Subdivision Geotechnical Investigation Report

1 Sutherlands Road & 848 Cashmere Road, Halswell, Christchurch

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Prepared for: **Yoursection Ltd**

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Revision	Status	Date	Prepared by	Reviewed by
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Table of Contents

Executive Summary

Miyamoto International NZ Ltd has been engaged by Yoursection Ltd to undertake a geotechnical investigation, evaluation and assessment of the site located at 1 Sutherlands Road & 848 Cashmere Road, Halswell, Christchurch.

This report documents the results of our desktop study and geotechnical assessment, together with preliminary land suitability and foundation recommendations for the proposed subdivision. Our findings and conclusions are summarised below:

GROUND CONDITIONS	**Ground profile**	The sub-surface conditions comprise mainly topsoil, sandy silt and silty sand underlain by silt and shallow gravel. The ground conditions are highly variable in horizontal and vertical spread.	
	Soil classification as per NZS 1170.5:2004	Class 'D' (deep or soft soil sites)	
	Depth to water table	Seasonal variation of the groundwater table to be around 1.5 metres below ground level (mbgl) within the upper cohesive silty soils, and within the underlying sands and gravels.	
SEISMIC ASSESSMENT	**Scenario**	**SLS/SLS2**	**ULS**
	Estimated "free-field" post-liquefaction volumetric settlements	Index Value: 5 – 70 mm	Index Value: 10 – 95 mm
	Liquefaction Severity Number (LSN) Index Value	0 – 17 Little to minor expression of liquefaction	2 – 34 Little to severe expression of liquefaction
	MBIE Technical Categorization (TC)	**Mapped MBIE**	Rural and Unmapped
		Site Specific Foundation TC	TC2 with specific engineering design
GEOTECHNICAL CONSIDERATIONS	Our assessment of the site under RMA Section 106 found that there are no further significant hazards present that pose undue risk to development on the site, other than those highlighted (presence of the upper soft soil layers and liquefaction induced subsidence) within this report. Where appropriate, measures can be put in place (as per our recommendations) in order to largely mitigate these hazards.		

1. Introduction

Miyamoto International NZ Ltd (MINZ) has been engaged by Yoursection Ltd to undertake a geotechnical investigation, evaluation and assessment to provide preliminary land suitability and foundation recommendations for consenting purposes at the proposed residential subdivision located at 1 Sutherlands Road & 848 Cashmere Road, Halswell, Christchurch.

The scope of this geotechnical engineering assessment was to evaluate the geotechnical conditions on site and to provide appropriate recommendations for the initial development of the sections. This assessment comprised the following.

- Research of the available information from the New Zealand Geotechnical Database (NZGD), Christchurch City Council (CCC) and Environment Canterbury (ECan);
- Site walkover inspection of the land;
- Shallow field investigation comprising hand-augered boreholes (HA) and sampling of soils for laboratory testing;
- Deep ground investigation comprising Cone Penetration Testing (CPT) and Seismic Cone Penetration Testing (SCPT);
- Multichannel Analysis of Surface Waves (MASW) geophysical survey to determine shear wave velocities of the soil;
- Evaluation of existing ground investigation data;
- Laboratory testing of soil samples for fines content (FC) and Plasticity Indices (PI);
- Liquefaction susceptibility evaluation and liquefaction triggering analyses using CPT and Shear Wave Velocity (Vs) based triggering procedures.

The geotechnical investigation and assessment were carried out considering the Ministry of Business, Innovation & Employment (MBIE) Guidance documents "Planning and engineering guidance for potentially liquefaction-prone land" - Version 1, dated September 2017, "Repairing and rebuilding houses affected by the Canterbury earthquakes" - Version 3, dated December 2012, and "Earthquake geotechnical engineering practice - Modules 2 & 3".

This report presents our findings and conclusions which are provided to facilitate the development of an initial subdivision plan for the site.

2. Site Description and Existing Features

The sites, legally described as Part Lot 6 DP 2380 (1 Sutherlands Road) and Lot 7 DP 2380 (848 Cashmere Road), are located in Halswell, Christchurch on predominantly flat ground of an approximate total area of 9.5 hectares. Part Lot 6 is located on the north-western corner of the intersection between Cashmere and Sutherlands Roads and is bound by rural sections on all other sides. Lot 7 is located on the north-western side of Cashmere Road, immediately west of Part Lot 6. A stormwater easement runs along the northern boundaries of both properties. The base of the Port Hills forms the southern boundary of the sections.

An existing single storey dwelling and attached garage are present on Part Lot 6 which is accessed via private driveway off Sutherlands Road. Four detached structures, including a set of stables and three other farm buildings, are also present approximately 50 m east of the main dwelling. A pond fed by a windmill-pumped well is present on Lot 7 approximately 10 m from the eastern boundary shared with Part Lot 6.

The site is within MBIE Technical Category Rural & Unmapped, indicating "*Normal consenting procedures apply in these areas*". The site location with reference to the MBIE technical categories is shown in Figure 1.

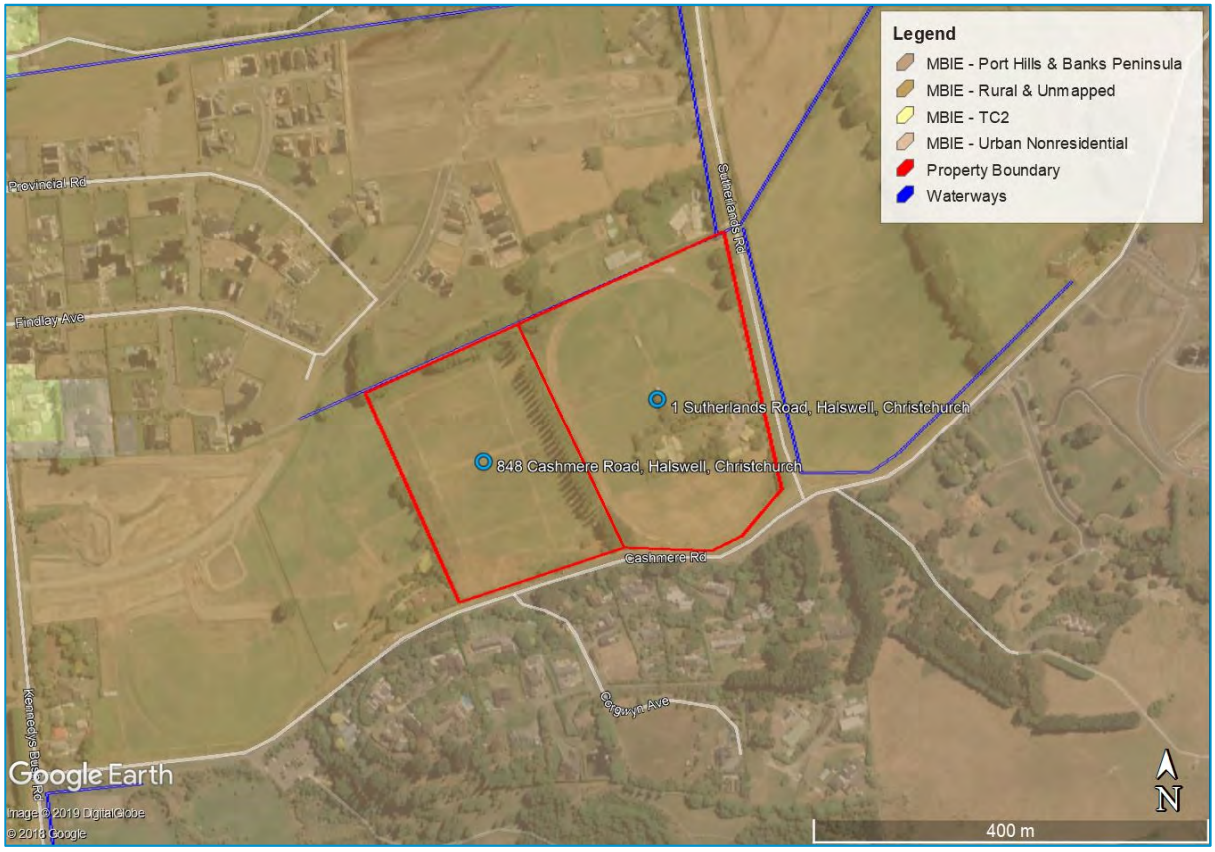

Figure 1: Site Location Plan Showing MBIE Technical Categories and Mapped Waterways

3. Desk Study

The following sources of third-party information were considered and are referenced in this report:

- New Zealand Geotechnical Database (NZGD);
- Environment Canterbury (ECan);
- Christchurch City Council (CCC).

3.1 Previous Geotechnical Investigations

Two previous geotechnical investigations have been undertaken at the site. These include the Soil and Rock Consultants (S&R) geotechnical investigation report for 1 Sutherlands Road dated 25 November 2016, and the KGA Consultants (KGA) Geotechnical Engineering Investigation report for 848 Cashmere Road dated 7 February 2017. The geotechnical data from these reports are presented in Appendix A, the sub-surface investigation data from which was used to supplement our investigation and assessment.

3.2 New Zealand Geotechnical Database

The NZGD website was reviewed to identify any additional information related to the extent of land damage after the CES on the site and in the immediate surrounding areas. The results of this review indicate that no significant land damage was observed across the site. Table 1 provides a summary of the information obtained from our review of the NZGD.

Table 1: Desk Study Information Summary (NZGD)

	September 2010 (M_w 7.1)	February 2011 (M_w 6.2)	June 2011 (M_w 6.0)	December 2011 (M_w 5.9)
Aerial Photography Review	Outside of photographed area	Small areas of potential ejecta identified in the northern part of both sections	Outside of photographed area	Outside of photographed area
Land damage observations	No observations	No observations (site); No observed liquefaction ejecta (road)	No observed liquefaction ejecta or ground cracking (road)	No data
Observed ground cracking	No cracks mapped on or within 150m of the site			
PGA (g) ± SD	0.280 ± 0.400	0.395 ± 0.425	0.155 ± 0.465	0.138 ± 0.350
Scaled $PGA_{7.5}$ $PGA_{16\%ile}$ to $PGA_{84\%ile}$[(I)] (g)	0.17 to 0.38	0.18 to 0.43	0.07 to 0.18	0.06 to 0.13

(I) Scaled to M7.5 using Idriss and Boulanger recommendations (2008); 68% confidence $PGA_{7.5}$ range

3.3 Contaminated Land Considerations

The ECan Listed Land Use Register (LLUR) was reviewed and holds no previous records for the site.

3.4 Flood Hazard

Christchurch is a low-lying city and there have always been areas that are prone to flooding during heavy rainfall. The CES has worsened flood risk in many areas of the city through damage to waterways and land. Flood Management Areas (FMAs) have been identified by CCC in the District Plan and take into consideration the impacts of the CES.

At the time of writing this report the site is not located within a FMA as indicated by the CCC District Plan.

3.5 Ground Motion

Using the MBIE and Bradley & Hughes (2012) procedures, we have found that the site was "sufficiently tested" to the Serviceability Limit State (SLS) level of earthquake demand during the September 2010 and February 2011 events of the CES. This indicates that land and building damage in a future SLS event is likely to be similar to these events.

Additionally, based on the SLS2 level of shaking (M_w 6.0 and PGA of 0.19g) which was introduced by MBIE following the updated liquefaction triggering CPT-based procedure by Boulanger & Idriss (2014), it is MINZ's opinion the site was "sufficiently tested" to the SLS2 level of earthquake demand during the September 2010 and February 2011 events of the CES.

Utilising a derivation of the Bradley and Hughes method, we can suggest that the site was not tested to an Ultimate Limit State (ULS) level of shaking during the CES, however in terms of liquefaction our analysis indicated that both September 2010 and February 2011 events were similar to ULS. Based on our analysis of the PGAs experienced at the site and our liquefaction assessment, the nature of land damage is likely to be similar during a future ULS event than that already experienced during the individual CES events.

4. Subsurface Conditions

4.1 Geological Setting

The geological map of the area (Forsyth et al., 2008) indicates that the site has surface geology consisting of Holocene aged "grey river alluvium" of the Springston Formation.

4.2 Field Investigations Summary

The NZGD website was reviewed to identify relevant geotechnical investigations completed within the site vicinity. 26No. Piezocone Penetration Tests (CPT) have been completed across the site as part of the aforementioned geotechnical investigations. The data obtained from these tests has been used as part of our assessment.

To supplement the existing ground investigation the following site-specific ground investigation works were undertaken:

- 10No. hand-augered boreholes (referenced HA1 to HA10);
- Laboratory testing including fines content (FC) and Plasticity Indices (PI);
- 3No. CPTs (referenced CPT-01 to 03);
- 3No. Seismic CPTs (SCPT) (referenced SCPT-04 to 06);
- Installation of 2No. standpipe piezometers;
- Multichannel Analysis of Surface Waves (MASW) geophysical survey.

The locations of the tests are presented in Figure 2 and Figure 3 (MASW) and details of the ground investigations are summarised in Table 2. A comprehensive summary of the existing ground investigations is presented in Appendix A.1, the MINZ HA logs, CPT and SCPT plots, and laboratory test results are provided in Appendix A.2, and the results of the geophysical survey, and accompanying report by Southern Geophysical, are presented in Appendix A.4.

Table 2: Summary of Ground Investigations

Test Ref.	Source	Source Ref.	Test Type	Depth (m)
CPT_87696 - 87715	Soil & Rock Consultants	C16254	CPT	4.55 – 15.0 m
CPT_88482 - 88488	KGA Consultants	CPT-01 – CPT-06	CPT	4.99 – 10.83 m
HA-01 - 10	MINZ	HA-01 - 10	Hand Auger	2.0 – 3.0 m
CPT-01 - 03		CPT-01 - 03	CPT	3.55 – 14.28 m
SCPT-04 - 06		SCPT-04 - 06	SCPT	6.15 – 15.17 m
MASW 1 - 14	Southern Geophysical Ltd	MASW 1 - 14	MASW	Up to ~75.0 m

Figure 2: Site Investigation Location Plan (Scale as Shown)

Figure 3: MASW Survey Locations (Scale as shown)

4.1 Laboratory Test Results

Lab testing was undertaken on samples obtained from our shallow sub-surface investigation in order to more accurately assess the soil characteristics across the site. Tests undertaken include wet sieving to determine the fines content, and Atterberg limits tests to determine the plastic and liquid limits. A summary of the test results is presented in Table 3, with full results presented in Appendix A.2.

Table 3: Laboratory Test Results

Test Ref.	Depth of sample (m)	Soil Description	Plasticity Index	% Passing		
				0.3 mm	0.15 mm	0.063 mm
C19-207	0.3 – 1.2 m	Sandy SILT, brown, sand is fine grained	5	100	100	69
C19-208	0.9 – 1.9 m	Fine to medium SAND, minor silt, dark greyish brown	-	99	45	11
C19-209	0.8 – 1.4 m	Silty SAND, greyish brown, sand is fine to medium	-	100	85	38
C19-210	1.8 – 3.0 m	SILT, traces of fine to medium sand, grey	24	99	97	91
C19-212	1.8 – 3.0 m	Sandy SILT, grey, sand is fine to medium grained	-	99	97	71

4.2 Soil Profile

The ground conditions interpreted from the on-site ground investigation and CPT data, correlated with the existing data available on the NZGD, are summarised in four profiles. These profiles are broken up into two categories:

- Shallow sub-surface profiles;
- Deep sub-surface cross sections.

4.2.1 Shallow soils

Shallow sub-surface conditions across the site interpreted from our on-site testing is summarised in the following Table 4.

Table 4: Soil Profile Based on Shallow Investigation

Layer	Maximum depth encountered (m)	Soil Description
a	0.4	SILT (TOPSOIL); low plasticity, greyish brown, with minor rootlets.
b	0.9	Sandy SILT (FILL); low plasticity, light brownish-grey, sand is fine grained
c	1.4	Sandy SILT; low plasticity, greyish-brown, sand is fine grained
d	1.9	Silty SAND; moderately sorted, grey, sand is fine to medium grained
e	2.4	SILT; low to moderately plastic, dark greyish-brown
f	3.0 (Extent of MINZ shallow investigations)	Sandy SILT; low plasticity, blueish-grey, dilatant

4.2.2 Sub-surface Profile A

The soil profile for the northern part of the sections is summarised in Table 5.

Table 5: Soil Profile Based on CPT data for the north part of the sections

Layer	Maximum depth encountered (m)	Soil Description
a	1.4	TOPSOIL and FILL overlying interbedded layers of SILT and silty SAND
b	4.3	Interbedded layers of silty SAND and sandy SILT
c	7.0	SAND with occasional layers of silty SAND
d	14.7	Interbedded layers of silty CLAY, sandy SILT and silty SAND
e	15.0 (Maximum depth of CPT penetration)	SAND and sandy GRAVEL

4.2.3 Sub-Surface Profile B

The soil profile for the central part of the sections is summarised in Table 6.

Table 6: Soil Profile Based on CPT data for the central part of the sections

Layer	Maximum depth encountered (m)	Soil Description
a	1.2	TOPSOIL and FILL overlying interbedded layers of SILT and silty SAND
b	5.0	Interbedded layers of silty SAND and sandy SILT
c	5.4	SAND with occasional layers of silty SAND

Layer	Maximum depth encountered (m)	Soil Description
d	5.2 - 15.0	Interbedded layers of silty CLAY and silty SAND
e	10.7	Silty SAND
f	15.0 (Maximum depth of CPT penetration)	SAND and sandy GRAVEL

4.2.4 Sub-Surface Profile C

The soil profile for the southern part of the sections is summarised in Table 7.

Table 7: Soil Profile Based on CPT data for the south part of the sections

Layer	Maximum depth encountered (m)	Soil Description
a	1.3	TOPSOIL and FILL overlying interbedded layers of SILT and silty SAND
b	2.4	Interbedded layers of silty SAND and sandy SILT
c	4.1	Layers of CLAY and silty CLAY
d	9.6	Interbedded layers of silty CLAY and silty SAND
e	15.0 (Maximum depth of CPT penetration)	SAND and sandy GRAVEL

4.3 MASW Survey

The MASW survey was primarily used to define the boundaries between the shallow soils and denser sand/gravelly layers, plus their likely thickness. The determination of denser sand/gravel layers across the site was based on a shear-wave velocity of >200m/s. The site was micro-zoned based on the depth to these gravel layers with Zone A being less than 5.0m depth, Zone B being between 5.0m and 10.0m depth, and Zone C being greater than 10m depth. Figure 4 shows these areas. It is noted that these zones are consistent with the depth to gravel in the ground profiles.

Figure 4: Depth to Gravel based on MASW Survey Results

4.4 Groundwater

The site falls outside of the GNS Science Median Groundwater Surface Elevations Layer on the NZGD website. Our site-specific investigation encountered groundwater levels between 0.7m and 2.2m bgl, though the 0.7 m measurement appears to be an outlier. The CPT data shows variable piezometric conditions beneath the upper cohesive soils (unsaturated or partially saturated soils with negative or close to zero pore water pressures).

Measurements taken from the two standpipe piezometers on site at the time of installation, and post installation indicate a standing ground water level of approximately 1.5 – 1.6 mbgl across the site.

Therefore, a range of in-situ groundwater depths was used for correcting the CPT raw data. However, 1.5 and 1.0 mbgl was used for the liquefaction triggering and free-field settlement assessment under SLS and ULS loading conditions respectively.

It should be noted that variable, cohesive / low permeability soils are encountered across the site to at least 15.0 mbgl which may well affect the measured water levels. It is unclear if the measured levels represent the ground water table, topsoil saturation or their combined effect.

5. Liquefaction Assessment

5.1 Initial Assessment

An assessment of the earthquake-induced free-field post-liquefaction volumetric settlement at the site has been carried out in general accordance with MBIE - NZGS Earthquake Geotechnical Engineering Practice Module 3 (May 2016) and MBIE Guidance (2012) including subsequent updates (Issue 7, October 2014). The design criteria are as follows:

- Buildings of normal use (Importance Level 2);
- Deep or soft soil sites (Class D);
- Magnitude M7.5 earthquake event with a PGA of 0.13g, and magnitude M6.0 earthquake event with a PGA of 0.19g (SLS1 and SLS2 respectively) for annual exceedance probabilities of 1/25 - considering the highest calculated total volumetric strain from either scenario adopted;
- Magnitude M7.5 earthquake event with a PGA of 0.35g for annual exceedance probabilities of 1/500 (ULS);
- Boulanger and Idriss (2014) methodology for liquefaction triggering;
- Kayen et al. (2013) methodology for shear wave velocity (SVs) based liquefaction triggering;
- Zhang et al. (2002) post-liquefaction volumetric strain calculation for estimating the free-field settlements.

Calculations were performed for the full depth of the CPTs and the upper 10m of the soil profile (as per the MBIE Guidance “index value” estimations).

5.2 Refined Analysis

The initial liquefaction induced free-field settlement analysis was carried out using Boulanger and Idriss (2014) simplified methodology to assess liquefaction triggering. However, due to limitations and uncertainties in the standard simplified CPT-based deterministic analyses, a “refined” analysis was performed for the site in an attempt to reconcile predictions of severe liquefaction with observations of no-liquefaction during the CES.

Due to the rapid changes at the interface between fine and coarse-grained soils, a layer correction was applied. The cone tip penetration, and subsequently the ability to resist liquefaction of a sandy material, is reduced by the surrounding silty layers, while the I_c of the silt layers is reduced due to the presence of the surrounding sandy layers and hence the susceptibility of the fine layers is overestimated. For our analysis, an I_c change of >0.05 per 10mm has been adopted, which eliminates the liquefaction potential for the layer. Additionally, the particle distribution tests indicate that the Boulanger and Idriss (2014) predicted fines content has generally been underestimated in comparison to laboratory test results. A fines correction factor (C_{FC}) of 0.2 was applied in an effort to reconcile the underestimation of the fines content.

The results of our refined liquefaction triggering analyses for the CPTs are presented in Appendix A.3 and summarised in Table 8.

Table 8: Estimated "Free-Field" Post-Liquefaction Volumetric Ground Surface Settlements

Earthquake scenario	Moment magnitude (M_w) / PGA (g)	MBIE "Index Value" (mm)	MBIE Technical Category	% of Assessed CPTs
GWD = various (in-situ measured/estimated) and 1.0 m (earthquake); Layer transition applied; C_{FC} = 0.2				
SLS1 SLS2	7.5 / 0.13 6.0 / 0.19	5 – 45 5 – 70	TC2 TC2/TC3	100 % 85 / 15 %
ULS	7.5 / 0.35	10 – 95	TC2	100 %

By limiting the analyses to the upper 10m (in accordance with MBIE Guidance) the analysis indicates that under SLS and ULS loading conditions the majority of predicted index value settlements across the site fall within the expected future land performance values for a TC2 category site, with 4 CPTs predicting TC3 category settlements under SLS2 conditions.

The liquefaction Severity Number (LSN) was also calculated as part of the liquefaction analysis. The values obtained are presented in Table 9.

Table 9: Liquefaction Severity Number (LSN) Values

Scenario	LSN Values
SLS	0 – 8
SLS2	0 – 17
ULS	2 – 34

LSN Values	Expression of Liquefaction
0 – 10	Little to none
10 – 20	Minor
20 – 30	Moderate
30 – 40	Moderate to severe
40 – 50	Major
50+	Extensive and severe damage

The LSN values presented refer to a land performance with 'none to minor' expression of liquefaction expected for a future SLS design event, and 'none to moderate - severe' expression of liquefaction for a future ULS design event.

Back-analysis to estimate the expected performance based on the September 2010 and February 2011 events was also undertaken in order to compare the predicted performance with the actual observed performance. Table 10 presents the results of the back-analysis for the uncorrected and refined analyses for these events.

Table 10: Back-analysis Results for the September 2010 and February 2011 Events

Event	Mw	PGA	Refined	Predicted Settlements	LPI	$LPI_{(ISH)}$	LSN
September 2010	7.1	0.29	Uncorrected	<5 – 175	1-24	1-19	4-42
			Corrected	<5 – 80	1-25	0-18	2-25
February 2011	6.2	0.38	Uncorrected	<5 – 175	1-27	2-22	4-43
			Corrected	<5 – 85	1-27	0-12	2-25

The results of the back-analysis show that the corrections are more in line with the observed performance of the site following the CES events. The uncorrected data appears to overestimate the liquefaction susceptibility, as only little to no ejecta was observed in the aerial photographs.

5.3 Additional Analysis

As previously mentioned, the refined liquefaction analysis produced results generally more in line with the observed performance following the CES events. However, results for some isolated areas continued to indicate liquefaction severity that contradicts what was observed during the CES.

In an attempt to further reconcile predictions of severe liquefaction with observations of no-liquefaction, a simplified liquefaction induced free-field settlement analysis was carried out using Kayen et al. (2013) methodology to assess liquefaction triggering utilising shear wave velocity (Vs) data obtained from seismic CPTs (SCPTs) and the MASW survey completed as part of our site-specific investigation.

The Vs obtained from the SCPT and adjacent MASW shear wave velocities show a good correlation with one-another and a good correlation with the shear wave velocity estimated from the non-seismic CPTs across the site. Subsequently, MASW survey data directly adjacent to the CPTs that indicated liquefaction severity contradictory to the event-specific observations (post-refined analysis) was used for the Vs based liquefaction triggering assessment.

Based on I_c values obtained from the refined analysis, liquefaction potential for certain layers was disabled in order to more accurately replicate the anticipated performance (susceptibility) of the soil column during liquefaction triggering.

The results of the Vs analysis (limited to the upper 10m of the soil column in accordance with MBIE Guidance) indicate that liquefaction triggering was further reduced under SLS and ULS scenarios to levels more consistent with liquefaction observations during the CES.

6. Site Designation Assessment

Based on the findings of our desk study, our site-specific ground investigation and observations, and assessment of the performance of the land, we consider the MBIE TC2 category generally appropriate for the site. Despite the deformation characteristics of TC2, the land does not meet the definition of 'Good Ground' as per the New Zealand Standards without modification to the standard foundation system and specific engineering design to account such.

7. Geotechnical Considerations for Subdivision Consent

The risk of building damage due to liquefaction in TC2 land and the soft/compressible soils can be mitigated by providing strengthened foundations, which reduce the differential settlement of the building and are designed to be re-levellable. The following generalised methodologies for liquefaction hazard mitigation are considered for the site:

- Foundation strengthening and ground reinforcement (i.e. stiff foundation elements on specifically designed rafts);
- Ground treatment as per MBIE Guidelines.

Implementation of these methodologies may also adequately mitigate the effects of the underlying soft soils; however, further consideration is required during the detailed foundation design.

7.1 Proposed Foundations

The following section outlines generalised foundation recommendations for subdivision development. Note that these do not constitute detailed design of foundations, with further investigation and assessment required at the building consent stage.

The following foundation types are considered suitable for the site in combination with specific engineering design for NZS 3604 compliant buildings:

- NZS 3604 timber floor and shallow piles where 300kPa ultimate bearing capacity is available (subject to confirmation at time of building consent);
- Specifically designed, enhanced NZS 3604 perimeter foundation wall and shallow piles;
- Specifically designed, reinforced concrete slab with engineered gravel raft - Combination of the MBIE TC2 Option 1 geogrid reinforced gravel raft with either an overlying Option 2 enhanced foundation slab (300 or 400 mm thick) or Option 4 (waffle slab) is recommended.

Alternatively, the sites can be developed using the following TC3 MBIE foundation options for timber floors. These foundations take the form of robust surface structures, as defined by Section 15.4 of the MBIE Guidance, and include:

- Type 1 lightweight platform with an enhanced NZS 3604 subfloor;
- Type 2 concrete underslab on gravel with timber floor.

Consideration should also be given to using lightweight construction materials (i.e. cladding and roofing) to reduce the dwelling mass and lead to reduced foundation movements and building damage in future large earthquakes.

7.2 Additional Considerations

A number of the proposed sections will likely require cut and / or fill earthworks and may require retaining structures to facilitate construction of the building platforms. These works will require detailed analysis and design to assess the most suitable options. We would be happy to undertake these services in collaboration with you as and when required. The proposed water management methods may also be affected by the proposed options.

8. Assessment Against RMA Section 106

As per the requirements of Section 106 of the Resource Management Act (RMA) (2017), we have undertaken an assessment of the significant geotechnical hazards that may affect the site. These hazards include, but are not limited to:

- Erosion;
- Falling debris;
- Slippage;
- Subsidence;
- Inundation.

At the time of our site visit, there was no evidence of erosion or erosional features on the site. The stream running along the northern boundary is unlikely to cause significant issues on the site. Likewise, no evidence was observed to suggest that lateral movement is an issue on the site, given it is generally flat. The sloping ground at the site is not considered to be susceptible to liquefaction induced movement, however, the stability of these slopes needs to be considered as part of the design of the building platforms.

Falling debris is also not considered be of significant risk. There is no evidence of past rockfall or sources of rockfall on or near the site.

As the site is not identified as being within a Flood Management Area (FMA) as defined by the CCC, inundation is unlikely to be a risk provided adequate stormwater discharge is appropriately managed.

Based on our assessment, we consider that there are no significant geotechnical hazards other than the potential for earthquake induced soil liquefaction and subsidence. However, provided that the geotechnical recommendations given in this report are followed, and the appropriate engineering measures implemented, we consider that the development is unlikely to be affected nor worsen, accelerate or result in material damage.

9. Limitations

This report has been prepared for the exclusive use of our client, Yoursection Ltd., their professional advisers and the relevant Territorial Authorities, with respect to the specific project brief described in this report. No liability is accepted in respect of its use for any other purpose or by any other person or entity. It is recommended that all other parties seek professional geotechnical advice to satisfy themselves as to its on-going suitability for their intended use.

The conclusions and opinions contained herein are based upon historical data, NZGD existing information, meetings and client provided information at the time of writing this report, as well as data from investigations undertaken on the site and observations of surface features. Desk study data was obtained from several investigations and modelling study sources made available to the public and engineering industry post the CES. The data is used in good faith and no responsibility can be taken for the accuracy or completeness of the data.

The sub surface information has been obtained from discrete investigation locations, which by their nature only provide information about a relatively small volume of subsoils. If subsoil conditions are identified to vary from those described or assumed to exist, then the matter should be referred to us immediately.

The susceptibility analyses carried out present probabilistic analyses of empirical liquefaction databases under various earthquakes globally. Future seismic events may change our understanding and the proposed empirical methods. It is recommended that if the report is more than two years old, or the proposed building that the report originally assumed has changed significantly and/or design loads have changed, then the report is reviewed by an appropriatley qualified and experienced Geotechnical Chartered Professional Engineer for current applicability.

If you have any queries or you require any further clarification on any aspects of this report, please do not hesitate to contact Miyamoto International (NZ) Ltd.

10. References

Bradley, B.A. and Hughes, M., 2012. *Conditional peak ground accelerations in the Canterbury earthquakes for conventional liquefaction assessment*. In Technical Report for the Ministry of Business, Innovation and Employment, New Zealand.

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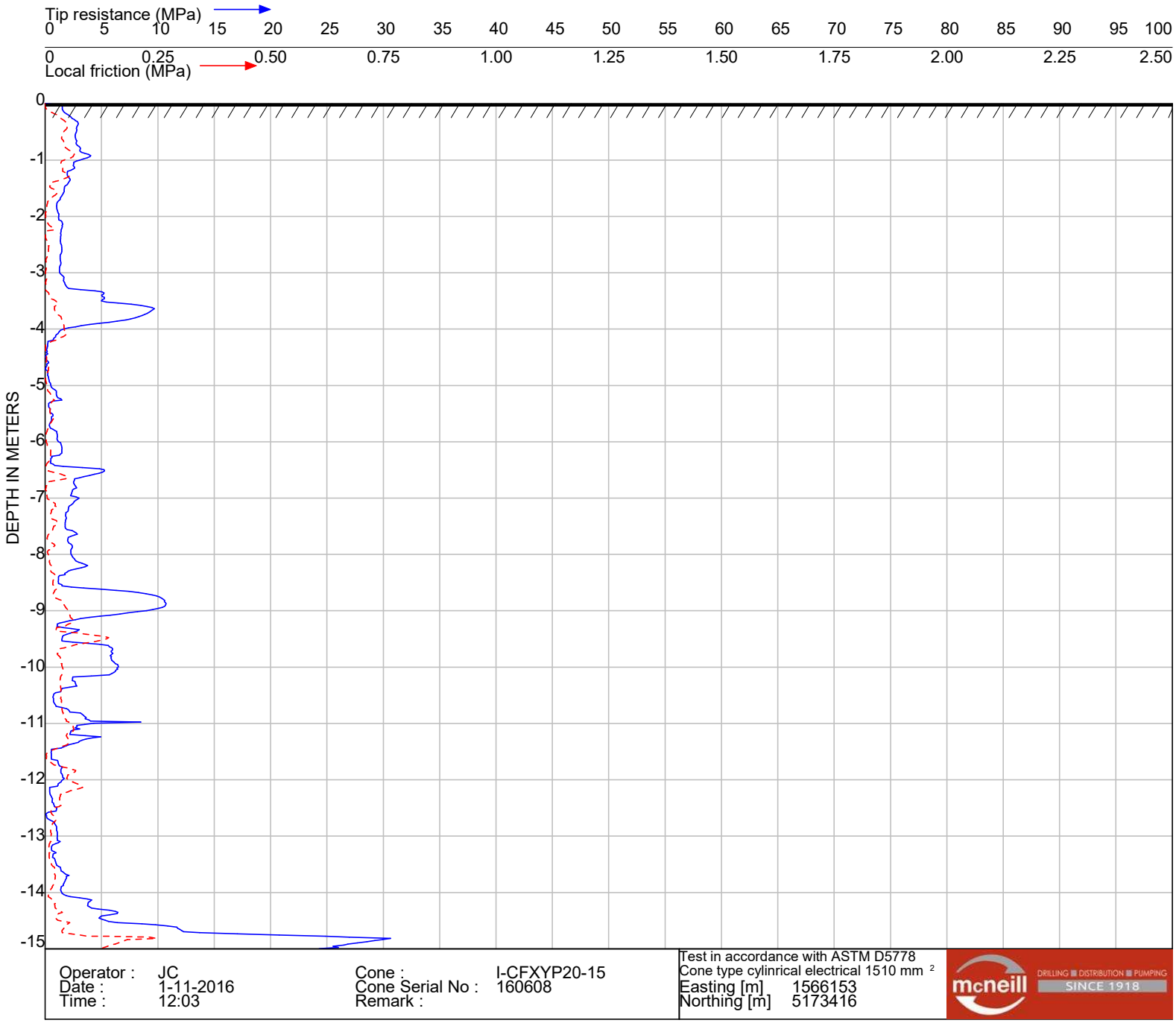
Appendices

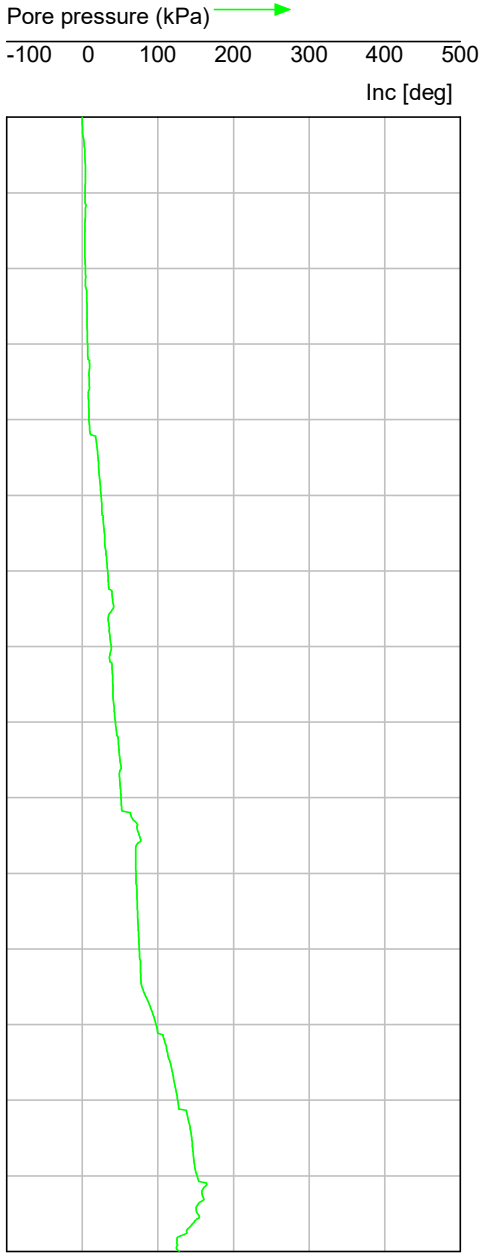
A.1: Desk Study Data – Existing Geotechnical Information

Existing investigation data

CPT Summary and Data Profiles

Test Ref.	Source	Source Ref.	Test Type	Depth (m)
CPT_87696	Soil & Rock Consultants	CPT_02	CPT	9.88
CPT_87697	Soil & Rock Consultants	CPT_01	CPT	15.00
CPT_87698	Soil & Rock Consultants	CPT_03	CPT	8.98
CPT_87699	Soil & Rock Consultants	CPT_04	CPT	4.66
CPT_87700	Soil & Rock Consultants	CPT_05	CPT	9.94
CPT_87701	Soil & Rock Consultants	CPT_06	CPT	9.16
CPT_87702	Soil & Rock Consultants	CPT_07	CPT	9.12
CPT_87703	Soil & Rock Consultants	CPT_08	CPT	15.00
CPT_87704	Soil & Rock Consultants	CPT_09	CPT	10.96
CPT_87705	Soil & Rock Consultants	CPT_10	CPT	8.96
CPT_87706	Soil & Rock Consultants	CPT_11	CPT	8.76
CPT_87707	Soil & Rock Consultants	CPT_12	CPT	7.28
CPT_87708	Soil & Rock Consultants	CPT_13	CPT	9.44
CPT_87709	Soil & Rock Consultants	CPT_14	CPT	10.48
CPT_87710	Soil & Rock Consultants	CPT_15	CPT	10.84
CPT_87711	Soil & Rock Consultants	CPT_16	CPT	9.40
CPT_87712	Soil & Rock Consultants	CPT_17	CPT	9.30
CPT_87713	Soil & Rock Consultants	CPT_18	CPT	7.78
CPT_87714	Soil & Rock Consultants	CPT_19	CPT	15.00
CPT_87715	Soil & Rock Consultants	CPT_20	CPT	8.66
CPT_88482	KGA Consultants	CPT_01	CPT	4.99
CPT_88483	KGA Consultants	CPT_02	CPT	10.83
CPT_88485	KGA Consultants	CPT_03	CPT	8.06
CPT_88486	KGA Consultants	CPT_04	CPT	8.65
CPT_88487	KGA Consultants	CPT_05	CPT	8.74
CPT_88488	KGA Consultants	CPT_06	CPT	10.98





Operator : JC
Date : 1-11-2016
Time : 12:03

Cone : I-CFXYP20-15
Cone Serial No : 160608
Remark :

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566153
Northing [m] 5173416

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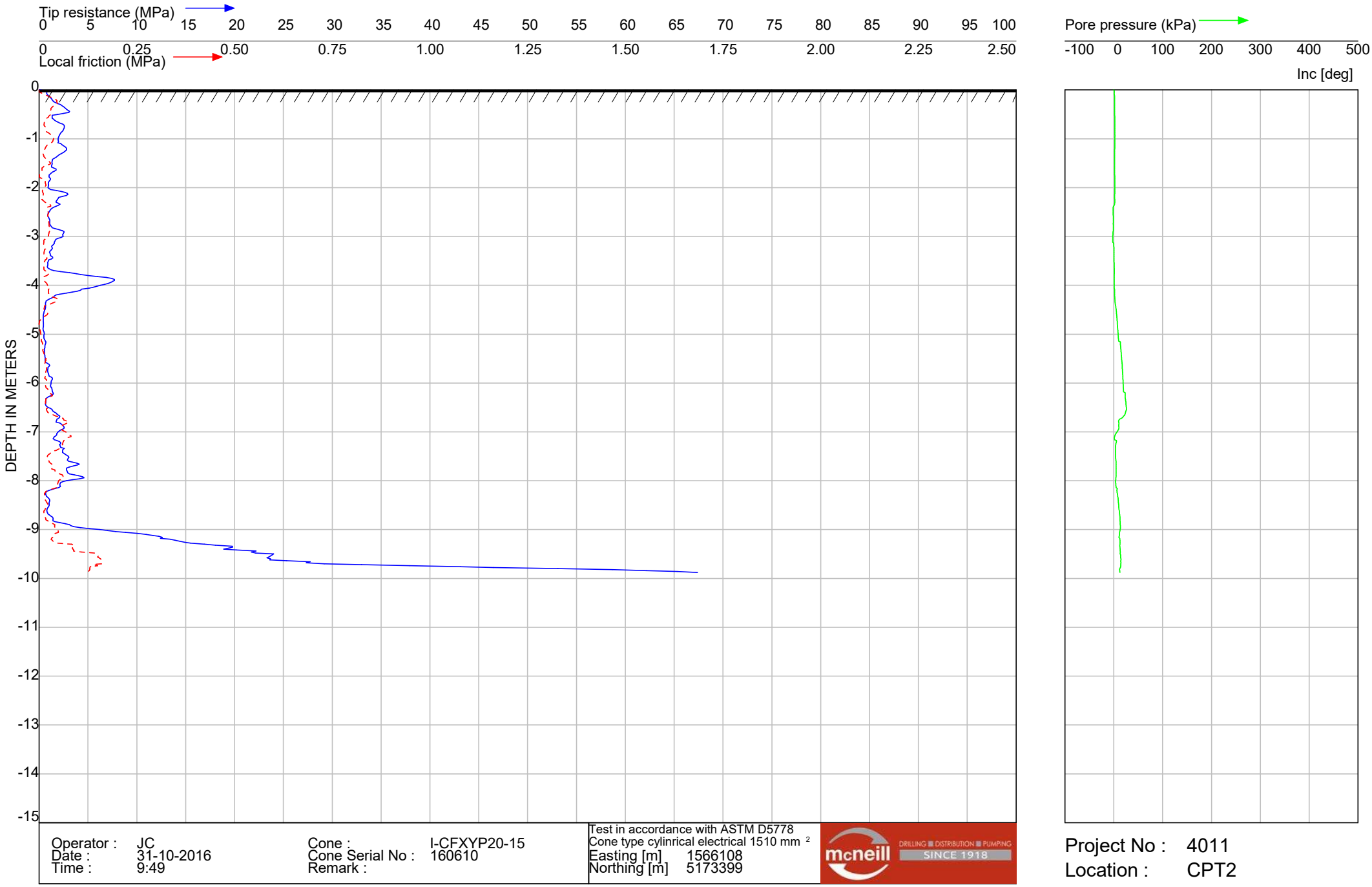
Project No : 4011
Location : CPT1

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator : JC
Date : 31-10-2016
Time : 9:49

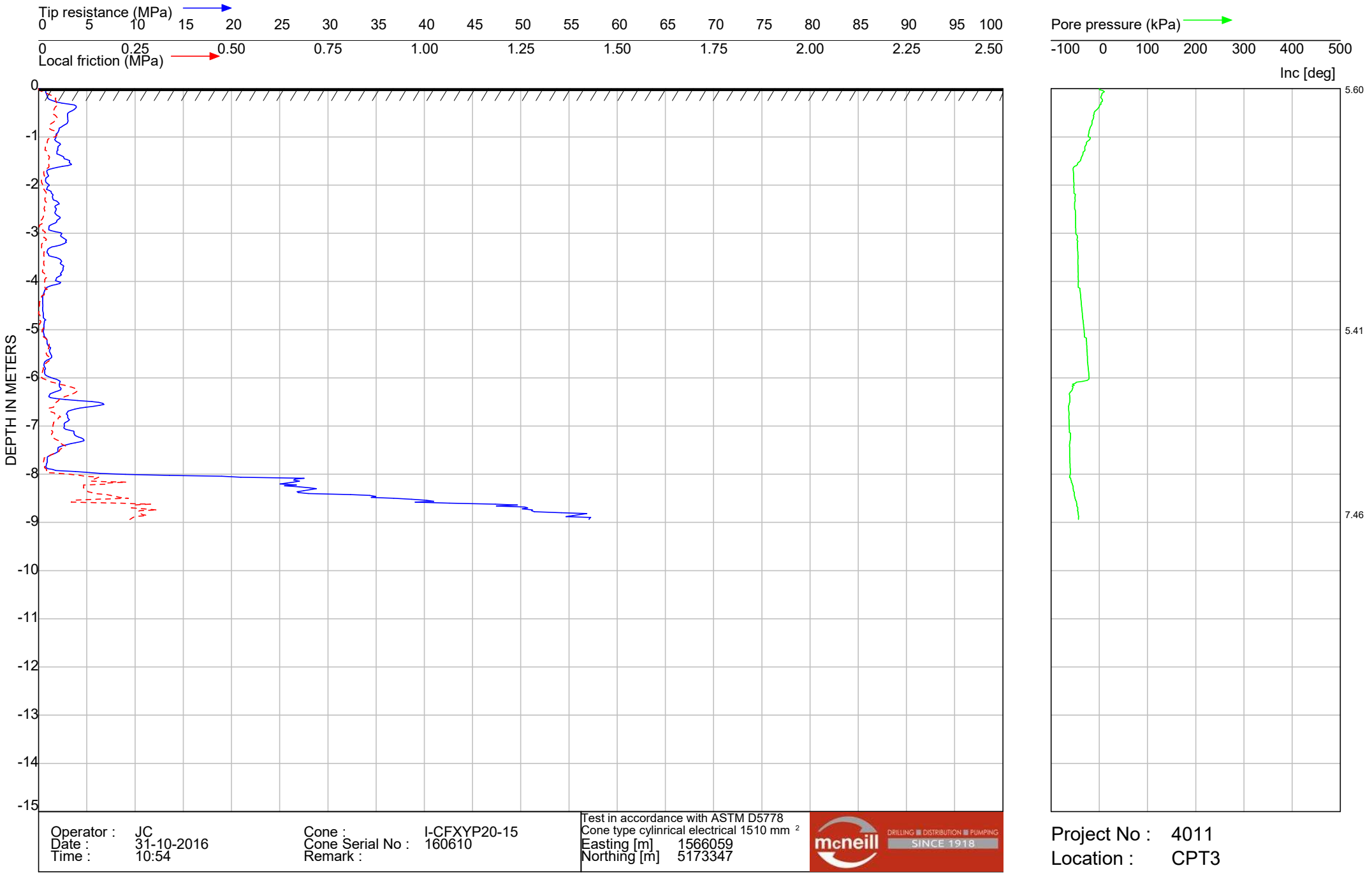
Cone : I-CFXYP20-15
Cone Serial No : 160610
Remark :

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566108
Northing [m] 5173399

Project No : 4011
Location : CPT2

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road

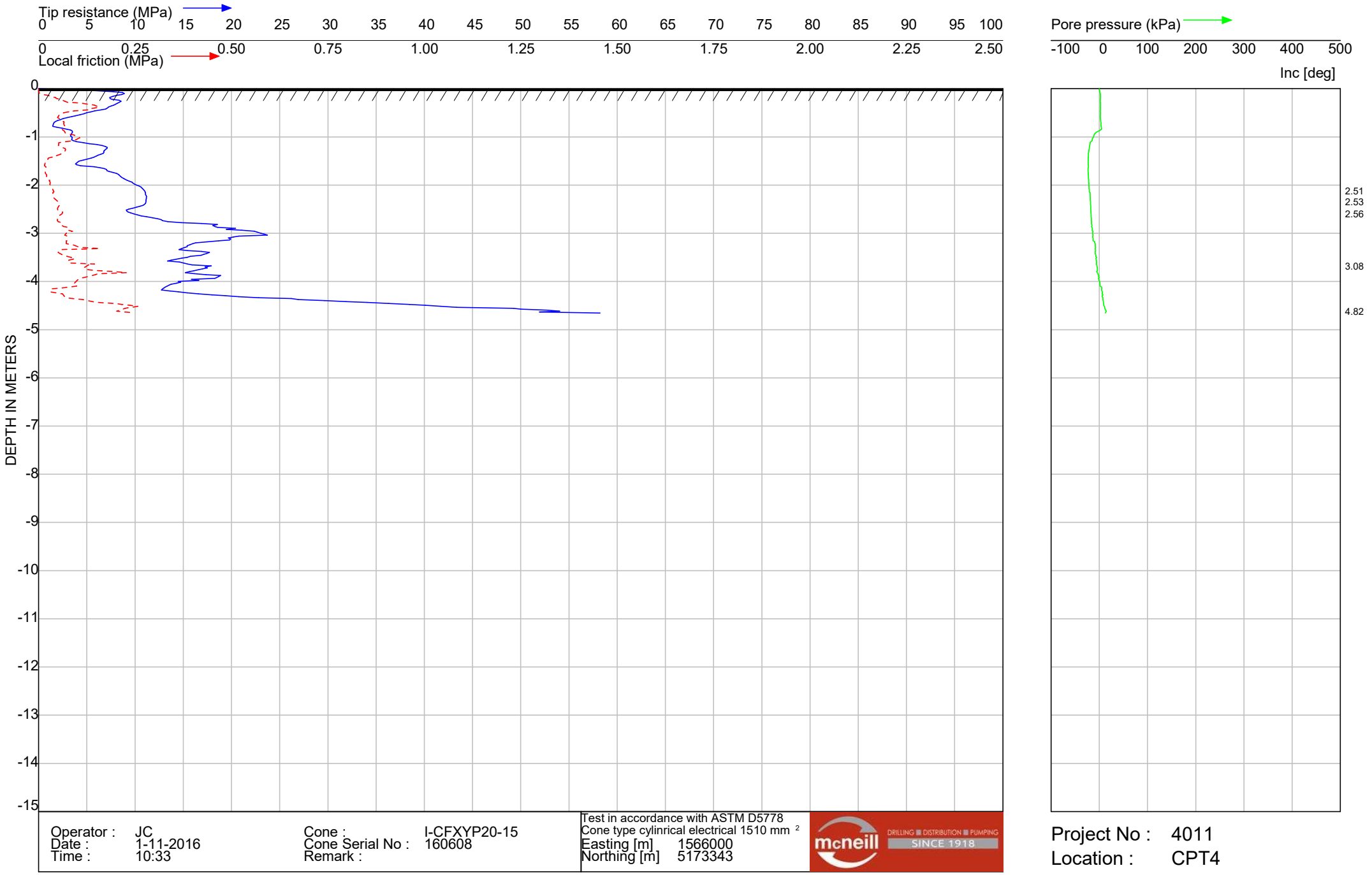


Operator :	JC	Cone :	I-CFXYP20-15	Test in accordance with ASTM D5778	
Date :	31-10-2016	Cone Serial No :	160610	Cone type cylinrical electrical 1510 mm ²	
Time :	10:54	Remark :		Easting [m]	1566059
				Northing [m]	5173347

Project No : 4011
Location : CPT3

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator : JC
Date : 1-11-2016
Time : 10:33

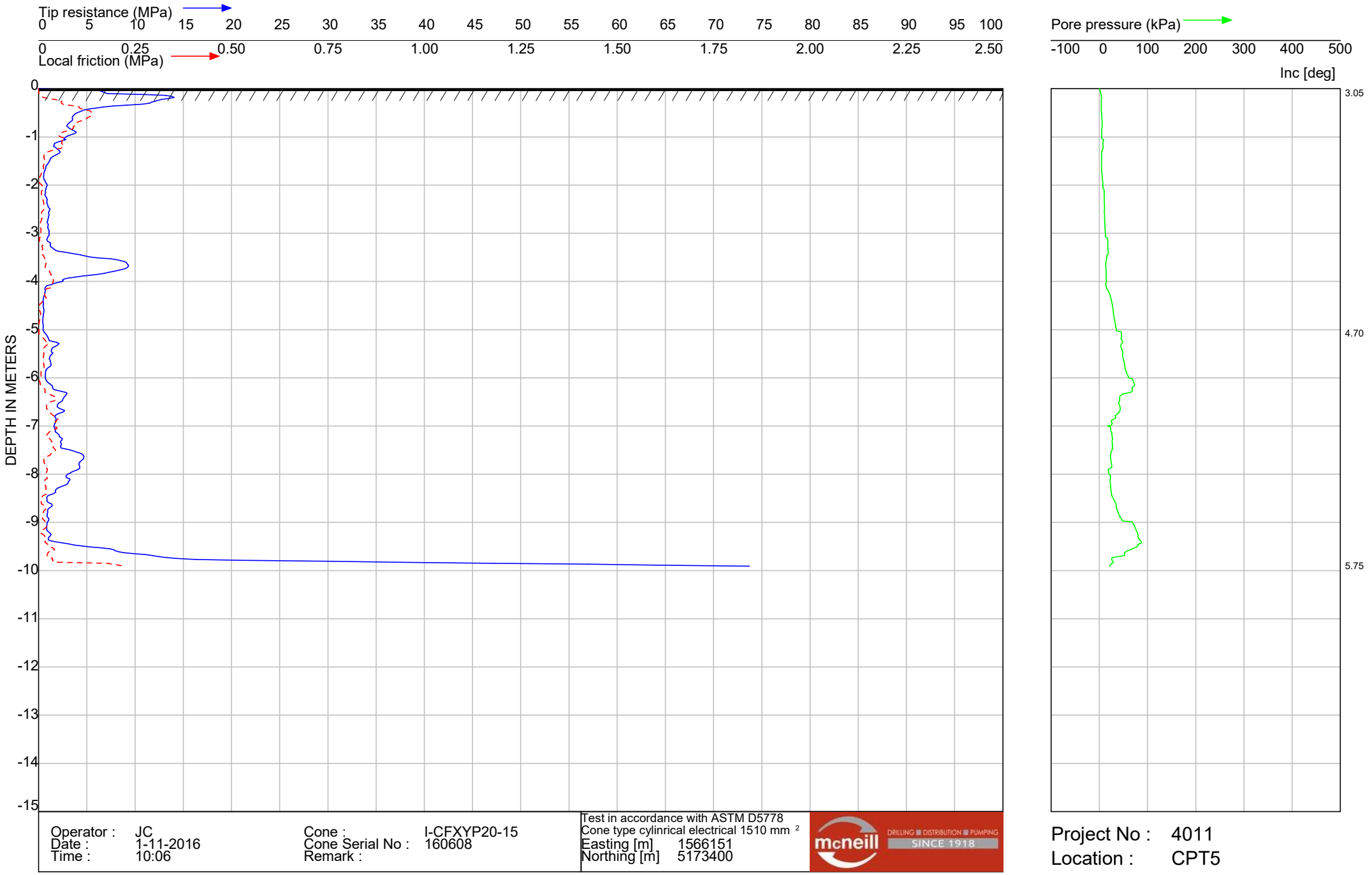
Cone :
Cone Serial No : I-CFXYP20-15
Remark : 160608

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566000
Northing [m] 5173343

Project No : 4011
Location : CPT4

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator :	JC	Cone :	I-CFXYP20-15
Date :	1-11-2016	Cone Serial No :	160608
Time :	10:06	Remark :	

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566151
Northing [m] 5173400

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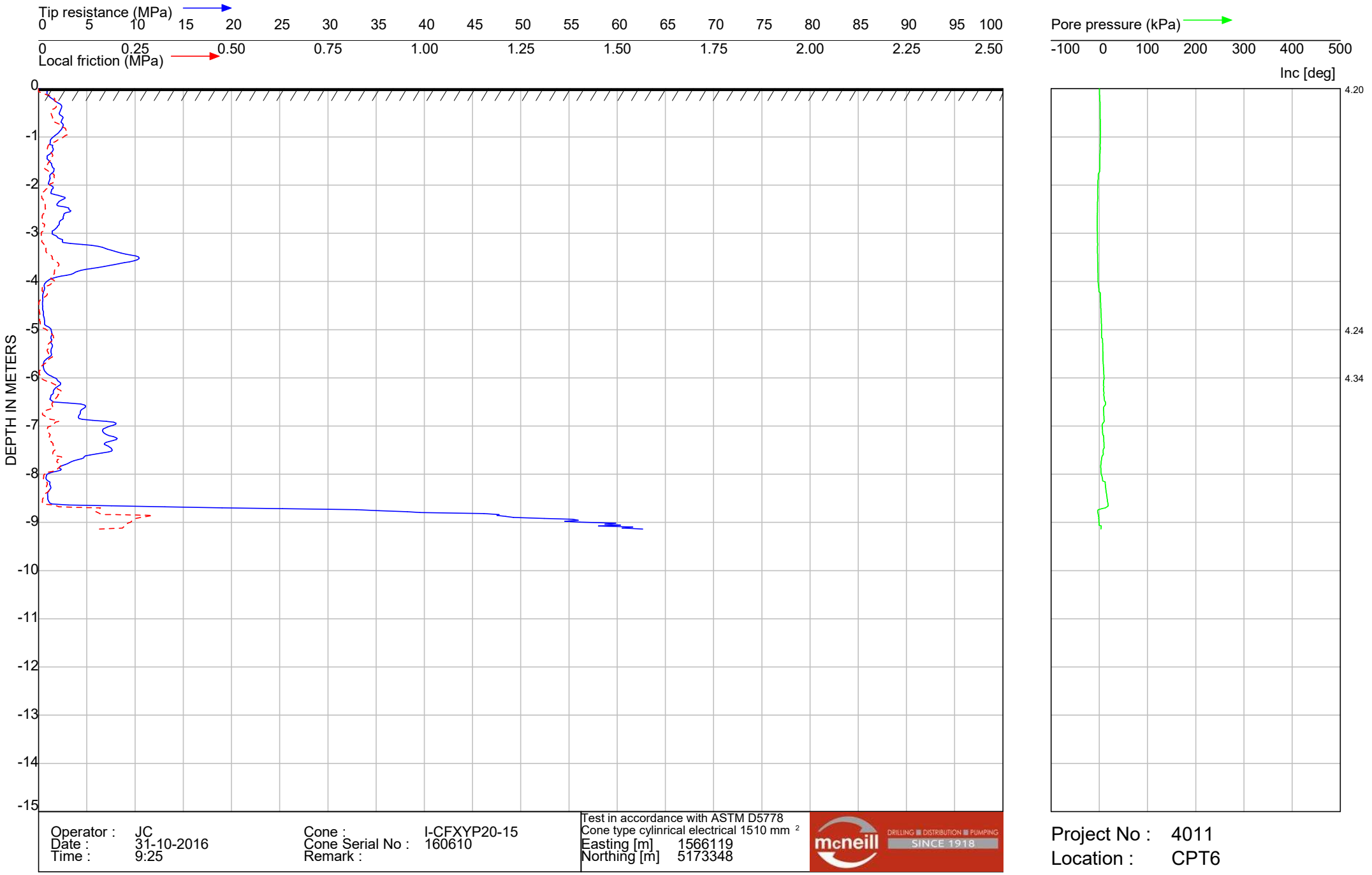
Project No : 4011
Location : CPT5

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator : JC
Date : 31-10-2016
Time : 9:25

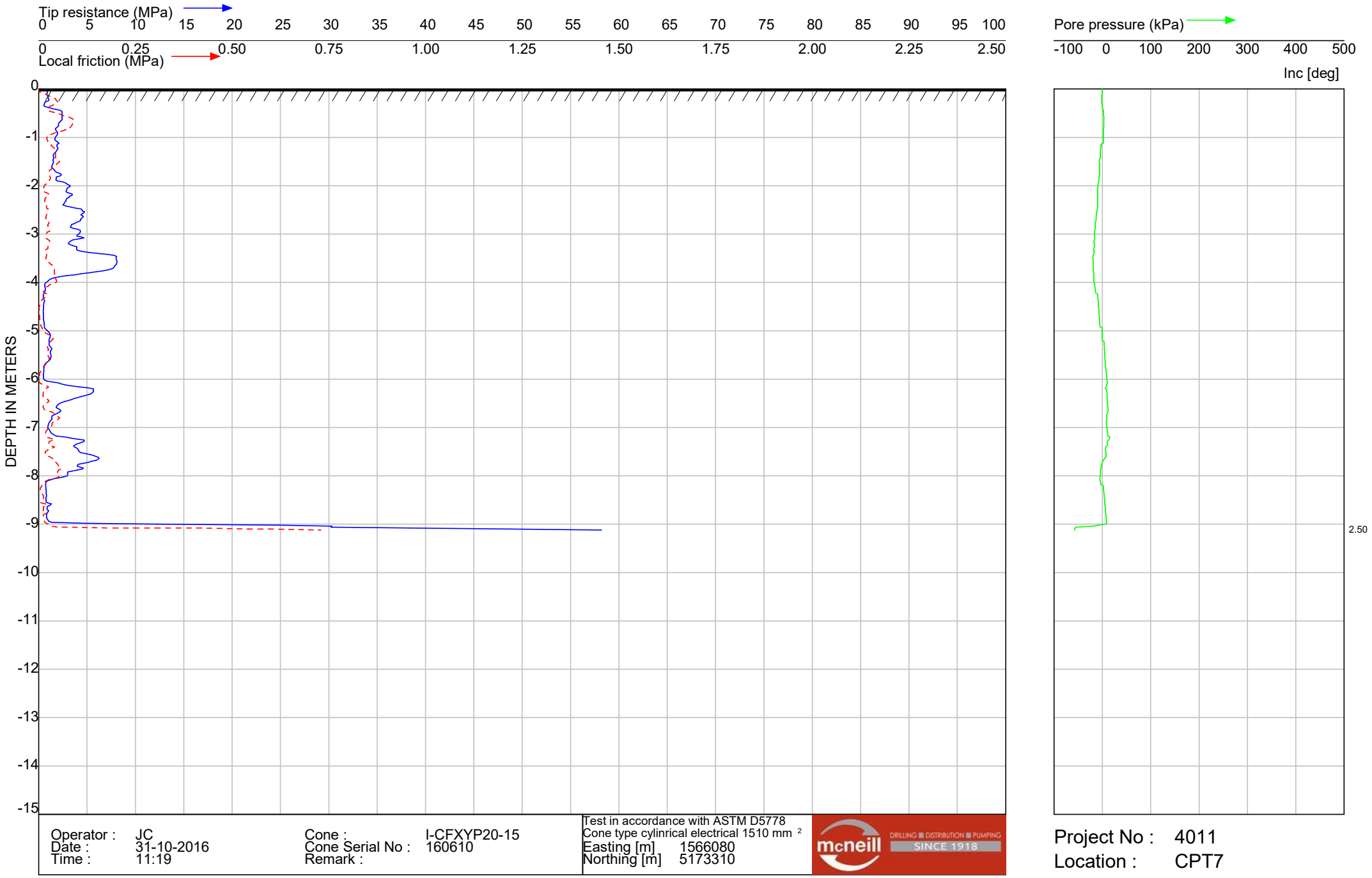
Cone : I-CFXYP20-15
Cone Serial No : 160610
Remark :

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566119
Northing [m] 5173348

Project No : 4011
Location : CPT6

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator :	JC	Cone :	I-CFXYP20-15	Test in accordance with ASTM D5778	
Date :	31-10-2016	Cone Serial No :	160610	Cone type cylinrical electrical 1510 mm ²	
Time :	11:19	Remark :		Easting [m]	1566080
				Northing [m]	5173310

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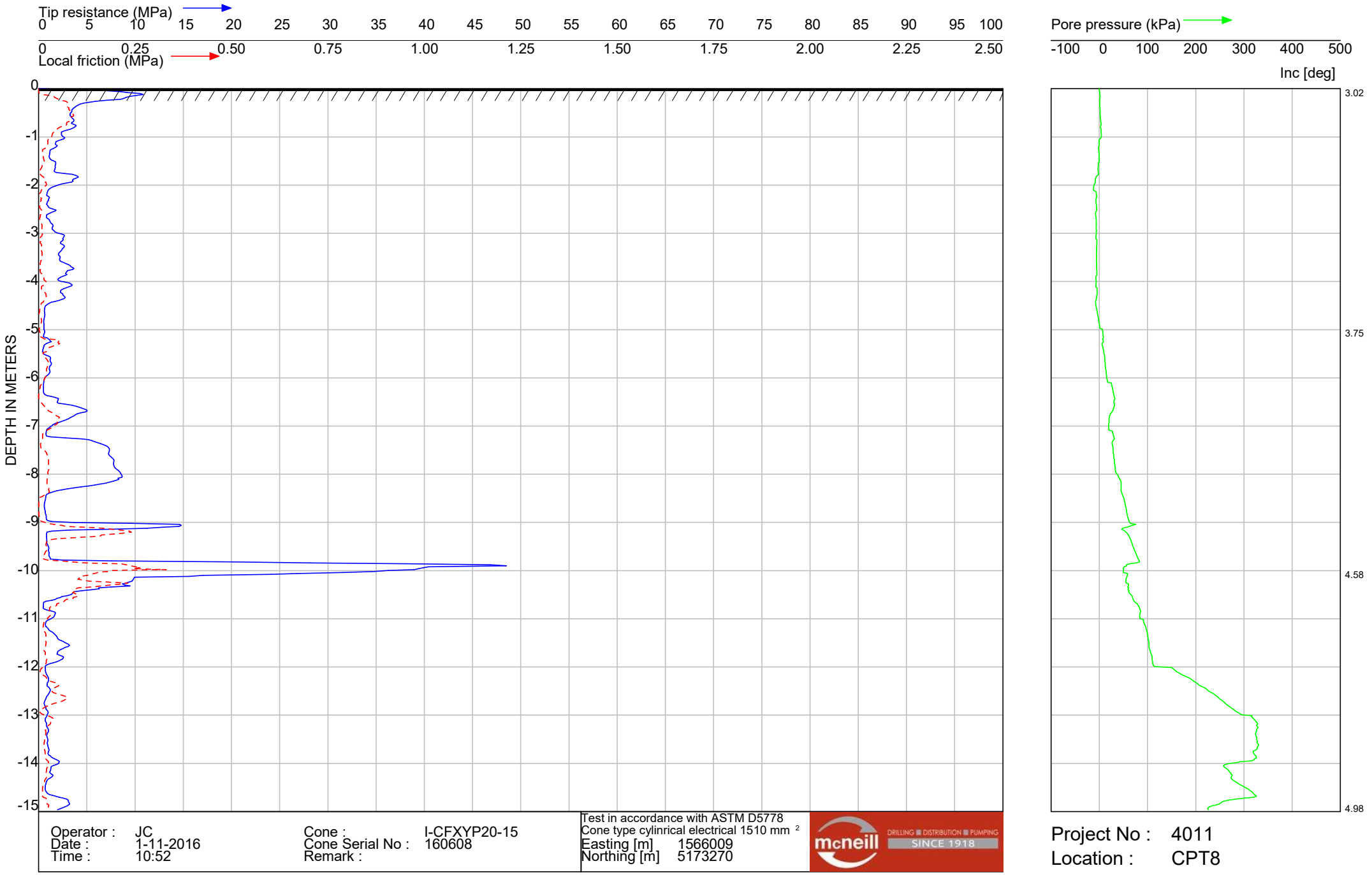
Project No : 4011
Location : CPT7

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator : JC
Date : 1-11-2016
Time : 10:52

Cone : I-CFXYP20-15
Cone Serial No : 160608
Remark :

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566009
Northing [m] 5173270

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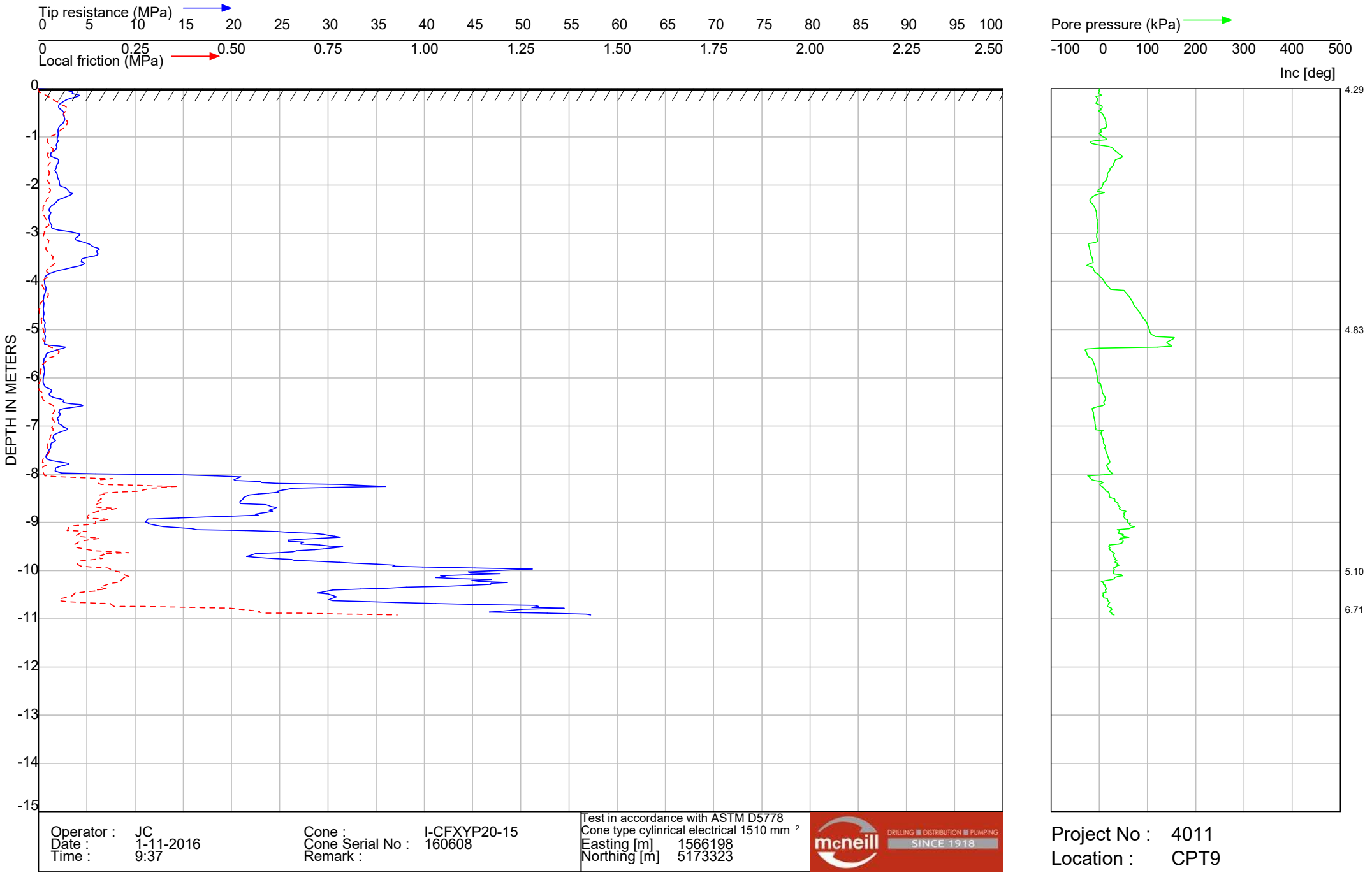
Project No : 4011
Location : CPT8

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator :	JC	Cone :	I-CFXYP20-15	Test in accordance with ASTM D5778	
Date :	1-11-2016	Cone Serial No :	160608	Cone type cylinrical electrical 1510 mm ²	
Time :	9:37	Remark :		Easting [m]	1566198
				Northing [m]	5173323

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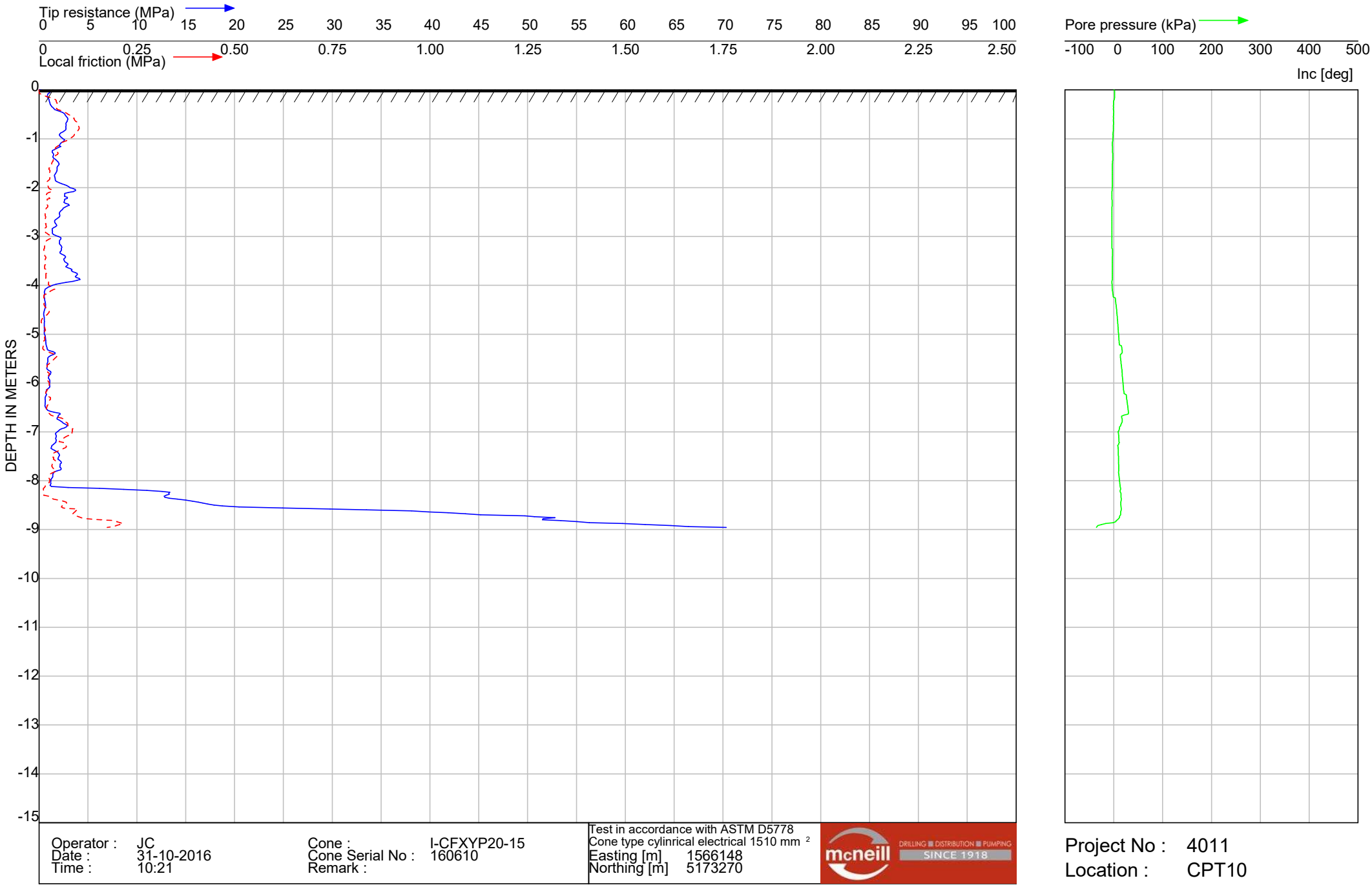
Project No : 4011
Location : CPT9

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator : JC
Date : 31-10-2016
Time : 10:21

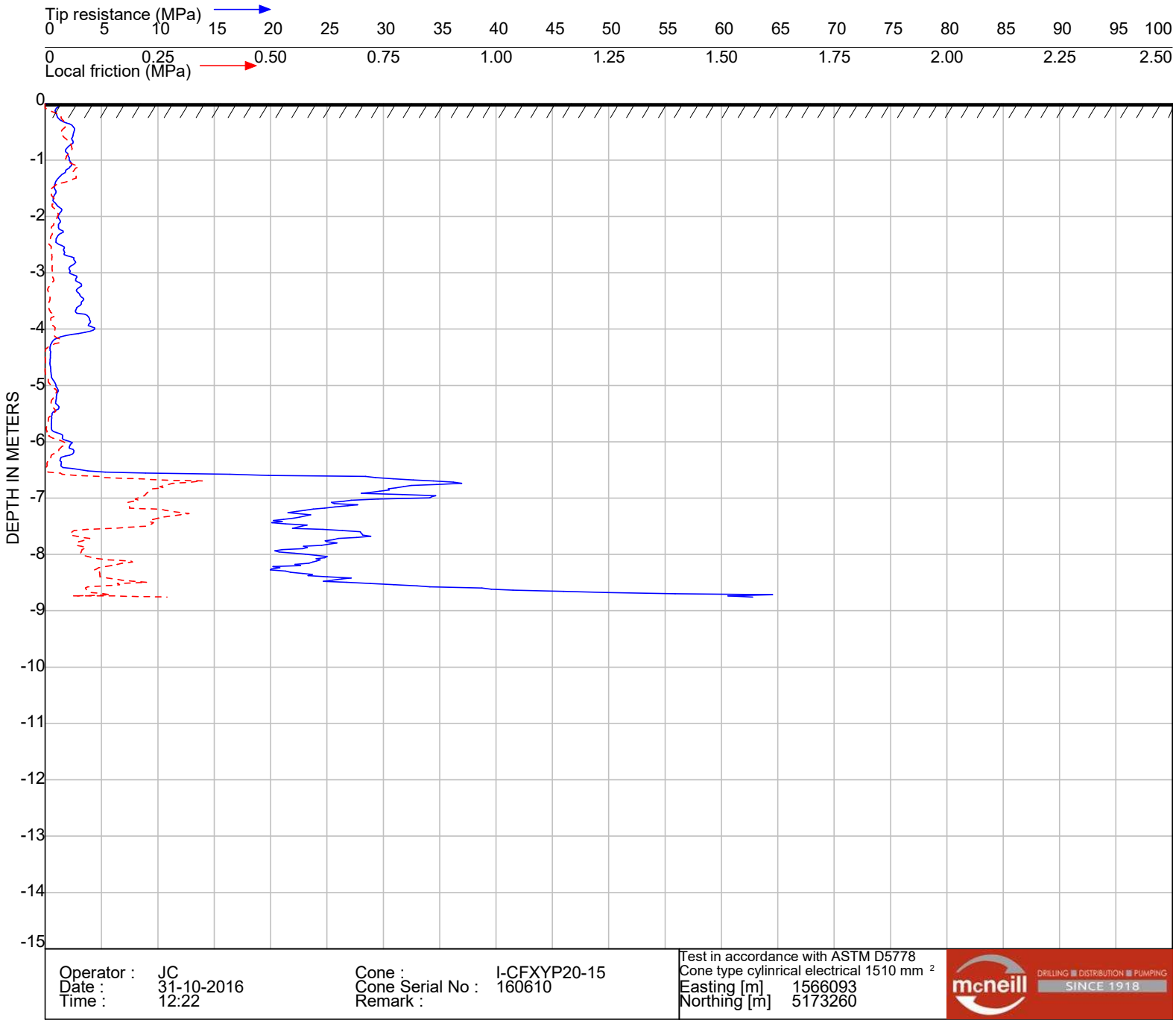
Cone : I-CFXYP20-15
Cone Serial No : 160610
Remark :

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566148
Northing [m] 5173270

Project No : 4011
Location : CPT10

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator : JC
Date : 31-10-2016
Time : 12:22

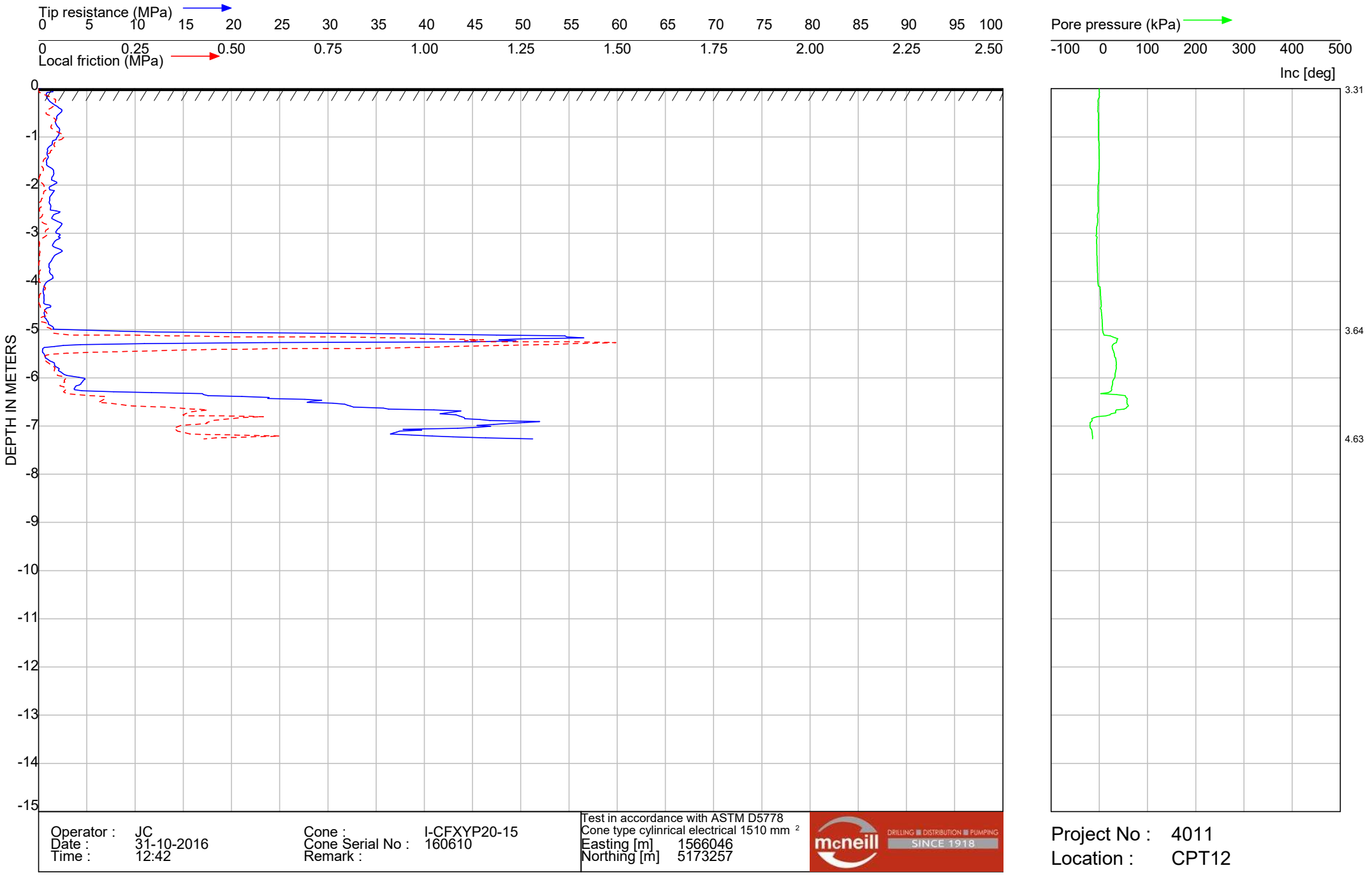
Cone : I-CFXYP20-15
Cone Serial No : 160610
Remark :

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566093
Northing [m] 5173260

Project No : 4011
Location : CPT11

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator : JC
Date : 31-10-2016
Time : 12:42

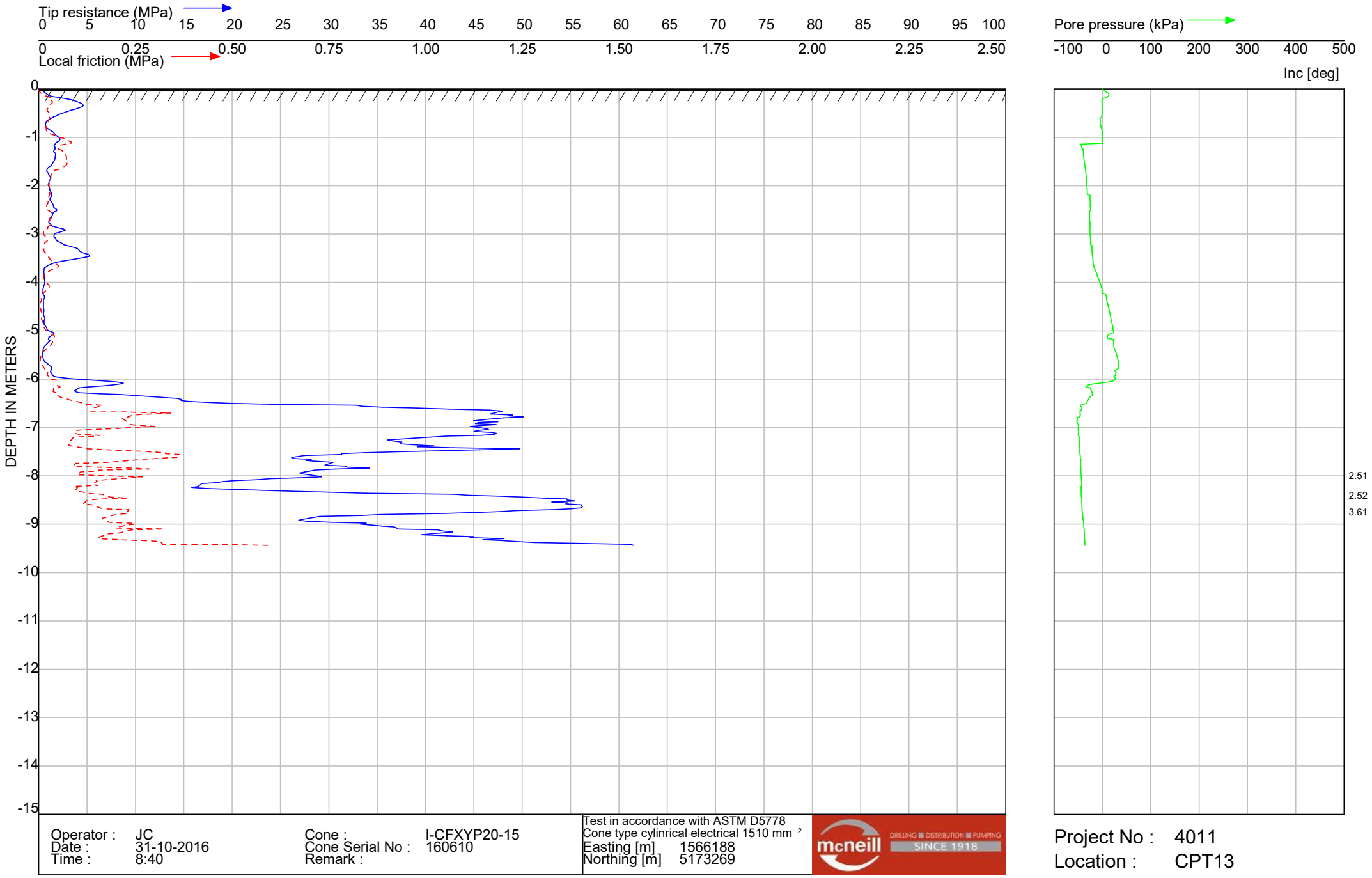
Cone : I-CFXYP20-15
Cone Serial No : 160610
Remark :

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566046
Northing [m] 5173257

Project No : 4011
Location : CPT12

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator : JC
Date : 31-10-2016
Time : 8:40

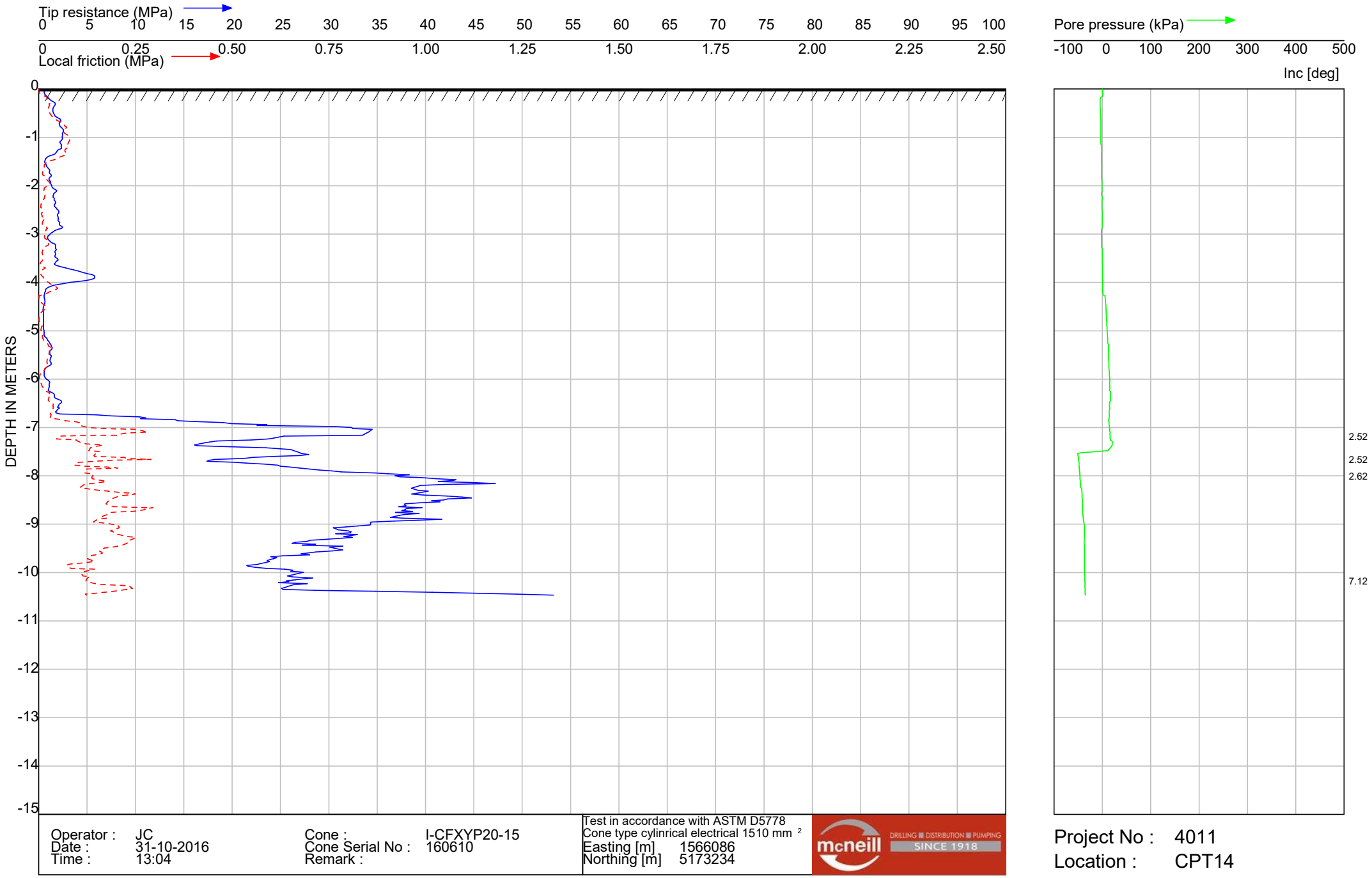
Cone : I-CFXYP20-15
Cone Serial No : 160610
Remark :

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566188
Northing [m] 5173269

Project No : 4011
Location : CPT13

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator : JC
Date : 31-10-2016
Time : 13:04

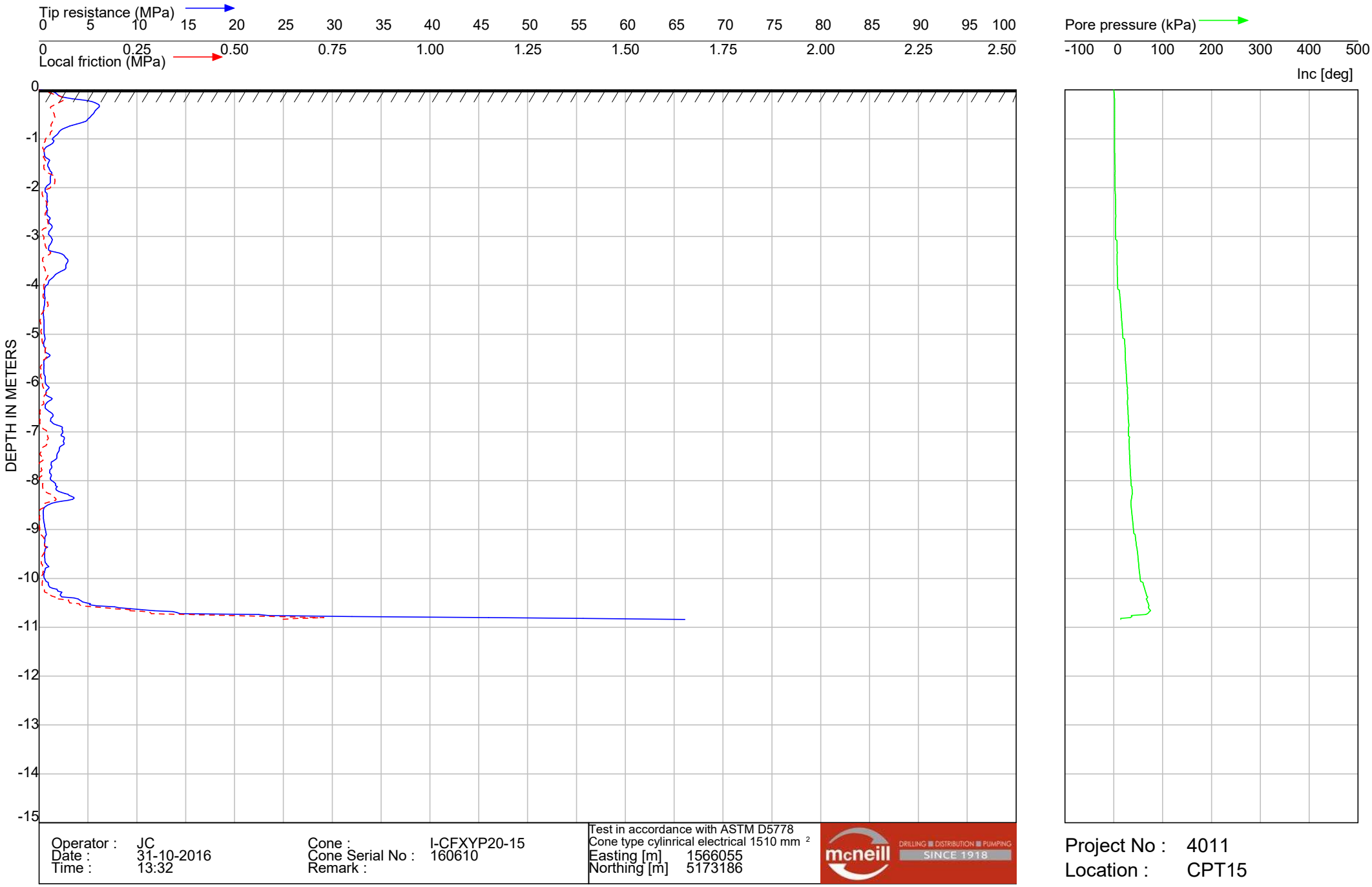
Cone : I-CFXYP20-15
Cone Serial No : 160610
Remark :

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566086
Northing [m] 5173234

Project No : 4011
Location : CPT14

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator : JC
Date : 31-10-2016
Time : 13:32

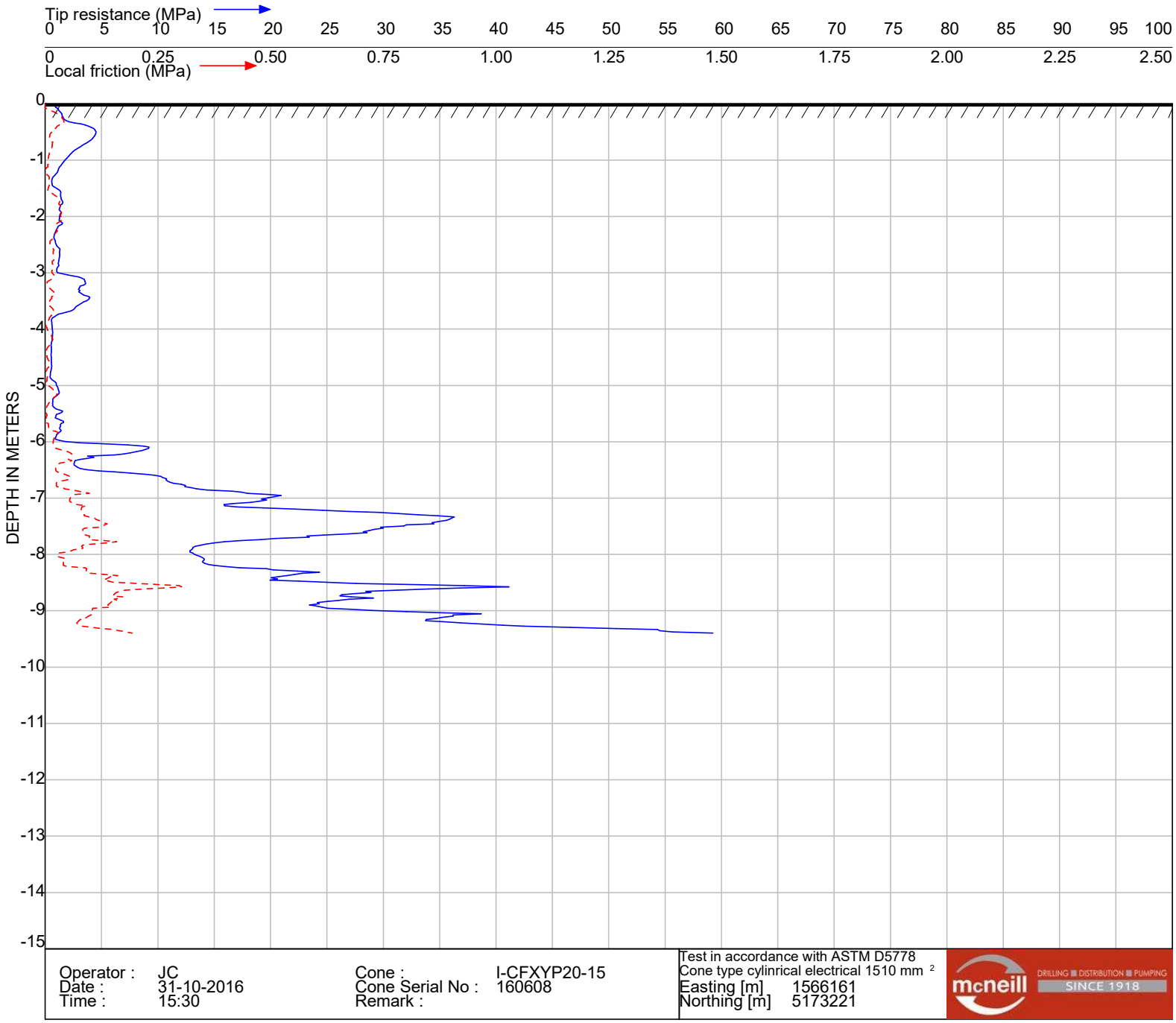
Cone : I-CFXYP20-15
Cone Serial No : 160610
Remark :

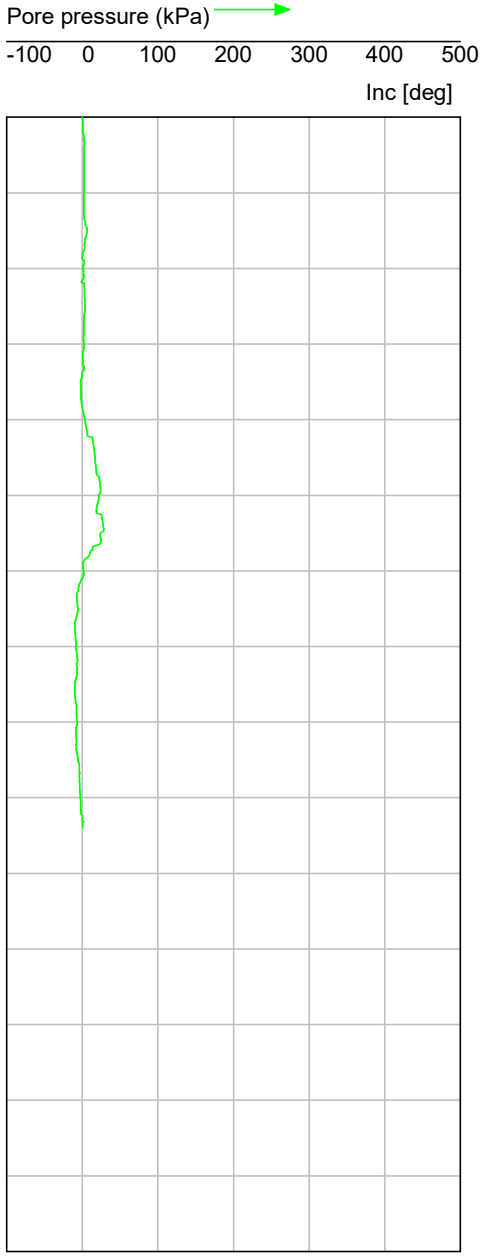
Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566055
Northing [m] 5173186

Project No : 4011
Location : CPT15

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road





Operator : JC
Date : 31-10-2016
Time : 15:30

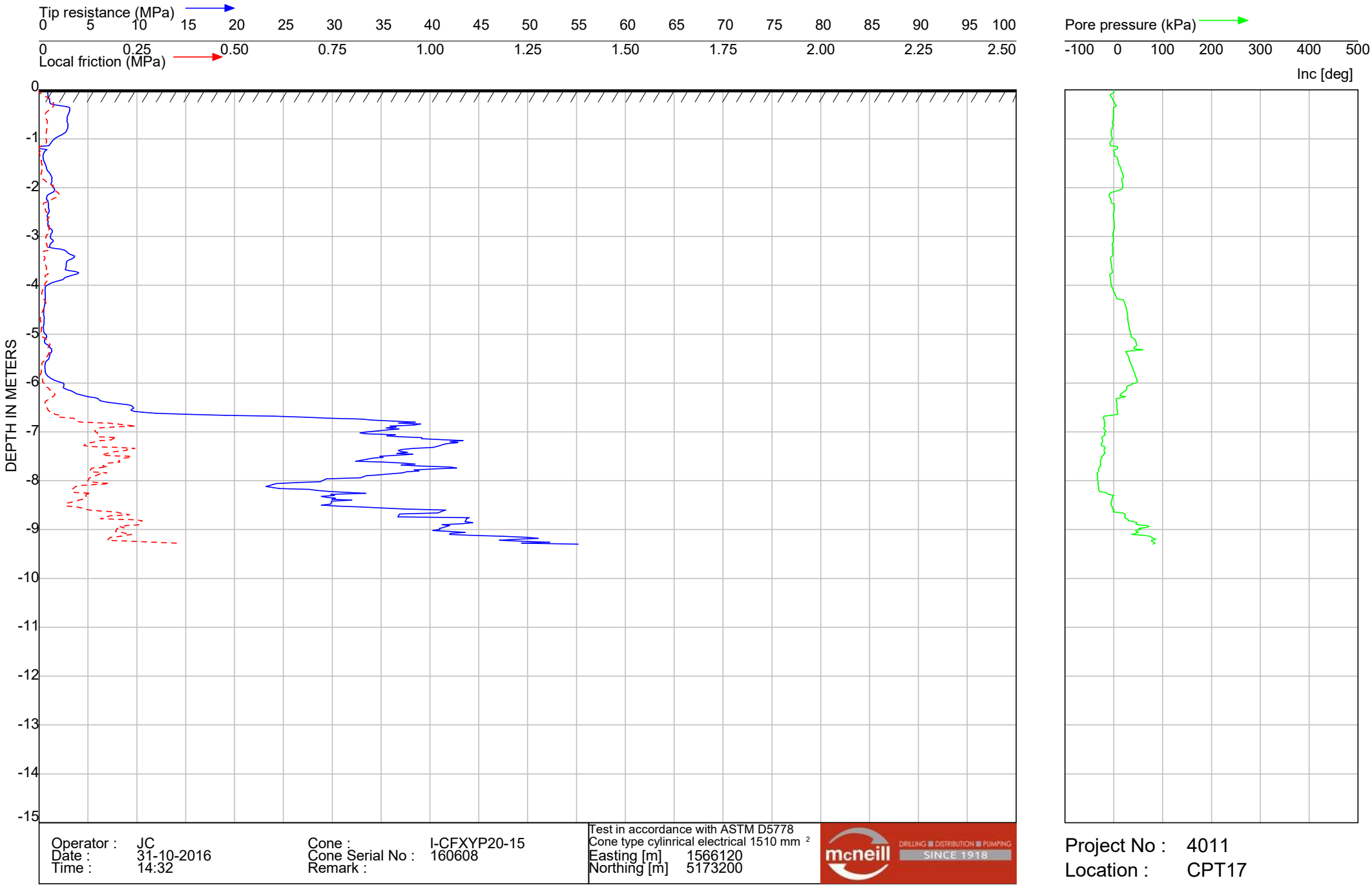
Cone : I-CFXYP20-15
Cone Serial No : 160608
Remark :

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566161
Northing [m] 5173221

Project No : 4011
Location : CPT16

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator : JC
Date : 31-10-2016
Time : 14:32

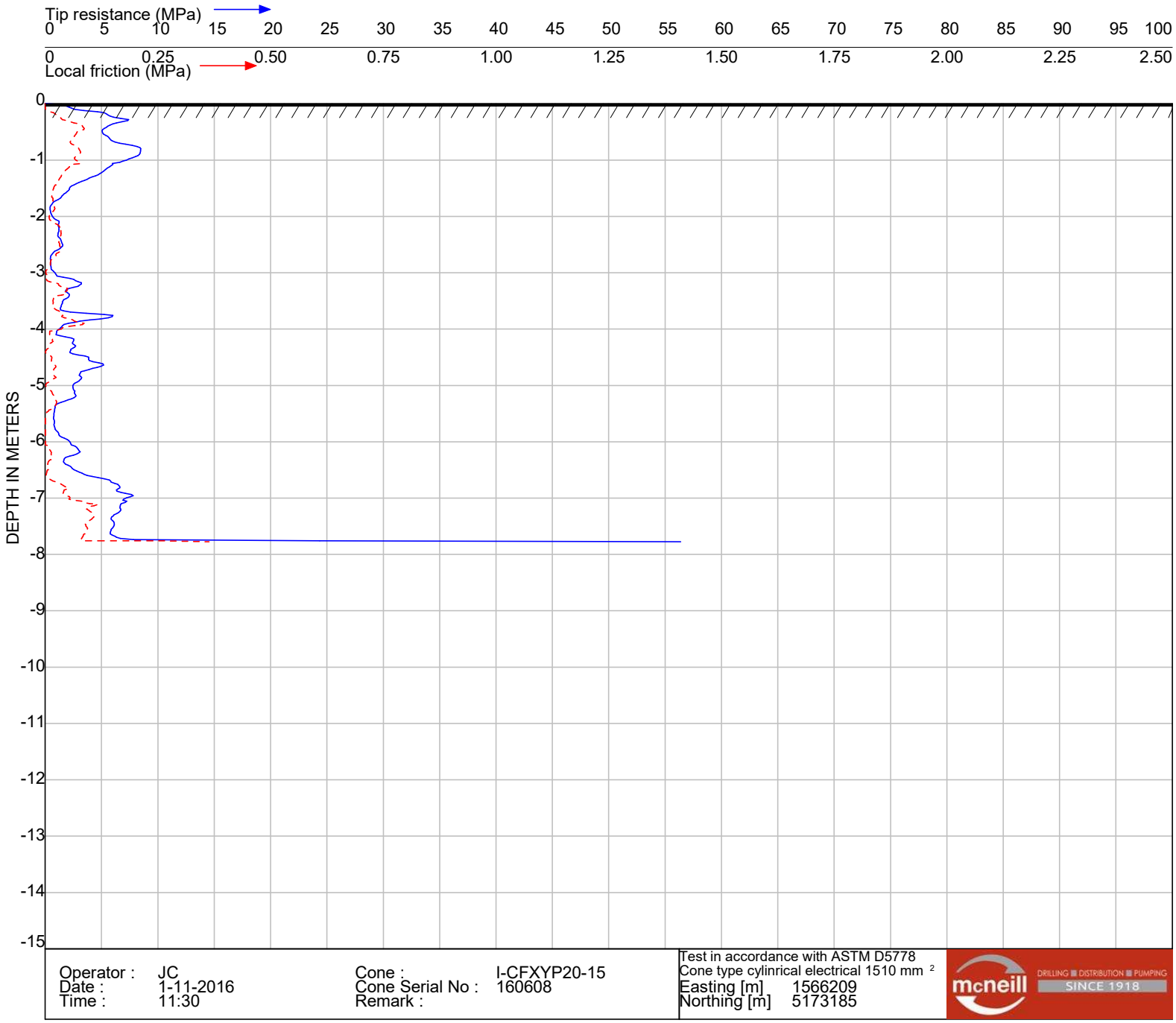
Cone : I-CFXYP20-15
Cone Serial No : 160608
Remark :

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566120
Northing [m] 5173200

Project No : 4011
Location : CPT17

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road



Operator : JC
Date : 1-11-2016
Time : 11:30

Cone : I-CFXYP20-15
Cone Serial No : 160608
Remark :

Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566209
Northing [m] 5173185

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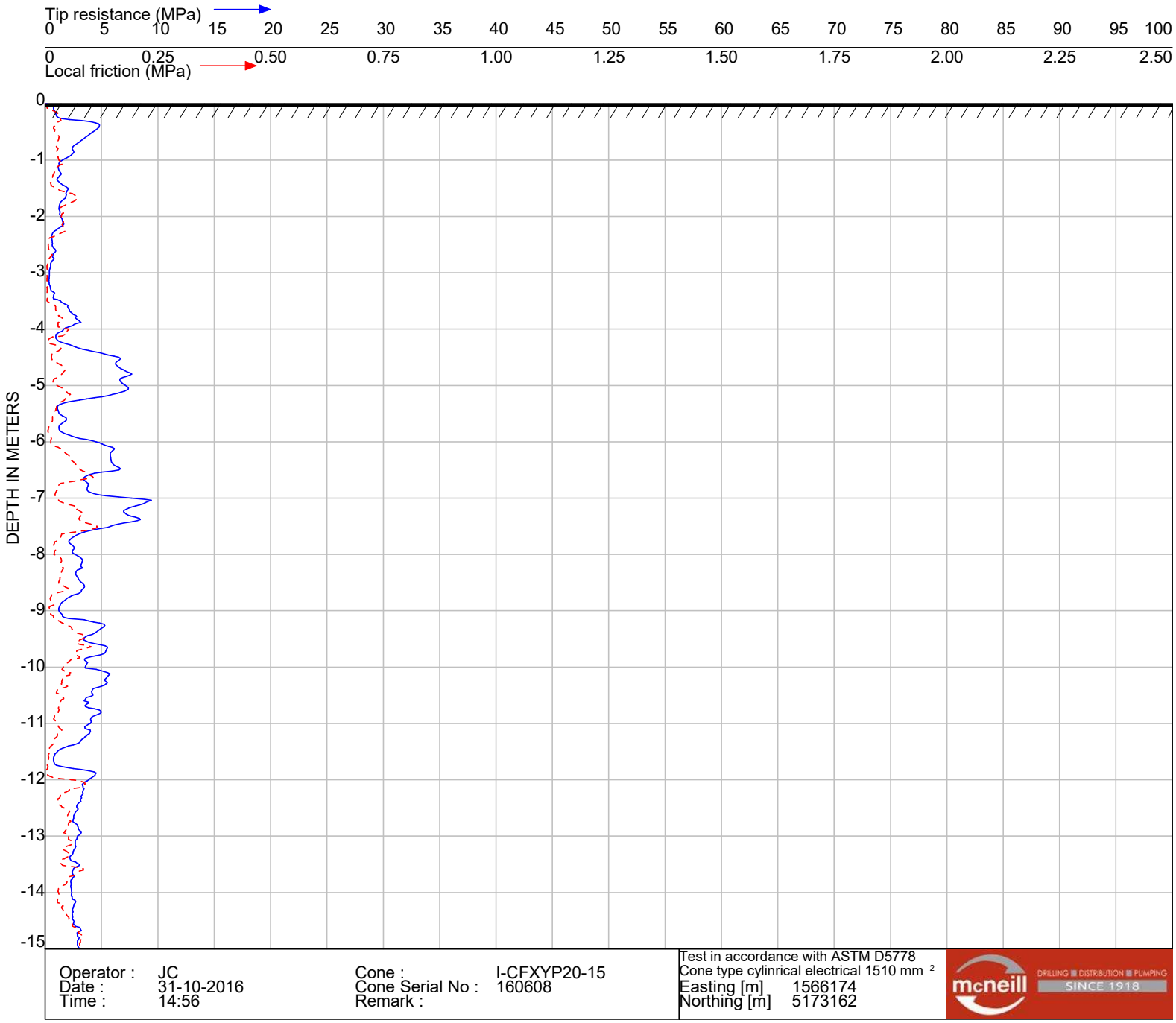
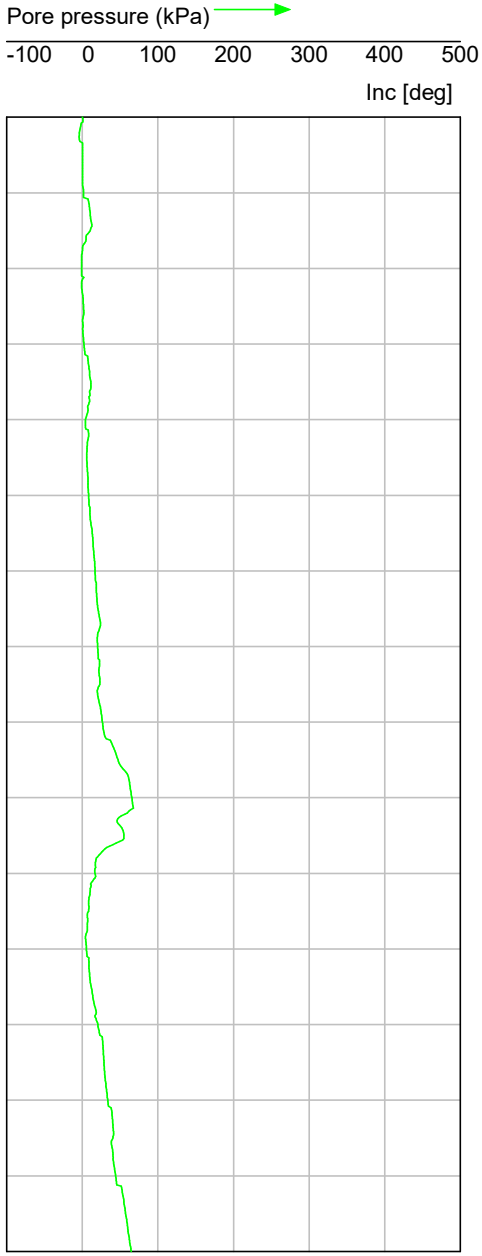
Project No : 4011
Location : CPT18

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road





Operator : JC
Date : 31-10-2016
Time : 14:56

Cone : I-CFXYP20-15
Cone Serial No : 160608
Remark :

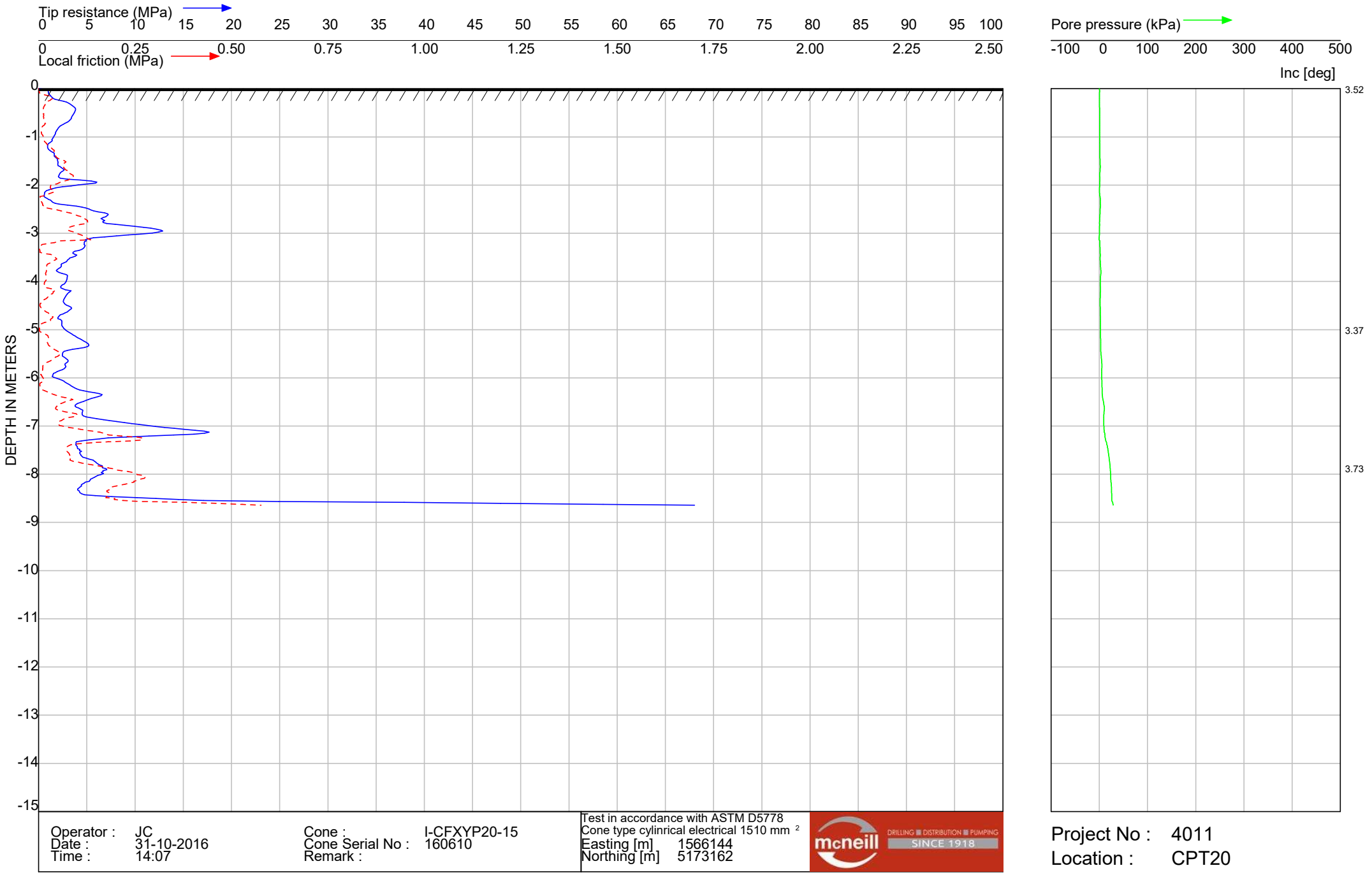
Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566174
Northing [m] 5173162

Project No : 4011
Location : CPT19

PIEZO CONE PENETRATION TEST

Client : Soil and Rock

Project : 1 Sutherlands Road



Operator : JC
Date : 31-10-2016
Time : 14:07

Cone : I-CFXYP20-15
Cone Serial No : 160610
Remark :

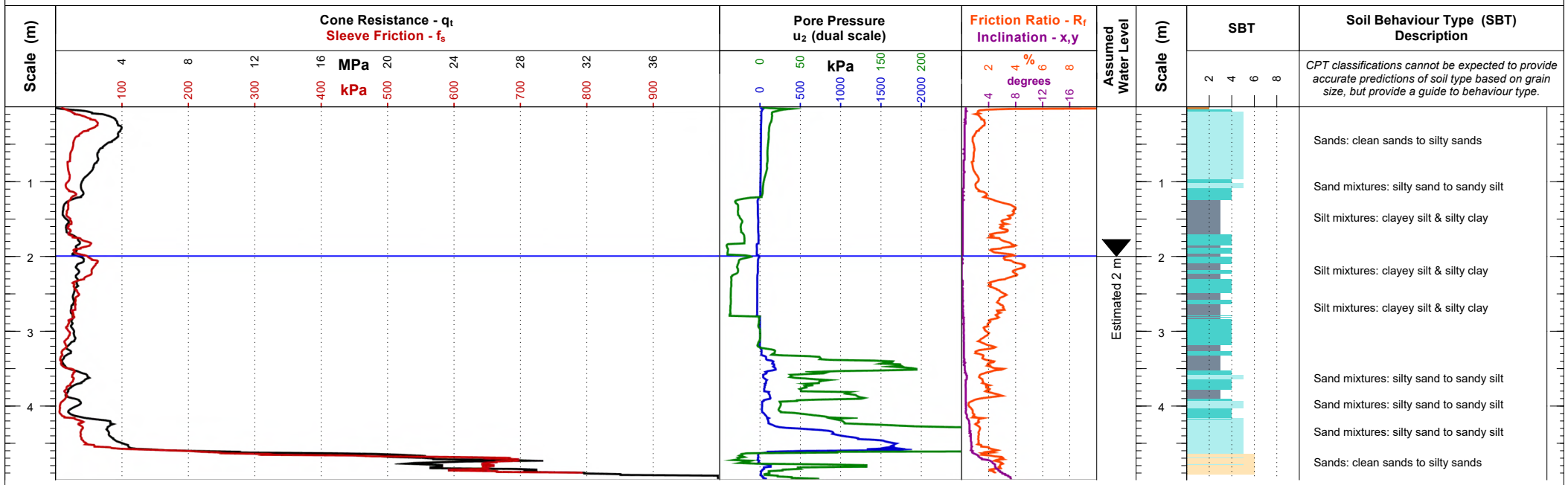
Test in accordance with ASTM D5778
Cone type cylinrical electrical 1510 mm ²
Easting [m] 1566144
Northing [m] 5173162

Project No : 4011
Location : CPT20

PIEZO CONE PENETRATION TEST

Client : Soil and Rock
Project : 1 Sutherlands Road

CONE PENETRATION TEST (CPT) LOG

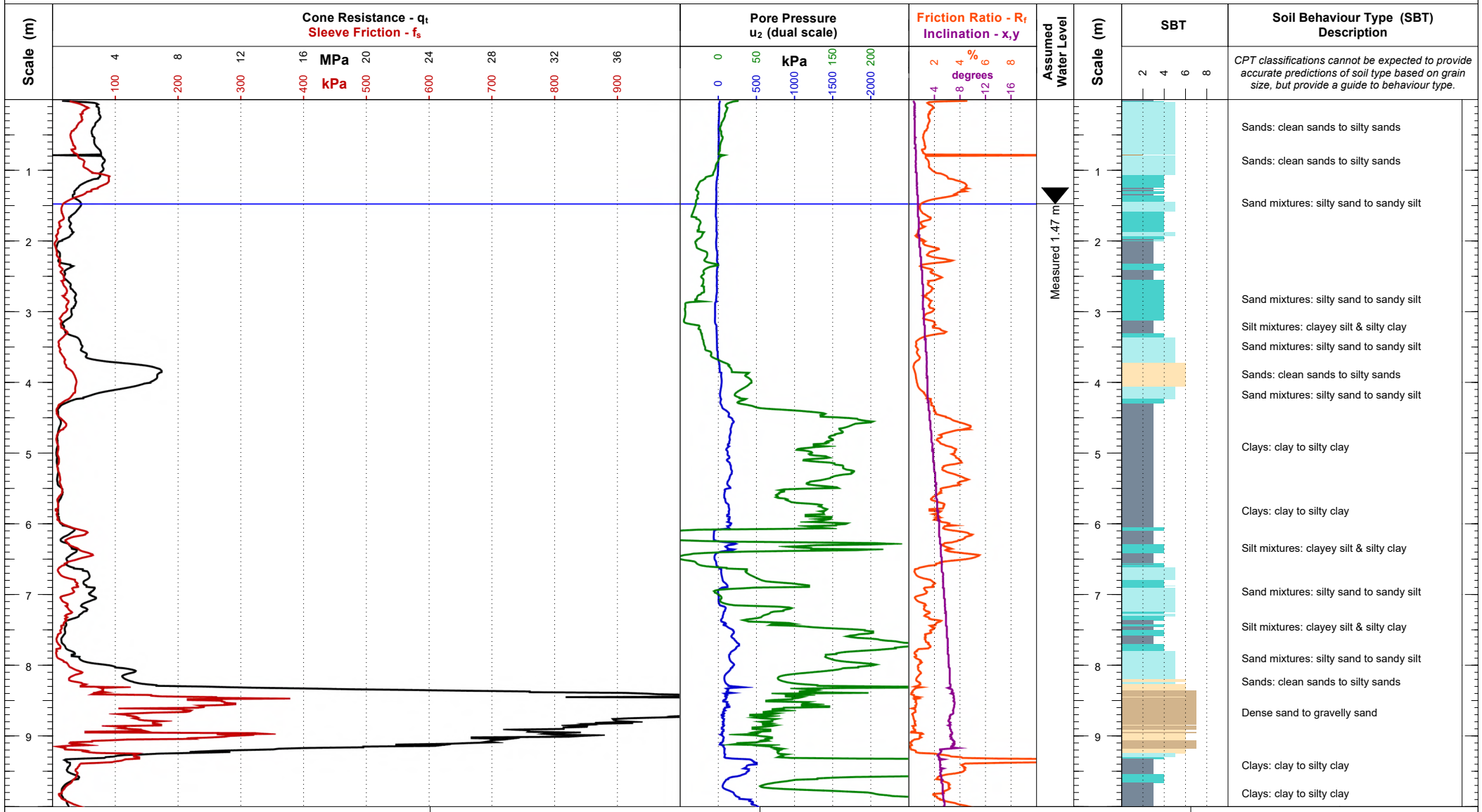


Client: KGA Geotechnical Ltd. Christchurch	**North (m):** 5173143.23	**Remarks:** Stopped due to high cone end resistance, continue with DPSH .	**Client Job Number:**
Project Name: 848 Cashmere Road	**East (m):** 1565921.96		**CPT Number:** **CPT-01**
Location: Halswell, Christchurch	**Elevation (m):** -		
Project Engineer: Hamish Hunt	**Location Method:** Handheld GPS	**Operator:** Peter Haywood / **Cone Area Ratio:** 0.8	**G.I. Job Number:** **17-014**
Contractor: Ground Investigation Ltd. www.g-i.co.nz	**Hole Depth (m):** 4.99	**Cone Number:** MKJ208 / **Sleeve Offset (m):** 0.08	**Date:** 26/01/2017 Page 1 of 1

CONE PENETRATION TEST (CPT) LOG

KGA GEOTECHNICAL

GROUND INVESTIGATION



Client: KGA Geotechnical Ltd. Christchurch

Project Name: 848 Cashmere Road

Location: Halswell, Christchurch

Project Engineer: Hamish Hunt

Contractor: Ground Investigation Ltd. www.g-i.co.nz

North (m): 5173201.34

East (m): 1565901.45

Elevation (m): -

Location Method: Handheld GPS

Hole Depth (m): 10.83

Remarks:

Stopped due to high cone end resistance

Operator:

Cone Number: MKJ309

Cone Area Ratio: 0.8

Sleeve Offset (m): 0.08

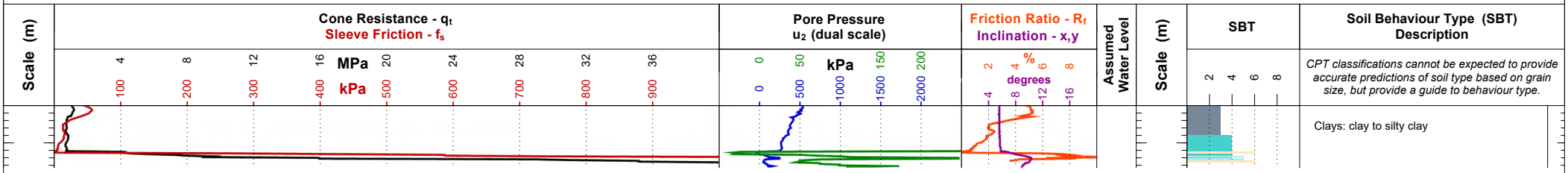
Client Job Number:

CPT Number: **CPT-02**

G.I. Job Number: **17-014**

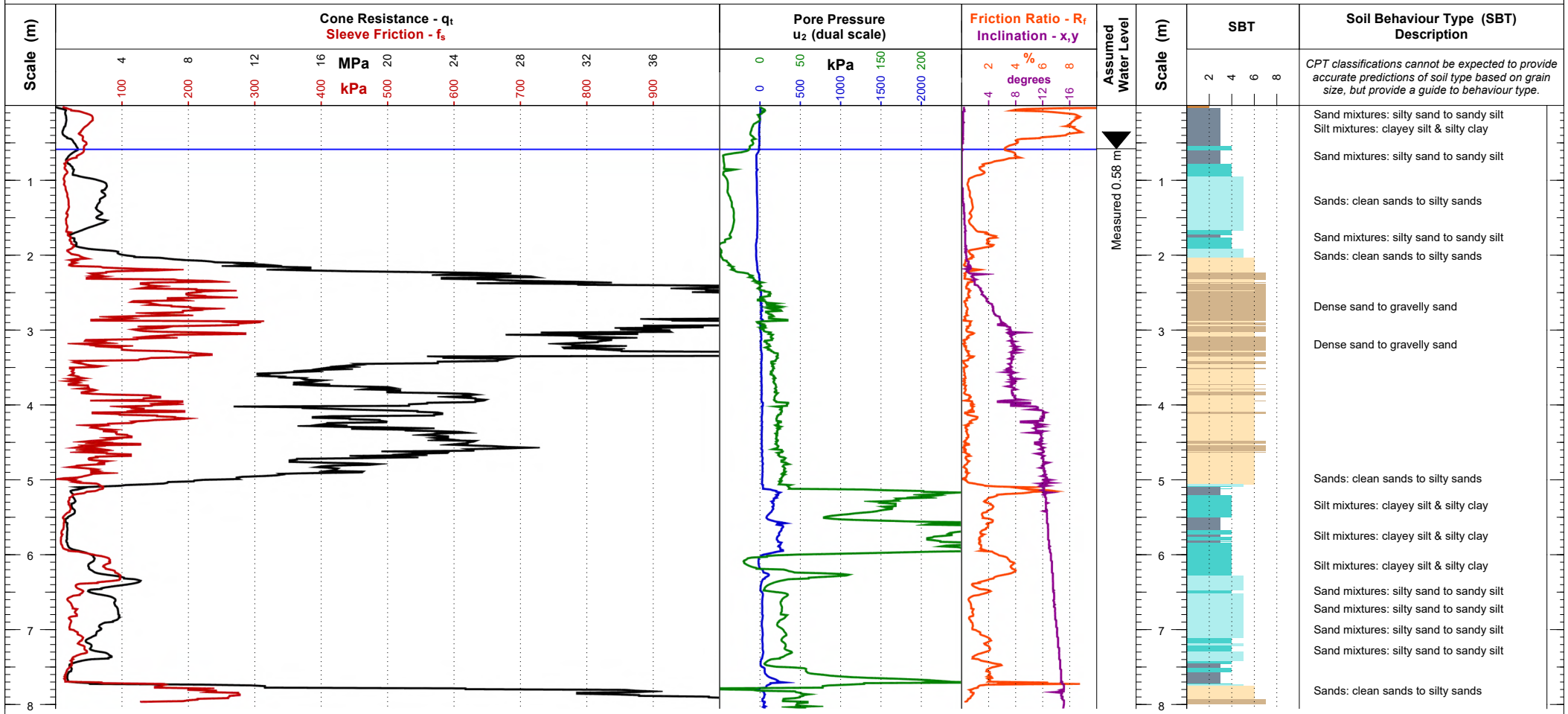
Date: 26/01/2017

CONE PENETRATION TEST (CPT) LOG



Client: KGA Geotechnical Ltd. Christchurch	**North (m):** 5173201.34	**Remarks:** Stopped due to high cone end resistance	**Client Job Number:**
Project Name: 848 Cashmere Road	**East (m):** 1565901.45		**CPT Number:** **CPT-02**
Location: Halswell, Christchurch	**Elevation (m):** -		
Project Engineer: Hamish Hunt	**Location Method:** Handheld GPS	**Operator:** / **Cone Area Ratio:** 0.8	**G.I. Job Number:** **17-014**
Contractor: Ground Investigation Ltd. www.g-i.co.nz	**Hole Depth (m):** 10.83	**Cone Number:** MKJ309 / **Sleeve Offset (m):** 0.08	**Date:** 26/01/2017 Page 2 of 2

CONE PENETRATION TEST (CPT) LOG



Client: KGA Geotechnical Ltd. Christchurch
Project Name: 848 Cashmere Road
Location: Halswell, Christchurch
Project Engineer: Hamish Hunt
Contractor: Ground Investigation Ltd. www.g-i.co.nz

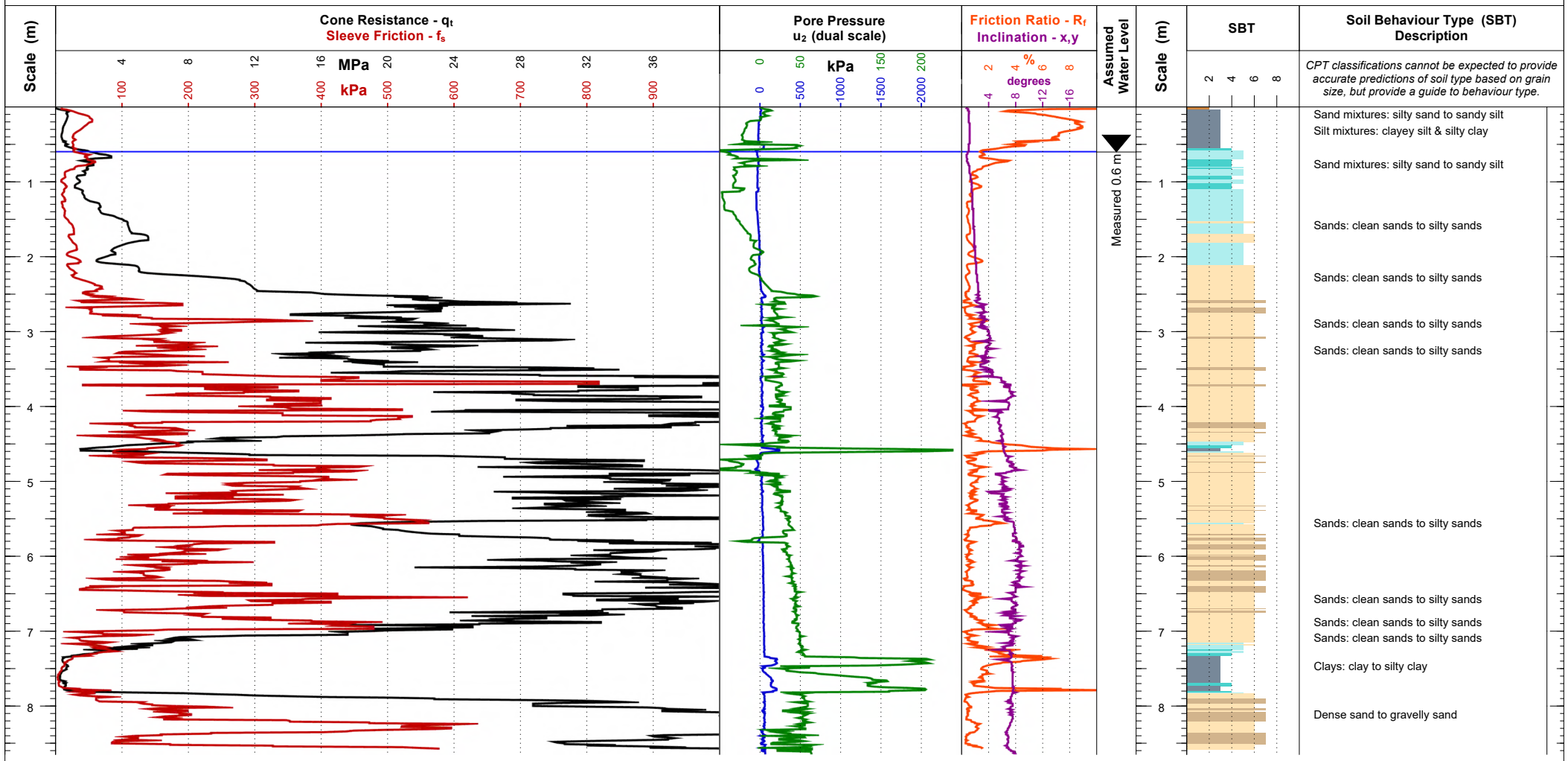
North (m): 5173276.22
East (m): 1565852.18
Elevation (m): -
Location Method: Handheld GPS
Hole Depth (m): 8.06

Remarks:
Stopped due to high cone end resistance

Operator: Peter Haywood
Cone Number: MKJ208
Cone Area Ratio: 0.8
Sleeve Offset (m): 0.08

Client Job Number:
CPT Number: CPT-03
G.I. Job Number: 17-014
Date: 26/01/2017

CONE PENETRATION TEST (CPT) LOG



Client: KGA Geotechnical Ltd. Christchurch
Project Name: 848 Cashmere Road
Location: Halswell, Christchurch
Project Engineer: Hamish Hunt
Contractor: Ground Investigation Ltd. www.g-i.co.nz

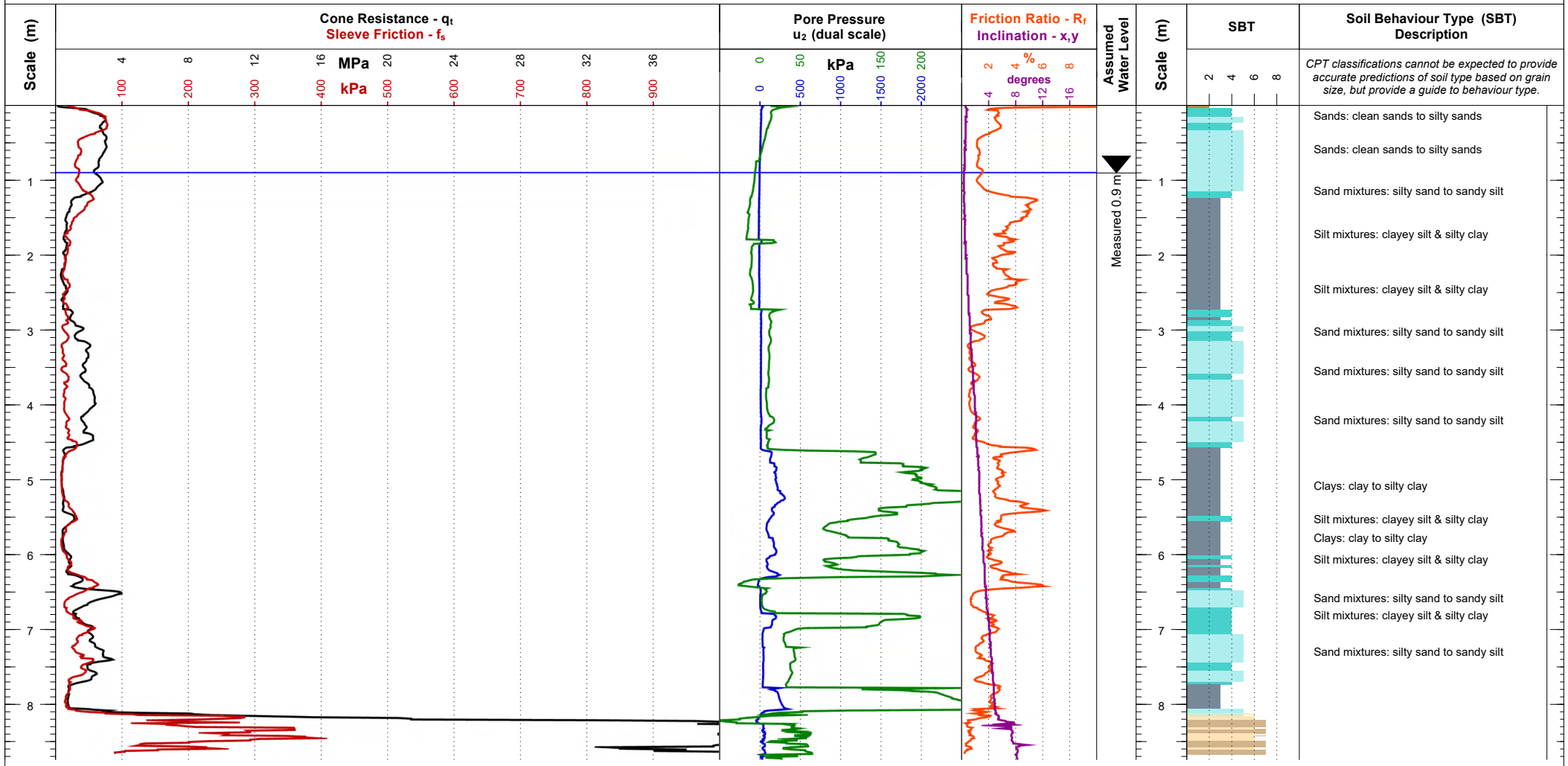
North (m): 5173301.87
East (m): 1565960.88
Elevation (m): -
Location Method: Handheld GPS
Hole Depth (m): 8.65

Remarks:
Stopped due to high cone end resistance

Operator: Peter Haywood
Cone Number: MKJ309
Cone Area Ratio: 0.8
Sleeve Offset (m): 0.08

Client Job Number:
CPT Number: CPT-04
G.I. Job Number: 17-014
Date: 26/01/2017

CONE PENETRATION TEST (CPT) LOG



Client: KGA Geotechnical Ltd. Christchurch
Project Name: 848 Cashmere Road
Location: Halswell, Christchurch
Project Engineer: Hamish Hunt
Contractor: Ground Investigation Ltd. www.g-i.co.nz

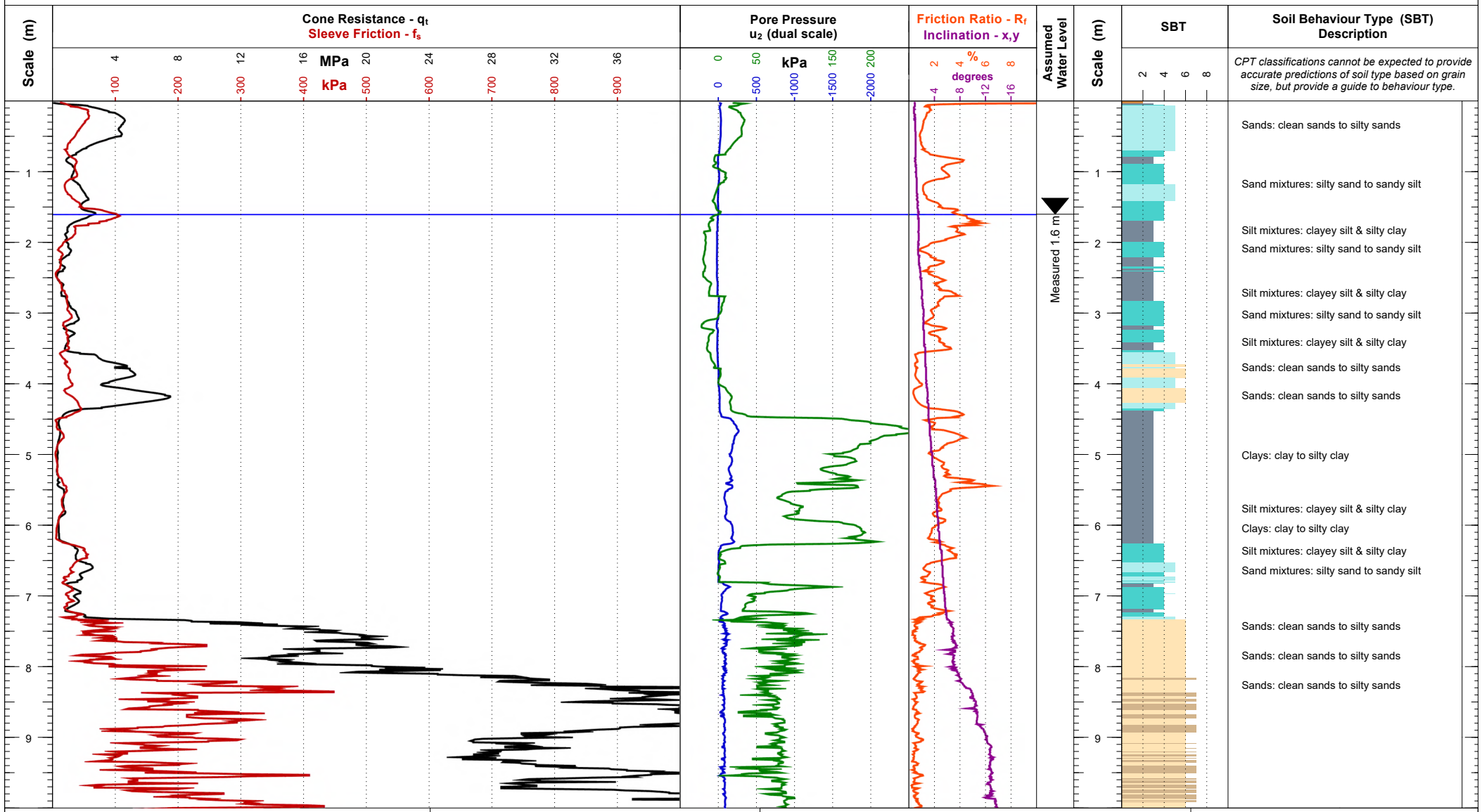
North (m): 5173243.22
East (m): 1565980.83
Elevation (m): -
Location Method: Handheld GPS
Hole Depth (m): 8.74

Remarks:
Limit of reaction force reached.

Operator: Peter Haywood
Cone Number: MKJ208
Cone Area Ratio: 0.8
Sleeve Offset (m): 0.08

Client Job Number:
CPT Number: CPT-05
G.I. Job Number: 17-014
Date: 26/01/2017

CONE PENETRATION TEST (CPT) LOG



Client: KGA Geotechnical Ltd. Christchurch
Project Name: 848 Cashmere Road
Location: Halswell, Christchurch
Project Engineer: Hamish Hunt
Contractor: Ground Investigation Ltd. www.g-i.co.nz

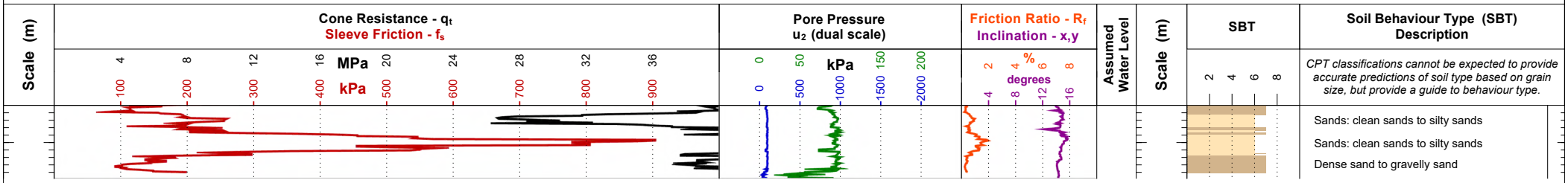
North (m): 5173192.62
East (m): 1566019.99
Elevation (m): -
Location Method: Handheld GPS
Hole Depth (m): 10.98

Remarks:
Limit of reaction force reached.

Operator: Peter Haywood
Cone Number: MKJ309
Cone Area Ratio: 0.8
Sleeve Offset (m): 0.08

Client Job Number:
CPT Number: CPT-06
G.I. Job Number: 17-014
Date: 26/01/2017

CONE PENETRATION TEST (CPT) LOG



Client: KGA Geotechnical Ltd. Christchurch	**North (m):** 5173192.62	**Remarks:** Limit of reaction force reached.	**Client Job Number:**
Project Name: 848 Cashmere Road	**East (m):** 1566019.99		**CPT Number:** CPT-06
Location: Halswell, Christchurch	**Elevation (m):** -		
Project Engineer: Hamish Hunt	**Location Method:** Handheld GPS	**Operator:** Peter Haywood / **Cone Area Ratio:** 0.8	**G.I. Job Number:** 17-014
Contractor: Ground Investigation Ltd. www.g-i.co.nz	**Hole Depth (m):** 10.98	**Cone Number:** MKJ309 / **Sleeve Offset (m):** 0.08	**Date:** 26/01/2017

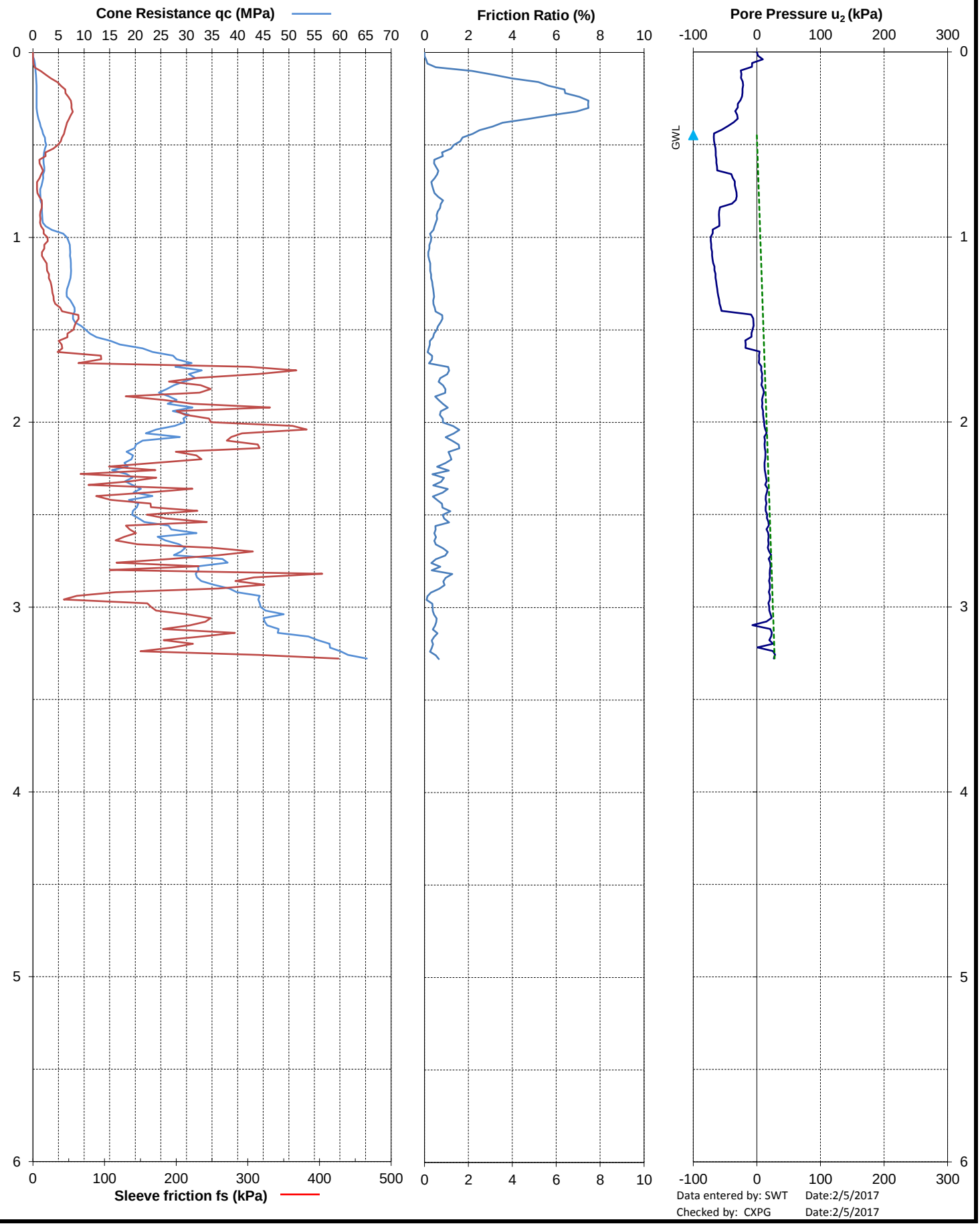
CPT04 33 Sutherlands Road, Christchurch - 01 May, 2017

Pre-Drill:	0m	**NZMG**	2476008mE 5735035mN 16m(amsl)
Assumed GWL:	0.45m (BGL)	**Other Tests:**	None
Operator:	Scott Thomas	**Comments:**	Anchor failure at 3.28m > 65 MPa
Located By:	Hand GPS/GE (el)		

45a Parkhouse Rd, Christchurch
e. christchurch@geotechnics.co.nz
p.+64 (0)3 361 0300

GEOTECHNICS

Geotechnics Ref: 1002992.0.0.0



Data entered by: SWT Date:2/5/2017
Checked by: CXPG Date:2/5/2017

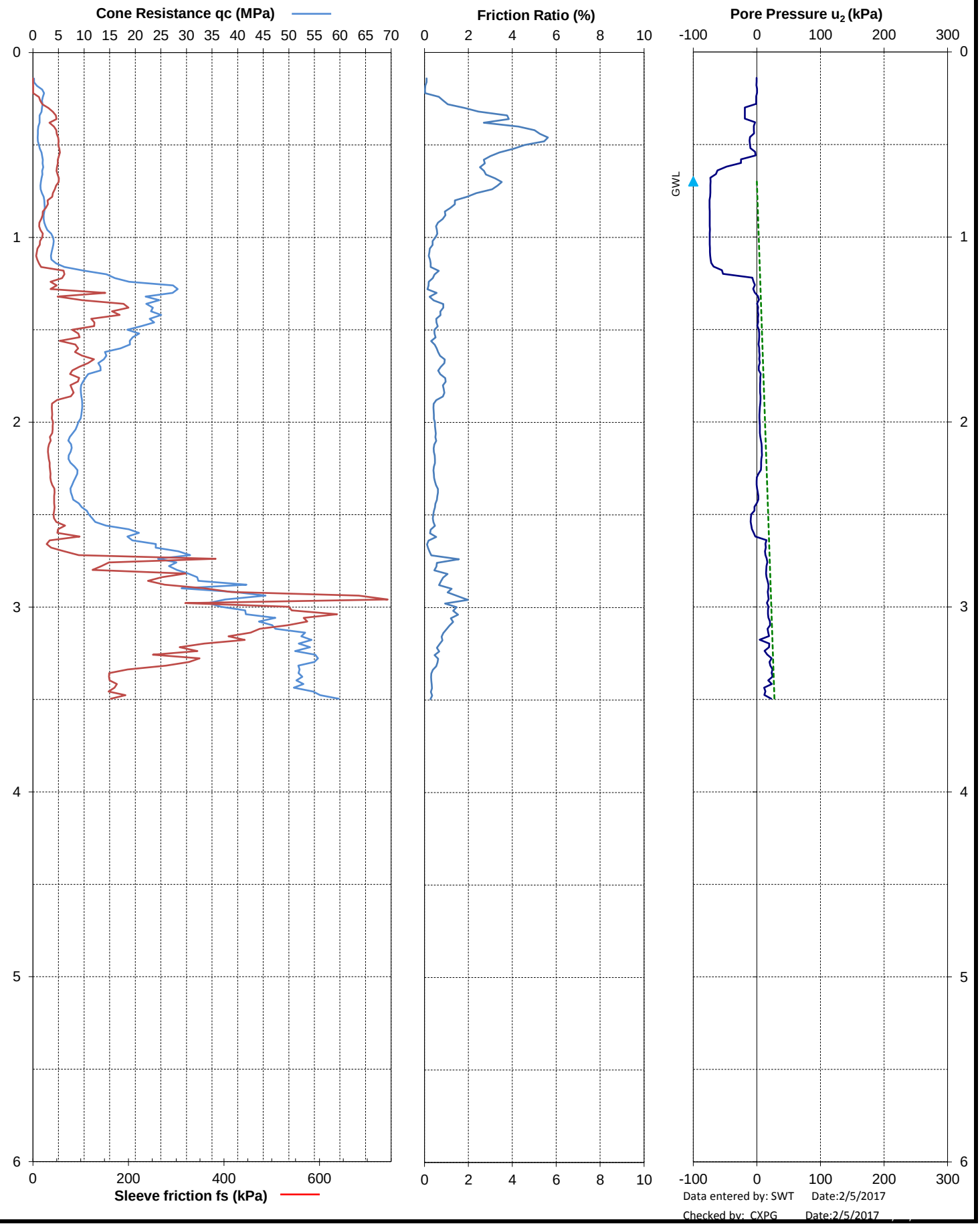
CPT05 33 Sutherlands Road, Christchurch - 02 May, 2017

45a Parkhouse Rd, Christchurch
e. christchurch@geotechnics.co.nz
p.+64 (0)3 361 0300

GEOTECHNICS

Pre-Drill:	0.15m	**NZMG**	2476072mE 5735048mN 16m(amsl)
Assumed GWL:	0.7m (BGL)	**Other Tests:**	None
Operator:	Scott Thomas	**Comments:**	Pre-drill to 0.15m. Anchor failure at 3.50m > 60 MPa
Located By:	Hand GPS/GE (el)		

Geotechnics Ref: 1002992.0.0.0



Data entered by: SWT Date:2/5/2017

Checked by: CXPG Date:2/5/2017

A.2: MINZ Geotechnical Investigation Logs

Hand-augered borehole logs

Laboratory Soil Sample Results

Summary CPT and SCPT Data Profiles

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS	*PROJECT NUMBER:*	**190017**
	CLIENT:	**Yoursection Limited**
	TESTING COMPLETED:	**4 February 2019**

SHALLOW GROUND INVESTIGATION LOG

HA1/DCP1

PROJECT:	**1 Sutherlands Road and 848 Cashmere Road, Halswell, Christchurch**				
LOGGED BY:	**AT/NH/TW**	*TOTAL DEPTH OF HOLE:*	**3.0 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**TW**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**N/A**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.8 mbgl**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
							Atterberg Limits			*Grain Size*			*WC (%)*	*UW*	
			USC	*Soil Characteristics*	*Graphic Log*		*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*			
0			ML	SILT (TOPSOIL); dark brown, moist, non-plastic, containing minor rootlets											
0.5			ML	SILT; dark brown streaked grey and orange, moist, low plasticity											
1.0			ML	SILT; dark brown streaked orange, moist, low plasticity, containing minor fine sand Becoming moderately plastic @ 1.2 mbgl											
1.5				Becoming wet @ 1.5 mbgl											
2.0		▽	MH	SILT; blueish-grey, wet, high plasticity, dilatant, highly compressive, containing trace fine sand											
2.5															
3.0				**EOH @ 3.0 mbgl (target depth)**											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS	*PROJECT NUMBER:*	**190017**
	CLIENT:	**Yoursection Limited**
	TESTING COMPLETED:	**4 February 2019**

SHALLOW GROUND INVESTIGATION LOG

HA2/DCP2

PROJECT:	**1 Sutherlands Road and 848 Cashmere Road, Halswell, Christchurch**				
LOGGED BY:	**AT/NH/TW**	*TOTAL DEPTH OF HOLE:*	**3.0 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**TW**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**N/A**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**N/E**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
							Atterberg Limits			*Grain Size*			*WC (%)*	*UW*	
			USC	*Soil Characteristics*	*Graphic Log*		*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*			
0		Not Encountered	ML	SILT (TOPSOIL); greyish-brown, dry, low plasticity, containing minor fine sand											
0.5			ML	Fine sandy SILT; light grey-brown streaked with orange, moist, low plasticity, containing trace clay Becoming moist @ 0.8 mbgl		Sample 1									
1.0															
1.5			ML	SILT; light greyish-brown streaked orange, wet, low - moderate plasticity, dilatant, containing minor clay and trace fine sand											
2.0			ML	SILT; blueish-grey, low - moderate plasticity, dilatant, containing trace fine sand											
2.5															
3.0				**EOH @ 3.0 mbgl (target depth)**											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS	*PROJECT NUMBER:*	**190017**
	CLIENT:	**Yoursection Limited**
	TESTING COMPLETED:	**4 February 2019**

SHALLOW GROUND INVESTIGATION LOG

HA3/DCP3

PROJECT:	**1 Sutherlands Road and 848 Cashmere Road, Halswell, Christchurch**				
LOGGED BY:	**AT/NH/TW**	*TOTAL DEPTH OF HOLE:*	**2.2 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**TW**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**N/A**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.2 mbgl**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
							Atterberg Limits			*Grain Size*			*WC (%)*	*UW*	
			USC	*Soil Characteristics*	*Graphic Log*		*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*			
0.0			ML	SILT (TOPSOIL); grey/brown, low plactisity, dry, containing minor fine sand and organics											
			ML	SILT; light brownish-grey, dry, low plasticity, containing trace fine sand											
0.5			ML	Sandy SILT; brownish-grey, moist, low plasticity											
1.0		▽	ML	Organic SILT (TOPSOIL); dark brown, moist, low plasticity, containing trace fine sand											
			ML	SILT; grey streaked orange, moist, low - moderate plasticity, containing trace fine sand and rootlets											
1.5			ML	Sandy SILT; blueish-grey, wet, low plasticity Becoming saturated @ 1.9 mbgl		Sample 6									
2.0				**EOH @ 2.2 mbgl (borehole collapse)**											
2.5															
3.0															

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS	*PROJECT NUMBER:*	**190017**
	CLIENT:	**Yoursection Limited**
	TESTING COMPLETED:	**4 February 2019**

SHALLOW GROUND INVESTIGATION LOG

HA4/DCP4

PROJECT:	**1 Sutherlands Road and 848 Cashmere Road, Halswell, Christchurch**				
LOGGED BY:	**AT/NH/TW**	*TOTAL DEPTH OF HOLE:*	**3.0 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**TW**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**N/A**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**0.7 mbgl**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
							Atterberg Limits			*Grain Size*			*WC (%)*	*UW*	
			USC	*Soil Characteristics*	*Graphic Log*		*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*			
0.0			ML	SILT (TOPSOIL); dark grey-brown, dry, low plasticity, containing trace fine sand and organics											
			ML	SILT; light brownish-grey streaked orange, dry, low plasticity, with trace fine-grained sand											
0.5		▽													
			SM	Silty fine SAND; brownish-grey streaked orange, moist, well sorted											
1.0															
			M	SILT; blueish-grey streaked orange, wet, low - moderate plasticity, dilatant, highly compressive, containing trace fine sand											
1.5															
2.0															
2.5				Becoming blueish-grey @ 2.2 mbgl											
3.0				**EOH @ 3.0 mbgl (target depth)**											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS	*PROJECT NUMBER:*	**190017**
	CLIENT:	**Yoursection Limited**
	TESTING COMPLETED:	**4 February 2019**

SHALLOW GROUND INVESTIGATION LOG

HA5/DCP5

PROJECT:	**1 Sutherlands Road and 848 Cashmere Road, Halswell, Christchurch**				
LOGGED BY:	**AT/NH/TW**	*TOTAL DEPTH OF HOLE:*	**3.0 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**TW**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**N/A**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**N/E**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
							Atterberg Limits			*Grain Size*			*WC (%)*	*UW*	
			USC	*Soil Characteristics*	*Graphic Log*		*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*			
0		Not Encountered	ML	Fine to medium sandy SILT (TOPSOIL); dark reddish-brown, moist, non-plastic, containing trace medium - coarse gravel and rootlets											
0.5			ML	Fine to medium sandy SILT; greyish-brown, moist, low plasticity, moderately sorted											
1.0			SP	Fine to medium SAND; orangey-grey, moist, well sorted											
			SP	Fine to medium SAND; bluish-grey, moist, moderately sorted		Sample 3									
1.5			ML	SILT; greyish-brown, wet, low plasticity, containing minor fine - medium sand											
2.0			ML	SILT; greyish-brown, wet, medium plasticity, highly compressible, containing trace fine sand											
2.5			ML	SILT; grey, saturated, medium plasticity, containing trace fine sand											
3.0				**EOH @ 3.0 mbgl (target depth)**											

LEGEND

ABBREVIATIONS								NOTES
DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL	
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND	
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT	
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	∇	STANDING GWL	

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS	*PROJECT NUMBER:*	**190017**
	CLIENT:	**Yoursection Limited**
	TESTING COMPLETED:	**4 February 2019**

SHALLOW GROUND INVESTIGATION LOG

HA6/DCP6

PROJECT:	**1 Sutherlands Road and 848 Cashmere Road, Halswell, Christchurch**				
LOGGED BY:	**AT/NH/TW**	*TOTAL DEPTH OF HOLE:*	**3.0 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**TW**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**N/A**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**2.2 mbgl**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
							Atterberg Limits			*Grain Size*			*WC (%)*	*UW*	
			USC	*Soil Characteristics*	*Graphic Log*		*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*			
0.5			ML	SILT (TOPSOIL/FILL); light brownish-grey, dry, low plasticity, containing minor fine sand											
1.0			SP	Fine to medium SAND; light grey, moist, moderately sorted, containing minor silt Becoming streaked orange @ 1.0 mbgl											
1.5			ML	SILT; brownish-grey streaked orange, wet, low plasticity, dilatant, containing minor fine sand											
2.0		▽	MH	SILT; blueish-grey, wet, moderate - high plasticity, dilatant, containing trace fine sand		Sample 4									
2.5															
3.0				**EOH @ 3.0 mbgl (target depth)**											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS	*PROJECT NUMBER:*	**190017**
	CLIENT:	**Yoursection Limited**
	TESTING COMPLETED:	**4 February 2019**

SHALLOW GROUND INVESTIGATION LOG

HA7/DCP7

PROJECT:	**1 Sutherlands Road and 848 Cashmere Road, Halswell, Christchurch**				
LOGGED BY:	**AT/NH/TW**	*TOTAL DEPTH OF HOLE:*	**3.0 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**TW**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**N/A**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.8 mbgl**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
							Atterberg Limits			*Grain Size*			*WC (%)*	*UW*	
			USC	*Soil Characteristics*	*Graphic Log*		*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*			
0			SM	Fine silty SAND (TOPSOIL); brown, dry, containing minor rootlets											
0.5			ML	Fine sandy SILT; brown streaked orange, dry, non-plastic, containing minor rootlets											
			ML	SILT; greyish-brown streaked orange, moist, low plasticity, containing trace fine sand											
1.0			ML	SILT; greyish-brown, wet, low - moderate plasticity, containing trace fine sand											
1.5		▽													
2.0															
2.5			MH	SILT; blueish-grey, wet, high-plasticity, highly dilatant, highly compressible, containing trace fine sand											
3.0				**EOH @ 3.0 mbgl (target depth)**											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS	*PROJECT NUMBER:*	**190017**
	CLIENT:	**Yoursection Limited**
	TESTING COMPLETED:	**4 February 2019**

SHALLOW GROUND INVESTIGATION LOG

HA8/DCP8

PROJECT:	**1 Sutherlands Road and 848 Cashmere Road, Halswell, Christchurch**				
LOGGED BY:	**AT/NH/TW**	*TOTAL DEPTH OF HOLE:*	**2.0 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**TW**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**N/A**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.0 mbgl**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
							Atterberg Limits			*Grain Size*			*WC (%)*	*UW*	
			USC	*Soil Characteristics*	*Graphic Log*		*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*			
0			ML	Fine to medium sandy SILT (TOPSOIL); dark brown, moist, non-plastic											
0.5			ML	SILT; dark brown streaked grey, moist, low plasticity, compressible											
1.0		▽	MH	SILT; blueish-grey, wet, moderate to high plasticity, dilatant, containing trace fine sand											
			SM	Fine silty SAND; blueish-grey, saturated, well sorted											
1.5			MH	SILT; blueish-grey, saturated, moderate -high plasticity, highly dilatant, containing minor fine sand											
2.0				**EOH at 2.0 mbgl (borehole collapse)**											
2.5															
3.0															

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS	*PROJECT NUMBER:*	**190017**
	CLIENT:	**Yoursection Limited**
	TESTING COMPLETED:	**4 February 2019**

SHALLOW GROUND INVESTIGATION LOG

HA9/DCP9

PROJECT:	**1 Sutherlands Road and 848 Cashmere Road, Halswell, Christchurch**				
LOGGED BY:	**AT/NH/TW**	*TOTAL DEPTH OF HOLE:*	**3.0 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**TW**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**N/A**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.3 mbgl**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
							Atterberg Limits			*Grain Size*			*WC (%)*	*UW*	
			USC	*Soil Characteristics*	*Graphic Log*		*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*			
0			ML	SILT (TOPSOIL); brownish-grey, moist, non-plastic, containing minor fine to medium sand											
0.5			SM	Fine to medium silty SAND; brownish-grey, moist, moderately sorted											
			ML	Fine to medium sandy SILT; brownish-grey, moist, low - moderate plasticity											
1.0		▽	ML	Fine to medium sandy SILT; brownish-grey, wet, low - moderate plasticity											
1.5			SP	Fine silty SAND; orangey-brown, wet, well sorted											
			ML	Sandy SILT; blueish-grey, wet, low - moderate plasticity, highly compressible											
2.0				Becoming highly compressible @ 2.2 mbgl		Sample 5									
2.5															
3.0				**EOH @ 3.0 mbgl (target depth)**											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS

PROJECT NUMBER:	**190017**
CLIENT:	**Yoursection Limited**
TESTING COMPLETED:	**4 February 2019**

SHALLOW GROUND INVESTIGATION LOG

HA10/DCP10

PROJECT:	**1 Sutherlands Road and 848 Cashmere Road, Halswell, Christchurch**				
LOGGED BY:	**AT/NH/TW**	*TOTAL DEPTH OF HOLE:*	**2.9 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**TW**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**N/A**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.4 mbgl**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
							Atterberg Limits			*Grain Size*			*WC (%)*	*UW*	
			USC	*Soil Characteristics*	*Graphic Log*		*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*			
0.0			SP	Fine SAND (TOPSOIL); light grey, dry, moderately sorted, containing trace silt and organics											
0.5			SP	Fine SAND; light grey, dry, moderately sorted, containing trace silt Becoming moist @ 0.8 mbgl											
1.0			SP	Fine to medium SAND; grey, moist, moderately sorted, containing trace silt		Sample 2									
1.5		▽		Becoming streaked orange @ 1.5 mbgl Becoming wet @ 1.7 mbgl											
2.0			ML	SILT; blueish-grey, wet, low - moderate plasticity, dilatant, containing trace fine sand											
2.5															
3.0				**EOH @ 2.9 mbgl (practical refusal)**											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

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M: 027 6565 317

GEO CIVIL
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DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

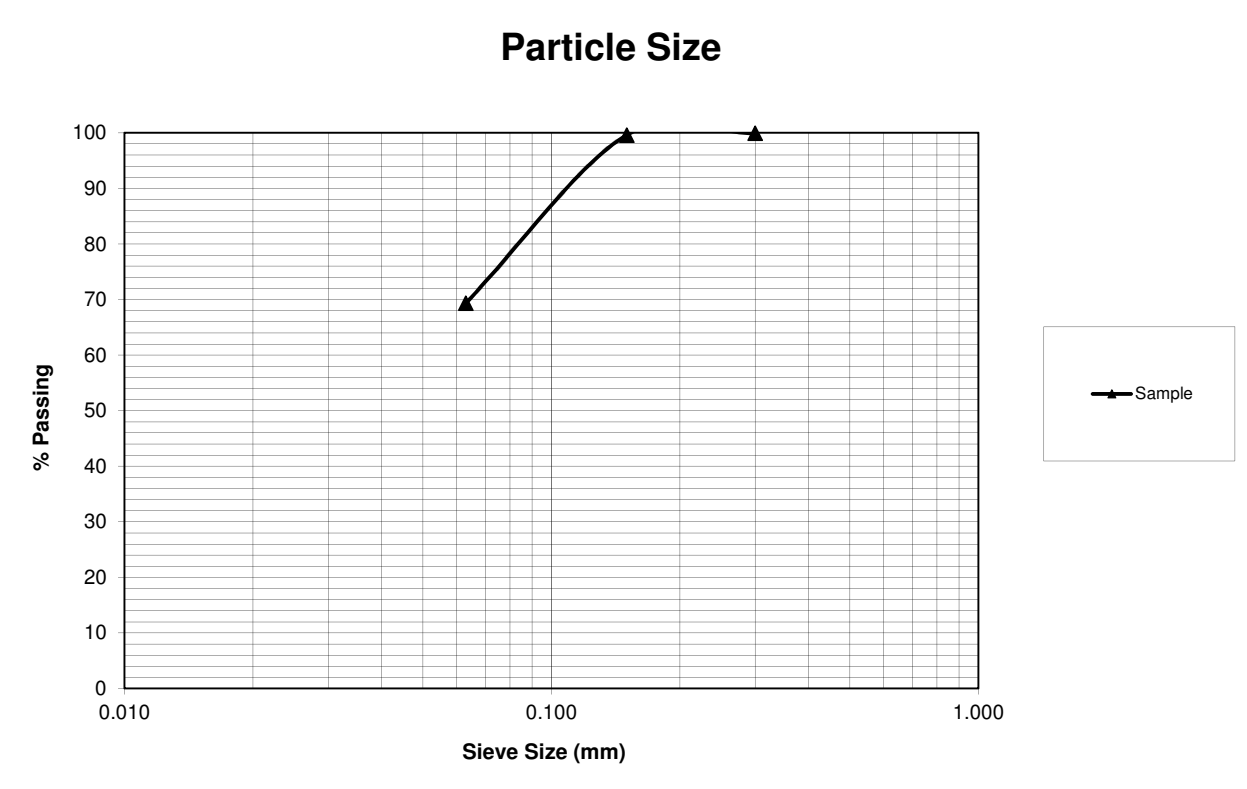
NZS 4402:1986 Test 2.8.1

Lab Job No:	8378-019	**Sample No:**	C19-207
Client:	Miyamoto International	**Tested By:**	B.L
Location:	Sutherlands Road HA2 - 0.3-1.2m	**Date:**	20/02/2019
Date Received:	14/02/2019	**Checked By:**	
Report No:	Miyamoto International	**Page:**	
REF:			
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	5/02/2019		
Test Details:	Wet sieving method		
History:	Natural		

Preliminary

Description of Sample: **Sandy SILT, brown, sand is; fine**

	% Passing		
Sieve Size	**Max**	**Min**	**Sample**
0.3			100
0.15			100
0.063			69



The percentage passing the finest sieve was obtained by difference

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DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

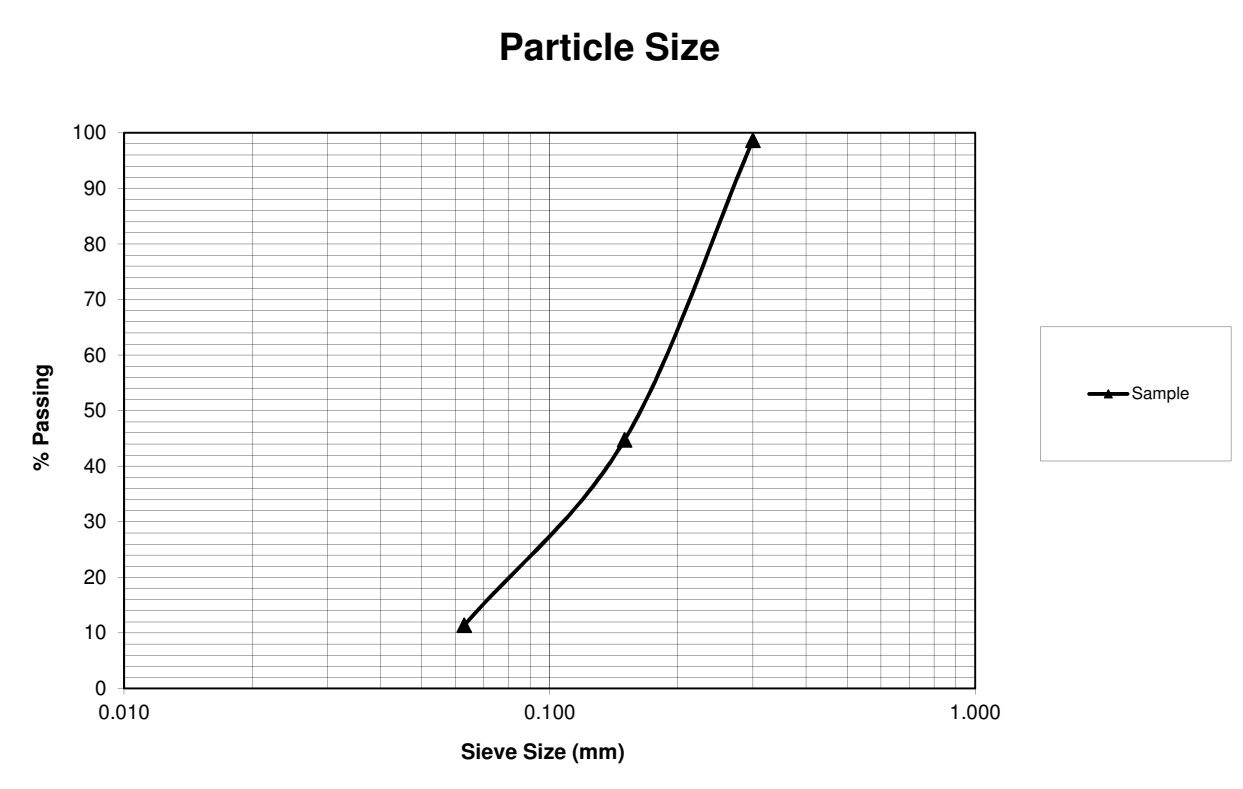
NZS 4402:1986 Test 2.8.1

Lab Job No:	8378-019	**Sample No:**	C19-208
Client:	Miyamoto International	**Tested By:**	B.L
Location:	Sutherlands Road HA10 0.9-1.9m	**Date:**	20/02/2019
Date Received:	14/02/2019	**Checked By:**	
Report No:	Miyamoto International	**Date:**	
REF:		**Page:**	
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	5/02/2019		
Test Details:	Wet sieving method		
History:	Natural		

Preliminary

Description of Sample: **Fine to medium SAND, minor silt, dark greyish brown**

	% Passing		
Sieve Size	**Max**	**Min**	**Sample**
0.3			99
0.15			45
0.063			11



The percentage passing the finest sieve was obtained by difference

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DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

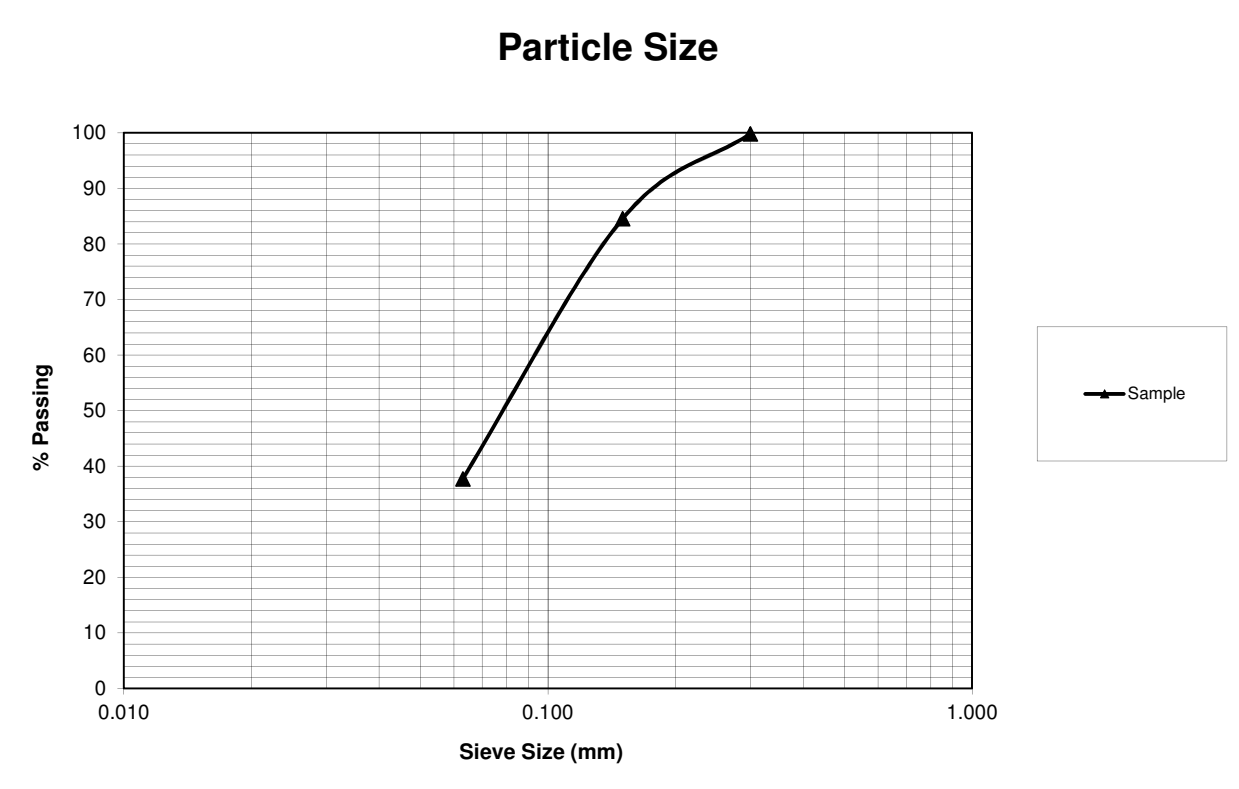
NZS 4402:1986 Test 2.8.1

Lab Job No:	8378-019	**Sample No:**	C19-209
Client:	Miyamoto International	**Tested By:**	B.L
Location:	Sutherlands Road HA5 0.8-1.4m	**Date:**	21/02/2019
Date Received:	14/02/2019	**Checked By:**	
Report No:	Miyamoto International	**Page:**	
REF:			
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	5/02/2019		
Test Details:	Wet sieving method		
History:	Natural		

Preliminary

Description of Sample: **Silty SAND, greish brown, sand is; fine to medium**

	% Passing		
Sieve Size	**Max**	**Min**	**Sample**
0.3			100
0.15			85
0.063			38



The percentage passing the finest sieve was obtained by difference

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DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

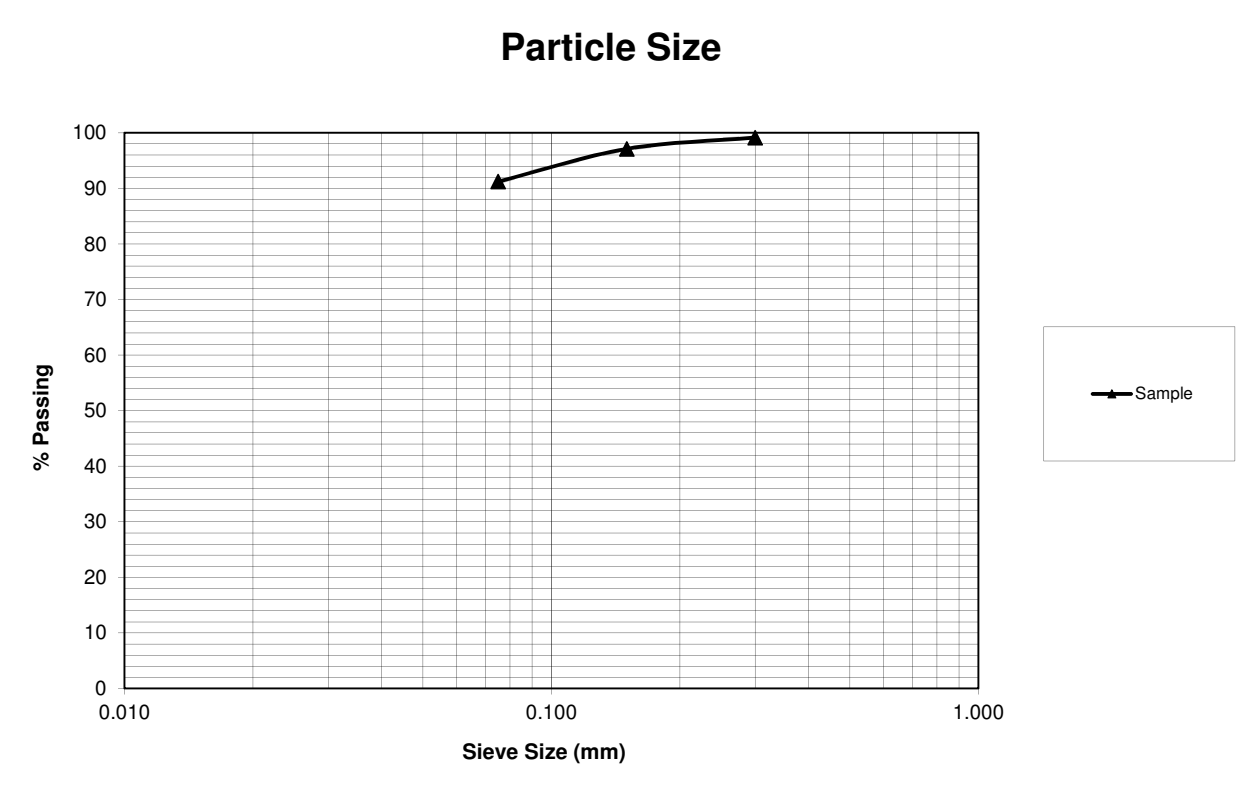
NZS 4402:1986 Test 2.8.1

Lab Job No:	8378-019	**Sample No:**	C19-210
Client:	Miyamoto International	**Tested By:**	B.L
Location:	Sutherlands Road HA6 - 1.8-3.0m	**Date:**	21/02/2019
Date Received:	14/02/2019	**Checked By:**	
Report No:	Miyamoto International	**Page:**	
REF:			
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	5/02/2019		
Test Details:	Wet sieving method		
History:	Natural		

Preliminary

Description of Sample: **SILT, traces of fine to medium sand, grey**

	% Passing		
Sieve Size	**Max**	**Min**	**Sample**
0.3			99
0.15			97
0.063			91



The percentage passing the finest sieve was obtained by difference

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DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

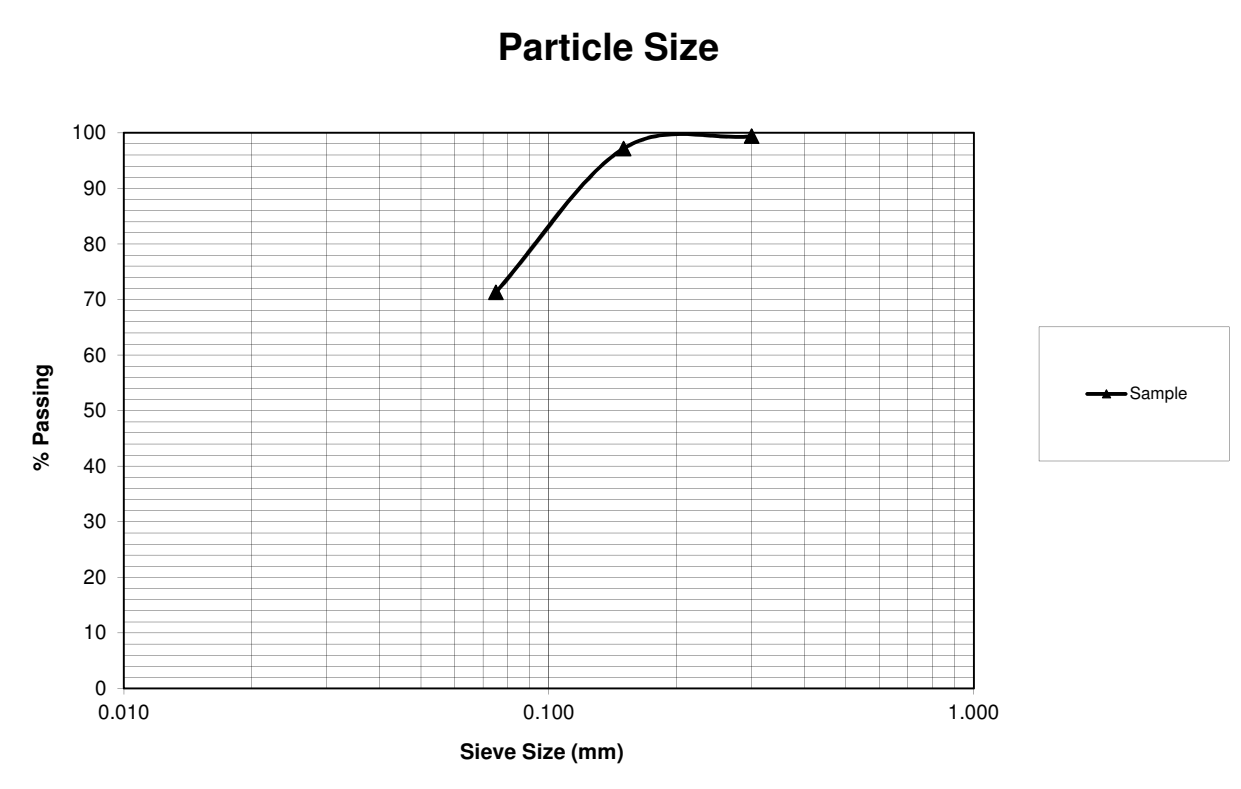
NZS 4402:1986 Test 2.8.1

Lab Job No:	8378-019	**Sample No:**	C19-212
Client:	Miyamoto International	**Tested By:**	B.L
Location:	Sutherlands Road HA2 - 1.8-3.0m	**Date:**	21/02/2019
Date Received:	14/02/2019	**Checked By:**	
Report No:	Miyamoto International	**Date:**	
REF:		**Page:**	
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	5/02/2019		
Test Details:	Wet sieving method		
History:	Natural		

Preliminary

Description of Sample: **Sandy SILT, grey, sand is; fine to medium**

	% Passing		
Sieve Size	**Max**	**Min**	**Sample**
0.3			99
0.15			97
0.063			71



The percentage passing the finest sieve was obtained by difference

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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.2,2.3,2.4

Lab Job No:	8378-019	**Sample No.:**	C19-207 0
Client:	Miyamoto International	**Tested By:**	
Location:	Sutherlands Road	**Date Tested:**	
	HA5 0.8-1.4m	**Checked By:**	
Date Received:	14/02/2019	**Date Checked:**	
Report No:		**Page:**	
REF:			
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client 0
Date Sampled:	5/02/2019		

Preliminary

Test Details:

Test performed on: Fraction passing 425µm sieve

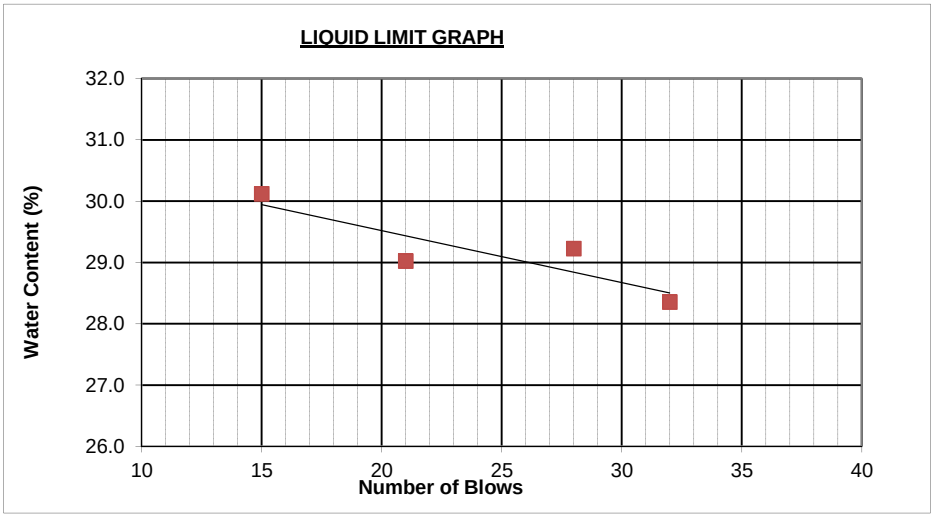
Sample history: Natural state

Description of Sample: **Sandy SILT, brown, sand is; fine**

	Liquid Limit			
No. of blows	15	21	28	32
Water content (%)	30.1	29.0	29.2	28.4

Plastic Limit	
23.5	23.7

NWC	**-**
Liquid Limit	**29**
Plastic Limit	**24**
Plasticity Index	**5**



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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.2,2.3,2.4

Lab Job No:	8378-019	**Sample No.:**	C19-210
Client:	Miyamoto International	**Tested By:**	B.L.
Location:	Sutherlands Road HA5 0.8-1.4m	**Date Tested:**	26/02/2019
		Checked By:	
Date Received:	14/02/2019	**Date Checked:**	
Report No:		**Page:**	
REF:			
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	5/02/2019		

Preliminary

Test Details:

Test performed on: Fraction passing 425μm sieve

Sample history: Natural state

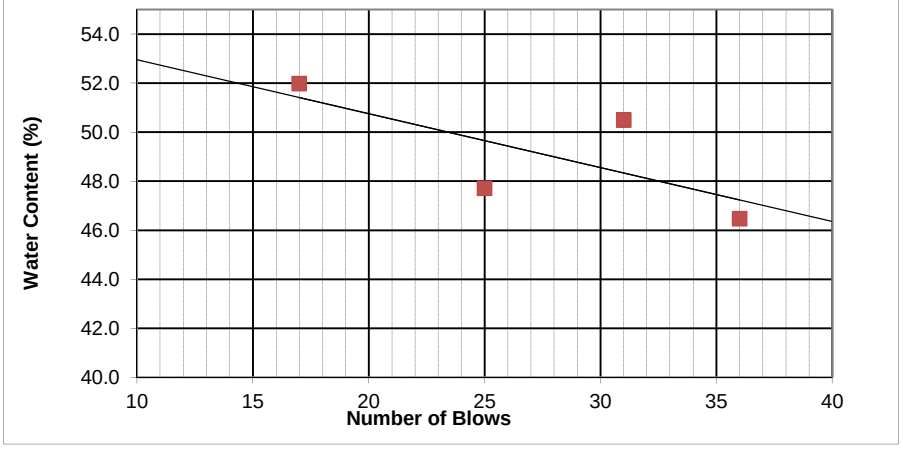
Description of Sample: **SILT, traces of fine to medium sand, grey**

	Liquid Limit			
No. of blows	17	25	31	36
Water content (%)	52.0	47.7	50.5	46.5

Plastic Limit	
24.7	25.7

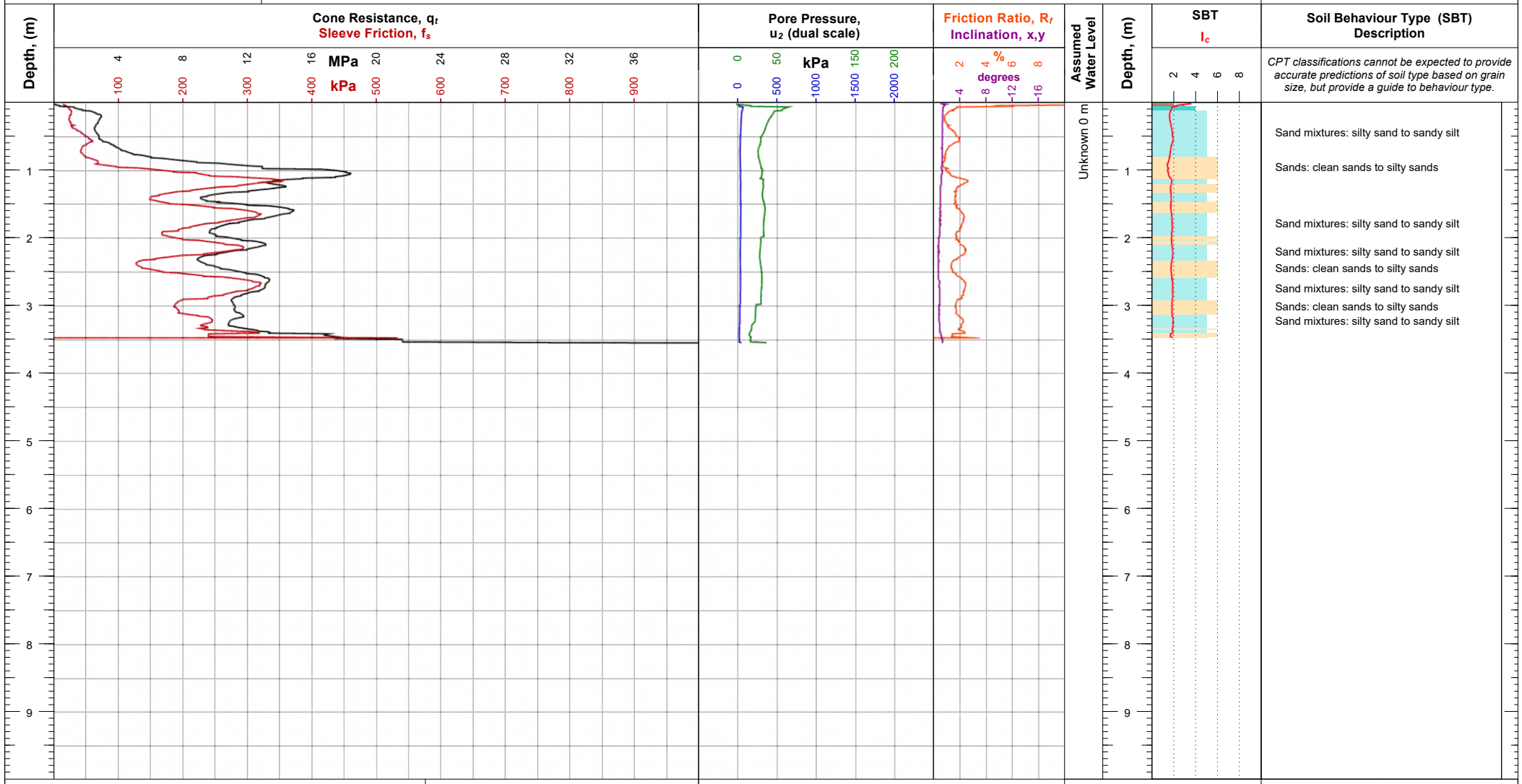
NWC	**-**
Liquid Limit	**49**
Plastic Limit	**25**
Plasticity Index	**24**

LIQUID LIMIT GRAPH



CONE PENETRATION TEST (CPT) LOGS

CONE PENETRATION TEST (CPT) LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ300
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5173107.95, 1565924.64
WGS84, (deg): -43.594221, 172.577850
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: Limit of reaction force

Elevation (m): Unknown
Date of Test: 1/07/2019
Depth (m): 3.55
Pre-Drill (m): N/A

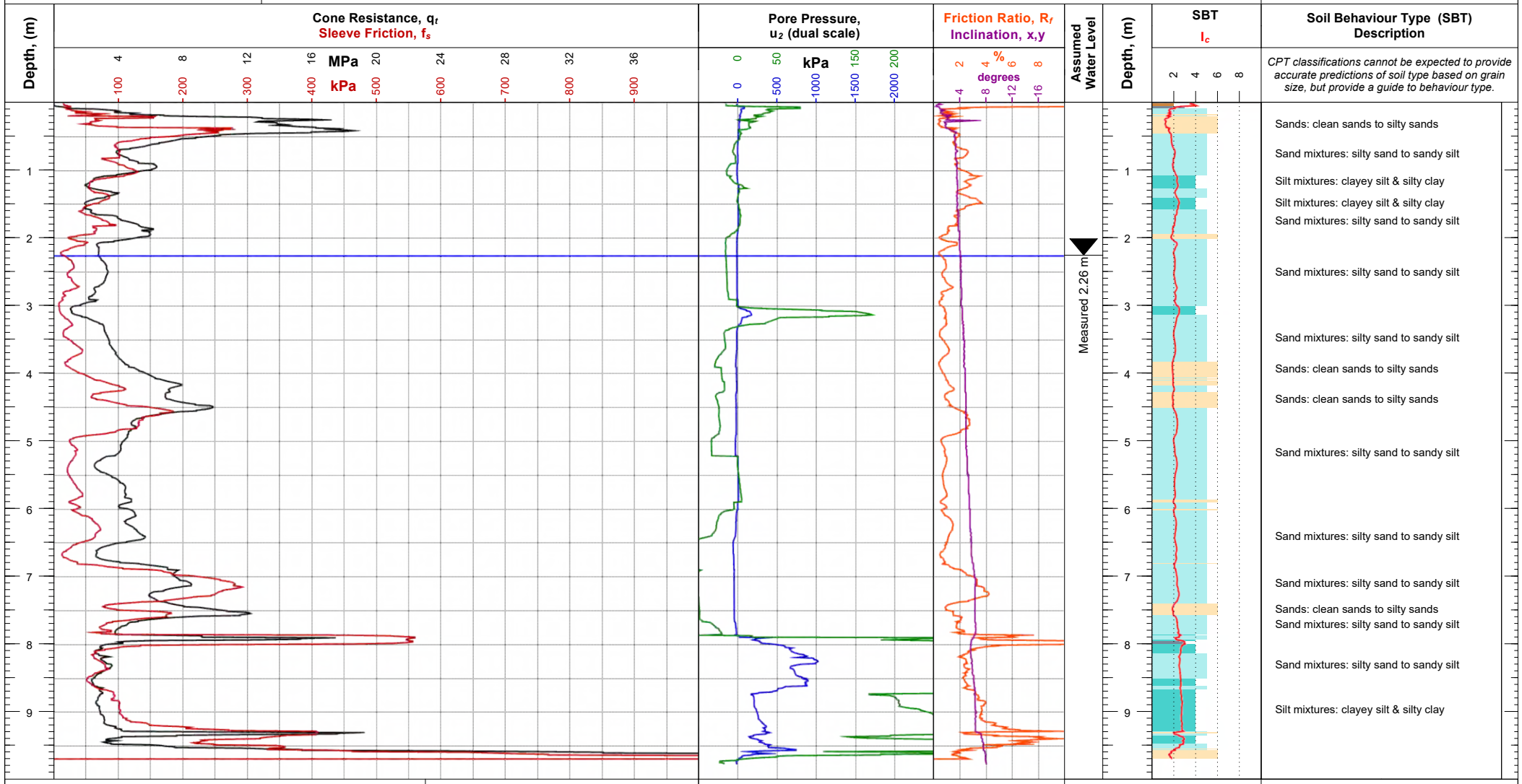
Client Job Ref:

CPT Number: CPT-01

G.I. Job Ref: 190422

Remarks: Continued with DPSH-01

CONE PENETRATION TEST (CPT) LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ300
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5173128.74, 1566021.91
WGS84, (deg): 43.594038, 172.579056
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: Limit of reaction force

Elevation (m): Unknown
Date of Test: 1/07/2019
Depth (m): 9.77
Pre-Drill (m): N/A

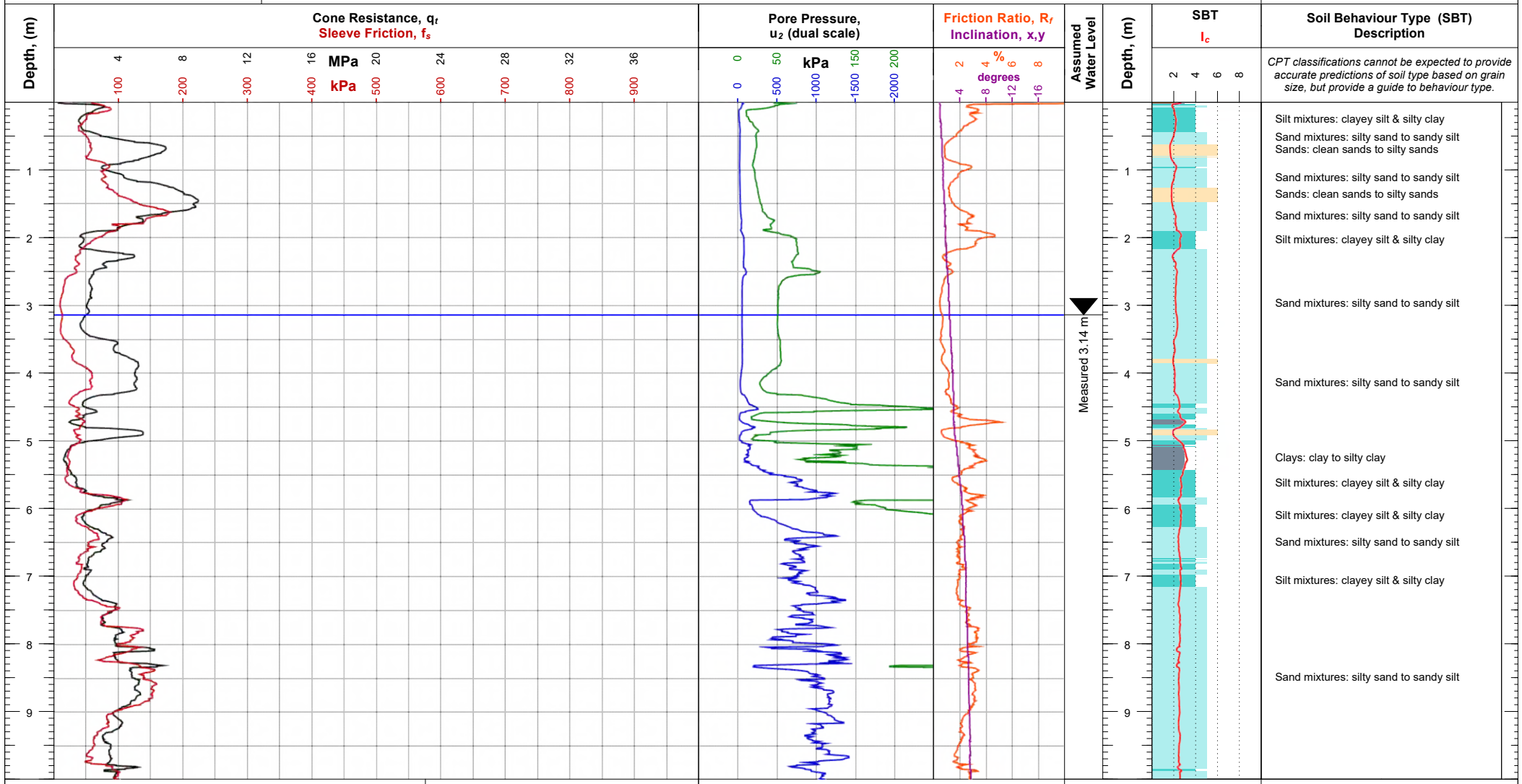
Client Job Ref:

CPT Number: CPT-02

G.I. Job Ref: 190422

Remarks:

CONE PENETRATION TEST (CPT) LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ300
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5173172.01, 1566208.23
WGS84, (deg): 43.593657, 172.581367
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: High friction resistance

Elevation (m): Unknown
Date of Test: 1/07/2019
Depth (m): 14.28
Pre-Drill (m): N/A

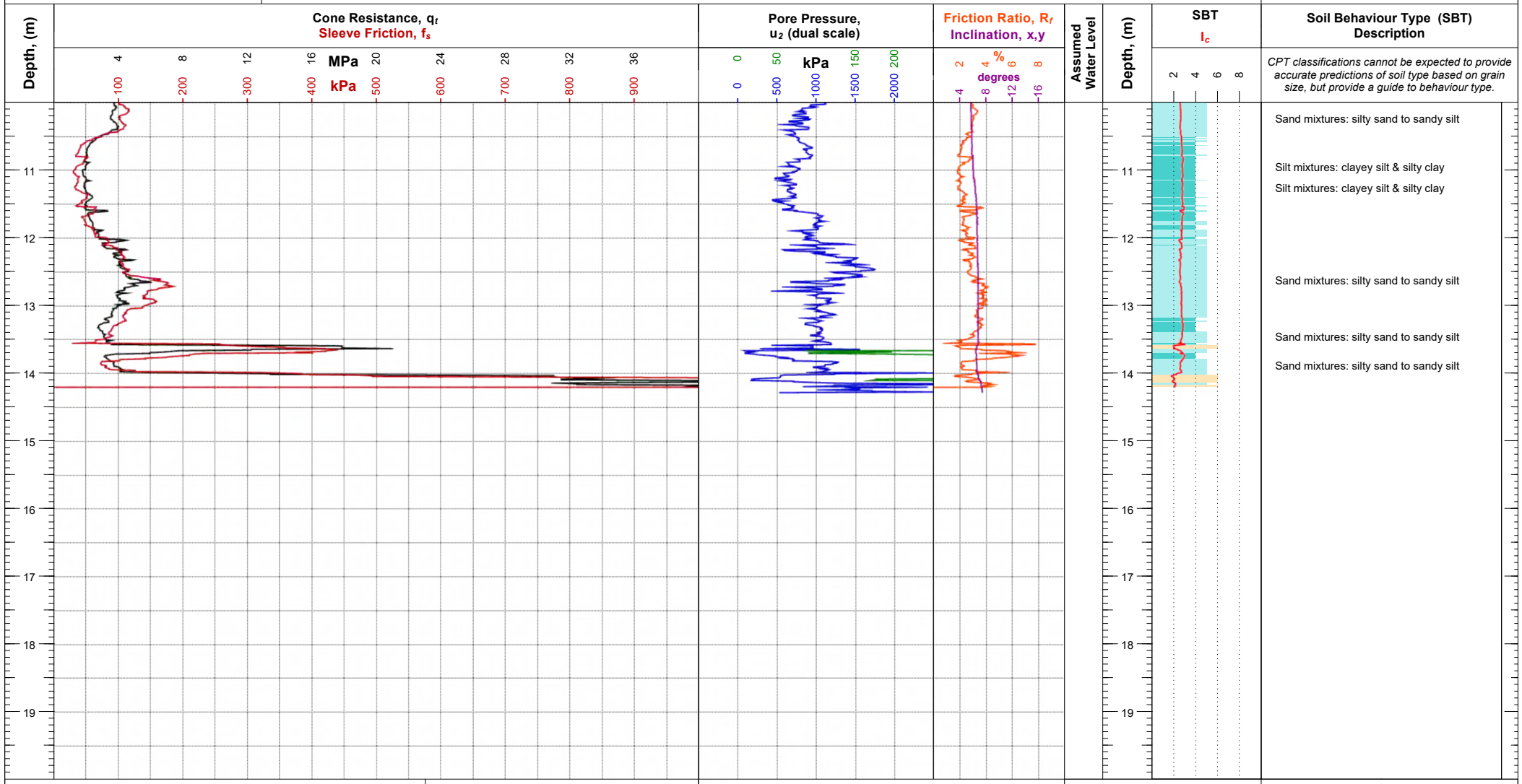
Client Job Ref:

CPT Number: CPT-03

G.I. Job Ref: 190422

Remarks:

CONE PENETRATION TEST (CPT) LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ300
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5173172.01, 1566208.23
WGS84, (deg): 43.593657, 172.581367
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: High friction resistance

Elevation (m): Unknown
Date of Test: 1/07/2019
Depth (m): 14.28
Pre-Drill (m): N/A

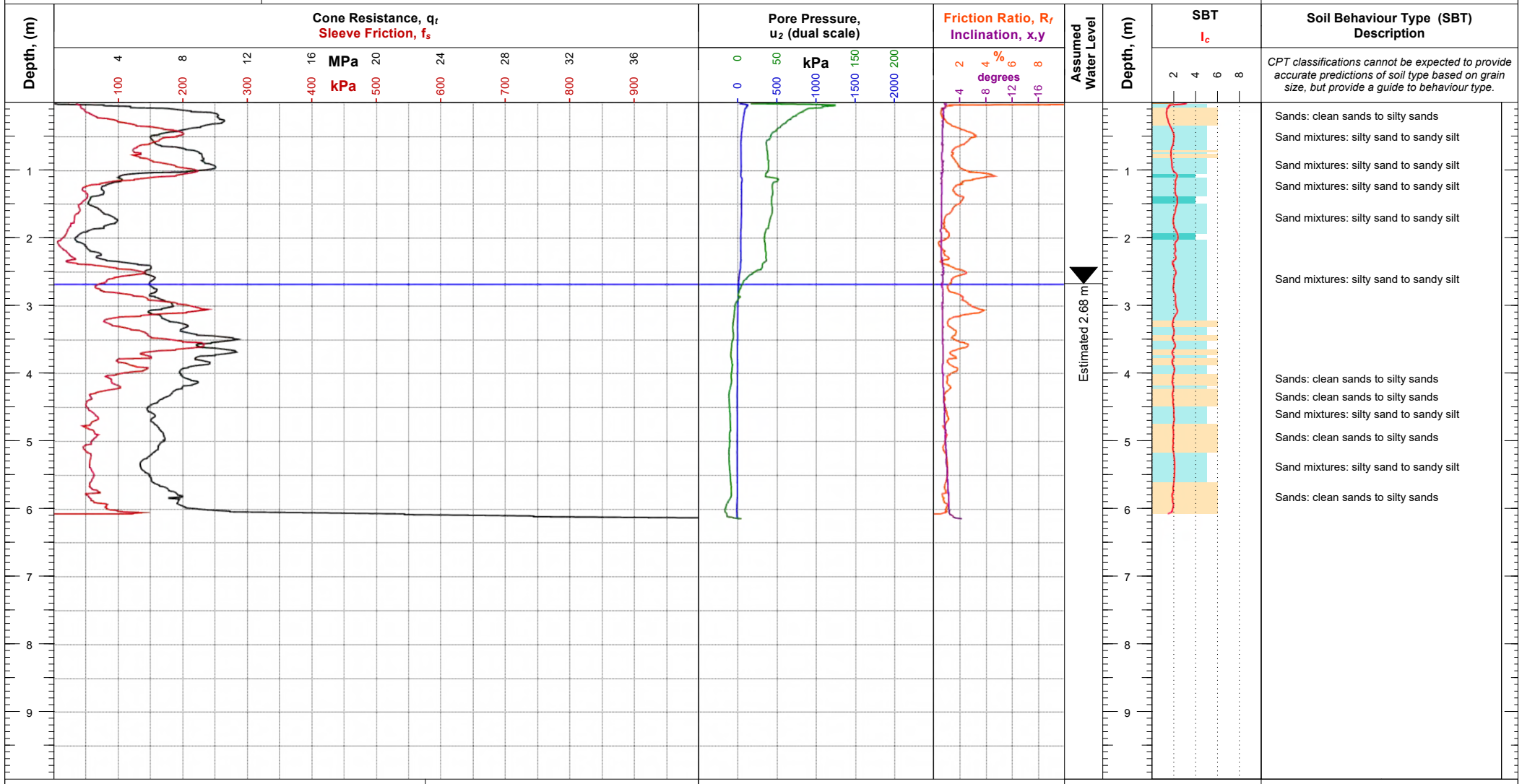
Client Job Ref:

CPT Number: CPT-03

G.I. Job Ref: 190422

Remarks:

CONE PENETRATION TEST (CPT) LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ300
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5173140.2, 1566142.36
WGS84, (deg): 43.593941, 172.580549
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: High cone end resistance

Elevation (m): Unknown
Date of Test: 2/07/2019
Depth (m): 6.15
Pre-Drill (m): N/A

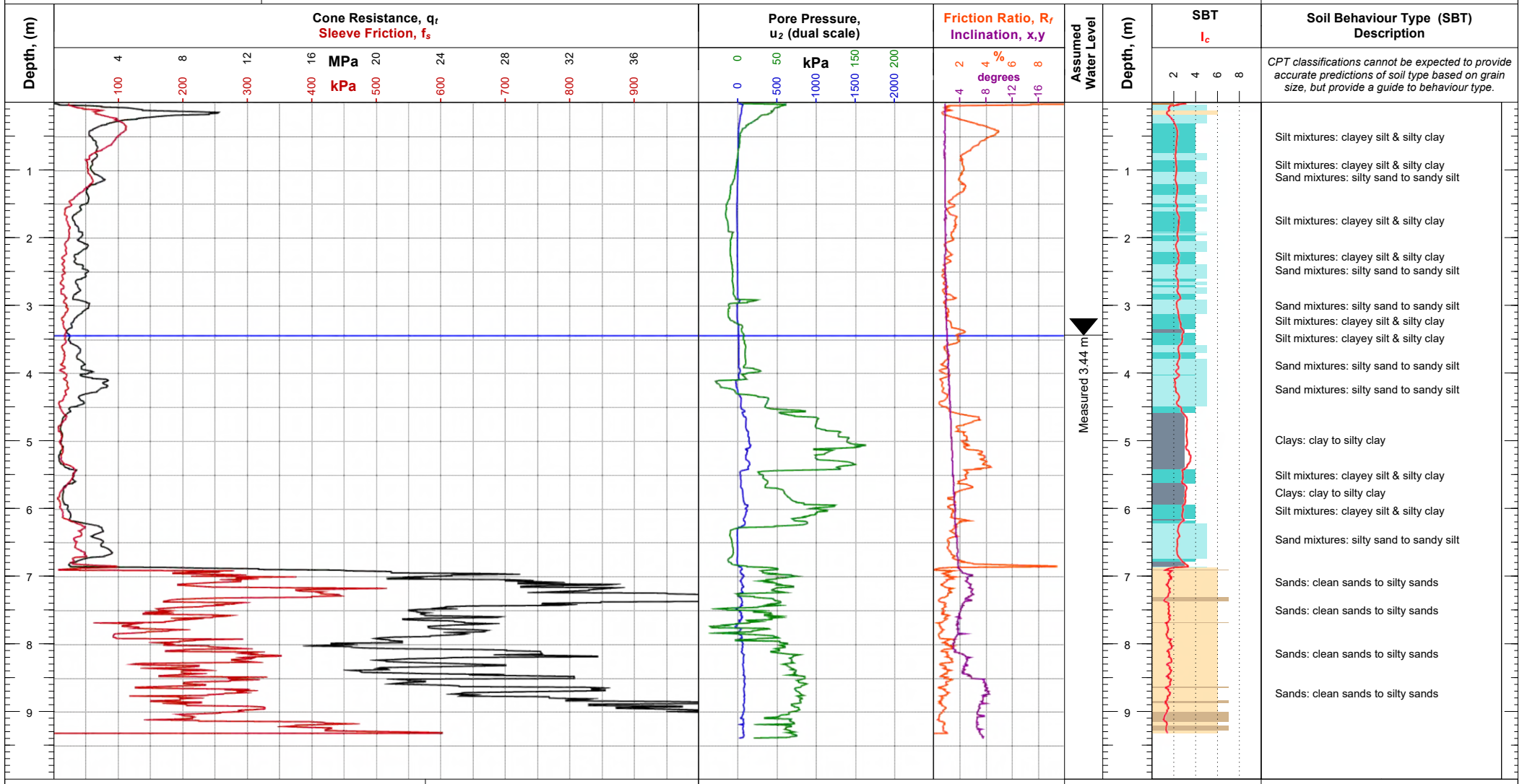
Client Job Ref:

CPT Number: SCPT-04

G.I. Job Ref: 190422

Remarks:

CONE PENETRATION TEST (CPT) LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ300
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5173253.19, 1566023.17
WGS84, (deg): 43.592918, 172.579079
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: High cone end resistance

Elevation (m): Unknown
Date of Test: 2/07/2019
Depth (m): 9.39
Pre-Drill (m): N/A

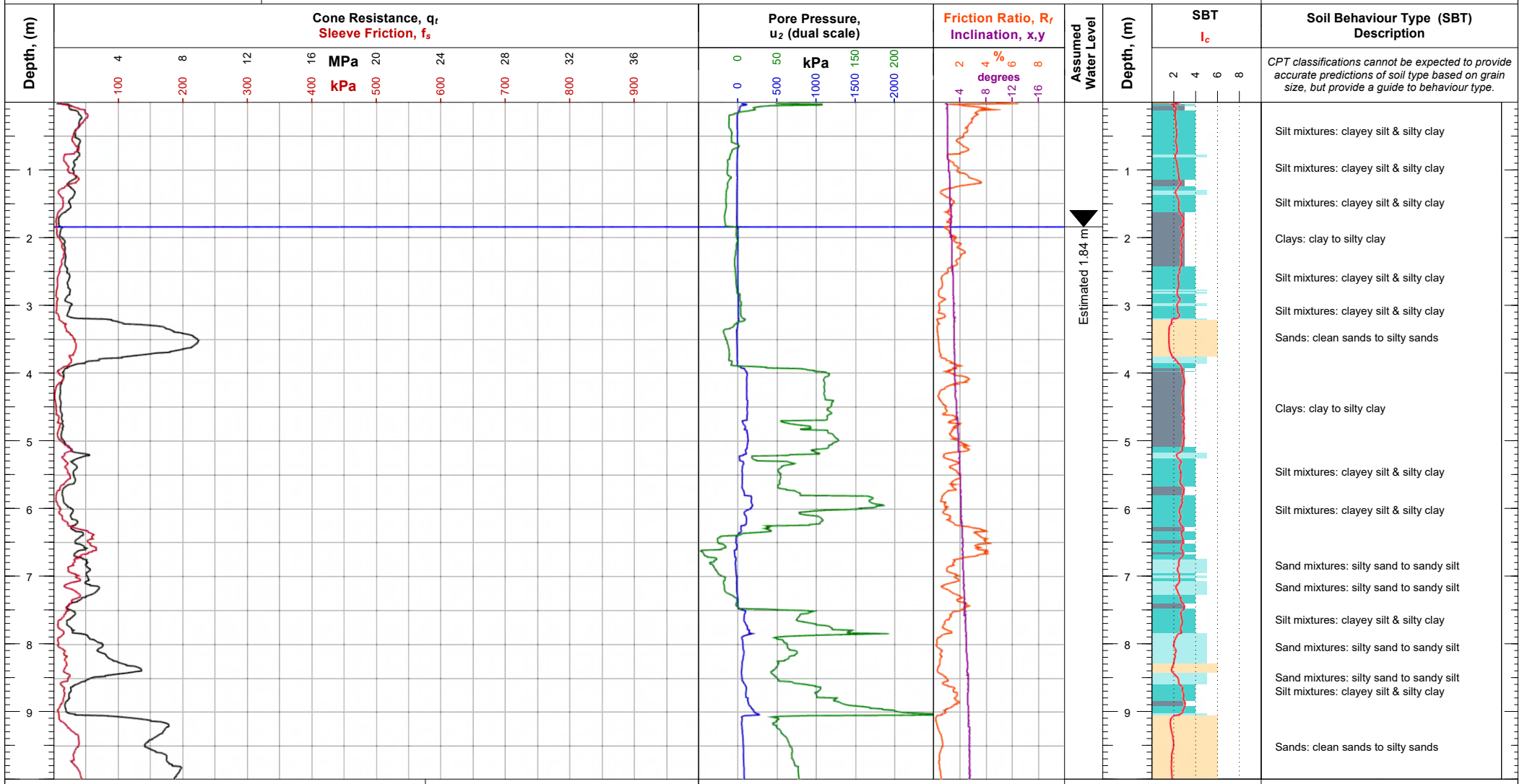
Client Job Ref:

CPT Number: SCPT-05

G.I. Job Ref: 190422

Remarks:

CONE PENETRATION TEST (CPT) LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ300
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5173409.72, 1566143.06
WGS84, (deg): 43.591514, 172.580574
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: Target depth

Elevation (m): Unknown
Date of Test: 2/07/2019
Depth (m): 15.17
Pre-Drill (m): N/A

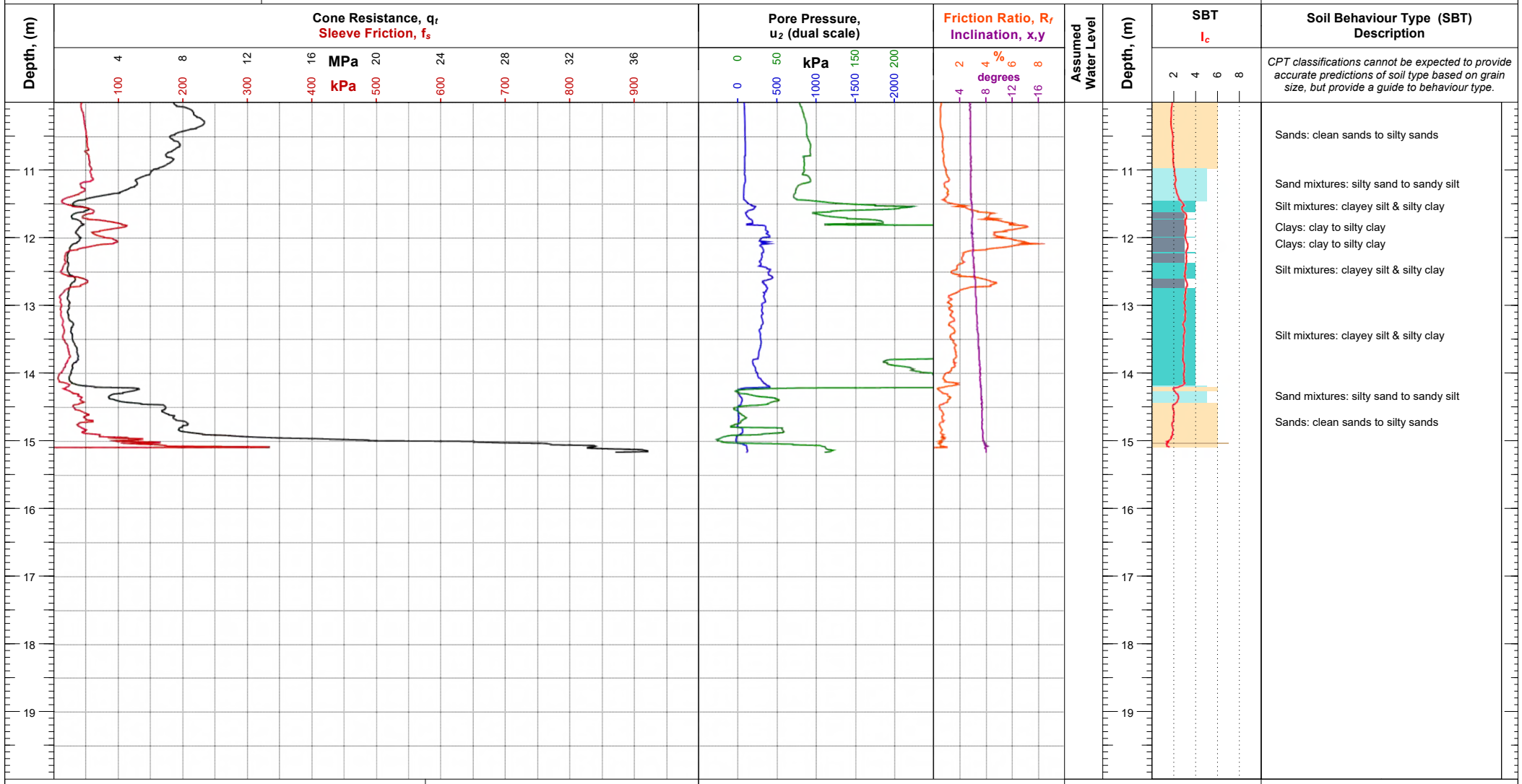
Client Job Ref:

CPT Number: SCPT-06

G.I. Job Ref: 190422

Remarks:

CONE PENETRATION TEST (CPT) LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ300
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5173409.72, 1566143.06
WGS84, (deg): 43.591514, 172.580574
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: Target depth

Elevation (m): Unknown
Date of Test: 2/07/2019
Depth (m): 15.17
Pre-Drill (m): N/A

Client Job Ref:

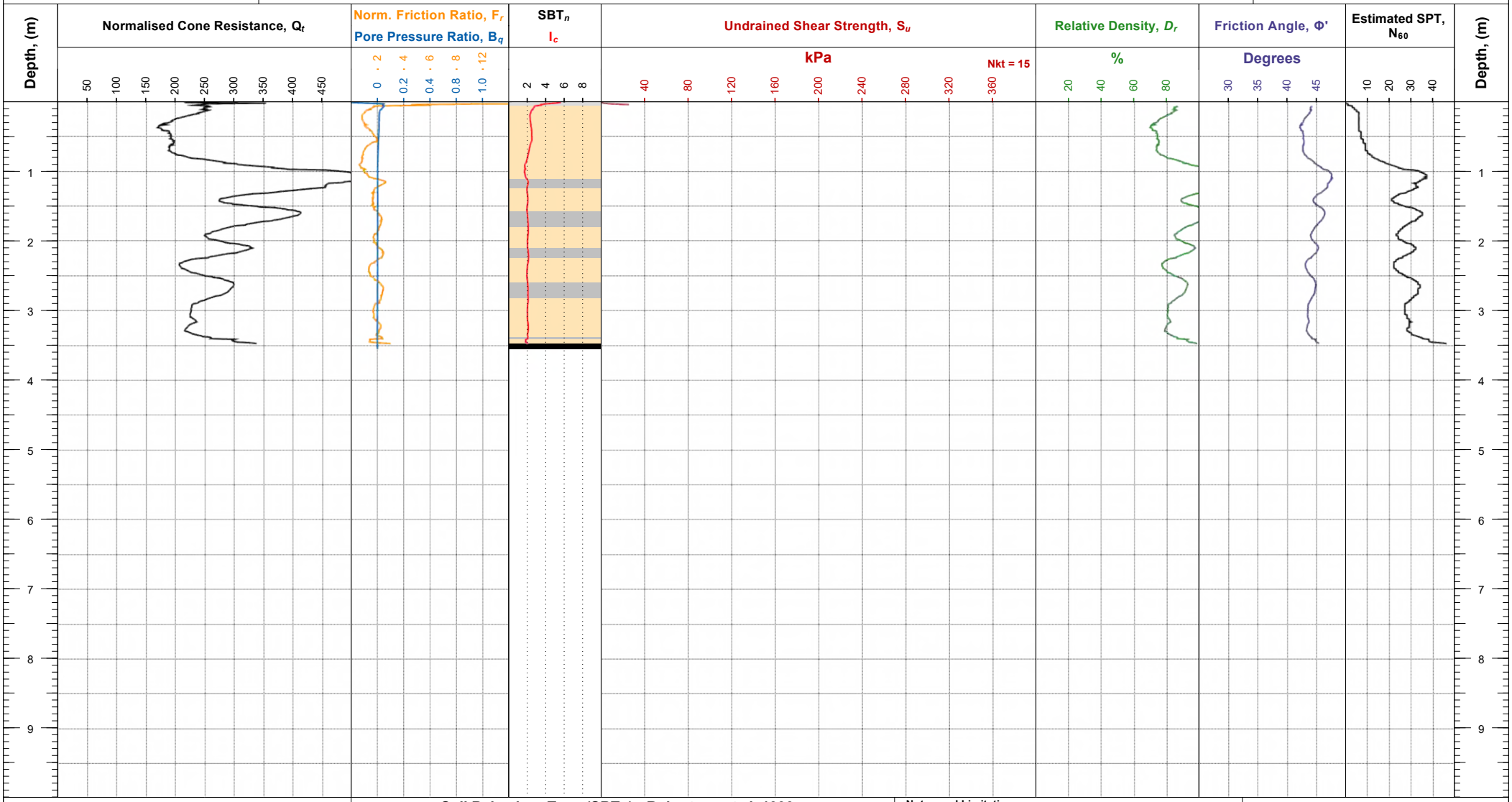
CPT Number: SCPT-06

G.I. Job Ref: 190422

Remarks:

CONE PENETRATION TEST (CPT) PARAMETER LOGS

CONE PENETRATION TEST (CPT) PARAMETER LOG



Client: Miyamoto International NZ Ltd

Project: 1 Sutherlands Road

Location: Halswell, Christchurch

Engineer: Charles McDermott

Contractor: Ground Investigation Ltd.

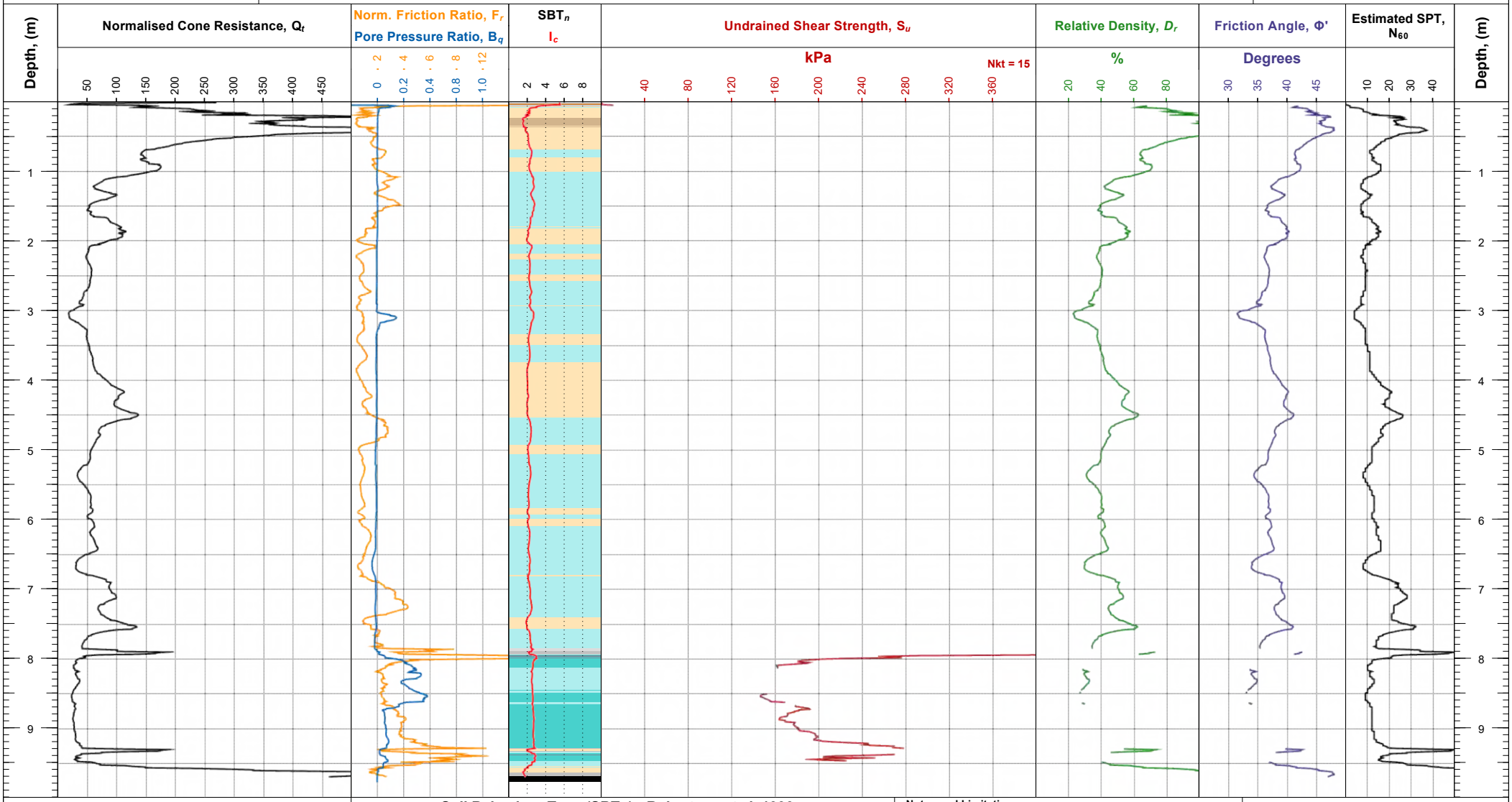
Soil Behaviour Type (SBTn) - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
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 & silty clay	9	Stiff fine-grained

Notes and Limitations:
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. Ground Investigation Ltd does not warrant the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Job Ref:	
CPT Number:	**CPT-01**
G.I. Job Ref:	**190422**
Test Date:	**02/07/2019**

CONE PENETRATION TEST (CPT) PARAMETER LOG



Client: Miyamoto International NZ Ltd

Project: 1 Sutherlands Road

Location: Halswell, Christchurch

Engineer: Charles McDermott

Contractor: Ground Investigation Ltd.

Soil Behaviour Type (SBTn) - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
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4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Notes and Limitations:
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. Ground Investigation Ltd does not warrant the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

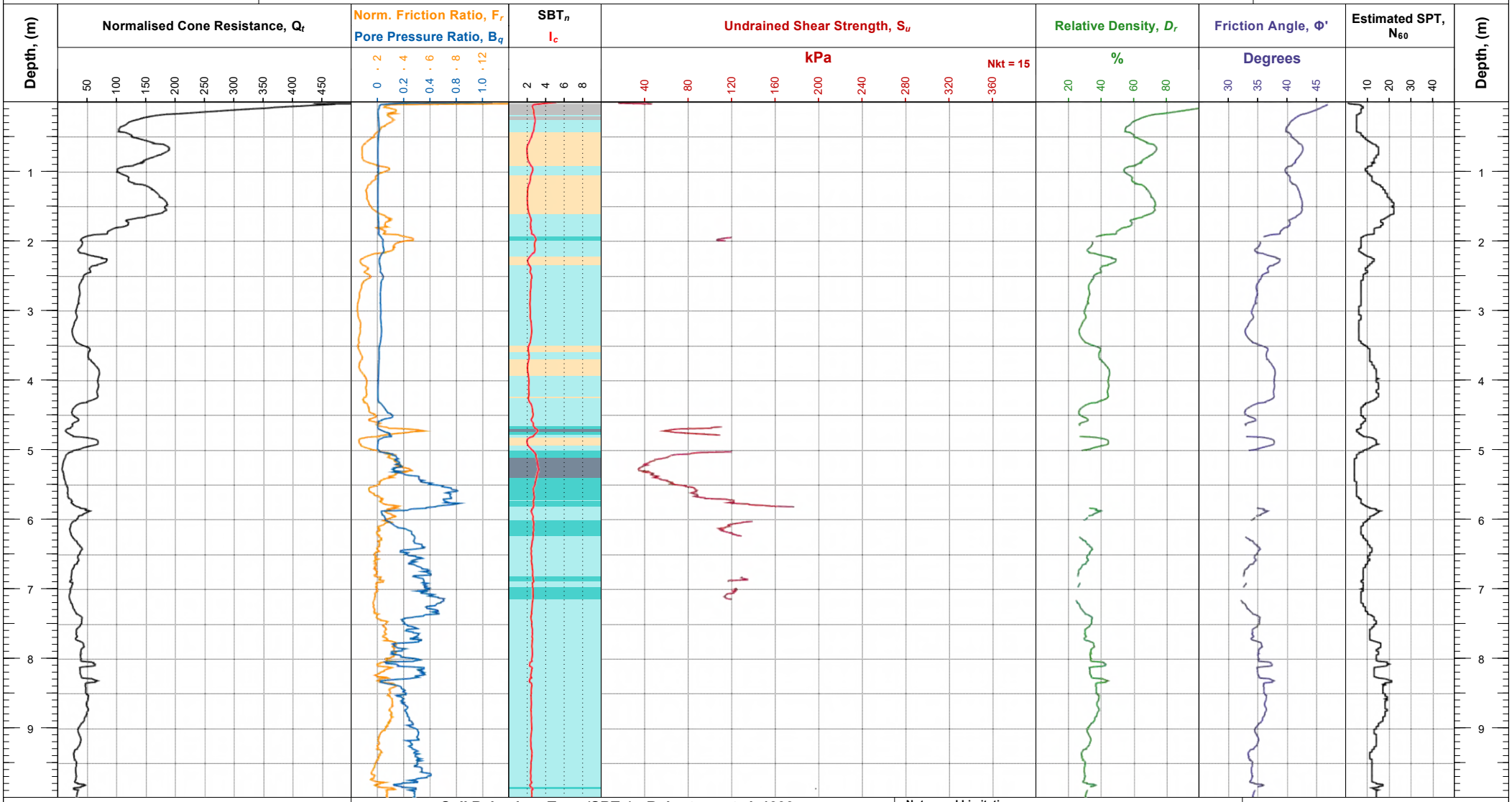
Client Job Ref:

CPT Number: **CPT-02**

G.I. Job Ref: **190422**

Test Date: **02/07/2019**

CONE PENETRATION TEST (CPT) PARAMETER LOG



Client: Miyamoto International NZ Ltd

Project: 1 Sutherlands Road

Location: Halswell, Christchurch

Engineer: Charles McDermott

Contractor: Ground Investigation Ltd.

Soil Behaviour Type (SBTn) - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
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 & silty clay	9	Stiff fine-grained

Notes and Limitations:
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. Ground Investigation Ltd does not warrant the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

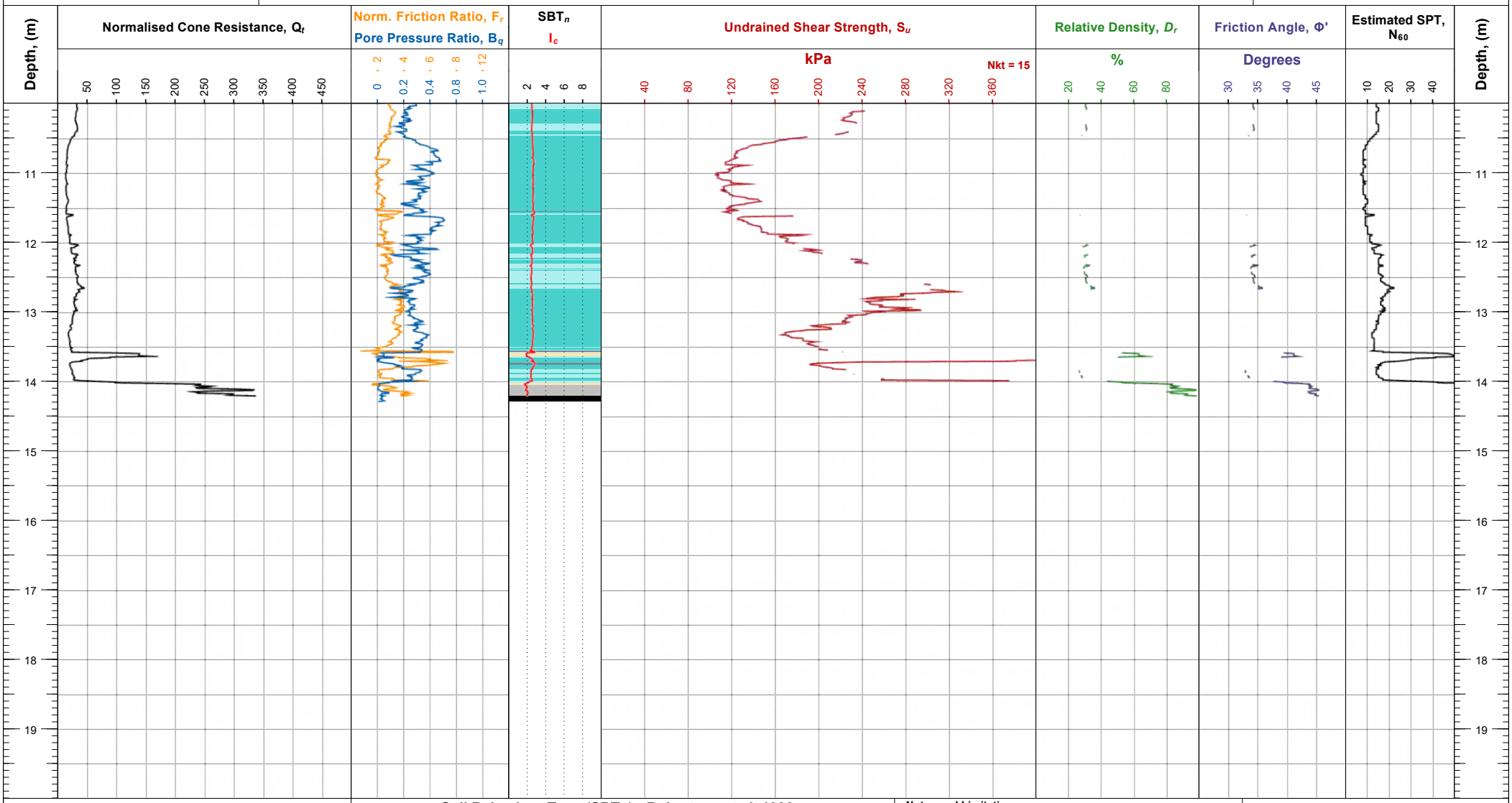
Client Job Ref:

CPT Number: **CPT-03**

G.I. Job Ref: **190422**

Test Date: **02/07/2019**

CONE PENETRATION TEST (CPT) PARAMETER LOG



Client: Miyamoto International NZ Ltd

Project: 1 Sutherlands Road

Location: Halswell, Christchurch

Engineer: Charles McDermott

Contractor: Ground Investigation Ltd.

Soil Behaviour Type (SBTn) - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
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 & silty clay	9	Stiff fine-grained

Notes and Limitations:
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. Ground Investigation Ltd does not warrant the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

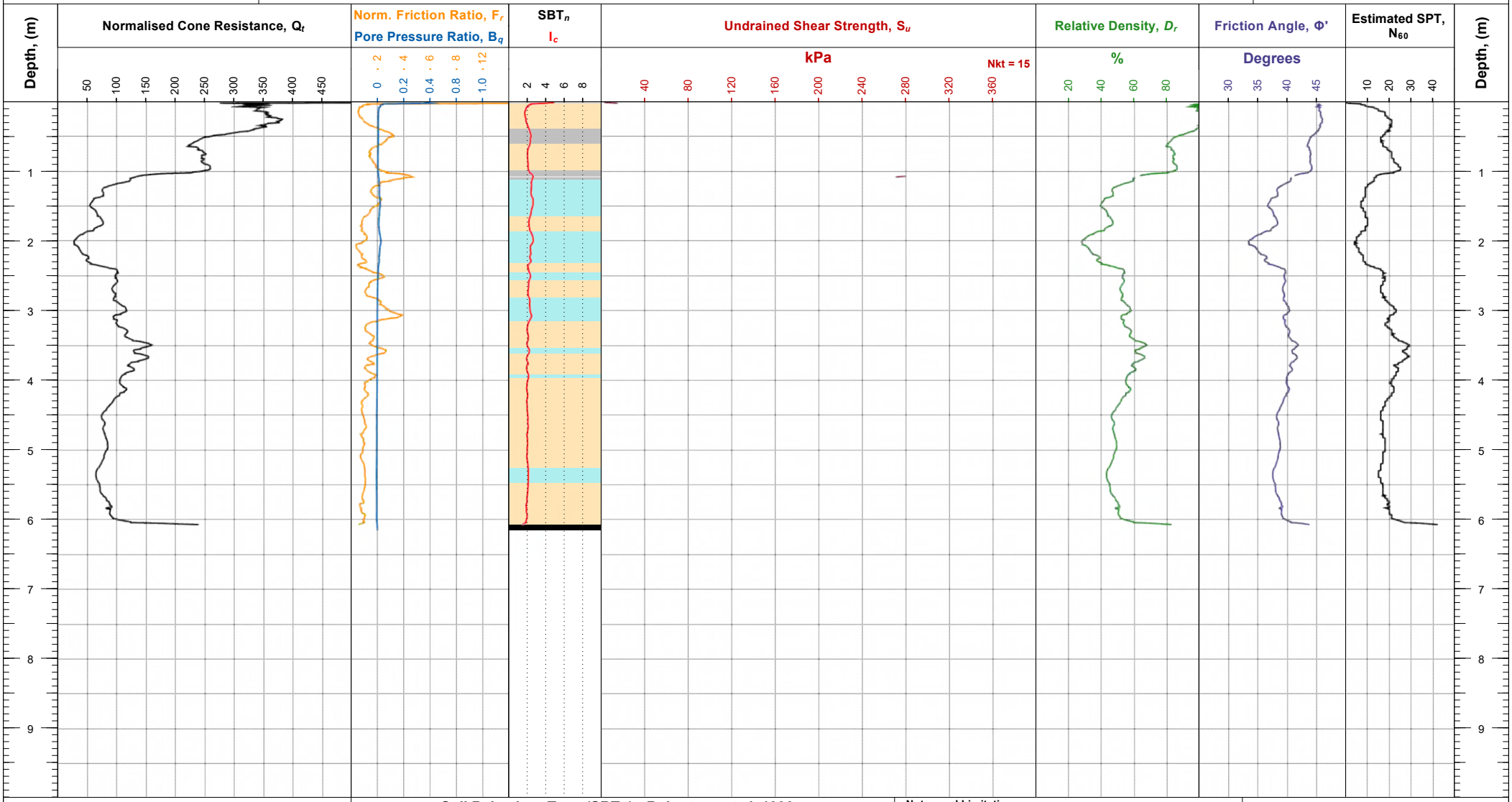
Client Job Ref:

CPT Number: CPT-03

G.I. Job Ref: 190422

Test Date: 02/07/2019

CONE PENETRATION TEST (CPT) PARAMETER LOG



Client: Miyamoto International NZ Ltd

Project: 1 Sutherlands Road

Location: Halswell, Christchurch

Engineer: Charles McDermott

Contractor: Ground Investigation Ltd.

Soil Behaviour Type (SBTn) - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
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4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Notes and Limitations:
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. Ground Investigation Ltd does not warrant the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

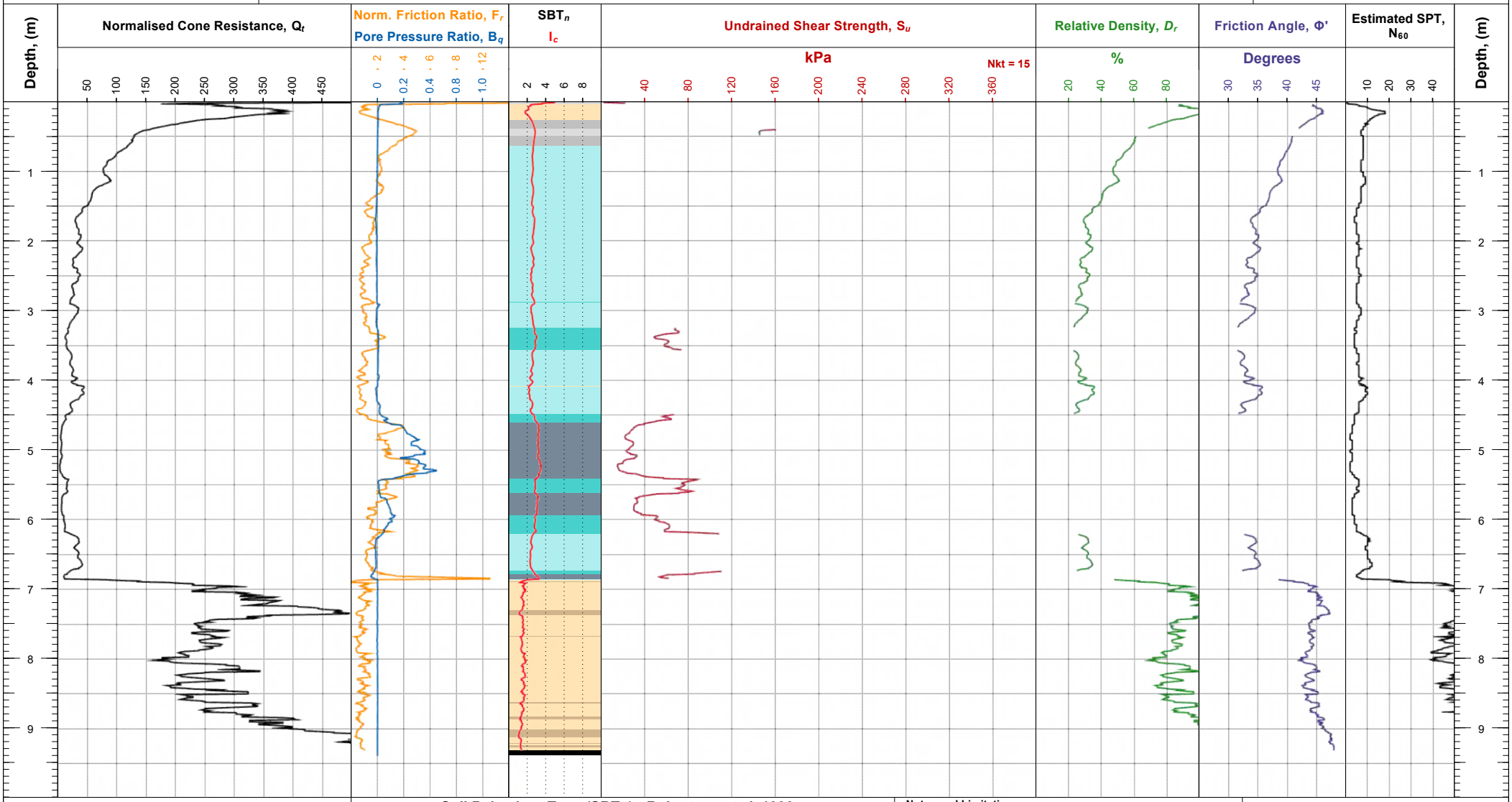
Client Job Ref:

CPT Number: SCPT-04

G.I. Job Ref: 190422

Test Date: 02/07/2019

CONE PENETRATION TEST (CPT) PARAMETER LOG



Client: Miyamoto International NZ Ltd

Project: 1 Sutherlands Road

Location: Halswell, Christchurch

Engineer: Charles McDermott

Contractor: Ground Investigation Ltd.

Soil Behaviour Type (SBTn) - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
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 & silty clay	9	Stiff fine-grained

Notes and Limitations:
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. Ground Investigation Ltd does not warrant the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

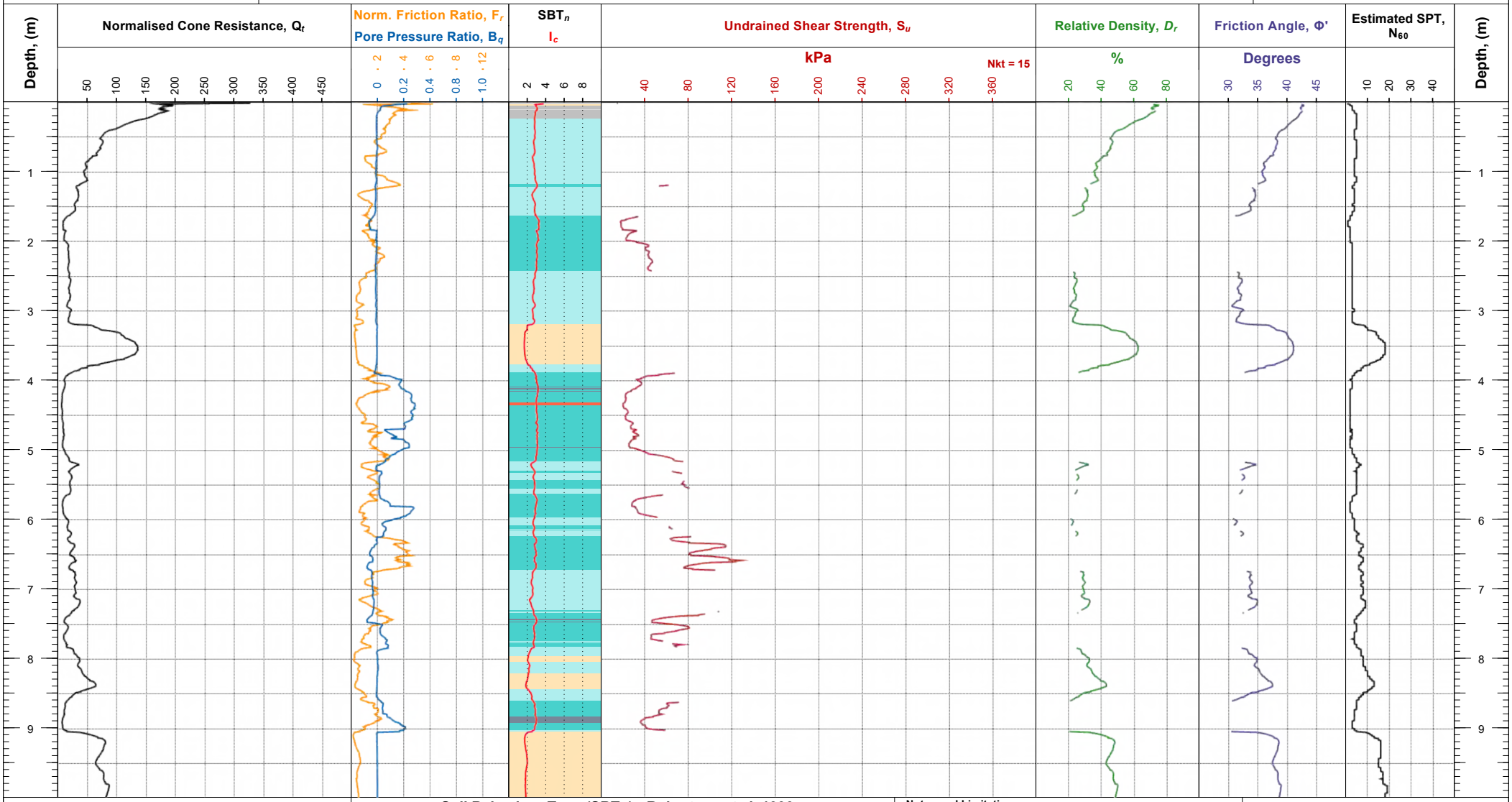
Client Job Ref:

CPT Number: SCPT-05

G.I. Job Ref: 190422

Test Date: 02/07/2019

CONE PENETRATION TEST (CPT) PARAMETER LOG



Client: Miyamoto International NZ Ltd

Project: 1 Sutherlands Road

Location: Halswell, Christchurch

Engineer: Charles McDermott

Contractor: Ground Investigation Ltd.

Soil Behaviour Type (SBTn) - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
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4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Notes and Limitations:
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. Ground Investigation Ltd does not warrant the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

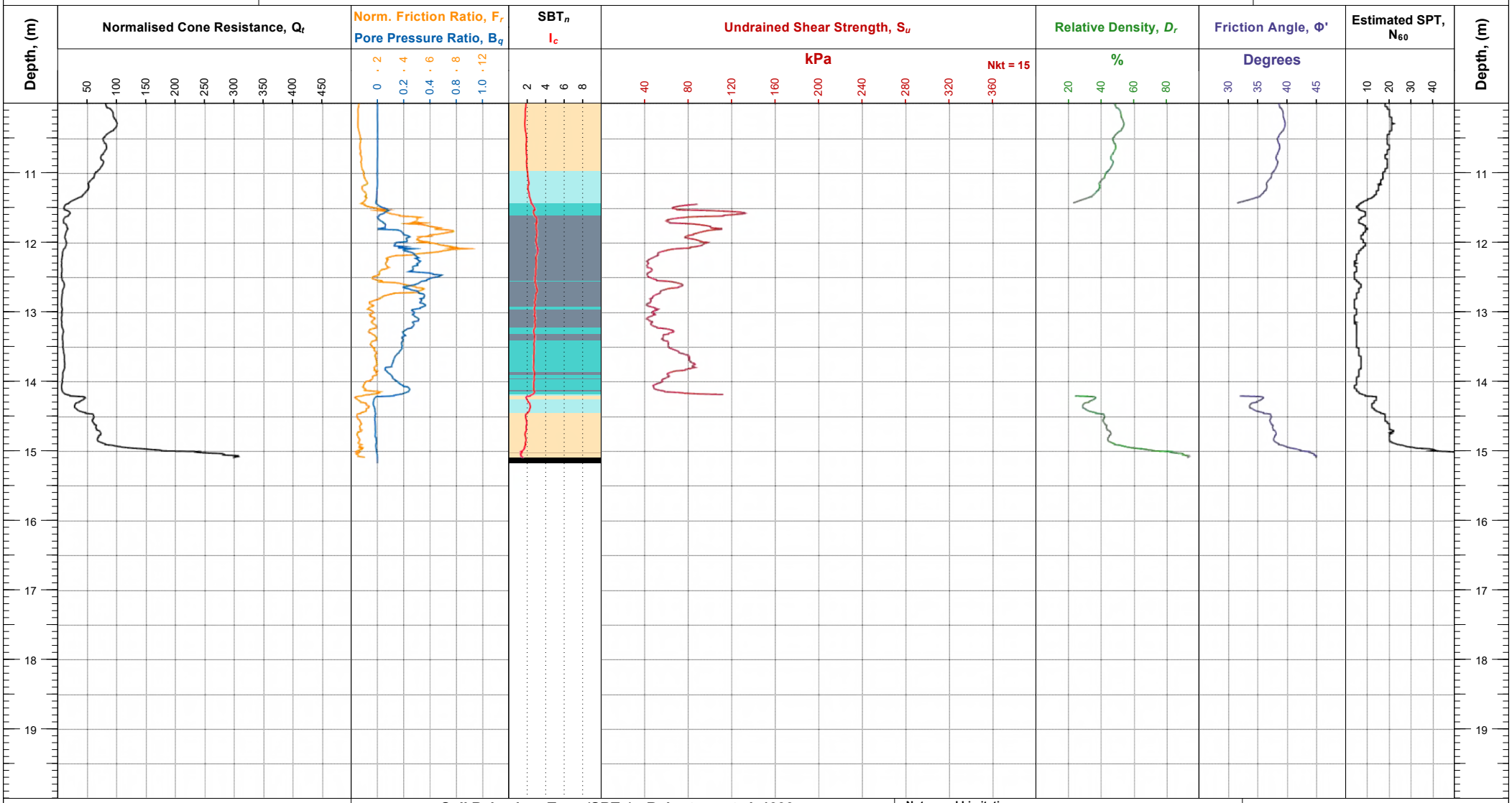
Client Job Ref:

CPT Number: **SCPT-06**

G.I. Job Ref: **190422**

Test Date: **02/07/2019**

CONE PENETRATION TEST (CPT) PARAMETER LOG



Client: Miyamoto International NZ Ltd

Project: 1 Sutherlands Road

Location: Halswell, Christchurch

Engineer: Charles McDermott

Contractor: Ground Investigation Ltd.

Soil Behaviour Type (SBTn) - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
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4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Notes and Limitations:
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. Ground Investigation Ltd does not warrant the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Job Ref:

CPT Number: SCPT-06

G.I. Job Ref: 190422

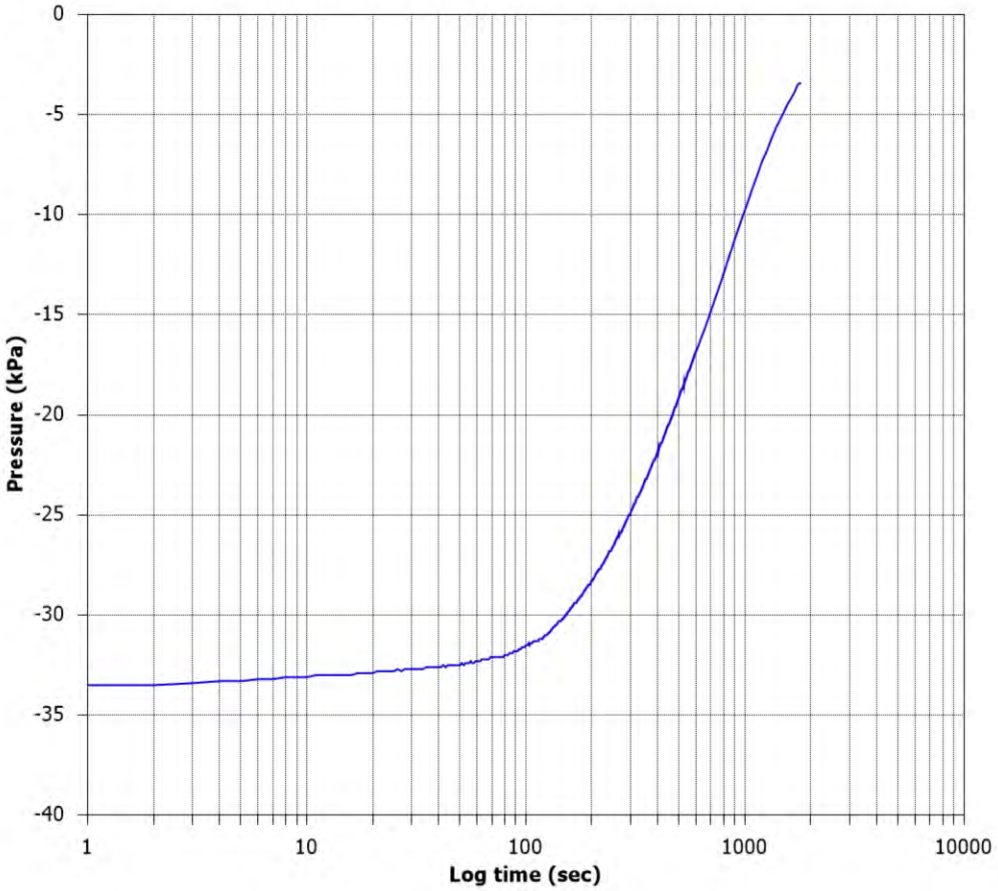
Test Date: 02/07/2019

DISSIPIATION LOGS

CPT DISSIPATION TESTS

1 Sutherlands Road

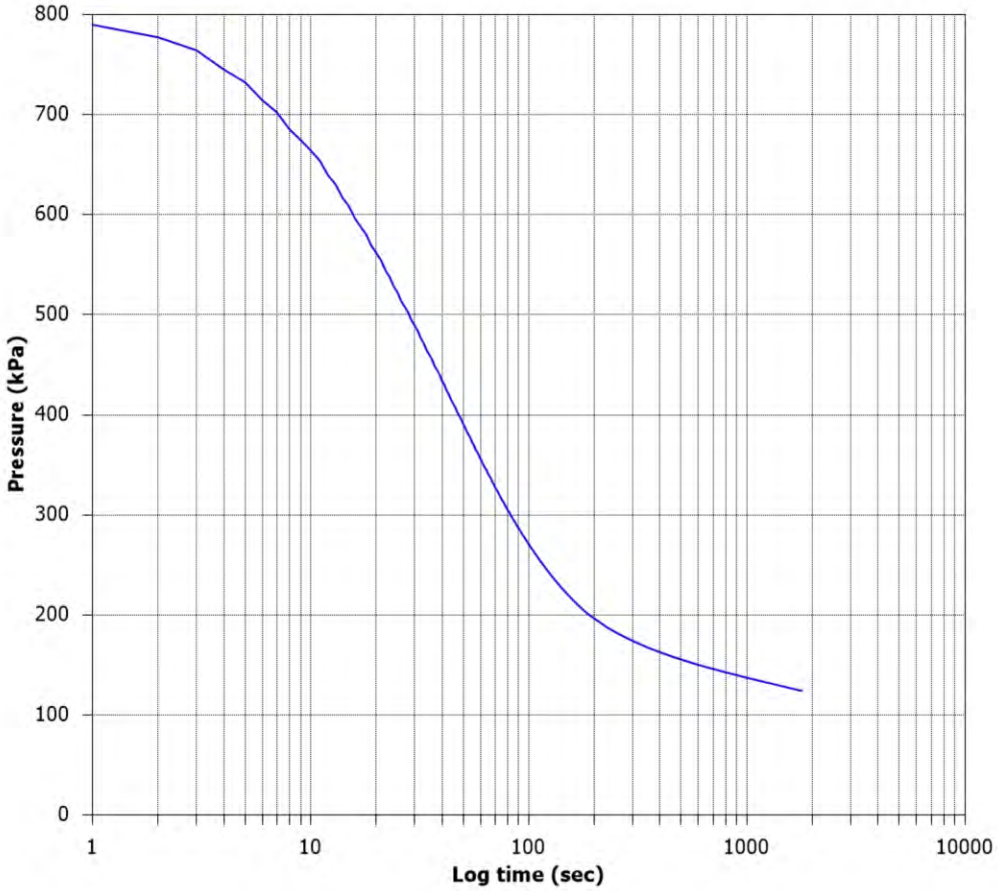
G.I. Ref: 190422



CPT Number: CPT-02 **Water Level:** 2.26 m Source: Measured

Test Date: 2/07/2019 **Depth (m):** 5.21

Remarks:



CPT Number: CPT-03 **Water Level:** 3.14 m Source: Measured

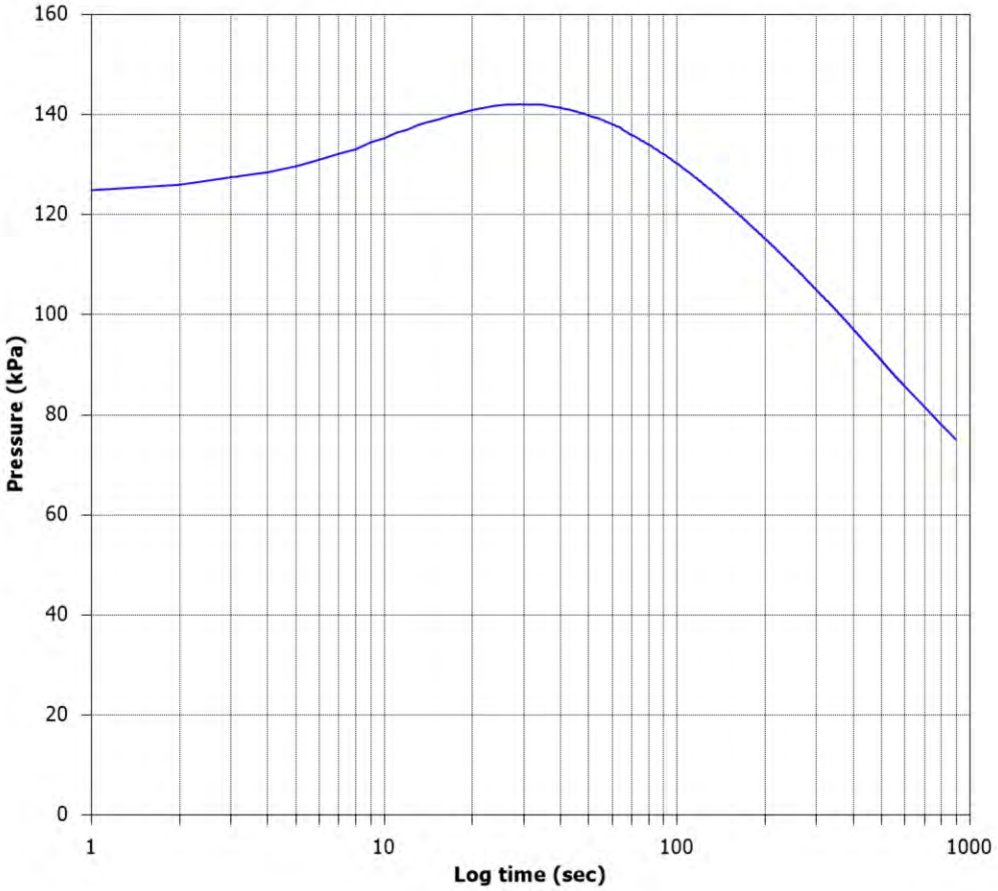
Test Date: 2/07/2019 **Depth (m):** 5.86

Remarks:

CPT DISSIPATION TESTS

1 Sutherlands Road

G.I. Ref: 190422



CPT Number: SCPT-06

Water Level: 1.84 m Source: Estimated

Test Date: 2/07/2019

Depth (m): 4.69

Remarks:

CPT ZEROS AND DRIFT RESULTS

CPT ZEROS AND DRIFT

1 Sutherlands Road

G.I. Ref: 190422

Cone Reference	CPT Name	Push Number	Tip Resistance			Local Friction			Pore Pressure		
			Initial (MPa)	Final (MPa)	Difference (%)	Initial (MPa)	Final (MPa)	Difference (%)	Initial (MPa)	Final (MPa)	Difference (%)
MKJ300	CPT-01	1	20.727	20.852	-0.25	0.272	0.269	0.19	2.845	2.841	0.14
MKJ300	CPT-02	1	20.795	20.763	0.06	0.271	0.270	0.07	2.847	2.851	-0.14
MKJ300	CPT-03	1	20.816	20.732	0.17	0.269	0.270	-0.04	2.817	2.834	-0.68
MKJ300	SCPT-05	1	20.800	20.816	-0.03	0.269	0.269	-0.01	2.831	2.843	-0.48
MKJ300	SCPT-06	1	20.763	20.732	0.06	0.269	0.269	-0.01	2.853	2.864	-0.43
MKJ300	SCPT-04	1	20.774	20.810	-0.07	0.271	0.269	0.12	2.836	2.814	0.86

Client: Miyamoto International NZ Ltd

Project: 1 Sutherlands Road

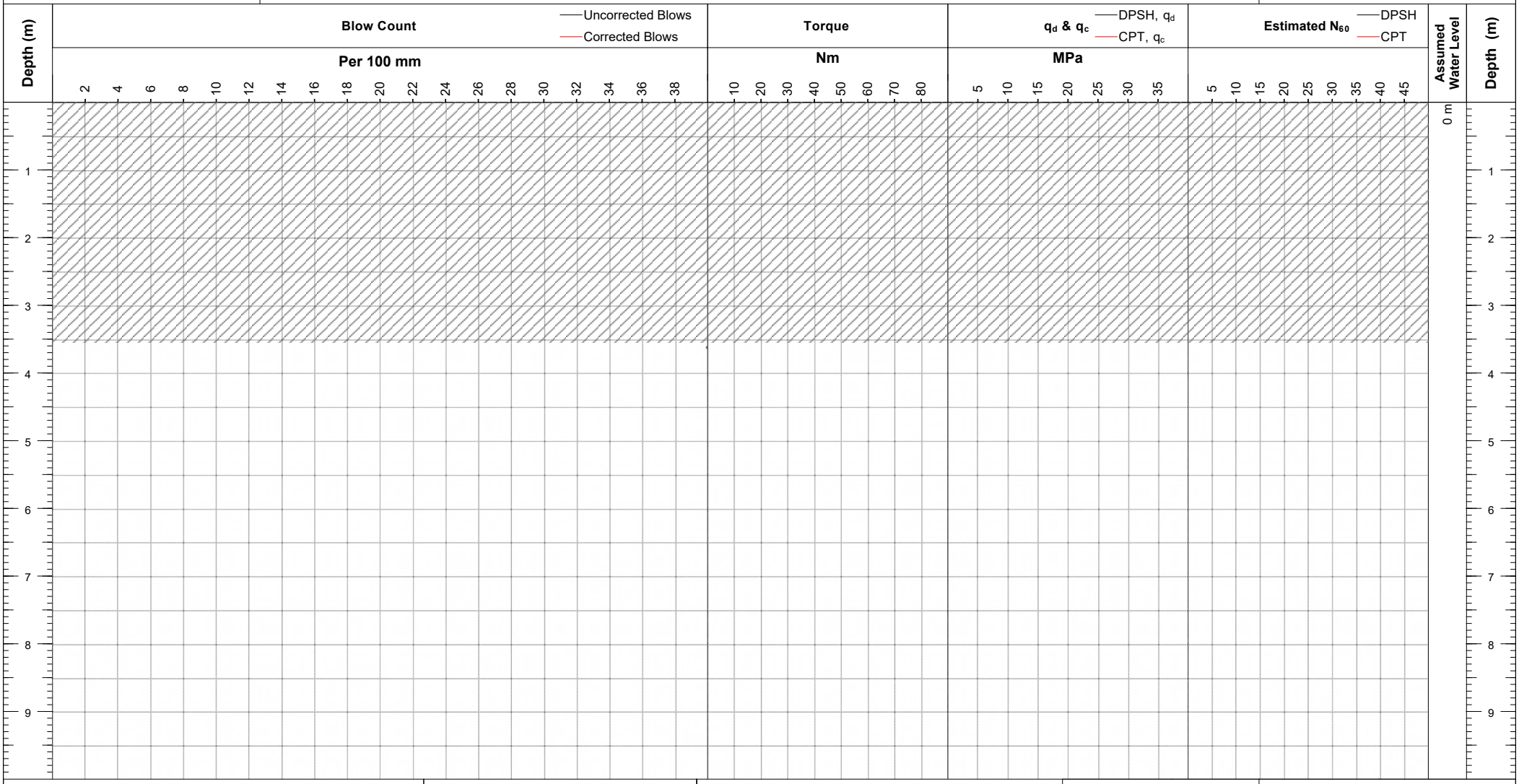
Location: Halswell, Christchurch

Engineer: Charles McDermott

NOTE: Percentage Zero Difference calculated following ASTM D5778-12. Green indicates a difference between -1% and 1%; yellow shows either -1% to -2% or 1% to 2%; red shows below -2% or over 2%

DPSH LOGS

DYNAMIC PROBE SUPER HEAVY (DPSH) LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Hammer Mass: 63.5 kg
Rod Mass: 6.2 kg/m
Energy Efficiency: 96 %
Measured Energy: 448.38
Cone Area: 0.002 m²

NZTM2000 N,E (m): 5173103.95, 1565924.85
WGS84, (deg): 43.594257, 172.577852
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: Very high blow count

Elevation (m): Unknown
Date of Test: 1/07/2019
Depth (m): 3.60
Pre-Drill (m): N/A

Client Job Ref:

DPSH Number: DPSH-01

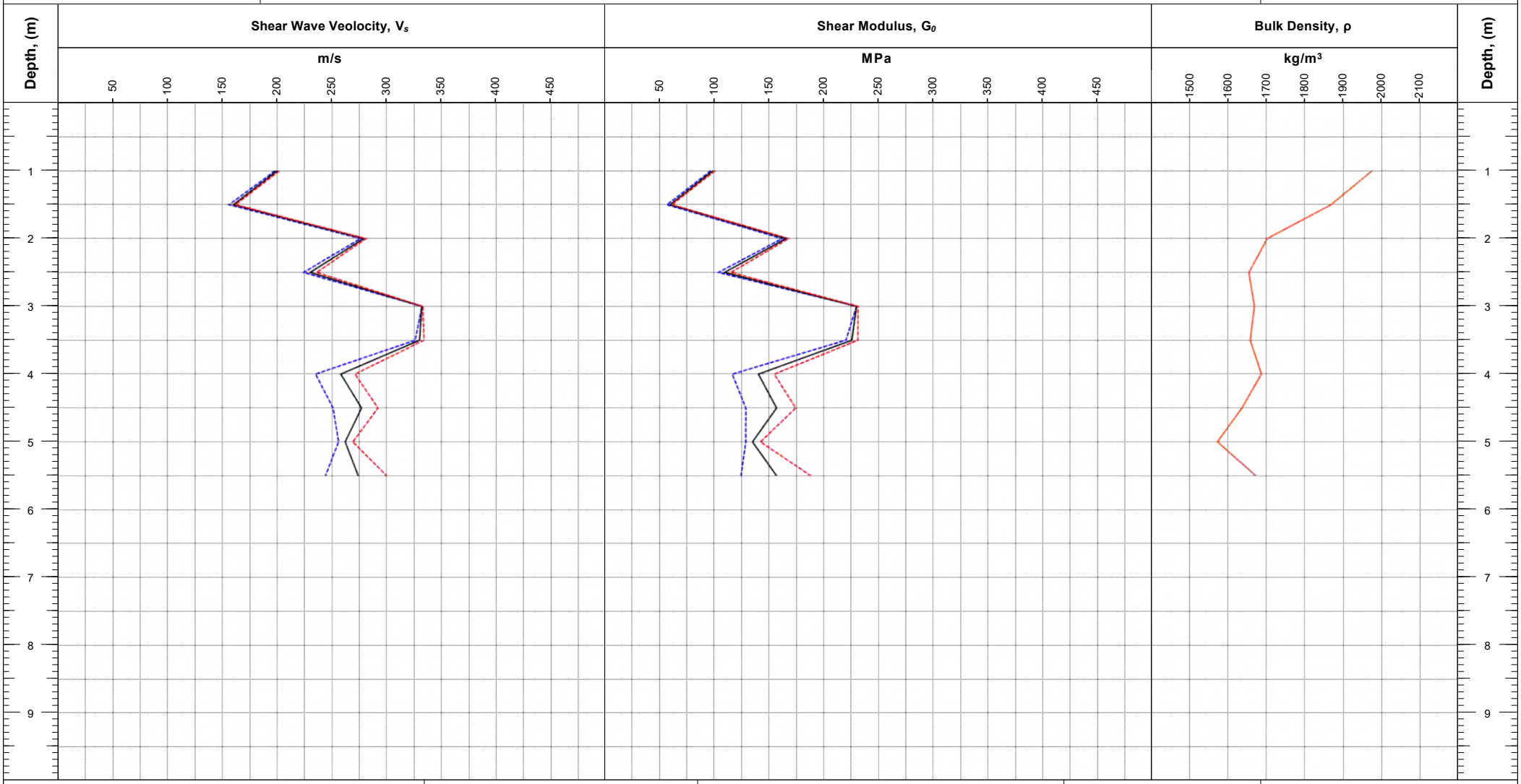
G.I. Job Ref: 190422

Remarks: Continued from CPT-01. Over 40 blows on first increment. Client requested to prove CPT terminated on rock.

Calculations performed in accordance with: ISO 22476-2 Dynamic Probing

DOWNHOLE SEISMIC TEST LOG

DOWNHOLE SEISMIC TEST LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Key:
- Measured Lower Bound
- Measured Average Value
- Measured Upper Bound
- ρ from G_0 Calculation

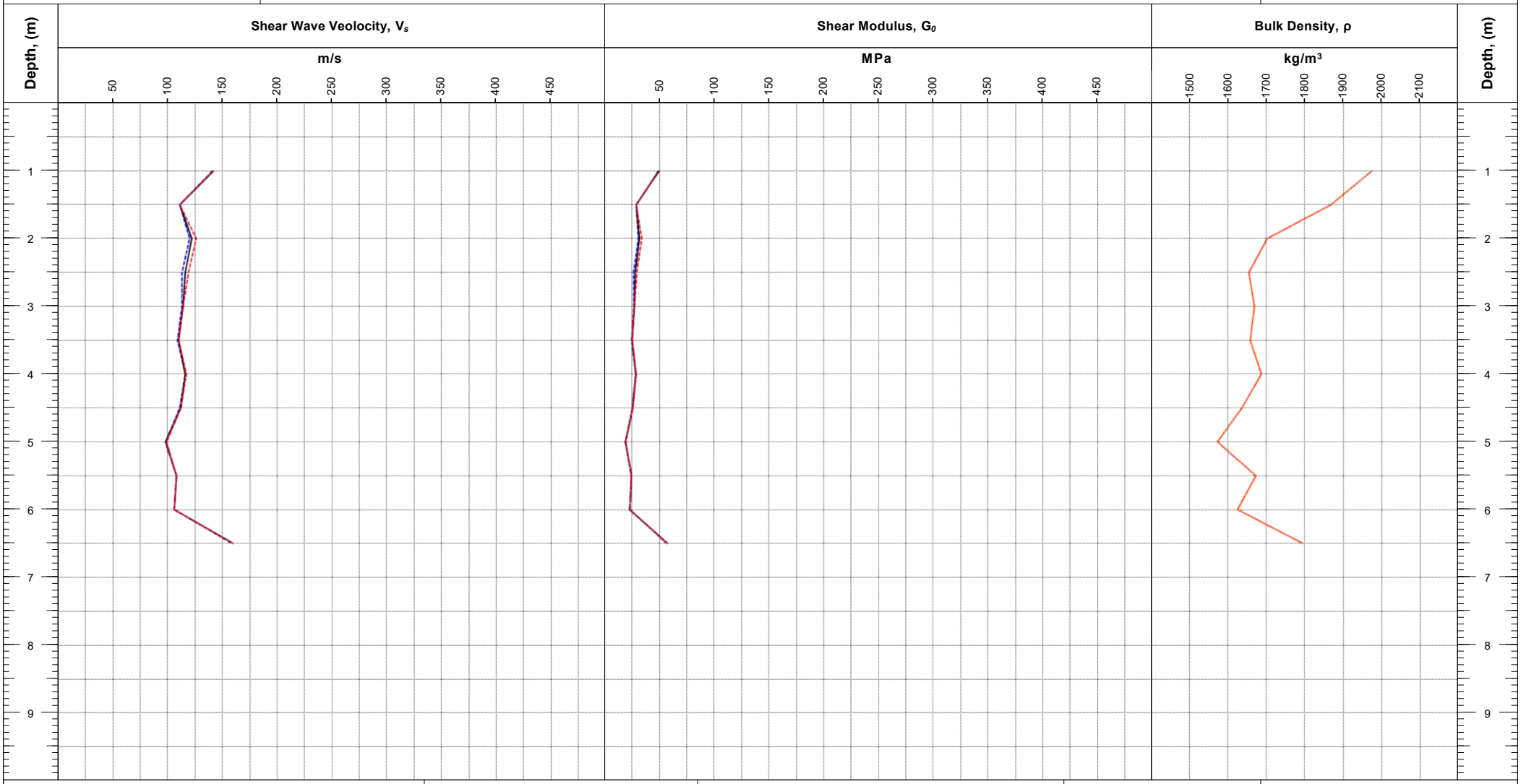
NZTM2000 N,E (m): 5173140.2, 1566142.36
WGS84, (deg): 172.580549, 43.593941
Location Method: Handheld GPS
Source Type: Wooden Block
Termination Reason: High cone end resistance

Elevation (m): Unknown
Date of Test: 3/07/2019
Depth (m): 6.15
Offset (m): 0.30

Test Number: SCPT-04
Client Job Ref:
G.I. Job Ref: 190422

Remarks:

DOWNHOLE SEISMIC TEST LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Key:
- Measured Lower Bound
- Measured Average Value
- Measured Upper Bound
- ρ from G_0 Calculation

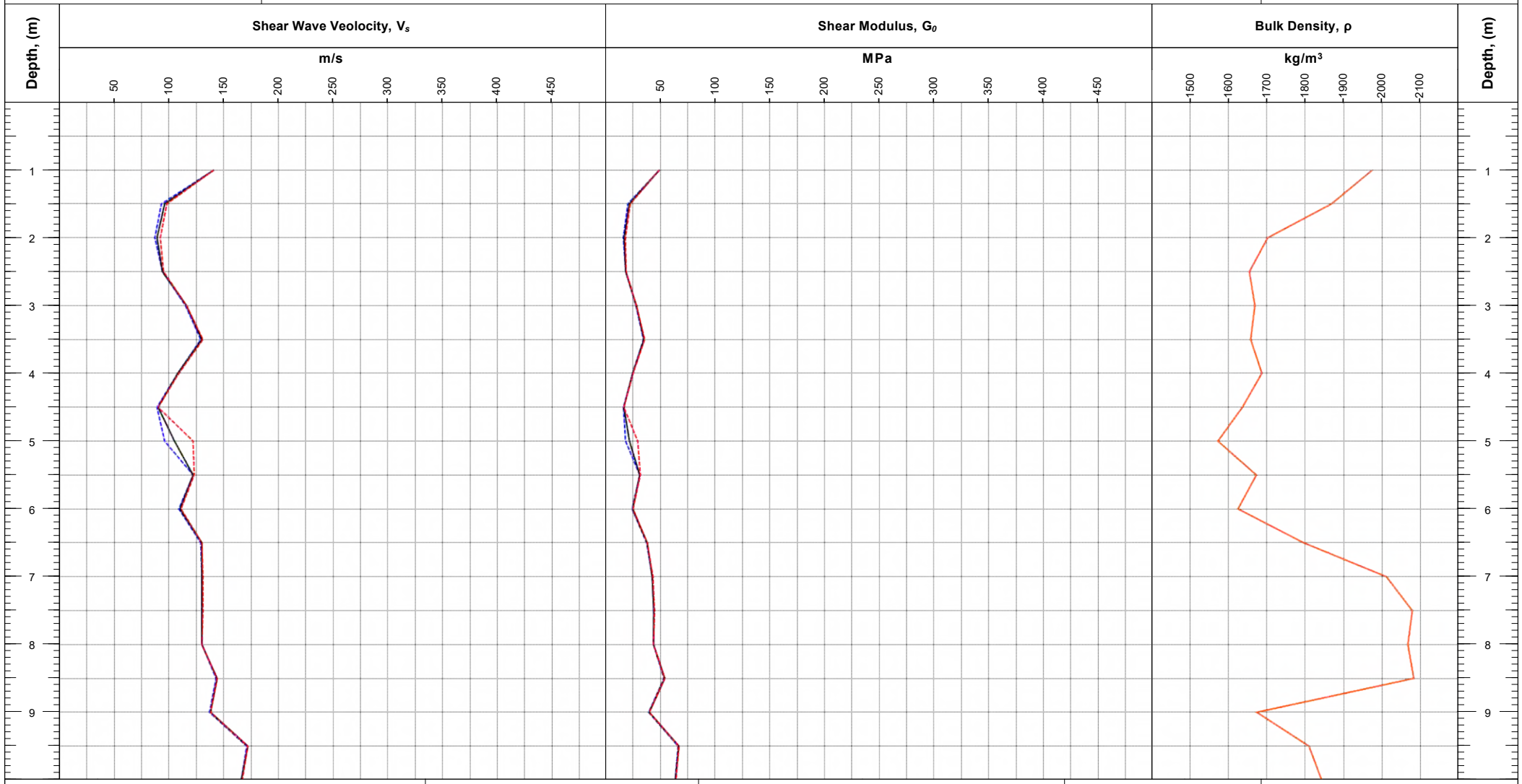
NZTM2000 N,E (m): 5173253.19, 1566023.17
WGS84, (deg): 172.579079, 43.592918
Location Method: Handheld GPS
Source Type: Wooden Block
Termination Reason: High cone end resistance

Elevation (m): Unknown
Date of Test: 2/07/2019
Depth (m): 9.39
Offset (m): 0.30

Test Number: SCPT-05
Client Job Ref:
G.I. Job Ref: 190422

Remarks:

DOWNHOLE SEISMIC TEST LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Key:
- Measured Lower Bound
- Measured Average Value
- Measured Upper Bound
- ρ from G_0 Calculation

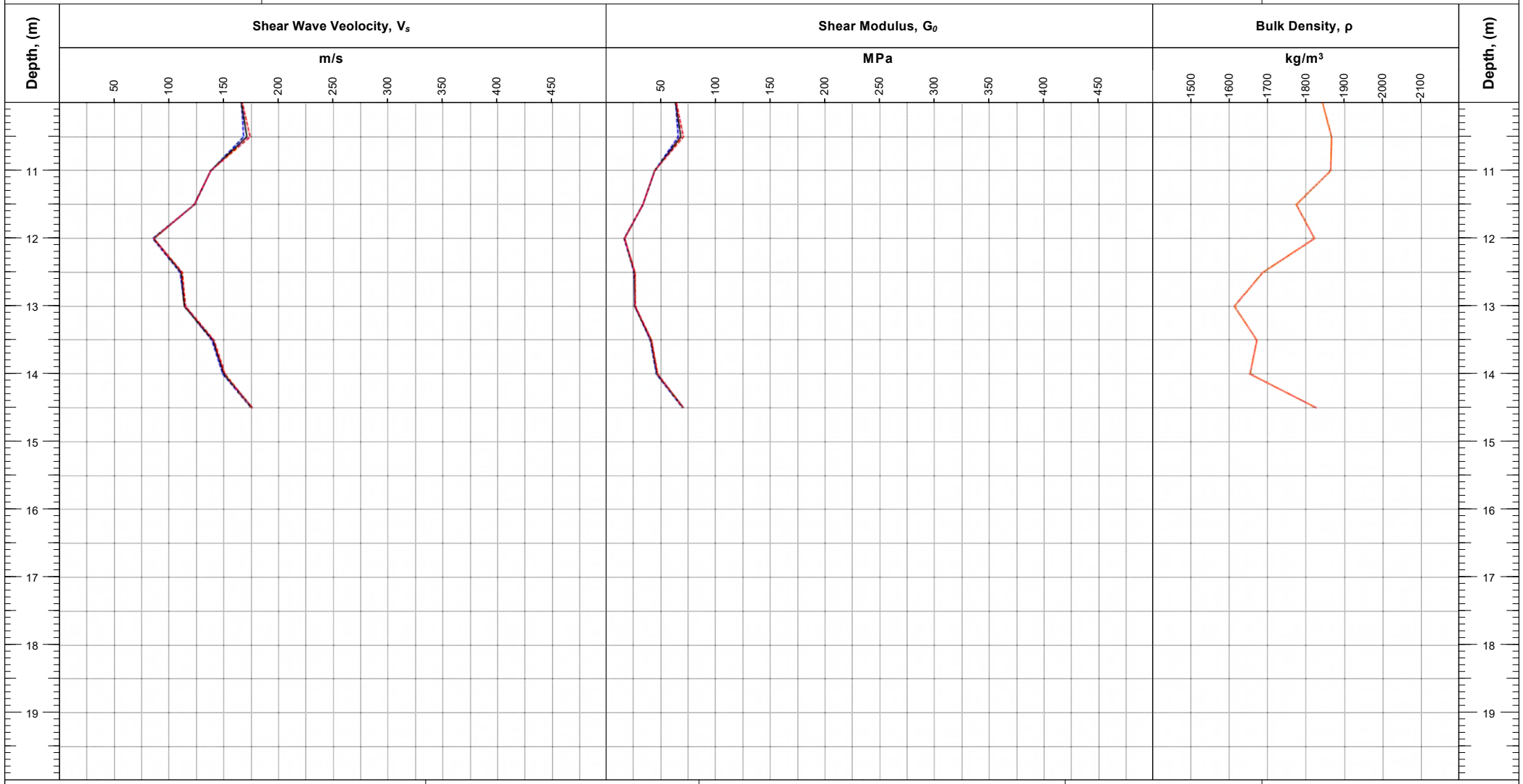
NZTM2000 N,E (m): 5173409.72, 1566143.06
WGS84, (deg): 172.580574, 43.591514
Location Method: Handheld GPS
Source Type: Wooden Block
Termination Reason: Target depth

Elevation (m): Unknown
Date of Test: 3/07/2019
Depth (m): 15.17
Offset (m): 0.30

Test Number: SCPT-06
Client Job Ref:
G.I. Job Ref: 190422

Remarks:

DOWNHOLE SEISMIC TEST LOG



Client: Miyamoto International NZ Ltd
Project: 1 Sutherlands Road
Location: Halswell, Christchurch
Engineer: Charles McDermott
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Key:
- Measured Lower Bound
- Measured Average Value
- Measured Upper Bound
- ρ from G_0 Calculation

NZTM2000 N,E (m): 5173409.72, 1566143.06
WGS84, (deg): 172.580574, 43.591514
Location Method: Handheld GPS
Source Type: Wooden Block
Termination Reason: Target depth

Elevation (m): Unknown
Date of Test: 3/07/2019
Depth (m): 15.17
Offset (m): 0.30

Test Number: SCPT-06
Client Job Ref:
G.I. Job Ref: 190422

Remarks:

A.3. Liquefaction Analyses

Liquefaction analyses of existing CPTs completed using CLiq software

Liquefaction analyses of MINZ SCPTs and CPTs completed using CLiq software

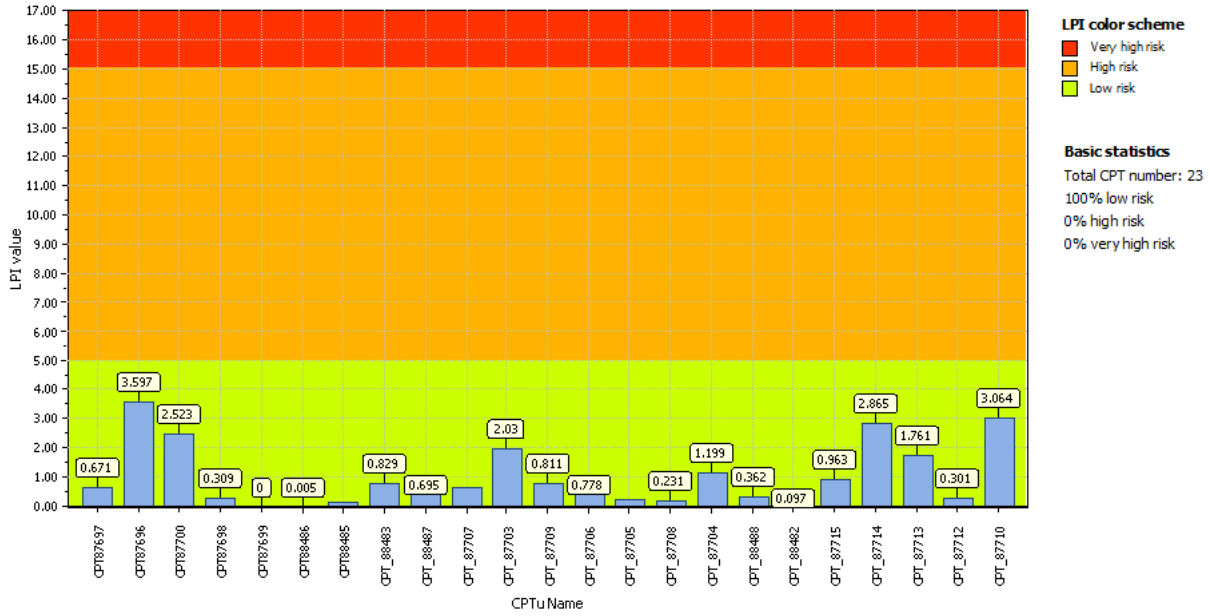
Liquefaction analyses completed using LiqSVs software

SLS

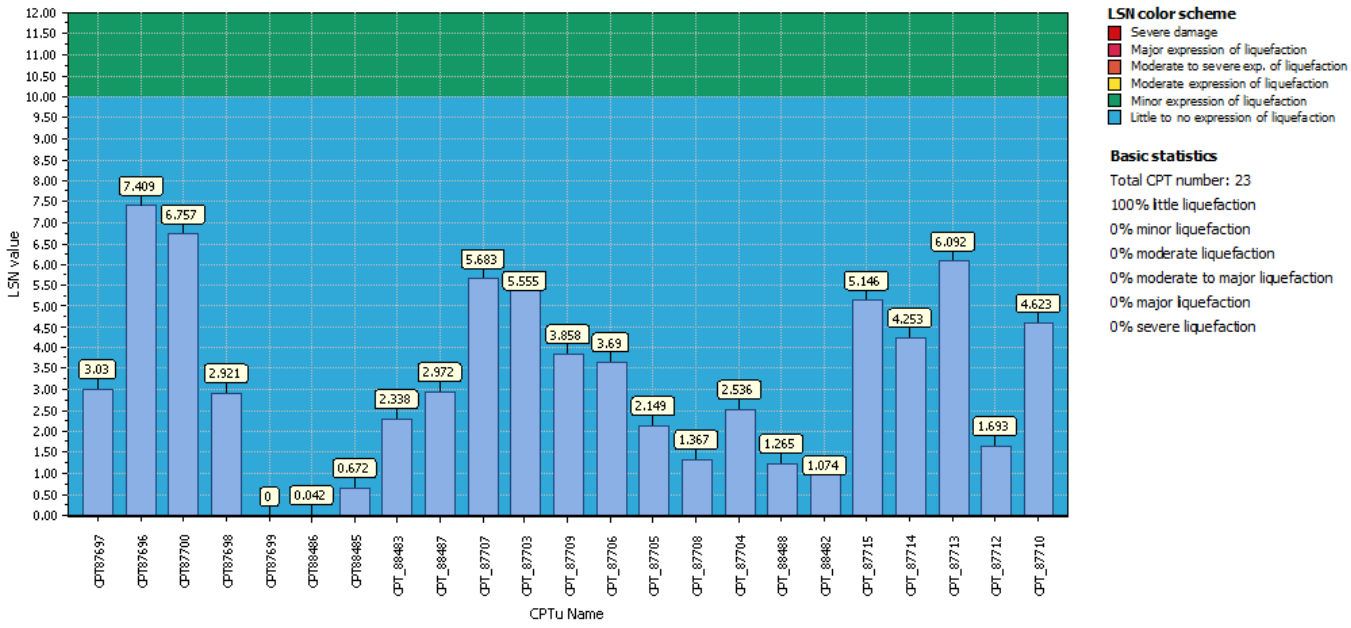
Project title : MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision

Location : Cashmere and Southerland Road, Halswell

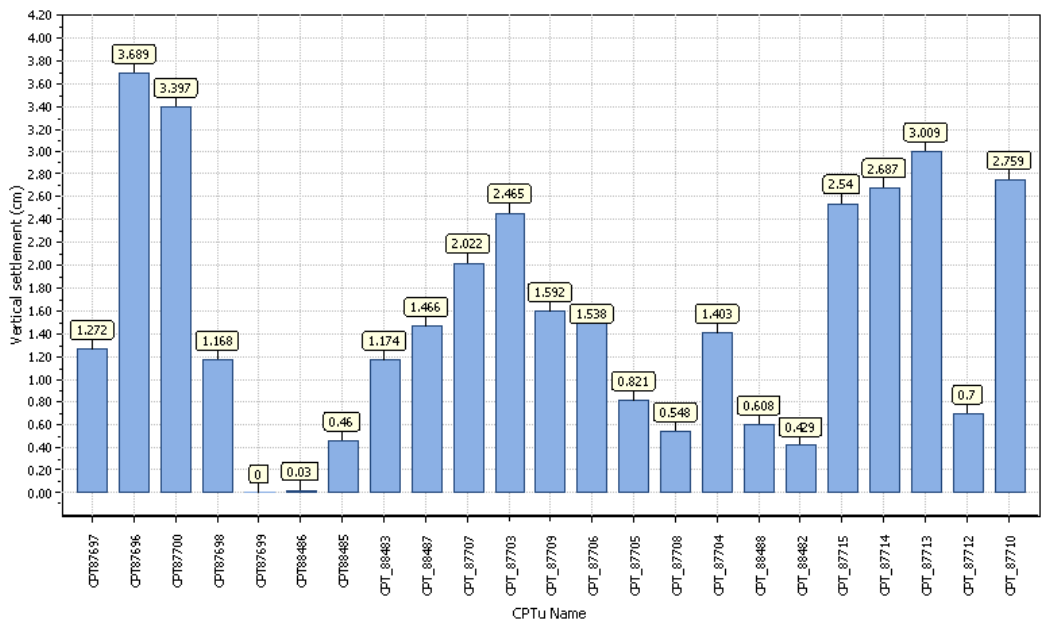
Overall Liquefaction Potential Index report



Overall Liquefaction Severity Number report

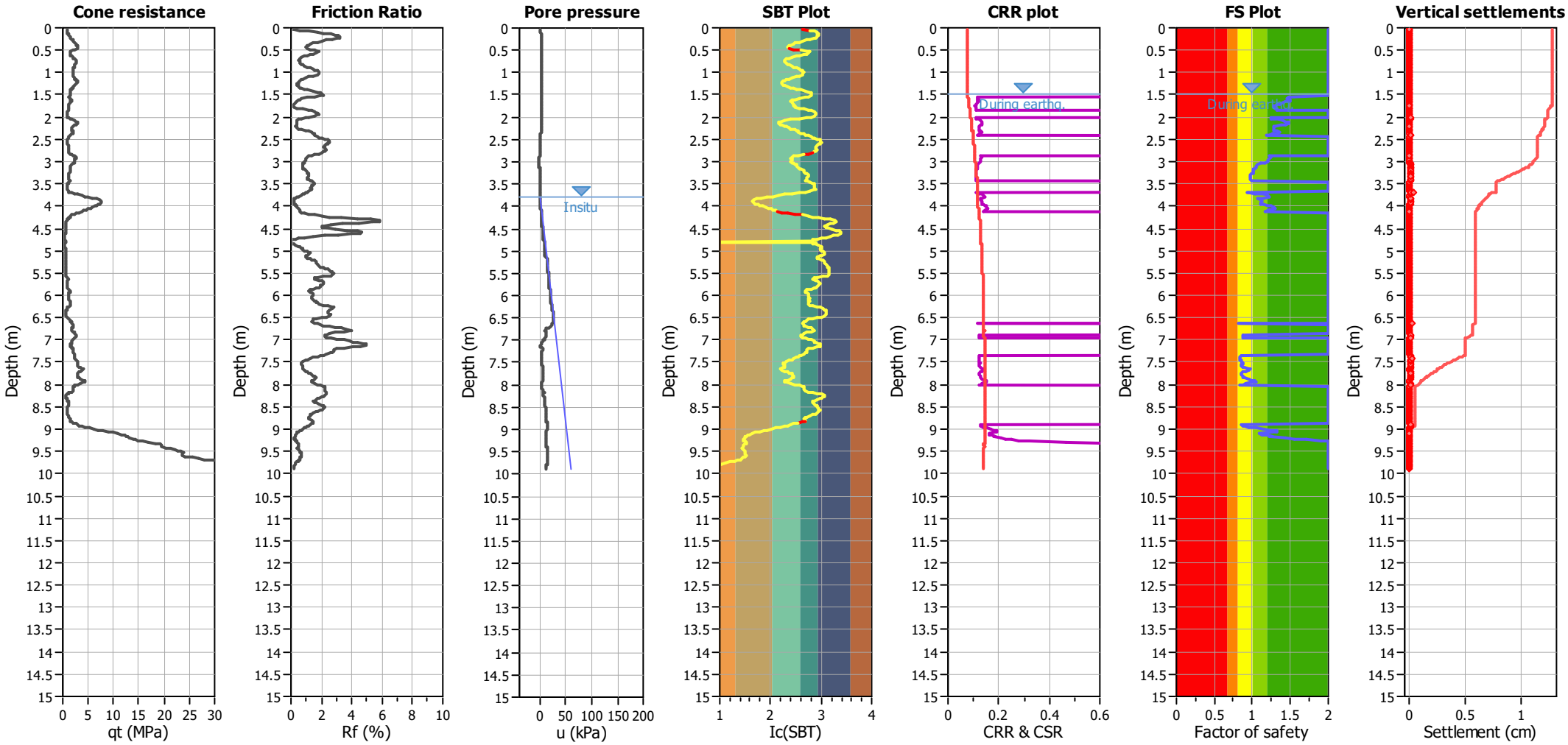


Overall vertical settlements report



Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

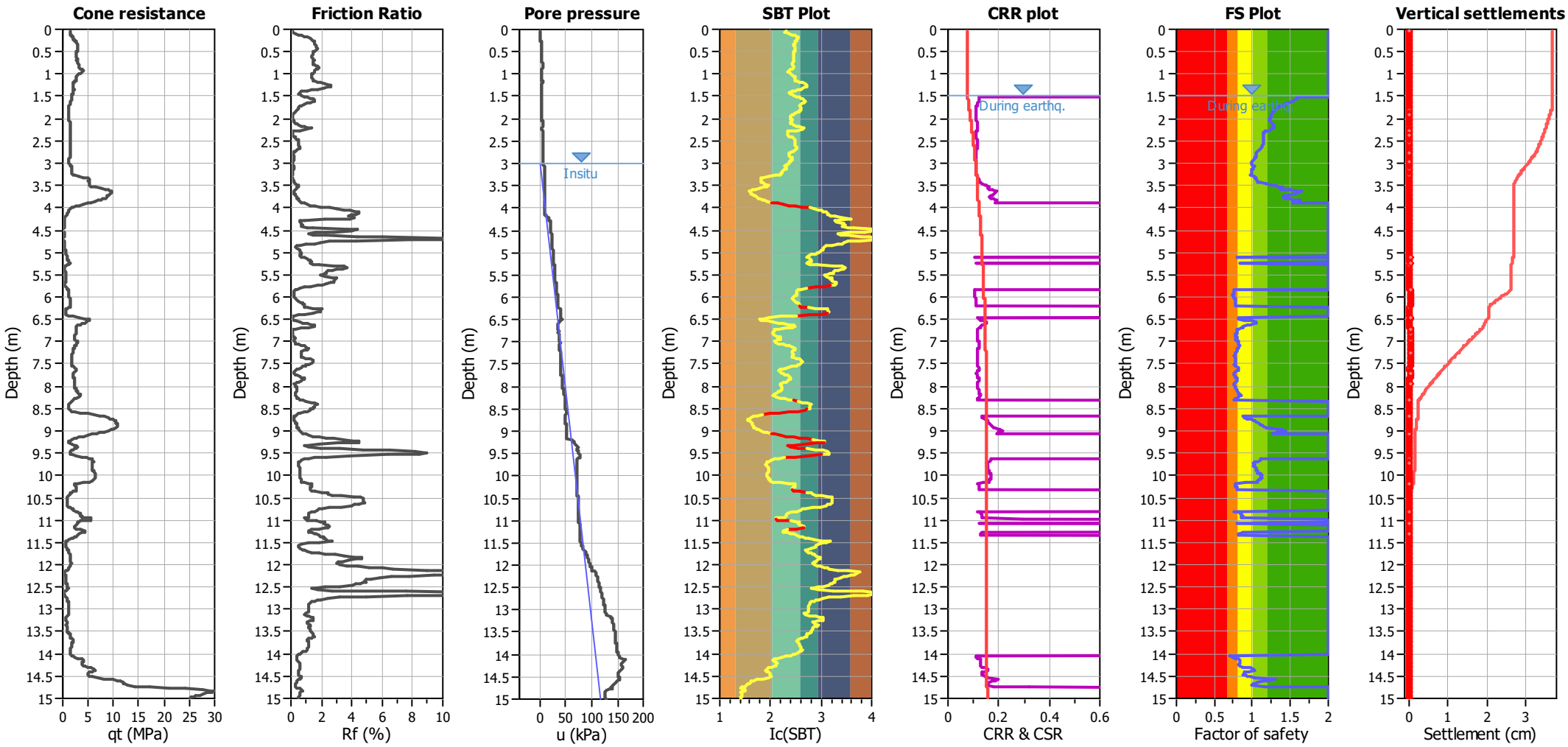
CPT: CPT87697
Total depth: 9.88 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

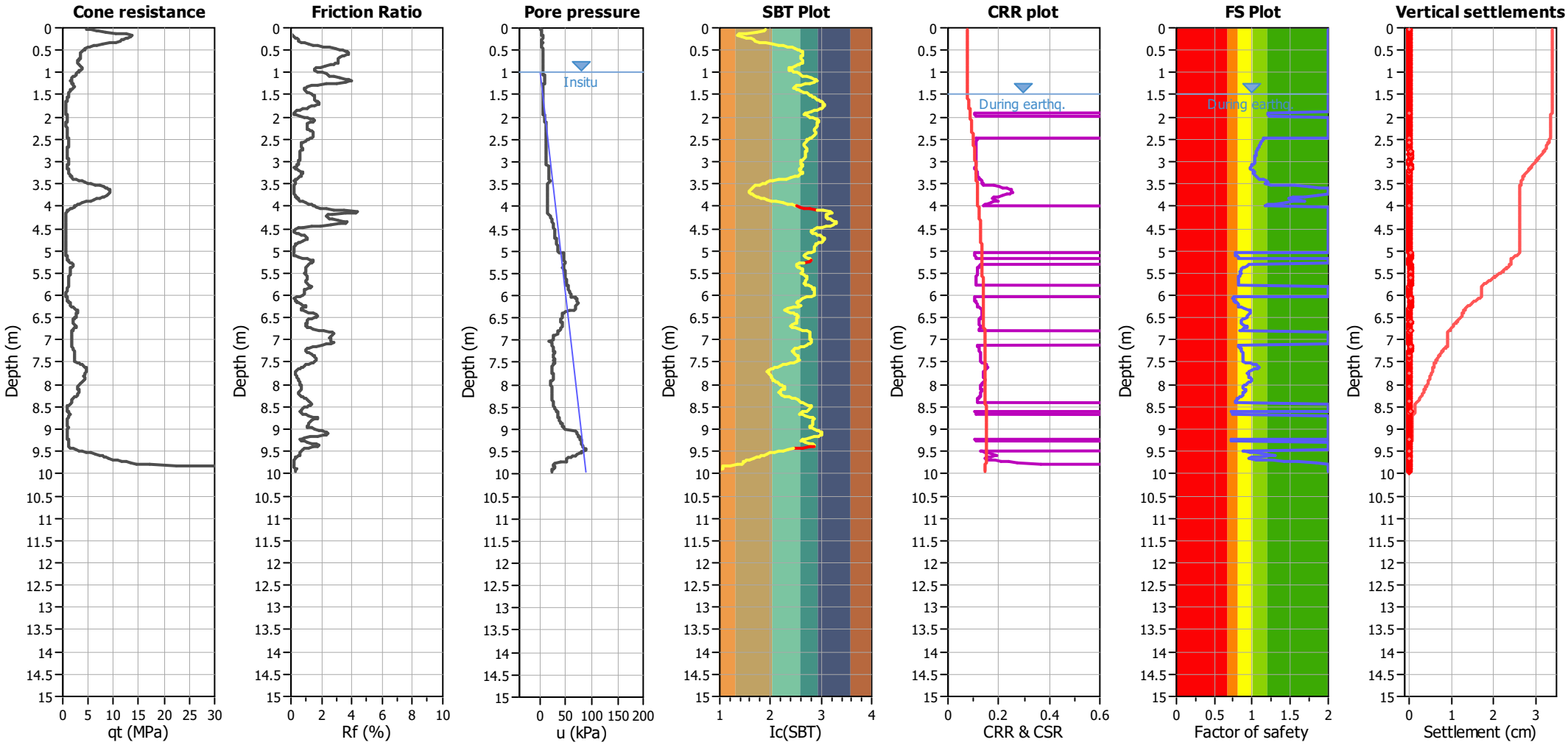
CPT: CPT87696
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

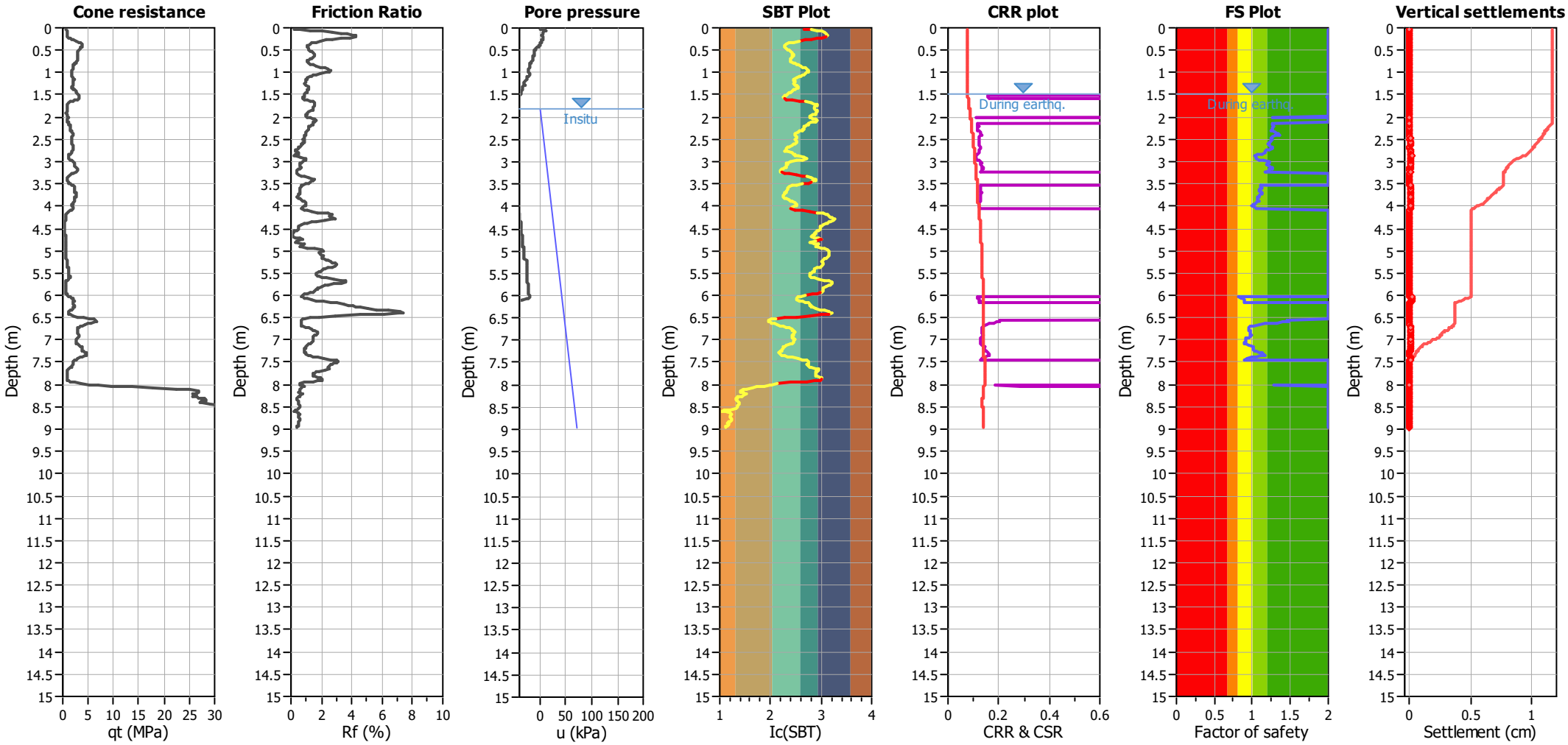
CPT: CPT87700
Total depth: 9.94 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

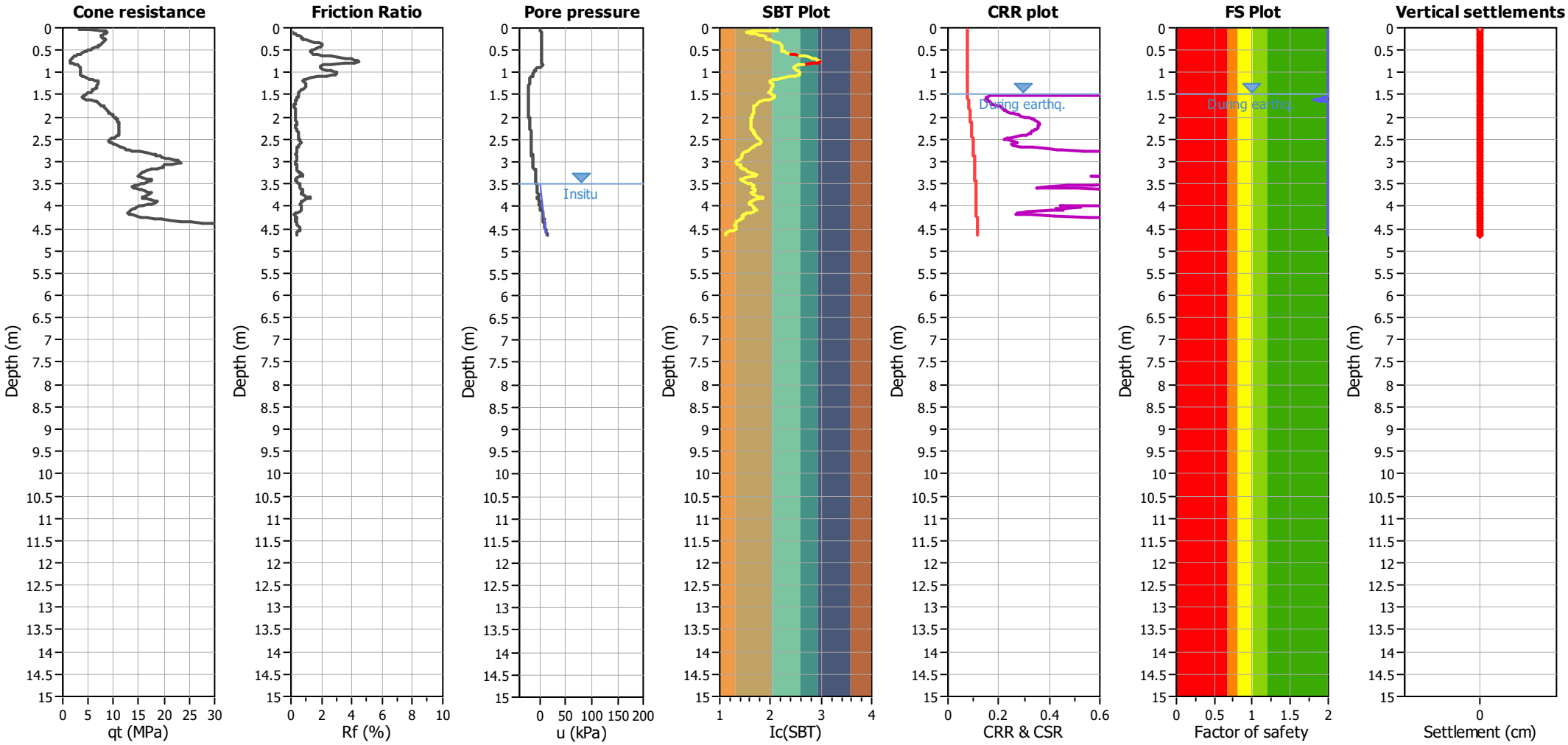
CPT: CPT87698
Total depth: 8.98 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

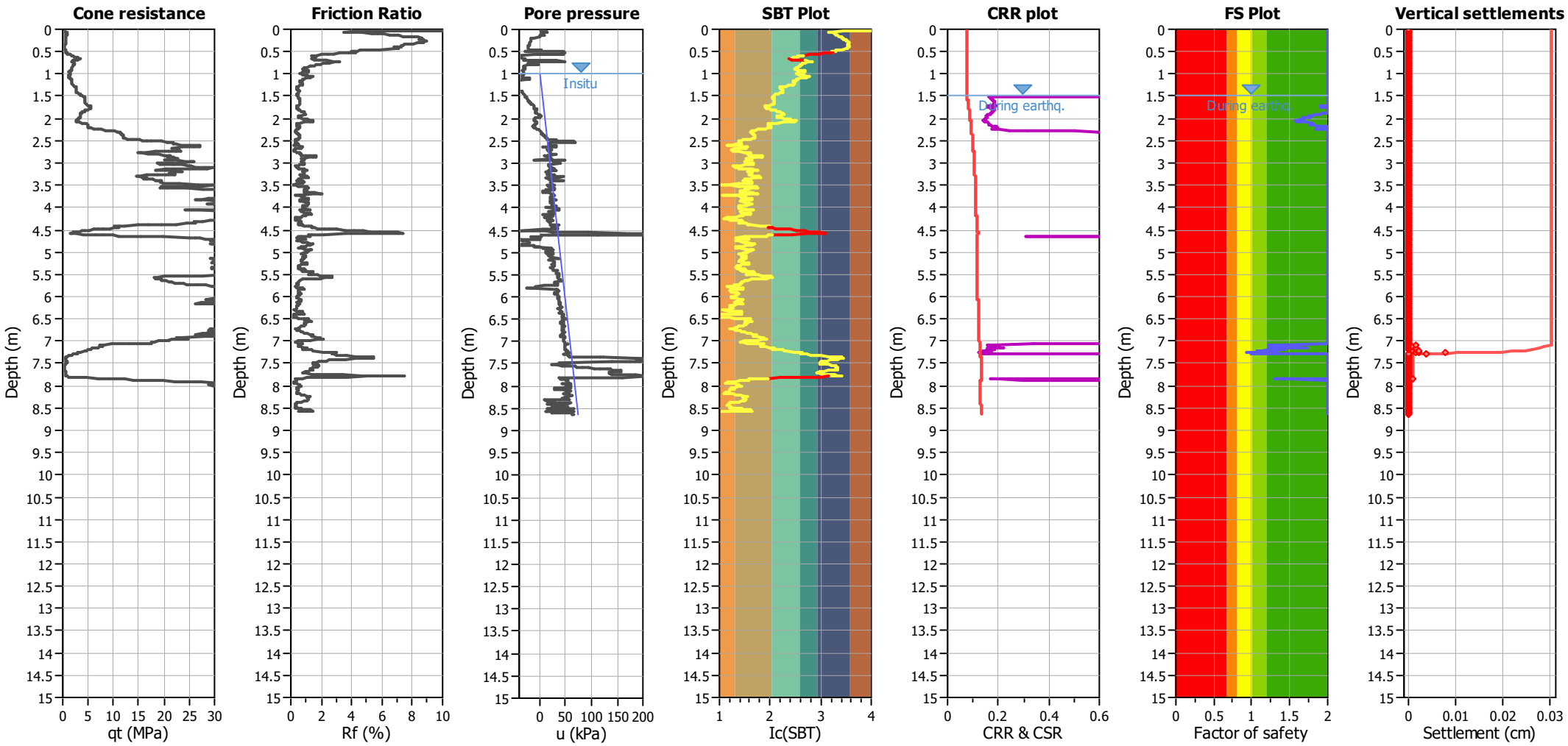
CPT: CPT87699
Total depth: 4.66 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Southerland Road, Halswell**

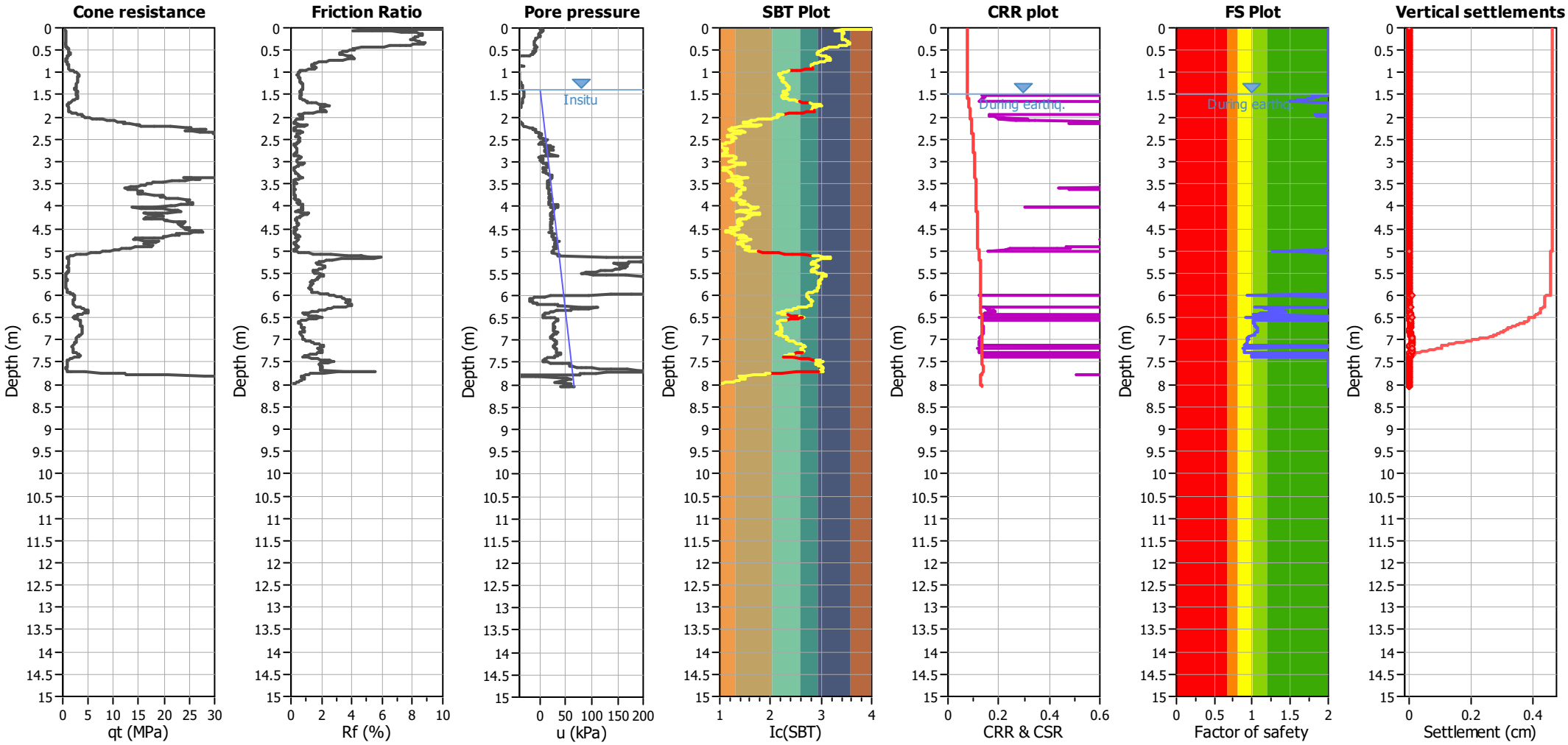
CPT: CPT88486
Total depth: 8.65 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

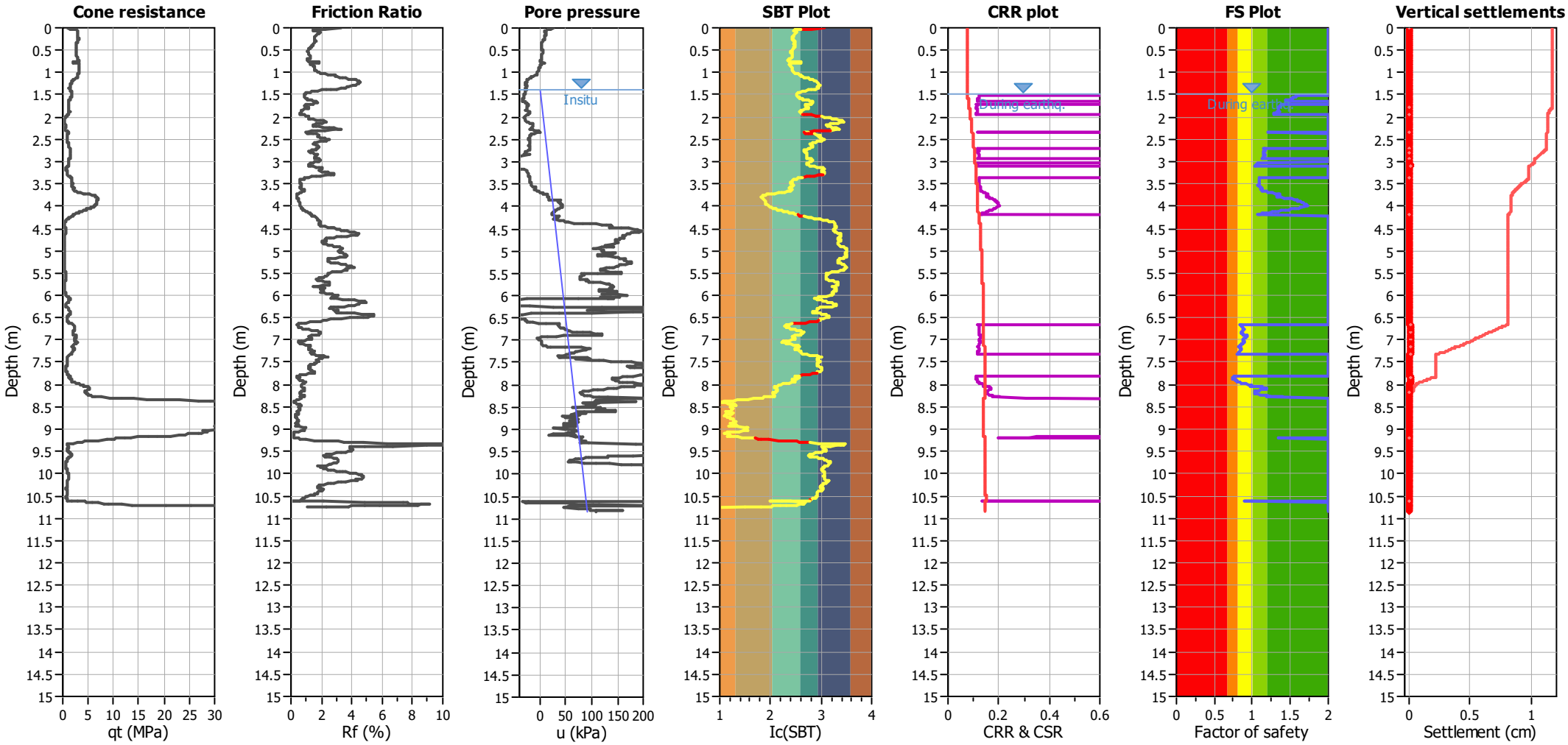
CPT: CPT88485
Total depth: 8.06 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.40 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Southerland Road, Halswell**

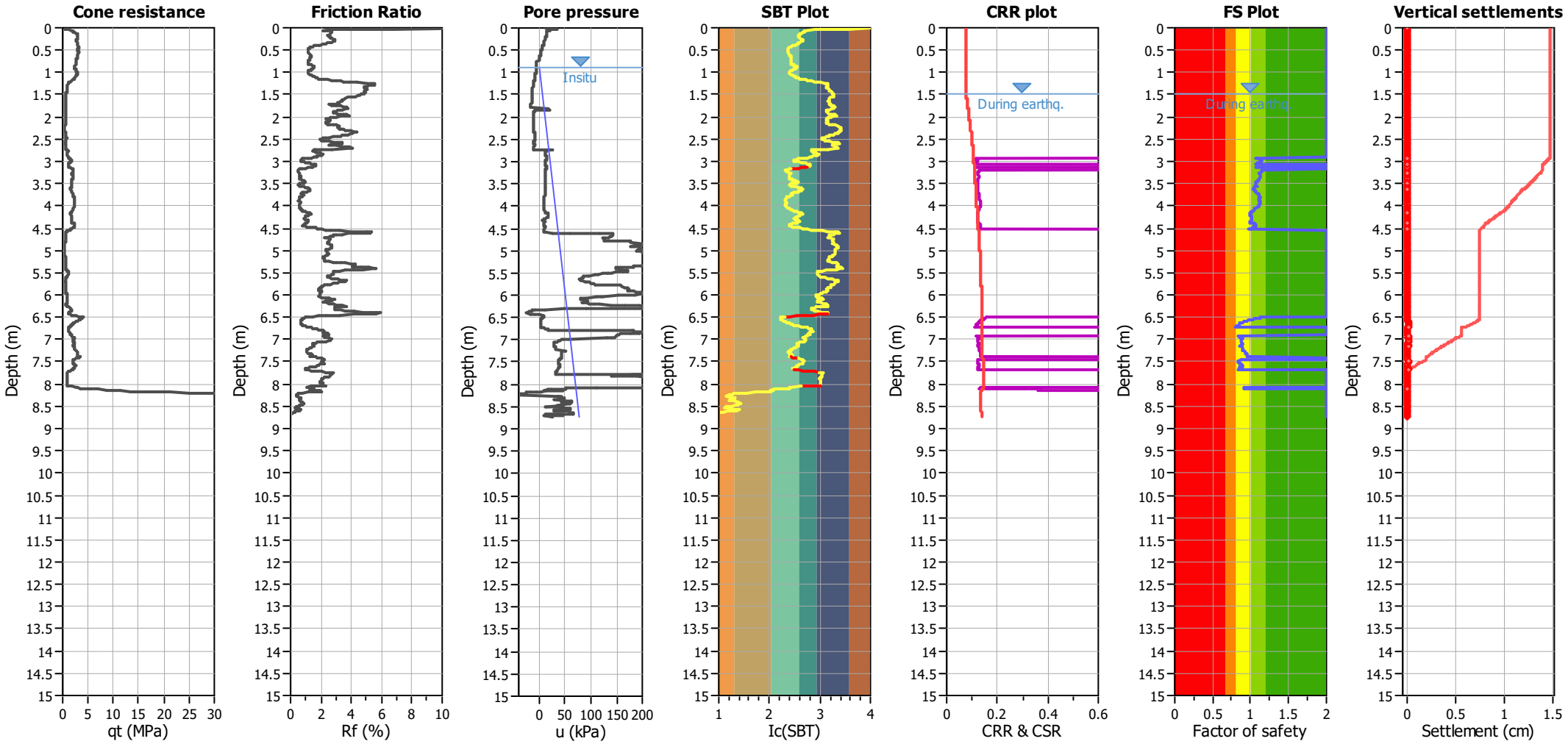
CPT: CPT_88483
Total depth: 10.83 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.40 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Southerland Road, Halswell**

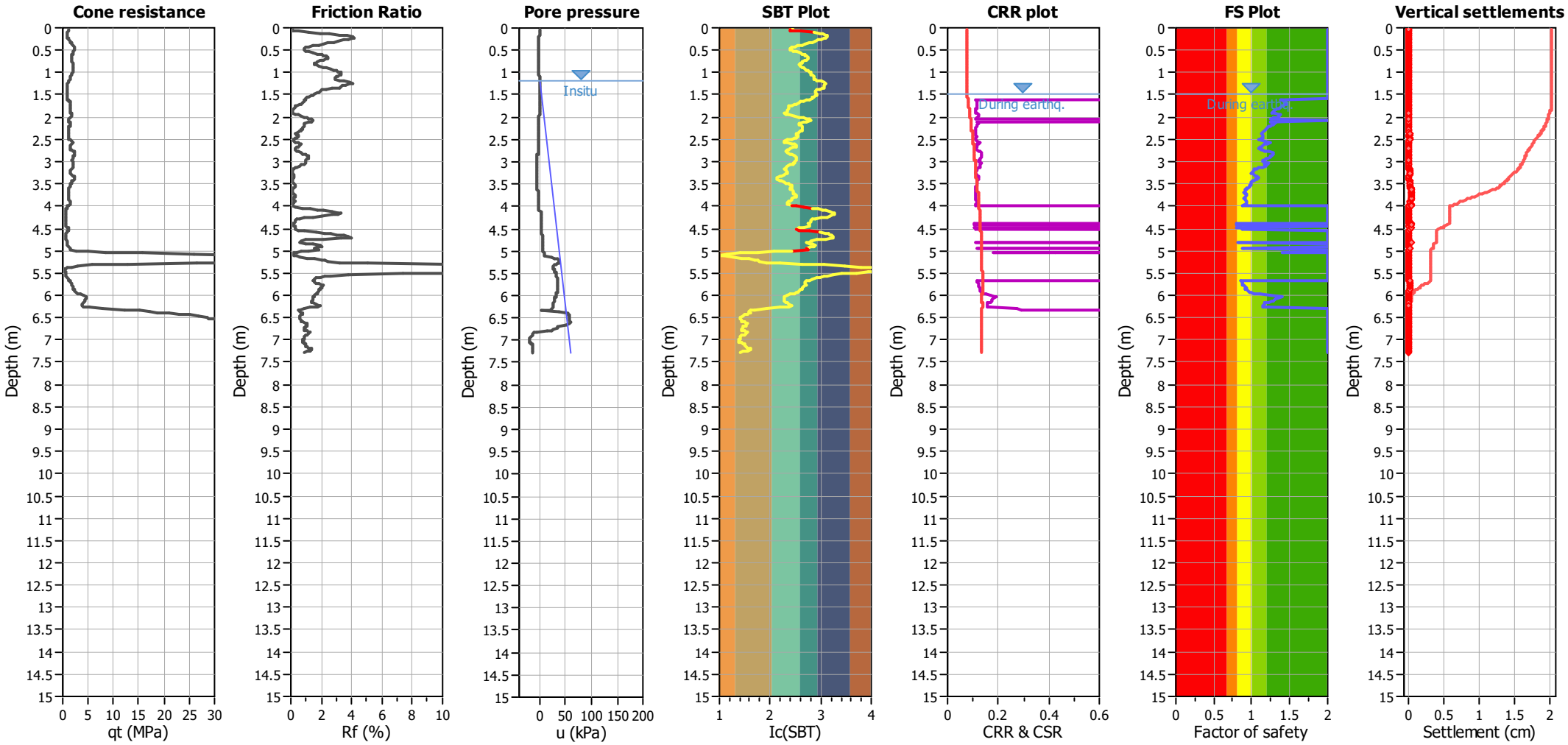
CPT: CPT_88487
Total depth: 8.74 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.90 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

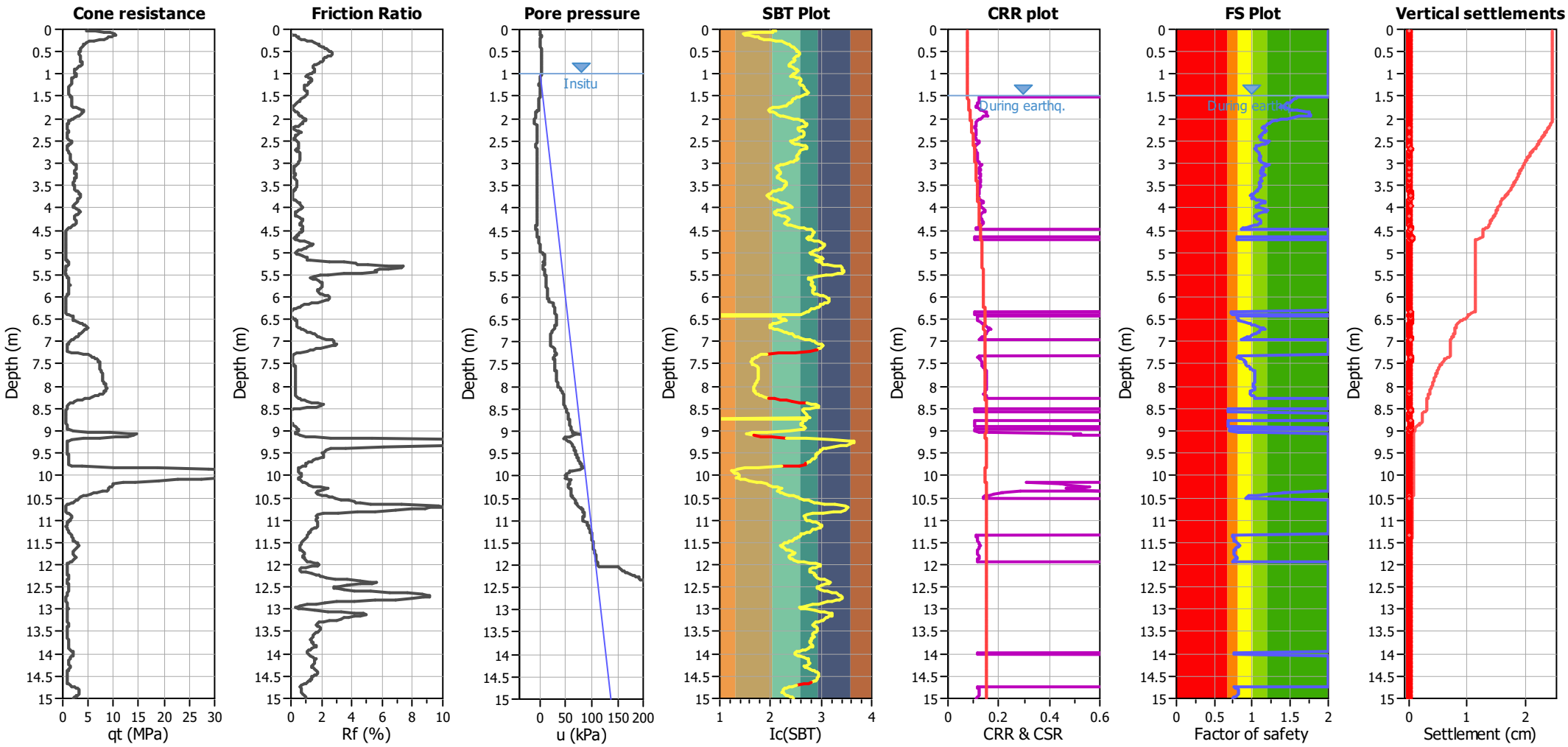
CPT: CPT_87707
Total depth: 7.28 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

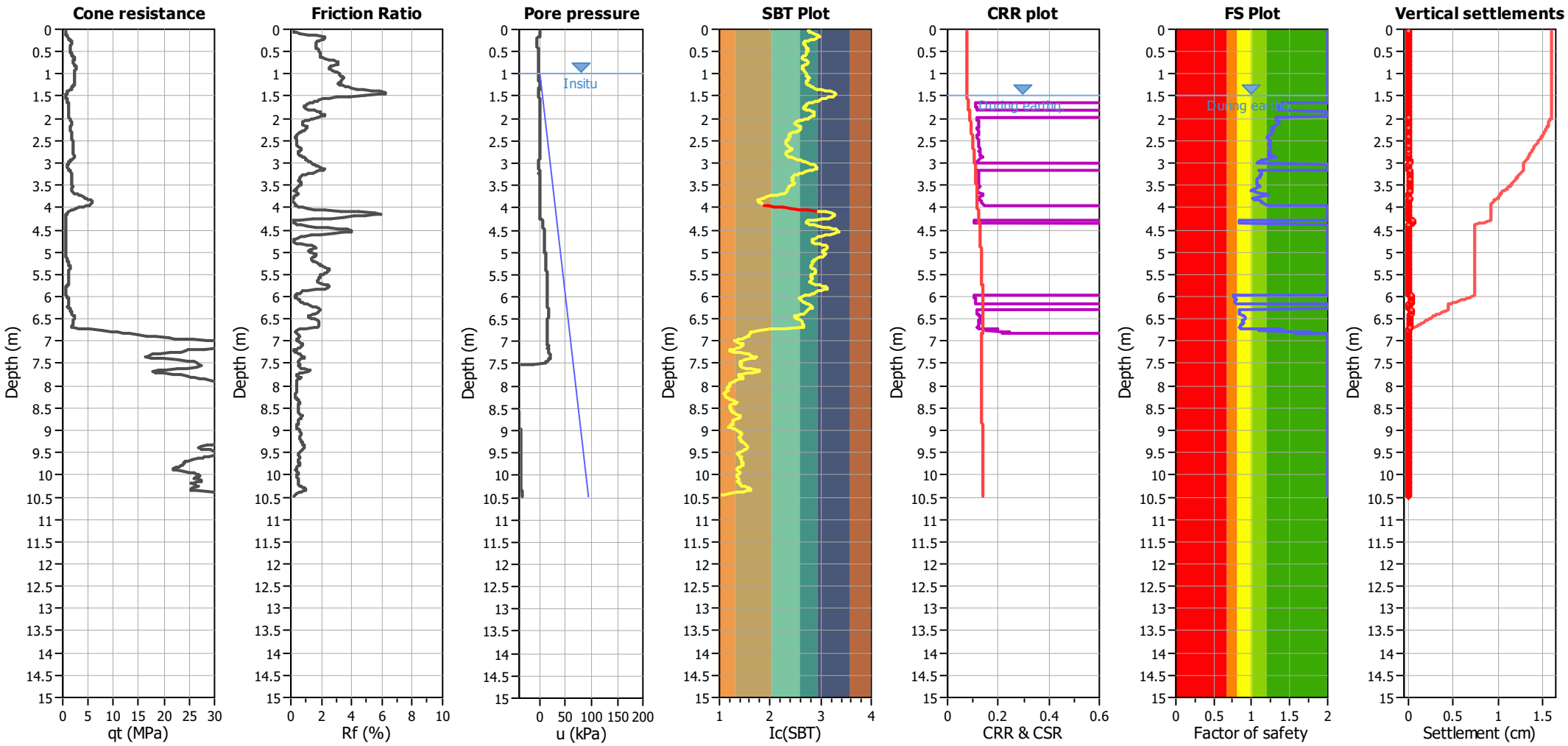
CPT: CPT_87703
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

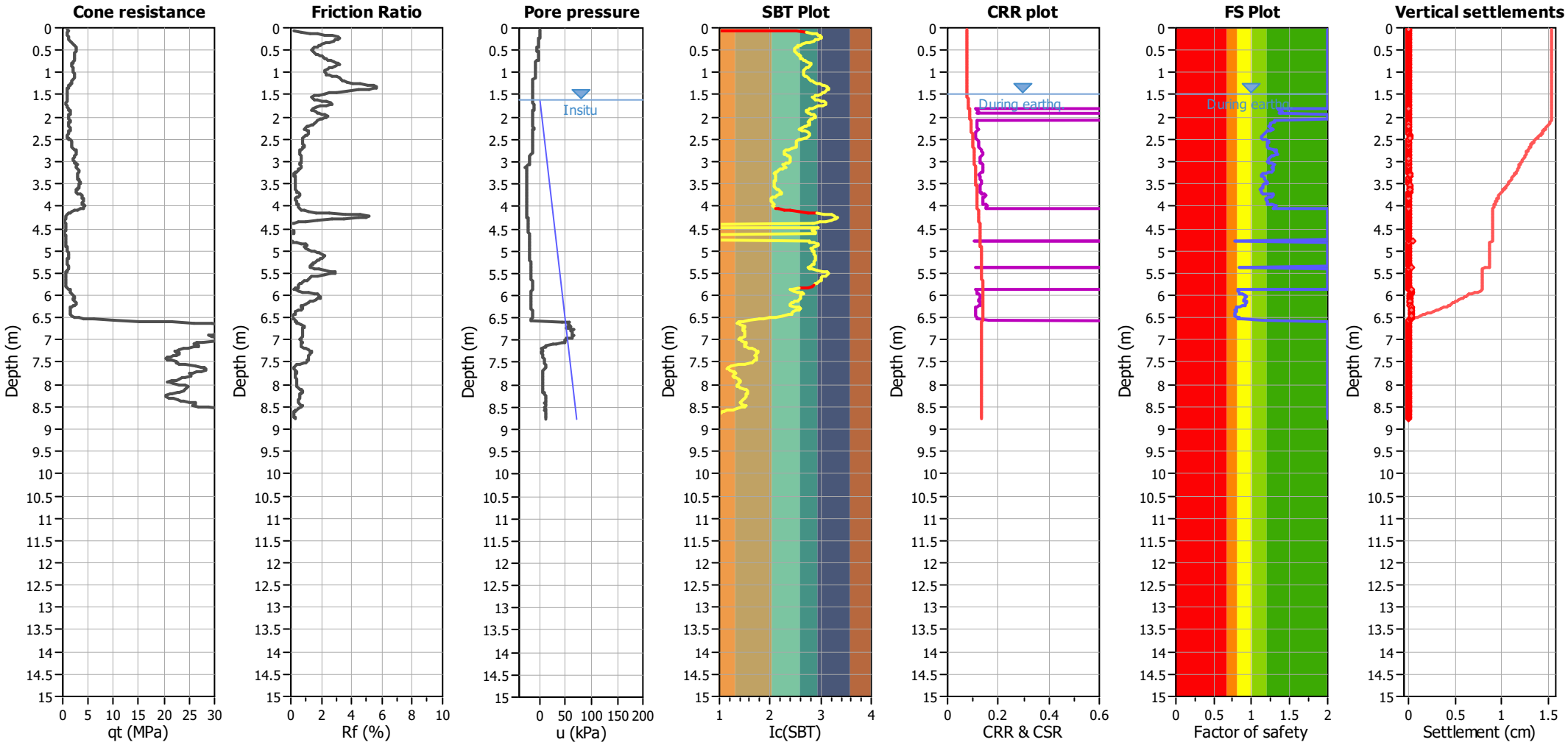
CPT: CPT_87709
Total depth: 10.48 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

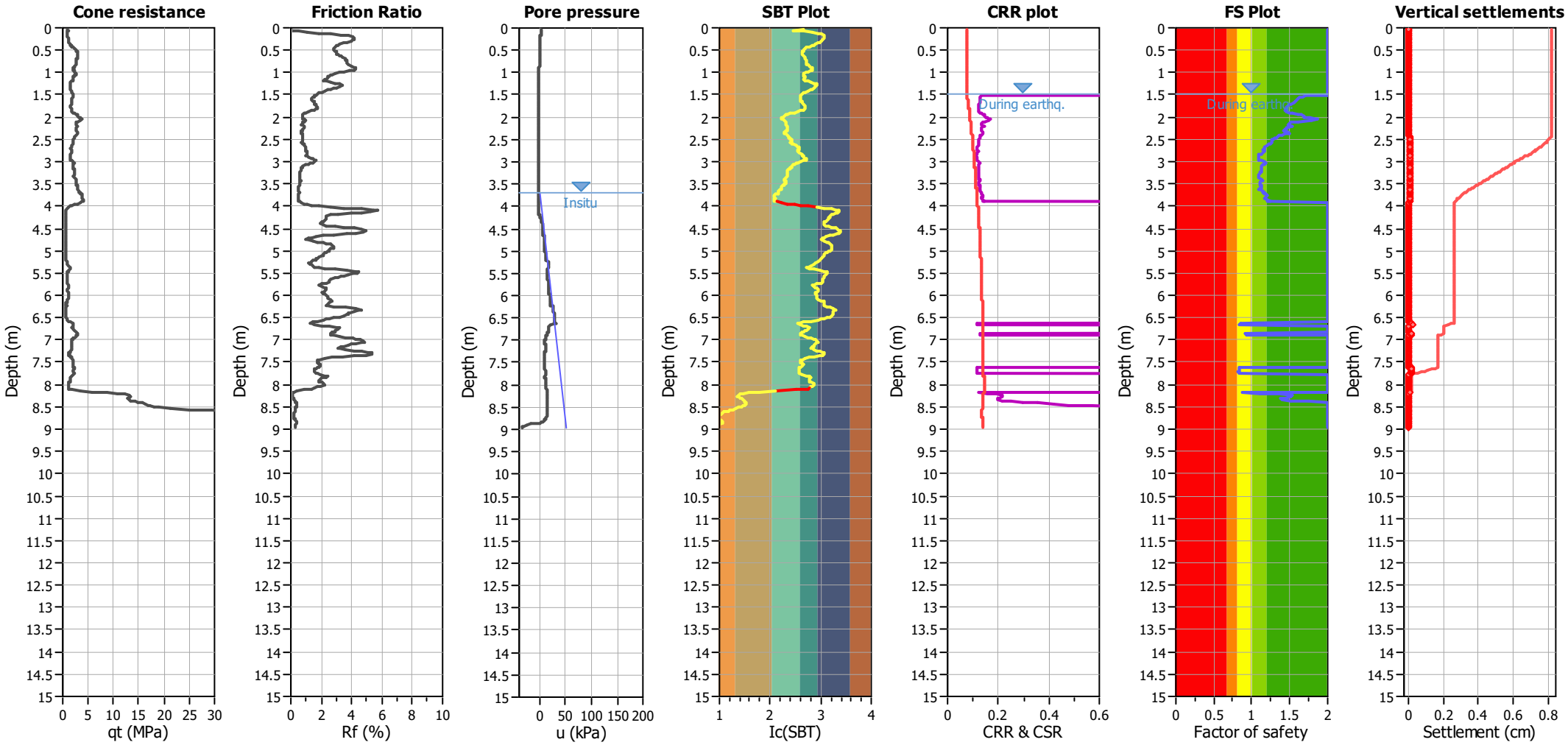
CPT: CPT_87706
Total depth: 8.76 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

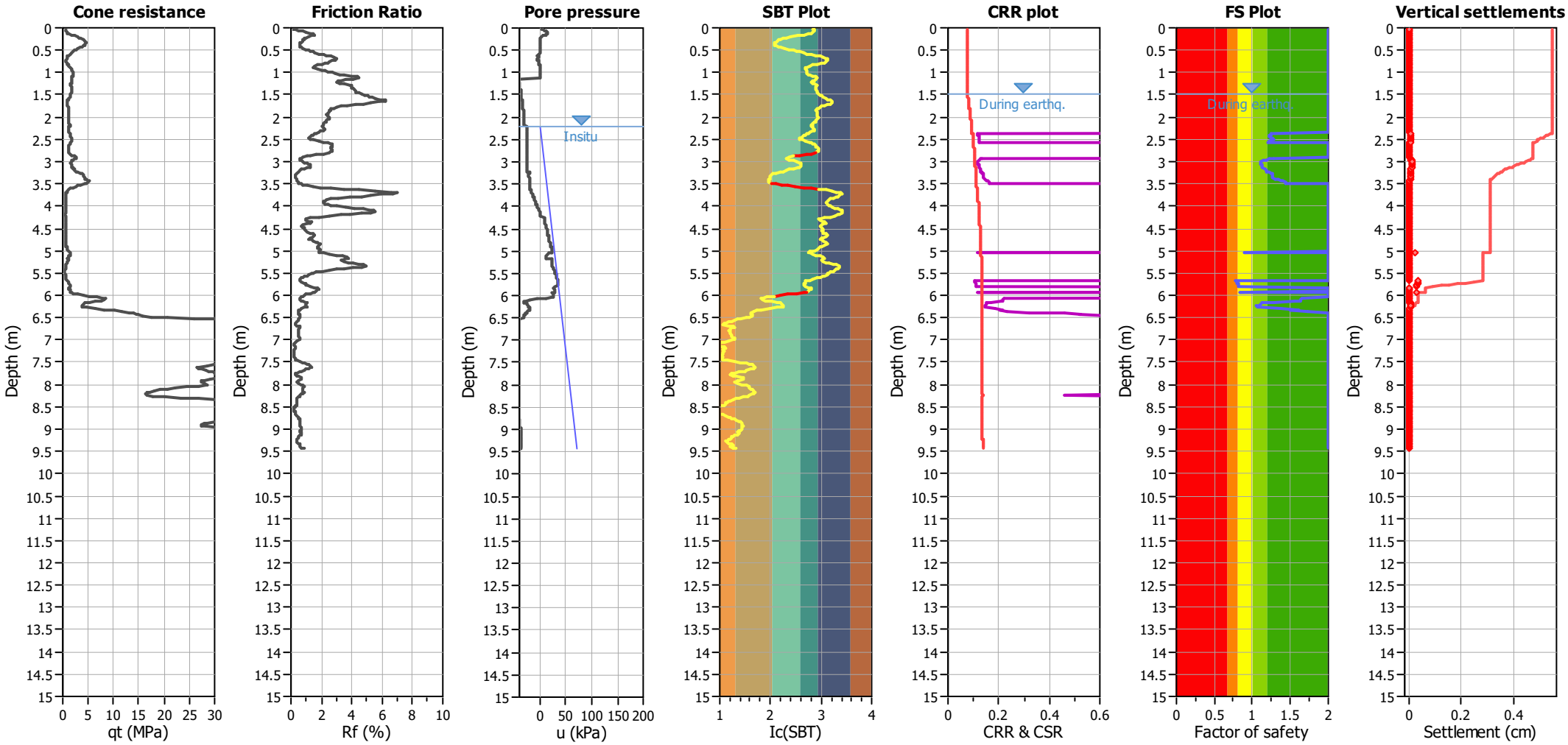
CPT: CPT_87705
Total depth: 8.96 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

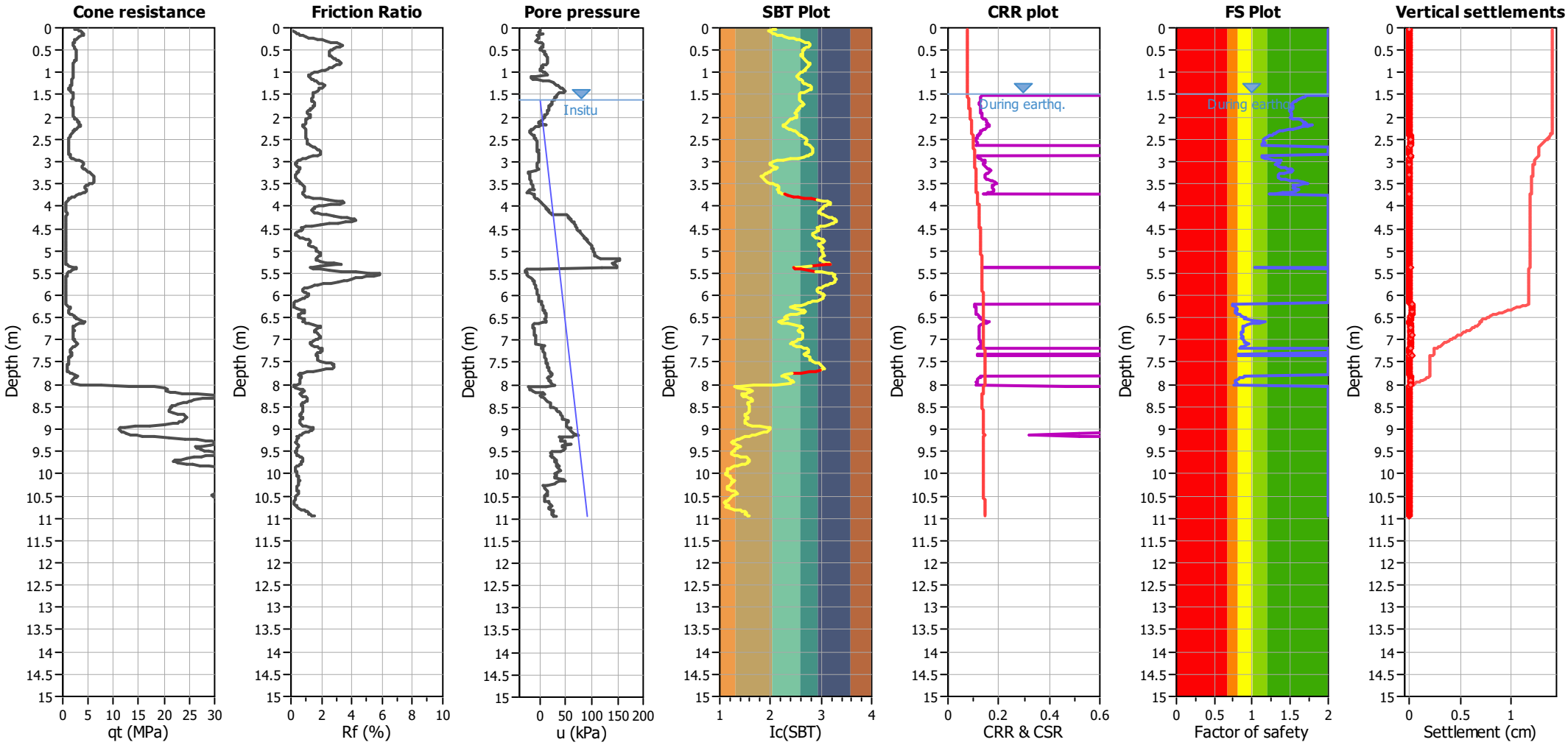
CPT: CPT_87708
Total depth: 9.44 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

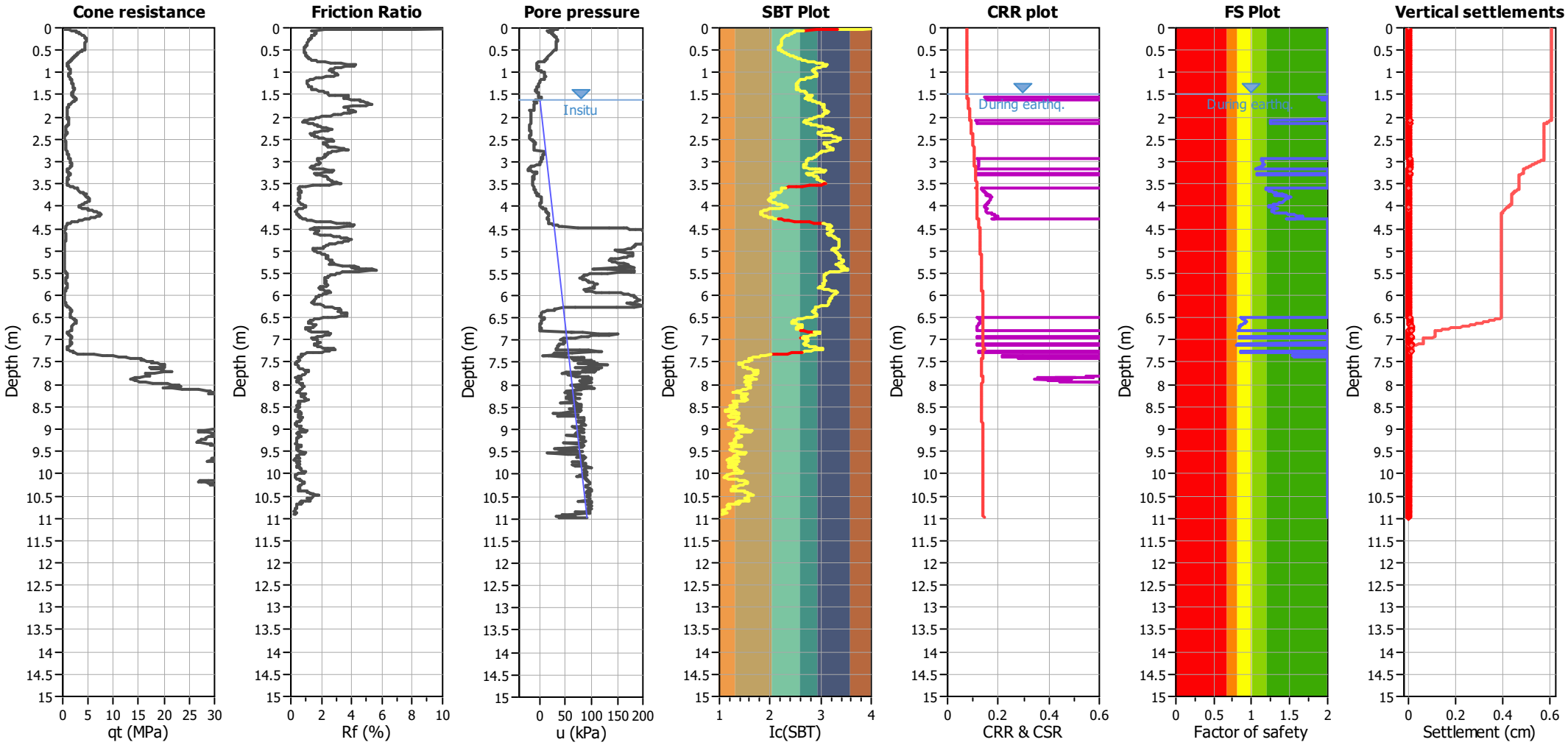
CPT: CPT_87704
Total depth: 10.96 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

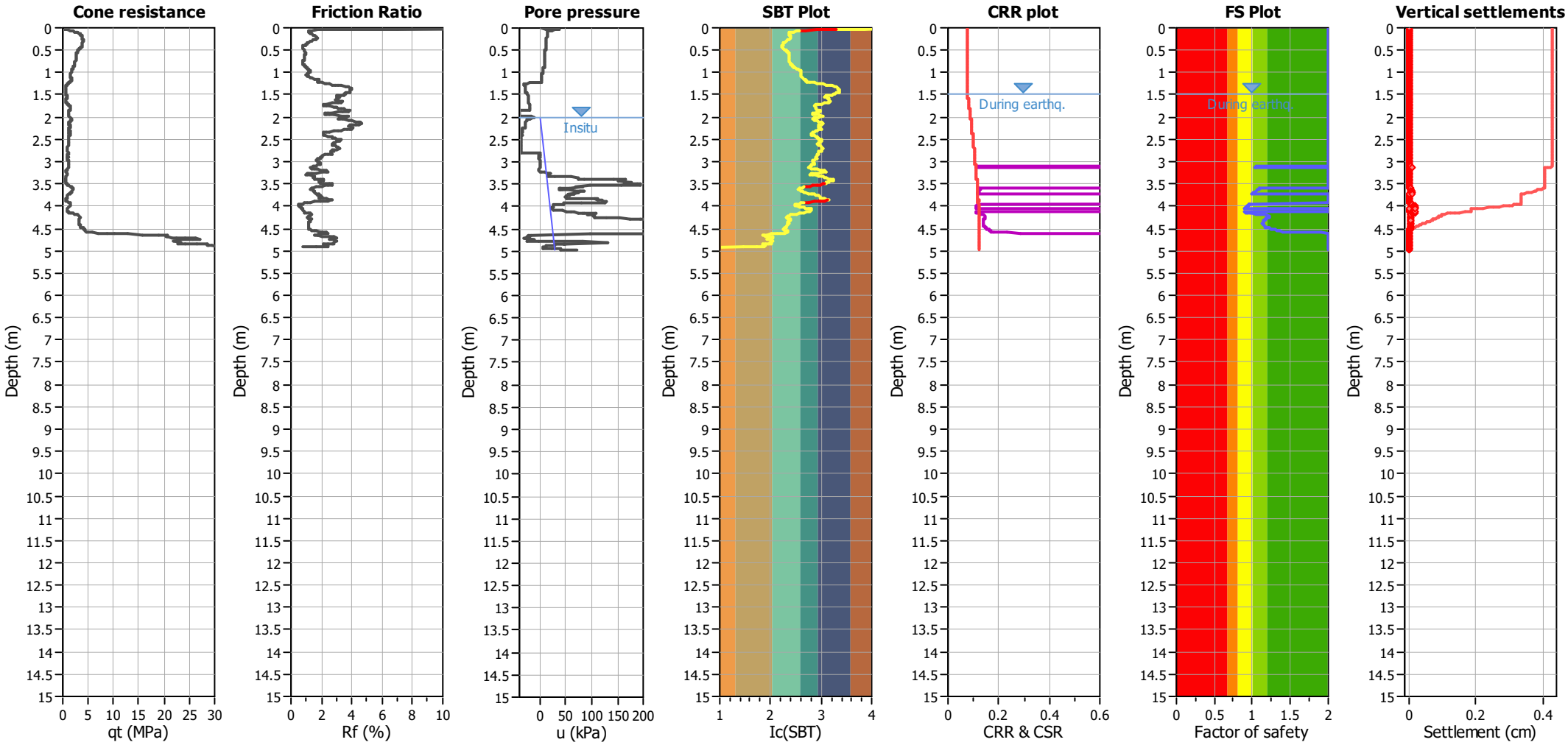
CPT: CPT_88488
Total depth: 10.98 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

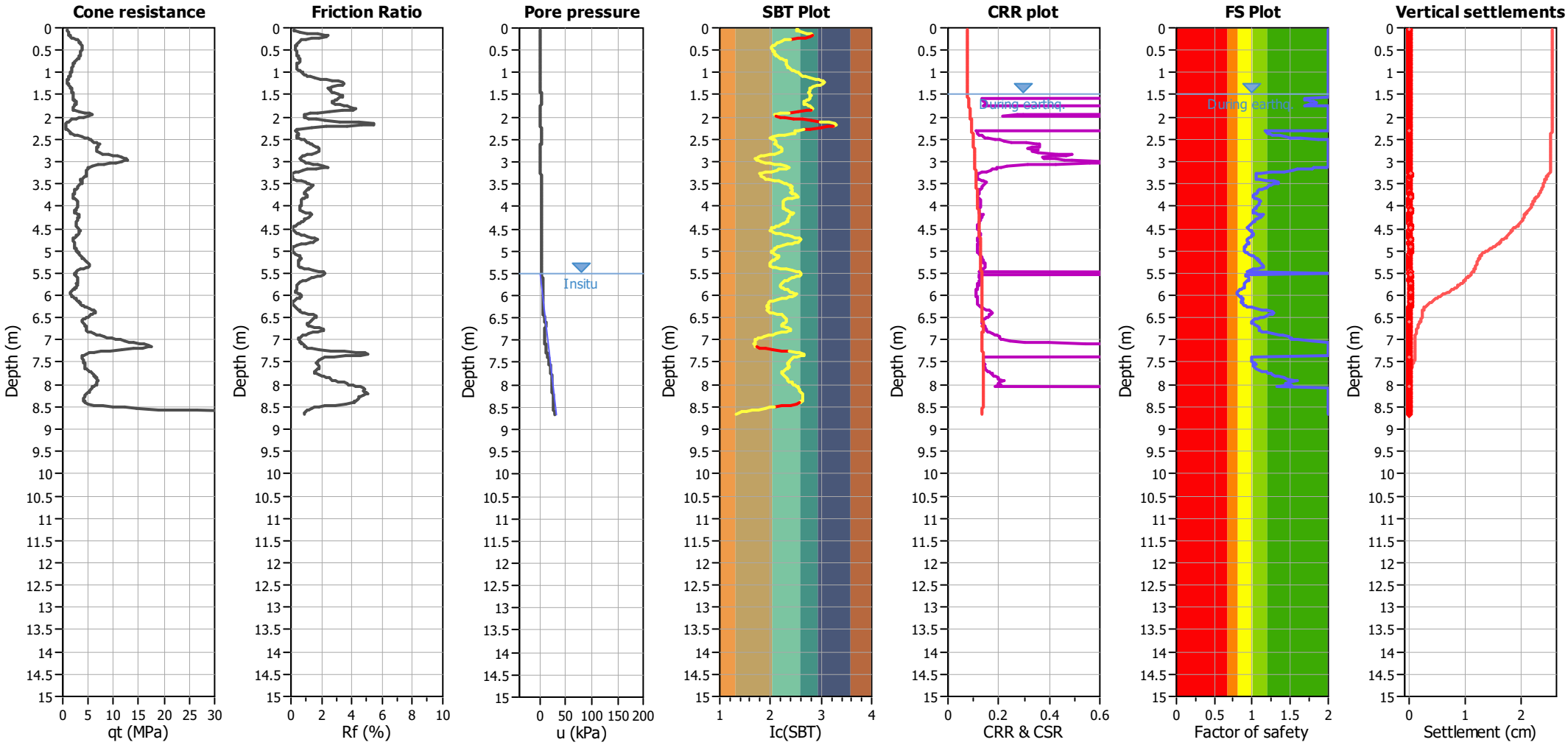
CPT: CPT_88482
Total depth: 4.99 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

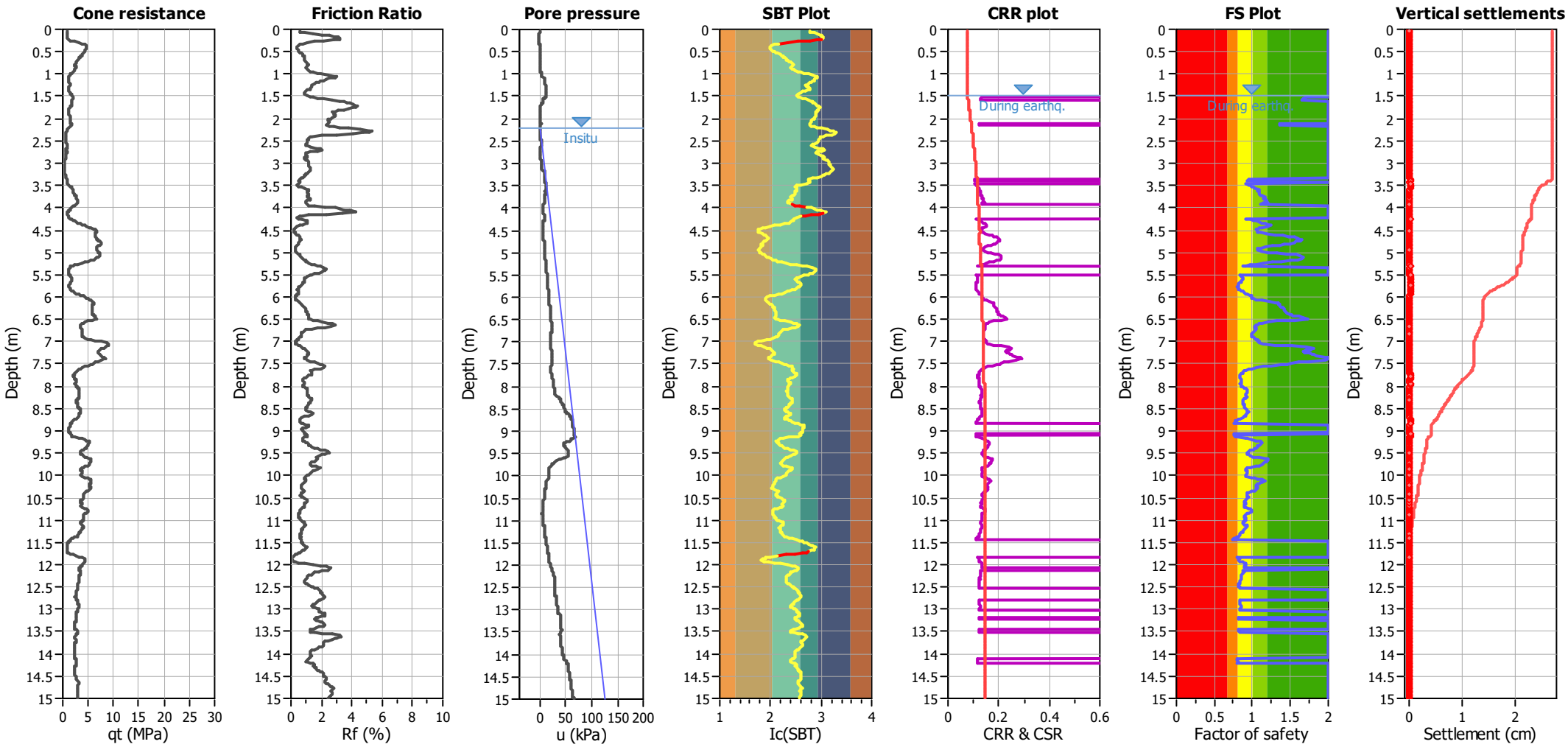
CPT: CPT_87715
Total depth: 8.66 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	5.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

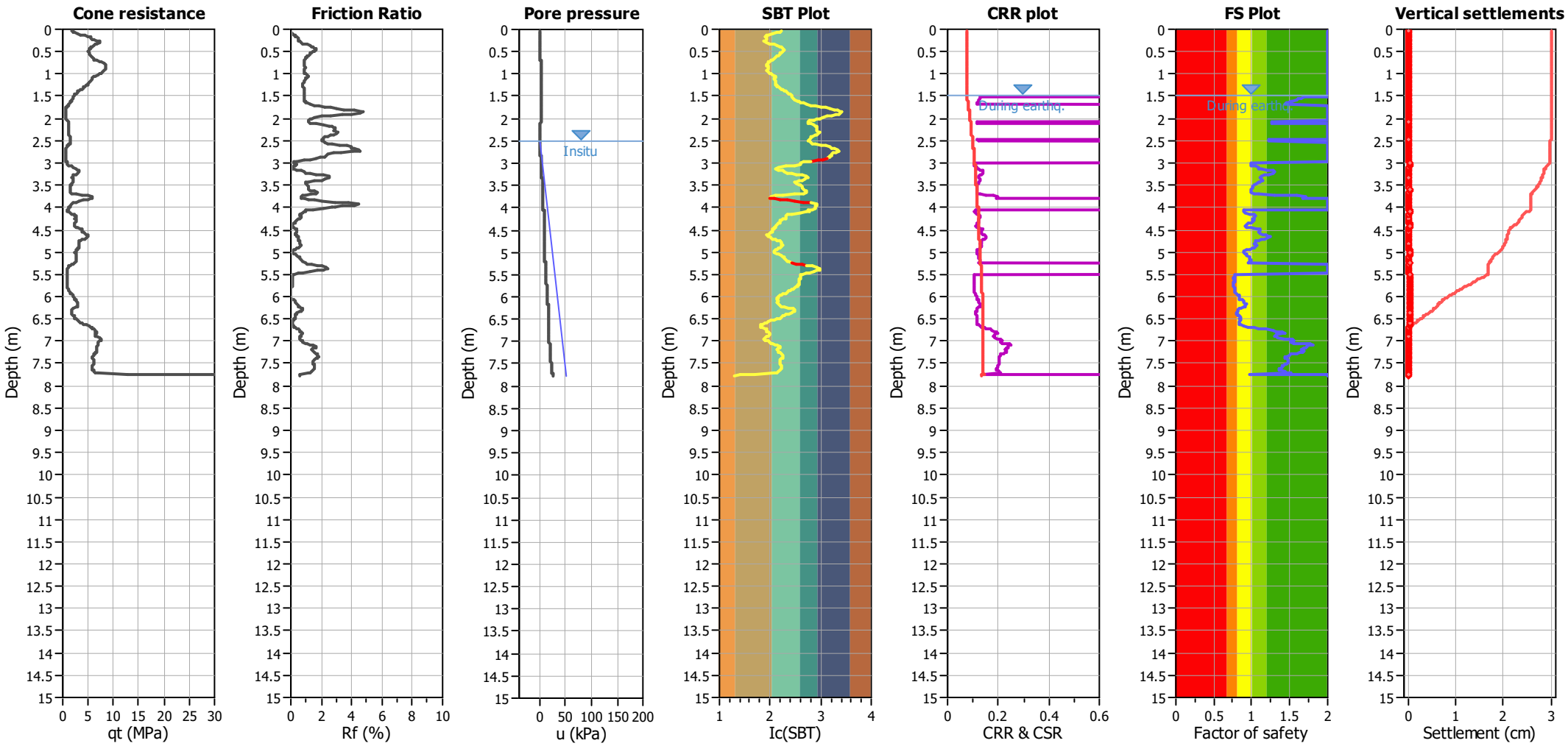
CPT: CPT_87714
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

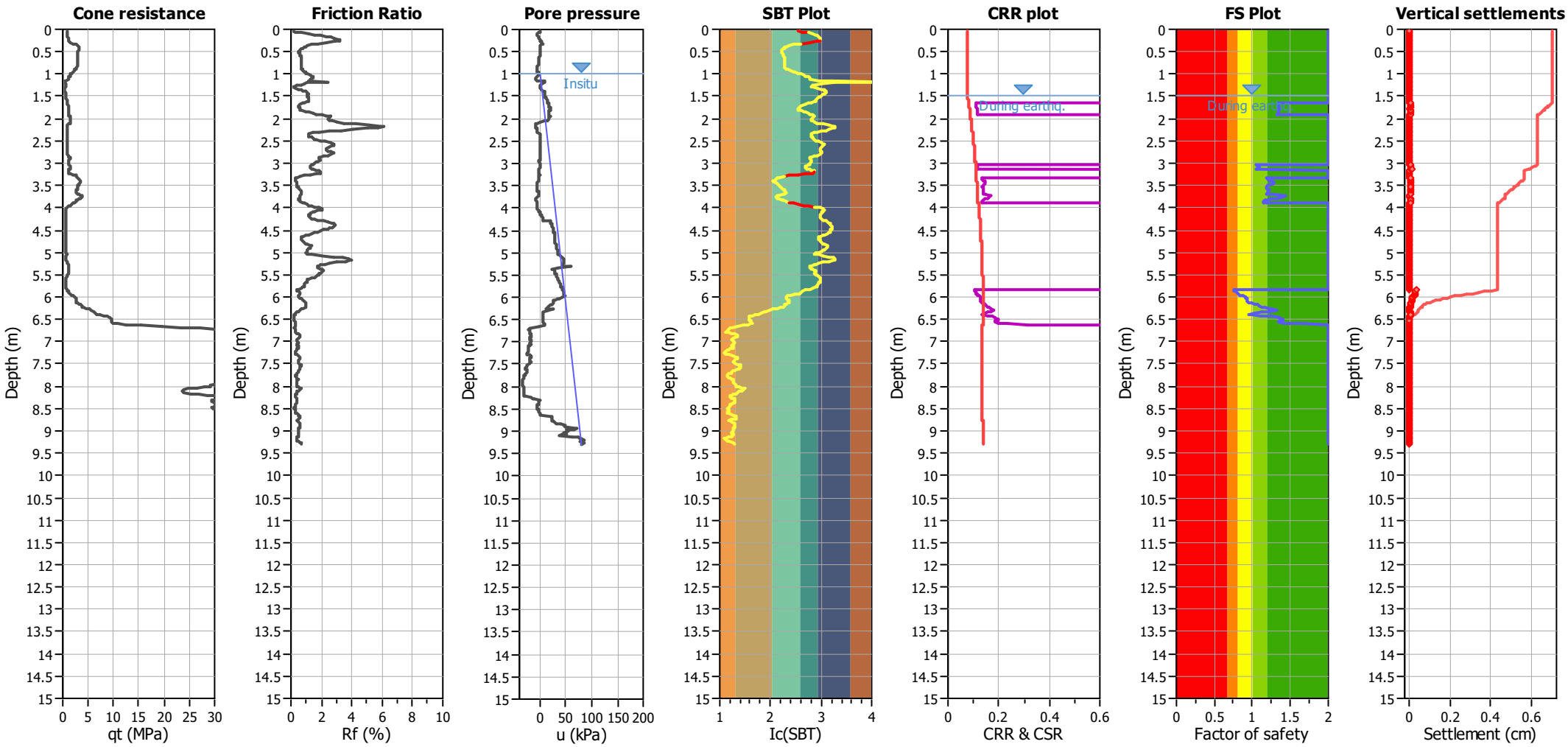
CPT: CPT_87713
Total depth: 7.78 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

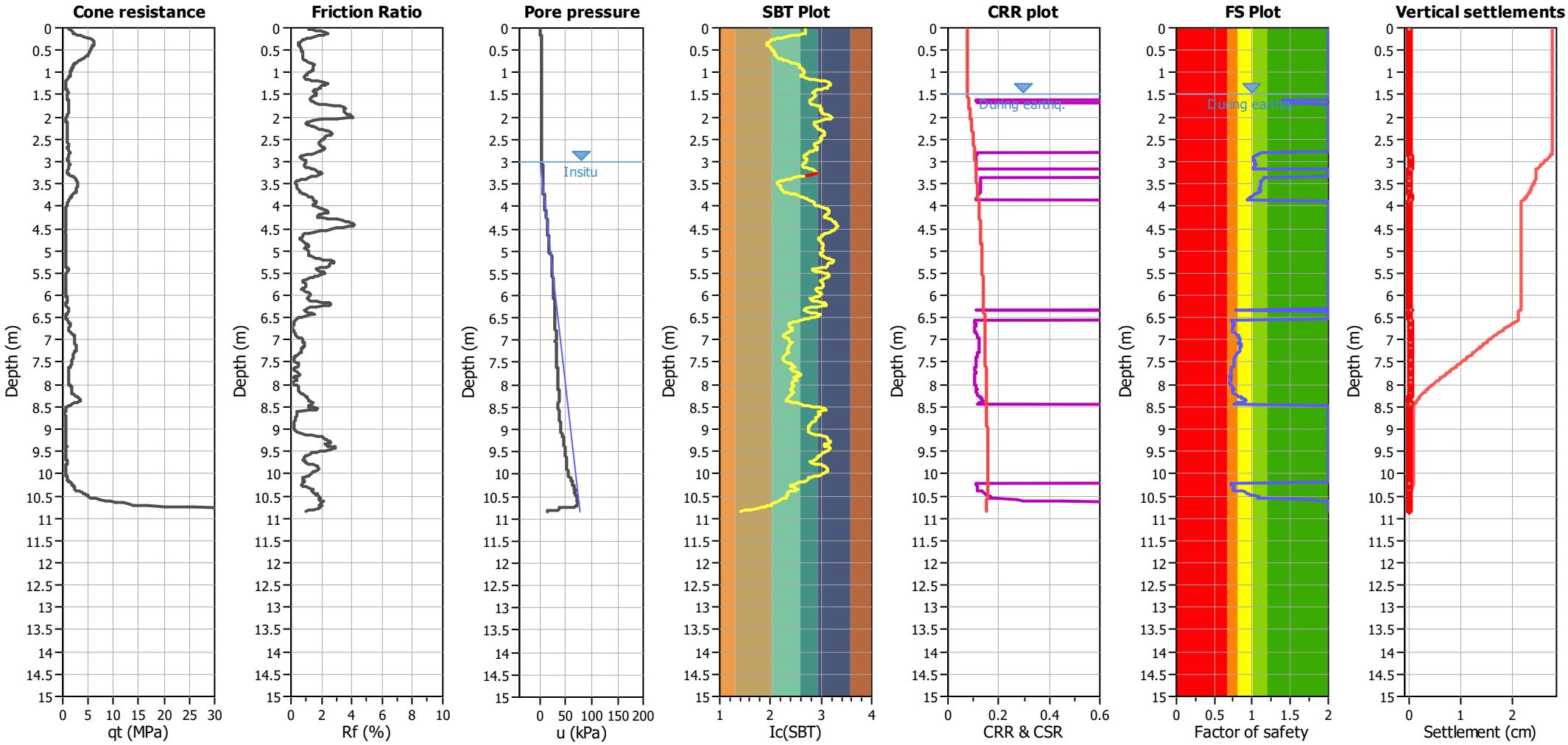
CPT: CPT_87712
Total depth: 9.30 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

CPT: CPT_87710
Total depth: 10.84 m



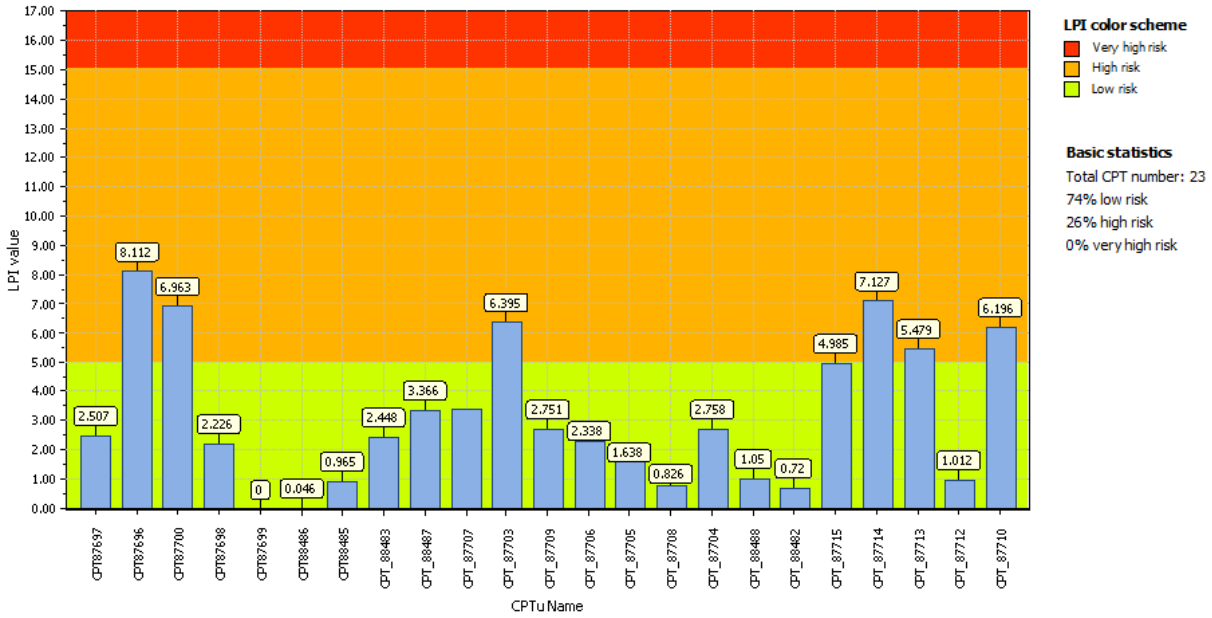
Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

SLS1

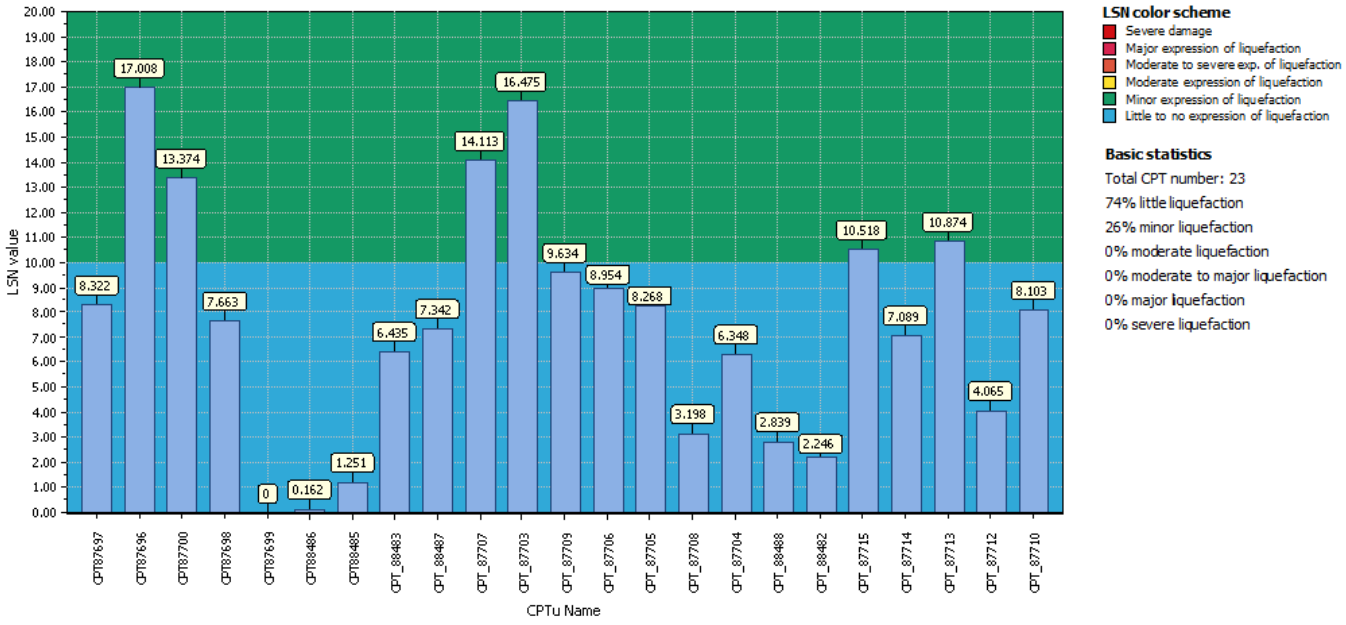
Project title : MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision

Location : Cashmere and Southerland Road, Halswell

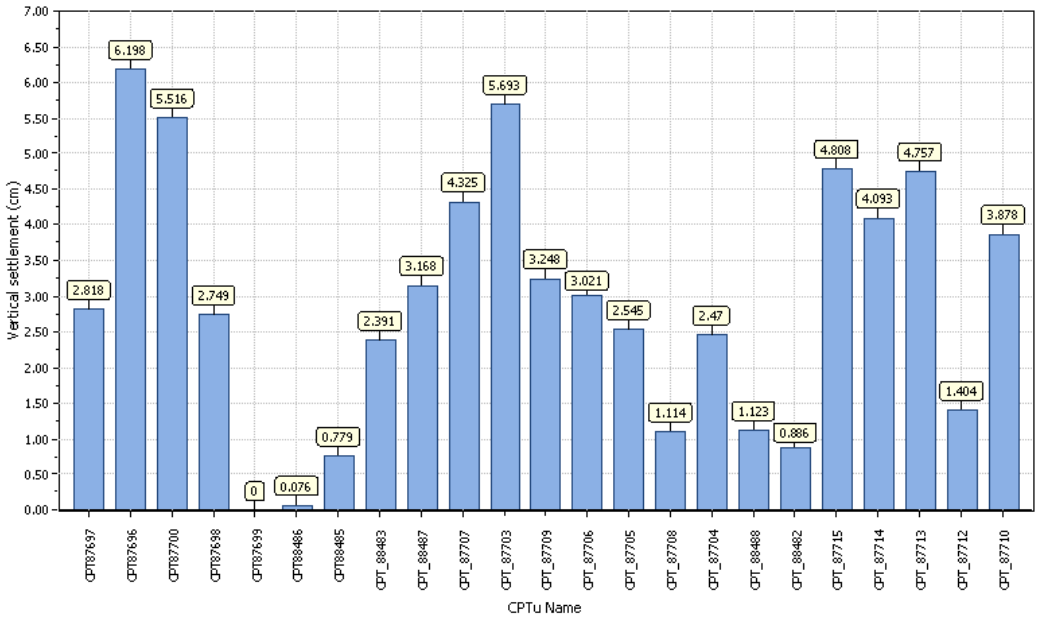
Overall Liquefaction Potential Index report



Overall Liquefaction Severity Number report

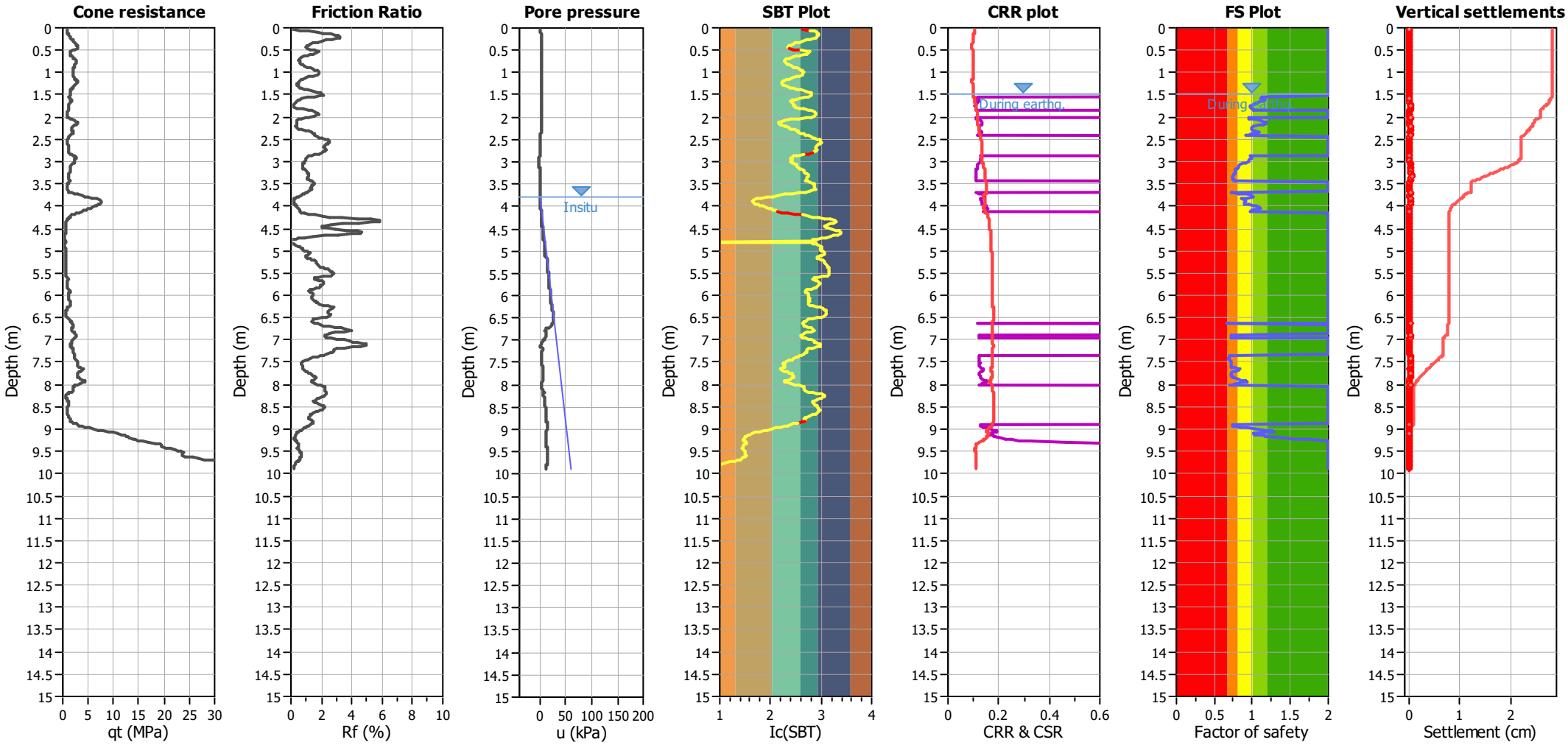


Overall vertical settlements report



Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

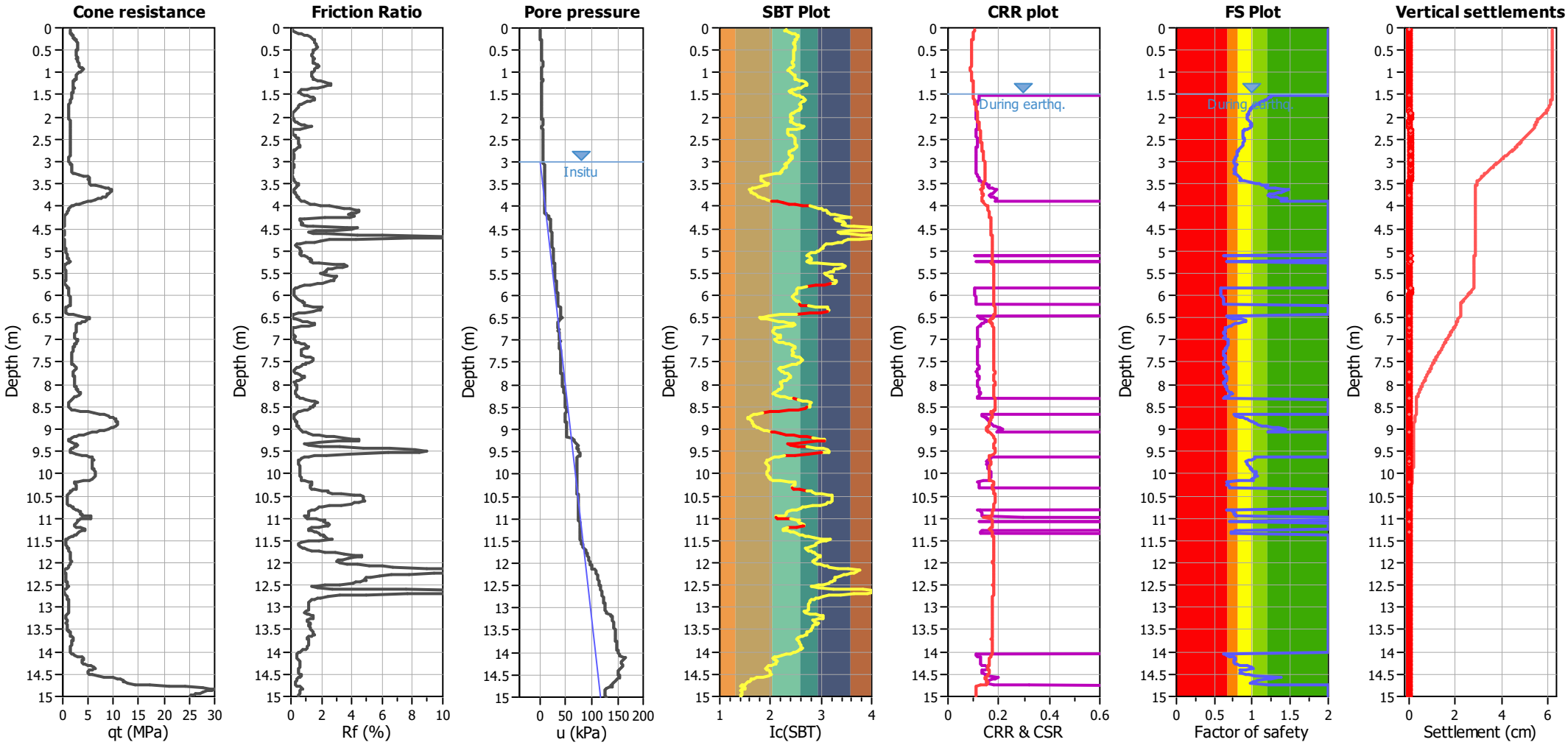
CPT: CPT87697
Total depth: 9.88 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

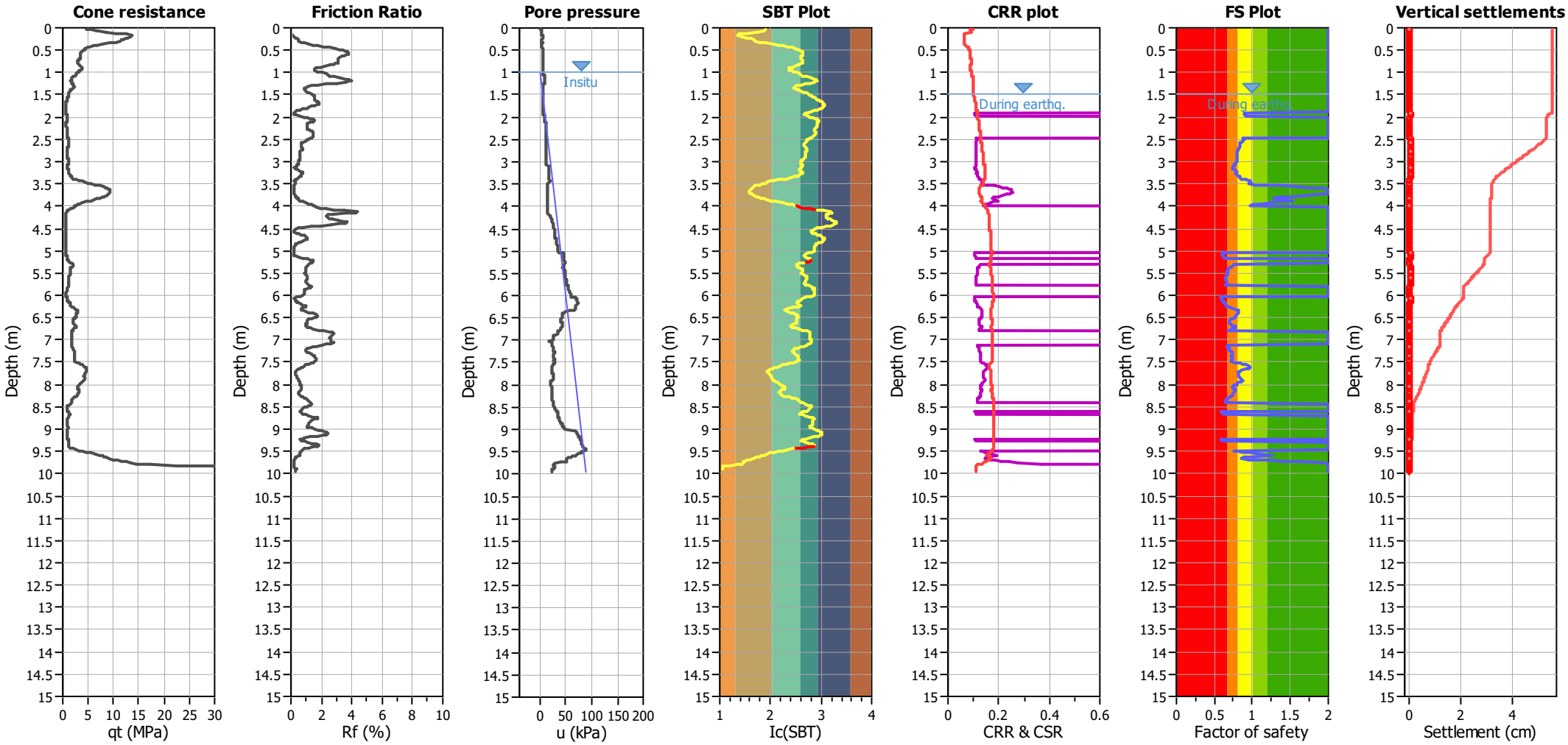
CPT: CPT87696
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

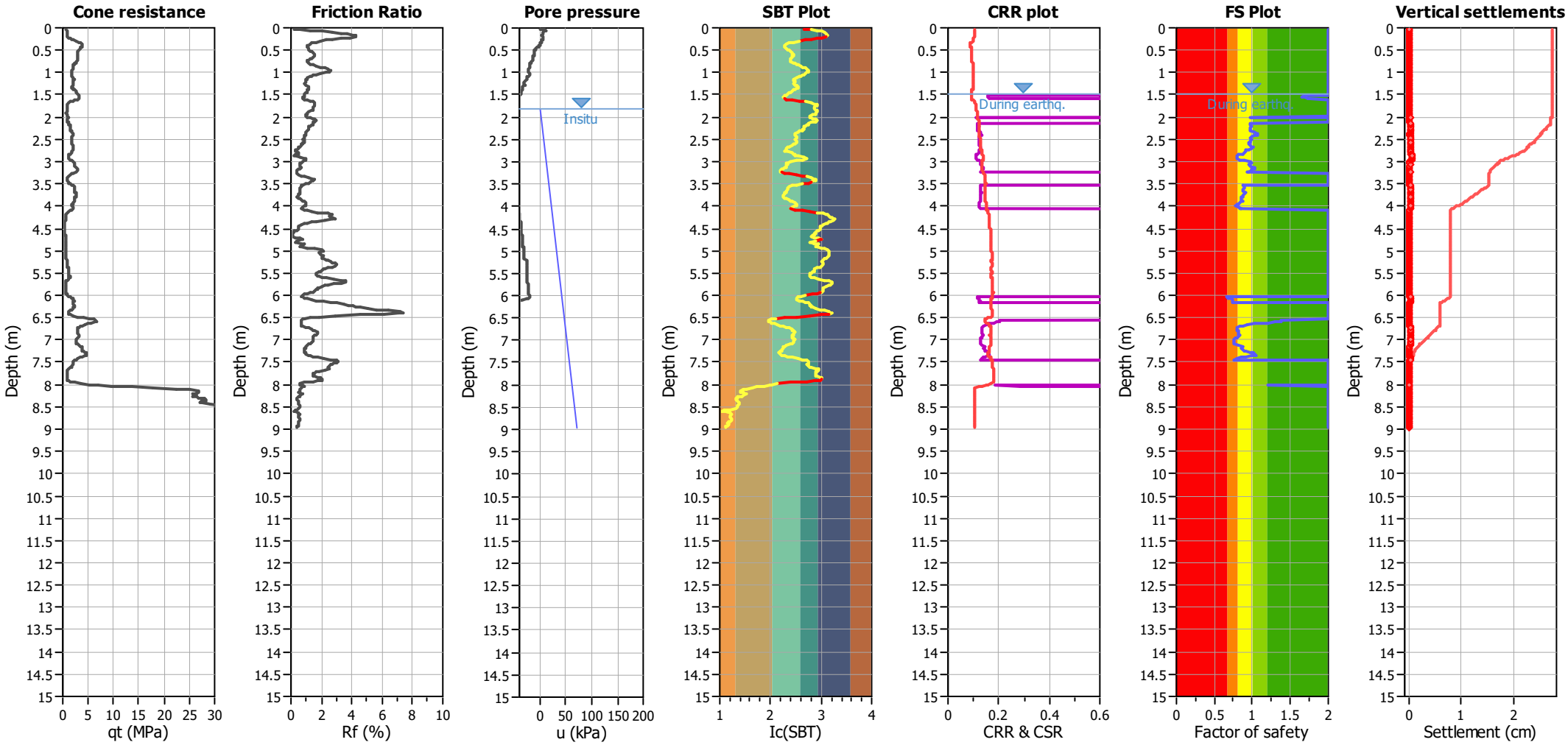
CPT: CPT87700
Total depth: 9.94 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

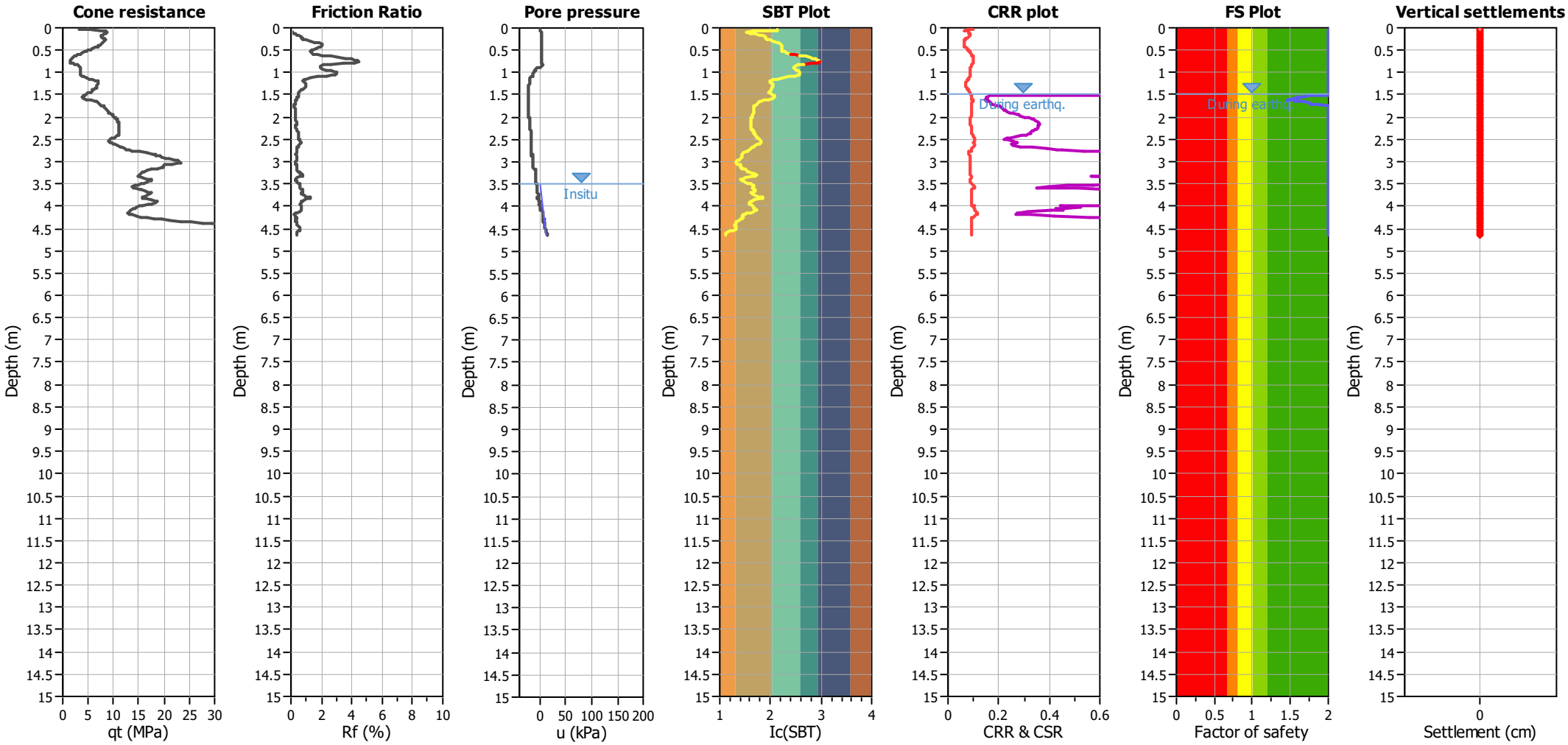
CPT: CPT87698
Total depth: 8.98 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

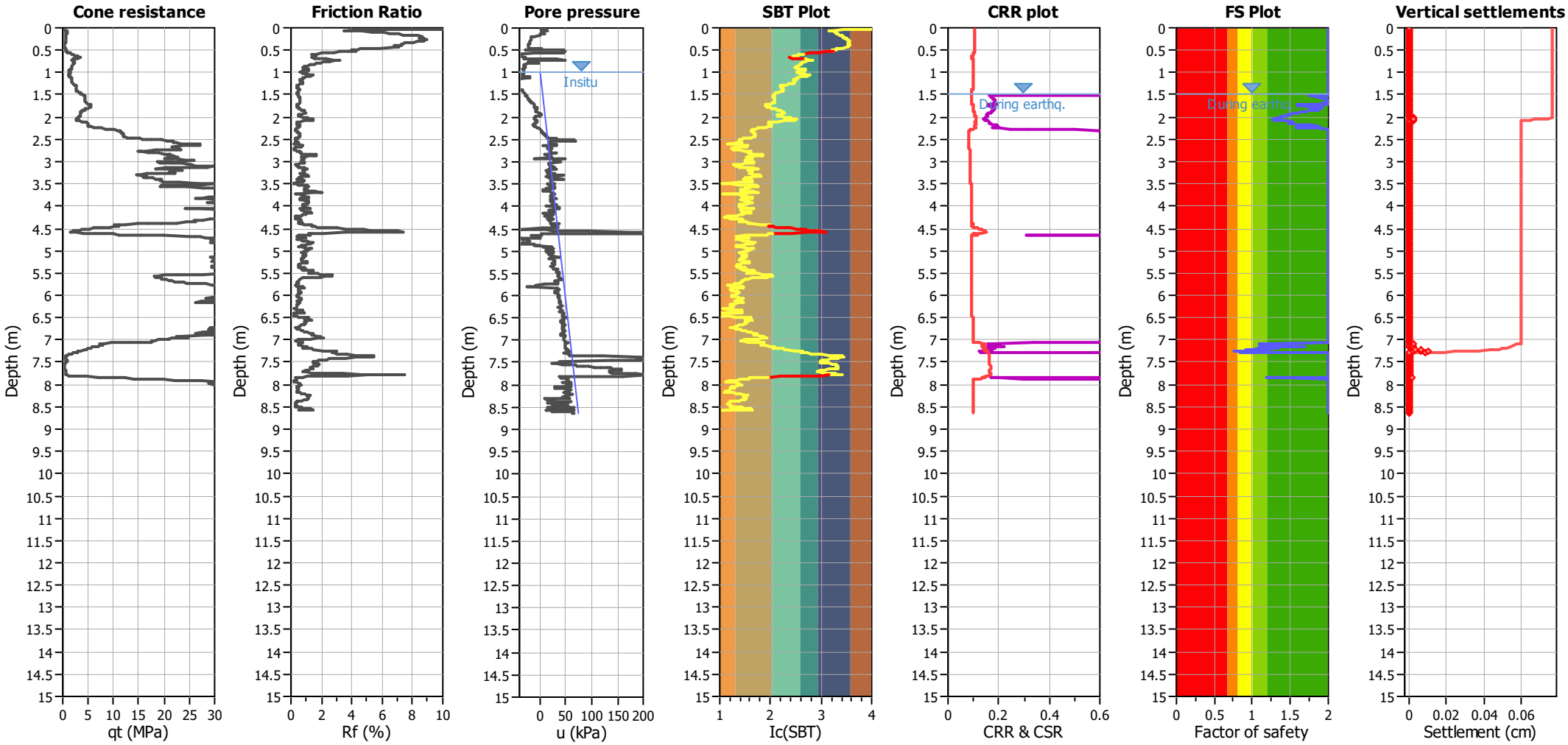
CPT: CPT87699
Total depth: 4.66 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

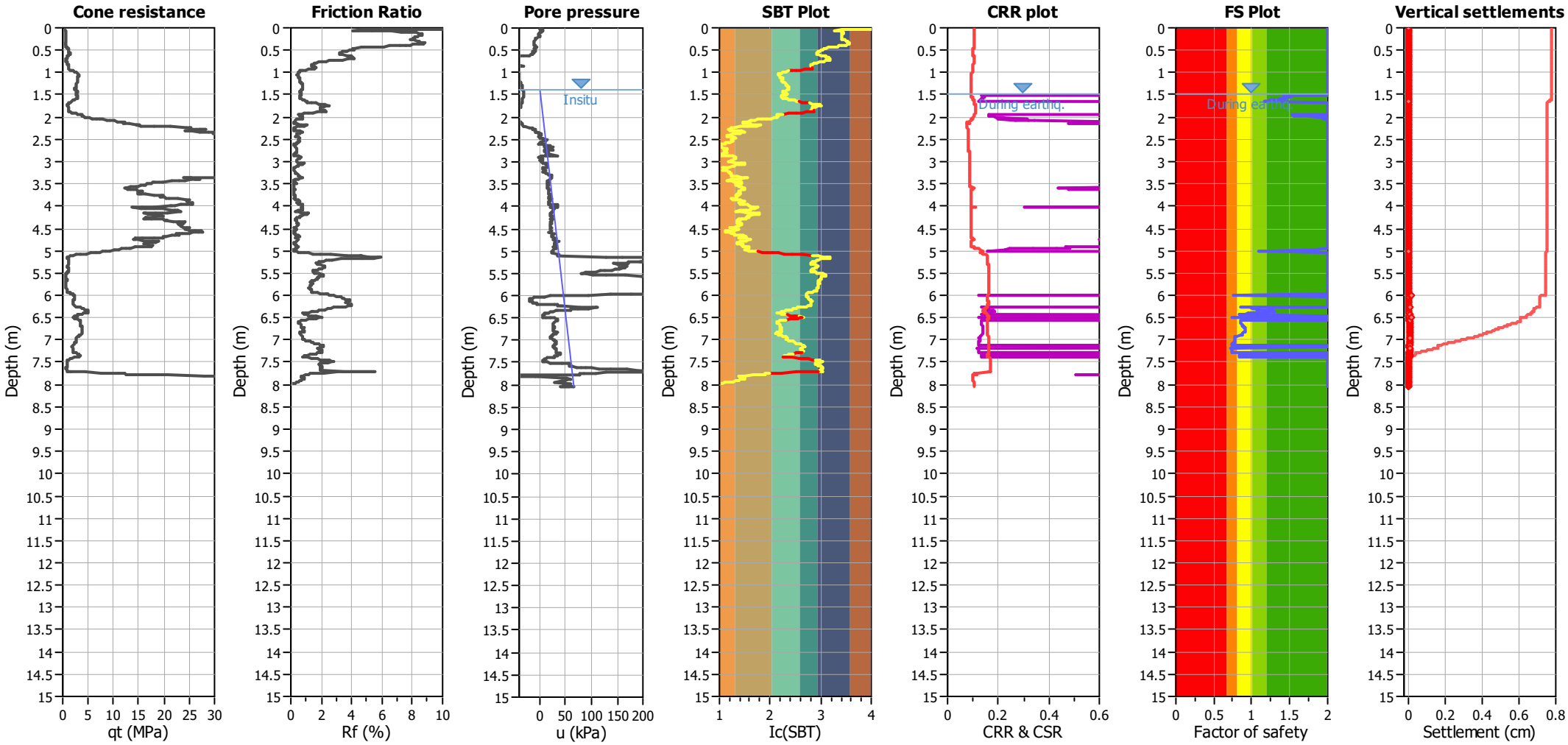
CPT: CPT88486
Total depth: 8.65 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

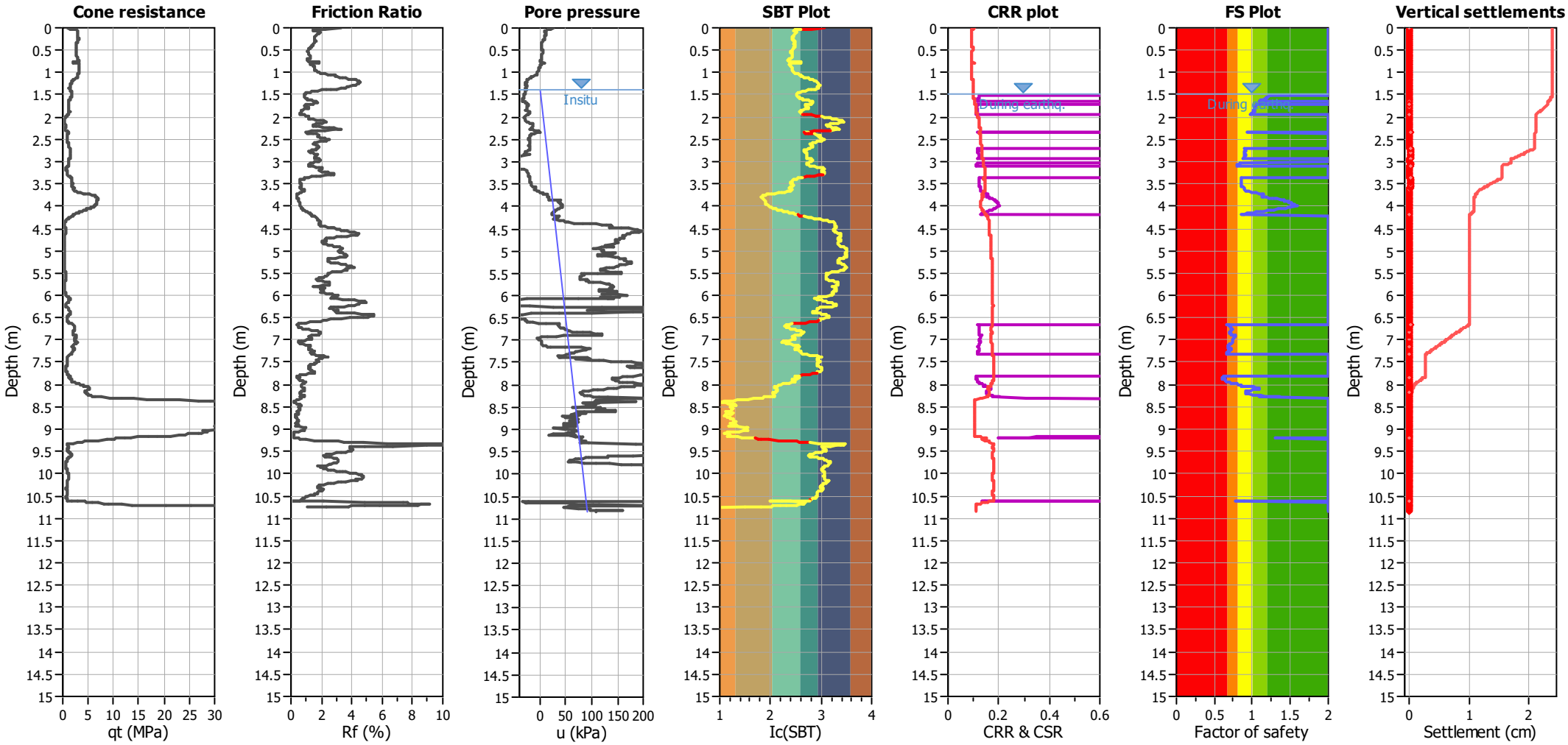
CPT: CPT88485
Total depth: 8.06 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.40 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

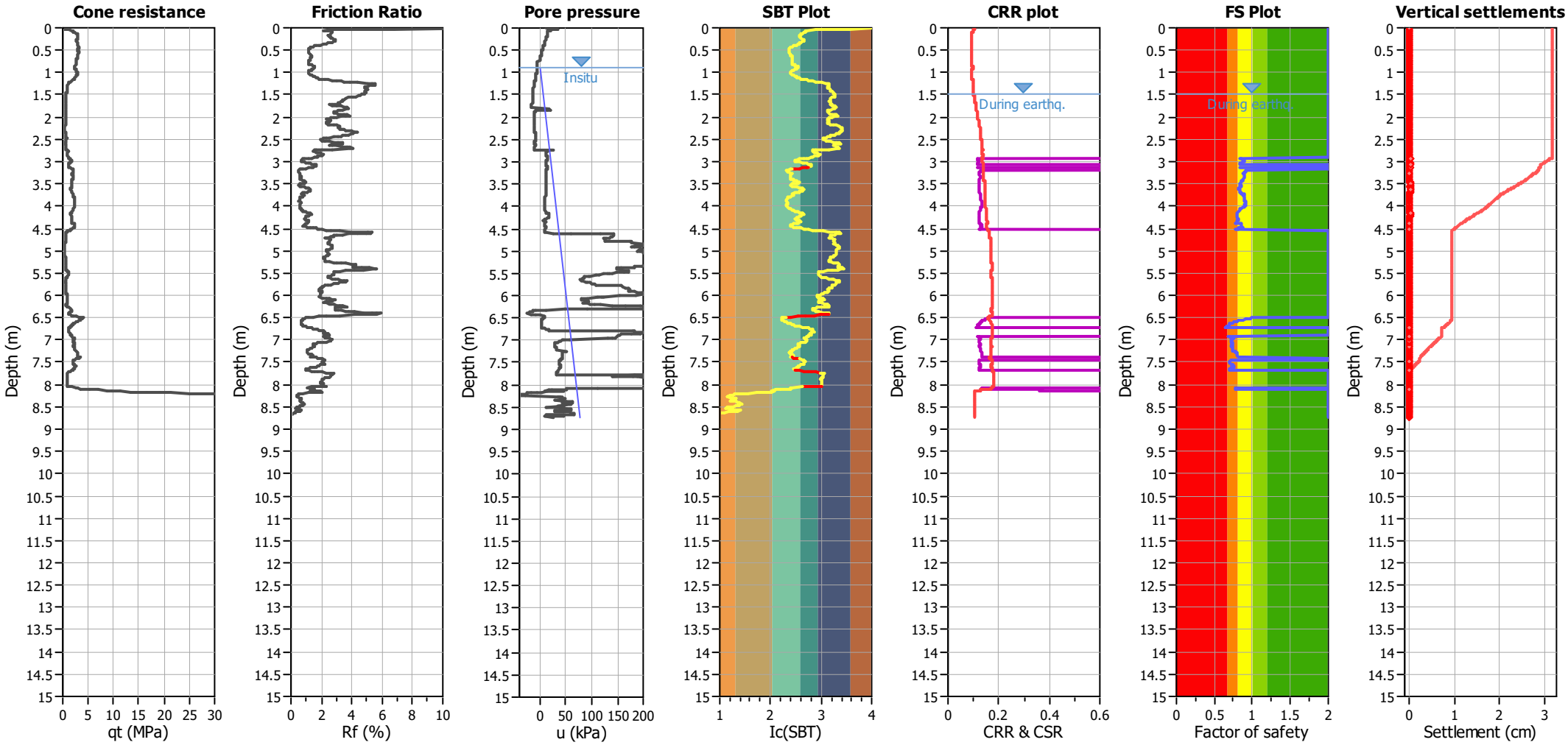
CPT: CPT_88483
Total depth: 10.83 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.40 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

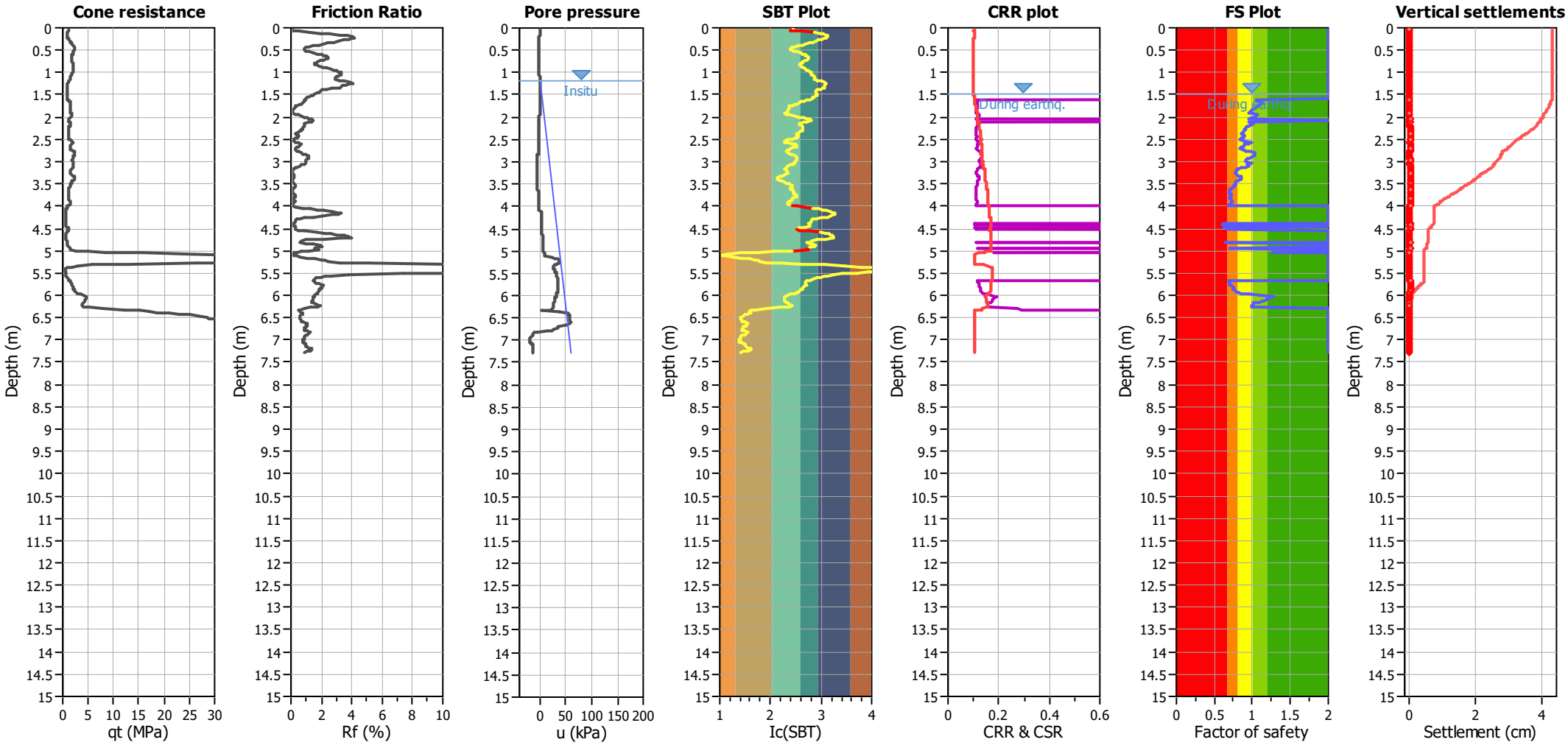
CPT: CPT_88487
Total depth: 8.74 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.90 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

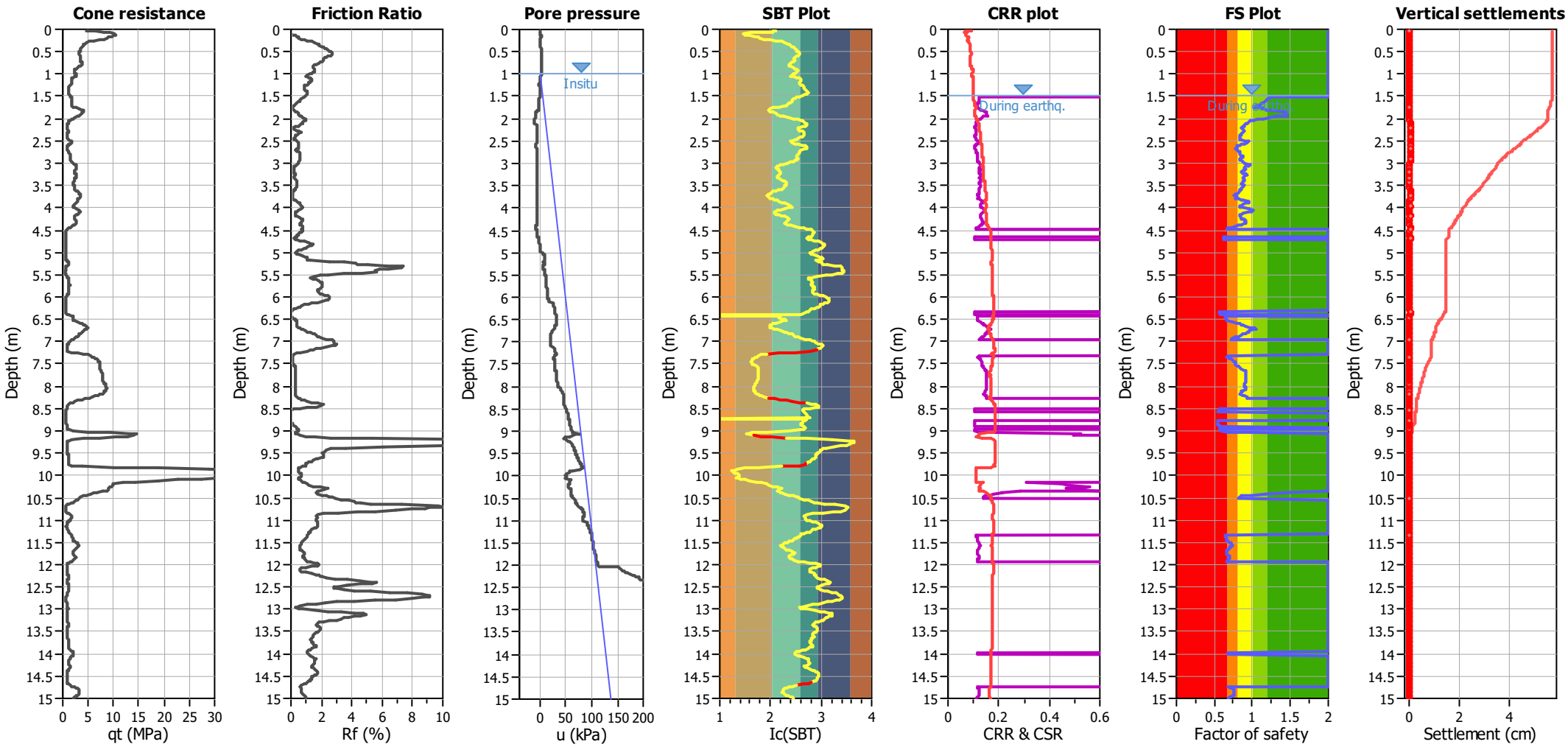
CPT: CPT_87707
Total depth: 7.28 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

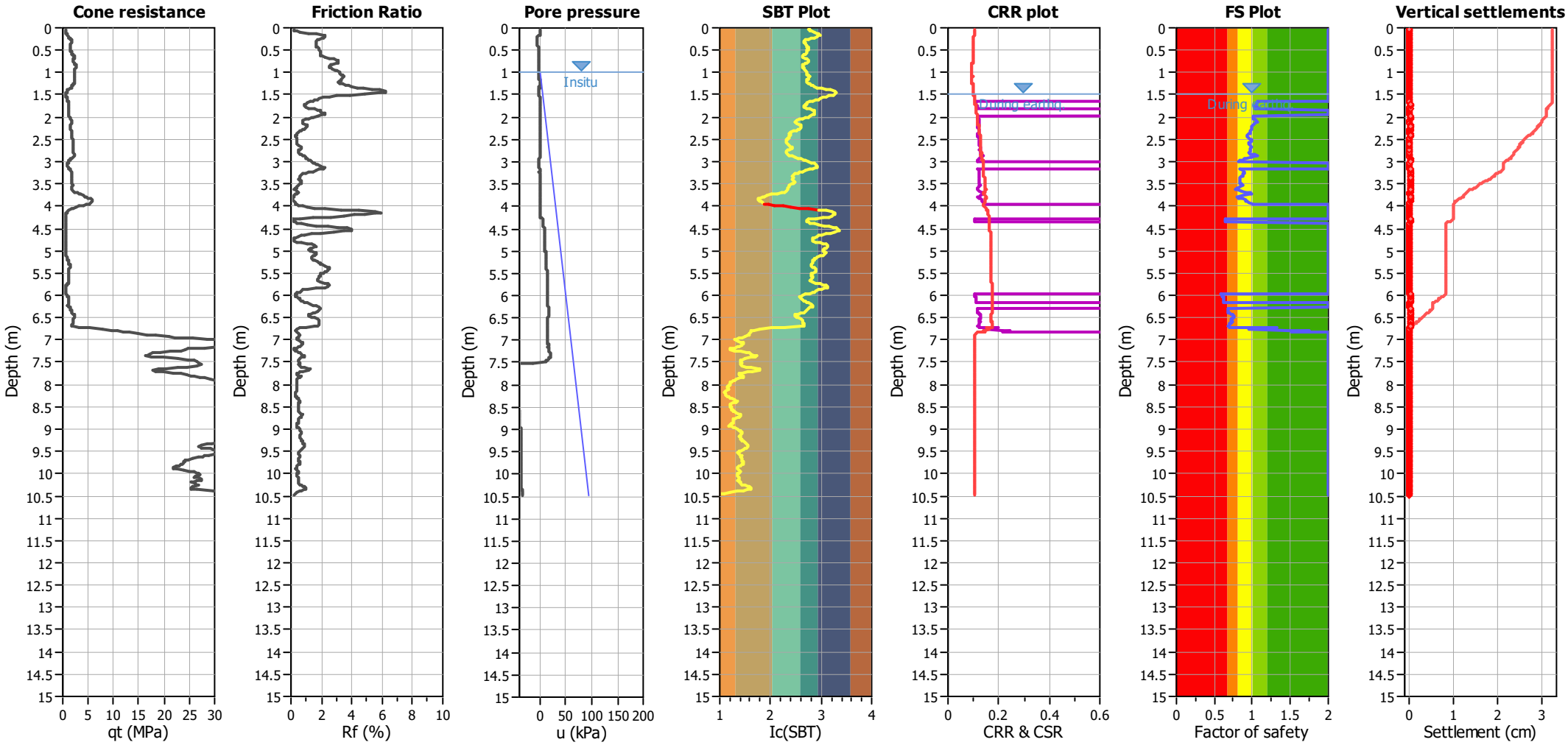
CPT: CPT_87703
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

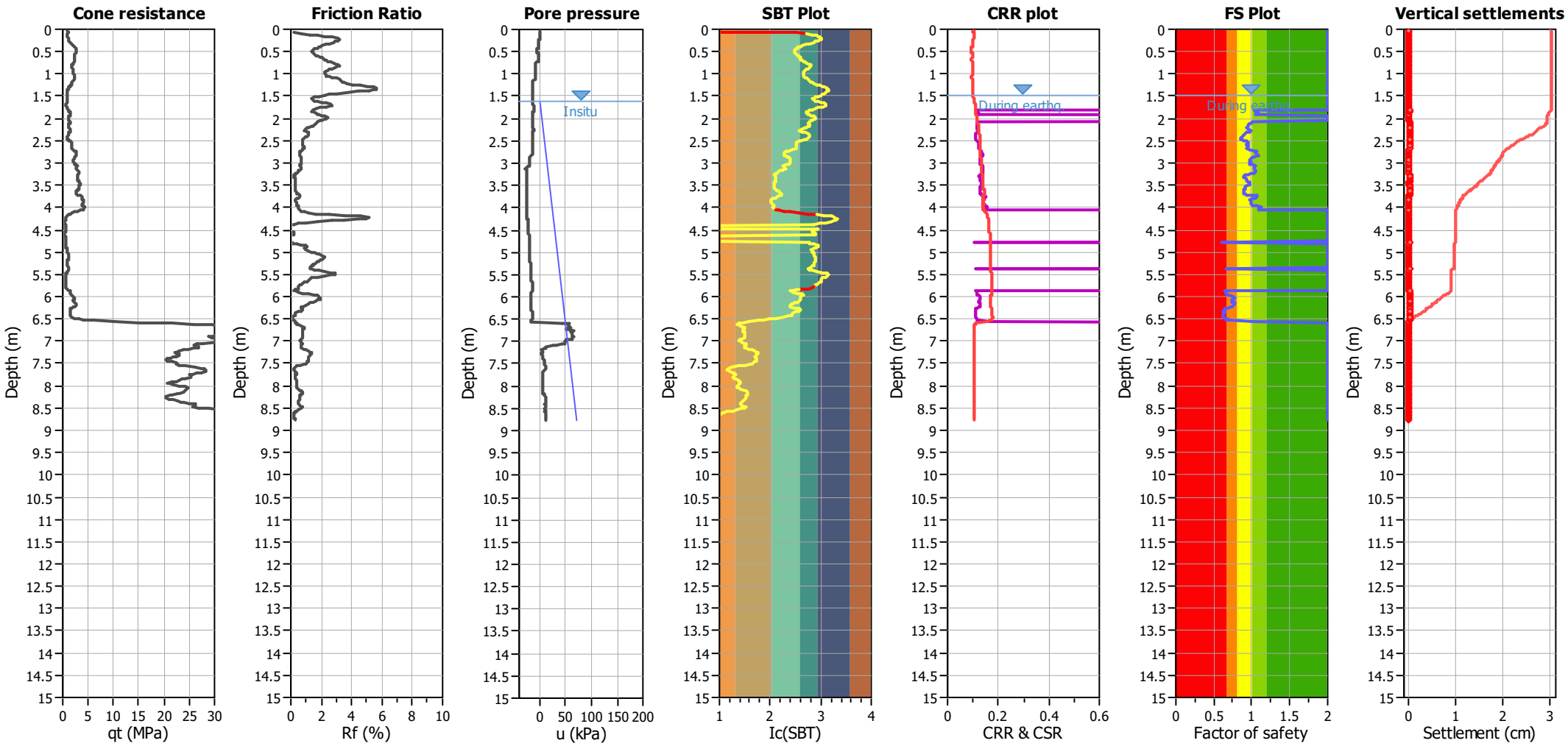
CPT: CPT_87709
Total depth: 10.48 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

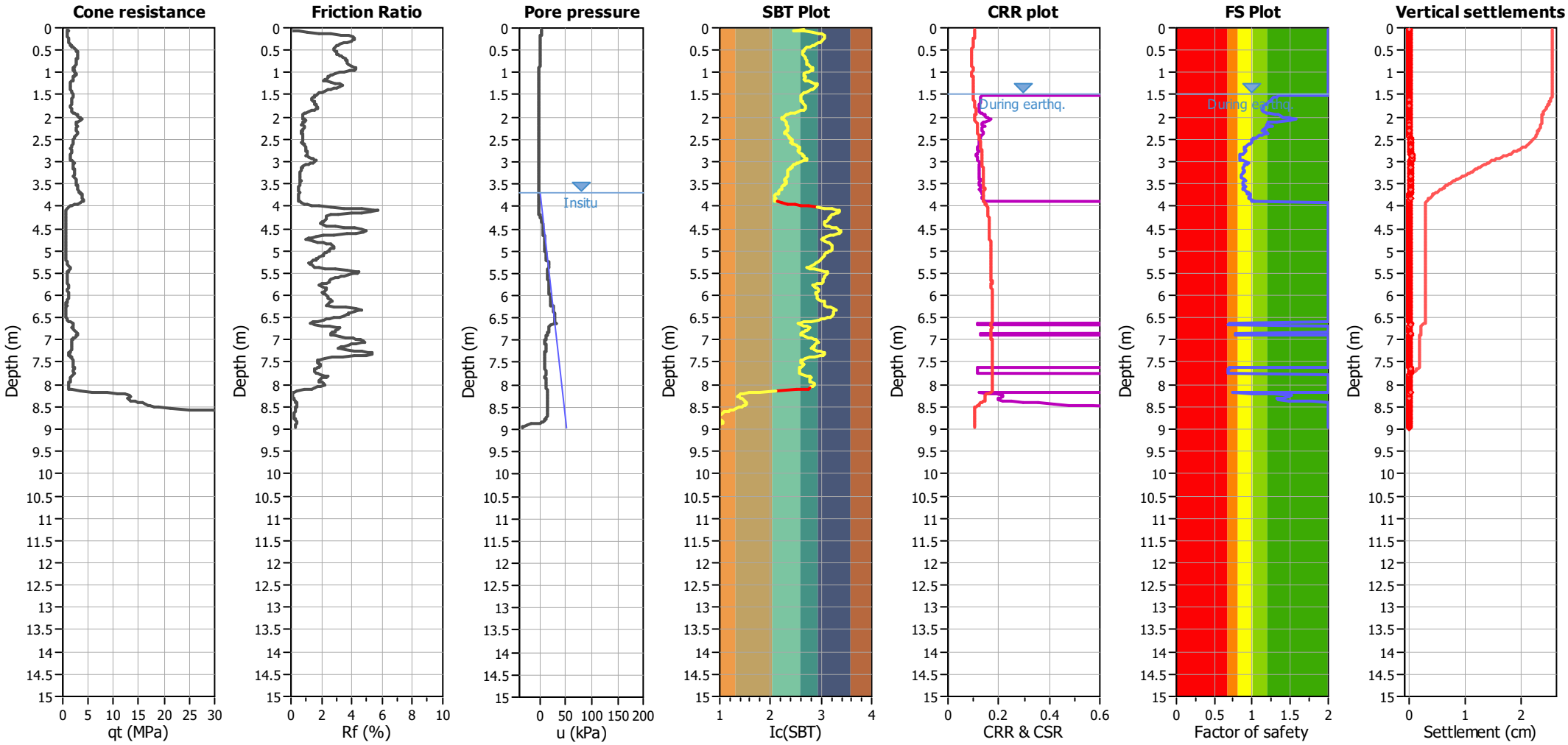
CPT: CPT_87706
Total depth: 8.76 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

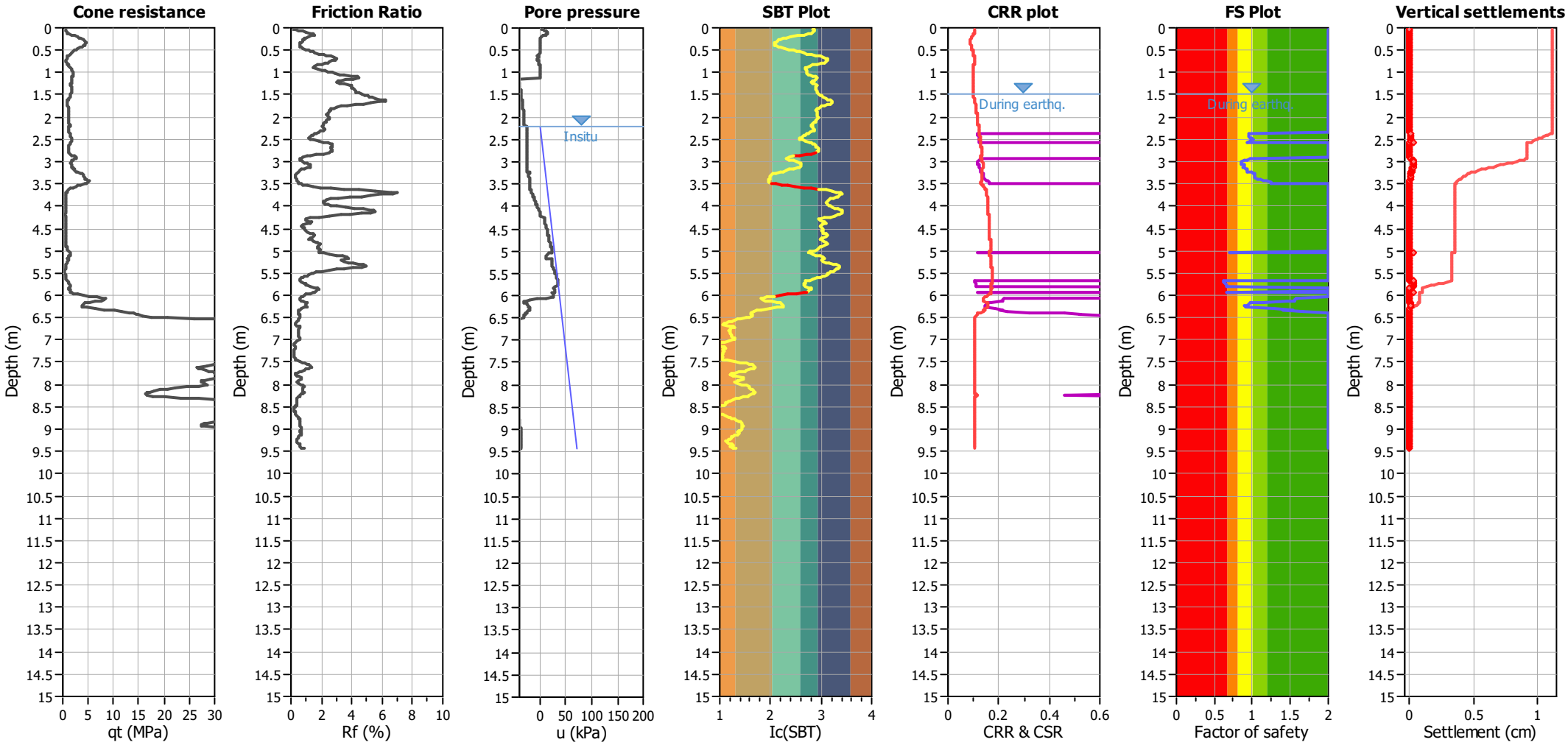
CPT: CPT_87705
Total depth: 8.96 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

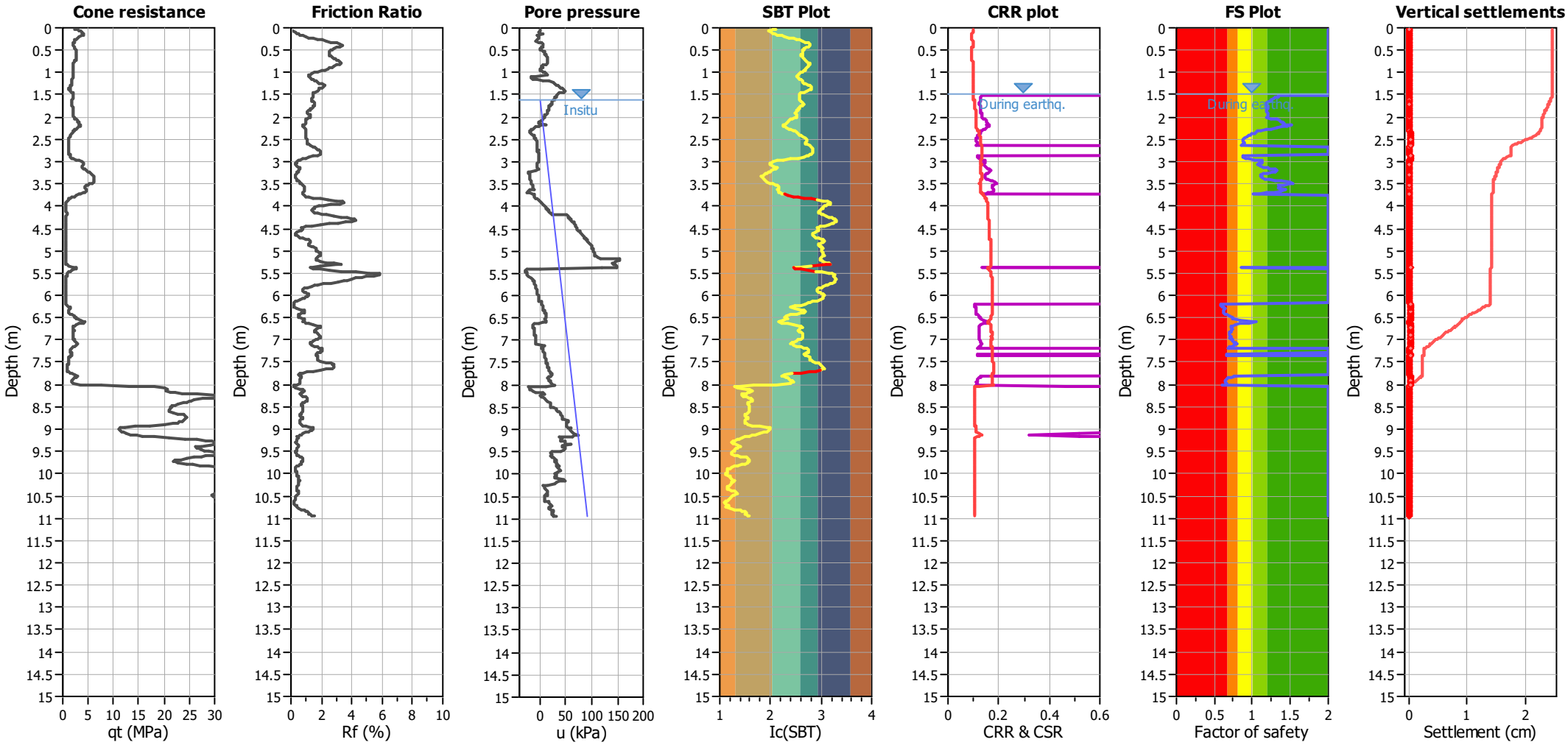
CPT: CPT_87708
Total depth: 9.44 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

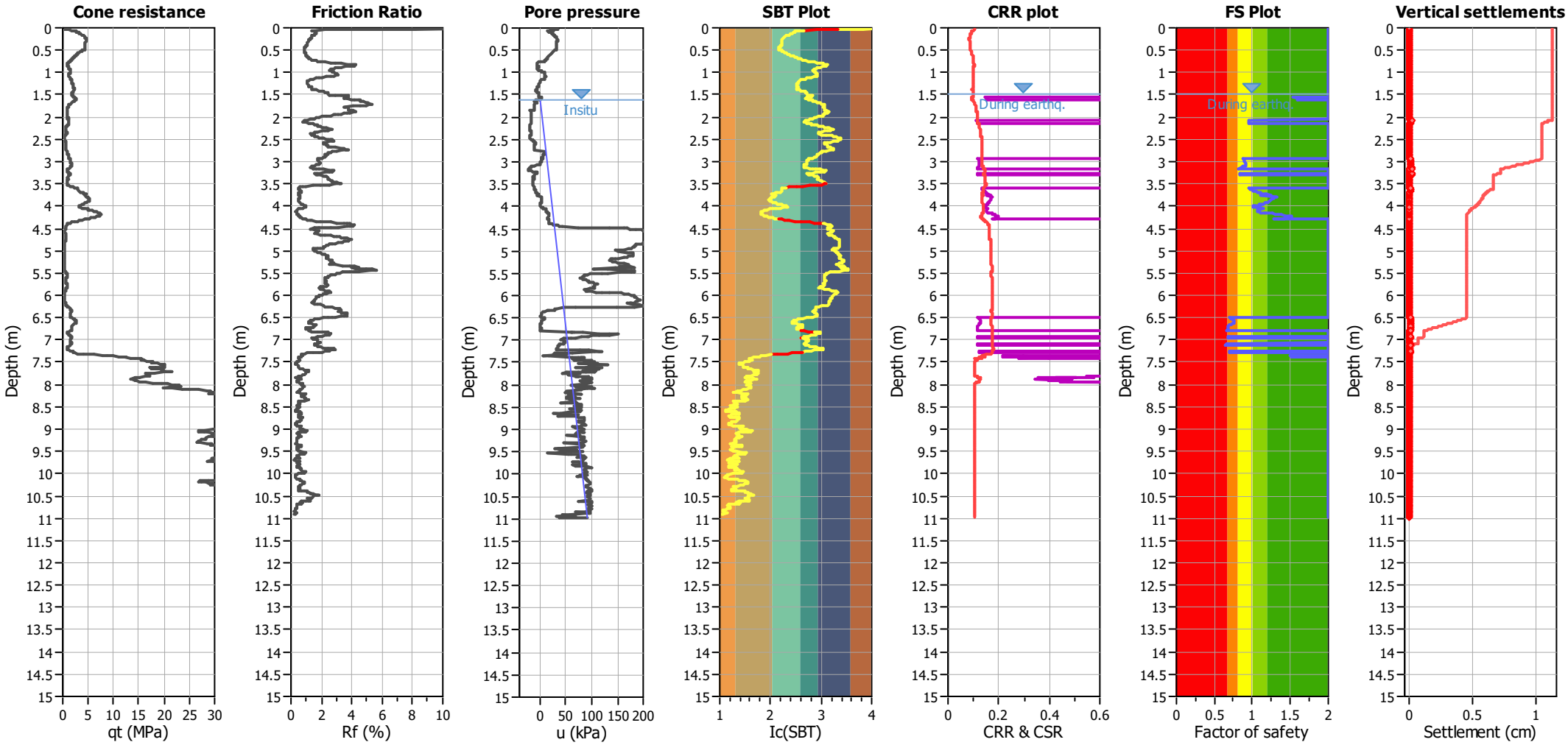
CPT: CPT_87704
Total depth: 10.96 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

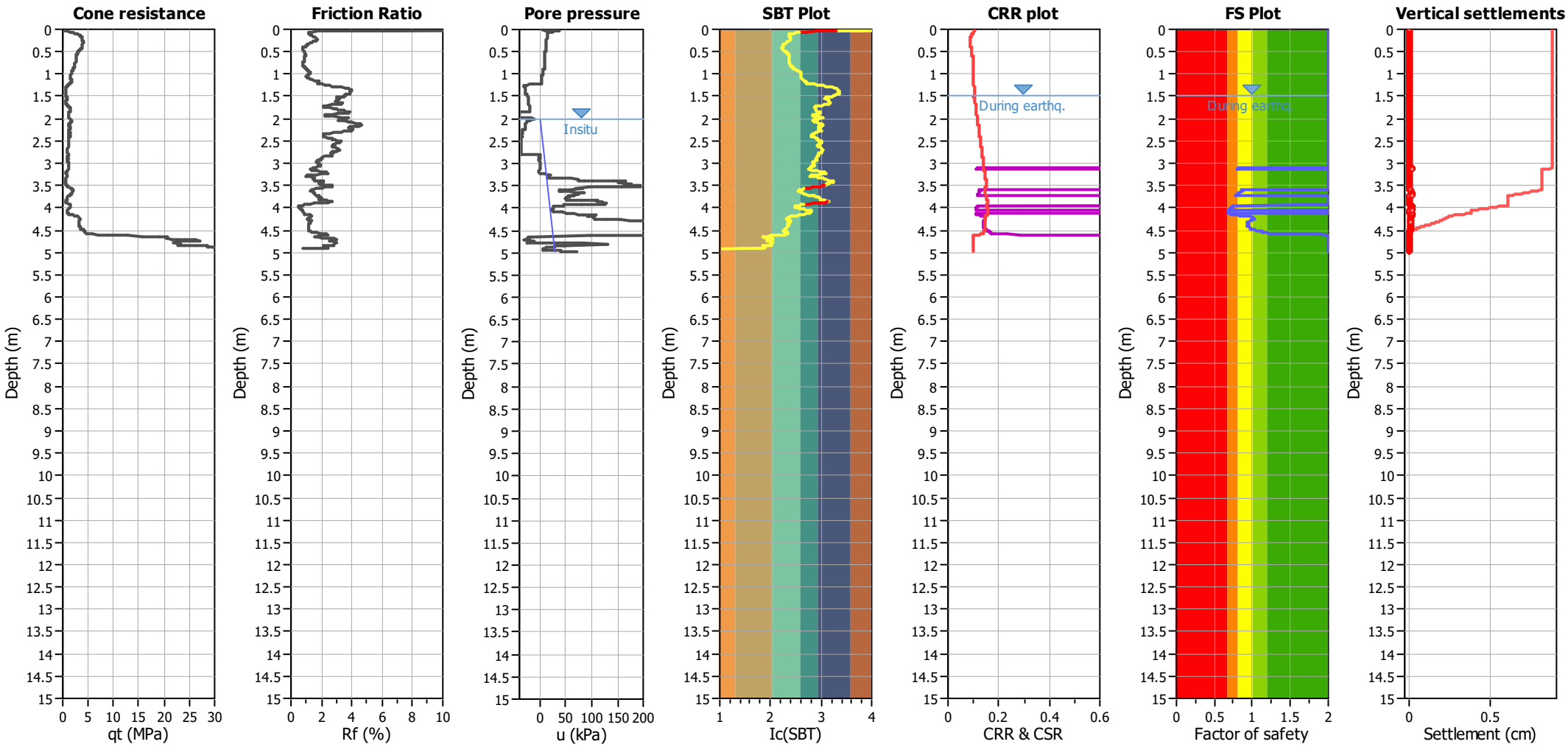
CPT: CPT_88488
Total depth: 10.98 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

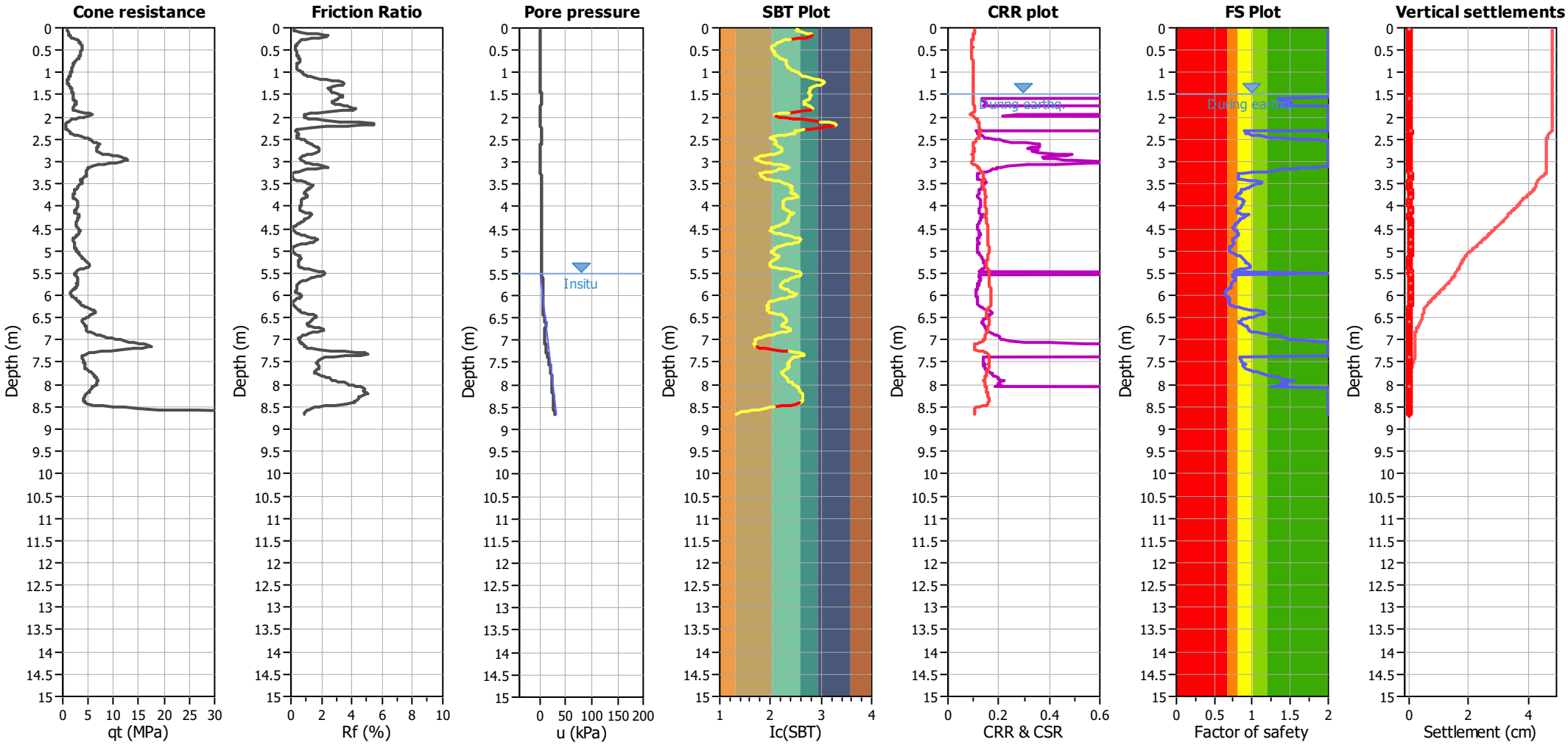
CPT: CPT_88482
Total depth: 4.99 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

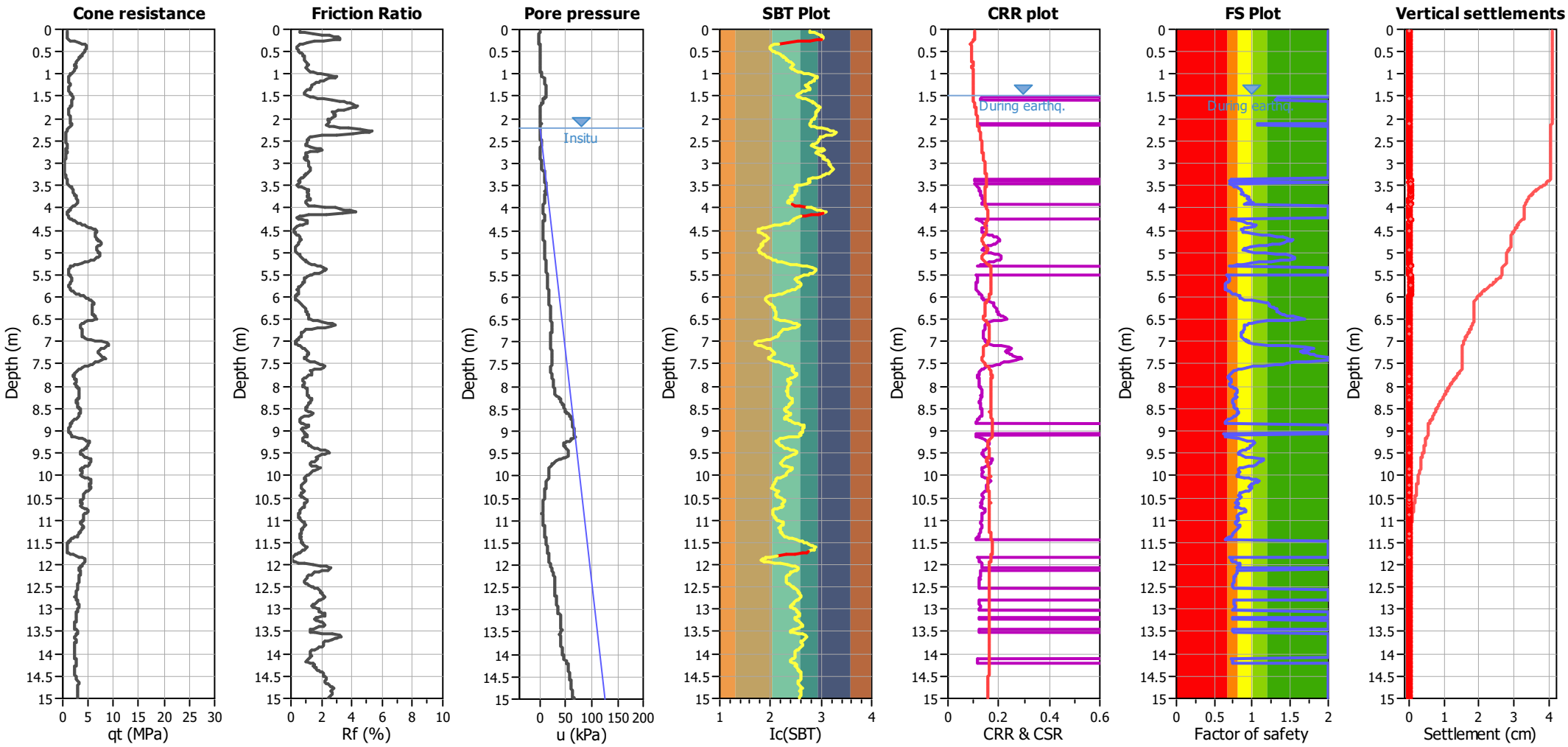
CPT: CPT_87715
Total depth: 8.66 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	5.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

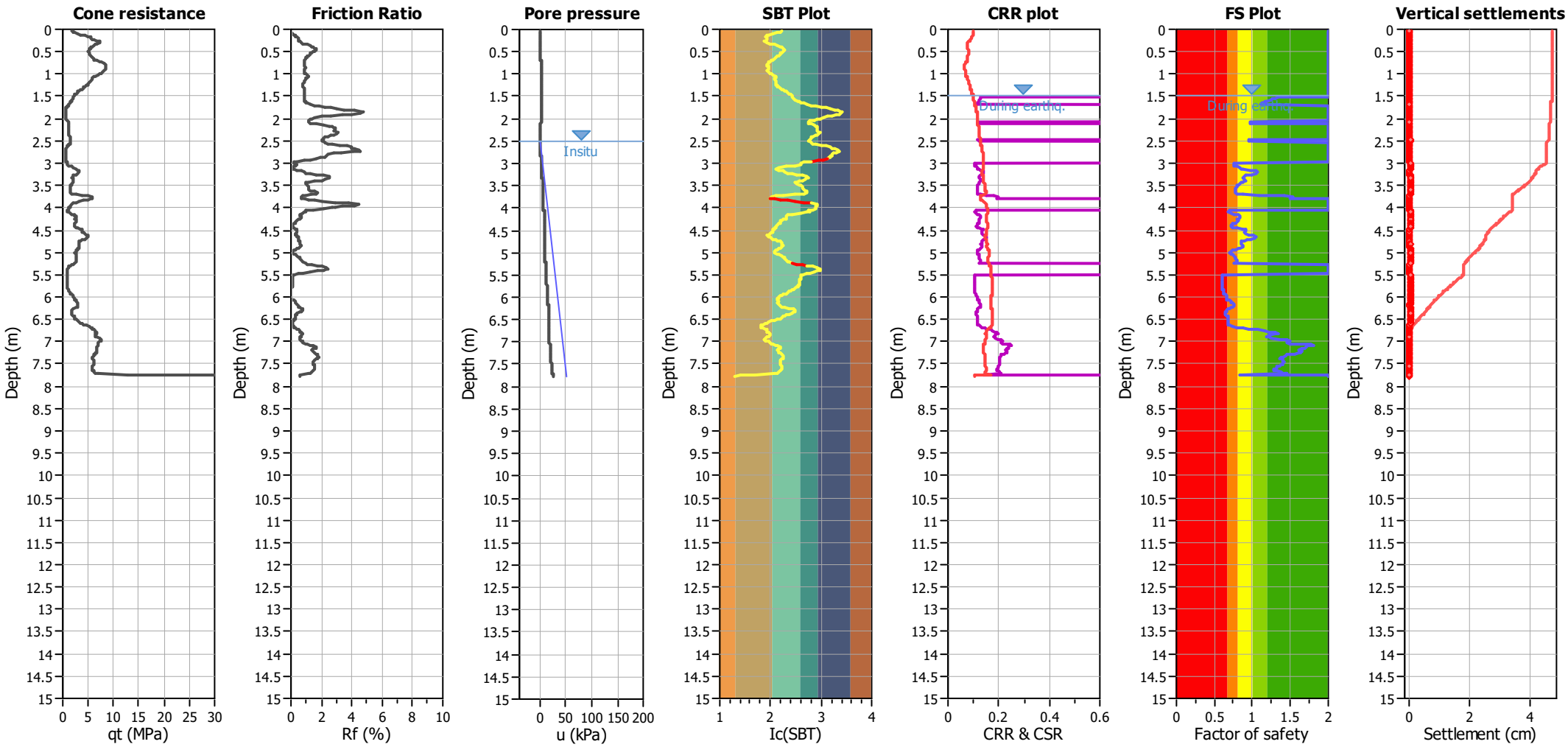
CPT: CPT_87714
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

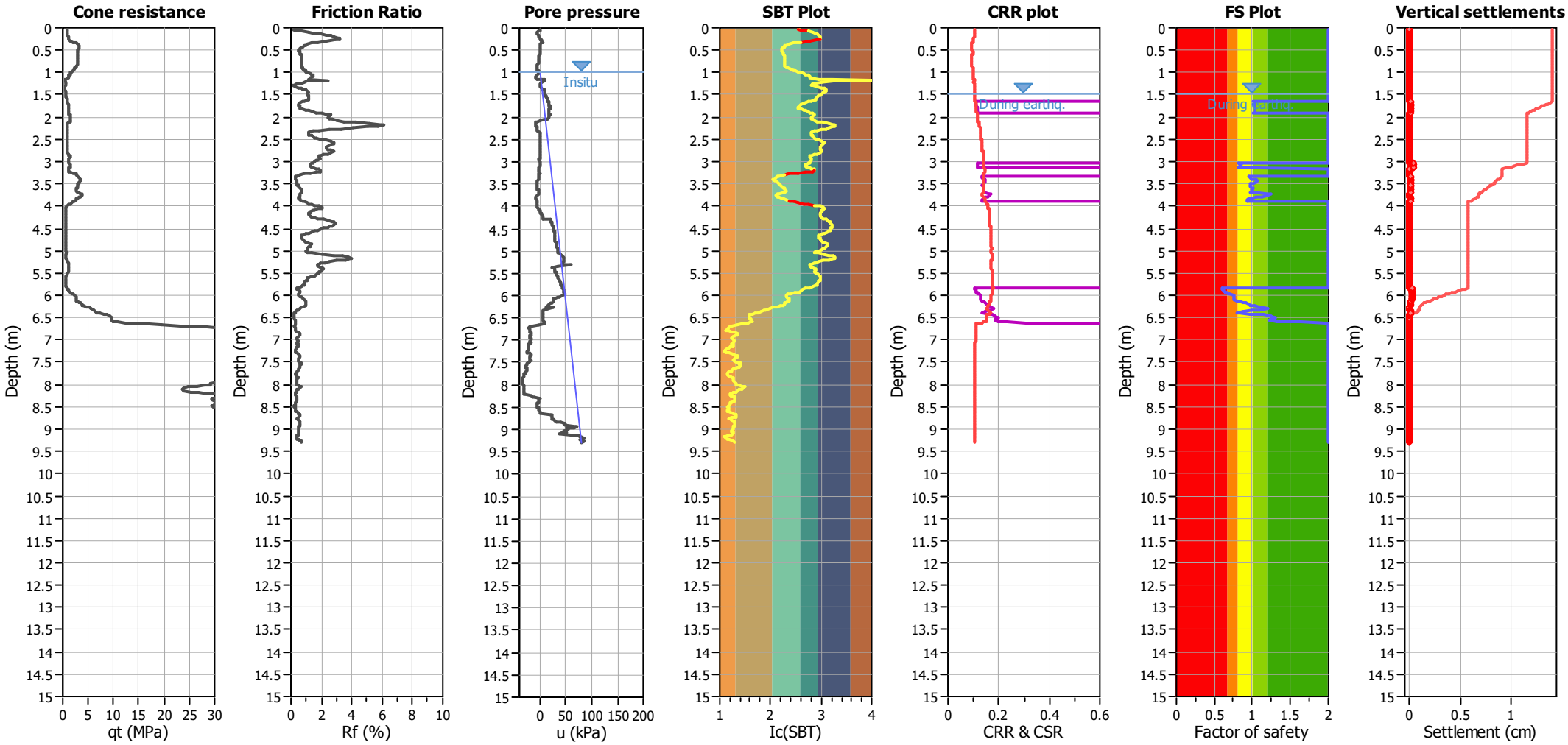
CPT: CPT_87713
Total depth: 7.78 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

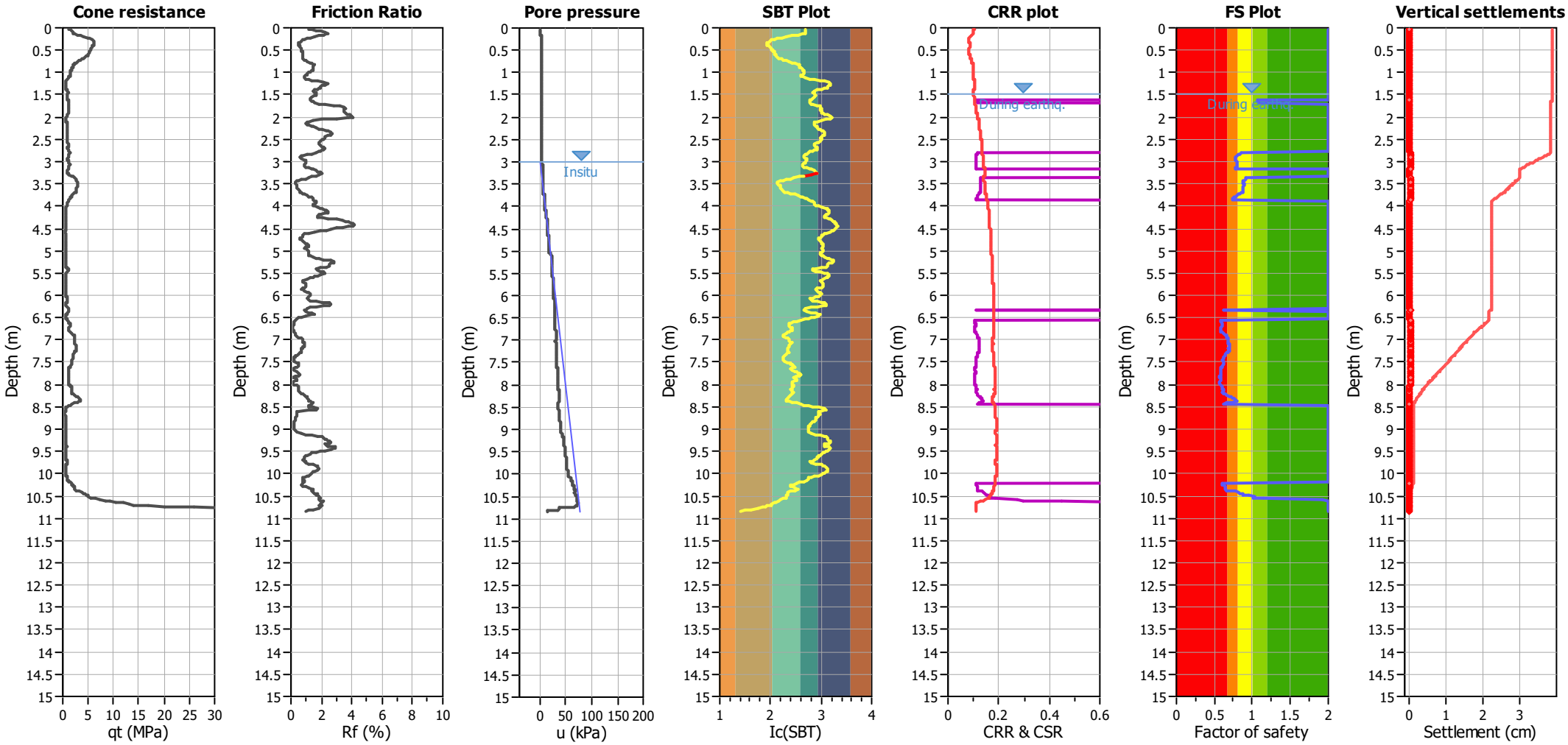
CPT: CPT_87712
Total depth: 9.30 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

CPT: CPT_87710
Total depth: 10.84 m



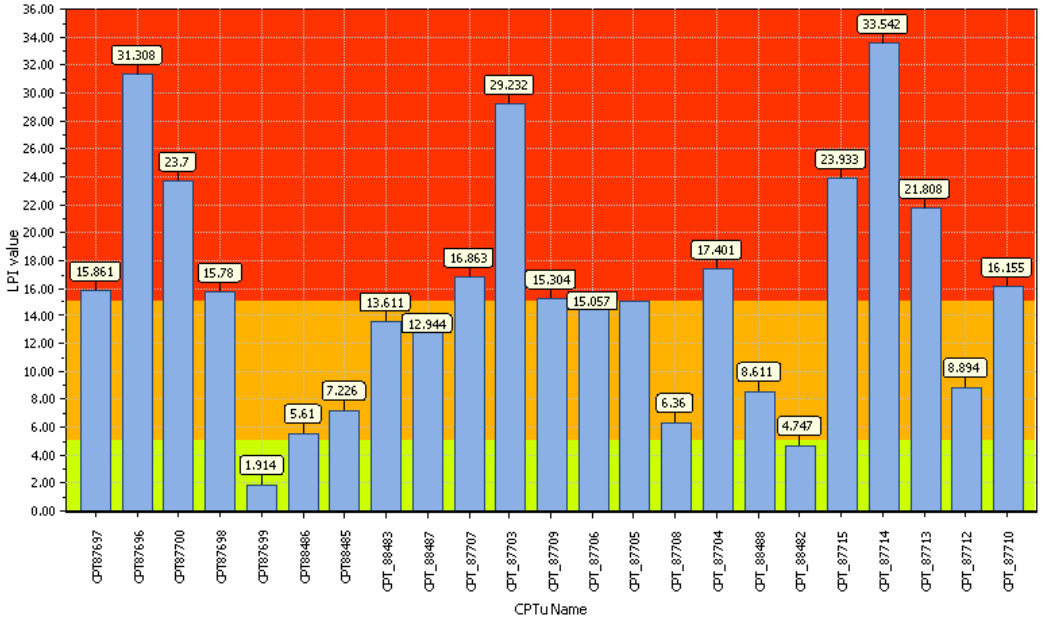
Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

ULS

Project title : MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision

Location : Cashmere and Southerland Road, Halswell

Overall Liquefaction Potential Index report



LPI color scheme

- Very high risk
- High risk
- Low risk

Basic statistics

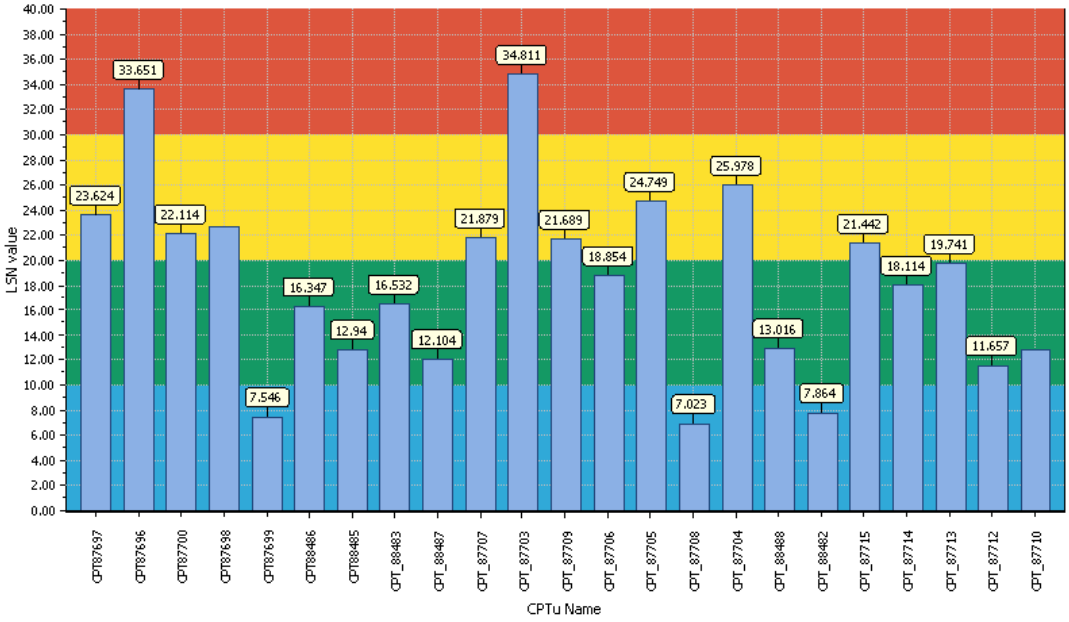
Total CPT number: 23

9% low risk

30% high risk

61% very high risk

Overall Liquefaction Severity Number report



LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

Basic statistics

Total CPT number: 23

13% little liquefaction

43% minor liquefaction

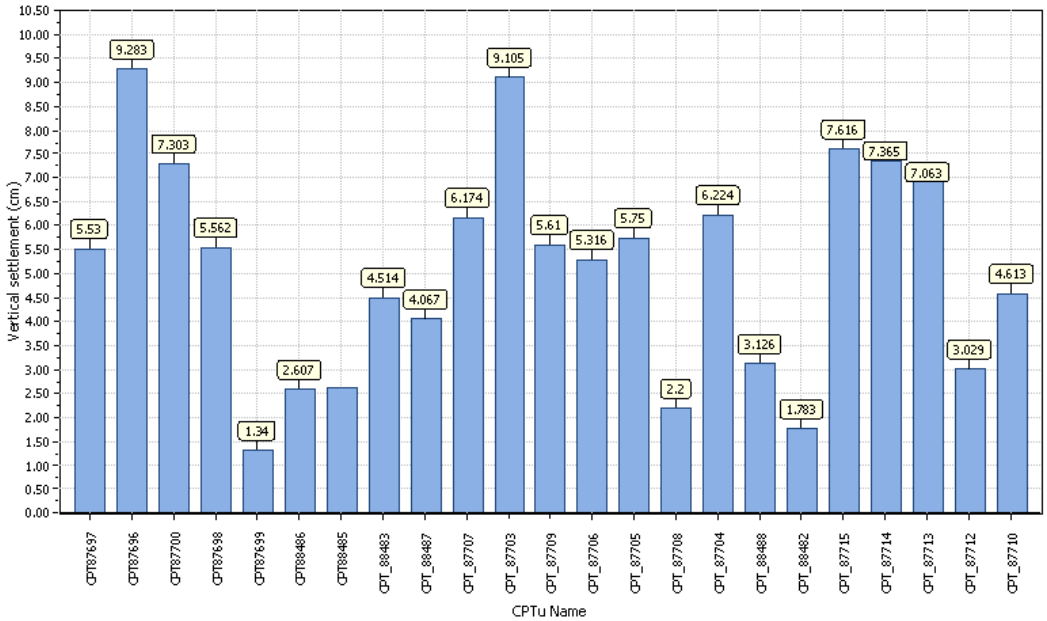
35% moderate liquefaction

9% moderate to major liquefaction

0% major liquefaction

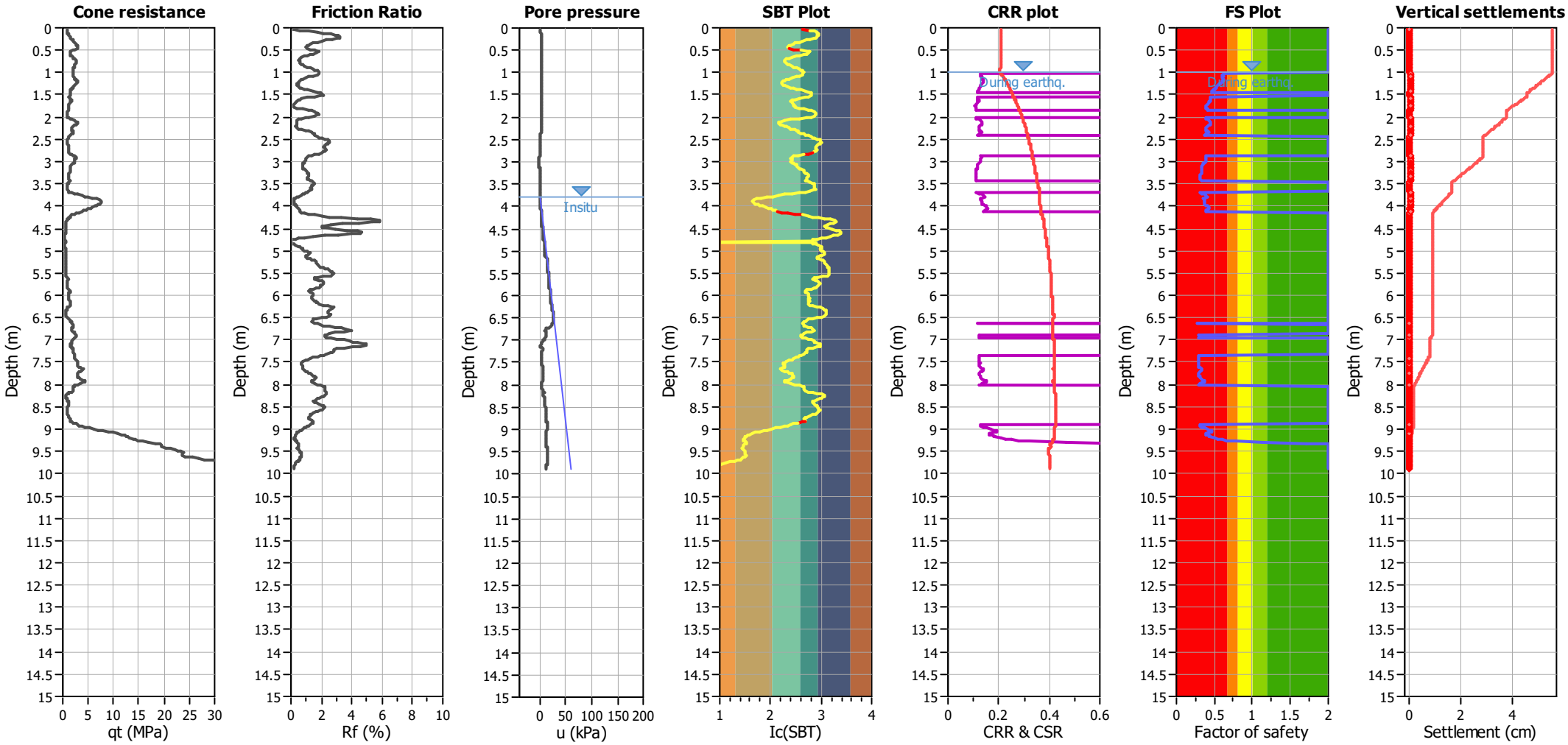
0% severe liquefaction

Overall vertical settlements report



Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

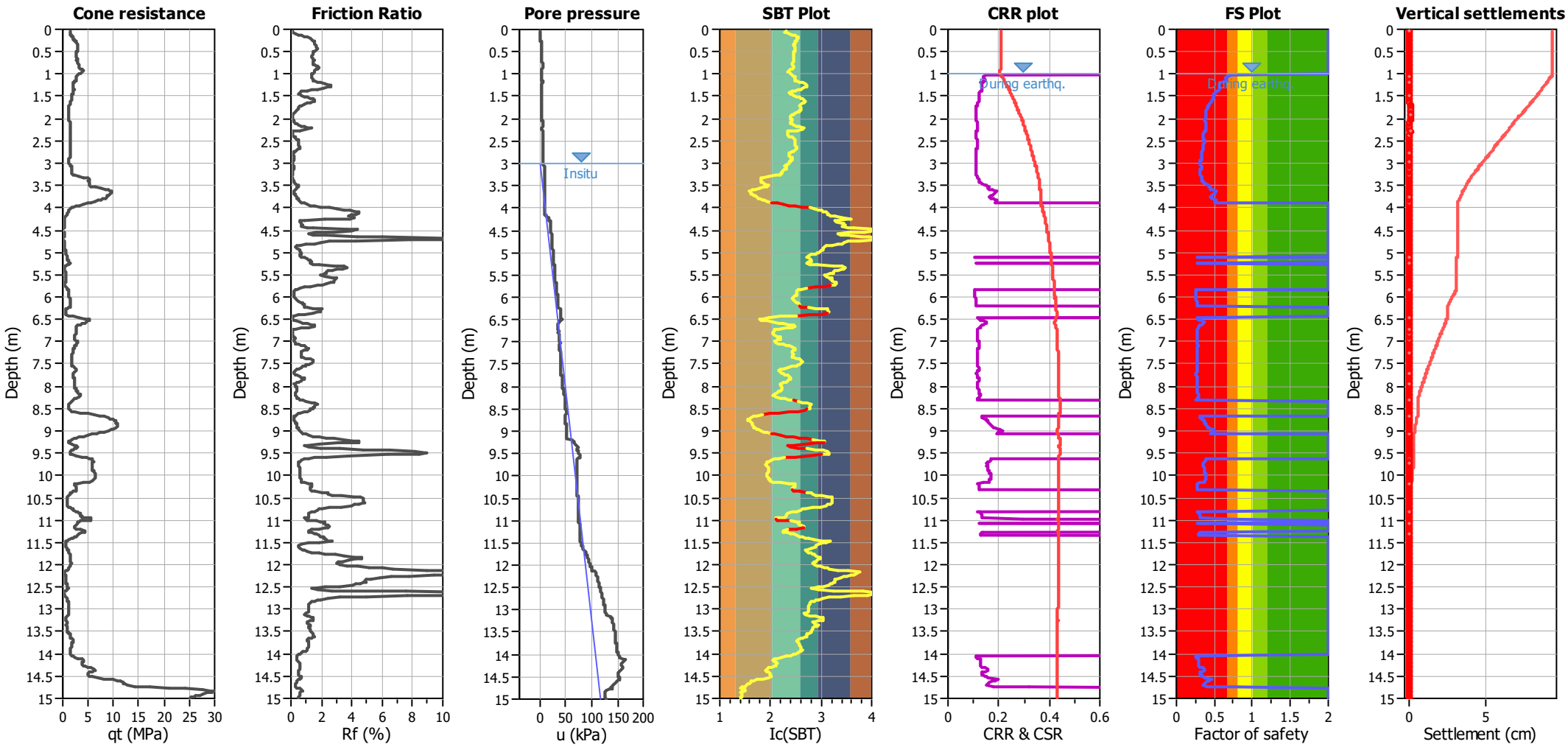
CPT: CPT87697
Total depth: 9.88 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

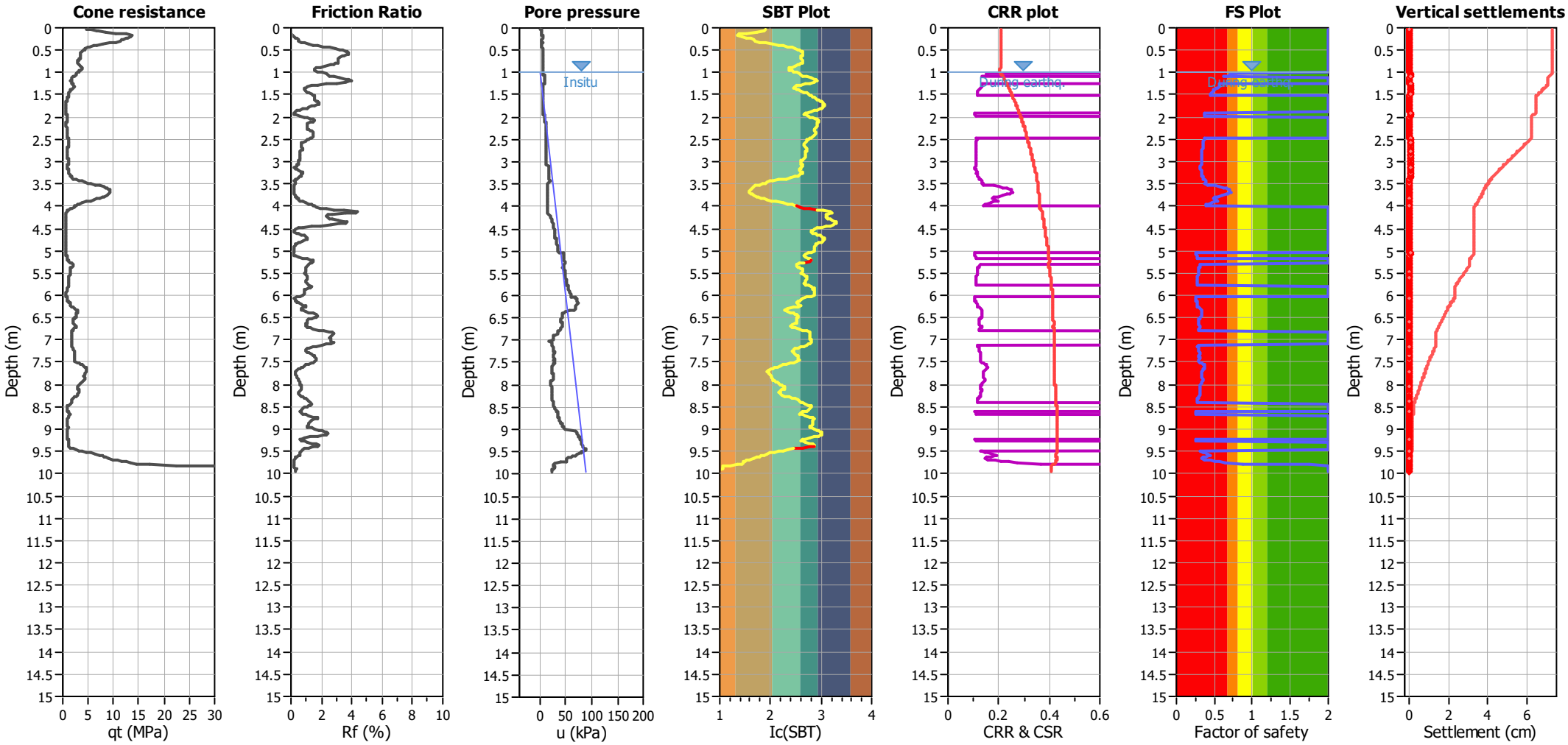
CPT: CPT87696
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

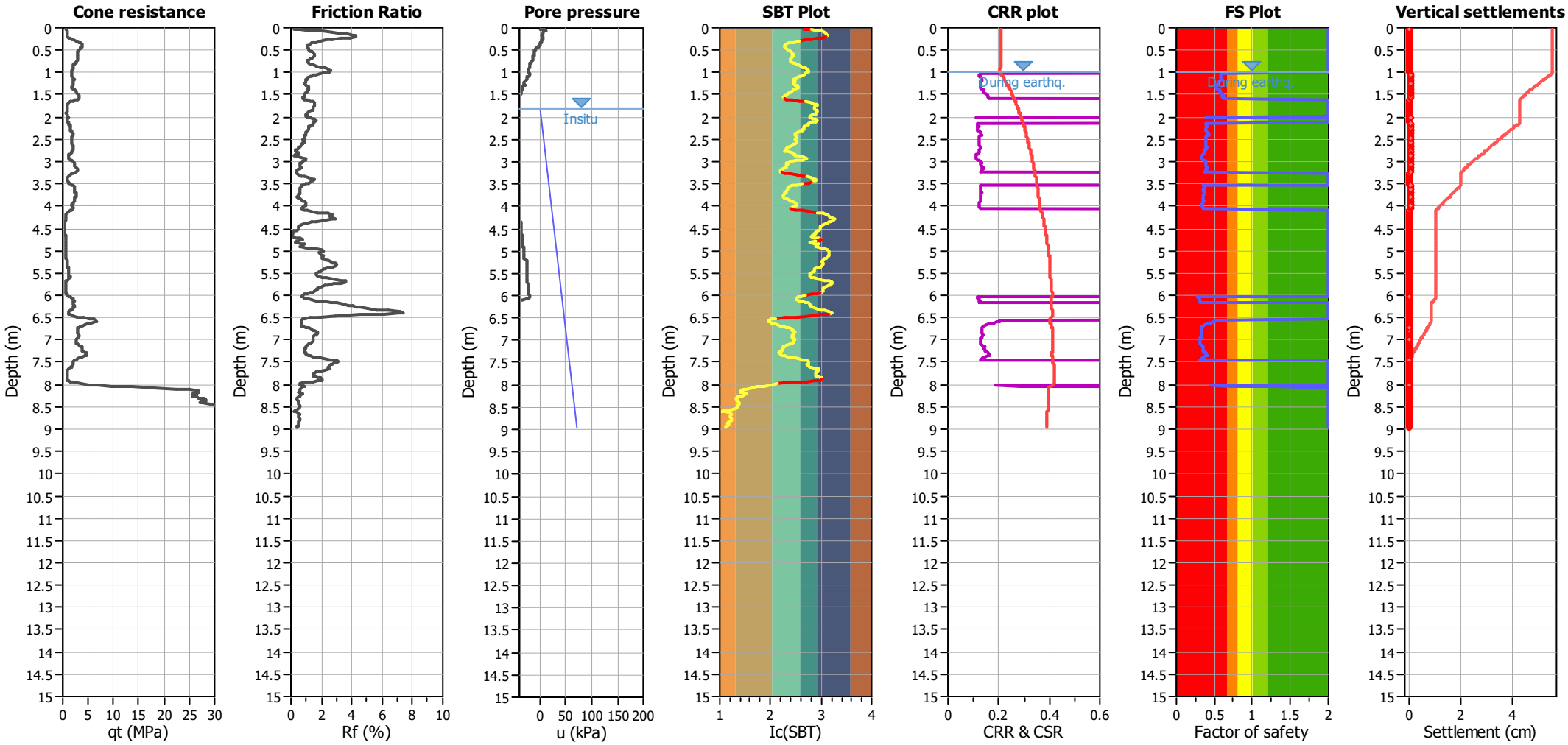
CPT: CPT87700
Total depth: 9.94 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

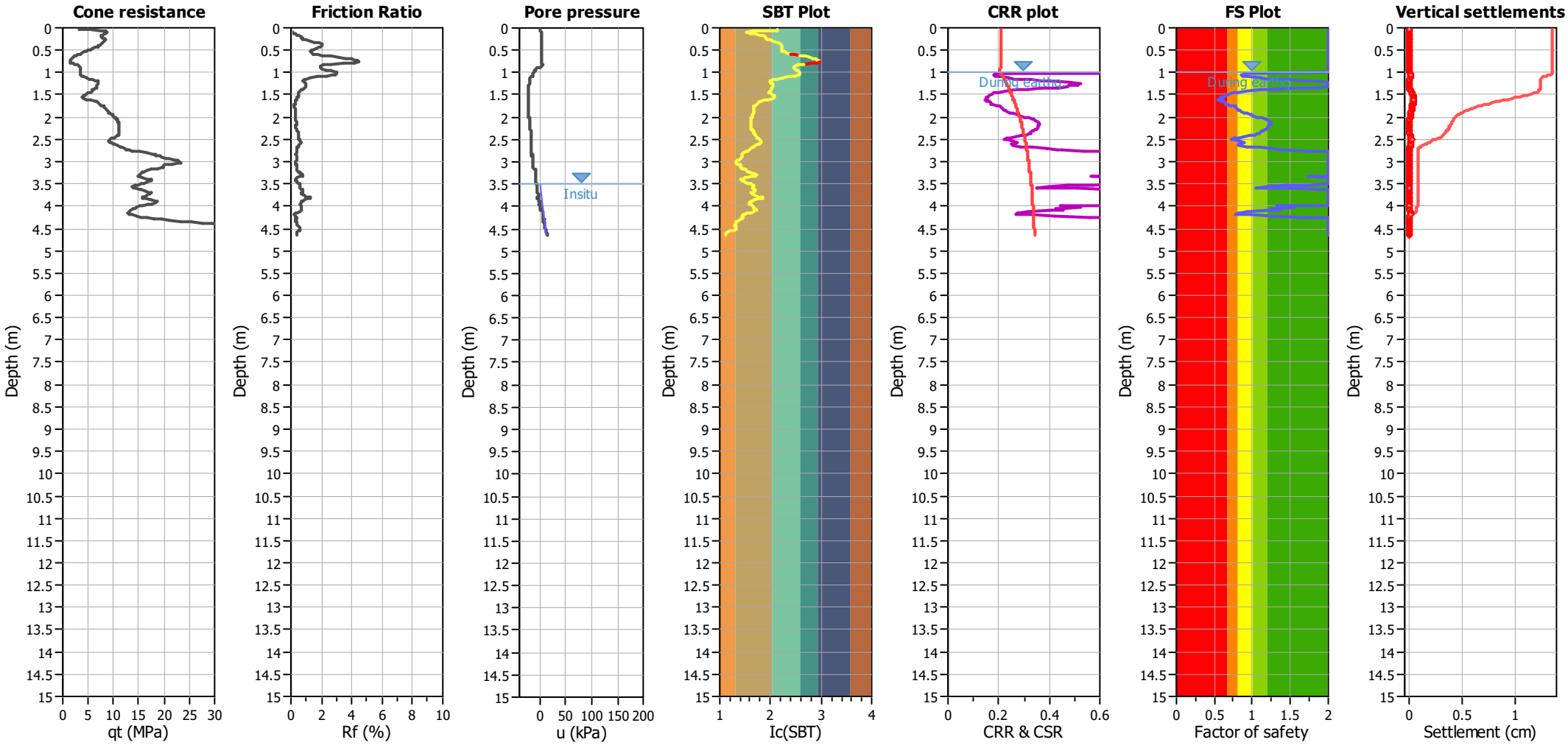
CPT: CPT87698
Total depth: 8.98 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

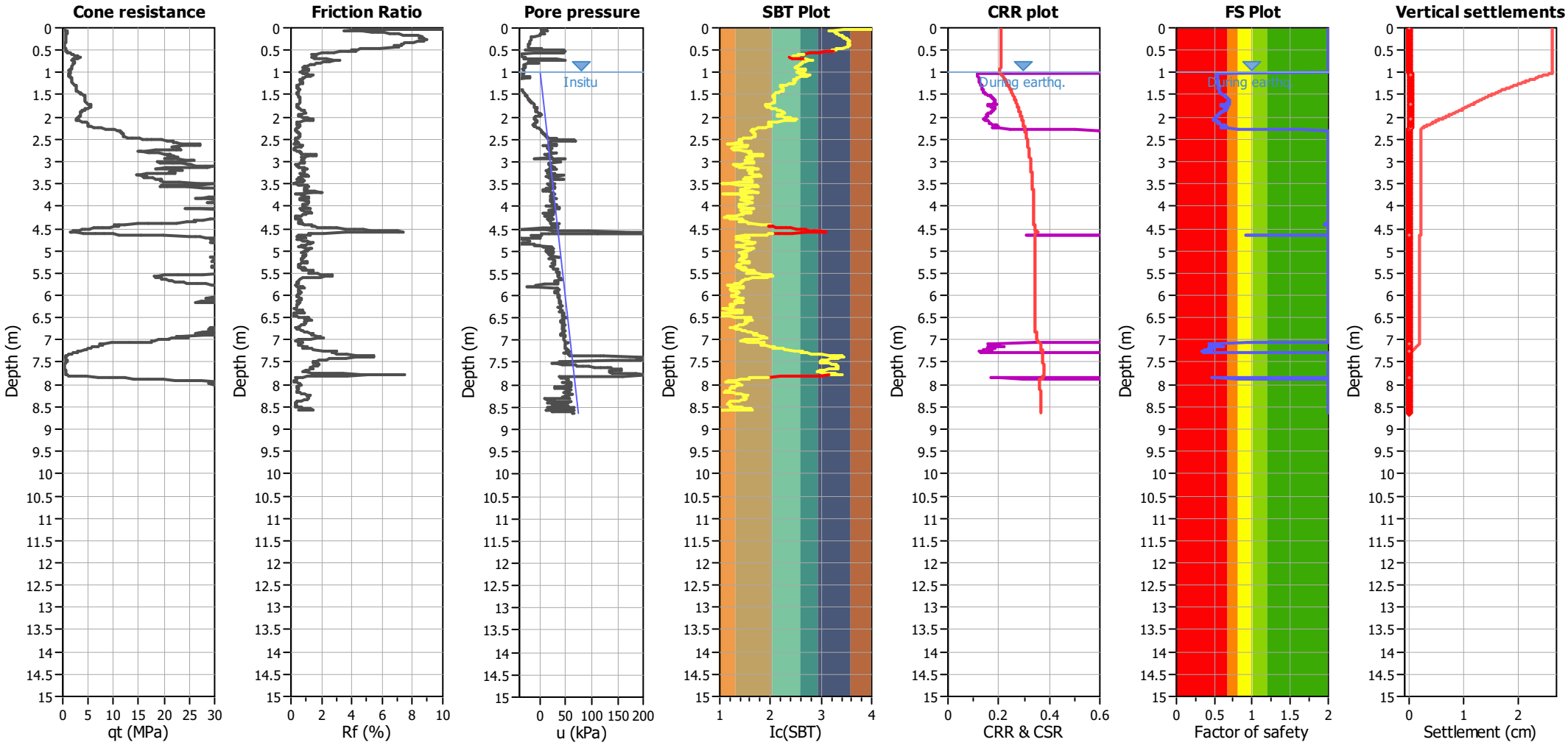
CPT: CPT87699
Total depth: 4.66 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

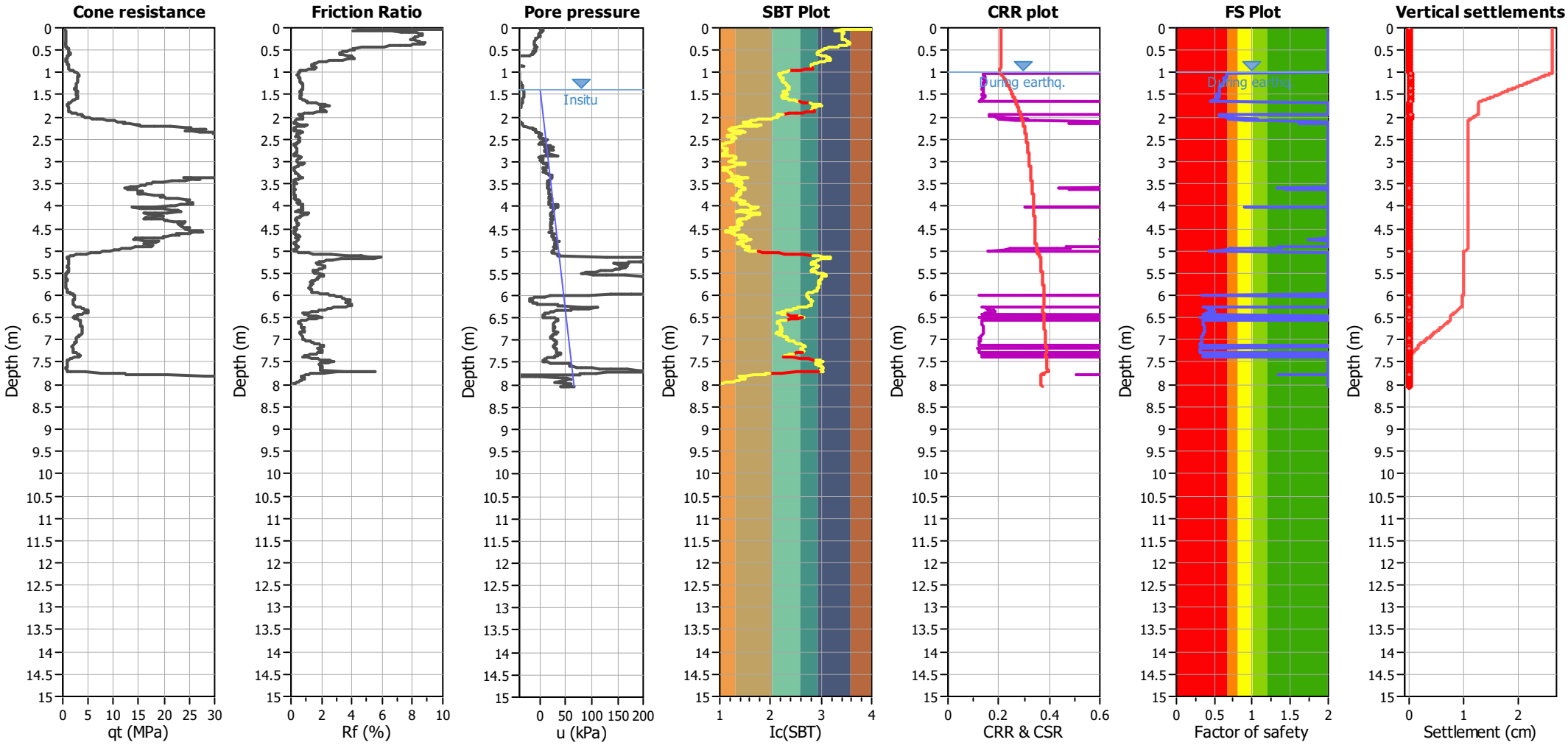
CPT: CPT88486
Total depth: 8.65 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

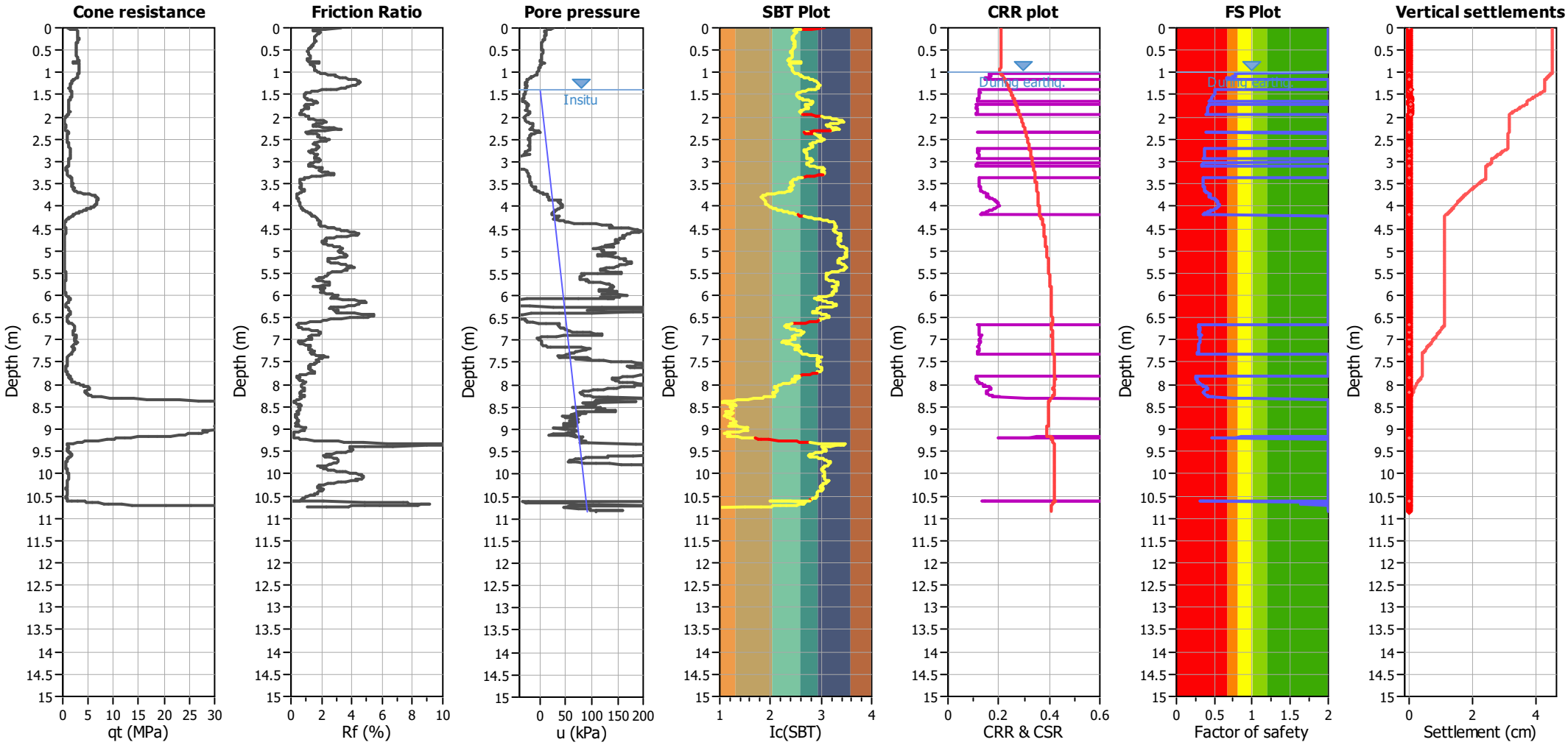
CPT: CPT88485
Total depth: 8.06 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.40 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

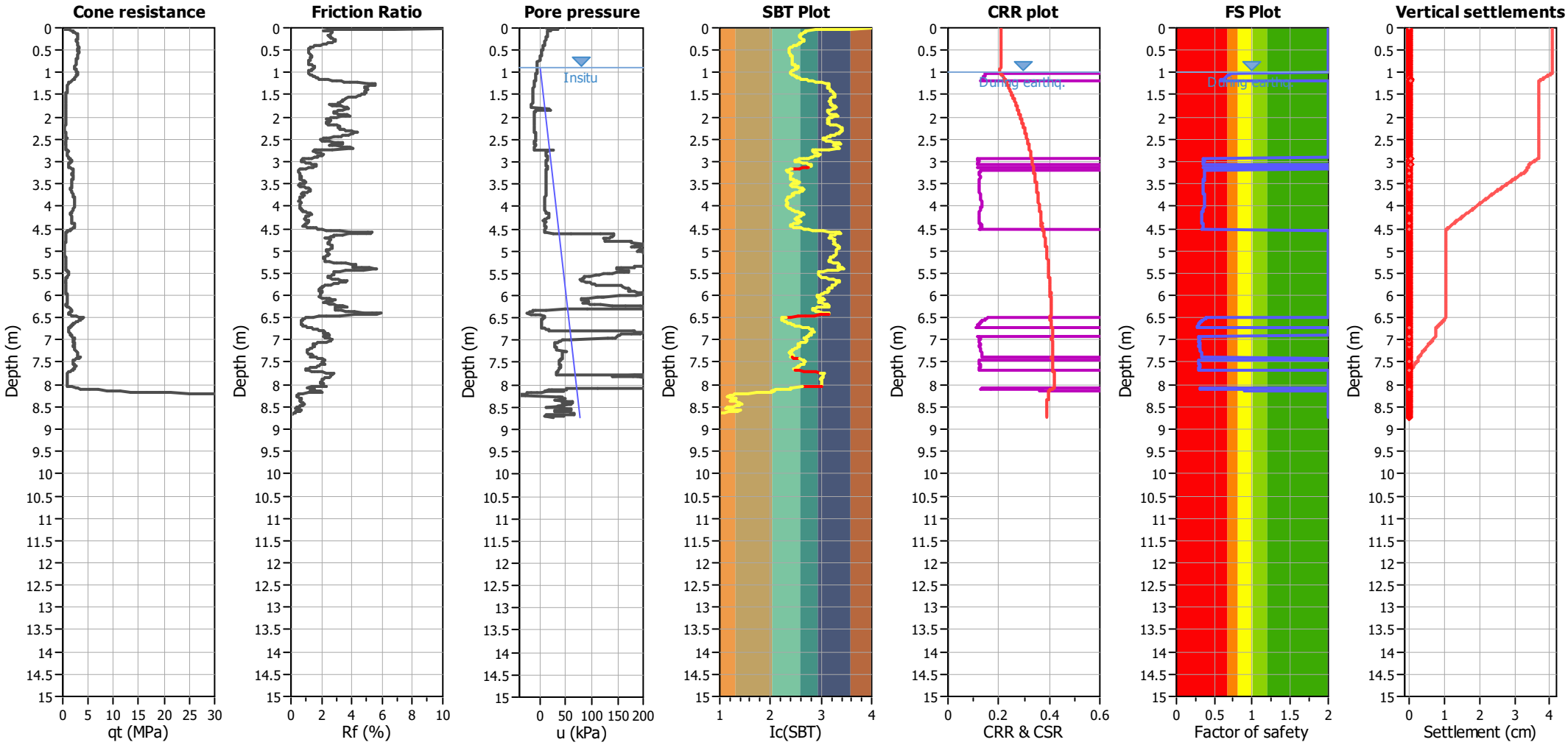
CPT: CPT_88483
Total depth: 10.83 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.40 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

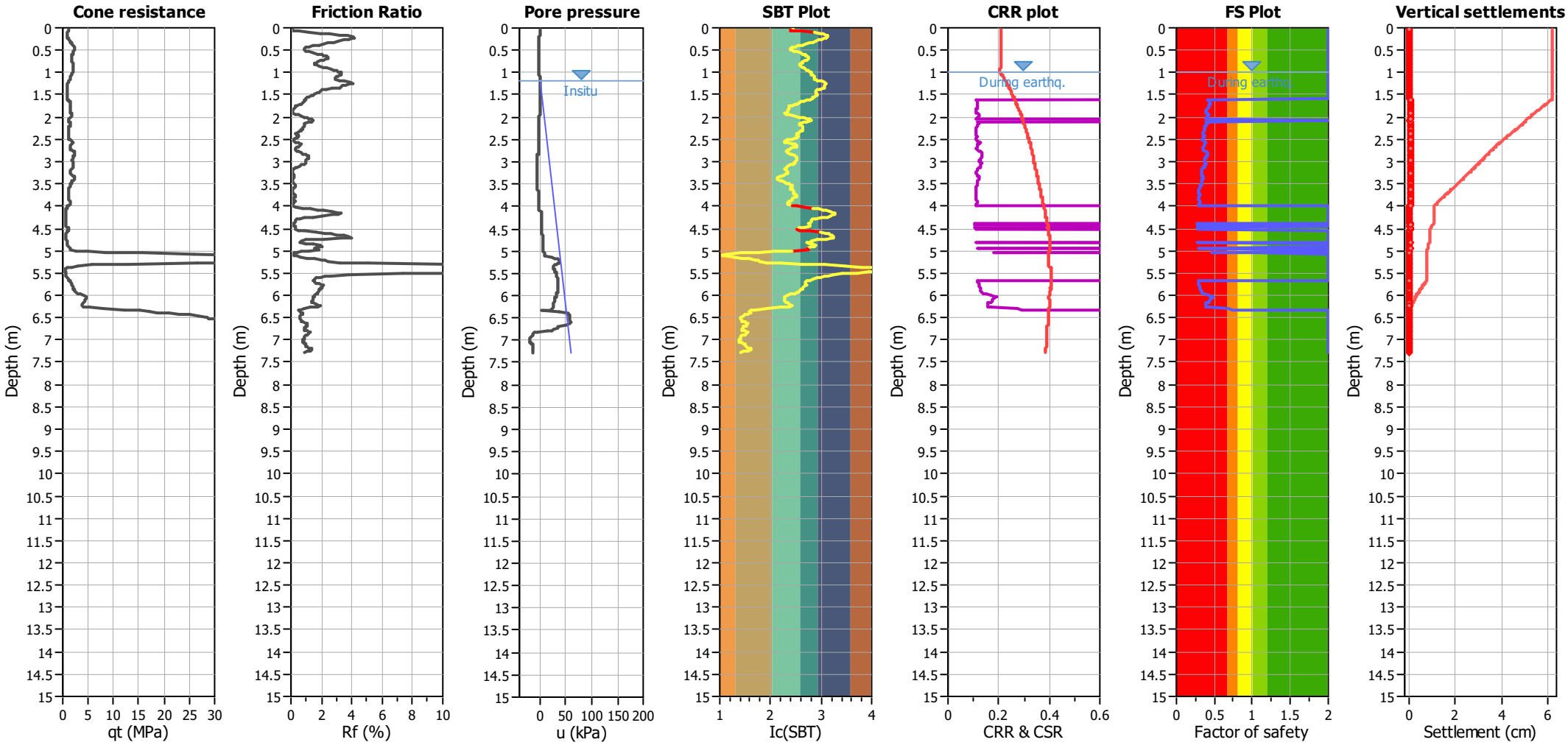
CPT: CPT_88487
Total depth: 8.74 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.90 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

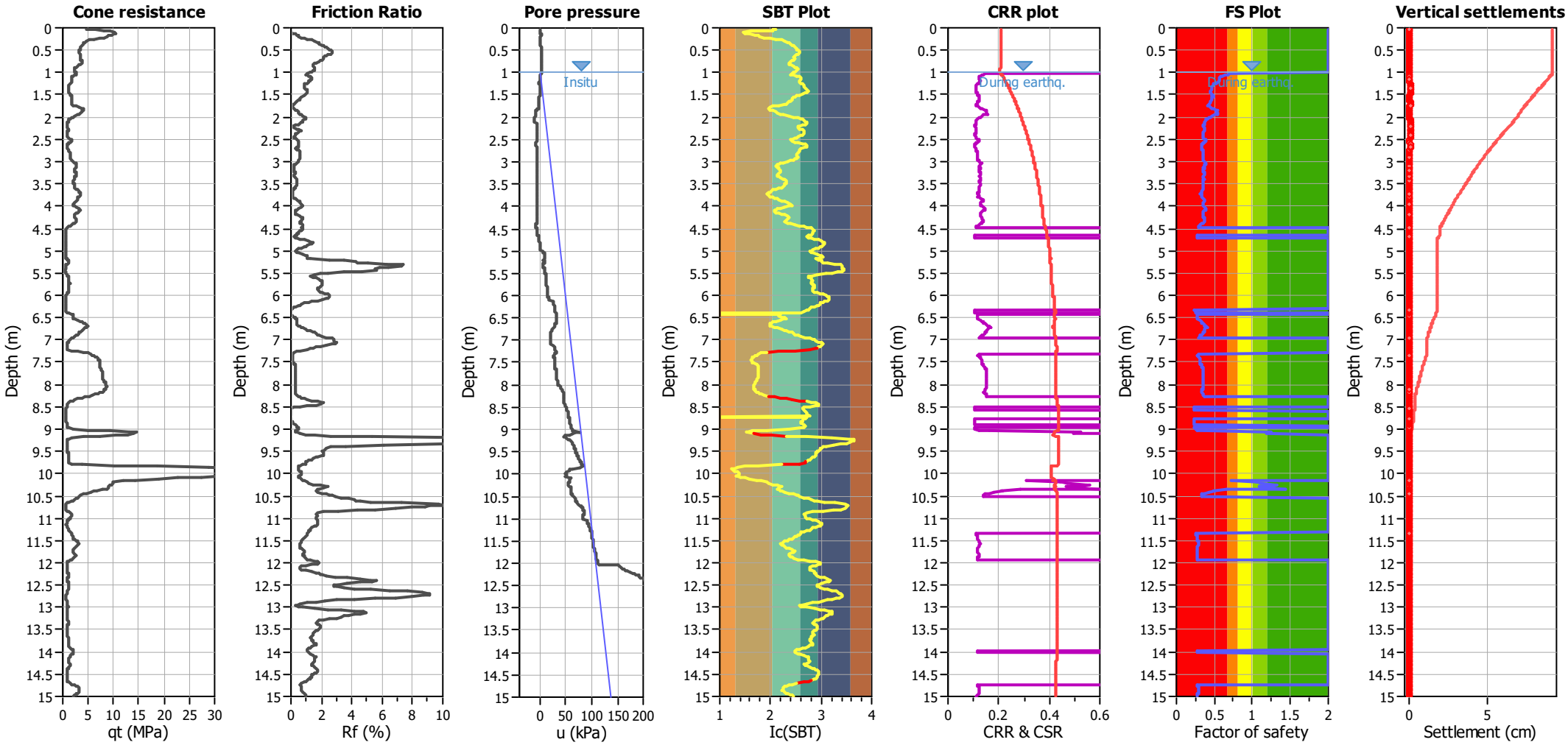
CPT: CPT_87707
Total depth: 7.28 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

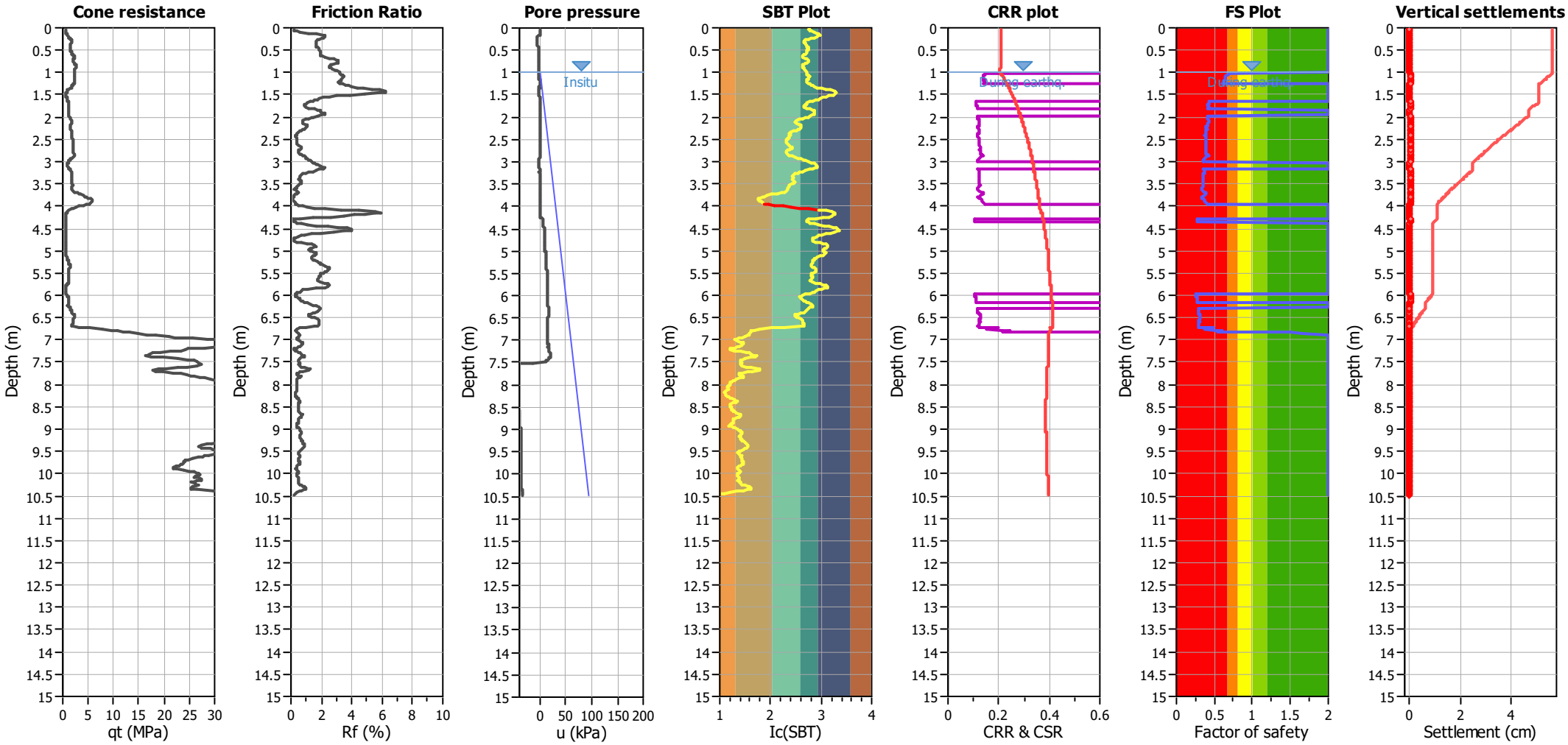
CPT: CPT_87703
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

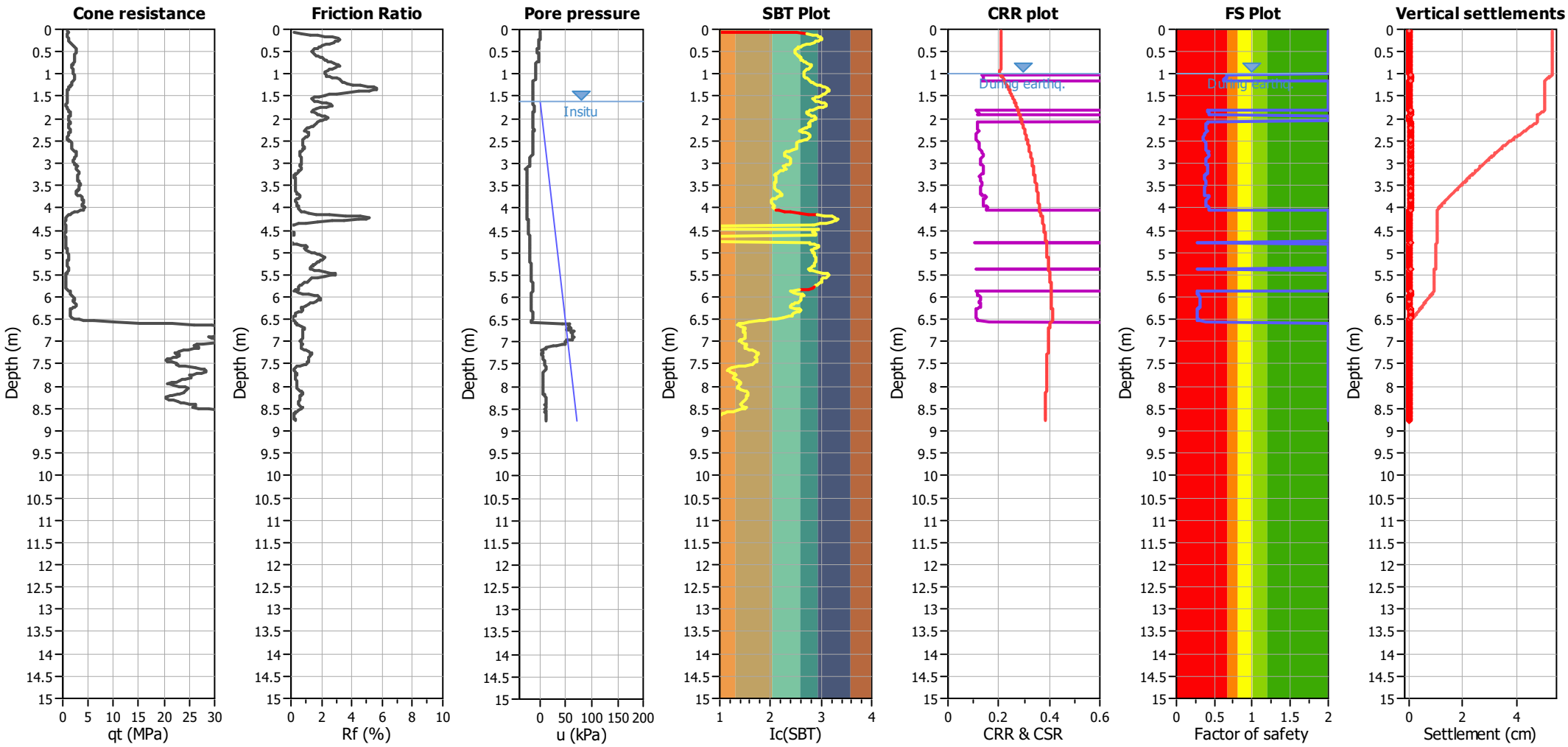
CPT: CPT_87709
Total depth: 10.48 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

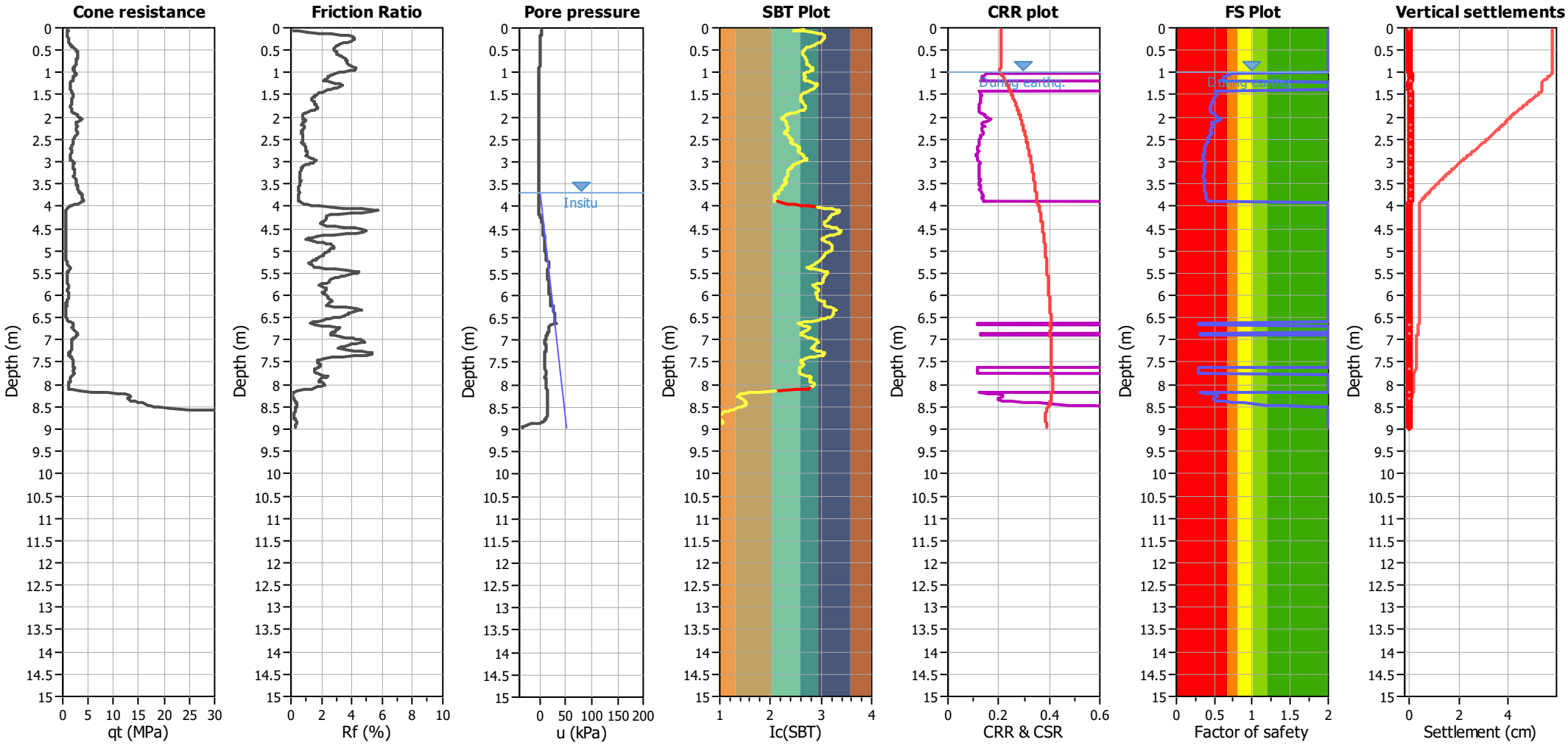
CPT: CPT_87706
Total depth: 8.76 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

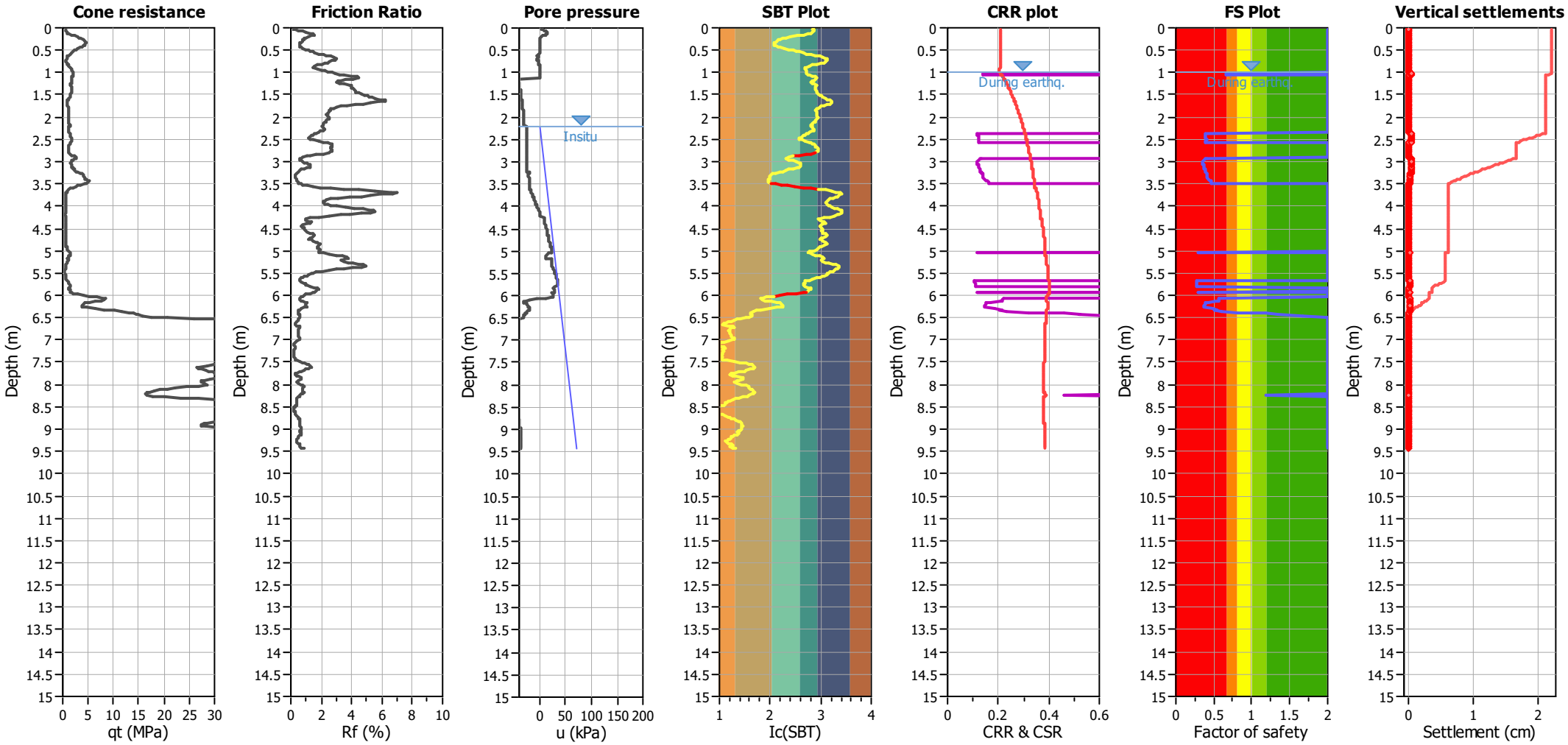
CPT: CPT_87705
Total depth: 8.96 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

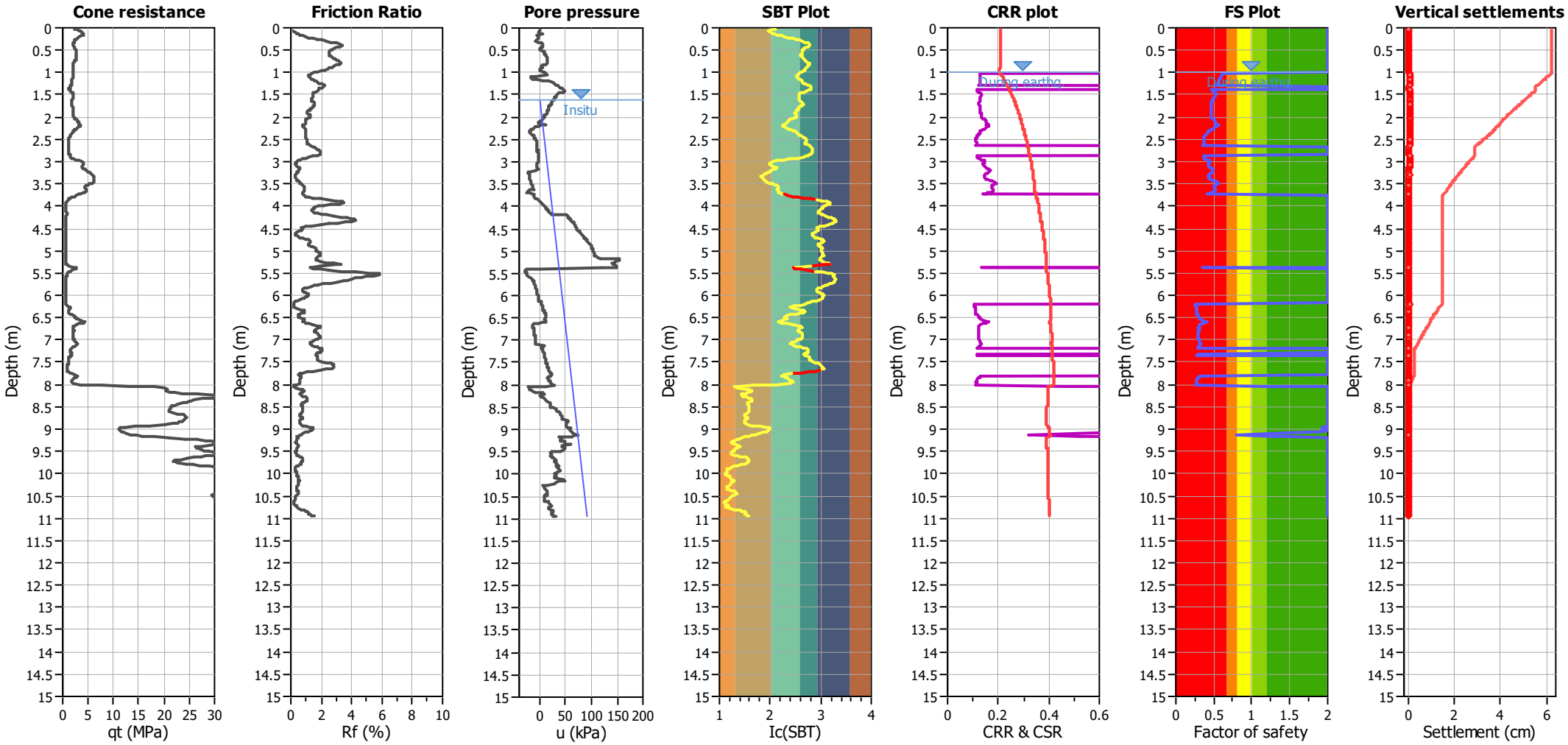
CPT: CPT_87708
Total depth: 9.44 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

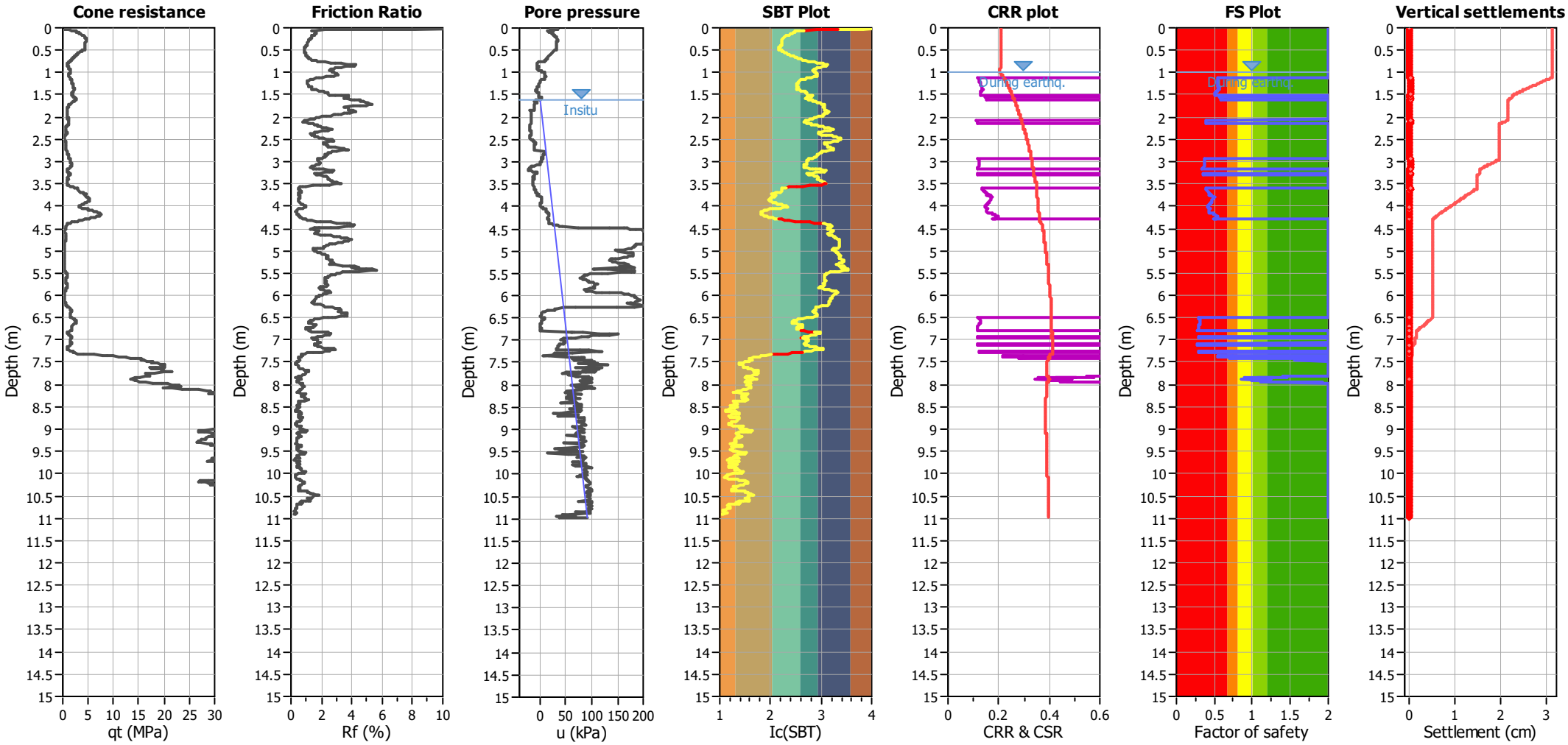
CPT: CPT_87704
Total depth: 10.96 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

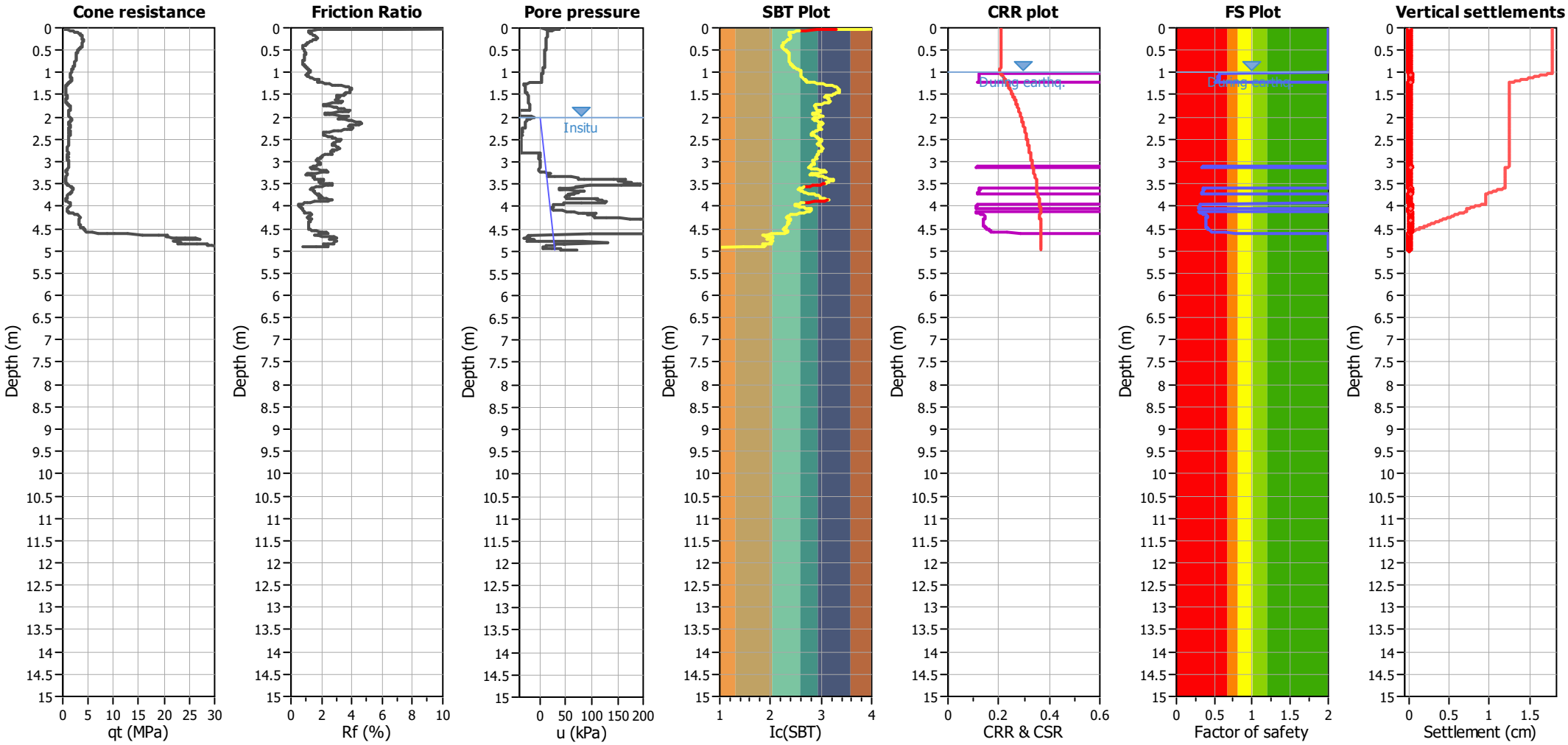
CPT: CPT_88488
Total depth: 10.98 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

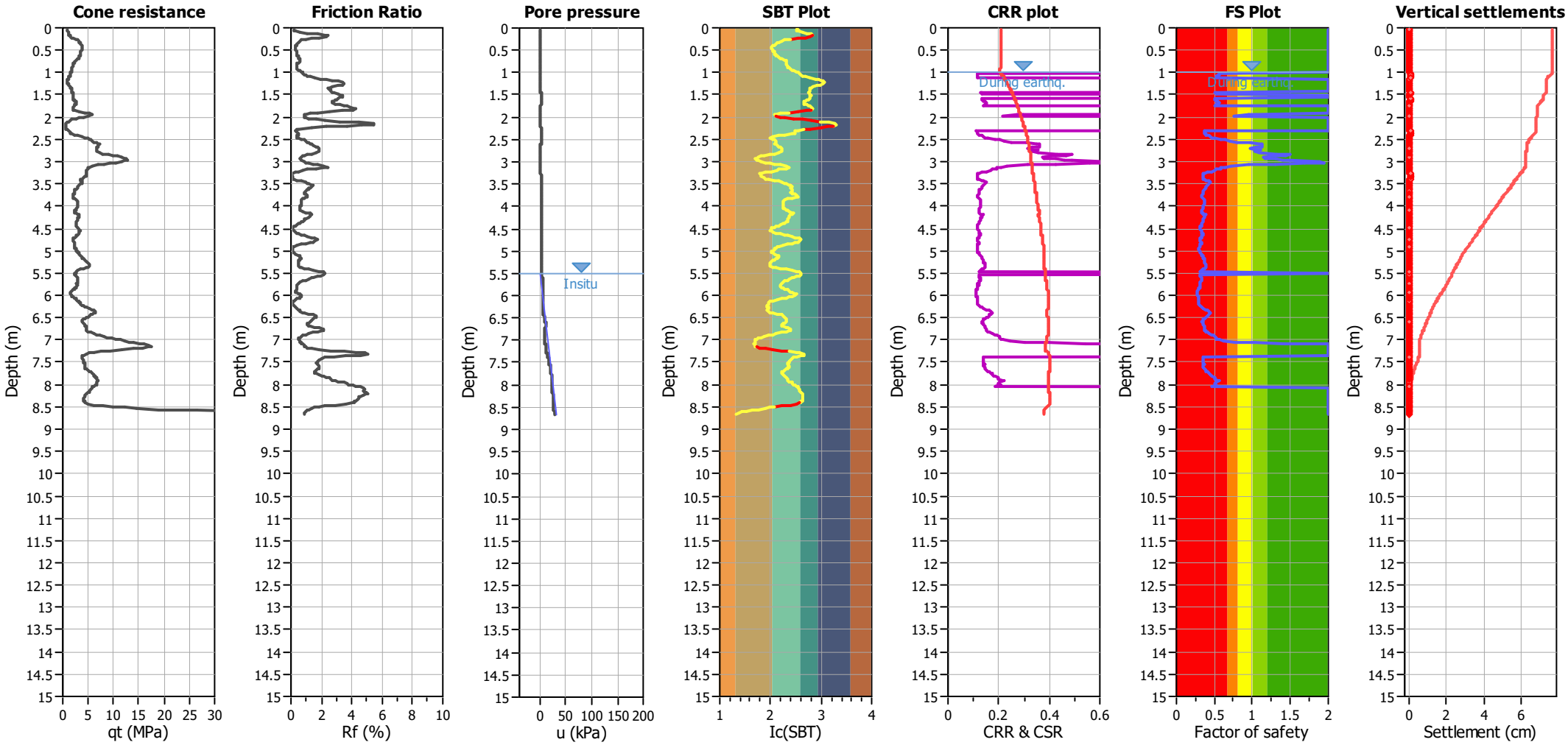
CPT: CPT_88482
Total depth: 4.99 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

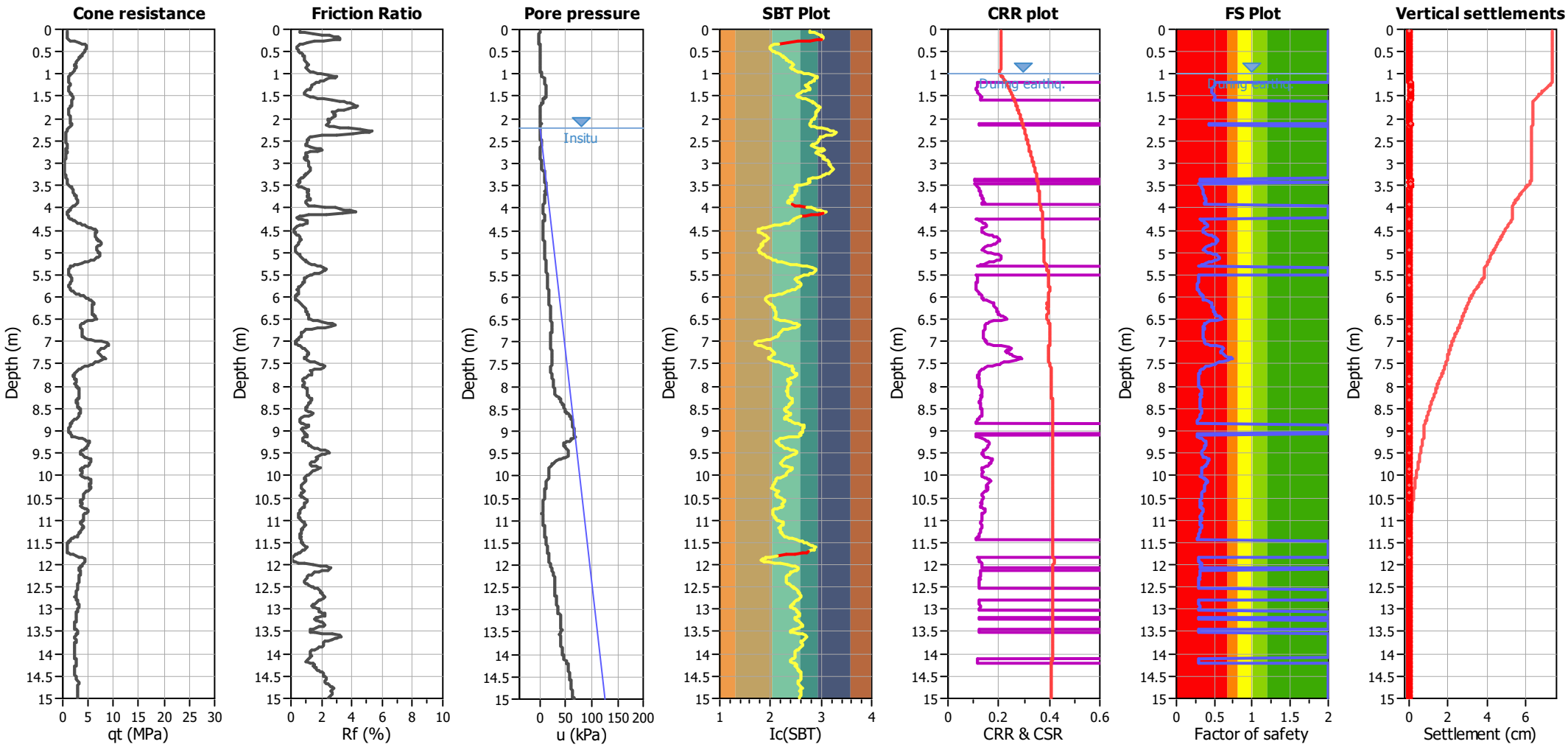
CPT: CPT_87715
Total depth: 8.66 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	5.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

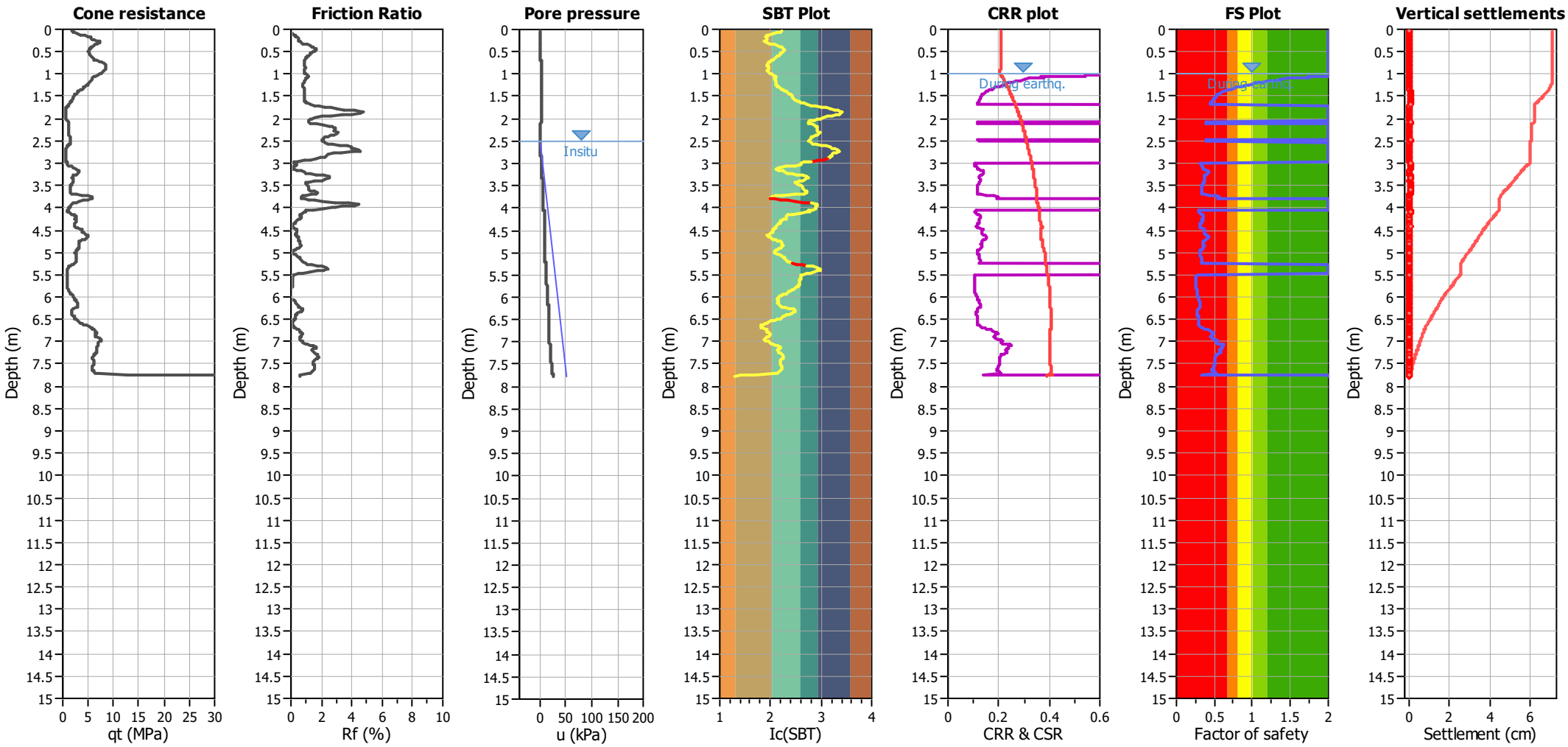
CPT: CPT_87714
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

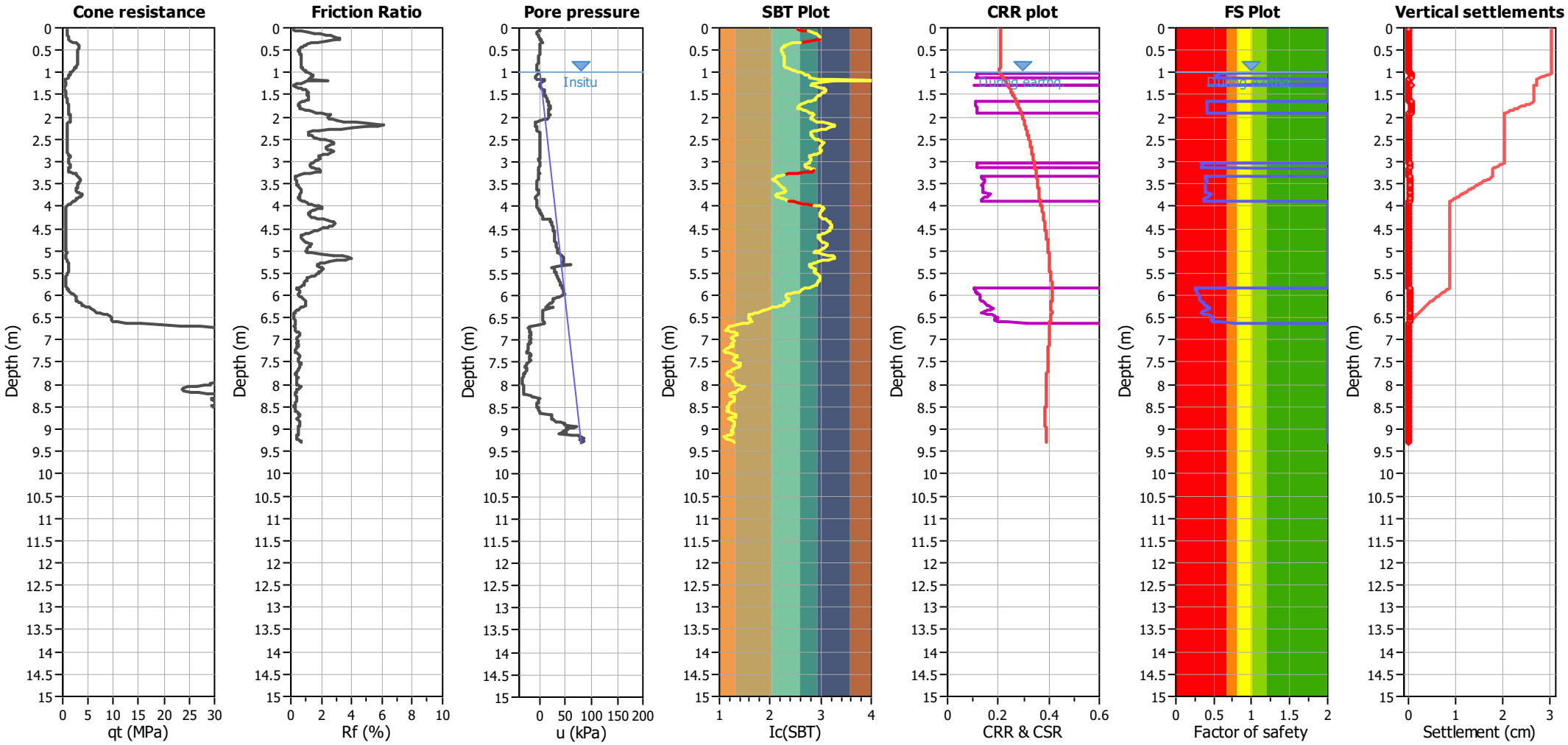
CPT: CPT_87713
Total depth: 7.78 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

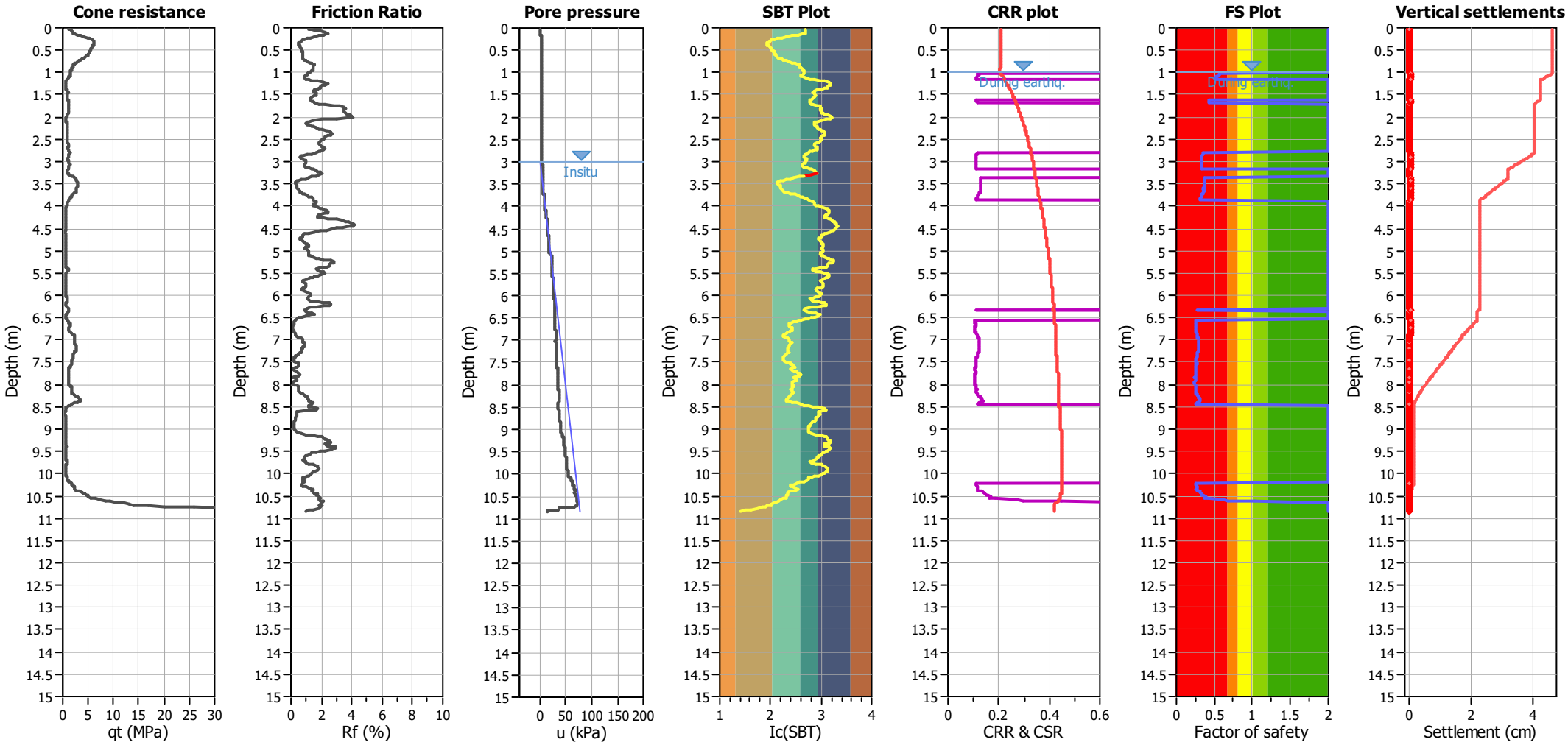
CPT: CPT_87712
Total depth: 9.30 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

CPT: CPT_87710
Total depth: 10.84 m



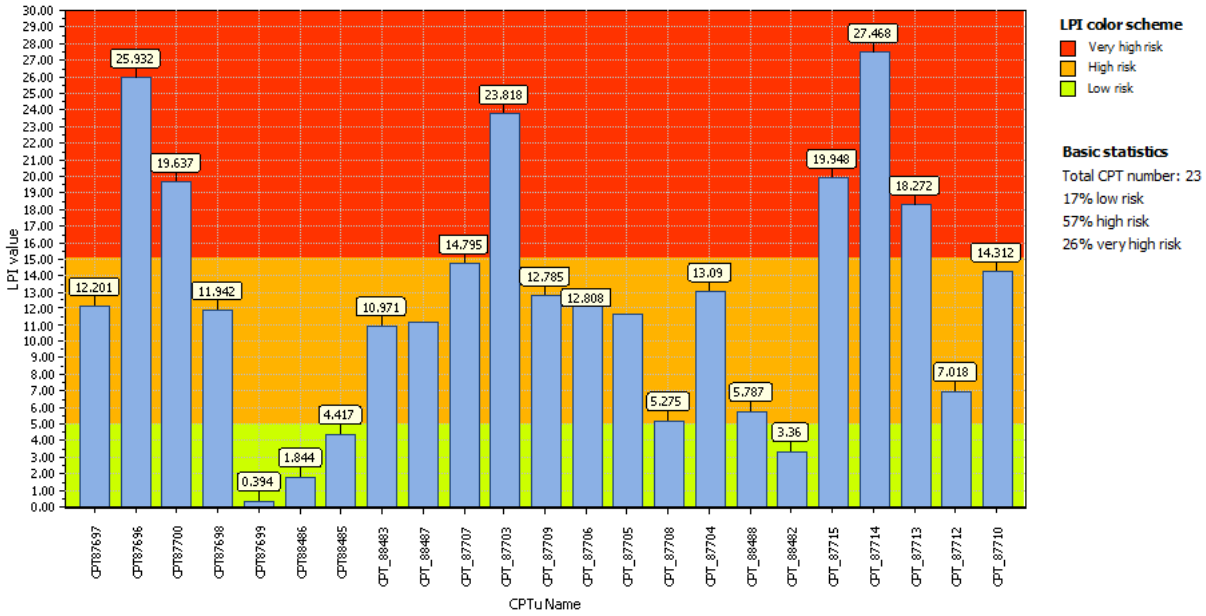
Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

February 2011 back analysis / similar to our SLS & ULS

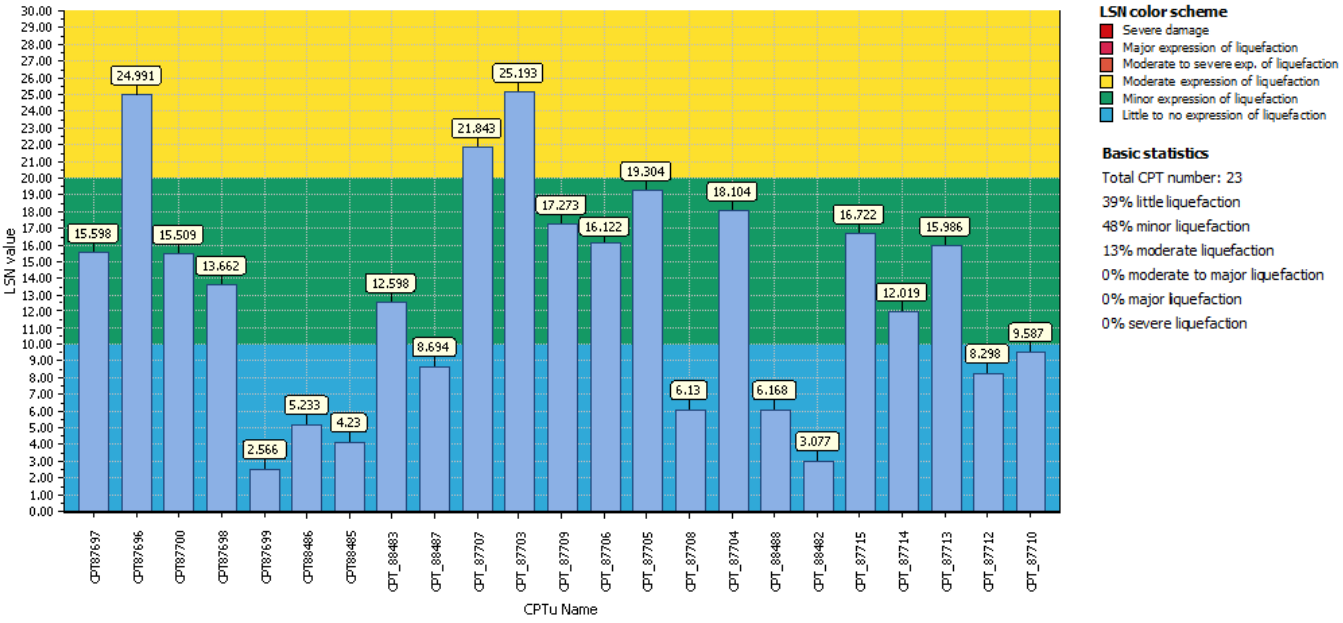
Project title : MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision

Location : Cashmere and Southerland Road, Halswell

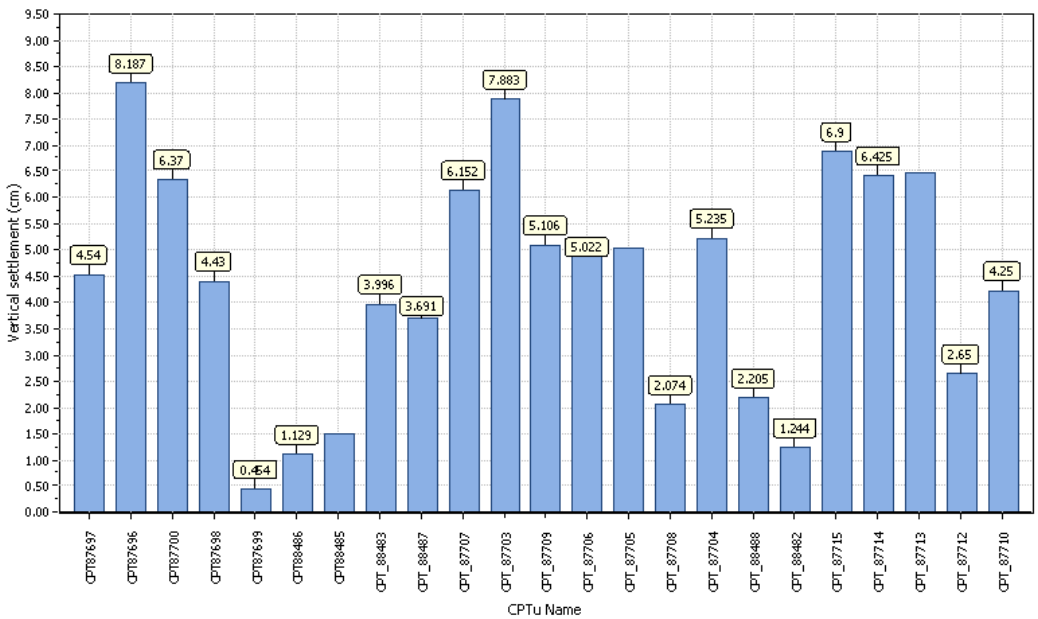
Overall Liquefaction Potential Index report



Overall Liquefaction Severity Number report

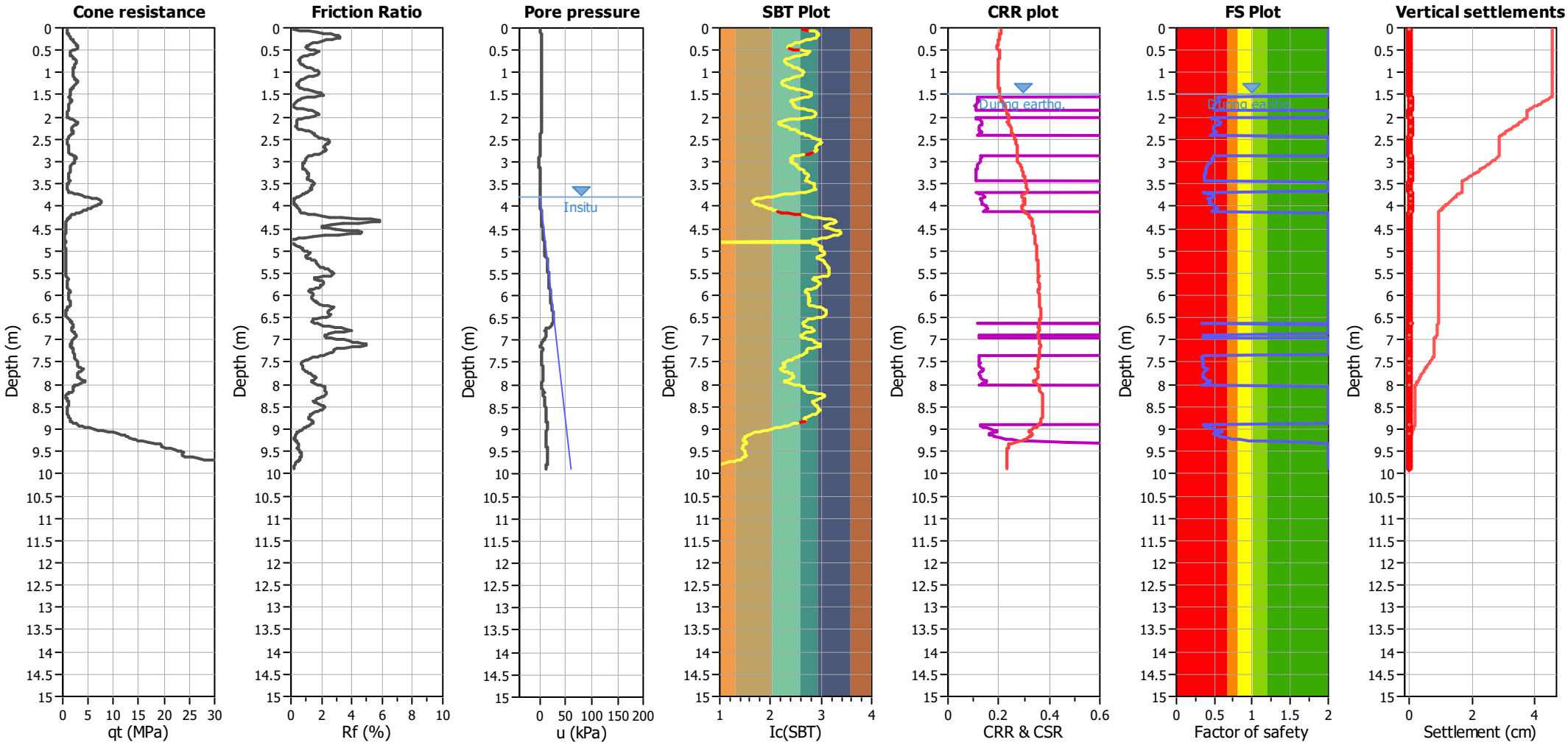


Overall vertical settlements report



Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

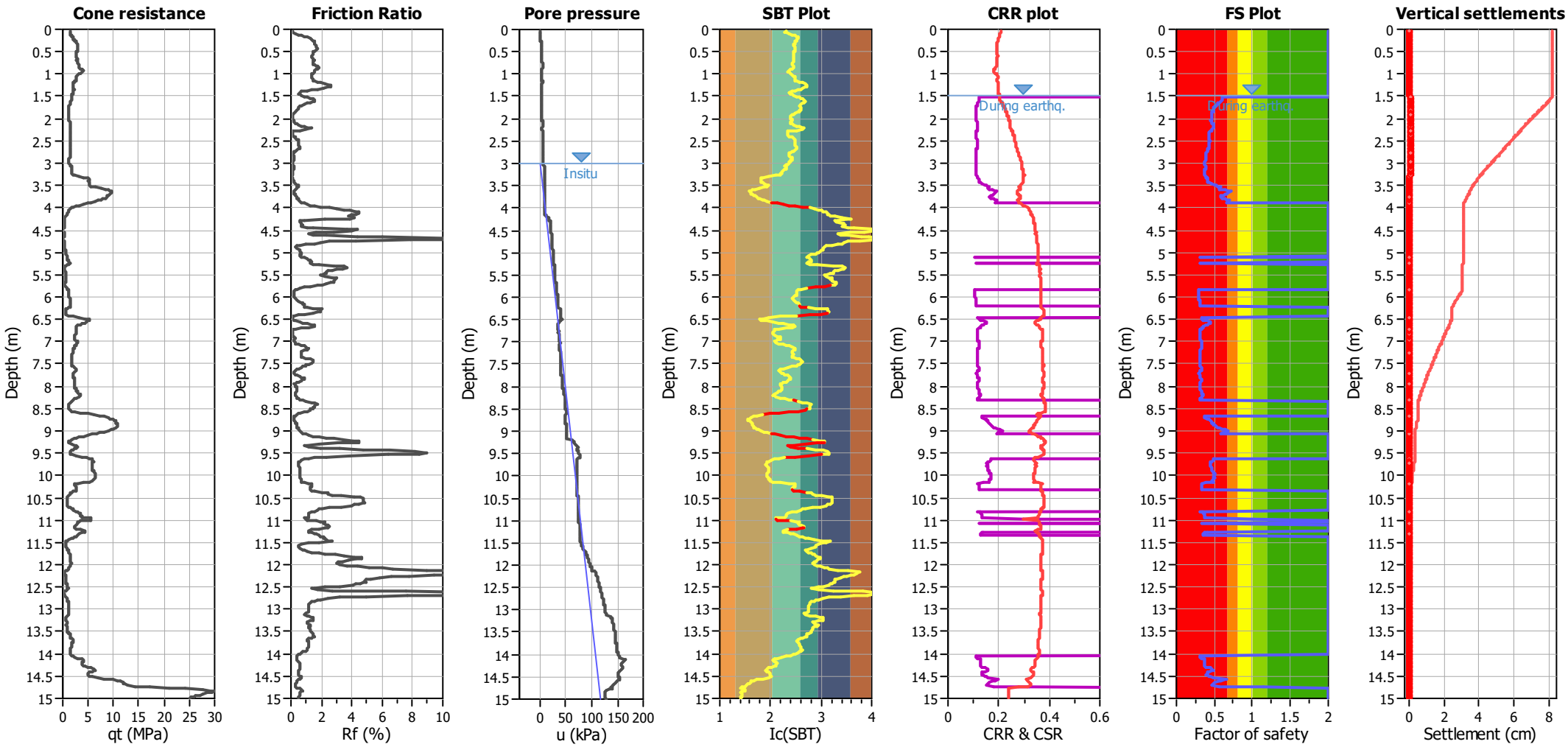
CPT: CPT87697
Total depth: 9.88 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

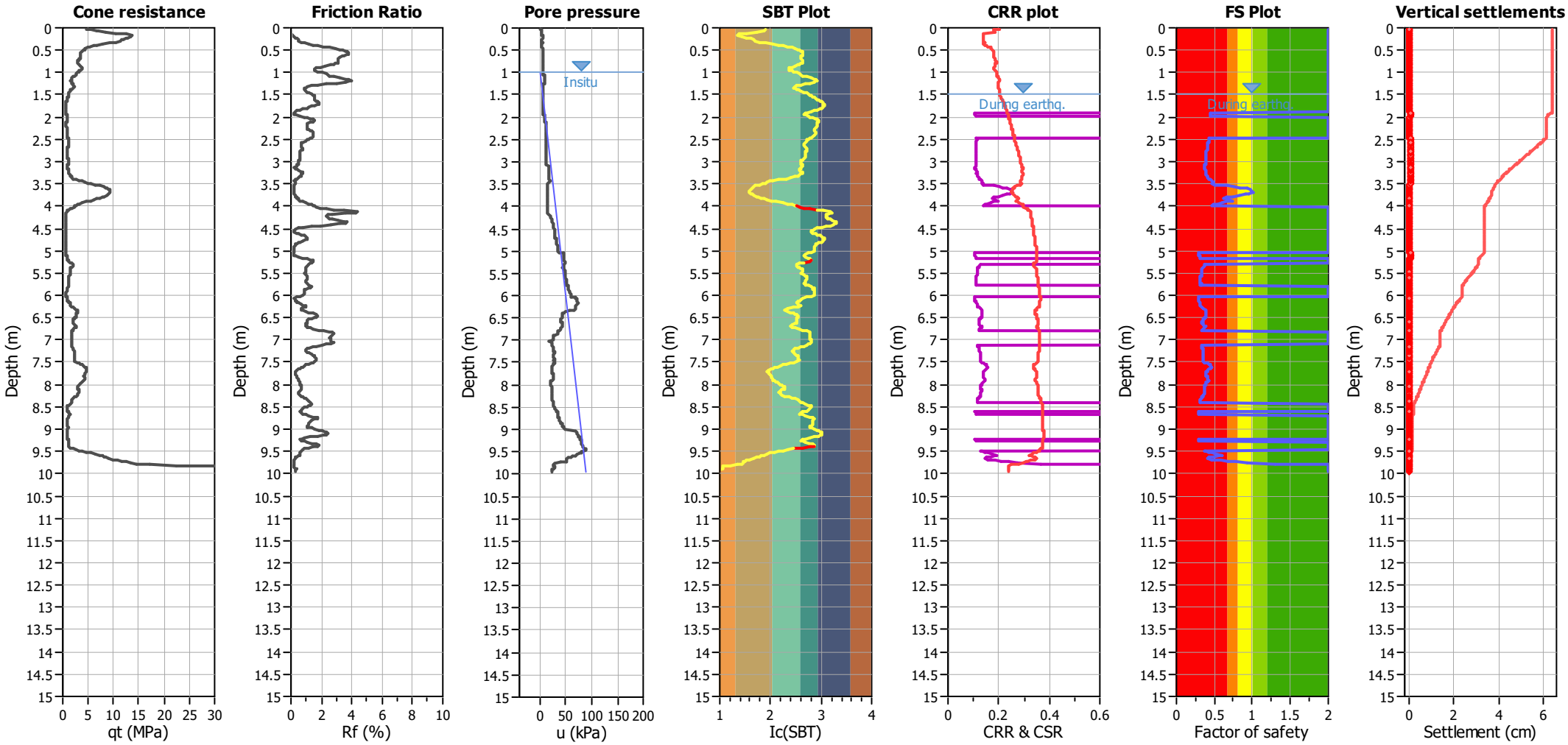
CPT: CPT87696
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

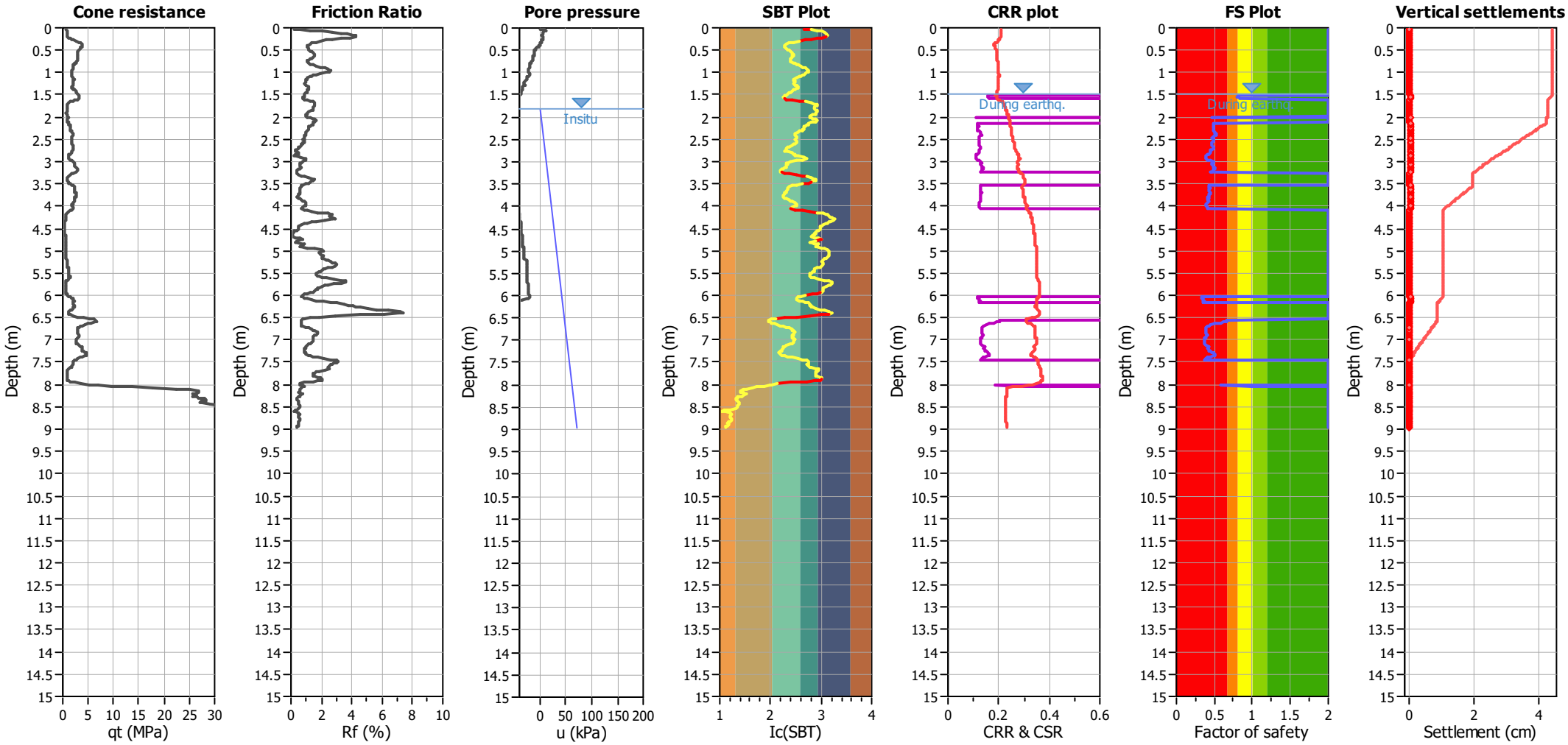
CPT: CPT87700
Total depth: 9.94 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

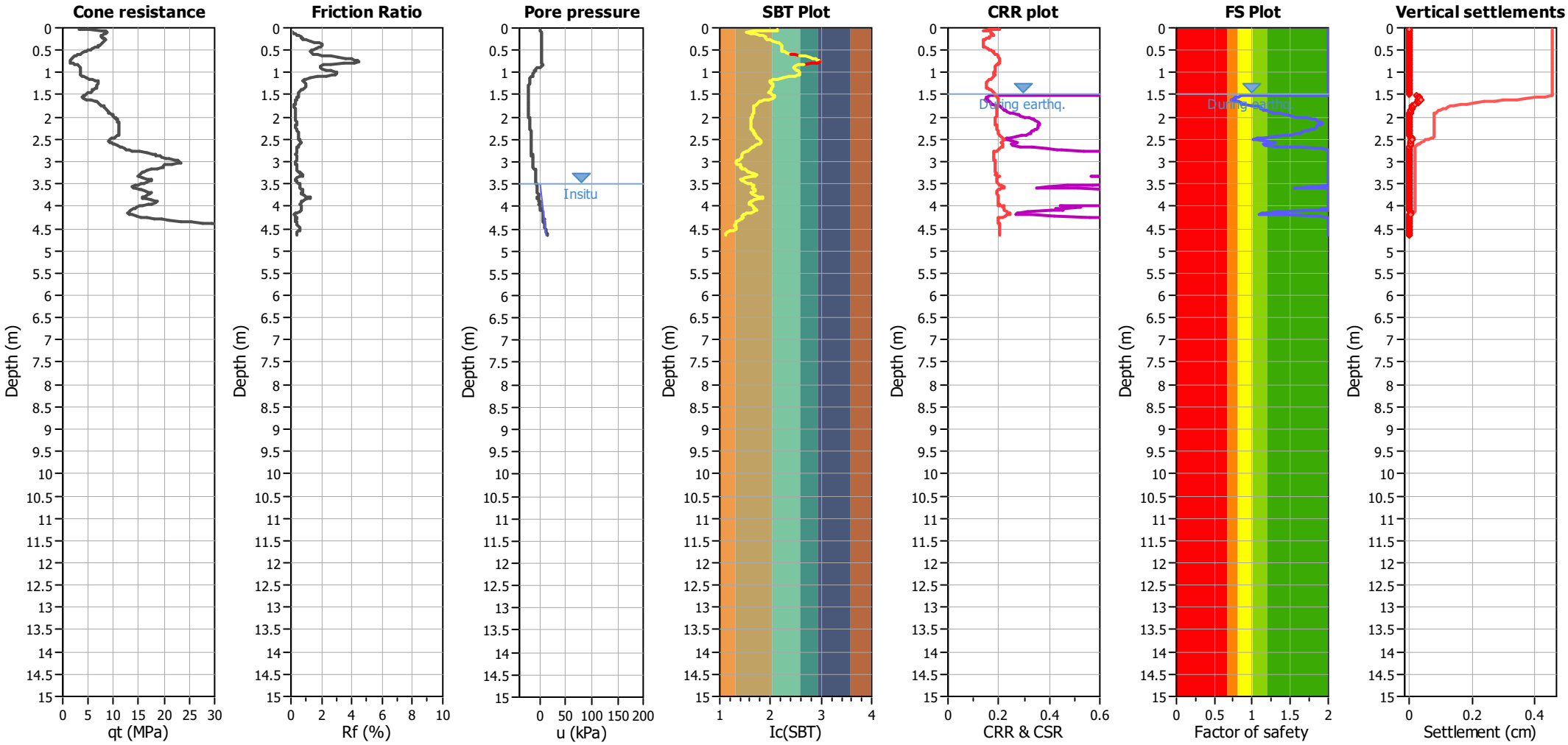
CPT: CPT87698
Total depth: 8.98 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

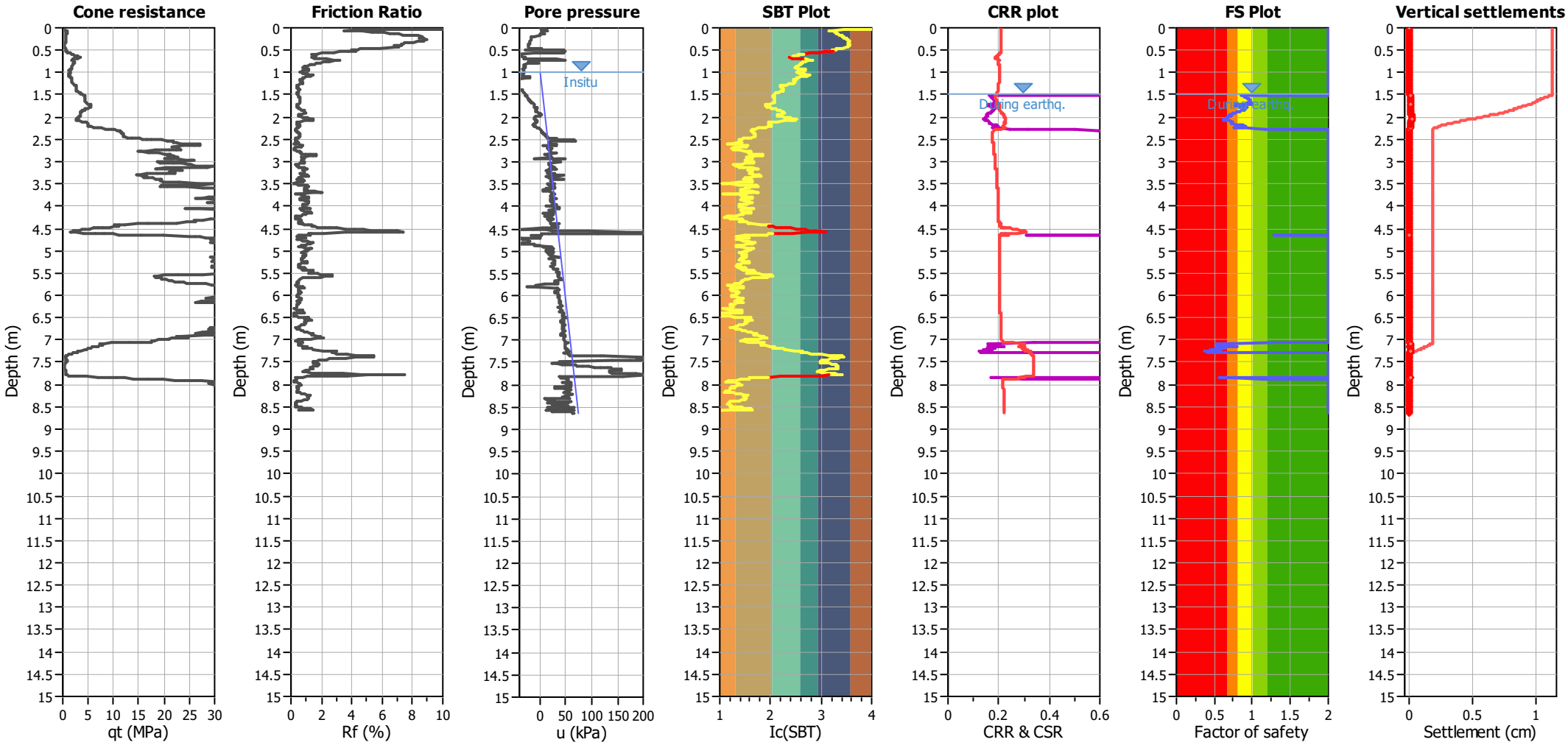
CPT: CPT87699
Total depth: 4.66 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

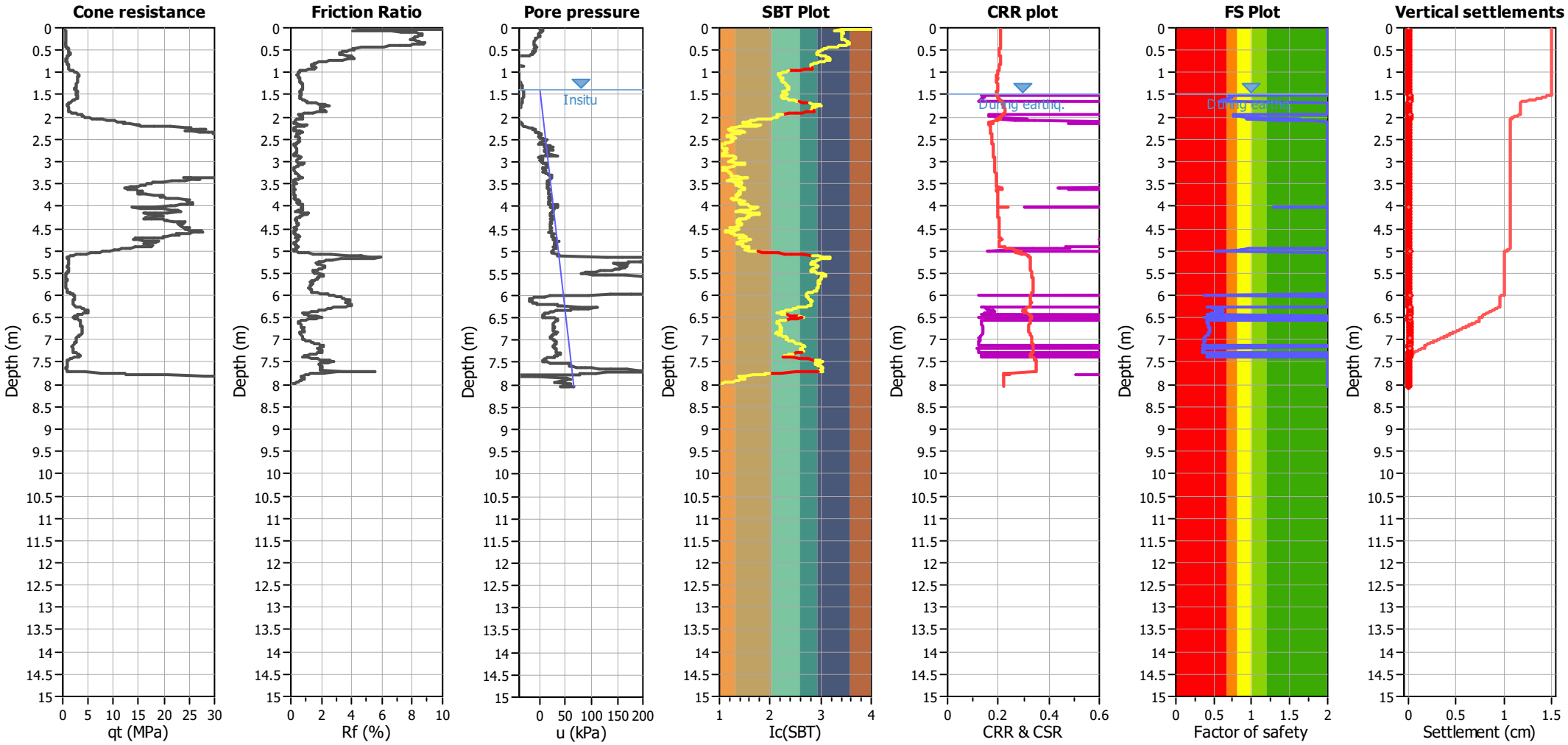
CPT: CPT88486
Total depth: 8.65 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

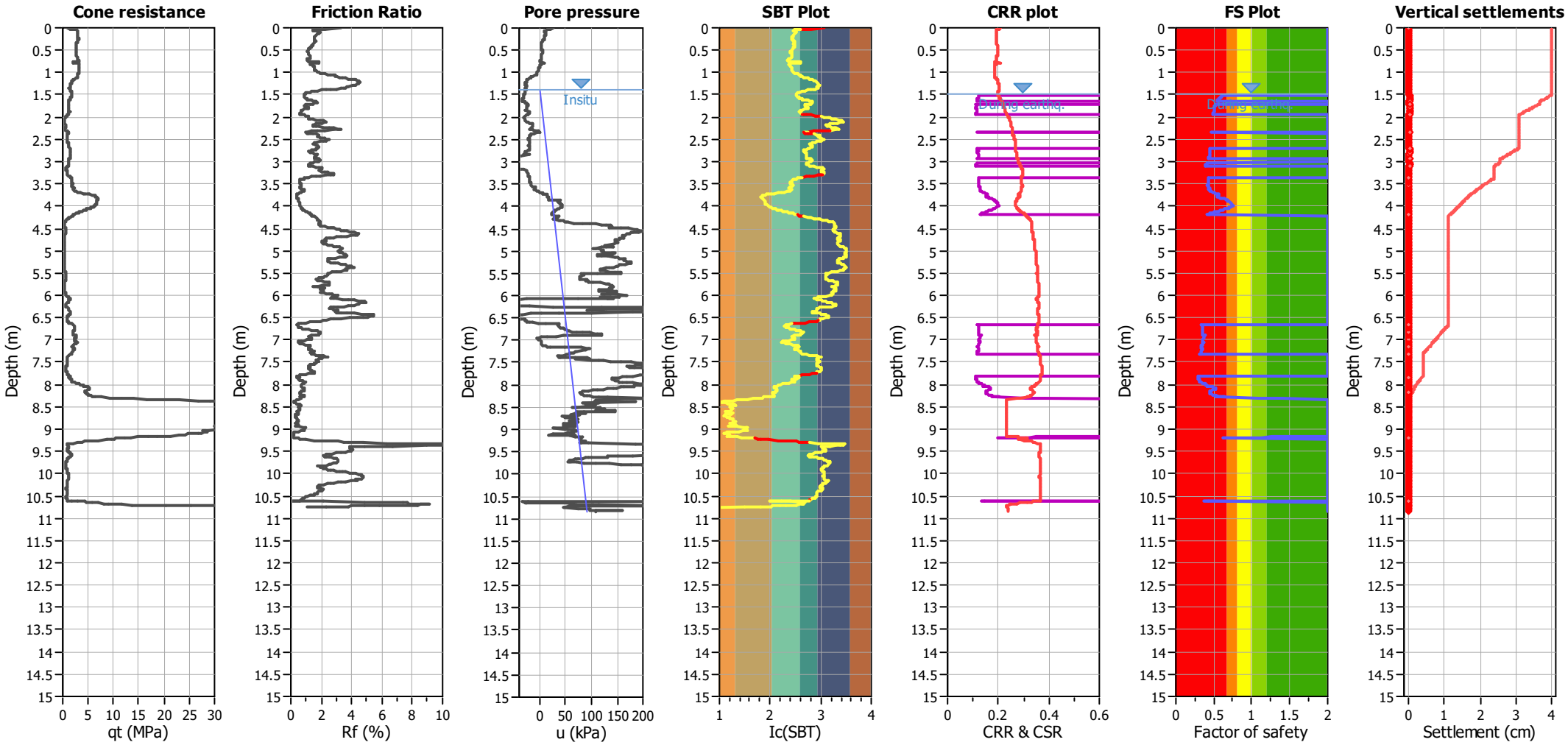
CPT: CPT88485
Total depth: 8.06 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.40 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

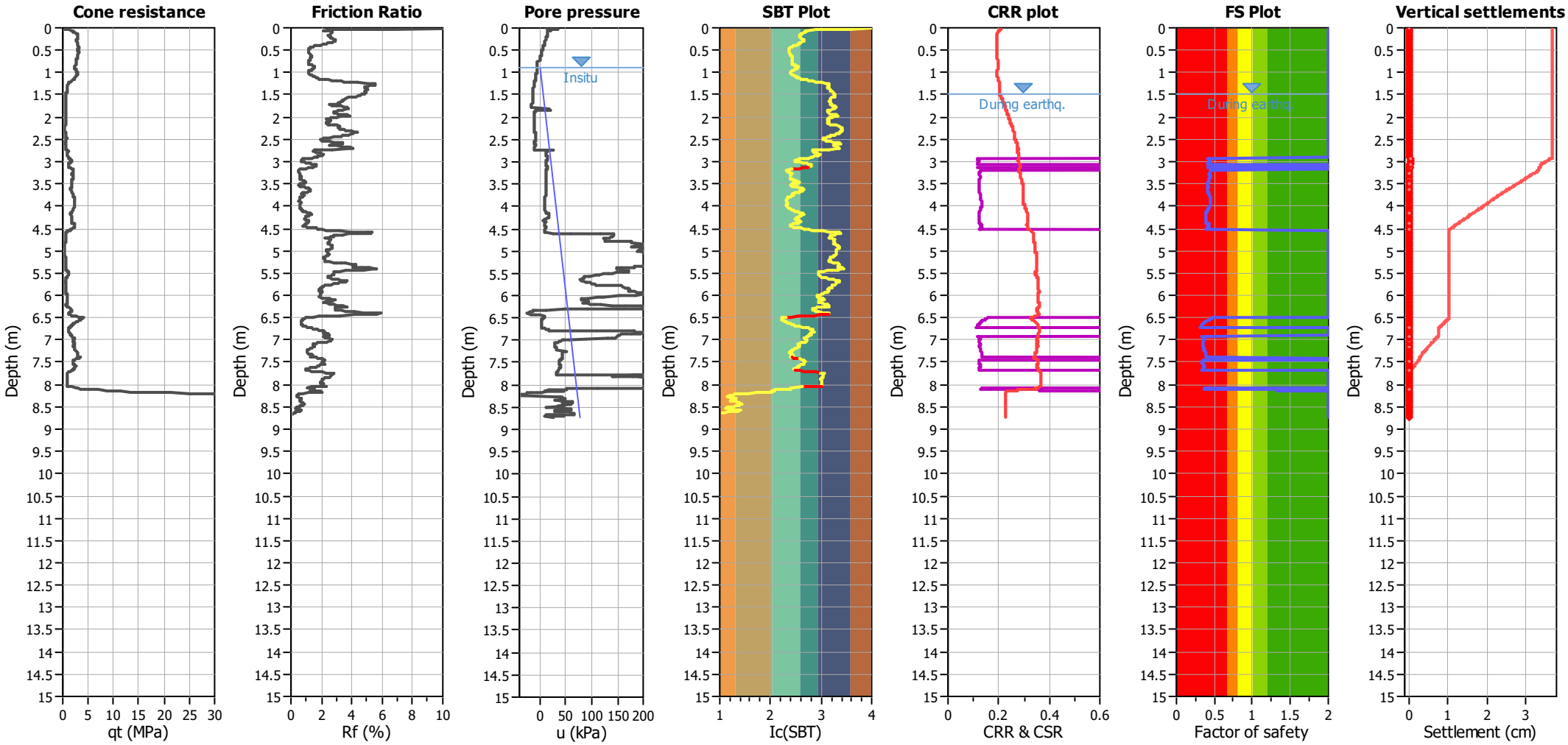
CPT: CPT_88483
Total depth: 10.83 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.40 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

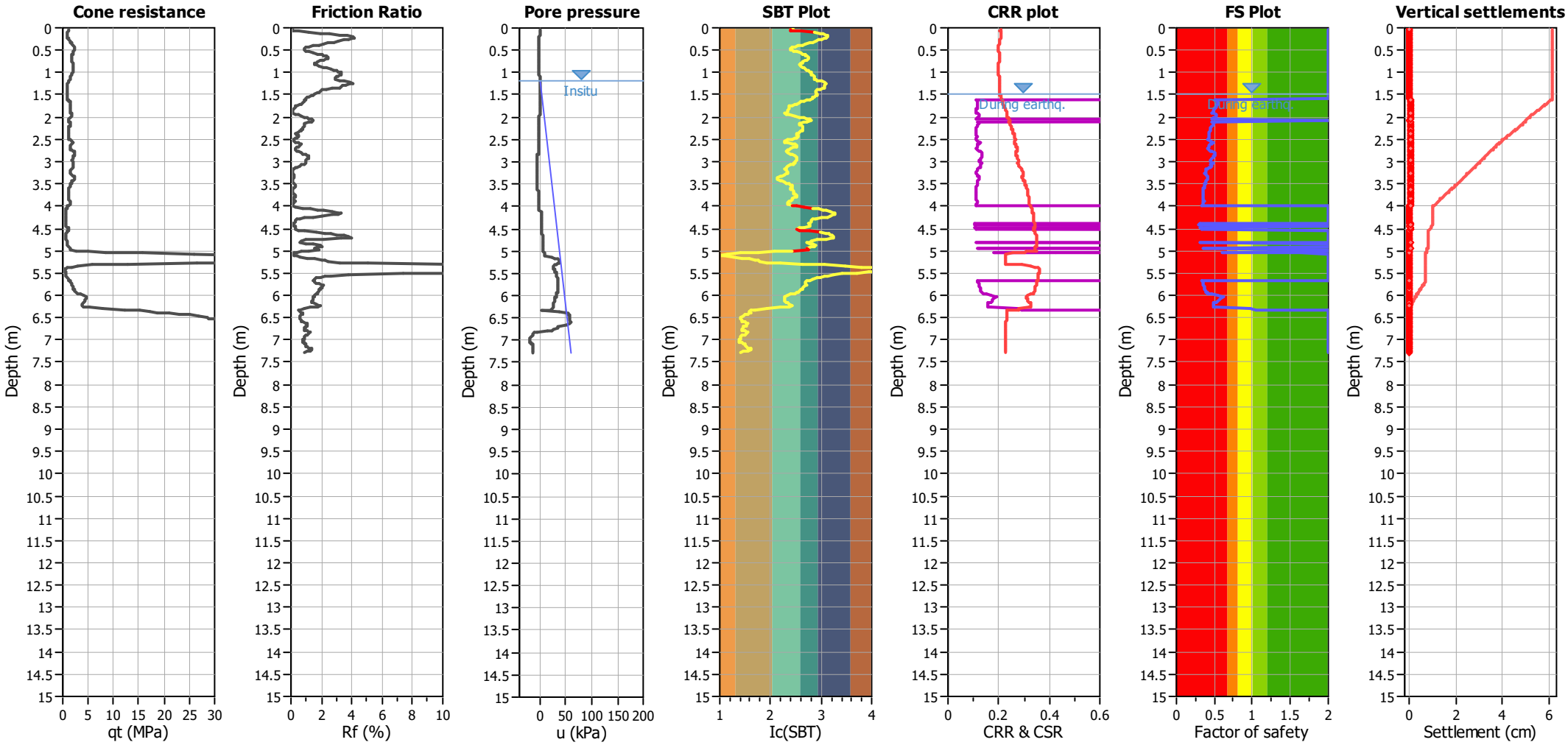
CPT: CPT_88487
Total depth: 8.74 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.90 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

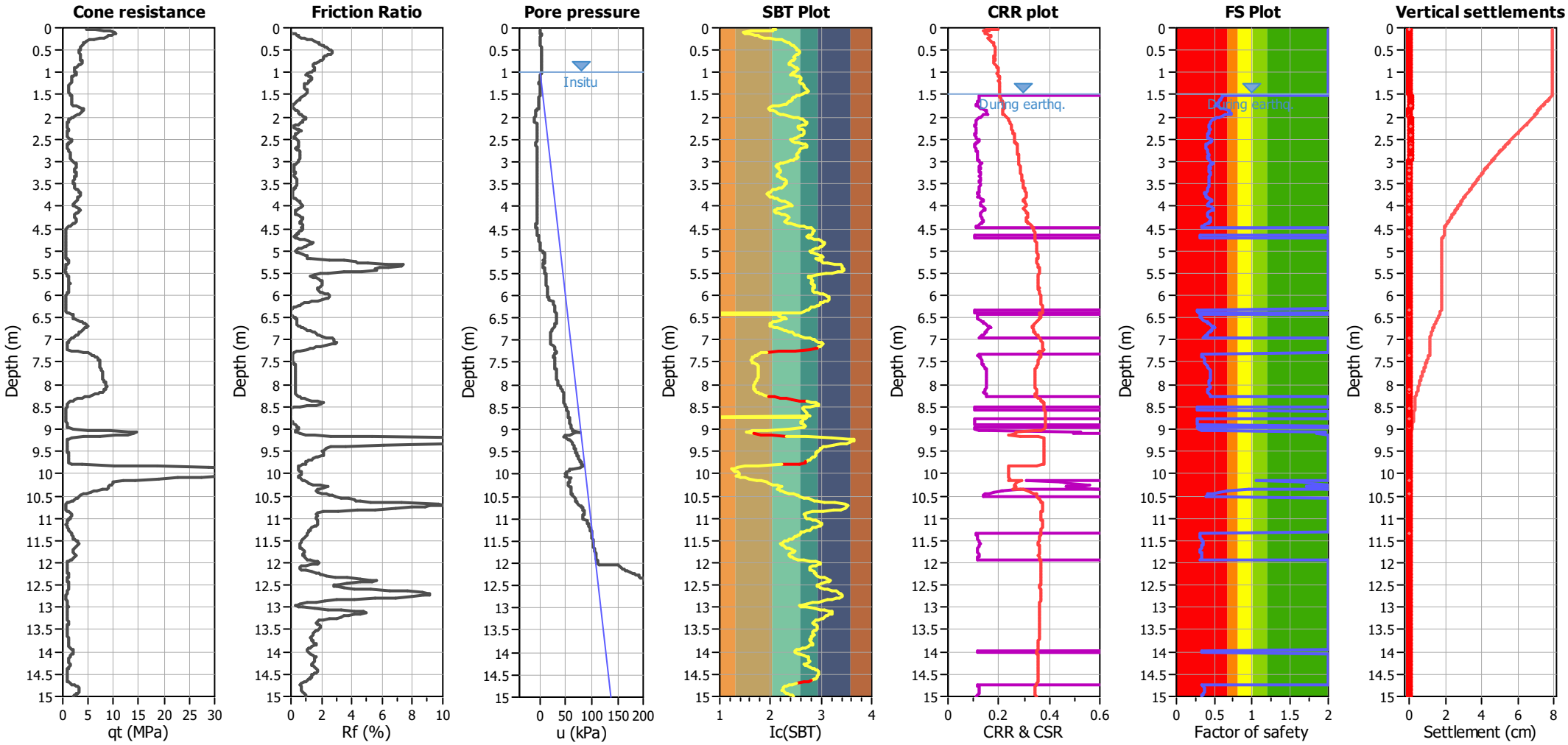
CPT: CPT_87707
Total depth: 7.28 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

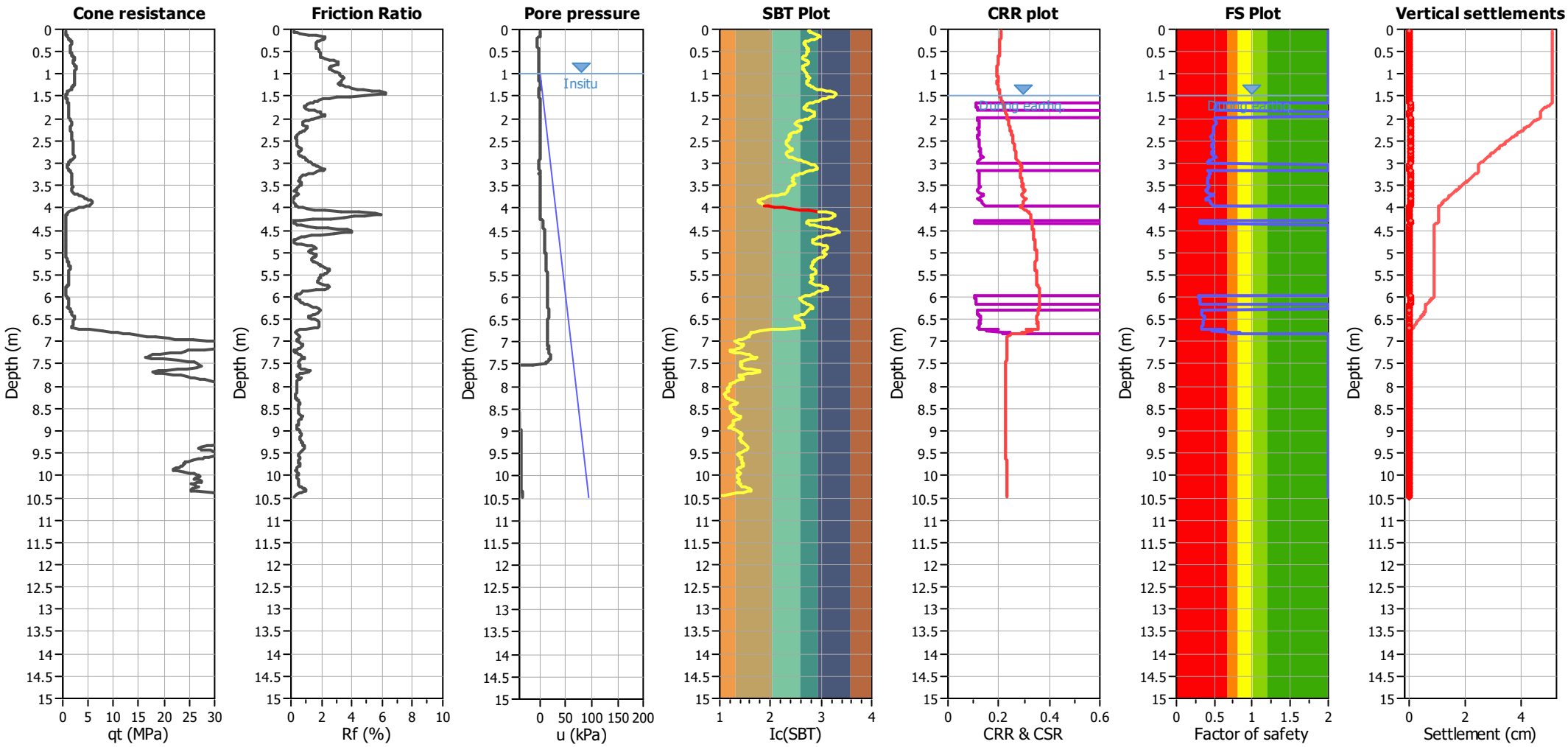
CPT: CPT_87703
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

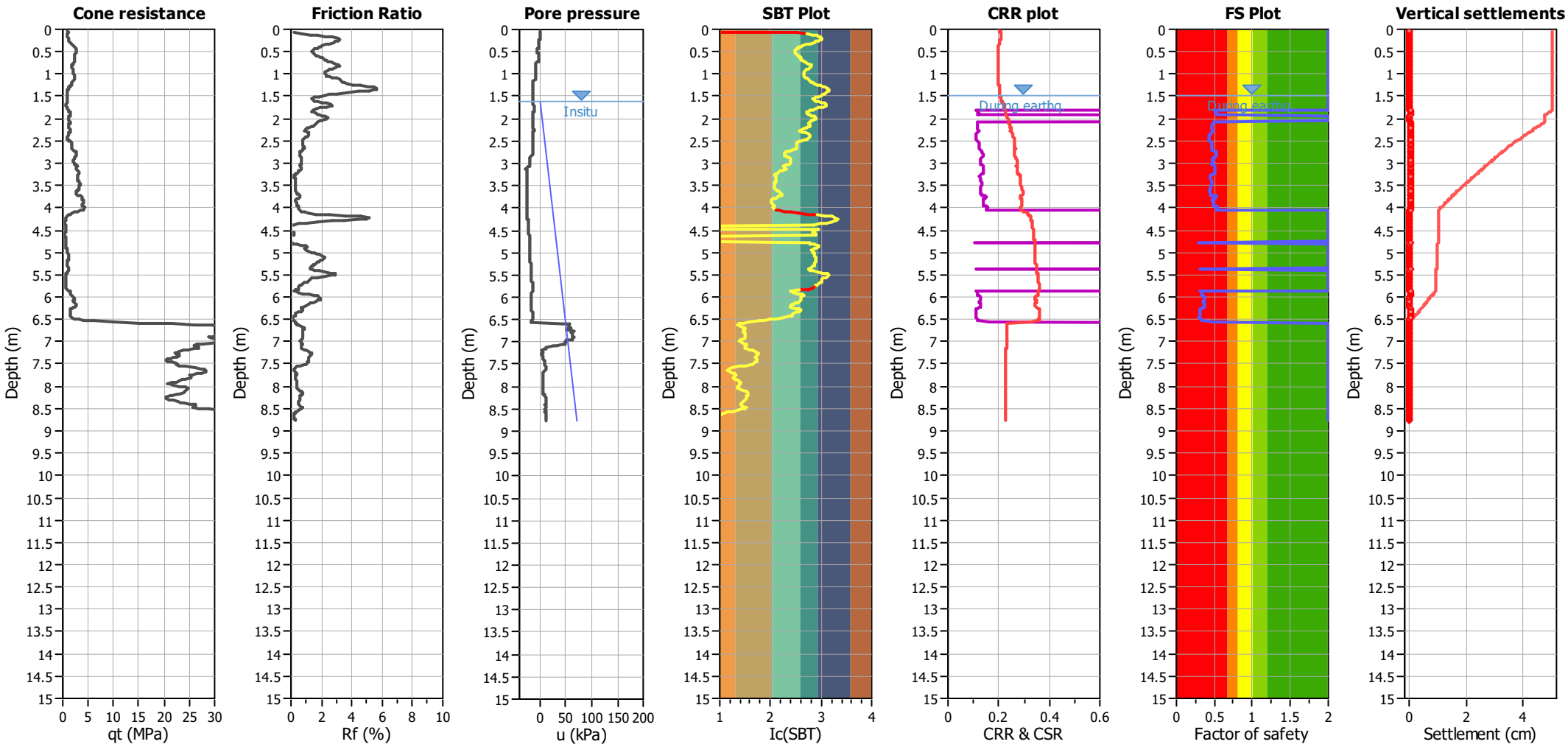
CPT: CPT_87709
Total depth: 10.48 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

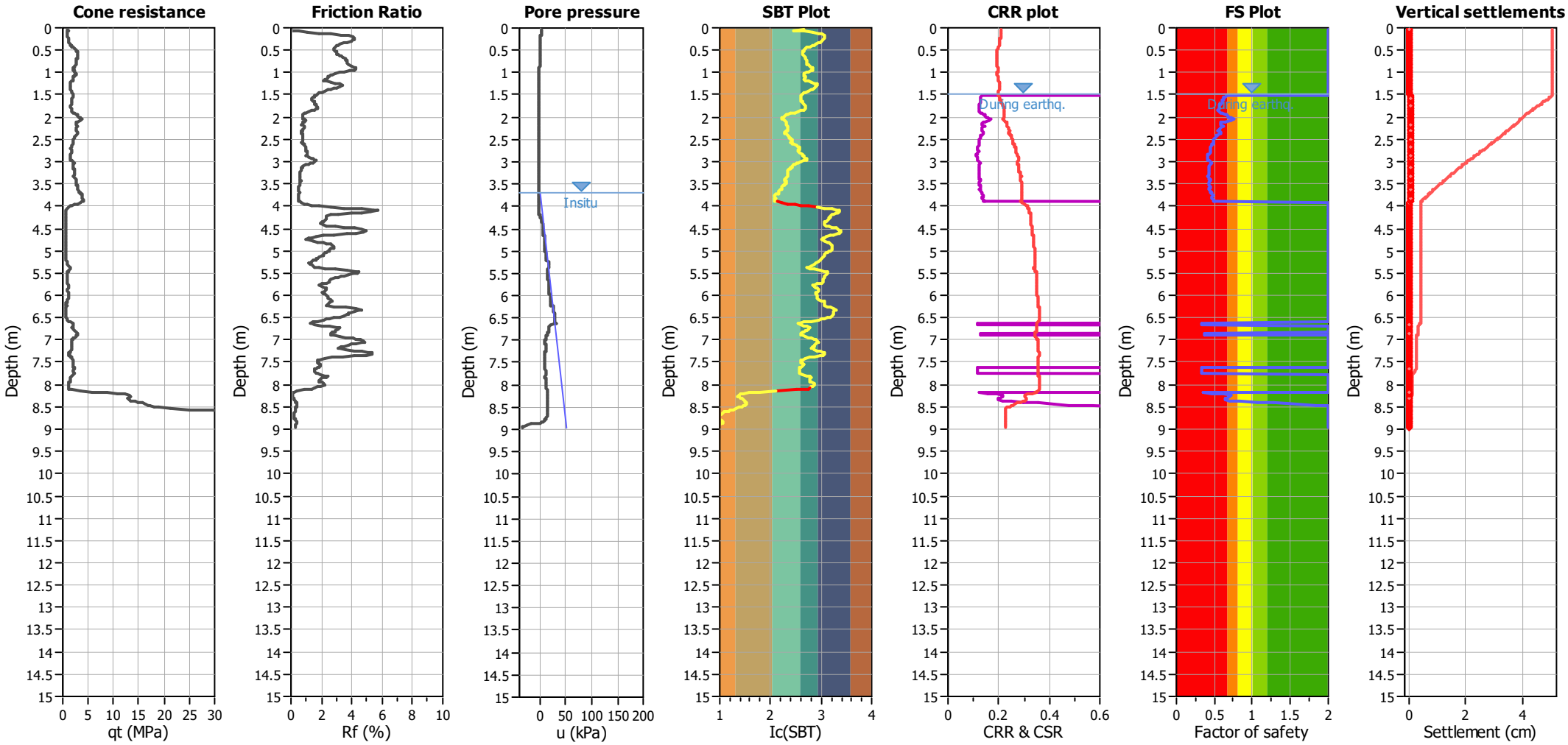
CPT: CPT_87706
Total depth: 8.76 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

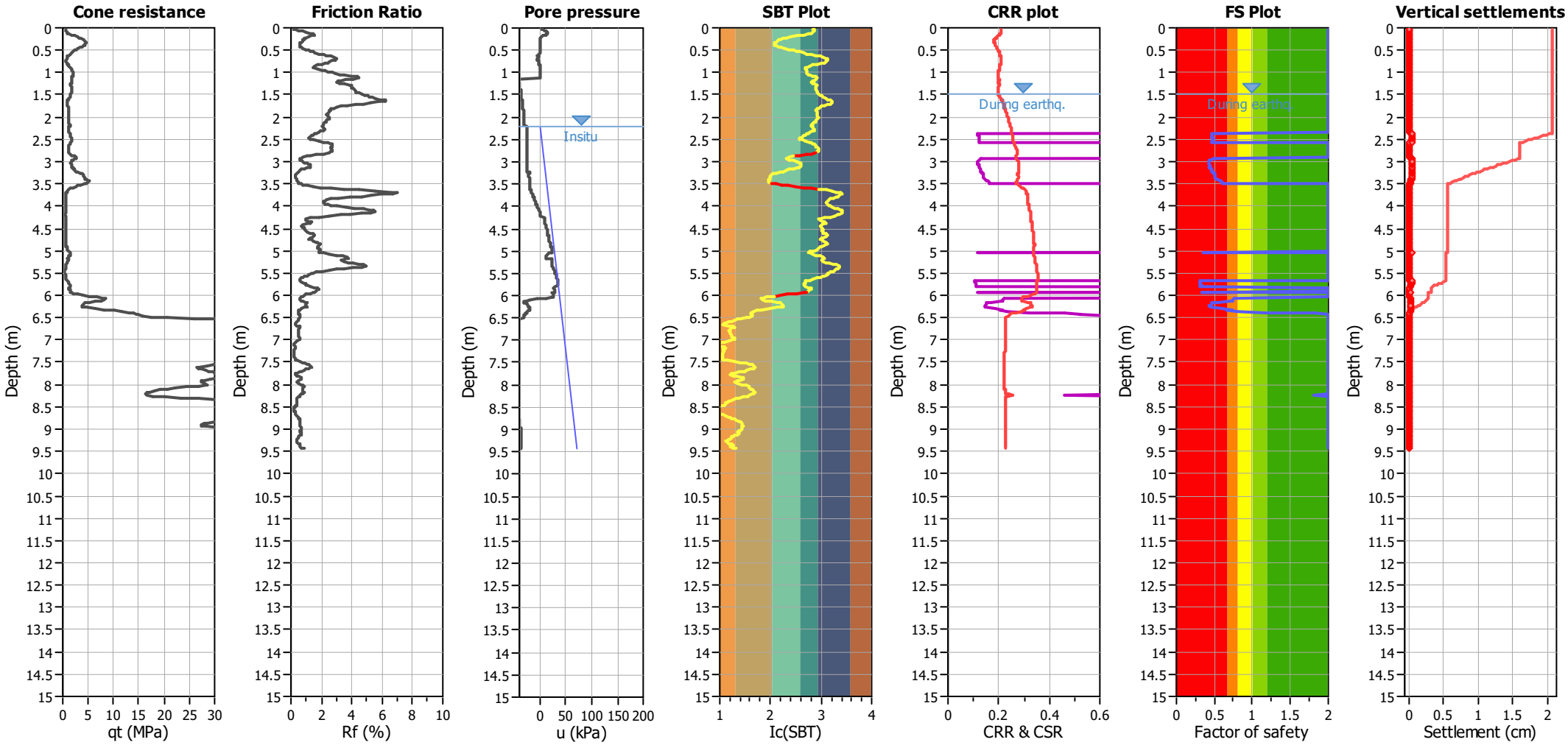
CPT: CPT_87705
Total depth: 8.96 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

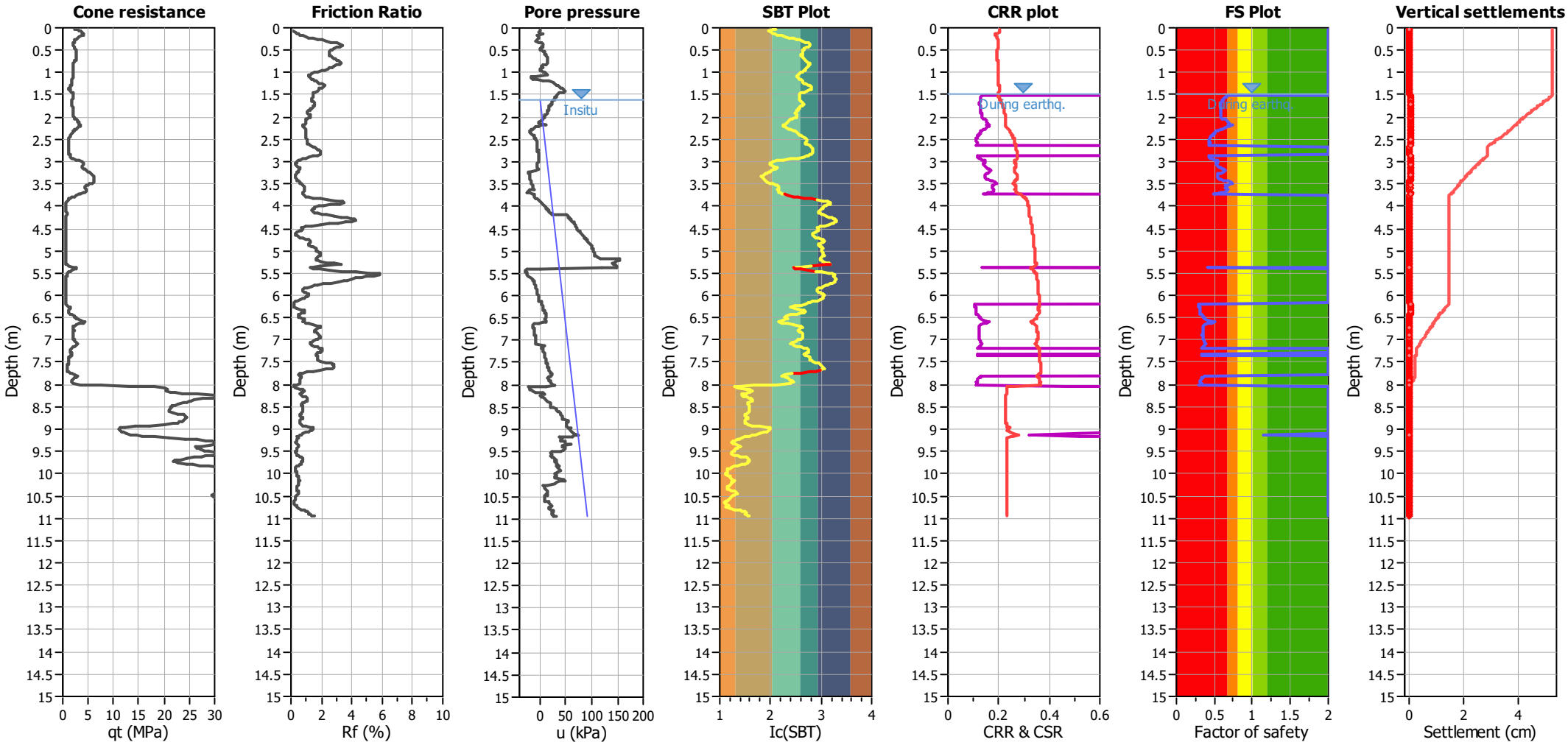
CPT: CPT_87708
Total depth: 9.44 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

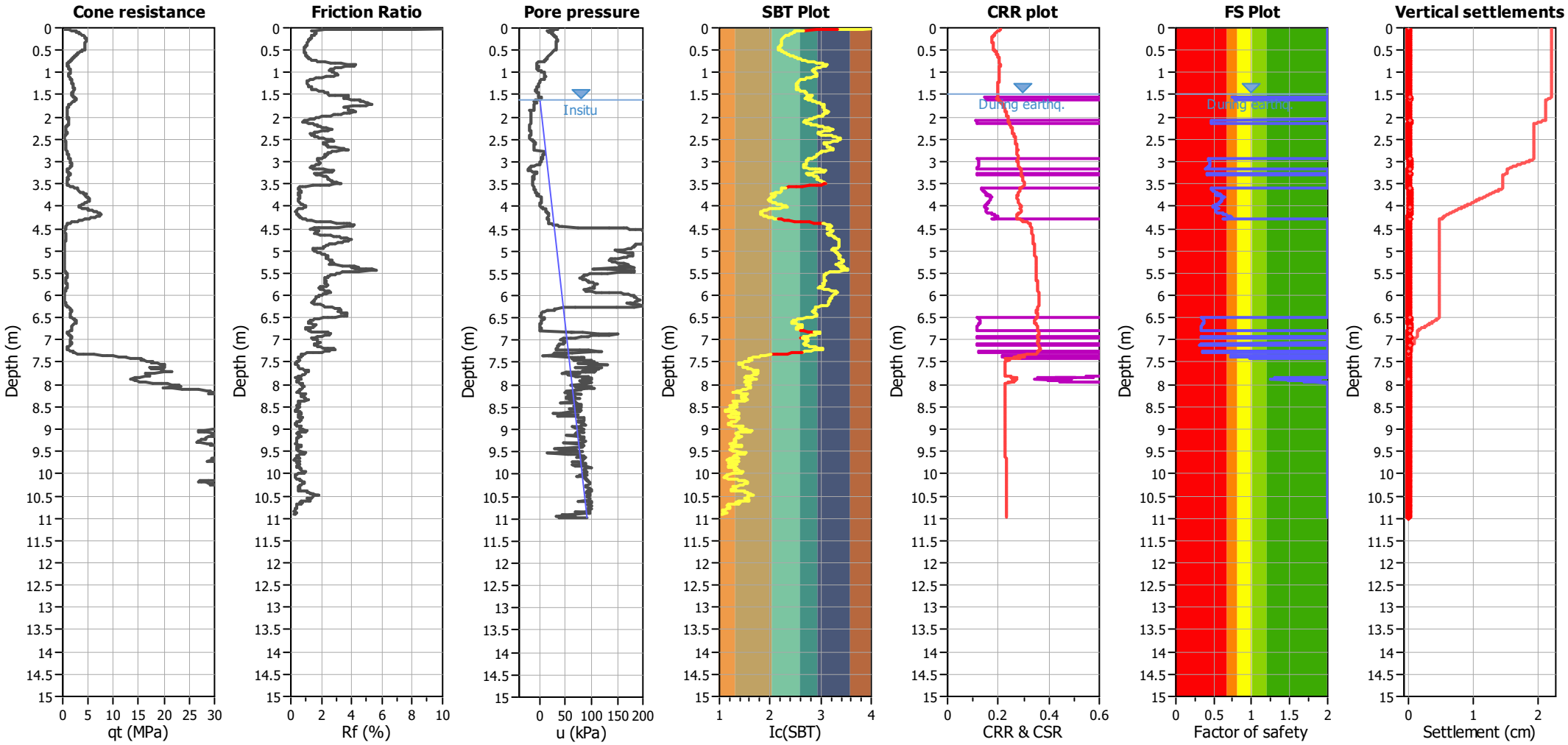
CPT: CPT_87704
Total depth: 10.96 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

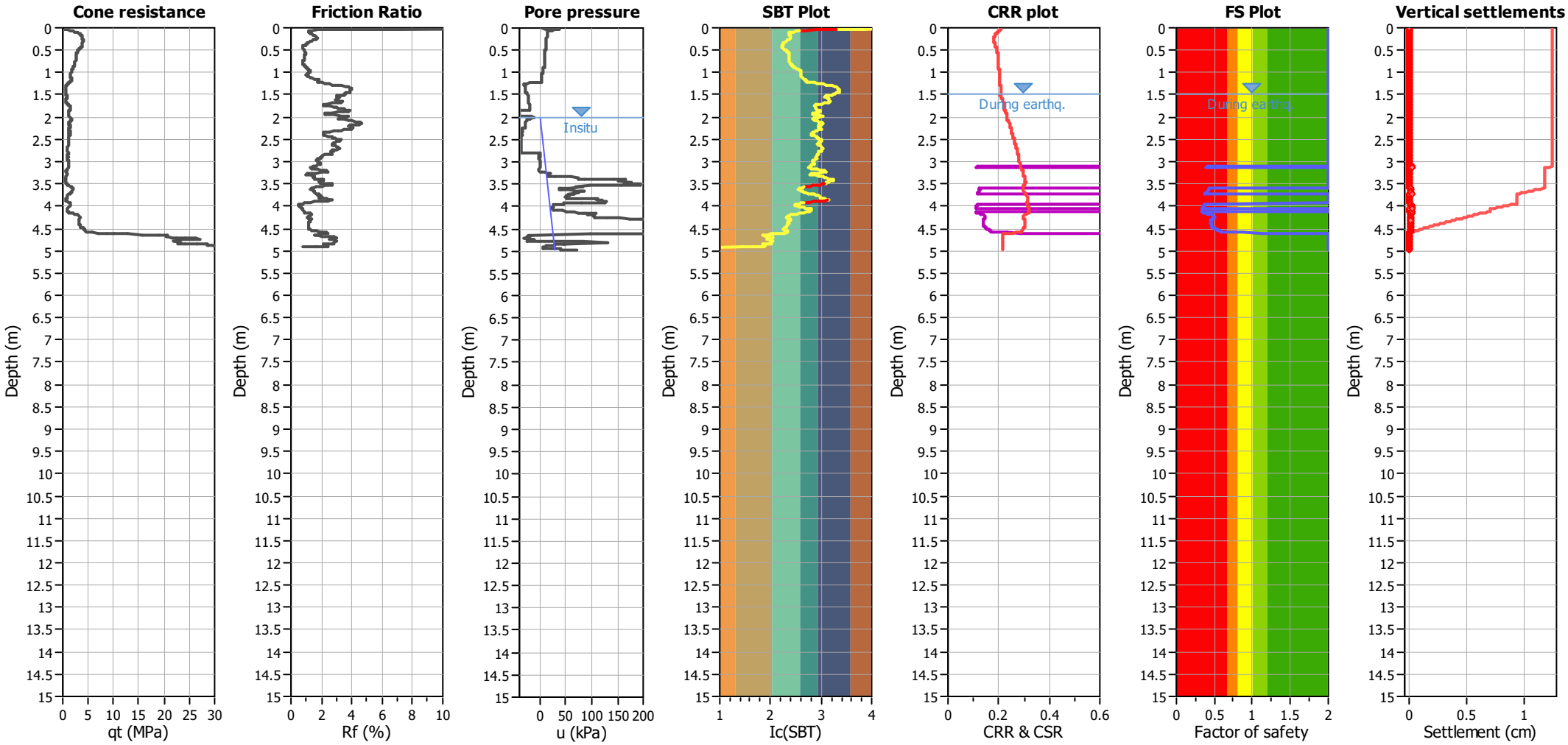
CPT: CPT_88488
Total depth: 10.98 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

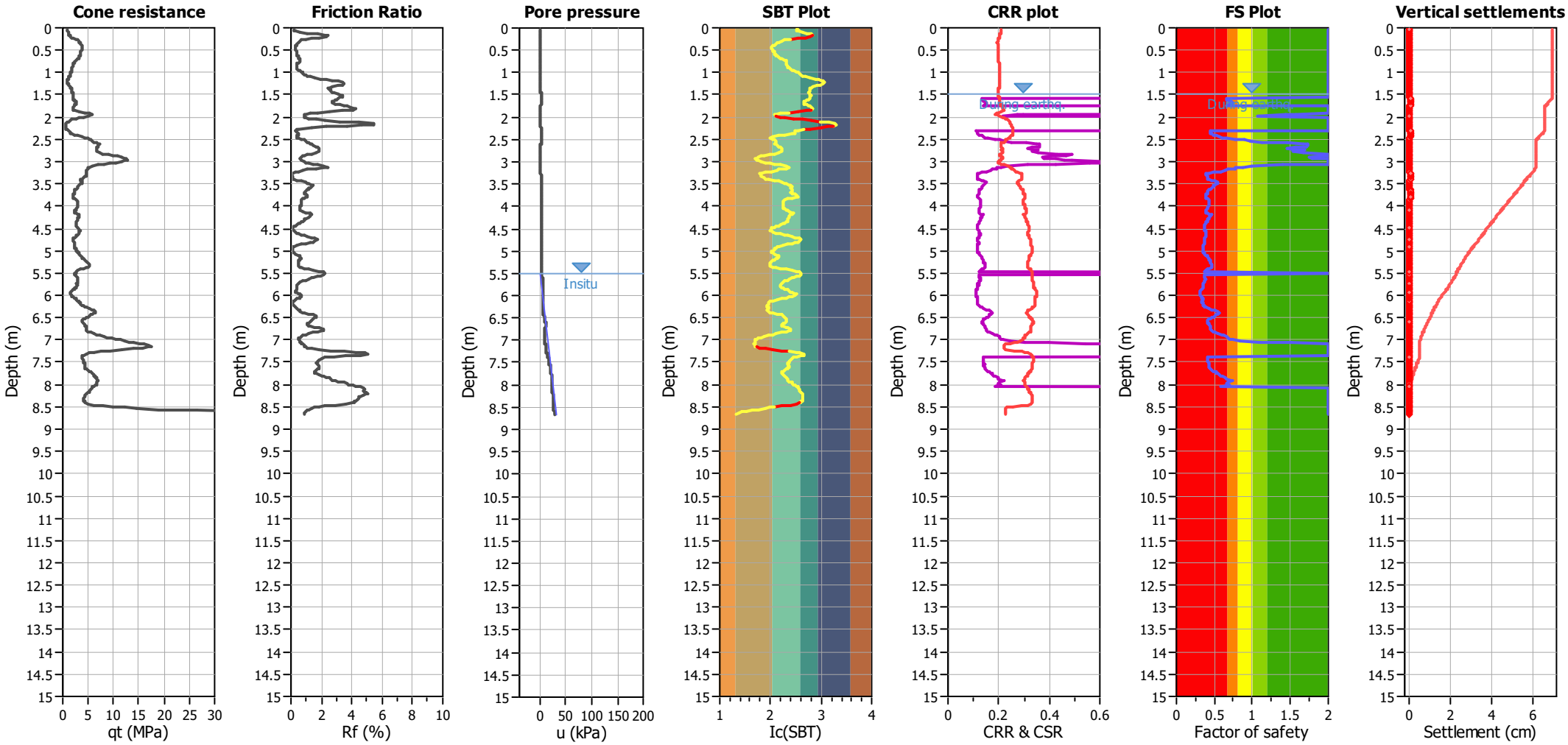
CPT: CPT_88482
Total depth: 4.99 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

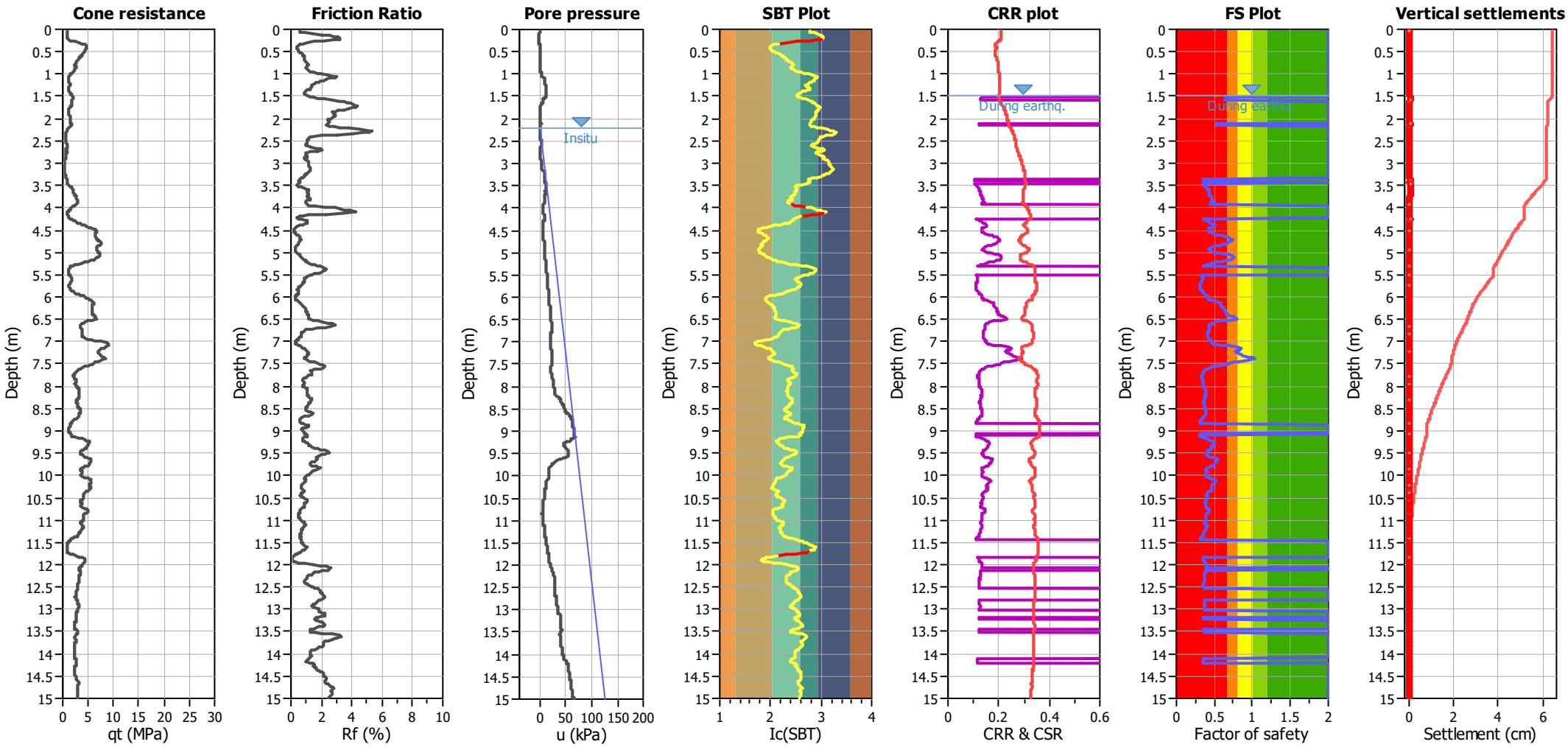
CPT: CPT_87715
Total depth: 8.66 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	5.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

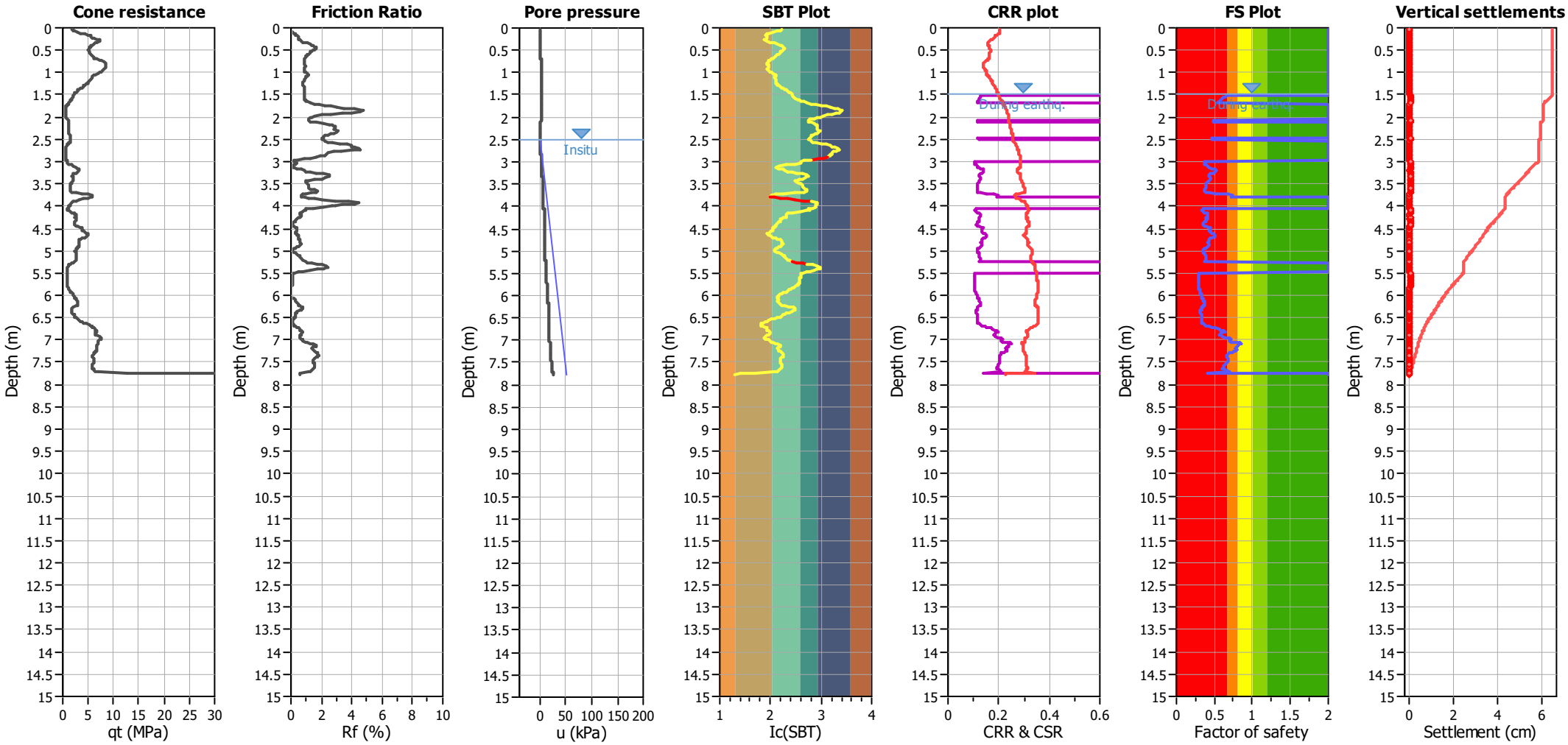
CPT: CPT_87714
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

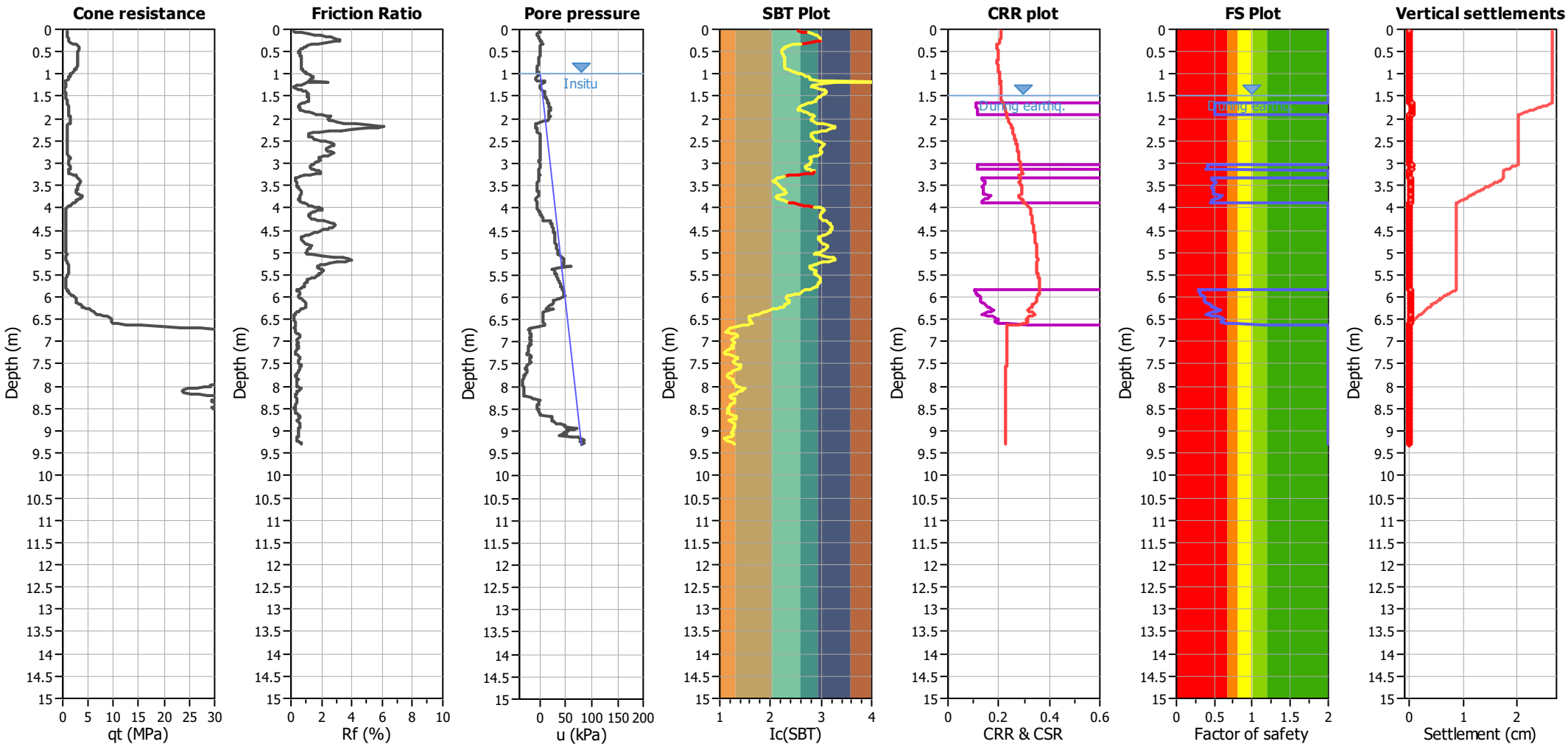
CPT: CPT_87713
Total depth: 7.78 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

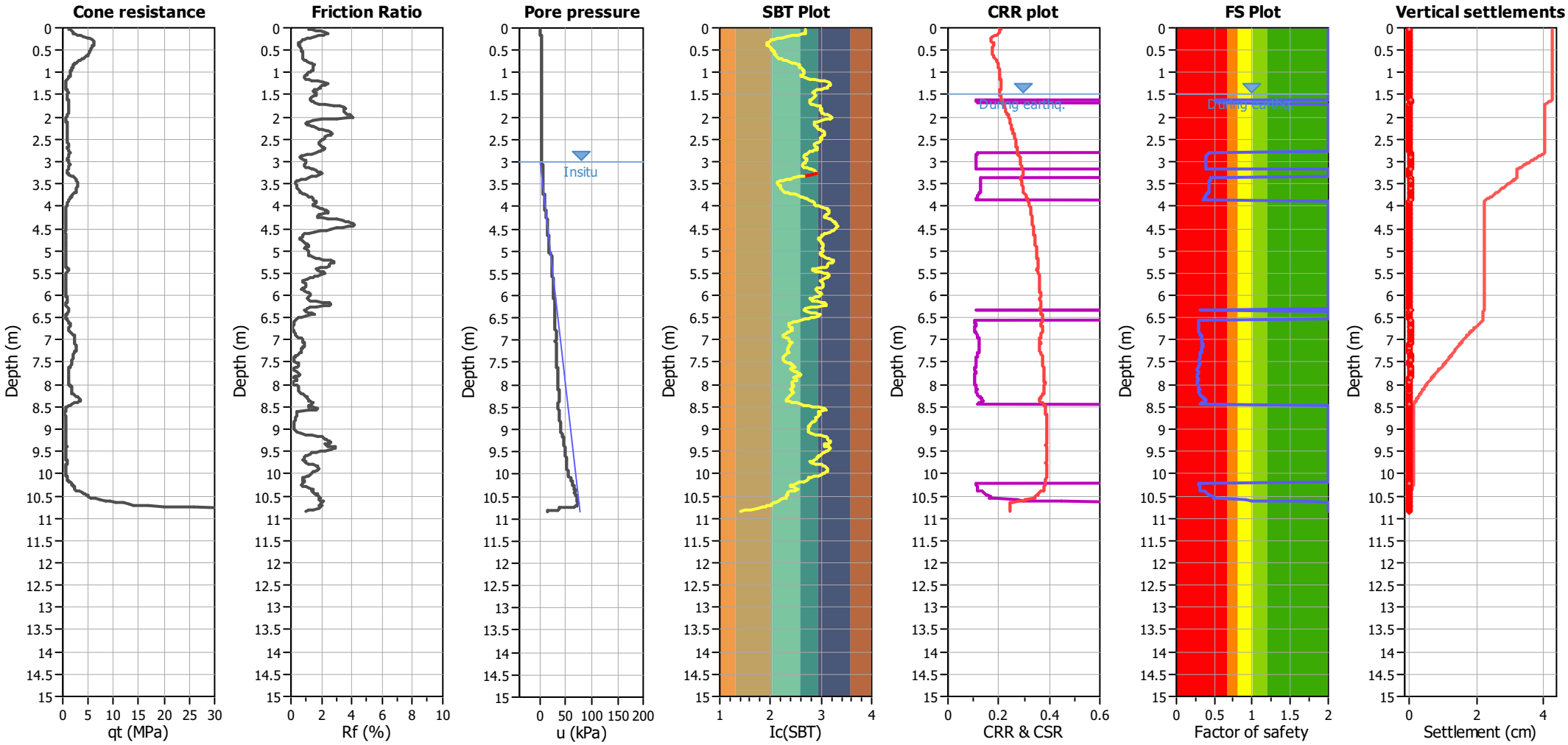
CPT: CPT_87712
Total depth: 9.30 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

CPT: CPT_87710
Total depth: 10.84 m



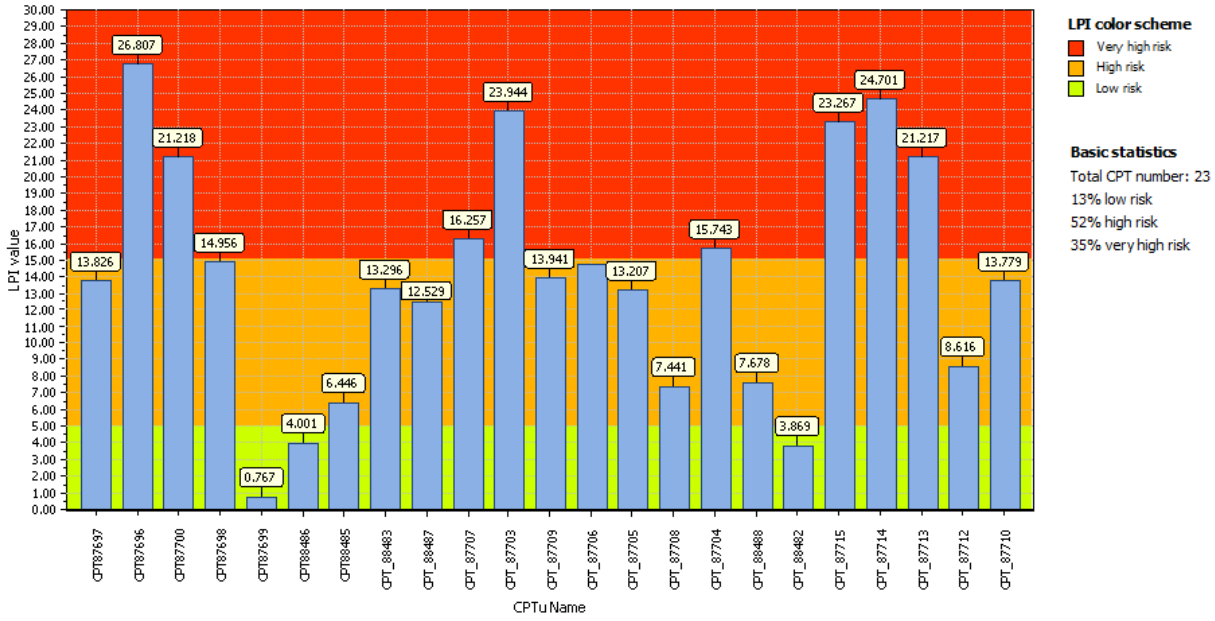
Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.38	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

February 2011 back analysis / MBIE analysis without further optimisation

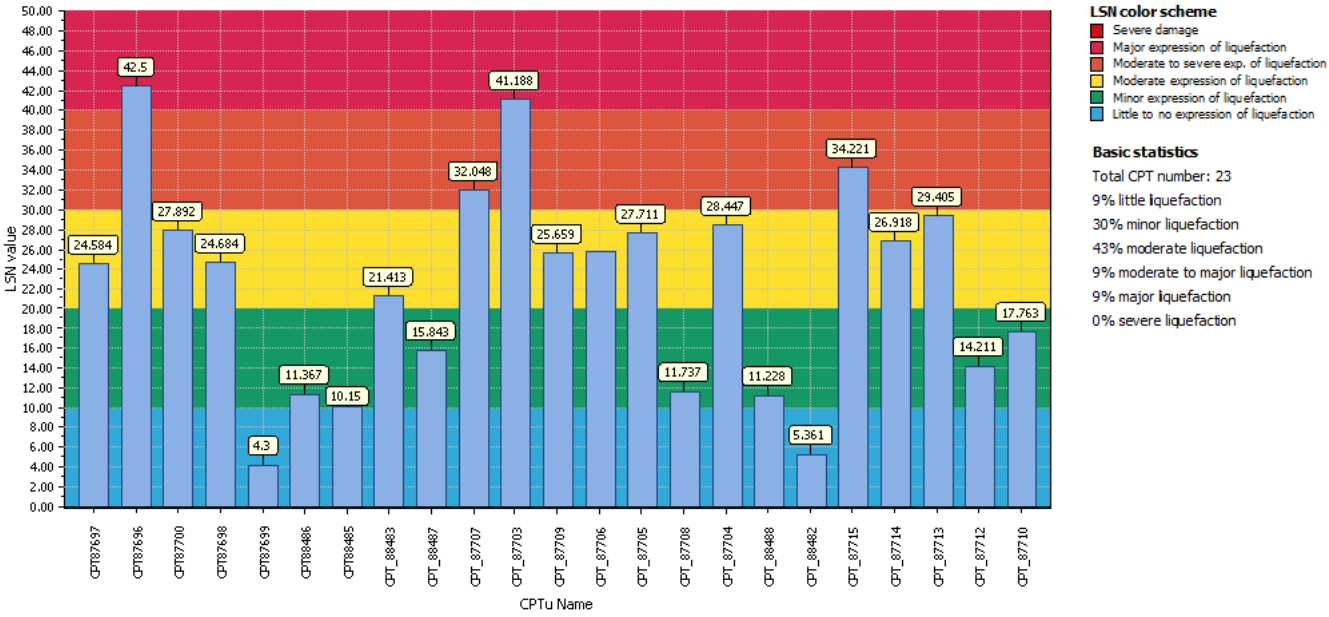
Project title : MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision

Location : Cashmere and Southerland Road, Halswell

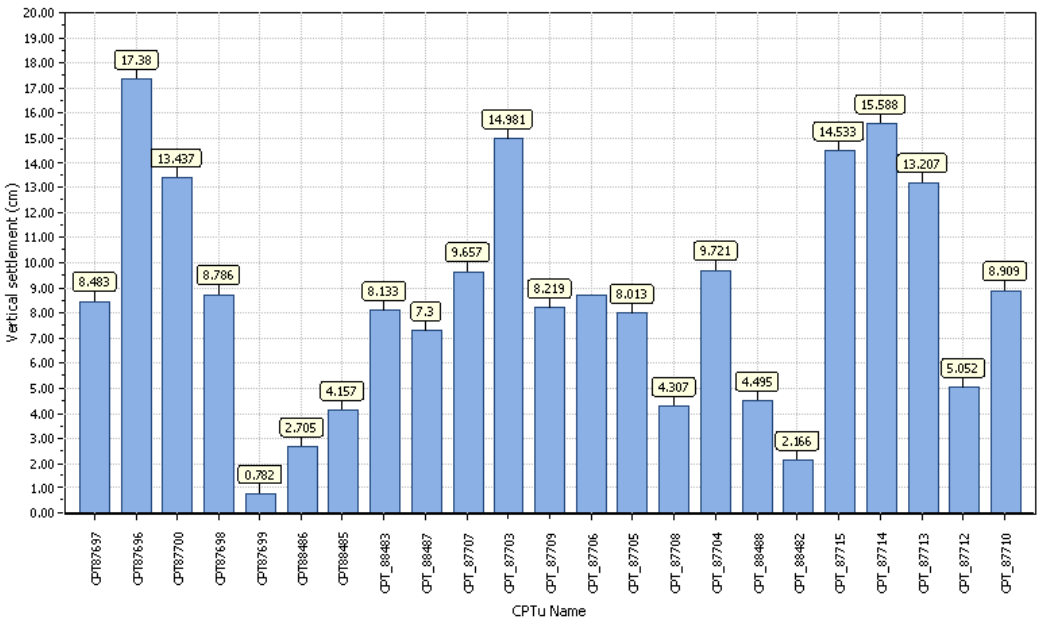
Overall Liquefaction Potential Index report



Overall Liquefaction Severity Number report



Overall vertical settlements report

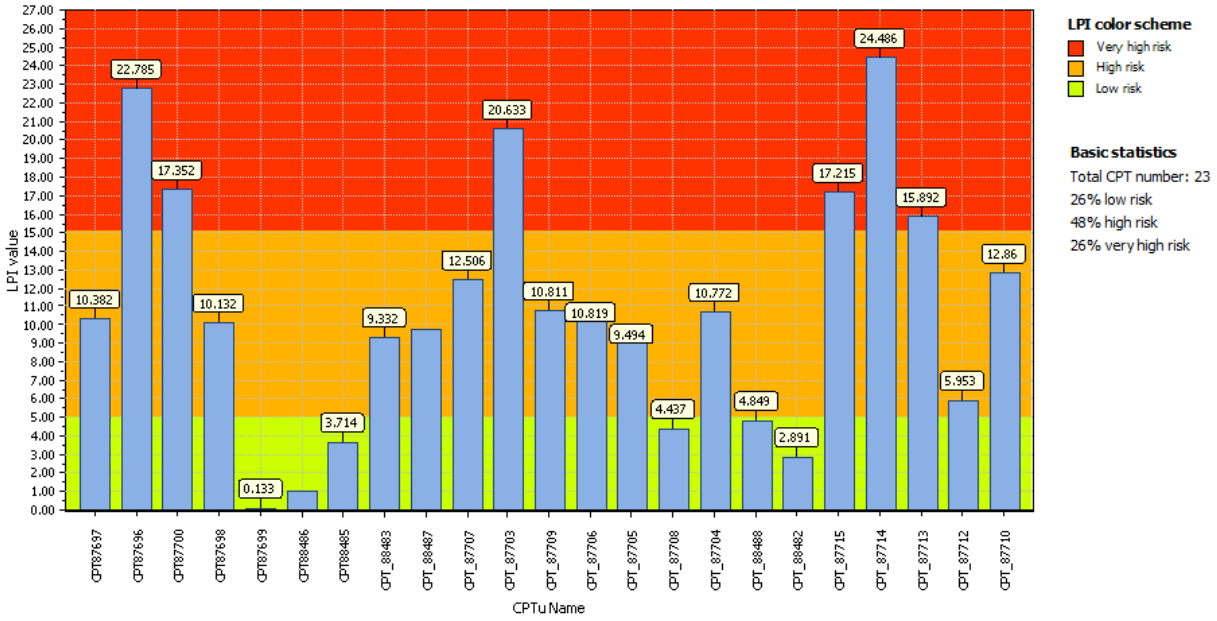


September 2010 back analysis / similar to our SLS & ULS

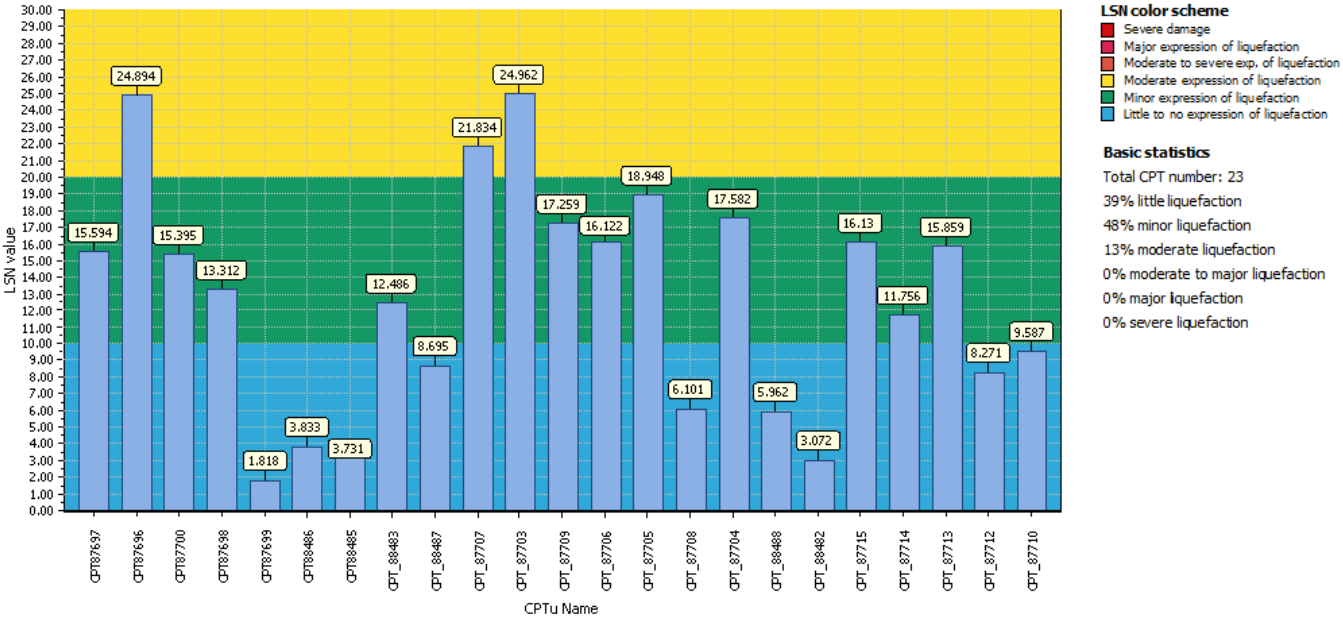
Project title : MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision

Location : Cashmere and Southerland Road, Halswell

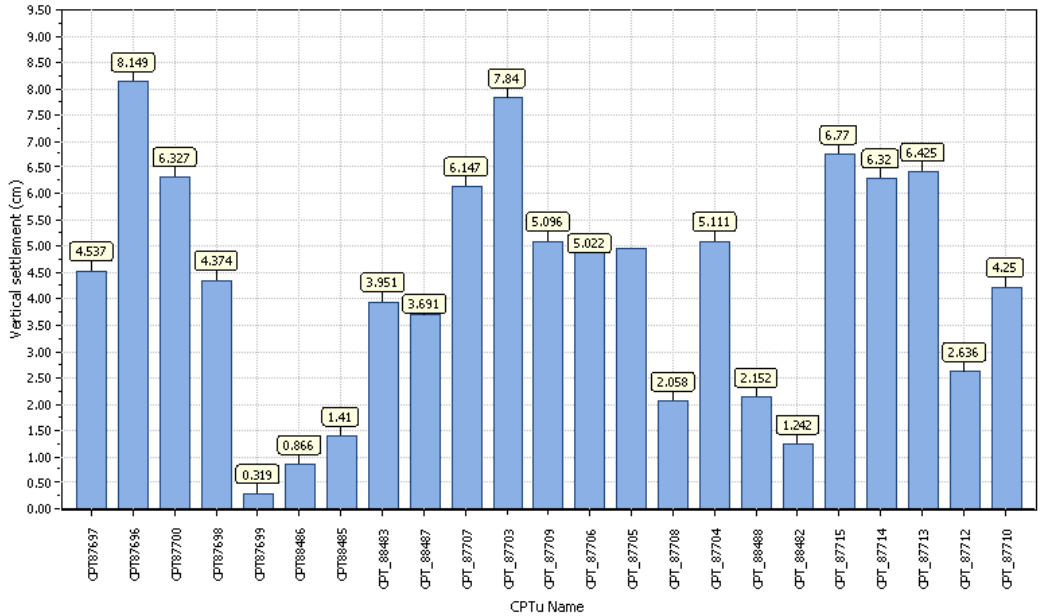
Overall Liquefaction Potential Index report



Overall Liquefaction Severity Number report



Overall vertical settlements report

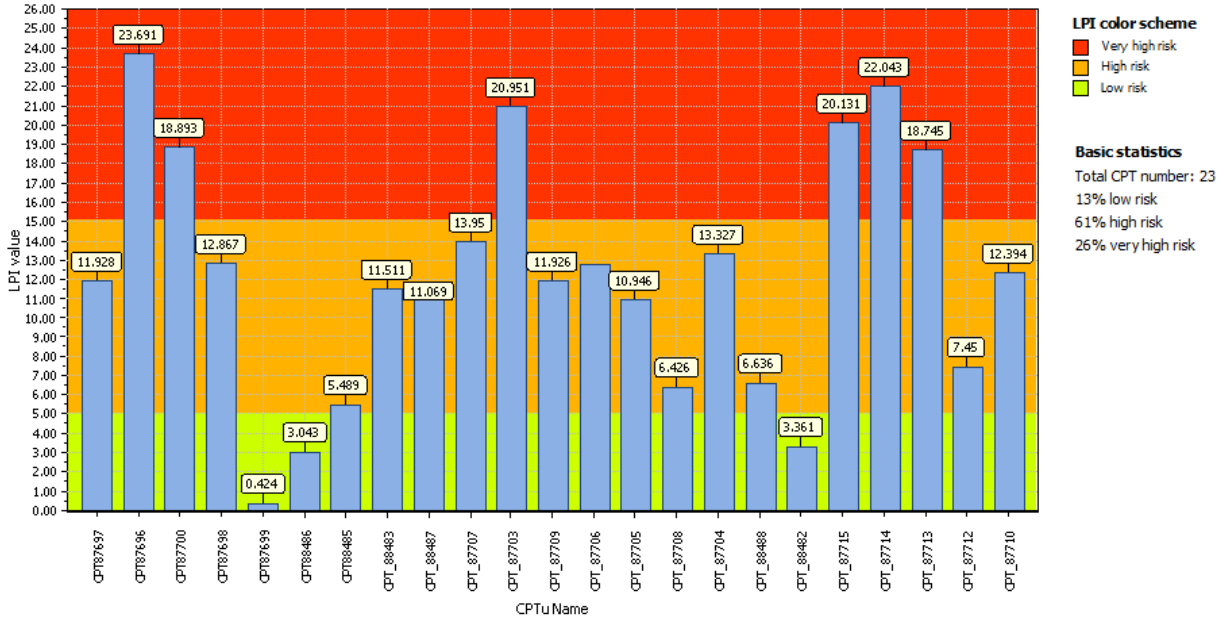


September 2010 back analysis / MBIE analysis without further optimisation

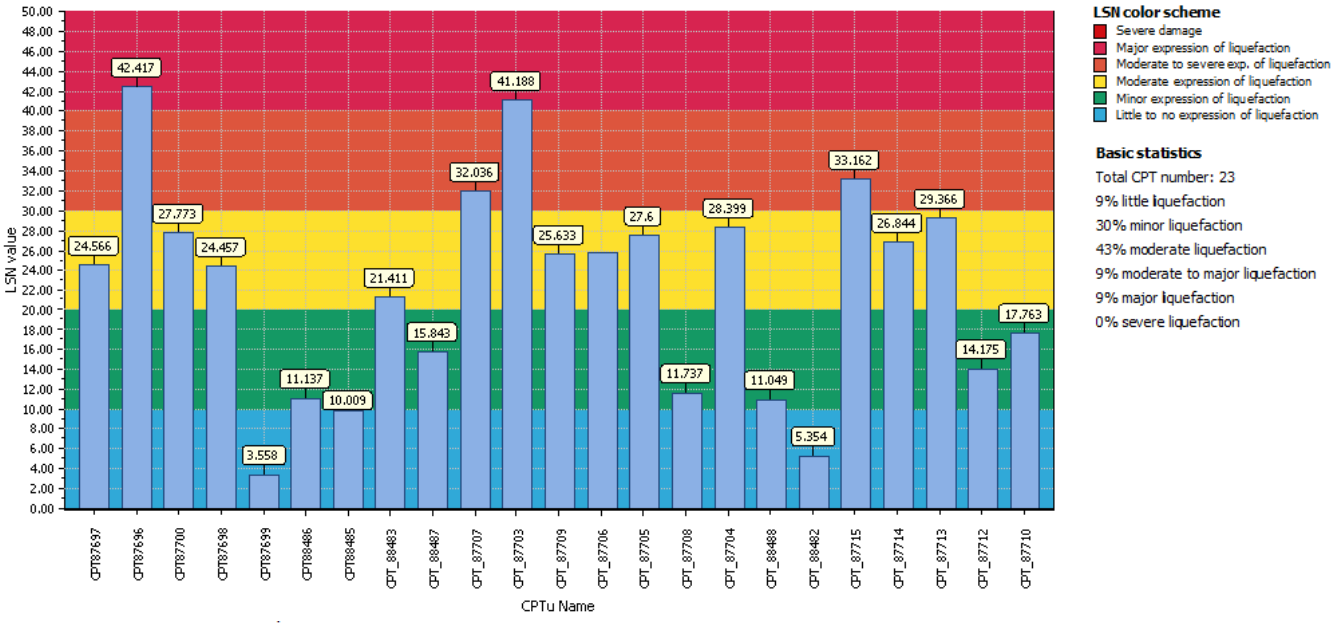
Project title : MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision

Location : Cashmere and Southerland Road, Halswell

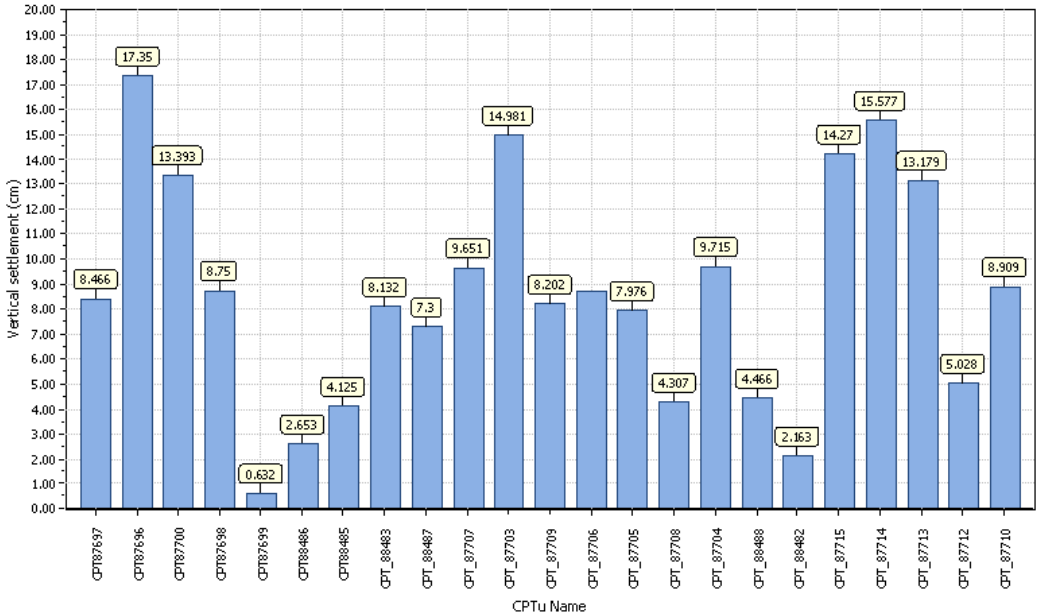
Overall Liquefaction Potential Index report



Overall Liquefaction Severity Number report

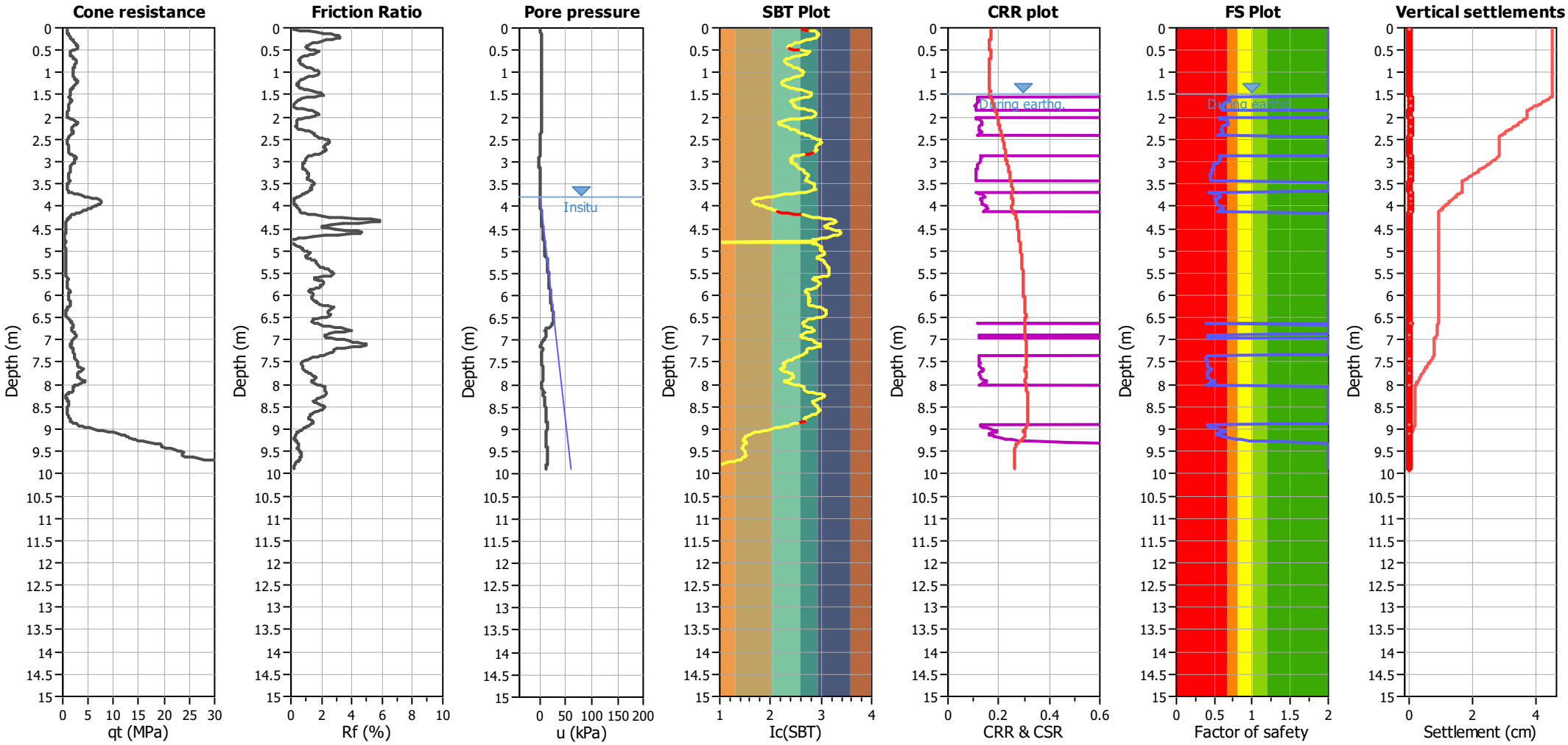


Overall vertical settlements report



Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

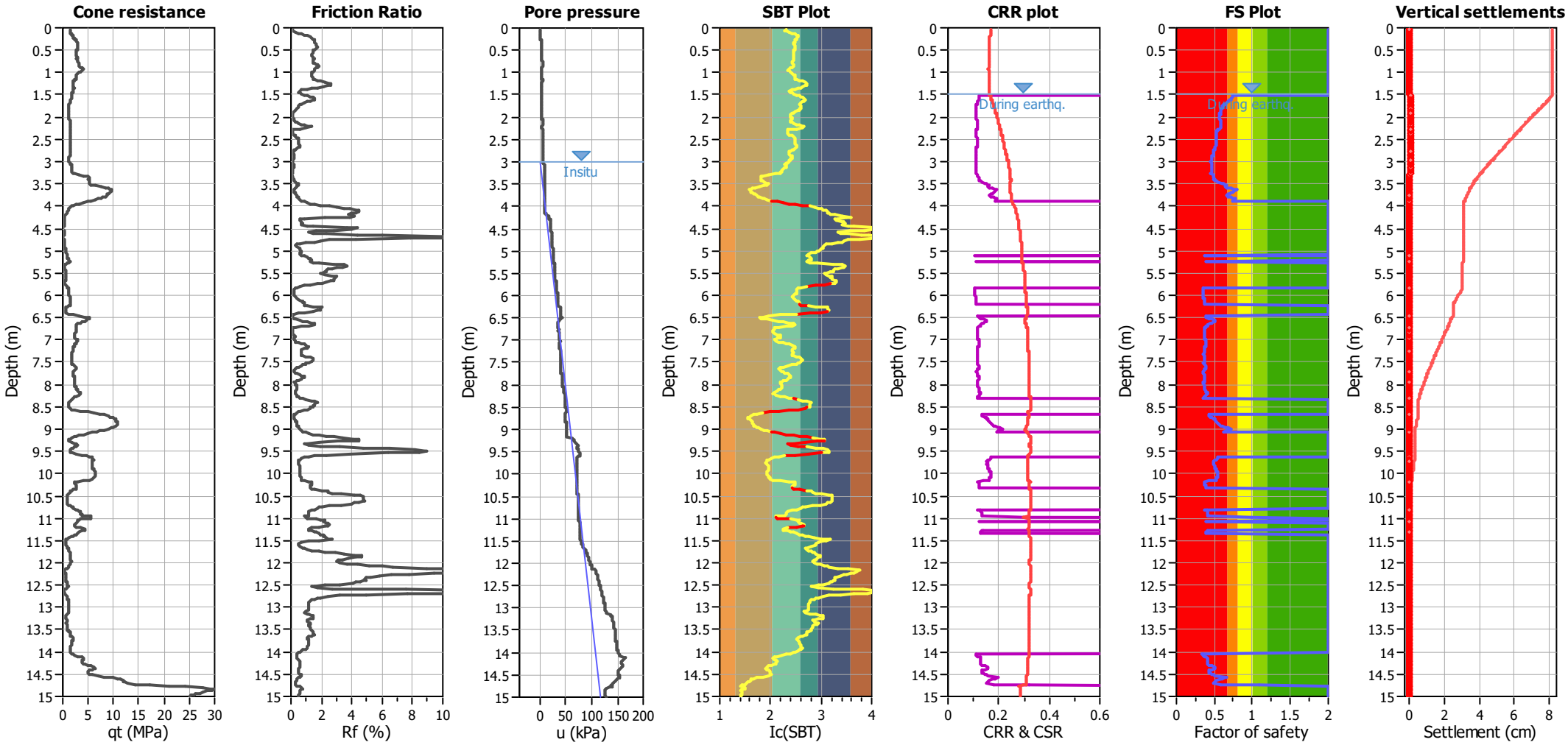
CPT: CPT87697
Total depth: 9.88 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

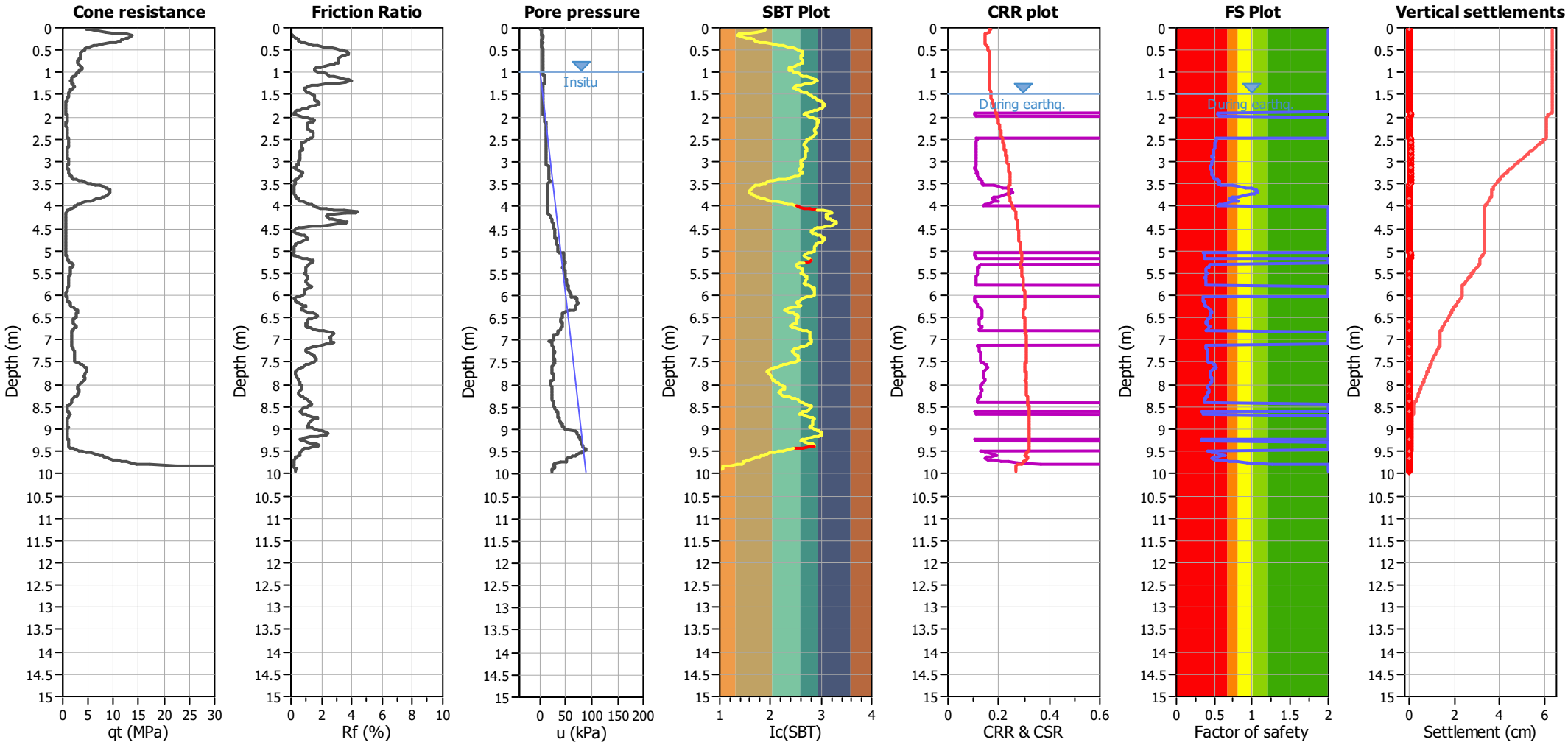
CPT: CPT87696
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

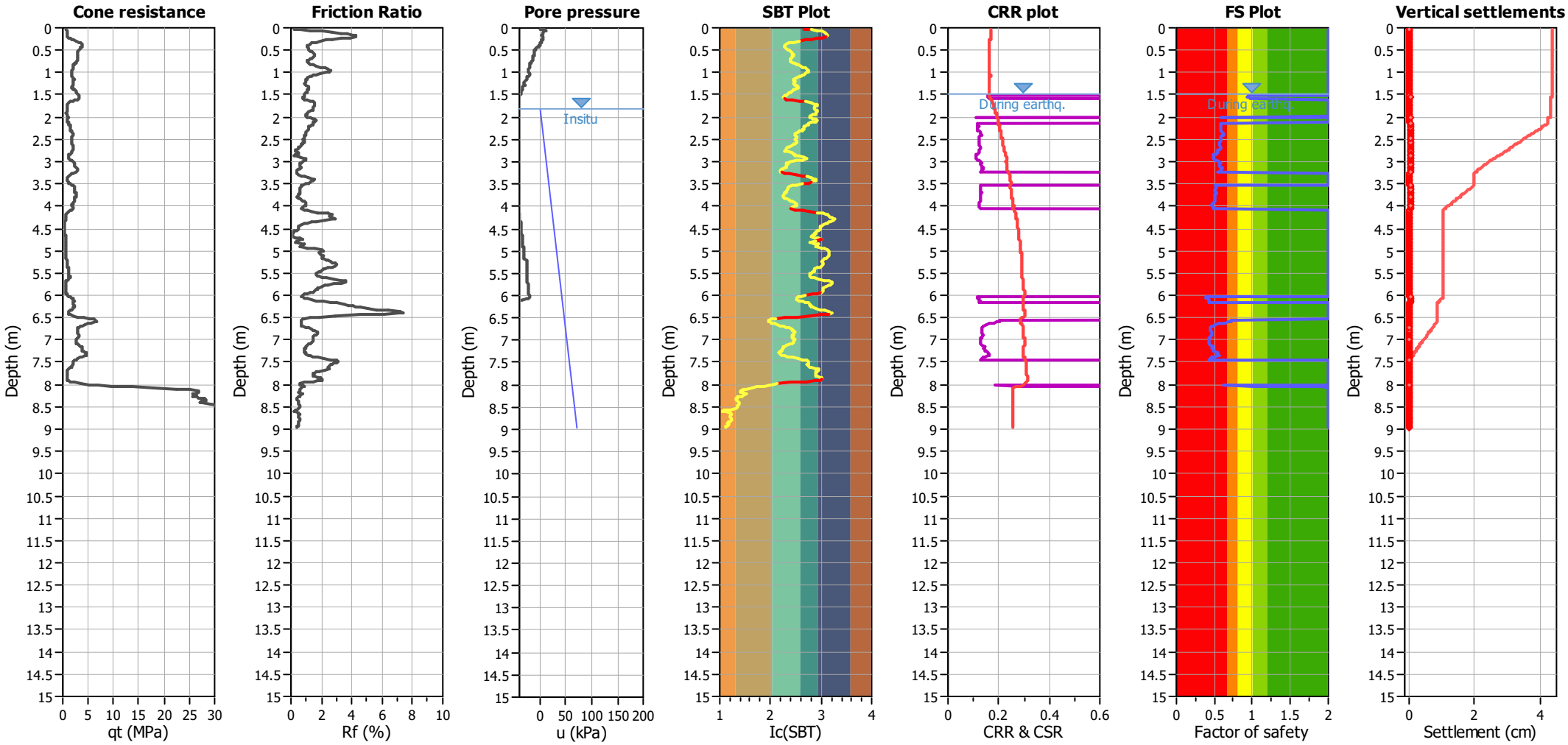
CPT: CPT87700
Total depth: 9.94 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

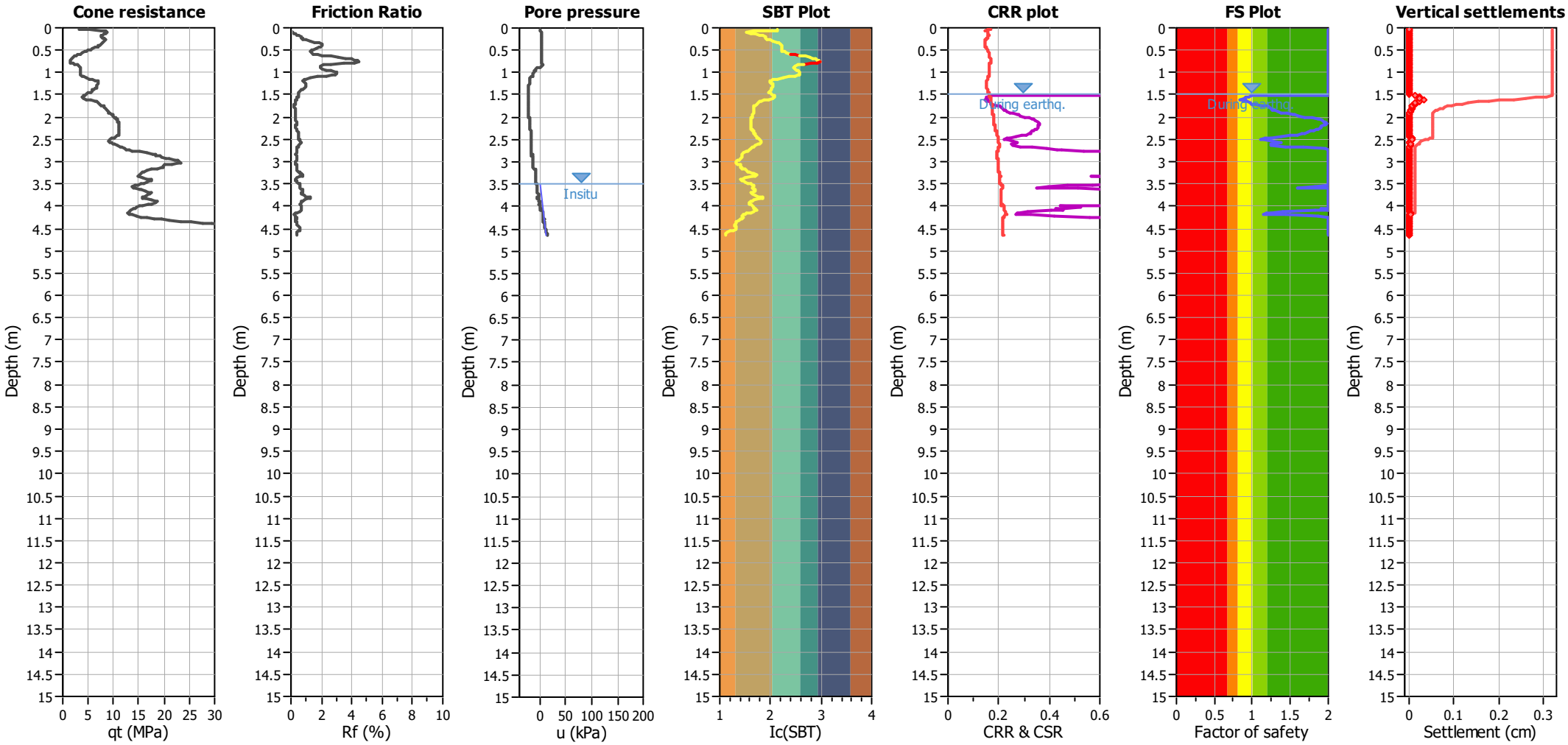
CPT: CPT87698
Total depth: 8.98 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

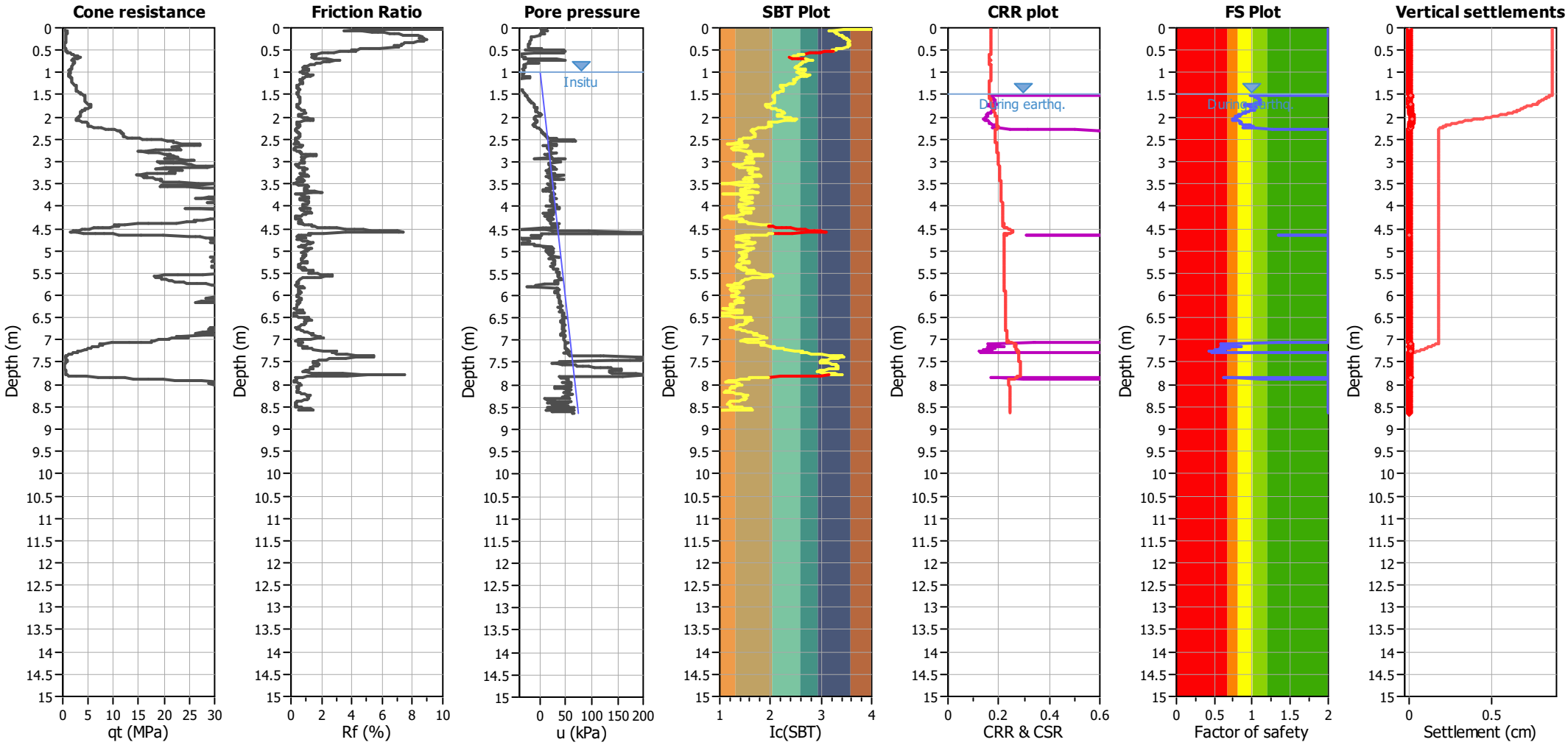
CPT: CPT87699
Total depth: 4.66 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Southerland Road, Halswell**

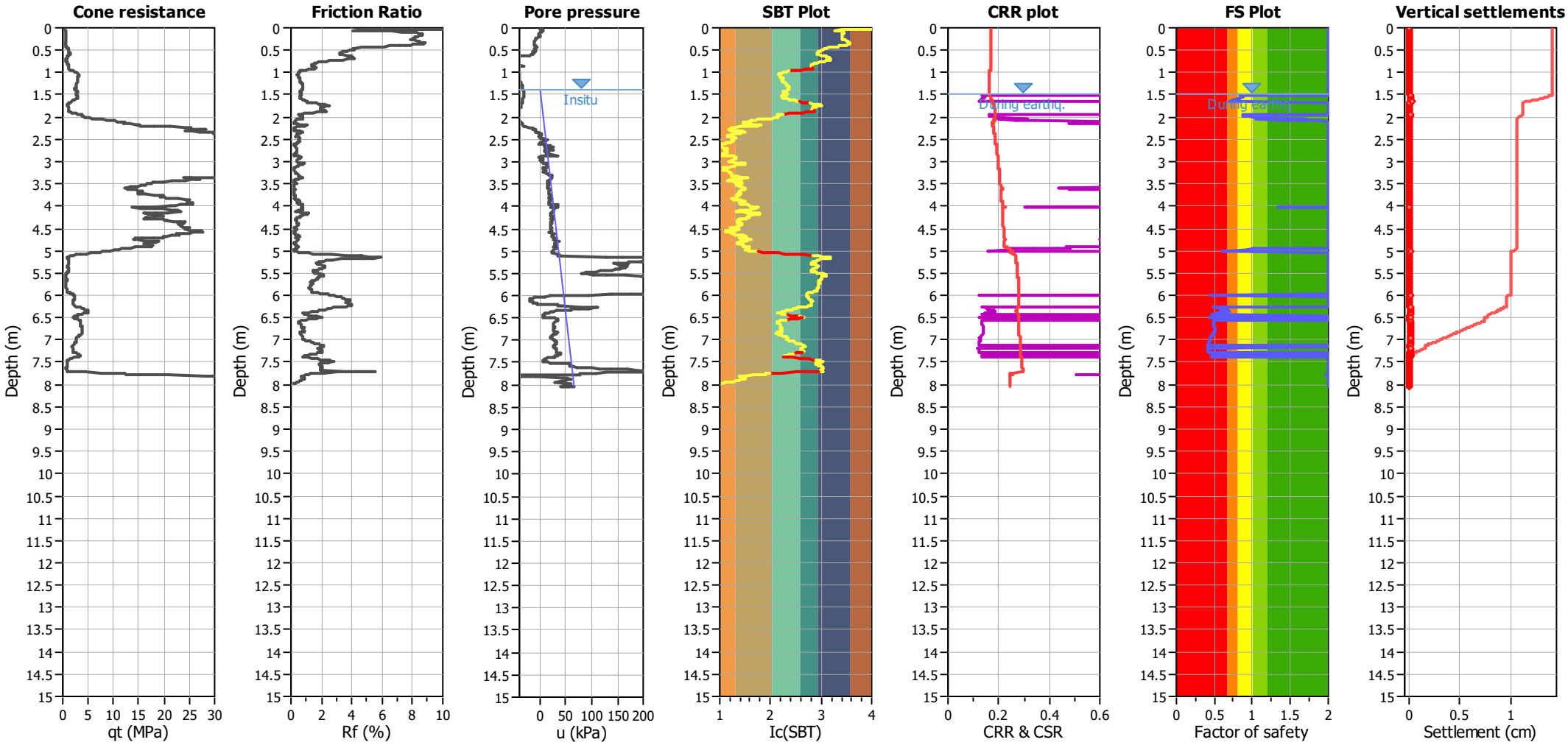
CPT: CPT88486
Total depth: 8.65 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

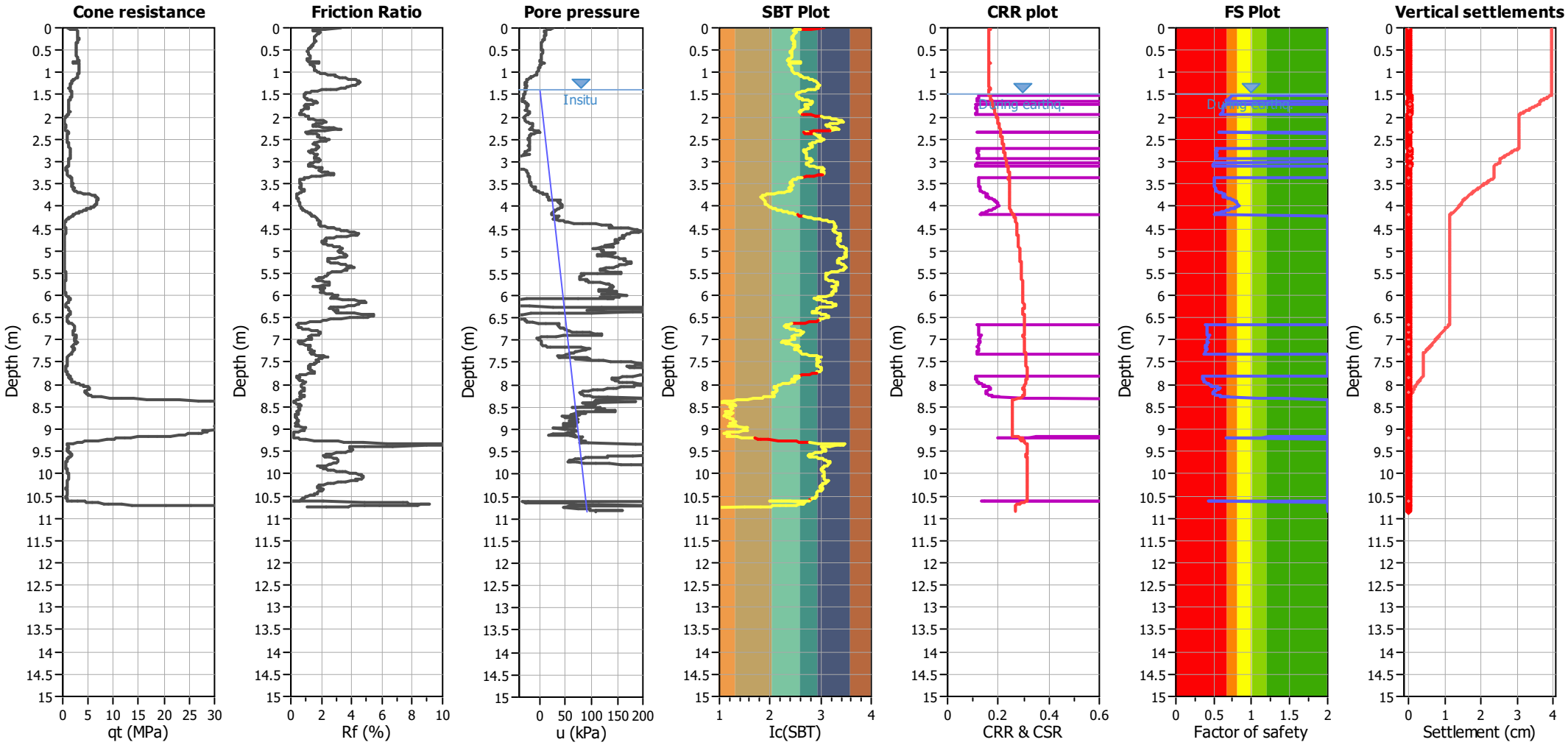
CPT: CPT88485
Total depth: 8.06 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.40 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Southerland Road, Halswell**

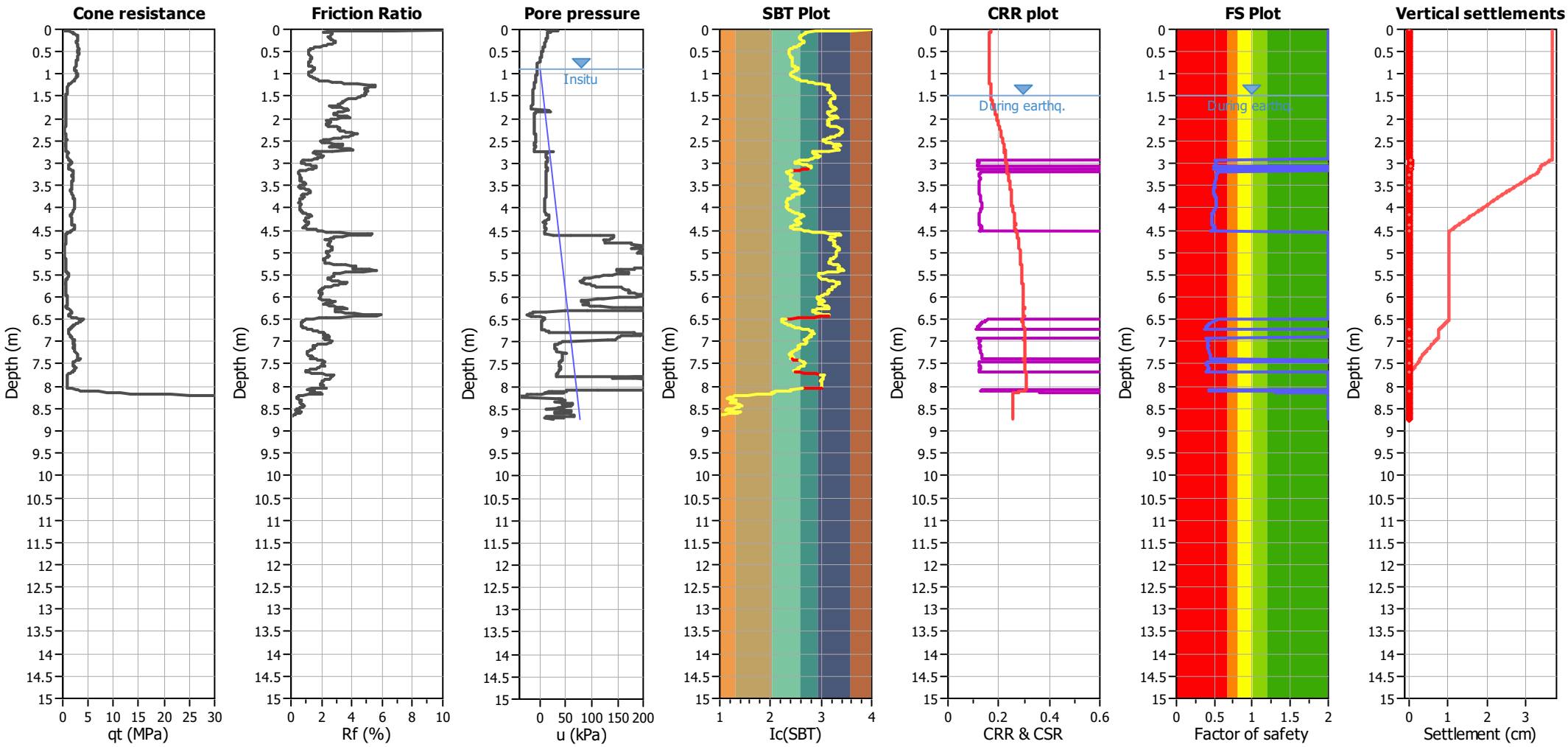
CPT: CPT_88483
Total depth: 10.83 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.40 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

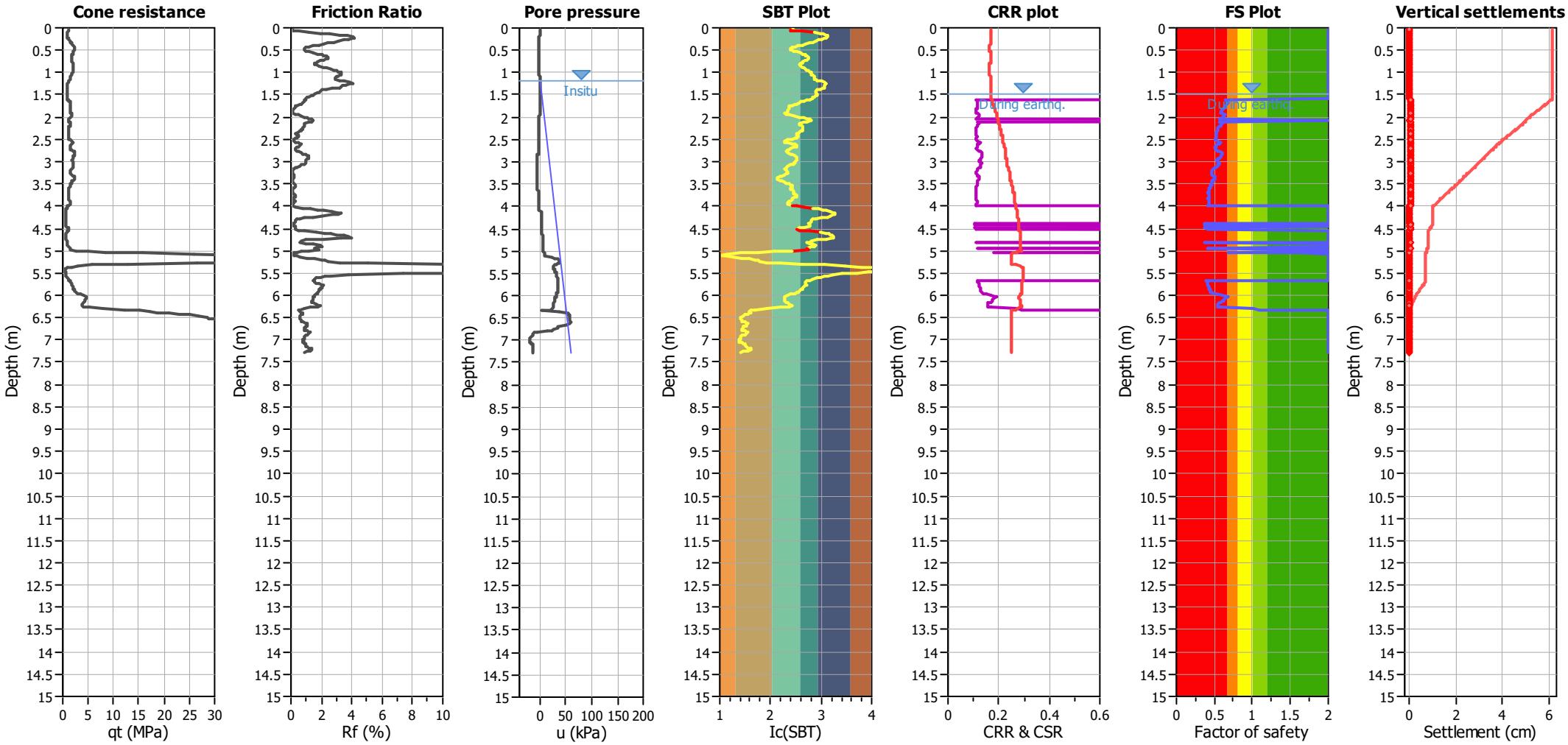
CPT: CPT_88487
Total depth: 8.74 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.90 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

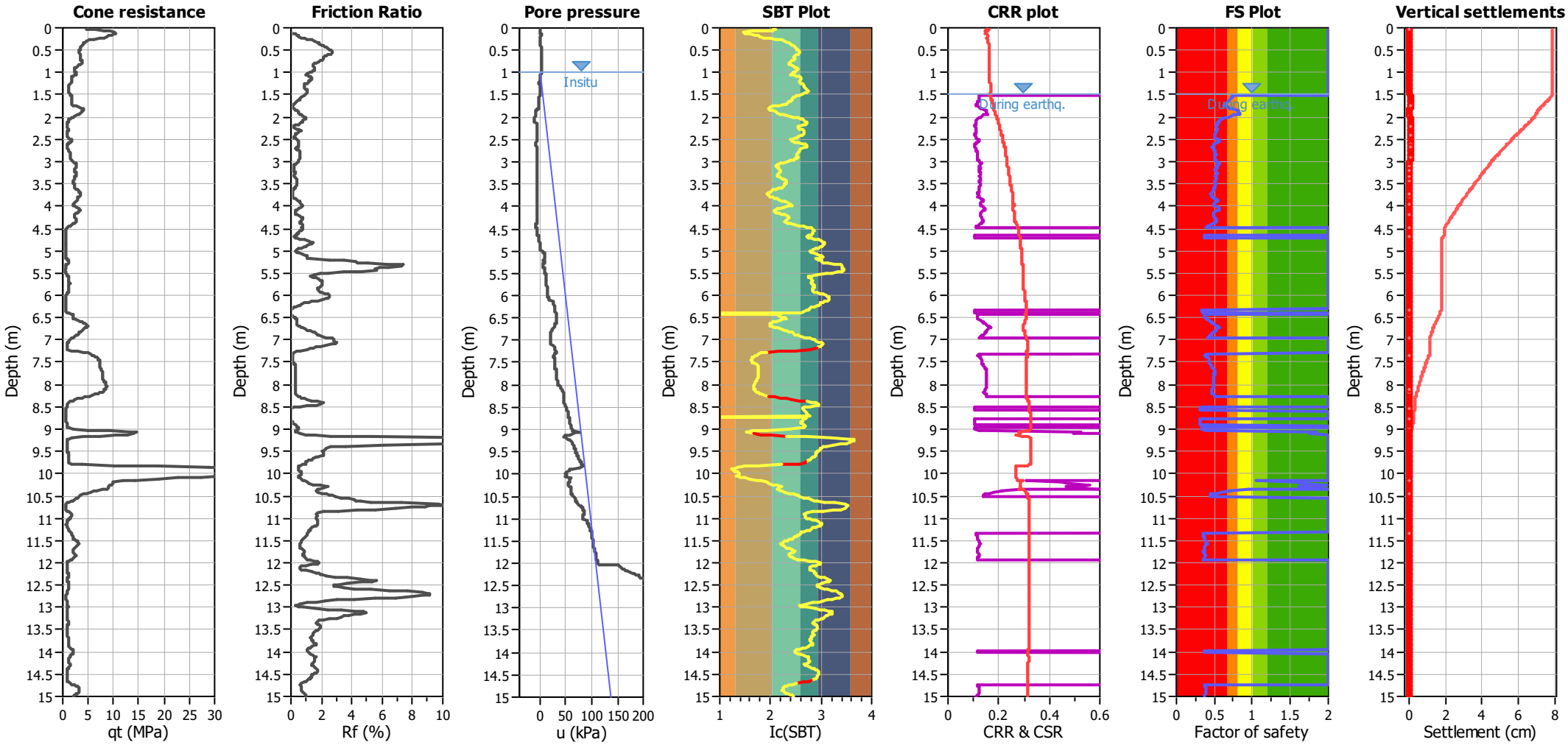
CPT: CPT_87707
Total depth: 7.28 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

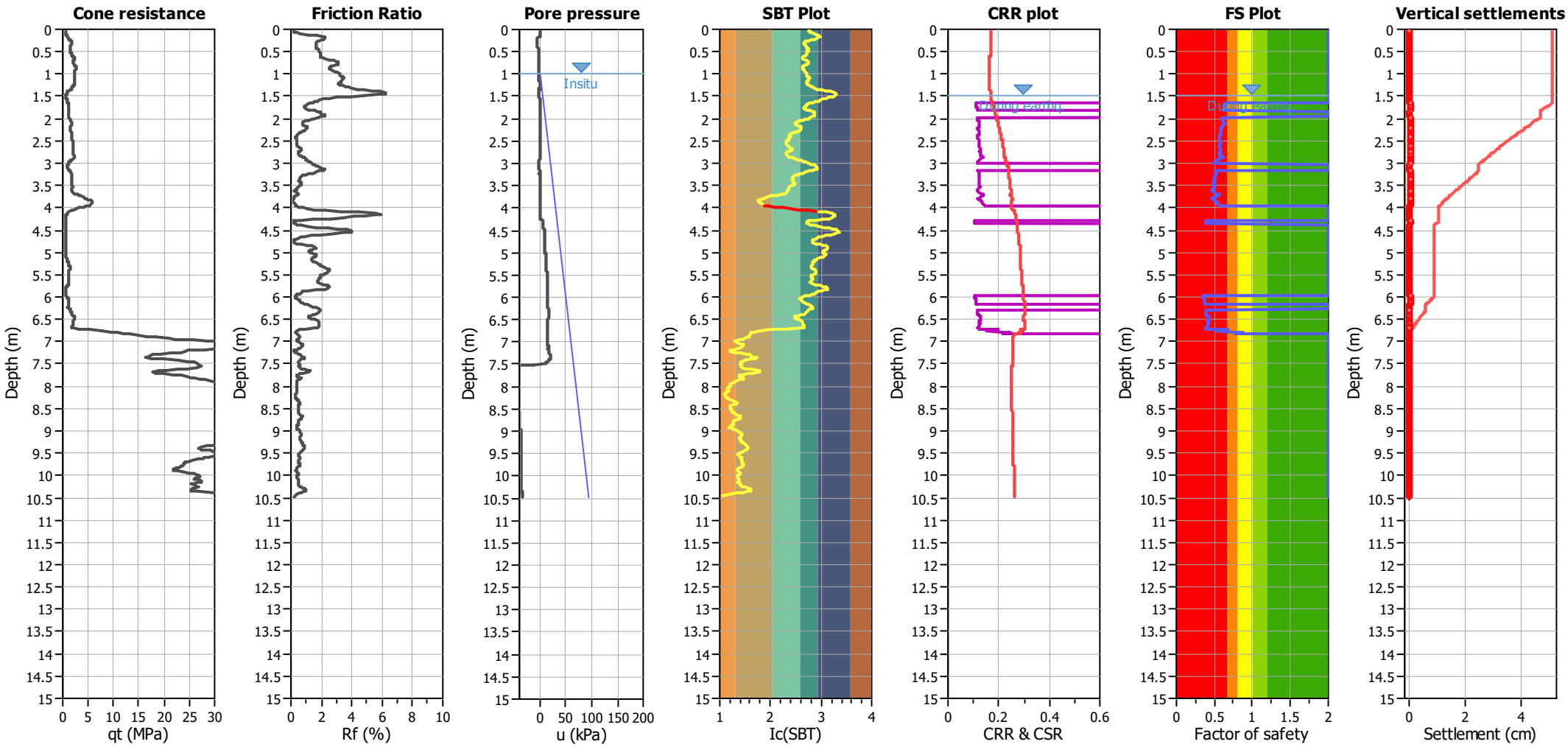
CPT: CPT_87703
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

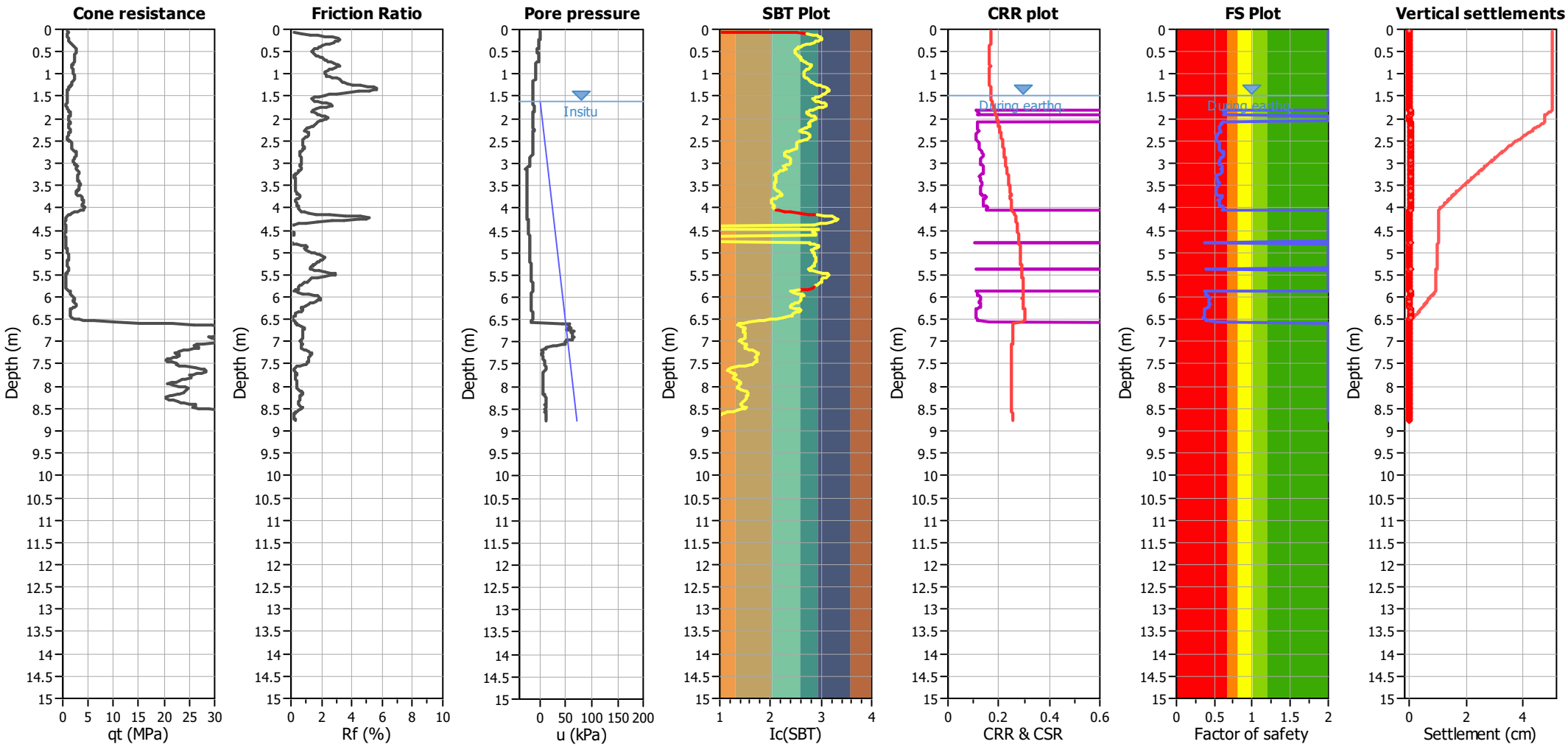
CPT: CPT_87709
Total depth: 10.48 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

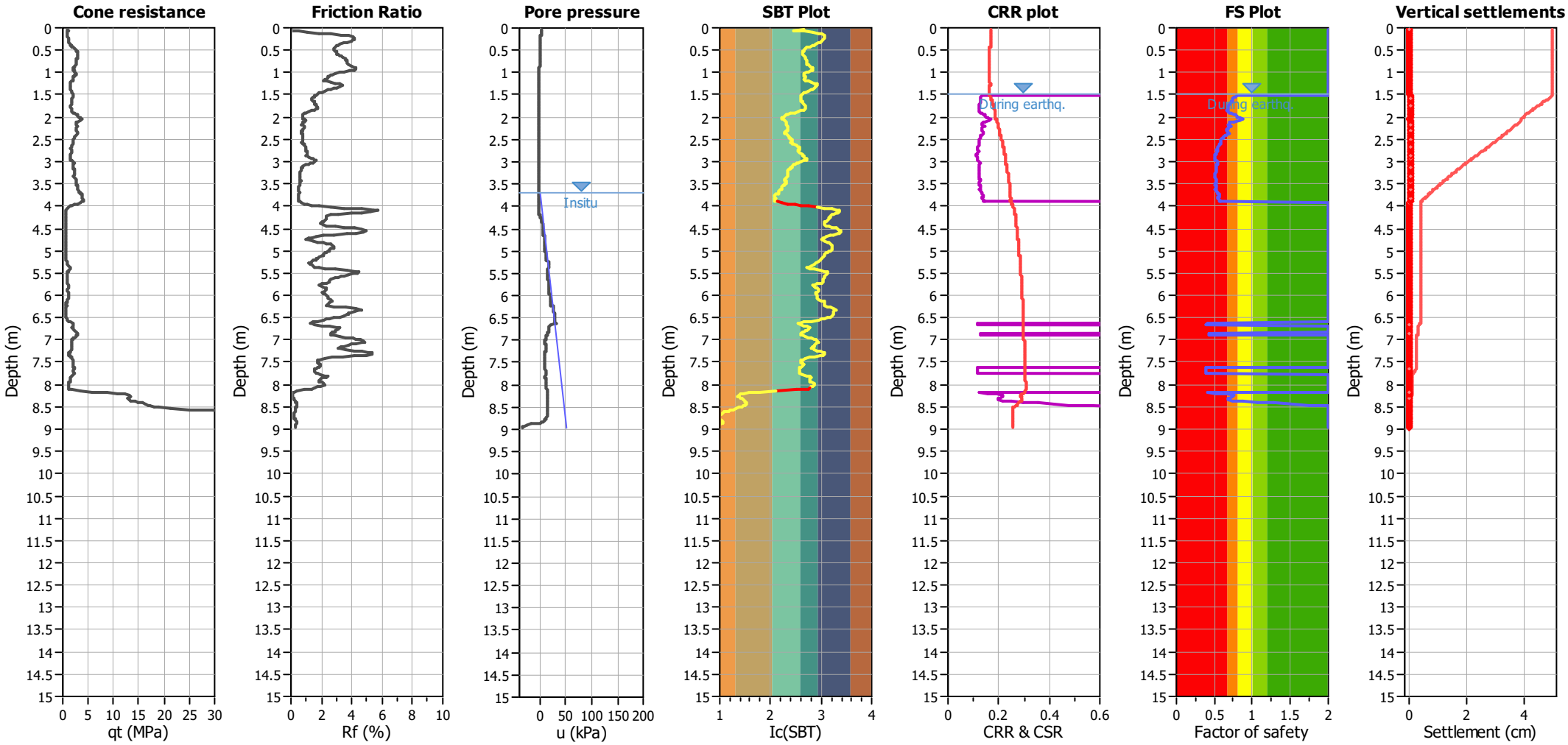
CPT: CPT_87706
Total depth: 8.76 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

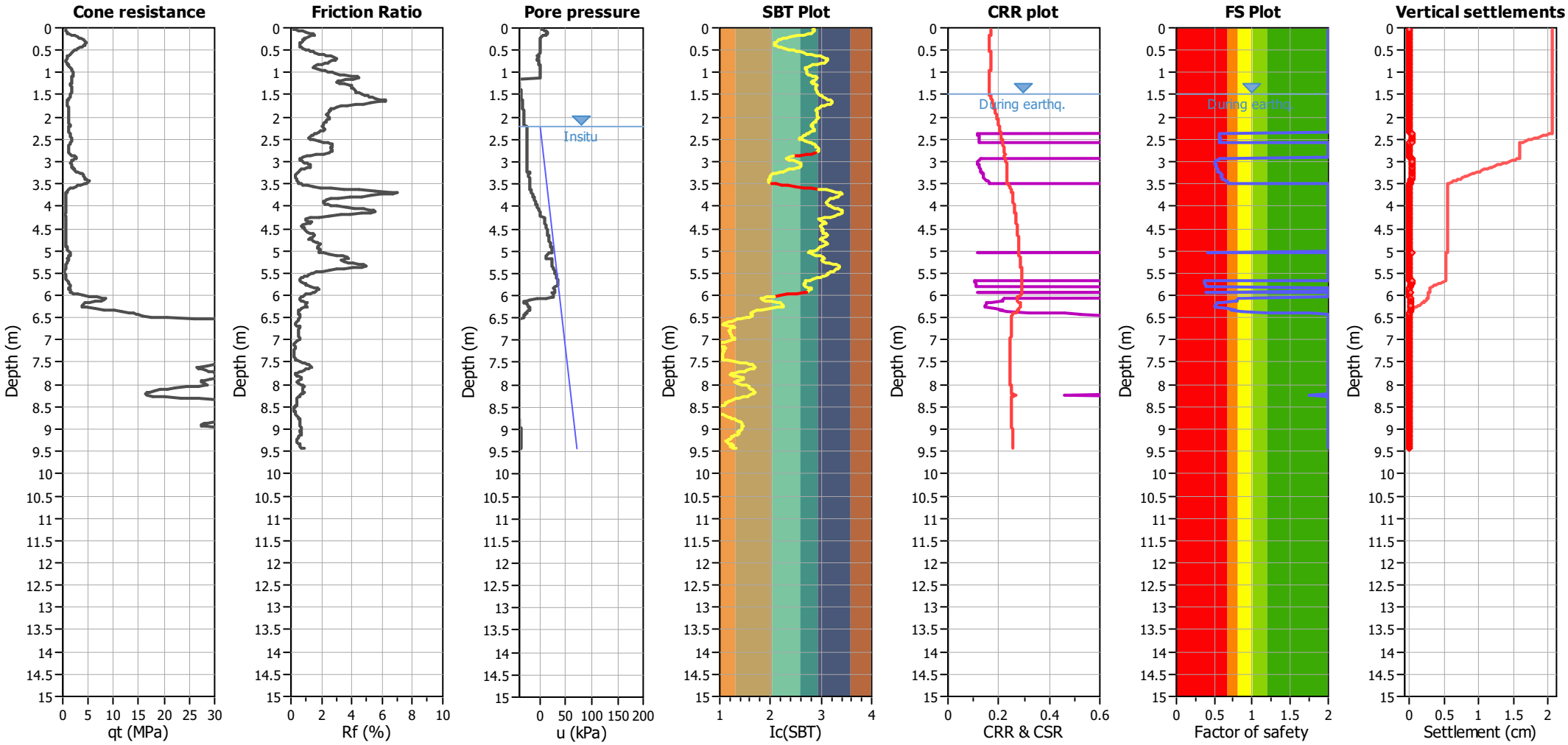
CPT: CPT_87705
Total depth: 8.96 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

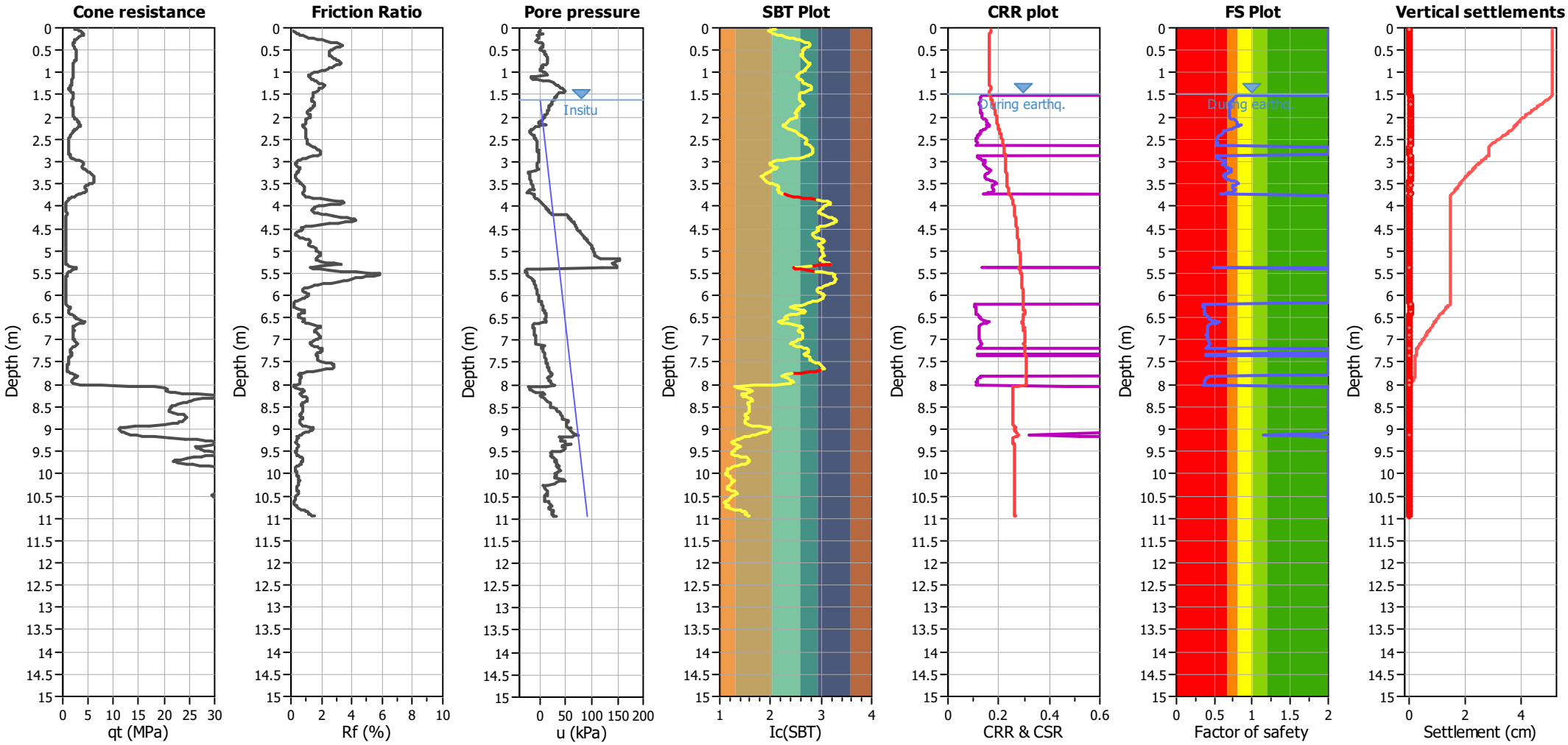
CPT: CPT_87708
Total depth: 9.44 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

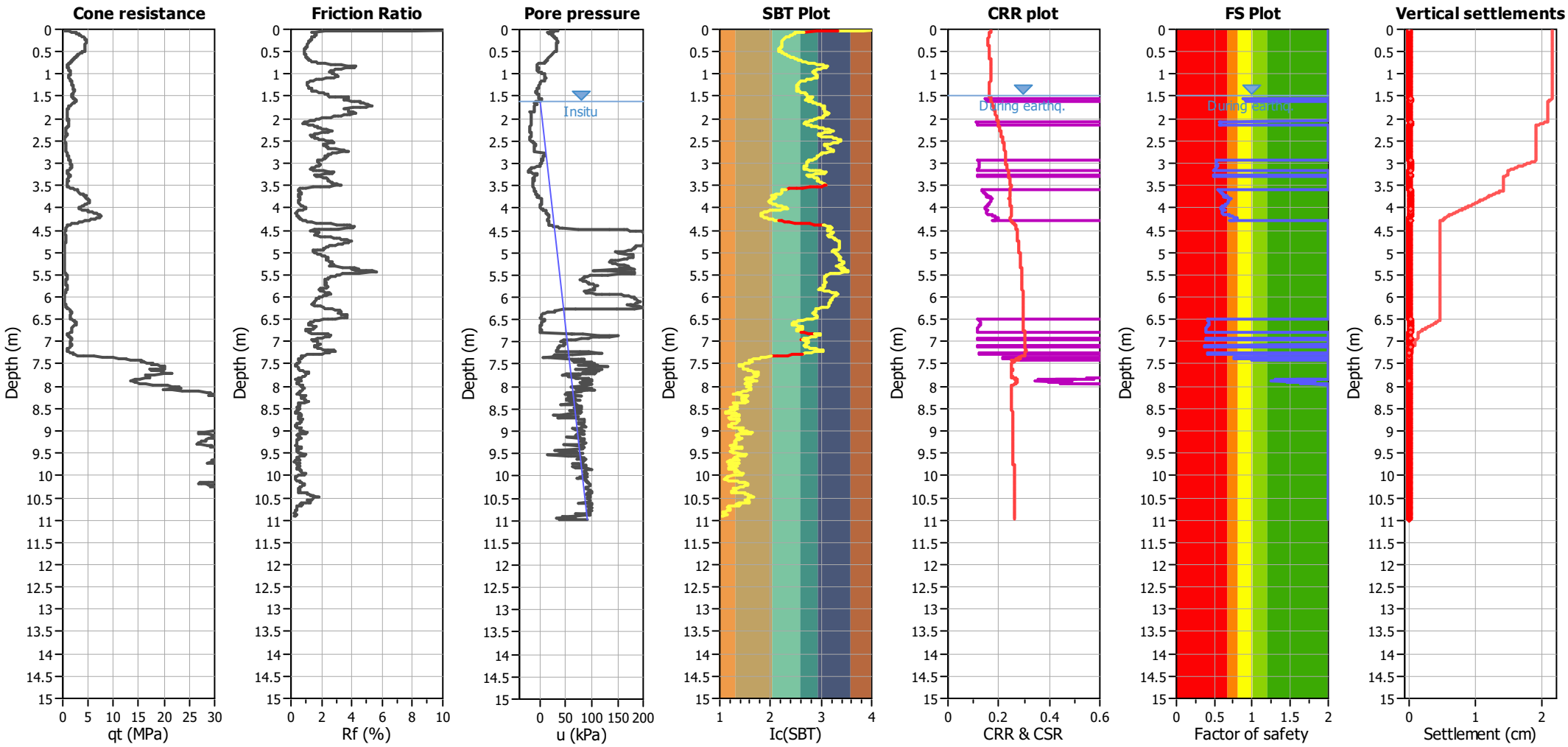
CPT: CPT_87704
Total depth: 10.96 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

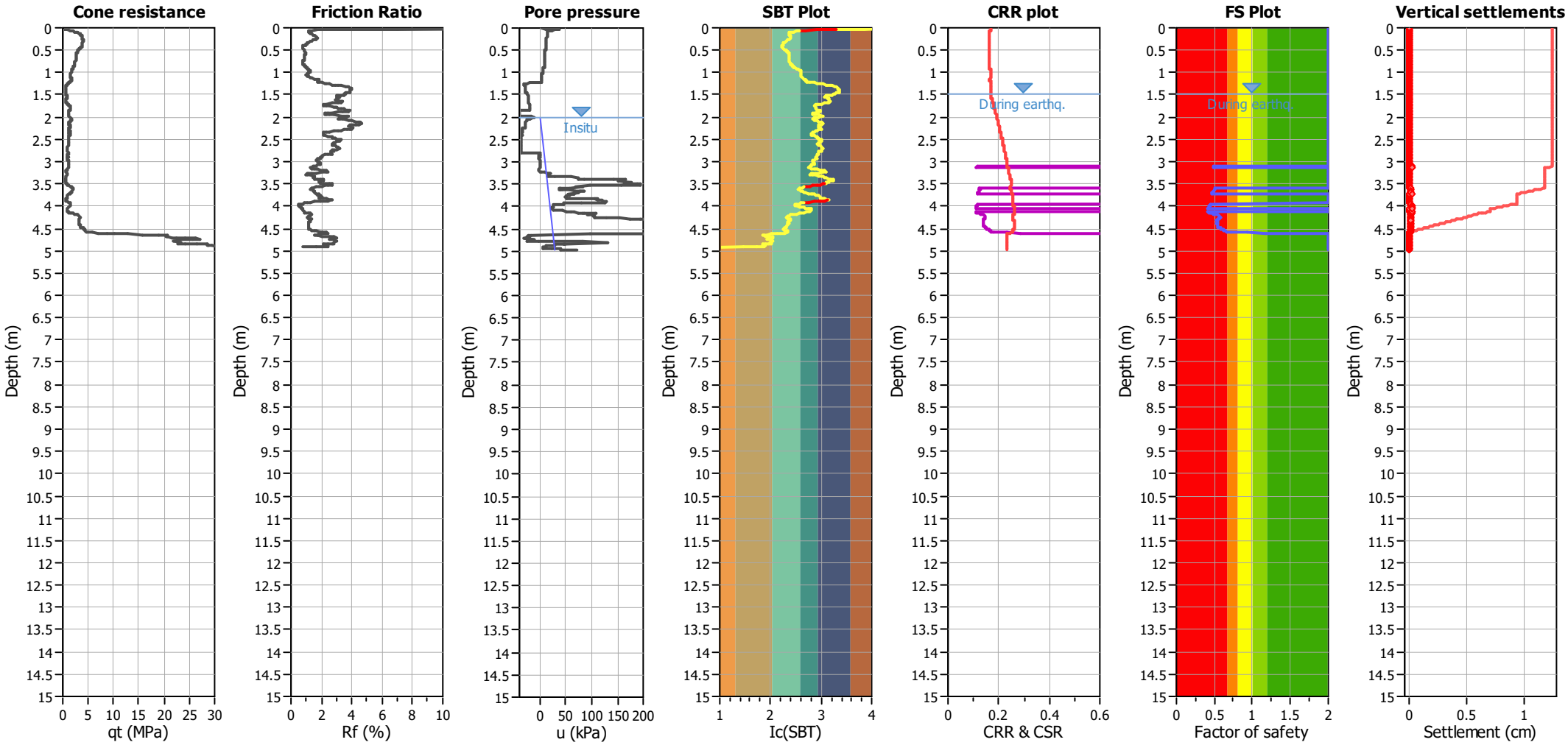
CPT: CPT_88488
Total depth: 10.98 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

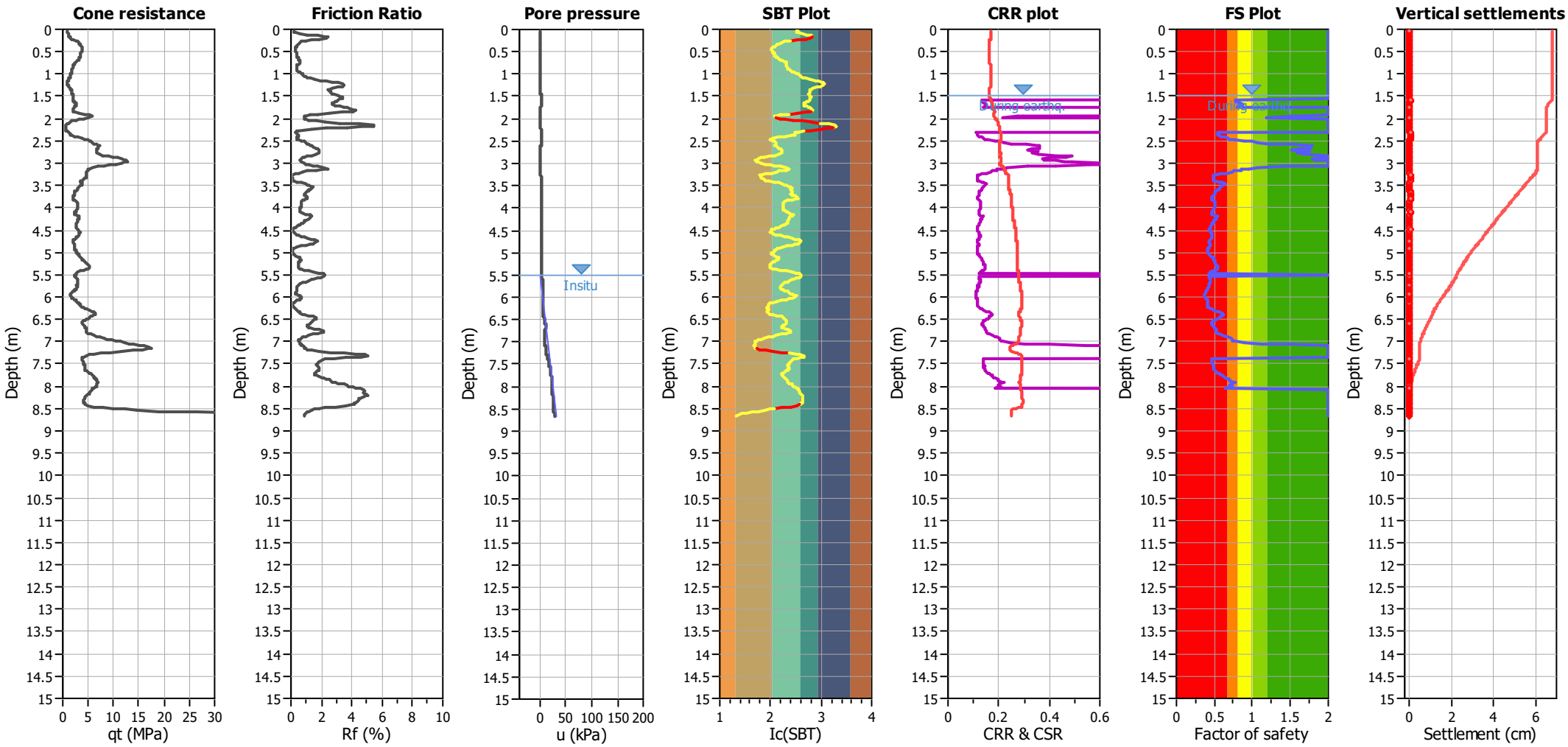
CPT: CPT_88482
Total depth: 4.99 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

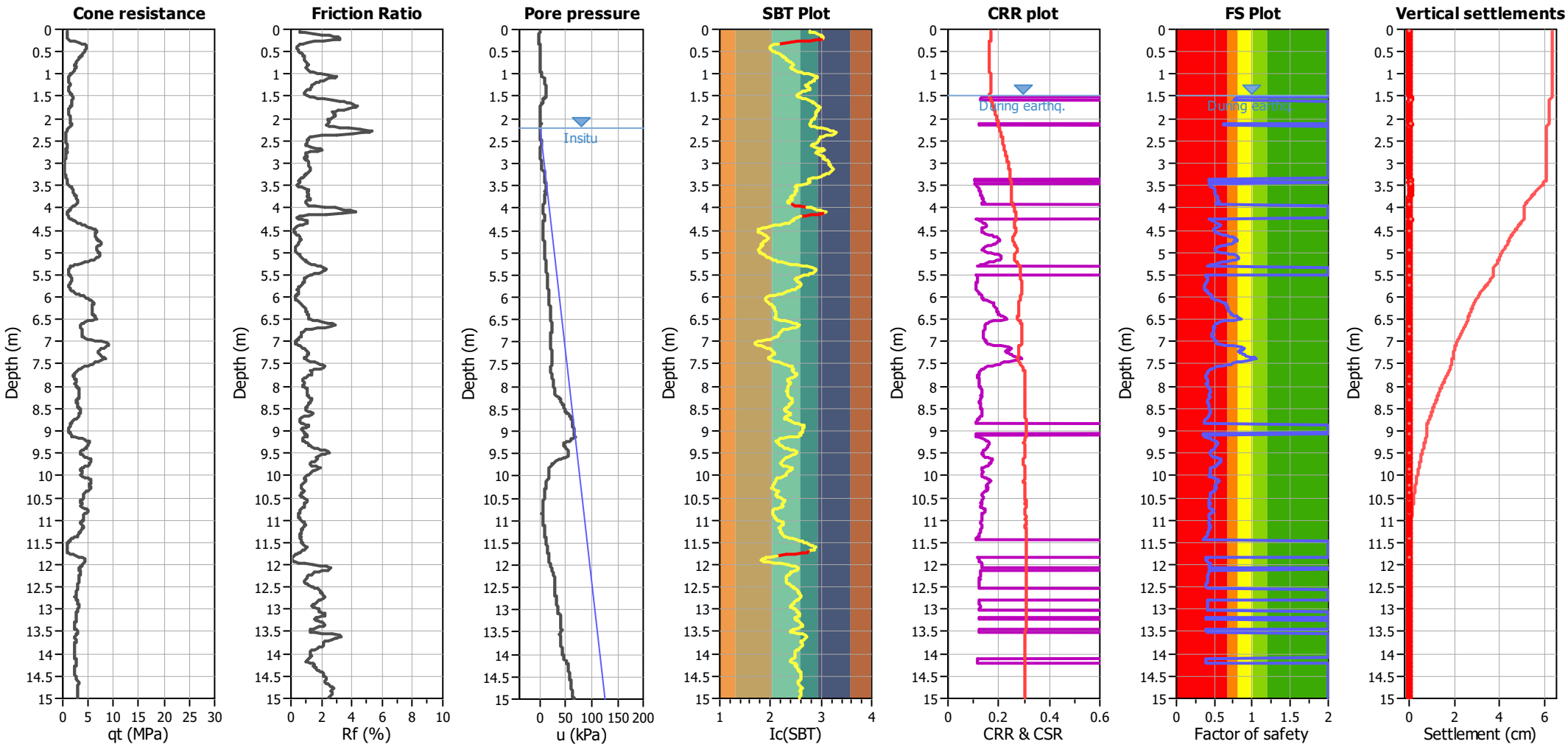
CPT: CPT_87715
Total depth: 8.66 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	5.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

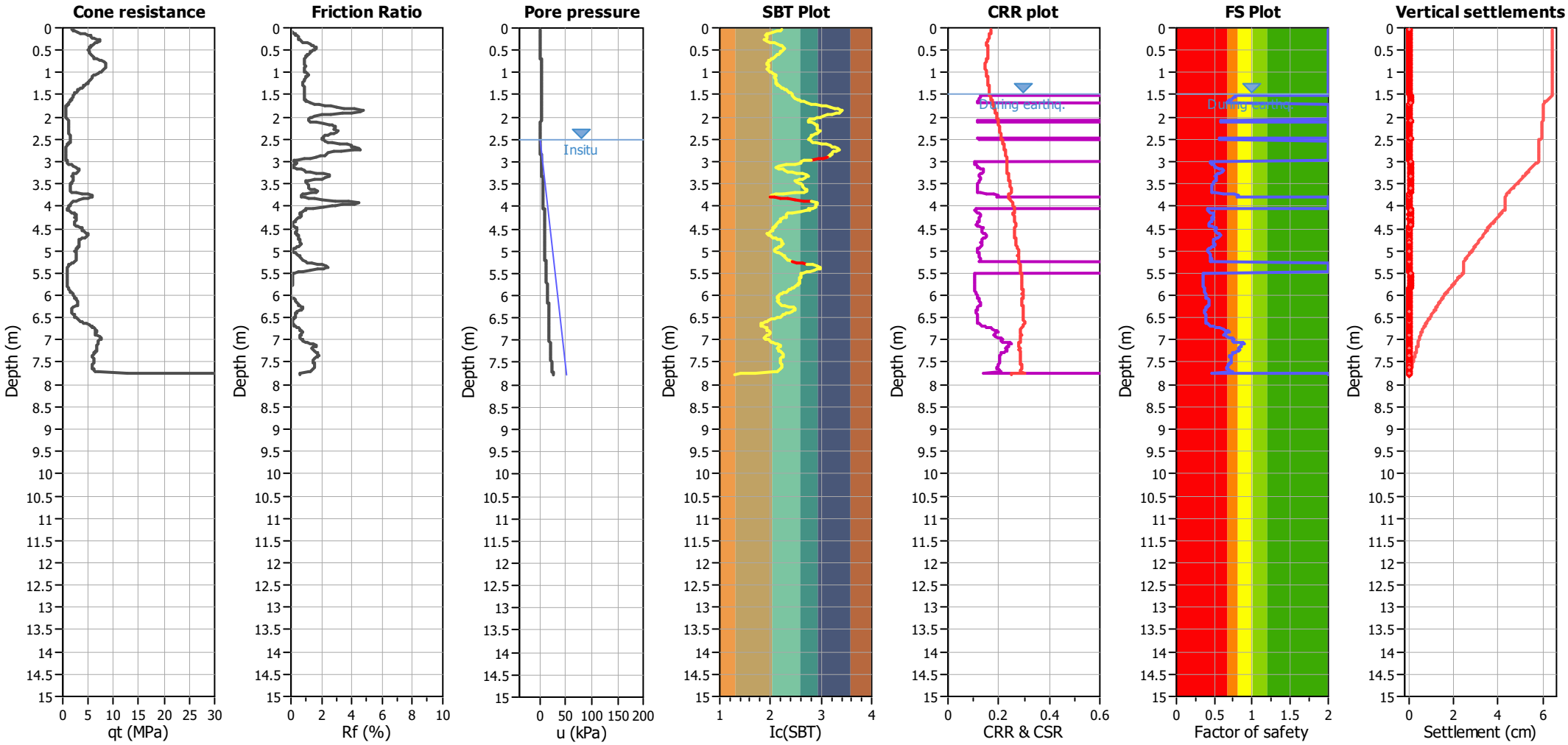
CPT: CPT_87714
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

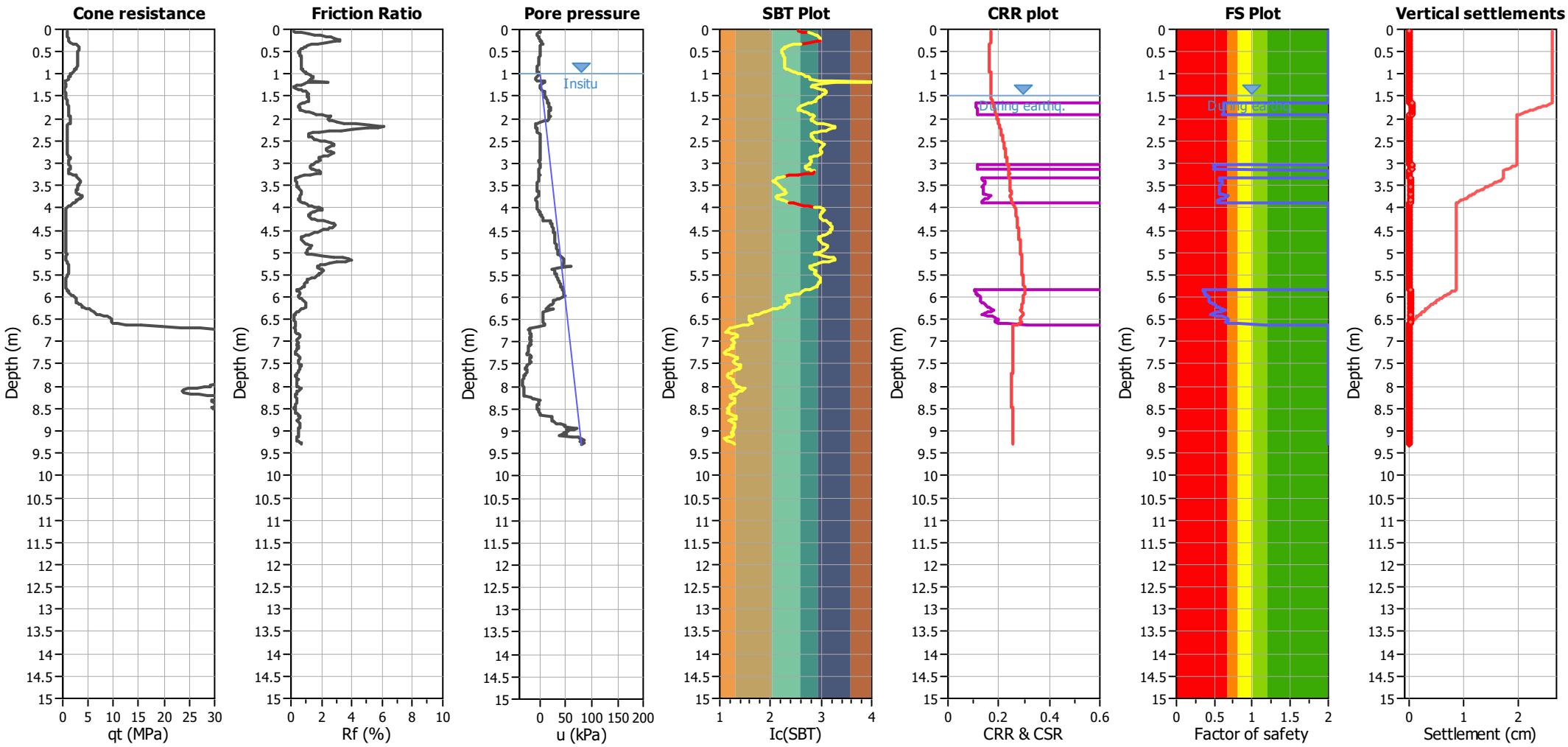
CPT: CPT_87713
Total depth: 7.78 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

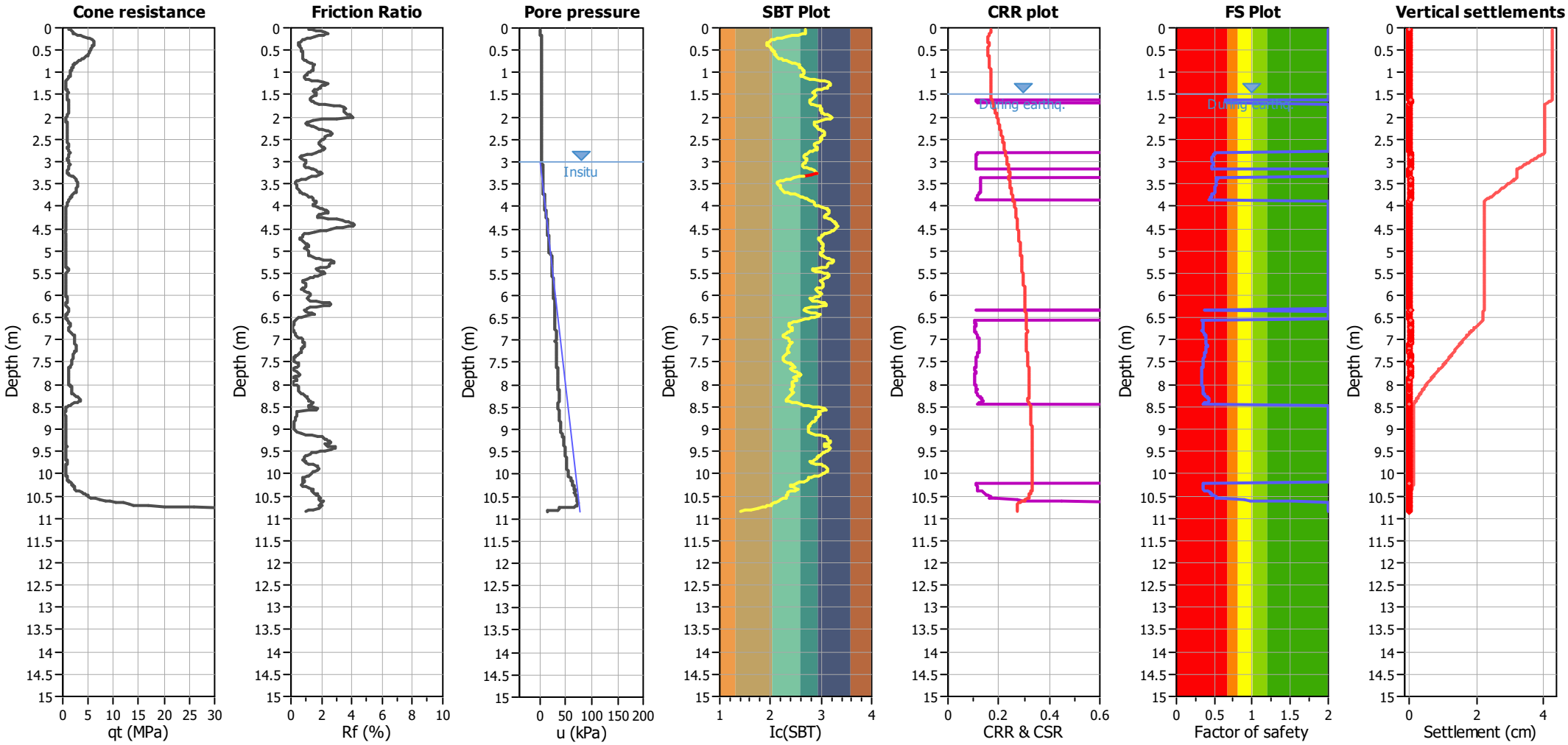
CPT: CPT_87712
Total depth: 9.30 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: MINZ190017 - Cashemere and Sutherlands Road, Halswell Subdivision
Location: Cashmere and Southerland Road, Halswell

CPT: CPT_87710
Total depth: 10.84 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.29	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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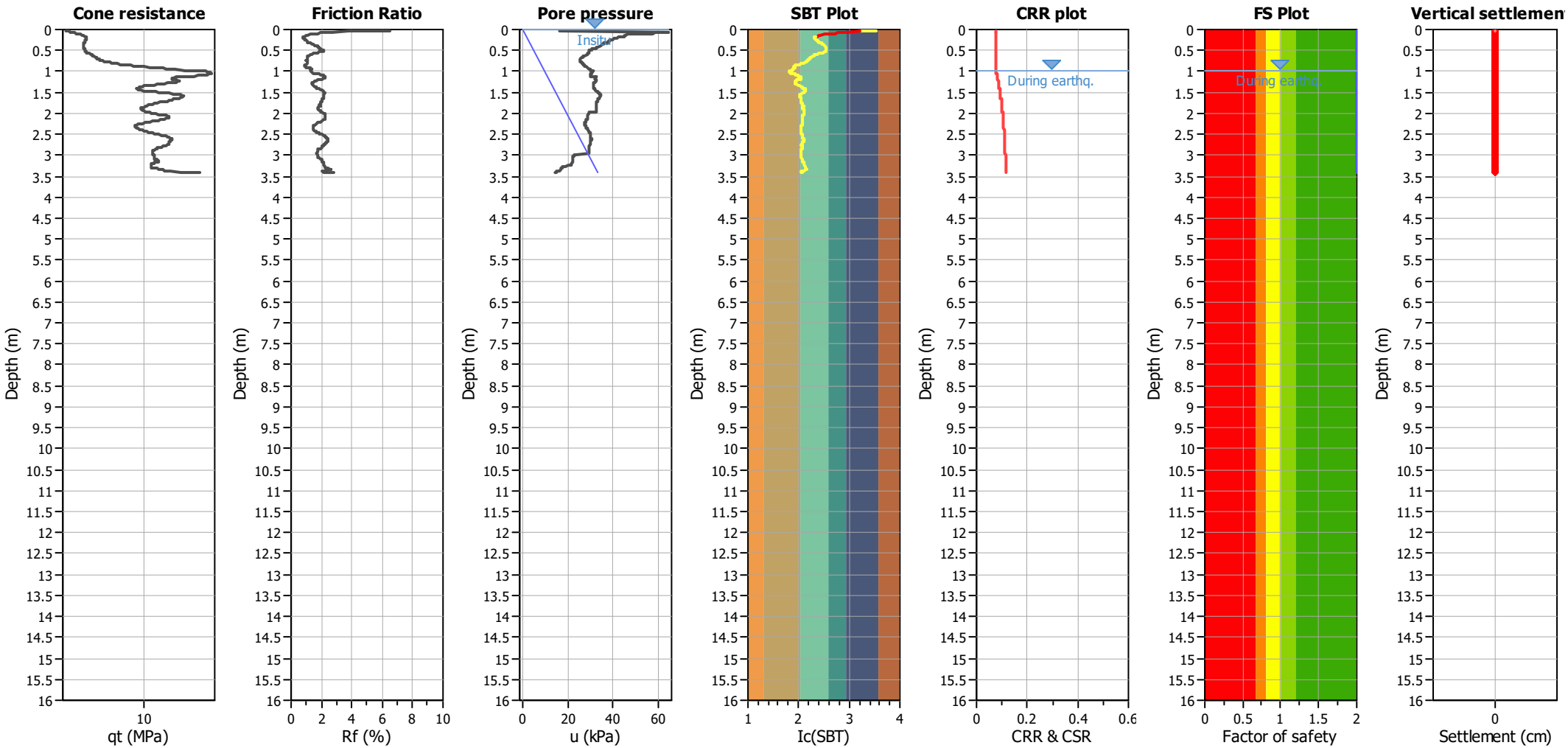
Project: 190017
Location: Cashmere & Sutherlands Road Subdivision, Halswell

CPT: CPT-01
Total depth: 3.42 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	10.00 m
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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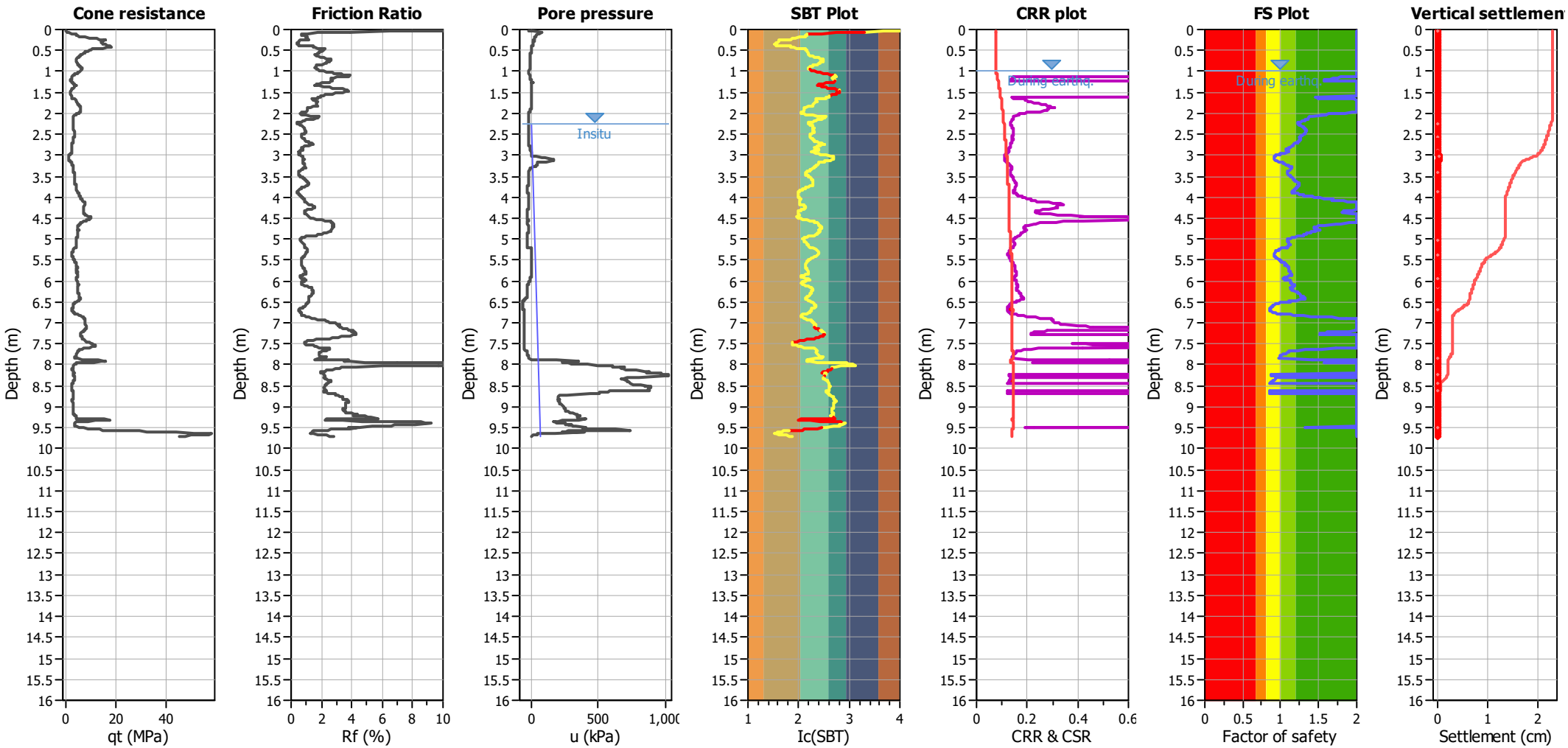
Project: 190017
Location: Cashmere & Sutherlands Road Subdivision, Halswell

CPT: CPT-02
Total depth: 9.71 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.26 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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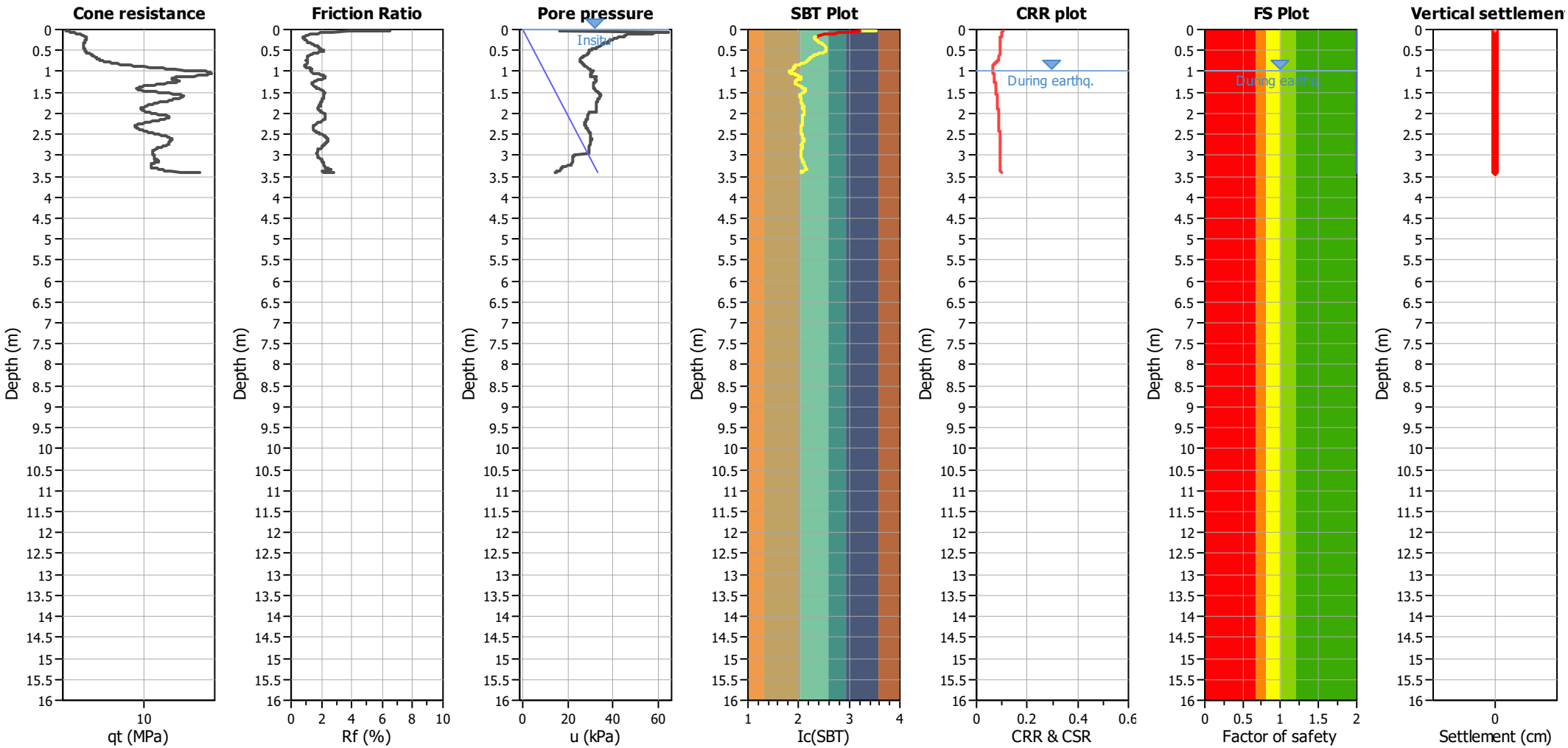
Project: 190017
Location: Cashmere & Sutherlands Road Subdivision, Halswell

CPT: CPT-01
Total depth: 3.42 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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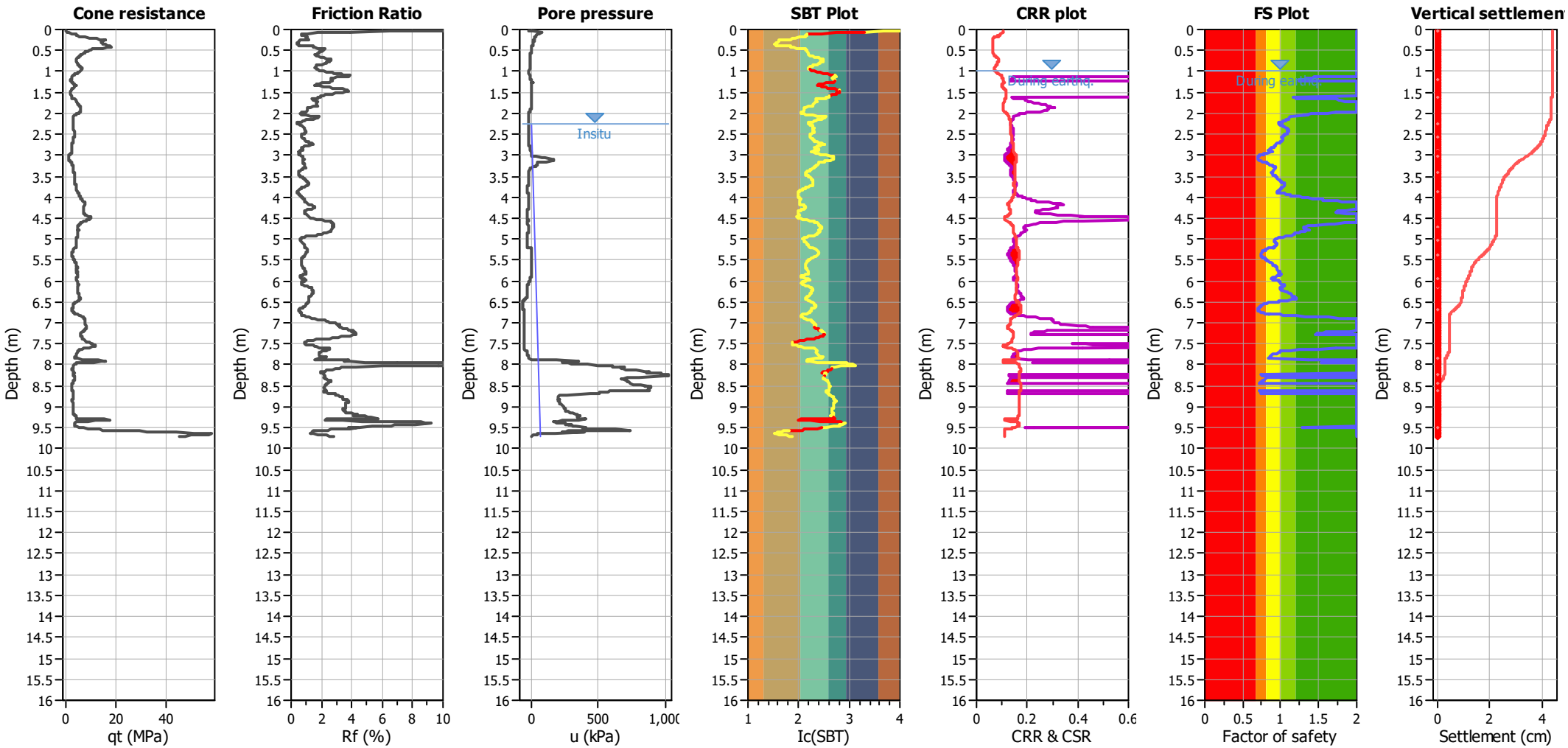
Project: 190017
Location: Cashmere & Sutherlands Road Subdivision, Halswell

CPT: CPT-02
Total depth: 9.71 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.26 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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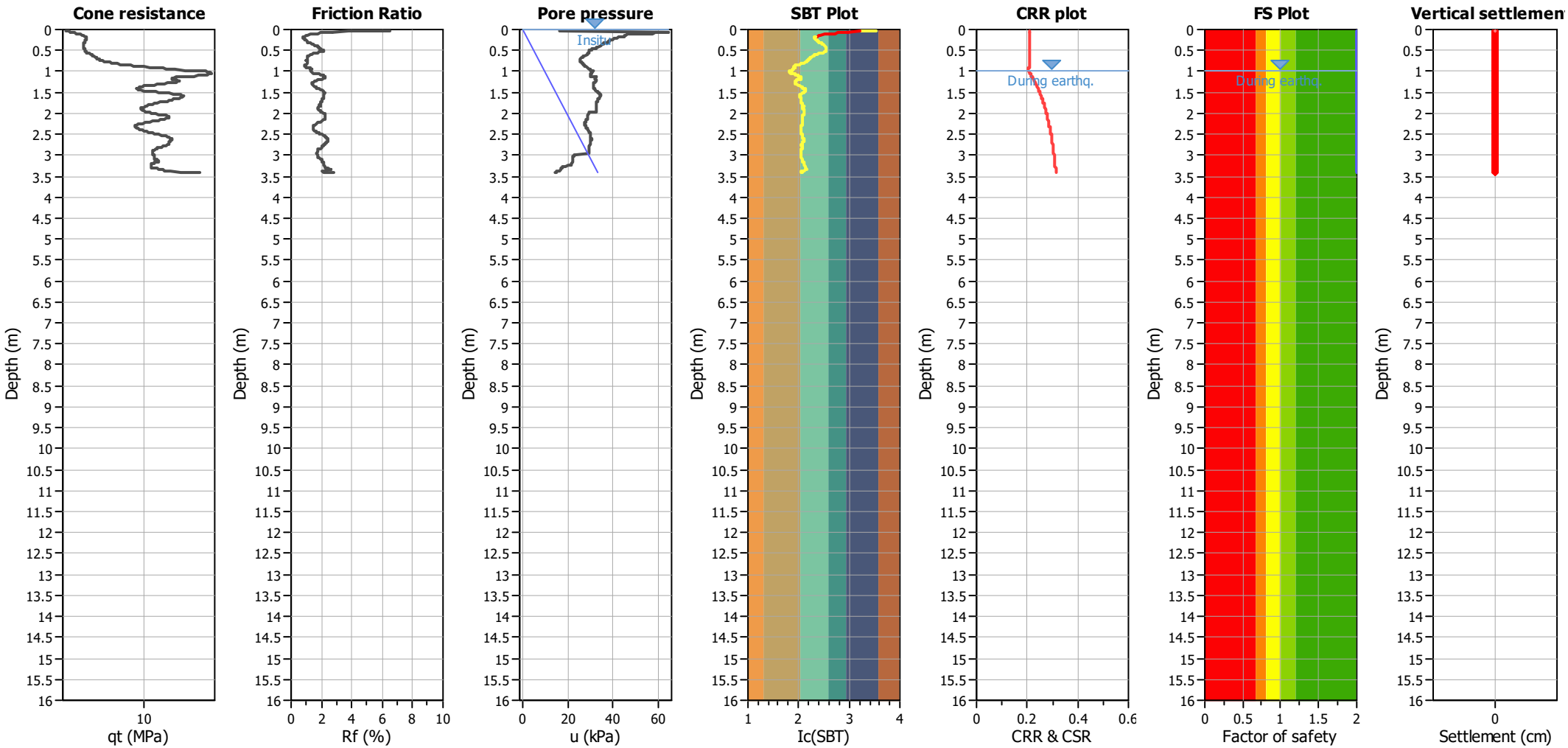
Project: 190017
Location: Cashmere & Sutherlands Road Subdivision, Halswell

CPT: CPT-01
Total depth: 3.42 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	10.00 m
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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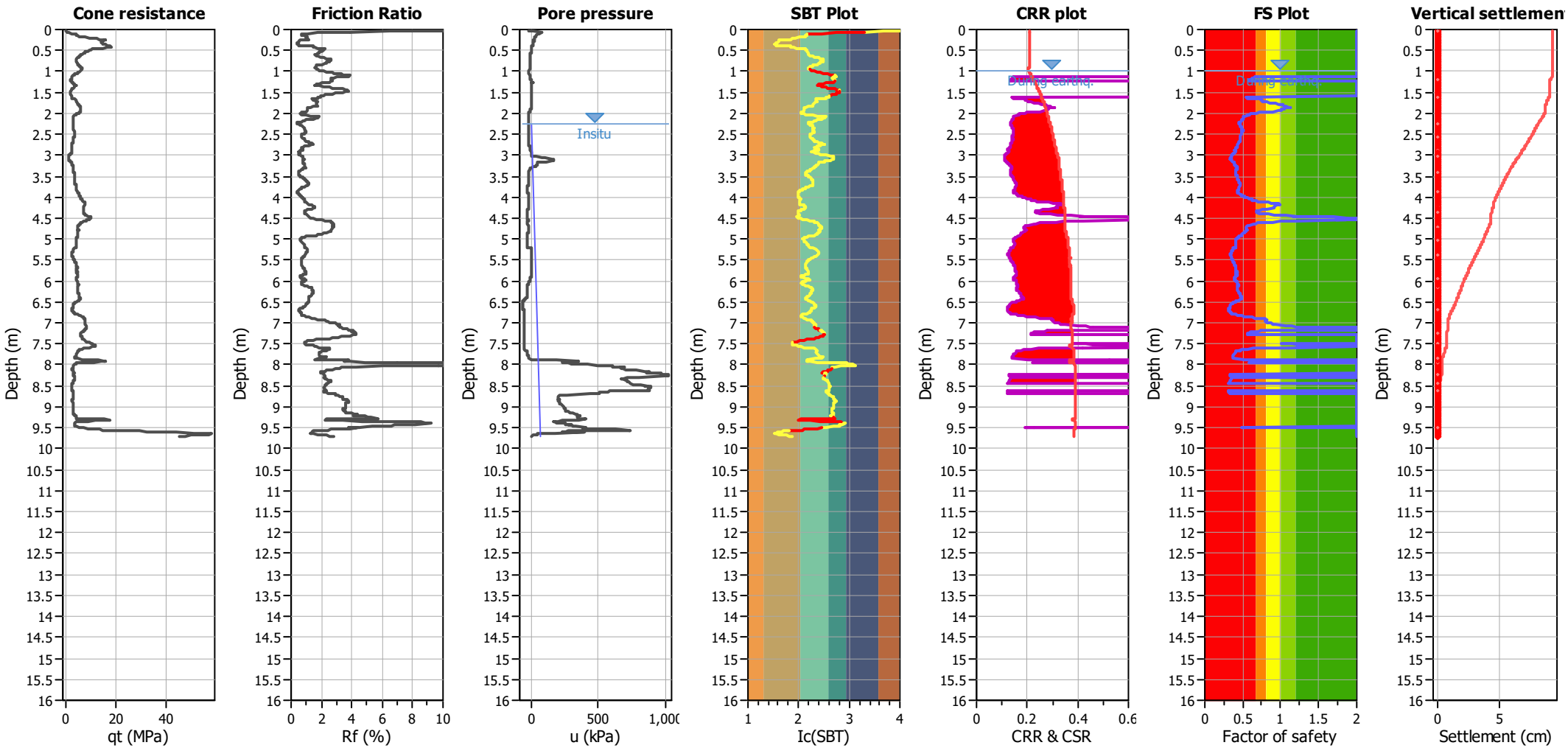
Project: 190017
Location: Cashmere & Sutherlands Road Subdivision, Halswell

CPT: CPT-02
Total depth: 9.71 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.26 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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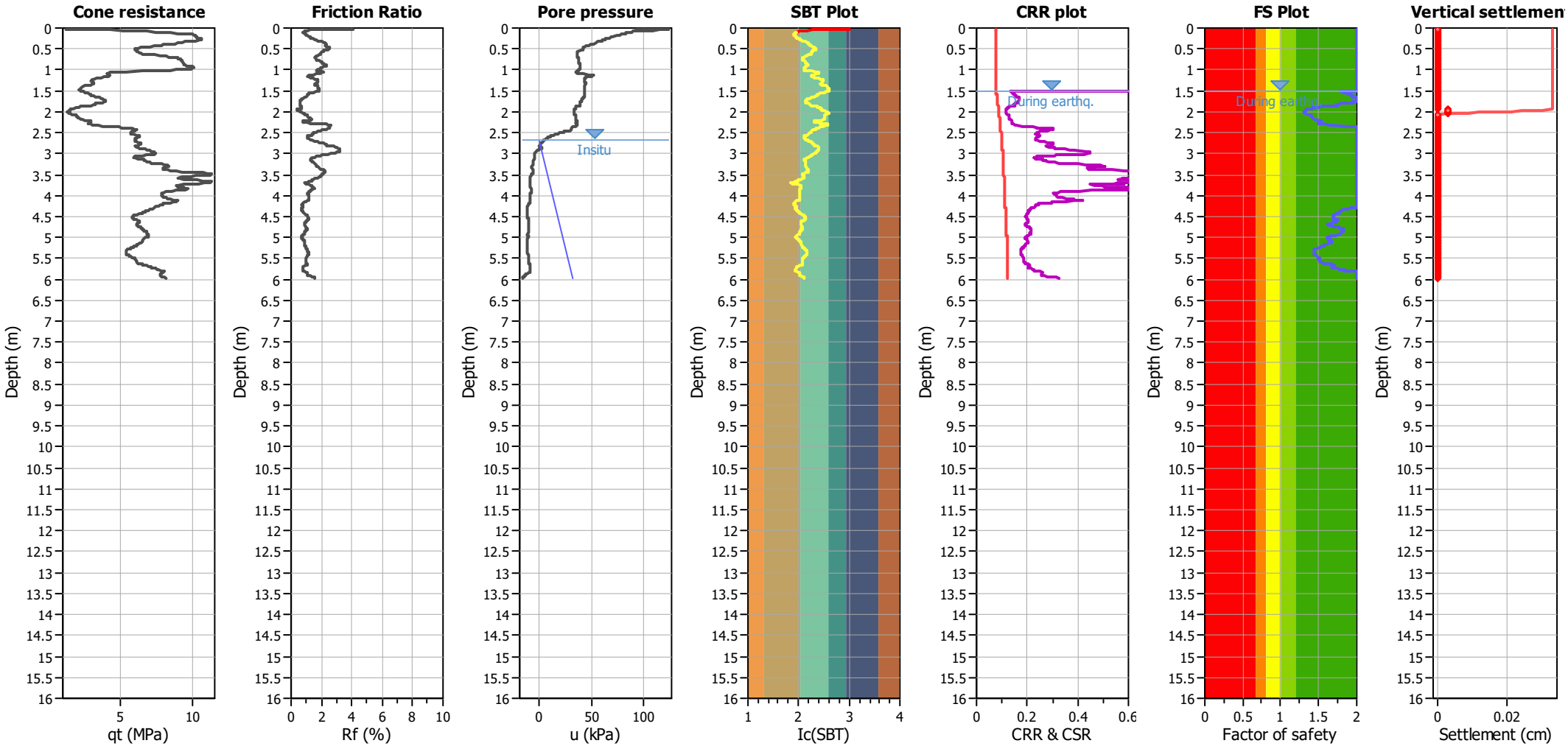
Project: **MINZ190017 - Cashmere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Sutherland Road, Halswell**

CPT: SCPT-04
Total depth: 5.97 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.68 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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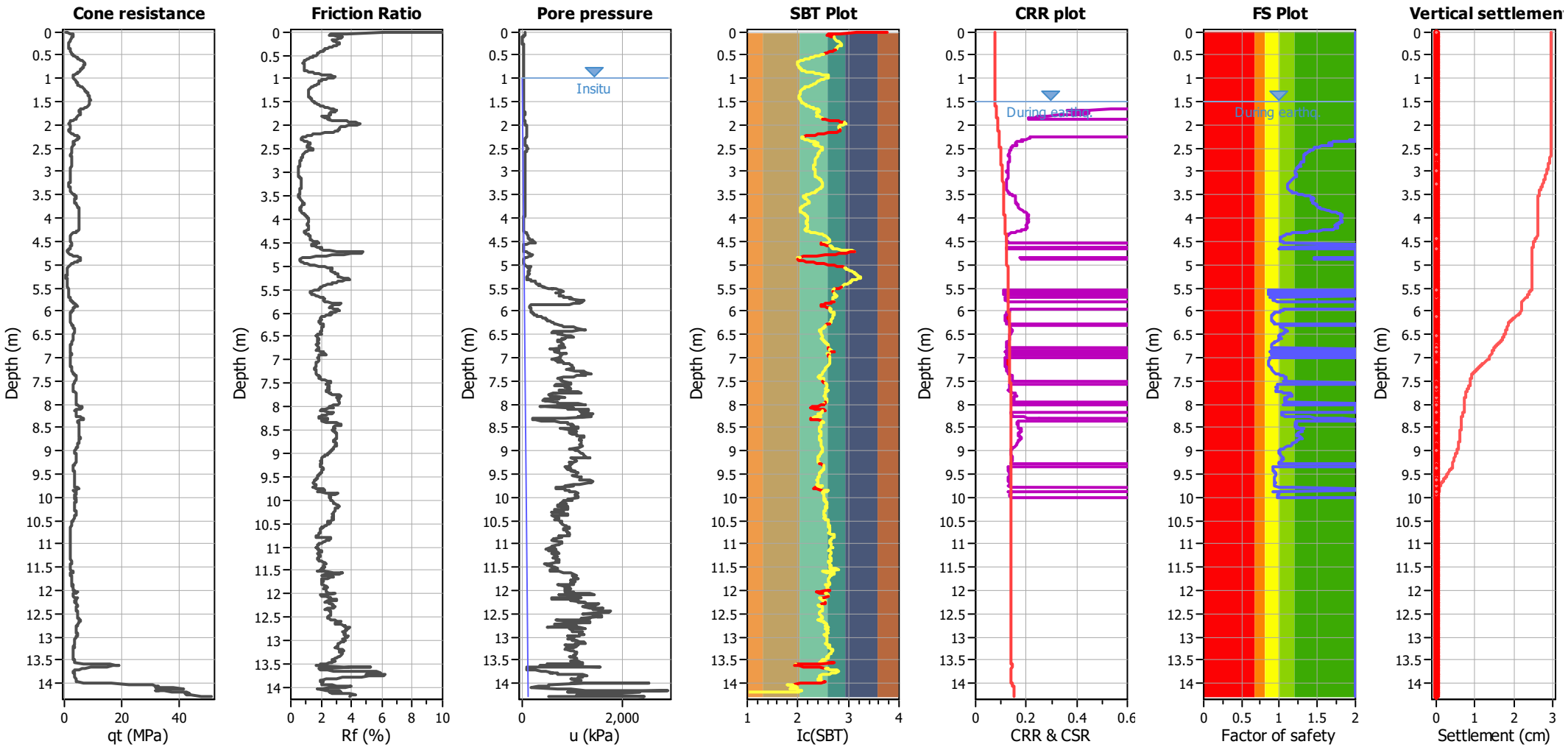
Project: **MINZ190017 - Cashmere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Sutherland Road, Halswell**

CPT: CPT-03
Total depth: 14.28 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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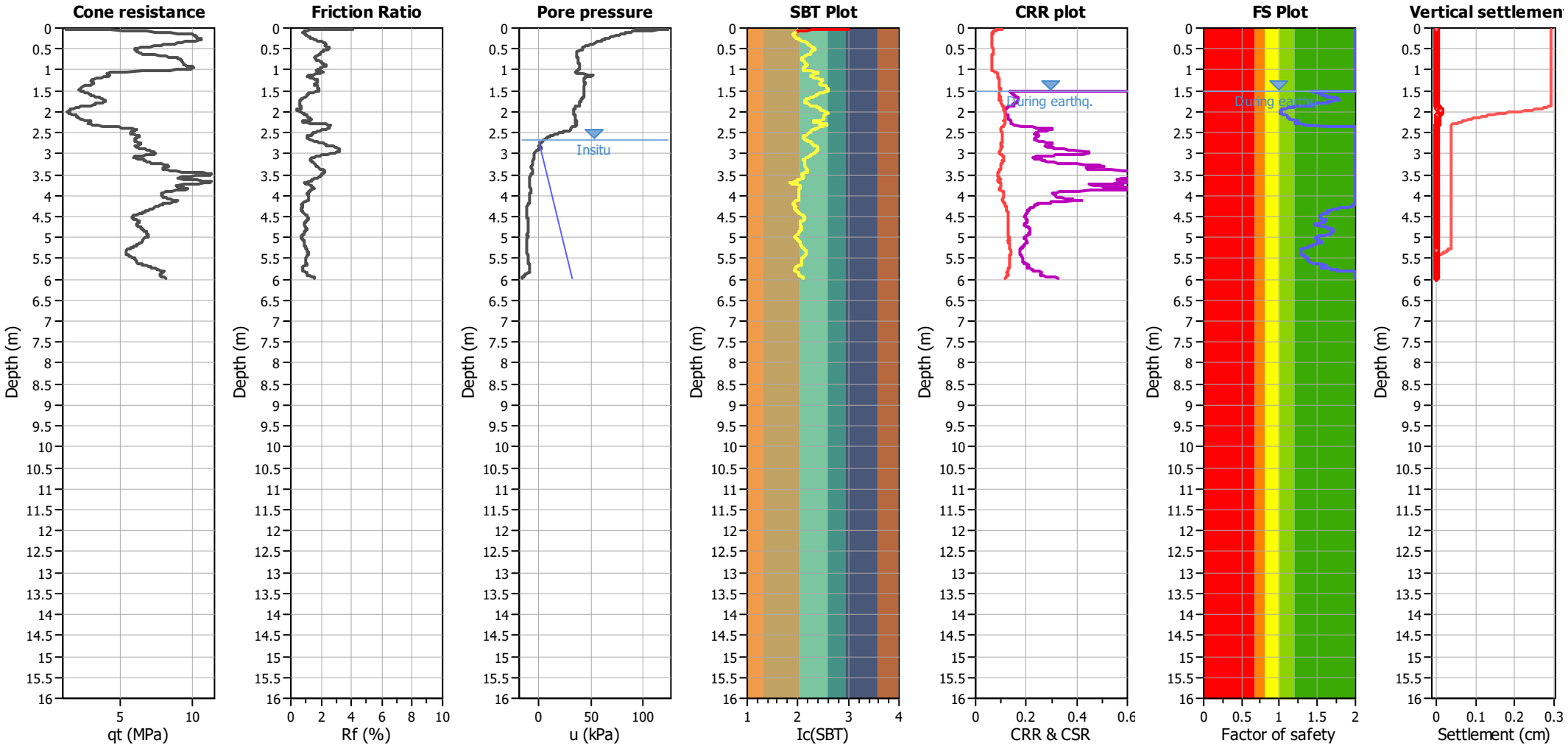
Project: **MINZ190017 - Cashmere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Sutherland Road, Halswell**

CPT: SCPT-04
Total depth: 5.97 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.68 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	10.00 m
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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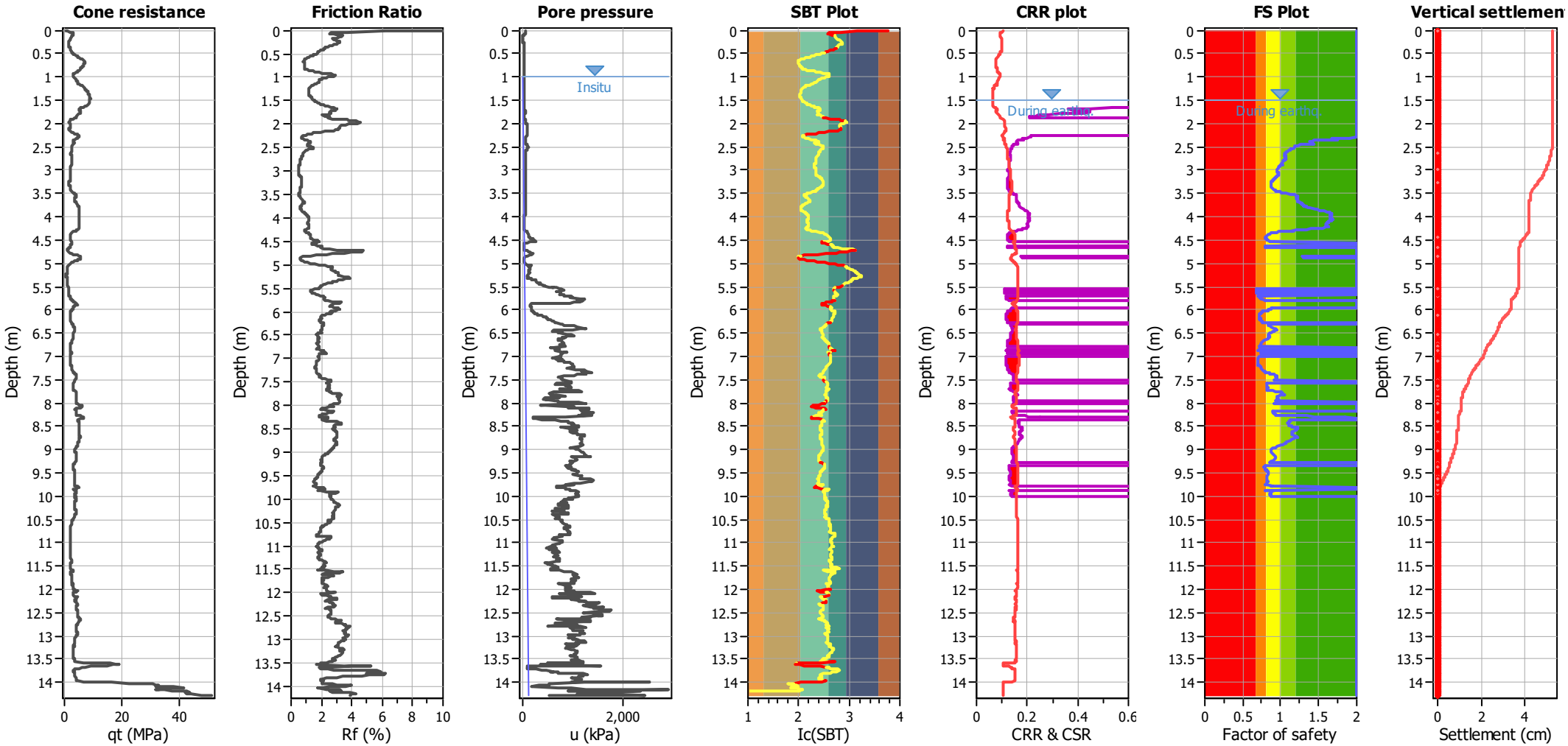
Project: **MINZ190017 - Cashmere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Sutherland Road, Halswell**

CPT: CPT-03
Total depth: 14.28 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	10.00 m
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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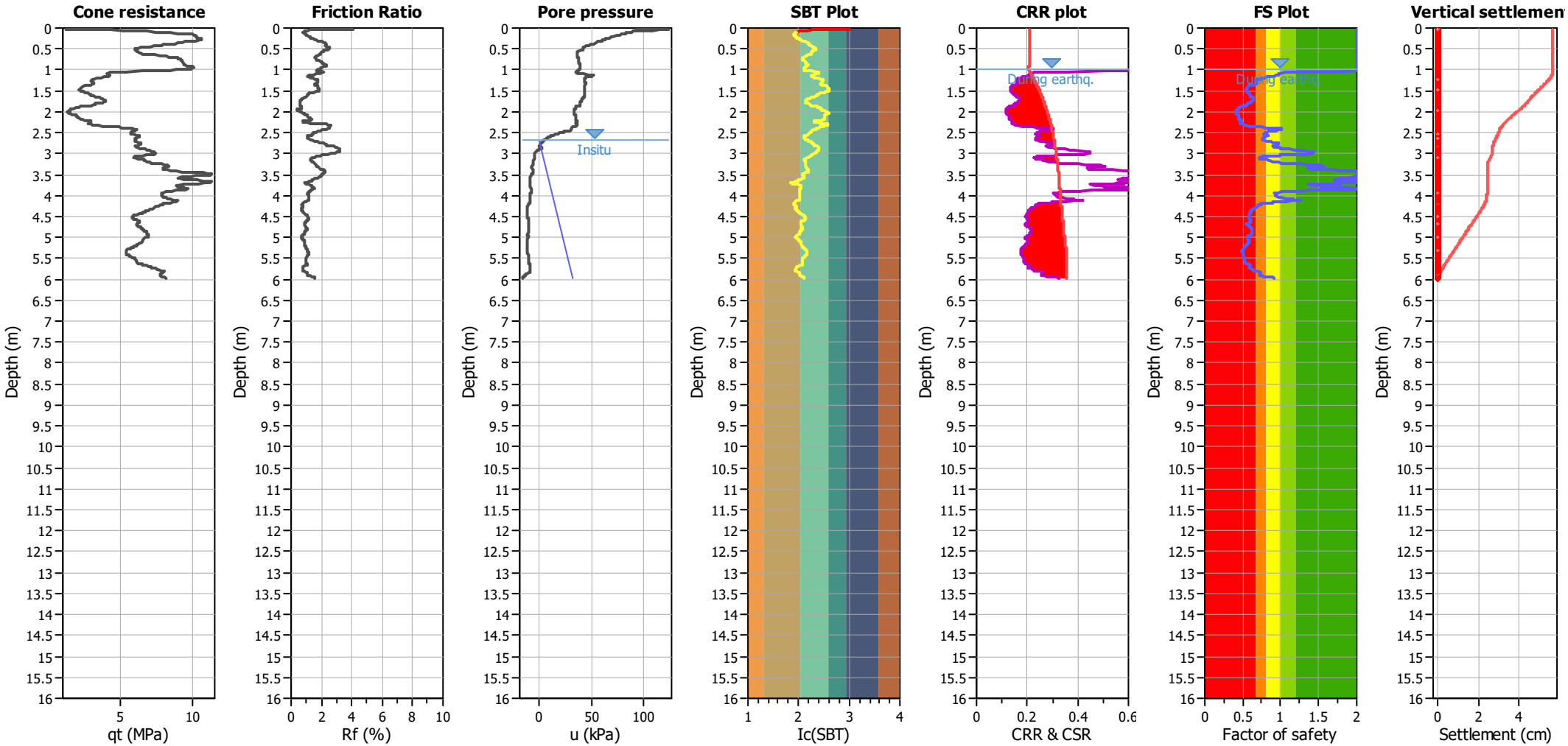
Project: **MINZ190017 - Cashmere and Sutherlands Road, Halswell Subdivision**

Location: **Cashmere and Sutherland Road, Halswell**

CPT: SCPT-04

Total depth: 5.97 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.68 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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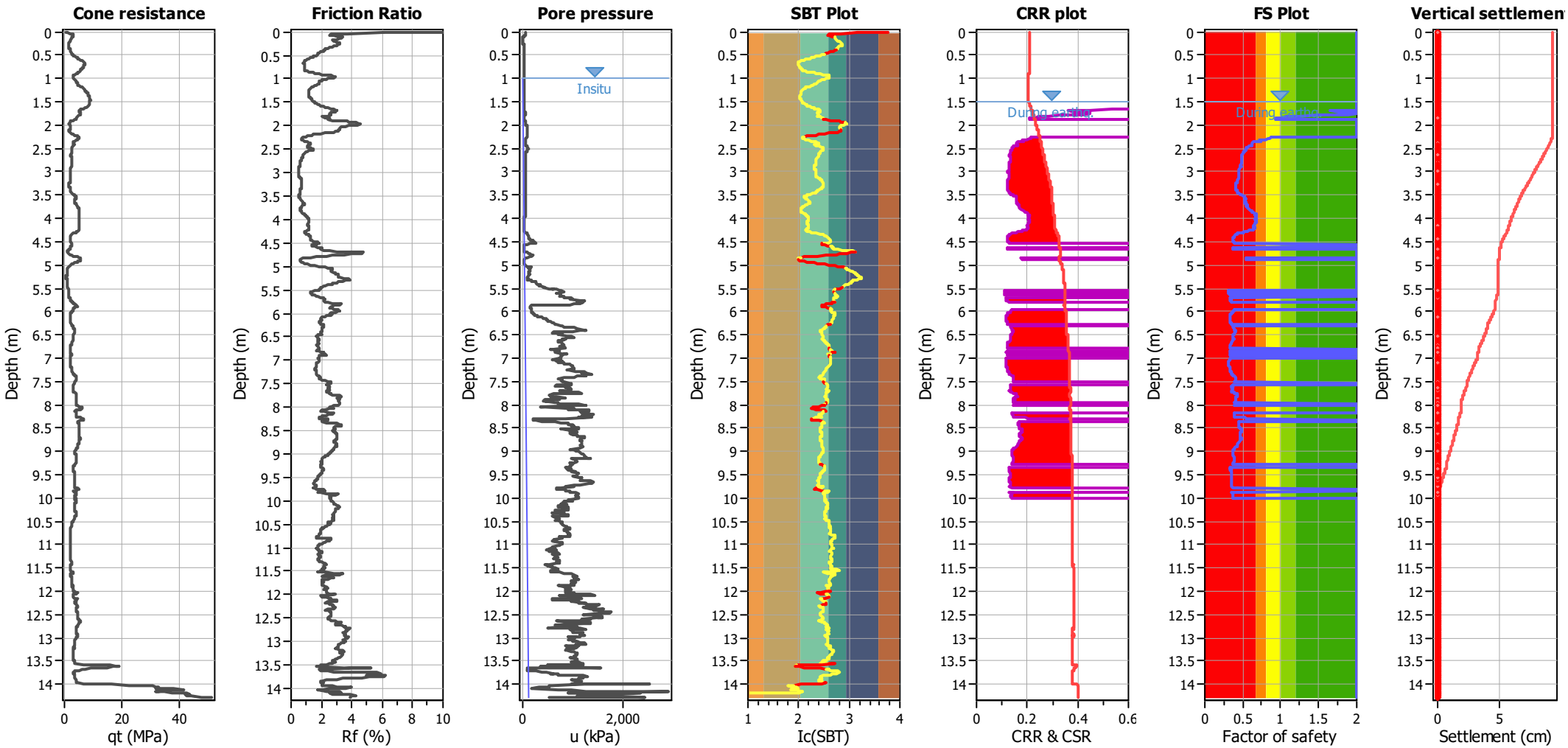
Project: **MINZ190017 - Cashmere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Sutherland Road, Halswell**

CPT: CPT-03
Total depth: 14.28 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	10.00 m
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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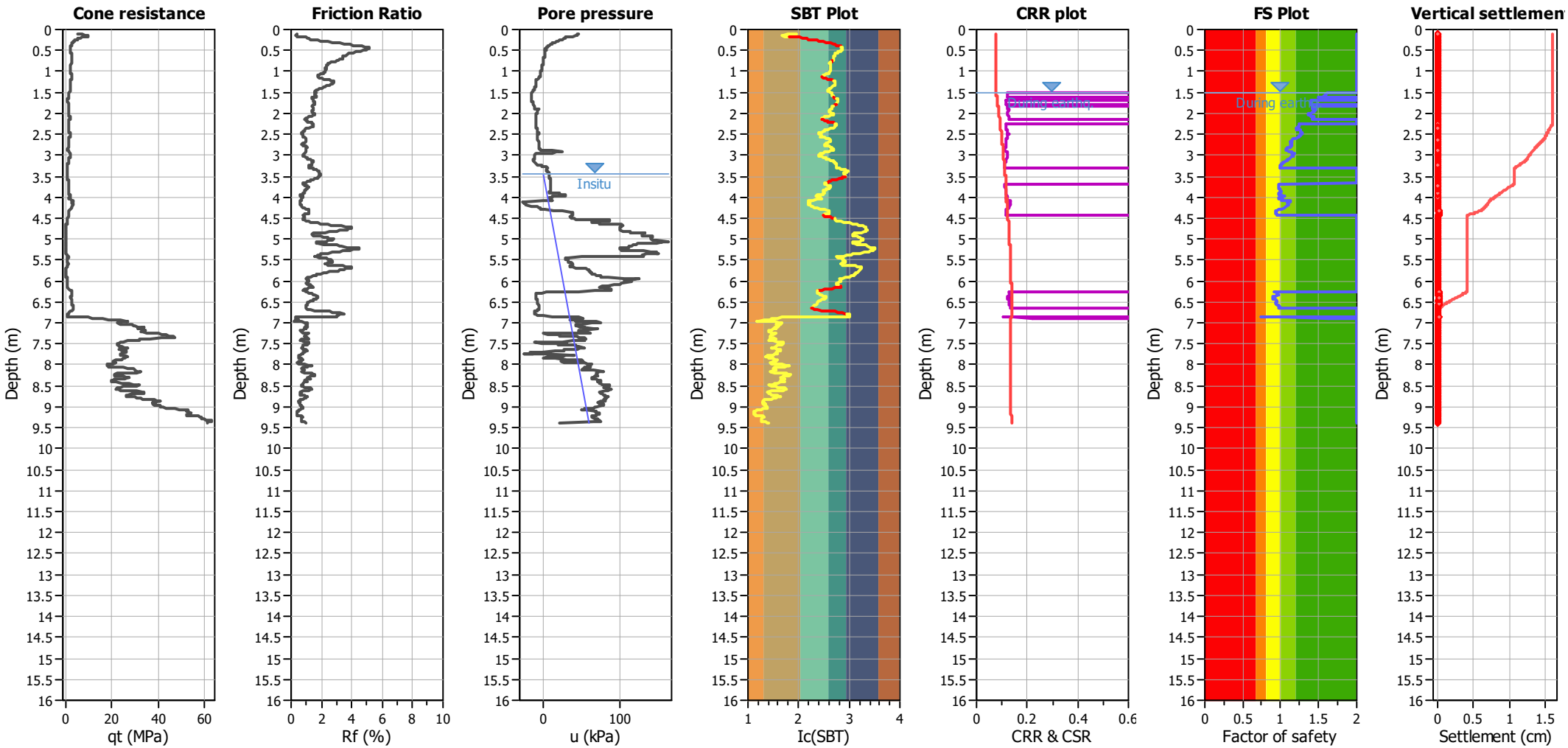
Project: **MINZ190017 - Cashmere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Sutherlands Road, Halswell**

CPT: SCPT-05
Total depth: 9.39 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.44 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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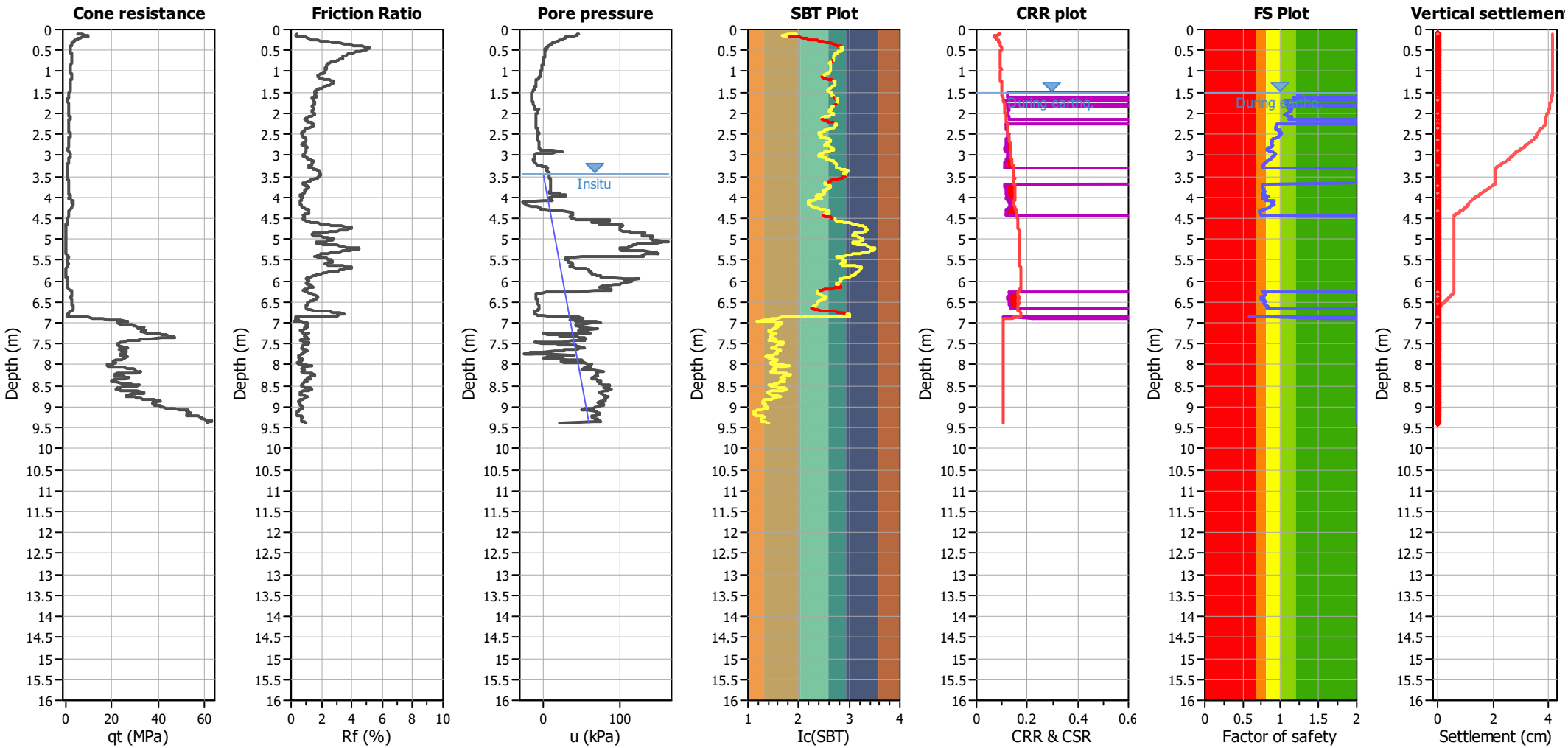
Project: **MINZ190017 - Cashmere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Sutherlands Road, Halswell**

CPT: SCPT-05
Total depth: 9.39 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.44 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	10.00 m
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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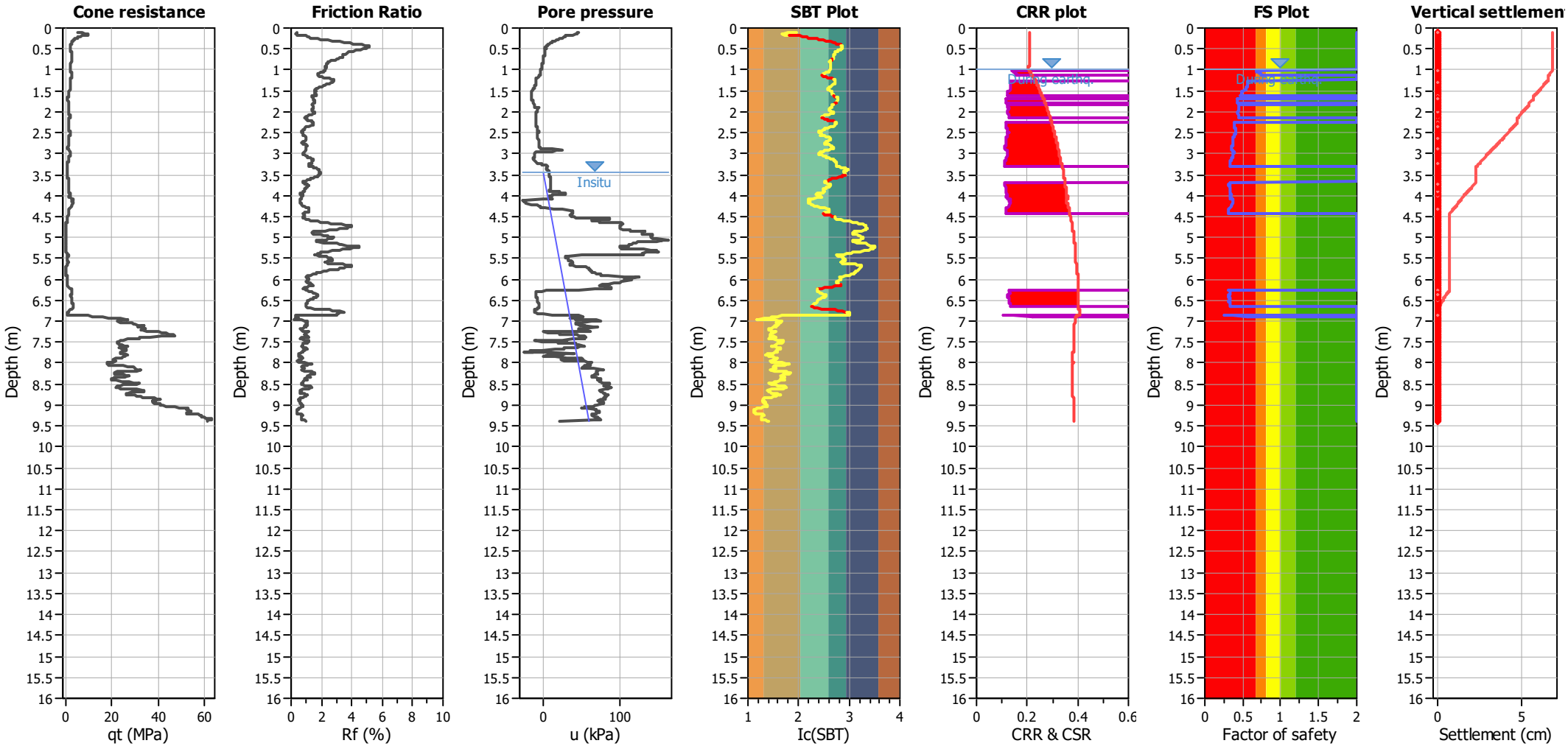
Project: **MINZ190017 - Cashmere and Sutherlands Road, Halswell Subdivision**

Location: **Cashmere and Sutherland Road, Halswell**

CPT: SCPT-05

Total depth: 9.39 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.44 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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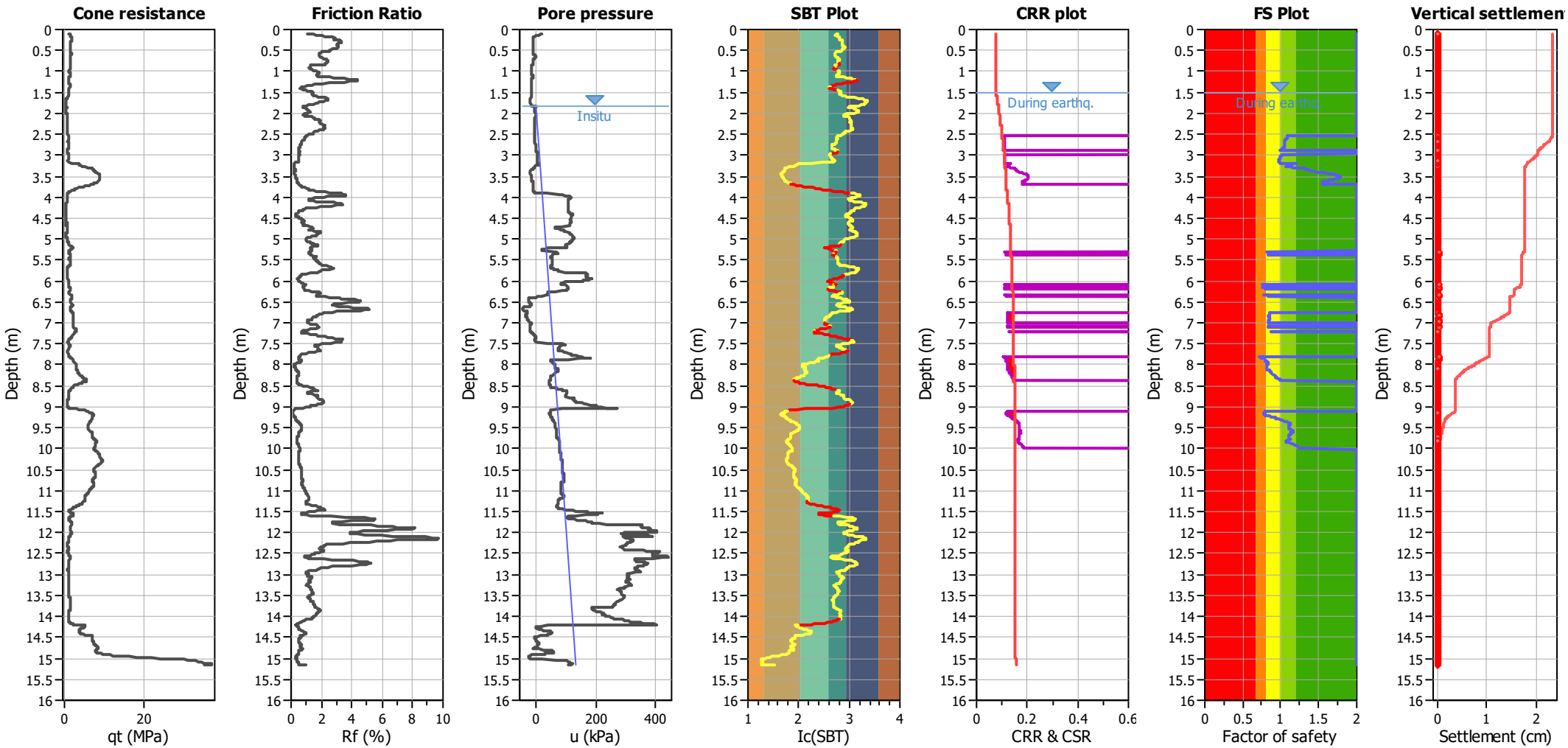
Project: **MINZ190017 - Cashmere and Sutherlands Road, Halswell Subdivision**

Location: **Cashmere and Sutherland Road, Halswell**

CPT: SCPT-06

Total depth: 15.17 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.84 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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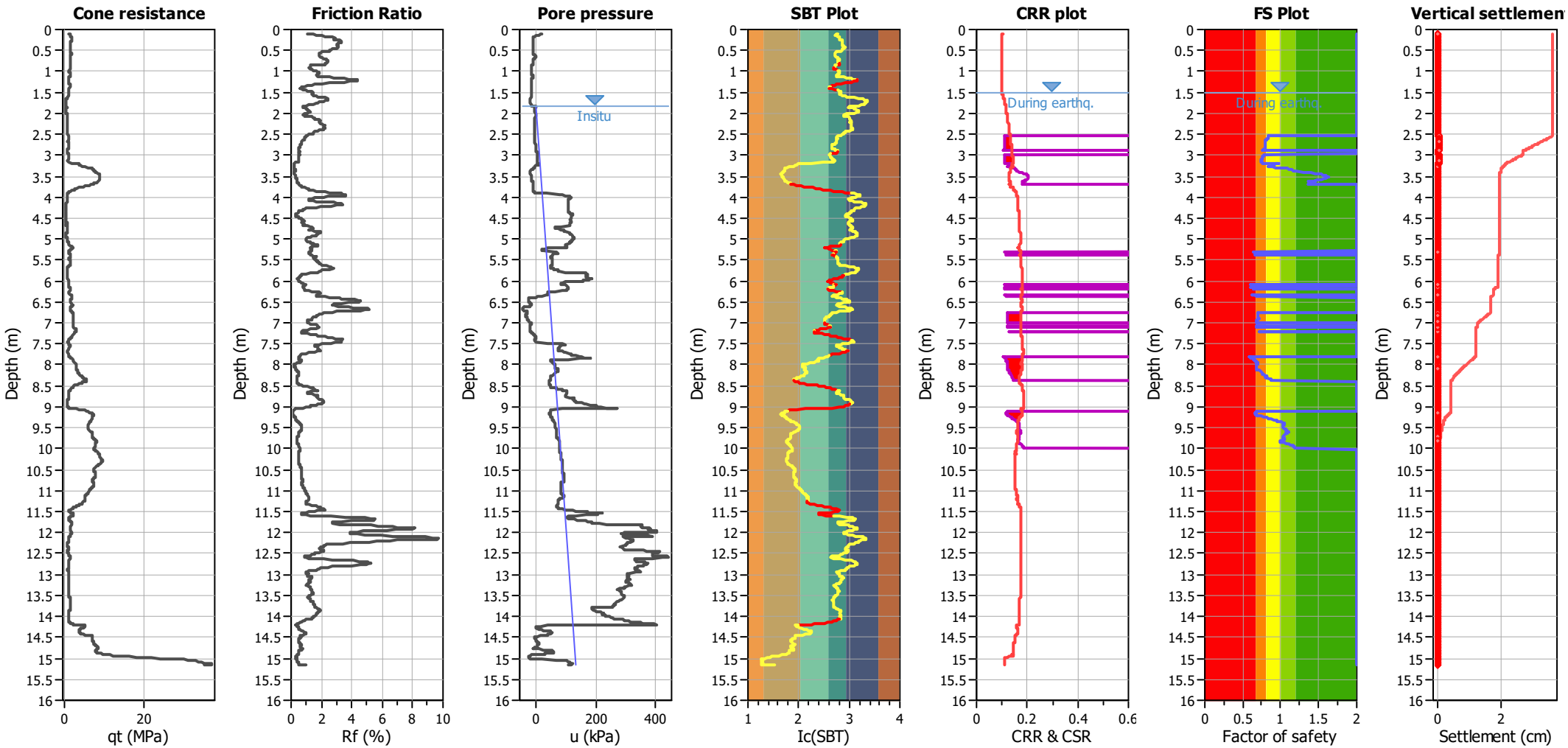
Project: **MINZ190017 - Cashmere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Sutherland Road, Halswell**

CPT: SCPT-06
Total depth: 15.17 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.84 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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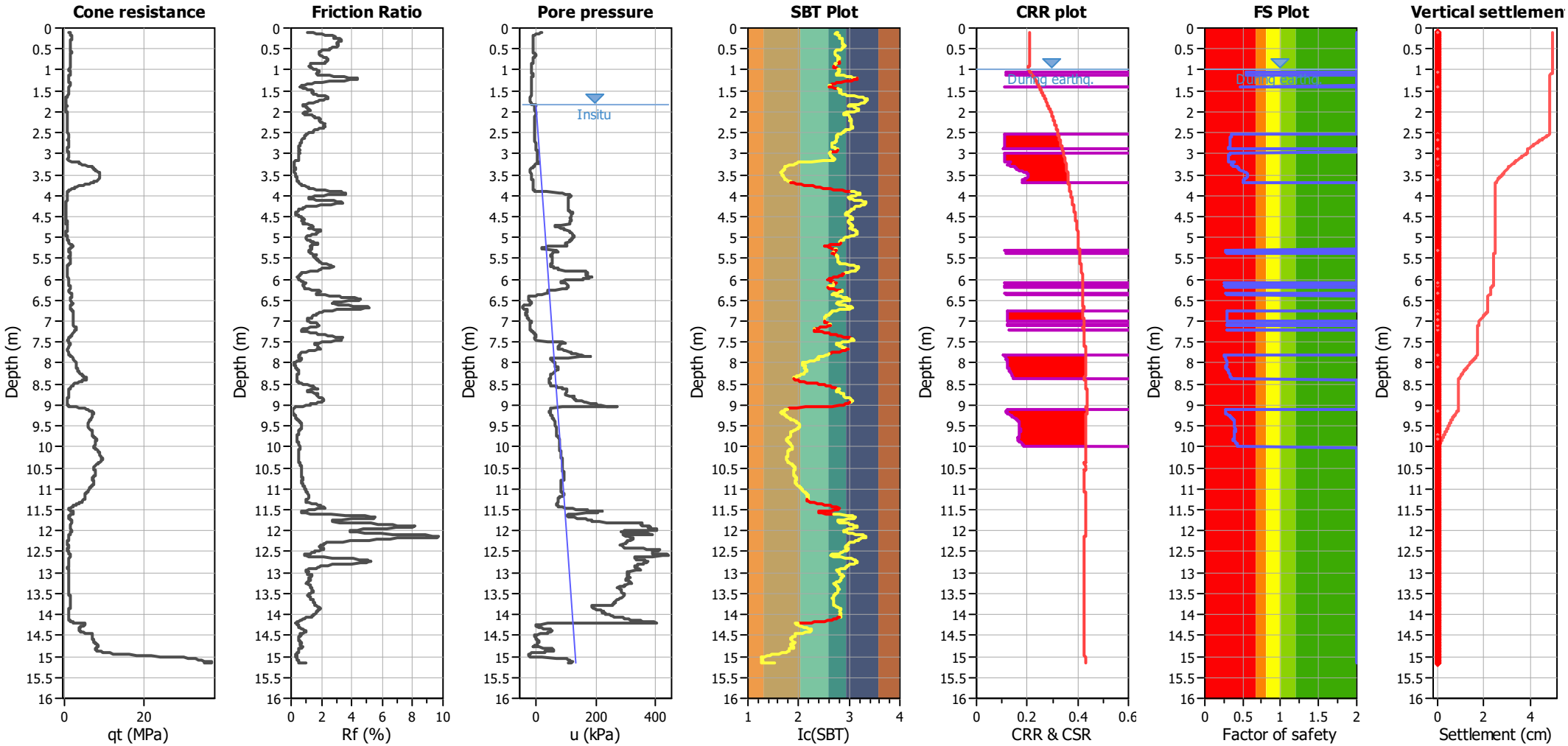
Project: **MINZ190017 - Cashmere and Sutherlands Road, Halswell Subdivision**
Location: **Cashmere and Sutherland Road, Halswell**

CPT: SCPT-06
Total depth: 15.17 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.84 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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V_s BASED LIQUEFACTION ANALYSIS REPORT

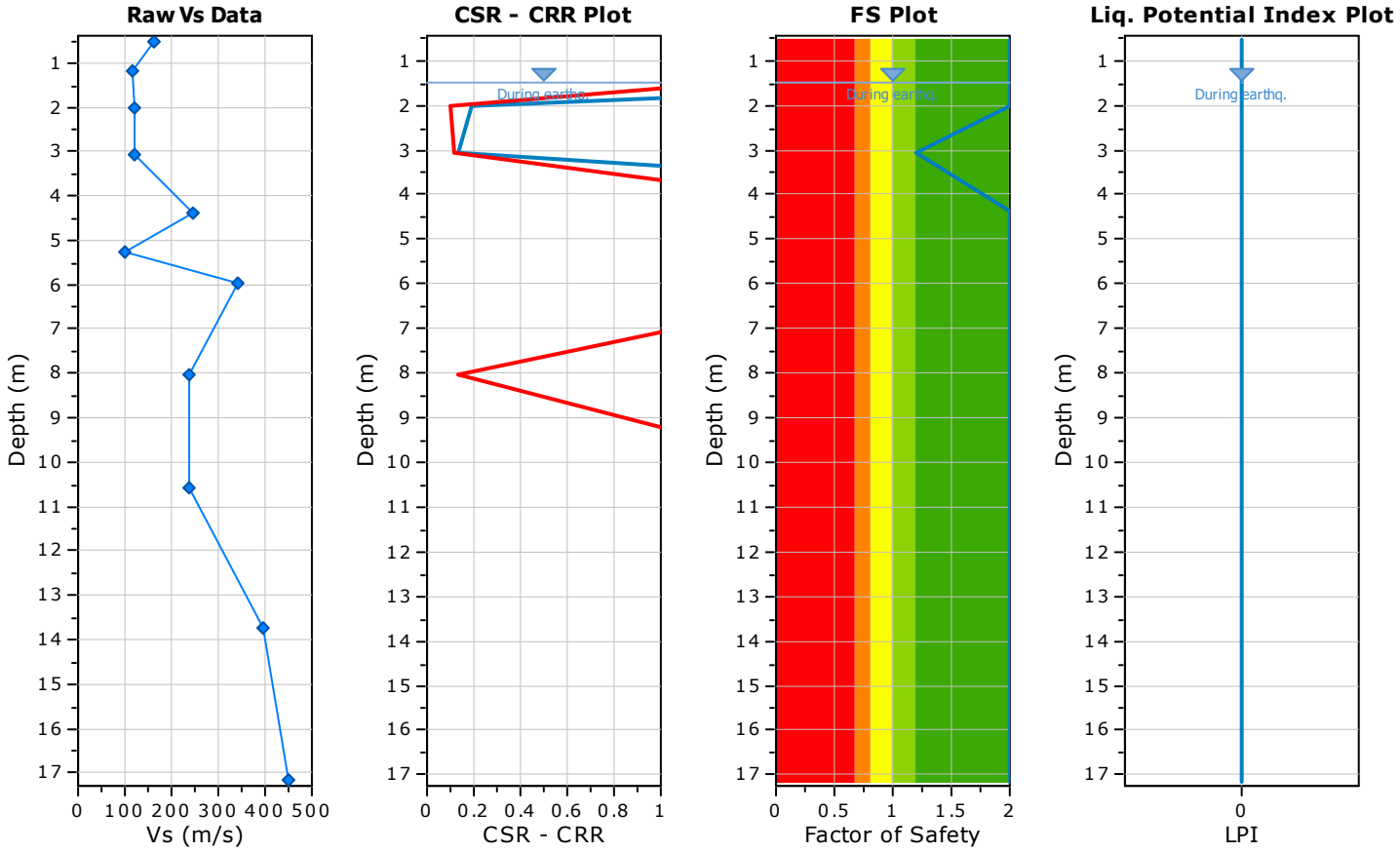
Project title : 190017

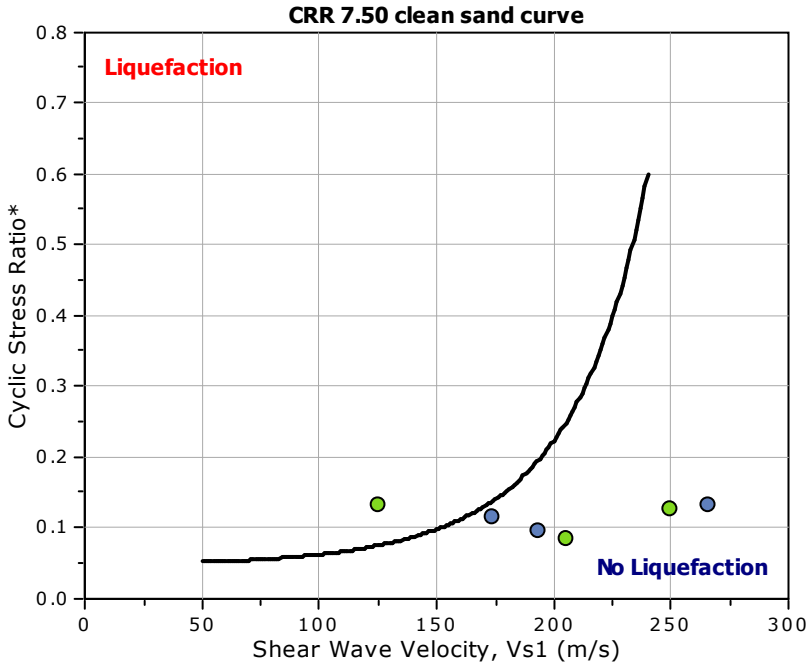
V_s Name: CPT-03 Vs_SLS

Location : Cashmere and Sutherlands Road, Halswell

:: Input parameters and analysis properties ::

Analysis method:	Kayen et al. 2013
G.W.T. (in-situ):	0.00 m
G.W.T. (earthq.):	1.50 m
Earthquake magnitude M_w:	7.50
Peak ground acceleration:	0.13 g
Eq. external load:	0.00 kPa





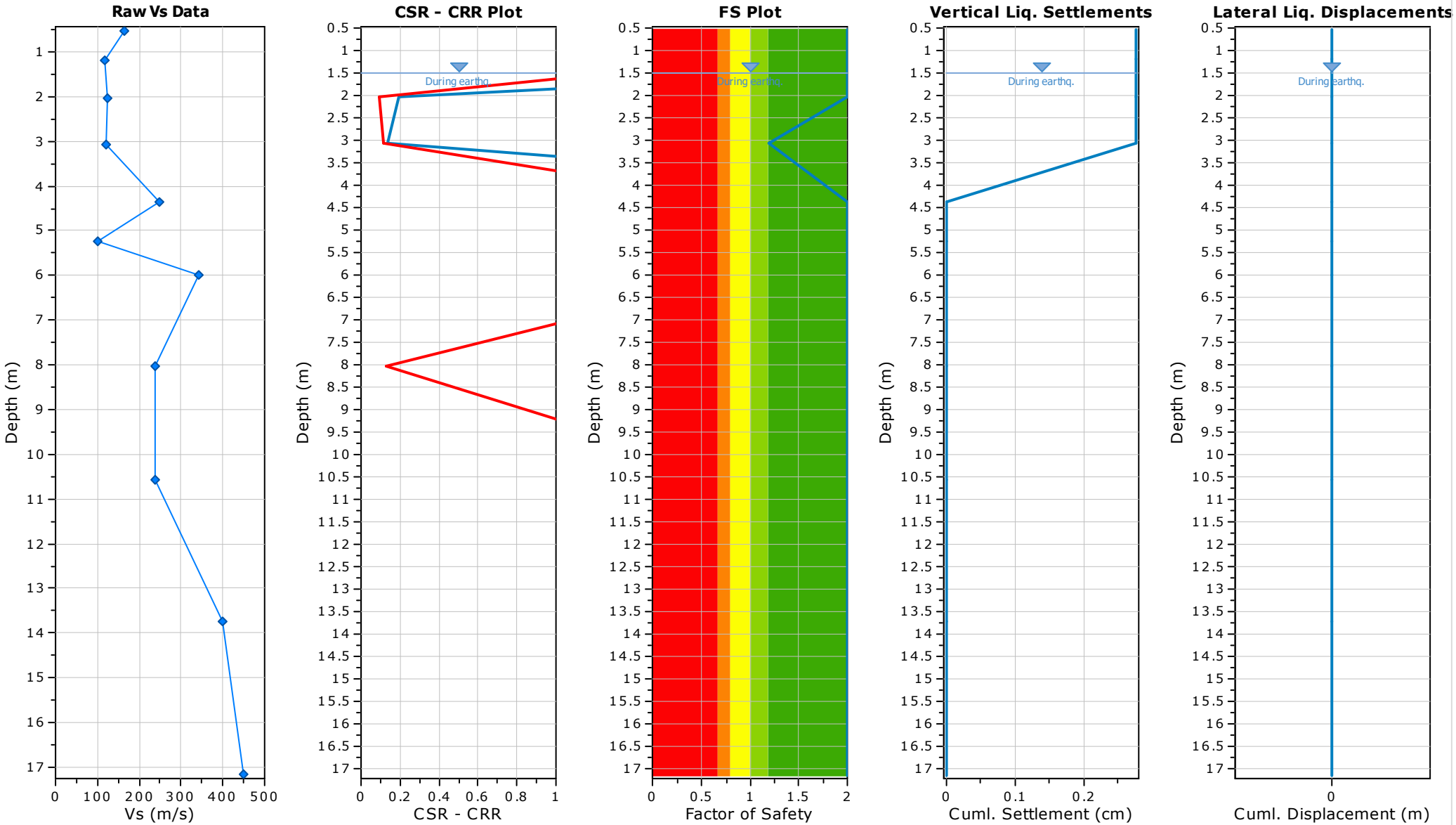
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



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V_s BASED LIQUEFACTION ANALYSIS REPORT

Project title : 190017

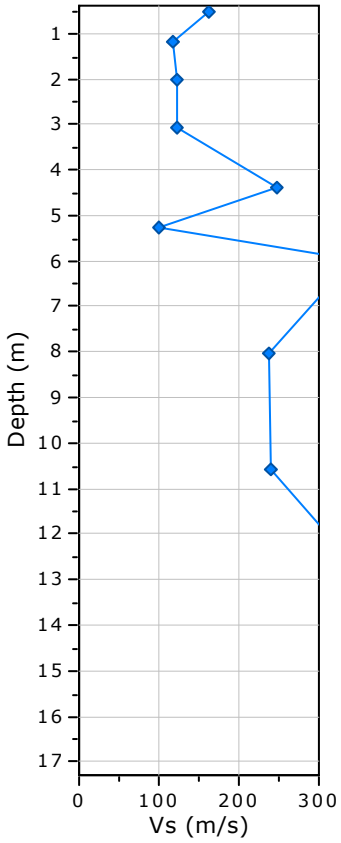
V_s Name: CPT-03 Vs_SLS2

Location : Cashmere and Sutherlands Road, Halswell

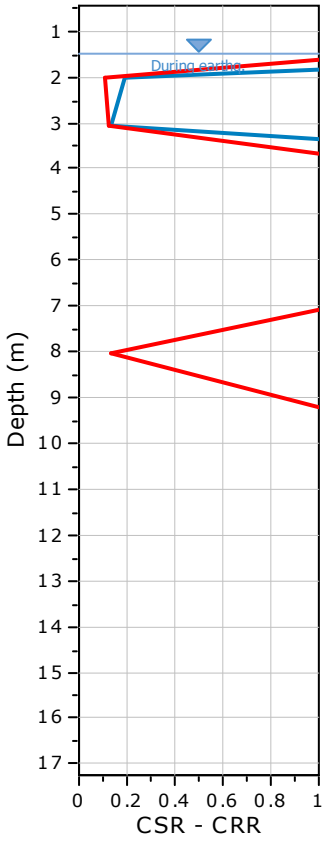
:: Input parameters and analysis properties ::

Analysis method:	Kayen et al. 2013
G.W.T. (in-situ):	0.00 m
G.W.T. (earthq.):	1.50 m
Earthquake magnitude M_w:	6.00
Peak ground acceleration:	0.19 g
Eq. external load:	0.00 kPa

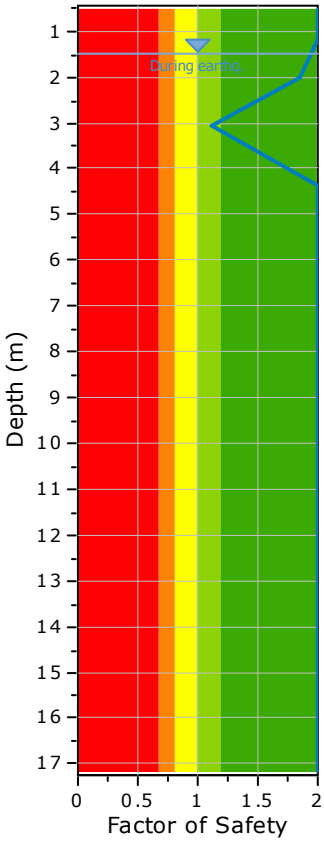
Raw Vs Data



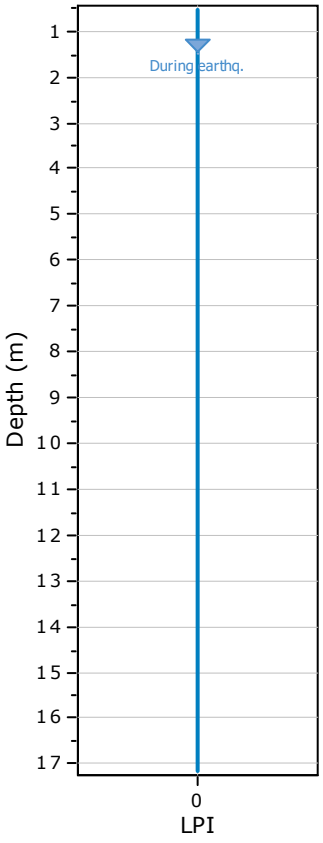
CSR - CRR Plot



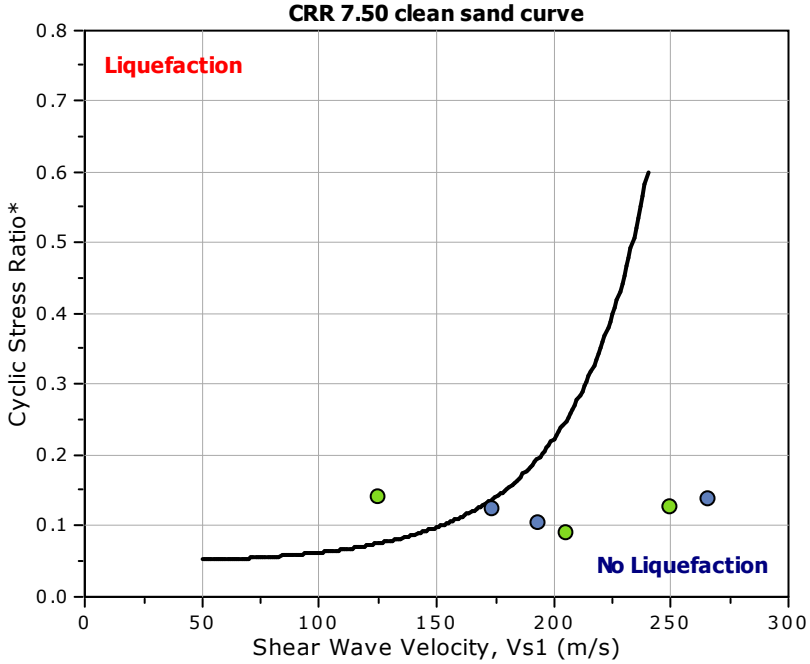
FS Plot



Liq. Potential Index Plot



CRR 7.50 clean sand curve



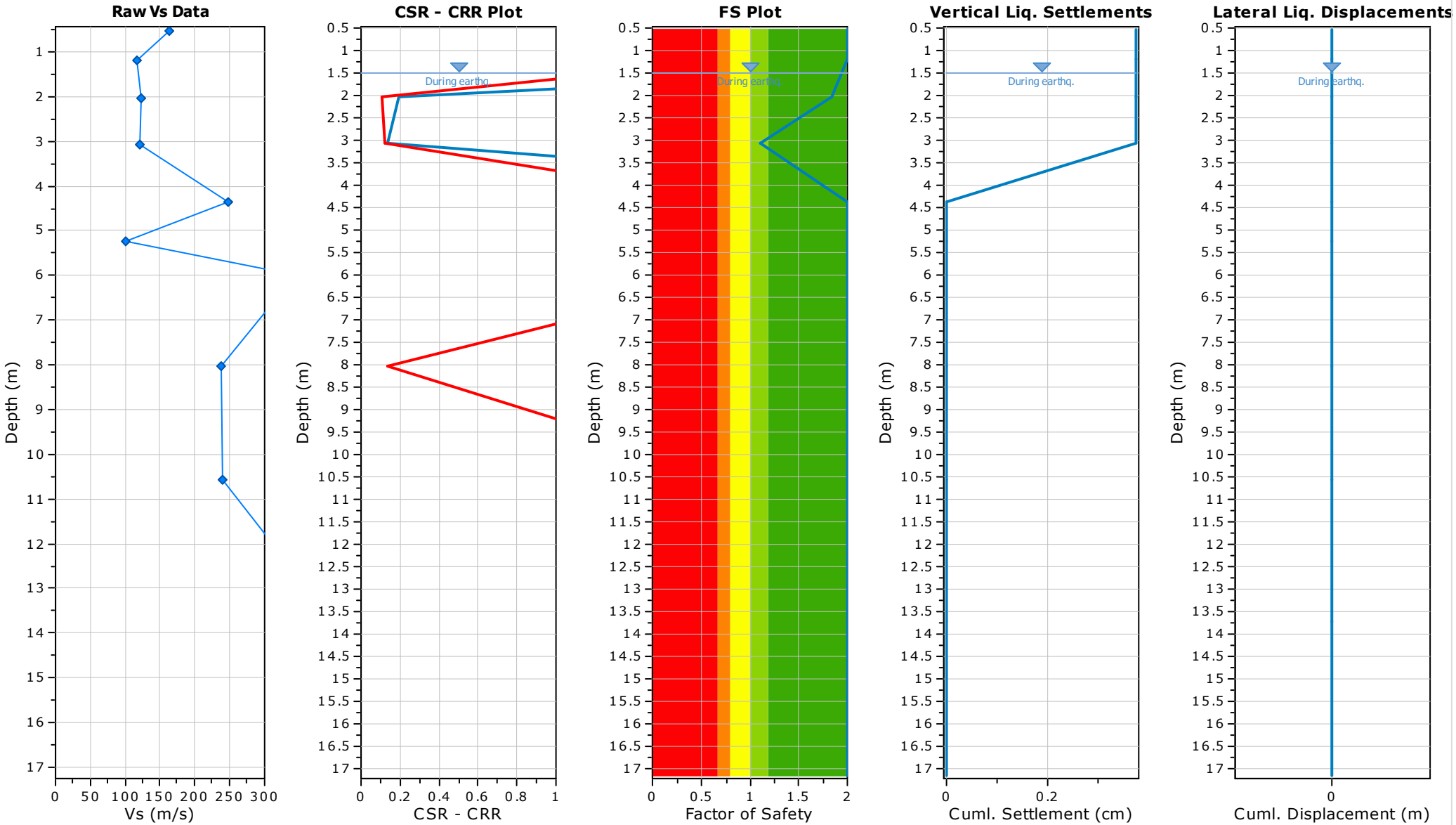
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



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V_s BASED LIQUEFACTION ANALYSIS REPORT

Project title : 190017

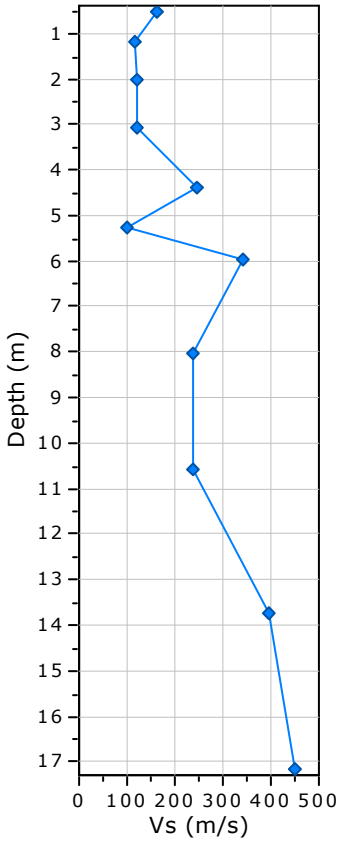
V_s Name: CPT-03 Vs_ULS

Location : Cashmere and Sutherlands Road, Halswell

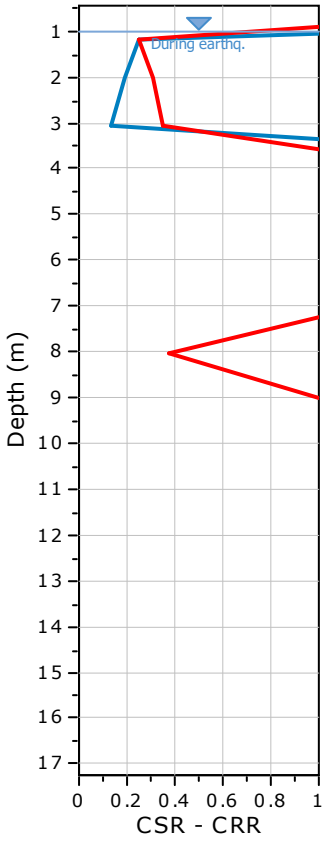
:: Input parameters and analysis properties ::

Analysis method:	Kayen et al. 2013
G.W.T. (in-situ):	0.00 m
G.W.T. (earthq.):	1.00 m
Earthquake magnitude M_w:	7.50
Peak ground acceleration:	0.35 g
Eq. external load:	0.00 kPa

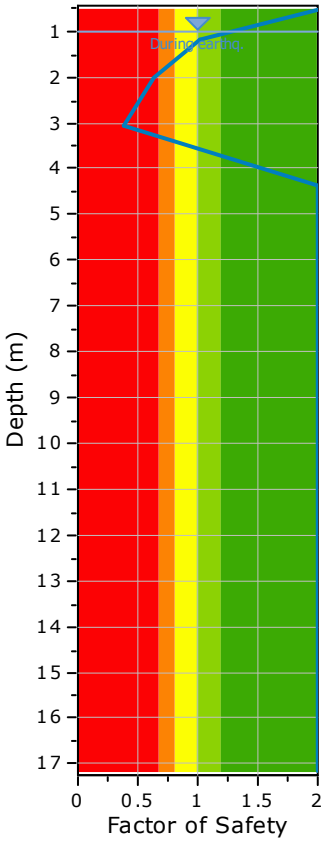
Raw Vs Data



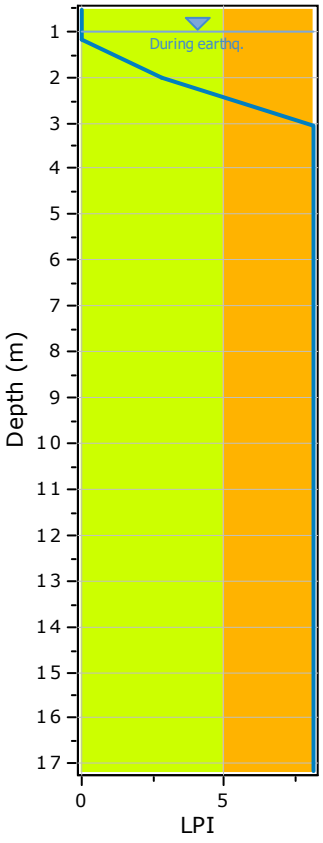
CSR - CRR Plot



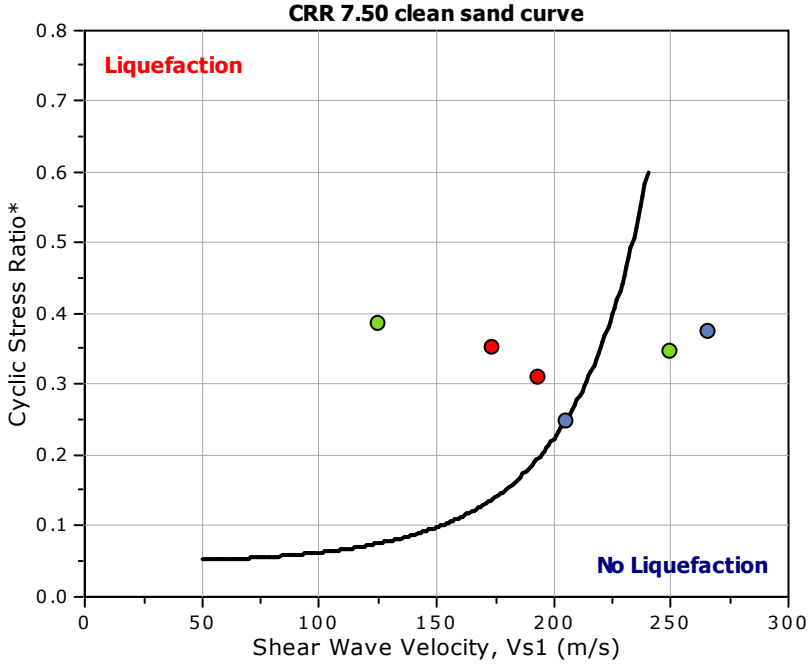
FS Plot



Liq. Potential Index Plot



CRR 7.50 clean sand curve



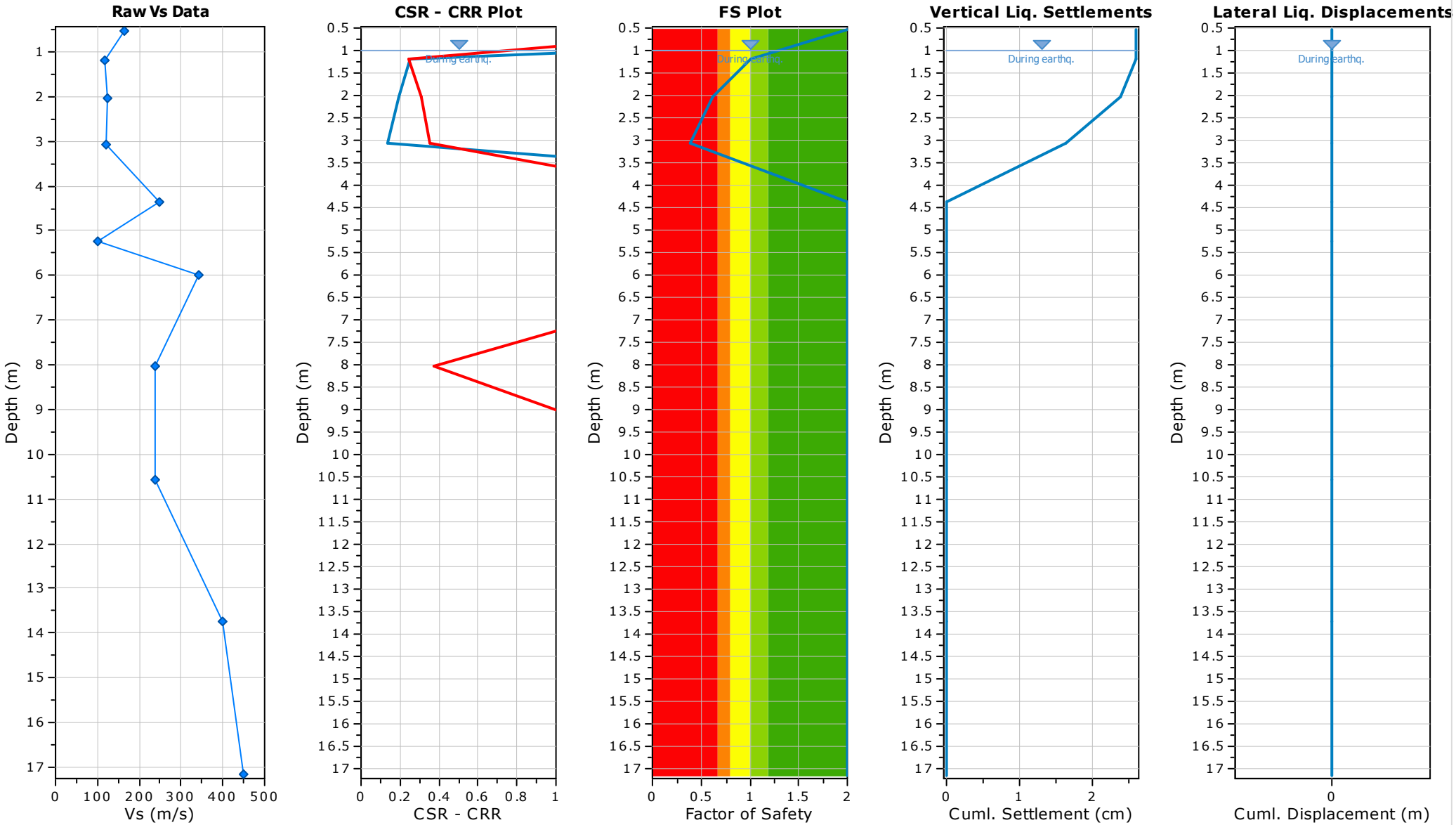
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



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V_s BASED LIQUEFACTION ANALYSIS REPORT

Project title : 190017

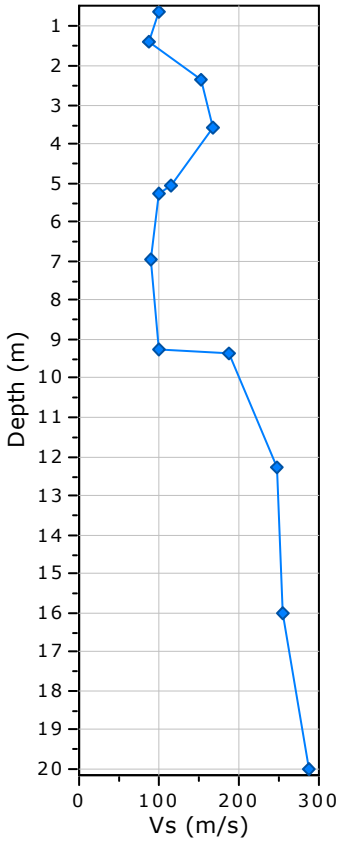
V_s Name: CPT_87703 Vs_SLS

Location : Cashmere and Sutherlands Road, Halswell

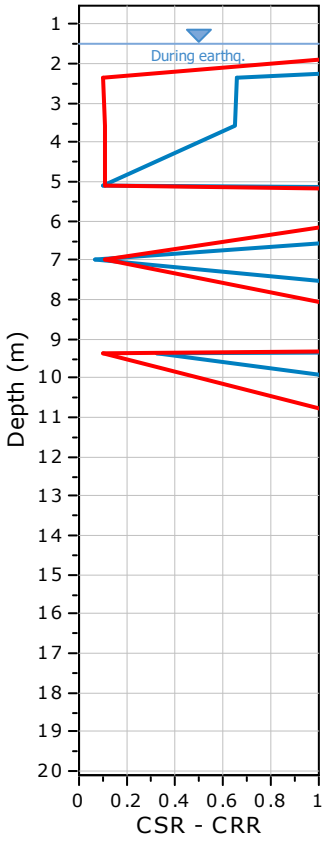
:: Input parameters and analysis properties ::

Analysis method:	Kayen et al. 2013
G.W.T. (in-situ):	0.00 m
G.W.T. (earthq.):	1.50 m
Earthquake magnitude M_w:	7.50
Peak ground acceleration:	0.13 g
Eq. external load:	0.00 kPa

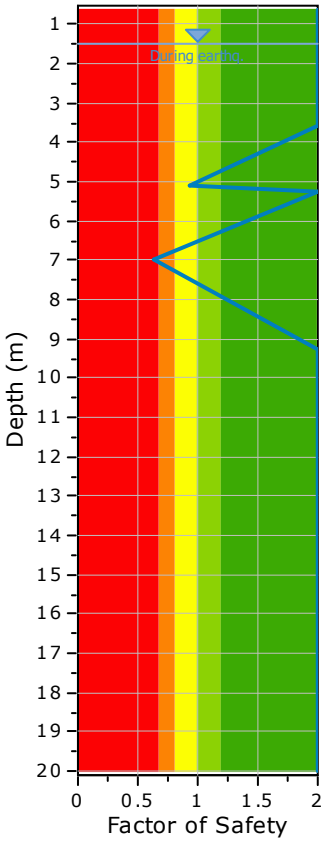
Raw Vs Data



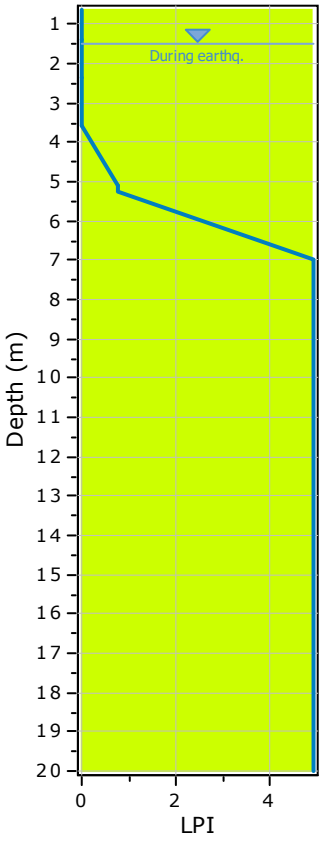
CSR - CRR Plot



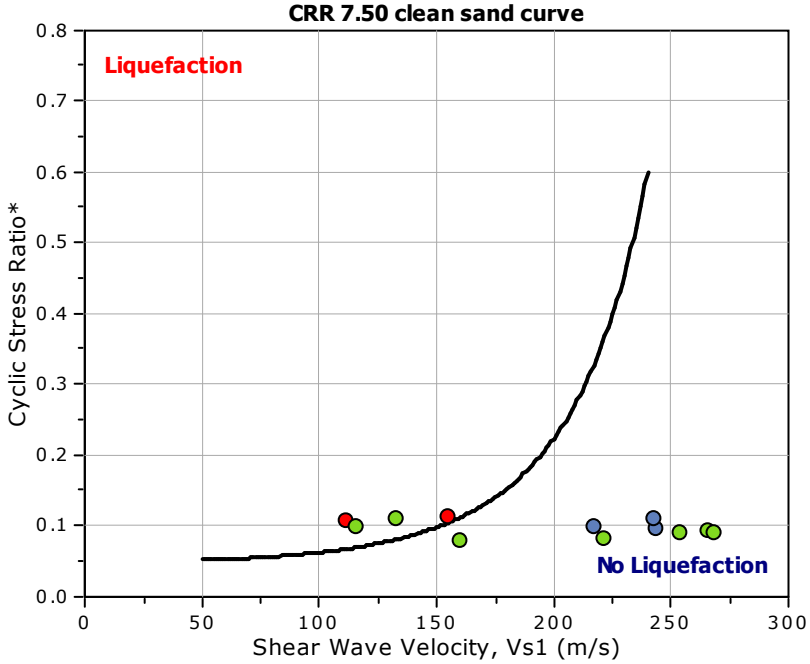
FS Plot



Liq. Potential Index Plot



CRR 7.50 clean sand curve



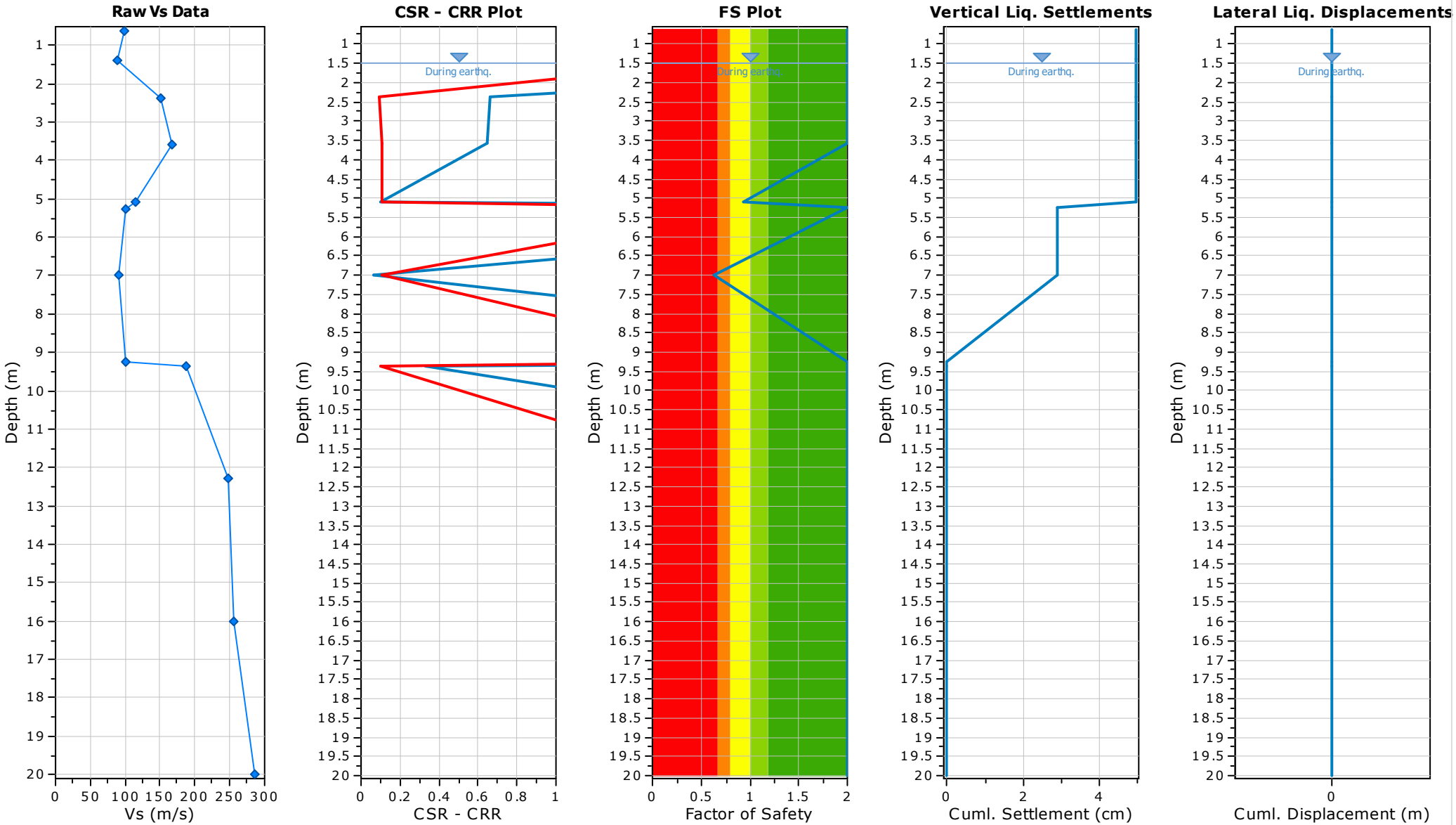
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



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V_s BASED LIQUEFACTION ANALYSIS REPORT

Project title : 190017

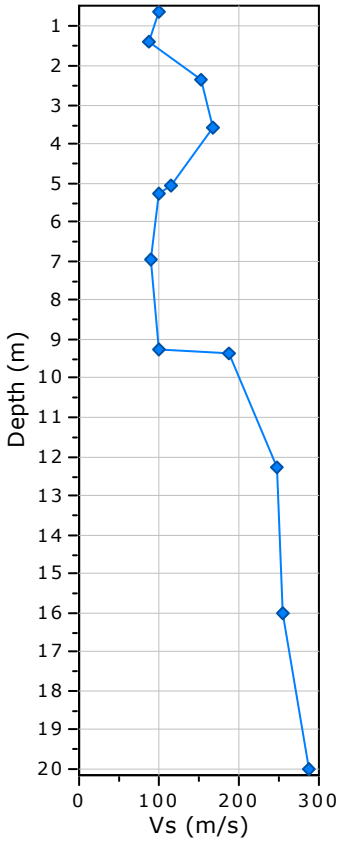
V_s Name: CPT_87703 Vs_SLS2

Location : Cashmere and Sutherlands Road, Halswell

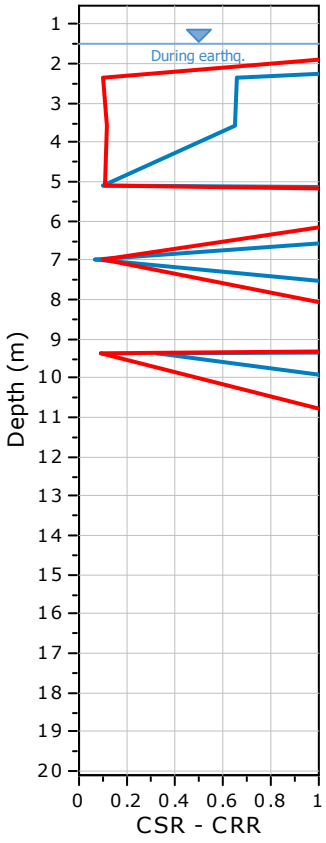
:: Input parameters and analysis properties ::

Analysis method:	Kayen et al. 2013
G.W.T. (in-situ):	0.00 m
G.W.T. (earthq.):	1.50 m
Earthquake magnitude M_w:	6.00
Peak ground acceleration:	0.19 g
Eq. external load:	0.00 kPa

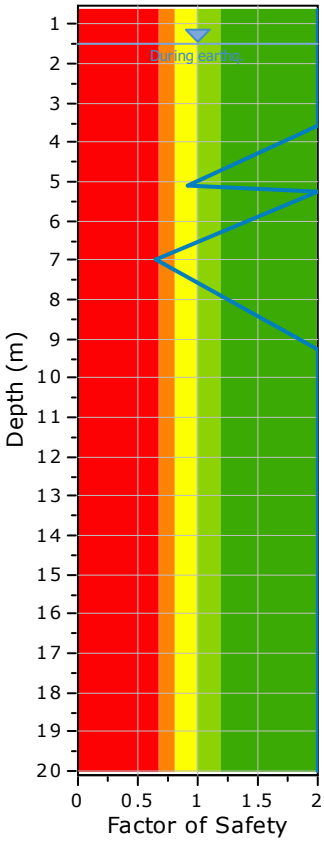
Raw Vs Data



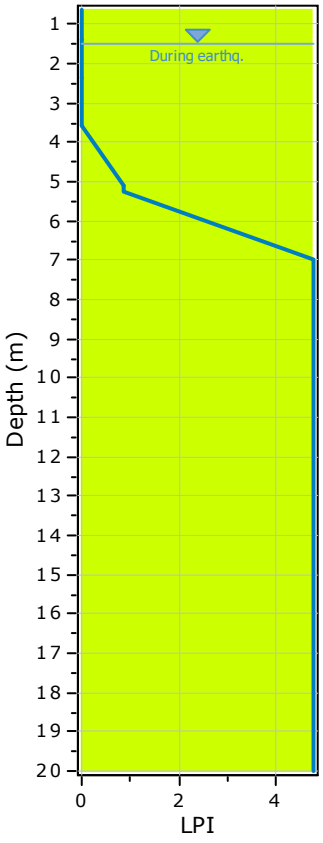
CSR - CRR Plot



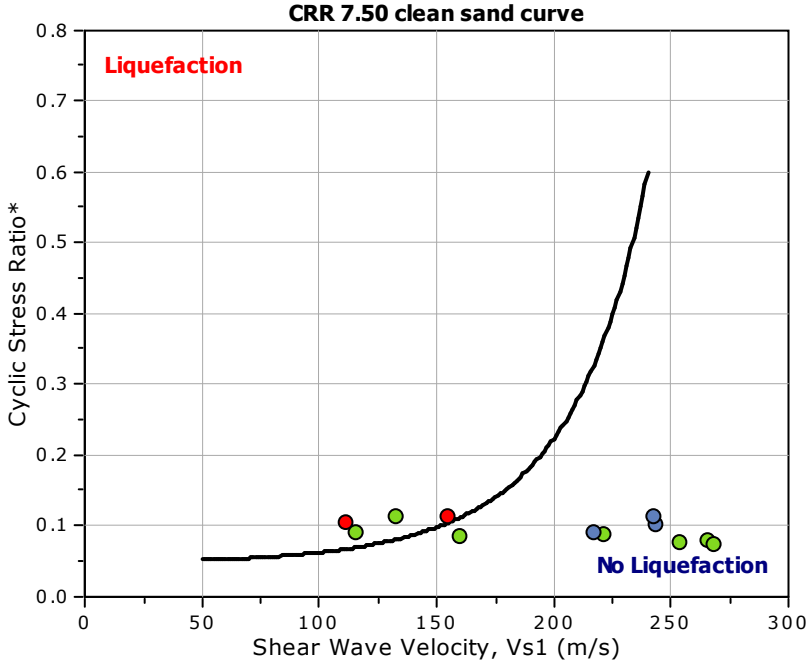
FS Plot



Liq. Potential Index Plot



CRR 7.50 clean sand curve



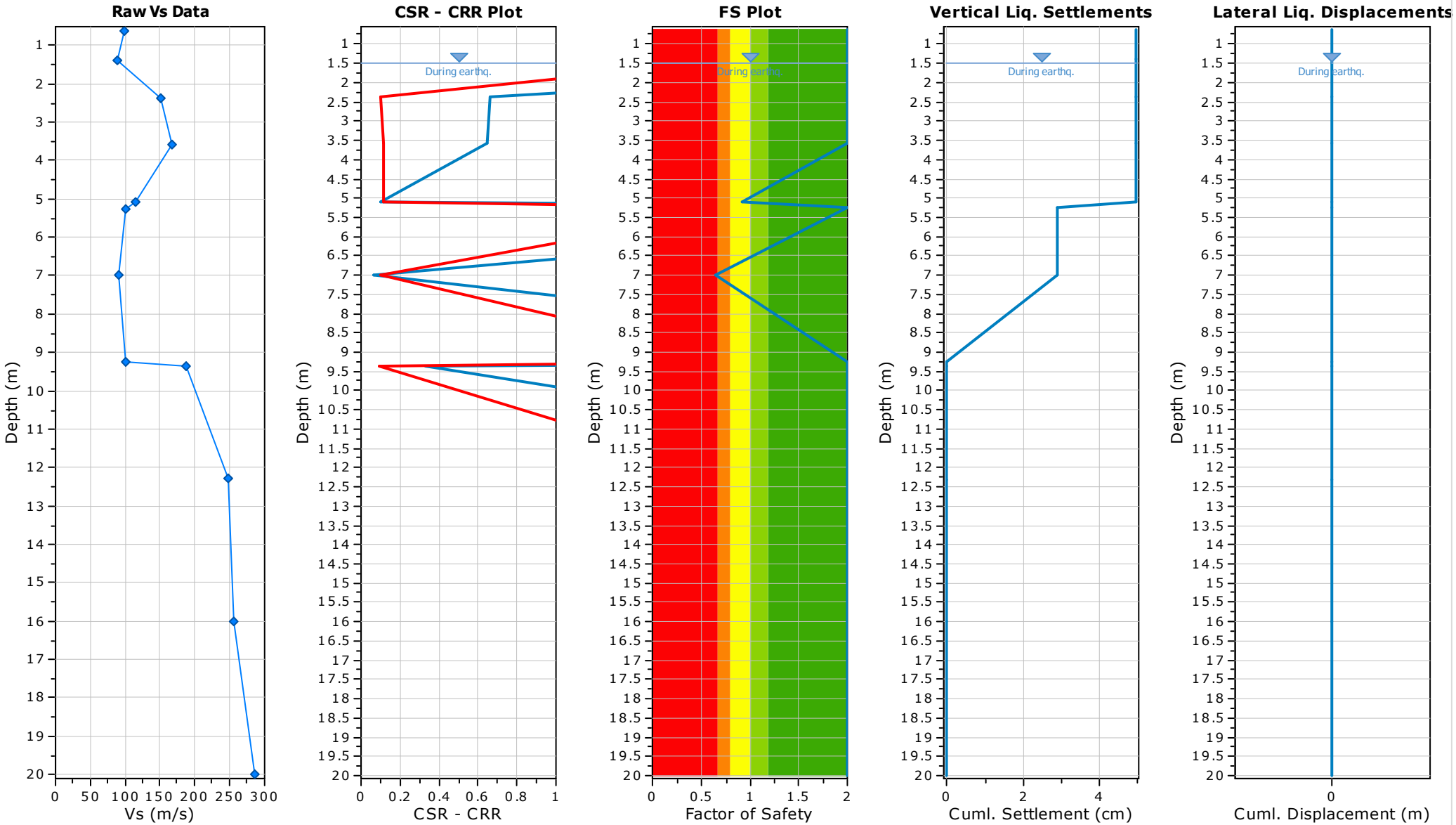
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



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V_s BASED LIQUEFACTION ANALYSIS REPORT

Project title : 190017

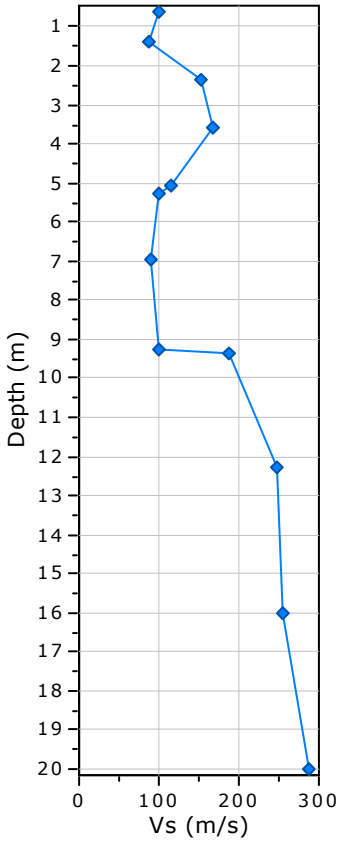
V_s Name: CPT_87703 Vs_ULS

Location : Cashmere and Sutherlands Road, Halswell

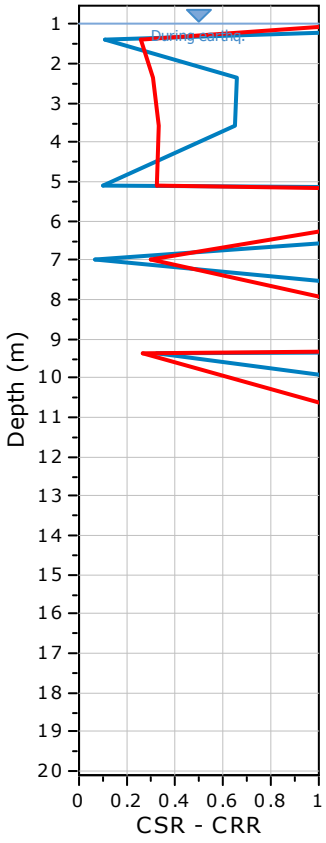
:: Input parameters and analysis properties ::

Analysis method:	Kayen et al. 2013
G.W.T. (in-situ):	0.00 m
G.W.T. (earthq.):	1.00 m
Earthquake magnitude M_w:	7.50
Peak ground acceleration:	0.35 g
Eq. external load:	0.00 kPa

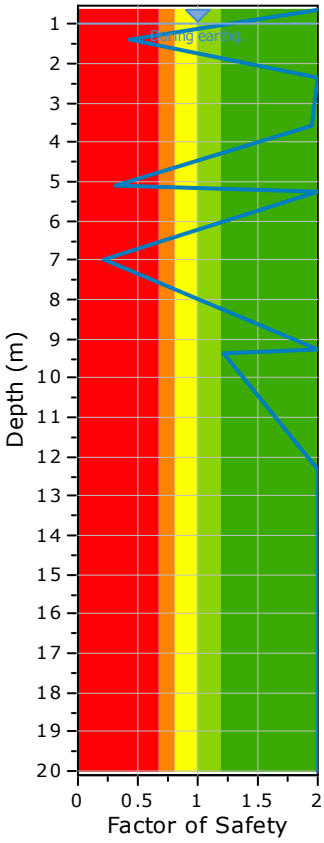
Raw Vs Data



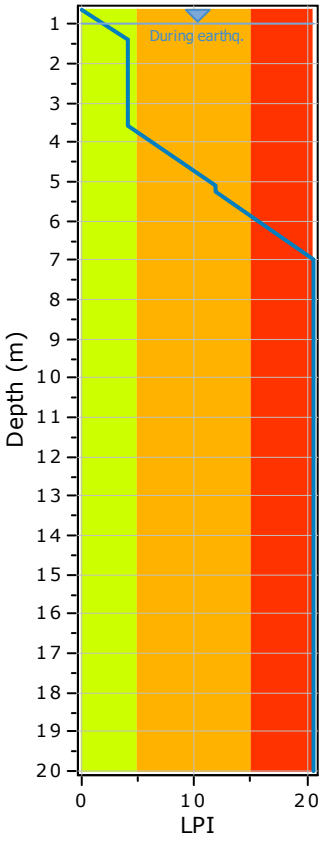
CSR - CRR Plot



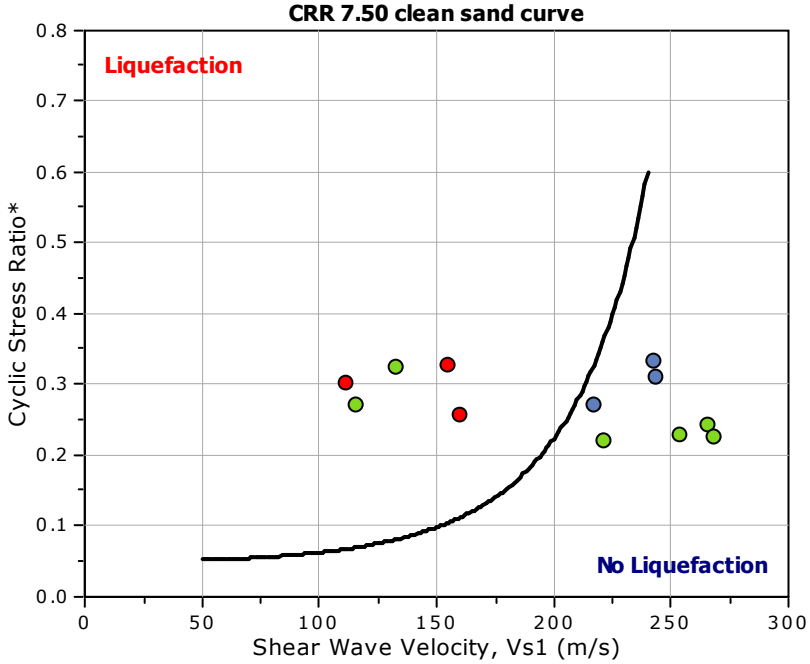
FS Plot



Liq. Potential Index Plot



CRR 7.50 clean sand curve



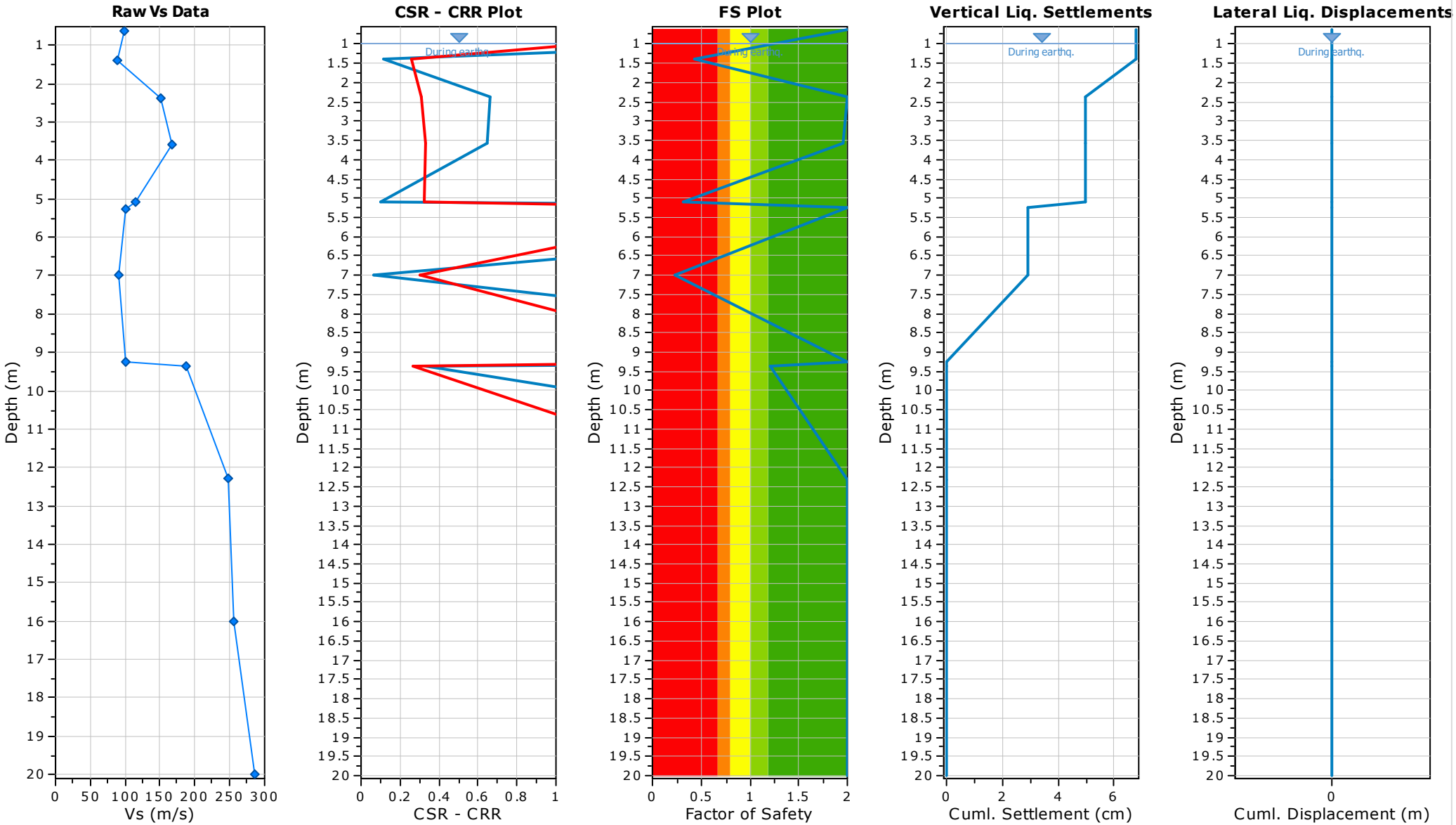
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



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V_s BASED LIQUEFACTION ANALYSIS REPORT

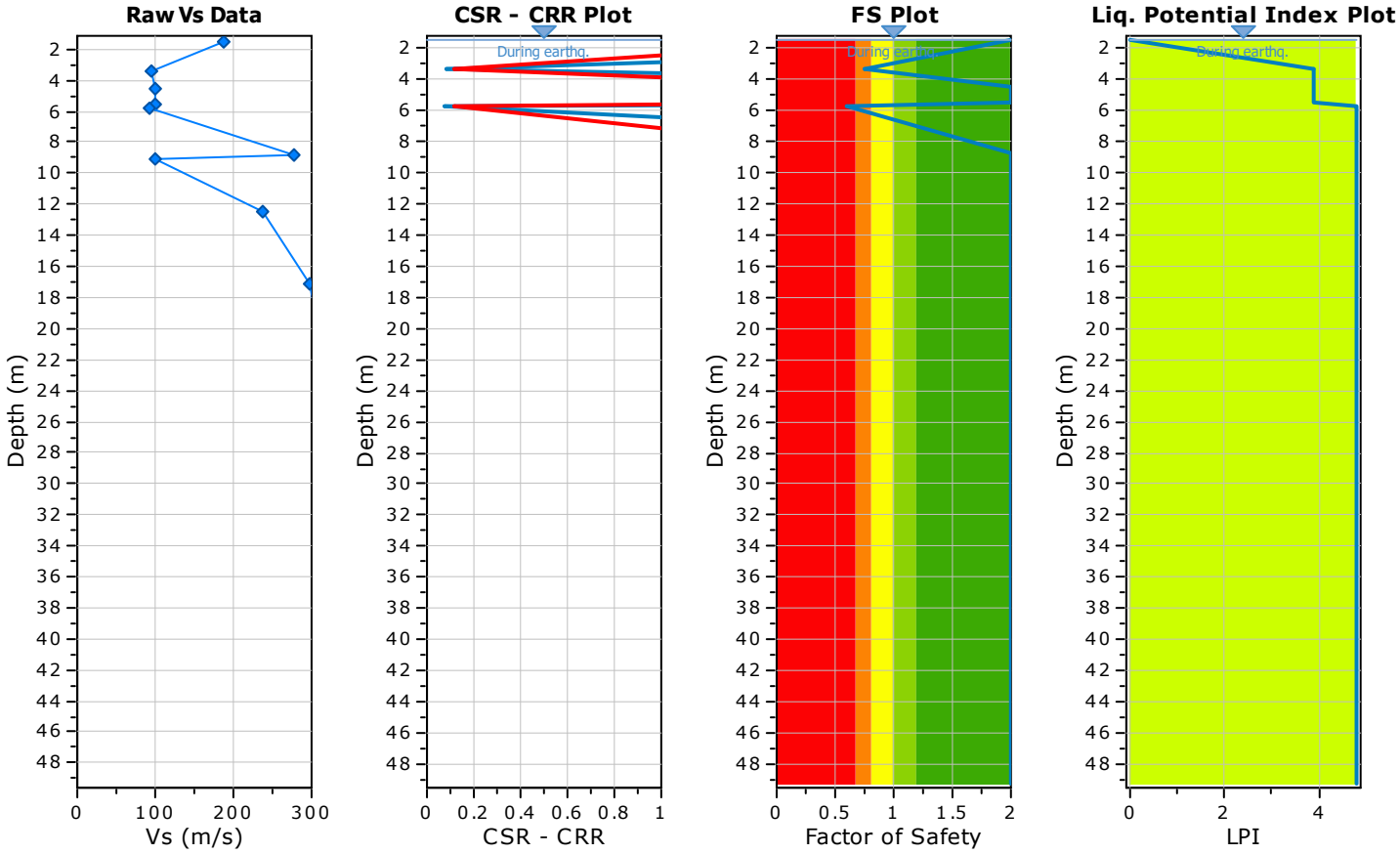
Project title : 190017

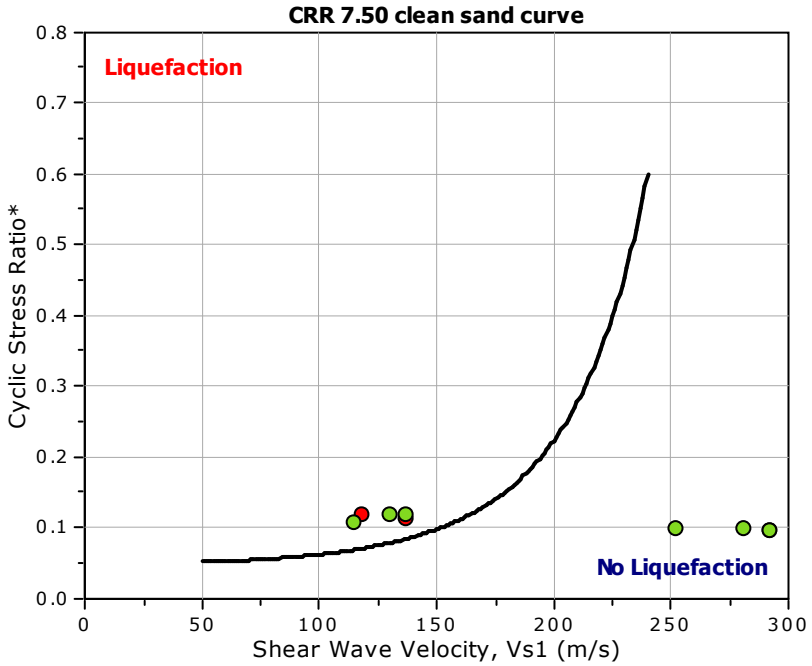
V_s Name: CPT_87696 Vs_SLS

Location : Cashmere and Sutherlands Road, Halswell

:: Input parameters and analysis properties ::

Analysis method:	Kayen et al. 2013
G.W.T. (in-situ):	0.00 m
G.W.T. (earthq.):	1.50 m
Earthquake magnitude M_w:	7.50
Peak ground acceleration:	0.13 g
Eq. external load:	0.00 kPa





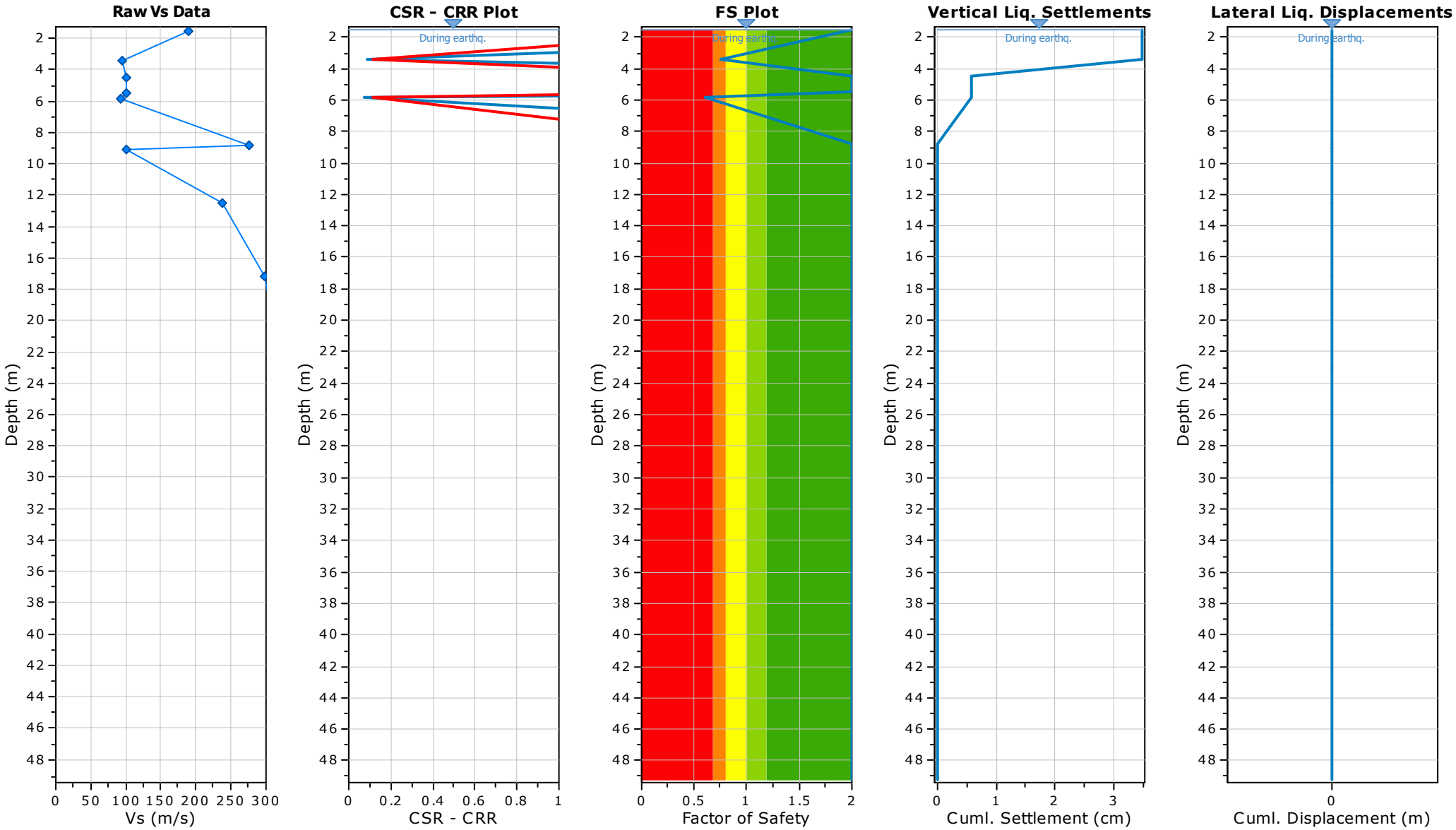
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



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V_s BASED LIQUEFACTION ANALYSIS REPORT

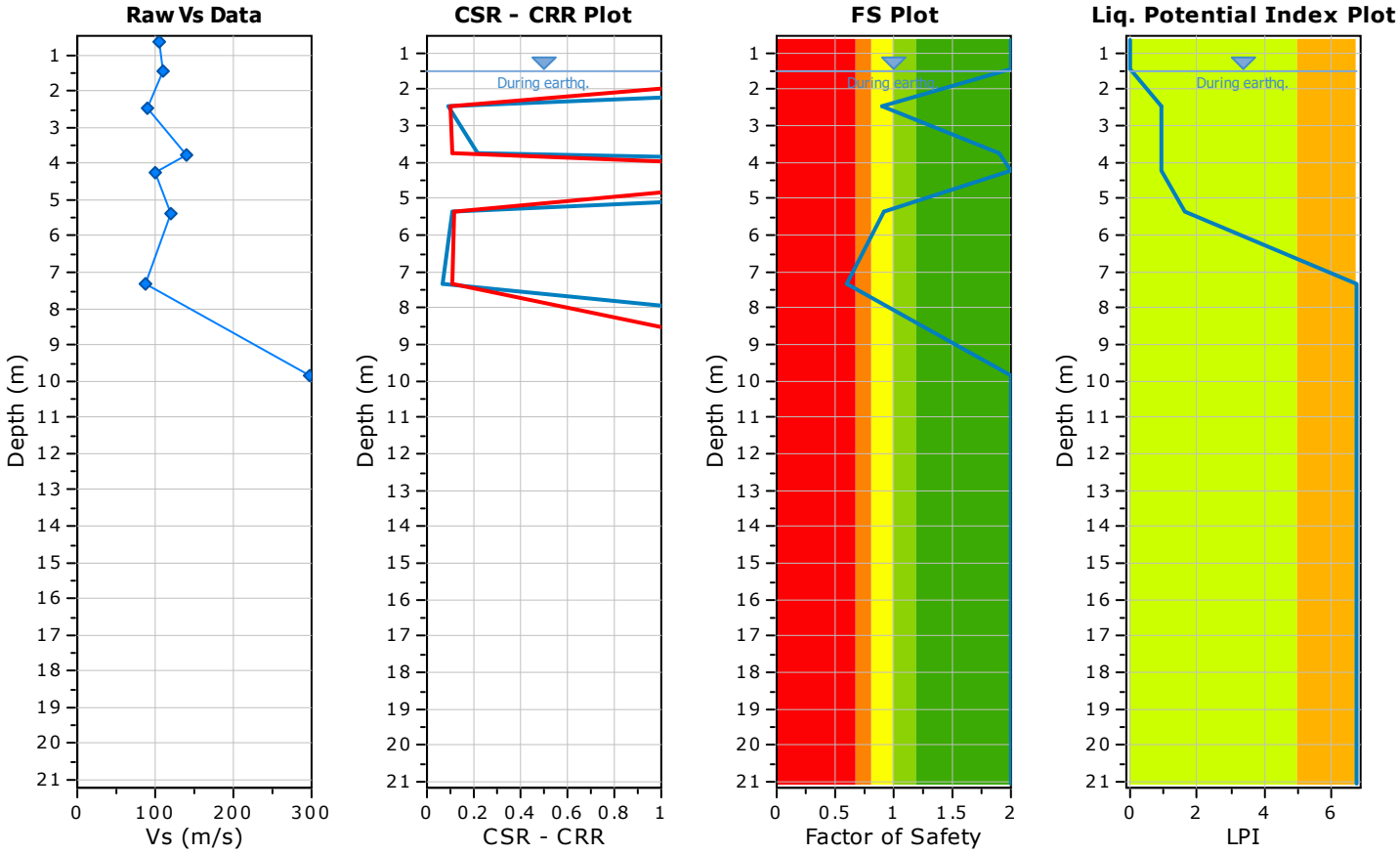
Project title : 190017

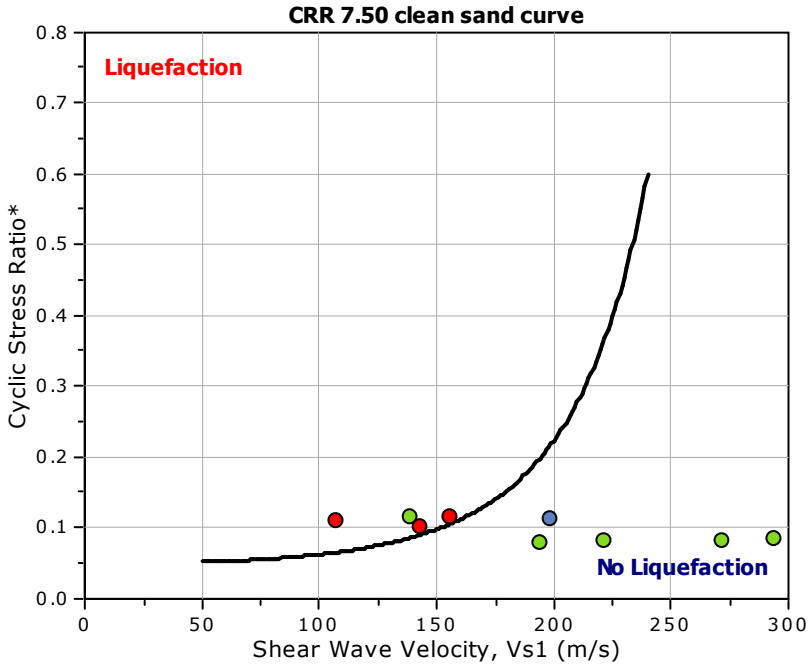
V_s Name: CPT_87700 Vs_SLS

Location : Cashmere and Sutherlands Road, Halswell

:: Input parameters and analysis properties ::

Analysis method:	Kayen et al. 2013
G.W.T. (in-situ):	0.00 m
G.W.T. (earthq.):	1.50 m
Earthquake magnitude M_w:	7.50
Peak ground acceleration:	0.13 g
Eq. external load:	0.00 kPa





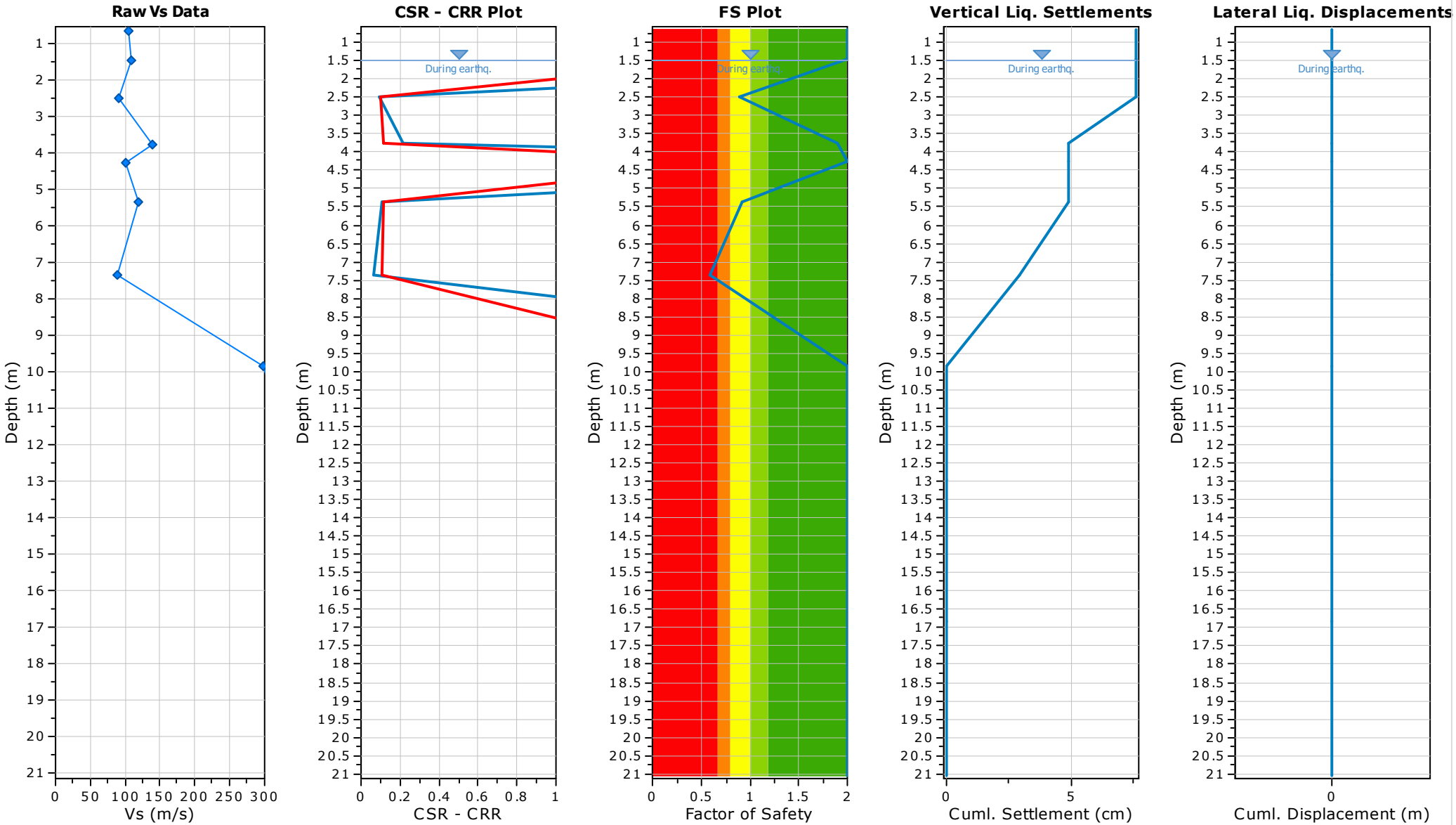
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



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V_s BASED LIQUEFACTION ANALYSIS REPORT

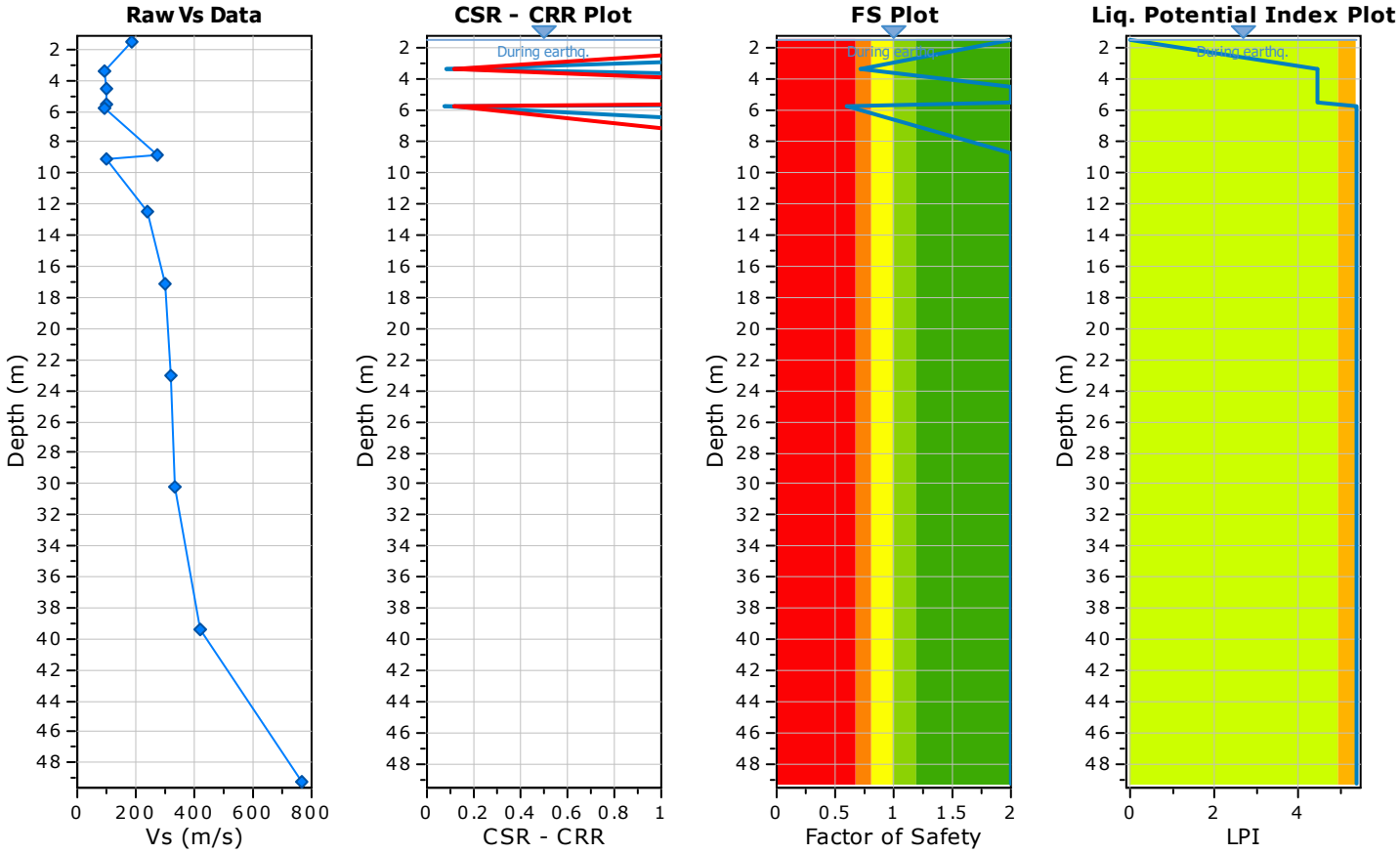
Project title : 190017

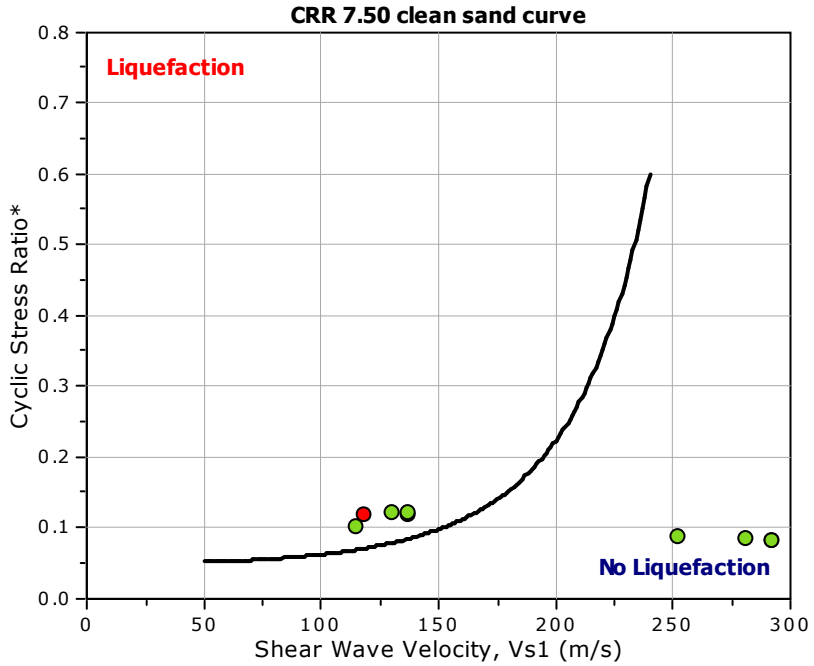
V_s Name: CPT_87696 Vs_SLS2

Location : Cashmere and Sutherlands Road, Halswell

:: Input parameters and analysis properties ::

Analysis method:	Kayen et al. 2013
G.W.T. (in-situ):	0.00 m
G.W.T. (earthq.):	1.50 m
Earthquake magnitude M_w:	6.00
Peak ground acceleration:	0.19 g
Eq. external load:	0.00 kPa





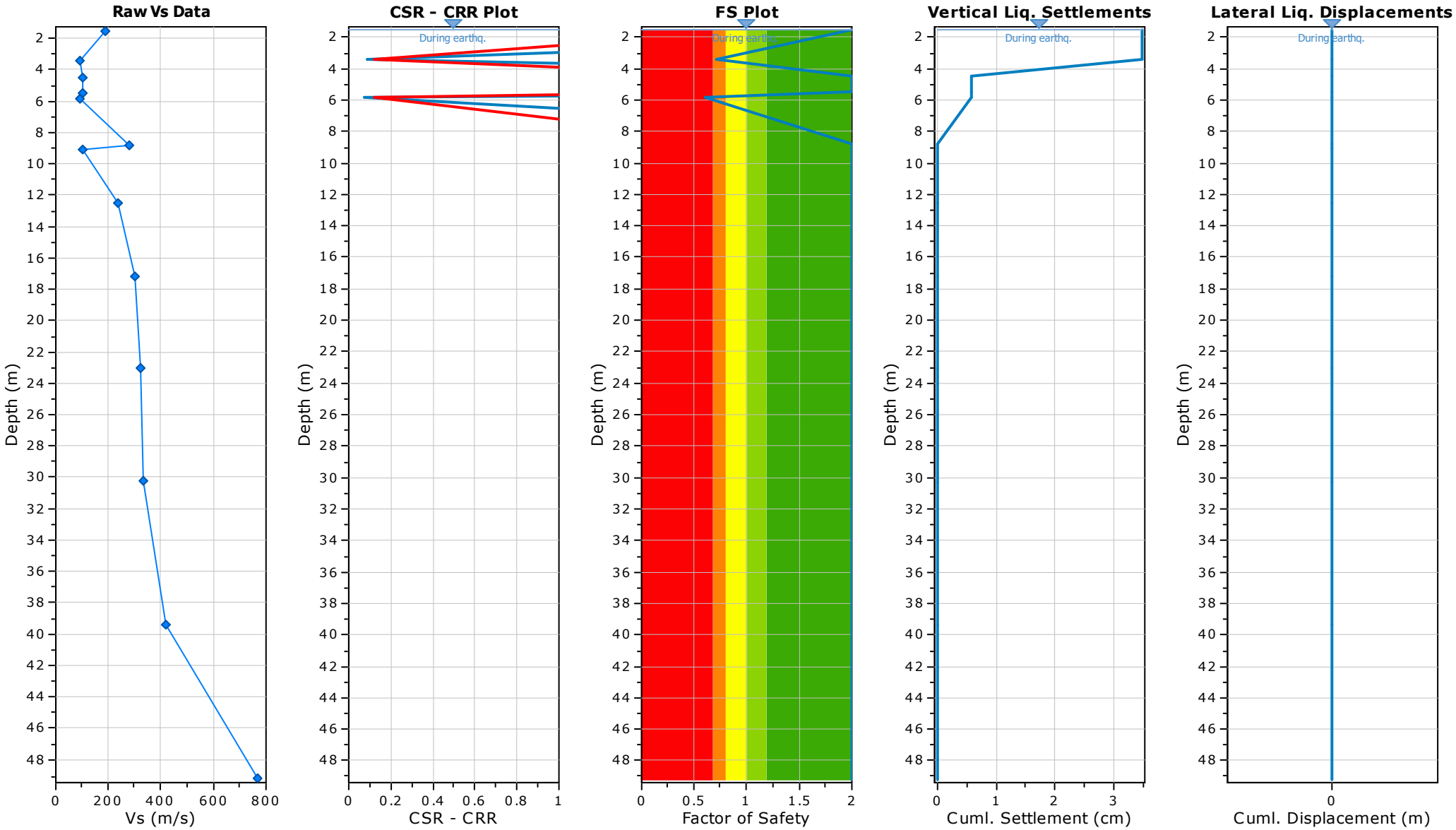
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



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V_s BASED LIQUEFACTION ANALYSIS REPORT

Project title : 190017

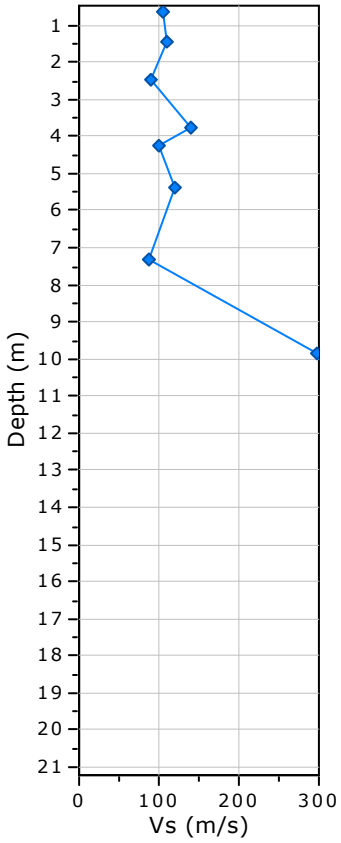
V_s Name: CPT_87700 Vs_SLS2

Location : Cashmere and Sutherlands Road, Halswell

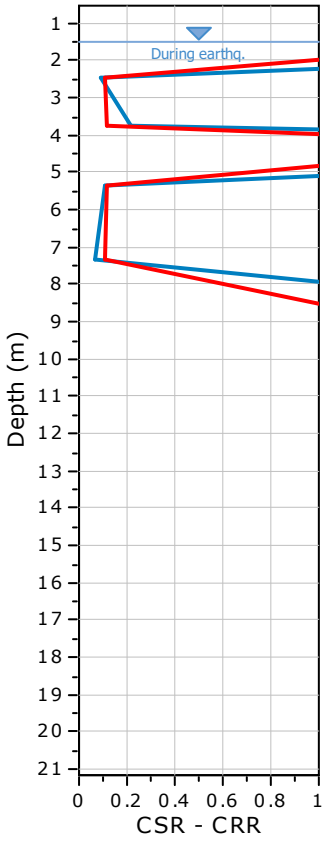
:: Input parameters and analysis properties ::

Analysis method:	Kayen et al. 2013
G.W.T. (in-situ):	0.00 m
G.W.T. (earthq.):	1.50 m
Earthquake magnitude M_w:	6.00
Peak ground acceleration:	0.19 g
Eq. external load:	0.00 kPa

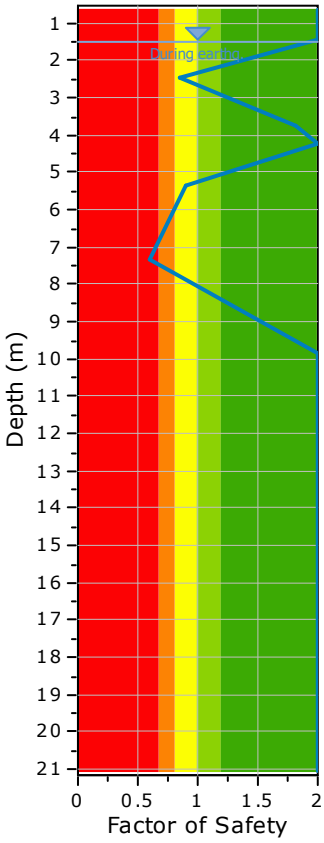
Raw Vs Data



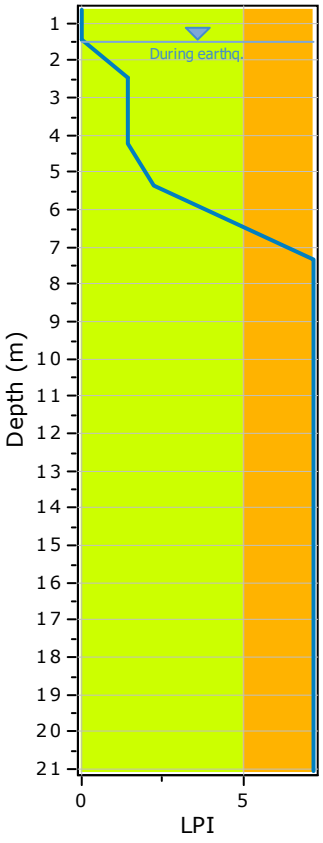
CSR - CRR Plot



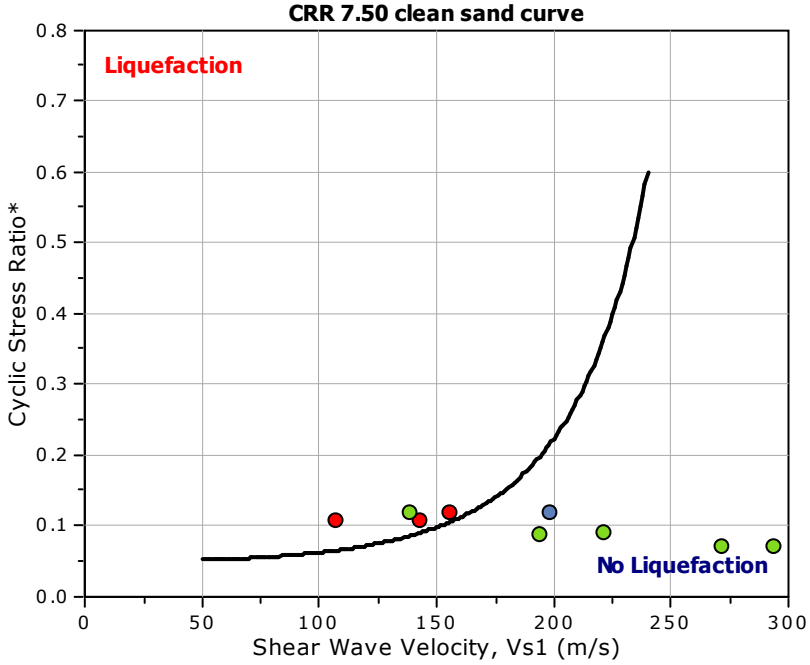
FS Plot



Liq. Potential Index Plot



CRR 7.50 clean sand curve



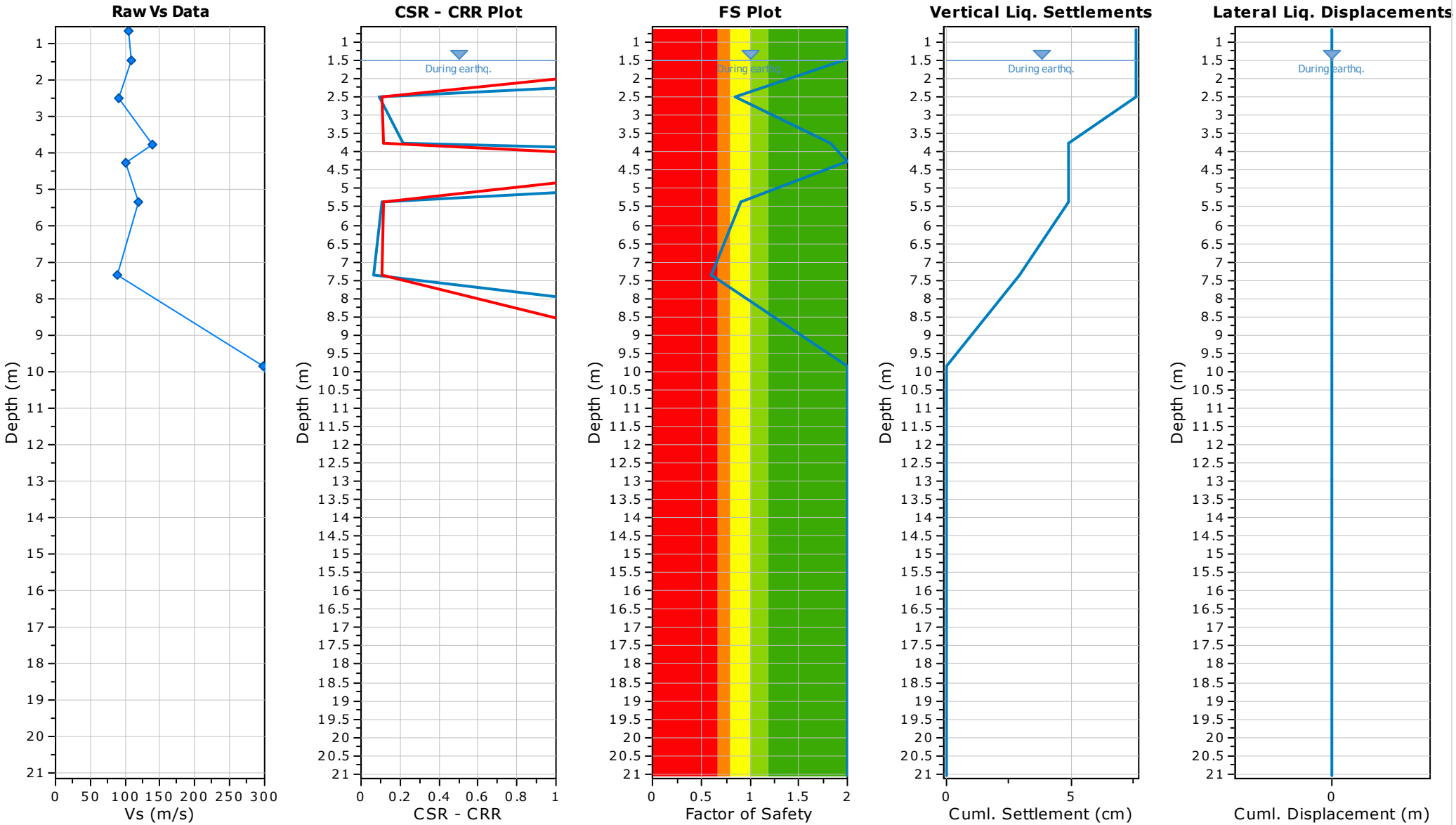
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



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V_s BASED LIQUEFACTION ANALYSIS REPORT

Project title : 190017

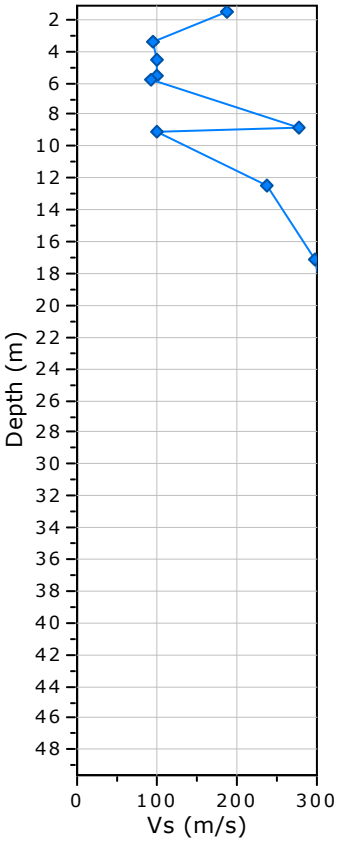
V_s Name: CPT_87696 Vs_ULS

Location : Cashmere and Sutherlands Road, Halswell

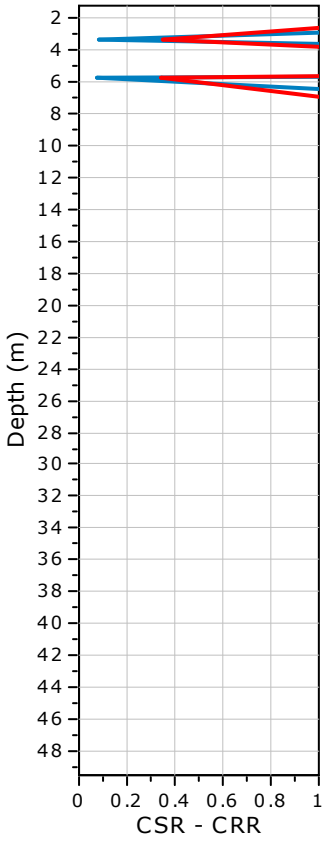
:: Input parameters and analysis properties ::

Analysis method:	Kayen et al. 2013
G.W.T. (in-situ):	0.00 m
G.W.T. (earthq.):	1.00 m
Earthquake magnitude M_w:	7.50
Peak ground acceleration:	0.35 g
Eq. external load:	0.00 kPa

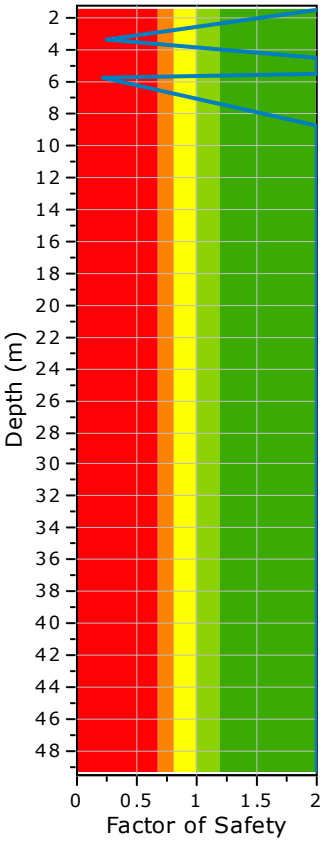
Raw Vs Data



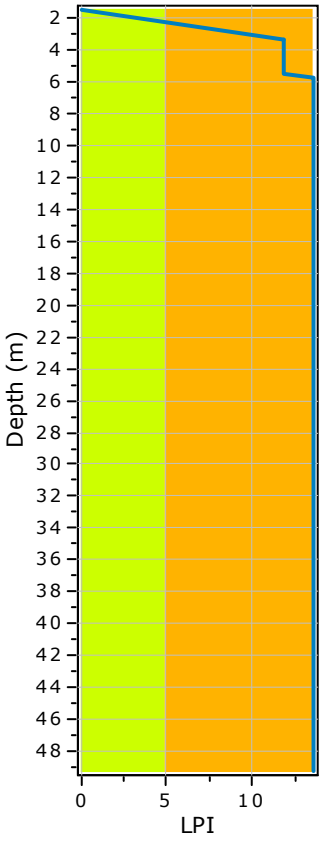
CSR - CRR Plot



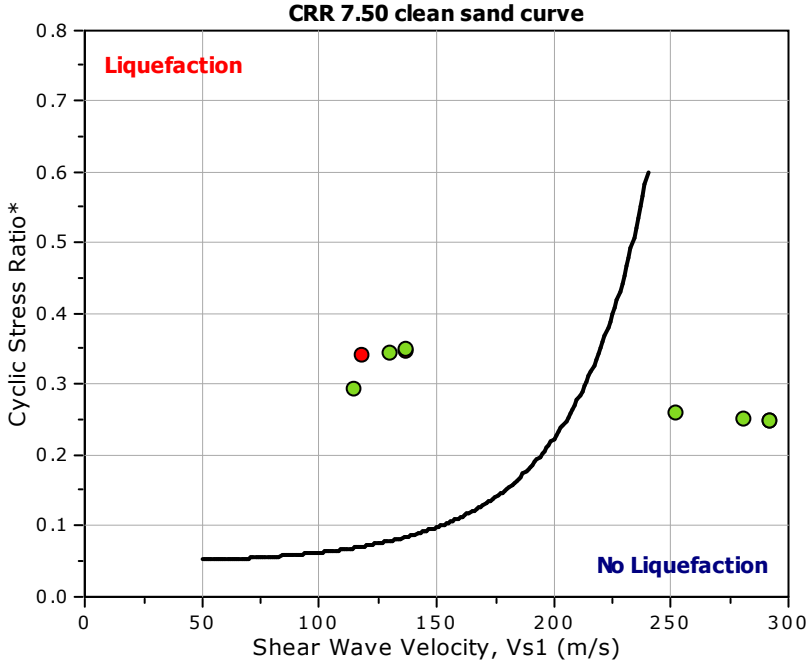
FS Plot



Liq. Potential Index Plot



CRR 7.50 clean sand curve



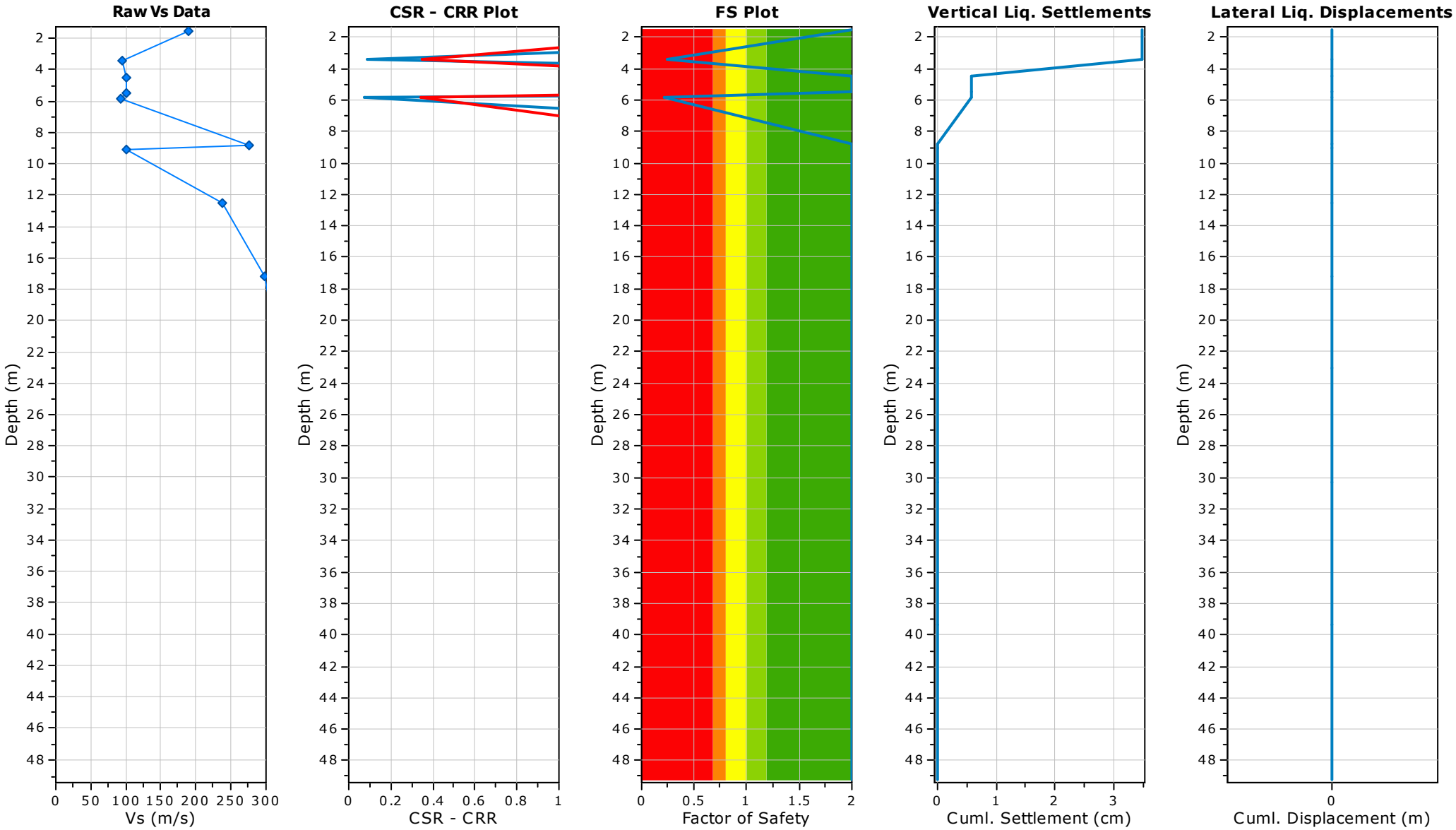
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



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V_s BASED LIQUEFACTION ANALYSIS REPORT

Project title : 190017

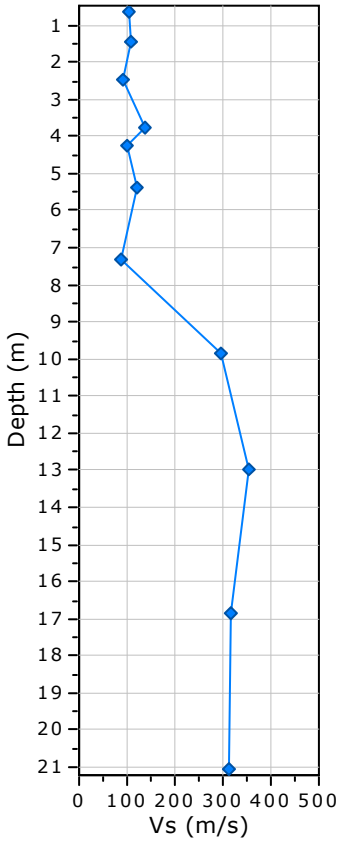
V_s Name: CPT_87700 Vs_ULS

Location : Cashmere and Sutherlands Road, Halswell

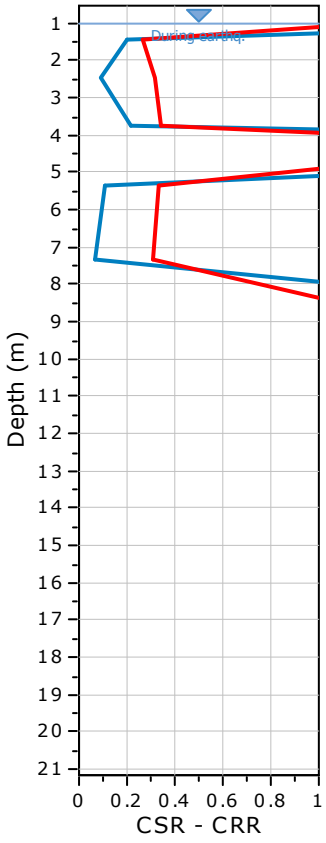
:: Input parameters and analysis properties ::

Analysis method:	Kayen et al. 2013
G.W.T. (in-situ):	0.00 m
G.W.T. (earthq.):	1.00 m
Earthquake magnitude M_w:	7.50
Peak ground acceleration:	0.35 g
Eq. external load:	0.00 kPa

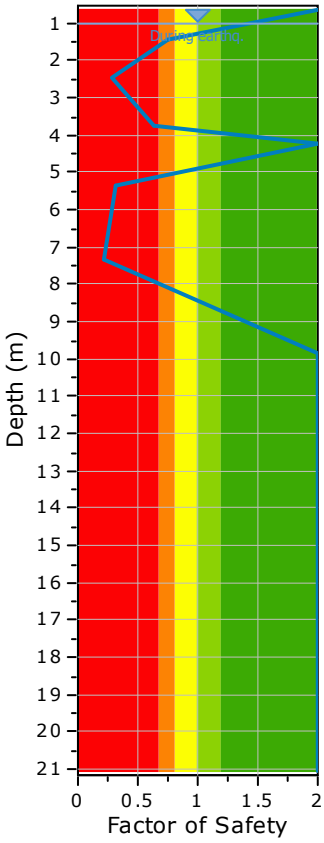
Raw Vs Data



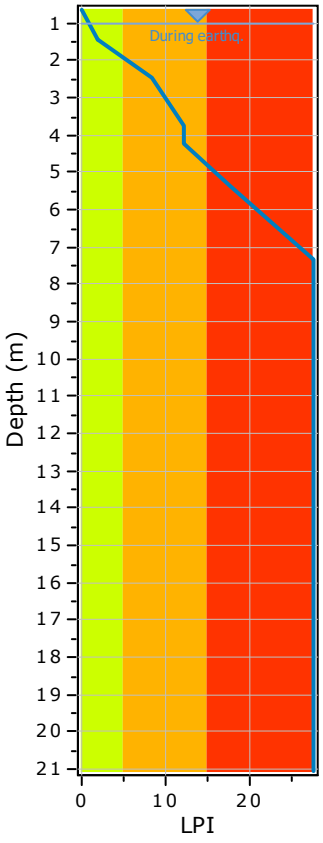
CSR - CRR Plot



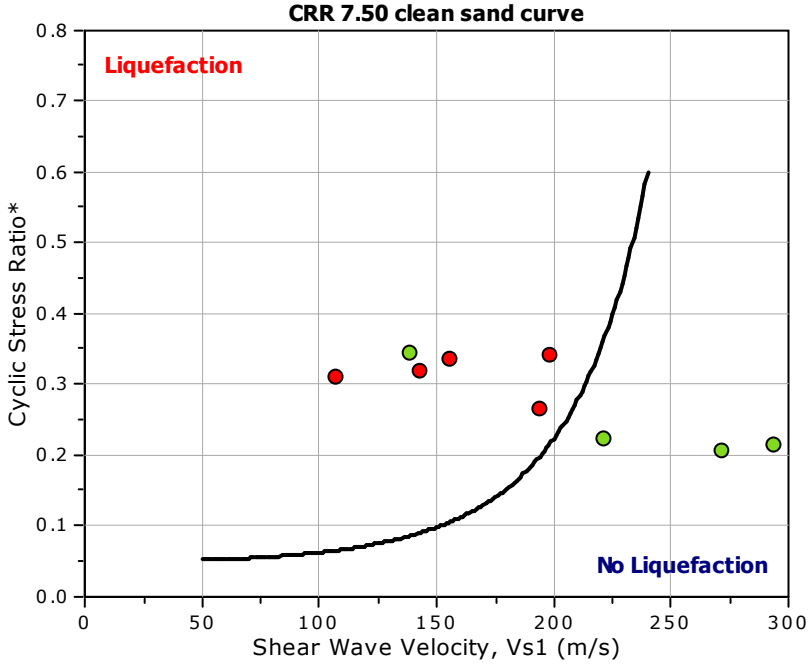
FS Plot



Liq. Potential Index Plot



CRR 7.50 clean sand curve



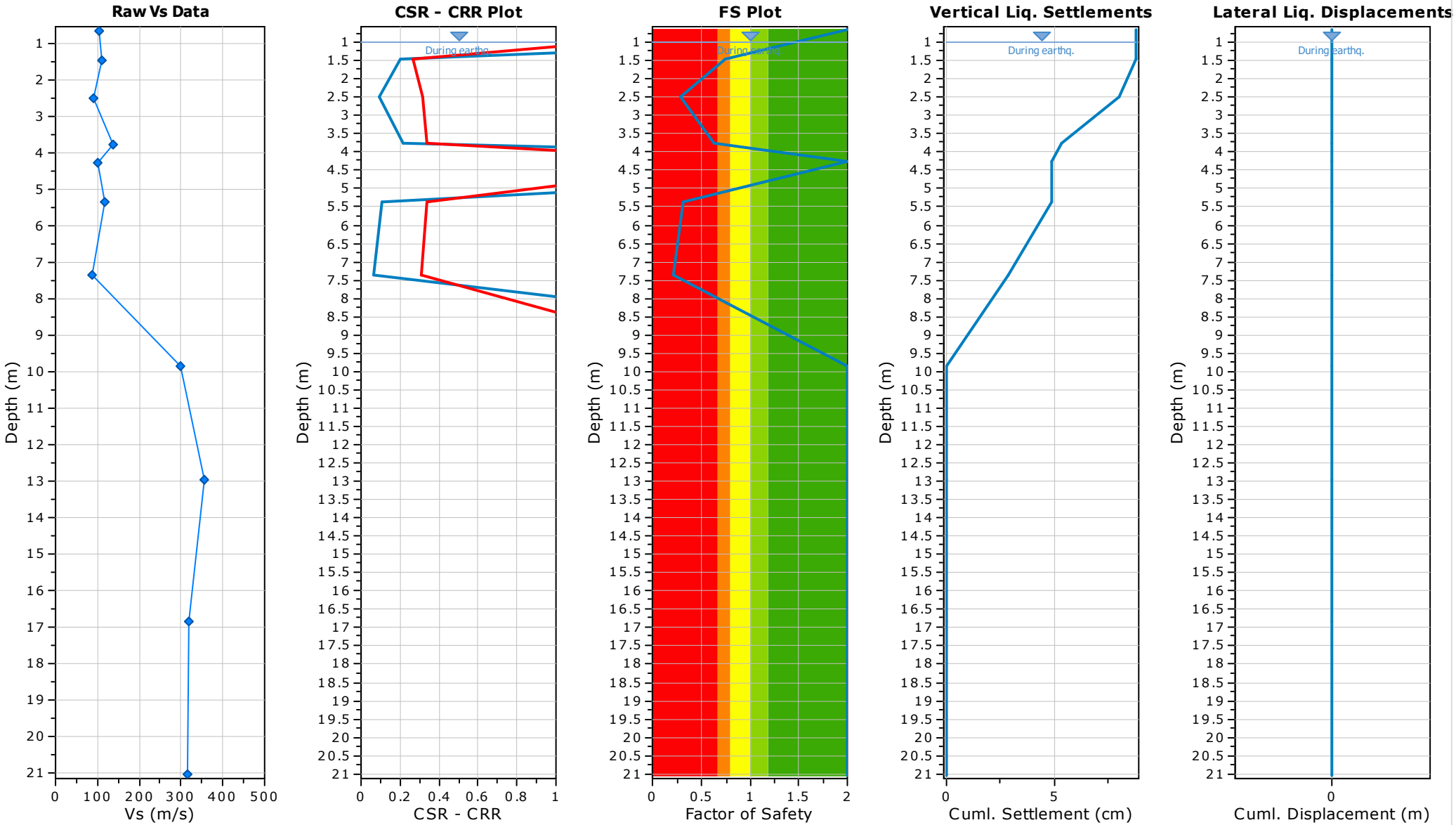
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



A.4: Southern Geophysical MASW Report

February 2019

GEOPHYSICAL REPORT

Geophysical Site Investigation:

1 Sutherlands Road,

Christchurch

Report prepared for Miyamoto International NZ Ltd

Southern Geophysical

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Data collected and report prepared for Southern Geophysical by:

Christian Ruegg (MSc), Geophysicist

Table of Contents

SGL Job 1751

Summary:

A series of Multi-channel Analysis of Surface Waves (MASW) surveys were undertaken at 1 Sutherlands Road on February 4 and 5, 2019. The geophysical testing included 14 MASW lines. Overall the quality of the data was good, with shear-wave velocities modelled to over 20 m depth across the site.

Methodology:

MASW is a geophysical technique that uses the dispersive nature of surface waves to model shear-wave velocity versus depth.

A MASW survey is undertaken as a series of lines or points across the surface of the site. The MASW lines in this survey were collected using a 24-channel towed seismic array, with 4.5 Hz geophones. The geophone spacing was 1 m and the source offset was 10 m. The active source was an 8 lb sledgehammer impacting an aluminium plate. Recording parameters for the MASW survey were set with a 0.25 ms sampling interval, 1.5 s record length, 24 dB gains, and an electric trigger system. Shot records were collected at 5 m spacing along the lines.

The field records were processed using the Kansas Geological Survey software package SurfSeis5 ©. The geometry was set according to the survey parameters and the dispersion curves were generated and edited. The inversions were run using a 10 layer variable depth model.

The velocity data was interpolated into 2D V_S profiles for the MASW lines. The output shear-wave velocity data is included as a series of data files (CSV format), supplementary to this report.

The midpoint of the MASW seismic array at each shot record was recorded with a Trimble GeoXH GPS system. The GPS points were differentially corrected and output using the New Zealand Geodetic Datum (NZGD) 2000, with NZTM 2000 coordinates. The site did not have significant elevation changes, and the profiles have not been corrected for topography.

Results:

Fourteen MASW lines with a total length of 1834 meters were surveyed at the site (Figure 1). Nine of the lines are aligned west to east (MASW 1, 4, 6, 7, 8, 9, 10, 11, and 13). The remainder of the lines are aligned south to north (MASW 2, 3, 5, 12, and 14) (Figure 1). The MASW imaged the substrate to over 20 m depth (Figures 2 to 5). The site had low levels of ambient noise and the data collected was generally of good quality.

Conclusions:

There appear to be two main units in the substrate based on the shear-wave velocities. The near surface materials, to a depth between 5 m and 10 m, have shear-wave velocities ranging from <100 m/s to 220 m/s, with some higher velocity layers (Figures 2 to 4). Below this unit, shear-wave velocities increase gradually from 220 m/s to over 350 m/s at 20 m depth. The geophysical site investigations seem to have characterised the substrate in good detail. It is recommended that the MASW profiles be correlated with any intrusive tests to confirm the site geology.

Disclaimer:

This document has been provided by Southern Geophysical Ltd subject to the following:

Non-invasive geophysical testing has limitations and is not a complete source of testing. Often there is a need to couple non-invasive methods with invasive testing methods, such as drilling, especially in cases where the non-invasive testing indicates anomalies.

This document has been prepared for the particular purpose outlined in the project proposal and no responsibility is accepted for the use of this document, in whole or in part, in other contexts or for any other purpose. Southern Geophysical Ltd did not perform a complete assessment of all possible conditions or circumstances that may exist at the site. Conditions may exist which were undetectable given the limited nature of the enquiry Southern Geophysical Ltd was retained to undertake with respect to the site. Variations in conditions often occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account. Accordingly, additional studies and actions may be required by the client.

We collected our data and based our report on information which was collected at a specific point in time. The passage of time affects the information and assessment provided by Southern Geophysical Ltd. It is understood that the services provided allowed Southern Geophysical Ltd to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes for whatever reason. Where data is supplied by the client or other sources, including where previous site investigation data have been used, it has been assumed that the information is correct. No responsibility is accepted by Southern Geophysical Ltd for incomplete or inaccurate data supplied by others. This document is provided for sole use by the client and is confidential to that client and its professional advisers. No responsibility whatsoever for the contents of this document will be accepted to any person other than the client. Any use which a third party makes of this document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. Southern Geophysical Ltd accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this document.

DRAWING- **Figure 1: Geophysical Site Investigation**

LOCATION- **1 Sutherlands Road, Christchurch**

NOTES- Coordinates NZ2000 TM Grid.
Aerial photograph sourced from LINZ, Crown Copyright ©

SCALE (m)
0 10 20 30 40 50 60 70 80 90 100

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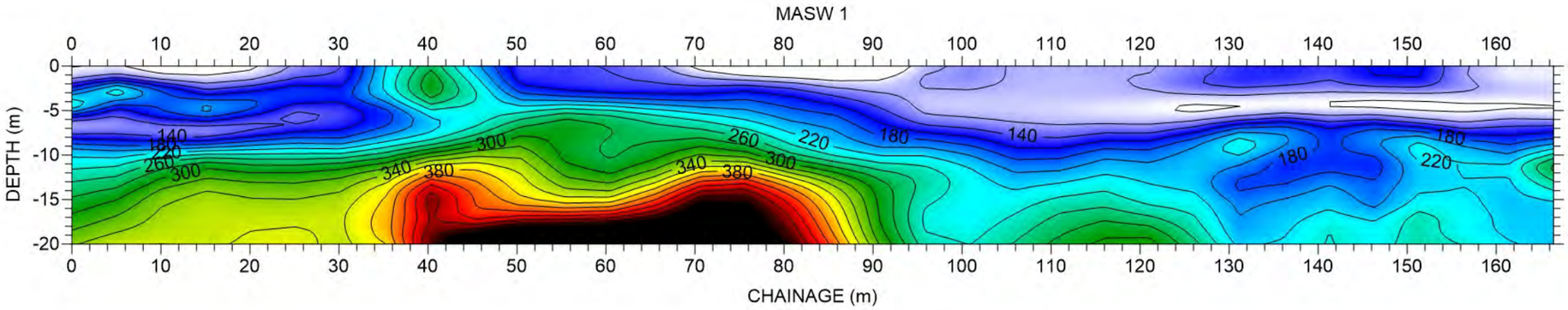

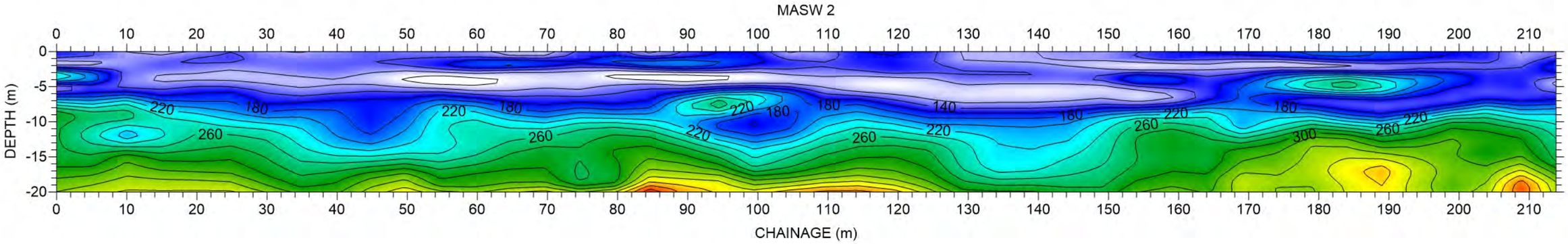

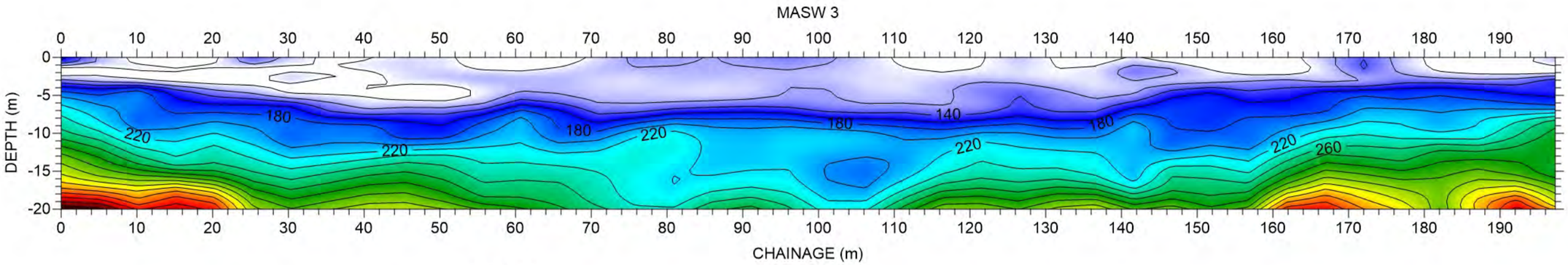

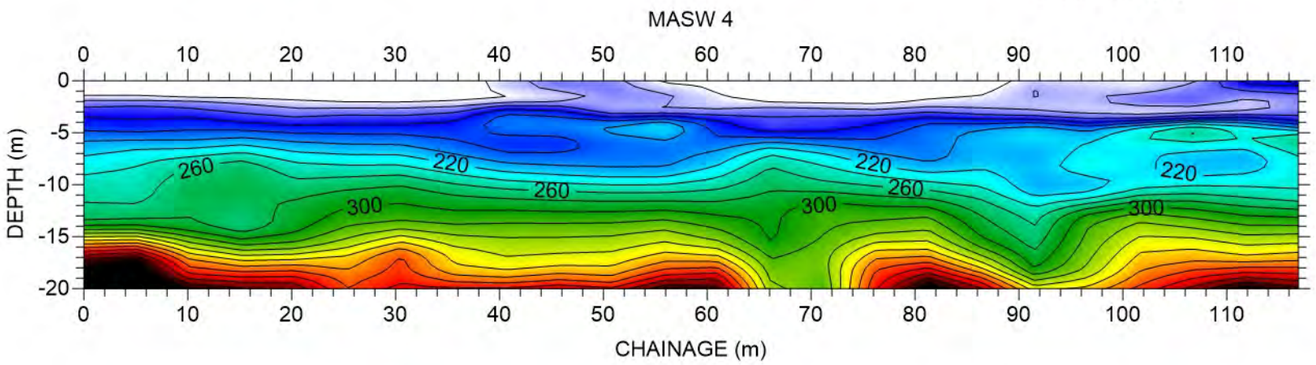

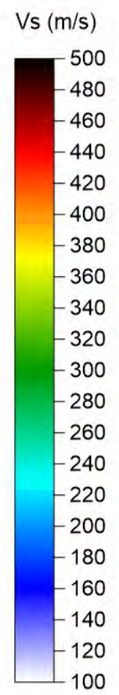

DRAWING- **Figure 2: MASW 2D Vs Profiles 1 to 4**

LOCATION- **1 Sutherlands Road, Christchurch**

NOTES MASW Vs profile has contour intervals of 20 m/s (Vs).

See site map for location of points.

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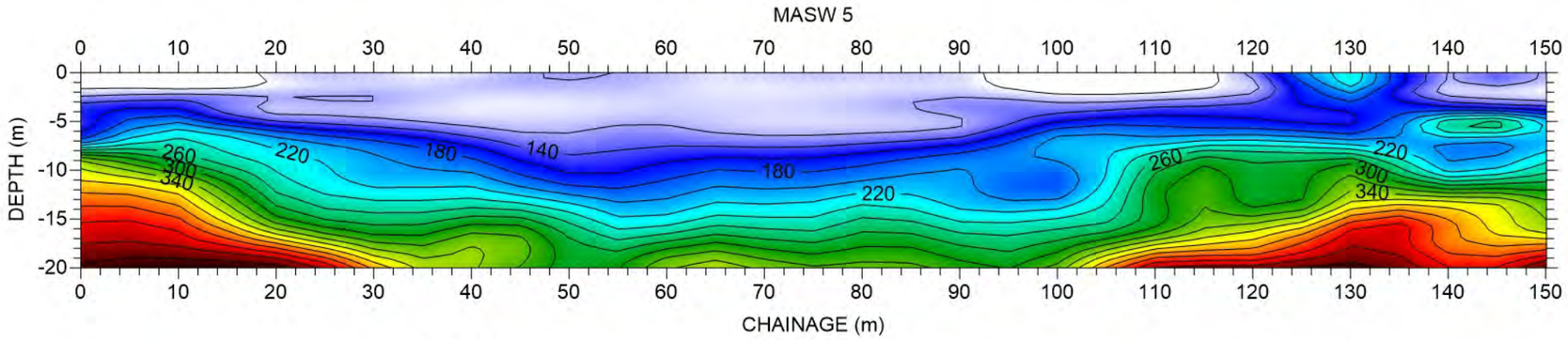

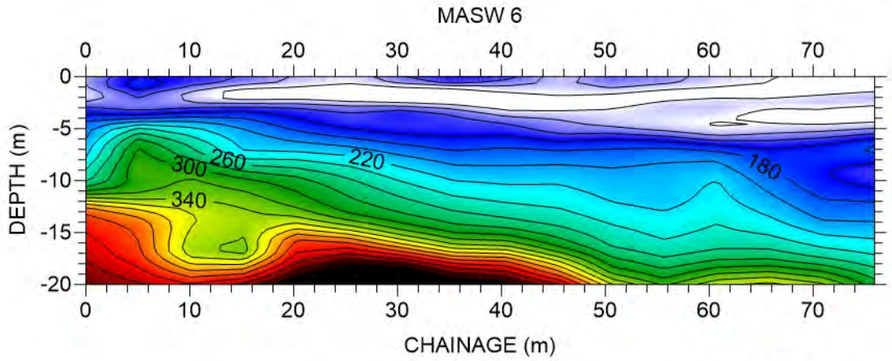

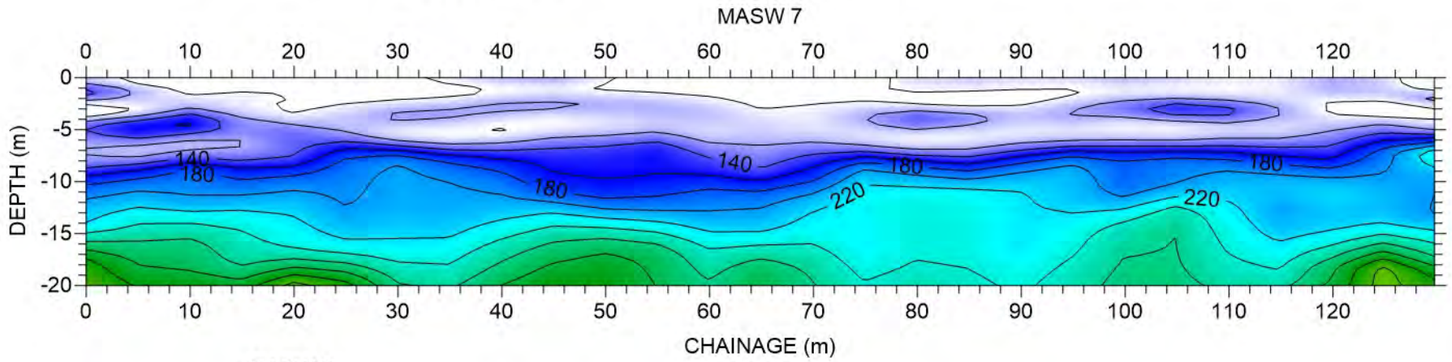

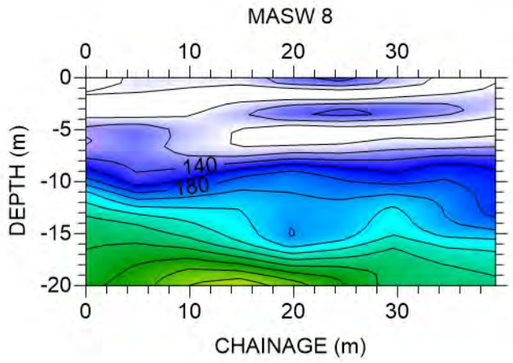

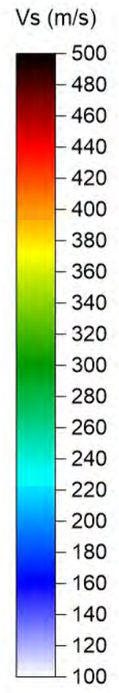

DRAWING- **Figure 3: MASW 2D Vs Profiles 5 to 8**

LOCATION- **1 Sutherlands Road, Christchurch**

NOTES MASW Vs profile has contour intervals of 20 m/s (Vs).

See site map for location of points.

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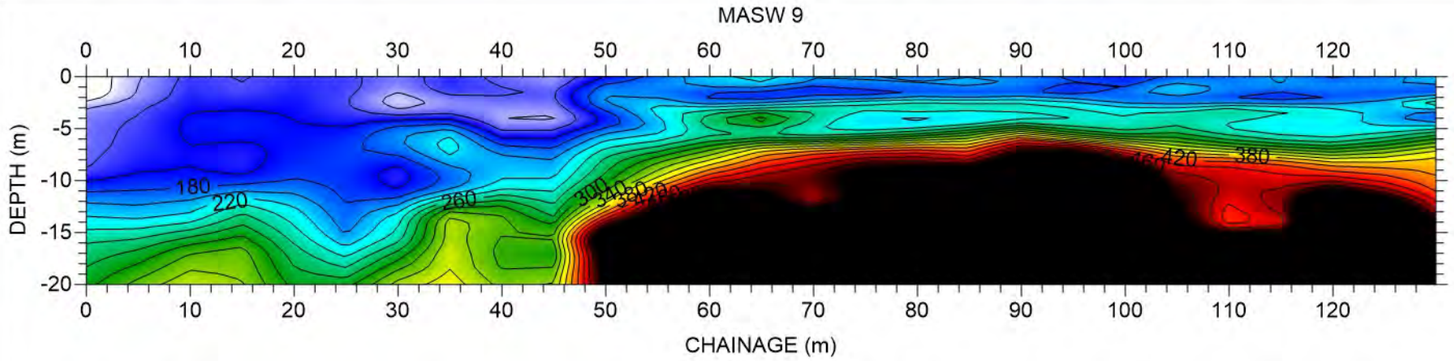

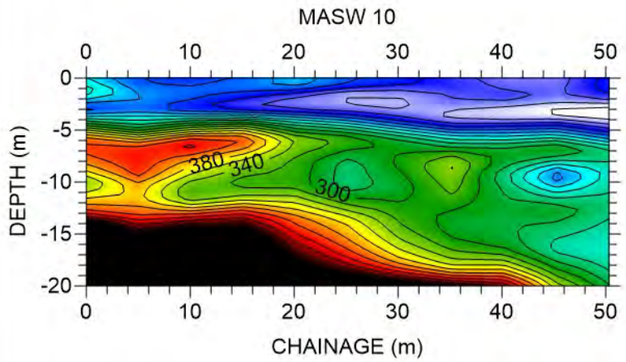

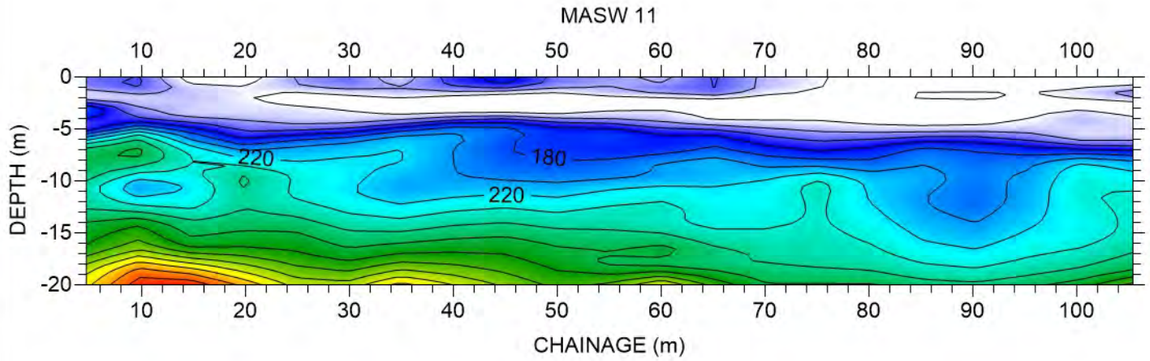

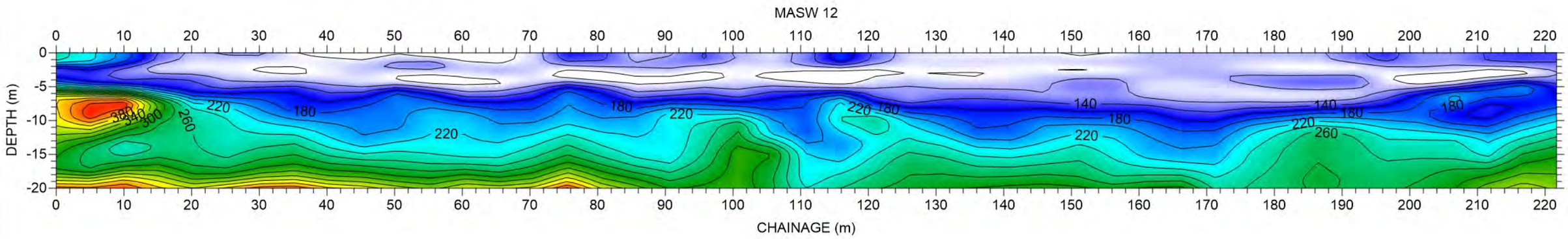

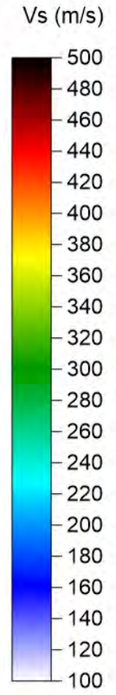

DRAWING- **Figure 4: MASW 2D Vs Profiles 9 to 12**

LOCATION- **1 Sutherlands Road, Christchurch**

NOTES MASW Vs profile has contour intervals of 20 m/s (Vs).

See site map for location of points.

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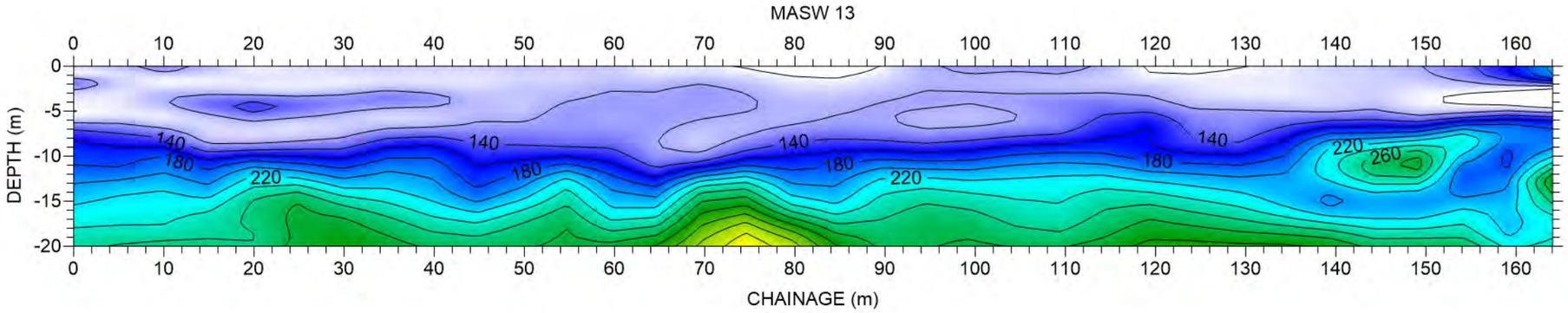

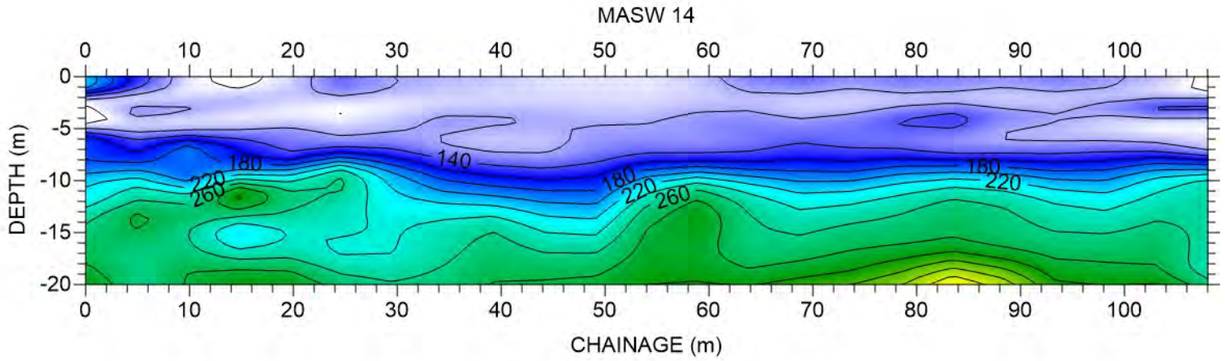

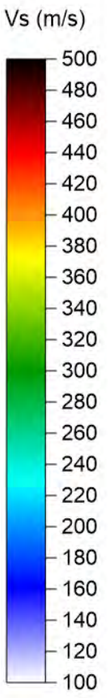

DRAWING- **Figure 5: MASW 2D Vs Profiles 13 to 14**

LOCATION- **1 Sutherlands Road, Christchurch**

NOTES MASW Vs profile has contour intervals of 20 m/s (Vs).

See site map for location of points.

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