9 April 2020 Reference No. 1896230-046-L-Rev0

Georgio Dall'Armi
Broken Hill Operations Pty Ltd
Eyre Street
Broken Hill
NSW

LIQUEFACTION ASSESSMENT OF TAILINGS – RASP MINE TAILINGS STORAGE FACILITY 1

Dear Georgio,

1.0 INTRODUCTION

Broken Hill Operations Pty Ltd (BHOP) has commissioned Golder Associates Pty Ltd (Golder) to assess the risk of liquefaction of an old tailings storage facility (TSF 1) at the Rasp Mine in Broken Hill, New South Wales. This document outlines the screening level assessment on data received from two cone penetration test (CPTu) programmes completed at TSF 1, the first programme in November 2019, and the second in March 2020. The second investigation was carried out to measure conditions closer to the eastern edge of the TSF, following an initial review of the results of the first investigation.

The first investigation comprised 5 CPT locations (CPT01 to CPT05) and the second investigation comprised another 4 CPT (CPT06A to CPT09) probe locations along the eastern edge, plus two locations (CPT4 and CPT5) on the eastern bench of Mt Hebbard. In the vicinity of the two locations on the eastern bench of Mt Hebbard numerous attempts were made to penetrate the subgrade in the general areas labelled CPT 4 and CPT 5C, but all attempts except one (CPT5C) refused near the surface. CPT 5C penetrated approximately 8 m before also refusing.

The layout of the locations of the CPT probes is presented in the attached Figure 1, in Appendix A. The measurement summaries of the CPT probes are presented in Appendix B, and the results of the analyses of the measurements are presented in Appendix C.

The mine also arranged for a few probes within the central portion of the TSF to collect samples for its' assessment of the materials from a process engineering point of view. The results of the CPTu measurements for these probes are also included, and are referenced CPT10B, CPT11, CPT12 and CPT13. No detailed analyses were carried out on these probe measurements, but the measurements included in Appendix B suggest that the central part of the TSF contains tailings that are low strength and saturated.

2.0 ANALYSIS

2.1 Method

Golder has conducted a screening level assessment on the data from nine CPTu probes using methods proposed by Been & Jefferies (1992) [1] and Robertson (2009[2] and 2015)[3].

The following process has been adopted in the screening level assessment:

- Estimation of the depth to the saturation.
- Assessment of the state parameter based on methods proposed by Been and Jefferies to identify the likely in situ state parameter and therefore susceptibility to static liquefaction.
- Estimate the factor of safety against cyclic liquefaction using methods proposed by Robertson.

2.2 Depth to saturation

A key factor in the potential for soil/tailings to liquefy is the moisture condition. Excess pore pressures may be generated when soil/tailings is subject to shear when it is saturated or in a near saturated condition. The in situ pore pressure profiles were estimated based on the commencement of sustained positive pore pressures during penetration and the results of dissipation testing.

A summary of the inferred depth to saturation is provided in Table 1. Generally, the information indicates tailings are saturated at depth below 14 m from surface, with three of the probes suggesting near saturation conditions at relatively shallow depths. Both CPTu04 and CPTu05 probes near the northern end of TSF 1 indicated consistent near saturation conditions over most of the depth of tailings.

Table 1: Depth to Saturation

CPT ID	Depth Probed (m)	Inferred Depth to near Saturation (m)
CPTu 01	24.0	16.5
CPTu 02	23.2	16.3
CPTu 03	23.5	16.5
CPTu 04	25.2	3.0
CPTu 05	21.2	5.0
CPTu 06A	30.5	28.0
CPTu 07	26.7	16.5
CPTu 08	27.0	14.4
CPTu 09	24.0	9.3

[1] Been, K. and Jefferies, M. G. 1992. “Towards systematic CPT interpretation”. Proceedings of the Wroth Memorial Symposium, pp.121-134. Thomas Telford, London.
[2] Robertson, P.K., 2009. “Interpretation of Cone Penetration Tests – a unified approach”. Canadian Geotechnical Journal, 46 pp 1337-1355.
[3] Robertson, P.K. 2015. Comparing CPT and Vs liquefaction triggering methods. Journal of Geotechnical and Geoenvironmental Engineering, ASCE, 141(9): pp. 842–853.

2.3 State Parameter

The state parameter (Ψ*)* of the tailings has been estimated using methods proposed by Been & Jefferies. The state parameter provides a framework for identification of soil/tailings that may be prone to rapid strength loss i.e. static liquefaction. Generally, soil/tailings with Ψ < -0.05 is dilative (dense) are immune to brittle strength loss during rapid or cyclic shearing. When Ψ > -0.05, there is a risk of strength loss under these conditions, with the likelihood of occurrence, and the severity of strength loss increasing with increasing Ψ.

Generally, the upper layers of tailings in the TSF are inferred to be in a dilative state with a characteristic state parameter less than -0.05, and thus not susceptible to static liquefaction. In some probes, there are discrete layers of contractive tailings within the upper portion, however the 85% percentile of test results indicates dilative tailings. Lower layers of tailings are typically contractive having a characteristic state parameter greater than -0.05. An example of the state parameter graph is shown in Figure 1.

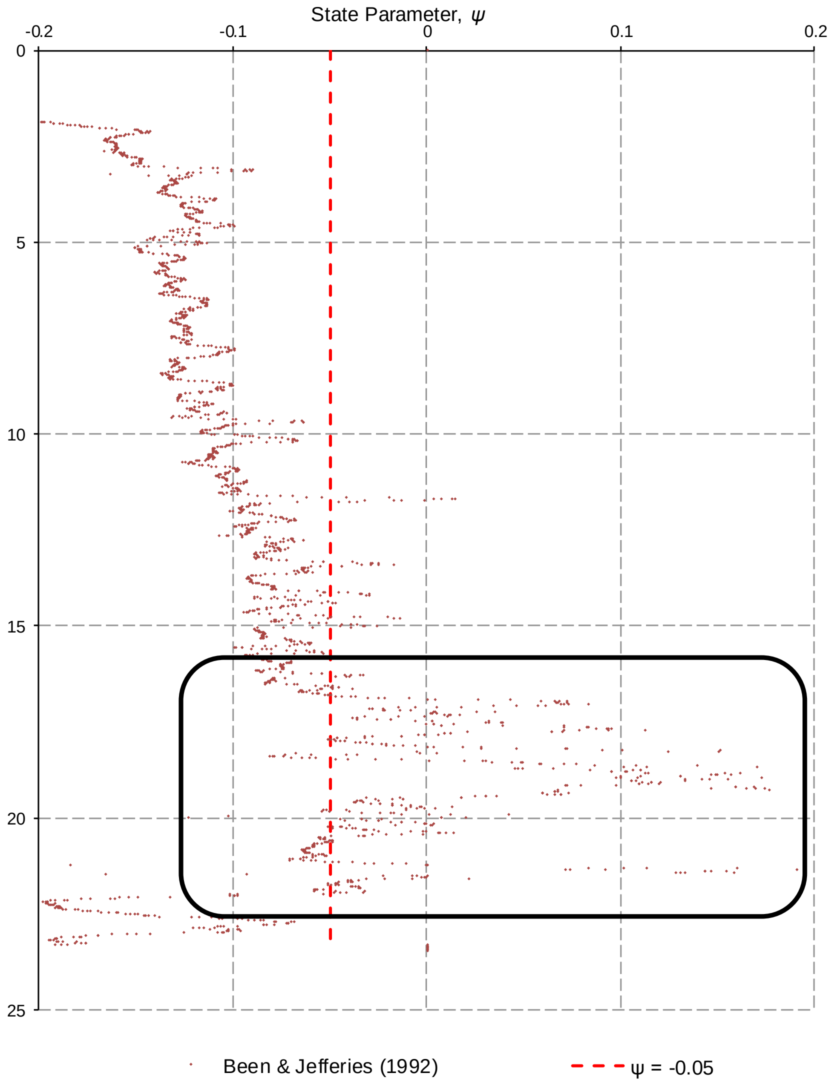


Figure 1: State parameter with depth bgl for CPTu 03 (lower layer of contractive tailings highlighted within the boxed zone).

A summary of the assessed elevation of top of the contractive tailings and the elevation of near saturation is presented in Table 2.

Table 2: Elevations of top of near saturation and contractive tailings

CPT ID	Elevation of contractive tailings RL (m)	Elevation of near saturation RL (m)
CPTu 01	302.6	306.5
CPTu 02	303.2	306.2
CPTu 03	306.3	306.7
CPTu 04	301.5	320.5
CPTu 05	None	318.0
CPTu 06A	298.5	294.5
CPTu 07	306.5	306.5
CPTu 08	299.0	308.6
CPTu 09	303.0	313.7

Note at all of the locations the tailings is assessed to be contractive below the elevation of near saturation, except at CPTu 06A. At CPTu 06A the top 4 m of contractive tailings are marginally contractive with a state parameter between 0 and -0.05, with contractive behaviour coinciding with the saturation elevation.

On this basis it is concluded that the lower portion of the tailings in the TSF are in a condition that could result in static liquefaction, if the trigger conditions exist.

2.4 Cyclic Liquefaction

2.4.1 Peak Ground Acceleration Estimate

The TSF has been assessed against a maximum credible earthquake (MCE) with a return period of 1 in 10 000 to meet closure requirements outlined in ANCOLD (2019). Geoscience Australia (Allen et al 2018) publishes seismic hazard maps and peak ground accelerations (PGA) for Australia for various return periods up to 5 000 years. In the absence of site specific hazard information we have extrapolated from this data to estimate the PGA for a return period of 10 000 years. This extrapolation is presented in Figure 2. The PGA for this return period is estimated at 0.147m/s^2.

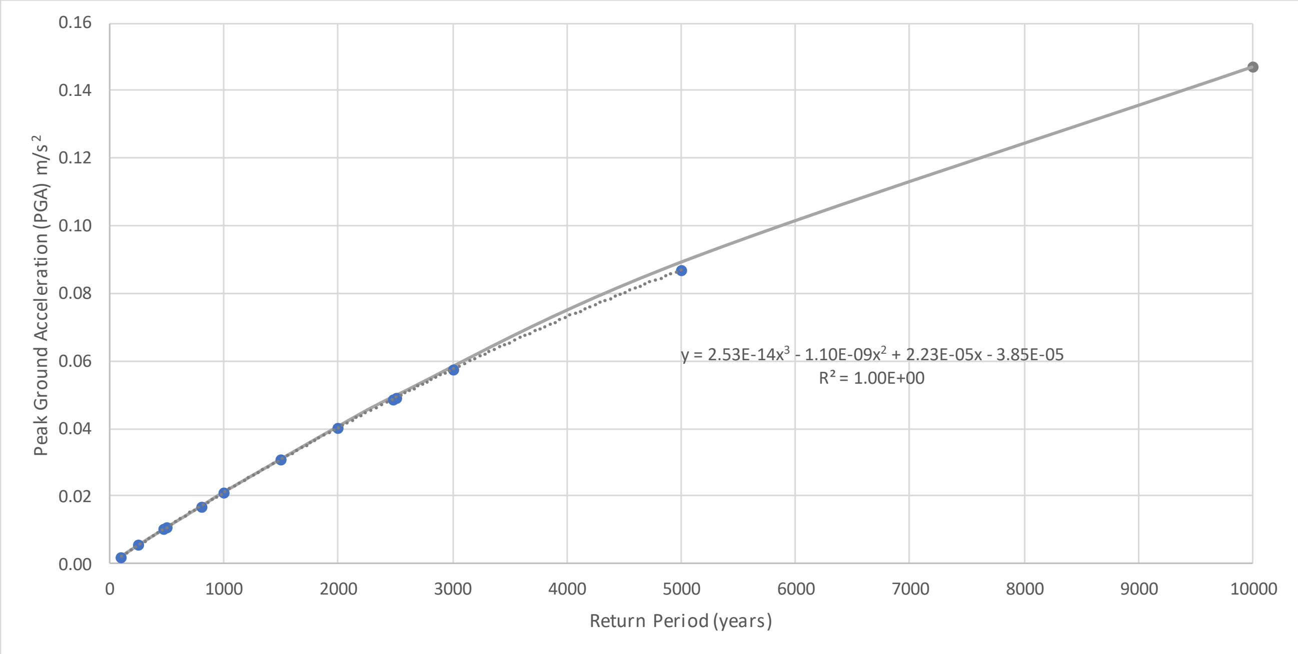


Figure 2: Return periods and peak ground acceleration relationship

2.4.2 Cyclic Resistance

Cyclic liquefaction occurs where seismic loading results in increased pore pressures resulting from cyclically induced strain. The increase in pore pressures results in a decrease in vertical effective stress and corresponding reduction in strength. The cyclic resistance ratio (CRR) is based on the method proposed by Robinson (2009) with the undrained shear strength capped to the critical state friction ratio of 1.2 (i.e. 30°) based on the a database of critical state properties for various soils presented by Been and Jefferies (1992).

The factor of safety (FoS) against liquefaction is estimated as the ratio of CRR/CSR for a magnitude 7.5 earthquake. Data for all the CPTu's analysed indicate a FoS above 1 for a PGA from a return period of 10 000 years or less (Appendix C). This indicates that the tailings are not expected to liquefy under these conditions. As an example the FoS plot for the results for CPTu 5 are shown in Figure 3.

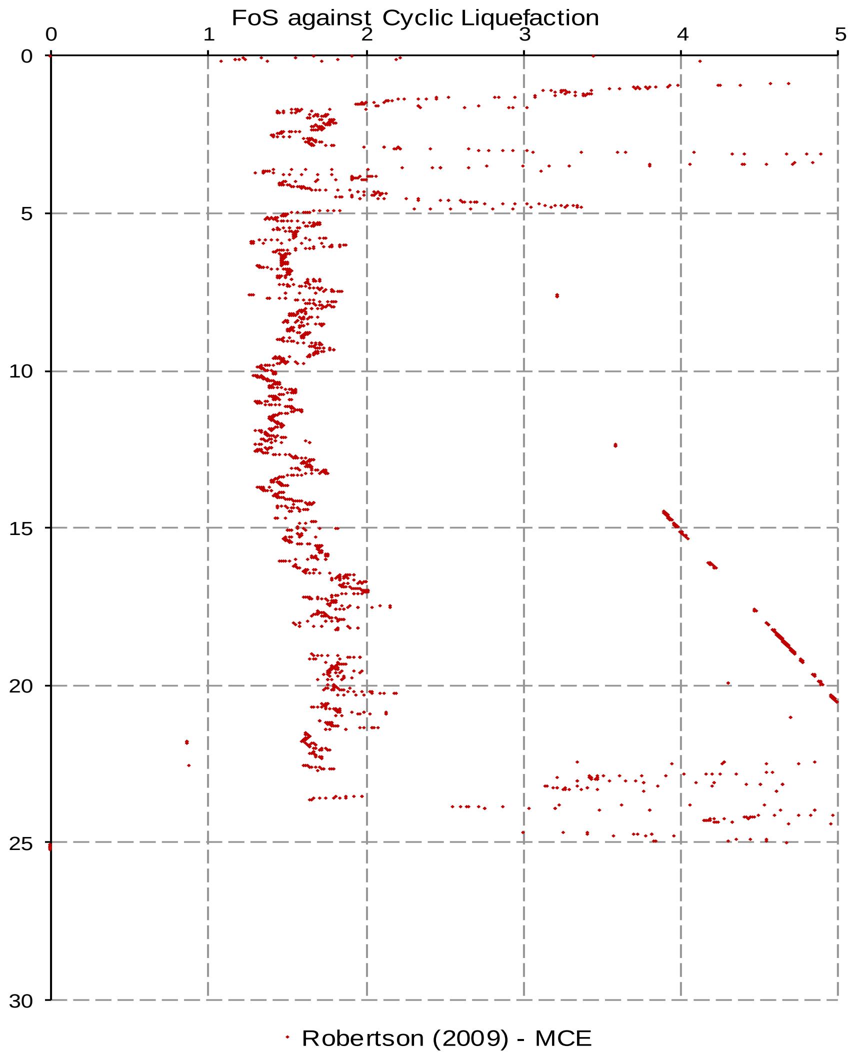


Figure 3: Factor of safety against MCE cyclic liquefaction for CPTu 05.

2.5 Eastern Edge of Mt Hebbard

The investigation was able to conduct only one shallow CPT probe (CPT 5C) on the eastern bench of Mt Hebbard. A number of test pits excavated by BHOP also refused on rockfill at depths less than 1 m. The results of the CPT probe returned high cone resistance measurements over the 8 m depth of the probe. The assessed state parameter of the material over the entire 8m is that it is dilative and not subject to static liquefaction. Similarly based on the CPT data, the material returned a high factor of safety against earthquake liquefaction.

It is noted that historical photographs of the site suggest that Mt Hebbard is at least partly an old sand dump, which would be supported by the results of the results of the CPTu 5C measurements. The sand dumps are understood to have been typically formed by end tipping of sandy materials, resulting in a relative dry mound of material. The historical data also suggests that some residue dams were formed near the eastern side of the dump. The lateral extent to the east of the sand dump has not been established and more detailed review of historical data may assist in refining the data related to the eastern edge details of Mt Hebbard.

3.0 DISCUSSION AND CONCLUSIONS

The TSF includes a bench along the east side of the facility. It is understood that this bench is formed from rockfill that was placed when the rockfill was placed on the outer slope of the TSF. The bench level varies from approximately RL 308 m at the south end to approximately RL 300 m at the north end. The bench is generally 10 m wide and 2 m to 3 m above the ground level to the east.

The analysis of the CPT's suggests that the tailings towards the eastern edge of the TSF, approximately below the crest alignment, are marginally stronger or in a similar condition to the tailings approximately 50 m back from the crest, and substantially higher strength than the lower strength material towards the center of the facility.

A preliminary slope stability analysis was conducted of the outer slope of TSF along the eastern side, with the top of contractive tailings at 2 m above the elevation of the bench. The remoulded shear strength of the dilative tailings was assumed based on the material being contractive. Based on this the FoS of the slope was estimated to be less than unity for the case if one of the trigger conditions occurred.

Typical trigger conditions include:

- Rise in phreatic surface in the TSF.
- Creep deformation of the tailings slope resulting in redistribution of stresses due to strength shedding from contractive layers.
- Loss of containment due to changes in geometry at the slope toe area, or changes in loading near the slope.

Mr Kane Kreeck of BHOP conducted an investigation of available old drawings and maps of the area of TSF. In the investigation he found a hand drawn map of 1930 which showed that this area included numerous liquid and residue dams. If the TSF was formed over these structures it may shed some light on why the bottom zone of the tailings in the TSF are of significantly lower strength.

Table 3 presents the relative difference in elevation between the top of tailings prone to liquefaction relative to the top of the bench.

Table 3: Bench elevation relative to top of contractive tailings zones

CPT location	Bench relative to contractive tailings (m) (Negative = bench is lower)
CPTu 01	3.4
CPTu 02	0.8
CPTu 03	- 4.3
CPTu 04	- 1.5
CPTu 05C	N/A
CPTu 06A	4.5
CPTu 07	- 4.5
CPTu 08	1.0
CPTu 09	2.0

The assessment indicates that the north eastern side of the TSF has potentially liquefiable tailings above the existing bench level. Based on the information considered, the geometric and strength conditions in this area suggest that static liquefaction movement could occur.

The conditions of the southern portion of the TSF also includes tailings that is conducive to static liquefaction, but the existing bench is providing a buttressing restraint to the zone of potentially static liquefiable tailings.

4.0 CLOSURE

The assessment indicates the following:

- The bottom zone of tailings along the outer eastern portion of the TSF are generally close to saturation;
- The in situ state parameter is dilative for the majority of the upper layers, and contractive for the bottom zone;
- The conditions of the upper part of the tailings do not support conditions of static liquefaction, whereas the conditions of bottom zone of the tailings may support potential static liquefaction.
- The factor of safety against cyclic liquefaction is above 1 for the MCE event.

Based on the results it is unlikely that the tailings in TSF 1 will cyclically liquefy in an MCE with a return period of 10 000 years. The risk of static liquefaction of the north east side of the TSF should be investigated further or strengthening works for the area developed.

The north eastern side of the TSF should be assessed further or development of strengthening measures to improve the restraint against potential movement. Further assessment of historical information related to this part of the site may assist in considering the conditions this area in more detail.

We are available to assist BHOP in the further assessment or development of a design for the strengthening works.

Golder Associates Pty Ltd

Fred Gassner
Senior Principal

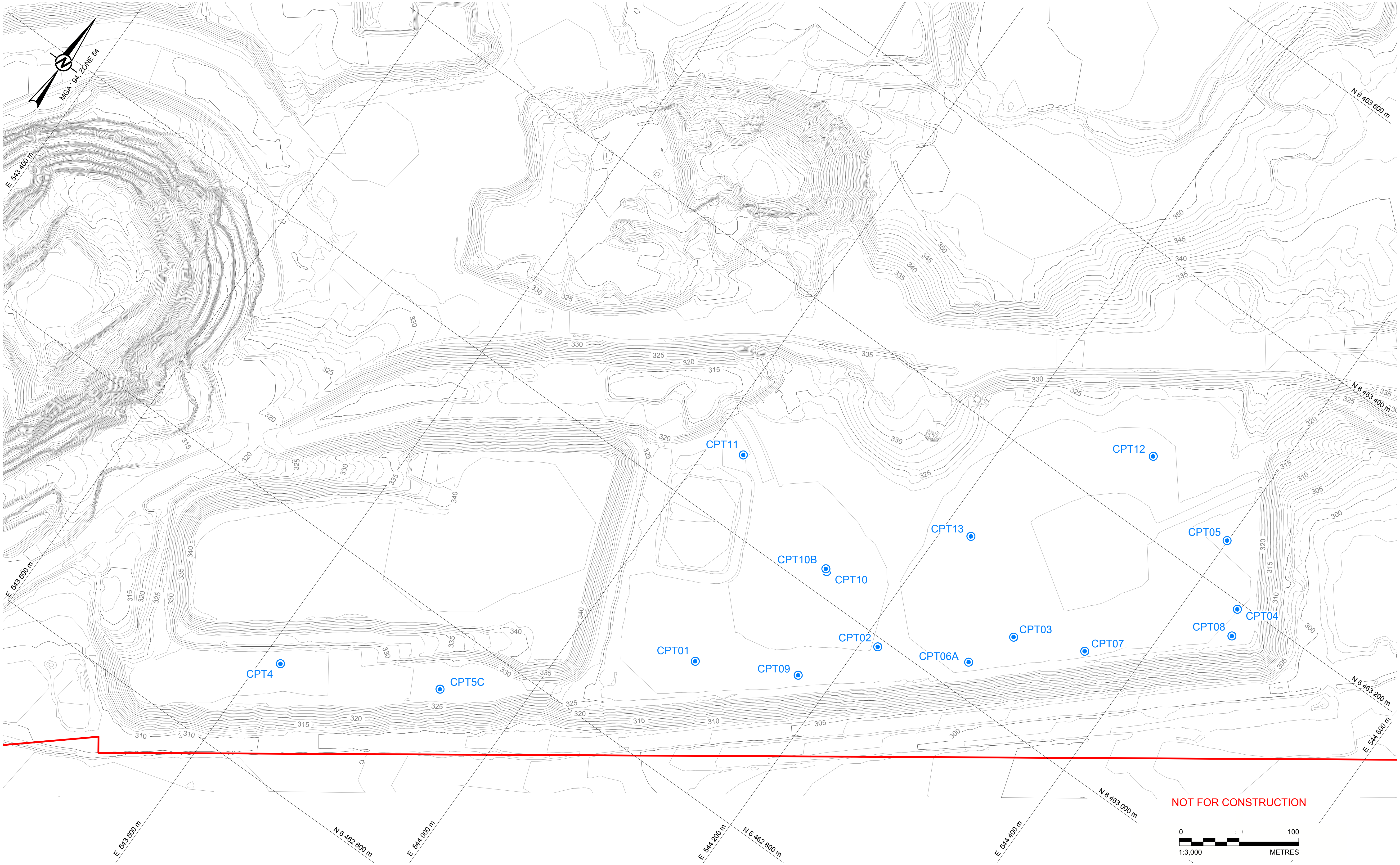
JE-FG/DW/fg

Attachments: Appendix A – Locations of CPT's
Appendix B - CPT probe results
Appendix C – Analyses of CPT probe results
Appendix D – Important Information

https://golderassociates.sharepoint.com/sites/25201g/deliverables/046 tsf 1 liquesfaction report/1896230-046-l-rev0 new.docx

APPENDIX A

Locations of CPT’s



LEGEND

EXISTING TAILINGS CONTOURS AT 1 m INTERVALS

SITE BOUNDARY

CPT1 APPROXIMATE CPT LOCATIONS

NOTE(S)

1. ALL LEVELS ARE REFERENCED IN METRES TO AUSTRLIAN HEIGHT DATUM (m AHD).

REFERENCE(S)

CONTOURS GENERATED FROM INFORMATION PROVIDED BY CBH RESOURCES ON 13 MARCH 2018 IN FILE: RASP Drone Survey MGA54.dxf

SITE BOUNDARY SHOWN FROM INFORMATION PROVIDED BY CBH RESOURCES IN FILE: surf_leases_mga.dxf,RECEIVED FROM CBH ON 11 MAY 2016

CPT LOCATIONS SHOWN FROM INFORMATION PROVIDED BY CBH RESOURCES IN FILES:

- G19-09-07 CBH Resources - Blackwoods Tailings Dam & TSF1 - Broken hill NSW - Stage 3.kmz, RECEIVED 02 APRIL 2020
- CPT_Testing Locations.pdf, DATED 09 JANUARY 2020

CLIENT
BROKEN HILL OPERATIONS PTY LTD

PROJECT
RASP MINE, BROKEN HILL

CONSULTANT

GOLDER

YYYY-MM-DD	2020-04-06
DESIGNED	PDM
PREPARED	PDM
REVIEWED	FWG
APPROVED	FWG

TITLE
TAILINGS SURFACE (MARCH 2018) - APPROXIMATE CPT LOCATIONS

PROJECT NO.	CONTROL	REV.	FIGURE
1896230	046-R	0	1

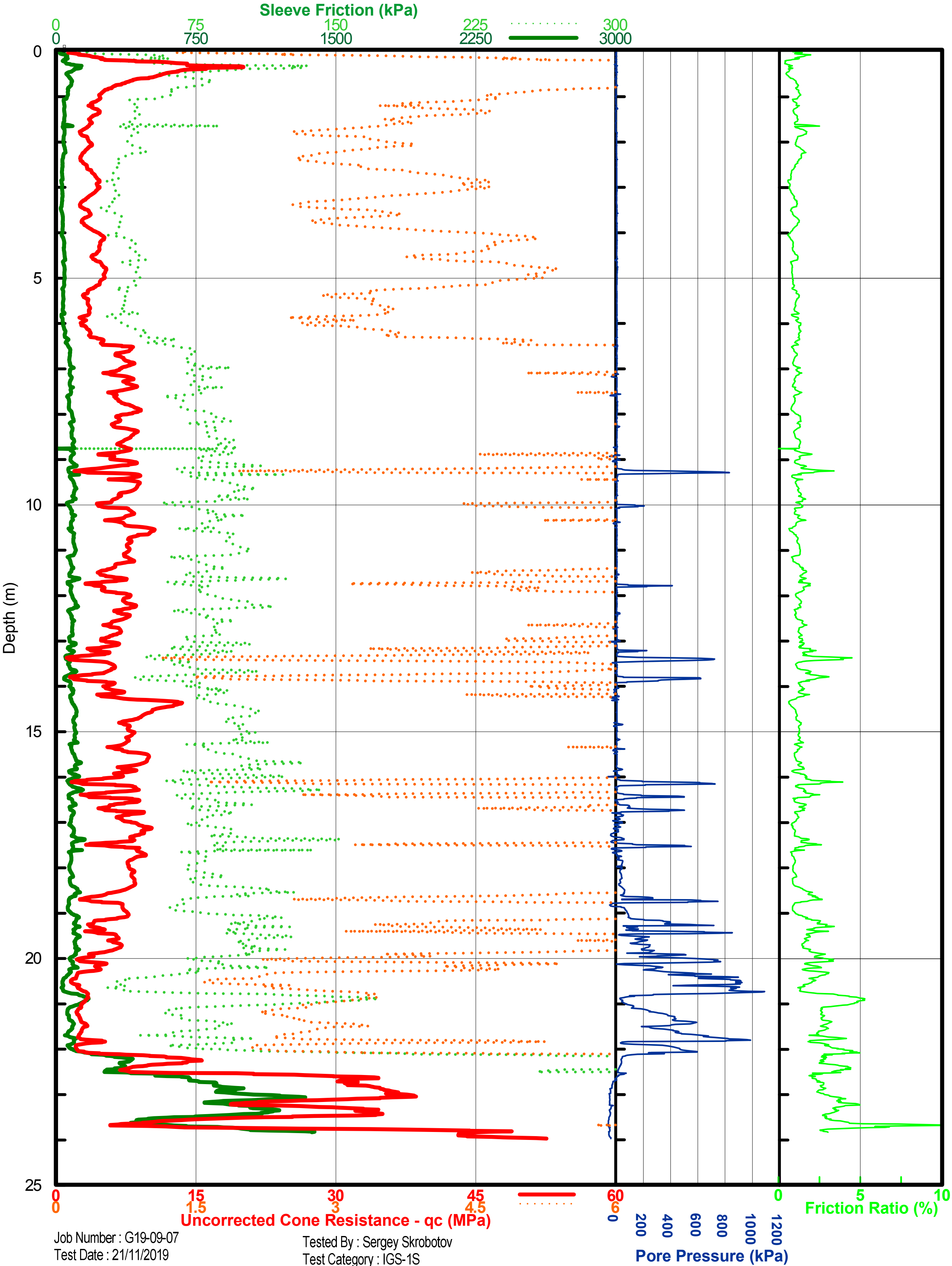
APPENDIX B

CPT probe results

CONE PENETROMETER TEST RESULT

CBH Resources
TSF 1
Broken Hill NSW

CPT01



Job Number : G19-09-07
Test Date : 21/11/2019
GPS Position : 54 J 0544100, 6462896
GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S16247
Predrill Depth : 0.00m
Dissipation Tests @ : 18.68m 20.34m
Terminated Due To : Equipment at Risk

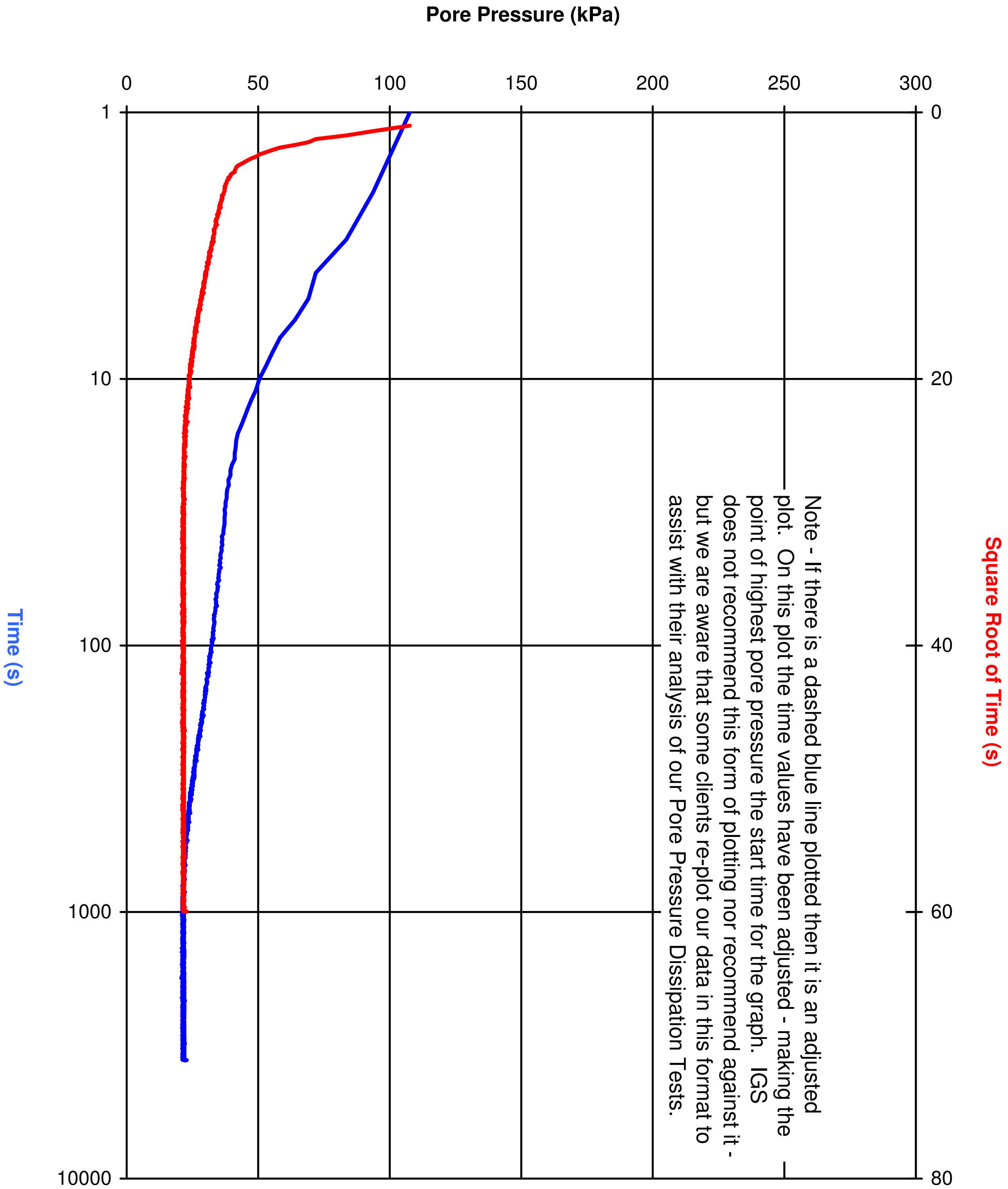
Tested By : Sergey Skrobotov
Test Category : IGS-1S
Checked By : TonyHitchcock

Insitu Geotech Services Pty Ltd
IGS

PORE PRESSURE DISSIPATION TEST RESULT

CBH Resources
TSF 1
Broken Hill NSW

CPT01
Depth: 18.68m



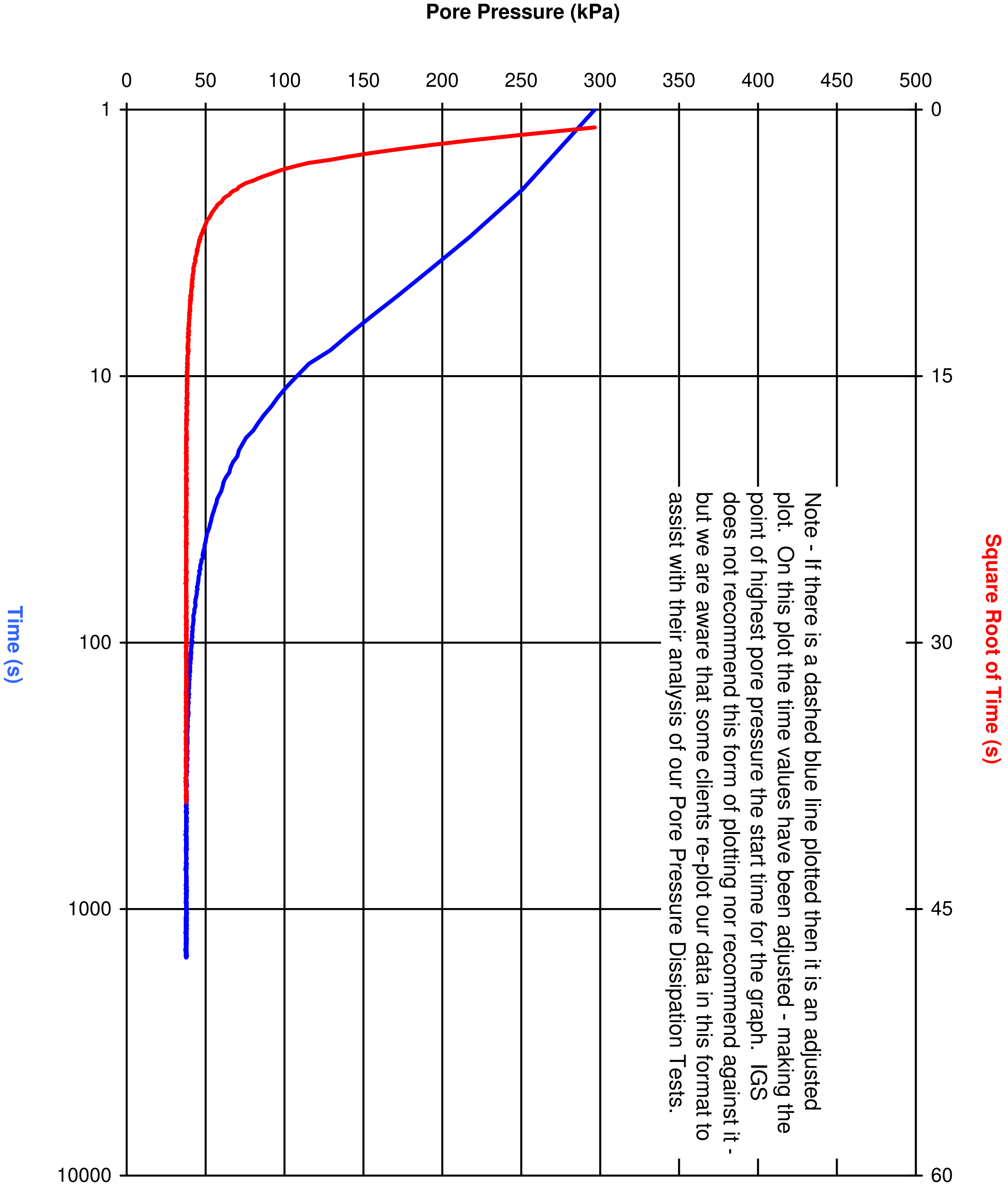
Tested By: Sergey Skrobotov
Test Duration: 1 Hours, 0 Minutes
Test Date: 21/11/2019
Job No: G19-09-07
Cone: S15CFIIP.S16247

Insitu Geotech Services Pty Ltd IGS

PORE PRESSURE DISSIPATION TEST RESULT

CBH Resources
TSF 1
Broken Hill NSW

CPT01
Depth: 20.34m



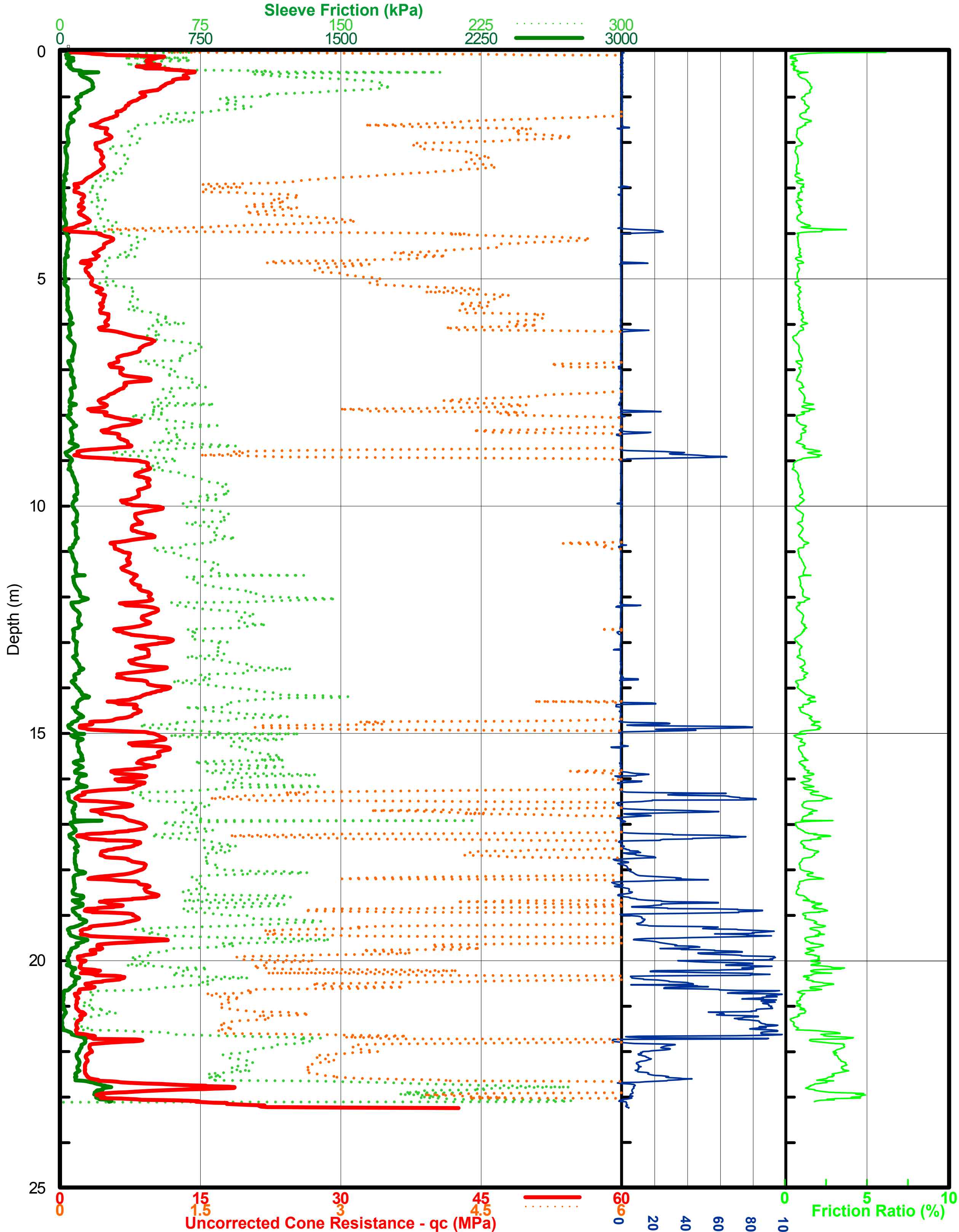
Tested By: Sergey Skrobotov
Test Duration: 0 Hours, 25 Minutes
Test Date: 21/11/2019
Job No: G19-09-07
Cone: S15CFIIP.S16247

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

CBH Resources
TSF 1
Broken Hill NSW

CPT02



Job Number : G19-09-07
Test Date : 22/11/2019
GPS Position : 54 J 0544210, 6462989
GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S16247
Predrill Depth : 0.00m
Dissipation Tests @ : 16.46m
Terminated Due To : Equipment at Risk

Tested By : Sergey Skrobotov
Test Category : IGS-1S
Checked By : Tony Hitchcock

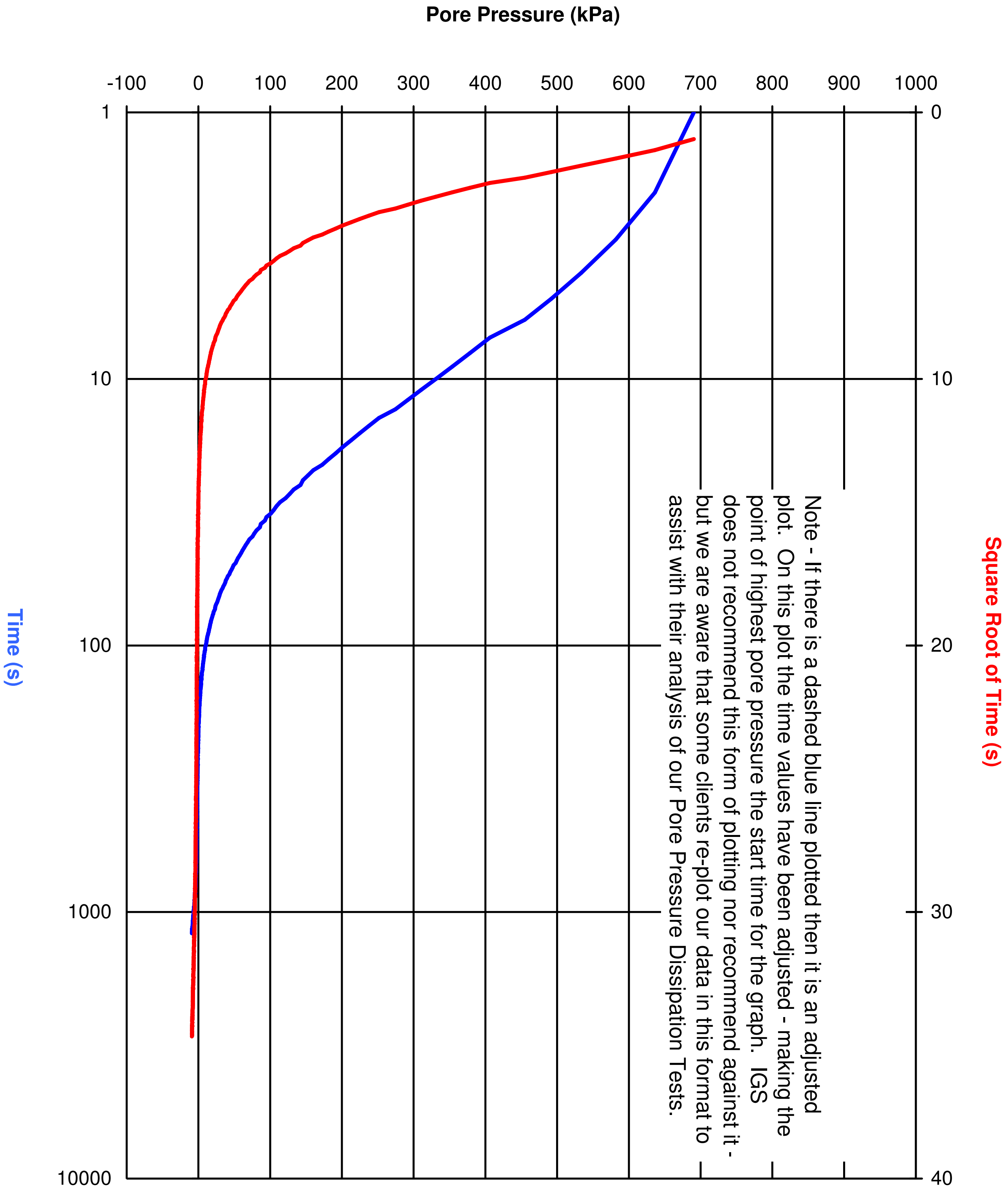
Insitu Geotech Services Pty Ltd

IGS

PORE PRESSURE DISSIPATION TEST RESULT

CBH Resources
TSF 1
Broken Hill NSW

CPT02
Depth: 16.46m



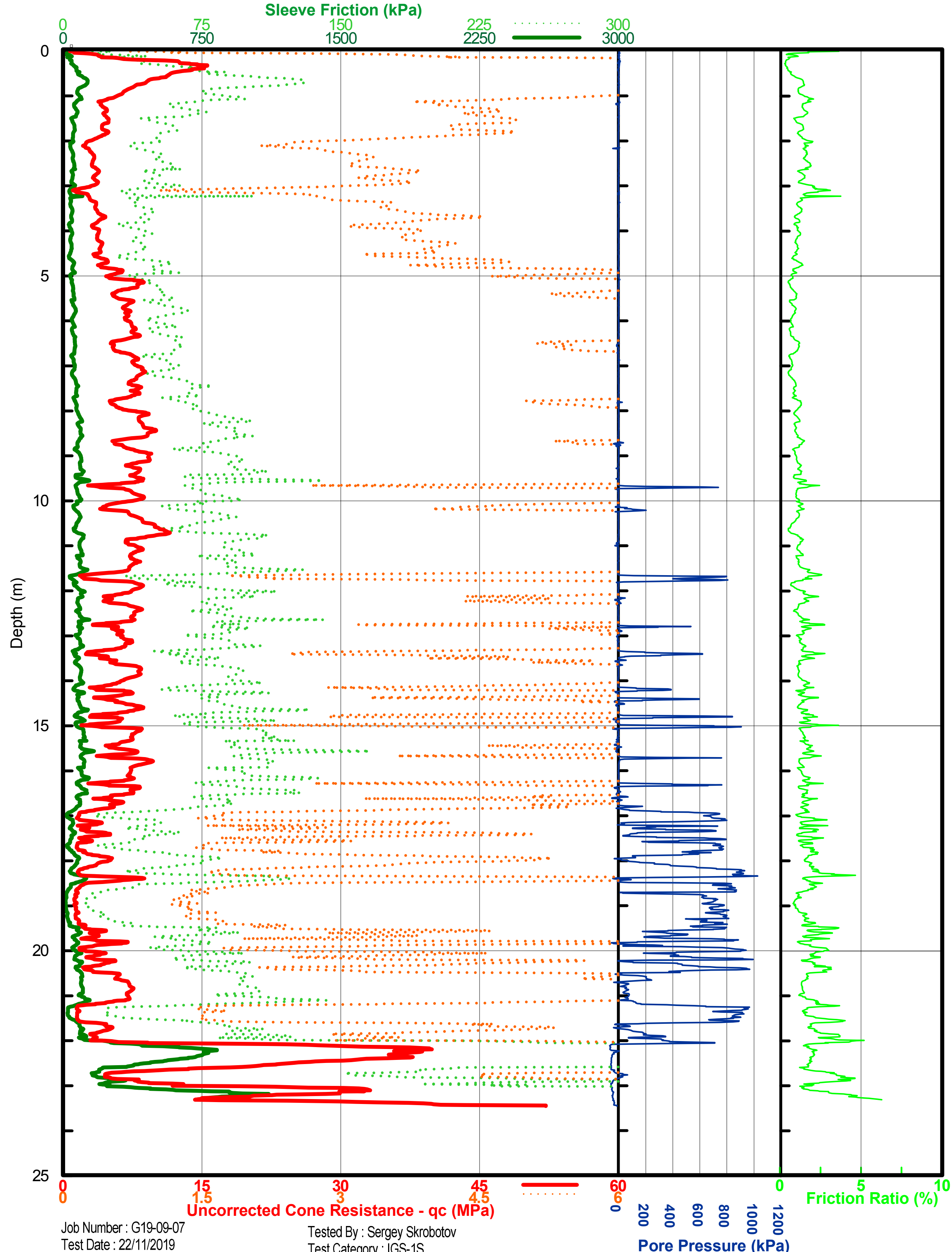
Tested By: Sergey Skrobotov
Test Duration: 0 Hours, 20 Minutes
Test Date: 22/11/2019
Job No: G19-09-07
Cone: S15CFIIP.S16247

Insitu Geotech Services Pty Ltd

CONE PENETROMETER TEST RESULT

CBH Resources
TSF 1
Broken Hill NSW

CPT03



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GPS Format : WGS 84
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Cone Number : S15CFIIP.S16247
Predrill Depth : 0.00m
Dissipation Tests @ : 18.69m
Terminated Due To : Equipment at Risk

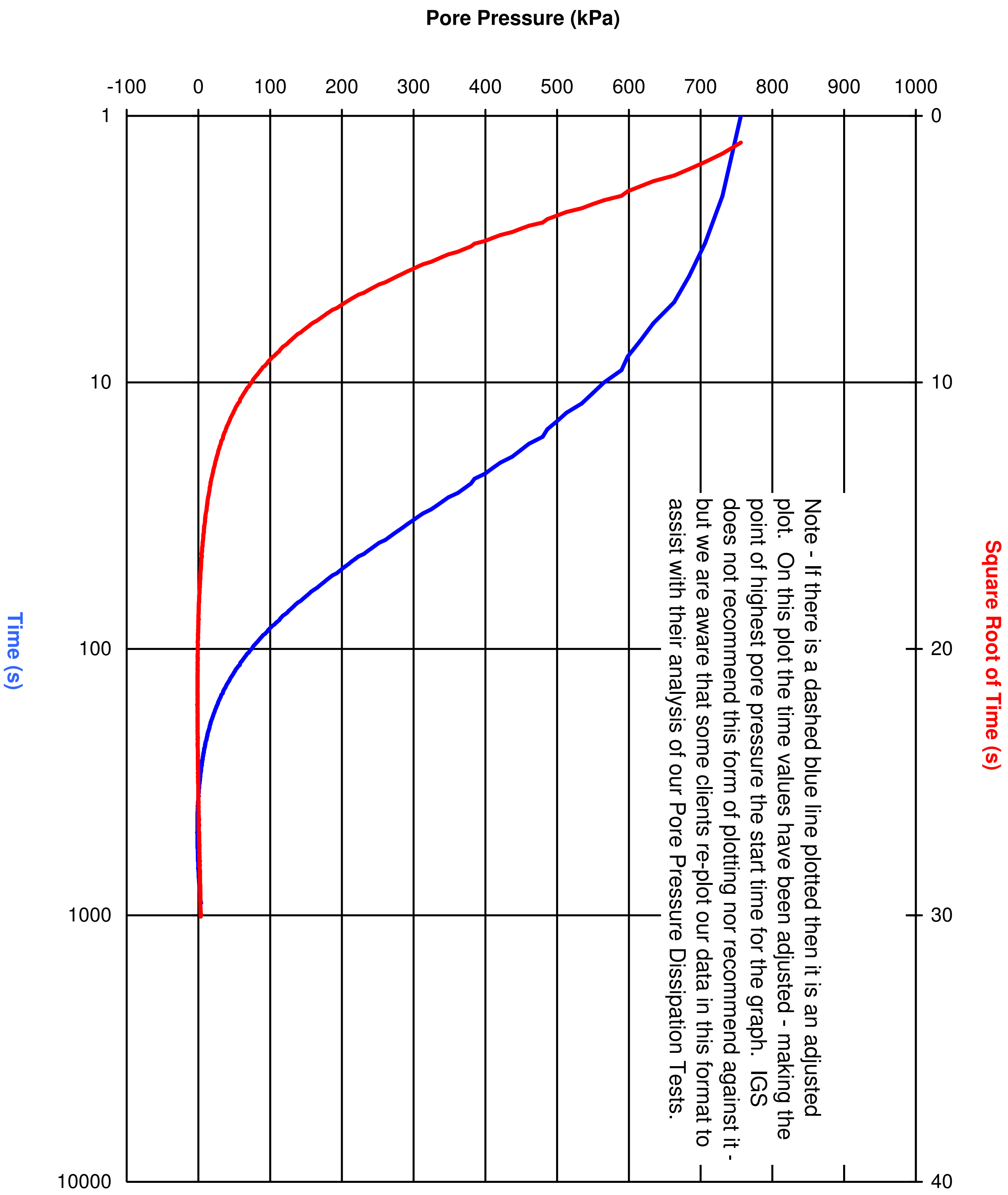
Tested By : Sergey Skrobotov
Test Category : IGS-1S
Checked By : Tony Hitchcock

Insitu Geotech Services Pty Ltd IGS

PORE PRESSURE DISSIPATION TEST RESULT

CBH Resources
TSF 1
Broken Hill NSW

CPT03
Depth: 18.69m



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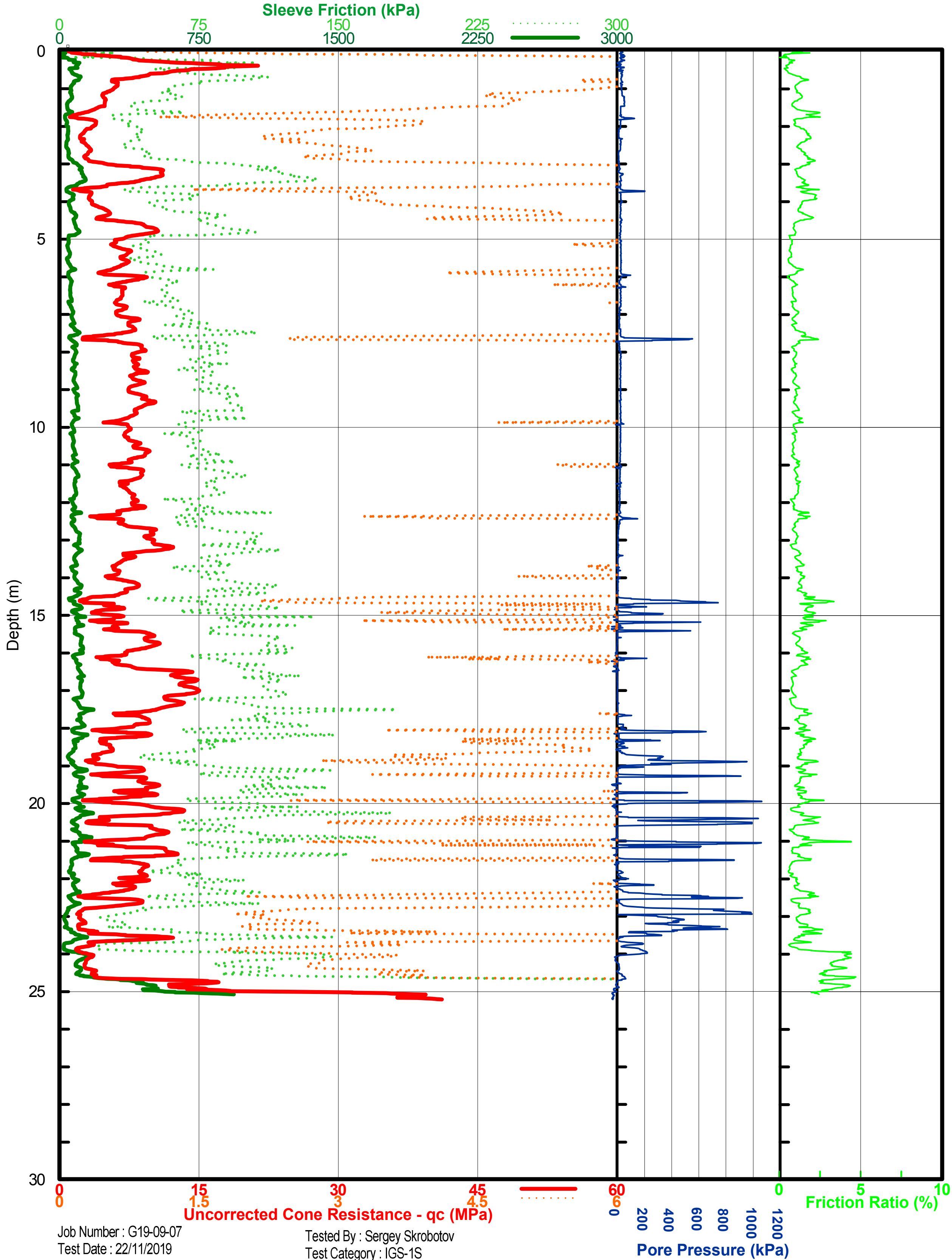
Test Duration: 0 Hours, 15 Minutes
Test Date: 22/11/2019
Job No: G19-09-07
Cone: S15CFIIP.S16247

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

CBH Resources
TSF 1
Broken Hill NSW

CPT04



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GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S16247
Predrill Depth : 0.00m
Dissipation Tests @ : 22.94m
Terminated Due To : Equipment at Risk

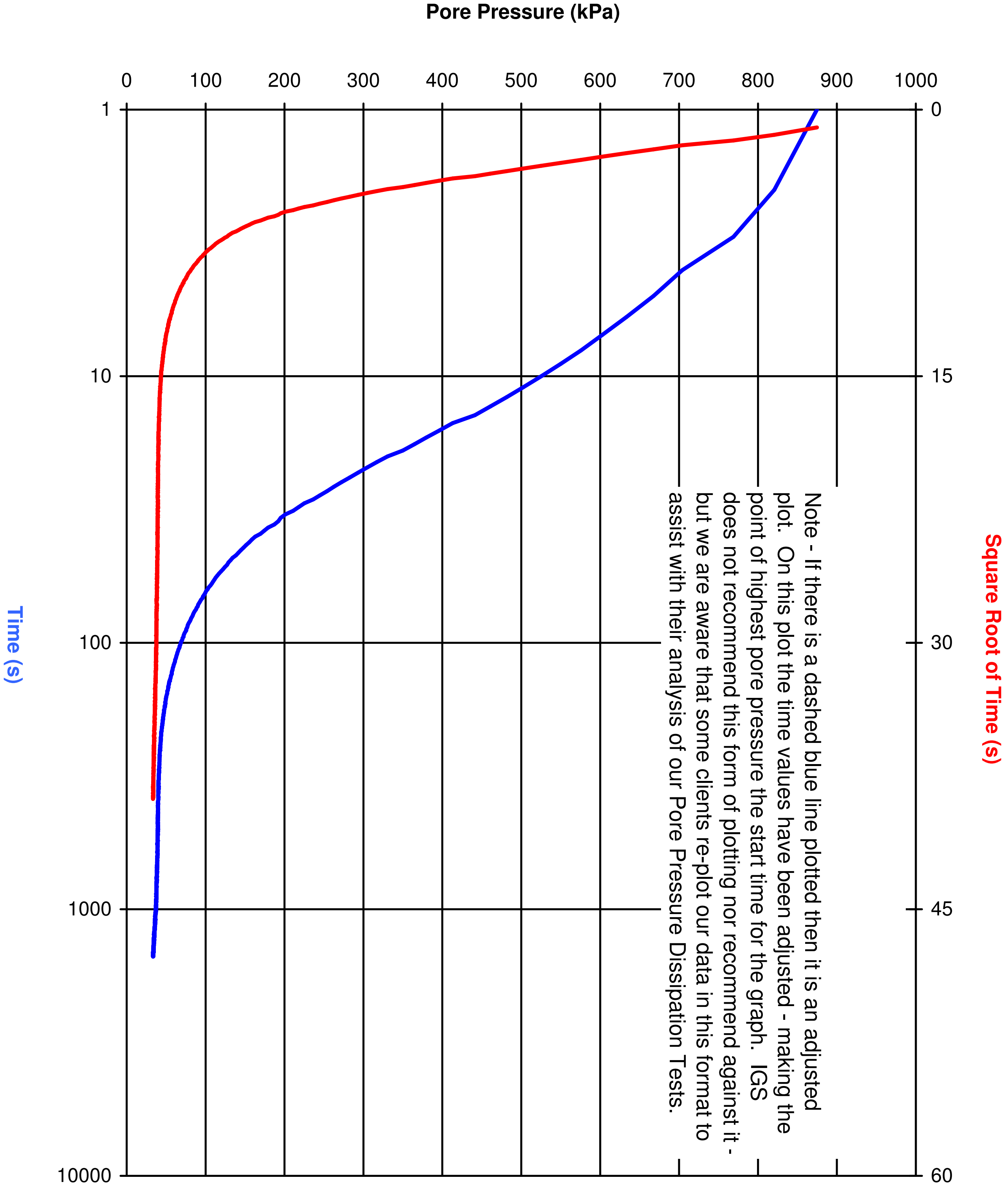
Tested By : Sergey Skrobotov
Test Category : IGS-1S
Checked By : Tony Hitchcock

Insitu Geotech Services Pty Ltd
IGS

PORE PRESSURE DISSIPATION TEST RESULT

CBH Resources
TSF 1
Broken Hill NSW

CPT04
Depth: 22.94m



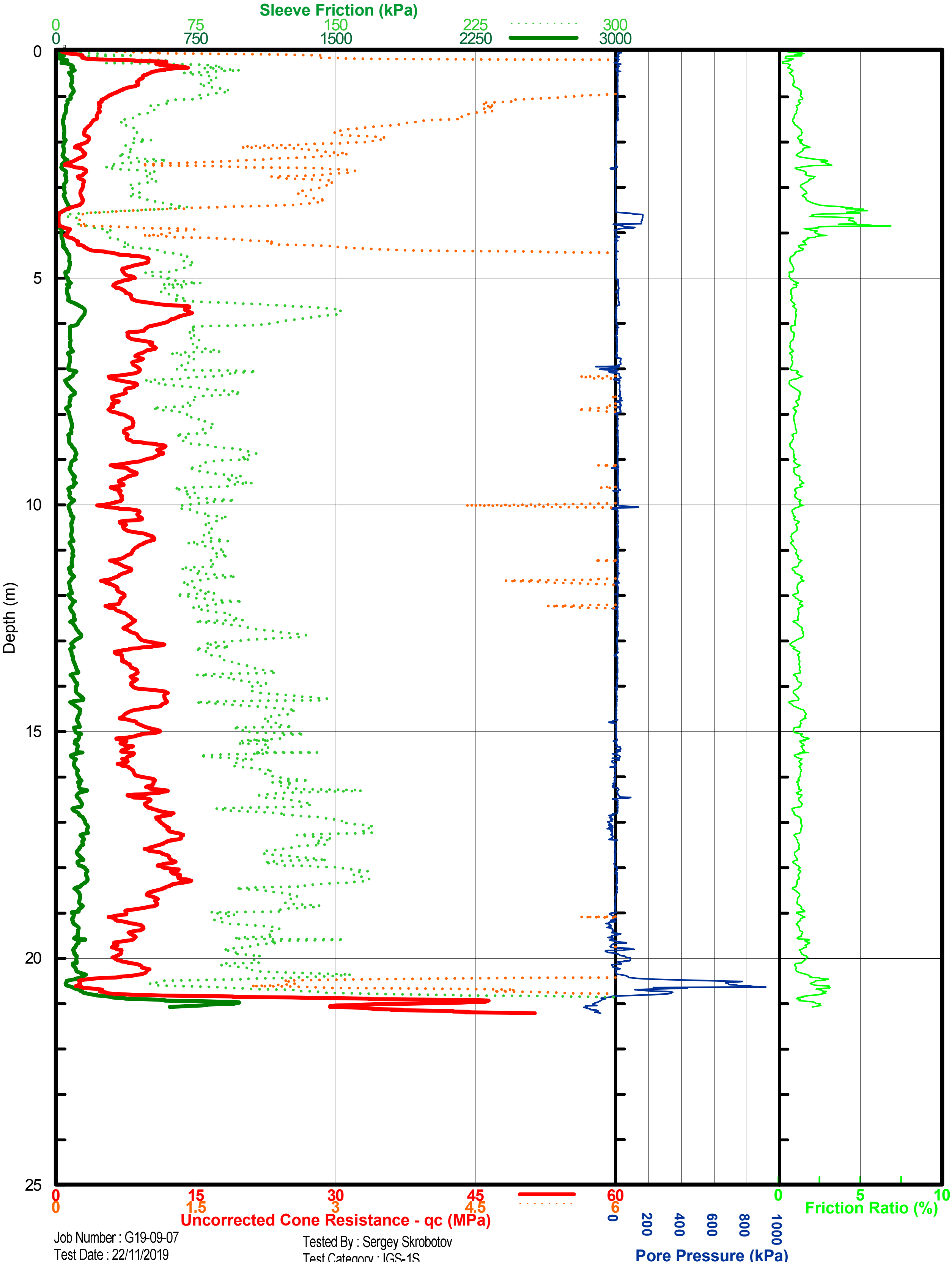
Tested By: Sergey Skrobotov
Test Duration: 0 Hours, 25 Minutes
Test Date: 22/11/2019
Job No: G19-09-07
Cone: S15CFIIP.S16247

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

CBH Resources
TSF 1
Broken Hill NSW

CPT05



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Test Date : 22/11/2019
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GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S16247
Predrill Depth : 0.00m
Dissipation Tests @ : 3.8m
Terminated Due To : Equipment at Risk

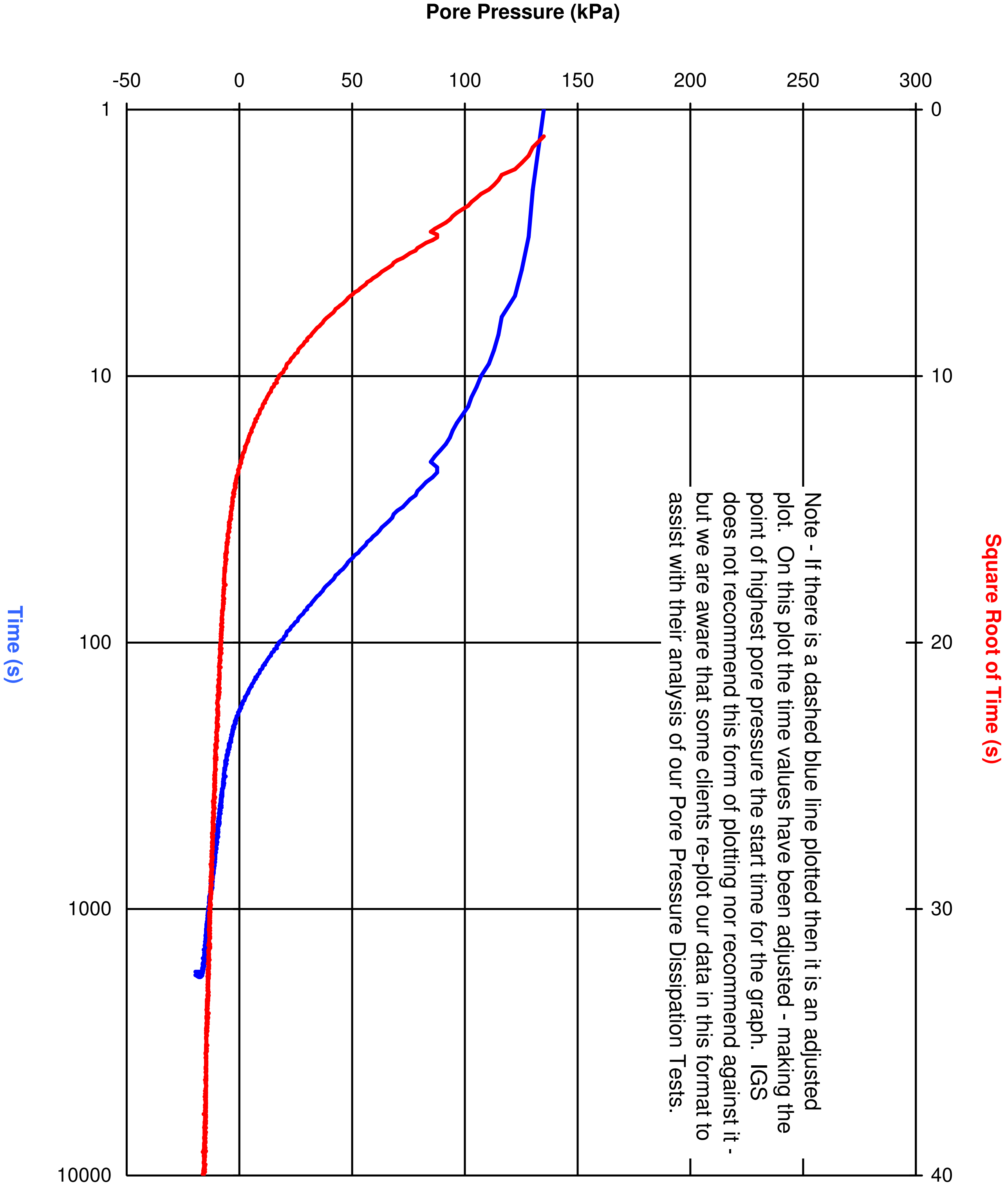
Tested By : Sergey Skrobotov
Test Category : IGS-1S
Checked By : Tony Hitchcock

Insitu Geotech Services Pty Ltd IGS

PORE PRESSURE DISSIPATION TEST RESULT

CBH Resources
TSF 1
Broken Hill NSW

CPT05
Depth: 3.8m



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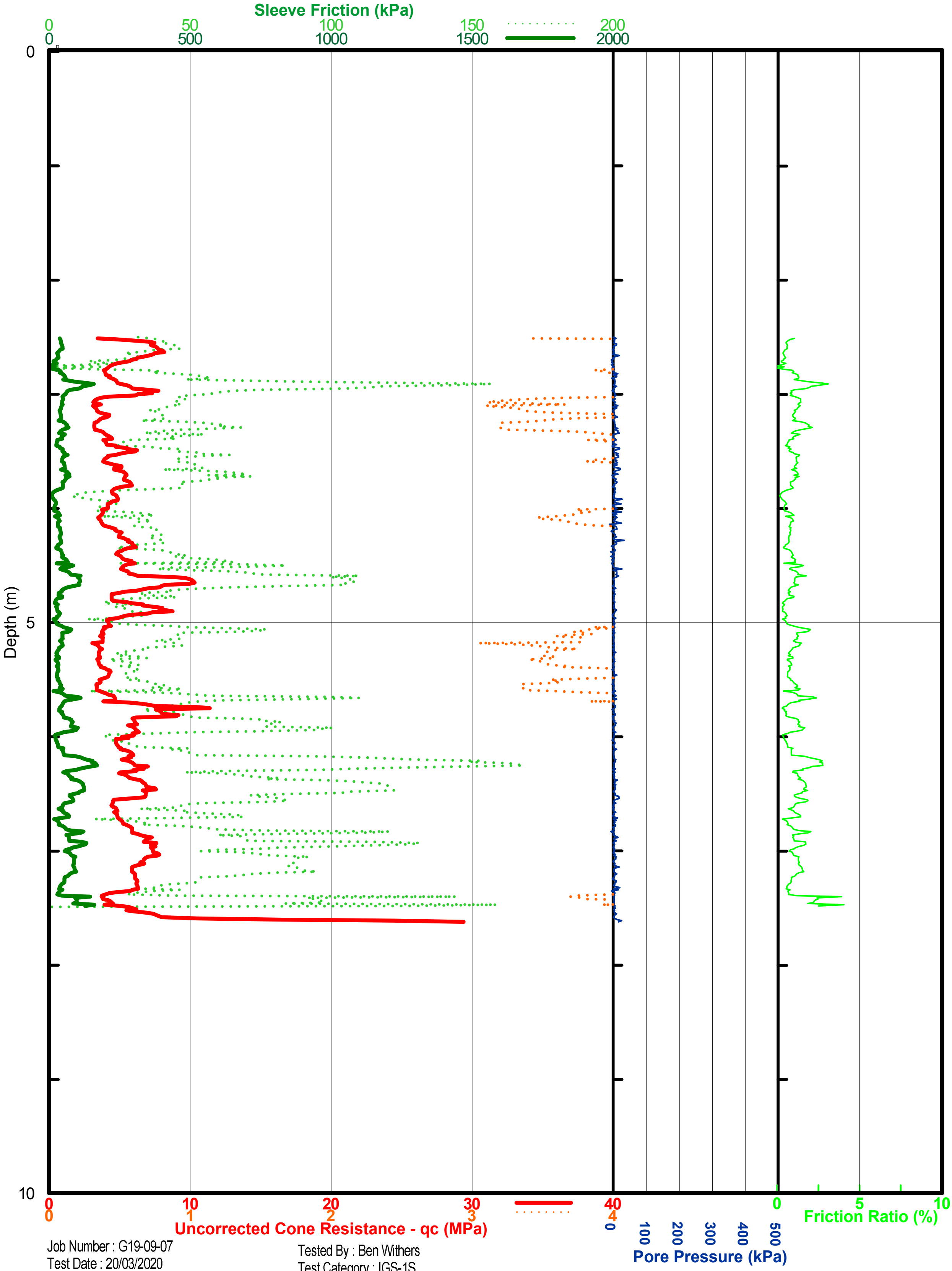
Test Duration: 0 Hours, 30 Minutes
Test Date: 22/11/2019
Job No: G19-09-07
Cone: S15CFIIP.S16247

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

CBH Resources
RASP Mine TSF
Broken Hill NSW

CPT5C



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Test Date : 20/03/2020
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GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S19288
Predrill Depth : 2.50m
Dissipation Tests @ : N/A
Terminated Due To : Equipment at Risk

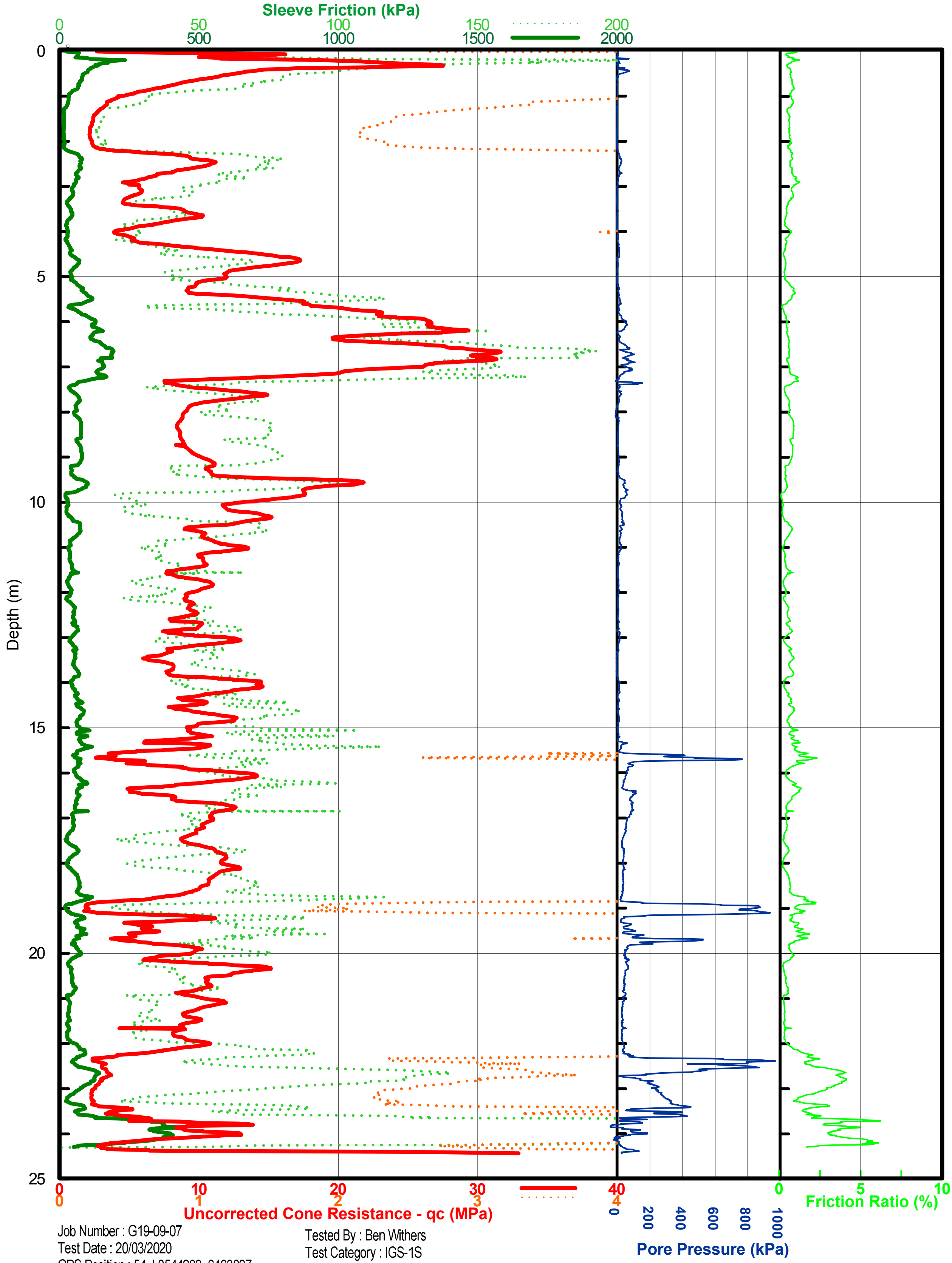
Tested By : Ben Withers
Test Category : IGS-1S
Checked By : Tony Hitchcock

Insitu Geotech Services Pty Ltd

CONE PENETROMETER TEST RESULT

CBH Resources
RASP Mine TSF
Broken Hill NSW

CPT6A



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GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S19288
Predrill Depth : 0.00m
Cone Stabilisation @ : 2m
Terminated Due To : Equipment at Risk

Tested By : Ben Withers
Test Category : IGS-1S
Checked By : Tony Hitchcock

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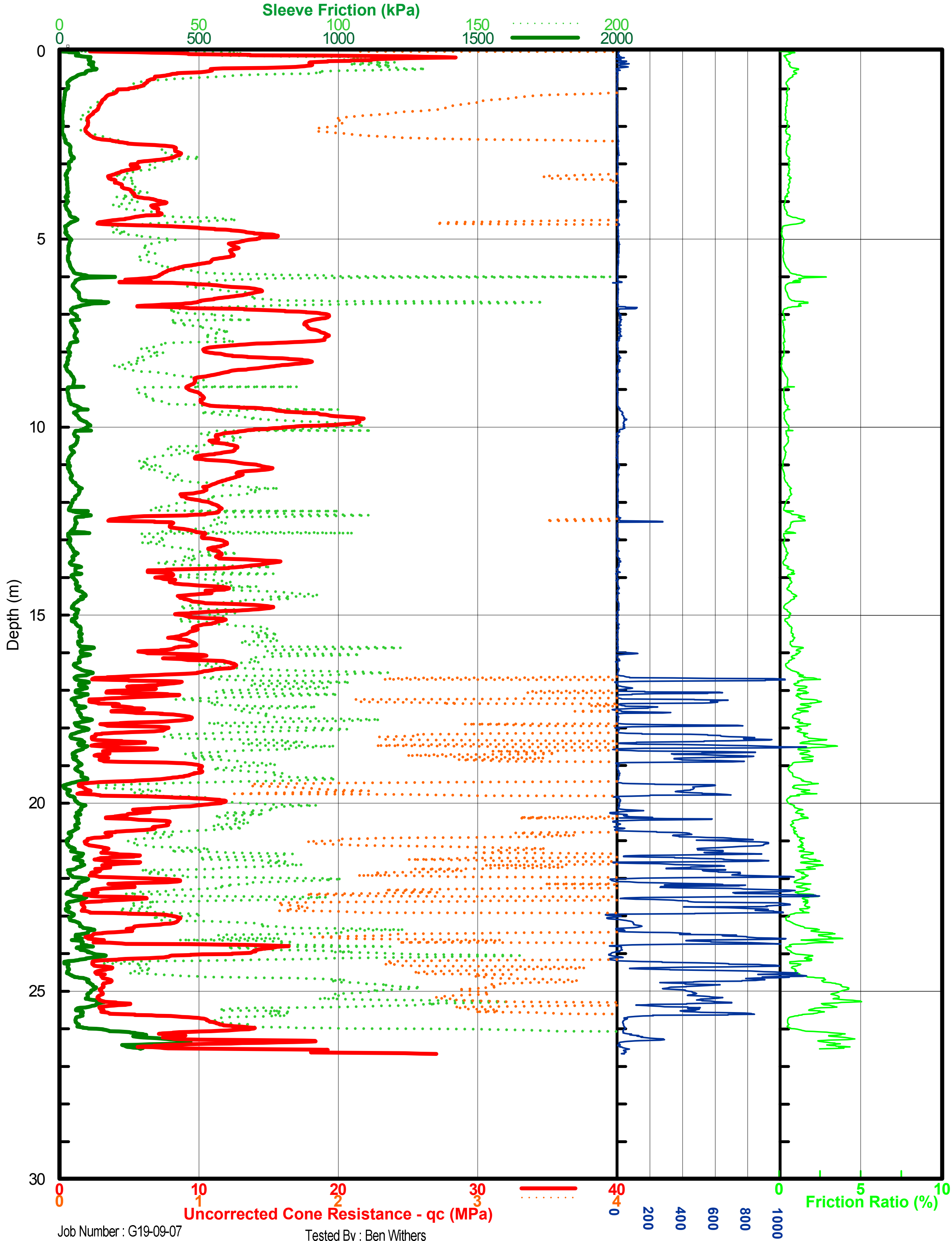
Services
Pty Ltd

CONE PENETROMETER TEST RESULT

CBH Resources
RASP Mine TSF
Broken Hill NSW

CPT7



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GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S19288
Predrill Depth : 0.00m
Cone Stabilisation @ : 2.0m
Terminated Due To : Equipment at Risk

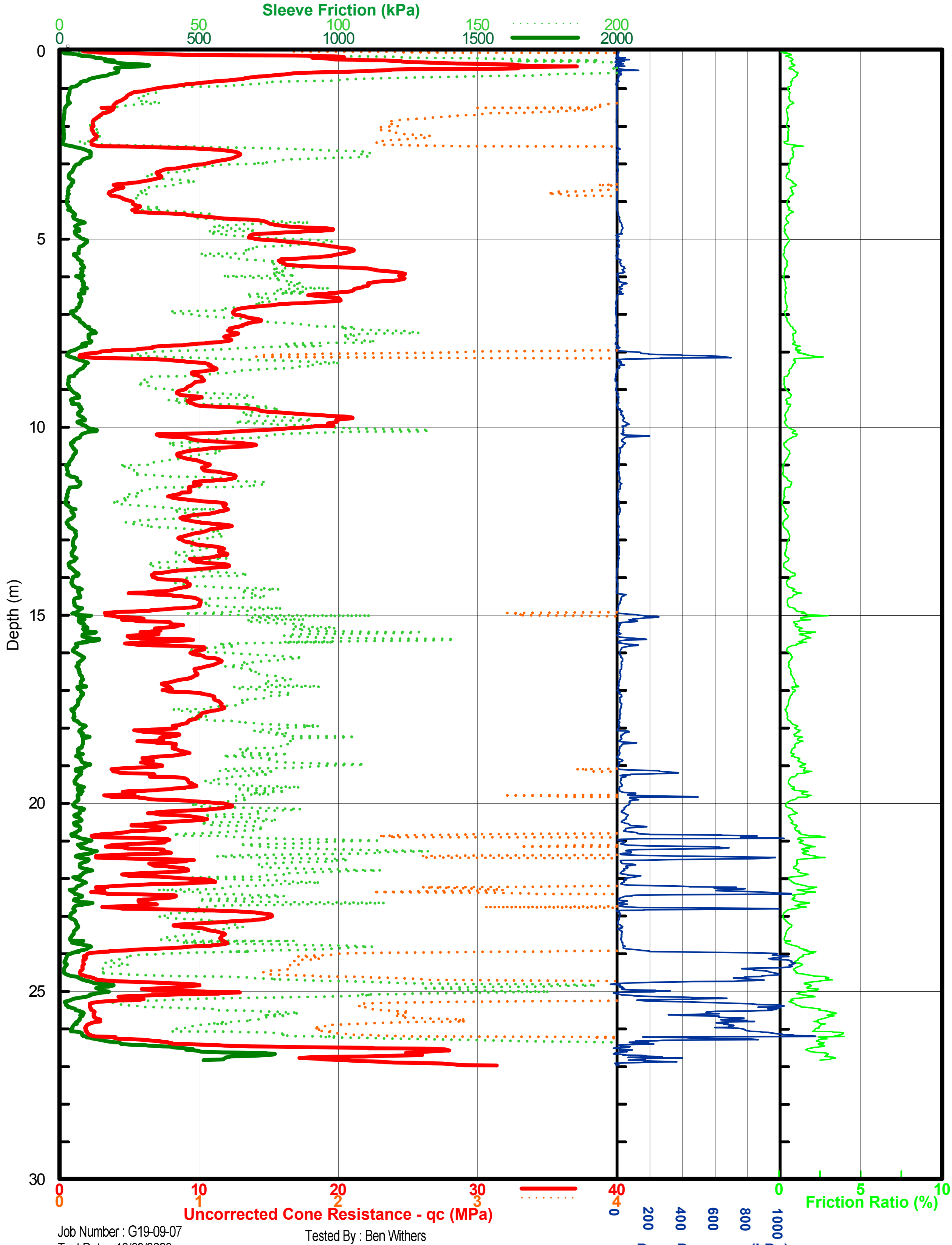
Tested By : Ben Withers
Test Category : IGS-1S
Checked By : Tony Hitchcock

Insitu Geotech Services Pty Ltd

CONE PENETROMETER TEST RESULT

CBH Resources
RASP Mine TSF
Broken Hill NSW

CPT8



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GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S19288
Cone Stabilisation : 2m
Dissipation Tests @ : 26.2m
Terminated Due To : Equipment at Risk

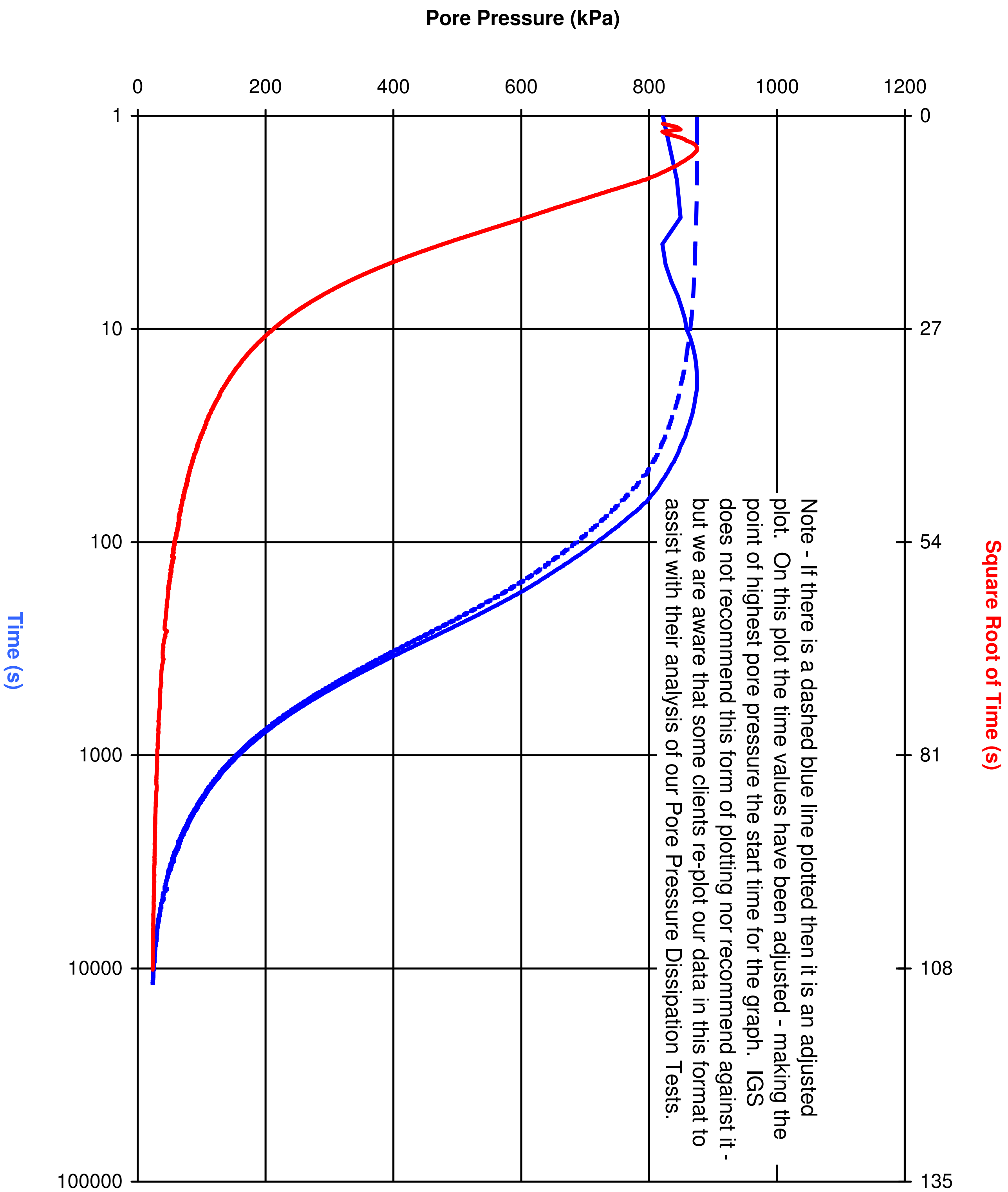
Tested By : Ben Withers
Test Category : IGS-1S
Checked By : Tony Hitchcock

Insitu Geotech Services Pty Ltd IGS

PORE PRESSURE DISSIPATION TEST RESULT

CBH Resources
RASP Mine TSF
Broken Hill NSW

CPT8
Depth: 26.2m



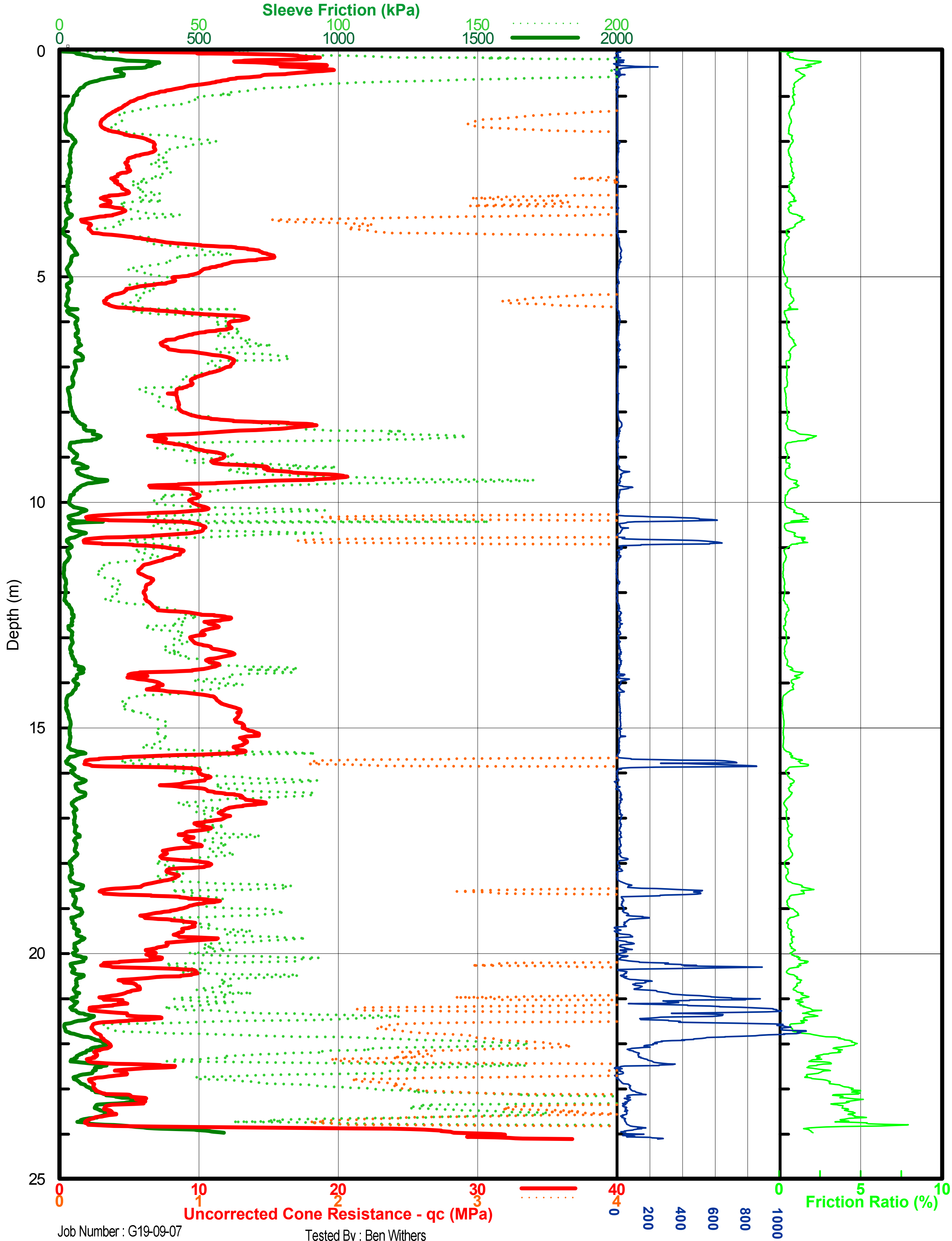
Tested By: Ben Withers
Test Duration: 3 Hours, 15 Minutes
Test Date: 19/03/2020
Job No: G19-09-07
Cone: S15CFIIP.S19288

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

CBH Resources
RASP Mine TSF
Broken Hill NSW

CPT9



Job Number : G19-09-07
Test Date : 20/03/2020
GPS Position : 54 J 0544172, 6462935
GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S19288
Predrill Depth : 0.00m
Cone Stabilisation @ : 2.0m
Terminated Due To : Equipment at Risk

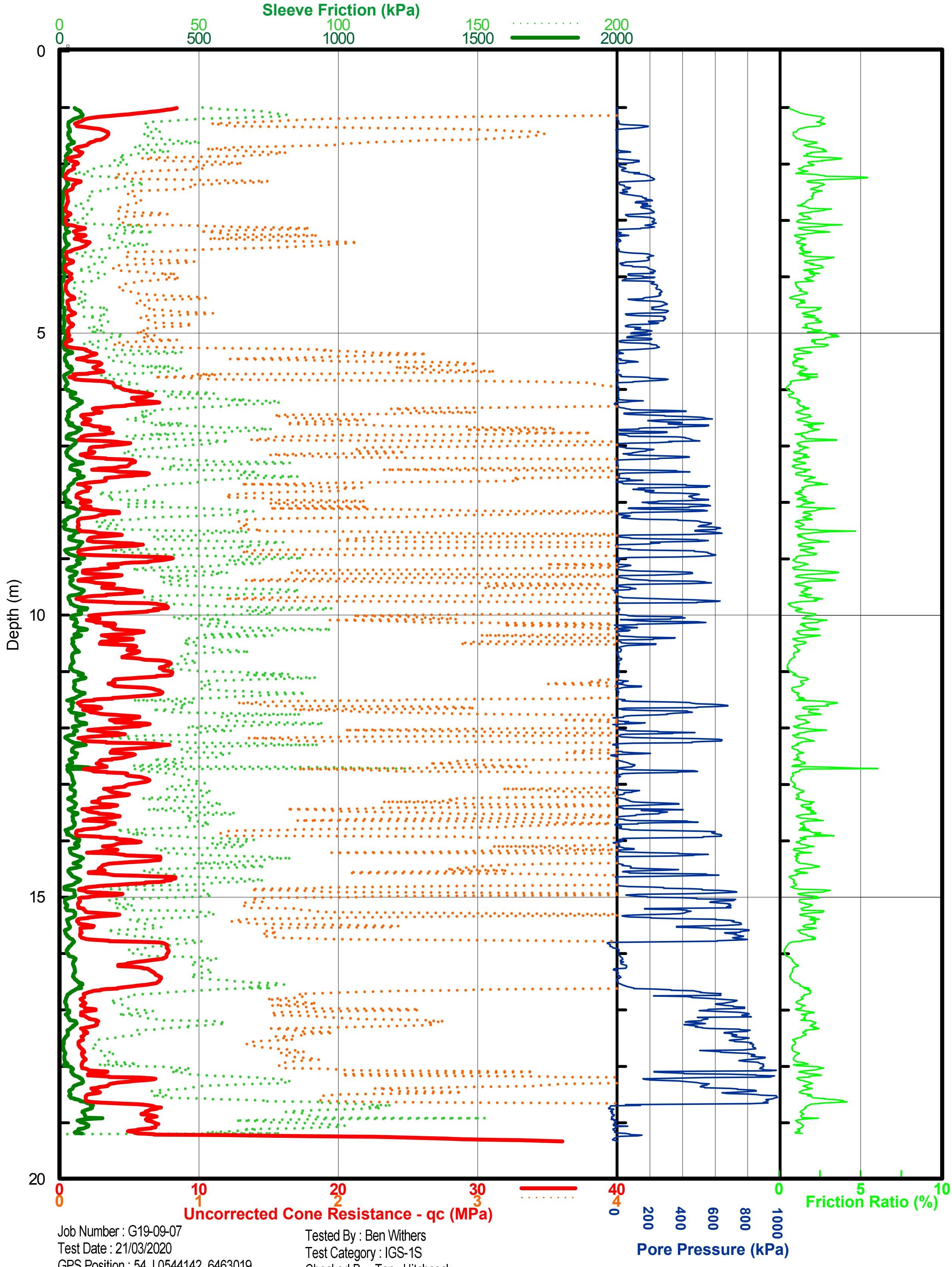
Tested By : Ben Withers
Test Category : IGS-1S
Checked By : Tony Hitchcock

Insitu Geotech Services Pty Ltd

CONE PENETROMETER TEST RESULT

CBH Resources
RASP Mine TSF
Broken Hill NSW

CPT10A



Job Number : G19-09-07
Test Date : 21/03/2020
GPS Position : 54 J 0544142, 6463019
GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S19288
Predrill Depth : 1.00m
Cone Stabilisation @ : 2.5m
Terminated Due To : Equipment at Risk

Tested By : Ben Withers
Test Category : IGS-1S
Checked By : Tony Hitchcock

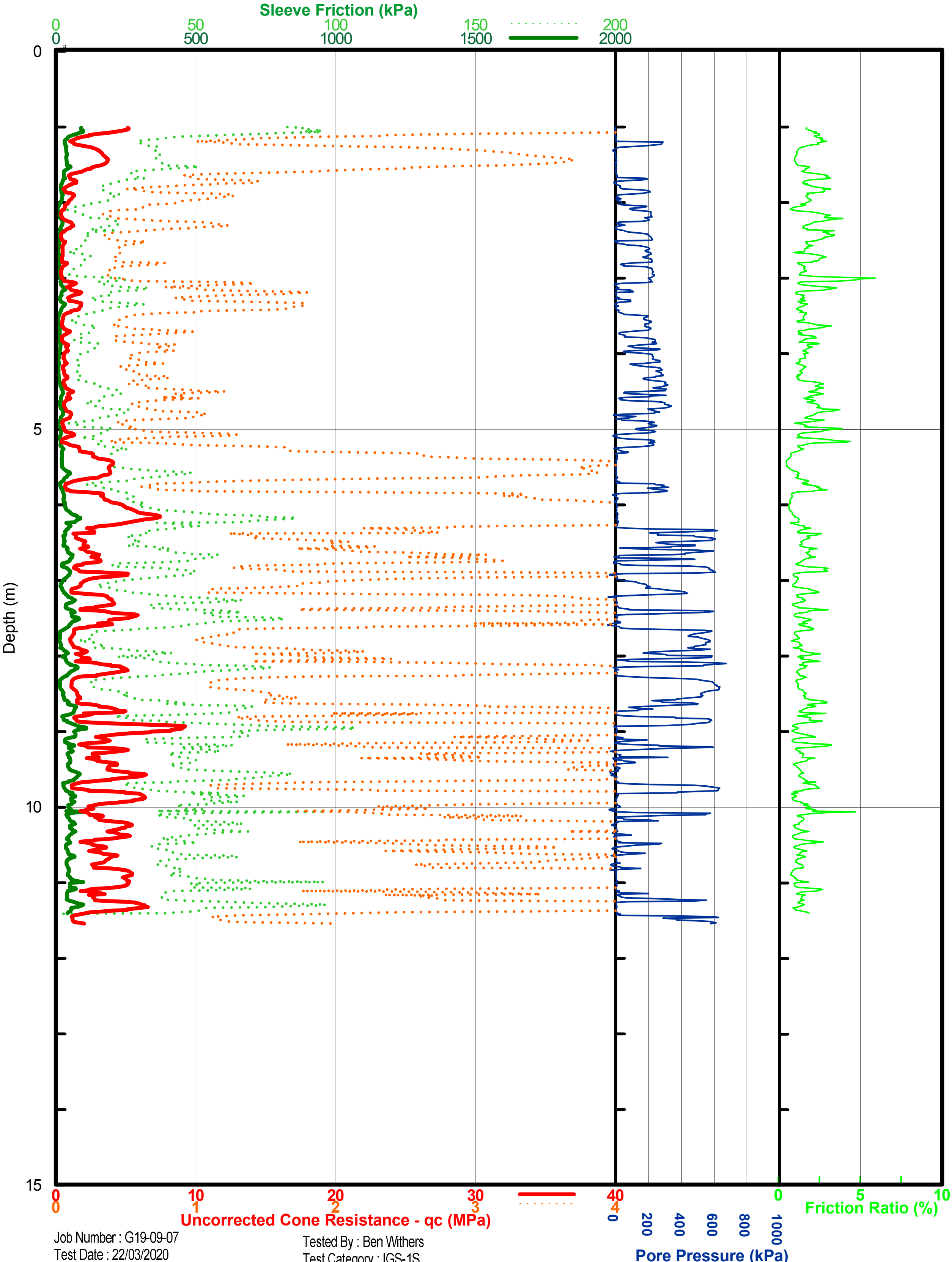
Insitu Geotech Services Pty Ltd

IGS

CONE PENETROMETER TEST RESULT

CBH Resources
RASP Mine TSF
Broken Hill NSW

CPT10B



Job Number : G19-09-07
Test Date : 22/03/2020
GPS Position : 54 J 0544140, 6463021
GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S19288
Predrill Depth : 1.00m
Cone Stabilisation @ : 2.5m 10m
Dissipation Tests @ : 11.54m
Terminated Due To : Required Depth Reached

Tested By : Ben Withers
Test Category : IGS-1S
Checked By : Tony Hitchcock

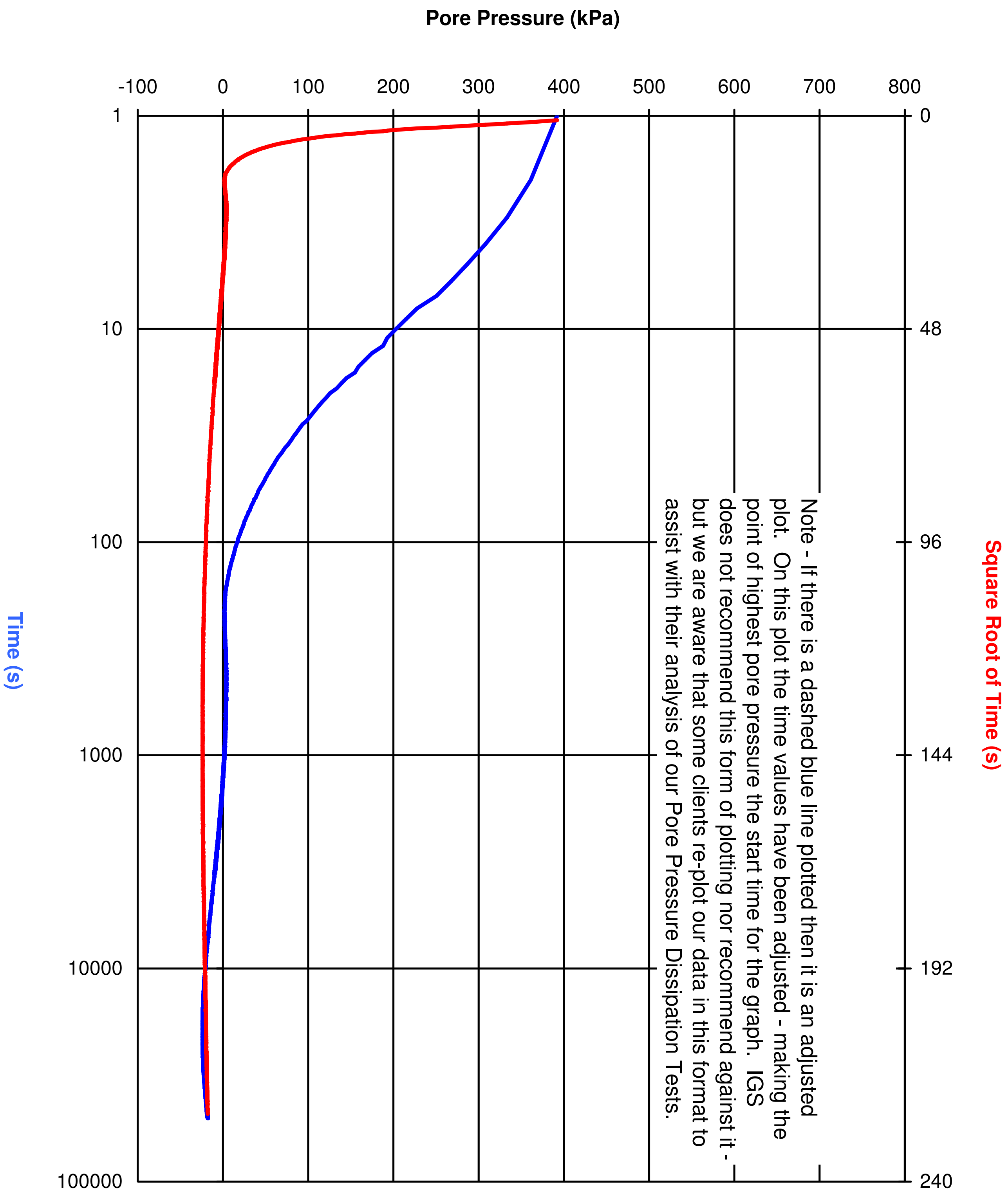
Insitu Geotech Services Pty Ltd

IGS

PORE PRESSURE DISSIPATION TEST RESULT

CBH Resources
RASP Mine TSF
Broken Hill NSW

CPT10B
Depth: 11.54m



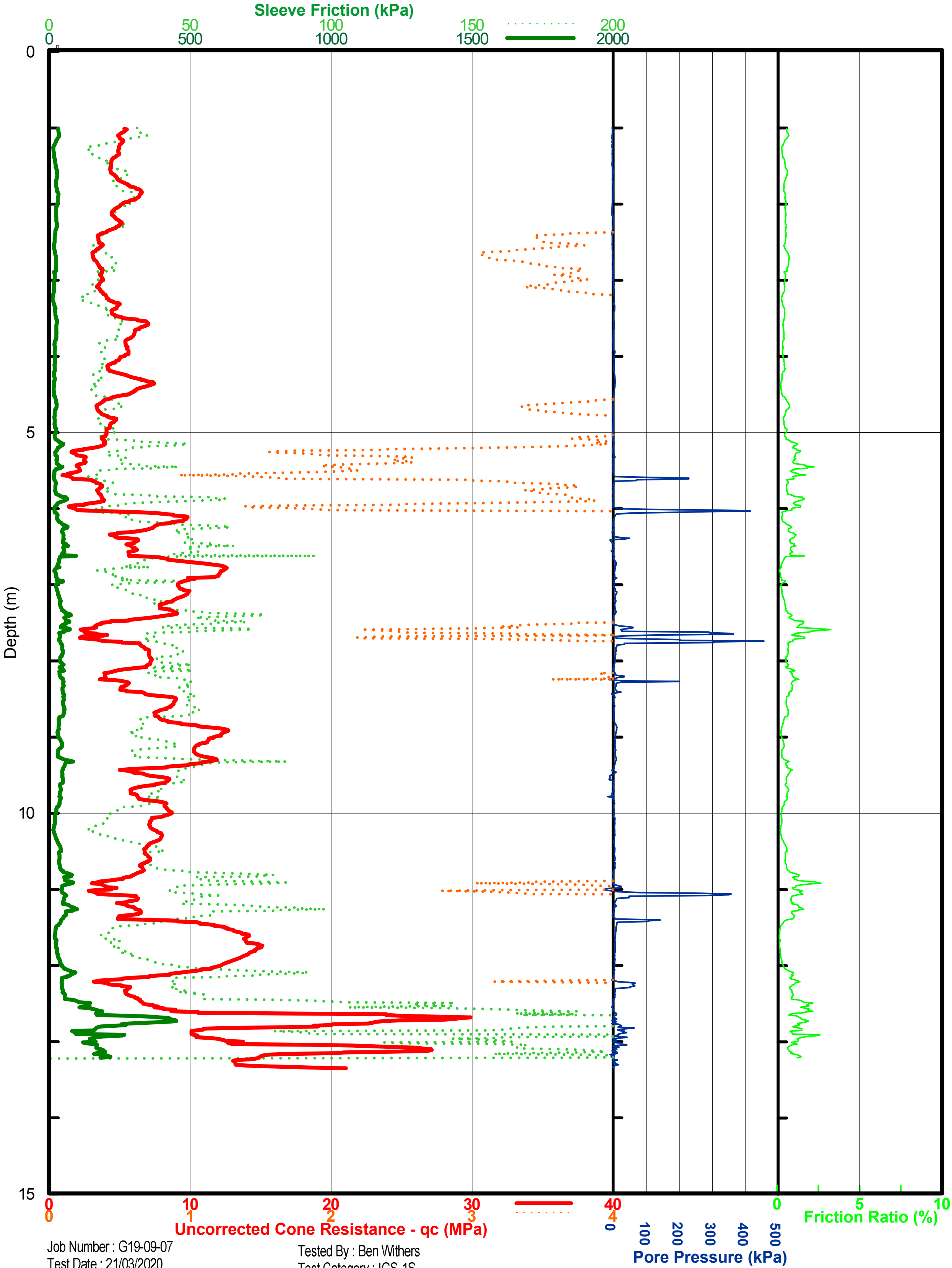
Tested By: Ben Withers
Test Duration: 14 Hours, 1 Minutes
Test Date: 22/03/2020
Job No: G19-09-07
Cone: S15CFIIP.S19288

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

CBH Resources
RASP Mine TSF
Broken Hill NSW

CPT11



Job Number : G19-09-07
Test Date : 21/03/2020
GPS Position : 54 J 0544028, 6463058
GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S19288
Predrill Depth : 1.00m
Cone Stabilisation @ : 3m
Terminated Due To : Abrupt Tilt

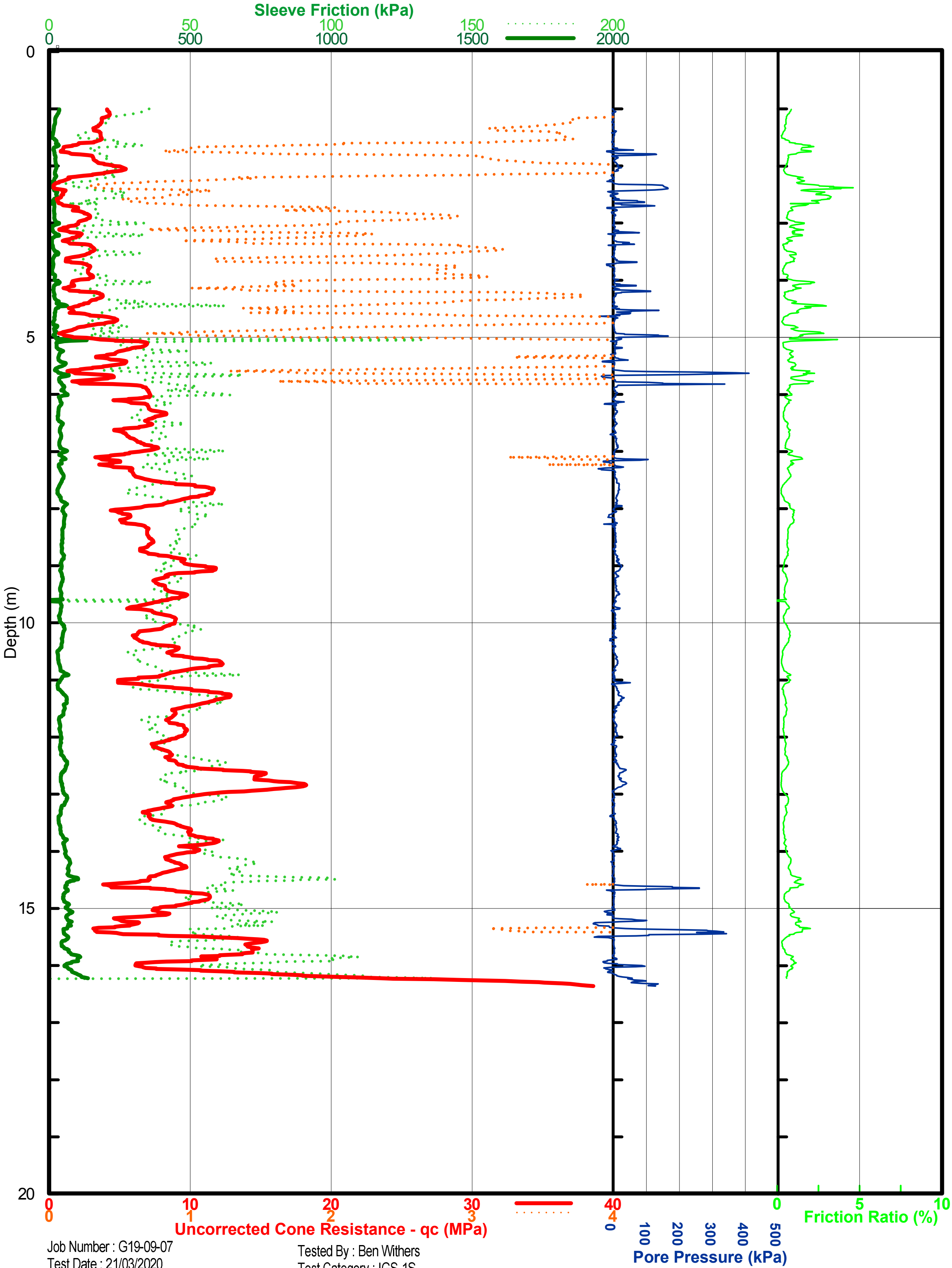
Tested By : Ben Withers
Test Category : IGS-1S
Checked By : Tony Hitchcock

Insitu Geotech Services Pty Ltd IGS

CONE PENETROMETER TEST RESULT

CBH Resources
RASP Mine TSF
Broken Hill NSW

CPT12



Job Number : G19-09-07
Test Date : 21/03/2020
GPS Position : 54 J 0544308, 6463257
GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S19288
Predrill Depth : 1.00m
Cone Stabilisation @ : 2.5m
Terminated Due To : Equipment at Risk

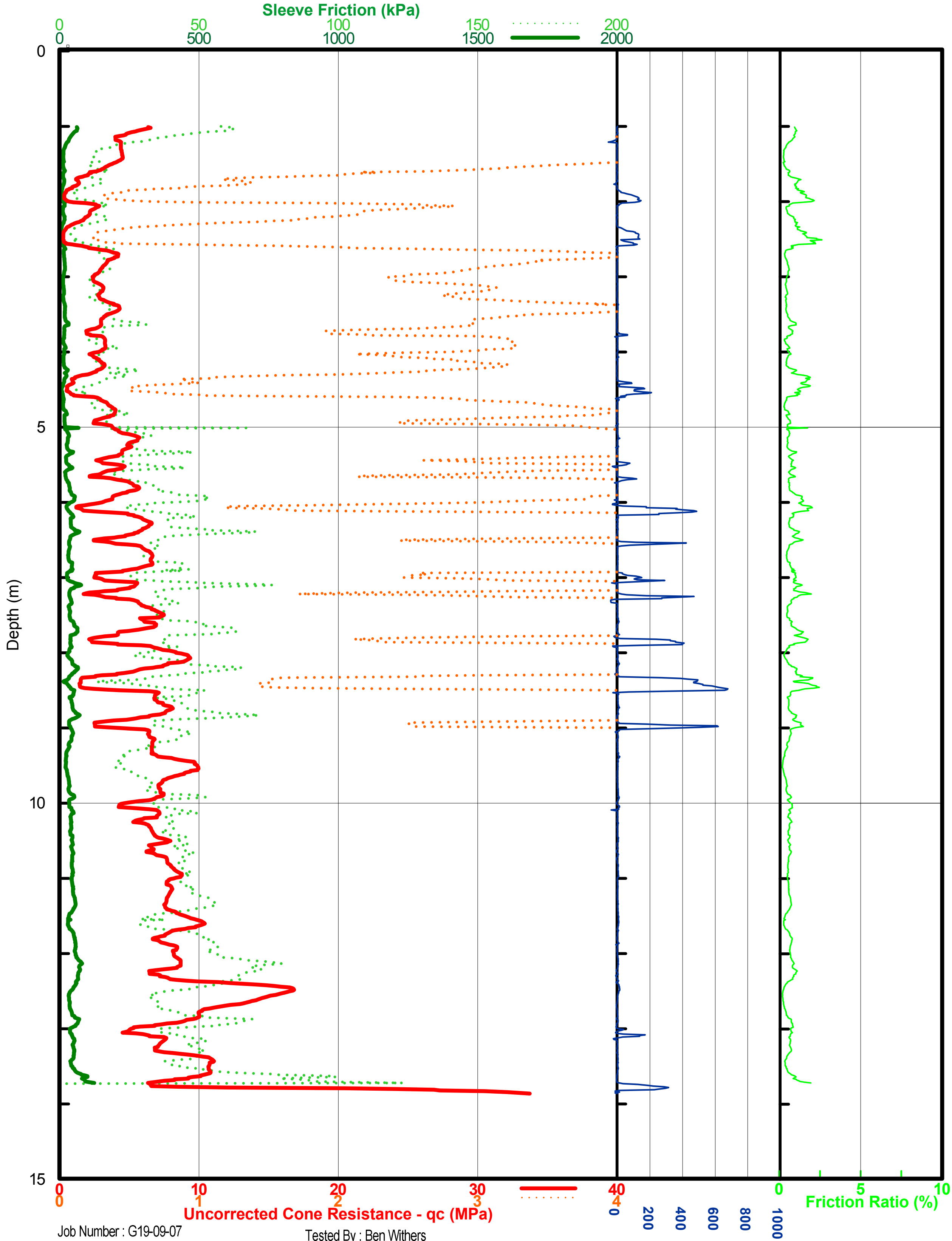
Tested By : Ben Withers
Test Category : IGS-1S
Checked By : Tony Hitchcock

Insitu Geotech Services Pty Ltd
IGS

CONE PENETROMETER TEST RESULT

CBH Resources
RASP Mine TSF
Broken Hill NSW

CPT13



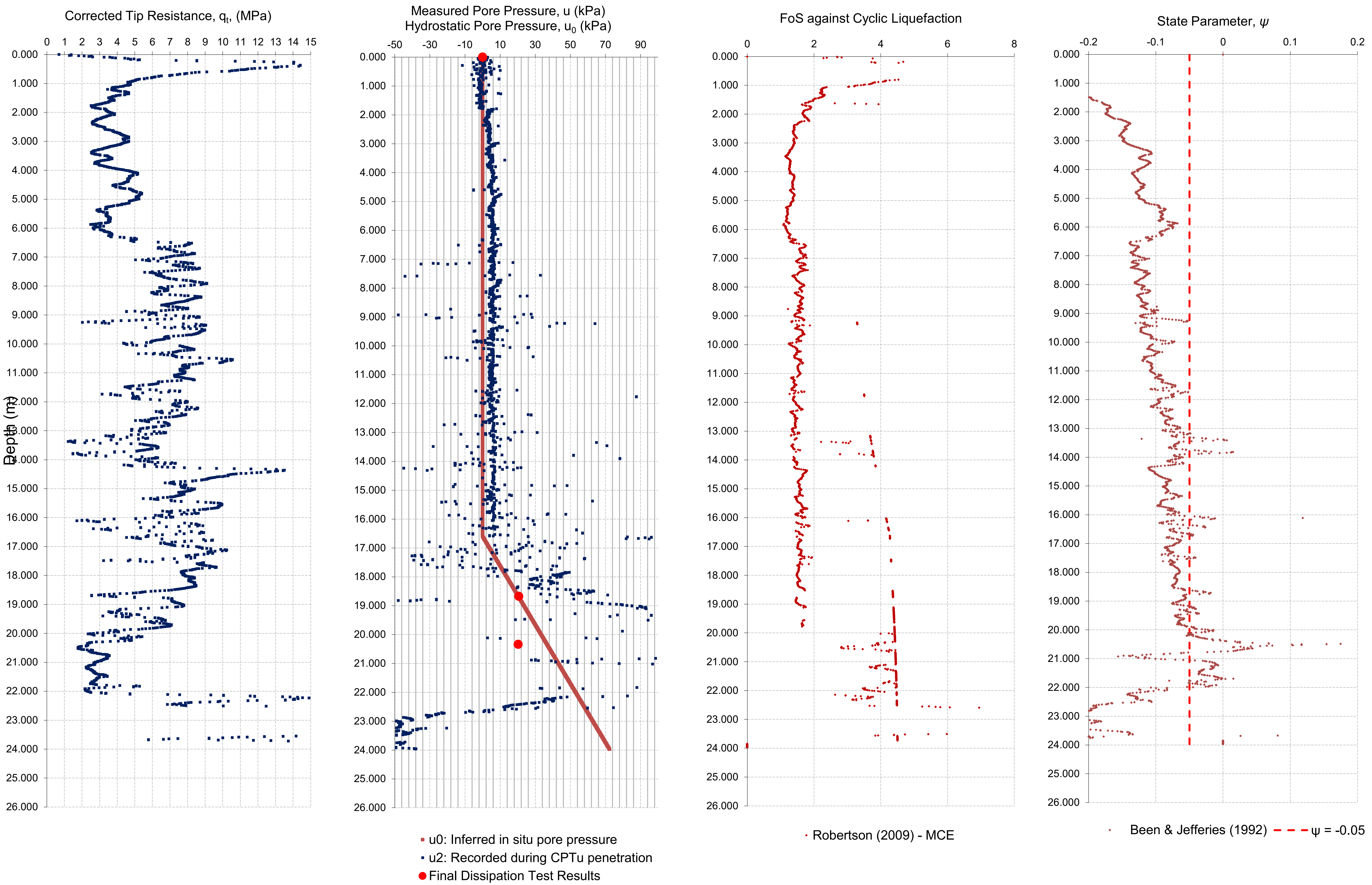
Job Number : G19-09-07
Test Date : 22/03/2020
GPS Position : 54 J 0544222, 6463114
GPS Format : WGS 84
Rig : Eunice
Cone Number : S15CFIIP.S19288
Predrill Depth : 1.00m
Cone Stabilisation @ : 2.5m
Terminated Due To : Equipment at Risk

Tested By : Ben Withers
Test Category : IGS-1S
Checked By : Tony Hitchcock

Insitu Geotech Services Pty Ltd
IGS

APPENDIX C

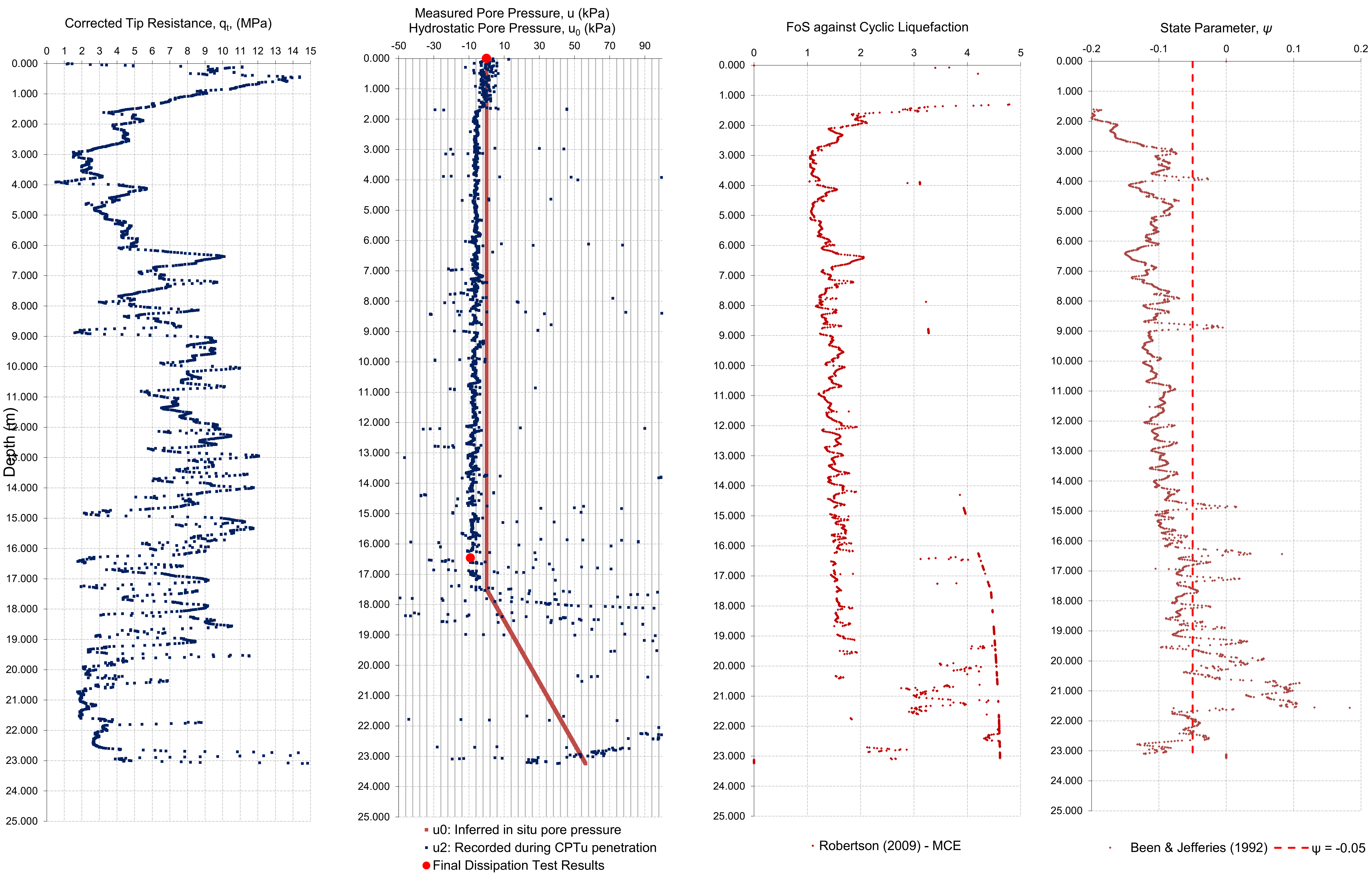
Analyses of CPT probe results



MCE: 1:10 000 years

PGA: 0.1471 m/s^2

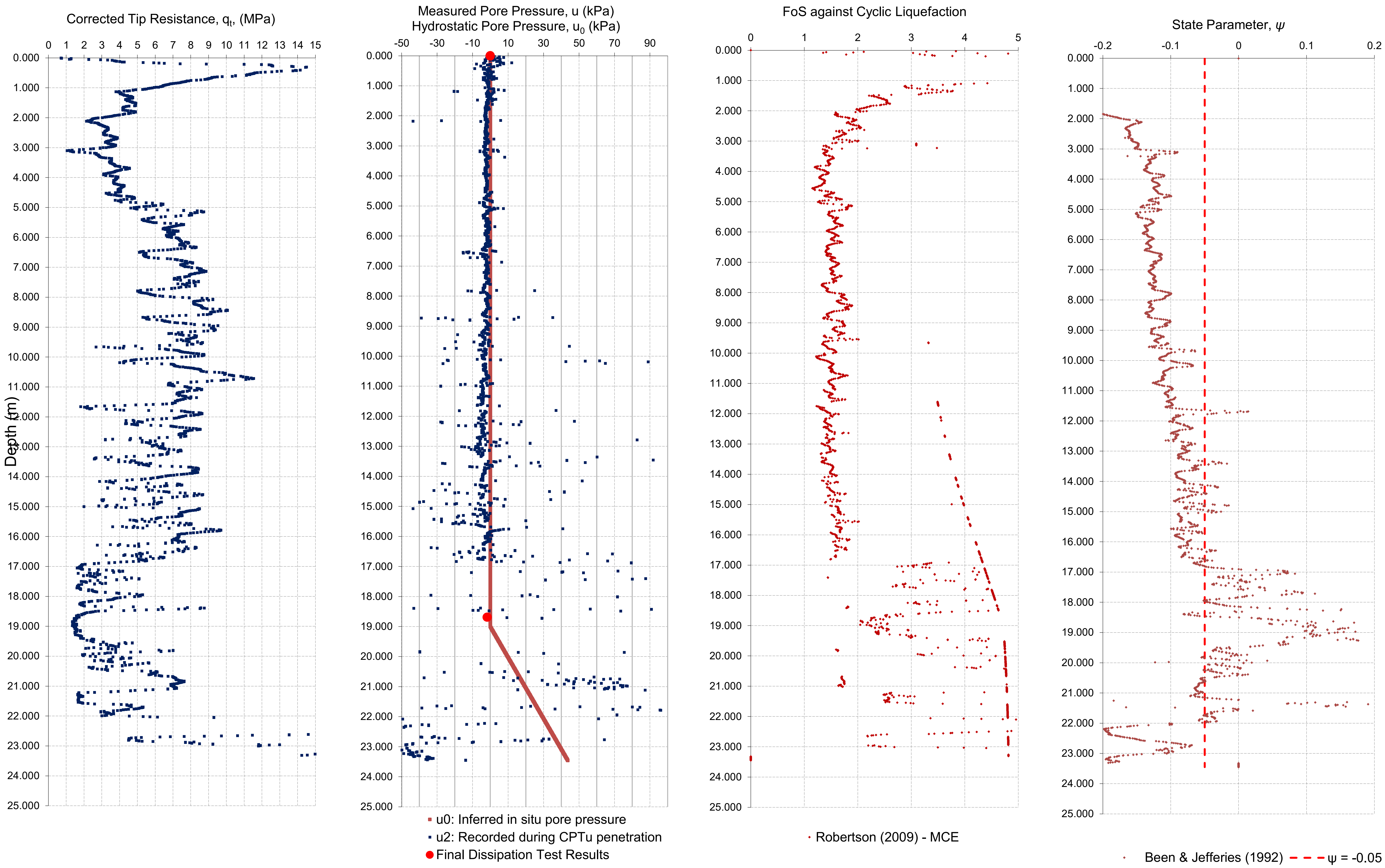
GOLDER	CLIENT CBH Resources		PROJECT Rasp Mine TSF Design	
	DRAWN JE	DATE 09-Dec-19	CPTu 01	
	CHECK 0	DATE 00-Jan-00		
	SCALE NTS	A4	PROJECT No.	1896230



MCE: 1:10 000 years

PGA: 0.1471 m/s^2

CLIENT CBH Resources		PROJECT Rasp Mine TSF Design	
DRAWN JE	DATE 09-Dec-19	**CPTu 02**	
CHECK 0	DATE 00-Jan-00		
SCALE NTS	A4	PROJECT No.	**1896230**

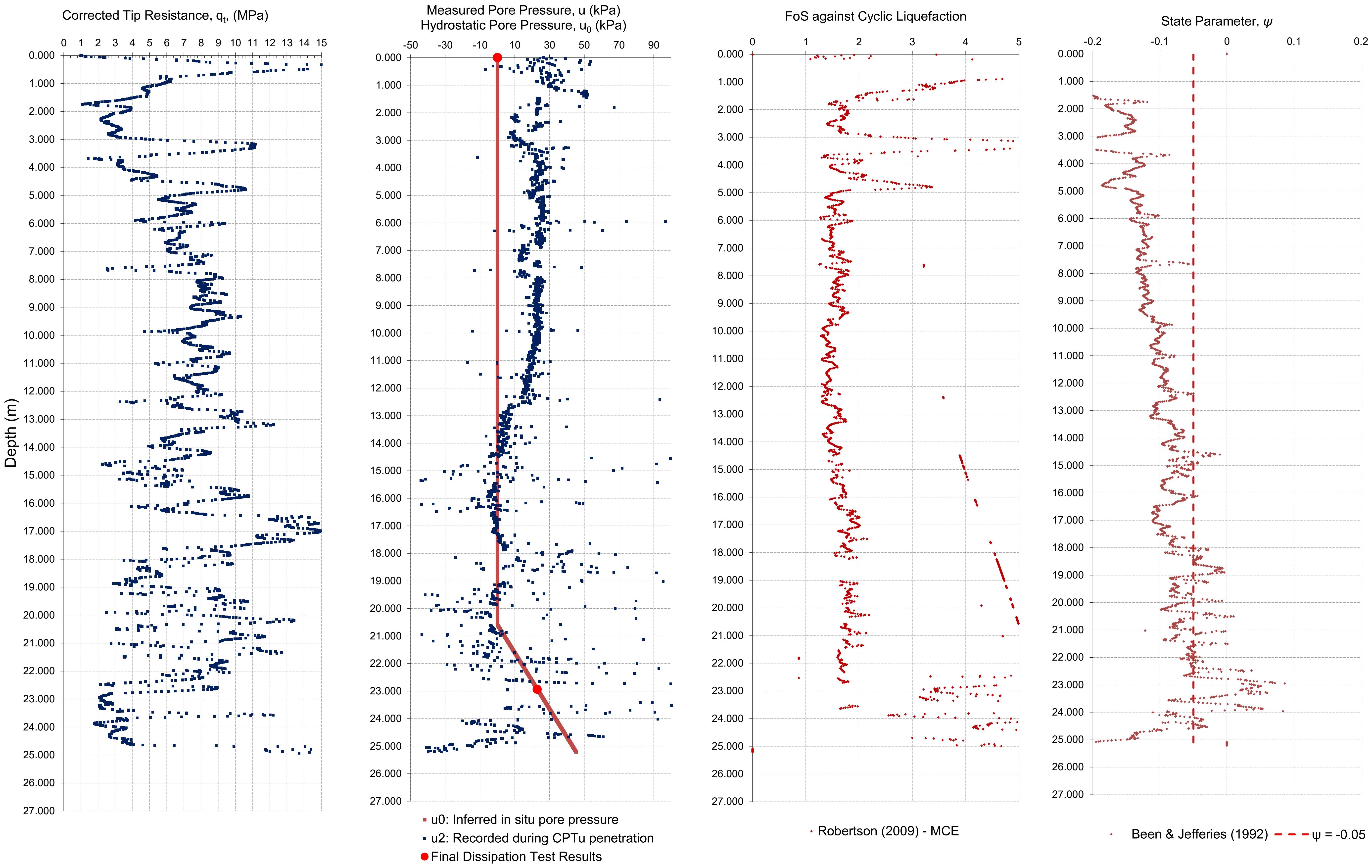


MCE: 1:10 000 years

PGA: 0.1471 m/s²

GOLDER

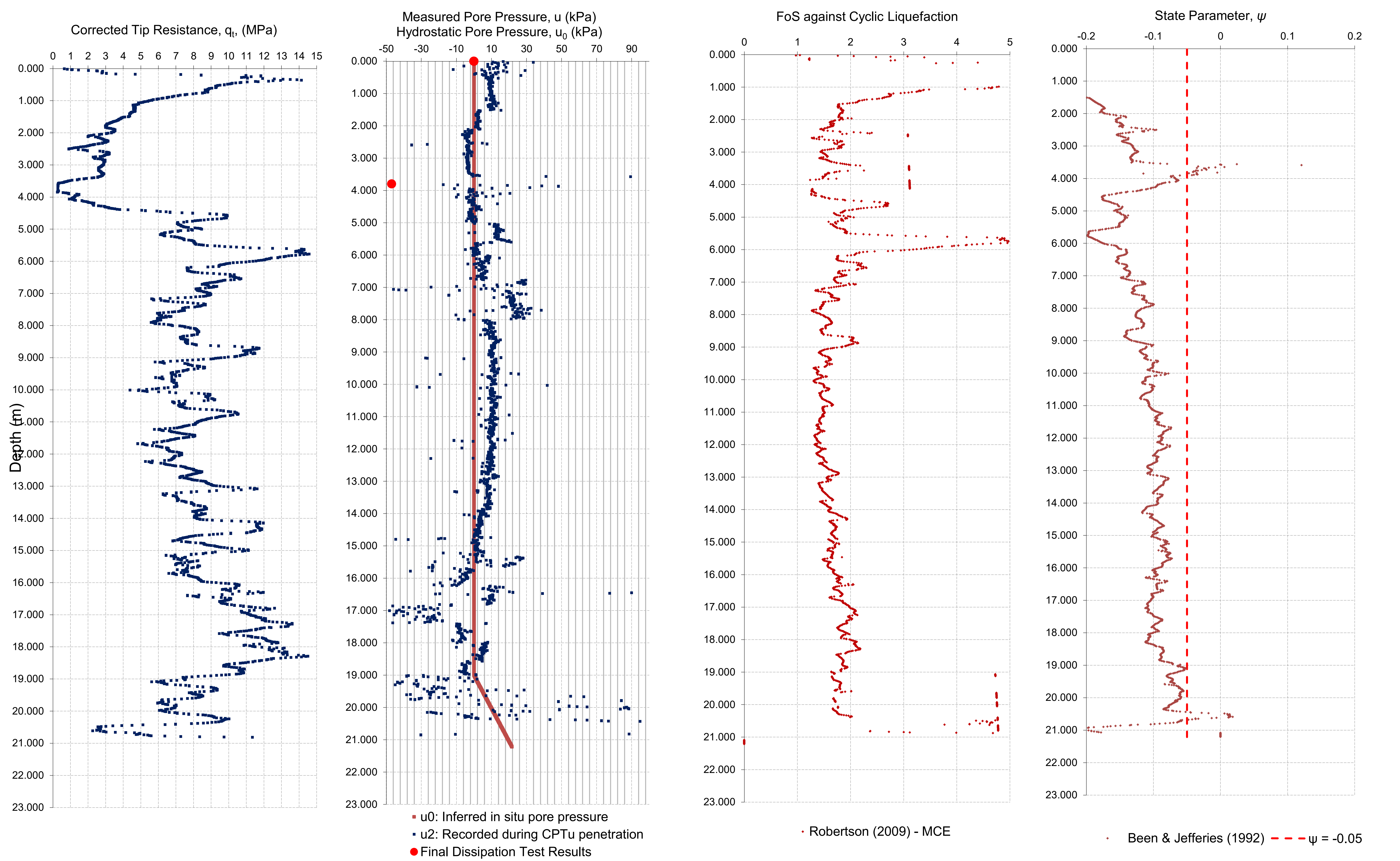
CLIENT CBH Resources		PROJECT Rasp Mine TSF Design	
DRAWN JE	DATE 09-Dec-19	CPTu 03	
CHECK 0	DATE 00-Jan-00		
SCALE NTS	A4	PROJECT No.	1896230



MCE: 1:10 000 years

PGA: 0.1471 m/s²

CLIENT	CBH Resources			PROJECT	Rasp Mine TSF Design
DRAWN	JE	DATE	09-Dec-19		CPTu 04
CHECK	0	DATE	00-Jan-00		
SCALE	NTS		A4	PROJECT No.	1896230

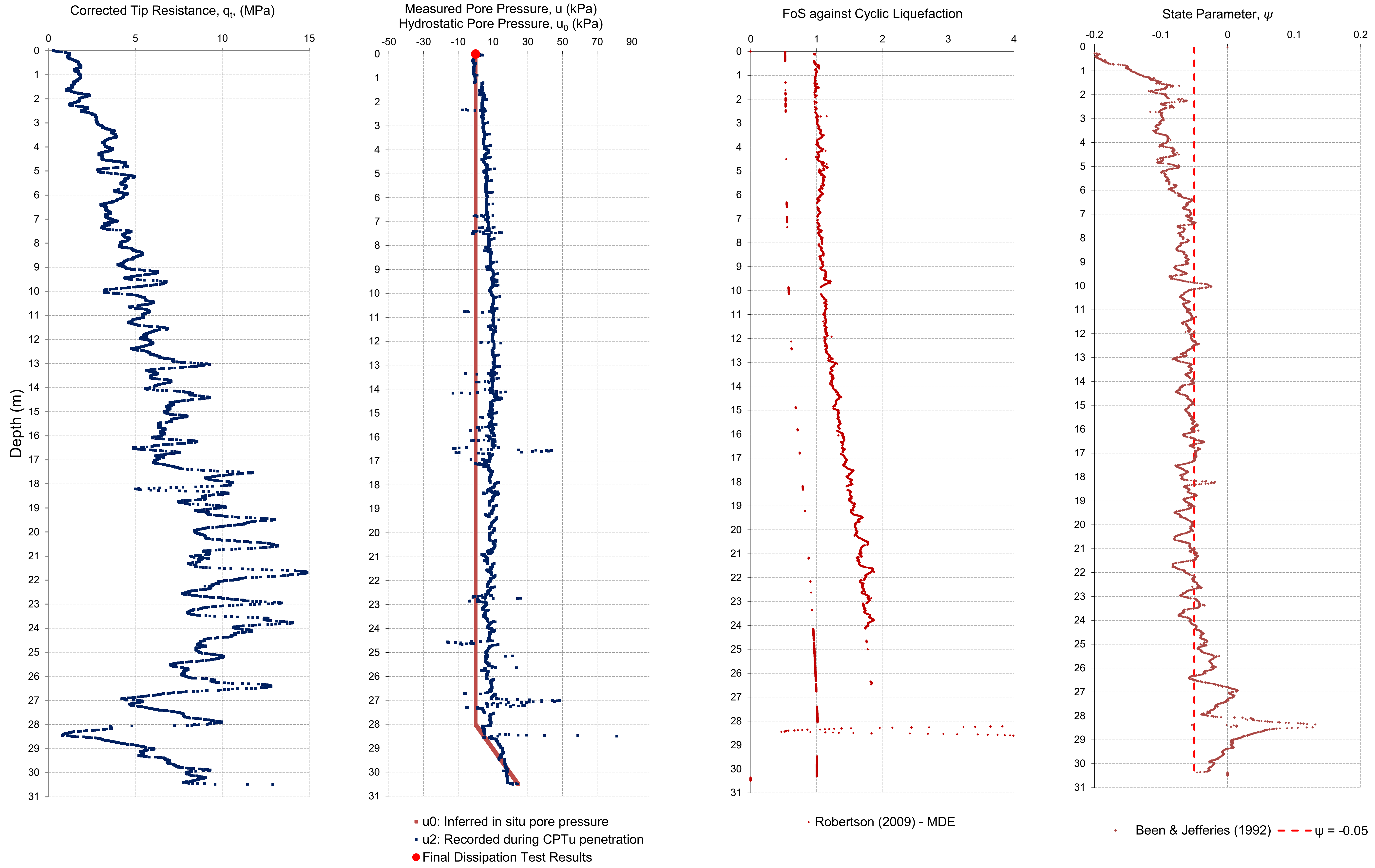


MCE: 1:10 000 years

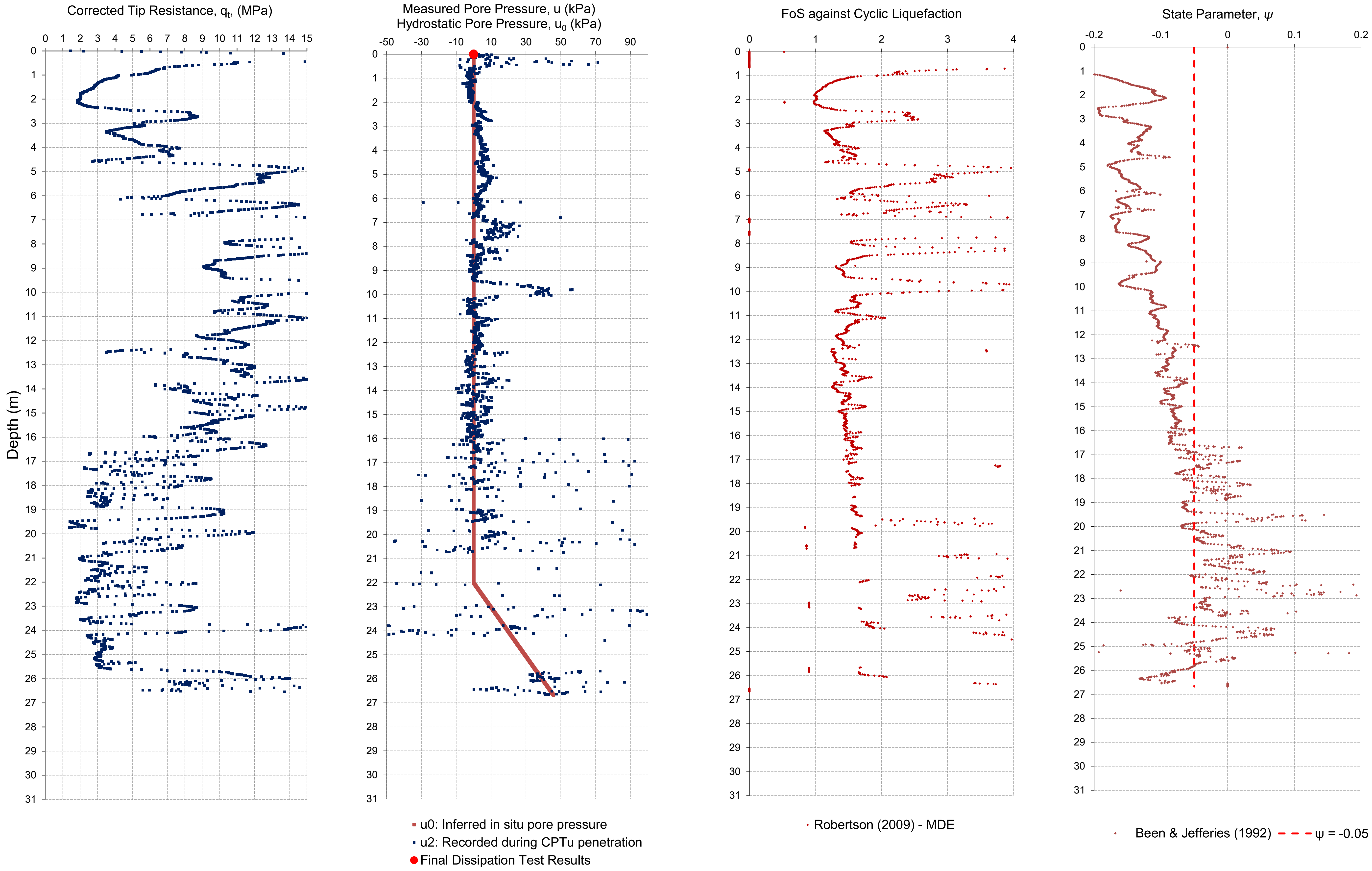
PGA: 0.1471 m/s²

CLIENT CBH Resources			PROJECT Rasp Mine TSF Design	
DRAWN JE	DATE 09-Dec-19		CPTu 05	
CHECK 0	DATE 00-Jan-00			
SCALE NTS	A4		PROJECT No.	1896230

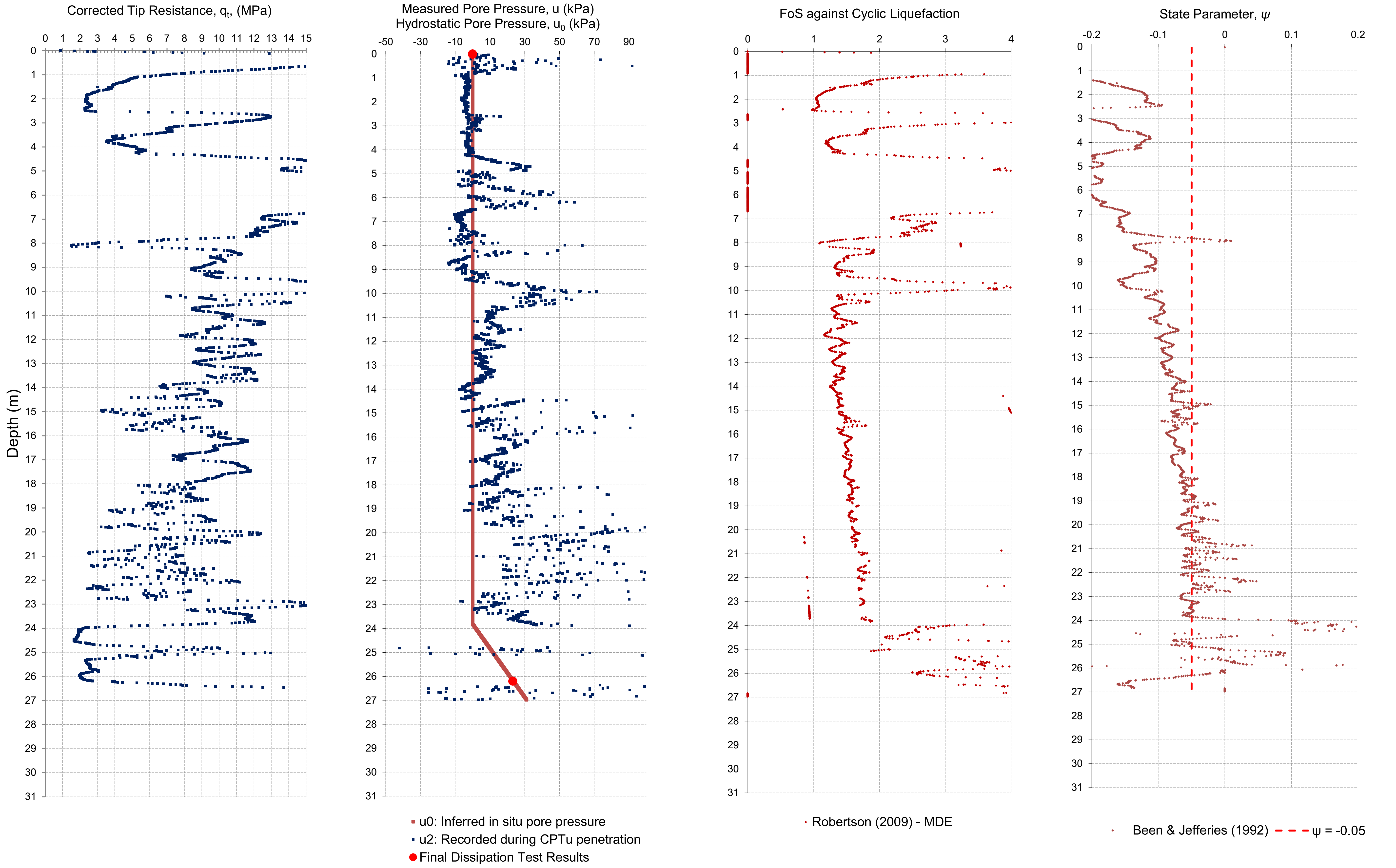
GOLDER



GOLDER	CLIENT CBH Resources		PROJECT Rasp Mine TSF Design	
	DRAWN JE	DATE 31-Mar-20	BW CPTu 06A	
	CHECK 0	DATE 00-Jan-00		
	SCALE NTS	A4	PROJECT No.	1896230

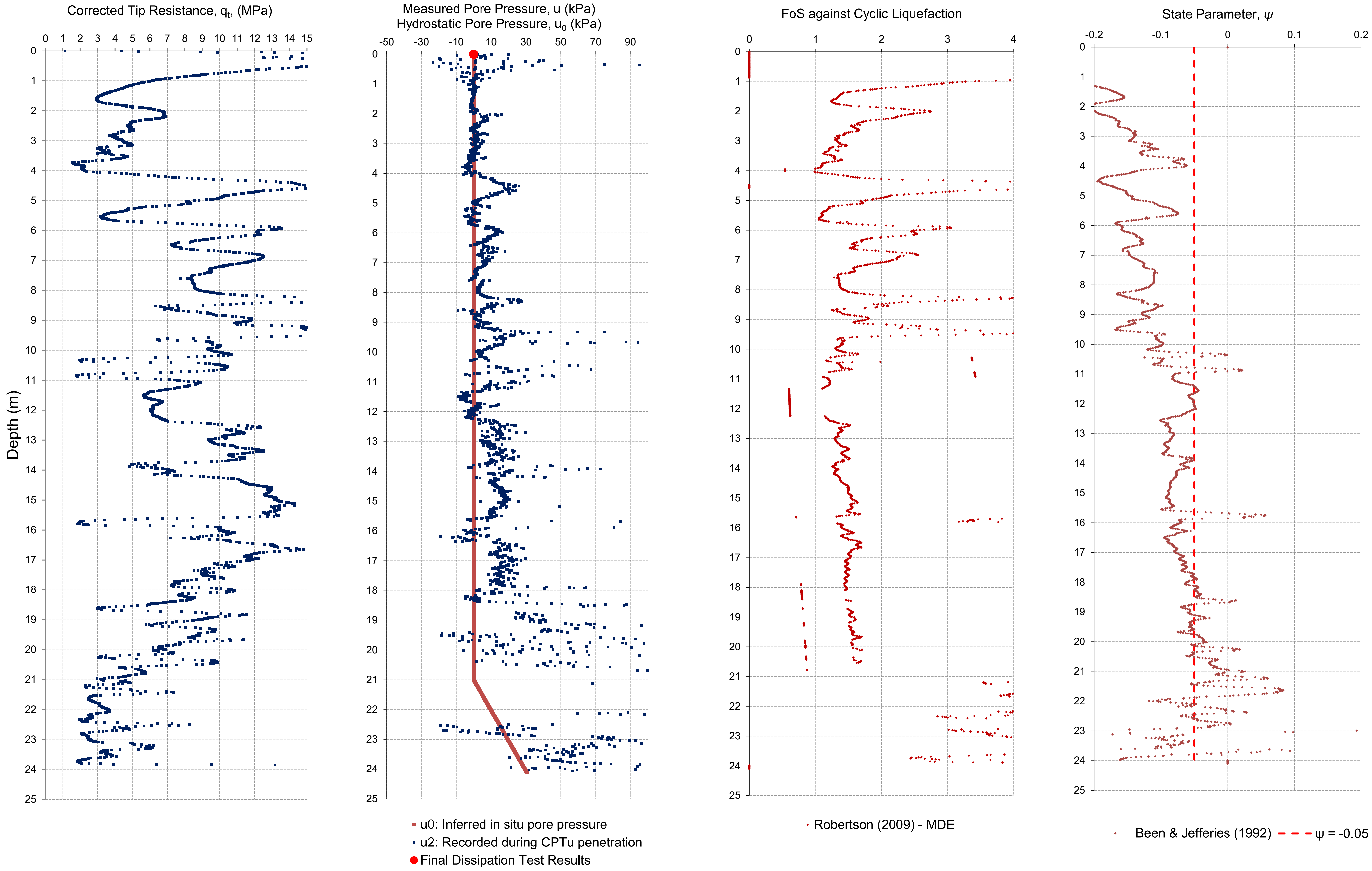


GOLDER	CLIENT CBH Resources			PROJECT Rasp Mine TSF Design	
	DRAWN JE	DATE 31-Mar-20		BW CPTu 07	
	CHECK 0	DATE 00-Jan-00			
	SCALE NTS	A4		PROJECT No.	1896230



GOLDER

CLIENT CBH Resources		PROJECT Rasp Mine TSF Design	
DRAWN JE	DATE 31-Mar-20	BW CPTu 08	
CHECK 0	DATE 00-Jan-00		
SCALE NTS	A4	PROJECT No.	1896230



GOLDER	CLIENT CBH Resources			PROJECT Rasp Mine TSF Design	
	DRAWN JE	DATE 31-Mar-20		BW CPTu 09	
	CHECK 0	DATE 00-Jan-00			
	SCALE NTS		A4	PROJECT No.	1896230

APPENDIX D

Important Information

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

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This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification