R	0.52	0.78	0.02	30.1	21.5	12.7	25.0	
CPTP8A01	4.00	R-U	0.52	1.33	0.01	52.3	37.4	22.0	19.9	
CPTP8A01	4.00	U-R	0.53	1.7	0.01	59.5	43	25.7	56.7	
CPTP8A03	3.00	R-U	0.48	1.24	0.01	62.7	43.8	24.9	23.7	
CPTP8A03	3.00	U-R	0.34	0.31	0.07	45.3	28.7	14.0	39.7	
CPTP8A04A	2.50	R-U	0.56	4.17	0.00	117.3	86.6	53.4	61.5	
CPTP8A04A	2.50	U-R	-	-	-	-	-	-	72.5	Data too noisy for non-linear analysis of G
CPTP8A04A	4.50	R-U	0.50	0.89	0.01	41.1	29	16.6	10.5	
CPTP8A04A	4.50	U-R	0.44	0.39	0.02	27.7	18.8	10.1	21.9	
CPTP8B01	2.75	U-R	0.36	0.62	0.06	80.9	51.8	25.6	67.8	
CPTP8B01	2.75	R-U	0.54	3.26	0.01	106.2	77.3	46.7	78.5	
CPTP8B01	2.75	U-R	0.32	0.41	0.14	73.1	45.6	21.6	86.1	
CPTP8B01	3.50	U-R	0.37	0.49	0.01	56.4	36.5	18.4	54.0	

Location ID	Depth (m)	Loop Type2	B&W1 Gradiant	B&W1 Shear Stress Constant Mpa	Strain at Yield	Gsec at 0.05% Strain	Gsec at 0.1% Strain	Gsec at 0.3% Strain	Gur MPa	Comments
CPTP8B01	3.50	U-R	0.37	0.43	0.02	50.4	32.7	16.4	54.2	
CPTP8B01	4.20	R-U	0.57	1.20	0.01	31.8	23.6	14.7	19.2	
CPTP8B01	4.20	U-R	0.60	2.22	0.00	47.8	36.1	23.2	34.7	
CPTP8B01	5.50	U-R	0.43	0.71	0.01	56.1	37.7	20.0	96.5	
CPTP8B01	5.50	R-U	0.45	0.95	0.01	62.6	42.7	23.3	43.9	
CPTP8B01	5.50	U-R	0.37	0.42	0.02	49.7	32.2	16.1	69.2	
CPTP8B01	5.50	U-R	0.37	0.44	0.02	53.0	34.3	17.2	100.5	

[1]Bolton and Whittle power law analysis parameter
[2] Mode of loop strain reversal: R-U = reload unload; U-R = unload-reload

Pressuremeter plots are presented in Appendix F

APPENDIX B GENERAL INFORMATION

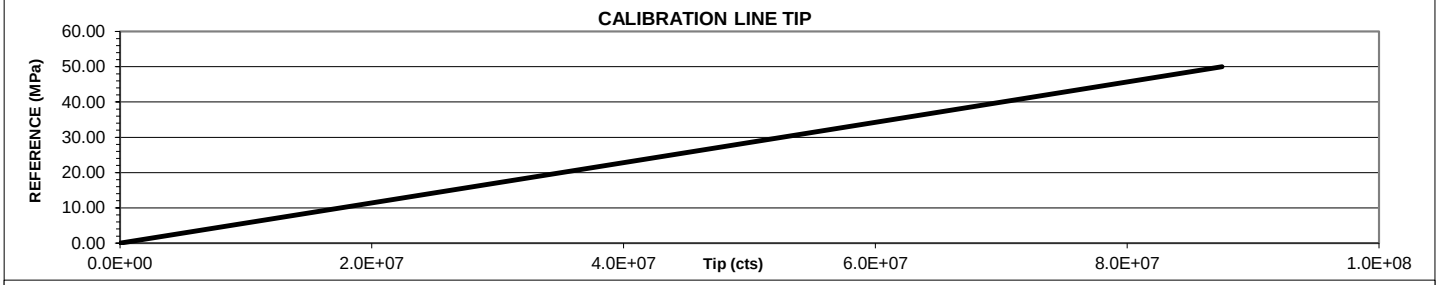
LIST OF FIGURES

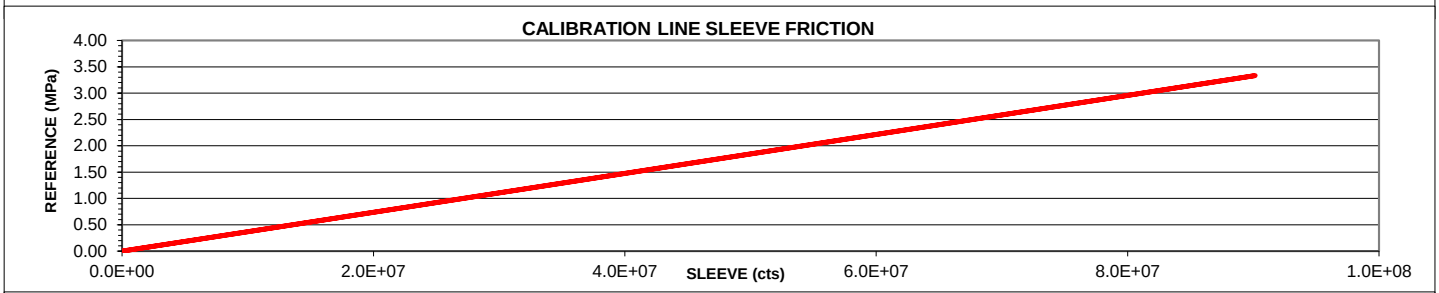
CALIBRATION CERTIFICATE

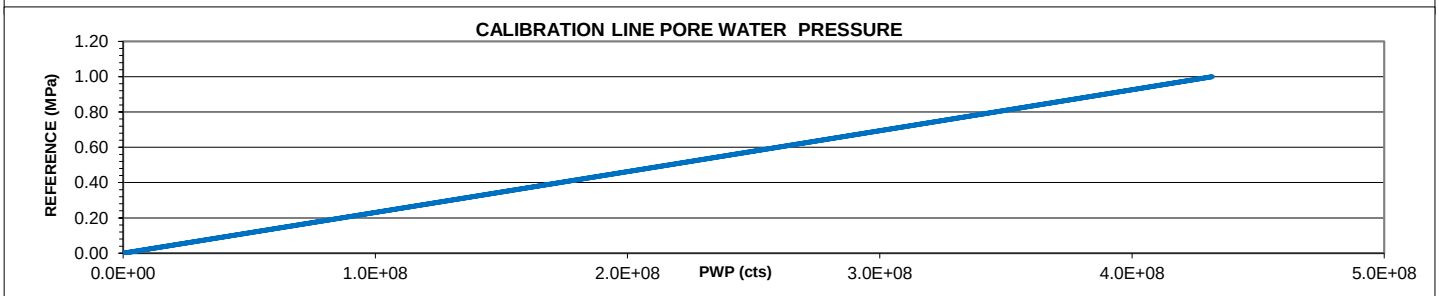
Digital-Geopoint-S15-150kN-2MPa

Cone Serial Number: DS15-CFIIPT.1768

REFERENCE INSTRUMENTS:	CONE END RESISTANCE	SLEEVE FRICTION	PORE WATER PRESSURE
ID	51998	51998	4009509
TYPE	AM DSCC-100kN	AM DSCC-100kN	Druck DPI 104
UNCERTAINTY (±%)	0.01	0.01	0.05
Nominal pressure (MPa,MPa,MPa)	50.00	3.33	1.00
Maximum pressure (MPa,MPa,MPa)	100.00	6.67	2.00
Area (cm²)	15	225	N/A
Sensitivity (cts/kPa)	1750.835	27048.29	431763.8
Calibration scaling factors:			
Nominal cal force (kN, kN, kPa)	75	75	1000
Nominal output (cts, cts, cts)	87,541,767	90,160,978	431,763,849
Zero point (cts)	1,153,828	719,621	-7,759,302
Resolution (N, N, Pa)	0.1	0.1	0.1
Cal Factor (0.1N, 0.1N, 0.1Pa)	0.008567	0.008318	0.023161
Sensitivity (cts/N, cts/N, cts/Pa)	1167.224	1202.146	431.764
Inclination calibration (cts)	X -20°= -25343, 0°= 513, 20°= 26357		Y -20°= -24087, 0°= 1026, 20°= 25849
Inclination cal factor (0.0001°)	9.671180		10.012704
Temperature calibration (cts):	0°C = -291,984,843	10°C = -165,339,992	15°C = -102,017,566 20°C = -38,695,140 30°C = 87,949,712
Temperature cal factor (0.0001°C)		0.000790	
Measured alpha factor:		0.81	
Uncertainty (%):			
Reproducibility	0.10	0.12	0.01
Linearity	0.10	0.08	0.07
Hysteresis	0.11	0.11	0.07
Combined expanded (k=2)	0.29	0.61	0.19
Application class	1	1	1
Temperature uncertainty (+/- °C)		0.01	







Instrument:	S15-150kN	Location:	Lankelma Calibration Laboratory
Serial number:	DS15-CFIIPT.1768	Temperature(° C)	22.6
Manufacturer:	Geopoint	Temperature Change(° C)	0.15
Date of calibration:	12/08/2019	Calibration Engineer	ed f. white
Calibration standard:	Conforms to BS8422, ASTM E74, ISO 22476-1	Calibration Expiry	11/11/2019

Calibration signed and dated by:

[redacted]

Calibration checked and dated by:

[redacted]

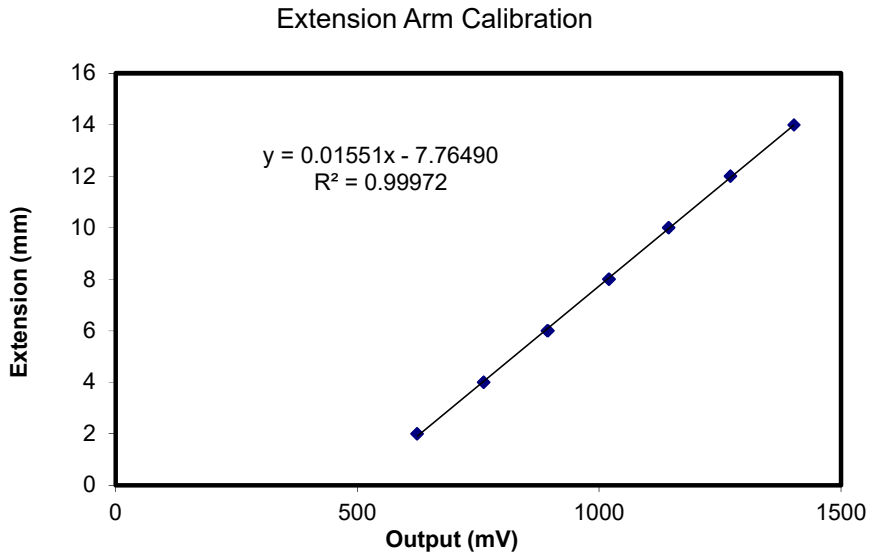
LANKELMA

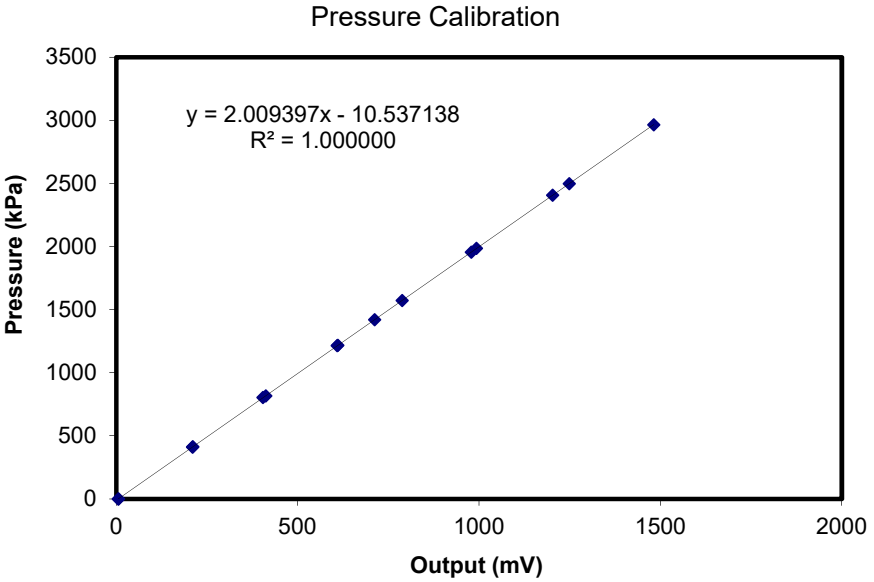
Pressuremeter Calibration Certificate

Project:	P16422-10	**Location:**	Lankelma
Client:	Geotechnics	**Date:***	11/09/2019
PM Number:	DPM 06	**Engineer:**	A. Harman
Notes:	PM Box 3 with 60m umbilical used during caibration		

Arm		**Pressure**	
mV	mm	mV	kPa
468.9	0	5.7	0
623.2	2	210.9	413
761.3	4	411.9	816.9
892.6	6	608.7	1213.1
1019.6	8	787.6	1572.8
1143.4	10	992.8	1984.8
1271.5	12	1248.8	2498.5
1403.1	14	1481.3	2964.9
1270.8	12	1202.8	2406
1144	10	978.5	1956
1020.8	8	711.9	1420.6
894.3	6	610.4	1216.3
760.8	4	404.3	802.4
623.5	2	209.6	411
469.9	0	5.6	0

*** Date of Calibration. This certificate is applicable to this project only.**





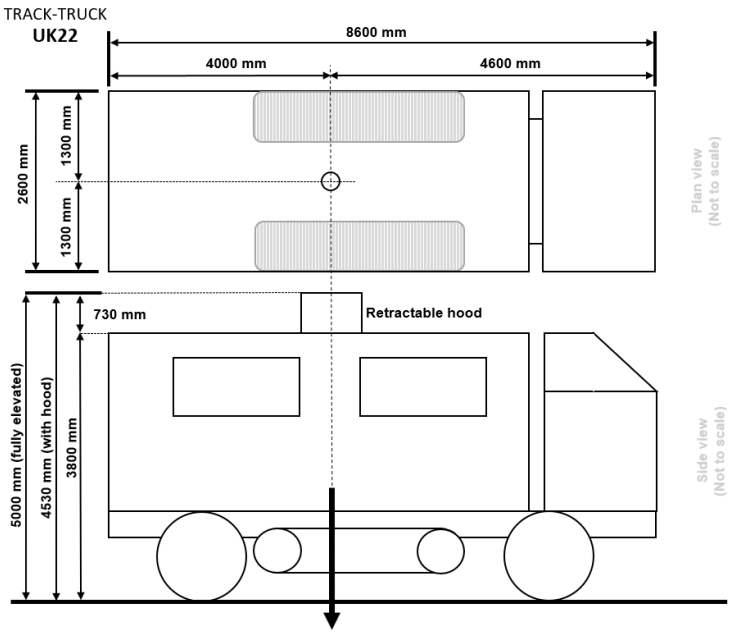
UK22
Track-truck

Rig weight	18 T
Max. operating ram capacity	200 kN
Max. travelling speed	4 km/h (tracking)
Track material	Composite
Track length	2800 mm
Track width	650 mm
Jack plate dimensions	Tracks act as jacks
Jack arrangements	1nr. on each side
Max. ground bearing pressure	76 kPa
Max. testing gradient	10 degrees
Max. traversing gradient	30 degrees (operator assessed)
Clamp arrangement	Automatic hydraulic
Ram stroke	1250 mm
Max. casing size	55 mm

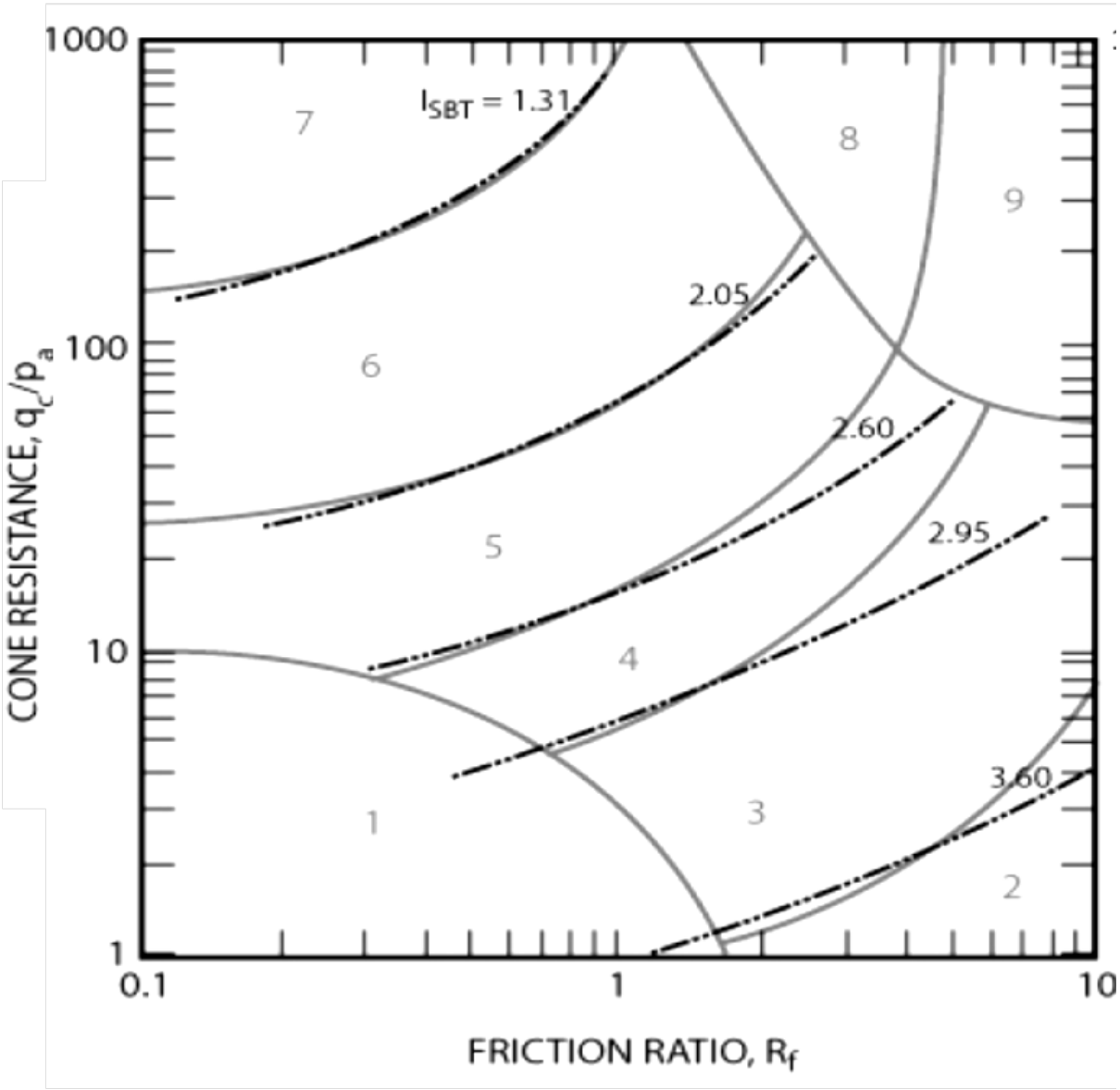
Lankelma's versatile track-truck is suitable for most geotechnical sites. The rig is driven to site as a self-contained HGV with tracks that can be deployed to cope with soft or uneven terrain.

UK22 complies with Euro 6 emission standards for use in London's low emissions zones (LEZ).

Production
An expected 100m+ of standard CPTu testing can be executed in a day (depending on conditions and access).



CPT SOIL BEHAVIOUR TYPE CHART



Non-normalised SBT chart by Robertson *et al.* (2010) based on dimensionless cone resistance (qc/Pa) and friction ration, Rf, showing contours of *Ic* index. The chart is also applicable to normalised tip/sleeve values Q_t and F_r.

Zone	Soil Behaviour Type (SBT)		
1	Sensitive fine-grained	6	Sands: clean sand to sandy silt
2	Clay – organic soil	7	Dense sand to gravelly sand
3	Clays: Clay to silty clay	8	Stiff sand to clayey sand*
4	Silt mixtures: clayey silt to silty clay	9	Stiff fine grained*
5	Sand mixtures: Silty sand to sandy silt	*Overconsolidated or cemented	

GLOSSARY OF CPT TERMS AND SYMBOLS

SYMBOLS

q_c :- **Cone resistance.** The total force acting on the cone Q_c, divided by the projected area of the cone, A_c; **(q_c=Q_c/A_c)**.

q_t :- **Corrected cone resistance.** The cone resistance q_c corrected for unequal pore water pressure effects on the cone face and shoulder.

f_s :- **Friction sleeve resistance.** The total frictional force acting on the friction sleeve, F_s, divided by its surface area, A_s. **f_s= F_s/A_s.**

R_f :- **Friction ratio** The ratio, expressed as a percentage, of the sleeve friction, f_s, to the cone resistance, q_c, both measured at the same depth; **[R_f= (f_s/q_c) · 100].**

$q_{t\text{-}net}$:- **Net cone resistance** (Method 1) **= (q_c – σ_v)**

Q_t :- **Normalised cone resistance** (Method 1) **= (q_c – σ_v)/σ'_v**

q_{t1}:- **Normalised cone resistance** (Method 2) **= (q_t)/(σ'_v)$^{0.5}$**

F_r:- **Normalised friction sleeve resistance = f_s /(q_c- σ_v)**

σ_v:- **Total overburden stress**

σ'_v:- **Effective overburden stress**

σ_{atm}, or, P_a:- **Reference atmospheric stress = 100kPa**

***I_c*:-** **Soil Behaviour Type Index**

B_q :- **Pore pressure ratio.** The net pore pressure normalized with respect to the net cone resistance. = **(u_2 – u_0)/(q_t -σ_v)**

TERMS

Cone (or 'tip'): - The conical tip section of the cone penetrometer.

Friction sleeve: - The section of the cone penetrometer upon which the sleeve friction is measured, located behind the cone tip.

Piezocone: - A cone penetrometer with a pore pressure measurement system.

Dynamic pore pressure: - The pore pressure generated during penetration and measured by a pore pressure sensor on the conical tip face (u_1) or just behind the conical tip (u_2).

APPENDIX C CONE PENETRATION TEST RESULTS

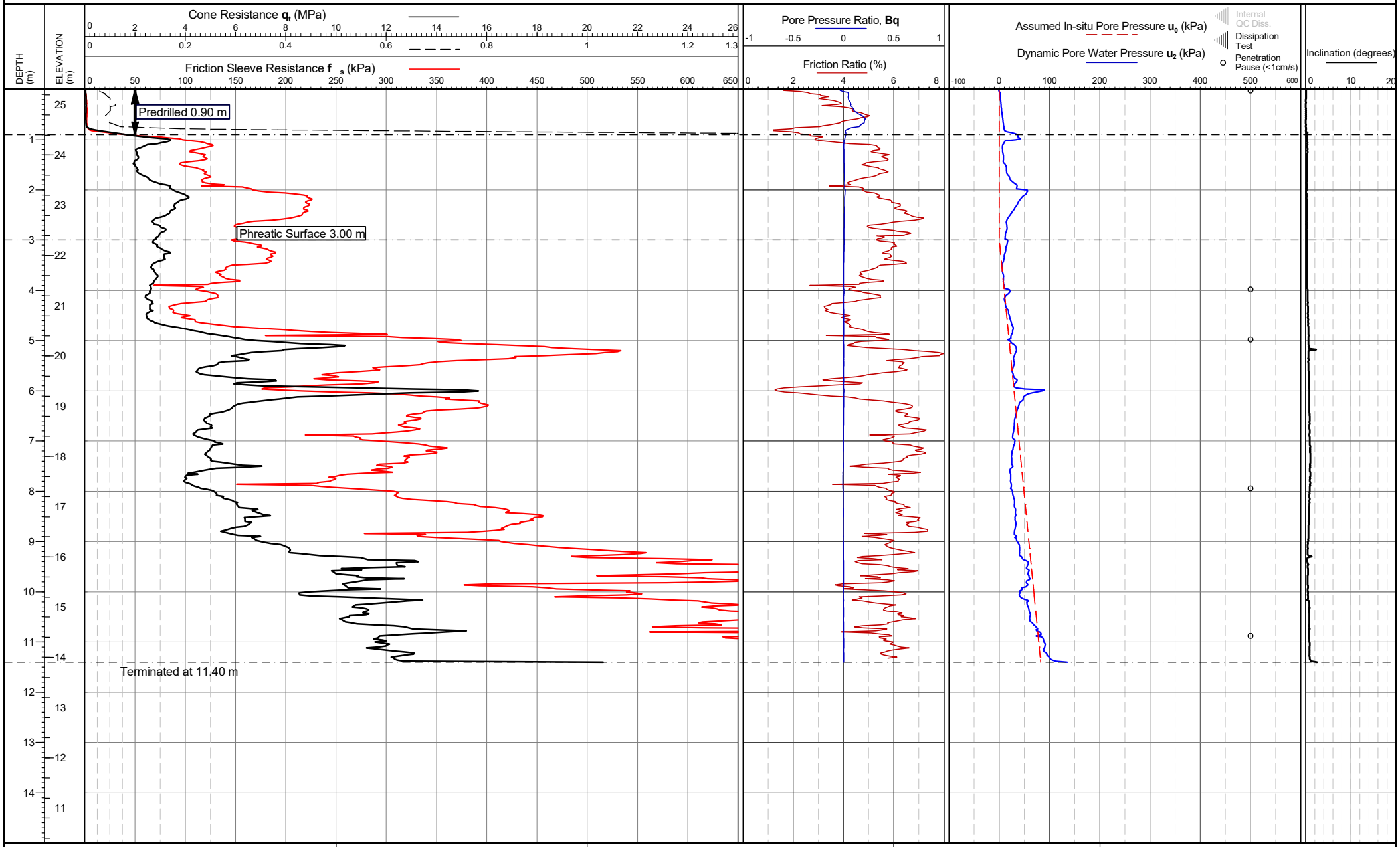
RAW DATA PLOTS

LIST OF FIGURES:

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 10:10:00

Location: Cheshire, UK
Coordinates: 354708.317, 390661.294
Elevation: 25.306
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

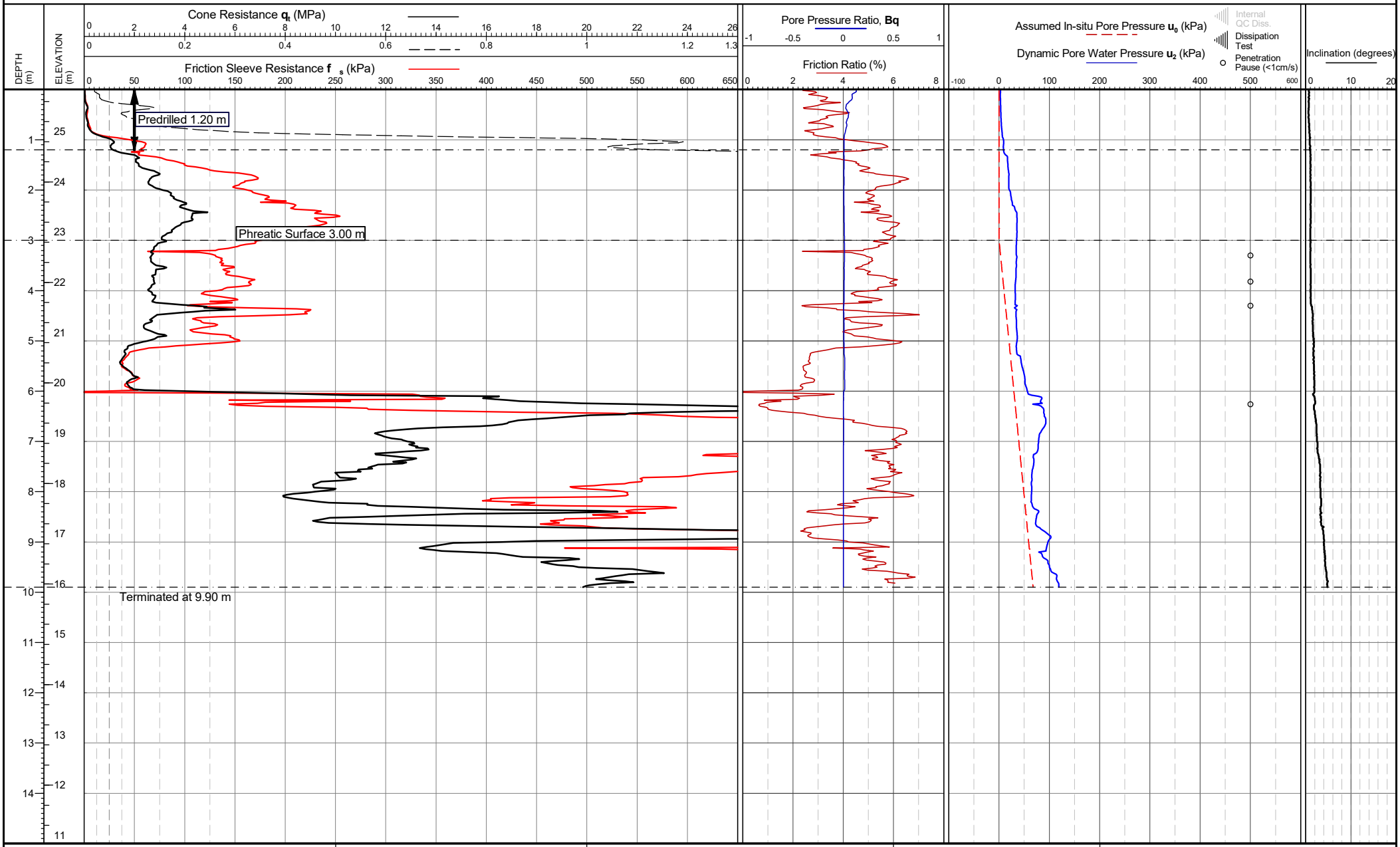
Checked by: Chris Player

TEST ID: CPT8A01

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS

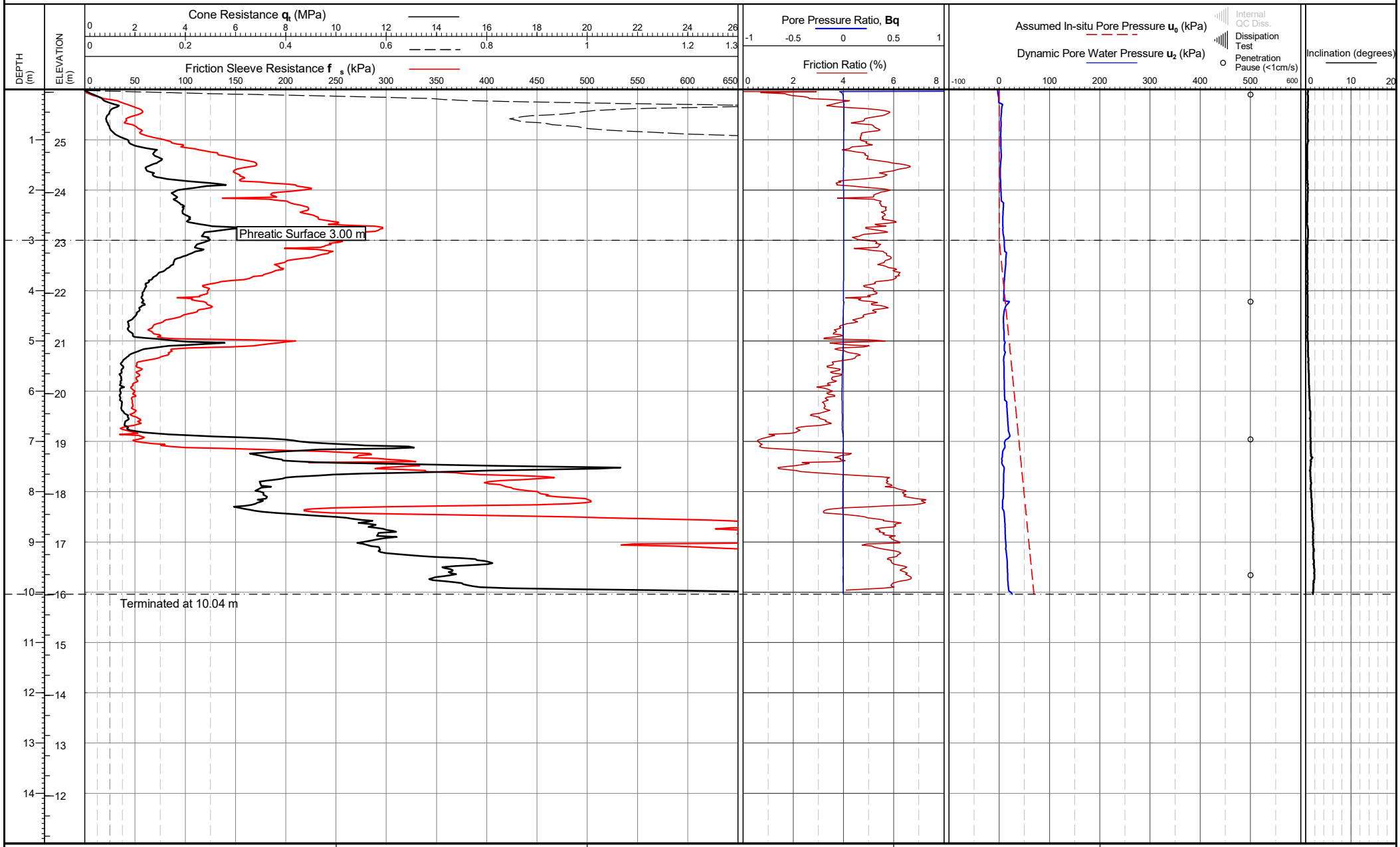


Cone area (mm2):1500 Cone ID: S15-CFIPT.1768 Operator: Rob Ashcroft Rig Used: UK22 Date of test: 01/10/2019 10:50:00	Location: Cheshire, UK Coordinates: 354749.627, 390698.494 Elevation: 25.837 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Sleeve load	Date of plot: 03-01-20 Checked by: Chris Player	Lankelma Project Ref: P-107284-10

TEST ID: CPT8A02

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 01/10/2019 09:34:00

Location: Cheshire, UK
Coordinates: 354779.753, 390751.32
Elevation: 26.051
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

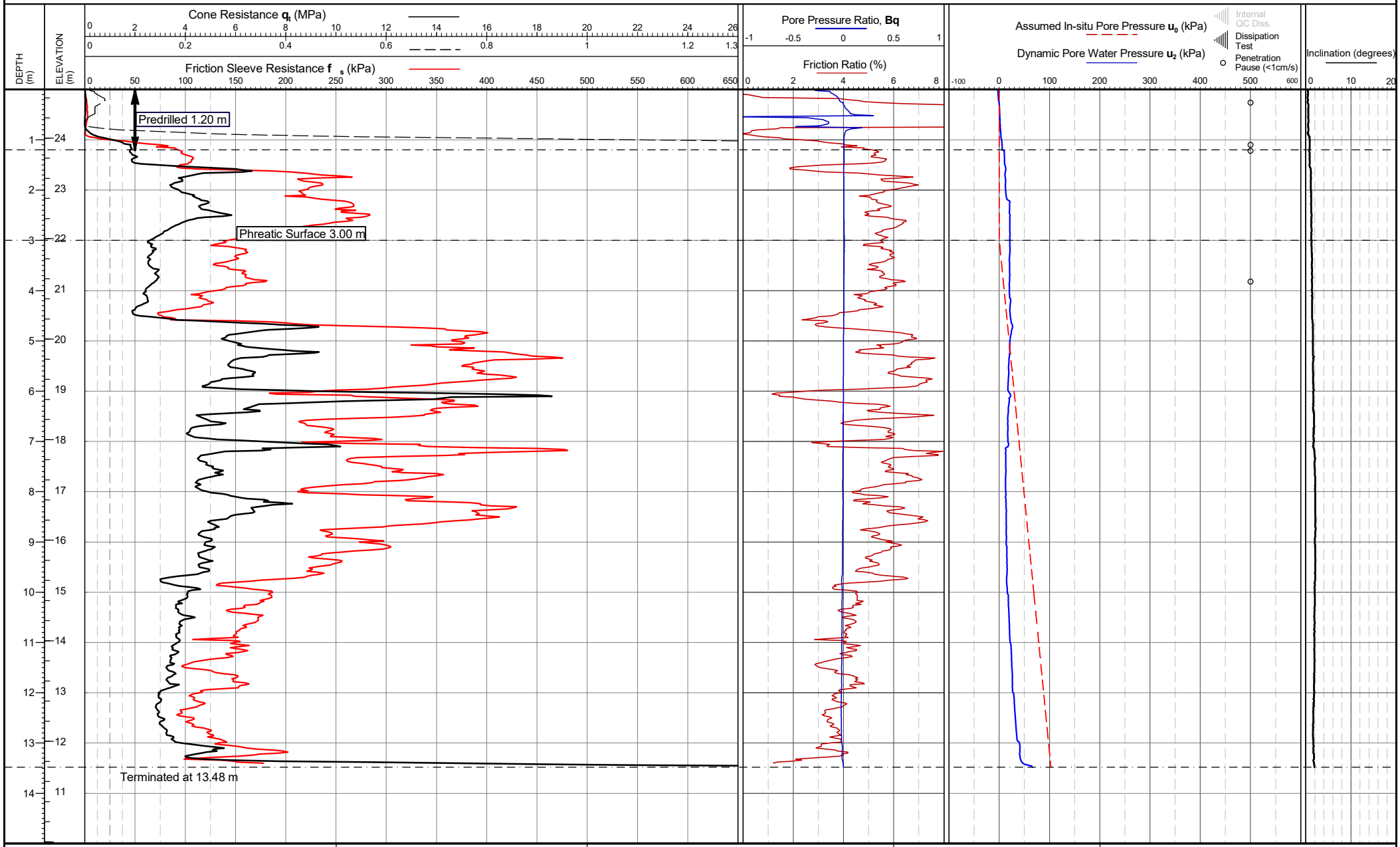
Lankelma Project Ref: P-107284-10

Checked by: Chris Player

TEST ID: CPT8A03

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 12:35:00

Location: Cheshire, UK
Coordinates: 354795.81, 390589.233
Elevation: 24.965
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

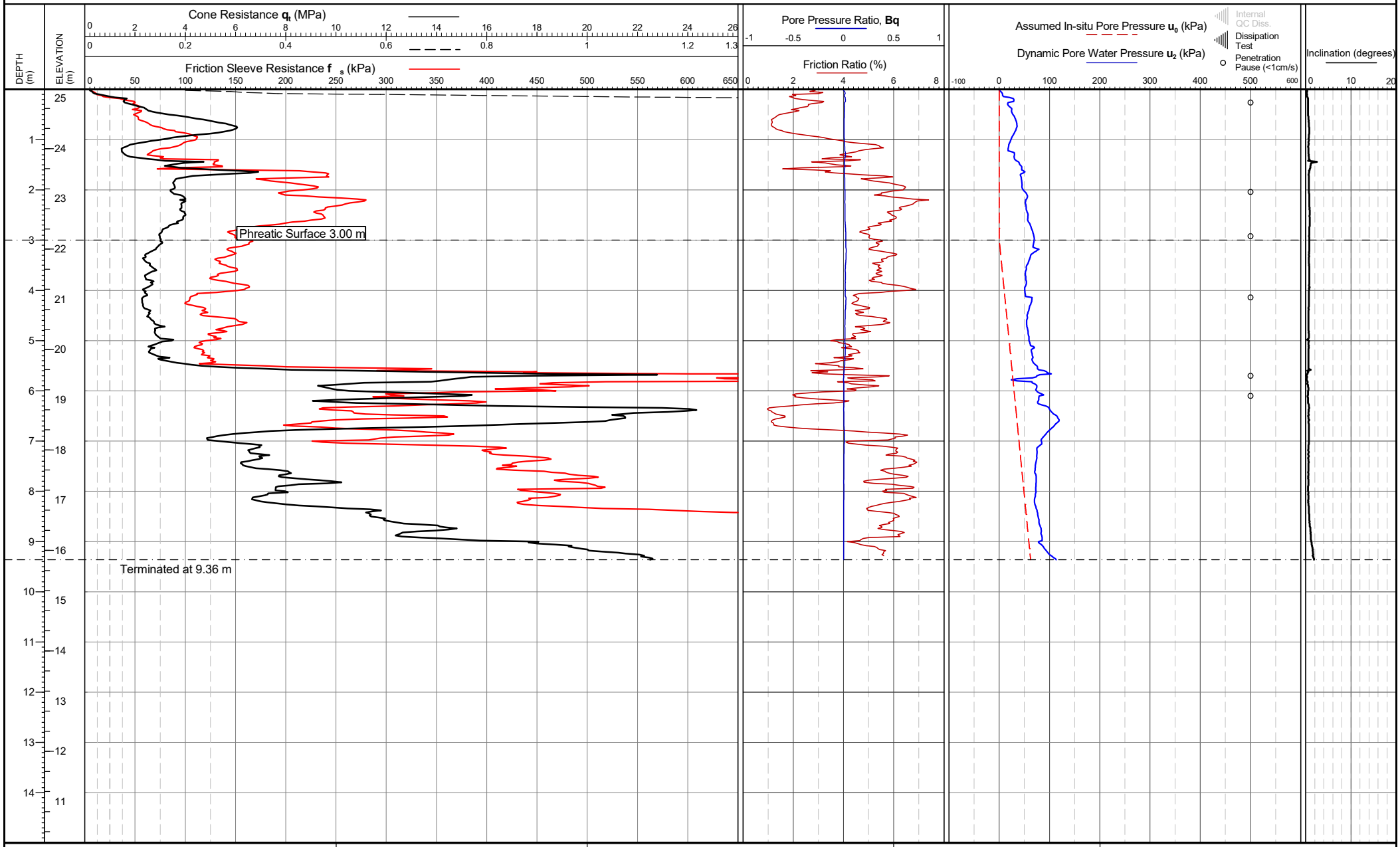
Lankelma Project Ref: P-107284-10

Checked by: Chris Player

TEST ID: CPT8A04

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 13:15:00

Location: Cheshire, UK
Coordinates: 354841.806, 390645.089
Elevation: 25.177
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

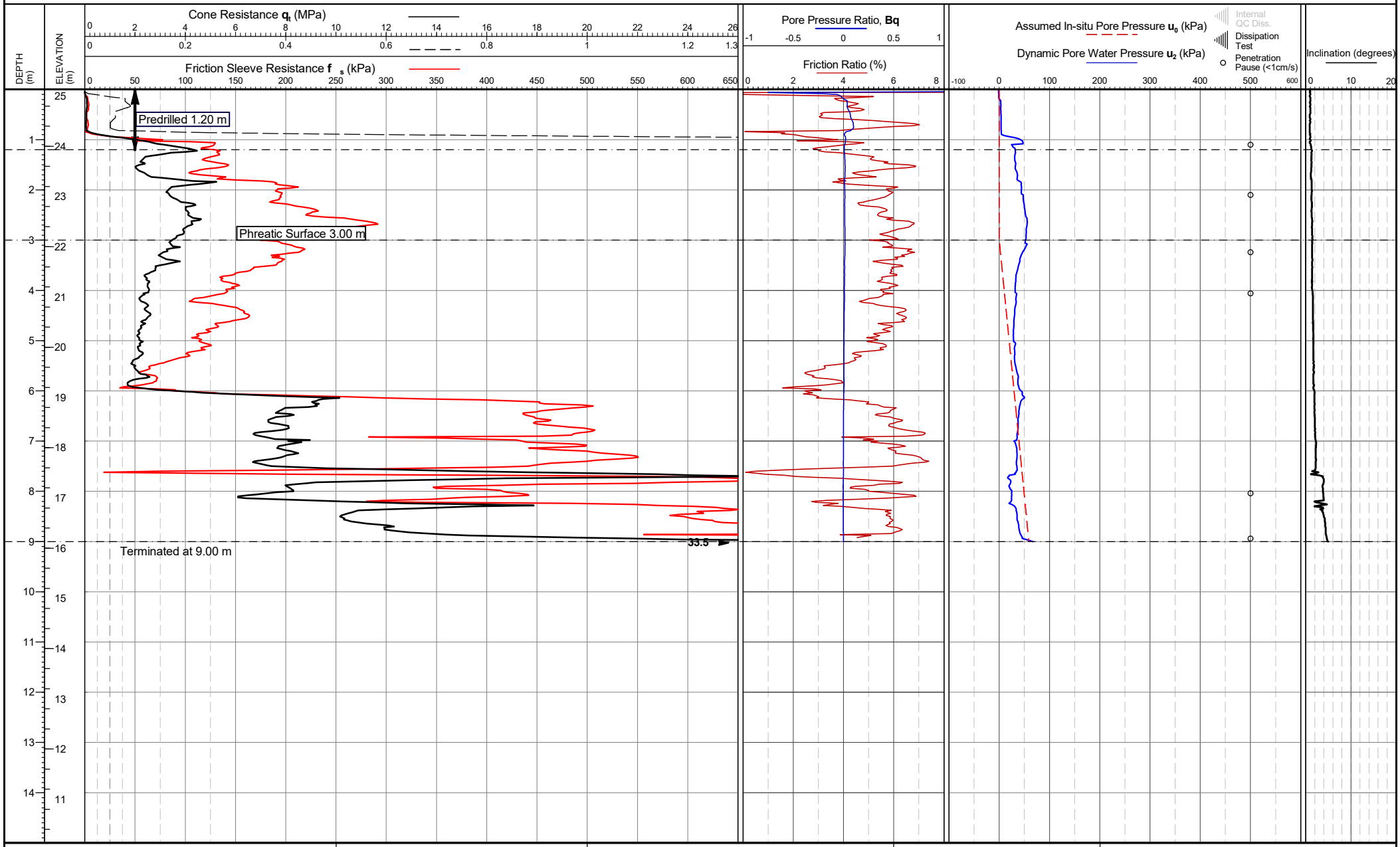
Checked by: Chris Player

TEST ID: CPT8A05

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 12:02:00

Location: Cheshire, UK
Coordinates: 354865.15, 390675.865
Elevation: 25.131
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

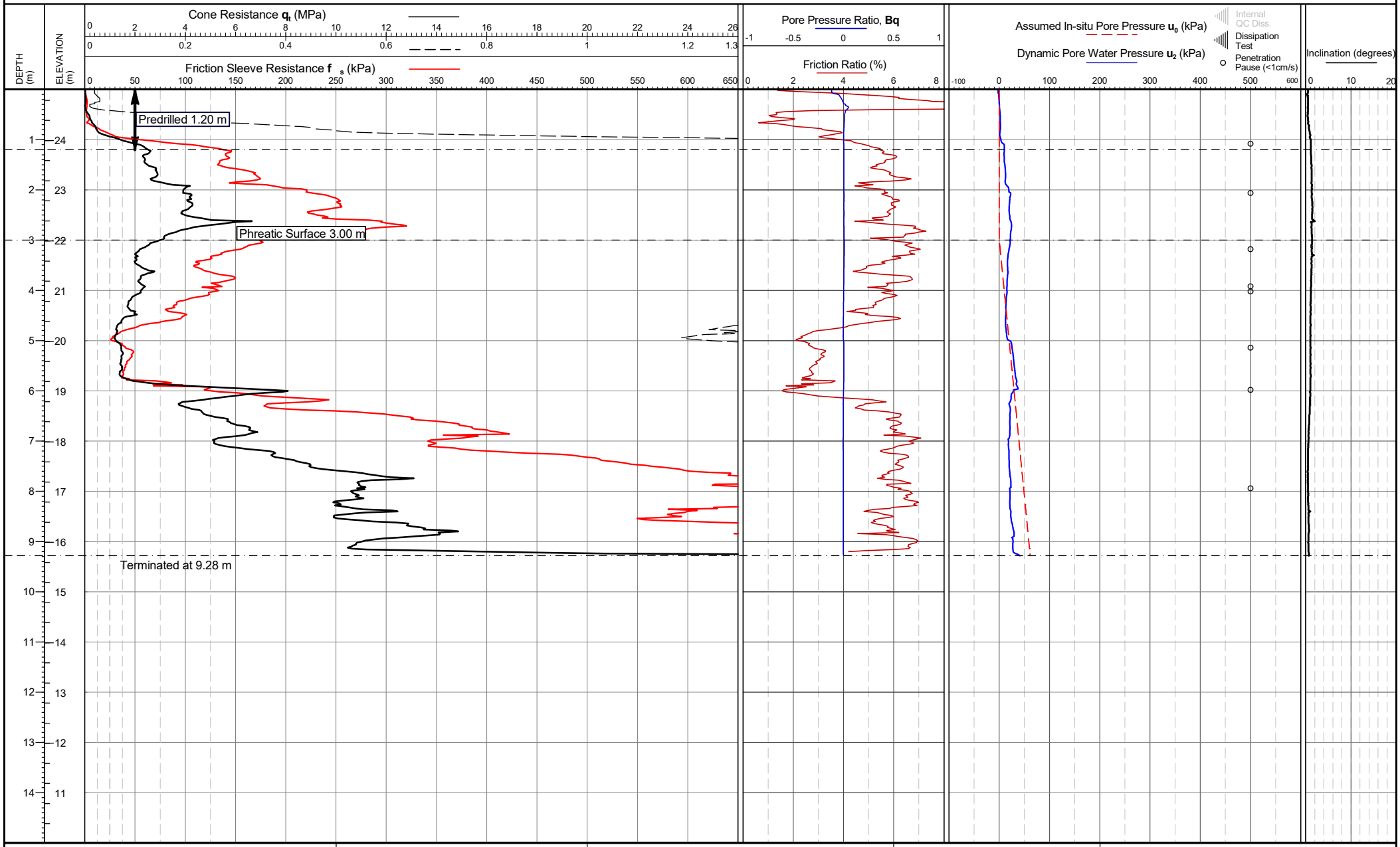
Checked by: Chris Player

TEST ID: CPT8A06

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 11:31:00

Location: Cheshire, UK
Coordinates: 354896.233, 390722.399
Elevation: 25.016
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

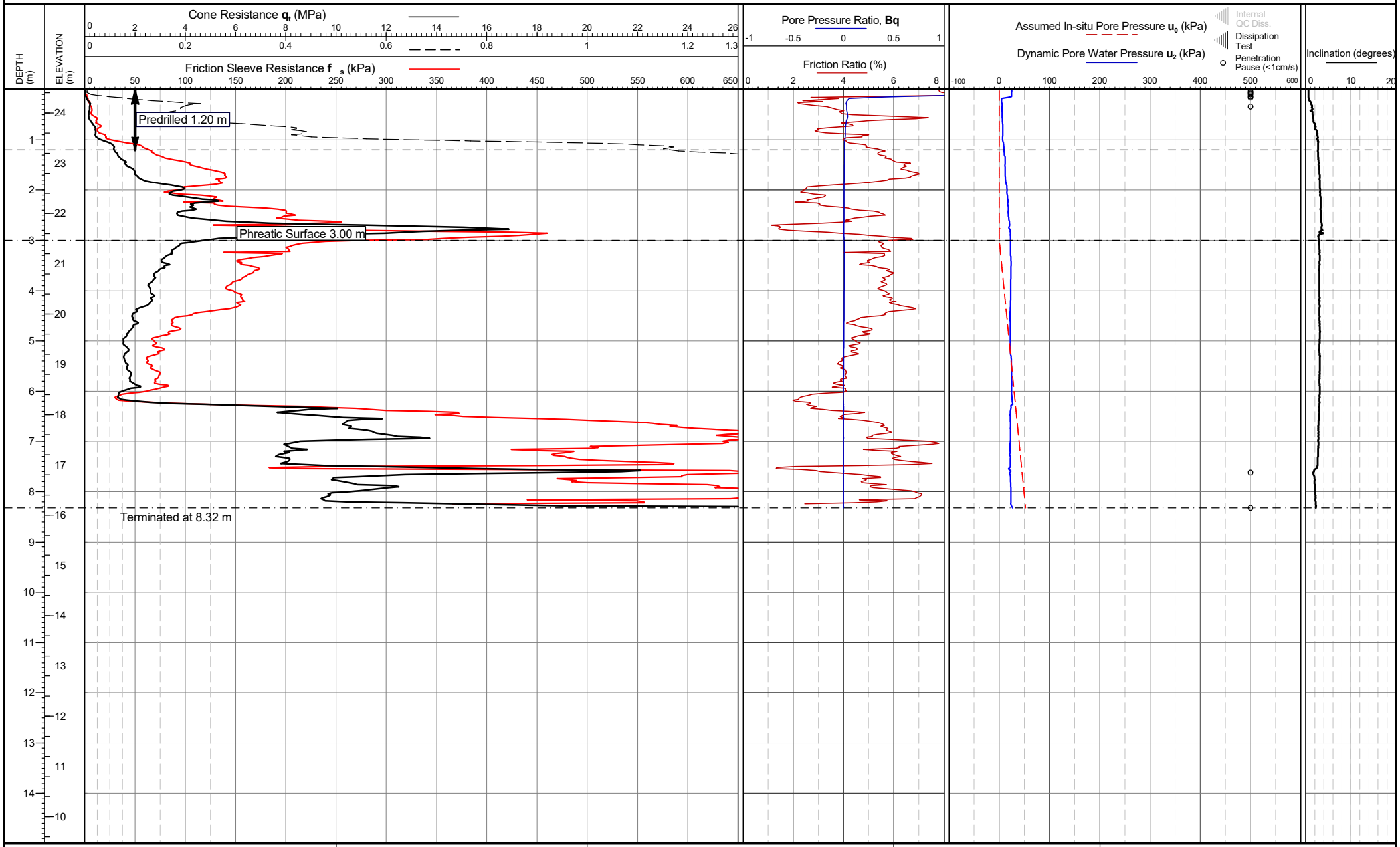
Lankelma Project Ref: P-107284-10

Checked by: Chris Player

TEST ID: CPT8A07

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 13:47:00

Location: Cheshire, UK
Coordinates: 354931.435, 390765.13
Elevation: 24.466
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

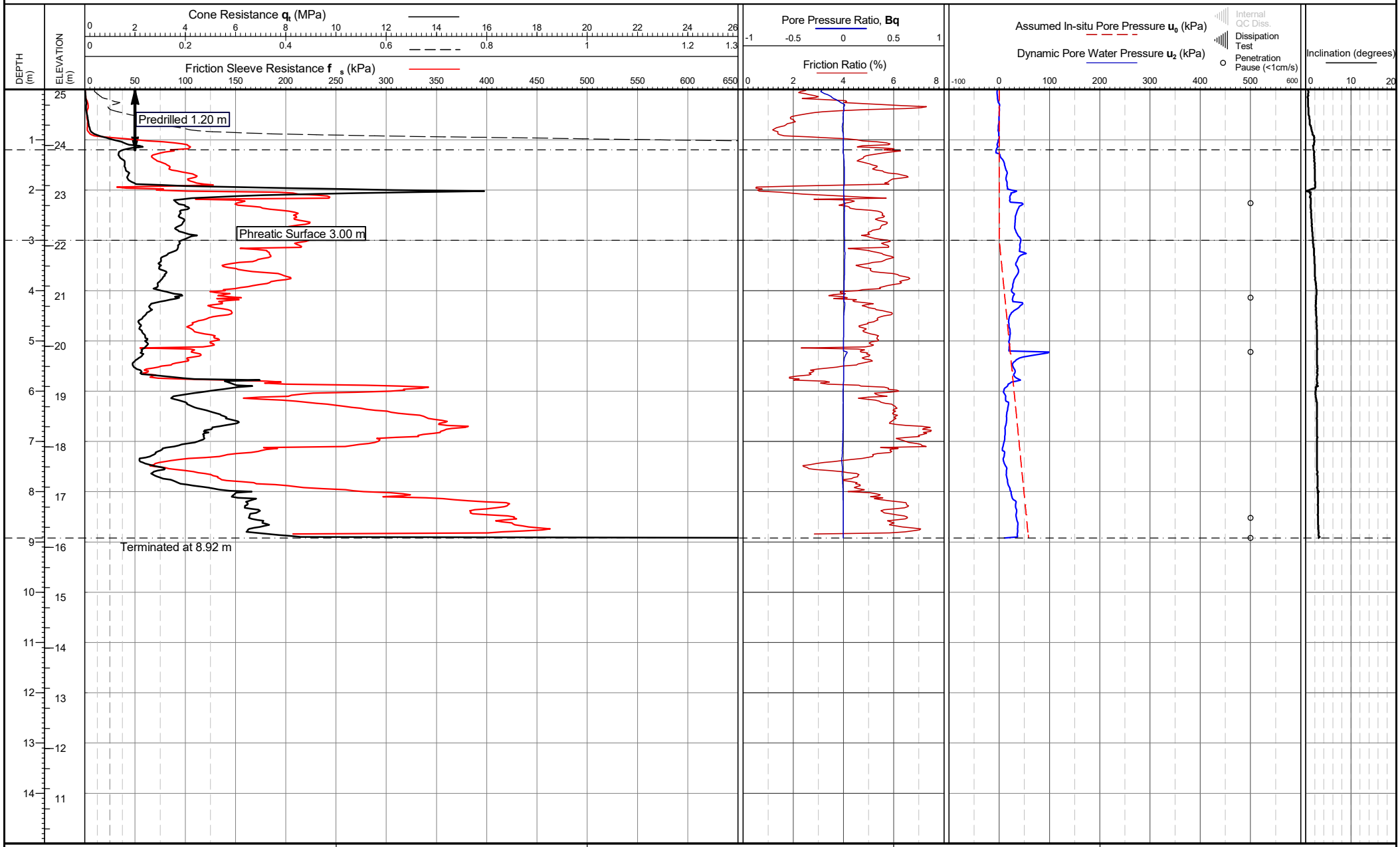
Checked by: Chris Player

TEST ID: CPT8A08A

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 15:28:00

Location: Cheshire, UK
Coordinates: 354951.213, 390611.664
Elevation: 25.109
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

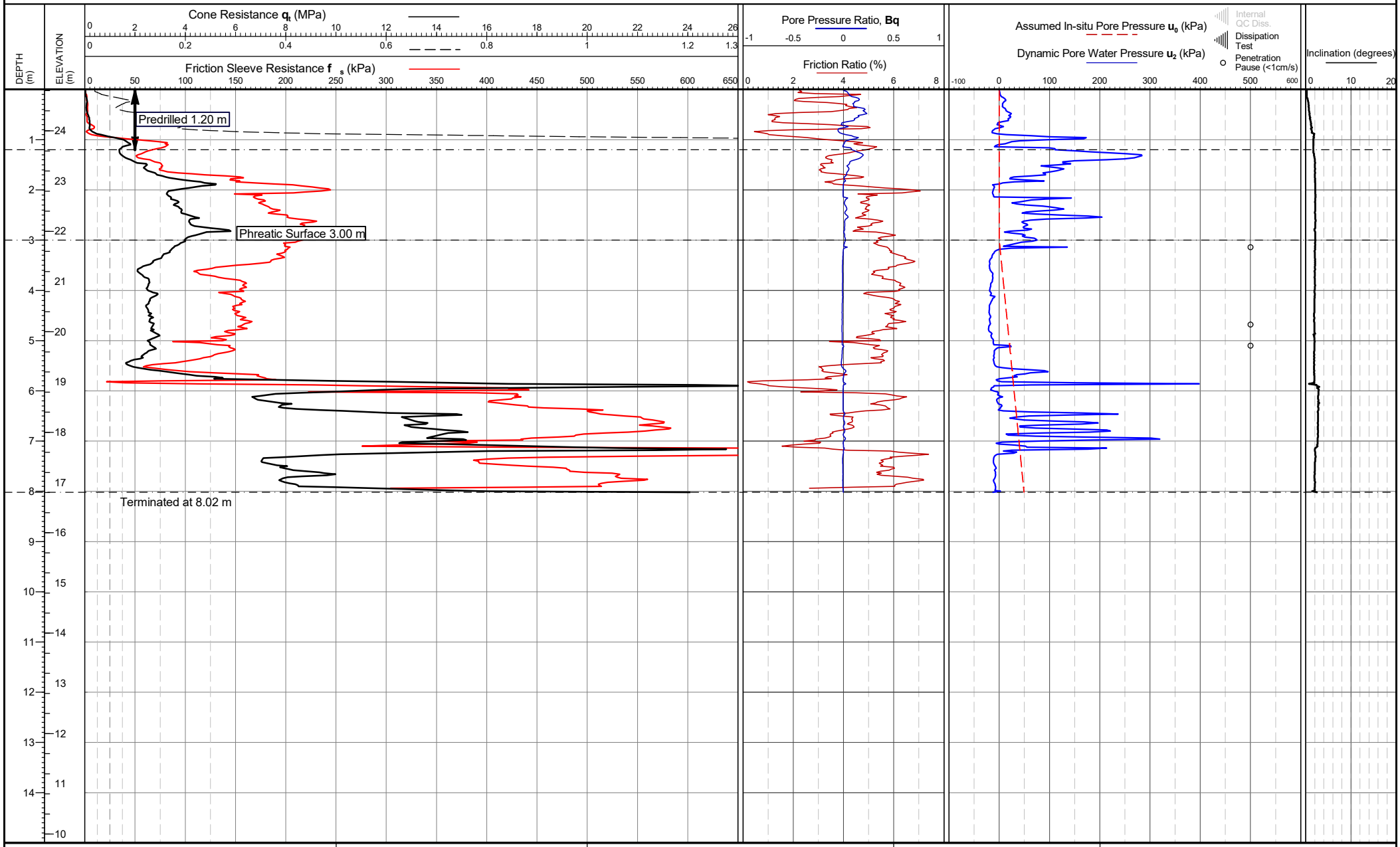
Checked by: Chris Player

TEST ID: CPT8A09

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 15:02:00

Location: Cheshire, UK
Coordinates: 354985.423, 390646.749
Elevation: 24.824
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

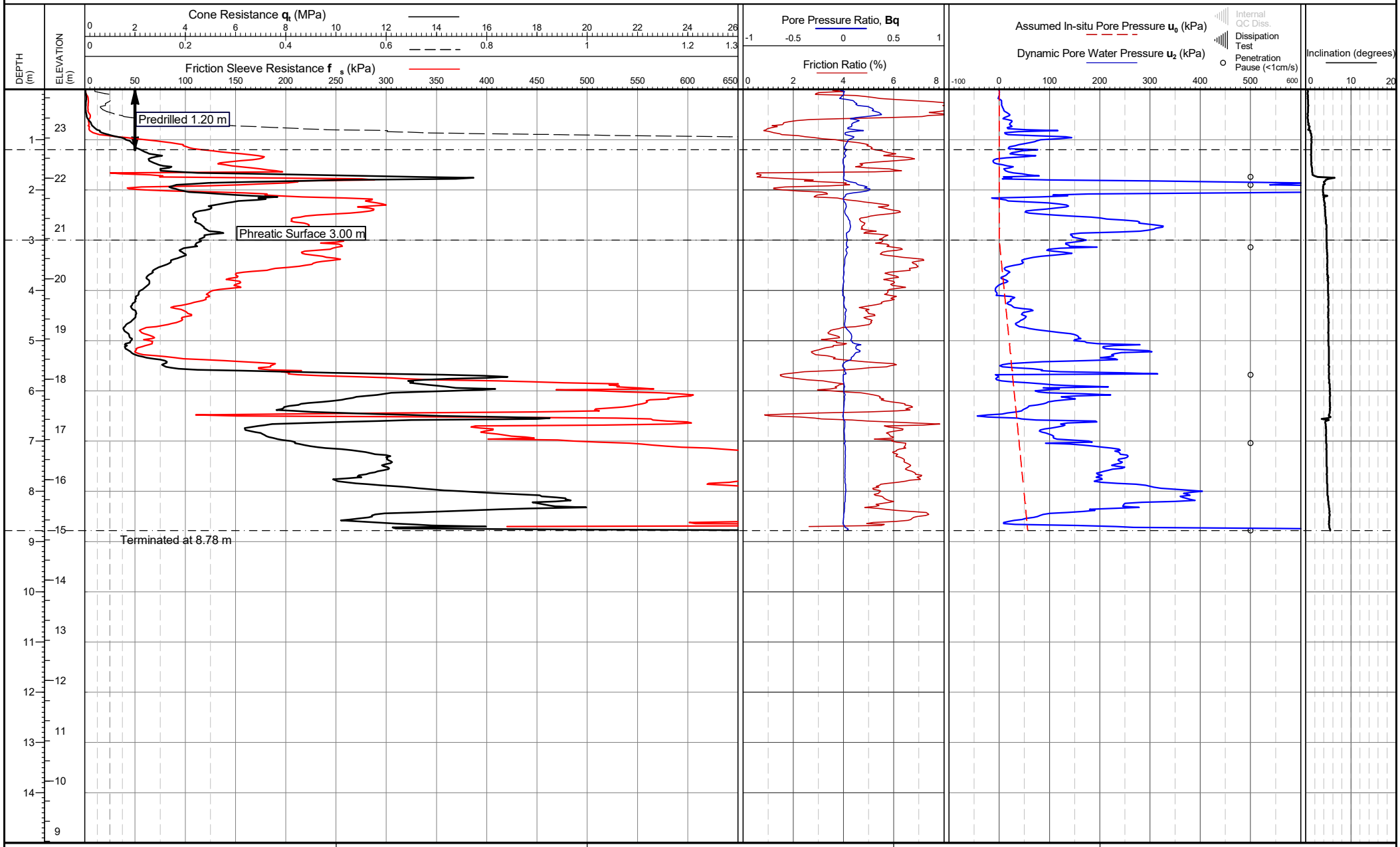
Checked by: Chris Player

TEST ID: CPT8A10

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 14:19:00

Location: Cheshire, UK
Coordinates: 355020.646, 390689.418
Elevation: 23.768
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

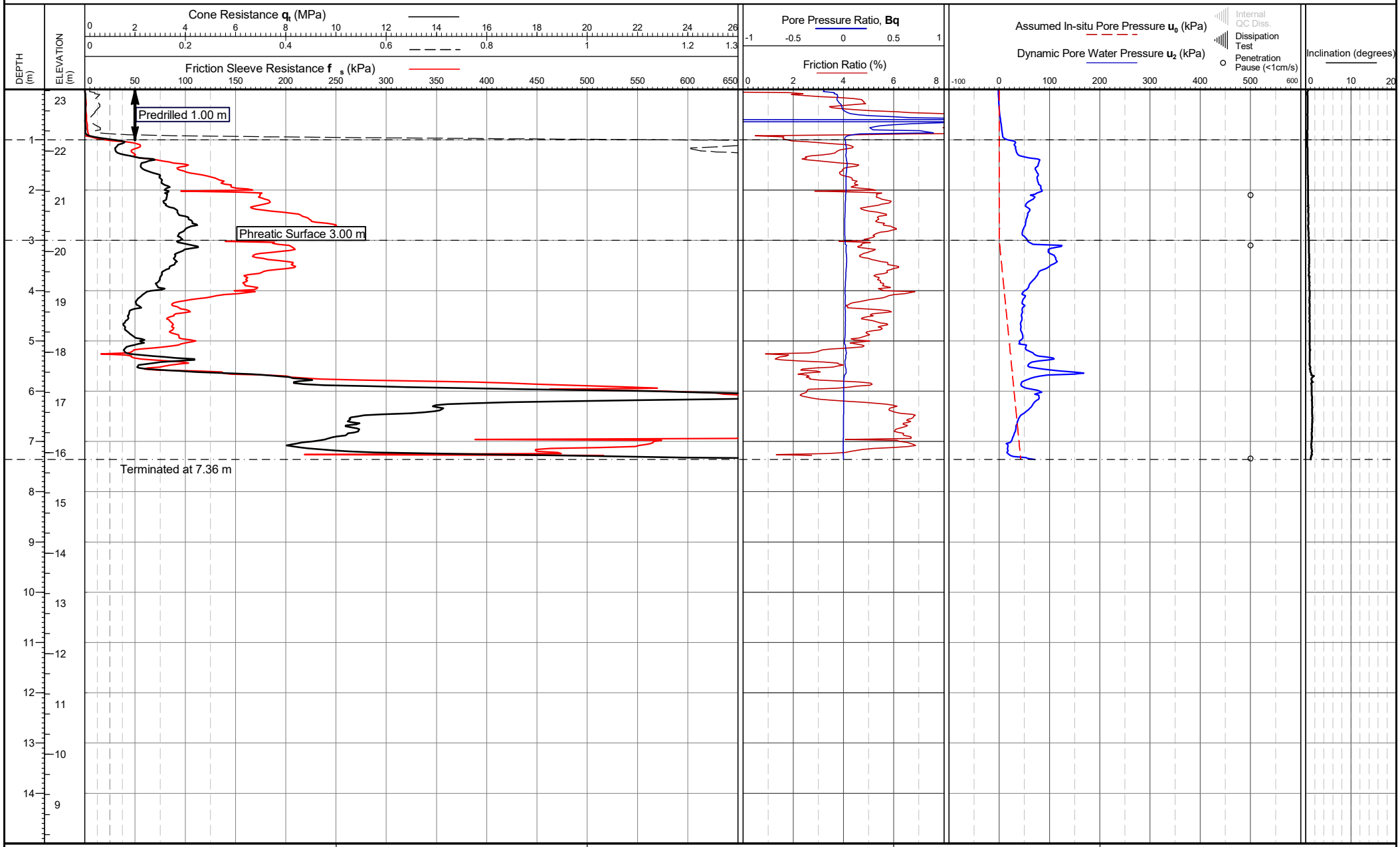
Lankelma Project Ref: P-107284-10

Checked by: Chris Player

TEST ID: CPT8A11

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 25/09/2019 10:23:00

Location: Cheshire, UK
Coordinates: 355083.729, 390736.585
Elevation: 23.224
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

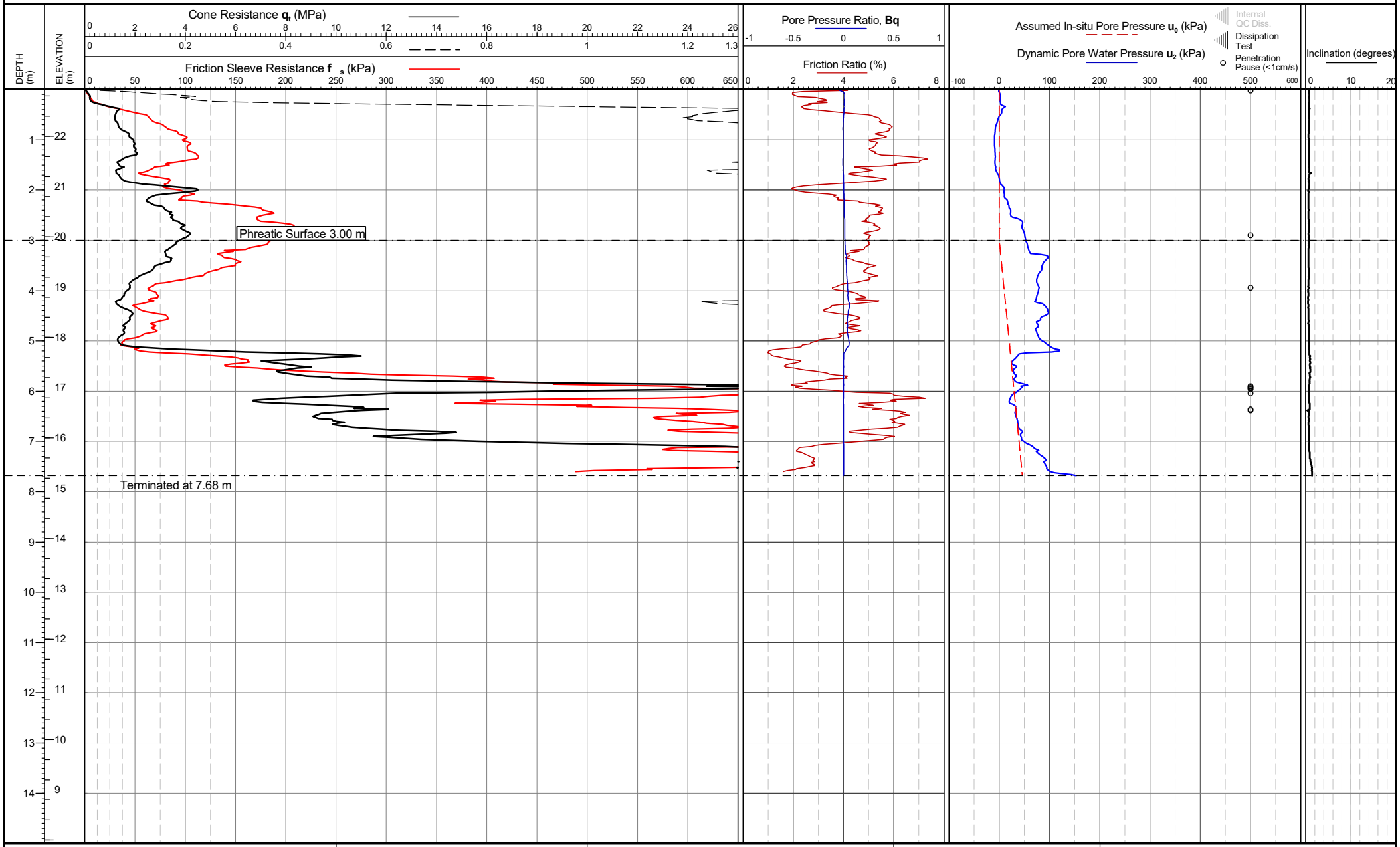
Lankelma Project Ref: P-107284-10

Checked by: Chris Player

TEST ID: CPT8B01

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 25/09/2019 09:52:00

Location: Cheshire, UK
Coordinates: 355139.955, 390794.903
Elevation: 22.93
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

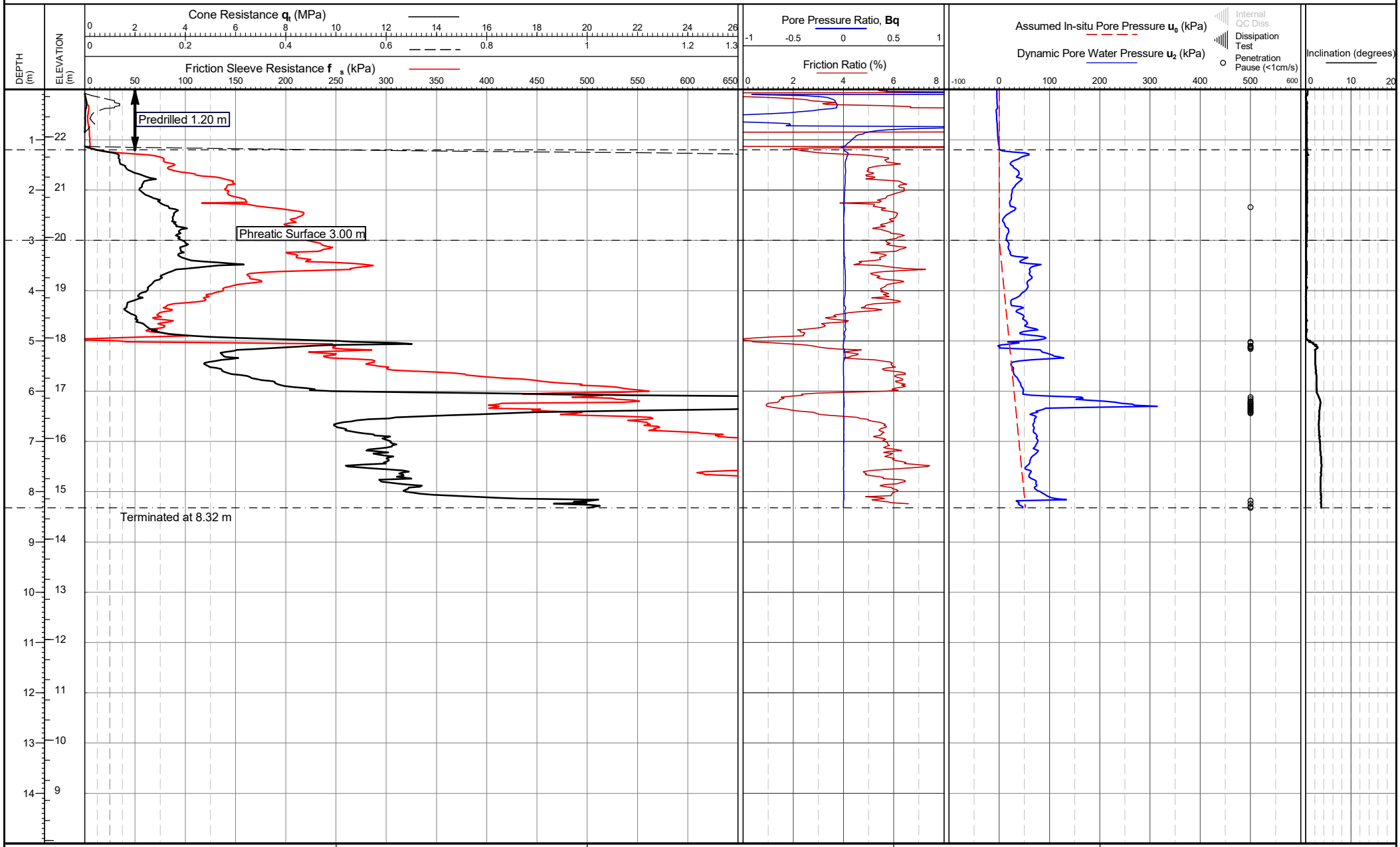
Lankelma Project Ref: P-107284-10

Checked by: Chris Player

TEST ID: CPT8B02

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 25/09/2019 11:09:00

Location: Cheshire, UK
Coordinates: 355143.117, 390638.942
Elevation: 22.942
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

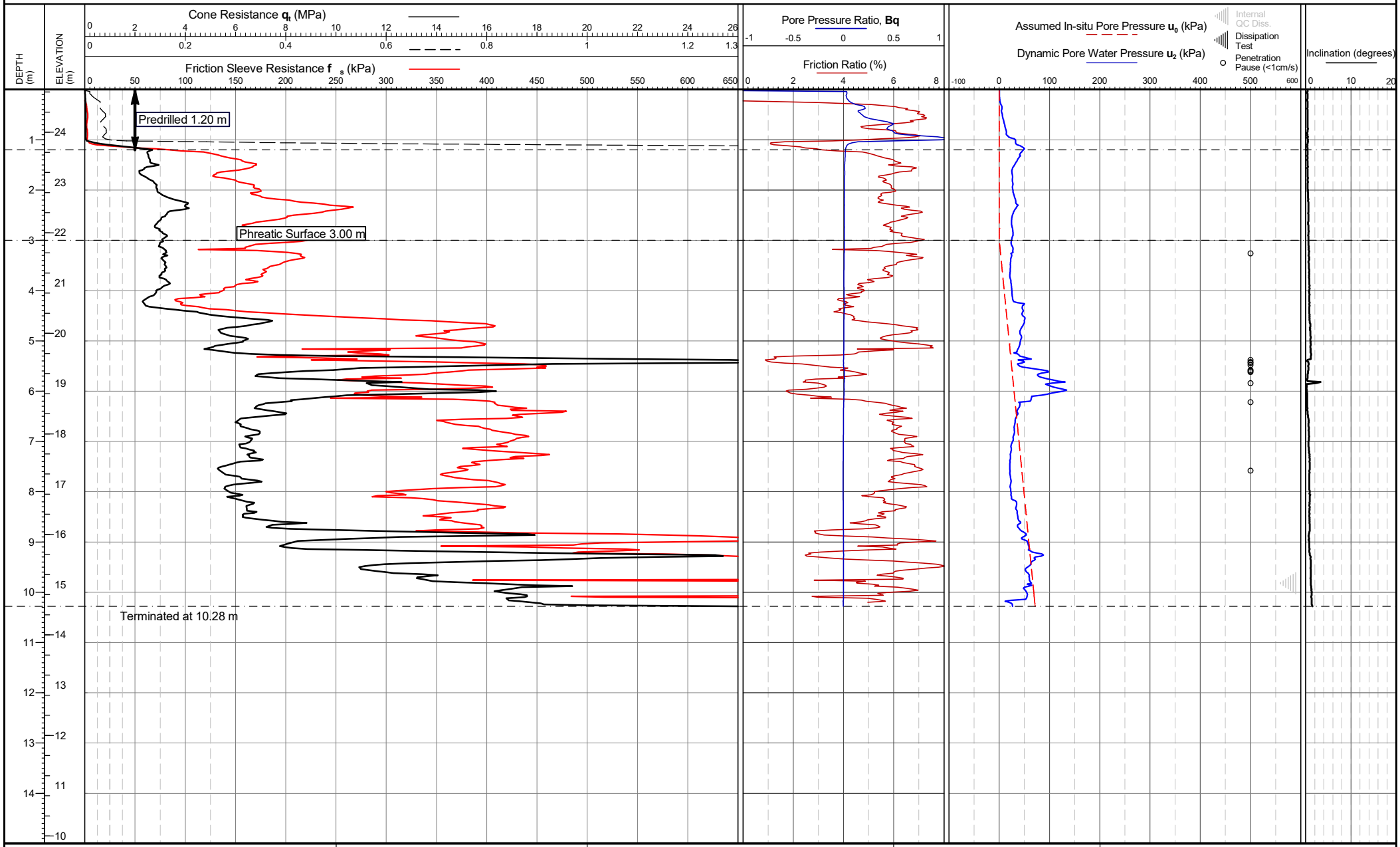
Checked by: Chris Player

TEST ID: CPT8B03

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 27/09/2019 11:09:00

Location: Cheshire, UK
Coordinates: 354747.865, 390623.751
Elevation: 24.849
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

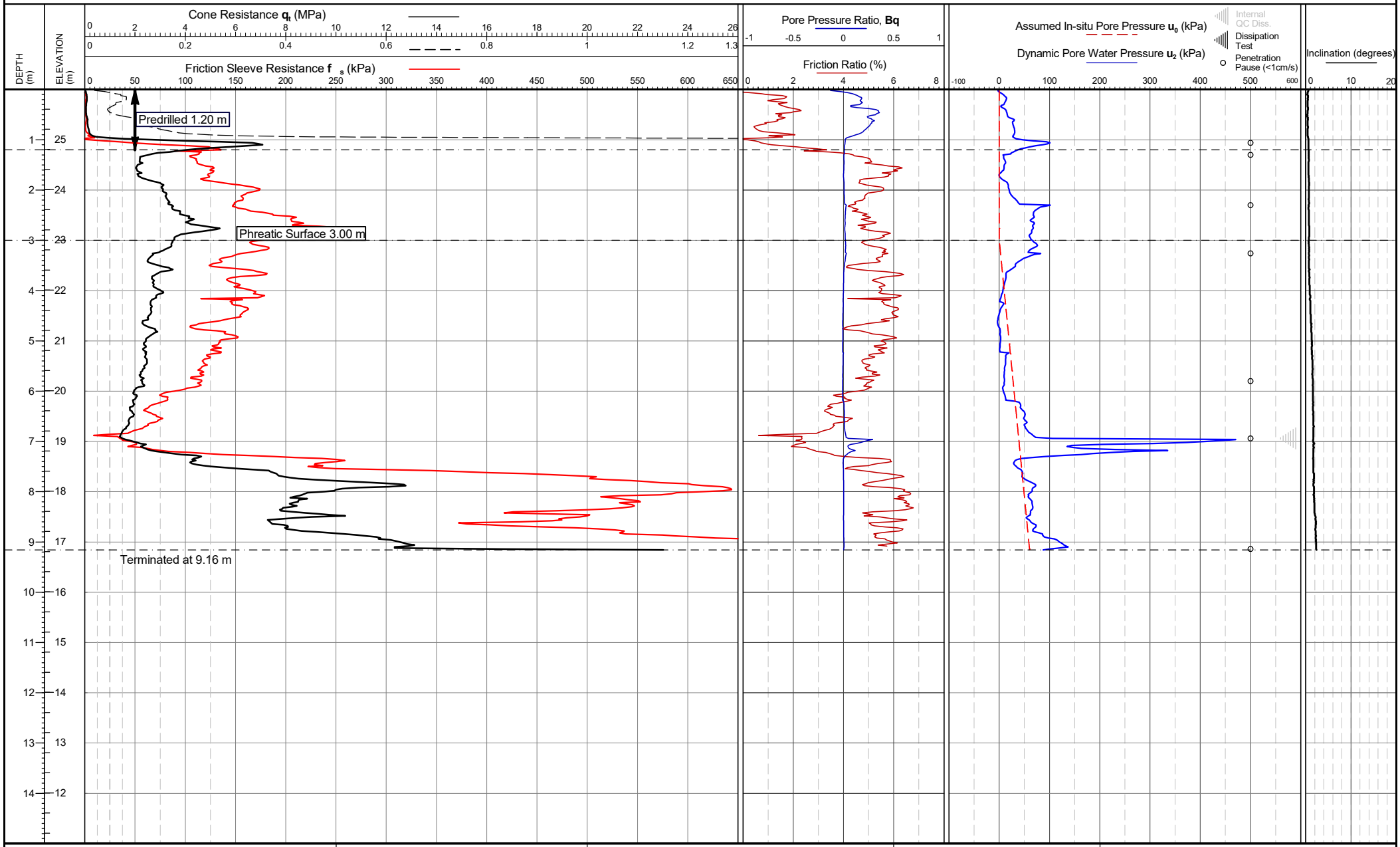
Lankelma Project Ref: P-107284-10

Checked by: Chris Player

TEST ID: CPTP8A01

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 27/09/2019 10:21:00

Location: Cheshire, UK
Coordinates: 354823.054, 390713.37
Elevation: 25.991
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

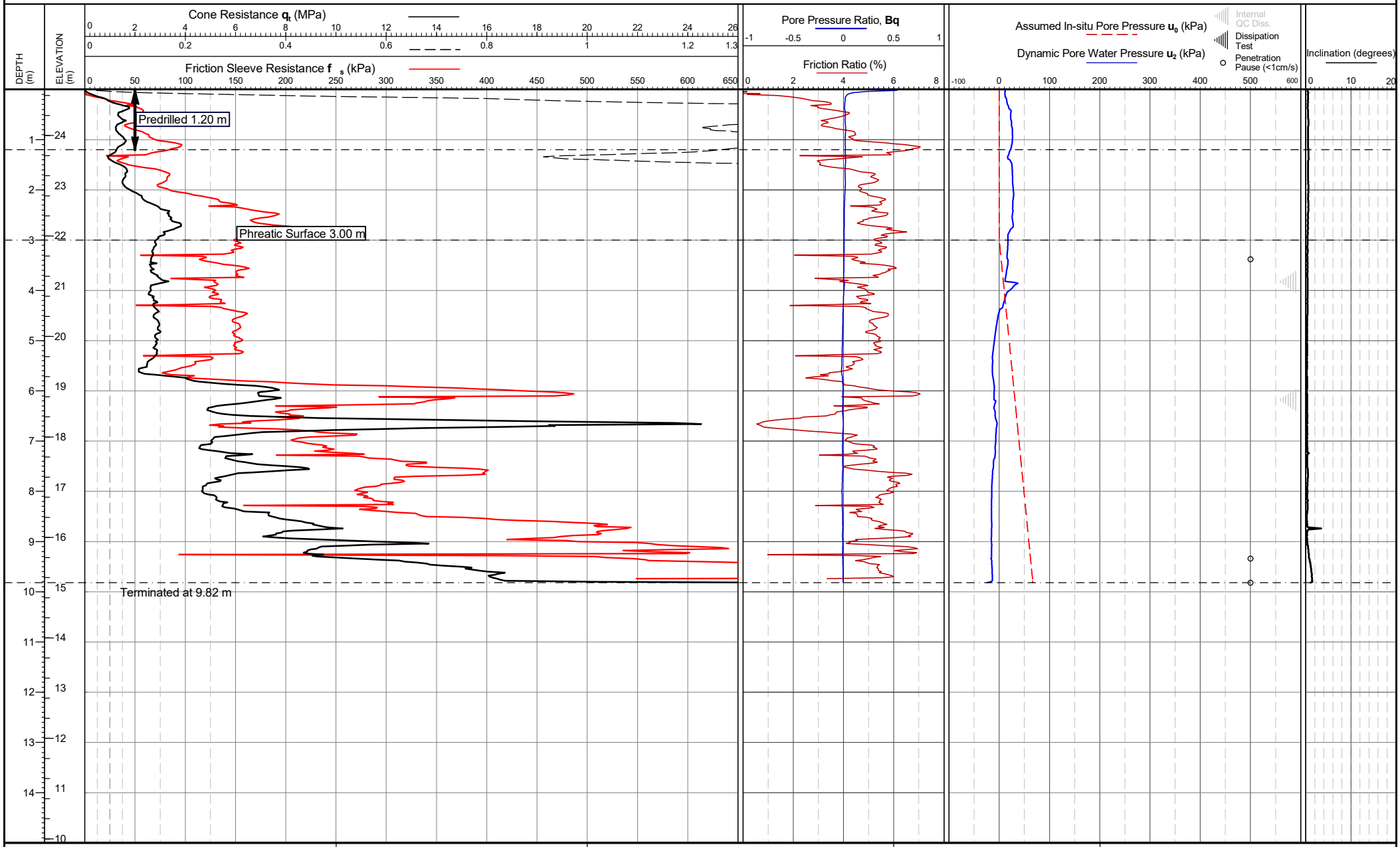
Lankelma Project Ref: P-107284-10

Checked by: Chris Player

TEST ID: CPTP8A02

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 27/09/2019 09:34:00

Location: Cheshire, UK
Coordinates: 354899.346, 390640.026
Elevation: 24.918
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

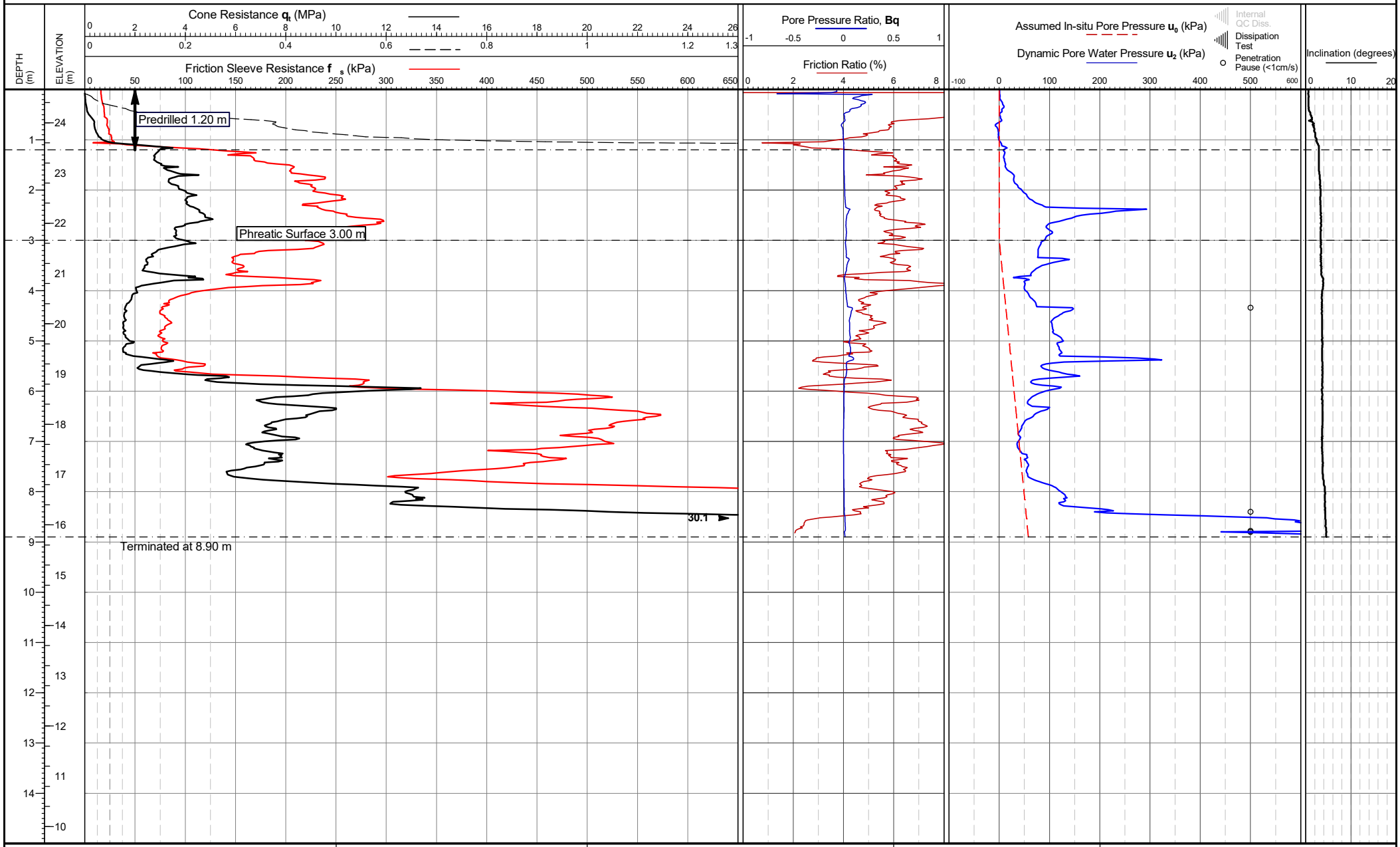
Checked by: Chris Player

TEST ID: CPTP8A03

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 27/09/2019 08:57:00

Location: Cheshire, UK
Coordinates: 354929.8, 390762.8
Elevation: 24.66
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

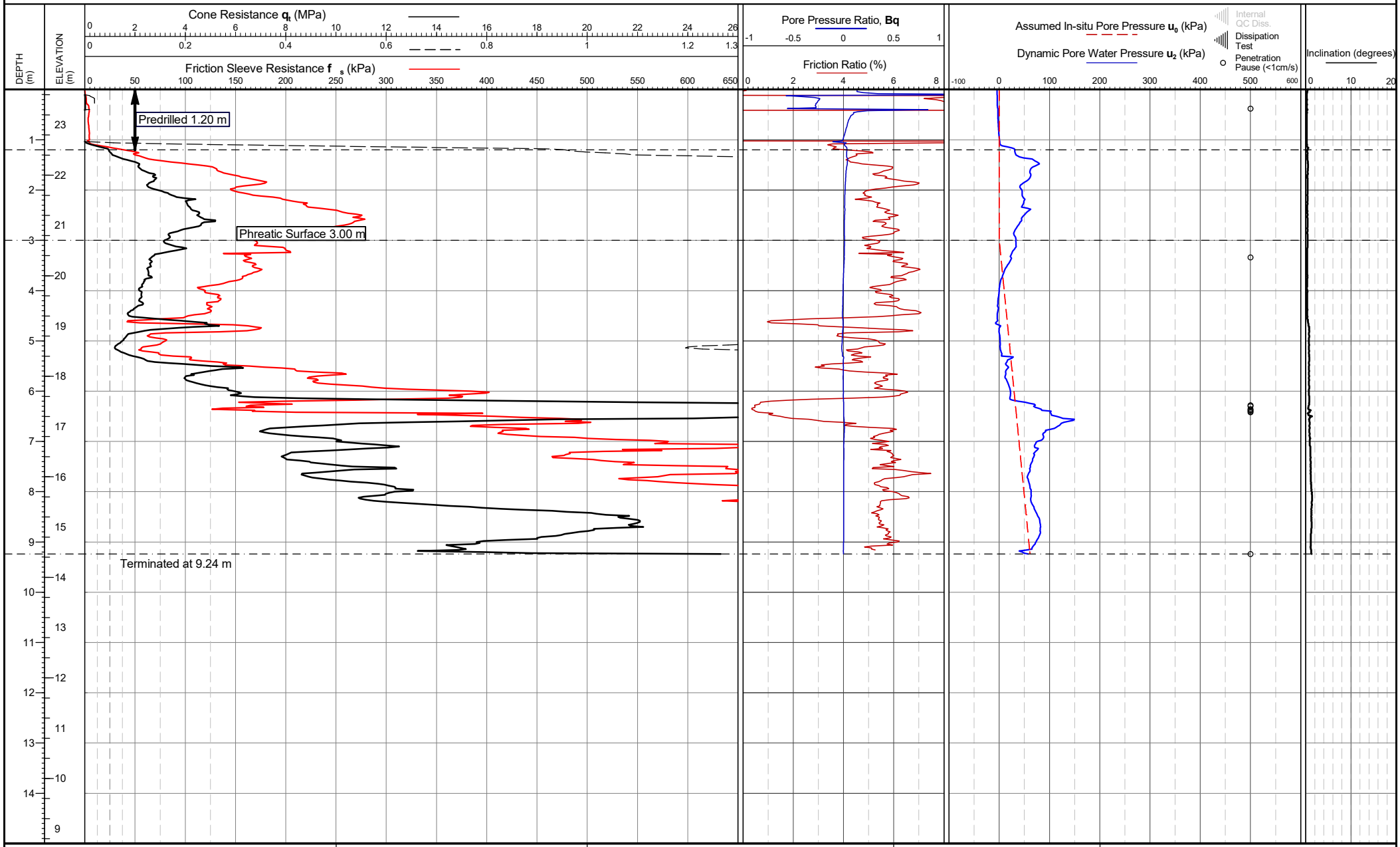
Lankelma Project Ref: P-107284-10

Checked by: Chris Player

TEST ID: CPTP8A04A

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
Cone ID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 25/09/2019 12:39:00

Location: Cheshire, UK
Coordinates: 355075.308, 390661.689
Elevation: 23.704
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Lateral support

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

Checked by: Chris Player

TEST ID: CPTP8B01

APPENDIX D STANDARD INTERPRETATION RESULTS - SET 1

UNDRAINED SHEAR STRENGTH
COEFFICIENT OF VOLUME CHANGE
OVERCONSOLIDATION RATIO
SOIL BEHAVIOUR TYPE (SBT) DESCRIPTIONS

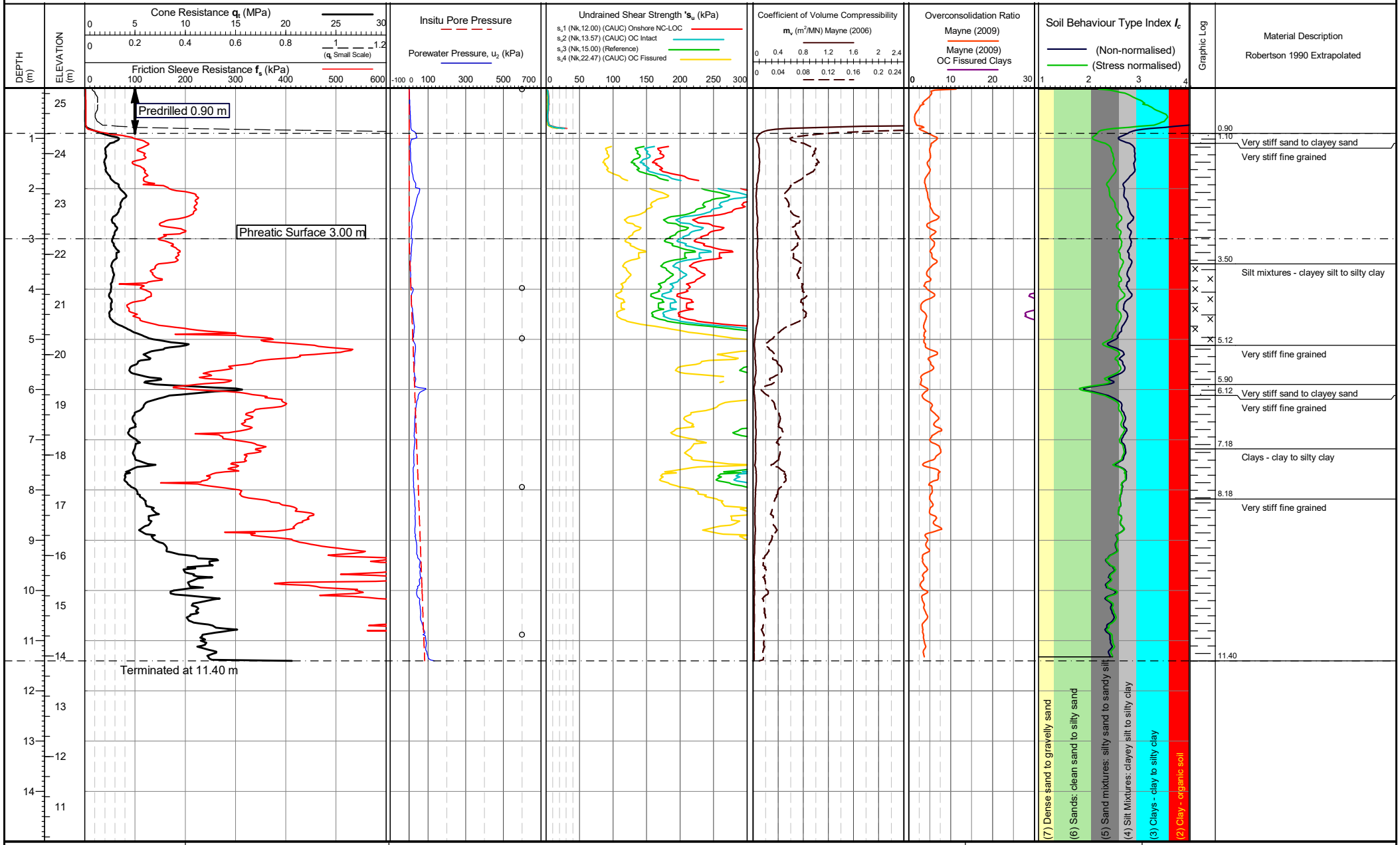
LIST OF FIGURES:

Location ID	Pages included
CPT8A01	1
CPT8A02	1
CPT8A03	1
CPT8A04	1
CPT8A05	1
CPT8A06	1
CPT8A07	1
CPT8A08A	1
CPT8A09	1
CPT8A10	1
CPT8A11	1
CPT8B01	1
CPT8B02	1
CPT8B03	1
CPTP8A01	1
CPTP8A02	1
CPTP8A03	1
CPTP8A04A	1
CPTP8B01	1

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 10:10:00

Location: Cheshire, UK
Coordinates: 354708.317, 390661.294
Elevation: 25.306
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

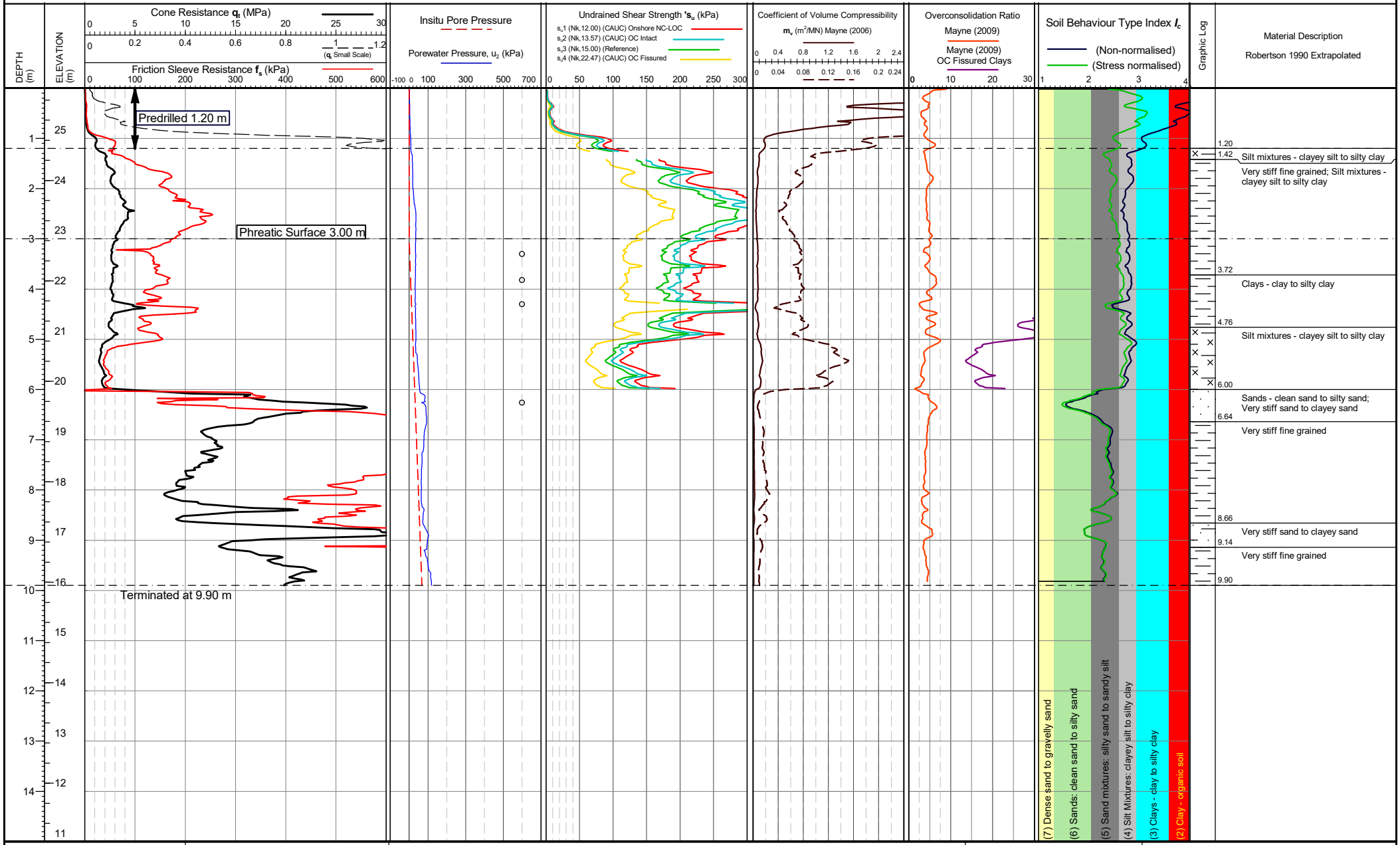
Checked by: Chris Player

TEST ID: CPT8A01

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 10:50:00

Location: Cheshire, UK
Coordinates: 354749.627, 390698.494
Elevation: 25.837
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Sleeve load

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

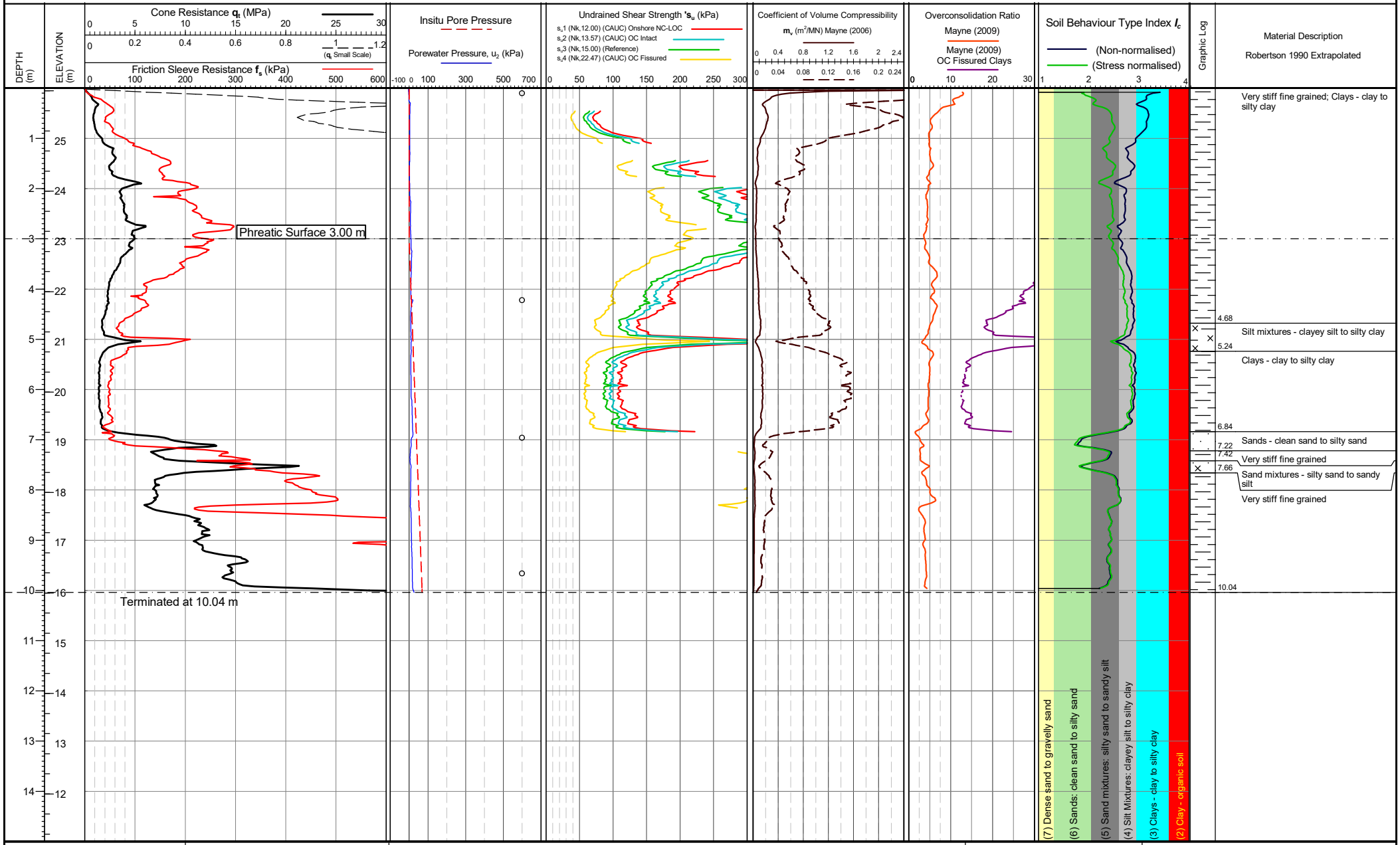
Checked by: Chris Player

TEST ID: CPT8A02

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 01/10/2019 09:34:00

Location: Cheshire, UK
Coordinates: 354779.753, 390751.32
Elevation: 26.051
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Checked by: Chris Player

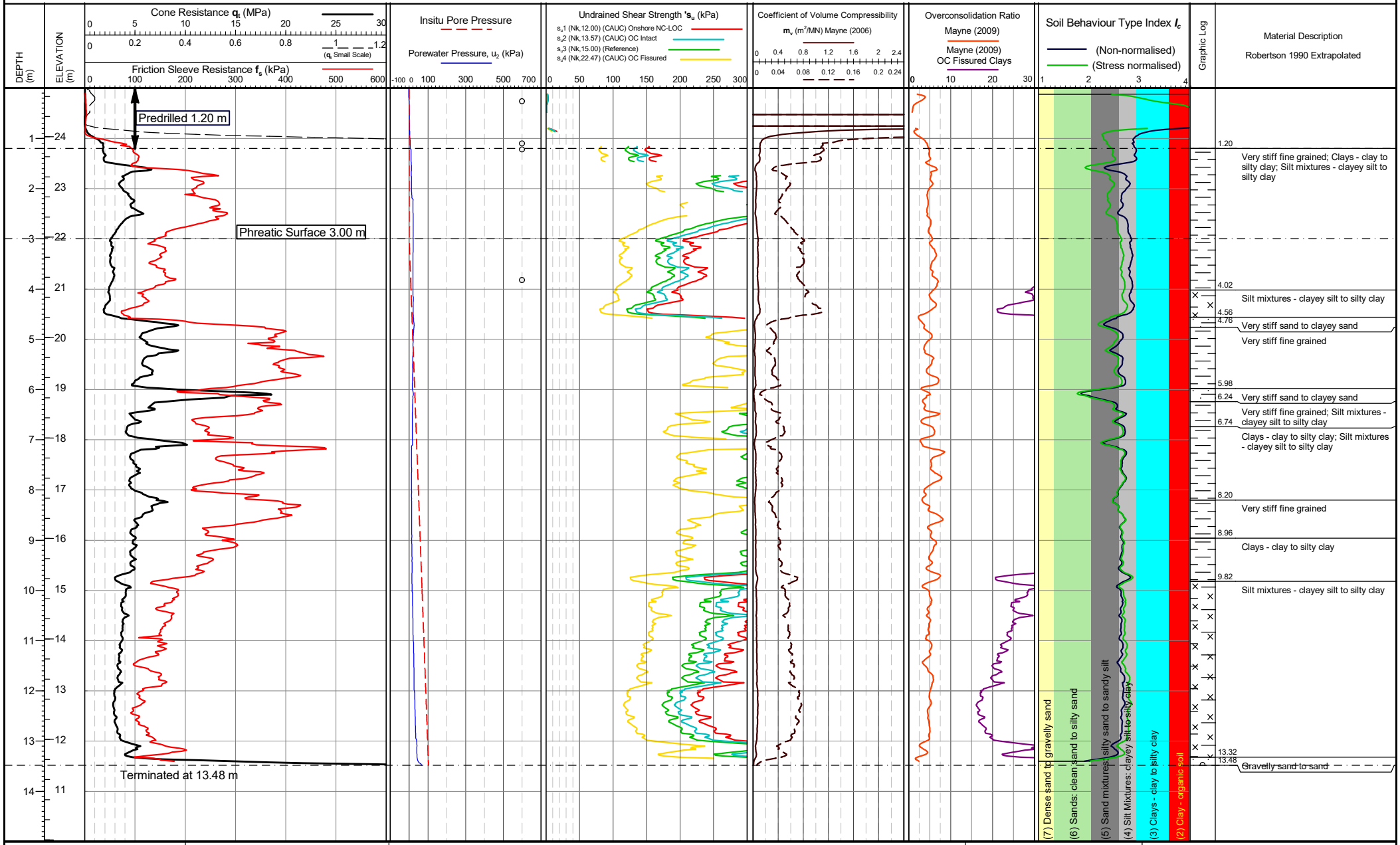
Lankelma Project Ref: P-107284-10

TEST ID: CPT8A03

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 12:35:00

Location: Cheshire, UK
Coordinates: 354795.81, 390589.233
Elevation: 24.965
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20
Lankelma Project Ref: P-107284-10

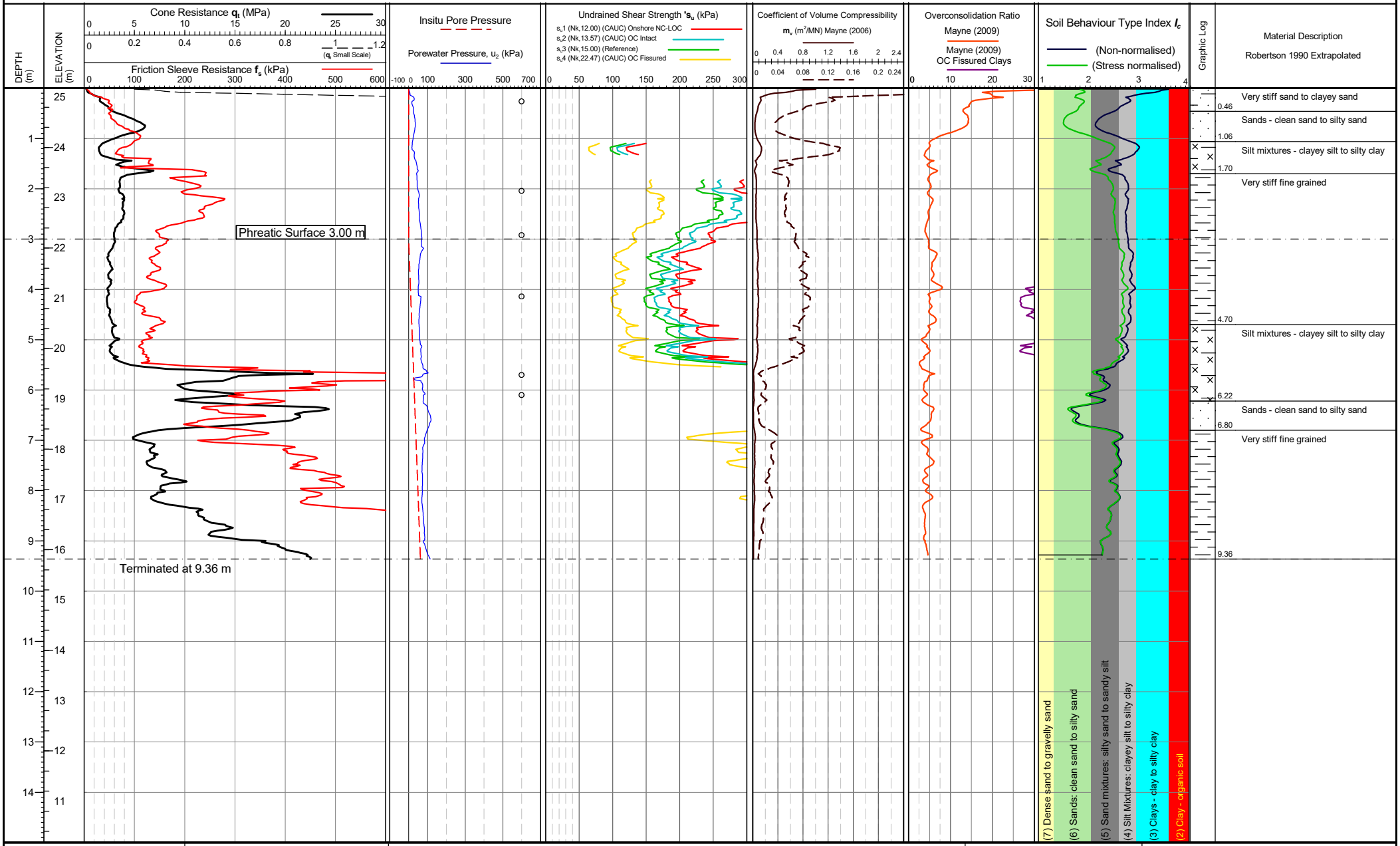
Checked by:
Chris Player

TEST ID: CPT8A04

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 13:15:00

Location: Cheshire, UK
Coordinates: 354841.806, 390645.089
Elevation: 25.177
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

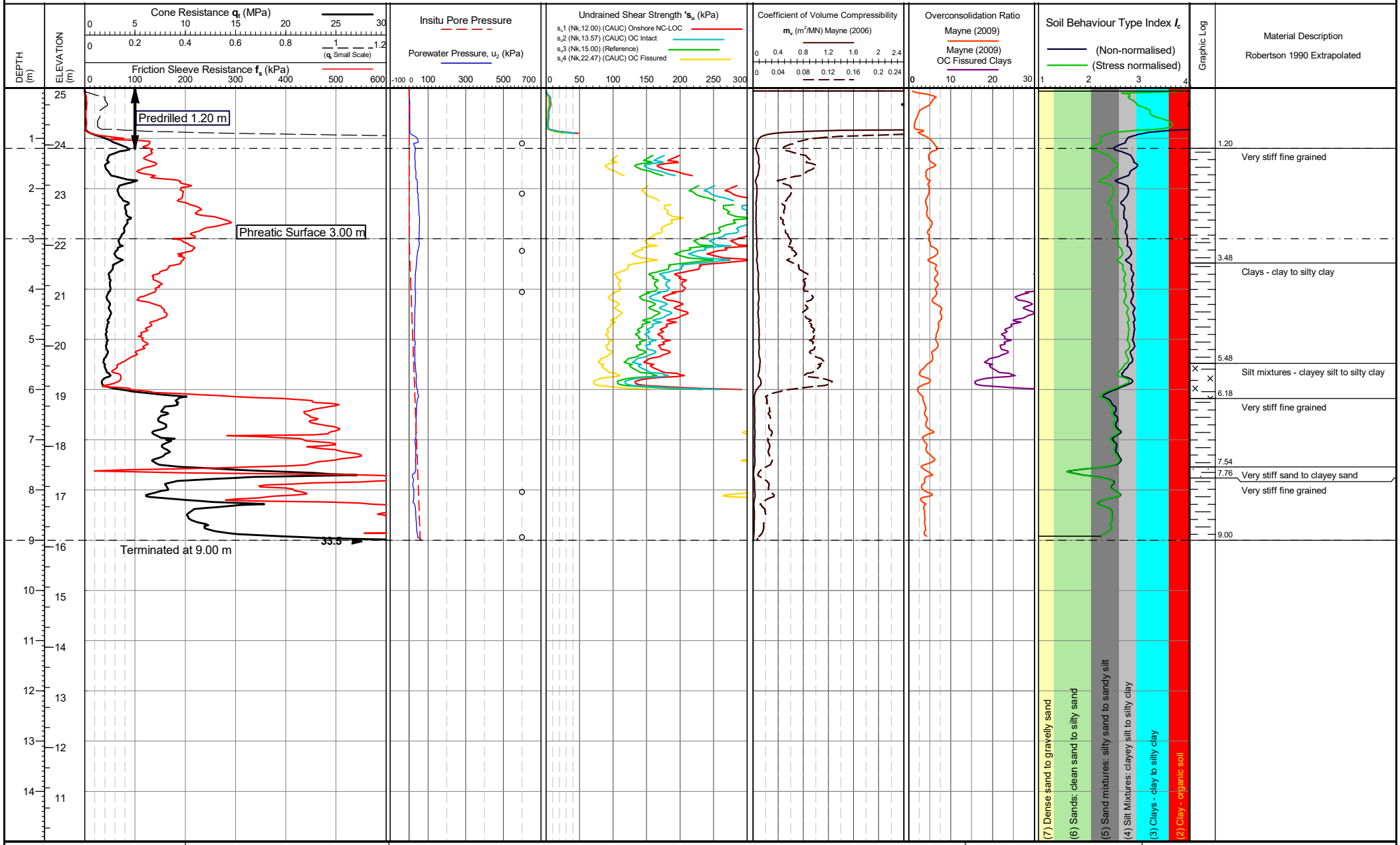
Checked by: Chris Player

TEST ID: CPT8A05

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 12:02:00

Location: Cheshire, UK
Coordinates: 354865.15, 390675.865
Elevation: 25.131
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Checked by: Chris Player

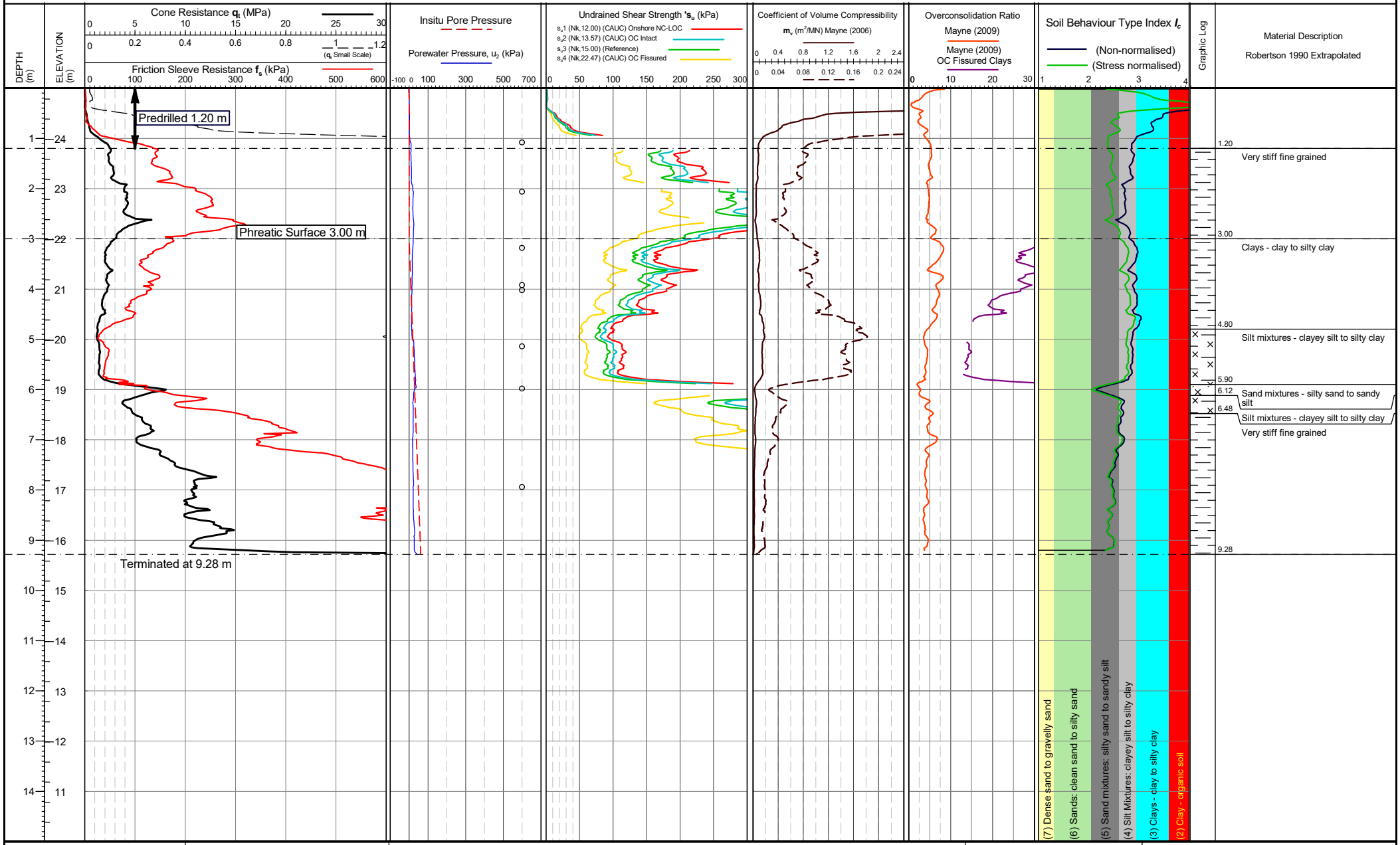
Lankelma Project Ref: P-107284-10

TEST ID: CPT8A06

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 11:31:00

Location: Cheshire, UK
Coordinates: 354896.233, 390722.399
Elevation: 25.016
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

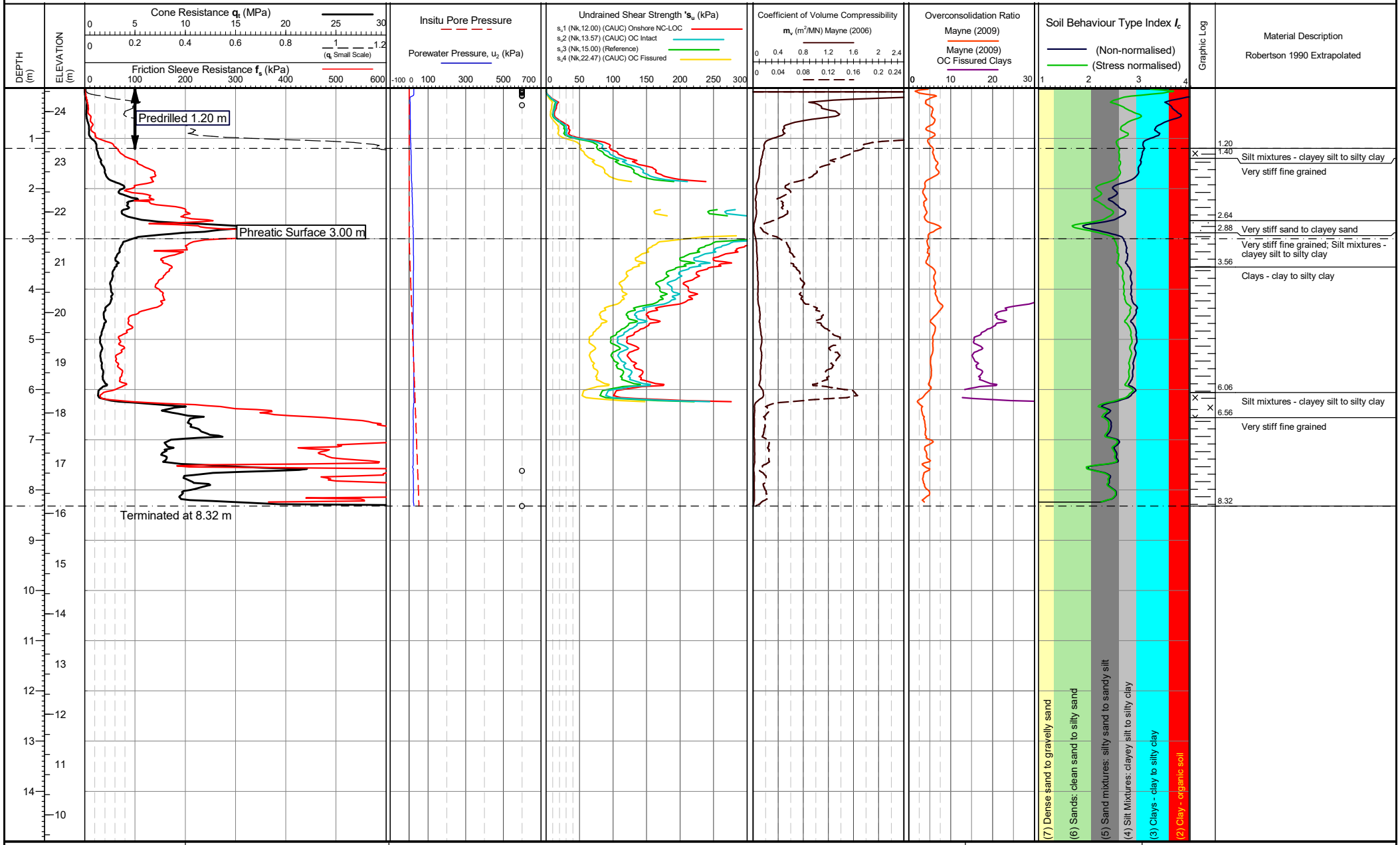
Checked by: Chris Player

TEST ID: CPT8A07

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Graphic Log

Material Description

Robertson 1990 Extrapolated

1.20 — Silt mixtures - clayey silt to silty clay

1.40 — Very stiff fine grained

2.64

2.88 — Very stiff sand to clayey sand

3.56 — Very stiff fine grained; Silt mixtures - clayey silt to silty clay

Clays - clay to silty clay

6.06 — Silt mixtures - clayey silt to silty clay

6.56 — Very stiff fine grained

8.32

Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 13:47:00

Location: Cheshire, UK
Coordinates: 354931.435, 390765.13
Elevation: 24.466
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

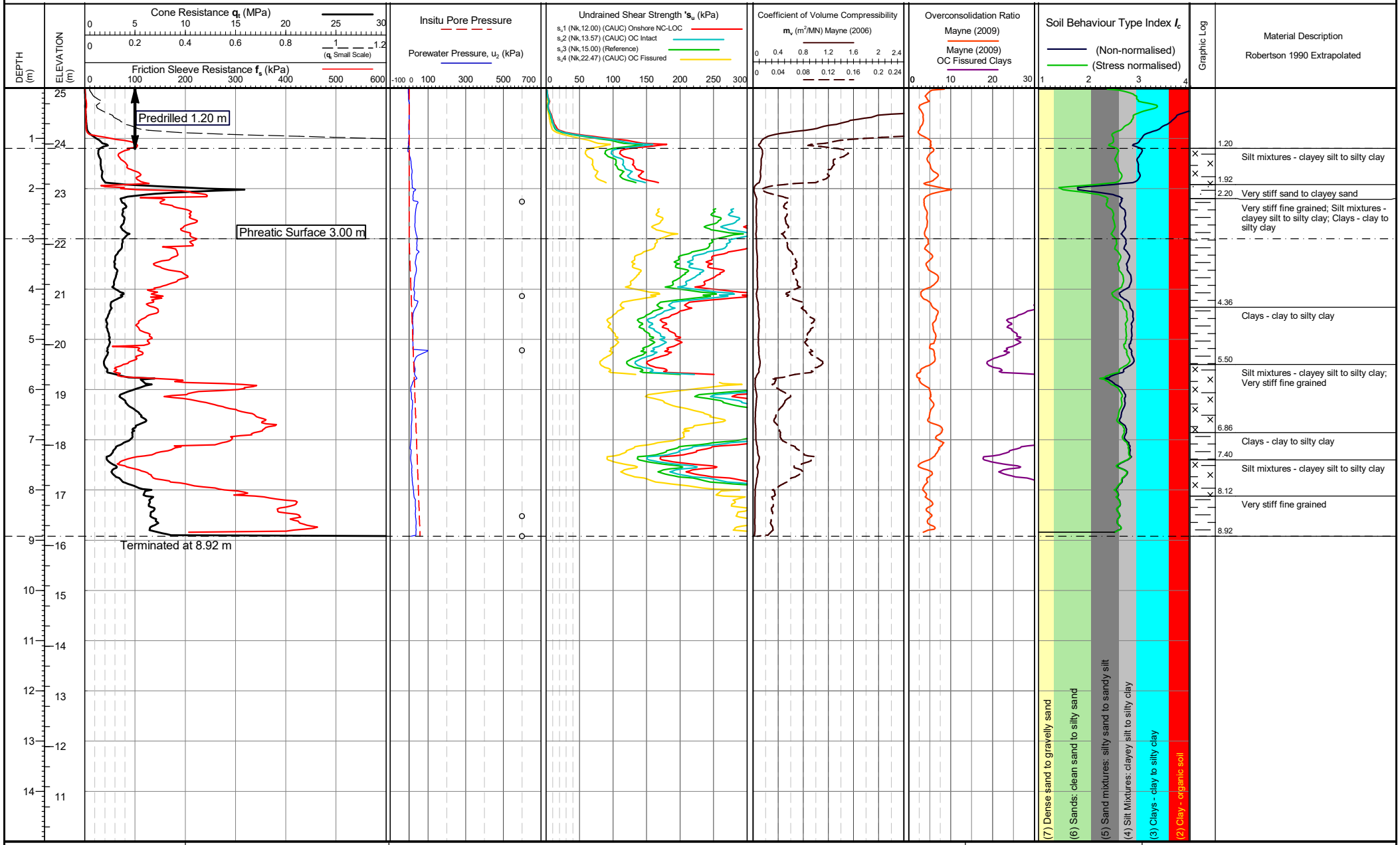
Checked by: Chris Player

TEST ID: CPT8A08A

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 15:28:00

Location: Cheshire, UK
Coordinates: 354951.213, 390611.664
Elevation: 25.109
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

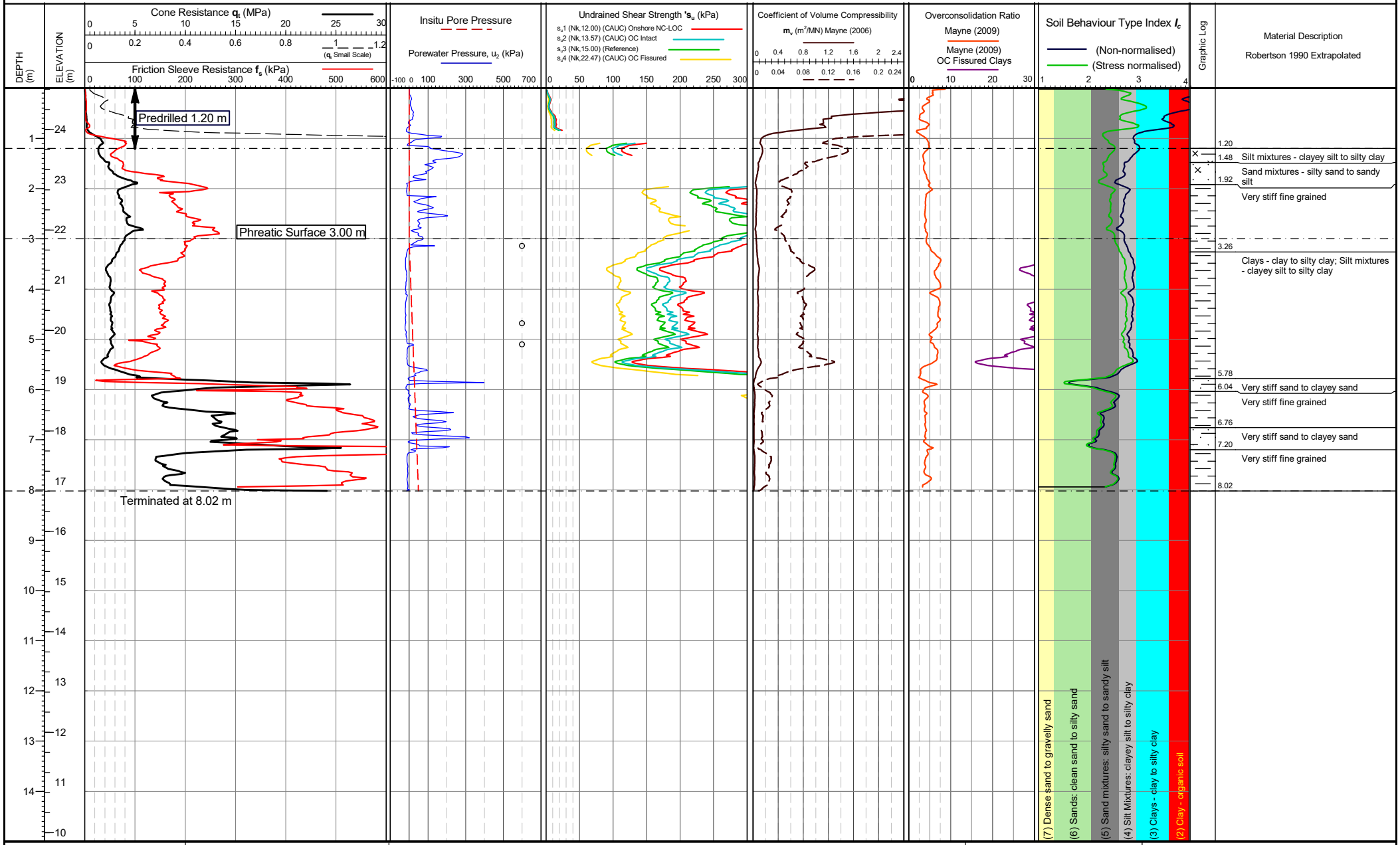
Checked by: Chris Player

TEST ID: CPT8A09

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 15:02:00

Location: Cheshire, UK
Coordinates: 354985.423, 390646.749
Elevation: 24.824
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

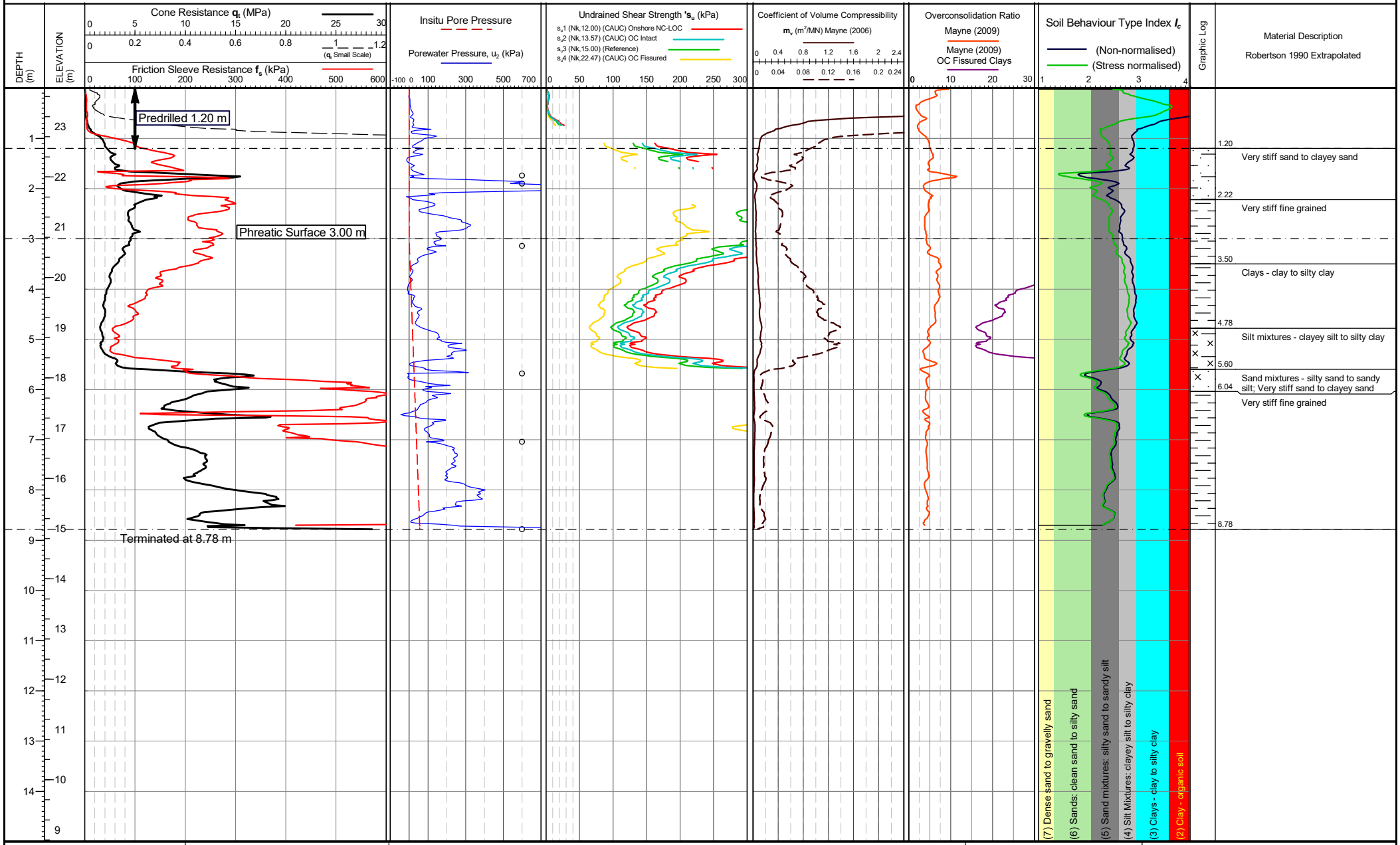
Checked by: Chris Player

TEST ID: CPT8A10

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Rob Ashcroft
Rig Used: UK22
Date of test: 01/10/2019 14:19:00

Location: Cheshire, UK
Coordinates: 355020.646, 390689.418
Elevation: 23.768
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

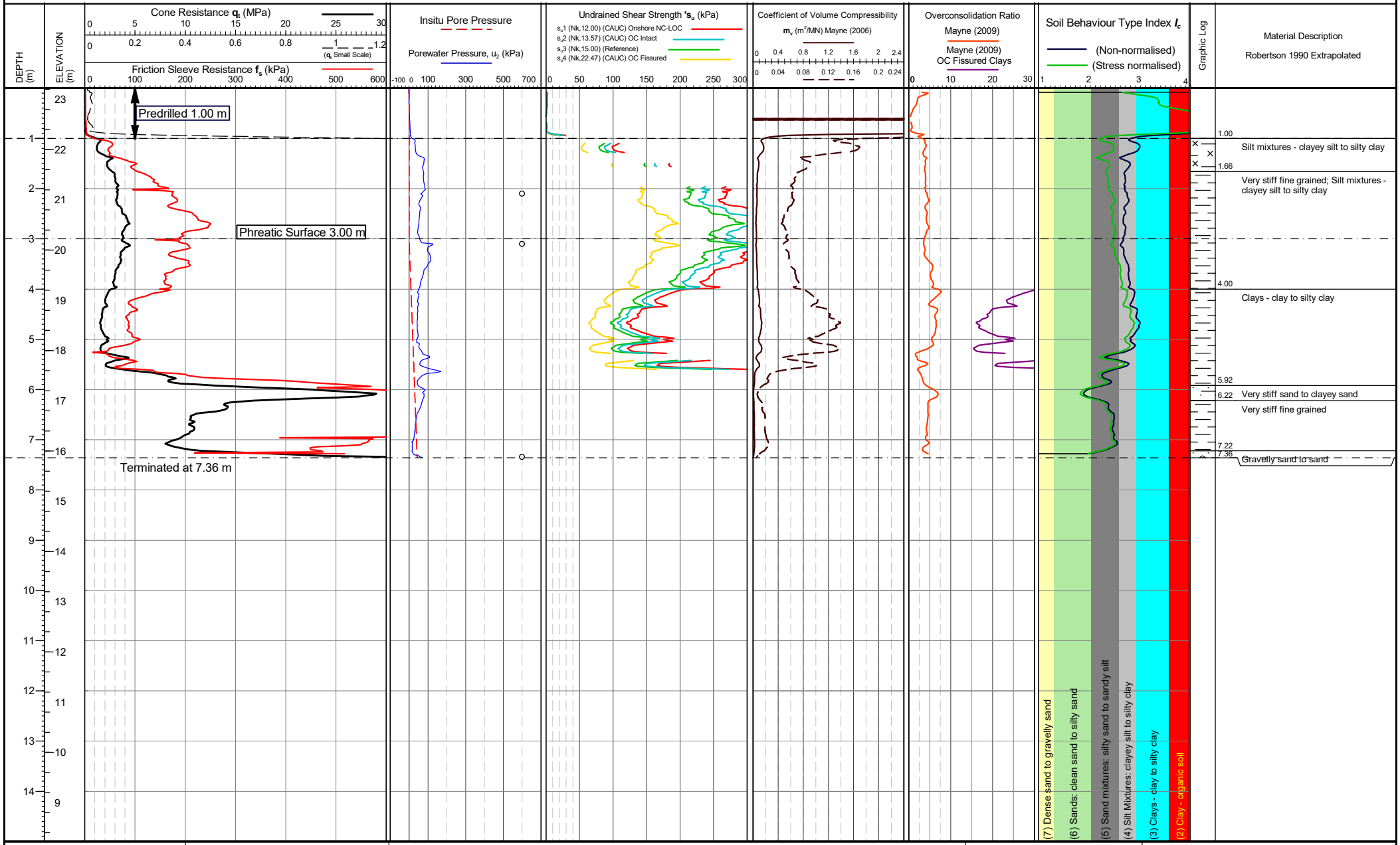
Checked by: Chris Player

TEST ID: CPT8A11

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 25/09/2019 10:23:00

Location: Cheshire, UK
Coordinates: 355083.729, 390736.585
Elevation: 23.224
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

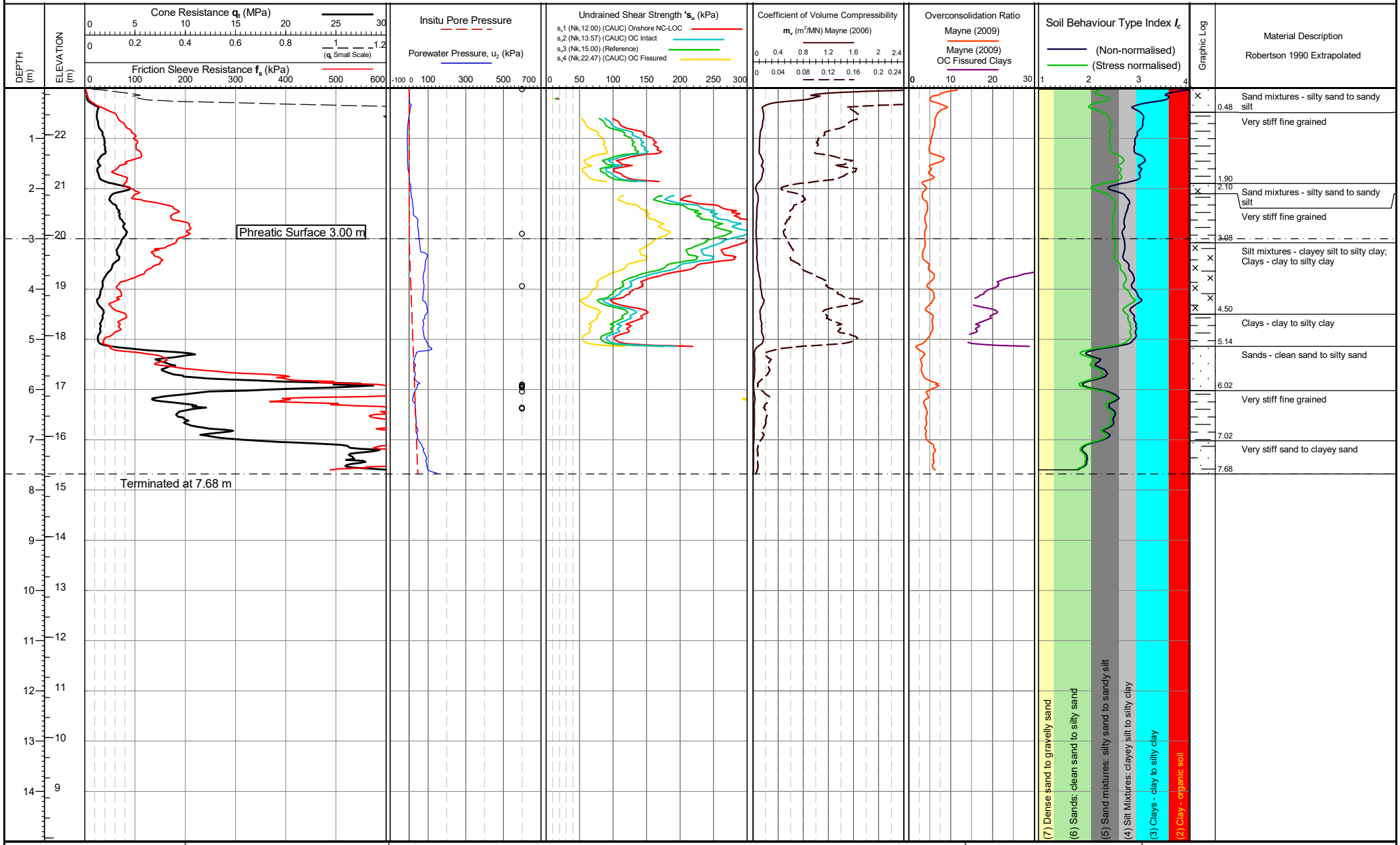
Checked by: Chris Player

TEST ID: CPT8B01

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 25/09/2019 09:52:00

Location: Cheshire, UK
Coordinates: 355139.955, 390794.903
Elevation: 22.93
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

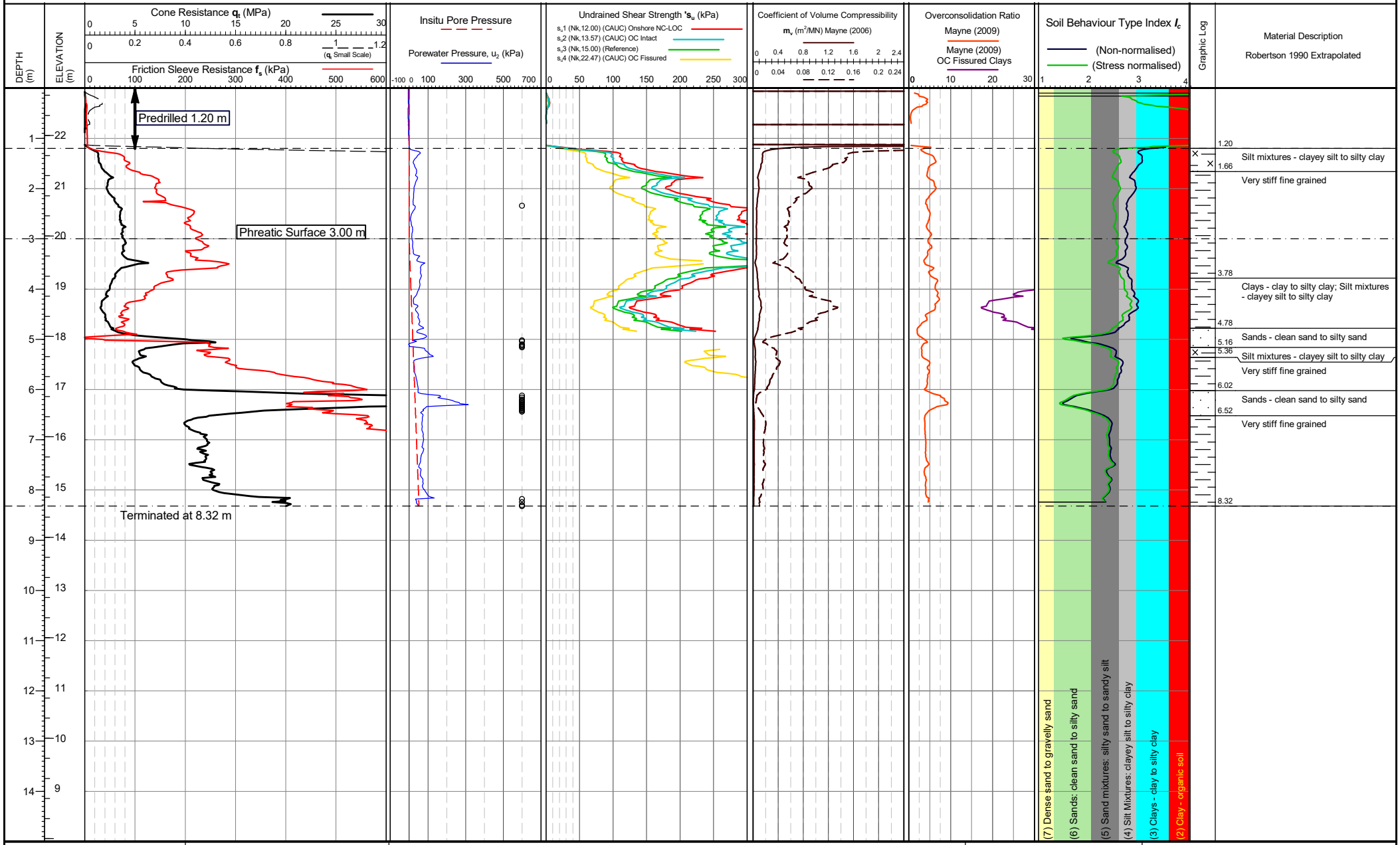
Checked by: Chris Player

TEST ID: CPT8B02

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 25/09/2019 11:09:00

Location: Cheshire, UK
Coordinates: 355143.117, 390638.942
Elevation: 22.942
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

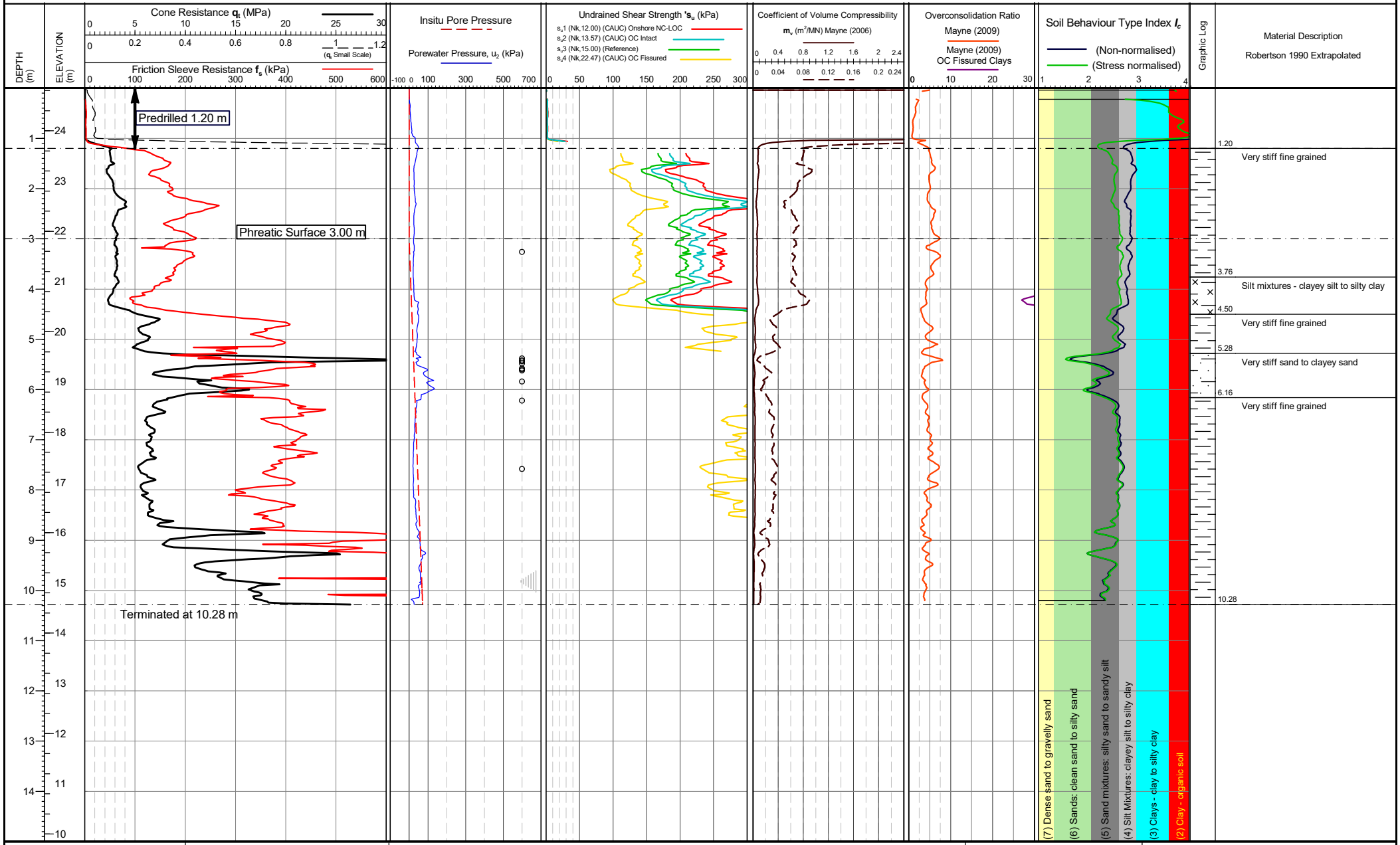
Checked by: Chris Player

TEST ID: CPT8B03

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 27/09/2019 11:09:00

Location: Cheshire, UK
Coordinates: 354747.865, 390623.751
Elevation: 24.849
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Checked by: Chris Player

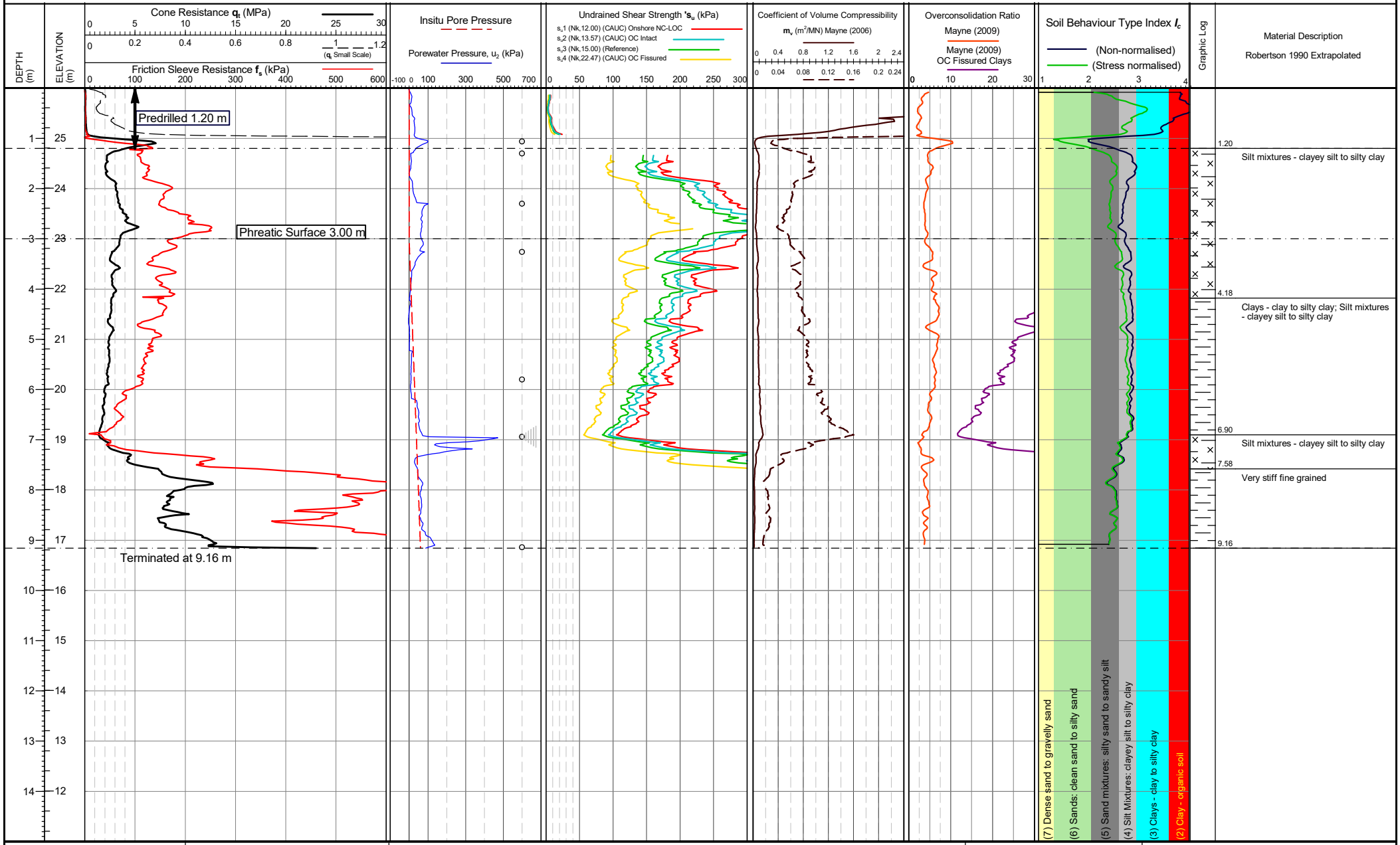
Lankelma Project Ref: P-107284-10

TEST ID: CPTP8A01

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 27/09/2019 10:21:00

Location: Cheshire, UK
Coordinates: 354823.054, 390713.37
Elevation: 25.991
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Checked by: Chris Player

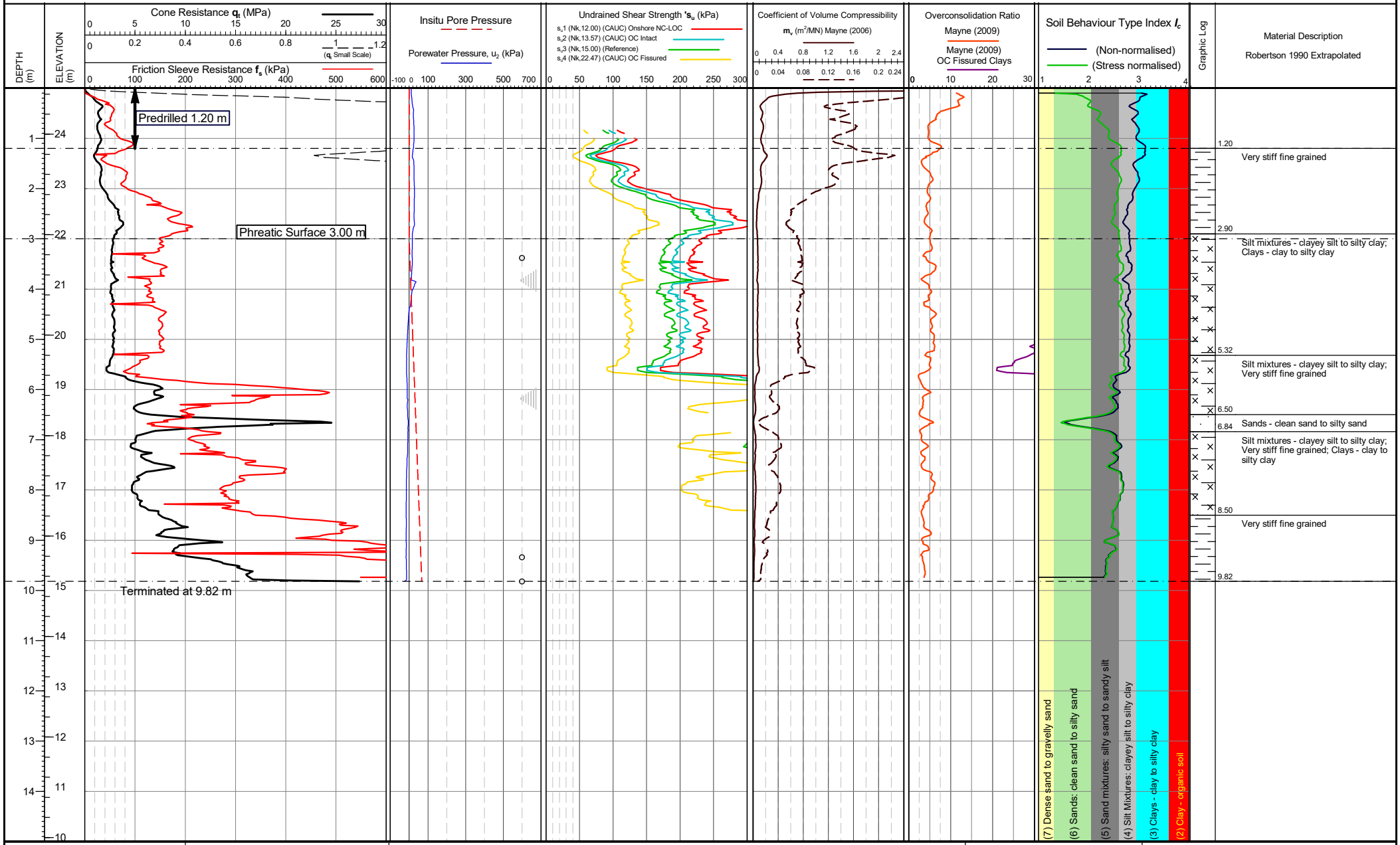
Lankelma Project Ref: P-107284-10

TEST ID: CPTP8A02

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 27/09/2019 09:34:00

Location: Cheshire, UK
Coordinates: 354899.346, 390640.026
Elevation: 24.918
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

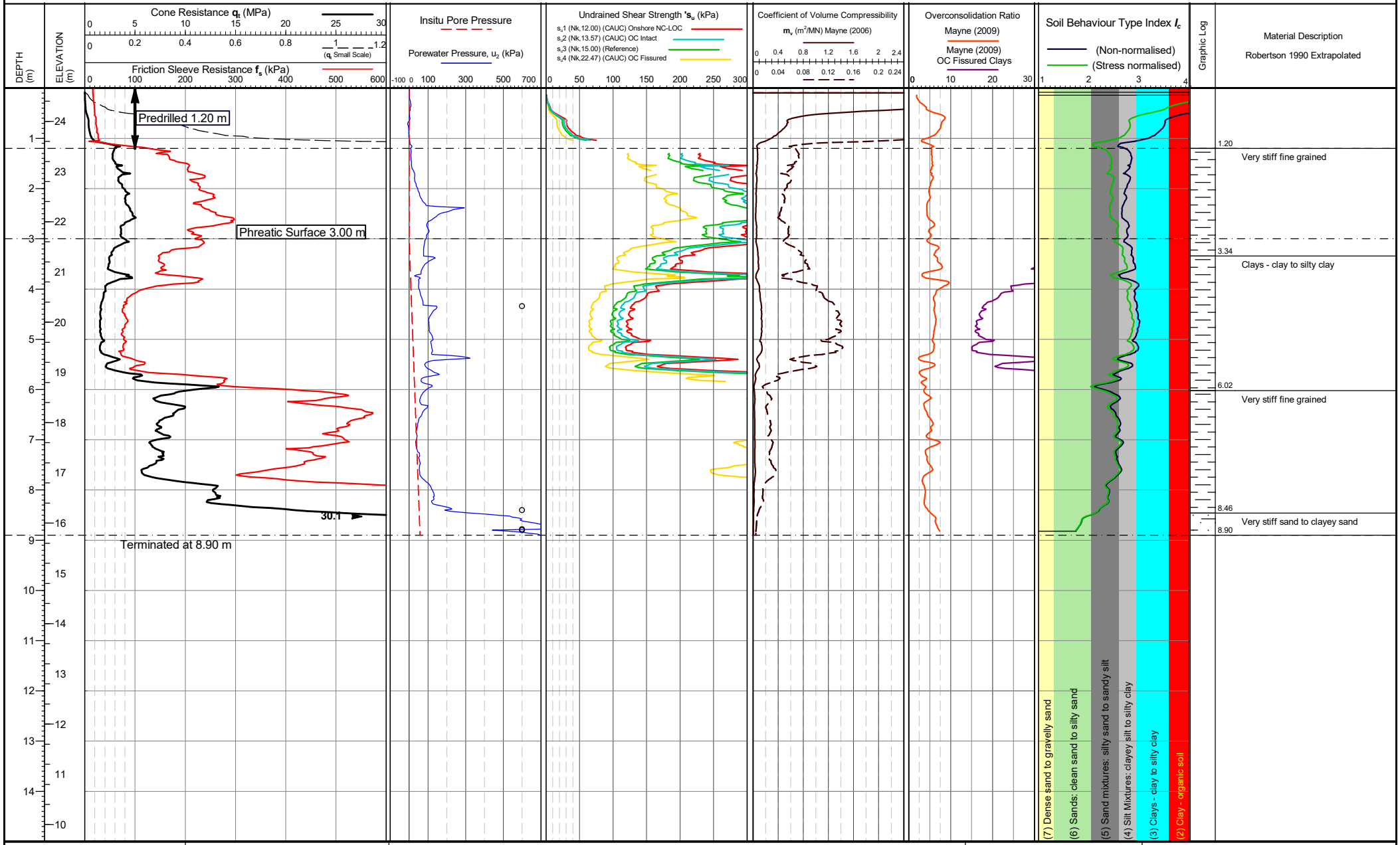
Checked by: Chris Player

TEST ID: CPTP8A03

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 27/09/2019 08:57:00

Location: Cheshire, UK
Coordinates: 354929.8, 390762.8
Elevation: 24.66
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Checked by: Chris Player

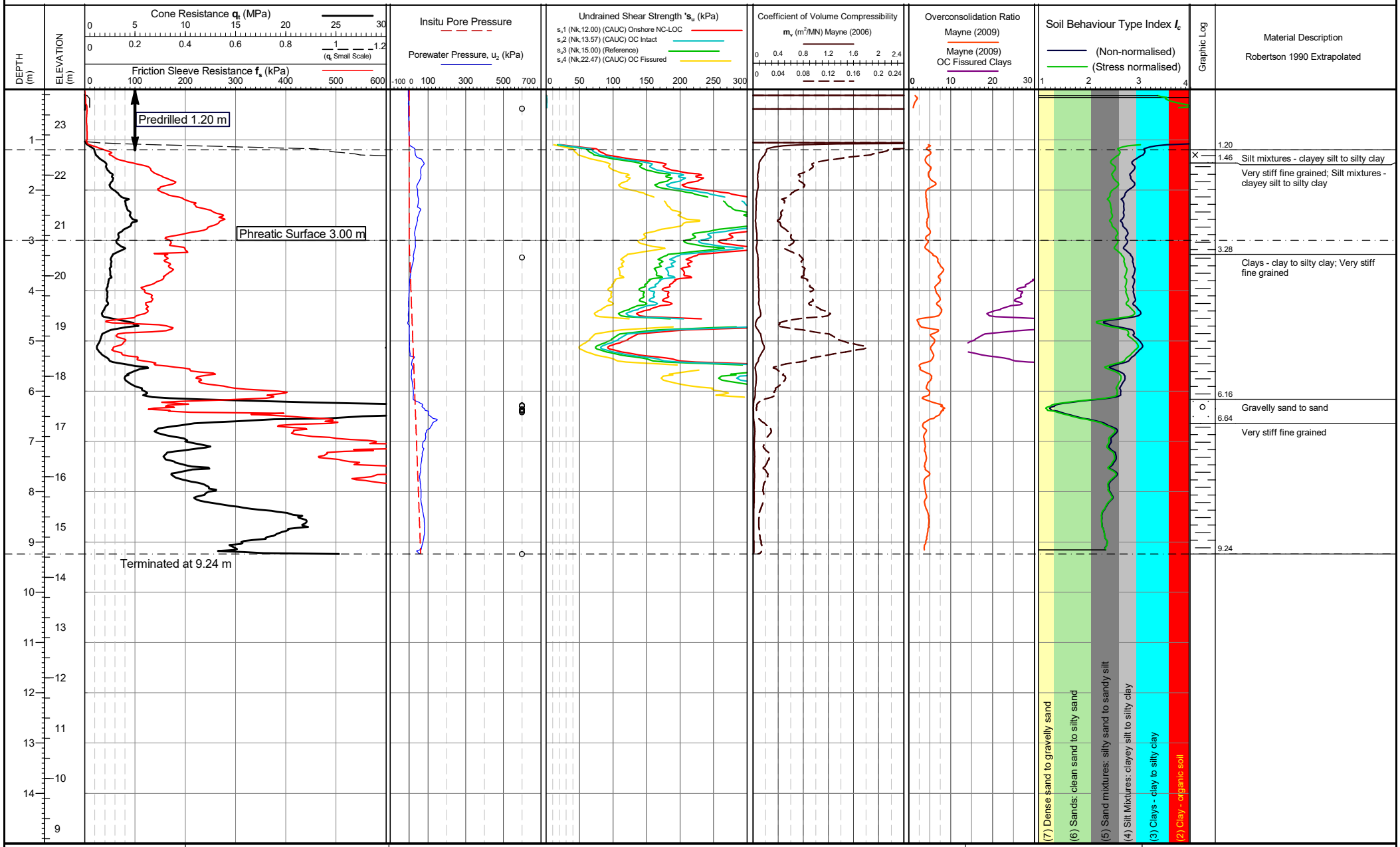
Lankelma Project Ref: P-107284-10

TEST ID: CPTP8A04A

LANKELMA

Project: WARRINGTON

Client: GEOTECHNICS



Cone area (mm2):1500
ConeID: S15-CFIPT.1768
Operator: Phillip Case
Rig Used: UK22
Date of test: 25/09/2019 12:39:00

Location: Cheshire, UK
Coordinates: 355075.308, 390661.689
Elevation: 23.704
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report section 'Drained and Undrained Behaviour' for discussion.

See report section 'Interpretive Data' for methods and discussion of parameter evaluation.

Date of plot: 03-01-20

Lankelma Project Ref: P-107284-10

Checked by: Chris Player

TEST ID: CPTP8B01